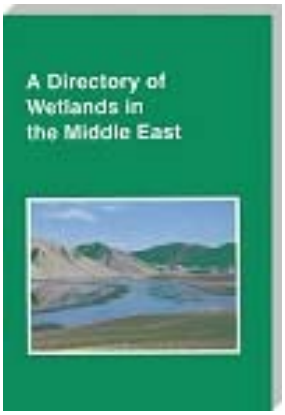
A Directory of Wetlands in the Middle East represents the culmination of a two year project, the Middle East Wetland Inventory, sponsored jointly by IUCN-The World Conservation Union, WWF-World Wide Fund For Nature, the International Waterfowl and Wetlands Research Bureau (IWRB), BirdLife International and the Bureau of the Convention on Wetlands of International Importance especially as Waterfowl Habitat (the Ramsar Convention). Funding was provided by WWF.

The Directory consists of a series of national chapters describing the principal wetlands in thirteen countries from Syria and Lebanon in the west to Afghanistan in the east and the Republic of Yemen in the south. Over fifty individuals and organizations have contributed to the Directory, many of them providing hitherto unpublished information on wetlands in the Middle East. Two hundred and twenty-three sites of international importance are described. These have been selected on the basis of criteria developed in relation to the Ramsar Convention. Although special attention is paid to the importance of the wetlands for wildlife, all wetland values, including water storage, flood control, coastal protection and fisheries production, have been taken into consideration.

The Directory thus provides for the conservation community a list of the highest priorities for conservation action. At the same time, it provides for governments and the development assistance community guidance on those sites where future activities will require the most intensive investment in environmental impact assessment and in the design and implementation of appropriate conservation measures.

A Directory of Wetlands In the Middle East



IUCN-The World Conservation Union

Founded in 1948, The World Conservation Union brings together States, government agencies and a diverse range of non-governmental organizations in a unique world partnership: over 800 members in all, spread across some 130 countries. As a Union, IUCN seeks to influence, encourage and assist societies throughout the world to conserve the integrity and diversity of nature and to ensure that any use of natural resources is equitable and ecologically sustainable. The World Conservation Union builds on the strengths of its members, networks and partners to enhance their capacity and to support global alliances to safeguard natural resources at local, regional and global levels.

WWF-World Wide Fund For Nature

WWF-World Wide Fund For Nature is the world's largest private international conservation organization, with 28 Affiliate and Associate National Organizations around the world and over 5.2 million regular supporters. WWF continues to be known as World Wildlife Fund in the United States and Canada.

International Waterfowl and Wetlands Research Bureau (IWRB)

IWRB was established in 1954 and is the only independent global organization concerned primarily with the conservation of wetland ecosystems. IWRB's goal is to promote the conservation of wetlands and wetland biodiversity, particularly waterbirds, by stimulating and coordinating international technical cooperation. This is achieved by coordinating international projects, organizing training workshops and disseminating information through conferences, workshops and publications. IWRB is governed by an Executive Board comprising national delegates from 45 member countries together with coordinators of more than 20 specialist networks which group international experts in wetland and waterbird management and conservation.

BirdLife International

BirdLife International is a worldwide partnership of over 100 national organizations working for the conservation of birds and their habitats and, through this, for the diversity of all life. BirdLife International pursues a programme of scientific research to identify the most threatened bird species and the most critical sites for avian diversity, field action to address these priorities, advocacy and policy development, and network building, to expand the global partnership of conservation organizations.

Ramsar Convention Bureau

The Convention on Wetlands of International Importance especially as Waterfowl Habitat, sometimes known as the Ramsar Convention from its place of adoption in 1971 in Iran, is an intergovernmental treaty which provides the framework for international cooperation for the conservation of wetland habitats. The Convention entered into force in 1975 and now has Contracting Parties from regions throughout the world. The United Nations Educational, Scientific and Cultural Organisation (UNESCO) serves as Depositary for the Convention. The secretariat, or Bureau, is an independent body sharing headquarters with IUCN in Gland, Switzerland.

A DIRECTORY OF WETLANDS IN THE MIDDLE EAST

Compiled by

Derek A. Scott

for

IUCN-The World Conservation Union

WWF-World Wide Fund For Nature

International Waterfowl and Wetlands Research Bureau (IWRB)

BirdLife International

Ramsar Convention Bureau

IUCN-The World Conservation Union
International Waterfowl and Wetlands Research Bureau
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The presentation of material in this book and the geographical designations employed do not imply the expression of any opinion whatsoever on the part of Wetlands International, IUCN, WWF, IWRB, BirdLife International or the Ramsar Convention Bureau concerning the legal status of any country, territory or area, or concerning the delimitation of its frontiers or boundaries.

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United Arab Emirates
Republic of Yemen

FOREWORD

[not available]

INTRODUCTION

In the development of an effective conservation programme for wetlands, one of the first steps is the compilation of an inventory of the most important wetland sites. Such wetland inventories already exist for most of North America, Europe, Africa, the Neotropical Realm, south and east Asia, and Australia and the Pacific. *A Directory of Wetlands in the Middle East* seeks to continue this global coverage by providing a comprehensive review of existing knowledge of the most important wetlands in thirteen nations in the Middle East, from Syria and Lebanon in the west to Afghanistan in the east and the Republic of Yemen in the south.

The *Directory* has been produced as the culmination of a two-year project - the Middle East Wetland Inventory - sponsored jointly by IUCN-The World Conservation Union, the World Wide Fund For Nature (WWF), the International Waterfowl and Wetlands Research Bureau (IWRB), BirdLife International and the Ramsar Convention Bureau. Emphasis was given to obtaining maximum participation by conservation bodies and academic institutions in the countries concerned. However, the project was also able to take advantage of the extensive information already available on wetland ecosystems in the Middle East, notably at IWRB headquarters in the U.K., and has benefitted greatly from BirdLife International's Important Bird Areas Project in the Middle East, completed in early 1994.

The main objectives of the Middle East Wetland Inventory were:

- to prepare a directory of wetlands of international importance in the Middle East;
- to identify organizations and individuals knowledgeable about wetlands in the Middle East;
- to encourage the countries under consideration to compile their own detailed national wetland inventories as a basis for the development of national wetland policies;
- to identify future priorities for action in wetland conservation and research in the Middle East;
- to promote active participation in the Convention on Wetlands of International Importance especially as Waterfowl Habitat (the Ramsar Convention) by states throughout the region.

The project was initiated in November 1993, and was coordinated jointly by Mr Francis Parakatil, Coordinator of IUCN's North Africa, Central and West Asia Programme, and Dr Derek A. Scott, the Project Technical Coordinator. The methodology closely followed that adopted by the Technical Coordinator in the Neotropical Wetlands Project completed in 1985, Asian Wetlands Inventory completed in 1988, and Oceania Wetland Inventory completed in 1992. Funding was provided by WWF.

A Directory of Wetlands in the Middle East follows a format similar to that of earlier wetland directories; thus the greater part of the *Directory* consists of a series of national reports. Each begins with an introduction which summarizes the general situation of the wetlands and

provides information on the institutional and legal base for wetland conservation and research. Then follows a series of accounts of those wetlands which are known or thought to be of greatest importance from the point of view of nature conservation. The site descriptions include basic information on size and location, physical features, ecological features, ownership, degree of protection, land use, threats and conservation values.

The term "wetland" is used in the sense defined in the text of the Ramsar Convention. Thus, wetlands are "areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres". Coral reefs and other exclusively marine systems are, however, generally excluded from this definition, and have not been considered in the *Directory* except in so far as they form an integral part of a site containing more typical wetland habitats. The principal reef systems of the Indian Ocean, Red Sea and Gulf have been described in volume two of *Coral Reefs of the World*, published jointly by UNEP and IUCN in 1988.

Each country report includes an outline map showing the location of the sites described in the *Directory*. For reasons of space, it has not been possible to include detailed maps of each site. However, the many individual site maps which have been provided by contributors are on file at IWRB headquarters in the United Kingdom, and constitute an important reference source.

Methodology

The compilation of *A Directory of Wetlands in the Middle East* has involved the collection of data through three main channels:

- national networks of contacts, each with a "national coordinator" responsible for the compilation of data in his or her country and preparation of a national report.
- direct contact with individuals or institutions with expertise on particular sites or species.
- a review of the recent literature.

In many cases, compilation of a national inventory was coordinated by a single individual (national coordinator) or institution in the country or territory concerned, and a comprehensive report was submitted. However, in several countries it proved impossible to coordinate the collection of information through a single person or institution, and material was received from several independent sources. In the case of Afghanistan, Syria and Yemen, no local contact could be established, and the material presented in the *Directory* is based entirely on expatriate sources and the literature. Emphasis was given throughout to obtaining recent information from individuals currently working on wetlands, and little attention was given to the older literature. *Important Bird Areas in the Middle East* (Evans, 1994), the report of BirdLife International's Important Bird Areas Project in the Middle East, has been a particularly valuable source of information, as virtually all of the sites identified as wetlands of international importance in the present *Directory* were identified as "Important Bird Areas" by BirdLife International and have been described in Evans (1994).

Site Descriptions

Contributors were requested to submit their information on standard wetland data sheets of a type used in similar wetland inventories in the Palearctic Region, Neotropical Region, southern and eastern Asia and Oceania. These data sheets were very similar in design to the information sheet currently being used by the Ramsar Convention Bureau in the presentation of information on sites listed under the Ramsar Convention. Information presented on the completed data sheets has been reproduced in this *Directory* in a slightly modified form, and in many cases with additional information from other sources.

The following data categories have been employed in the site accounts:

Title: The name of the wetland with a reference number used in the accompanying map.

Location: The geographical coordinates (Greenwich) and general location of the site.

Area: The area of the wetland habitat in hectares. In the case of some rivers and coastal zones, only the approximate length of the site is known.

Altitude: The altitude of the wetland in metres above sea level.

Overview: A brief description of the wetland, summarizing the principal physical and ecological features and highlighting the main conservation values.

Physical features: A brief description of the principal physical features of the site, including information on hydrology, soil type and chemistry, water quality, depth, fluctuations and permanence, as well as a note on climatic conditions.

Ecological features: A brief description of the main habitats and vegetation types present, with information on the dominant plant communities and species present.

Land tenure: Details of the ownership of the wetland and the ownership of surrounding areas.

Conservation measures taken: Details of any protected areas established at or around the wetland and any other conservation measures taken at the site.

Conservation measures proposed: Details of any proposals for the conservation of the wetland.

Land use: Details of the principal forms of land use and human activities at the wetland and in surrounding areas.

Possible changes in land use: Any information available on proposed changes in land use and development plans which might affect the ecological character of the wetland.

Disturbances and threats: Details of existing and possible future threats to the wetland and its wildlife.

Hydrological and biophysical values: Information on the principal hydrological and biophysical values of the wetland.

Social and cultural values: Information on the principal social and cultural values of the wetland.

Noteworthy fauna: The importance of the wetland for wildlife, including mammals, birds, reptiles, amphibians, fishes and invertebrates.

Noteworthy flora: Information on any plant species or communities for which the wetland is particularly important.

Scientific research and facilities: Information on major research activities at the wetland and any existing facilities for research.

Conservation education: Information on any existing programmes and facilities for conservation education and training.

Recreation and tourism: Information on the present and potential use of the wetland for recreation and tourism.

Management authority and jurisdiction: Details of the authority responsible for the conservation and management of the wetland, and the authority or authorities with territorial and functional jurisdiction over the wetland.

References: Abbreviated references to published literature and unpublished reports relevant to the site. The references are given in full at the end of each national section.

Reasons for inclusion: An indication of those features for which the site is considered to be internationally important, with a numerical reference to the criterion or criteria which justify the inclusion of the site in the *Directory*. The criteria used in the selection process are those developed for the identification of wetlands of international importance for designation under Article 2 of the Ramsar Convention. These criteria, as adopted by the Fourth Conference of the Contracting Parties in Montreux, Switzerland, in June 1990, are as follows:

(1.) Criteria for representative or unique wetlands.

A wetland should be considered internationally important if:

(a) it is a particularly good representative example of a natural or near-natural wetland, characteristic of the appropriate biogeographical region;

or (b) it is a particularly good representative example of a natural or near-natural wetland, common to more than one biogeographical region;
or (c) it is a particularly good representative example of a wetland which plays a substantial hydrological, biological or ecological role in the natural functioning of a major river basin or coastal system, especially where it is located in a trans-border position;
or (d) it is an example of a specific type of wetland, rare or unusual in the appropriate biogeographical region.

(2.) General criteria based on plants or animals.

A wetland should be considered internationally important if:

(a) it supports an appreciable assemblage of rare, vulnerable or endangered species or subspecies of plant or animal, or an appreciable number of individuals of any one or more of these species;
or (b) it is of special value for maintaining the genetic and ecological diversity of a region because of the quality and peculiarities of its flora and fauna;
or (c) it is of special value as the habitat of plants or animals at a critical stage of their biological cycle;
or (d) it is of special value for one or more endemic plant or animal species or communities.

(3.) Specific criteria based on waterfowl.

A wetland should be considered internationally important if:

(a) it regularly supports 20,000 waterfowl;
or (b) it regularly supports substantial numbers of individuals from particular groups of waterfowl, indicative of wetland values, productivity or diversity;
or (c) where data on populations are available, it regularly supports 1% of the individuals in a population of one species or subspecies of waterfowl.

A wetland is suitable for inclusion in the Ramsar Convention "List of Wetlands of International Importance" and hence in this *Directory* if it meets any one of the criteria set out above.

For proper application of the Ramsar criteria, it is essential that a considerable body of information be available on the site in question. For many wetlands in the Middle East, the information is so scanty that no objective evaluation of the importance of the site can be made. If all such sites were to be ignored, the *Directory* would become little more than an inventory of wetlands which have been well studied and well documented, and would lose its value as a basis for the identification of priorities in future wetland surveys and research. In those cases where very little information is available, the selection of sites for inclusion in the *Directory* has been based almost entirely on the judgement of the contributors.

Source: Names of individuals and institutions providing information on the site.

Some headings, such as "Conservation measures proposed", "Possible changes in land use", "Scientific research and facilities", "Conservation education", "Recreation and tourism" and "References", have been omitted when no relevant information was available to the compiler. The heading "Overview" has been omitted when very little information was available on the site in question.

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AFGHANISTAN

INTRODUCTION

Area: 636,265 sq.km.

Population: 16,557,000 (1990).

The Republic of Afghanistan is a mountainous, land-locked country centred on the Hindu Kush system and over 500 km distant from the nearest ocean. It is bounded in the north by Turkmenistan, Uzbekistan and Tadzhikistan, in the east and south by Pakistan, and in the west by Iran. A narrow tongue of land in the extreme northeast (the Wakhan Corridor) extends to the borders of Xinjiang Autonomous Region in China. The Hindu Kush are the second highest mountain range in the world, reaching heights of over 7,320 m, and supporting forests on their slopes and alpine tundra on their summits. Northwest of the Hindu Kush, the land slopes rapidly to as low as 350 m on the plains of the Amu Darya (Oxus) River on the Tadzhikistan border, and 200 m in the fertile valley of the Hari Rud, towards the border with Turkmenistan. South of the mountains, arid uplands descend gradually into desert in the southwest, with elevations falling below 500 m in the Seistan Basin on the Iranian border in the extreme southwest.

Afghanistan has a continental climate, with winter severity being increased by the effects of altitude. Summers are warm everywhere except on the highest peaks. Winters can be extremely cold with considerable snowfall at high altitudes, but at lower elevations, winters are milder and the climate is desertic or semi-desertic. Mountain ranges to the south protect most of the country from summer monsoonal rains, except in the extreme east, which receives summer rainfall of up to 1,000 mm. Elsewhere, the average annual precipitation is generally less than 300 mm, with most occurring during winter and spring, and often as snow.

There is good evidence that the natural vegetation of large parts of Afghanistan was originally woodland and forest, the present steppes reflecting centuries of wood-cutting by man and grazing and browsing by domestic livestock. According to Sayer and van der Zon (1981), in the late 1970s approximately 84% of the country was rangeland, 12 % arable land and only 3.4% forest. Rangelands are being degraded and abused, while in more arid regions, dryland farming has exhausted soils and led to serious soil erosion. The few remaining forested areas are being destroyed at an alarming rate to meet the fuel requirements of the major cities (Day, 1988).

The country is divided into 29 provinces, with Kabul as the largest city and administrative capital. Agriculture has traditionally been the basis of the economy, the main crops being wheat, fruit and vegetables, maize, barley, cotton, sugar-beet and sugar cane. The rearing of livestock, mainly sheep, cattle and goats, is also important, and is the principal activity throughout the desert and semi-desert areas. The little industrial activity concentrates on food

processing, textiles, leather goods and furniture. Natural gas production in the north is largely for export. Since 1979, most sectors of the economy have been badly affected by almost continuous civil warfare.

Summary of Wetland Situation

Much of Afghanistan is mountainous and the remainder, in the southwest, is extremely arid. As a consequence, it possesses few wetlands other than its major river systems rising in the high mountain ranges in the centre and northeast of the country. Much the largest lake system is the Hamun-i Puzak, one of a group of three large freshwater lakes in the Seistan Basin, an inland drainage basin surrounded by desert on the border with Iran. These wetlands receive most of their water from the Helmand River and Khash River, which rise far away to the northeast in the Hindu Kush. The only other large natural lakes are two brackish to saline lakes in the central highlands, Dashte Nawar and Ab-i Istada, both of which are renowned as breeding areas for the Greater Flamingo *Phoenicopterus ruber*, and two high altitude freshwater lakes, Zor Kol and Chaqmatin Lake, in the Pamir Ranges in the Wakhan Corridor. Kole Hashmat Khan, a small eutrophic lake in the foothills of the Hindu Kush near Kabul, is the only remaining water body of the formerly extensive wetlands on the plain of Kabul. Other notable wetlands include a chain of six lapis lazuli lakes separated by travertine terraces in the Bande Amir Valley and several small freshwater lakes along the Kabul River, notably Lake Sarobi and Lake Duronta. In the north, there were formerly extensive floodplain wetlands along the Amu Darya river on the border with Tadzhikistan, but much of this habitat has probably now been lost to agriculture.

Undoubtedly the most serious threat to wetlands in Afghanistan has been the drainage of wetlands for agriculture and urban development, and diversion of water supplies for irrigation purposes. Ab-i Istada and Kole Hashmat Khan have been affected by the diversion of water from the inflowing rivers, while flood control projects and irrigation schemes on the Helmand River have reduced the extent of flooding in the Hamun-i Puzak, especially during years of below average rainfall. At many wetlands, heavy grazing of marsh vegetation by domestic livestock is inhibiting natural plant succession, and is causing permanent damage to aquatic plant communities as the highly palatable species are grazed to extinction. This has been reported to be a serious problem at Dashte Nawar, Ab-i Istada, the Bande Amir lakes and Kole Hashmat Khan.

Waterfowl hunting occurs commonly at wetlands throughout Afghanistan, and uncontrolled hunting and the collection of birds' eggs have been reported to be serious problems at most of Afghanistan's wetlands. The rapid decline and eventual extinction of the Central Asian population of the Siberian Crane *Grus leucogeranus*, which formerly wintered at Bharatpur in India, is now thought to have been at least partly due to excessive hunting at Ab-i Istada, a key staging area for this crane flock in spring and autumn (Archibald & Landfried, 1993).

Wetland Research

Most of Afghanistan's major wetlands were surveyed during the 1960s and 1970s, but none is as yet properly documented, and further survey and study is urgently required. Savage (1968), summarizing the meagre information available at that time, identified six wetlands in Afghanistan as being especially important for waterfowl. In the early 1970s, the Government of Afghanistan requested the assistance of the United Nations Development Programme (UNDP) in the conservation and management of its wildlife and natural areas. A project on National Parks and Wildlife was initiated by the Food and Agriculture Organization (FAO) in 1972, and ran until the onset of hostilities in 1979. The project involved field surveys in many of Afghanistan's most important wildlife areas, including five of the principal wetlands, Ab-i Istada, Dashte Nawar, Bande Amir, Kole Hashmat Khan and Hamun-i Puzak, and provided the best information hitherto available on these sites (*e.g.* Petocz & Habibi, 1975; Petocz & Skogland, 1974; Petocz *et al.*, 1975; Rahim & Larsson, 1978; Shank & Larsson, 1977; Shank & Rodenburg, 1977). Mid-winter waterfowl counts were undertaken at lakes in the Kabul Valley, Ab-i Istada and Hamun-i Puzak between 1971 and 1974 under the sponsorship of the International Waterfowl and Wetlands Research Bureau (*e.g.* Koning & Dijksen, 1971; Koning & Walmsley, 1972 & 1973), and the Hamun-i Puzak was surveyed from the air in January 1976 as part of a joint aerial survey of the wetlands of the Seistan Basin involving the Afghani Directorate of Wildlife and National Parks and the Iranian Department of Environment (Petocz *et al.*, 1976). Other investigations involving wetlands have included studies of Greater Flamingos *Phoenicopterus ruber* at Ab-i Istada and Dashte Nawar (*e.g.* Akhtar, 1947; Klockenhoff & Madel, 1970; Niethammer, 1970; Nogge, 1974) and general ornithological surveys in wetland areas (*e.g.* Madge, 1970; Niethammer 1967 & 1971; Nogge, 1973). As far as is known, the only serious investigation to have been carried out at a wetland in Afghanistan since the outbreak of war in 1979 was a survey of Ab-i Istada in November 1993, sponsored by the International Crane Foundation and BirdLife International (Jamil, 1994).

A recent inventory of Important Bird Areas in the Middle East, sponsored by BirdLife International, has identified 17 sites as being of special importance for bird conservation in Afghanistan (Evans, 1994). Five of these sites are wetlands and a further four contain significant tracts of wetland habitat. All of these wetland areas are included in the present inventory.

Wetland Area Legislation

Nature conservation began in Afghanistan around the beginning of this century with the establishment of hunting preserves for use by royalty. These reserves, which included several wetlands, were individually declared by Royal Decree. As of 1991, there was still apparently no overall enabling legislation to provide for the establishment and management of protected areas (IUCN, 1992). Several protected areas were established in the 1970s on the basis of government orders in response to petitions submitted to the Head of State, but few if any of these were formally gazetted (Day, 1988). A draft Law of Forests has been prepared, but this has not as yet

been legislated. It has been proposed that this draft legislation be revised to incorporate provisions for the establishment and management of protected areas. Unregulated hunting was curbed in the 1970s, and the sport was reserved for tourists in certain specified areas.

At international level, Afghanistan ratified the World Heritage Convention in March 1979, and has signed the Biodiversity Convention. No natural World Heritage Sites have been designated.

Wetland Area Administration

The Department of Forests and Range, established in 1957 in the Ministry of Agriculture, is responsible for wildlife protection and the establishment and management of protected areas. A system of protected areas was established in the early 1970s with the assistance of the UNDP/FAO National Parks and Wildlife Project. This system included two categories of protected areas: National Parks and Waterfowl Reserves or Sanctuaries. Of the six protected areas designated between 1973 and 1978, four included important wetlands: Ab-i Istada Waterfowl Sanctuary, Dashte Nawar Waterfowl Sanctuary, Kole Hashmat Khan Waterfowl Sanctuary and Bande Amir National Park (Day, 1988).

A Directorate of Wildlife and National Parks was established within the Department of Forests and Range in 1973, but apparently this was never given any specific and approved jurisdictional powers (Day, 1988). One of its first activities concerned the protection of waterfowl at Ab-i Istada, especially the breeding flamingos. The Afghan Tourist Organization was largely responsible for the commercial exploitation of wildlife, and retained jurisdiction over Afghanistan's only national park, Bande Amir. The Republican Guard, a cadre of the Afghan army directly linked to the presidential office, was given charge of former royal hunting reserves (which include Kole Hashmat Khan Waterfowl Sanctuary) when the monarchy was abolished in 1973 (Day, 1988). Conservation activities were brought to an abrupt halt in 1979 due to political unrest, and since then there has been extremely limited activity in the field of conservation and the management and administration of protected areas (MacPherson, 1991).

Organizations involved with Wetlands

Department of Forests and Range, Ministry of Agriculture
: Directorate of Wildlife and National Parks
: Responsible for the conservation and management of wildlife and protected areas.

Afghan Tourist Organization
: Responsible for sport hunting and the management of Bande Amir National Park.

Republican Guard
: In charge of former royal hunting reserves (*e.g.* Kole Hashmat Khan Waterfowl Sanctuary).

National bodies involved in scientific research have included the Science Research Centre at the Afghanistan Academy of Sciences and the Faculty of Agriculture at Kabul University. There are no non-governmental organizations concerned with nature conservation in Afghanistan.

WETLANDS

Site descriptions compiled from the literature.

Zor Kol and Chaqmatin Lake (1)

Location: Zor Kol 37°27'N, 73°40'E; Chaqmatin Lake 37°14'N, 74°12'E; near the eastern tip of the Wakhan Corridor, Badakhshan Province.
Area: Zor Kol c.3,500 ha; Chaqmatin Lake c.2,500 ha.
Altitude: Zor Kol c.4,100 m; Chaqmatin Lake c.4,000 m.
Physical and ecological features: Two high altitude lakes in broad valleys in the Pamir Mountains near the eastern tip of the Wakhan Corridor, close to the borders with China, Pakistan and Tadzhikistan. Zor Kol lies on the border with Tadzhikistan in a broad east-west valley in the headwaters of the Pamir River. The lake is about 17 km long and up to 4 km wide. It is fed by snow-melt from the Big Pamir to the southwest and mountain ranges in Tadzhikistan to the north, and overflows through an outlet at the western end into the Pamir River. Chaqmatin Lake, some 45 km southeast of Zor Kol, lies in a broad valley between the Big Pamir and Small Pamir ranges, and is fed by snow-melt from both these ranges. It is about 16 km long and up to 2 km wide. The lake drains through an outlet at its eastern end into the Aksu River, which joins the Pamir River in Tadzhikistan. The lakes are surrounded by barren mountain ranges rising to peaks at over 6,100 m in the Big Pamir and 5,900 m in the Small Pamir.
Land tenure: No information.
Conservation measures taken: None. The two lakes are included within a much larger site (the Small Pamir, c.200,000 ha) identified as an Important Bird Area by BirdLife International (Evans, 1994).
Conservation measures proposed: None known.
Land use: The Small Pamir are inhabited by about 2,000 Kirghiz people who are primarily pastoralists, grazing their flocks on the lower slopes. Hunting tours were allowed into the area in the 1970s.
Possible changes in land use: None known.
Disturbances and threats: There are few threats to the area, due to its remoteness and the sparse human population. The eggs of Bar-headed Geese *Anser indicus* were being collected for

human consumption in the 1970s. Very heavy grazing pressure and the cutting of *Artemisia* bushes for fuel have resulted in some degradation of the alpine steppe vegetation (Evans, 1994).
Hydrological and biophysical values: No information.
Social and cultural values: No information.
Noteworthy fauna: No information is available on the aquatic fauna of the lakes. The Bar-headed Goose *Anser indicus* is a summer visitor to the region, with important breeding colonies at both lakes. Other breeding species include *Tadorna ferruginea*, *Netta rufina*, *Mergus merganser* and *Charadrius mongolus*. Hundreds of Common Cranes *Grus grus* are reported to pass through the area on migration.
Noteworthy flora: No information.
Scientific research and facilities: Basic faunal surveys were conducted in the 1970s (Nogge, 1973; Petocz, 1978).
Management authority and jurisdiction: No information.
References: Evans (1994); Nogge (1973); Petocz (1978); Sayer & van der Zon (1981).
Reasons for inclusion: 1a & 2c. Good examples of high mountain lakes, and the only such lakes in the Pamirs; important as a breeding area for *Anser indicus* and some other waterfowl.
Source: See references.

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Amu Darya Marshes (2)

Location: 37°10'-37°35'N, 68°40'-69°40'E; along the Amu Darya River on the border with Tadzhikistan, 60 km north of Kunduz and 80 km north of Taloqan, Kunduz and Takhar Provinces.
Area: Present area unknown; formerly at least 40,000 ha.
Altitude: 350-470 m.
Physical and ecological features: The site comprises the riverine and floodplain wetlands of the Amu Darya (Oxus) River in Kunduz and Takhar Provinces. The main areas are some 20,000 ha of floodplain wetlands along a 40 km stretch of river near Imam Sahib (37°15'N, 68°50'E) in the west, and some 20,000 ha of wetlands along a 45 km stretch of river near Darqad (37°25'N, 69°30'E) in the east. The wetlands consist of networks of braided river channels and creeks with numerous large and small islands, vast tracts of reeds *Phragmites* interspersed with thickets of *Tamarix* and *Salix* trees, and quite large stands of *Elaeagnus* woodland. Extensive swamp woodland formerly dominated this region, but large areas had already been cleared by the late 1970s, and it is doubtful if any significant stands of woodland remain.
Land tenure: No information.
Conservation measures taken: Both the Imam Sahib and Darqad areas were declared Royal Hunting Preserves in the early part of the century, with restrictions on settlement, access, conversion to agriculture and hunting. However, the reserves were never gazetted, and no conservation measures were formally proposed. The two main areas, Imam Sahib and Darqad, have been identified as Important Bird Areas by BirdLife International (Evans, 1994).
Conservation measures proposed: None.

Land use: No information.
Possible changes in land use: Any future damming of the Amu Darya river upstream in Tadzhikistan would pose a serious threat to the integrity of the site.
Disturbances and threats: Habitat destruction is a very great threat and has probably reached critical proportions. It is likely that much of the area has already been destroyed and converted into cultivation, as it has on the north side of the river in Tadzhikistan. The swamp woodland was being severely deforested and converted into cultivation by settlers in the late 1970s, following the overthrow of the monarchy. Both *Cervus elaphus bactrianus* and *Phasianus colchicus bianchii* were hunted extensively and without control in the 1970s, and their survival is in doubt (Evans, 1994).
Hydrological and biophysical values: No information.
Social and cultural values: No information.
Noteworthy fauna: In the 1970s, the swamp woodland still contained a small population of *Phasianus colchicus bianchii*, the last remnants of this subspecies of the Common Pheasant in Afghanistan. The area was reported to be important habitat for waterfowl throughout the year, and *Marmaronetta angustirostris* was thought to breed in the marshes (Savage, 1968). Other probable breeding species included *Vanellus leucurus*, *Riparia paludicola*, *Acrocephalus concinens*, *A. melanopogon* and *Panurus biarmicus* (Evans, 1994).
The area was also extremely important for tiny remnant populations of an endangered subspecies of the Red Deer *Cervus elaphus bactrianus* and the Caspian Tiger *Panthera tigris virgatus*. Tracks of the tiger were reported in the Darqad area as recently as 1967. The continued presence of these large mammals is now highly unlikely, and the Caspian Tiger is considered to be extinct (Evans, 1994).
Noteworthy flora: Any surviving stands of swampy woodland would be of considerable botanical interest as this community has been widely destroyed or degraded throughout the region.
Scientific research and facilities: The entire area is very poorly known.
Management authority and jurisdiction: No information.
References: Evans (1994); Savage (1968); Sayer & van der Zon (1981).
Reasons for inclusion: 1d, 2a & 2b. Formerly an example of a wetland type (swampy woodland) with very limited distribution in this part of Central Asia; important for several globally threatened species and subspecies of animals, and one of the last known haunts of the Caspian Tiger.
Source: See references.

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Bande Amir Lakes (3)

Location: 34°50'N, 67°15'E; in Bande Amir National Park in the Hazarajat Mountains of the western Hindu Kush, 55 km west of Bamiyan Town, Bamiyan Province.
Area: Combined area of lakes 600 ha; area of National Park 41,000 ha.
Altitude: The lakes lie at approximately 2,900 m; surrounding peaks rise to 3,832 m.
Overview: A chain of six lapis lazuli lakes separated by travertine terraces in the Bande Amir

Valley, an area of outstanding scenic beauty in the western Hindu Kush. The area was declared a National Park in 1973.

Physical features: The lakes of Bande Amir consist of a chain of six lapis lazuli lakes nestled between 300 m high magenta rock walls in the Bande Amir Valley. From west to east, these are Gholaman, Qambar, Haibat, Panir, Pudina and Zulfiqar. Travertine dams, about 10 m high and 3 m thick, and formed by the precipitation of calcium carbonate, separate the lakes from each other in a series of terraces. The two largest lakes, Haibat and Zulfiqar, cover 490 ha and 90 ha, respectively. Panir Lake, at only 100 m in diameter, is the smallest. Qambar Lake is also of limited extent, but gastropod shells found beyond its present water level indicate that it used to be larger. After clearing the final travertine terrace of Gholaman Lake, the Bande Amir flows down the northern slopes of the Hindu Kush and peters out in the desert near the Tadzhikistan border. The waters of the lakes are oligotrophic and calcareous, with a pH of 7.8. Their deep blue colour is a result of the water's purity and high lime content. Surface water temperatures reach 14-17°C during summer; in winter, the lakes freeze over. The high rolling steppe around the lakes rises steeply in the west to rugged limey schist and conglomerate peaks (Day, 1988).

The climate is strongly continental, with low air humidity, high evaporation, and extreme temperature variations. The average annual rainfall is about 400 mm, all of which falls between October and May, with 50% falling in April alone.

Ecological features: Lake shore vegetation is dominated by reeds *Phragmites australis*, cat-tail *Typha laxmanni* and species of *Carex* and *Scirpus*. *Salix* bushes cover some of the limestone dams. Uncultivated ground between the lakes and the steep cliffs is covered in meadows of dense grasses and herbs. These meadows have been invaded by nitrophilous plants due to grazing practices. Common meadow plants of natural origin include *Mantha longifolia*, *Plantago gentianoides*, *Gentiana* spp., *Calamagrostis* spp., sedges and rushes. The Darae Sabzel and Darae Bande Amir creeks downstream from the lakes are flooded each spring as a result of snow-melt. Vegetation on the creek banks is therefore dominated by pioneer species. Below the normal high water level, sedges and the rush *Juncus turkestanicus* are found. Above normal high water level, where flooding is only occasional, are shrubs, notably *Myricaria germanica*, willows *Salix* spp. and sea buckthorn *Hippophae rhamnoides*. Elsewhere in the National Park, the vegetation consists of alpine steppe with an *Artemisia-Acantholimon* community and grassy steppe, formerly dominated by species of *Stipa*, *Festuca*, *Herdeum* and *Poa*, but now much affected by centuries of overgrazing (Dieterle, 1973; Shank & Larsson, 1977).

Land tenure: The lakes are state owned. Wheat fields around the lakes are also state owned, but subject to traditional farming rights, passed on by patrilineal descent (Day, 1988). Much of the land elsewhere in the National Park is common land, used for grazing.

Conservation measures taken: The Bande Amir area was declared a National Park (41,000 ha) in September 1973 in response to a petition from the Afghan Tourist Organization. This declaration was never published in the official Government Gazette by the Ministry of Justice, and therefore has no legal status (Day, 1988). The boundaries of the National Park encompass the entire catchment area of the headwaters of the Bande Amir river. A strategy for the establishment and development of the National Park was prepared in 1977 (Shank & Larsson, 1977). The long-term objectives of this strategy were to conserve the natural landscapes through a system of zonation and to develop the tourist potential of the area. Traditional land-use practices would continue within a buffer area, while an inner core zone would protect the

lakes and their immediate uplands. Activities in the park were interrupted in 1979 at the onset of hostilities in Afghanistan.

Bande Amir National Park has been identified as an Important Bird Area by BirdLife International (Evans, 1994).

Conservation measures proposed: None known, other than those contained within the strategy of Shank and Larsson (1977).

Land use: The immediate banks of the lakes are quite densely inhabited by a predominantly Hazara population, estimated at 3,000-5,000 residents in the 1970s. The land surrounding the lakes is extensively farmed for wheat, while elsewhere in the National Park the steppe is heavily grazed by domestic livestock. In the 1970s, there were an estimated 10,000 sheep and goats, 1,500 cattle and 200 horses belonging to local residents, and a further 1,500-3,000 sheep owned by semi-nomadic kuchis and mulclan. The latter arrive in the area in May, and remain there for three or four months (Shank & Larsson, 1977).

Possible changes in land use: It has been suggested that the lakes be stocked with Rainbow Trout *Salmo irideus*.

Disturbances and threats: Heavy grazing pressure and the cutting of *Phragmites* and *Salix* for fuel have degraded the lakeside vegetation. Unlimited grazing by domestic livestock and uprooting of shrubs have caused serious degradation of steppic vegetation throughout the park, with resulting soil erosion.

Hydrological and biophysical values: No information.

Social and cultural values: The lakes have considerable cultural significance, their creation having been attributed to Ali, son-in-law of Mohammed, the founder of Islam. A small mosque, built in 1904, commemorates the spot where Ali recited two ragats (cycles) of prayer on the shores of Haibat Lake (Day, 1988).

Noteworthy fauna: A species of carp (Cyprinidae), known locally as milk fish or "shir moi", is abundant in the lakes. The lakes are mostly too deep and steep-sided for waterfowl, although a number of species have been recorded in small numbers on migration, including *Ixobrychus minutus*, *Casmerodius albus*, *Aythya nyroca*, *Fulica atra*, *Himantopus himantopus*, *Charadrius dubius*, *Tringa ochropus* and *Actitis hypoleucos* (Petocz *et al.*, 1975). The lakeside vegetation provides an attractive staging area for many migratory birds, especially passerines; 152 species of birds have been recorded, mostly during a study of bird migration through the area in August and September 1970 (Madge, 1970). No large mammals occur in the vicinity of the lakes because of the high levels of human disturbance. Small mammals include Afghan Pika *Ochotona rufescens*, Long-tailed Marmot *Marmota caudata* and the jerboa *Allactaga williamsi* (Day, 1988).

Noteworthy flora: The National Park contains four of the eleven plant species endemic to Bamiyan Province (Day, 1988).

Scientific research and facilities: Preliminary surveys of the geology (Jux & Kempf, 1971), vegetation (Dieterle, 1973) and wildlife (Petocz & Skogland, 1974) have been carried out. A study of bird migration through the area was undertaken in August and September 1970 (Madge, 1970).

Recreation and tourism: The Bande Amir area is one of the most beautiful natural landscapes in Afghanistan, and was a popular tourist attraction in the 1970s, attracting several thousand visitors each year. Day tours from Bamiyan were operated by the Afghan Tourist Organization (Shank & Larsson, 1977).

Management authority and jurisdiction: The Afghan Tourist Organization maintained control over the National Park in the 1970s.
References: Day (1988); Dieterle (1973); Evans (1994); Jux & Kempf (1971); Madge (1970); Petocz & Skogland (1974); Petocz *et al.* (1975); Shank & Larsson (1977).
Reasons for inclusion: 1d. A very good example of a series of mineral lakes with travertine terraces, in an area of outstanding scenic beauty.
Source: See references.

Kole Hashmat Khan (4)

Location: 34°30'N, 69°12'E; on the southeastern outskirts of Kabul, just south of the Kabul to Gardez highway, Kabul Province.
Area: 191 ha.
Altitude: 1,793 m.
Overview: A natural, brackish lake and marshes on the outskirts of Kabul, important as a staging area for migratory waterfowl, and also to a lesser extent as a breeding and wintering area. The lake has been partially protected for centuries as a waterfowl hunting area for royalty, and was declared a Waterfowl Sanctuary in 1973. It is under considerable threat from diversion of water supplies, pollution and various forms of human disturbance.
Physical features: Kole Hashmat Khan (also known as Lake Chaman) is a small, shallow, slightly saline, eutrophic lake in a basin on a large shelf in the foothills of the Hindu Kush. It is surrounded by hills on two sides and opens up into the Logar Valley to the northeast. The lake is the only remaining water body and marsh area of the formerly extensive wetlands on the plain of Kabul. It is fed by a tributary of the Logar River, and has no outlet except when the water level is exceptionally high. The lake is L-shaped, about 2.5 km in length and 0.3-1.0 km in width, and has a maximum depth of no more than 1.5 m. Formerly much more extensive, the lake has been reduced in size as a result of the development of irrigation systems which have tapped the Logar River, and large areas of former wetland have been converted into agricultural land. The water level fluctuates seasonally, being highest in winter and early spring, and lowest in late summer, when the lake almost dries up. High evaporation creates slightly saline conditions (Rahim & Larsson, 1978).
Summers are hot and dry, and winters are cold. The average annual precipitation is 295 mm, with most falling between December and April. Precipitation normally falls as snow from December to March. The mean annual temperature is 11.8°C; the warmest month is July with a mean of 24.9°C, and the coldest month is February with a mean of -2.6°C. The lake is usually frozen over for two to three months of the year (Rahim & Larsson, 1978).
Ecological features: The lake is strongly eutrophic and supports an abundant growth of algae, *Utricularia* sp. and *Ranunculus* spp. Approximately half of the lake is covered with dense reed-beds of *Phragmites australis*. A meadow-type halophytic plant community dominates the ground cover on the lake margins. This has been strongly modified by grazing and fertilization from animal droppings. Species present include *Ranunculus arvensis*, *Bromus danthoniae*, *Centaurea* sp., *Eleocharis* sp. and several species belonging to the families Cyperaceae,

Crucifereae and Compositeae (Rahim & Larsson, 1978). Most of the lake shore above high water level is under cultivation, mainly for wheat. The irrigated wheat fields eventually give way to a dry overgrazed steppe community on the mountain slopes.

Land tenure: The lake is state owned. Fields to the south belong to a Public Bath, those to the north are privately owned.

Conservation measures taken: During the reign of Amin Habibullah Khan (1901-1919), the lake was closed to all hunting except by a few privileged individuals. In the 1930s, King Mohammed Zahir Shah took a personal interest in the area and declared it a waterfowl reserve. The lake was then well protected as a private hunting area for the king until the 1970s, but little if any management was carried out. The lake was declared a Waterfowl Sanctuary by the Directorate of Wildlife and National Parks in 1973, but this has never been legally gazetted. Access has been restricted since 1979, and management activities have ceased.

Kole Hashmat Khan has been identified as an Important Bird Area by BirdLife International (Evans, 1994).

Conservation measures proposed: Rahim and Larsson (1978) made a number of recommendations for research and management aimed at establishing a waterfowl sanctuary and environmental education centre. In particular, they recommended that the lake and its shoreline (up to high water level) be legally gazetted as a Waterfowl Sanctuary and placed under the management of the Department of Forests and Range.

Land use: The lake has been used as a waterfowl hunting area since Moghul times, and was maintained as a royal hunting ground until 1973. Hunting continued through the 1970s, and took place from small boats manoeuvred through the reed-beds. Between 15 and 400 waterfowl were reportedly shot every Friday during late spring and early summer (Rahim & Larsson, 1978). The lake is used as a source of water for irrigation in the surrounding wheat fields, and cattle and water buffalo are allowed to graze in the reed-beds. Nomadic pastoralists utilize the area for one or two months in spring en route to the central Hindu Kush, their animals grazing on the lake shore. The surrounding area is densely populated, and there is a village (Tujik) immediately to the west of the lake.

Possible changes in land use: No information.

Disturbances and threats: The ecology of the lake has been much affected by the surrounding human population. Numerous irrigation channels take water from the tributary stream of the Logar River feeding the lake to irrigate wheat and alfalfa fields in the area. This has been a major factor contributing to low water levels in the lake during drought periods. Various pollutants, including domestic sewage, agricultural effluents and some industrial waste, enter the lake from the Logar River, and part of the marshes has been used as a rubbish dump. Domestic animals grazing in the reed-beds are a major cause of disturbance to breeding birds, especially when the water level is low. Reeds are cut, and there is considerable hunting pressure. The shore is used as a playground by children, and clothes are laundered in the lake (Rahim & Larsson, 1978; Sayer & van der Zon, 1981). Various Cyprinid fish have been introduced into the lake, including the Common Carp *Cyprinus carpio*.

Hydrological and biophysical values: No information.

Social and cultural values: The lake is an important recreational site for the population of Kabul, and is also of considerable religious and historical significance. The shrine of Jubur Ansar is situated near the lake; this was built in 645 AD in memory of soldiers killed in an effort to convert the Afghan population from Buddhism and Hinduism to Islam. The remains of

an old road pass through the lake itself, and there is an old fort, Qala-i-Hashmat Khan, nearby. This fort was built during the reign of Amir Habibullah Khan and used as a royal guest house (Rahim & Larsson, 1978).

Noteworthy fauna: The lake is an important staging area for migratory waterfowl in spring and autumn, and when not completely frozen over, is used by small numbers of several species in winter (Savage, 1968). Mid-winter waterfowl counts in 1972 and 1973 included up to 40 *Anas strepera*, 400 *A. crecca*, 300 *A. platyrhynchos*, 50 *A. acuta*, 180 *A. clypeata*, 74 *Netta rufina*, 150 *Aythya ferina*, 80 *A. fuligula*, 3 *Mergellus albellus* and 1,500 *Fulica atra* (Koning & Walmsley, 1972 & 1973). Counts of waterfowl on passage have included up to 233 *Podiceps nigricollis*, 471 *Anas clypeata*, 2,210 *Aythya ferina*, 10,000 *Fulica atra*, 500 *Tringa glareola* and 150 *Chlidonias hybridus* (Evans, 1994). *Marmaronetta angustirostris* and *Oxyura leucocephala* were recorded in small numbers on passage in the 1960s and 1970s, and the latter may have bred. Other scarce passage migrants have included *Plegadis falcinellus*, *Platalea leucorodia*, *Phoenicopterus ruber* and *Aythya nyroca*. Several species of waterbirds were breeding at the lake in the 1960s and 1970s, including *Tachybaptus ruficollis*, *Podiceps nigricollis* (30 pairs), *Aythya ferina* (2 pairs), *Gallinula chloropus* and *Fulica atra*. Possible breeding species included *Botaurus stellaris*, *Netta rufina* and *Porzana pusilla*. By 1978, 157 species of birds had been recorded at the lake, including 46 species of waterfowl (Rahim & Larsson, 1978).

Mammals recorded from around the lake include the voles *Alticola roylei* and *Microtus afghans*, Jackal *Canis aureus* and Red Fox *Vulpes vulpes*. Other mammals known to occur in the general area include Wolf *Canis lupus*, Marbled Polecat *Vormela peregusna*, Euphrates Jerboa *Allactaga euphratica* and Grey Hamster *Cricetulus migratorius* (Rahim & Larsson, 1978).

The lake itself contains a typical aquatic community of crustaceans, insects and some amphibians, notably the toad *Bufo viridis* and frogs *Rana* spp. Golden Carp have been introduced and thrive, together with other carp of the family Cyprinidae (Rahim & Larsson, 1978).

Noteworthy flora: None known.

Scientific research and facilities: Niethammer (1967) and Puget (1971) studied the avifauna of Kole Hashmat Khan, and Rahim and Larsson (1978) conducted an ecological survey of the lake to assess its conservation importance.

Conservation education: Situated in the outskirts of Kabul, the site has excellent potential for conservation education. An environmental education centre was proposed by Rahim and Larsson (1987).

Recreation and tourism: Many Kabul residents visit the religious shrines and large cemetery near the lake, and also visit the lake for recreational purposes. Conversion of the old fort of Qala-i-Hashmat Khan into a hotel, restaurant or visitor centre has been suggested.

Management authority and jurisdiction: The Republican Guard was given jurisdiction over the former royal hunting reserve when the monarchy was abolished in 1973. In 1978, jurisdiction passed to the Department of Forests and Range, but effective control remained with the Republican Guard (Day, 1988).

References: Day (1988); Evans (1994); Niethammer (1967); Puget (1971); Rahim & Larsson (1978); Savage (1968); Sayer & van der Zon (1981).

Reasons for inclusion: 1d, 2a, 2b & 3b. One of the few examples of a natural eutrophic lake in

the Hindu Kush, and the only remaining water body of the formerly extensive wetlands on the plain of Kabul. The lake lies on a major bird migration route through the Hindu Kush, and is an important staging area for migratory waterfowl including the globally threatened *Oxyura leucocephala*.
Source: See references.

Lake Sarobi and Lake Duronta (5)

Location: Lake Sarobi 34°35'N, 69°45'E; Lake Duronta 34°30'N, 70°20'E; in the valley of the Kabul River, 70 and 10 km west of Jalalabad, respectively, Nangarhar Province.
Area: Lake Sarobi 200 ha; Lake Duronta 2,000 ha.
Altitude: Lake Sarobi c.1,200 m; Lake Duronta c.600 m.
Physical and ecological features: Two small freshwater lakes, Sarobi and Duronta, in the valley of the Kabul River west of Jalalabad. Lake Sarobi is a small lake of about 200 ha, created by a barrage on the Kabul River. Lake Duronta, near the city of Jalalabad, is an open freshwater lake of about 2,000 ha, with reed-beds along its western shore. Both lakes are normally ice-free in winter.
Land tenure: No information.
Conservation measures taken: None. The two lakes are included within a much larger site (the Jalalabad Valley, 25,000 ha) identified as an Important Bird Area by BirdLife International (Evans, 1994).
Conservation measures proposed: None known.
Land use: No information.
Possible changes in land use: There is a possibility of Lake Duronta being developed as a recreational area.
Disturbances and threats: No information.
Hydrological and biophysical values: No information.
Social and cultural values: No information.
Noteworthy fauna: The lakes are used extensively by waterfowl on passage, and by small numbers of several species in winter (Savage, 1968). Waterfowl recorded in winter in the early 1970s included up to 90 *Podiceps cristatus*, 13 *P. nigricollis*, 6 *Phalacrocorax carbo*, 6 *Casmerodius albus*, 50 *Ardea cinerea*, 50 *Anas strepera*, 430 *A. crecca*, 1,020 *A. platyrhynchos*, 42 *A. acuta*, 20 *A. clypeata*, 63 *Netta rufina*, 50 *Aythya ferina*, 80 *A. fuligula*, 15 *Mergellus albellus*, 19 *Mergus merganser*, 1 *Melanitta fusca*, 400 *Fulica atra*, 130 *Vanellus vanellus*, 7 *Larus cachinnans* and 27 *L. ridibundus*. *Riparia paludicola* is common at Lake Sarobi in summer.
Noteworthy flora: None known.
Scientific research and facilities: Some mid-winter waterfowl counts were undertaken in the early 1970s (Koning & Dijksen, 1971; Koning & Walmsley 1972 & 1973).
Management authority and jurisdiction: No information.
References: Carp (1980); Evans (1994); Koning & Dijksen (1971); Koning & Walmsley (1972, 1973); Savage (1968).

Reasons for inclusion: 1a & 3b. Freshwater lakes important as staging and wintering areas for migratory waterfowl.
Source: See references.

Dashte Nawar (6)

Location: 33°35'N, 67°48'E; about 55 km northwest of Ghazni, Ghazni Province.
Area: Ab-i Nawar 3,500 ha; Waterfowl Sanctuary 7,500 ha; Dashte Nawar plain 70,000 ha.
Altitude: 3,200 m.
Overview: A shallow brackish lake, Ab-i Nawar, in the middle of a high desert plateau at 3,200 m in the Hindu Kush; the highest known breeding locality for *Phoenicopterus ruber* in the world, and an important staging area for migratory waterfowl. The lake was declared a Waterfowl Sanctuary in 1977.
Physical features: Dashte Nawar is a high desert plateau, about 40 km from north to south and up to 15 km from east to west, in the Koh-i Baba Range of the Hindu Kush. It is surrounded on all sides by mountains rising to peaks in excess of 4,800 m, and contains a shallow, brackish lake, Ab-i Nawar, which covers about 3,500 ha. The lake is approximately 14 km long by 3 km wide, and contains about 40 small islands varying in size from 35 sq.m to 500 sq.m. The water volume of the lake typically drops from nearly 20 million cubic metres in spring to only two million cubic metres in autumn, and the lake may dry out completely in winter. The water supply comes primarily from spring snow-melt from the surrounding mountains.
Summers are dry and relatively warm, and winters extremely cold. The average annual precipitation at Nawar, 20 km to the west of the lake, is 184 mm, of which 72% falls as snow during the winter months. For most of the year, temperatures are low, with only three months of the year having a mean minimum temperature above freezing point. When not completely dry, the lake is frozen over and covered with snow throughout the winter months.
Ecological features: The lake bottom supports a dense cover of higher algae belonging to the family Characeae. The mudflats surrounding the lake are mostly devoid of vegetation, except at the outer edge where the herbs *Glaux maritima*, *Crypsis aculeata* and *Polygonum sibiricum* become common. The surrounding plain consists of an extensive meadow of low grasses and herbs. Common grasses include *Bromus gracillimus*, *Puccinellia stapfiana* and *Aelunopus littoralis*; common herbs include *Halocharis clavata*, *Polygonum paronychioides*, *Potentilla komaroviana*, *Gentiana kaufmanniana*, *Tragopogon* sp. and *Artemisia* sp. Dry, shallow stream beds support distinctive communities, with *Taraxacum bessarabicum*, *Triglochin palustre*, *Ranunculus* sp., *Juncus bufonius* and the grass *Eremopoa bellula* (Shank & Rodenburg, 1977).
Land tenure: State owned. Semi-nomadic people have traditional grazing rights.
Conservation measures taken: Dashte Nawar was declared a National Flamingo and Waterfowl Sanctuary by the Directorate of Wildlife and National Parks in 1974. The lake was approved as a Waterfowl Sanctuary (7,500 ha) in December 1977 by the Head of State, but it appears that the Sanctuary was never formally gazetted. The Sanctuary includes the entire lake and a 1 km wide peripheral strip of land. A management plan was prepared in 1977 (Shank & Rodenburg, 1977). Principal objectives outlined in the plan include protecting birds from

adverse influences of human origin and initiating a monitoring programme upon which to base future management decisions. In 1975, assistance was received from WWF to provide quarters for a resident warden and research facilities. Work was interrupted in May 1979 at the onset of hostilities in Afghanistan.

Dashte Nawar was identified as a wetland of international importance by Carp (1980), and has been identified as an Important Bird Area by BirdLife International (Evans, 1994).

Conservation measures proposed: Petocz and Habibi (1975) make a number of recommendations for the conservation of the site.

Land use: Dashte Nawar is relatively isolated and accessible only in summer. It is sparsely inhabited; in the 1970s, there were about 25 villages on the plain, with an estimated resident population of 1,200-1,500. In addition, an estimated 1,300 semi-nomadic people (260 families) traditionally used the area as summer grazing grounds for an estimated 5,000-7,000 sheep and goats and 700 camels (Shank & Rodenburg, 1977).

Possible changes in land use: None known.

Disturbances and threats: Overgrazing by domestic livestock has degraded the vegetation on the surrounding plains, and the collection of eggs and human disturbance are also reported to be problems (Shank & Rodenburg, 1977).

Hydrological and biophysical values: No information.

Social and cultural values: Dashte Nawar is an important archaeological site, exhibiting intact stratigraphic sequences. Several mounds representing early dwellings have been discovered with accompanying artifacts, which suggest occupation from Palaeolithic to Buddhist times (Shank & Rodenburg, 1977).

Noteworthy fauna: Dashte Nawar is probably the highest of all known regular breeding haunts of the Greater Flamingo *Phoenicopterus ruber*. Breeding was first reported in 1969 (Klockenhoff & Madel, 1970), and between then and 1975, the number of adult flamingos at the breeding colony fluctuated between 1,300 (1974) and 12,000 (1970). Breeding is known to have occurred in every year except the drought years of 1971 and 1972, when the lake almost dried up (Savage, 1972b; Petocz & Habibi, 1975). Other species which are known to have bred at the lake include *Recurvirostra avosetta*, *Charadrius leschenaultii*, *Tringa totanus* and *Sterna hirundo* (Klockenhoff & Madel, 1970). Over 40,000 waterfowl were present at the lake in September 1975; most were ducks (*Tadorna ferruginea*, *T. tadorna*, *Anas crecca*, *Aythya ferina*), but other species present included *Ardea cinerea*, *Grus virgo*, *Fulica atra*, *Charadrius dubius*, *C. alexandrinus*, *Tringa glareola*, *T. ochropus*, *Actitis hypoleucos*, *Larus genei* and *Chlidonias hybridus* (Petocz *et al.* 1975). Shank and Rodenburg (1977) list 31 species of waterfowl that are known to have occurred at Dashte Nawar.

Mammals recorded in the area include Long-tailed Marmot *Marmota caudata*, Fulvous Ground Squirrel *Citellus fulvus*, Jackal *Canis aureus*, Wolf *Canis lupus* and Red Fox *Vulpes vulpes*. A toad *Bufo andersoni* and a skink *Ablepharus* sp. are the only amphibians and reptiles known to occur (Shank & Rodenburg, 1977). There are no fish in the lake, but aquatic invertebrates and planktonic organisms are periodically abundant. Shank and Rodenburg (1977) give a list of aquatic organisms collected in the lake.

Noteworthy flora: None known.

Scientific research and facilities: The birds of Dashte Nawar, and particularly the Greater Flamingos, have been studied by Klockenhoff and Madel (1970), Nogge (1974) and Petocz *et al.* (1975).

Management authority and jurisdiction: The Directorate of Wildlife and National Parks in the Department of Forests and Range is responsible for management of the Waterfowl Sanctuary.
References: Carp (1980); Day (1988); Evans (1994); Klockenhoff & Madel (1970); Nogge (1971, 1974); Petocz & Habibi (1975); Petocz *et al.* (1975); Savage (1972a, 1972b); Shank & Rodenburg (1977).
Reasons for inclusion: 1a, 2c, 3a & 3c. A good example of a high altitude salt lake, important as a breeding and feeding site for *Phoenicopterus ruber*, and as a staging area for migratory waterfowl. Except for Ab-i Istada (Site 7), the nearest comparable staging area for waterfowl is 600 km away in the Seistan Basin.
Source: See references.

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Ab-i Istada (7)

Location: 32°30'N, 67°55'E; 35 km south-southeast of the village of Moqur and 130 km south-southwest of Ghazni, Ghazni Province.
Area: Maximum area of lake c.13,000 ha; Waterfowl Sanctuary 27,000 ha.
Altitude: 1,968 m.
Overview: A large alkaline lake in the southern foothills of the Hindu Kush, famous for its breeding Greater Flamingos *Phoenicopterus ruber*, but also an important breeding area for several other species of waterfowl, and an extremely important staging area in spring and autumn for a wide variety of migratory waterfowl, including (formerly) *Grus leucogeranus*. The lake was declared a Waterfowl Sanctuary in 1977, but is threatened by dams and irrigation schemes on the rivers which feed it, and is much disturbed by hunters and egg-collectors.
Physical features: Ab-i Istada is a shallow, alkaline lake of about 13,000 ha, measuring 16 km across at its widest point. It lies on a gently rolling plateau in the southern foothills of the Koh-i Baba and Koh-i Paghman ranges. The size and shape of the lake vary widely throughout the year and from year to year, depending on rainfall. During normal years, the lake's volume ranges from 270 million cubic metres in spring to about 140 million cubic metres in autumn, which results in a 1 m change in depth. At low water levels, the lake is surrounded by extensive mudflats, which extend for up to 7 km on the east side but only 0.5 km on the west. There are normally three small islands in the lake, but at high water levels, only one of these remains exposed. Winter rainfall and snow-melt enter the lake through a river at the northeast corner, formed by the confluence of the Gandez, Ghazni and Nahara rivers; this area supports a small marsh. The water level in the lake is also to some extent dependent on groundwater. The lake dried out almost completely in the summer of 1971, partly because of an exceptionally severe drought, but partly because of the construction of the Bandeh Sardeh Dam on one of the feeder rivers. In 1992 and 1993, the water level was exceptionally high, apparently because the local government opened the sluice gates on Bandeh Sardeh Dam in 1992 following very heavy snowfall and rainfall in the catchment. This resulted is a sharp drop in salinity levels (Jamil, 1994).
Summers are hot and dry, and winters are cold. The average annual precipitation at Moqur, 30

km to the northwest of the lake, is 216 mm, of which 92% falls as snow during the winter months. Mean monthly maximum temperatures remain above freezing point year-round, but most of the lake freezes over in winter, with only tiny pools of open water remaining.

Ecological features: Stream banks and the marshy area at the river mouth support a lush growth of *Carex* sp. The only higher plant to be found in the lake itself is *Ruppia maritima*. In the 1960s and 1970s, the mudflats were almost entirely devoid of plant life, the only conspicuous vegetation being colonies of *Taraxacum monochlamydeum*. However, in the early 1990s, following exceptional flooding and a sharp drop in salinity, broad belts of reeds (presumably *Phragmites*) became established along the southern shore of the lake (Jamil, 1994). A sparsely vegetated transition zone between the mudflats and the steppe proper contains a diversity of small herbs such as the mat-forming *Psylliostachys beldushistanica*, which is usually associated with *Ranunculus* sp., clumps of *Asperugo procumbens* in sheltered areas, and such common and widely dispersed species as *Valerianella cymbicarpa*, *Veronica* sp., *Eremopyrum orientala*, *Papaver* spp. and many species of the families Crucifereae and Papillionaceae. The steppe zone is represented by an *Amygdalus* shrubland community, with scattered thorny shrubs and dispersed grasses. Shrubs such as *Amygdalus* sp., *Cousinia* sp., *Tamarix laxa* and *Artemisia* sp. are predominant. *Bromus gracillimus*, *B. tectorum*, *B. danthoniae* and *Boissiera squarrosa* are common grasses (Shank & Rodenburg, 1977).

Land tenure: State owned. Semi-nomadic people have traditional grazing rights in the area.

Conservation measures taken: Ab-i Istada was declared a National Flamingo and Waterfowl Sanctuary by the Directorate of Wildlife and National Parks in 1974, and game guards were stationed on the shore of the lake to prevent local people from raiding the flamingo nesting colony. The lake was approved as a Waterfowl Sanctuary (27,000 ha) by the Head of State in December 1977. The sanctuary includes mudflats but not cultivated land within a 2 km-wide belt of land around the lake. A management plan was prepared in 1977 (Shank & Rodenburg, 1977). Principal objectives outlined in the plan include protecting birds from adverse influences of human origin and initiating a monitoring programme upon which to base future management decisions. In 1975, assistance was received from WWF to provide quarters for a resident warden and research facilities. Work was interrupted in May 1979 at the onset of hostilities in Afghanistan, and since then there has been no effective administration, management or control of the area (Jamil, 1994).

Ab-i Istada was identified as a wetland of international importance by Carp (1980), and has been identified as an Important Bird Area by BirdLife International (Evans, 1994).

Conservation measures proposed: Ab-i Istada has been proposed as a National Park (Shank & Rodenburg, 1977; Sayer & van der Zon, 1981). Petocz and Habibi (1975) made a number of recommendations for the conservation of the site.

Land use: In the 1970s, there were more than 15 villages within 10 km of the lake, with a total population of about 2,500. The major concentrations were about 8 km to the northeast and 2 km to the west of the lake. In addition, there were some 200-300 people living in scattered settlements and about 300 semi-nomadic people (muldar or kuchis), who temporarily resided on the rolling plains in summer to graze their livestock (Shank & Rodenburg, 1977). During the thirteen year period 1978-1991, there was a military base at Taraki village, about 7.8 km from the lake. As a result of the war and local military operations, the local settled population abandoned their villages around the lake and fled to Pakistan and elsewhere as refugees. About ten families of nomads remained in the area throughout the conflict, and are now partially

settled and cultivating land to within 500 m of the lake. As peace has returned to the area, some refugees have come back to their former villages (Jamil, 1994).

Possible changes in land use: No information.

Disturbances and threats: The greatest threat to the lake is dam-building, water diversion and irrigation schemes along the Ghazni and Gandez Rivers which flow into the lake. As the volume of water in the lake decreases, the salinity increases, affecting the ecology of the lake. The upper part of one of the rivers was dammed in about 1970, and this led to a reduction in the extent of flooding and disappearance of the swampy area at the northeast corner of the lake near the river mouth (Savage, 1972b). In recent years, returning refugees have started digging wells around the lake and using diesel pumps to pump water for irrigation. Other threats include overgrazing by domestic livestock on the lake shores, the collection of birds' eggs for human consumption, and hunting throughout the year (Shank & Rodenburg, 1977). When water levels were very low in the late 1960s and early 1970s, the flamingo colony became accessible to local inhabitants who shot adult birds and collected all the eggs. Hunting is reported to have been especially heavy during the war years (1979-1991), when a military garrison was stationed near the lake (Jamil, 1994). There are also reports of helicopter gunships bombing the lake and causing considerable disturbance to wildlife. Waterfowl hunting, almost entirely with shot-guns, was very much in evidence in November 1993, with many hunters shooting from blinds along the lake shore (Jamil, 1994). The rapid decline and eventual extinction of the Central Asian population of the Siberian Crane *Grus leucogeranus*, which formerly wintered in India, is now thought to have been at least partly due to hunting at Ab-i Istada, a key staging area for this crane flock in autumn.

Hydrological and biophysical values: No information.

Social and cultural values: Ab-i Istada is an important archaeological site, exhibiting intact stratigraphic sequences. Several mounds representing early dwellings have been discovered with accompanying artifacts, which suggest occupation from Palaeolithic to Buddhist times (Shank & Rodenburg, 1977).

Noteworthy fauna: Ab-i Istada is an important breeding area for Greater Flamingos *Phoenicopterus ruber*. The presence of vast flocks of flamingos at Ab-i Istada was perhaps first documented in the memoirs of the Moghul Emperor Babur the Great, who observed tens of thousands in 1504. Between 1969 and 1976, the number of adult flamingos at the breeding colony fluctuated between 1,000 (1971) and 9,000 (1974), but breeding is known to have been attempted only in 1969, 1970 and 1972, and successful only in 1969, when about 1,000 juveniles were reared (Petocz & Habibi, 1975; Shank & Rodenburg, 1977). Fluctuations in flamingo numbers and breeding success have been linked to the changes in water level and salinity, and increased accessibility of the breeding islands (and hence persecution by humans) at low water levels (Nogge, 1975; Petocz & Habibi, 1975). When conditions are unsuitable at Ab-i Istada, the flamingos shift to Dashte Nawar (Site 6). Other breeding birds at Ab-i Istada include *Tadorna tadorna* (100 pairs), *Himantopus himantopus*, *Recurvirostra avosetta*, *Charadrius alexandrinus*, *C. leschenaultii*, *Larus genei* and *Gelochelidon nilotica*. *Glareola pratincola*, *Tringa totanus*, *Sterna hirundo* and *S. albifrons* have been recorded during the breeding season, and are thought to breed (Savage, 1972b; Shank & Rodenburg, 1977).

Ab-i Istada is also an extremely important staging area for migratory waterfowl, with smaller numbers of some species remaining throughout the winter in mild years. Wintering birds have included up to 263 *Ardea cinerea*, 188 *Casmerodius albus* and 1,457 *Anser anser* (Evans,

1994). Up to 50,000 or more waterfowl have been recorded on passage (Savage, 1972a). Counts of waterfowl on spring passage in 1969, 1970 and 1971 included up to 376 *Tadorna tadorna*, 480 *Anas penelope*, 40 *A. strepera*, 1,050 *A. crecca*, 3,100 *A. platyrhynchos*, 1,060 *A. acuta*, 1,600 *A. clypeata*, 200 *A. querquedula*, 15,000 *Aythya ferina*, 41 *A. fuligula*, 2,660 *Fulica atra*, 52 *Haematopus ostralegus*, 594 *Himantopus himantopus*, 258 *Recurvirostra avosetta*, 310 *Charadrius alexandrinus*, 91 *Vanellus leucurus*, 236 *Limosa limosa*, 124 *Numenius arquata*, 290 *Tringa nebularia*, 22 *T. stagnatilis*, 104 *T. glareola*, 6,300 *Calidris minuta*, 1,940 *C. alpina* and 1,300 *Philomachus pugnax* (Nogge, 1971). Over 20,000 waterfowl were present on the lake in November 1993, including at least 200 *Casmerodius albus*, 100 *Ardea cinerea*, 500 *Anas penelope*, 500 *A. strepera*, 3,000 *A. platyrhynchos*, 3,000 *Aythya ferina*, 7,000 *Fulica atra* and 5,000 *Larus ridibundus* (Jamil, 1994). Large numbers of Common Cranes *Grus grus* are also reported to use the lake on passage. *Oxyura leucocephala* was recorded at the lake in May 1977 (Anstey, 1989).

Ab-i Istada appears to have been a major staging area for the small Central Asian population of Siberian Cranes *Grus leucogeranus* which wintered mainly at Bharatpur in Northern India. Seventy-six Siberian Cranes were observed at Ab-i Istada in March 1970; three were again present in December 1970, and two were present in spring 1974 (Savage, 1972a; Shank & Rodenburg, 1977). Only five individuals were found in India in the winter of 1992/93, and none has been seen since, suggesting that this population may now be extinct. Shank and Rodenburg (1977) list 66 species of waterfowl that are known to have occurred at the lake.

Small mammals are numerous around the lake. The Fulvous Ground Squirrel *Citellus fulvus* and a jird *Meriones libycus* are common (Shank & Rodenburg, 1977). Red Fox *Vulpes vulpes*, Long-eared Hedgehog *Hemiechinus auritus* and Marbled Polecat *Vormela peregusna* have been recorded in the area (Niethammer, 1971).

Amphibians are apparently absent, but several species of reptiles occur, including the tortoise *Testudo horsfieldii*, the lizard *Agama agilis* and a small skink *Ablepharus* sp. (Shank & Rodenburg, 1977). There were no fish in the lake in the 1970s, but local people report having found live fish in the lake in 1992 and 1993, following exceptional flooding (Jamil, 1994). Invertebrates and planktonic organisms are seasonally abundant. Shank and Rodenburg (1977) give a list of aquatic organisms collected in the lake.

Noteworthy flora: None known.

Scientific research and facilities: Most of the research at Ab-i Istada has focused on the ecology of the breeding flamingos (Akhtar, 1947; Niethammer, 1970; Nogge, 1974; Petocz & Habibi, 1975). More extensive work on the avifauna was conducted by Niethammer (1971), Nogge (1971) and Petocz *et al.* (1975). An ornithological survey, sponsored by the International Crane Foundation and BirdLife International, was carried out by Abdul Jamil, an agricultural officer with the International Rescue Committee, in November 1993 (Jamil, 1994).

Management authority and jurisdiction: The Directorate of Wildlife and National Parks in the Department of Forests and Range is responsible for management of the Waterfowl Sanctuary.

References: Akhtar (1947); Anstey (1989); Carp (1980); Day (1988); Evans (1994); Jamil (1994); Koning & Dijksen (1971); Niethammer (1970, 1971); Nogge (1971, 1974); Petocz & Habibi (1975); Petocz *et al.* (1975); Savage (1968, 1972a, 1972b); Sayer & van der Zon (1981); Shank & Rodenburg (1977).

Reasons for inclusion: 1a, (2a), 2b, 2c, 3a & 3c. An outstanding example of a high altitude salt

lake, important as a breeding area for *Phoenicopterus ruber* and extremely important as a staging area for migratory waterfowl. Formerly an important staging area for the globally threatened *Grus leucogeranus*.
Source: See references.

Hamun-i Puzak (8)

Location: 31°20'-31°40'N, 61°35'-61°50'E; in southwestern Afghanistan on the border with Iran, 100 km south-southwest of Farah, Nimroz Province.
Area: c.35,000 ha.
Altitude: 475 m.
Overview: The Afghani portion of the Hamun-i Puzak, a large, shallow, freshwater lake with extensive permanent and seasonal marshes in the Seistan Basin on the border with Iran; extremely important as a wintering area for migratory waterfowl and probably also as a breeding and staging area. The wetland is unprotected, and is threatened by dams and irrigation schemes on the rivers which feed into it. The adjacent Iranian portion of the Hamun-i Puzak was designated as a Ramsar Site in 1975, but is otherwise unprotected (see Site 48 in the Iran chapter).
Physical features: The Hamun-i Puzak is one of a group of three large freshwater lakes in the Seistan Basin, an inland drainage basin surrounded by desert on the border with Iran. These wetlands receive most of their water from the Khash River and Helmand (Hirmand) River, which originate in the Koh-i Baba, Koh-i Paghman and Siyah Band ranges in the Central Highlands to the northeast.
The Hamun-i Puzak is a large, perennial, freshwater lake with extensive reed-beds. The greater part of the lake and its marshes (about 35,000 ha) lies in Nimroz Province of southwestern Afghanistan, but in the southwest there are some 14,900 ha of shallow lakes and marshes in Sistan/Baluchistan Province of neighbouring Iran. The entire lake is very shallow, with the maximum depth probably not exceeding four metres. Much of the hamun consists of a complex of open-water areas with rich submergent vegetation and extensive reed-beds. It receives most of its water from the Khash Rud and the Parian branch of the Helmand River, which enters the lake in two distributaries, one in the north and one in the east. These river are nearly dry in summer, but in late winter and early spring carry large quantities of floodwater from snow-melt in the Hindu Kush, raising the water level in the lake. Following the construction of the Kajaki Dam on the Helmand River in the 1970s and diversion of water for irrigation purposes, this river became less important as a source of water for the lake.
The Hamun-i Puzak has always been subject to wide fluctuations in size according to variations in rainfall and snowfall in the catchment. However, it is the first of the three hamuns in the Seistan Basin to fill during periods of flooding, and probably never dries out completely, even during the severest droughts. Most of the hamun dried out during the summer of 1971, following several years of exceptionally severe drought, and at this time, all of the wetlands on the Iranian side of the border were completely dry. During the drought years of the mid- to late-1980s, when the Iranian wetlands were again completely dry, satellite imagery showed that the

Afghani portion of the Hamun-i Puzak remained flooded with vast reed-beds. In the early 1990s, following a series of very wet years, the Hamun was completely flooded and the wetlands were in excellent condition.

The climate is hot and dry, with mean January temperatures of 15-20°C and mean July temperatures of 35-40°C. However, temperatures occasionally fall well below freezing in mid-winter. The average annual rainfall is about 100 mm, with most rain falling in winter.

Ecological features: Vast reed-beds of *Phragmites australis* cover much of the Hamun-i Puzak, and there are only relatively small areas of open water. These support a very rich growth of submerged vegetation, principally *Ceratophyllum demersum*, while the margins of the wetland are fringed with *Tamarix* thickets. There are several small villages along the edge of the marsh, and the adjacent land is degraded *Artemisia* steppe and irrigated cultivation.

Land tenure: No information.

Conservation measures taken: None. The site has been identified as an Important Bird Area by BirdLife International (Evans, 1994). The greater part of the wetland on the Iranian side of the border (10,000 ha) was designated as a Ramsar Site in June 1975.

Conservation measures proposed: The Hamun-i Puzak was proposed for National Park status in the 1970s. Petocz *et al.* (1976) recommended that all future settlement along the lake shore be prohibited, that game guards be stationed in the marshes to prevent disturbance to breeding birds, and that only local residents be allowed to hunt waterfowl.

Land use: In the late 1970s, there were few permanent villages around the hamun, with an estimated total population of less than 1,000. The economy of the local Baluchi people is based largely on cattle breeding, with some supplementary income from fishing. Reeds are used for a number of purposes: as forage for domestic animals, for constructing boats ("tutans"), for fabricating wind-breaks for the mud houses, and as a source of fuel for cooking and heating. Waterfowl hunting was common in the 1970s, but the firearms were largely outdated, and harvesting levels appeared to be low.

Possible changes in land use: A proposal was made in 1976 to set up a paper factory in adjacent Helmand Province, and to use reeds from the Hamun-i Puzak as raw material (Petocz *et al.*, 1976). The impact of such a scheme on the wetland ecosystem is unknown but potentially very severe. A proposal has recently been made to build a new dam on the Helmand River in Afghanistan (the Kamal Khan Dam). On the Iranian side of the border, a major project, the "Seistan Drainage and Irrigation Completion and Rehabilitation Project", is currently being developed, and if it goes ahead, could result in a general lowering of water levels throughout the Hamun-i Puzak.

Disturbances and threats: Flood control projects and irrigation schemes on the Helmand River, both in Afghanistan and Iran, reduced the extent of flooding in the Hamun-i Puzak in the 1970s and 1980s, especially during years of below average rainfall. However, devastating floods in the spring of 1991 destroyed the Kajaki Dam and most of the other water control structures on the Helmand River, and the wetlands were then more extensive than at any time for over a decade. Recent developments on the Iranian side of the border likely to affect the Hamun-i Puzak wetlands include the construction of a number of major irrigation canals taking water directly from the Helmand River and its distributaries, and the construction of a large reservoir (Chahnimeh) in the desert east of Zabol, supplied by a feeder canal from the Parian branch of the Helmand River.

Parts of the wetland have been damaged by reed-cutting and burning, wood-chopping for fuel,

and overgrazing. Vast areas of reed-beds are regularly burnt to improve the grazing for domestic livestock, and there is considerable disturbance to wildlife from fishing and hunting. In the 1970s, the shooting and netting of waterfowl were widespread and uncontrolled. However, as birds were being taken only by local people for their own consumption, the hunting was thought to be sustainable (Petocz *et al.*, 1976).

Hydrological and biophysical values: No information.

Social and cultural values: The reed-beds of the Hamun-i Puzak play a significant role in the economy of the local inhabitants who live in villages along the shoreline. Although primarily dependent on livestock breeding, the local people are increasingly taking advantage of the lake's rich fishery to supplement their incomes.

Noteworthy fauna: An extremely important staging and wintering area for migratory waterfowl of a wide variety of species, and also an important breeding area for many species, especially in wet years. Over 369,000 waterfowl were recorded during an aerial survey of the Afghan portion of the Hamun-i Puzak in January 1976, including 250 *Pelecanus onocrotalus*, 351 *P. crispus*, 1,400 *Phalacrocorax carbo*, 1,826 *Casmerodius albus*, 425 *Ardea cinerea*, 12 *A. purpurea*, 3,150 *Anser anser*, 5 *Cygnus cygnus*, 470 *Tadorna tadorna*, 11,050 *Anas penelope*, 12,050 *A. strepera*, 27,200 *A. crecca*, 21,300 *A. platyrhynchos*, 15,600 *A. acuta*, 10,100 *A. clypeata*, 55 *Marmaronetta angustirostris*, 2,500 *Netta rufina*, 50,000 *Aythya ferina*, 100 *A. nyroca*, 2,500 *A. fuligula*, 43 *Mergellus albellus*, 10 *Oxyura leucocephala*, 5 *Grus grus*, 175,000 *Fulica atra*, 175 *Vanellus vanellus*, 512 *Limosa limosa*, 1,400 small shorebirds, 100 *Larus ichthyaetus*, 600 *L. ridibundus/genei*, 100 *L. cachinnans* and 75 *Chlidonias hybridus* (D.A. Scott, *in litt.*). Notable observations during a ground count of a small part of the wetland in February 1971 included 1,260 *Pelecanus onocrotalus*, 87 *Phoenicopterus ruber*, 1,457 *Anser anser*, 6 *Cygnus cygnus* and 63 *Marmaronetta angustirostris* (Koning & Dijksen, 1971). *Anser erythropus* was listed as a winter visitor by Savage (1968), but there were no records of this species in the 1970s. Wintering birds of prey have included *Pandion haliaetus*, *Haliaeetus albicilla* (maximum 11), *Circus aeruginosus* (maximum 150), *C. cyaneus*, *C. macrourus*, *Aegypius monachus*, *Aquila clanga* and *A. heliaca* (maximum 7). No waterfowl censuses have been undertaken during the migration seasons, but it seems very likely that the Hamun-i Puzak is used as a staging area by large numbers of migrating birds, especially in spring when water levels are high.

Very little is known about the breeding birds. Species known to breed in the marshes along the Iranian border include *Tachybaptus ruficollis*, *Podiceps cristatus*, *Ardea purpurea*, *Porphyrio porphyrio*, *Gallinula chloropus*, *Fulica atra*, *Vanellus leucurus*, *Sterna albifrons*, *Chlidonias hybridus* and *Acrocephalus stentoreus*. *Phoenicopterus ruber*, *Anser anser*, *Cygnus olor* and *Marmaronetta angustirostris* were found breeding in the wetlands at the turn of the century, and *M. angustirostris* was probably still breeding in small numbers in the 1970s (Savage, 1968; Green, 1993). *Botaurus stellaris* and *Aythya nyroca* probably breed, as they occur in summer in the reed-beds on the Iranian side of the border. *Oxyura leucocephala* is known to have bred in the marshes in the early part of this century, and may still do so; at least 10 were present on the main lake in January 1976 (Savage, 1968; Anstey, 1989). A subspecies of the Dead Sea Sparrow *Passer moabiticus yatii*, known only from the wetlands of the Seistan Basin, occurs in the marshes and breeds in the *Tamarix* scrub.

Mammals known to occur in the Seistan Basin include Wolf *Canis lupus*, Golden Jackal *Canis aureus*, Red Fox *Vulpes vulpes*, Striped Hyaena *Hyaena hyaena* and Wild Boar *Sus scrofa*. The

latter was still common in the marshes in 1976.
Noteworthy flora: No information.
Scientific research and facilities: Petocz *et al.* (1976) carried out an ornithological survey of the Hamun-i Puzak in February and March 1976. A mid-winter waterfowl census was carried out in February 1971 (Koning & Dijksen, 1971), and an aerial census was carried out in January 1976 as part of a joint aerial survey of the wetlands of the Seistan Basin involving the Afghani Directorate of Wildlife and National Parks and the Iranian Department of Environment. No surveys have been undertaken in the Afghani portion of the Hamun-i Puzak in recent years, but a mission from the Ramsar Convention Bureau visited the Iranian portion of the marshes in January 1992 (Scott & Smart, 1992).
Management authority and jurisdiction: No information.
References: Anstey (1989); Evans (1994); Green (1993); Koning & Dijksen (1971); Petocz *et al.* (1976); Savage (1968); Scott (1975, 1993); Scott & Smart (1992).
Reasons for inclusion: 1c, 1d, 2a, 2b, 3a & 3c. The Hamun-i Puzak is an excellent example of a large, permanent, freshwater lake with extensive reed-beds in an extremely arid desert region. Spanning the international border between Afghanistan and Iran, the wetland plays a substantial hydrological and ecological role in the natural functioning of a major river basin shared between two countries. It supports an extremely diverse wetland fauna and flora, and thus plays an important role in maintaining the genetic and ecological diversity of the region. The wetland is extremely important as a wintering area, and probably also as a staging area, for migratory waterfowl; it supports wintering populations of at least three globally threatened species of birds, *Pelecanus crispus*, *Oxyura leucocephala* and *Aquila heliaca*, and probably also supports a small resident population of the globally threatened *Marmaronetta angustirostris*.
Source: See references.

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BAHRAIN

INTRODUCTION

by Saeed A. Mohamed

Area: 706.5 sq.km (Anon, 1992a).

Population: 519,000 (Anon, 1992a).

The State of Bahrain consists of more than 33 islands which vary considerably in size and structure. The largest island, known as Bahrain or Awal, is 48 km long from north to south and 16 km at its broadest. The islands lie in the southwestern waters of the Arabian Gulf, some 25 km to the east of the Saudi Arabian coast at 26°05'N and 50°33'E (Bahrain Island). The total area of all islands is around 700 sq.km. The most recent population census was in 1992, and indicated that the total population was 519,000. The seas around the islands are shallow and rarely exceed 20 metres in depth. Salinities range from 40 parts per thousand in the north to 60 parts per thousand in the southwest.

Bahrain is located in the core of an extensive zone of aridity, and forms part of Arabia. Geologists refer to the structure of the main Bahrain island as that of an eocene eroded limestone dome (Doornkamp *et al.*, 1980). The highest point of the island, located in the middle of the island, is known as Jabal Ad-Dukhan, and reaches a height of 122.4 metres above sea level. Most of the other islands are lowland. These include Muharraq (32 sq.km), Sitra (29 sq.km), Umm Nassan (20 sq.km) and Sawad (8 sq.km). Hawar Island (41 sq.km) and other small islets such as Hajiat and Jidda are limestone cliff islands which may exceed 20 m above sea level (Anon, 1972 & 1992a).

The main island of Bahrain is composed of five distinctive physiographic regions:

1. Central Plateau and Jabals
   An elevated central plateau with scattered hills. The general surface of the plateau is at 40-60 metres above sea level, with the highest point on Jabal Ad-Dukhan (Mountain of Smoke) at 122.4 m.

2. Interior Basin
   An asymmetrical ring of lowland surrounding the central plateau. The surface elevation ranges from less than 20 metres around the basin margin up to 70 m.

3. Multiple Escarpment
   A multiple escarpment rising up from the outer perimeter of the interior basin.

4. Main Backslope
   The gently sloping land from the crest of the escarpment to the edge of the coastal lowlands.

5. Coastal Lowlands
   This zone starts from the base of the backslope, and has an elevation of less than 10 m down to sea level. Soil studies have shown that four soil types are present: solonchaks, regosols, vermosols and fluvisols.

Bahrain has a remarkable variety of gypsum accumulation which could be explained as a result of continuous upwelling of sulphate-rich groundwater since the last pluvial period (Vine, 1986). Despite the high gypsum content of the soil, the inhabitants of Bahrain have succeeded in cultivating various trees and vegetables where suitable irrigation water is available. On the northern part of the main island, as well as on Muharraq, Sitra and Nabih Saleh, date palms have been cultivated for thousands of years. The availability of an abundant supply of fresh water from natural springs has been the essential factor in the flourishing agriculture. Apart from oil production, which accounts for over 60% of the national income, banking, light industry, fishing and agriculture form the backbone of Bahrain's economy.

The country has a hot desert climate. Rainfall is rare, and almost non-existent from June to September. The average annual rainfall is approximately 77 mm, with March being the wettest month. There has been considerable annual variation in rainfall over the years with, for instance, a total of 232.9 mm falling in 1976. The temperature pattern shows less variation from year to year. The average daily temperature in winter is 14.7^{o}C, and in summer 37.7^{o}C. However, daily temperatures in summer are greatly influenced by wind direction, with the prevailing northerly winds creating the coolest conditions. Humidity is high and may reach 100% at certain times of the year.

Summary of Wetland Situation

The principal wetlands in Bahrain are coastal mudflats. These occur around many of the islands, and cover a large area in relation to the size of the country. The tidal regime is semi-diurnal, with a maximum annual tidal range of about 2.5 metres. The lowest spring tides occur during the night in the hot summer and during the day in winter. This regime has a beneficial effect on the inter-tidal flora and fauna, which would otherwise experience greater thermal stress (Vousden, 1986).

Most of the larger areas of mudflat are to be found on the eastern side of the main island. Tubli Bay, located near the northeast corner of the island, is much the most important of these. This bay contains the last remaining stand of mangroves (*Avicennia marina*) in Bahrain, and is an important nursery ground for commercially important shrimps, mainly *Penaeus semisulcatus*, but also *Metapenaeus stebbingi* (Abdulqader, 1994). Thousands of waterbirds utilize the abundant food resources available in the bay. Over 45 species of birds, mainly herons, shorebirds, gulls and terns, regularly visit the area during the migration periods and in winter

(Mohamed, 1994). Algae, which represent the main food for the commercially important Rabbit Fish *Siganus canaliculatus*, are collected in the bay by fishermen to be used as bait in fishing (Basson, 1989).

Other significant coastal wetlands on the main island include a sheltered stretch of coast in the southwest, which provides a good breeding site for White-cheeked Terns *Sterna repressa* and is also visited regularly by overwintering shorebirds and Greater Flamingos *Phoenicopterus ruber* (Mohamed, 1991), and a large area of inter-tidal mudflats at Ras Hayan on the southeast coast. The latter area supports a wide variety of fish species at high tide and many migratory shorebirds at low tide. It is the second most important wintering area for Greater Flamingos in Bahrain, after the Hawar Islands. The northern parts of the main island and Muharraq have moderately exposed shores, a large proportion of which has been reclaimed from the sea in the last 20 years.

Bahrain's coral reefs have recently been described by UNEP/IUCN (1988), and are therefore not included in this inventory. Coral fringes occur around the north and east coast of the main island of Bahrain and off Muharraq and Sitra. Further offshore to the north and east there are several large platform reefs and various small patch reefs which may have reef slopes extending to 10 m depth but rarely more. Reefs are also found off Askar. The largest reefs are Fasht Adhm off the northeast coast of Bahrain Island and Fasht al Jarim in the north. Thirty-one coral species in 19 genera have been reported.

Many of Bahrain's smaller offshore islands support breeding colonies of seabirds and other wildlife. The Hawar Islands, comprising an archipelago of large and small islands scattered in shallow water, are especially important. The breeding birds include Socotra Cormorant *Phalacrocorax nigrogularis*, Osprey *Pandion haliaetus*, Sooty Falcon *Falco concolor*, Caspian Tern *Sterna caspia*, White-cheeked Tern *S. repressa* and Bridled Tern *S. anaethetus*.

Bahrain has been known for a long time for its many natural freshwater springs which are scattered around Nabih Saleh and Sitra islands, and are particularly numerous around the northern and eastern side of the main island of Bahrain. Plantations of trees and agriculture have flourished because of the occurrence of these springs, and provide habitat which attracts many animals and migratory birds in particular. Starting in the early 1970s, the flow of fresh water from subterranean springs has dwindled or become progressively more saline because of a lowering of the water table as a result of depletion and over-use of the aquifer (Louri, 1990). This has led to the dereliction of many hectares of date garden and other cultivation.

The largest inland wetland in Bahrain is the artificial lake known as Dumistan or Lawzi Lake. The salinity varies from almost fresh in the northern part of the lake to hypersaline at the southern end. Some waterbirds, such as Moorhen *Gallinula chloropus* and Black-winged Stilt *Himantopus himantopus*, have colonized the area and now breed there (Mohamed, 1993). Various studies have been carried out on the water chemistry of the lake and its microbiology (Al-Sayed *et al.*, 1992).

Wetlands are under threat from various human activities, and are also affected directly by oil

spills. Large areas of coastal wetland around Bahrain were affected by a major oil spill in 1980 (Al-Alawi, 1981), but fortunately the country was not affected by any major oil slicks during the Gulf War of 1991, although overhead concentrations of smoke were reported at that time. Situated in the most densely populated part of the island, Tubli Bay is under heavy pressure from various human activities, such as land-fill, uncontrolled fishing and sewage disposal. Treated sewage effluent is discharged continuously into the bay from two treatment plants. Most serious, however, has been the reclamation of land for development, which has resulted in the destruction of biologically rich areas such as muddy shores and mangroves.

A recent inventory of Important Bird Areas in the Middle East, sponsored by BirdLife International, identified four sites of special importance for bird conservation in Bahrain (Evans, 1994). Three of these are coastal wetlands of considerable importance for waterfowl and seabirds, namely Tubli Bay, the southwest coast of Bahrain Island, and the Hawar Islands. All three are included in the present inventory, along with one other coastal wetland (Ras Hayan) and the artificial Lawzi Lake.

Wetland Research

Various ecological and biological studies have been conducted on the wetlands of Bahrain. Bodies involved in the study of wetlands have included the University of Bahrain, the Technical Secretariat of the Environmental Protection Committee, Bahrain Centre for Studies and Research, and the Directorate of Fisheries. Major research programmes have included studies of the following:

- mangrove ecology and biology in Tubli Bay;
- sewage effluents and their effect on marine organisms;
- birds in wetlands, and shorebird migration;
- the microbiology of Tubli Bay and Lawzi Lake;
- coastal halophytes;
- the importance of wetlands, particularly Tubli Bay, for fisheries.

In 1985, the Environmental Protection Committee conducted detailed surveys of all critical habitats in the inter-tidal and sub-littoral zones around the major islands of the Bahrain and Hawar archipelagos. The habitat maps resulting from this study show the distribution of coastal and marine habitat types around Bahrain including areas of scientific and commercial importance and areas recommended for protection, conservation and management (Vousden, 1986). The most intensively studied wetland to date has been Tubli Bay, which was the focus of a special symposium organized in January 1994 to discuss problems and solutions regarding this important wetland. Much of the information on the importance of Bahrain's wetlands for waterfowl has been derived from mid-winter waterfowl counts, which have been undertaken in most winters since 1987/88 as part of the IWRB/AWB Asian Waterfowl Census.

Wetland Area Legislation

The National Committee for Wildlife Protection (NCWP) was established in October 1993 with the aim of protecting important ecosystems, including wetlands, other critical habitats, and vulnerable and endangered animal and plant species. A Law by Decree for the protection of wildlife in Bahrain was issued by His Highness the Amir in January 1995. This Law by Decree gives the NCWP the mechanism for the protection of wildlife in general and wetlands in particular.

At international level, Bahrain has ratified the World Heritage Convention and has signed the Biodiversity Convention and the Regional Convention for Cooperation on the Protection of the Marine Environment from Pollution, including the Kuwait Action Plan (Evans, 1994). The Government is currently giving serious consideration to ratification of the Convention on the Conservation of Wetlands of International Importance especially as Waterfowl Habitat (the Ramsar Convention). Two sites, Hawar Islands and Tubli Bay, have been proposed for designation as Ramsar Sites under this Convention.

Wetland Area Administration

Prior to 1995, the Environmental Protection Committee (EPC) was the main body concerned with the administration and management of protected areas in Bahrain. However, in January 1995 the recently established National Committee for Wildlife Protection (NCWP) assumed responsibility for protected areas, legislation concerning wildlife matters, and international conventions relating to wildlife. The first step taken by Bahrain to protect its wildlife was the establishment of the Alareen Wildlife Park in 1976. Although concerned primarily with the conservation of endangered species of Arabian wildlife and increasing public awareness, Alareen Wildlife Park is also taking an active part in protecting and managing selected areas, in particular on Hawar Island. In 1988, the mangrove swamp at Ras Sanad in Tubli Bay was declared as a protected area under the supervision of the Environmental Protection Committee (EPC), established in 1982. The EPC retains responsibility for the management of the Ras Sanad mangroves, and has been involved in conducting various studies in Tubli Bay. It has alerted public awareness to the values of wetlands in general and to the importance of Tubli Bay in particular. In recent years, the NCWP has been making efforts to have the whole of the bay designated as a protected area.

The Government, through the NCWP, is taking various steps with the help of the Ministry of the Interior and Ministry of Defence to protect important sites in the Hawar Islands, and to minimize human disturbance to the wildlife. In addition, a considerable degree of protection is given to the southern part of Bahrain Island and the smaller archipelagos.

Organizations involved with Wetlands

National Committee for Wildlife Protection

The main body concerned with the administration and management of protected areas. The NCWP drafts legislation and makes recommendations for the protection of critical

ecosystems and habitats, and protection of rare and endangered species of animals and plants; it also designates new sites as protected areas.

Environmental Protection Committee
: Concerned with aspects relating to pollution and monitoring of effluents and other discharges. The EPC is the official body in charge of the Wildlife Reserve at Ras Sanad in Tubli Bay.

Directorate of Fisheries
: Monitors and controls fishing in wetland areas.

Central Municipal Council
: Involved in the cleaning of shores in wetland areas.

Alareen Wildlife Park
: Involved in the monitoring of some birds, such as Osprey and Sooty Falcon, and mammals, such as the Arabian Rheem Gazelle, Arabian Oryx and Cape Hare, on the Hawar Islands.

Non-governmental bodies such as the Bahrain Natural History Society (BNHS) are involved in public awareness campaigns and the cleaning of coastal areas, including some wetlands. The BNHS also conducts faunal and floral surveys and publishes biennial reports entitled "Wildlife in Bahrain".

WETLANDS

Site descriptions compiled by Saeed A. Mohamed of the Department of Biology, University of Bahrain.

Tubli Bay (1)

Location: 26°11'N, 50°34'E; at the northeast corner of the main island of Bahrain, almost surrounded by the capital city Manama.
Area: Approximately 2,500 ha.
Altitude: Sea level.
Overview: A sheltered bay with large areas of inter-tidal mudflats and the last remaining stand of mangroves in Bahrain; an important nursery area for fishes and prawns, and a staging and wintering area for thousands of migratory waterfowl, but under considerable pressure from urban and industrial development.
Physical features: A natural, shallow, sheltered bay in an urban area near the northeast corner of Bahrain Island. The bay contains extensive inter-tidal mudflats, mainly on the east side, and

a large area of mangrove at Ras Sanad in the southwest. It receives freshwater run-off from nearby irrigated plantations and treated sewage effluent from two treatment plants. There are many freshwater springs offshore and onshore, the latter supporting reed-beds and date palm gardens. The tidal regime is semi-diurnal, with a maximum tidal range of about two metres; the salinity is about 40 parts per thousand.

Ecological features: The inter-tidal zone supports a stand of the Black Mangrove *Avicennia marina* and an abundance of green algae. Adjacent sandy areas support halophytic plants including species of *Salicornia*, *Suaeda* and *Hammada*. Reeds *Phragmites australis* and rushes *Juncus* sp. occur along drains and ditches, and at the mouths of sewage outfalls.

Land tenure: State owned; adjacent areas are privately owned.

Conservation measures taken: In 1988, the entire mangrove swamp at Ras Sanad was declared a Wildlife Reserve, with supervision entrusted to the Environmental Protection Committee (EPC). The reserve covers about 250 ha. A mangrove re-planting programme is under way to restore former areas of mangrove. Since its establishment in 1982, the EPC has been involved in conducting various studies in Tubli Bay, and has alerted public awareness to the importance of the bay for fisheries and wildlife. The site has been identified as an Important Bird Area by BirdLife International (Evans, 1994).

Conservation measures proposed: The National Committee for Wildlife Protection (NCWP) has been making efforts to have the whole of the bay designated as a protected area. Tubli Bay has been identified as one of two sites in Bahrain suitable for designation as a Ramsar Site if and when the Government of Bahrain ratifies the Ramsar Convention. An Action Plan for the Conservation of Wetlands in South and West Asia, drawn up at an international conference held in Karachi, Pakistan, in 1991, recommended to the Government of Bahrain that a ban be placed on all in-filling of mangrove and mudflat areas along the eastern shore of the main island of Bahrain (Anon, 1992b).

Land use: Fishing and recreation. Green algae, the main food plant of the commercially important Rabbit Fish, are collected by fishermen to be used as bait in fishing (Basson, 1989). The city of Manama surrounds much of the bay, although there are still some date gardens and other cultivated areas close by.

Possible changes in land use: Further filling in of the bay and reclamation of land for urban development is likely.

Disturbances and threats: Situated in the most densely populated part of the island, Tubli Bay is under heavy pressure from various human activities, such as land-fill, uncontrolled fishing, the dumping of rubbish, sewage disposal and oil pollution. Since 1975, most of the original mangrove and large areas of inter-tidal mudflat have been lost to housing and other urban and industrial development, especially along the north shore of the bay, and reclamation of land for development is continuing. Fine silt is accumulating as a result of these reclamation activities. Treated sewage effluent is discharged continuously into the bay from two treatment plants. Recreational activities cause some disturbance to wildlife, but hunting is no longer a problem, as hunting with any type of weapon is now illegal throughout the country.

Hydrological and biophysical values: The only mangrove area in Bahrain, and an important nursery ground for commercially important shrimps, such as *Penaeus semisulcatus* and *Metapenaeus stebbingi*, as well as marine fishes.

Social and cultural values: The site represents a good example of the natural heritage for the people of Bahrain. It is an ideal place for outdoor recreation, especially bird-watching.

Noteworthy fauna: The most important site in Bahrain for migratory waterfowl. Over 45 species of waterfowl, mainly herons, shorebirds, gulls and terns, have been recorded during the migration seasons and in winter (Mohamed, 1994). Peak counts have included 100 *Egretta garzetta*, 250 *Ardea cinerea*, 300 *Charadrius hiaticula*, 500 *C. alexandrinus*, 2,000 *C. mongolus*, 500 *Pluvialis squatarola*, 250 *Arenaria interpres*, 1,000 *Calidris minuta*, 800 *Limicola falcinellus*, 150 *Larus ichthyaetus*, 2,000 *L. ridibundus* and 3,000 *L. genei*. Moorhen *Gallinula chloropus* and Black-winged Stilt *Himantopus himantopus* breed in the mangroves. Various species of fishes visit the bay at high tide, including the commercially valuable Rabbit Fish *Siganus canaliculatus*.
Noteworthy flora: The site contains the only stand of mangrove in Bahrain, as well as an interesting saltmarsh community.
Scientific research and facilities: Various surveys and research projects have been carried out on different aspects of the bay. A special symposium was organized in January 1994 to discuss the problems affecting the bay, and to seek possible solutions for its conservation.
Conservation education: The Public Awareness Committee of the EPC has an educational programme which focuses on the site. The Mangrove Technical Committee has arranged several visits to the Wildlife Reserve for the general public. The NCWP has recently produced a documentary film on the bay.
Recreation and tourism: The site has considerable potential for outdoor recreation and tourism. Promising discussions have been held with the Directorate of Tourism concerning the promotion of the bay for tourism.
Management authority and jurisdiction: The Environmental Protection Committee is the official body in charge of the Wildlife Reserve in the mangrove area.
References: Abdulqader (1994); Anon (1992b); Basson (1989); Evans (1994); Gallagher & Rogers (1978); Mohamed (1994); Vousden (1986).
Reasons for inclusion: 1a, 1c & 3b. The largest area of inter-tidal mudflats in the country, with the only surviving stand of mangroves; a major staging and wintering area for migratory waterfowl, and an important nursery area for fish and shrimps.
Source: Saeed A. Mohamed.

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Lawzi (Dumistan) Lake (2)

Location: 26°08'N, 50°30'E; in the north-central part of the main island of Bahrain.
Area: 240 ha.
Altitude: Less than 15 m.
Overview: A small, artificial lake with a wide range of salinities and stands of *Phragmites* reeds; the largest inland wetland in Bahrain. A wide variety of waterbirds has been recorded on passage and in winter, and at least two species breed.
Physical features: Lawzi (or Dumistan) Lake is a man-made body of water near the centre of the main island of Bahrain. It was created by the excavation of sand from a large pit, and is fed by seepage from underground sources and by run-off from adjacent irrigated land. The water is generally rather shallow, and has a maximum depth of about 2.5 metres in the middle. The

salinity shows a steep gradient from almost fresh (2 parts per thousand) at the northern end to hypersaline (60 parts per thousand) at the southern end. The lake is surrounded by housing and industrial estates and areas of irrigated agriculture.
Ecological features: Dense stands of reeds *Phragmites australis* grow along the northern edge of the lake where the salinity is low.
Land tenure: The lake is state owned; surrounding areas are privately owned.
Conservation measures taken: None.
Conservation measures proposed: The National Committee for Wildlife Protection has proposed that at least the northern part of the lake be protected as a nature reserve.
Land use: The lake is used as a reservoir to take excess irrigation water from adjacent agricultural land.
Possible changes in land use: Development projects might be approved in the area. Part of the site might be developed as a public park for outdoor recreation.
Disturbances and threats: None at present.
Hydrological and biophysical values: None known.
Social and cultural values: None known.
Noteworthy fauna: Some waterbirds, such as Moorhen *Gallinula chloropus* and Black-winged Stilt *Himantopus himantopus*, have colonized the area and now breed there. Many species of waterfowl occur in small numbers on migration, including *Ardea cinerea*, *Anas crecca*, *A. platyrhynchos*, *Recurvirostra avosetta*, many other shorebirds, gulls and terns. The Arabian Killifish is present in the lake.
Noteworthy flora: The site contains some of the best stands of *Phragmites australis* in Bahrain.
Scientific research and facilities: Studies have been carried out on the water chemistry and microbiology of the lake (Al-Sayed *et al.*, 1992).
Conservation education: None at present.
Recreation and tourism: There is a proposal to develop part of the area as a public park for outdoor recreation and tourism.
Management authority and jurisdiction: Ministry of Housing and Bahrain Central Municipality.
References: Al-Sayed *et al.* (1992); Mohamed (1993).
Reasons for inclusion: 1d & 2b. The largest inland water body in Bahrain, supporting a diverse avifauna.
Source: Saeed A. Mohamed.

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Southwest Coast of Bahrain (Mumtalah) (3)

Location: 25°54'N, 50°31'E; on the southwest coast of the main island of Bahrain.
Area: 200 ha.
Altitude: Sea level.
Overview: A long sandy beach with adjacent sand dunes and a small area of inter-tidal mudflats, important as a breeding area for White-cheeked Terns *Sterna repressa*, and as a

wintering area for Greater Flamingos *Phoenicopterus ruber* and shorebirds. Access is restricted, and the area is relatively undisturbed.

Physical features: The site comprises a long stretch of sheltered sandy beach backed by low sand dunes and an adjacent small area of inter-tidal mudflats and sand flats on the southwest coast of Bahrain Island. The tidal regime is semi-diurnal with a maximum tidal range of about two metres. The inshore waters are shallow, with a maximum depth of 5 m and a relatively high salinity of over 50 parts per thousand.

Ecological features: Marine algae are represented by brown algae such as *Sargassum* sp. and *Hormophysa* sp. The sand dunes behind the beach support scattered halophytic plants such as *Halopeplis* sp., *Hammada* sp. and *Suaeda* sp.

Land tenure: The site is state owned; inland areas to the north are privately owned.

Conservation measures taken: The National Committee for Wildlife Protection has recently designated the southern region of Bahrain Island, including the coastal wetlands, as a protected area. No public disturbance or hunting is allowed in the whole region. The site has been identified as an Important Bird Area by BirdLife International (Evans, 1994).

Conservation measures proposed: Additional measures have been proposed to minimize human disturbance in the area.

Land use: None at the site. Some camels graze in the adjacent sand dunes.

Possible changes in land use: None known.

Disturbances and threats: There is some overgrazing of dune vegetation by camels, and the tern colonies are vulnerable to oil pollution on the beaches, but otherwise the area is little disturbed.

Hydrological and biophysical values: None known.

Social and cultural values: None known.

Noteworthy fauna: The area supports a native population of Arabian Rheem Gazelles *Gazella subgutturosa marica* (50-70 individuals) and the largest breeding colony of White-cheeked Terns *Sterna repressa* in Bahrain. Between 1978 and 1983, the breeding population of *S. repressa* fluctuated between 1,500 and 2,030 pairs (Gallagher *et al.*, 1984), but in recent years there have been only about 500 pairs. Other breeding birds include Kentish Plover *Charadrius alexandrinus* and Hoopoe Lark *Alaemon alaudipes*. Between 50 and 100 Greater Flamingos *Phoenicopterus ruber* normally winter along this sheltered stretch of coast (Mohamed, 1991). The commercially important Rabbit Fish *Siganus canaliculatus* occurs in inshore waters.

Noteworthy flora: None known.

Scientific research and facilities: The gazelle and breeding bird populations are monitored on a regular basis, but otherwise there have been no specific research projects in the area.

Conservation education: None.

Recreation and tourism: None.

Management authority and jurisdiction: The area is managed by Alareen Wildlife Park, and is under the jurisdiction of the State.

References: Evans (1994); Gallagher *et al.* (1984); Mohamed (1991).

Reasons for inclusion: 1a, 1c & 3b. A relatively undisturbed coastal site, important for Arabian Rheem Gazelles, breeding White-cheeked Terns and wintering Greater Flamingos and shorebirds.

Source: Saeed A. Mohamed.

Ras Hayan (4)

Location: 26°02'N, 50°37'E; on the southeast coast of the main island of Bahrain.
Area: 500 ha.
Altitude: Sea level.
Overview: A large area of relatively undisturbed inter-tidal mudflats with extensive seagrass beds close inshore; an important staging and wintering area for Greater Flamingos *Phoenicopterus ruber*, shorebirds and gulls.
Physical features: A large area of inter-tidal mudflats on the sheltered southeast coast of Bahrain Island; the largest area of relatively undisturbed mudflats in the country. The shoreline is very gently shelving and most areas are covered in very fine sediments, although there are also areas with scattered boulders. The tidal regime is semi-diurnal with a maximum tidal range of about two metres; salinities range from 38-40 parts per thousand.
Ecological features: Sub-tidal areas support extensive beds of the seagrasses *Halodule* sp. and *Halophila* sp. Sandy areas above the high-water mark support halophytes such as *Halopeplis amplexicaulis*, *Halocnemum strobilaceum* and *Suaeda vermiculata*. Scattered boulders form a good substrate for many sessile animals including tube worms and sponges. The very rich mudflats support a rich invertebrate fauna of polychaetes, crabs, bivalves *etc.* which provide important food items for thousands of wading birds at low tide and fishes at high tide. Crabs, including the mud crab *Macrophthalmus* sp., occur at very high densities.
Land tenure: State owned; adjacent areas inland are privately owned.
Conservation measures taken: None.
Conservation measures proposed: The National Committee for Wildlife Protection has proposed that at least a part of the area be protected as a nature reserve.
Land use: Fishing, using traditional fish traps; housing and other development inland. State fish farms and a mariculture centre are located in this area.
Possible changes in land use: There is a proposal to establish a new city near the site. This would change the entire area, and could result in the complete destruction of the site.
Disturbances and threats: Further development of housing along the shore is likely, and there is also a possibility that some of the mudflats will be reclaimed for development.
Hydrological and biophysical values: An important area for fisheries.
Social and cultural values: There are many traditional fish traps scattered throughout the area.
Noteworthy fauna: Over 30 species of waterfowl have been recorded. Thousands of waterfowl occur on the mudflats during the migration seasons and in winter, especially shorebirds which are present at most times of the year except mid-summer. The mudflats are the second most important wintering area for Greater Flamingos *Phoenicopterus ruber* in Bahrain (after the Hawar Islands); birds are present for most of the year, and numbers may exceed 300 in December. Over 50,000 Black-headed Gulls *Larus ridibundus* were recorded in November 1990. The rich inshore waters support a wide variety of fishes.
Noteworthy flora: Extensive seagrass beds.
Scientific research and facilities: Some studies have been carried out on coastal birds and marine ecology. The Directorate of Fisheries has conducted trials with mangrove replanting in

the area.
Conservation education: The mudflats are an important research and educational site for the University of Bahrain. Field work for ecology courses takes place here.
Recreation and tourism: The site contains a good beach for use by the public, and has considerable potential for bird-watching.
Management authority and jurisdiction: The State.
References: Saleh & Mohamed (1990, 1993).
Reasons for inclusion: 1a & 2a. A large and relatively undisturbed area of inter-tidal mudflats, attracting large numbers of waterfowl on migration and in winter; one of the few intact mudflats in Bahrain.
Source: Saeed A. Mohamed.

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Hawar Islands (5)

Location: 25°40'N, 50°50'E; in the Gulf of Bahrain, 25 km southeast of the main island of Bahrain.
Area: Approximately 5,300 ha of islands.
Altitude: Sea level to 20 m above sea level.
Overview: An archipelago of small desert islands and islets surrounded by shallow seas with extensive seagrass beds; still in a relatively pristine condition, and especially important for breeding seabirds (notably the world's largest concentration of Socotra Cormorants *Phalacrocorax nigrogularis*), Dugongs *Dugong dugon* and sea turtles. Six islands have been designated as protected areas, and access to all except the main island is severely restricted by the coast guard and the military.
Physical features: The Hawar Islands are an archipelago of 16 small, limestone, desert islands and islets in the Gulf of Bahrain. Some of the islands are hilly with cliffs up to 20-30 m high; others are flat and sandy with gently sloping shores. The largest island, Hawar, covers more than 4,100 ha. The surrounding seas are shallow, with depths of less than five metres in most areas. The sheltered shores feature scattered boulders, pebbles or sand. The tidal regime is semi-diurnal, with the maximum spring tide not exceeding 2.5 metres.
Ecological features: Some of the islands support a relatively dense cover of halophytes, the dominant plants being species of *Halopeplis*, *Limonium*, *Halocnemum*, *Phragmites*, *Hammada*, *Salicornia*, *Zygophyllum* and *Suaeda*. There are very extensive beds of seagrasses and algae in the surrounding shallow seas.
Land tenure: The islands and surrounding waters are state owned.
Conservation measures taken: Six small islands have been designated as protected areas by the National Committee for Wildlife Protection (NCWP) because of their importance for breeding seabirds. Access to the area is controlled by the coast guard and Ministry of Defence because of a military presence on the islands. The islands thus receive some protection from non-military disturbance. The NCWP is taking various measures to protect the most important sites and minimize human disturbance to the wildlife, with the help of the Ministry of the Interior and the Ministry of Defence. The islands have been identified as an Important Bird

Area by BirdLife International (Evans, 1994).

Conservation measures proposed: An Action Plan for the Conservation of Wetlands in South and West Asia, drawn up at an international conference held in Karachi, Pakistan, in 1991, makes the following recommendation: "Adequate protection should be given to the small offshore islands, such as the Hawar Group, which support huge colonies of breeding waterbirds (including the largest colony of Socotra Cormorants in the world) as well as breeding Ospreys and Sooty Falcons" (Anon, 1992b). The Hawar Islands have been identified as one of two sites in Bahrain suitable for designation as a Ramsar Site if and when the Government of Bahrain ratifies the Ramsar Convention.

Land use: The islands are uninhabited except for a police and military garrison. Local fishermen are allowed to fish in adjacent waters, and there is some recreational fishing and other tourism, *e.g.* diving. There is, however, very little human activity on most of the islands.

Possible changes in land use: No major changes are proposed or expected.

Disturbances and threats: In general, there is very little human disturbance to the islands and surrounding marine ecosystems, and the sea remains very clean and unpolluted compared to the situation elsewhere in Bahrain. Fishermen cause some disturbance to breeding seabirds, and the collection of eggs and capturing of birds (especially Socotra Cormorant chicks) is reported to have been a problem (Evans, 1994). The islands have been affected by major oil spills in the past (*e.g.* during the Iran-Iraq war in 1980-88), and this remains a serious potential threat, especially during the breeding season.

Hydrological and biophysical values: The shallow seas around the islands support a rich fishery.

Social and cultural values: The islands remain in almost pristine condition and afford excellent opportunities for eco-tourism because of their scenic beauty, large breeding colonies of sea-birds, and populations of Arabian Oryx and Rheem Gazelle.

Noteworthy fauna: The Hawar Islands hold the world's largest breeding concentration of Socotra Cormorants *Phalacrocorax nigrogularis*. The main breeding site is on Suwad al Janubiyah island, where there were estimated to be between 200,000 and 300,000 adults (100,000-150,000 breeding pairs) in November 1992. In January 1995, this island held an estimated 155,000 pairs of Socotra Cormorants along with about 110,000 chicks. Other breeding birds include Western Reef Egret *Egretta gularis* (100 pairs), Osprey *Pandion haliaetus* (11 pairs), Sooty Falcon *Falco concolor* (15 pairs), Caspian Tern *Sterna caspia* (10 pairs), White-cheeked Tern *S. repressa* (100 pairs), Bridled Tern *S. anaethetus* (100 pairs) and Saunders's Little Tern *S. saundersi* (100 pairs). Up to 750 Greater Flamingos *Phoenicopterus ruber* winter amongst the islands, and it is suspected that some of these birds may occasionally breed.

A free-ranging herd of Arabian Oryx *Oryx leucoryx* has been established on the main Hawar Island by Alareen Wildlife Park. Native mammals on the main island include Arabian Rheem Gazelle *Gazella subgutturosa marica*, Cape Hare *Lepus capensis* and jerboas *Jaculus* sp. The shallow seas around the Hawar Islands support a very large population of Dugong *Dugong dugon*, which is thought to exceed 700 individuals in winter. The Green Turtle *Chelonia mydas*, Hawksbill *Eretmochelys imbricata*, Leatherback *Dermochelys coriacea* and Loggerhead *Caretta caretta* occur amongst the islands, and *C. mydas* may breed. Other reptiles include the Spiny-tailed Lizard or Dhab *Uromastix* sp. and several species of geckos such as *Stenodactylus* sp. The extensive beds of seagrasses and algae support a rich fish fauna including commercially

important species such as the Rabbit Fish *Siganus canaliculatus*. The pearl oyster *Pinctada* sp. occurs in the area.
Noteworthy flora: Extensive beds of seagrasses.
Scientific research and facilities: Several surveys of the breeding birds have been undertaken, and Sooty Falcons have been the subject of a ringing programme.
Conservation education: Various educational films about the islands have been shown on local television, and a series of documentary films on the breeding birds of the Hawar Islands has almost been completed.
Recreation and tourism: The islands have considerable potential for eco-tourism. The Municipality has already built some chalets for visitors, and organizes daily trips to the main island by boat.
Management authority and jurisdiction: National Committee for Wildlife Protection, Bahrain Municipality and Alareen Wildlife Park.
References: Anon (1992b); Evans (1994); Gallagher & Rogers (1978); Gallagher *et al.* (1984); Hill & Webb (1986); UNEP/IUCN 1988.
Reasons for inclusion: 1a, 1c, 2a, 2c, 3a & 3c. A beautiful and virtually pristine group of islands with the world's largest breeding concentration of Socotra Cormorants and an internationally important population of Dugongs. The islands have a fauna and flora which is perhaps typical and representative of the few remaining unspoilt islands in the whole Arabian Gulf.
Source: Saeed A. Mohamed.

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ISLAMIC REPUBLIC OF IRAN

INTRODUCTION

by Jamshid Mansoori

Area: 1,648,195 sq.km.

Population: 58,206,250 (1992 census).

The Islamic Republic of Iran is one of the largest countries in Southwest Asia, with a land area almost equal to that of Italy, Spain, France and the British Isles combined. It is bounded to the north by Armenia, Azerbaijan, the Caspian Sea and Turkmenistan, to the east by Afghanistan and Pakistan, to the south by the Gulf of Oman and the Persian Gulf, and to the west by Iraq and Turkey. Altitudes range from 26 metres below sea-level on the shores of the Caspian to 5,774 m at the summit of Mount Damavand, an almost perfect volcanic cone in the central Alborz Mountains near Tehran.

Approximately 60% of Iran is classified as desert and semi-desert, and over half of the country is mountainous, with ranges oriented more or less parallel to its international borders. The Alborz Mountains run from west to east across the north of the country, and the Zagros Mountains from northwest to southeast along its western borders. The Alborz Mountains, with their eastern extensions, and the Zagros Mountains which merge into the Mekran Range in the southeast, form a giant supine "V" which encloses the vast and roughly triangular area constituting Iran's central plateau. This arid plateau, which continues eastward into Afghanistan and Pakistan, has an average elevation of 1,200-1,300 m above sea level, and comprises a number of salt basins and sand deserts including the Dasht-e Kavir (Great Salt Desert) and the Dasht-e Lut (Great Sand Desert). There are also many isolated chains of mountains within the central plateau, running mostly parallel to the Zagros Mountains.

Geographically, the Iranian plateau dates from the Tertiary period, although older formations exist in many areas. Severe orogenic uplift and folding produced much of this land from an enormous sea in the mid-Miocene. Due to their comparatively young ages, the principal mountain ranges are still settling, and this seems to be one of the causes of the earthquakes that frequently rock the country.

Climatic differences are great. Much of the country has a desert climate with an average annual precipitation of less than 300 mm, but some parts of the Caspian lowlands and north slope of the Alborz Mountains receive as much as 2,000 mm of rainfall. Summers are generally warm to hot with almost continuous sunshine, while winters can be extremely cold, with cold airstreams blowing from the northeast. Mean January temperatures range from 20°C along the Gulf of

Oman coast in the southeast to minus 2°C in northwestern Iran, while extreme temperatures range from a maximum of 53°C in the south to minus 38°C in the extreme northwest.

Iran may be divided into four main physiographic regions: the Caspian region; the central plateau; the Zagros and associated ranges; and the southern coastal lowlands (Firouz, 1974). The Caspian region comprises a humid region of comparatively high precipitation, ranging from 2,000 mm in Gilan in the west to about 500 mm in Gorgan in the east, and with the rainfall more evenly distributed throughout the year than elsewhere in the country. The northern slopes of the Alborz Mountains overlooking the Caspian Sea receive some of the highest rainfall in the country, and support dense deciduous forest. To the south of the Alborz, the arid central plateau extends eastward from the Zagros Mountains in the west to the border with Afghanistan in the east. The high mountain barriers in the north and west exclude the moisture-bearing clouds from the Caspian and Mediterranean regions, resulting in low annual precipitation ranging from a maximum of about 350 mm to a minimum of less than 40 mm.

The complex Zagros Mountains, which form the western and southern borders of the central plateau, extend approximately 1,770 km from the Turkish border southeastward to the province of Baluchistan in extreme southeastern Iran. In their higher parts, these mountains rise to elevations of between 3,000 and 4,600 m. Annual precipitation decreases from west to east and from north to south, ranging from about 1,000 mm in the northwest to as little as 200 mm in the southeast. Much of this region was formerly characterized by a climax woodland of two main types: a forest dominated by evergreen oaks *Quercus* spp. at higher elevations, and a steppe-forest composed of pistachio *Pistacia* spp. and almond *Amygdalus* spp. trees at lower elevations. Dry farming has been practised in the Zagros for many millennia and this, together with the cutting of wood for fuel, has been instrumental in the disappearance of a major part of the woodland. Large tracts of woodland now survive only in some of the remoter areas of the high Zagros and on certain isolated mountain ranges on the southern edge of the central plateau.

The narrow coastal plain along the shores of the Persian Gulf and Gulf of Oman is characterized by open park-like stands of *Acacia*, *Prosopis* and *Tamarix* and extensive date-palm groves. Annual precipitation ranges from 100 to 300 mm, mostly falling between November and April, although in the extreme southeast, the southwest monsoon occasionally brings some rain in late summer. In the extreme southwest, the Mesopotamian lowlands extend into Iran in Khuzestan Province, and here, along the major rivers, there are still some remnants of the once extensive riverine thickets of *Populus euphraticus* and *Tamarix* spp.

Iran possesses an extremely diverse fauna and flora, partly because of its
great range of habitats - from permanent snows to deep deserts and from lush deciduous forests in the north to palm groves and mangroves in the south - and partly because of its position at a crossroads between three major faunal regions. The greater part of the country is situated in the Palearctic Region, with typically Western Palearctic species predominating throughout the northwest, west and central parts of the country and some typically Eastern Palearctic species extending into northeastern Iran in the highlands of Khorasan. In southern Iran, two other faunal regions have a pronounced influence: the Indo-malayan Region in the southeast, and the Afro-tropical Region in the extreme southwest. About 125 species of mammals (Harrington,

1977; Eetemad, 1986) and 500 species of birds (Scott *et al.*, 1975; Mansoori, 1995) have been recorded, while at least 270 species of fish (including 33 endemic species) are known from the Persian Gulf and Caspian Sea. A recent check-list records over 1,000 species of fish as being known to occur or potentially occurring in Iranian fresh and salt waters.

Botanically, Iran forms a bridge between four major phyto-geological regions: the Irano-Turanian, Saharo-Arabian, Euro-Siberian and Sudanian (Zohary, 1973). It is also one of the largest speciation centres of the Holarctic desert flora, with Irano-Turanian species predominating. The total number of plant species present has been variously estimated at between seven thousand and ten thousand, about 20% of which are endemic.

Approximately 11.5% of Iran's land area is under cultivation, with wheat, rice and tobacco being the principal crops. Wheat is grown mostly in the uplands in the west and northwest, while rice and tobacco are grown mainly in the Caspian lowlands. Other crops include barley, sugar-beet, cotton, dates, raisins and tea. Over much of the arid interior of the country, the principal farming activity is livestock raising, especially sheep and goats. The Islamic Republic of Iran is one of the world's largest oil producers, and much of the economy is based on the petroleum industry. The country has rich mineral resources, including iron ore, copper, manganese, chromite, coal and salt, and has an important textile industry. Other industries include sugar-refining, food processing and the production of petrochemicals, iron and steel, cement and building materials. Traditional handicrafts, notably carpets, also play an important role in the economy.

Summary of Wetland Situation

Although much of Iran is extremely dry, the country possesses a great diversity of wetland ecosystems, most of which can be grouped into six major systems: the wetlands of the south Caspian lowlands in Gilan and Mazandaran Provinces in the north; the wetlands of the Uromiyeh Basin in Azarbayjan Province in the northwest; the wetlands of Khuzestan Province in the southwest; the wetlands of central Fars Province in the southern Zagros; the wetlands of the Sistan Basin on the border with Afghanistan in the east; and the wetlands along the Persian Gulf and Gulf of Oman coasts in the south.

The wetlands of Gilan and Mazandaran comprise an almost unbroken chain of freshwater lakes and marshes, brackish lagoons, irrigation ponds and rice paddies stretching for some 700 km along the shores of the Caspian Sea from the border with the Republic of Azerbaijan in the west to the border with Turkmenistan in the east. Two of the most important wetlands in these lowlands are Anzali Mordab in the west and the Gorgan Bay/Miankaleh complex in the east. The former comprises a complex of shallow, freshwater lakes with extensive reed-beds and surrounding flood-meadows, while the latter is a large shallow brackish lagoon with extensive seasonally flooded sedge marshes and tamarisk thickets, almost completely cut off from the Caspian Sea by the 60 km long Miankaleh Peninsula.

One of the most important types of wetland in the south Caspian lowlands is the "ab-bandan", a

small, man-made reservoir or flooded rice paddy with a luxuriant growth of underwater vegetation. These shallow wetlands, varying in size from 3 ha to 1,000 ha, provide excellent feeding and roosting areas for large numbers of migratory waterfowl. Most were originally built as temporary water storage areas to provide water for irrigation during the dry summer months. However, many also serve as private reserves for duck-trapping during the winter months; some have been built specifically for this purpose, and as such are jealously guarded. In the late 1950s, Savage (1963) estimated that there were some 400 ab-bandans in Mazandaran alone, covering about 11,000 ha. Recent surveys by personnel from the Department of the Environment have revealed that there are still about 115 ab-bandans and "damgah" (ponds created specially for duck-trapping) in Gilan and Mazandaran, totalling some 10,000 ha. Although these ab-bandans represent only a small proportion of the total wetland habitat in the south Caspian, they comprise a very important component of the habitat available for waterfowl because they embrace some of the richest feeding habitats in the region, and provide undisturbed areas where waterfowl can rest during the day. The construction of large dams on the main rivers at some time in the future would render many of the ab-bandans obsolete for irrigation purposes, and could lead to their conversion to agricultural land, very much to the detriment of wintering waterfowl. In recognition of this potential threat, the maintenance and preservation of ab-bandans has become an important part of the Department of the Environment's programme of wetland conservation in the south Caspian region.

The Uromiyeh Basin in the highlands of Azarbayjan in northwestern Iran includes a number of important wetlands centred on Lake Uromiyeh itself, a vast, shallow, hypersaline lake of some 483,000 ha with numerous small islands and spectacular breeding colonies of White Pelicans (*Pelecanus onocrotalus*), Greater Flamingos (*Phoenicopterus ruber*) and many other species of waterfowl. Although the lake is too saline to support any plants or animals other than the alga *Enteromorpha* and the brine shrimp *Artemia*, the numerous small fresh and brackish water lakes and marshes along the rivers which enter the lake support abundant aquatic vegetation and are very rich in wildlife.

In extreme southwestern Iran, three large rivers rising in the Zagros Mountains (the Karun, Dez and Kharkeh) flow out onto the plains of Khuzestan and create a vast complex of seasonal floodplain wetlands which extend southward to the head of the Gulf. In the west, these wetlands are contiguous with the great floodplain wetlands of lower Mesopotamia in Iraq. The most important wetland in this region is Shadegan Marshes, some 290,000 ha of seasonally flooded sedge marsh and brackish lagoons adjacent to the extensive intertidal mudflats at the head of the Gulf. Other similar, but much smaller, floodplain wetlands occur further south along the Gulf coast, notably in the delta of the Helleh River near Bushire.

Near the eastern end of the Zagros Mountains in central Fars Province, there is a group of large wetlands set in broad valleys between rugged mountain ranges. These wetlands include freshwater lakes and marshes, such as Dasht-e Arjan and the Haftbarm Lakes, and brackish to saline lakes with extensive brackish marshes, such as Parishan, Maharloo, Bakhtegan and Tashk. Lake Bakhtegan and Lake Tashk (together known as the Neiris Lakes) are fed by the Kur River; during years of heavy rainfall they unite to form a single lake of about 108,000 ha. In most years, however, the water surface is much less than this, and the two lakes are

surrounded by extensive bare salt flats.

In the Sistan Basin, on the border between Iran and Afghanistan, there is a vast complex of freshwater lakes with extensive reed-beds which at times of peak flooding can cover over 200,000 ha. These wetlands are unusual in that although the three main lakes, Hamoun-i Puzak, Hamoun-i Sabari and Hamoun-i Hirmand, lie within an internal drainage basin, they are predominantly freshwater. The system is fed by the Hirmand River, which rises in the Hindu Kush in northern Afghanistan. During long periods of drought, as occurred throughout the late 1960s and again in the 1980s, the Hirmand supplies sufficient water to flood only the uppermost of the lakes, the Hamoun-i Puzak, which lies almost entirely within Afghanistan. However, during years of unusually heavy rainfall, as occurred in the late 1970s and again in 1990, the floodwaters of the Hirmand sweep through all three lakes and overflow into a vast salt waste to the southeast, flushing the salts out of the system in the process.

Each of these five major regions comprises a complex of large and small lakes and marshes, providing a wide diversity of habitat types and supporting a rich and diverse flora. *Phragmites* reed-beds are characteristic of many of the wetlands, and are particularly extensive at Anzali Mordab in the southwest Caspian, in the Hamoun wetlands in the Sistan Basin, at Dasht-e Arjan and Lake Parishan in Fars, and at several of the wetlands in the Uromiyeh Basin in Azarbayjan. The reed-beds are highly productive, and provide breeding habitat for many species of waterfowl. The reeds are traditionally used for thatching, especially in Gilan, Mazandaran and Sistan, where reeds are harvested on a large scale not only for local use but also for export to other parts of the country for roofing materials and mat-making.

The sixth major wetland system in Iran comprises the numerous tidal creeks and large areas of intertidal mudflats and mangrove swamps along Iran's 2,000 km of coastline on the Persian Gulf and Gulf of Oman. Mangroves are at the extreme limit of their distribution in the southern Gulf, and comprise only a single species, *Avicennia marina*. Harrington (1976b) gives a detailed description of mangrove distribution in Iran, and estimates the total area of mangrove at 8,900 ha. Much the largest of the mangrove/mudflats ecosystems is found in the Khouran Straits north of Qeshm Island, where there are some 100,000 ha of low-lying islands, mangroves, mudflats and creeks. Further east, along the Gulf of Oman coast in Persian Baluchistan, offshore depths increase to over 50 m and the coastline has extensive sand dunes, long sandy beaches and stretches of sea-cliffs interrupted at intervals by large creek systems with extensive mangroves and mudflats. Where the sublittoral has hard substrates, coral reefs and seagrass beds appear. The large bays at Pozm and Chahbahar in the east lie in a region with an extremely rich and diverse marine fauna.

There are seven large offshore islands in the eastern Gulf, Qeshm, Hormoz, Larak, Hengam, Kish, Henderabi and Lavan, as well as many smaller islands and islets, some of which are extremely important for breeding sea-birds and marine turtles. All of the larger islands are rocky and sparsely populated, and the easternmost are surrounded by substantial coral reefs. The little information available on Iran's coral reefs has been summarized by UNEP/IUCN (1988).

The desert interior of Iran is almost completely surrounded by a ring of high mountain ranges, the source of numerous perennial and seasonal rivers which flow down into the interior deserts and are eventually lost in great salt wastes such as the Dasht-e Kavir in the north and the Hamoun-i Jaz Murian in the south. Some of the larger rivers terminate in extensive brackish and saline lakes, such as Gavekhoni Lake at the mouth of the Zaindeh Rud in Isfahan Province. In years of high rainfall, such wetlands may remain flooded throughout the year. Elsewhere in the country, there are various isolated small lakes, spring-fed pools and seasonal marshes, particularly in the west, west-central and northwest, many of which support a diverse aquatic flora and fauna, and some of which may, at certain times of the year, be important for migratory waterfowl.

The wetlands of Iran constitute vital staging and wintering areas for millions of migratory waterfowl using the West Siberian-Caspian-East African and Central Siberian-Indus-South Asian flyways, and also support large breeding populations of many species. Several million waterfowl utilize the wetlands as wintering habitat, while perhaps as many birds again use the wetlands as staging areas on their way to and from wintering areas further to the southwest or southeast. The wetlands of Iran are very important for seven species of birds listed as globally threatened in the 1994 IUCN List of Threatened Animals (Groombridge, 1993), namely Pygmy Cormorant (*Phalacrocorax pygmaeus*), Dalmatian Pelican (*Pelecanus crispus*), Lesser White-fronted Goose (*Anser erythropus*), Marbled Teal (*Marmaronetta angustirostris*), White-headed Duck (*Oxyura leucocephala*), White-tailed Eagle (*Haliaeetus albicilla*) and Siberian Crane (*Grus leucogeranus*). A further four threatened species formerly occurred in significant numbers, but are now only scarce passage migrants or vagrants, namely Red-breasted Goose (*Branta ruficollis*), Pallas' Sea-Eagle (*Haliaeetus leucoryphus*), Sociable Plover (*Chettusia gregaria*) and Slender-billed Curlew (*Numenius tenuirostris*). The status of three of the globally threatened species, *Marmaronetta angustirostris*, *Oxyura leucocephala* and *Numenius tenuirostris*, within Iran and throughout their world ranges has recently been summarized by Green (1993), Anstey (1989) and Gretton (1991), respectively.

In many parts of Iran, the level of exploitation of wetlands is high. Floodplain wetlands, river banks and lake shores are utilized for the cultivation of cereals, rice or vegetables, while the rivers and lakes themselves support intensive freshwater fisheries. The wetlands provide vital sources of water for domestic and industrial consumption, and constitute natural water storage reservoirs which can be utilized for irrigation purposes. Many of the larger rivers have been dammed to provide the means for generating hydro-electricity, while some of the inland salt lakes are exploited as an abundant source of various salts. Reeds are widely used for thatching and weaving purposes or as fuel, and in the vast reed-beds of the Sistan Basin, marsh-dwelling communities were until recently almost totally dependent on reeds for their construction needs. Large numbers of domestic livestock, particularly cattle and water buffalo, are allowed to graze on wetland vegetation, and in some areas, aquatic plants are harvested to provide fodder during the winter months.

Waterfowl hunting occurs at wetlands throughout Iran. Sport hunting is common, and occurs on a large scale at wetlands near the larger cities. In many rural areas, however, waterfowl are shot, netted or trapped primarily for their meat value. In the south Caspian lowlands in particular,

enormous numbers of waterbirds are harvested on a commercial basis, and provide a livelihood for hundreds of people. Savage (1963) has given an early account of waterfowl hunting in the south Caspian region. He studied waterfowl hunting in northern Iran between 1957 and 1959, and concluded that over 1,200,000 ducks were being killed annually in Gilan and Mazandaran during an average season. The principal method of capture at that time was by means of a net, gong and flare at night. Mist-nests and clap-nets sited at pools to which ducks were attracted by trained decoy-ducks were also widely used, as were long flight nets. Shooting, although increasing, accounted for only about 9% of the kill in 1957-59. A survey of duck hunting in the south Caspian region in the early 1970s, conducted by personnel from the Department of the Environment, suggested that the annual harvest of ducks and coots may have been as high as three million birds. Use of the traditional net, gong and flare technique and clap-netting were still widespread, but shooting and flight-netting had increased considerably since the 1950s. Between the 1970s and the early 1990s, the number of waterfowl wintering in the south Caspian region fell dramatically, almost certainly as a result of the excessive hunting pressure, and the annual harvest, although still high, is now well below the 1970s levels.

Wetlands in Iran, as elsewhere in the region, are increasingly coming under pressure from man's activities. Undoubtedly the most serious threats to wetlands have been the drainage and "reclamation" of wetlands for agriculture, industry and urban development, and diversion of water supplies for irrigation purposes. Flood control projects and irrigation schemes on the Hirmand River in Afghanistan have considerably affected the wetlands of the Sistan Basin, especially during years of below average rainfall. Increased siltation is becoming a problem at some wetlands, as deforestation and overgrazing in the water catchment areas lead to severe soil erosion, increased silt loads in the rivers and flash-flooding. Such problems are especially serious in the south Caspian lowlands; the wetlands of the Anzali Mordab complex, in particular, are threatened by increased rates of siltation and accelerated eutrophication. Most of Iran's major rivers have been dammed to permit the generation of hydro-electricity and to provide water for irrigation purposes, industrial use and domestic consumption. Because of soil erosion in the catchment areas, many of the dams have silted up much more rapidly than was anticipated, with consequent loss in water storage capacity and greatly reduced value for water supply and generation of electricity. In the 1970s, increased coastal erosion in the delta of the Sefid Rud in the south Caspian was attributed to a reduction in the amount of silt reaching the delta following the construction of a large dam upstream in the Alborz Mountains. At some wetlands, especially in the Sistan Basin, heavy grazing of marsh vegetation by domestic livestock is inhibiting natural plant succession, and is causing permanent damage to aquatic plant communities as the highly palatable species are grazed to extinction. This degradation of wetland vegetation and the introduction of exotic fish species have had a detrimental effect on some of the native freshwater fishes. Some of the mangrove communities in the Persian Gulf have also been degraded by excessive utilization for fuelwood and fodder, and over-grazing by camels. Many wetlands, especially those downstream of large urban centres and major farming areas, have been polluted with domestic sewage, herbicides, pesticides, fertilizers, industrial effluents and other waste products, and some of Iran's coastal wetlands and inshore waters are now badly polluted. The petrochemical industry in the Persian Gulf continues to pose a number of threats to the environment, not least pollution. The movement of oil tankers through the Gulf presents a continued threat to marine life and to the increasingly important Gulf fisheries.

One of the major environmental threats to wetlands in southwestern Iran during the 1980s came from the consequences of the prolonged military conflict between Iran and Iraq. In 1983, the Nowruz oil field in the Persian Gulf northwest of Kharg Island was damaged, resulting in severe pollution of the sea by oil and gas leakage. The very important Shadegan Marshes and tidal mudflats of Khor-al Amaya and Khor Musa (a Ramsar Site) in Khuzestan and Lake Zaribar in Kurdistan were also damaged during the war, particularly because of the use of chemical weapons by Iraq. The Gulf War in 1990-91 seems to have had much less of an impact on wetlands in Iran. At the invitation of the Iranian Government, a Japanese mission visited Iran in July and August 1991 to assess the environmental impact of the Gulf War on Iran's Gulf coast. This mission investigated the Gulf coast from Khuzestan to Bushire and Kharg Island, but was unable to find any direct evidence of damage to wildlife populations from oil spills. However, air pollution from the burning oil wells in Kuwait is reported to have damaged vegetation at some of the wetlands in Khuzestan, and this problem is still being investigated.

Despite the high human pressures on wetland resources and increasing demand for more land for agriculture, there have been relatively few major losses of wetland habitat in Iran in recent decades. Locally, losses have been severe, especially in the wetlands of Khuzestan in the southwest and in the Hamoun wetlands in the Sistan Basin. However, in most regions of the country, many of the wetlands remain in relatively good condition. This is due in large part to the active policy of wetland conservation pursued by the Government of Iran since the late 1960s, and the establishment of an effective network of protected areas which includes many of the country's most important wetlands.

The first protected area incorporating a major wetland (Lake Uromiyeh) was established in 1967 by the Iran Game and Fish Department, later to become the Department of the Environment. By the end of 1991, the system of protected areas in Iran included seven National Parks, 23 Wildlife Refuges, 43 Protected Areas and four National Nature Monuments, totalling at least 8,041,265 ha and covering over 4.8% of the country. Wetlands figure prominently in this network of reserves. One of the National Parks, nine of the Wildlife Refuges and ten of the Protected Areas were established primarily to protect wetland ecosystems, while a further two Protected Areas and a Wildlife Refuge incorporate important wetland habitat. These 23 reserves are listed in Table 1. Of the 63 internationally important wetlands described in this inventory, no less than 20 are now wholly or partly included within reserves. In the mid-1970s, it was estimated that between 40% and 75% of all ducks, geese, swans and coots wintering in Iran did so within protected areas, and with increased levels of disturbance at unprotected wetlands in recent years, this proportion may now be considerably higher.

Wetland Research

A great deal of information is available on the wetlands of Iran, particularly with respect to their importance for birds. Early accounts of the wetlands and their waterfowl were provided by Savage (1964), Firouz (1968), Savage and Firouz (1968) and Firouz and Ferguson (1970a, 1970b). The wetlands of Gilan Province in the southwest Caspian were described in some detail

by Ferguson (1972). Information available up to the end of 1970 was summarized in a small booklet on the wetlands and waterfowl of Iran produced by the Game and Fish Department for distribution at the International Conference on Conservation of Wetlands and Waterfowl held in Ramsar, Iran, in January and February 1971 (Anon, 1971).

As a Contracting Party to the Ramsar Convention, the Islamic Republic of Iran has presented a considerable amount of information on its major wetlands and conservation activities at the Conferences of the Parties to the Convention and at related international wetland meetings (*e.g.* Ashtiani-Zarandi, 1990; Division of Research and Development, 1972; Mansoori, 1984; Scott, 1976c; Vahedi, 1982). Information on the 18 wetlands of international importance designated by Iran for inclusion in the Ramsar List has been published in successive editions of *A Directory of Wetlands of International Importance* (most recently in WCMC, 1990, and Ramsar Convention Bureau, 1993). The 18 Ramsar sites have also been described in some detail by Carp (1980) in *A Directory of Western Palearctic Wetlands*. A recent inventory of Important Bird Areas in the Middle East, sponsored by BirdLife International, describes 105 sites of special importance for bird conservation in the Islamic Republic of Iran (Evans, 1994). These include all of the 63 wetlands of international importance identified in the present inventory, as well as a number of smaller wetlands of only national or regional importance.

Iran was the first country in the Middle East to carry out a national wetlands inventory. This was undertaken by personnel of the Department of the Environment during the early 1970s, and identified a total of 286 wetlands, 33 of which were considered to be of international importance (Scott, 1976a & 1976c). In 1990, the Department of the Environment launched a major project to update the wetland inventory and to describe the key wetlands in Iran, which special attention being given to aquatic plants, waterbirds and mammals. During the first phase of the project (1990-1994), some 58 of the most important wetlands were investigated (Motalebbi-Pour, 1993).

Much of the information on the importance of Iran's wetlands for waterfowl has been derived from mid-winter waterfowl counts. Annual mid-winter counts were initiated by the Game and Fish Department in 1966/67, and have been continued ever since, except for a gap of one year (1979) during the revolution. Initially, counts were confined to the south Caspian region, but in early 1970, coverage was extended to the wetlands of Azarbayjan, Fars and Sistan. The important wetlands of Khuzestan were counted for the first time in February 1971, as were some of the wetlands along the coast of the Persian Gulf and Persian Baluchistan. Small fixed-winged aircraft were used for censusing waterfowl at the huge and otherwise largely inaccessible wetlands of Khuzestan, Fars and Sistan from 1973 to 1976, and the entire south coast of Iran was surveyed from the air in the winters of 1973/74 and 1974/75. The overall coverage of the mid-winter waterfowl counts was considered to be very good at this time, with between 160 and 300 sites being covered each winter (Scott, 1976d). In an effort to obtain a better understanding of waterfowl movements within Iran during the course of the winter, nationwide counts of waterfowl were also carried out during the month of November in 1972, 1973 and 1974. Also during the early 1970s, breeding season surveys were undertaken at all wetlands in Iran which were thought likely to be important for breeding waterfowl. These surveys included several aerial censuses of the huge breeding colonies of Greater Flamingo,

White Pelican and other waterfowl at Lake Uromiyeh, and boat surveys to islands in the Persian Gulf known or thought to be important for breeding sea-birds. Estimates of the wintering and breeding populations of waterfowl and sea-birds in Iran, based on surveys undertaken between 1970 and 1976, are given in Table 2.

Aircraft ceased to become available for waterfowl counts in 1977, and for a few years immediately following the revolution, the mid-winter counts occurred at a greatly reduced level. However, some 40 sites were being counted annually by the mid-1980s, and since then the number of sites counted has increased rapidly to levels comparable with those achieved in the early 1970s. Thus, over 100 sites were counted in January 1988, 124 in January 1992 and 153 sites in January 1994. Unfortunately, it has not been possible to carry out any aerial counts in recent years, and since effective coverage of many of the vast wetlands in central and southern Iran can only be achieved from the air, direct comparison between some of the count data from the early 1970s and count data from the early 1990s remains difficult (Perennou *et al.*, 1994).

In 1966, the Game and Fish Department initiated a duck-banding programme in the south Caspian region, and in 1970, banding activities were extended to include Greater Flamingos at the Lake Uromiyeh colony. In the early 1970s, the Department of the Environment established a national bird-banding scheme, with its own rings bearing a Tehran address. Banding activities were rapidly expanded to take in a wide variety of waterfowl, notably White Pelicans and gulls (*Larus* spp.) at Lake Uromiyeh, Great Cormorants (*Phalacrocorax carbo*) in Gilan, herons and egrets (Ardeidae) in Fars and on the Gulf coast, Common Cranes (*Grus grus*) in Fars, shorebirds in the south Caspian region and Tehran area, and terns (*Sterna* spp.) in the Gulf. Bird-banding activities in Iran and all recoveries reported up to the end of 1975 have been summarized by Cornwallis and Ferguson (1970) and Argyle (1975a, 1976a).

Many other wetland-related research activities were initiated by the Game and Fish Department and later the Department of the Environment in the late 1960s and 1970s. These included the following:

- Monthly counts of waterfowl from September to March at selected sites in the south Caspian lowlands (1971/1972 and 1972/73).
- Research on breeding Greater Flamingos at Lake Uromiyeh (initiated in 1970 and continuing).
- A study of waterfowl hunting in the south Caspian region, including an assessment of the annual harvest (early 1970s).
- A nationwide census of breeding White Storks (*Ciconia ciconia*), carried out in 1974 as part of an international census of storks in Europe and the Middle East (Fotoohi & Scott, 1975).
- Surveys of breeding sea-birds on islands in the Persian Gulf (1972-1977).
- A study of Peregrine Falcons (*Falco peregrinus*) in the Caspian littoral with particular reference to the Anzali Mordab area and Miankaleh Wildlife Refuge (Carnie, 1973).
- Studies on marine turtles in the Persian Gulf, especially at Sheedvar Island (early 1970s).

In the winter of 1975/76, the Department of the Environment, in collaboration with the International Crane Foundation, initiated a project to re-establish the endangered Siberian Crane as a wintering species in Iran through cross-fostering with Common Cranes. The first phase of the project involved the banding and colour-marking of Common Cranes on their wintering grounds at Dasht-e Arjan in Fars. One hundred and eighty-three Common Cranes were marked in 1976, 1977 and 1978 (Farhadpour, 1987). However, with the rediscovery of a wild population of Siberian Cranes wintering in Iran in 1977/78, this project was abandoned.

Since the revolution in 1978, the Department of the Environment has been formulating a policy of wetland conservation, and has been carrying out a systematic investigation of its wetlands and waterfowl populations. Some of the most important projects in recent years have been as follows:

- An investigation of the phenomenon of sea-level rise in the Caspian Sea since the late 1970s.
- Research on the limnology, ecology, flora and fauna of Siahkeshim Marsh in the Anzali Mordab complex in the southwest Caspian. The results of this study have been presented in an illustrated booklet published in Farsi (Riazi, undated).
- A project for the restoration of the wetlands of the Anzali Mordab. This project, which was initiated in 1990, is expected to be continued and expanded with the cooperation of the World Bank.
- A study of the ecology, biology and economic values of *Phalacrocorax carbo* in the south Caspian region (Monavari, 1988).
- A project to promote sustainable utilization of wetland resources in the Hamoun wetlands in the Sistan Basin.
- Research on changes in the aquatic vegetation of the Hamoun wetlands, with particular reference to the disappearance of *Phragmites* reed-beds.

A considerable amount of fisheries research has been carried out in the Caspian Sea and in adjacent coastal wetlands by the National Fisheries Organization (Shilot). This organization has also conducted limnological and hydrological research in the Caspian, particularly with respect to the rise in sea level since the late 1970s. The National Centre for Marine Science is responsible for marine research in the Persian Gulf. A marine laboratory was established at Bandar Abbas in the southern Gulf in the early 1970s, and a marine research station was constructed on nearby Hormoz Island.

Other wetland research has included several investigations on the hydrobiology of the Neiris Lakes in Fars, the Hamoun wetlands in Sistan, and Lake Uromiyeh in Azarbayjan (*e.g.* Loffler, 1959, 1961, 1968; Savage, 1968). In the 1960s, the University of Shiraz provided support for a major study of the wetlands of Fars Province (Cornwallis, 1968a, 1968b). In recent years, the University of Tehran has also been involved in research on wetland fauna and flora. Two M.Sc. students from this university are currently studying the limnology and avifauna of Lakes Ajigol and Ulmagol on the Turkoman Steppes in Mazandaran. The University of Tabriz is currently undertaking a project on the sustainable utilization of wetland resources at Lake Uromiyeh in Azarbayjan.

Wetland Area Legislation

Early descriptions of environmental management and protection in Iran are given in Firouz *et al*. (1970), Firouz (1974), Firouz and Harrington (1976) and Harrington (1976a). More recently, environmental legislation has been summarized by IUCN (1992). The first law concerning the conservation of nature in Iran was passed in 1956 and created the Game Council of Iran, which was charged with the control of hunting activities and the establishment of hunting centres for the protection of endangered species. In 1967, two new laws were enacted: the Law of Protection and Exploitation of Forest and Range and the Law on Game and Fish. The latter created the Game and Fish Department as an independent governmental organization, and gave this body the powers to declare certain areas for the protection of flora and fauna. The Game and Fish Law, as amended in 1975, represents the basic legal control through which exploitation of wildlife is curtailed, hunting and shooting are regulated, and game species are legally protected.

The Environmental Protection and Enhancement Act of 1974 superseded all previous enabling nature conservation legislation, and remains the main law covering conservation within Iran. This Act placed wetlands under the jurisdiction of the newly created Department of the Environment. Since the proclamation of Iran as an Islamic Republic on 1 April 1979, all laws relating to the conservation of the natural environment have been implemented on the basis of Constitutional Act No.50 of the Republic, which states that all citizens are required to honour the conservation of nature and natural resources.

In 1971, Iran hosted an International Conference on the Conservation of Wetlands and Waterfowl at the small resort town of Ramsar on the shores of the Caspian Sea. It was at this conference that the final text of the Convention on the Conservation of Wetlands of International Importance especially as Waterfowl Habitat (the Ramsar Convention) was approved and opened for signature. The Government of Iran ratified the Convention on 23 June 1975, and designated 18 wetlands (totalling 1,357,550 ha) for inclusion in the Convention List of Wetlands of International Importance (Table 3). No new sites have been added to the Ramsar List since then, but several sites are currently being considered by the Department of the Environment for designation in the near future.

Also at international level, the Islamic Republic of Iran has ratified the World Heritage Convention, although it has not designated any natural World Heritage Sites, and has signed (but not ratified) the Biodiversity Convention. Iran participates in the UNESCO Man and the Biosphere Programme, and as of December 1993, had designated nine Biosphere Reserves covering a total of 2,699,731 ha. Four of these Biosphere Reserves (Arjan, Hara, Uromiyeh and Miankaleh) contain internationally important wetlands described in this inventory. The Islamic Republic of Iran has also ratified the Regional Convention for Cooperation on the Protection of the Marine Environment from Pollution, and the Action Plan for the Protection and Development of the Marine Environment and the Coastal Areas (Evans, 1994). A joint agreement was signed with the USSR in 1973 to combat pollution in the Caspian Sea (IUCN, 1992).

Wetland Area Administration

The Department of the Environment, established in March 1972, is the only organization responsible for the investigation, management and conservation of wetlands in Iran. Under the Environmental Protection and Enhancement Act of 1974, this Department superseded the Game and Fish Department (created in 1967), which itself superseded the Game Council of Iran (created in 1956). The Department is responsible for the protection of wildlife, hunting and fishing in inland waters, as well as protection of the natural environment. The Department undertakes long-term environmental studies and management projects, with responsibilities which include the conservation and enhancement of wildlife resources and prevention of pollution. It puts forward regulations on habitat management, and has introduced environmental legislation regarding pollution. Long-term programmes include the cleaning of the Caspian Sea and Iranian rivers, and prevention of air pollution (IUCN, 1992).

After the proclamation of the Islamic Republic in 1979, the Department of the Environment became responsible for environmental preservation according to a new philosophy, policy aim and strategy, centred on the continued utilization of environmental resources (IUCN, 1992). Any development activity likely to have an impact on wetlands must receive the necessary permission from the Department of the Environment, and an environmental impact assessment must be carried out before any work can begin. However, any organization or institute wishing to carry out research in wetlands is allowed to do so, provided that permission has first been obtained from the Department.

The establishment of hunting reserves in Iran dates back to ancient Persian times, but it was not until the creation of the Game Council in 1956 that the foundations for the present system of protected areas were laid. The Game Council was created with a policy to set up hunting centres for the protection of endangered species and the control of hunting. In 1967, the newly created Game and Fish Department was empowered by law to declare certain areas for the protection of flora and fauna. Two types of designated area were established: Protected Regions in which hunting and land-use activities were subject to certain controls, and Wildlife Parks in which wildlife and their habitats were strictly protected. These sites were re-classified in 1974 following the introduction of the Environmental Protection and Enhancement Act, which defined four categories of protected natural area: National Park, Wildlife Refuge, Protected Area and National Natural Monument (Firouz & Harrington, 1976). These four categories are described by IUCN (1992) and Evans (1994).

The Game and Fish Law of 1967 also provided for the establishment of Protected Rivers and Fishing Refuges. Protected Rivers are areas designated to protect natural habitats from fishing. By the end of 1991, there were five Protected Rivers under the jurisdiction of the Department of the Environment: the Chalus, Karadj, Lar/Haraz, Sardab and Jajerud. Other specified areas include all marshes, wetlands, waterways and bays along the Caspian Sea, all of which are declared protected in so far as fishing is concerned (IUCN, 1992).

Organizations involved with Wetlands

Department of the Environment

Protection and enhancement of the environment; management of wildlife and fisheries in inland waters; jurisdiction and management of protected areas and wetlands; prevention of pollution and environmental degradation; promulgation of emission and quality standards and criteria for air, water, soil, wastes and noise.

Ministry of Water and Power

Enforcement of water quality standards and criteria; water treatment plants and sewage systems; dam construction and irrigation; hydrobiological and hydrochemical research.

Ministry of Agriculture and Natural Resources

Management and conservation of forests and range lands, including watershed and soil conservation.

National Fisheries Organization (Shilot)

Management of fisheries in the Caspian region; limnological, hydrological and fisheries research.

National Centre for Marine Science

Marine research.

Tehran University

Research on wetland fauna and flora.

University of Tabriz

Research on wetland fauna and flora.

University of Shiraz

Research on the wetlands of Fars Province.

WETLANDS

Site descriptions compiled by Derek A. Scott from internal reports of the Iran Department of the Environment, IWRB waterfowl counts in Iran (1967-1993), the published literature, and personal observations (1970-76), with additional information received from personnel of the Department of the Environment, Eskandar Firouz and Mohammad Nosrati. All of the 63 internationally important wetlands described in this inventory have also been identified as "Important Bird Areas" by BirdLife International, and are described in Evans (1994).

Akh Gol (1)

Location: 39°33'N, 44°47'E; in the Aras Valley in extreme northwestern Iran, 115 km north of Khoy, Azarbayjan Province.
Area: 600 ha.
Altitude: 820 m.
Overview: A small brackish lake with associated marshes in a region of semi-arid steppic hills in the uplands of northwestern Iran, important primarily as a breeding area for waterfowl including *Marmaronetta angustirostris*.
Physical features: Akh Gol is a small brackish lake and marshes set in an amphitheatre of rugged lava hills on the south side of the Aras River valley near the border with the Republic of Armenia. The lake is fed by small springs and local run-off, and drains eastwards into the Aras River about 5 km away. The small western portion of the lake retains water throughout the summer, but the main eastern section dries out in late summer, exposing extensive bare mudflats. The lake is generally frozen over and under snow cover in mid-winter.
Ecological features: Fresh to brackish marshes with extensive *Phragmites* reed-beds around the western margins of the lake, and a large area of brackish *Salicornia* flats with scattered clumps of *Phragmites* and *Tamarix* on the plains to the east. The hills to the north and south support steppic vegetation dominated by *Artemisia*.
Land tenure: Public (Government).
Conservation measures taken: The lake has been designated a No-Hunting Area. It has been identified as an "Important Bird Area" by BirdLife International (Evans, 1994).
Conservation measures proposed: None known.
Land use: Livestock grazing and probably some waterfowl hunting.
Possible changes in land use: None known.
Disturbances and threats: The lake is in the process of being drained for agricultural land.
Hydrological and biophysical values: No information.
Social and cultural values: No information.
Noteworthy fauna: The site is primarily important for its breeding waterfowl which include 100-150 pairs of *Himantopus himantopus*. At least one pair of *Marmaronetta angustirostris* bred in 1974, and *Oxyura leucocephala* may have bred in recent years. Other breeding species include *Podiceps cristatus*, *Burhinus oedicnemus*, *Charadrius dubius*, *C. alexandrinus* (20-30

pairs), *Vanellus vanellus* (10-15 pairs), *Tringa totanus* (15-20 pairs), *T. hypoleucos* and *Acrocephalus arundinaceus*. *Circus pygargus* has been observed in summer and may breed in the area. Up to 90 *Tadorna ferruginea* have been recorded on passage (November).
Noteworthy flora: No information.
Scientific research and facilities: Several waterfowl censuses have been carried out by personnel of the Department of the Environment, mostly during the breeding season.
Management authority and jurisdiction: No information.
References: Evans (1994); Firouz & Ferguson (1970b); Green (1993); Scott (1976a).
Reasons for inclusion: 1a & 3c (possibly also 2a). Akh Gol is a good representative example of a natural wetland characteristic of the uplands of northwestern Iran. It is probably a regular breeding area for *Marmaronetta angustirostris* (a threatened species), and regularly supports over 1% of the regional breeding population of *Himantopus himantopus*.
Source: Derek A. Scott.

Dasht-e Moghan (2)

Location: 39°35'N, 48°00'E; near the town of Parsabad on the plains of the Aras River in extreme northeastern Azarbayjan Province, about 160 km north of Ardabil.
Area: 3,000 ha.
Altitude: 10 m.
Overview: An area of wet cultivated plains along the Aras River, important for wintering geese (*Anser* spp.). Unprotected.
Physical features: The Dasht-e Moghan is a wet cultivated plain, about 30 sq.km in extent, bordered in the northwest by the Aras River and in the northeast by the international frontier with the Republic of Azerbaijan. At this point, the Aras River is wide and meandering, with many braided channels, shingle banks, quiet backwaters with marsh vegetation, and shrub-covered islands. The river, which forms the border with the Republic of Azerbaijan, flows in a broad valley about 1.5-2.0 km wide and 10 m below the level of the adjacent plains. These are densely populated, with many small villages, and are almost entirely under cultivation for cotton and wheat.
Ecological features: Riverine habitats include braided channels, shingle banks, stagnant pools with emergent marsh vegetation, open *Tamarix* scrub (mainly on the many small islands) and grassy areas. The plains are mostly under cultivation for cotton and wheat, although there are some areas of short grassland and *Artemisia* steppe in the east and stands of poplars around the villages.
Land tenure: Public (Government).
Conservation measures taken: None. The site has been identified as an "Important Bird Area" by BirdLife International (Evans, 1994).
Conservation measures proposed: None known.
Land use: Agriculture (mainly cotton and wheat) and some livestock grazing.
Possible changes in land use: None known.
Disturbances and threats: The goose flocks feeding on the cultivated plains are subject to

high levels of disturbance from farm workers, and there is some waterfowl hunting.
Hydrological and biophysical values: No information.
Social and cultural values: No information.
Noteworthy fauna: An important wintering area for geese (*Anser albifrons* and *A. anser*) and ducks. Up to 320 *A. albifrons* and 1,370 *A. anser* have been recorded, this being one of the best areas for *A. albifrons* in Iran. The goose flocks feed at dawn and dusk on the cultivated plains of the Dasht-e Moghan and spend much of the day loafing on shingle banks in the river where they are free from disturbance. Four *Anser erythropus* were present in the area in November 1971. Small numbers of *Mergus merganser* (maximum 18) occur along the river and *Ciconia nigra* has been recorded in winter. Other wintering birds have included up to 188 *Egretta alba*, 274 *Cygnus olor*, 149 *Tadorna ferruginea*, 2,320 *Anas crecca*, 1,660 *A. platyrhynchos*, 200 *Aythya ferina*, 400 *A. fuligula*, 400 *Vanellus vanellus* and 9 *Tringa nebularia*. *Aquila heliaca*, *Falco cherrug*, *F. peregrinus* and *F. columbarius* are regular winter visitors, and small numbers of *Tetrax tetrax* have occurred in late autumn.
Noteworthy flora: No information.
Scientific research and facilities: Mid-winter waterfowl censuses have been carried out by personnel of the Department of the Environment on a number of occasions since 1969.
Management authority and jurisdiction: No information.
References: Evans (1994); Firouz & Ferguson (1970b); Savage & Firouz (1968); Scott (1976a).
Reasons for inclusion: 3c. The Dasht-e Moghan regularly supports over 1% of the regional wintering population of *Anser albifrons* and *A. anser*.
Source: Derek A. Scott.

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Gori Gol (3)

Location: 37°50'N, 46°40'E; on the north side of the main Tabriz to Tehran highway, about 40 km east-southeast of Tabriz, Azarbayjan Province.
Area: 120 ha.
Altitude: 1,950 m.
Overview: A small freshwater lake with associated marshes in the steppic uplands of northwestern Iran, important primarily as a breeding area for waterfowl including *Oxyura leucocephala*. The lake has been designated as a Ramsar Site, but is otherwise unprotected.
Physical features: Gori Gol (or Gory Gol) is a fresh to brackish, eutrophic lake fed by local rainfall, springs and small streams, and receiving the bulk of its water after the spring snow-melt. The lake has an average depth of about 2-3 metres, and shows little fluctuation in water level. It overflows at its northeast corner into a small stream. The bottom consists of a mud deposit on shale and rocks. The lake is generally frozen over by late December and remains frozen, often under deep snow cover, throughout the winter.
Ecological features: There are extensive areas of *Phragmites*, *Juncus*, *Carex* and *Scirpus* around the shores of the lake and abundant underwater vegetation. The surrounding area is semi-arid, steppic country with one small settlement and wheat cultivation on the west and

damp grassland on the southwest. The main Tabriz-Tehran road passes close by the south side of the lake.

Land tenure: Public (Government).

Conservation measures taken: There is no legal habitat protection. However, hunting is prohibited, and the Department of the Environment maintains some control over the area. Lake Gori (120 ha) was designated as a Ramsar Site on 23 June 1975, and has been identified as an "Important Bird Area" by BirdLife International (Evans, 1994).

Conservation measures proposed: None known.

Land use: Sport fishing, grazing, reed-cutting and wildfowl hunting. Some outdoor recreation by the inhabitants of Tabriz, especially at weekends and holidays.

Possible changes in land use: None known.

Disturbances and threats: The lake remains in good condition, and there are no serious threats. However, lying close to the main Tabriz-Tehran road and only 45 km from Tabriz, the lake is subjected to intensive recreational use, including shooting and fishing. This causes a considerable amount of disturbance to breeding waterbirds.

Hydrological and biophysical values: No information.

Social and cultural values: The site has some value for outdoor recreation for the people of Tabriz.

Noteworthy fauna: An important site for breeding waterfowl, notably *Podiceps nigricollis* (125-150 pairs), *Aythya nyroca* (several pairs) and *Oxyura leucocephala* (several pairs), and the only known breeding locality in Iran for *Podiceps grisegena* (1 or 2 pairs). Other breeding species include *Fulica atra* (100s of pairs), *Vanellus vanellus* (15-20 pairs), *Tringa totanus* (15-20 pairs), *Acrocephalus melanopogon* and *A. arundinaceus*. *Porzana parva* has been heard calling in summer, and may breed. Feeding flocks of *Pelecanus onocrotalus* occasionally frequent the lake in summer, presumably from the breeding colony at Lake Uromiyeh. A wide variety of waterfowl occur on passage, including up to 70 *Ardeola ralloides*, 100 *Tadorna ferruginea*, 1,000 *Anas querquedula*, 150 *A. clypeata*, 400 *Aythya fuligula*, 40 *A. nyroca*, 15 *O. leucocephala*, 12,500 *Fulica atra*, 100 *Himantopus himantopus*, 70 *Charadrius hiaticula*, 100 *Calidris minuta*, 200 *Philomachus pugnax*, 25 *Tringa stagnatilis*, 100 *T. glareola*, 22 *Gelochelidon nilotica*, 80 *Chlidonias hybridus* and 400 *C. leucopterus*. *Botaurus stellaris*, *Circus pygargus* and *Falco cherrug* have been recorded on passage in small numbers. The lake has no value for wintering waterfowl as it is completely frozen over during the mid-winter period.

Noteworthy flora: No information.

Scientific research and facilities: The Ornithology Unit at the Department of the Environment has carried out a number of surveys of breeding waterfowl.

Management authority and jurisdiction: The Ramsar Site is administered by the Department of the Environment.

References: Anstey (1989); Carp (1980); Evans (1994); Mansoori (1984); Ramsar Convention Bureau (1993); Scott (1976a, 1976c); Vahedi (1982); WCMC (1990).

Reasons for inclusion: 1a, 2a, 2b, 2c & 3c. Gori Gol is a good representative example of a natural wetland characteristic of the uplands of northwestern Iran. It is a breeding site for *Aythya nyroca* and *Oxyura leucocephala* (globally threatened species), and is the only known breeding site for *Podiceps grisegena* in Iran. It is an important breeding site for many other species of waterfowl, and regularly supports over 1% of the regional breeding population of

Podiceps nigricollis.
Source: Derek A. Scott.

Lake Uromiyeh (4)

Location: 37°30'N, 45°30'E; in a large internal drainage basin in western Azarbayjan Province, 60 km southwest of Tabriz.
Area: 483,000 ha.
Altitude: 1,280 m (Kabudan peak at 1,525 m).
Overview: A large, shallow, hypersaline lake with numerous islands and extensive fringing brackish to saline marshes, in a large internal drainage basin in the uplands of northwestern Iran. The lake is of great importance as a breeding area for many species of waterfowl, notably *Phoenicopterus ruber* and *Pelecanus onocrotalus*, and as a staging area for migratory species in spring and autumn. The lake is protected as a National Park and Ramsar Site.
Physical features: Lake Uromiyeh (Orumiyeh), formerly known as Lake Rezaiyeh, is a vast hypersaline lake of great scenic beauty with numerous small islands and extensive salt-encrusted flats and shingle beaches. The lake is about 140 km long (from northwest to southeast) and up to 55 km wide near its southern end. The average depth of the lake is about five metres, except in the southern portion where depths reach 8 m. The bottom consists of mud or silt, often covered by salt crystals. Salinities range from 80 to 280 p.p.t. and the water temperature from 3°C to 30°C; the salts present in the lake are very similar to those in sea water. Seasonal inflow is mostly from snow-melt. This causes the lake to rise in spring by 1-2 m, and reach its highest levels in the first half of June. Evaporation then lowers the level again throughout the summer and autumn. Water temperatures are at their highest in August. There are several large areas of fresh to brackish marshes with abundant aquatic vegetation in the "deltas" of the many small rivers and streams which flow into the lake. The most extensive of these marshes is found at the mouth of the Jogatu Chay (river) at the south end of the lake. The lake includes 56, mostly small, uninhabited islands. The largest island, Kabudan (Ghoyoon Daghi), comprises 3,125 ha of hilly terrain covered with steppe vegetation and scattered trees. The climate is semi-arid, with very hot summers and extremely cold winters (temperatures regularly falling below -25°C). The mean annual rainfall is in the range 400-600 mm.
Ecological features: The lake supports an abundant growth of the alga *Enteromorpha intestinalis* (Ulvaceae) and there is a build up of brine shrimp *Artemia salina* during the summer months. Savage (1968) has described secondary productivity in the lake ecosystem. In years when salt concentrations remain low, *Enteromorpha* becomes so abundant that the whole lake takes on the appearance of a thin vegetable soup. *Artemia* begins to appear in April, but does not build up in great strength until June; successive hatches maintain high numbers until September. The lake is too saline to support any other plants or animals. The shoreline vegetation is dominated by species of *Atriplex*, *Frankenia* and *Suaeda*. The marshes around the lake have typical saltmarsh plant communities with *Juncus*, some *Phragmites* reed-beds at river mouths, and occasional stands of *Tamarix*. Remnant stands of *Pistasia atlantica* woodland survive on the larger islands, notably Kabudan (Goyoon Daghi) and Ashk. Other conspicuous

plants on the larger islands include *Rhamnus pallasii* and species of *Artemisia*, *Dianthus*, *Cerasseus*, *Hodeum* and *Bromus*. There are rolling wheat-lands to the west and south of the lake, and semi-arid steppe and hills to the north and east. Much of the surrounding semi-arid steppe has been converted to wheat fields. There are small human settlements at various points on the shore.

Land tenure: Public (Government).

Conservation measures taken: Ghoyoon Daghi (Kabudan) Island was established as a Protected Region in February 1960. This was enlarged to encompass the entire lake and all its islands (483,000 ha) in August 1967. The Protected Region was reduced in size to 465,000 ha and given National Park status in the early 1970s. The National Park has since been reduced to its present size of 463,600 ha. The entire lake (483,000 ha) was designated as a Ramsar Site on 23 June 1975. 462,600 ha of the National Park were designated as a UNESCO (MAB) Biosphere Reserve in June 1976. The site has been identified as an "Important Bird Area" by BirdLife International (Evans, 1994).

Conservation measures proposed: Cornwallis (1976) recommended that the boundaries of the National Park be extended to the upper limit of the inundation zone of the lake. This would involve no conflict with agricultural interests, and would incorporate the Gordeh Git and Mamiyand marshes (site 6), the Talab-e-Garrous marshes, and Ghopi Bob Haydar (a small lake and freshwater marsh about 4 km southeast of Talab-e-Garrous) within the National Park.

Land use: Several small steamer services operate on the lake, ferrying people and supplies between five small ports, and there is some grazing by domestic livestock in peripheral marshes, but otherwise the entire area is protected as a National Park.

Possible changes in land use: None known.

Disturbances and threats: Freshwater discharge into the marshes at the south end of the lake was reduced in the early 1970s following the construction of a dam on the Mahabad River (as part of the Mahabad Multipurpose Drainage and Irrigation Project). However, this was partially compensated for by discharge from the irrigation scheme through two main drains emptying into one of the marshes (Talab-e-Garrous). These drains provide water to the marsh throughout the summer and have improved its value for nesting birds (Cornwallis, 1976). The most serious threat is likely to be water-borne pollution from towns in the catchment area, especially the large city of Tabriz to the northeast and the town of Uromiyeh to the west, and pollution with toxic chemicals used in the surrounding agricultural land.

Hydrological and biophysical values: No information.

Social and cultural values: The lake has little value for conventional outdoor recreation because of its extremely high salinity, but has exceptionally high values for eco-tourism because of its great scenic beauty and spectacular concentrations of waterbirds. Local people believe that the lake-side mud has special medicinal properties.

Noteworthy fauna: The lake is extremely important for breeding *Pelecanus onocrotalus* (1,000-1,600 pairs), *Egretta garzetta* (90 pairs), *Plegadis falcinellus* (100+ pairs), *Platalea leucorodia* (50-100 pairs), *Phoenicopterus ruber* (15,000-25,000 pairs), *Tadorna ferruginea* (300-500 pairs), *Tadorna tadorna* (4,000-5,000 pairs), *Himantopus himantopus* (300-500 pairs), *Recurvirostra avosetta* (1,500-2,000 pairs), *Tringa totanus* (2,000-3,000 pairs), *Larus (cachinnans) armenicus* (4,000-5,000 pairs) and *Larus genei* (3,000-4,000 pairs). Other breeding birds include several pairs of *Anser anser*, *Marmaronetta angustirostris* (maximum of 25 adults present in summer) and *Aythya nyroca*. *Charadrius leschenaultii* has been recorded

during the summer months and may breed on the saline flats around the lake. The pelicans, spoonbills, *Egretta garzetta* and many of the gulls breed on a group of small islands (the Dowguzlar Islands) near the south end of the lake, and flight to the extensive brackish and freshwater wetlands on the plain to the south of the lake to feed. Savage (1964) surveyed the lake in 1960 and found only about 100 non-breeding flamingos; he located some old nest-mounds, and speculated that flamingos had bred in the past. However, some 10,000 to 12,000 birds were found breeding in 1965 and 1966, and in 1970, there were an estimated 40,000 birds at the colony. Aerial censuses of the breeding colonies in 1971 and 1972 indicated 15,000-20,000 pairs in both years, with an additional 5,000-10,000 non-breeders present. Flamingos are known to have bred in large numbers at Lake Uromiyeh every year since then, and numbers appear to be increasing slightly, with perhaps as many as 25,000 breeding pairs in recent years. The birds have bred at many localities amongst the numerous islands in the lake, and in some years there are several large colonies. After hatching, the chicks gather together in large creches and swim to the south end of the lake to feed in the extensive shallows. Towards the end of the breeding season, the adults congregate in huge rafts to moult.

Most other species of waterfowl breed on the mudflats surrounding the lake or in the extensive fresh to brackish marshes at the main river mouths.

The vast mudflats surrounding the lake are the most important autumn staging area for migratory shorebirds and *Anas querquedula* in Iran, while the open waters of the lake occasionally support huge numbers of passage *Podiceps nigricollis*. Over 425,000 waterfowl of at least 53 species were recorded in the Uromiyeh Basin during an aerial survey on 29-31 August 1973. These included an estimated 146,000 unidentified small shorebirds (probably mostly *Calidris minuta* and *C. ferruginea*) on the mudflats around the lake, along with over 21,000 *A. querquedula* and 13,600 *Recurvirostra avosetta*. The lake appears to be an important moulting area for *Tadorna tadorna* (with up to 35,000 in August), and in mild winters may support large numbers of wintering waterfowl. Peak counts of waterfowl are given in Table 4.

The islands in Lake Uromiyeh are the only known breeding locality for *Falco biarmicus* in Iran (at least five pairs) and also provide nesting sites for at least ten pairs of *Neophron percnopterus*. *Falco cherrug* and *F. peregrinus* have been recorded during the summer months and may breed; *Gyps fulvus* and *Aegypius monachus* are regular visitors from the surrounding hills; and *Haliaeetus albicilla* and *Falco columbarius* occur in winter. The Great Bustard *Otis tarda* was a regular visitor to the plains around the lake in the 1970s, with up to 19 being recorded in August, but the birds were not known to breed in the area. At least 187 species of birds have been recorded in the National Park.

Wild Sheep (*Ovis ammon*) of the western red race were introduced onto Kabudan Island in the 19th century, while Mesopotamian Fallow Deer (*Dama dama mesopotamica*) were introduced onto Ashk Island in the late 1970s. The sheep population peaked at over 4,000 in 1971/72, but then crashed to only about 1,150 in 1973/74. Leopard (*Panthera pardus*) were introduced onto Kabudan in about 1970 in an attempt to control Wild Sheep numbers. Although the Leopard are known to have bred on the island, they are believed to have died out towards the end of the decade.

Noteworthy flora: Several of the islands, notably Ashk and Kabudan, support almost pristine stands of Azarbayjan Pistachio (*Pistacia atlantica*) forest. The few surviving stands of this forest type elsewhere in northwestern Iran are now much degraded.

Scientific research and facilities: The Department of the Environment has carried out a

considerable amount of research on the fauna of the lake and its islands, and especially on the introduced populations of *Ovis ammon* and *Dama dama mesopotamica*, and the breeding colony of *Phoenicopterus ruber*. A flamingo ringing programme was initiated in 1970, and by 1990, over 35,000 chicks had been ringed with metal rings bearing the inscription of the Department of the Environment. Pelican chicks have also been ringed on a regular basis since 1970, although in much smaller numbers, and some gulls were ringed in the late 1970s. Mid-winter waterfowl counts have been carried out on an annual basis since the early 1970s, and several aerial censuses of breeding waterfowl were conducted during the 1970s. Accommodation for research workers and basic laboratory facilities are available at the park headquarters on Kabudan Island.

Management authority and jurisdiction: Department of the Environment. The Ramsar Site is administered by the Department of the Environment.

References: Ashtiani-Zarandi (1990); Carp (1980); Cornwallis (1976); Division of Research and Development (1972); Evans (1994); Firouz (1974); Firouz & Ferguson (1970b); Firouz *et al.* (1970); Green (1993); Mansoori (1984); Ramsar Convention Bureau (1993); Savage (1964, 1968); Savage & Firouz (1968); Scott (1973b, 1975c, 1976a, 1976b, 1976c, 1993); Summers *et al.* (1987); Vahedi (1982); WCMC (1990).

Reasons for inclusion: 1a, 2a, 2b, 2c, 3a & 3c. Lake Uromiyeh is a magnificent example of a natural, hypersaline lake with great scenic beauty. It is a regular breeding site for *Marmaronetta angustirostris* and *Aythya nyroca* (globally threatened species), and supports a great diversity of wetland fauna and flora associated with brackish and saline to hypersaline conditions. It is particularly important for its large breeding colonies of *Pelecanus onocrotalus*, *Phoenicopterus ruber* and *Larus (cachinnans) armenicus*, but also supports over 1% of the regional breeding populations of seven other species of waterfowl. During the migration seasons and in winter, it regularly supports over 1% of the regional populations of an additional five species of waterfowl.

Source: Derek A. Scott.

Shur Gol, Yadegarlu and Dorgeh Sangi Lakes (5)

Location: Shur Gol 37°01'N, 45°28'E; Yadegarlu 37°02N, 45°32'E; Dorgeh Sangi 36°59'N, 45°34'E. On the plains to the south of Lake Uromiyeh, 7-10 km south of the southeast corner of the lake and about 30-35 km northwest of Mahabad, Azarbayjan.

Area: 2,500 ha (Shur Gol 2,000 ha; Yadegarlu 350 ha; Dorgeh Sangi 150 ha).

Altitude: 1,290 m.

Overview: A group of fresh to brackish and saline lakes and marshes on the plains to the south of Lake Uromiyeh in the uplands of northwestern Iran, important for breeding, passage and wintering waterfowl. The wetlands have been designated as a Ramsar Site, but are otherwise unprotected.

Physical features: Shur Gol and the associated Hassanlu Marshes consist of a shallow, brackish to saline lake and marshland fed by local rainfall, springs, seepages and several small streams. The maximum depth of the lake is about one metre. Flooding occurs in autumn and

winter, but drainage is virtually closed and the complex dries out completely only in very dry years. The much smaller Yadegarlu and Dorgeh Sangi wetlands a few km to the east and southeast are shallow freshwater lakes with peripheral eutrophic marshes. Both are subject to wide fluctuations in water level, and are often completely frozen over in winter.

Ecological features: The extensive marshes at Shur Gol and Yadegarlu are dominated by sedges (*Carex*) and grasses. There is relatively little aquatic vegetation at Dorgeh Sangi, where extensive bare mudflats are exposed at low water levels. The surrounding land includes wheat fields on the rolling hills and plains to the north, and more intensive agriculture in the vicinity of the villages to the south.

Land tenure: Public (Government).

Conservation measures taken: There is no legal habitat protection, but the Department of the Environment exerts some control over hunting activities in the area. All three wetlands were designated as a single Ramsar Site of 2,500 ha on 23 June 1975. The wetlands have been identified as an "Important Bird Area" by BirdLife International (Evans, 1994).

Conservation measures proposed: Cornwallis (1976) recommended that Wildlife Refuges be established at Yadegarlu and Dorgeh Sangi lakes.

Land use: Waterfowl hunting, grazing of lakeshore vegetation by domestic livestock, and some traditional reed-cutting.

Possible changes in land use: Possible conversion of marshes for agriculture.

Disturbances and threats: Hunting pressure on waterfowl is reported to have been excessive, especially in the years immediately following the revolution, and grazing pressure on the aquatic vegetation is very high. There have been reports of wetland drainage for agriculture at Yadegarlu. However, all three wetlands were reported to be in good condition in January 1995.

Hydrological and biophysical values: No information.

Social and cultural values: No information.

Noteworthy fauna: The wetlands are especially important for breeding waterfowl, notably *Ciconia ciconia*, *Plegadis falcinellus* (50-75 pairs), *Marmaronetta angustirostris* (10-15 pairs), *Aythya nyroca* (several pairs), *Oxyura leucocephala* (several pairs) and *Glareola pratincola* (50-80 pairs), and passage ducks, *Fulica atra* (up to 120,000) and shorebirds. When not frozen over, the lakes also support large numbers of wintering waterfowl, mainly dabbling ducks and *F. atra*. A small flock of *Cygnus columbianus* (maximum 57) occurred regularly at these lakes in the early 1970s, and this was the only regular wintering site for *C. columbianus* in Iran at that time, with 41 in 1969/70, 57 in 1970/71, 4 in 1971/72 and 14 in 1974/75. A few *C. columbianus* were present in a flock of 30 swans (mainly *C. cygnus*) in January 1995. Small flocks of *Anser erythropus* (maximum 175) were recorded on autumn passage in the 1970s, and up to 120 *Anser albifrons* were present in winter, along with several hundred *Anser anser*. *Ciconia nigra* and *Charadrius asiaticus* have occurred as scarce passage migrants. Peak counts of some waterfowl are given in Table 5. The Great Bustard *Otis tarda* was an occasional visitor to the surrounding plains in the 1970s (maximum 6). *Haliaeetus albicilla* is a regular winter visitor, with up to three birds present at one time.

Noteworthy flora: No information.

Scientific research and facilities: Mid-winter waterfowl censuses have been carried out by personnel of the Department of the Environment in most years since 1970, and there have been several surveys during the breeding season.

Management authority and jurisdiction: The Ramsar Site is administered by the Department

of the Environment.
References: Carp (1980); Cornwallis (1976); Division of Research and Development (1972); Evans (1994); Green (1993); Mansoori (1984); Ramsar Convention Bureau (1993); Scott (1976a, 1976c); Vahedi (1982); WCMC (1990).
Reasons for inclusion: 2a, 2b, 3a & 3c. Shur Gol, Yadegarlu and Dorgeh Sangi lakes provide habitat for at least five threatened species of birds: *Marmaronetta angustirostris*, *Aythya nyroca* and *Oxyura leucocephala* breed in the wetlands, and *Anser erythropus* and *Otis tarda* occur on passage. The wetlands support a high diversity of wetland fauna and flora, and constitute important feeding habitat for *Pelecanus onocrotalus* and other species from the internationally important breeding colonies at nearby Lake Uromiyeh. The wetlands regularly hold more than 20,000 waterfowl during the migration seasons and in winter, as well as over 1% of the regional populations of eight species of waterfowl.
Source: Derek A. Scott.

Gerde Gheet and Mamiyand (6)

Location: 37°02'N, 45°40'E; on the plains to the south of Lake Uromiyeh, 10 km from the south end of the lake and about 30 km north of Mahabad, Azarbayjan.
Area: 500 ha.
Altitude: 1,300 m.
Overview: An area of freshwater marshes on the plains to the south of Lake Uromiyeh in the uplands of northwestern Iran, important for breeding and wintering waterfowl. Unprotected.
Physical features: The wetland comprises two adjacent areas of freshwater marsh, Gerde Gheet and Mamiyand (Gordeh Git and Meimand), on the plains to the south of Lake Uromiyeh.
Ecological features: Most of the wetland is covered in tall stands of *Phragmites* reeds.
Land tenure: Public (Government).
Conservation measures taken: The Department of the Environment controls hunting activities in the area. The site has been identified as an "Important Bird Area" by BirdLife International (Evans, 1994).
Conservation measures proposed: Cornwallis (1976) recommended that the boundaries of the Lake Uromiyeh National Park be extended to the upper limit of the inundation zone of the lake. This would bring the Gerde Gheet and Mamiyand marshes within the boundaries of the National Park.
Land use: There is some waterfowl hunting in winter, and some grazing of aquatic vegetation by domestic livestock.
Possible changes in land use: No information.
Disturbances and threats: No information.
Hydrological and biophysical values: No information.
Social and cultural values: No information.
Noteworthy fauna: A breeding area for *Ardea purpurea* (several pairs), *Ciconia ciconia*, *Circus aeruginosus* (several pairs) and *Glareola pratincola* (50+ pairs). One or two pairs of *Oxyura leucocephala* were breeding in the marshes in the 1970s, and *Marmaronetta*

angustirostris and *Gelochelidon nilotica* probably bred. Up to 20 Great Bustards *Otis tarda* have occurred on the surrounding plains in winter. Large numbers of wintering waterfowl have been recorded in recent years, including large numbers of *Anser anser*, up to 2,500 *Tadorna ferruginea* and 3,000 *T. tadorna*.

Noteworthy flora: No information.

Scientific research and facilities: Mid-winter waterfowl censuses have been carried out by personnel of the Department of the Environment in most years since 1970, and there have been several surveys during the breeding season.

Management authority and jurisdiction: No information.

References: Cornwallis (1976); Evans (1994); Scott (1976a).

Reasons for inclusion: 2a & 3c. Gerde Gheet and Mamiyand support a small breeding population of *Oxyura leucocephala* (a threatened species) and probably also *Marmaronetta angustirostris*. In winter, the wetlands regularly support over 1% of the regional populations of *Tadorna ferruginea* and *T. tadorna*.

Source: Derek A. Scott.

Ghara Gheshlaq Marshes (7)

Location: 37°10'N, 45°50'E, on the plains to the south of Lake Uromiyeh, 12 km from the south end of the lake and about 20 km north of Mahabad, Azarbayjan.

Area: 400 ha.

Altitude: 1,290 m.

Overview: An area of freshwater marshes on the plains to the south of Lake Uromiyeh in the uplands of northwestern Iran, important for breeding, passage and wintering waterfowl. The marshes have been designated as a No-hunting Area.

Physical features: Ghara Gheshlaq Marshes comprise some 400 ha of permanent and seasonally flooded freshwater marshes on the plains to the south of Lake Uromiyeh. The marshes are flooded to a maximum depth of about one metre, and are eutrophic. They are usually frozen over and under snow cover during the winter months. Peripheral areas of the wetland have been drained and converted to agricultural land.

Ecological features: Permanent freshwater marshes with extensive *Phragmites* reed-beds and little open water, surrounded by a belt of seasonally flooded sedge marshes and grassland.

Land tenure: Public (Government).

Conservation measures taken: The marshes have recently been designated as a No-Hunting Area, and are likely to be given Protected Area status within five years. The site has been identified as an "Important Bird Area" by BirdLife International (Evans, 1994).

Conservation measures proposed: The Department of the Environment has proposed that Ghara Gheshlaq Marshes be designated as a Ramsar Site.

Land use: Livestock grazing in the wetland, and agriculture in surrounding areas. There is a great deal of waterfowl hunting around the edges of the No-Hunting Area.

Possible changes in land use: Conversion of wetlands to agricultural land.

Disturbances and threats: Large portions of the marsh were drained by the Mahabad

Multipurpose Drainage and Irrigation Project in the 1970s. Since the early 1980s, large-scale die-offs of waterfowl have been reported on several occasions during the breeding and migration seasons. As many as 100,000 waterfowl are believed to have died in a single year. The reason for the die-offs is unknown, but disease (possibly botulism) has been suspected.

Hydrological and biophysical values: No information.

Social and cultural values: No information.

Noteworthy fauna: The marshes are especially important for breeding waterfowl, including *Podiceps cristatus* (10-15 pairs), *Nycticorax nycticorax* (25 pairs), *Egretta garzetta* (25 pairs), *Plegadis falcinellus* (60 pairs), *Marmaronetta angustirostris* (10-20 pairs), *Glareola pratincola* (25 pairs) and *Vanellus vanellus* (common). *Oxyura leucocephala* and *Himantopus himantopus* have been recorded in summer, and may breed. Small flocks of *Pelecanus onocrotalus* and *Platalea leucorodia* from the nearby breeding colonies at Lake Uromiyeh regularly feed in the marshes during the summer months. The marshes occasionally hold large numbers of ducks and shorebirds during the migration seasons (*e.g.* up to 10,000 *Anas acuta*, 150 *A. querquedula*, 300 *Philomachus pugnax* and 100 *Tringa glareola*). In most winters, the wetland is frozen over and devoid of birds, but in mild years it may support large numbers of geese and ducks, *e.g.* up to 3,280 *Anser anser*, 280 *Tadorna ferruginea*, 15,000 *T. tadorna*, 500 *Anas platyrhynchos* and 2,700 *Aythya fuligula*. *Anser albifrons* and *A. erythropus* have occurred in small numbers. About 600 swans, mostly *Cygnus cygnus* but also including some *C. olor* and a few *C. columbianus*, were present in the winter of 1991/92. *Circus pygargus* (a scarce bird in Iran) was observed regularly during the summer months in the 1970s, and was believed to breed. *Pandion haliaetus*, *Circus cyaneus* and *C. macrourus* have been recorded on passage, and *C. aeruginosus* probably breeds. In recent years, the Great Bustard *Otis tarda* has occurred as a winter visitor to the area, with 24 in 1993 and 26 in 1994.

Noteworthy flora: No information.

Scientific research and facilities: Mid-winter waterfowl censuses have been carried out by personnel of the Department of the Environment in most years since 1970, and there have been several surveys during the breeding season.

Management authority and jurisdiction: No information.

References: Cornwallis (1976); Evans (1994); Green (1993); Scott (1976a, 1976c); Scott & Smart (1992).

Reasons for inclusion: 2a & 3c. Ghara Gheshlaq Marshes support a significant breeding population of *Marmaronetta angustirostris* (a threatened species). During the migration seasons and in winter, the wetlands regularly support over 1% of the regional populations of *Anser anser*, *Tadorna tadorna*, *Anas acuta* and *Aythya fuligula*.

Source: Derek A. Scott.

Lake Kobi (8)

Location: 36°57'N, 45°30'E; on the plains to the south of Lake Uromiyeh, 30 km from the south end of the lake and about 25 km northeast of Mahabad, Azarbayjan. (The longitude of this lake have often been given erroneously as 45°52'E, *e.g.* in all Ramsar documentation).

Area: 1,200 ha.
Altitude: 1,290 m.
Overview: A fresh to brackish lake and associated marshes on the plains to the south of Lake Uromiyeh in the uplands of northwestern Iran, important for breeding, passage and wintering waterfowl. The lake has been designated as a Ramsar Site, but is otherwise unprotected.
Physical features: Lake Kobi (or Ghopi Bob Ali) is a shallow, eutrophic, fresh to brackish lake with extensive seasonally flooded marshes, receiving its water from local rainfall, several springs, seepages and temporary watercourses fed by snow-melt. The maximum depth is about 1.5 m; the bottom is comprised of mud. The lake overflows when full, flooding marshland to the north and west. It regularly freezes over in winter.
Ecological features: The lake supports an abundant growth of submerged vegetation; there are extensive sedge marshes around much of the shoreline, and *Phragmites* reed-beds occur in the south and to the northwest, together with some grassland. The whole area is surrounded by rolling steppic hills, with scattered settlements and cultivation to the north and south.
Land tenure: Public (Government).
Conservation measures taken: No legal protection. Lake Kobi (1,200 ha) was designated as a Ramsar Site on 23 June 1975. The lake has been identified as an "Important Bird Area" by BirdLife International (Evans, 1994).
Conservation measures proposed: None known.
Land use: Grazing of livestock and wildfowl hunting.
Possible changes in land use: None known.
Disturbances and threats: None known.
Hydrological and biophysical values: No information.
Social and cultural values: No information.
Noteworthy fauna: The marshes support a variety of breeding waterfowl, notably *Nycticorax nycticorax* (100 pairs), *Ardeola ralloides* (100 pairs), *Egretta garzetta* (100 pairs), *Plegadis falcinellus* (100-150 pairs) and *Aythya nyroca* (several pairs), and there was a breeding colony of 50 pairs of *Podiceps nigricollis* at the lake in 1972. *Sterna albifrons* is present in summer and may breed. *Oxyura leucocephala* occurs during the summer (maximum 33), but these birds appear to be non-breeders or feeding birds from breeding sites at other wetlands in the general area. The lake is an extremely important staging area for ducks, *Fulica atra* and shorebirds in autumn, regularly holding in excess of 100,000 birds. Peak counts have included 6,600 *Phoenicopterus ruber*, 3,000 *Anas querquedula*, 5,000 *A. clypeata*, 20,000 *Aythya ferina* and 50,000 *F. atra*, as well as over 100 *O. leucocephala*. Large numbers of ducks and coots remain throughout the winter in very mild years when the lake remains unfrozen. A flock of 16 *Branta ruficollis* in January 1970 was exceptional, as was a single *Grus virgo* in August 1972. Small numbers of *Marmaronetta angustirostris* and *Charadrius asiaticus* have been recorded on autumn passage. Peak counts of some waterfowl are given in Table 6. *Haliaeetus albicilla* and *Falco columbarius* are regular winter visitors, and *Circus pygargus* has been recorded in summer and may breed. The Great Bustard *Otis tarda* is an occasional visitor in small numbers to the surrounding plains (maximum 6).
Noteworthy flora: No information.
Scientific research and facilities: Mid-winter waterfowl censuses have been carried out by personnel of the Department of the Environment in most years since 1970, and there have been several surveys during the breeding season.

Management authority and jurisdiction: The Ramsar Site is administered by the Department of the Environment.
References: Anstey (1989); Carp (1980); Cornwallis (1976); Evans (1994); Mansoori (1984); Ramsar Convention Bureau (1993); Scott (1976a, 1976c, 1978a); Vahedi (1982); WCMC (1990).
Reasons for inclusion: 1a, 2a, 3a & 3c. Lake Kobi is a particularly good representative example of a natural brackish lake characteristic of the uplands of northwestern Iran. It supports significant numbers of two globally threatened species, *Aythya nyroca* and *Oxyura leucocephala*, during the summer and autumn, and *Marmaronetta angustirostris* has occurred on passage. *Otis tarda* is a regular visitor to the surrounding plains. The lake often holds over 20,000 waterfowl during the migration seasons and in winter, and regularly supports over 1% of the regional populations of *Phoenicopterus ruber*, *Anser anser*, *Tadorna ferruginea*, *T. tadorna*, *Anas clypeata*, *Aythya ferina*, *Fulica atra* and *Himantopus himantopus*.
Source: Derek A. Scott.

Nowruzlu Dam (9)

Location: 36°55'N, 46°10'E; in the valley of the Zarrineh Rud, 15 km southeast of Miandoab and about 45 km east-northeast of Mahabad, Azarbayjan.
Area: 1,000 ha.
Altitude: 1,260 m.
Overview: A small reservoir with adjacent arable land along the Zarrineh Rud to the southeast of Lake Uromiyeh in the uplands of northwestern Iran, important as a feeding area for *Pelecanus onocrotalus* in summer, and as a wintering area for ducks and geese (Anatidae). Unprotected.
Physical features: Nowruzlu Dam is a small water storage reservoir on the Zarrineh Rud, one of the principal rivers flowing into Lake Uromiyeh; it is situated in a region of undulating plains set between ranges of stony hills. There is a small marshy area with some reed-beds and shrubby vegetation where the river enters the dam. The plain is fairly heavily populated, with several villages and a complex network of gravel and dirt roads.
Ecological features: The dam supports little emergent aquatic vegetation except for a small stand of *Phragmites* at the mouth of the river. The adjacent plains are under cultivation (primarily wheat); nearby rolling hills support *Artemisia* steppe.
Land tenure: No information.
Conservation measures taken: None. The site has been identified as an "Important Bird Area" by BirdLife International (Evans, 1994).
Conservation measures proposed: None known.
Land use: Water supply for irrigation. There is some waterfowl hunting in autumn and winter. The principal land-use activity throughout the region is wheat cultivation. Livestock (mainly sheep and goats) graze on fallow land and the adjacent steppic hills.
Possible changes in land use: None known.
Disturbances and threats: There are high levels of disturbance from farming activities on the

surrounding plains.
Hydrological and biophysical values: No information.
Social and cultural values: No information.
Noteworthy fauna: The dam is an important feeding area for *Pelecanus onocrotalus* (maximum 830) and *Platalea leucorodia* (maximum 64) from the breeding colonies at Lake Uromiyeh, and there is a small breeding colony of *Nycticorax nycticorax* (20 pairs). Flocks of *Anser albifrons* (maximum 156) and *A. anser* (maximum 415) frequent the area in winter, and small numbers of ducks occur on the dam when ice-free (*e.g.* up to 310 *Aythya ferina*, 55 *Mergellus albellus* and 5 *Mergus merganser*). Much larger numbers of waterfowl are present during the spring and autumn migration seasons. Peak counts have included 100 *Phalacrocorax carbo*, 35 *Ardeola ralloides*, 25 *Ardea cinerea*, 150 *Plegadis falcinellus*, 650 *Tadorna ferruginea*, 1,880 *Anas crecca*, 1,060 *A. platyrhynchos*, 5,000 *A. querquedula*, 1,790 *Fulica atra*, 46 *Haematopus ostralegus*, 50 *Himantopus himantopus*, 50 *Recurvirostra avosetta*, 300 *Calidris minuta*, 250 *Philomachus pugnax*, 50 *Tringa stagnatilis* and 200 *Chlidonias leucopterus*. *Haliaeetus albicilla* and *Falco cherrug* have been recorded in winter. The surrounding plains are reported to have been an important breeding area for Great Bustards *Otis tarda* in the 1960s, and there were still several females nesting there in the 1970s. The plains are regularly visited by flocks of *O. tarda* in spring and autumn, with a maximum of 37 in November 1972.
Noteworthy flora: No information.
Scientific research and facilities: Mid-winter waterfowl censuses have been carried out by personnel of the Department of the Environment in most years since 1971, and there have been several surveys during the breeding season.
Management authority and jurisdiction: No information.
References: Evans (1994); Fotoohi & Scott (1975); Scott (1976a).
Reasons for inclusion: 3c. Nowruzlu Dam is an important feeding area for flocks of *Pelecanus onocrotalus* from the large breeding colony at Lake Uromiyeh, regularly holding over 1% of the regional population. The wetland also occasionally supports over 1% of the regional wintering population of *Anser albifrons*.
Source: Derek A. Scott.

South Caspian Shore (10)

Location: From 38°25'N, 48°52'E at Astara in the west to 37°21'N, 53°57'E at the Turkmenistan border in the east; the southern limit lies at 36°35'N. The shore and inshore waters of the Caspian Sea from Astara on the border with the Republic of Azerbaijan in the west to the border with the Republic of Turkmenistan, about 35 km north-northwest of Gomishan, in the east. In the provinces of Gilan and Mazandaran.
Area: 650 km of shoreline.
Altitude: 26 m below sea level.
Overview: The sandy beaches and inshore waters of the Caspian Sea in Iran, from the border with Azerbaijan in the west to the border with Turkmenistan in the east; of outstanding

importance for fisheries production and as a staging and wintering area for huge numbers of migratory waterfowl. Short sections of the beach are included within two Protected Areas in the southwest Caspian, and a 60 km stretch of beach is included in the Miankaleh Wildlife Refuge in the southeast

Physical features: The site comprises the entire shoreline (some 650 km) and inshore waters of the Caspian Sea in Iran. The present coastline of the South Caspian, produced as it was by shrinkage of the water surface, appears generally straight or only slightly curved, and without any prominent headlands or cliffs. It is characterized by a sequence of sand beaches, dunes, spits and bars, bordered by a series of low-lying brackish and freshwater lagoons and marshes. The shore itself is almost entirely a narrow, hard, sand beach, except in the extreme west where there are stretches of shingle, and at one point to the west of Alamdeh (central coast) where there is a small area of rocky shore. Along most of is length, the shore is backed by a line of sand dunes from 10-20 m high and at varying distances from the water's edge, but no more than about 600 m wide. The salinity of the Caspian Sea is about 12-13 p.p.t.

Between 1866 and 1933, the level of the Caspian Sea fluctuated between 25.2 and 26.0 metres below sea level. In the early 1930s, however, following the construction of several major dams on the Volga River in the former U.S.S.R., the level started to fall and this continued almost without break (other than seasonal fluctuations) until 1977/78, when the level had reached 28 metres below sea level. Then began a sudden and rapid rise, averaging over 10 cm per year. By the end of 1991, the water had risen by approximately 1.8 metres, bringing the level of the Caspian Sea almost back to its level in the 1930s. In the mid-1970s, when the Caspian Sea was at its lowest, the beach was generally 30-50 metres wide and in some areas up to 100 metres wide, but by 1992, most of the beach had been submerged and in many places the sea was invading the adjacent vegetated dunes. The changes in sea level prior to 1970 have been summarized by Ferguson (1972).

There remains considerable uncertainty as to the cause of this sudden rise in sea level. It has been argued that the rise has been deliberately engineered by the Government of the former U.S.S.R., in an effort to restore the sea to its original level. Two major engineering works could have contributed to the rise in sea level: the closing of Karabogaz Bay in the east Caspian in 1978 (thereby reducing the loss of water by evaporation), and the diversion of two Siberian rivers into the Ural River (thereby increasing the inflow of fresh water). According to some calculations, the closing of Karabogaz Bay could alone have been responsible for a rise in sea level of between 40 and 45 cm. However, there is also a strong body of opinion in favour of the view that the rise in sea level is a natural phenomenon and merely part of a long-term cycle.

The climate throughout the South Caspian lowlands is characterized by warm, humid summers and mild winters, with a relatively low annual range in temperature. The average annual rainfall is 1,950 mm, with rain falling throughout the year but mainly in winter. Relative humidity averages 80-85%, with highest readings during spring and autumn. The lowest temperatures occur in February (mean around 6°C) and the highest in August (mean maximum nearly 25°C); extremes are -11°C and 30°C. Hard frosts and snow are relatively infrequent, especially in the southeast Caspian.

Ecological features: Shallow inshore waters of the Caspian Sea, long sandy beaches, some stretches of shingle beach (mainly in the west), and a small area of rocky shoreline (in the centre). The lower beach is generally devoid of macrophytes. Characteristic vegetation of the non-mobile sands of the spray zone include *Agriophyllum latifolium*, *Crepis foetida*,

Convolvulus persicus, Tournefortia arguzia, Daucus littoralis and *Salsola kali*.
Land tenure: Public (Government).
Conservation measures taken: Short sections of Caspian beach are included within the Lavandavil Protected Area (see site 11) and Lisar Protected Area in Gilan, and about 60 km of beach are included within the Miankaleh Wildlife Refuge in Mazandaran (see site 20). The entire South Caspian shoreline has been identified as an "Important Bird Area" by BirdLife International (Evans, 1994).
Conservation measures proposed: None known.
Land use: Fishing, both from large and small vessels in inshore waters, and from long seine nets operated from the beach. The long sandy beaches of the South Caspian are very popular for outdoor recreation during the warm summer months, especially in the vicinity of the larger towns such as Astara, Bandar Anzali, Ramsar, Chalus, Babolsar and Sari. Many private villas have been constructed in the coastal dunes, and there are a number of public parking areas and picnic grounds adjacent to the beach.
Possible changes in land use: None known.
Disturbances and threats: The falling level of the Caspian Sea in the 1960s and 1970s was becoming a cause of concern to fishing and shipping interests, as important fish spawning areas in coastal wetlands were drying out, and much of the very shallow northern Caspian was becoming too shallow for shipping. Thus the recent rapid rise in sea level has been welcomed. Significant changes have occurred at coastal wetlands in the South Caspian, including three Ramsar Sites (the Miankaleh/Gorgan Bay complex, the Anzali Mordab complex and the Bandar Kiashahr/Sefid Rud complex), but on the whole, the rise in sea level has probably had more positive than negative effects. There seems widespread agreement that the "optimum" level for the Caspian Sea is about 26 metres below sea level, *i.e.* a little higher than its present level. Fisheries departments and the shipping industry are undoubtedly benefitting from the higher level, and few of the towns, ports and coastal installations around the Caspian have been adversely affected, since most were established in the early part of the century when the sea level was still high. The major losses, in economic terms, have been in beach development and tourism, especially in Iran, where the rising sea level has almost obliterated the former extensive sandy beaches, and has caused considerable damage to beach houses, hotels and other recreation facilities.
Hydrological and biophysical values: No information.
Social and cultural values: The inshore waters of the Caspian Sea support a major fishery, while the beach is an important recreation area for Iranian holiday-makers during the summer months.
Noteworthy fauna: Important for a wide variety of migratory waterfowl, notably wintering grebes, cormorants, diving ducks and gulls, and passage terns. *Pelecanus crispus* occasionally feeds in inshore waters, especially off the Mazandaran coast in the east, where up to 83 have been recorded in January. The sea is used extensively as a day roost for wintering surface-feeding ducks which feed at night on freshwater marshes and rice fields on the coastal plain. Large numbers of shorebirds stop over briefly along the beach during the spring and autumn migration seasons, but rather few remain throughout the winter. Peak counts of some waterfowl during mid-winter and the migration seasons are given in Table 7. Other species occurring in much smaller numbers include *Gavia arctica* (maximum 2), *G. stellata* (maximum 2), *Podiceps grisegena, Pelecanus onocrotalus* (maximum 6), *Cygnus cygnus* (maximum 8), *C. columbianus*

(maximum 2), *Aythya nyroca* (maximum 8), *Mergus serrator* (maximum 9) and *M. merganser* (maximum 3). There have also been records of single *Marmaronetta angustirostris* and *Oxyura leucocephala*. (The most important stretches of shoreline for waterfowl, *i.e.* along Miankaleh Peninsula and along the coast north of Gomishan, are described separately as parts of sites 20 and 21). *Haliaeetus albicilla* remains fairly common throughout the South Caspian Region, especially in winter, and frequently scavenges along the shore or fishes in inshore waters. *Falco peregrinus* is also a relatively common winter visitor and passage migrant, frequently hunting along the shoreline. *Melanitta nigra* and *Clangula hyemalis* have occurred as vagrants. Caspian Seals (*Phoca caspica*) are occasional offshore.

Noteworthy flora: None known.

Scientific research and facilities: A Joint Committee was formed in the late 1980s by the governments of Iran and the former U.S.S.R. to discuss the problems caused by the sudden rise in level of the Caspian Sea. The focal point for this committee in Iran is the Ministry of Power (formerly Ministry of Water and Electricity), although several other ministries and the Department of the Environment are involved. The rise in sea level is being carefully monitored by researchers in Iran and the four republics of the former U.S.S.R. bordering on the Caspian Sea, and considerable attention is being given to the obvious economic aspects of the sea level rise. A considerable amount of limnological and fisheries research has been carried out by the National Fisheries Organization (Shilot). Annual mid-winter waterfowl censuses have been carried out by the Ornithology Unit, Department of the Environment, since 1967. Many ornithological surveys have been undertaken at other times of the year, including comprehensive waterfowl censuses in mid-November in 1972, 1973 and 1974.

Management authority and jurisdiction: No information.

References: Evans (1994); Ferguson (1972); Scott (1976a, 1976c); Scott & Smart (1992).

Reasons for inclusion: 1a, 1c, 2a, 2b, 2c, 2d, 3a & 3c. The shoreline and inshore waters of the Caspian Sea in Iran constitute a significant portion of a unique wetland ecosystem (the world's largest lake), shared between Iran and several of the new republics of the C.I.S. As such, they are of outstanding limnological, biological and ecological importance. The Iranian sector provides habitat for *Pelecanus crispus*, a globally threatened species, and regularly holds well in excess of 20,000 waterfowl in winter and during the migration seasons. At least 12 species of waterfowl occur in internationally significant numbers in winter, and two others (*Calidris alba* and *Sterna albifrons*) do so during the migration seasons.

Source: Derek A. Scott.

Lavandavil Marsh (11)

Location: 38°20'N, 48°50'E; on the shore of the Caspian Sea about 10 km south of Astara, Gilan.

Area: Area of wetland unknown; within a Protected Area of 949 ha.

Altitude: 24 m below sea level.

Overview: A small area of swampy woodland and freshwater marsh adjacent to the shore of the southwest Caspian, of considerable botanical interest and of some importance for passage

and wintering waterfowl including *Phalacrocorax pygmaeus*. The wetland is included in the Lavandavil Protected Area.

Physical features: Lavandavil Marsh is a small area of swampy woodland and freshwater marsh adjacent to the Caspian beach, about 10 km south of Astara. The narrow coastal plain in this region consists of a series of old beach ridges, with alder woodland and scrub growing on the high ground and permanent pools with emergent marsh vegetation in the depressions. The site is bordered to the east by the Caspian Sea and to the west by the main coast road from Astara to Bandar Anzali.

Ecological features: Swampy woodland dominated by *Alnus*, freshwater marshes with extensive stands of *Juncus*, and typical strand vegetation along the Caspian beach.

Land tenure: Public (Government).

Conservation measures taken: The wetland is included within the Lavandavil Protected Area (949 ha), originally designated as the Astara Wildlife Refuge in about 1975. The entire Protected Area has been identified as an "Important Bird Area" by BirdLife International (Evans, 1994).

Conservation measures proposed: None known.

Land use: None, other than nature protection.

Possible changes in land use: None known.

Disturbances and threats: Some changes have occurred to the wetlands as a result of the rise in Caspian sea level, but details are lacking.

Hydrological and biophysical values: No information.

Social and cultural values: No information.

Noteworthy fauna: The wetland supports small numbers of waterfowl in winter, including up to 70 *Cygnus olor*, 14 *C. cygnus*, 360 *Anas strepera*, 445 *A. clypeata*, 30 *Larus ichthyaetus* and 50 *L. minutus*, while the adjacent beach occasionally holds substantial numbers of shorebirds for short periods during the migration seasons, *e.g.* 180 *Calidris alba* and 100 *C. minuta*. *Phalacrocorax pygmaeus* is a regular winter visitor; there are generally 15-50 birds in the area, but a maximum of 146 has been recorded. Situated on the west coast of the Caspian, at a point where the coastal plain is almost at its narrowest, the site lies in a bird migration "corridor", and is thus an excellent locality for observing bird migration. Large numbers of herons and egrets have been observed migrating south over the site and adjacent Caspian Sea in autumn (including 360 *Ardeola ralloides*, 170 *Egretta garzetta*, 340 *Ardea cinerea* and 520 *Ardea purpurea* in a single day in September 1973). Other migrants have included up to 200 *Phalacrocorax carbo*, 63 *Plegadis falcinellus*, 4 *Porzana porzana* and 8 *Chlidonias niger*. A pair of *Haliaeetus albicilla* bred in the area in the 1970s, and may still do so. *Aquila heliaca*, *Falco peregrinus* and *Asio flammeus* are regular winter visitors in small numbers, and *Panurus biarmicus* has occurred (a party of 6 in October 1970). At least 167 species of birds have been recorded in the reserve.

Noteworthy flora: The reserve contains excellent stands of *Alnus* woodland which has become rare in the South Caspian lowlands outside Protected Areas.

Scientific research and facilities: Mid-winter waterfowl censuses have been carried out by the Ornithology Unit, Department of the Environment, in most years since about 1975, and the area has been surveyed by ornithologists during the breeding and migration seasons.

Management authority and jurisdiction: Department of the Environment.

References: Evans (1994); Scott (1976a).

Reasons for inclusion: 1d, 2a & 2b. Lavandavil Marsh is a good example of a natural wetland ecosystem (swampy *Alnus* woodland and freshwater marsh) characteristic of the South Caspian lowlands, but now becoming rare outside protected areas. The wetland provides wintering habitat for *Phalacrocorax pygmaeus* (a globally threatened species), and plays an important role in maintaining faunal and floral diversity in the region.
Source: Derek A. Scott.

Abbas-abad Dam (12)

Location: 38°23'N, 48°50'E; on the coastal plain of the Caspian Sea, about 7 km south of Astara, Gilan.
Area: 45 ha.
Altitude: 20 m below sea level.
Overview: A small reservoir with adjacent seasonally flooded woodland in the southwest Caspian lowlands, important primarily for its large breeding colonies of *Phalacrocorax carbo* and Ardeidae. Unprotected.
Physical features: Abbas-abad Dam is a small water storage reservoir used for irrigation purposes in an area of deciduous woodland on the narrow coastal plain of the Caspian Sea, about 7 km south of Astara. The dam lies at the foot of the forested coastal ranges, to the west of the main highway from Astara to Bandar Anzali. At maximum flooding in late winter and spring, parts of the surrounding woodland are flooded, while at low water level in late summer, some mudflats are exposed.
Ecological features: A small artificial lake with some emergent marsh vegetation and an adjacent area of swampy woodland. There are many tall dead trees in the lake.
Land tenure: No information.
Conservation measures taken: None. The dam has been identified as an "Important Bird Area" by BirdLife International (Evans, 1994).
Conservation measures proposed: None known.
Land use: The dam is used as a source of water for irrigation during the dry summer months, and there is some waterfowl hunting in autumn and winter.
Possible changes in land use: None known.
Disturbances and threats: Much of the surrounding forest has been cleared for pastureland and cultivation (mainly fruit and vegetables).
Hydrological and biophysical values: No information.
Social and cultural values: No information.
Noteworthy fauna: The swampy woodland and dead trees in the lake support a large breeding colony of *Phalacrocorax carbo* (1,200-1,500 pairs), along with about 70 pairs of *Nycticorax nycticorax*, 50 pairs of *Ardeola ralloides*, 10 pairs of *Bubulcus ibis* and 40 pairs of *Egretta garzetta*. *Phalacrocorax pygmaeus* is a regular winter visitor in very small numbers (maximum 3), and there are usually a few duck present (*e.g.* up to 20 *Netta rufina*). *Scolopax rusticola* is a common winter visitor in the surrounding swampy woodland, and up to 100 *Chlidonias hybridus* occur on passage in autumn. A pair of *Haliaeetus albicilla* breeds in the area, and

Falco cherrug and *F. peregrinus* have been recorded in winter.
Noteworthy flora: No information.
Scientific research and facilities: Annual mid-winter waterfowl censuses have been carried out by the Ornithology Unit, Department of the Environment, since 1969, and the area has been surveyed by ornithologists on a number of occasions during the breeding and migration seasons. Some ringing of cormorants, herons and egrets was carried out in the late 1970s.
Management authority and jurisdiction: No information.
References: Evans (1994); Scott (1976a, 1978a).
Reasons for inclusion: 2a, 2c & 3c. Abbas-abad Dam provides wintering habitat for *Phalacrocorax pygmaeus* (a globally threatened species); in summer, it supports important breeding colonies of cormorants, herons and egrets, including over 1% of the regional breeding population of *Phalacrocorax carbo*.
Source: Derek A. Scott.

Nur Gol (13)

Location: 38°00'N, 48°33'E; in the northwestern Alborz Mountains about 50 km south of Astara, Azarbayjan.
Area: 200 ha.
Altitude: 2,300 m.
Overview: A small freshwater lake set high in the western Alborz, of considerable limnological and botanical interest, and of some importance for breeding waterfowl. The lake and its watershed are protected within the Lisar Protected Area.
Physical features: Nur Gol (or Neur Gol) is a small freshwater lake with extensive sedge marshes in a depression at 2,300 m on the relatively dry western slope of the Alborz Mountains, west of the Caspian Sea. The lake drains north into a tributary of the Aras River. The wetland provides some breeding habitat for waterbirds, but is completely frozen over for about six months of the year.
Ecological features: The lake supports extensive freshwater marshes and is rich in submergent vegetation. Surrounding hillsides support montane steppe. Nearby rocky peaks rise to summits at almost 3,200 m.
Land tenure: Public (Government).
Conservation measures taken: Nur Gol and its entire catchment are included within the Lisar Protected Area, established in 1970 with an area of 31,250 ha and subsequently enlarged to its present size of 33,050 ha. The Protected Area incorporates the entire watershed of the Lisar River from its source near the crest of the Alborz in the west to the Caspian shore in the east (about 30 km), and also part of the much drier western slope of the Alborz around Nur Gol. The entire Protected Area has been identified as an "Important Bird Area" by BirdLife International (Evans, 1994).
Conservation measures proposed: None known.
Land use: Trout were introduced into the lake in the early 1970s, in an effort to promote sport-fishing within the Protected Area. There are many small settlements and farming areas at low

elevations in the reserve, but the upper regions of the reserve around Nur Gol remain sparsely populated and relatively undisturbed.
Possible changes in land use: None known.
Disturbances and threats: None known at the wetland. Large areas of forest at low elevations have been cleared for cultivation and pastureland, and much of the remaining forest has been degraded by cutting for fuelwood and grazing by domestic livestock. There has been some illegal logging in the reserve.
Hydrological and biophysical values: No information.
Social and cultural values: No information.
Noteworthy fauna: The wetland supports small numbers of breeding waterfowl, including *Tadorna ferruginea* (maximum of 90 birds), *Anas platyrhynchos*, *Tringa totanus* and *T. hypoleucos*. *Ciconia nigra* has been recorded at the lake in summer and may breed. As many as 50 *Tringa ochropus* have been recorded during autumn migration.
Noteworthy flora: No information.
Scientific research and facilities: The Fisheries Unit at the Department of the Environment has investigated the lake with a view to the development of sport fishing, and several breeding season surveys have been carried out by the Department's Ornithology Unit.
Management authority and jurisdiction: Department of the Environment.
References: Evans (1994); Firouz & Ferguson (1970b); Scott (1976b).
Reasons for inclusion: 1d. Nur Gol is the only significant, relatively undisturbed lake at high altitude in the Alburz Mountains, and is thus of considerable limnological and botanical interest.
Source: Derek A. Scott.

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Anzali Mordab Complex (14)

Location: 37°25'N, 49°28'E; in the western part of the broad deltaic plains around the city of Rasht in the southwest Caspian Region, Gilan. The town of Bandar Anzali is situated at the mouth of the main Mordab lagoon.
Area: Approximately 15,000 ha.
Altitude: 23 m below sea level.
Overview: A large complex of freshwater lagoons with extensive reed-beds, shallow impoundments ("ab-bandans") and seasonally flooded meadows in the southwest Caspian lowlands, extremely important as spawning and nursery grounds for fishes, and as breeding, staging and wintering areas for a wide variety of waterfowl. Parts of the wetland are protected in the Siahkesheem Protected Area and Selke Wildlife Refuge; the entire wetland has been designated as a Ramsar Site.
Physical features: The Anzali Mordab comprises a complex of large, shallow, eutrophic, freshwater lagoons, marshes and seasonally flooded grasslands, separated from the Caspian Sea by a sandy barrier, about one km wide, with open grassland, pomegranate scrub and sand dune vegetation. The main Mordab covers about 11,000 ha, and comprises an open lagoon, 26 km long and 2.0-3.5 km wide, surrounded by reed-beds which extend its eastern limits a further

seven km. Siahkesheem Marsh (6,700 ha; 37°24'N, 49°22'E) lies in the partially enclosed basin of the Rud-e-Esfand in the southwest. This lagoon was probably once a part of the main lagoon, and is about 12 km long by 4.5 km wide. Several perennial streams emanating in the nearby Talesh Mountains feed into the Mordab complex, chief of which are the Bohambar, Chakoor, Esfand and Siahdarveshan. Inflow is usually at its greatest in autumn, when the level of the Mordab may rise by a metre or more. The entire marsh and lagoon complex drains into the deep-water harbour of Bandar Anzali through several short channels at the northeast end of the main lagoon. The 1.8 metre rise in the level of the Caspian Sea since 1978 has resulted in a one metre rise in the water level in the main Mordab and increased salt water intrusion during the summer months (when the level of the Caspian is at its highest and inflow of freshwater is at its lowest).

Much of the central and eastern portions of the main Mordab support vast stands of tall reeds, while the western portion is mainly open water. Siahkesheem Marsh is almost entirely overgrown with dense reed-beds. The permanent wetland area is surrounded by a broad belt of flood meadows and ab-bandans (shallow impoundments constructed to retain water for irrigation purposes during the dry summer months). These largely seasonal wetlands cover about 1,000 ha and flood to a maximum depth of about 50 cm; they border on arable land to the west, south and east. Selke Ab-bandan (360 ha; 37°24'N, 49°29'E) is situated on the southern edge of the main Mordab, and comprises 360 ha of shallow freshwater marshes and flood meadows with tall reed-beds to the north and arable land to the south. The wetland is surrounded by a low embankment and was originally created as a water storage pond and duck-hunting area. Other similar shallow marshes along the southern edge of the Mordab and around its eastern end remain in private hands and continue to be maintained as duck-hunting reserves.

The soils are fine-textured alluvials and continually or intermittently wet hydromorphic soils. They range from silt loam to silty-clay loam, clay loam and even clay at the surface. The hydromorphic soils are a variety of low-humic, humic gley and half-bog, pseudo-gley and gley, generally formed from sedimentation in the Caspian. Gradual lowering of the ground water and removal of salts makes these soils very fertile. They are, however, poorly drained.

The climate is characterized by warm, humid summers and mild winters, with a relatively low annual range in temperature. The average annual rainfall is 1,950 mm, with rain falling throughout the year but mainly in winter. Relative humidity averages 80-85%, with highest readings during spring and autumn. The lowest temperatures occur in February (mean around 6°C) and the highest in August (mean maximum nearly 25°C); extremes are -11°C and 30°C. Snow is relatively rare due to the warming effects of the Caspian Sea, but exceptional storms, as occurred in January/February 1969 and January/February 1972, may deposit several metres of snow within a few days.

Ecological features: The dominant vegetation throughout much of the Mordab consists of vast beds of *Phragmites australis* which in places grows to six metres in height. A rapid expansion in the extent of the *Phragmites* reed-beds began in the late 1960s, and by the early 1980s, almost the entire eastern and central portions of the main Mordab were covered in reeds. This rapid spread of *Phragmites* has been attributed to falling water levels in the Mordab, as a result of the then continuing fall in the level of the Caspian Sea, and accelerated eutrophication as a result of increased inflow of domestic sewage, fertilizers and other organic material. The situation had become so serious by the end of the 1970s that the Department of the Environment was investigating possible methods of control. It seems likely, however, that the

recent rapid rise in water level in the Mordab, coupled with increased salt water intrusion during the summer months, will eventually check the expansion of *Phragmites*. The open-water areas of the Mordab support extensive beds of the water lily *Nelumbium (caspicum) maciferum* and a very rich growth of other floating and submerged vegetation including *Nymphoides indica*, *Nymphaea alba*, *Utricularia vulgaris*, *Salvinia natans*, *Hydrocharis morsus-ranae*, *Hydrocotyle vulgaris*, *Lemna minor*, *L. trisulca*, *L. polyrhiza*, *Trapa natans*, *Lymnanthemum nymphoides*, *Polygonum* spp., *Spirodella polyrhiza*, *Riccia* sp., *Myriophyllum verticillatum*, *M. spicatum*, *Ceratophyllum sudmercum*, *C. demersum*, *Hydrilla verticillata*, *Potamogeton pectinatus*, *P. crispus*, *Elodea nutalli* and *Ranunculus divaricatus*. The marshes and flood meadows support a wide variety of emergents including *Sparganium neglectum*, *Typha latifolia*, *Echinochloa crus-galli*, *Glyceria luitans*, *Scirpus palustris*, *Cyperus longus*, *Juncus* spp., *Sium angustifolium*, *Nasturtium amphibium*, *Sagittaria sagittaefolia*, *Alisma plantigo-aquatica*, *Butomus umbellatus* and *Equisetum* sp. Patches of woodland with alders *Alnus glutinosus* and willows *Salix* sp. occur on higher ground and along river levees. The flora of Siahkesheem Marsh has been described in some detail by Riazi (undated). The wetlands are bordered to the north by sand dunes with grassland and scrubby vegetation, and to the south by cultivated land (mainly rice) and patches of woodland.

Land tenure: Mainly public (Government); some of the ab-bandans along the south side of the Mordab are privately owned.

Conservation measures taken: Two reserves have been established in the Anzali Mordab complex. The central portion of Siahkesheem Marsh (3,515 ha) was first established as a Protected Region in August 1967. The reserve was enlarged to 6,701 ha and upgraded to Wildlife Refuge in 1971, but reduced to its present size of 4,500 ha and downgraded to Protected Area in the 1980s. Selke Ab-bandan (360 ha) has been protected as a Wildlife Refuge since September 1970. In an effort to increase the level of protection afforded to waterfowl in the Anzali Mordab, the Department of the Environment has recently taken steps to establish a non-hunting area at Sorkhan Kol in the central Mordab.

The Anzali Mordab complex (15,000 ha) was designated as a Ramsar Site on 23 June 1975. This encompasses the whole of the Anzali Mordab, Siahkesheem Marsh, Selke Ab-bandan and several other ab-bandans bordering the marshes. The wetlands have been identified as an "Important Bird Area" by BirdLife International (Evans, 1994).

Conservation measures proposed: Fotoohi (1974) and Howell (1976) have made a number of recommendations for the management of Selke Wildlife Refuge. A Ramsar Monitoring Procedure Mission to the wetlands in January 1992 recommended that the Department of the Environment should investigate a variety of possibilities for conserving waterfowl populations in the Mordab while at the same time maintaining hunting opportunities for the general public. These might include the following:

- imposing stricter controls on the number of hunters, number of days when hunting is permitted, bag limits, hunting techniques *etc.*;
- giving greater encouragement to duck hunting communities using traditional hunting techniques to manage and patrol their hunting areas (*e.g.* as occurs at Gasghiasheh Ab-bandans in the eastern Mordab);
- encouraging sport hunters (using shot-guns) to form their own hunting clubs or societies to manage their activities more wisely;
- improving the protection of Siahkesheem Protected Area;

- creating a buffer zone around Selke Wildlife Refuge to reduce poaching around the edge of this extremely important reserve;
- establishing additional non-hunting areas in other parts of the Anzali Mordab (*e.g.* at Sorkhan Kol).

Land use: Anzali Mordab supports a major local fishery. The Mordab and deeper rivers flowing into it are used for transportation of farm goods as well as people and other materials to the various villages around the wetland and to Bandar Anzali. This busy fishing port and market town straddles the channels which connect the Mordab with the Caspian Sea. Parts of the *Phragmites* marsh and the open wetlands bordering the south side of the Mordab are heavily utilized by domestic livestock for grazing. Several villages cut and use the reeds for mat-weaving, fencing and building materials. Duck-hunting is an extremely important activity in winter, including both sport hunting and market hunting for sale in local markets and export to Tehran. Many of the ab-bandans surrounding the Mordab are managed as duck-hunting areas throughout the winter months. At these sites, the duck hunters employ a traditional dazzling and hand-netting technique (the "net, gong and flare" method) to catch ducks and coots from a boat at night. Elsewhere in the Mordab, hunting is mostly by shot-gun. The ab-bandans also provide a source of water for irrigation during the dry summer months. Surrounding areas are used mainly for the production of rice and vegetable crops, although there is also some tea grown.

Possible changes in land use: None known.

Disturbances and threats: The Anzali Mordab seems to have been relatively undisturbed until the late 1950s. However, in the 1960s and 1970s, a number of development projects in Gilan greatly affected the wetland ecosystem. New roads were constructed into areas formerly served only by foot trail or by boat, particularly on the south side of the Mordab. The harbour facilities at Bandar Anzali were expanded, and an industrial site was developed on the south side of the Mordab. In the late 1960s, a drainage canal, two km long and 20 m wide, was constructed from the northeast corner of the Mordab to the Caspian Sea to facilitate the reclamation of 5,000 ha of reed marsh for agriculture. In recent years, there has been a massive spread of the water fern *Azolla*, which was introduced into the Caspian wetlands by rice-farmers in the 1970s. This aquatic weed now covers much of the water surface within the reed-beds and in most of the quieter backwaters. The ecological consequences of this invasion by *Azolla* have yet to be fully documented. However, it is believed that the greatly reduced abundance of *Nelumbium maciferum* and *Trapa natans* (both valuable waterfowl food plants) can in part be attributed to the spread of *Azolla*.

Waterfowl populations are subjected to very high levels of disturbance from fishing activities, boat traffic and hunting. Hunting pressure on waterfowl populations in the Anzali Mordab has increased greatly since the 1970s. The number of licensed hunters in Gilan Province has increased from about 6,000 in the 1970s to about 20,000 at the present time. Traditional hunting (using the "net, gong and flare" method) continues at a high level, and is thought to account for at least 100,000 waterfowl per season. Hunting with shot-guns has increased considerably, and there are now about 1,000 hunters hunting in this way at Anzali Mordab. These are thought to account for another 100,000 waterfowl per season. A considerable amount of illegal flight-netting occurs, and Siakesheem Marsh is now dotted with shacks used by the duck-netters. Unless some measures are introduced to curb hunting pressure and its associated disturbance, there is a high likelihood that within a few years, the once vast flocks of migratory waterfowl will have disappeared completely from all those areas of the Anzali Mordab open to hunting for

the general public. Only those areas protected as refuges by the Department of the Environment or jealously guarded by private land-owners for their own hunting activities will remain as havens for waterfowl. Poaching is reported to have been a very serious problem in the reserves in the first few years after the revolution, but the situation has improved considerably in recent years, especially at Selke Wildlife Refuge where there is a new Game Guard Station and protection is excellent.

Hydrological and biophysical values: The Mordab is a very important spawning and nursery area for economically important species in the Caspian Sea fishery.

Social and cultural values: Throughout the winter months, a large proportion of the local human population are involved either directly or indirectly in waterfowl hunting, and this is of considerable importance in the local economy.

Noteworthy fauna: The Anzali Mordab and its satellite wetlands such as Siahkesheem Marsh and Selke Ab-bandan are extremely important for a wide variety of breeding, passage and wintering waterfowl. The wetlands support a very large breeding colony of *Chlidonias hybridus* (2,000-4,000 pairs), small colonies of six species of Ardeidae, and (at least formerly) a large resident population of *Porphyrio porphyrio*. The wetlands also support huge wintering concentrations of ducks, geese, swans and coots. The Anzali Mordab is the most important wintering area in Iran for *Phalacrocorax pygmaeus*, regularly holding more than 500 in mid-winter (maximum 650 in November 1972). *Pelecanus onocrotalus*, *P. crispus*, *Botaurus stellaris* and *Anser erythropus* are occasional winter visitors in small numbers, while *Oxyura leucocephala*, *Charadrius asiaticus*, *Vanellus gregarius* and *Gallinago media* have been recorded on passage. *Scolopax rusticola* is a very common winter visitor to the surrounding damp woodlands and scrub, while *Acrocephalus melanopogon* and *A. arundinaceus* are very common breeding birds in the reed-beds. Peak counts of some waterfowl are given in Table 8.

The number of waterfowl wintering in Anzali Mordab in recent years has been much lower than in the 1970s, when the total count of ducks and *Fulica atra* usually exceeded 200,000. The great majority of waterfowl are now confined to the well protected Selke Wildlife Refuge, Siahkesheem Marsh and a chain of a duck-netting marshes along the south side of the Mordab protected from disturbance by the local people. The recent scarcity of ducks and coots on the open waters of the main Mordab (open to duck shooting) is clearly a result of the great hunting pressure in the area. This continues a trend first recorded in the early 1970s, when numbers of *Fulica atra* in Gilan fell from over 100,000 in 1972/73 to only 34,000 by 1974/75. This decline was attributed to the extremely heavy hunting pressure in Gilan and the almost continuous disturbance from hunters in unprotected wetlands, especially Anzali Mordab. Selke Wildlife Refuge continues to support large numbers of birds, but there is evidence of a change in species composition, with more diving ducks and *Fulica atra* and fewer dabbling ducks and geese than in the 1970s. This change is undoubtedly a result of the higher water levels in the Refuge caused by the rise in level of the Caspian Sea.

There has been a dramatic decline in the population of Purple Swamphen (*Porphyrio porphyrio*) at Anzali Mordab in recent years. The reasons for this decline are unknown, as the extent of suitable habitat appears to have increased enormously during the last decade, but may be related to the great increase in water depth and/or spread of *Azolla*. Numbers of wintering Pygmy Cormorants (*Phalacrocorax pygmaeus*) have, however, remained relatively stable over the past 20 years. At least 237 were recorded in January 1992, a figure that compares well with single-day counts of the early 1970s (which ranged from 210 to 325).

The Mordab is a very important wintering area for birds of prey, holding up to 20 *Haliaeetus albicilla*, six *Aquila heliaca*, 24 *A. clanga* and six *Falco peregrinus*, along with smaller numbers of *Falco cherrug*, *F. columbarius* and *Asio flammeus*. *Circus aeruginosus* is common throughout the year, with some 15-25 breeding pairs, up to 85 individuals in winter, and up to 130 during autumn passage. At least 144 species of birds have been recorded in Siahkesheem Protected Area and at least 157 species in Selke Wildlife Refuge.

Mammals include the Golden Jackal (*Canis aureus*), Common Otter (*Lutra lutra*) Jungle Cat (*Felis chaus*), Wild Boar (*Sus scrofa*), White-toothed Shrew (*Crocidura leucodon*) and Crested Porcupine (*Hystrix indica*). A pack of wolves (*Canis lupus*) appeared in the marshes during the extremely severe weather of early 1972.

The Mordab is one of the principal breeding grounds of "mahi sefid" or White Fish *Rutilus frisii*, commercially one of the most important fish in the South Caspian after sturgeon. It is also an important breeding ground for the local sander *Lucioperca lucioperca*, while the pike *Essox lucius* is abundant. Other fishes include *Perca fluviatilis*, *Silurus glanis*, *Rutilus rutilus*, *Aspius aspius*, *Tinca tinca*, *Barbus brachycephalus*, *Chalcalburnus chalcoides*, *Abramis brama*, *Vimba vimba* and *Cyprius carpio*. Four species of frogs have been recorded: *Rana caucasia*, *R. ridibunda*, *R. esculenta* and the tree frog *Hyla arborea*. Reptiles include the lizards *Agama agilis*, *Lacerta chlorogaster*, *L. strigata*, *Ophisaurus apodus* and *Anguis fragilis*, the snakes *Natrix natrix*, *Oligodon taeniolatus*, *Coluber fugularis* and *C. najadum*, and two freshwater turtles *Emys orbicularis* and *Clemmys caspica*. Riazi (undated) lists the common zooplankton and invertebrates of Siahkesheem Marsh.

Noteworthy flora: The Anzali Mordab contains much the most extensive stands of tall *Phragmites* reed-beds in the country.

Scientific research and facilities: Numerous limnological and hydrological studies have been conducted by the National Fisheries Organization (Shilot). Annual mid-winter waterfowl censuses have been carried out by the Ornithology Unit, Department of the Environment, since 1967. Many ornithological surveys have been undertaken at other times of the year, including comprehensive waterfowl censuses in mid-November in 1972, 1973 and 1974, and a duck-ringing programme was initiated by the Ornithology Unit in January 1967. The Department of the Environment has also carried out investigations on duck-hunting in the Mordab, and the spread of *Phragmites*. The Department is currently undertaking a major programme of research, which has involved the establishment of 35 monitoring stations throughout the Mordab, to measure a variety of parameters including changes in water level, water quality and physico-chemical characteristics. The Department has recently published a book on the ecology and wildlife of Siahkesheem Marsh in Farsi (Riazi, undated). Excellent research facilities are available in the nearby town of Bandar Anzali, and the Department of the Environment maintains a guest house for visiting researchers on the north edge of the marshes near Bandar Anzali.

Management authority and jurisdiction: The Ramsar Site is administered by a local Council under the supervision of the Department of the Environment; this department is also responsible for the management of Siahkesheem Protected Area and Selke Wildlife Refuge.

References: Carnie (1973); Carp (1980); Division of Research and Development (1972); Evans (1994); Ferguson (1972); Firouz (1968); Firouz & Ferguson (1970b); Firouz *et al.* (1970); Fotoohi (1974); Howell (1976); IUCN (1992); Mansoori (1984); Nielsen (1969); Nielsen & Speyer (1967); Ramsar Convention Bureau (1993); Riazi (undated); Savage (1963); Savage &

Firouz (1968); Scott (1976a, 1976b, 1976c, 1978a, 1993); Scott & Smart (1992); Vahedi (1982); WCMC (1990).
Reasons for inclusion: 1a, 1c, 2a, 2b, 2c, 3a & 3c. The Anzali Mordab is an outstanding example of a natural freshwater lagoon system characteristic of the South Caspian lowlands. It plays a substantial hydrological and ecological role in the functioning of the deltaic and coastal systems of the southwest Caspian, and supports an extremely diverse wetland fauna and flora. It is an important breeding and nursery grounds for various fish species, and supports large breeding colonies of several species of waterfowl. It also provides important habitat for at least three globally threatened species of birds: *Phalacrocorax pygmaeus*, *Aythya nyroca* and *Aquila heliaca*. The wetland regularly holds well in excess of 20,000 waterfowl; it supports over 1% of the regional breeding population of *Chlidonias hybridus*, and in winter supports over 1% of the regional populations of *Podiceps nigricollis*, *Phalacrocorax carbo*, 12 species of Anatidae, *Fulica atra*, *Limosa limosa* and *Larus ridibundus*.
Source: Derek A. Scott.

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Bandar Kiashar Lagoon and mouth of Sefid Rud (15)

Location: 37°20'N, 49°55'E; about 40 km east of Bandar Anzali, Gilan. Bandar Kiashar Lagoon lies immediately to the east of the mouth of the Sefid Rud (River).
Area: 500 ha.
Altitude: 25 m below sea level.
Overview: A shallow sea bay (formerly brackish lagoon), associated freshwater marshes and the nearby riverine marshes at the mouth of the Sefid Rud in the southwest Caspian, important as spawning and nursery grounds for fishes, and as breeding, staging and wintering areas for a wide variety of waterfowl. The wetlands have been designated as a Ramsar Site but are otherwise unprotected.
Physical features: The wetland complex comprises a shallow sea bay (formerly an enclosed lagoon), the nearby mouth of the main channel of the Sefid Rud, and the associated fresh to brackish marshes. The Sefid Rud is the second largest river in Iran; it has a catchment area of over 54,000 sq.km in the western Alborz Mountains, and a natural flood discharge of 3,400 to 4,200 cubic metres per second. This diminishes to a minimum flow of less than 20 cubic metres per second during late summer. The river divides into several distributary channels on the plains of Gilan, the main channel entering the Caspian at Bandar Kiashar. Bandar Kiashahr Lagoon (formerly Bandar Farahnaz Lagoon) is situated in an area of coastal sand dunes and grassland about 1.5 km east of the mouth of the Sefid Rud. In the 1960s and 1970s, this wetland was a shallow, brackish coastal lagoon, 3.75 km long by 1.5 km wide, with fringing *Juncus* marshes and about 140 ha of *Phragmites* and *Typha* reed-beds at its west end. The lagoon was fed by two streams from the Sefid Rud and local run-off, and drained northeast through a narrow channel into the Caspian Sea. The bottom was a mixture of sand and mud, and the waters were predominantly oligotrophic, except towards the marshy western extremity. The lagoon had been formed as recently as 1960 as a result of the falling level of the Caspian Sea and development of coastal sand spits. The 1.8 m rise in the level of the Caspian Sea since 1978 has obliterated the

sand barrier between the lagoon and the sea, with the result that the wetland now constitutes a sea bay with broad entrance to the sea (similar to the situation in the 1950s). The marshy grassland and sand dune areas at the mouth of the Sefid Rud have, however, remained more or less unchanged, while new wetland habitats have been created to the west of the river mouth.

Ecological features: The lagoon supports relatively little vegetation other than algae. Freshwater marshes at the extreme west end of the lagoon support some reed-beds (*Phragmites* and *Typha*), while the southern and eastern shores are dominated by *Juncus* sp. and grasses. Sandy areas to the west and northwest are covered in scrub and grassland which give way to sand dune vegetation near the Caspian shore. Grassland along the banks of the Sefid Rud is subject to seasonal flooding. Land to the south of the wetland is mostly under cultivation, although there are some relict patches of *Alnus* woodland near the wetland.

Land tenure: Public (Government).

Conservation measures taken: No legal protection. Bandar Kiashahr Lagoon and the mouth of Sefid Rud were designated as a Ramsar Site on 23 June 1975. The Ramsar Site (500 ha) includes the whole of the lagoon area, its associated marshes and the marshes and sand flats at the mouth of the Sefid Rud to the west. The site has been identified as an "Important Bird Area" by BirdLife International (Evans, 1994).

Conservation measures proposed: Further investigations are required to assess the ecological changes which have occurred at the wetland, and to identify ways of reducing the disturbance to waterfowl from fishing activities.

Land use: Fishing in the lagoon and adjacent coastal waters; grazing by domestic livestock, reed-cutting and wildfowl hunting in the marshes. There is a fish-processing warehouse on the south side of the lagoon.

Possible changes in land use: None known.

Disturbances and threats: There is heavy hunting pressure on waterfowl throughout the winter months, and the lagoon is subjected to high levels of disturbance from fishing activities and the passage of boats to and from the fish-processing warehouse on the south side. There is also considerable disturbance from recreation activities at weekends and holidays. The disappearance of the wintering flock of *Pelecanus crispus* in the late 1970s and great decrease in the numbers of other wintering waterfowl during the last decade have been attributed to the increasing disturbance from fishing activities and heavy hunting pressure.

Hydrological and biophysical values: No information.

Social and cultural values: The lagoon is an important centre for commercial fishing.

Noteworthy fauna: An important staging and wintering area for a wide variety of migratory waterfowl, notably grebes, *Phalacrocorax pygmaeus* (up to 300), ducks, shorebirds, gulls and terns. A flock of *Pelecanus crispus* (usually 30-40 birds) wintered at the mouth of the Sefid Rud in the 1970s but apparently disappeared by about 1980, probably because of increased disturbance. *Anser erythropus* was also an occasional winter visitor to the area in the 1970s, with a maximum of 10 in January 1973, but none has been seen in recent years. The open grassy areas and dunes near the river mouth provide breeding habitat for 20-30 pairs of *Glareola pratincola* and a few pairs of *Sterna hirundo*, while a small patch of woodland to the south of the lagoon supports a large breeding colony of *Phalacrocorax carbo* (1,000 pairs), *Nycticorax nycticorax* (200 pairs) and other Ardeidae. Peak counts of some waterfowl are given in Table 9. Scarce winter visitors and vagrants have included *Botaurus stellaris*, *Branta ruficollis* (one in January 1973), *Oxyura leucocephala* (three in February 1972), *Phalaropus*

fulicarius and *Rissa tridactyla*. *Haliaeetus albicilla* is present year-round and breeds locally (up to five have been observed at one time), while *Circus aeruginosus* (maximum 20) and *Falco peregrinus* (maximum 4) are regular winter visitors. *Aquila heliaca*, *Buteo lagopus*, *Falco cherrug*, *F. columbarius* and *Asio flammeus* have also been recorded.
The Golden Jackal (*Canis aureus*) is common in the area.
Noteworthy flora: No information.
Scientific research and facilities: A considerable amount of fisheries research has been carried out by the National Fisheries Organization (Shilot). Annual mid-winter waterfowl censuses have been carried out by the Ornithology Unit, Department of the Environment, since 1968. Many ornithological surveys have been undertaken at other times of the year, including comprehensive waterfowl censuses in mid-November in 1972, 1973 and 1974.
Management authority and jurisdiction: The Ramsar Site is administered by the Department of the Environment.
References: Carp (1980); Evans (1994); Ferguson (1972); Firouz & Ferguson (1970b); Mansoori (1984); Ramsar Convention Bureau (1993); Scott (1976a, 1976c, 1978a); Scott & Smart (1992); Summers *et al.* (1987); Vahedi (1982); WCMC (1990).
Reasons for inclusion: 1a, 2a, 2c & 3c. Bandar Kiashar Lagoon and the mouth of the Sefid Rud are good representative examples of natural wetlands characteristic of the South Caspian lowlands. The lagoon is an important breeding and nursery grounds for various fish species, and supports large breeding colonies of several species of waterfowl. The wetlands also provide important wintering habitat for *Phalacrocorax pygmaeus* (a globally threatened species), and, formerly, supported a wintering flock of *Pelecanus crispus*. The wetlands regularly support over 1% of the regional breeding population of *Phalacrocorax carbo*, and over 1% of the regional wintering populations of *Podiceps nigricollis*, *Anas platyrhynchos* and *Larus ridibundus*.
Source: Derek A. Scott.

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Amirkelayeh Lake (16)

Location: 37°18'N, 50°10'E; on the coastal plain of the Caspian Sea, about 12 km north of Langarud, Gilan.
Area: 1,230 ha.
Altitude: 20 m below sea level.
Overview: A permanent freshwater lake with extensive reed-beds in the southwest Caspian lowlands, important for passage and wintering waterfowl, notably *Phalacrocorax pygmaeus* and *Netta rufina*. The lake is protected as a Wildlife Refuge, and has been designated as a Ramsar Site.
Physical features: Amirkelayeh Lake is a permanent, eutrophic, freshwater lake with rich growth of floating and submergent vegetation, extensive fringing reed-beds of *Typha* and *Phragmites* and some willow thickets. The lake is about 4.5 km long by up to 1.7 km wide; the water is extremely clear, with an average depth of about 3-4 m and maximum depth of 6 m. It is fed by springs and local run-off and, at high water levels, drains from the northwest through a

small stream into a channel of the Sefid Rud some 1.5 km away. The lake is sufficiently high above the level of the Caspian Sea to have been unaffected by the recent rise in sea level.

Ecological features: The open-water areas of the lake support abundant submerged and floating vegetation including species of *Nelumbium*, *Lemna*, *Potamogeton*, *Hydrilla*, *Myriophyllum* and *Ceratophyllum*. The surrounding emergent marshes are dominated by *Phragmites* with some *Typha* and *Salix*. The surrounding area comprises rice paddies with patches of woodland of *Salix caprea*, *S. micans* and *Pterocarya fraxinifolia*, and there are remnants of former coastal forest.

Land tenure: Public (Government).

Conservation measures taken: The lake and marshes were designated as a Protected Region in 1970 and upgraded to Wildlife Refuge (1,230 ha) in 1971. This Wildlife Refuge of 1,230 ha was designated as a Ramsar Site on 23 June 1975. Following the revolution in the late 1970s, the Department of the Environment experienced some difficulty in managing the Wildlife Refuge properly. A Ramsar Monitoring Procedure Mission to Gilan in January 1992 recommended that the Department of the Environment should seek to re-establish its authority at the site (Scott & Smart, 1992). Considerable progress has been made since then; the Department of the Environment was able to re-establish control of the area in 1994, and duck-hunting has now been stopped. The lake has been identified as an "Important Bird Area" by BirdLife International (Evans, 1994).

Conservation measures proposed: None known.

Land use: Formerly duck-hunting for local consumption and export. The hunters used a traditional clap-netting technique, with the clap-nets set on poles in deep water and operated from hides (blinds) in the nearby reed-beds. The lake provides a source of water for irrigation during the dry summer months. There are several small villages in the area, and an all-weather road passes close to the eastern side of the lake.

Possible changes in land use: None known.

Disturbances and threats: There are no major threats to the habitat, and the ecological character of the site has remained unchanged since the establishment of the Wildlife Refuge in 1971. Prior to its designation as a Wildlife Refuge, the lake had been an important waterfowl hunting area for local villagers, who employed a traditional clap-netting technique to trap ducks and coots for the market. During the revolution, local villagers burned down the Department of the Environment's Game Guard Station and Watch Tower, and re-assumed control of the lake. Duck-trapping re-commenced, and by 1992 there were some 60 teams of duck-netters operating at the lake. However, the Department re-established control of the area in 1994, and hunting has again been prohibited.

Hydrological and biophysical values: No information.

Social and cultural values: Formerly an important duck hunting area.

Noteworthy fauna: A very important wintering area for diving ducks, notably *Netta rufina* (maximum 2,500) and *Aythya ferina* (maximum 4,200), and *Fulica atra* (maximum 45,000), and a wintering area for up to 100 *Phalacrocorax pygmaeus*. Other wintering waterfowl have included up to five *Podiceps auritus*, 100 *Tachybaptus ruficollis*, 200 *Cygnus olor*, 25 *C. cygnus*, 16 *C. columbianus*, 1,300 *Anas strepera*, 4,560 *A. crecca*, 1,220 *A. platyrhynchos*, 910 *Aythya fuligula*, five *A. nyroca*, small numbers of *Rallus aquaticus* and 200 *Larus minutus*. Some 700 swans *Cygnus* spp. were present on neighbouring ab-bandans in November 1993. Passage migrants in spring and autumn have included up to 140 *Egretta alba*, 20 *Ardea*

purpurea, 300 *Anas querquedula*, three *Porzana parva* and 30 *Gallinago gallinago*. A single *Marmaronetta angustirostris* was observed in November 1969. Several pairs of *Porphyrio porphyrio* breed in the reed-beds, along with large numbers of *Gallinula chloropus*, *Acrocephalus melanopogon* and *A. arundinaceus*, and *Panurus biarmicus* has been recorded (a party of five in October 1970). *Pandion haliaetus* is regular on passage, and a pair of *Haliaeetus albicilla* nested in a tree close to the lake in the 1970s. *Circus aeruginosus* is a common winter visitor (maximum 20), and *Falco peregrinus* is an occasional winter visitor. At least 101 species of birds have been recorded in the Wildlife Refuge.
Mammals known to occur in the refuge include Golden Jackal (*Canis aureus*), Jungle Cat (*Felis chaus*) and Wild Boar (*Sus scrofa*).
Noteworthy flora: No information.
Scientific research and facilities: Annual mid-winter waterfowl censuses have been carried out by the Ornithology Unit, Department of the Environment, since 1968. Many ornithological surveys have been undertaken at other times of the year, including comprehensive waterfowl censuses in mid-November in 1972, 1973 and 1974, and a duck-ringing programme was initiated by the Ornithology Unit in 1968. The Department of the Environment has also carried out some investigations on duck-hunting techniques and harvesting levels at the lake.
Management authority and jurisdiction: Department of the Environment. The Ramsar Site is administered by a local Council under the supervision of the Department of the Environment.
References: Carp (1980); Division of Research and Development (1970b); Evans (1994); Ferguson (1972); Mansoori (1984); Ramsar Convention Bureau (1993); Scott (1976a, 1976b, 1976c); Scott & Smart (1992); Vahedi (1982); WCMC (1990).
Reasons for inclusion: 1a, 2a, 3a & 3c. Amirkelayeh Lake is a good representative example of a natural wetland characteristic of the South Caspian lowlands. It provides important wintering habitat for *Phalacrocorax pygmaeus* (a globally threatened species), and regularly holds over 20,000 waterfowl in winter, including over 1% of the regional populations of *Netta rufina*, *Aythya ferina* and *Fulica atra*.
Source: Derek A. Scott.

Fereidoonkenar Marshes (17)

Location: 36°35'N, 52°31'E; on the coastal plain of the South Caspian, 5 km south of the village of Fereidoonkenar (Fereydun Kenar) and 13 km southwest of Babolsar, Mazandaran.
Area: 1,000 ha.
Altitude: 20 m below sea level.
Overview: A complex of shallow freshwater impoundments developed for irrigation purposes and as a duck-hunting area and surrounded by rice paddies, in the southeast Caspian lowlands; of outstanding importance as the winter quarters of the entire western population of the Siberian Crane (*Grus leucogeranus*), but also extremely important as a wintering area for many other species of waterfowl, notably dabbling ducks (*Anas* spp.) and geese (*Anser* spp.). A small part of the area is under protection as a Protected Area.
Physical features: Fereidoonkenar (Fereydun Kenar) "damgah" is an artificial wetland, created

and maintained primarily as a duck-hunting area, but also utilized as a supply of water for irrigation during the summer months. The core of the damgah comprises a series of shallow, freshwater impoundments with a rich growth of submerged and floating aquatic vegetation. The impoundments are almost entirely surrounded by an embankment and narrow belt of tall trees in which there are about 100 duck-trapping stations. The wetland is situated in the middle of a large expanse of rice paddies which provide excellent feeding habitat for ducks, geese, shorebirds and the Siberian Cranes.

Ecological features: The shallow impoundments support abundant floating and submerged aquatic vegetation and some fringing reed-beds of *Phragmites australis* and *Typha* sp. *Cyperus rotundus* (the principal food of the wintering cranes) is common. The surrounding plains are under rice cultivation.

Land tenure: Private.

Conservation measures taken: Part of the area is under protection as the Fereidoonkenar Protected Area (148 ha). This was originally established in the late 1970s as a Wildlife Refuge, but has since been downgraded in status. To ensure that the waterfowl are not disturbed, the duck trappers enforce a very strict ban not only on shooting activities in the area, but also on all other unnecessary human activity. As a result, the damgah wetland and surrounding paddies constitute one of the best protected and least disturbed wetlands in the South Caspian lowlands. Few birds other than *Anas platyrhynchos* and *A. crecca* are trapped, and thus for the many thousands of other ducks, geese and shorebirds and for the cranes, conditions are ideal. The site has been identified as an "Important Bird Area" by BirdLife International (Evans, 1994).

Conservation measures proposed: None known.

Land use: Duck-hunting for local consumption and export. The duck-hunting was originally developed as market hunting and provided many local people with a livelihood throughout the winter months, but in recent years, the primary interest of many hunters has been for the sport. The hunters operate from trapping stations set on the embankment surrounding the main ab-bandan, and use live decoy Mallard (*Anas platyrhynchos*) to lure other ducks (principally Mallard, but also occasionally Teal *A. crecca*) into flight nets. The duck-netting is carried out under licence from the Department of the Environment, each of the 100 or so trapping stations (each manned by two men) being permitted to capture up to five birds a day throughout the hunting season. The ab-bandans also provide a supply of water for irrigation during the dry summer months.

Possible changes in land use: None known.

Disturbances and threats: The restrictions imposed on access by the local land-owners extend even to personnel of the Department of the Environment, and the Department therefore has no control over hunting activities. Towards the end of each season, when duck-netting becomes unprofitable, the area is opened up to hunting with guns in a massive "shoot-out". Large numbers of waterfowl of many species are shot at this time, and there is a danger that Siberian Cranes could be accidentally killed.

Hydrological and biophysical values: No information.

Social and cultural values: A very important duck-hunting area.

Noteworthy fauna: The artificially-maintained shallow impoundments and extensive rice fields at Fereidoonkenar provide excellent feeding and roosting habitat for large numbers of wintering waterfowl, notably *Phalacrocorax carbo* (maximum 1,560), dabbling ducks (maximum 200,000), *Anser albifrons* (maximum 1,700), *A. anser* (maximum 6,000), *Vanellus*

vanellus (maximum 16,000) and *Limosa limosa* (maximum 5,000). Peak counts of dabbling ducks have included 14,500 *Anas penelope*, 20,000 *A. strepera*, 80,000 *A. crecca*, 80,000 *A. platyrhynchos*, 60,000 *A. acuta* and 12,000 *A. clypeata*. A small flock of 11 *Anser erythropus* was present in January 1992. Other wintering waterfowl have included up to 500 *Aythya ferina*, 330 *A. fuligula*, 900 *Fulica atra*, 15 *Pluvialis apricaria* and 40 *Gallinago gallinago*. These large concentrations of waterbirds attract a variety of wintering raptors including *Haliaeetus albicilla* (maximum 4), *Aquila heliaca*, *A. clanga* and *Falco peregrinus*. Large concentrations of *Philomachus pugnax* (maximum 2,800) have been recorded on spring migration. The wetland gained international fame in 1978 when ornithologists from the Department of the Environment discovered a tiny wintering population of the endangered Siberian Crane (*Grus leucogeranus*) at the site. The local duck-hunters were very familiar with the cranes, and reported that they had been coming to this area for many years. The cranes arrive in October and depart in mid-March. Since the discovery of the cranes in mid-January 1978, their numbers have fluctuated between 7 and 14. At least 11 cranes were present in January 1992, including two juveniles. Thus the alarming rumours in early 1991 that four or fives cranes had been shot or captured for zoos were clearly erroneous, as nine of the ten birds present in the winter of 1990/1991 could still be accounted for. Eleven cranes were present in the winter of 1992/93, and nine in the winter of 1993/94. The rediscovery of *Grus leucogeranus* in the South Caspian, after an absence of records for 60 years, has been described by Ashtiani (1987).

Noteworthy flora: No information.

Scientific research and facilities: Annual mid-winter waterfowl censuses have been carried out by the Ornithology Unit, Department of the Environment, since 1974. The small wintering population of *Grus leucogeranus* has been monitored closely since its discovery in 1978, and the Department of the Environment has now established a long-term research and conservation project on the cranes, in consultation with the International Crane Foundation. A proposal by the International Crane Foundation to use radio-telemetry and satellite-tracking in an attempt to follow the cranes to their breeding areas in Russia is currently under consideration.

Management authority and jurisdiction: The Department of the Environment is responsible for the management of the small protected area.

References: Archibald & Landfried (1993); Ashtiani (1987); Evans (1994); Firouz & Ferguson (1970b); Scott (1976a, 1980); Scott & Smart (1992).

Reasons for inclusion: 2a, 3a & 3c. Fereidoonkenar Marshes are critically important as the wintering grounds of the entire western population of *Grus leucogeranus* (7-14 birds). They regularly hold well in excess of 20,000 waterfowl in winter, including over 1% of the regional populations of *Phalacrocorax carbo*, eight species of Anatidae, *Vanellus vanellus* and *Limosa limosa*.

Source: Derek A. Scott.

Seyed Mohalli, Zarin Kola and Larim Sara (18)

Location: 36°45'N, 53°00'E (Seyed Mohalli and Zarin Kola 36°44'N, 53°00'E; Larim Sara 36°45'N, 53°03'E); on the coastal plain of the South Caspian, about 20 km north of Sari and 10

km from the Caspian shore, Mazandaran.
Area: 1,600 ha (Seyed Mohalli and Zarin Kola 600 ha; Larim Sara 1,000 ha).
Altitude: 20 m below sea level.
Overview: A complex of shallow freshwater impoundments ("ab-bandans"), developed for irrigation purposes and managed throughout the winter as duck-hunting areas, and an adjacent area of marshy plains and rice paddies, in the southeast Caspian lowlands; important both as a breeding area and a wintering area for many species of waterfowl, notably herons and egrets (Ardeidae) and ducks and geese (Anatidae). Unprotected.
Physical features: The Seyed Mohalli (Saidmahaleh) and Zarin Kola ab-bandans comprise a large complex of shallow, freshwater irrigation ponds surrounded by rice fields on the coastal plains of the South Caspian, to the east of the Rud-e Tajan (river) and about 10 km from its mouth. The ab-bandans are maintained throughout the winter months as private duck-hunting reserves. The nearby Larim Sara plains formerly consisted of an open grassy plain with a low-lying central area of *Salicornia* flats subject to winter flooding. Much of this area has now been converted to agricultural land.
Ecological features: Shallow freshwater impoundments with rich submerged, floating and emergent aquatic vegetation, including extensive stands of *Typha* and *Phragmites*; willow thickets (*Salix* sp.); rice fields; and seasonally flooded grassland and *Salicornia* flats.
Land tenure: Private.
Conservation measures taken: None. The duck hunters protect the waterfowl from disturbance by day, and prohibit all shooting in the area during the main duck-hunting season. The wetlands have been identified as an "Important Bird Area" by BirdLife International (Evans, 1994).
Conservation measures proposed: None known.
Land use: The ab-bandans are used as a source of water for irrigation in summer, and as duck-hunting reserves in winter. The duck hunters use the same "net, gong and flare" technique that is used at Anzali Mordab. As many as 40 teams of hunters were operating at the ab-bandans in the 1970s, and reportedly were able to catch as many as a thousand ducks in a single night. The surrounding region is a very important rice-growing area.
Possible changes in land use: With the construction of a large dam on the Rud-e Tajan and development of a network of irrigation canals, the importance of the ab-bandans as a source of water for irrigation will diminish, and there is the danger that some of them will fall into disrepair and/or be converted in agricultural land.
Disturbances and threats: Much of the Larim Sara plains has been converted to agricultural land and there may be little, if any, natural wetland vegetation remaining in this area. Huge numbers of ducks were trapped each year at the Seyed Mohalli and Zarin Kola ab-bandans in the 1970s.
Hydrological and biophysical values: No information.
Social and cultural values: An important duck-hunting area.
Noteworthy fauna: A very important wintering area for a wide variety of waterfowl, especially dabbling ducks (regularly over 100,000 in the 1970s), swans, *Fulica atra* (up to 34,000) and some shorebirds, and a breeding area for five species of Ardeidae (including about 250 pairs of *Ardeola ralloides*) and *Chlidonias hybridus* (150-200 pairs). *Phalacrocorax pygmaeus* is a regular winter visitor (generally 10-30 but occasionally as many as 100); *Aythya nyroca* occurs in substantial numbers on passage (maximum 185 in November), and *Oxyura leucocephala* has

been recorded in winter (maximum 27). Peak counts of some waterfowl are given in Table 10. In the 1970s, the Larim Sara plains were an important wintering area for *Phoenicopterus ruber* (up to 965), *Anser erythropus* (maximum of 359 in February 1972) and *A. anser* (up to 630), and also supported a small breeding colony of *Glareola pratincola* (30-40 pairs), but much of the area has since been reclaimed for agriculture and most of these birds have disappeared. Huge flocks of *Anser erythropus* are reported to have wintered in this area in the 1950s and early 1960s, along with much smaller numbers of *Branta ruficollis*. A pair of *Haliaeetus albicilla* nested near Seyed Mohalli in the 1970s. *Circus aeruginosus* is a very common winter visitor (maximum 60), and *Aquila heliaca*, *A. clanga*, *Falco cherrug*, *F. peregrinus*, *F. columbarius* and *Asio flammeus* are regular winter visitors in small numbers. *Acrocephalus melanopogon* and *A. arundinaceus* are abundant breeding birds, and *Remiz pendulinus* probably breeds. *Motacilla citreola* is a regular winter visitor in small numbers, and *Panurus biarmicus* has been recorded (a party of five in January 1971). During the exceptionally severe winter of 1971/72, over 1,000 *Melanocorypha leucoptera* and several hundred *M. yeltoniensis* were present on Larim Sara plains.

Noteworthy flora: No information.

Scientific research and facilities: Annual mid-winter waterfowl censuses have been carried out by the Ornithology Unit, Department of the Environment, since 1971. Many ornithological surveys have been undertaken at other times of the year, including comprehensive waterfowl censuses in mid-November in 1972, 1973 and 1974, and the Department of the Environment has also carried out some investigations on duck-hunting techniques and harvesting levels at the ab-bandans.

Management authority and jurisdiction: No information.

References: Division of Research and Development (1972); Evans (1994); Firouz & Ferguson (1970b); Scott (1976a, 1976c, 1978a); Scott & Smart (1992).

Reasons for inclusion: 2a, 2c, 3a & 3c. The Seyed Mohalli, Zarin Kola and Larim Sara wetlands provide important habitat for three threatened species of birds: *Phalacrocorax pygmaeus, Aythya nyroca* and *Aquila heliaca*, and have held appreciable numbers of two other threatened species in the recent past, *Anser erythropus* and *Oxyura leucocephala*. The wetlands support important breeding colonies of Ardeidae and *Chlidonias hybridus*, and regularly hold well in excess of 20,000 waterfowl in winter, including over 1% of the regional populations of eight species of Anatidae and *Fulica atra*.

Source: Derek A. Scott.

Lapoo-Zargmarz Ab-bandans (19)

Location: 36°50'N, 53°17'E; near the Caspian shore, 5-10 km west of Miankaleh Wildlife Refuge and about 25 km northwest of Behshahr, Mazandaran.

Area: 950 ha.

Altitude: 20 m below sea level.

Overview: Two shallow freshwater lagoons with extensive reed-beds, adjacent to the Caspian beach in the southeast Caspian lowlands; important primarily as a wintering area for ducks

(Anatidae) and *Fulica atra*. The wetlands are included within a large Ramsar Site, but are otherwise unprotected.

Physical features: The Lapoo-Zargmarz Ab-bandans are two long narrow freshwater lagoons with fringing reed-beds on the landward side of the coastal dunes bordering the Caspian Sea. The lagoons are situated about 10 km west of the extreme west end of the Gorgan Bay marshes. They are fed by irrigation ditches and local run-off, and drain east into the Gorgan Bay marshes. The water level fluctuates considerably, and extensive mudflats are exposed at low water levels. The ab-bandans do not appear to have been affected by the recent rise in level of the Caspian Sea.

Ecological features: Open-water areas of the ab-bandans support a rich growth of submerged and floating aquatic vegetation. The fringing marshes are dominated by *Phragmites* reed-beds with some *Typha*, but there are scrubby areas of *Salix*, *Ribes*, *Rubus* and *Punica* (pomegranate). The wetlands are bounded to the north by dune vegetation and to the south by arable land (cotton and wheat).

Land tenure: Privately owned by inhabitants of the nearby village of Zargmarz.

Conservation measures taken: The Lapoo-Zargmarz Ab-bandans have no legal protection, but are protected and managed as a private waterfowl hunting area by inhabitants of the nearby village of Zargmarz. These villagers pay a warden to patrol the area throughout the hunting season and prevent poaching. The ab-bandans are included within the Miankaleh Peninsula and Gorgan Bay Ramsar Site (100,000 ha), designated on 23 June 1975. The site has been identified as an "Important Bird Area" by BirdLife International (Evans, 1994).

Conservation measures proposed: None known.

Land use: The ab-bandans are used for waterfowl hunting in winter and as a source of water for irrigation during the summer months. Under an agreement with the Department of the Environment, the owners are permitted to hunt at the ab-bandans on a maximum of three days per month throughout the hunting season. In recent years, however, the owners have hunted at the site on only three or four occasions per season. There is also some reed-cutting in the marshes, and a little fishing.

Possible changes in land use: None known.

Disturbances and threats: None known.

Hydrological and biophysical values: No information.

Social and cultural values: A traditional duck-hunting area.

Noteworthy fauna: The wetland is used by a wide variety of waterfowl during the migration seasons and in winter, but few species occur in large numbers except *Anas strepera* (maximum 1,500) and *Fulica atra* (maximum 18,600). *Phalacrocorax pygmaeus* is a regular winter visitor in small numbers (maximum 15), and *Botaurus stellaris* has been recorded in winter. During periods of low water level in late summer and autumn, the wetland occasionally attracts large numbers of migrant shorebirds, *e.g.* up to 300 *Philomachus pugnax* and 175 *Tringa stagnatilis*, and *Porzana parva* has been recorded. There is a large breeding colony of *Chlidonias hybridus* (100-150 pairs). Other breeding species include *Podiceps cristatus* (10-15 pairs), *Tachybaptus ruficollis* (20 pairs) and *Gallinula chloropus* (at least 50 pairs). *Acrocephalus melanopogon* and *A. arundinaceus* are common breeding birds in the reed-beds. A small flock of *Oxyura leucocephala* (maximum of 28 in January 1972) wintered in the area in the 1970s, feeding by night on the ab-bandans and roosting by day on the adjacent Caspian Sea. No *O. leucocephala* have been recorded since 1978, but it may be that the birds have simply moved a few

kilometres east to Gorgan Bay, where the increased water depth has created more favourable conditions for the species. The numbers of other Anatidae using the site have increased in recent years, presumably because of the better protection from disturbance now being afforded to the wetland by the local duck hunters. Peak counts of some waterfowl are given in Table 11. Up to three *Haliaeetus albicilla* have been recorded in winter, and the species breeds locally. *Falco peregrinus* and *F. columbarius* are regular winter visitors in small numbers.
Noteworthy flora: No information.
Scientific research and facilities: Annual mid-winter waterfowl censuses have been carried out by the Ornithology Unit, Department of the Environment, since 1968. Many ornithological surveys have been undertaken at other times of the year, including waterfowl censuses in mid-November in 1972, 1973 and 1974.
Management authority and jurisdiction: No information.
References: Carp (1980); Evans (1994); Mansoori (1984); Ramsar Convention Bureau (1993); Scott (1976a, 1976c); Scott & Smart (1992); Vahedi (1982); WCMC (1990).
Reasons for inclusion: 2a & 3c. The Lapoo-Zargmarz Ab-bandans provide important habitat for *Phalacrocorax pygmaeus*, a globally threatened species, and were an important wintering area for another threatened species, *Oxyura leucocephala*, in the recent past. The ab-bandans also regularly support over 1% of the regional wintering population of *Anas strepera*.
Source: Derek A. Scott.

Miankaleh Peninsula and Gorgan Bay (20)

Location: 36°50'N, 53°45'E; at the extreme southeast corner of the Caspian Sea, north and east of the town of Behshahr, Mazandaran.
Area: 97,200 ha.
Altitude: 18-25 m below sea level.
Overview: A large, shallow, brackish bay at the extreme southeast corner of the Caspian Sea, cut off from the open sea except at its eastern end by a long sandy peninsula, and with extensive freshwater marshes at its western end and along the south side; of great importance as spawning and nursery grounds for fishes, and of outstanding importance for breeding, passage and wintering waterfowl of a very wide variety of species. The greater part of the wetland is protected in the Miankaleh Wildlife Refuge; the entire wetland has been designated as a Ramsar Site along with the nearby Lapoo-Zargmarz Ab-bandans.
Physical features: Gorgan Bay is a large shallow inlet at the extreme southeast corner of the Caspian Sea, almost totally cut off from the open sea by the 60 km long Miankaleh Peninsula - a low sandy peninsula with coastal dunes, pomegranate scrub and grassland. The peninsula, which covers 24,200 ha, averages about two km in width, with the narrowest point being about one km wide and the widest about 4 km. A chain of 50 metre-wide sand dunes parallels the Caspian Sea coast. The dunes, which rise to about 4 m above the sea level, form the highest points in the area. Gorgan Bay (23,800 ha) has a muddy bottom, and is oligotrophic, with a salinity of 10-12 p.p.t. It receives freshwater inflow from a number of small rivers and streams rising on the humid north slope of the Alborz Mountains to the south. There are extensive

freshwater marshes at the west end of the bay and along its south shore, where freshwater inflow is greatest. These are flooded in autumn and winter, and are eutrophic due to the inflow of numerous streams, agricultural run-off and irrigation channels. There are also extensive tracts of seasonally flooded *Tamarix* woodland at the west end of the bay.

The rise in level of the Caspian Sea during the last decade has resulted in a marked increase in the level of Gorgan Bay and re-flooding of all those bare flats at the west end of the bay which had been exposed by falling sea levels during the previous decades. On the seaward side of the peninsula, the sandy beach has virtually disappeared, and no longer provides easy vehicular access to the fishing village of Ashuradeh at the extreme eastern tip of the peninsula.

The climate is characterized by warm, humid summers and mild winters, with a relatively low annual range in temperature. The annual rainfall varies from as little as 200 mm to over 1,000 mm, with rain falling throughout the year but mainly in winter. Temperatures range from -6°C to +34°C. Frosts and snowfalls are rare due to the warming effects of the Caspian Sea.

Ecological features: Most of the peninsula is covered with a carpet of herbaceous plants and grasses, such as *Agropyron*, *Bromus*, *Dactylis*, *Cynodon* and *Festuca*. The western half also supports scrubby woodland with scattered Wild Pomegranate (*Punica granatum*), hawthorn (*Crataegus* sp.), rhamnus (*Rhamnus* sp.) and blackberry (*Rubus* sp.). There are a few large willow trees (*Salix* sp.) planted around some of the shepherds' houses. Much of the shoreline of the bay is fringed with a broad belt of *Juncus* sp. and there are some large areas of *Salicornia* flats. The extensive seasonally flooded marshes at the west end of the bay are dominated by sedges (*Carex* spp.), with small patches of *Phragmites*, clumps of *Juncus* and a large stand of *Tamarix*. This tamarisk forest increased greatly in size as water levels fell during the early 1970s, but has since started to die back as the Caspian level has risen again. Cultivation bordering the bay in the south is predominantly wheat and cotton.

Land tenure: Public (Government).

Conservation measures taken: The entire area (97,200 ha) was designated as a Protected Region in May 1970. Cultivated land along the southern edge of the bay was subsequently excised from the reserve, reducing the area to 68,800 ha, and the reserve was upgraded to Wildlife Refuge. This refuge includes Miankaleh Peninsula, the open waters of Gorgan Bay and the marshes at the west end of the bay. Miankaleh Peninsula, Gorgan Bay and the nearby Lapoo-Zargmarz Ab-bandans were designated as a Ramsar Site of 100,000 ha on 23 June 1975. The entire Wildlife Refuge (68,800 ha) was designated as a UNESCO (MAB) Biosphere Reserve in June 1976. The site has been identified as an "Important Bird Area" by BirdLife International (Evans, 1994).

Conservation measures proposed: Various recommendations for management have been made by Harrington and Scott (1972), Matthews (1973) and van Beuningen *et al.* (1975). A Ramsar Monitoring Procedure Mission to the site in January 1992 concluded that the construction of a proposed paved highway along the peninsula would have a detrimental effect on the reserve and should not proceed (Scott & Smart, 1992).

Land use: Fishing in Gorgan Bay and in the inshore waters of the adjacent Caspian Sea. There is a fishing village with about 300 inhabitants (1970) and fish processing factory at the eastern end of the peninsula (Ashuradeh), and there are about ten small fishing stations scattered along the Caspian shore of the peninsula. Much of the peninsula is heavily grazed by flocks of sheep, goats and water buffalo, and there are several small farms within the reserve. In 1975, it was estimated that there were about 8,700 sheep, 3,090 water buffalo, 2,900 cows and 200 horses on

the peninsula. Land to the south and west of the bay is under cultivation, mainly for wheat and cotton. There are several small villages along the southern edge of the bay linked by road and rail, and a large power station is situated on the Caspian shore about 10 km west of the reserve.

Possible changes in land use: None known.

Disturbances and threats: Some poaching occurred in the 1970s along the southwestern boundary of the reserve, but this was not thought to be a serious problem. However, poaching has increased considerably in recent years, and now occurs throughout the reserve. Much of the peninsula is open to livestock grazing, and in the western portion of the reserve this has been excessive. The number of cattle has increased in recent years; shacks have been built, and the cattle herders appear to be settling in. Irrigation schemes on agricultural land to the south and west reduce the flow of freshwater into the marshes and bay, especially in summer. The major threat to the area is the construction of an asphalt highway down the centre of the peninsula to provide easy access to the fishery stations along the beach and at Ashuradeh. A highway was constructed up to the western boundary of the reserve in the late 1980s, but work was halted following intervention by the Department of the Environment. Recent reports indicate that work on the road has resumed. While the road itself might not have any significant impact on the wetland ecosystems, the greatly increased access to the reserve will inevitably lead to increased pressure for settlement, increased farming activities and increased poaching.

Hydrological and biophysical values: Gorgan Bay is a very important spawning and nursery area for economically important species in the Caspian Sea fishery.

Social and cultural values: The bay and adjacent inshore waters of the Caspian Sea support an important commercial fishery.

Noteworthy fauna: Miankaleh Wildlife Refuge is undoubtedly one of the finest waterfowl reserves in the Western Palearctic Region. Some 126 species of waterfowl have been recorded, of which about 40 have occurred in internationally significant numbers. The reserve is extremely important throughout the year, supporting perhaps as many as 250,000 waterfowl throughout the winter months and large breeding colonies of herons, egrets, pratincoles and terns in summer. It also serves as a major staging area for waterbirds and land-birds during the spring and autumn migration seasons, and is the most important staging area for many species of shorebirds in the South Caspian region. The reserve is especially noted for its large wintering populations of grebes, *Pelecanus crispus* (up to 690), *Phalacrocorax carbo* (up to 15,000), herons, *Phoenicopterus ruber* (up to 25,000), swans, geese, surface-feeding ducks, diving ducks, shorebirds and gulls, and its breeding colonies of herons and egrets, *Glareola pratincola* (over 500 pairs) and *Sterna albifrons* (300-400 pairs). *Botaurus stellaris* is an occasional winter visitor; it was heard booming in the western marshes in April 1973 and may have bred. Peak counts of the commoner species are given in Table 12. Rare visitors and vagrants have included *Gavia stellata*, *Anser fabalis*, *Aythya marila*, *Mergus merganser*, *Porzana parva*, *Grus virgo*, *Glareola lactea*, *Charadrius mongolus*, *Eudromias morinellus*, *Phalaropus fulicarius*, *Stercorarius pomarinus* and *Larus melanocephalus*.

The 1.8 m rise in the level of the Caspian Sea since 1978 has had a profound influence on waterfowl populations in the marshes at the west end of Gorgan Bay, which are now permanently flooded. These marshes formerly held between 3,000 and 10,000 *Anser anser*, 4,000-5,000 *A. erythropus* and huge numbers of surface-feeding ducks. Large numbers of waterfowl continue to winter in the marshes, but the great majority of these are now *Fulica atra*, a species which was relatively uncommon in the 1970s (usually between 500 and 2,500).

Only small numbers of *Anser anser* have been observed in recent years, and no *A. erythopus* have been recorded since 1989. These changes in bird populations are clearly related to the increased depth of water in the western marshes.

Nine globally threatened species of waterfowl have been recorded in the reserve. *Phalacrocorax pygmaeus* is a regular winter visitor in small numbers to the western marshes between October and March (maximum 28). *Pelecanus crispus* is a common winter visitor to Gorgan Bay and the adjacent Caspian Sea between October and March. Up to 350 were recorded during the 1970s, but as many as 690 were observed in the 1980s; at least 355 were present in January 1992. *Anser erythropus* was a regular winter visitor in the 1970s, with the flocks arriving in October and departing in April. Numbers in mid-winter built up rapidly from 1,350 in 1970/71 to peaks of 4,900 in 1974/75 and 4,400 in 1975/76. Numbers then fell rapidly again in the late 1970s, and the flocks disappeared in the early 1980s, presumably because the rise in the Caspian Sea had flooded their main feeding area. A small flock of 19 *Branta ruficollis* was present with the *A. erythropus* flock in the winter of 1975/76. *Marmaronetta angustirostris* is an occasional passage migrant; 29 were recorded in late February 1972 and three in October 1978. *Aythya nyroca* occurs in very small numbers on passage and in winter (maximum 9 in August). *Oxyura leucocephala* is a regular winter visitor in small numbers to Gorgan Bay and the channel at Ashuradeh. There are usually less than 20 birds, but at least 453 were present in the severe winter of 1971/72. *Vanellus gregarius* and *Numenius tenuirostris* have both occurred as scarce passage migrants, the former in October/November 1971, and the latter in August 1963.

The reserve is also very important for its large populations of raptors. Twenty-eight species have been recorded. Breeding species include *Pandion haliaetus* (several pairs, with up to 14 birds on passage), *Circaetus gallicus* (several pairs) and *Haliaeetus albicilla* (at least two pairs bred on the peninsula in the 1970s). The latter is also very common in winter, with between 50 and 100 individuals present in the reserve (maximum count on one day 47). Other wintering raptors include *Circus cyaneus* (maximum 21), *C. macrourus* (maximum 4 in winter but up to 20 on passage), *C. aeruginosus* (maximum 30), *Buteo lagopus* (maximum 2), *Aquila heliaca* (maximum 6), *A. clanga* (maximum 4), *Falco cherrug* (maximum 4), *F. peregrinus* (maximum 9) and *F. columbarius* (maximum 16). *Circus pygargus* occurs as a scarce passage migrant in spring and autumn, and *Haliaeetus leucoryphus* has been recorded (an immature in August 1975).

Francolinus francolinus and *Phasianus colchicus* are common in the scrubby areas of the peninsula. The Little Bustard *Tetrax tetrax* was a common winter visitor to the peninsula in the early 1970s (October to March) in flocks of over 100 birds (maximum count of 602 in January 1972). A few pairs were present throughout the summer and presumably bred. Numbers fell rapidly in the late 1970s and early 1980s; small flocks were reported until the late 1980s, but none has been seen in recent years. *Chlamydotis undulata* and *Otis tarda* have also been recorded on passage. A wide variety of land-birds occur during the migration seasons, and large numbers of larks, thrushes, finches and buntings remain throughout the winter. Common breeding passerines associated with the wetlands include *Acrocephalus melanopogon* and *A. agricola*; wintering birds include *Remiz pendulinus* and *Emberiza schoeniclus*. Other notable species recorded in the reserve include *Bubo bubo*, *Asio flammeus*, *Caprimulgus aegyptius*, *Melanocorypha leucoptera*, *M. yeltoniensis*, *Phylloscopus nitidus* and *Sturnus roseus*. At least 288 species of birds have been recorded in the reserve.

The Golden Jackal (*Canis aureus*) and Wild Boar (*Sus scrofa*) are abundant in the reserve, and the Jungle Cat (*Felis chaus*) also occurs. Caspian Seals (*Phoca caspica*) occasionally haul out on the Caspian beach.

Noteworthy flora: No information.

Scientific research and facilities: Annual mid-winter waterfowl censuses have been carried out by the Ornithology Unit, Department of the Environment, since 1968. Many ornithological surveys have been undertaken at other times of the year, including comprehensive waterfowl censuses in mid-November in 1972, 1973 and 1974. Some bird ringing was carried out in the 1970s, particularly of migratory shorebirds. A considerable amount of limnological and fisheries research has been conducted by the National Fisheries Organization (Shilot), and there is a large Fisheries Station at Ashuradeh, at the eastern end of the peninsula. Feeny *et al.* (1968) investigated bird migration in autumn, Harrington and Scott (1972) and Matthews (1973) considered management options for the reserve, and van Beuningen *et al.* (1975) investigated land-use problems. Accommodation facilities are available for visiting researchers at two Game Guard Stations on the peninsula.

Management authority and jurisdiction: Department of the Environment.

References: Anstey (1989); van Beuningen *et al.* (1975); Carnie (1973); Carp (1980); Division of Research and Development (1972); Evans (1994); Feeny *et al.* (1968); Firouz & Ferguson (1970b); Green (1993); Gretton (1991); Harrington & Scott (1972); Mansoori (1984); Matthews (1973); Ramsar Convention Bureau (1993); Savage & Firouz (1968); Scott (1976a, 1976b, 1976c, 1978a, 1993); Scott & Smart (1992); Summers *et al.* (1987); Vahedi (1982); WCMC (1990).

Reasons for inclusion: 1a, 1c, 2a, 2b, 2c, 3a & 3c. The wetlands of Miankaleh Peninsula and Gorgan Bay are an outstanding example of a natural sand spit/coastal lagoon system characteristic of the South Caspian. They play a substantial hydrological and ecological role in the functioning of the coastal systems of the southeast Caspian, and support an extremely diverse wetland fauna and flora. Gorgan Bay is an important breeding and nursery grounds for various fish species, while the peninsula and marshes support large breeding colonies of Ardeidae, Laridae and several species of shorebirds. The wetlands provide important wintering habitat for four threatened species of birds: *Pelecanus crispus*, *Phalacrocorax pygmaeus*, *Oxyura leucocephala* and *Aquila heliaca*, and were formerly of great importance for wintering *Anser erythropus*. Five other threatened species of waterfowl have occurred as occasional visitors in small numbers. The wetlands regularly hold well in excess of 20,000 waterfowl; they support over 1% of the regional breeding populations of *Glareola pratincola* and *Sterna albifrons*, and during the migration seasons and in winter, support over 1% of the regional populations of at least 32 other species of waterfowl.

Source: Derek A. Scott.

Gomishan Marshes and Turkoman Steppes (21)

Location: 37°15'N, 53°55'E; on the east coast of the Caspian Sea from the region of Gomishan north and northwest for about 35 km to the border with the Republic of Turkmenistan,

Mazandaran.
Area: c.20,000 ha including 4,850 ha of lagoons.
Altitude: 23 m below sea level.
Overview: A large area of shallow brackish lagoons and seasonally flooded steppe on the plains to the east of the Caspian Sea; of great importance for breeding and wintering waterfowl of a wide variety of species. Part of the wetland has been designated as a No-hunting Area.
Physical features: In the 1970s, the Gomishan wetlands consisted of a chain of narrow, brackish lagoons behind the Caspian Sea beach, stretching from two km north of the town of Gomishan north to the Turkmenistan border (and beyond). In the east, the wetland bordered on a vast area of low-lying plains with halophytic vegetation. The recent 1.8 m rise in the level of the Caspian Sea has resulted in extensive flooding of these plains, with the result that the Gomishan Marshes now comprise a large area of shallow, brackish lagoons and marshes covering at least 5,000 ha. The wetland lies at the western edge of the Turkoman Steppes, a vast region of grass-covered plains and rolling hills extending for over 100 km to the east in Iran and even further to the north in the Republic of Turkmenistan. Much of the natural grasslands in the southwest, near Gomishan Marshes, has been converted to arable land.
Ecological features: The main wetland area comprises shallow, brackish lagoons with salt marsh vegetation and seasonally-inundated flats with species of *Salicornia*, *Halostachys* and *Halocnemum*. In the west, the site is bounded by low coastal dunes with typical sand-dune vegetation and the Caspian beach. In the east, the site extends onto the short-grass plains of the Turkoman Steppes, large areas of which are under cultivation for wheat and cotton.
Land tenure: Public (Government).
Conservation measures taken: Part of the wetland has recently been designated as a No-Hunting Area, and there are plans to upgrade this to Protected Area within five years. The entire area has been identified as an "Important Bird Area" by BirdLife International (Evans, 1994).
Conservation measures proposed: It has been proposed that Gomishan Marshes be designated as a Ramsar Site.
Land use: Livestock grazing (mainly sheep and goats) and waterfowl hunting. Cultivation of wheat and cotton in the east.
Possible changes in land use: None known.
Disturbances and threats: In recent years, the wetland has been subjected to very intensive hunting pressure (shooting) during the winter months. Large areas of natural grassland in the east have been converted to agricultural land.
Hydrological and biophysical values: No information.
Social and cultural values: No information.
Noteworthy fauna: In the 1970s, when the permanent wetland area was restricted to a chain of narrow, brackish lagoons behind the Caspian beach, the area was important in summer for breeding *Himantopus himantopus* (250 pairs), *Larus genei* (50 pairs), *Gelochelidon nilotica* (20 pairs), *Sterna hirundo* (100-150 pairs), *S. albifrons* (200-300 pairs) and *Chlidonias hybridus* (100 pairs). In winter, the vast plains to the east attracted large numbers of geese (including up to 1,770 *Anser erythropus*), *Vanellus vanellus* (up to 5,000) and *Pterocles alchata* (up to 50,000). About 160 *Syrrhaptes paradoxus* were found amongst the large flocks of *P. alchata* in December 1970, and the species may be a regular winter visitor to this area. Other birds recorded in winter included *Pluvialis apricaria* (up to 5), *Nyctea scandiaca* (one in December

1974), *Bubo bubo* and *Melanocorypha leucoptera*. *Charadrius leschenaultii* was a regular passage migrant, with up to 60 occurring in July. In recent years, the rise in level of the Caspian Sea has flooded large areas of former *Salicornia* flats, creating large lagoons which have rapidly become of great importance for wintering waterfowl of many species, notably *Pelecanus crispus* (maximum 334), *Phoenicopterus ruber* (maximum 55,000), *Anser anser* (maximum 3,200), dabbling ducks (regularly over 50,000), *Fulica atra* (maximum 65,000) and *Himantopus himantopus* (maximum 1,700). Peak counts of wintering waterfowl in recent years are given in Table 13. *Haliaeetus albicilla* and *Aquila heliaca* are regular winter visitors (maxima of 4 and 3 respectively), and there is a breeding colony of *Falco naumanni* (20 pairs) in the town of Bandar-e Shah at the southern edge of the site.
The Golden Jackal (*Canis aureus*) is common in the area.
Noteworthy flora: No information.
Scientific research and facilities: Mid-winter waterfowl censuses have been carried out by the Ornithology Unit, Department of the Environment, in most years since 1969, and breeding-season surveys have been undertaken on several occasions.
Management authority and jurisdiction: No information.
References: Division of Research and Development (1972); Evans (1994); Scott (1976a, 1976c); Scott & Smart (1992).
Reasons for inclusion: 1a, 2a, 3a & 3c. The Gomishan Marshes and Turkoman Steppes are a good representative example of a natural coastal wetland of the eastern Caspian region. The wetlands provide important wintering habitat for two globally threatened species of birds: *Pelecanus crispus* and *Aquila heliaca*, and were formerly of great importance for wintering *Anser erythropus*. The wetlands regularly hold well in excess of 20,000 waterfowl; they support over 1% of the regional breeding populations of *Himantopus himantopus* and *Sterna albifrons*, and in winter, support over 1% of the regional populations of *Phalacrocorax carbo, Egretta alba, Ardea cinerea, Phoenicopterus ruber*, nine species of Anatidae and *Fulica atra*.
Source: Derek A. Scott.

Lake Alagol, Lake Ulmagol and Lake Ajigol (22)

Location: Lake Alagol 37°21'N, 54°35'E; Lake Ulmagol 37°25'N, 54°38'E; Lake Ajigol 37°24'N, 54°40'E; on the Turkoman Steppes near the border with Turkmenistan, about 60 km north-northeast of Gorgan, Mazandaran.
Area: 1,540 ha (Alagol 900 ha; Ulmagol 280 ha; Ajigol 360 ha); Ramsar Site 1,400 ha.
Altitude: Sea level.
Overview: A group of three small brackish and freshwater lakes with associated marshes on the rolling grassy steppes to the east of the Caspian Sea, of importance for breeding, passage and wintering waterfowl. The lakes have been designated as a Ramsar Site, but are otherwise unprotected.
Physical features: Lakes Alagol, Ulmagol and Ajigol are three small, rather isolated lakes in a region of gently undulating grassy plains on the Turkoman Steppes east of the Caspian Sea. Lake Alagol lies about 6 km to the southwest of Ulmagol and Ajigol; it is a slightly saline lake

fed by seepage, springs and local run-off, flooding in winter and drying out completely in dry summers. When full, it overflows westwards. The lake bottom consists of mud and sand, and the water is oligotrophic, supporting little aquatic vegetation. Lake Ulmagol and Lake Ajigol are eutrophic freshwater lakes fed by local rainfall in autumn and winter. Both are subject to wide fluctuations in water level, and occasionally dry out completely during periods of drought. The lakes rarely, if ever, freeze over in winter.

Ecological features: Lake Alagol supports little aquatic vegetation except for some *Juncus*, *Carex* and grasses, mainly in the northeast, and a few small patches of *Phragmites*. Ulmagol and Ajigol support a more varied vegetation of *Juncus*, *Lemna*, *Phragmites*, *Alhagi* and algae. Much of Ajigol is overgrown with *Phragmites* reeds, and there are some stands of *Tamarix* by this lake. The lakes are situated on the Turkoman Steppes, a vast region of gently undulating grasslands with low sandy hills. There are several small human settlements in the vicinity of the lake complex.

Land tenure: Public (Government).

Conservation measures taken: No legal protection. Lakes Alagol, Ulmagol and Ajigol were designated as a Ramsar Site on 23 June 1975, with the area given as 1,400 ha. The lakes have been identified as an "Important Bird Area" by BirdLife International (Evans, 1994).

Conservation measures proposed: None known.

Land use: Reed-cutting, grazing, wildfowl hunting and some fishing. In recent years, local farmers have begun to take water from Lake Alagol for irrigation purposes and for a fish hatchery. There are several small settlements in the general area.

Possible changes in land use: None known.

Disturbances and threats: The extraction of water from Lake Alagol for irrigation purposes and a fish hatchery has resulted in lower water levels in the lake, especially in summer. Ulmagol and Ajigol have long been subjected to high levels of disturbance from wildfowl hunters, and Alagol (the least accessible of the three) is also now being affected by disturbance from hunters.

Hydrological and biophysical values: No information.

Social and cultural values: No information.

Noteworthy fauna: The lakes are utilized by a wide variety of waterfowl during the migration seasons and in winter, and are especially important for *Phoenicopterus ruber* (up to 1,125), *Anser anser* (up to 750), dabbling ducks, *Netta rufina* (up to 1,700), *Mergellus albellus* (up to 250) and *Fulica atra* (up to 50,000). Breeding species include *Podiceps cristatus* (10-15 pairs), *Ixobrychus minutus*, *Himantopus himantopus* (60 pairs), *Glareola pratincola* (5 pairs), *Charadrius alexandrinus* (100 pairs), *Vanellus leucurus* (one pair) and *Larus genei* (300-350 pairs). Up to 10 *Ciconia nigra* have been recorded in summer, and may breed in the area. Small flocks of *Anser erythropus* (150) and *Oxyura leucocephala* (19) have been recorded at the lakes in winter, and single *Gavia arctica* and *Pelecanus crispus* have been recorded. Peak counts of wintering waterfowl are given in Table 14. Birds of prey are common in winter, with up to 9 *Haliaeetus albicilla*, 6 *Circus cyaneus*, 5 *Aquila heliaca*, 3 *Falco columbarius*, 3 *Asio otus* and 2 *A. flammeus*, and the occasional *Aegypius monachus*, *Buteo lagopus* and *Falco cherrug*. *Francolinus francolinus*, *Remiz pendulinus* and *Passer hispaniolensis* breed in the tamarisk thickets, and *Acrocephalus arundinaceus* is a common summer visitor to the reed-beds. *Luscinia svecica* is a winter visitor, and *Panurus biarmicus* has occurred (20 in December 1970).

Noteworthy flora: No information.
Scientific research and facilities: Annual mid-winter waterfowl censuses have been carried out by the Ornithology Unit, Department of the Environment, since 1969, and breeding-season surveys have been undertaken on several occasions. Two M.Sc. students from Tehran University are currently conducting research on the avifauna and physico-chemical characteristics of the lakes, respectively.
Management authority and jurisdiction: The Ramsar Site is administered by the Department of the Environment.
References: Carp (1980); Evans (1994); Firouz & Ferguson (1970b); Mansoori (1984); Ramsar Convention Bureau (1993); Scott (1976a, 1976c); Vahedi (1982); WCMC (1990).
Reasons for inclusion: 1a, 2a, 3a & 3c. Lakes Alagol, Ulmagol and Ajigol are good representative examples of natural brackish and freshwater lakes characteristic of the vast plains to the east of the Caspian Sea. They provide wintering habitat for four threatened species of birds (*Pelecanus crispus*, *Anser erythropus*, *Oxyura leucocephala* and *Aquila heliaca*), and regularly hold over 20,000 waterfowl in winter, including over 1% of the regional populations of *Anas strepera*, *Aythya fuligula* and *Fulica atra*.
Source: Derek A. Scott.

Incheh Borun Lake (23)

Location: 37°13'N, 54°30'E; on the Turkoman Steppes about 40 km north of Gorgan, Mazandaran.
Area: 50 ha.
Altitude: Sea level.
Overview: A small, isolated, freshwater lake with associated marshes on the rolling plains of the Turkoman Steppes, important for wintering waterfowl and birds of prey. Unprotected.
Physical features: No information.
Ecological features: Freshwater lake and marshes; grassy steppe and arable land in surrounding areas.
Land tenure: No information.
Conservation measures taken: None. The site has been identified as an "Important Bird Area" by BirdLife International (Evans, 1994).
Conservation measures proposed: None known.
Land use: No information.
Disturbances and threats: No information.
Hydrological and biophysical values: No information.
Social and cultural values: No information.
Noteworthy fauna: A wintering area for a wide variety of waterfowl including up to 135 *Egretta alba*, 123 *Ardea cinerea*, 225 *Phoenicopterus ruber*, 185 *Cygnus olor*, 44 *Anser anser*, 150 *Tadorna tadorna*, 360 *Anas platyrhynchos*, 60 *Netta rufina*, 250 *Mergellus albellus*, 10 *Mergus merganser* and 220 *Fulica atra*. Small flocks of *Anser erythropus* (36) and *Oxyura leucocephala* (4) have been recorded in winter, and *Branta ruficollis* has occurred (one in

February 1973). *Haliaeetus albicilla* and *Aquila heliaca* are regular winter visitors, and *Aegypius monachus* occurs in the area. About 10 pairs of *Himantopus himantopus* breed at the lake. The surrounding plains are probably an important staging area for *Charadrius asiaticus*; up to 110 have been recorded at the site in July.
Noteworthy flora: No information.
Scientific research and facilities: Annual mid-winter waterfowl censuses have been carried out by the Ornithology Unit, Department of the Environment, since 1971, and breeding-season surveys have been undertaken on several occasions.
Management authority and jurisdiction: No information.
References: Evans (1994); Scott (1976a).
Reasons for inclusion: 2a. Incheh Borun lake and marshes are a regular wintering area for *Aquila heliaca*, a globally threatened species. Two other threatened species, *Anser erythropus* and *Oxyura leucocephala*, are occasional winter visitors in small numbers.
Source: Derek A. Scott.

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Voshmigir Dam (24)

Location: 37°12'N, 54°45'E; on the Gorgan Rud (River), about 50 km north-northeast of Gorgan and 35 km west of Gonbad-e Qaboos, Mazandaran.
Area: 500 ha.
Altitude: 10 m.
Overview: A small reservoir at the southern edge of the Turkoman Steppes, important for wintering waterfowl, notably *Mergellus albellus*. Unprotected.
Physical features: A small water storage reservoir on the Gorgan River, in a region of steppic plains and arable land. The water level fluctuates widely, and extensive bare mudflats are exposed at low water levels. In most places, the banks are steeply shelving, and there is little emergent marsh vegetation.
Ecological features: The reservoir supports little aquatic vegetation. The surrounding plains are almost entirely under cultivation.
Land tenure: No information.
Conservation measures taken: None. The site has been identified as an "Important Bird Area" by BirdLife International (Evans, 1994).
Conservation measures proposed: None.
Land use: A water storage reservoir, used for irrigation.
Possible changes in land use: None known.
Disturbances and threats: No information.
Hydrological and biophysical values: No information.
Social and cultural values: No information.
Noteworthy fauna: An important wintering area for grebes and ducks, and a staging area for shorebirds. Wintering birds include up to 63 *Podiceps cristatus*, 40 *Egretta alba*, 550 *Anas crecca*, 1,660 *A. platyrhynchos*, 340 *Netta rufina*, 770 *Aythya ferina*, 250 *A. fuligula*, 15 *A. nyroca*, 11 *Bucephala clangula*, 340 *Mergellus albellus*, 430 *Recurvirostra avosetta* and 200

Larus ridibundus. A few *Pelecanus crispus* have also been recorded. Peak counts of shorebirds during autumn migration have included 53 *Charadrius dubius*, 350 *C. alexandrinus*, 110 *Calidris minuta*, 420 *C. ferruginea*, 200 *Philomachus pugnax* and 20 *Tringa ochropus*. About 15 pairs of *Chlidonias hybridus* and 40 pairs of *Sterna albifrons* breed around the dam. *Buteo lagopus* and *Falco columbarius* are occasional winter visitors.
Noteworthy flora: No information.
Scientific research and facilities: Annual mid-winter waterfowl censuses have been carried out by the Ornithology Unit, Department of the Environment, since 1972, and breeding-season surveys have been undertaken on several occasions.
Management authority and jurisdiction: No information.
References: Evans (1994); Scott (1976a).
Reasons for inclusion: 2a & 3c. Voshmigir Dam supports small numbers of *Aythya nyroca*, a globally threatened species, and regularly supports over 1% of the regional wintering populations of *Mergellus albellus* and *Recurvirostra avosetta*.
Source: Derek A. Scott.

Lake Bibishervan and Lake Eymar (25)

Location: Lake Bibishervan 37°09'N, 54°52'E; Lake Eymar 37°08'N, 54°52'E; on the southern edge of the Turkoman Steppes, 30 km west-southwest of Gonbad-e Qaboos, Mazandaran.
Area: 550 ha (Bibishervan 300 ha; Eymar 250 ha).
Altitude: 25 m.
Overview: Two small, rather isolated, freshwater lakes and marshes at the southern edge of the Turkoman Steppes, important for breeding and wintering waterfowl. Unprotected.
Physical features: Two shallow freshwater lakes, Lake Bibishervan (Byby Shirvan) and Lake Eymar, with fringing reed-beds and sedge marshes. The lakes are surrounded by cultivated plains of the Turkoman Steppes.
Ecological features: Freshwater lakes and marshes with some *Phragmites* reed-beds; in a region of cultivated plains.
Land tenure: No information.
Conservation measures taken: None. The lakes have been identified as an "Important Bird Area" by BirdLife International (Evans, 1994).
Conservation measures proposed: None known.
Land use: No information.
Disturbances and threats: No information.
Hydrological and biophysical values: No information.
Social and cultural values: No information.
Noteworthy fauna: An important wintering area for a wide variety of waterfowl including up to 52 *Cygnus olor*, 400 *Anas crecca*, 2,000 *A. platyrhynchos*, 200 *A. acuta*, 740 *Netta rufina*, 900 *Aythya ferina*, 210 *A. fuligula*, 1,845 *Fulica atra*, 3,000 *Vanellus vanellus*, 70 *Larus minutus* and 150 *L. canus*. *Cygnus cygnus* (maximum 8), *Mergellus albellus* (maximum 11), *Oxyura leucocephala* (maximum 6) and *Calidris temminckii* (maximum 8) have also occurred

in winter. Breeding birds include a few pairs of *Ixobrychus minutus*, 10 pairs of *Himantopus himantopus*, about 75 pairs of *Glareola pratincola*, at least one pair of *Vanellus leucurus*, 150 pairs of *Chlidonias hybridus*, and many *Acrocephalus melanopogon* and *A. arundinaceus*. *Tetrax tetrax* was probably a regular winter visitor to the area in the 1970s, with a flock of 430 on the plains by the lakes in February 1972. *Buteo lagopus*, *Falco columbarius* and *Panurus biarmicus* have been recorded in winter, and up to 10 *Aquila clanga* have been observed on autumn migration. *Passer hispaniolensis* is a very common resident, with concentrations of over 1,000 recorded during the winter months.

Noteworthy flora: No information.

Scientific research and facilities: Annual mid-winter waterfowl censuses have been carried out by the Ornithology Unit, Department of the Environment, since 1969, and breeding-season surveys have been undertaken on several occasions.

Management authority and jurisdiction: No information.

References: Evans (1994); Scott (1976a, 1976c).

Reasons for inclusion: 1a (possibly also 2a). Lakes Bibishervan and Eymar are good representative examples of natural freshwater lakes characteristic of the vast plains to the east of the Caspian Sea. One threatened species of waterfowl, *Oxyura leucocephala*, has occurred in small numbers.

Source: Derek A. Scott.

Lake Zaribar (26)

Location: 35°32'N, 46°07'E; in the foothills of the western Zagros Mountains near the Iraq border, 3 km west of the town of Marivan and 85 km west-northwest of Sanandaj, Kurdistan.

Area: 1,550 ha.

Altitude: 1,285 m.

Overview: A relatively deep, freshwater lake with extensive fringing marshes in the western Zagros Mountains, very important as a breeding area for waterfowl, notably *Oxyura leucocephala*, and also important as a wintering area for a wide variety of Anatidae including *Mergus merganser*. Unprotected.

Physical features: Lake Zaribar is a relatively deep, permanent freshwater lake with extensive reed-beds and sedge marshes at its northern and southern ends, set in a broad valley in the Western Zagros. The water is very clear, with an average depth of about 3.5 m and maximum depth of 6 m. The lake receives most of its water from springs, especially a large spring at the northeast corner, and there are only a few small streams entering the lake. The annual fluctuation in water level is about 1.5 m; at high levels, the lake overflows into a small river at its south end. It is often frozen over during mid-winter. Soils are lomy clay and silt. The plains to the north and south of the lake are intensively cultivated, while the steep hillsides to the east and west are covered in oak woodland and scrub.

The climate is characterized by hot dry summers and cold winters, with an average annual rainfall of 78 mm and a mean annual temperature of 13°C.

Ecological features: The extensive marshes at the north and south ends of the lake are

dominated by *Phragmites australis*, *Typha* sp., *Juncus* spp. and *Cyperus* sp., with scattered clumps of *Salix* sp. and *Populus* sp. Other common aquatic plants include *Nymphaea alba*, *Hippuris vulgaris*, *Ranunculus lingua*, *Utricularia vulgaris*, *Alisma lanceolatum*, *Botumis umbellatus*, *Lemna* sp. and *Veronica* sp. Wet meadows adjoin the marshes, while the surrounding plains are mainly arable land (principally wheat), with orchards and poplar groves. Nearby stony hillsides support heavily grazed oak scrub on the lower slopes and taller, less disturbed oak forest on the upper slopes.

Land tenure: Public (Government); surrounding areas are in private ownership.

Conservation measures taken: None. The lake has been identified as an "Important Bird Area" by BirdLife International (Evans, 1994).

Conservation measures proposed: None known.

Land use: Fishing and waterfowl hunting at the lake; agriculture and livestock grazing in surrounding areas. Some reeds are harvested for construction purposes and fuel. There is a small resort area at the southeast corner of the lake.

Possible changes in land use: Increasing development for tourism and outdoor recreation.

Disturbances and threats: Some of the peripheral marshes have been drained for agriculture, and drainage channels have been constructed near the lake. A government organization has recently introduced three exotic fish species into the lake. The exotic fish *Pseudorasbora parva* has also recently colonized the lake and become extremely abundant, possibly to the detriment of native species. The lake was badly affected during the prolonged Iran/Iraq war in the 1980s because of hits by missiles and rockets. Some of the reed-beds were destroyed, and parts of the lake became deeper while other parts dried out. The lake is also reported to have been damaged by chemical warfare during this war (Ashtiani-Zarandi, 1990). Oak forest on the lower slopes around the lake has been badly degraded by overgrazing and cutting for fuelwood.

Hydrological and biophysical values: Flood control and maintenance of water quality.

Social and cultural values: Outdoor recreation in summer.

Noteworthy fauna: The extensive marshes around the lake are important for breeding waterfowl, including 50-100 pairs of *Podiceps cristatus*, at least 25 pairs of *Tachybaptus ruficollis*, many *Ixobrychus minutus*, at least ten pairs of *Ardea purpurea*, several pairs of *Anser anser*, 20-50 pairs of *Aythya nyroca*, several pairs of *Oxyura leucocephala*, many *Rallus aquaticus* and 50 pairs of *Vanellus vanellus*, along with five pairs of *Circus aeruginosus* and many *Acrocephalus melanopogon*, *A. arundinaceus* and *Remiz pendulinus*. At least eight adult *O. leucocephala* and six chicks were present in July 1974, along with a total of 250 *A. nyroca*. There is an exceptionally large breeding colony of *Ciconia ciconia* (about 120 pairs) in a patch of forest to the north of the lake, and the marshes provide important feeding habitat for the birds from this colony. The lake is also of some importance for wintering waterfowl, especially diving ducks, and is the most important wintering site for *Mergus merganser* in Iran (maximum 35). The wintering waterfowl include up to 20 *Anser albifrons*, 110 *A. anser*, 360 *Anas strepera*, 455 *A. crecca*, 2,060 *A. platyrhynchos*, 30 *Netta rufina*, 3,000 *Aythya ferina*, 4,000 *A. fuligula*, 150 *Mergellus albellus*, 16,000 *Fulica atra*, 450 *Vanellus vanellus* and 50 *Gallinago gallinago*. Three *Marmaronetta angustirostris* were present in January 1975, and *Phoenicopterus ruber* has occurred (9 in February 1994). Passage migrants have included up to 13 *Plegadis falcinellus* and 35 *Tringa glareola*.

Ten species of fish have been recorded in the lake, although only three of these are indigenous: *Capoeta buhsei* and *Leuciscus cephalus* (Cyprinidae) and *Mastacembelus mastacembelus*

(Mastacembelidae). The introduced species are *Ctenopharyngodon idella*, *Cyprinus carpio* (two varieties), *Hypophthalmichthys molitrix*, *H. nobilis*, *Pseudorasbora parva*, *Alburnus charusni* and *Gambusia affinis*.
Noteworthy flora: No information.
Scientific research and facilities: Annual mid-winter waterfowl censuses have been carried out by the Ornithology Unit, Department of the Environment, since 1970, and breeding-season surveys have been undertaken on several occasions. Investigations have also been carried out on the fish fauna. Little work was possible in the area in the 1980s because of the conflict with Iraq.
Recreation and tourism: A resort hotel is being constructed beside the lake, and efforts are being made to promote tourism and outdoor recreation in the area.
Management authority and jurisdiction: Department of the Environment.
References: Anstey (1989); Ashtiani-Zarandi (1990); Evans (1994); Firouz & Ferguson (1970b); Fotoohi & Scott (1975); Scott (1976a, 1976c).
Reasons for inclusion: 1d, 2a, 2b & 3c. Lake Zaribar is a good example of a relatively deep freshwater lake at medium elevation in the uplands of western Iran, and one of the few such lakes in this part of the Middle East. It supports a rich and varied wetland fauna and flora, and thus plays a significant role in maintaining the genetic and ecological diversity of the region. The lake is an important breeding area for two globally threatened species of waterfowl: *Aythya nyroca* and *Oxyura leucocephala*. In winter, it regularly supports over 1% of the regional population of *Aythya fuligula*.
Source: Mohammad Nosrati and Derek A. Scott.

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Hashelan Marsh (27)

Location: 34°33'N, 46°55'E; in a broad intermontane basin in the western Zagros Mountains about 20-30 km northwest of Kermanshah, Kermanshah Province.
Area: 400 ha.
Altitude: c.1,500 m.
Overview: A complex of permanent spring-fed pools and marshes in an area of cultivated plains in the uplands of western Iran, important both for breeding and wintering waterfowl, notably *Aythya nyroca*. Unprotected.
Physical features: Hashelan Marsh is a small area of permanent freshwater pools and marshes fed by a group of large springs, at the northern end of a very flat cultivated plain which extends to the region of Doh Tappeh about 10 km to the south. The wetland is bordered to the north, east and west by hill ranges. There are several small villages in the area.
Ecological features: Freshwater pools with abundant submerged and floating aquatic vegetation, and extensive emergent marshes dominated by sedges and rushes. The adjacent plains support heavily-grazed pastureland and cultivation (mainly cereals); adjacent rocky hillsides support semi-arid steppic vegetation.
Land tenure: Public (Government).
Conservation measures taken: None. The marshes, along with a large area of the surrounding

plains, have has been identified as an "Important Bird Area" by BirdLife International (Evans, 1994).

Conservation measures proposed: The establishment of a reserve encompassing the wetlands and an area of plains to the south was proposed in the 1970s, but this was never implemented.

Land use: Agriculture, livestock grazing and some wildfowl hunting.

Possible changes in land use: None known.

Disturbances and threats: There is a considerable amount of duck-hunting at the marsh. The plains are densely populated and disturbance levels are high. However, recent reports indicate that the wetland remains in reasonably good condition.

Hydrological and biophysical values: No information.

Social and cultural values: No information.

Noteworthy fauna: Hashelan Marsh supports breeding populations of *Tachybaptus ruficollis* (at least 20 pairs), *Ardea purpurea* (several pairs), *Aythya nyroca* (several pairs), *Rallus aquaticus*, *Vanellus vanellus* (at least 25 pairs) and *Acrocephalus melanopogon*. *Ciconia ciconia* is a common summer visitor, with about 15-20 pairs breeding in the area. The marsh is also of some importance for wintering waterfowl, with up to 100 *Tachybaptus ruficollis*, 50 *Egretta alba*, 800 *Anas platyrhynchos*, 130 *Aythya nyroca*, 620 *Fulica atra* and 20 *Gallinago gallinago*. Waterfowl recorded on passage include up to 20 *Ardeola ralloides*, 250 *Anas querquedula*, 12 *Tringa ochropus* and 80 *Chlidonias leucopterus*. *Circus aeruginosus* is a regular winter visitor to the marsh (maximum 6), and *Neophron percnopterus* is a regular summer visitor to the area. The Great Bustard *Otis tarda* was a summer visitor to the plains near Doh Tappeh, about 10 km south of the wetland, in the 1970s. Between five and 10 females were thought to nest in the area.

Noteworthy flora: No information.

Scientific research and facilities: Annual mid-winter waterfowl censuses have been carried out by the Ornithology Unit, Department of the Environment, since 1970, and breeding-season surveys have been undertaken on several occasions. The wetland is currently being investigated by the Department of the Environment.

Management authority and jurisdiction: No information.

References: Evans (1994); Fotoohi & Scott (1975); Scott (1976a).

Reasons for inclusion: 1a, 2a, 2b & 3c. Hashelan Marsh is a good representative example of natural spring-fed wetland characteristic of the uplands of western Iran. It supports a rich and varied fauna and flora, and thus plays a significant role in maintaining the genetic and ecological diversity of the region. In winter, it regularly supports over 1% of the regional population of *Aythya nyroca*, a globally threatened species.

Source: Derek A. Scott.

Dez Dam (28)

Location: 32°38'N, 48°28'E; on the Dez River in the southwestern foothills of the Zagros Mountains, about 15 km northeast of the city of Dezful, Khuzestan.
Area: 1,500 ha.
Altitude: c.230 m.
Overview: A large water storage reservoir on the Dez River in the arid foothills of the southwestern Zagros Mountains, northeast of the town of Dezful; important for wintering waterfowl including *Marmaronetta angustirostris*. Unprotected.
Physical features: No information.
Ecological features: No information.
Land tenure: No information.
Conservation measures taken: None. The site has been identified as an "Important Bird Area" by BirdLife International (Evans, 1994).
Conservation measures proposed: None known.
Land use: Water storage for domestic and industrial supply and irrigation.
Possible changes in land use: None known.
Disturbances and threats: No information.
Hydrological and biophysical values: No information.
Social and cultural values: No information.
Noteworthy fauna: An important site for wintering waterfowl, notably *Egretta alba* (maximum 300), *E. garzetta* (maximum 300), *Ardea cinerea* (maximum 190), *Anser anser* (maximum 4,500) and *Grus grus* (maximum 1,125). Up to 70 *Marmaronetta angustirostris* have been recorded at the site in mid-winter.
Noteworthy flora: None known.
Scientific research and facilities: Mid-winter waterfowl censuses have been carried out by the Ornithology Unit, Department of the Environment, in most years since the late 1970s.
Management authority and jurisdiction: No information.
References: Evans (1994).
Reasons for inclusion: 2a & 3c. Dez Dam provides wintering habitat for *Marmaronetta angustirostris* (a threatened species), and regularly supports over 1% of the regional populations of *Anser anser* and *Grus grus* in winter.
Source: Derek A. Scott.

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Karkheh River Marshes (29)

Location: 31°45'N, 48°25'E; along the Karkheh River on the plains of Khuzestan, about 35-90 km north-northwest of Ahwaz, Khuzestan.
Area: c.15,000 ha (3,500 ha of permanent wetlands).
Altitude: c.30-90 m.
Overview: Riverine marshes and riparian woodland along the Karkheh River in the Khuzestan

lowlands of southwestern Iran, important for wintering waterfowl and breeding *Marmaronetta angustirostris*. The greater part of the site is protected in a Wildlife Refuge and Protected Area.

Physical features: The site comprises a 55 km stretch of the Karkheh River north of the city of Ahwaz, and the adjacent marshy plains. Dense riparian forest up to several hundred metres in width lines the river banks. The river flows in a deep channel with steep earthen banks. The adjacent plains, which are largely under cultivation, are dotted with shallow marshy depressions and meandering creeks which flood in winter.

Ecological features: Dense riverine forest of *Tamarix* spp. and *Populus euphraticus*, cultivated plains (mainly wheat), and marshy depressions subject to winter flooding.

Land tenure: No information.

Conservation measures taken: A Protected Region of 18,125 ha was established in November 1960 to protect the dwindling habitat of the endangered Mesopotamian Fallow Deer (*Dama dama mesopotamica*). The reserve was reduced in size to 13,027 ha in the early 1970s, and re-notified partly as a Wildlife Refuge (3,600 ha) and partly as a Protected Area (9,427 ha). The site has been identified as an "Important Bird Area" by BirdLife International (Evans, 1994).

Conservation measures proposed: None known.

Land use: Grazing by domestic livestock and illegal cutting of firewood in the reserve; agriculture on the adjacent plains.

Possible changes in land use: None known.

Disturbances and threats: Much of the riparian forest has been degraded as a result of grazing by domestic livestock and the cutting of fuelwood. The cultivated plains are subject to high levels of disturbance from farming activities and hunters.

Hydrological and biophysical values: No information.

Social and cultural values: No information.

Noteworthy fauna: The river and adjacent floodplain are of some importance for wintering *Pelecanus crispus*, ducks and coots. Peak counts have included 62 *P. crispus*, 300 *Anas strepera*, 2,050 *A. crecca*, 605 *A. platyrhynchos*, 650 *A. clypeata*, 150 *Aythya ferina* and 2,500 *Fulica atra*. A few pairs of *Marmaronetta angustirostris* probably breed in the reserve, and up to 250 have been recorded in winter. Other wintering waterfowl have included up to 40 *Egretta alba*, 13 *Ciconia ciconia*, 10 *Anas querquedula* and three *Aythya nyroca*. *Ardeola ralloides* is common on passage (maximum 60). The riverine forest supports a typical Mesopotamian bird fauna including large breeding populations of *Hypocolius ampelinus* and *Passer moabiticus*. Other breeding species include *Francolinus francolinus*, *Ceryle rudis*, *Halcyon smyrnensis*, *Acrocephalus melanopogon*, *A. stentoreus*, *Sylvia mystacea*, *Passer hispaniolensis* and *Petronia xanthocollis*.

A tiny population of the endangered Mesopotamian Fallow Deer (*Dama dama mesopotamica*) still survived in the riparian forests along the Karkheh River until the early 1970s, but this population apparently became extinct in the mid- or late 1970s, leaving the population along the Dez River to the east as the only known extant population in the wild. Other mammals which still occur in the area include Goitred Gazelle (*Gazella subgutturosa*), Jungle Cat (*Felis chaus*), Jackal (*Canis aureus*), Honey Badger (*Mellivora capensis*), Wild Boar (*Sus scrofa*) and Crested Porcupine (*Hystrix indica*).

Noteworthy flora: The reserve contains one of the few remaining relatively undisturbed stands of native *Populus euphraticus* riverine forest, once widespread in southwestern Iran and neighbouring southern Iraq.

Scientific research and facilities: Annual mid-winter waterfowl censuses have been carried out by the Ornithology Unit, Department of the Environment, since 1971, and breeding-season surveys have been undertaken on several occasions.
Management authority and jurisdiction: Department of the Environment.
References: Evans (1994); Firouz *et al.* (1970); Green (1993); Scott (1976a, 1976b, 1976c, 1980).
Reasons for inclusion: 1d & 2a. The Karkheh River marshes contain significant stands of native riparian woodland, a habitat type which was once widespread in the lowlands of southwestern Iran and neighbouring Iraq, but is now extremely rare outside protected areas. As recently as the late 1970s, this woodland was one of only two remaining localities with wild populations of the endangered Mesopotamian Fallow Deer *Dama dama mesopotamica*. The marshes support a significant breeding population of *Marmaronetta angustirostris* and a wintering population of *Pelecanus crispus* (both threatened species).
Source: Derek A. Scott.

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Dez River Marshes and Plains (30)

Location: 31°50'N, 48°38'E; along the Dez River on the plains of Khuzestan, about 35-90 km north of Ahwaz, Khuzestan.
Area: c.20,000 ha (8,000 ha of permanent wetlands).
Altitude: 30-90 m.
Overview: Riverine marshes, riparian woodland and marshy plains along the Dez River in the Khuzestan lowlands of southwestern Iran, important for Mesopotamian Fallow Deer (*Dama dama mesopotamica*), wintering waterfowl and breeding *Marmaronetta angustirostris*. The greater part of the site is protected in a Wildlife Refuge and Protected Area.
Physical features: The site comprises a 55 km stretch of the Dez River, several associated oxbow lakes, and the adjacent marshy plains of Deh Noh and Ahu Dasht, north of the city of Ahwaz. Dense riparian forest up to several hundred metres in width lines the river banks and surrounds the oxbow lakes. The river flows in a deep channel with steep earthen banks. The adjacent plains, which are largely under cultivation for wheat and other crops, are dotted with shallow marshy depressions and meandering creeks which flood in winter.
Ecological features: Dense riparian forest of *Tamarix* spp. and *Populus euphraticus*; cultivated plains (mainly wheat), and marshy depressions subject to winter flooding. There are some stands of *Phragmites* reed-beds around the oxbow lakes.
Land tenure: No information.
Conservation measures taken: A Protected Region of 18,812 ha was established in November 1960 to protect the dwindling habitat of the endangered Mesopotamian Fallow Deer (*Dama dama mesopotamica*). Some 3,837 ha of this reserve were re-notified as a Wildlife Park in January 1970. The reserve was reduced in size to 15,873 ha in the early 1970s, and re-notified partly as a Wildlife Refuge (5,240 ha) and partly as a Protected Area (10,633 ha). Since then, the status has remained unchanged. The site has been identified as an "Important Bird Area" by BirdLife International (Evans, 1994).

Conservation measures proposed: None known.
Land use: Grazing by domestic livestock and illegal cutting of firewood in the reserve; agriculture on the adjacent plains.
Possible changes in land use: None known.
Disturbances and threats: Parts of the riparian forest have been degraded as a result of grazing by domestic livestock and the cutting of fuelwood. The cultivated plains are subject to high levels of disturbance from farming activities and hunters, and the wetlands are reported to have become very polluted in recent years.
Hydrological and biophysical values: No information.
Social and cultural values: No information.
Noteworthy fauna: The wetlands are very important for wintering cormorants, herons, egrets, geese (including up to 190 *Anser erythropus*), surface-feeding ducks and some shorebirds (see Table 15). *Pelecanus crispus* is a regular winter visitor, usually with about 30 present but occasionally as many as 160. The marshy plain is one of the best areas in Iran for *Threskiornis aethiopicus*; the species is a regular winter visitor to the area, with peak counts of 26 in January 1972, 23 in January 1973, 25 in January 1974 and 41 in January 1975. *Aythya nyroca* is a regular winter visitor in small numbers (maximum 11), and some 10-20 pairs of *Marmaronetta angustirostris* breed around the oxbow lakes. Other breeding species include *Vanellus indicus* and *V. leucurus*. The stretch of river is the only known haunt of *Anhinga rufa* in Iran. This species was a very scarce winter visitor in the 1970s, presumably from breeding areas in the Mesopotamian Marshes of neighbouring southern Iraq; three individuals were observed in January 1973, one in November 1973, and one in December 1974 and January 1975. Other scarce winter visitors have included *Botaurus stellaris*, *Branta ruficollis* (one in February 1971), *Tetrax tetrax* and *Chlamydotis undulata*. The reed-beds around the oxbow lakes are one of the very few sites in Iran where *Turdoides altirostris* is known to occur. Wintering raptors include *Circus aeruginosus* (maximum 10), *Aquila heliaca* (maximum 3) and *A. clanga* (maximum 2). *Eudromias morinellus* has been recorded on passage in autumn (maximum 8). The riverine thickets support a typical Mesopotamian bird fauna, with large breeding populations of *Streptopelia turtur* (over 1,000 birds in June 1974), *Hypocolius ampelinus* and *Passer moabiticus*, but also several species, such as *Columba palumbus*, *Turdus merula* and *Parus major*, which are more typical of Zagros oak forest. Other breeding species include *Francolinus francolinus*, *Tyto alba*, *Ceryle rudis*, *Halcyon smyrnensis*, *Acrocephalus melanopogon*, *A. stentoreus*, *Sylvia mystacea*, *Passer hispaniolensis* and *Petronia xanthocollis*. *Luscinia svecica* is a fairly common winter visitor. At least 133 species of birds have been recorded in the area.
A tiny population of the endangered Mesopotamian Fallow Deer (*Dama dama mesopotamica*) still survives in the riparian forests along the Dez River. This population, which numbers a few tens of individuals, is the only known truly wild population. Other mammals include Goitred Gazelle (*Gazella subgutturosa*), Jungle Cat (*Felis chaus*), Jackal (*Canis aureus*), Honey Badger (*Mellivora capensis*), Wild Boar (*Sus scrofa*) and Crested Porcupine (*Hystrix indica*).
Noteworthy flora: The reserve contains one of the few remaining relatively undisturbed stands of native *Populus euphraticus* riverine forest, once widespread in southwestern Iran and neighbouring southern Iraq.
Scientific research and facilities: Annual mid-winter waterfowl censuses have been carried out by the Ornithology Unit, Department of the Environment, since 1971, and breeding-season

surveys have been undertaken on several occasions.
Management authority and jurisdiction: Department of the Environment.
References: Evans (1994); Firouz *et al.* (1970); Green (1993); Scott (1976a, 1976b, 1976c, 1980); Scott & Carp (1972).
Reasons for inclusion: 1d, 2a, 2b & 3c. The Dez River marshes contain significant stands of native riparian woodland, a habitat type which was once widespread in the lowlands of southwestern Iran and neighbouring Iraq, but is now extremely rare outside protected areas. The woodland supports the only population of the endangered Mesopotamian Fallow Deer *Dama dama mesopotamica* still surviving in the wild, as well as a number of bird species with very restricted distributions in the Middle East. The wetland thus plays a significant role in maintaining the genetic and ecological diversity of the region. The marshes support a significant breeding population of *Marmaronetta angustirostris*, and regular wintering populations of *Pelecanus crispus*, *Anser erythropus*, *Aythya nyroca* and *Aquila heliaca* (all threatened species). Wintering waterfowl include over 1% of the regional populations of *Threskiornis aethiopicus*, *Anser albifrons* and *Anas platyrhynchos*.
Source: Derek A. Scott.

Karun River Marshes (31)

Location: 31°45'N, 48°54'E; near the Karun River on the plains of Khuzestan, about 30 km south of Shushtar and 55 km north-northeast of Ahwaz, Khuzestan.
Area: 2,500 ha.
Altitude: c.90 m.
Overview: Seasonally flooded arable land with small areas of permanent marsh along the Karun River in the Khuzestan lowlands of southwestern Iran, important for wintering waterfowl, especially geese (*Anser* spp.) and *Grus grus*. Unprotected.
Physical features: The Karun River Marshes comprise an area of about 25 sq.km of seasonally flooded arable land on the east bank of the Karun River, with scattered ponds and permanent marshy areas. Most of the area dries out completely in summer, but a few of the deeper pools and meandering watercourses remain wet and provide some breeding habitat for waterfowl.
Ecological features: Seasonally flooded arable land (mainly wheat), small freshwater ponds and freshwater marshes.
Land tenure: No information.
Conservation measures taken: None. The site has been identified as an "Important Bird Area" by BirdLife International (Evans, 1994).
Conservation measures proposed: None known.
Land use: Agriculture.
Possible changes in land use: None known.
Disturbances and threats: The area is subject to high levels of disturbance from farming activities and hunters.
Hydrological and biophysical values: No information.
Social and cultural values: No information.

Noteworthy fauna: A very important wintering area for geese, *Tadorna ferruginea*, surface-feeding ducks, *Grus grus* and several shorebirds. Peak counts have included 1,730 *Anser albifrons*, 590 *A. erythropus*, 10,050 *A. anser*, 400 *T. ferruginea*, 15,000 *A. crecca*, 3,000 *A. clypeata*, 1,350 *G. grus*, 150 *Vanellus leucurus* and 2,000 *Limosa limosa* (see Table 15). Up to 3,500 *A. albifrons* and 1,500 *T. ferruginea* have been recorded in November. Small numbers of *Pelecanus crispus* (maximum 6), *Threskiornis aethiopicus* (maximum 12), *Marmaronetta angustirostris* (maximum 12) and *Aythya nyroca* (maximum 4) occur in winter, and *Botaurus stellaris* and *Branta ruficollis* have been recorded, the latter in February 1971 (two). *M. angustirostris* probably also breeds in the area, as up to 34 have been observed in summer. Other breeding birds include *Francolinus francolinus*, *Halcyon smyrnensis*, *Ceryle rudis* and *Passer hispaniolensis*. Passage migrants have included up to 42 *Ardeola ralloides* and 32 *Eudromias morinellus*. Wintering raptors include small numbers of *Aquila heliaca*, *Falco cherrug* and *Falco columbarius*. Huge flocks of Pin-tailed Sandgrouse *Pterocles alchata* appear in winter (maximum 11,000), while wintering passerines include *Motacilla citreola* and *Luscinia svecica*.
Noteworthy flora: No information.
Scientific research and facilities: Annual mid-winter waterfowl censuses have been carried out by the Ornithology Unit, Department of the Environment, since 1971, and breeding-season surveys have been undertaken on several occasions.
Management authority and jurisdiction: No information.
References: Evans (1994); Fotoohi & Scott (1975); Green (1993); Scott (1976a, 1976c, 1980); Scott & Carp (1972).
Reasons for inclusion: 2a, 3a & 3c. The Karun River marshes support wintering populations of five threatened species: *Pelecanus crispus*, *Anser erythropus*, *Marmaronetta angustirostris*, *Aythya nyroca* and *Aquila heliaca*. The marshes regularly hold over 20,000 waterfowl in winter, including over 1% of the regional populations of *Threskiornis aethiopicus*, *Anser albifrons*, *A. anser*, *Anas crecca*, *Grus grus* and *Limosa limosa*.
Source: Derek A. Scott.

Horeh Bamdej (Sadi Shavour Marshes) (32)

Location: 31°45'N, 48°36'E; on the plains of Khuzestan between the Karkheh and Dez Rivers, 45 km north-northwest of Ahwaz, Khuzestan.
Area: 12,000 ha.
Altitude: c.45 m.
Overview: A permanent, freshwater marsh with extensive reed-beds in the Khuzestan lowlands of southwestern Iran, very important for breeding and wintering waterfowl, especially *Marmaronetta angustirostris*. Unprotected.
Physical features: Horeh Bamdej (or Sadi Shavour Marshes) is a large permanent freshwater marsh with extensive reed-beds and relatively little open water, in an inter-fluvial depression between the Dez and Karkheh Rivers. Surrounding agricultural land is subject to seasonal flooding.

Ecological features: Permanent freshwater marshes dominated by *Phragmites* and *Typha*, with a surrounding belt of seasonally inundated sedge marshes and arable land. Open water areas support an abundant growth of floating and submerged aquatic vegetation.
Land tenure: No information.
Conservation measures taken: None. The site has been identified as an "Important Bird Area" by BirdLife International (Evans, 1994).
Conservation measures proposed: None known.
Land use: Some grazing by domestic livestock; agriculture in surrounding areas.
Possible changes in land use: Conversion of wetland to agricultural land.
Disturbances and threats: Parts of the wetland are currently being drained for agriculture.
Hydrological and biophysical values: No information.
Social and cultural values: No information.
Noteworthy fauna: Horeh Bamdej and the Sadeh Shavour Marshes are an important breeding area for a wide variety of waterfowl including *Ixobrychus minutus*, *Nycticorax nycticorax* (30 pairs), *Ardeola ralloides* (60 pairs), *Bubulcus ibis* (40 pairs), *Egretta garzetta* (50 pairs), *Ardea purpurea* (60 pairs), *Marmaronetta angustirostris* (at least 20 pairs), *Circus aeruginosus* (10+ pairs), *Porphyrio porphyrio*, *Himantopus himantopus* (100-150 pairs), *Glareola pratincola* (150-200 pairs), *Vanellus leucurus* (at least 100 pairs) and *Sterna albifrons* (15 pairs). Other common breeding birds include *Francolinus francolinus*, *Halcyon smyrnensis*, *Ceryle rudis*, *Acrocephalus melanopogon* and *A. stentoreus*. The site is also very important for wintering *Pelecanus crispus* (up to 51), herons and egrets, *Platalea leucorodia* (up to 120), *Anser anser* (up to 2,500), surface-feeding ducks (regularly over 20,000 including up to 1,000 *M. angustirostris*), *Grus grus* (up to 3,000), *Fulica atra* (up to 23,000), *Himantopus himantopus* (up to 620), *Vanellus leucurus* (up to 390) and *Limosa limosa* (up to 980). As many as 50 *Threskiornis aethiopicus* have occurred in winter, and small numbers (apparently non-breeders) have been observed in summer, along with up to 230 *Ciconia ciconia*. Other notable species recorded at the site include *Phalacrocorax pygmaeus* (one in January 1975), *Aythya nyroca* (maximum 7), *Haliaeetus albicilla*, *Falco cherrug* and *Pterocles alchata* (up to 600 in winter). Peak counts of wintering waterfowl are given in Table 15.
Noteworthy flora: The wetland supports the most extensive permanent freshwater marshes with tall reed-beds (*Phragmites* and *Typha*) in Khuzestan.
Scientific research and facilities: Annual mid-winter waterfowl censuses have been carried out by the Ornithology Unit, Department of the Environment, since 1971, and breeding-season surveys have been undertaken on several occasions.
Management authority and jurisdiction: No information.
References: Evans (1994); Green (1993); Scott (1976a, 1976c, 1978a); Scott & Carp (1972).
Reasons for inclusion: 1a, 2a, 2b, 3a & 3c. The Horeh Bamdej Marshes are a good representative example of a permanent freshwater reed marsh characteristic of the lowlands of southwestern Iran and neighbouring Iraq. They support an extremely diverse wetland fauna and flora, and thus play a significant role in maintaining the genetic and ecological diversity of the region. They support a substantial breeding and wintering population of *Marmaronetta angustirostris*, and wintering populations of two other threatened species of waterfowl: *Pelecanus crispus* and *Aythya nyroca*. The marshes regularly hold over 20,000 waterfowl in winter, including over 1% of the regional populations of *Threskiornis aethiopicus*, *Anser anser*, five species of ducks, *Fulica atra* and *Grus grus*. The marshes are also important breeding

habitat for *Himantopus himantopus*, supporting over 1% of the regional population.
Source: Derek A. Scott.

Hamidieh Plains (33)

Location: 31°20'N, 48°20'E; on the plains of Khuzestan about 30 km west-northwest of Ahwaz, Khuzestan.
Area: 20,000 ha.
Altitude: c.15 m.
Overview: Seasonally flooded semi-desertic plains and arable land along the Karkheh River in the Khuzestan lowlands of southwestern Iran, important for wintering waterfowl and breeding *Marmaronetta angustirostris*. Unprotected.
Physical features: The Hamidieh (or Omidiyeh) Plains comprise an area of about 200 sq.km of semi-desertic plains and arable land subject to winter flooding on the floodplain of the Karkheh River northwest of Ahwaz. At peak winter flooding, the maximum depth of water is about 30 cm. The site includes Hamidieh Lake - an old oxbow lake of the Karkheh River about 3 ha in area and with extensive reed-beds.
Ecological features: Seasonally inundated plains with semi-desertic steppe vegetation and irrigated agricultural land; also a small permanent freshwater lake with extensive fringing reed-beds of *Phragmites* and *Typha.*
Land tenure: No information.
Conservation measures taken: None. The site has been identified as an "Important Bird Area" by BirdLife International (Evans, 1994).
Conservation measures proposed: None known.
Land use: Grazing by domestic livestock and agriculture.
Possible changes in land use: None known.
Disturbances and threats: No information.
Hydrological and biophysical values: No information.
Social and cultural values: No information.
Noteworthy fauna: The floodplain wetlands are an important wintering area for *Anser anser* (maximum 9,700), *Tadorna tadorna* (maximum 1,320) and surface-feeding ducks, notably *Anas penelope* (maximum 3,835), *A. strepera* (maximum 6,440) and *A. clypeata* (maximum 4,900). Other common winter visitors include *Egretta alba* (up to 110), *Ardea cinerea* (up to 110), *Fulica atra* (up to 500), *Grus grus* (up to 100), *Himantopus himantopus* (up to 650) and *Recurvirostra avosetta* (up to 290). About 15-20 pairs of *Marmaronetta angustirostris* breed at Hamidieh Lake, and small numbers have been recorded on the floodplain wetlands in winter (maximum 20). Several pairs of *Turdoides altirostris* are resident in the reed-beds; *Hypocolius ampelinus* is a fairly common summer visitor to the scrub around the lake, and *Passer moabiticus* is probably resident in the area. Other breeding species include *Ixobrychus minutus*, *Vanellus leucurus*, *Sterna albifrons*, *Halcyon smyrnensis*, *Ceryle rudis* and *Acrocephalus stentoreus*. *Porzana porzana* and *Glareola pratincola* have been recorded in summer and may breed. Up to 50 *Ardeola ralloides* have been recorded during migration. *Aquila heliaca* has

been recorded in winter.
Noteworthy flora: No information.
Scientific research and facilities: Annual mid-winter waterfowl censuses have been carried out by the Ornithology Unit, Department of the Environment, since 1971, and breeding-season surveys have been undertaken on several occasions.
Management authority and jurisdiction: No information.
References: Evans (1994); Green (1993); Scott (1976a).
Reasons for inclusion: 2a & 3c. Hamidieh Plains support a significant breeding and wintering population of *Marmaronetta angustirostris*, as well as wintering *Aquila heliaca* (both threatened species). In winter, the wetlands regularly support over 1% of the regional populations of *Anser anser*, *Tadorna tadorna*, *Anas penelope*, *A. strepera*, *A. clypeata*, *Himantopus himantopus* and *Recurvirostra avosetta.*
Source: Derek A. Scott.

Susangerd Marshes (34)

Location: 31°45'N, 47°55'E; near the border with Iraq, at the extreme eastern edge of the Hoor Al Azim marshes, 60-90 km west-northwest of Ahwaz, Khuzestan.
Area: c.30,000 ha.
Altitude: c.15 m.
Overview: Permanent and seasonal marshes and seasonally flooded arable land on the floodplain of the Karkheh River in the Khuzestan lowlands of southwestern Iran, important for wintering waterfowl. Unprotected.
Physical features: The Susangerd Marshes (or Horeh Sosangerd) comprise a complex of permanent and seasonal, freshwater to brackish marshes and seasonally flooded arable land on the floodplain of the Karkheh River near the Iraqi border. These wetlands constitute the northeastern extremity of the vast Hoor Al Azim marshes, the great bulk of which lies over the border in Iraq.
Ecological features: Permanent and seasonal fresh to brackish marshes and seasonally inundated arable land adjacent to semi-desertic plains with sparse steppic vegetation.
Land tenure: No information.
Conservation measures taken: None. The site has been identified as an "Important Bird Area" by BirdLife International (Evans, 1994).
Conservation measures proposed: None known.
Land use: Fishing, reed-cutting and grazing by domestic livestock; irrigated agriculture on the adjacent plains.
Possible changes in land use: None known.
Disturbances and threats: Parts of the wetland are reported to have been damaged during the Iran/Iraq war.
Hydrological and biophysical values: No information.
Social and cultural values: No information.
Noteworthy fauna: An important wintering area for geese, surface-feeding ducks and

shorebirds. Peak counts have included 1,995 *Anser anser*, 1,755 *Anas strepera*, 8,500 *A. crecca*, 140 *Himantopus himantopus*, 50 *Recurvirostra avosetta*, 72 *Vanellus indicus* and 52 *V. leucurus*. Breeding birds include *Francolinus francolinus*, *Halcyon smyrnensis* and *Ceryle rudis*. Up to 20 *Calidris temminckii* and 250 *Limosa limosa* have been recorded on passage, and 60 *Marmaronetta angustirostris* were present in November 1973. Other notable species have included *Botaurus stellaris* (two records in winter), *Haliaeetus albicilla* (one record in winter) and *Hypocolius ampelinus*.

Noteworthy flora: No information.

Scientific research and facilities: Annual mid-winter waterfowl censuses have been carried out by the Ornithology Unit, Department of the Environment, since 1971, and breeding-season surveys have been undertaken on several occasions.

Management authority and jurisdiction: No information.

References: Ashtiani-Zarandi (1990); Evans (1994); Green (1993); Scott (1976a).

Reasons for inclusion: 1a, 3a & 3c (possibly also 2a). Susangerd Marshes are a good representative example of permanent and seasonal wetlands characteristic of the lowlands of southwestern Iran and neighbouring Iraq. *Marmaronetta angustirostris* (a globally threatened species) has occurred in the area, and is probably regular. The marshes regularly hold over 20,000 waterfowl in winter, including over 1% of the regional populations of *Anser anser* and *Anas strepera*.

Source: Derek A. Scott.

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Shadegan Marshes and Tidal Mudflats of Khor-al Amaya and Khor Musa (35)

Location: Shadegan Marshes 30°20'N, 48°20'E; Khor-al Amaya 30°00'N, 48°40'E; Khor Musa 30°10'N, 49°00'E; at the head of the Persian Gulf near Abadan, 50-150 km south of Ahwaz, Khuzestan.

Area: 425,140 ha (Shadegan Marshes 282,500 ha; Khor-al Amaya 19,200 ha; Khor Musa 123,440 ha). Ramsar Site 400,000 ha.

Altitude: Sea level to 15 m.

Overview: The largely seasonal floodplain wetlands of the Dez and Karun Rivers and the adjacent tidal mudflats at the head of the Persian Gulf in the Khuzestan lowlands of southwestern Iran; extremely important for wintering waterfowl, especially *Marmaronetta angustirostris*, and also for breeding and passage waterfowl of a wide variety of species. The greater part of the site is protected in a Wildlife Refuge and has been designated as a Ramsar Site.

Physical features: The wetland comprises the southern portion of the extensive floodplain and delta system of the Karun, Dez and several other major rivers which rise in the northwest Zagros Mountains of western Iran. The better-drained areas in the north support fresh to brackish sedge marshes which give way to halophytic vegetation in the central floodplain and bare, dry mudflats in the south. Shoreline relief is typically a narrow or indistinct beach with vast silt or sandy tidal flats, up to 10 km wide in places. Numerous small islands exist, and

additional islands are forming as a result of deposition from the Karun River and Shatt Al Arab. Autumn and winter rains in the high Zagros cause extensive flooding throughout the delta, creating a vast complex of shallow lagoons with extensive sedge marshes. These dry out gradually through the long, hot summer, and the entire area may be completely dry by the end of the summer. The main highway from Ahwaz to Abadan passes along the west side of the site, while the main highway from Abadan to the port of Bandar Shahpur runs from west to east across the southern edge of the marshes.

The region is characterized by its extremely high temperatures, with mean July temperatures in excess of 45°C and mean January temperatures in excess of 7°C. Frosts are rare. The average annual rainfall is 146 mm, 92% of which falls as winter precipitation, with an abrupt onset in November and a more gradual termination in April or May. Run-off is at its maximum in late winter, when discharge from the Karun River may increase tenfold over late summer levels.

Ecological features: The extensive seasonal freshwater marshes in the north are dominated by *Schoenoplectus* sp., and there are only small areas of *Phragmites australis* and *Typha* sp. The brackish and saline areas further south are dominated by *Salicornia* sp. and other salt marsh species, with patches of tamarisk scrub (*Tamarix* sp.) on higher ground. The wetland is bordered by barren flats to the north, east and northwest, but there is a large area of rice fields, date gardens and human settlement to the northeast.

Land tenure: Mainly public (Government), with about 1,000 ha of privately-owned rice paddies in the north (Vahedi, 1982).

Conservation measures taken: A Wildlife Refuge of 296,000 ha, encompassing all the main wetland areas and the coastal mudflats in the south, was established in 1972 and has remained unchanged since then. The central and southern portions of Shadegan Marshes and the mudflats of Khor-al Amaya and Khor Musa (a total of 400,000 ha) were designated as a Ramsar Site on 23 June 1975. The site has been identified as an "Important Bird Area" by BirdLife International (Evans, 1994).

Conservation measures proposed: Harrington (1976b) proposed that several of the islands between the Arvand River and Cape Bahrgan in the southeast should be appended to the Shadegan Wildlife Refuge. Most important among these are Bune and Dara Islands.

Land use: Reeds are harvested on a large scale in mid-summer to provide materials for thatching and weaving. There is also some grazing by domestic livestock and fishing. Part of the wetland is cultivated in privately owned rice paddies. A major oil terminal is located at Bandar Shahpur in the southeast, and there is a considerable amount of shipping traffic in the south, to and from the ports of Khorramshahr, Bandar Mashur and Bandar Shahpur. Large areas of mudflat in the south are extremely difficult of access and not used.

Possible changes in land use: None known.

Disturbances and threats: Shadegan Marshes are situated in a currently sensitive military zone close to the border with Iraq. The Iranian national reports to the Regina Conference in 1987 and Montreux Conference in 1990 indicated that wetlands in the border areas had been severely polluted by bombardment with chemical weapons during the Iran/Iraq war in the 1980s. It was estimated that about 10% of Shadegan Marshes had been destroyed in this way (Ashtiani-Zarandi, 1990). The marshes may also have suffered some damage as a result of "acid rainfall" during the Gulf War in 1991. The principal long-term threat to the marshes is diminished water supply as a result of diversion of water for irrigation schemes further north. An irrigation scheme along the Karun River to the north has already reduced the inflow of

freshwater into the marshes, and some of the area has been degraded to sterile silt flats by soil deterioration resulting from poorly managed irrigation schemes in the past. Some oil pollution has been reported on the beaches around Bandar Shahpur in the southeast. Illegal hunting occurs throughout the area, and there is little control by Department of the Environment personnel.

Hydrological and biophysical values: No information.

Social and cultural values: The harvest of reeds is of considerable importance in the local economy.

Noteworthy fauna: An extremely important wintering area for a wide variety of waterfowl, especially dabbling ducks, and also a very important breeding and staging area. Shadegan Marshes are the most important site in the world for *Marmaronetta angustirostris*, regularly supporting 10,000-20,000 in winter (30-60% of the world population). Peak counts have included 12,600 in January 1971, 10,000 in January 1972, 20,000 in January 1973 and 15,100 in January 1992. A few pairs probably breed (*e.g.* 10 birds in June 1974). Other noteworthy concentrations of wintering waterfowl have included 1,340 *Ciconia ciconia*, 2,080 *Anser anser*, in excess of 500,000 dabbling ducks (mainly *Anas crecca* and *A. acuta*) and over 15,000 gulls (mainly *Larus ridibundus* and *L. genei*). The wetland is also an important wintering area for *Pelecanus crispus*, with up to 75 birds present, and at least one pair bred near Bandar Shapur in 1975. *Threskiornis aethiopicus* is an occasional visitor in winter and spring, with a maximum of 8 in May 1972. The mudflats at the head of the Gulf hold many thousands of shorebirds in winter, including large numbers of *Haematopus ostralegus*, *Limosa lapponica*, *Numenius arquata* and *Tringa totanus*. Breeding waterfowl include various herons and egrets, a few pairs of *Aythya nyroca*, various shorebirds, 400-800 pairs of *Larus genei* and colonies of five species of terns. *Botaurus stellaris* presumably breeds, as at least six were booming in the marshes in May and June 1972. Peak counts of some waterfowl are given in Table 16. The vast sedge marshes are the stronghold of *Cisticola juncidis* in Iran. Raptors are abundant in winter, and have included up to 370 *Milvus migrans*, 70 *Circus aeruginosus*, 4 *Haliaeetus albicilla*, 19 *Aquila heliaca* and 9 *A. clanga*, as well as single *Falco cherrug*, *F. peregrinus* and *F. columbarius*. *Pandion haliaetus* is a regular passage migrant, with up to five present at one time. *Circus aeruginosus* is a common breeding bird, with some 25-50 pairs. Other breeding birds include *Halcyon smyrnensis*, *Ceryle rudis* (maximum count of 550), *Acrocephalus melanopogon* and *A. stentoreus*. A variety of landbirds typical of the Gulf coastal plain occur in the surrounding scrub and date gardens, including *Hypocolius ampelinus*. At least 149 species of birds have been recorded in the reserve.

Golden Jackal (*Canis aureus*) and Wild Boar (*Sus scrofa*) are common in the reserve.

Noteworthy flora: No information.

Scientific research and facilities: Annual mid-winter waterfowl censuses have been carried out by the Ornithology Unit, Department of the Environment, since 1971 (with aerial surveys in 1973, 1974 and 1975), and breeding-season surveys have been undertaken on several occasions.

Management authority and jurisdiction: Department of the Environment.

References: Ashtiani-Zarandi (1990); Carp (1972, 1980); Evans (1994); Green (1993); Harrington (1976b); IUCN (1992); Mansoori (1984); Ramsar Convention Bureau (1993); Scott (1972b, 1975b, 1976a, 1976c, 1978a, 1993); Scott & Carp (1972); Summers *et al.* (1987); Vahedi (1982); WCMC (1990).

Reasons for inclusion: 1a, 1c, 2a, 2b, 2c, 3a & 3c. Shadegan Marshes and the tidal mudflats of

Khor-al Amaya and Khor Musa are outstanding examples of floodplain wetlands and coastal mudflat ecosystems characteristic of the Persian Gulf, and play a significant hydrological and ecological role in the natural functioning of the northern Gulf. They support an extremely diverse wetland fauna and flora, and thus play an important role in maintaining the genetic and ecological diversity of the region. The seasonal marshes and mudflats are important breeding and nursery grounds for various fish species, and support large breeding colonies of several species of birds. The marshes provide wintering habitat for some 30-60% of the world population of *Marmaronetta angustirostris*, and appreciable numbers of three other threatened species: *Pelecanus crispus*, *Aythya nyroca* and *Aquila heliaca*. The wetlands regularly hold well in excess of 20,000 waterfowl. During the breeding season, they support over 1% of the regional populations of *Larus genei*, *Gelochelidon nilotica* and *Sterna albifrons*; during the migration seasons, over 1% of the regional population of *Anas querquedula*; and in winter, over 1% of the regional populations of *Ciconia ciconia*, *Phoenicopterus ruber*, nine species of Anatidae, *Haematopus ostralegus*, *Himantopus himantopus*, *Recurvirostra avosetta* and *Larus ridibundus*.
Source: Derek A. Scott.

Izeh and Shiekho Lakes (36)

Location: 31°52'N, 49°54'E; in the southwestern foothills of the Zagros Mountains, 125 km east-northeast of Ahwaz, Khuzestan.
Area: 1,400 ha.
Altitude: c.90 m.
Overview: Two freshwater lakes with extensive marshes in the foothills of the Zagros Mountains in southwestern Iran, important for breeding and wintering waterfowl. Unprotected.
Physical features: Lake Izeh and Lake Shiekho are small freshwater lakes situated in a broad valley in the foothills of the southwestern Zagros Mountains near the small town of Izeh. Shiekho, the larger of the two lakes, lies to the northwest of the town; it is a shallow freshwater lake almost entirely overgrown with emergent vegetation except around the edges where heavy grazing and trampling by cattle maintain some areas of open water. Izeh Lake, to the east of the town, is somewhat deeper, with much more open water. Both lakes are fed by local run-off and large springs at the base of the nearby hills. The plains around the lakes and to the south are under cultivation, mainly for wheat, and there are several small villages and seasonal nomad encampments in the general vicinity.
Ecological features: Shallow freshwater lakes with extensive sedge marshes, surrounded by cultivated plains (mainly wheat). Sparsely vegetated stony hillsides rise abruptly to the north.
Land tenure: Public (Government).
Conservation measures taken: None. The lakes have been identified as an "Important Bird Area" by BirdLife International (Evans, 1994).
Conservation measures proposed: None known.
Land use: Grazing by domestic livestock in the marshes, and some fishing; wheat cultivation in surrounding areas. The lakes provide a source of water for irrigation during the dry summer

months.
Possible changes in land use: None known.
Disturbances and threats: The emergent marsh vegetation is heavily grazed by cattle and sheep.
Hydrological and biophysical values: No information.
Social and cultural values: No information.
Noteworthy fauna: An important wintering area for herons, egrets, *Anser anser*, *Tadorna ferruginea*, surface-feeding ducks, diving ducks, *Fulica atra* and *Grus grus*. Several species of waterfowl breed in small numbers, including *Podiceps cristatus*, and about 40-50 pairs of *Ciconia ciconia* nest in the general area (including over 20 pairs on telegraph poles in Izeh town). *Acrocephalus stentoreus* is a common summer visitor to the reed-beds. Mid-winter waterfowl counts in the 1970s seldom exceeded 5,000, but numbers have been much higher in recent years, with up to 3,500 *Anser anser*, 750 *Tadorna ferruginea*, 400 *Anas penelope*, 4,150 *A. strepera*, 13,150 *A. crecca*, 6,200 *A. platyrhynchos*, 12,100 *A. acuta*, 5,860 *A. clypeata*, 9,360 *Aythya ferina*, 6,400 *A. fuligula* and 86,550 *Fulica atra*. The numbers of *Grus grus* appear to have remained stable at around 400. Other wintering waterfowl include very large numbers of *Tachybaptus ruficollis* and up to 330 *Egretta alba*, 400 *E. garzetta*, 260 *Ardea cinerea*, 400 *Recurvirostra avosetta* and 3,000 *Vanellus vanellus*.
Noteworthy flora: No information.
Scientific research and facilities: Mid-winter waterfowl censuses have been carried out by the Ornithology Unit, Department of the Environment, in most years since 1975, and breeding-season surveys have been undertaken on several occasions.
Management authority and jurisdiction: No information.
References: Evans (1994); Scott (1976a, 1980).
Reasons for inclusion: 1a, 3a & 3c. The Izeh and Shiekho lakes are good examples of permanent freshwater lakes characteristic of southwestern Iran. They regularly hold over 20,000 waterfowl in winter, including over 1% of the regional populations of six species of Anatidae, *Fulica atra*, *Grus grus* and *Recurvirostra avosetta*.
Source: Derek A. Scott.

Choghakor Marsh (37)

Location: 31°55'N, 50°54'E; in the upper drainage of the Karun River in the Zagros Mountains, about 95 km west of Shahreza, Chaharmahal and Bakhtiari.
Area: 1,600 ha.
Altitude: c.2,100 .
Overview: A permanent freshwater marsh in the northern Zagros Mountains, important for passage and wintering waterfowl. Unprotected.
Physical features: Choghakor Marsh is a permanent freshwater marsh on a broad grassy plain in the highlands of the northern Zagros Mountains southwest of Esfahan. The marsh floods in winter and spring to a maximum depth of about 2 metres, but by late summer much of the wetland is dry and the remainder is almost entirely overgrown with emergent marsh vegetation.

Large portions of the plains around the wetland are under cultivation for wheat.
Ecological features: Freshwater marshes with a central area of *Phragmites* and *Typha* reed-beds surrounded by sedge marshes. Grassy plains and wheat fields in surrounding areas.
Land tenure: Public (Government).
Conservation measures taken: There is no formal protection, but the wetland is patrolled by Department of the Environment personnel. The site has been identified as an "Important Bird Area" by BirdLife International (Evans, 1994).
Conservation measures proposed: The site has been proposed for Protected Area status, and has been recommended for designation as a Ramsar Site.
Land use: Grazing by domestic livestock.
Possible changes in land use: None known.
Disturbances and threats: None known; recent reports indicate that the wetland remains in good condition.
Hydrological and biophysical values: No information.
Social and cultural values: No information.
Noteworthy fauna: An important wintering area for *Egretta alba* (maximum 100), *Anas platyrhynchos* (maximum 6,700) and *Aythya nyroca* (maximum 103), and a feeding area for *Ciconia ciconia* during the summer months (maximum 62). *Oxyura leucocephala* has been recorded in recent years, and 57 *Marmaronetta angustirostris* were present in January 1992.
Noteworthy flora: No information.
Scientific research and facilities: Mid-winter waterfowl censuses have been carried out by the Ornithology Unit, Department of the Environment, in most years since 1971, and breeding-season surveys have been undertaken on several occasions.
Management authority and jurisdiction: No information.
References: Evans (1994); Green (1993); Scott (1976a); Scott & Smart (1992).
Reasons for inclusion: 1a, 2a & 3c. Choghakor Marsh is a good representative example of a freshwater marsh characteristic of the western uplands of Iran. The wetland regularly supports over 1% of the regional population of *Aythya nyroca* (a globally threatened species) in winter, and two other threatened species, *Marmaronetta angustirostris* and *Oxyura leucocephala*, have occurred.
Source: Derek A. Scott.

Gandoman Marsh (38)

Location: 31°50'N, 51°07'E; in the upper drainage of the Karun River in the Zagros Mountains, about 25 km southwest of Borujen and 75 km west-southwest of Shahreza, Chaharmahal and Bakhtiari.
Area: 1,500 ha.
Altitude: 2,250 m.
Overview: A largely seasonal freshwater marsh in the northern Zagros Mountains, important for passage and wintering waterfowl. Unprotected.
Physical features: Gandoman Marsh is a largely seasonal freshwater marsh on a vast grassy

plain in the highlands of the northern Zagros Mountains southwest of Isfahan. The wetland floods in winter and spring, but by late summer it is almost completely dry. There is some rice cultivation along the main stream through the centre of the wetland, and some wheat cultivation on the surrounding plains.
Ecological features: Freshwater marshes dominated by sedges with some areas of rice cultivation; grassy plains and wheat fields in surrounding areas.
Land tenure: A mixture of public (Government) and private.
Conservation measures taken: There is no formal protection, but the wetland is patrolled by Department of the Environment personnel. The site has been identified as an "Important Bird Area" by BirdLife International (Evans, 1994).
Conservation measures proposed: The site has been proposed for Protected Area status, and has been recommended for designation as a Ramsar Site.
Land use: Grazing by domestic livestock.
Possible changes in land use: None known.
Disturbances and threats: None known; recent reports indicate that the wetland remains in good condition.
Hydrological and biophysical values: No information.
Social and cultural values: No information.
Noteworthy fauna: An important wintering area for *Egretta alba* (up to 70), *Ardea cinerea* (up to 70), *Tadorna ferruginea* (up to 750), *Anas platyrhynchos* (up to 5,000) and *Aythya nyroca* (up to 140). Other wintering waterfowl have included up to 30 *Anser anser*, 300 *Anas crecca* and 1,660 *Fulica atra*. Up to 600 *Grus grus* have been observed during the spring migration. *Ciconia ciconia* is a common breeding summer visitor in the area, and *C. nigra* has been recorded. *Haliaeetus albicilla* and *Aquila clanga* have been recorded in winter.
Noteworthy flora: No information.
Scientific research and facilities: Mid-winter waterfowl censuses have been carried out by the Ornithology Unit, Department of the Environment, in most years since 1970, and breeding-season surveys have been undertaken on several occasions.
Management authority and jurisdiction: No information.
References: Evans (1994); Scott (1976a, 1976c); Scott & Smart (1992).
Reasons for inclusion: 1a, 2a & 3c. Gandoman Marsh is a good representative example of a freshwater marsh characteristic of the western uplands of Iran. The wetland regularly supports over 1% of the regional population of *Aythya nyroca* (a globally threatened species) in winter, and over 1% of the regional population of *Grus grus* during the migration seasons.
Source: Derek A. Scott.

Gavekhoni Lake and marshes of the lower Zaindeh Rud (39)

Location: Gavekhoni Lake 32°20'N, 52°47'E; at the western edge of the Central Plateau, about 40-100 km east-southeast of the city of Isfahan, Isfahan Province.
Area: 63,300 ha (Gavekhoni Lake 13,000 ha, including about 1,000 ha of marsh). Ramsar Site 43,000 ha.

Altitude: 1,470 m.
Overview: A large salt lake with associated fresh to brackish marshes, and a chain of freshwater marshes and floodplain wetlands along the main river entering the lake, on the western edge of Iran's Central Plateau; important for wintering waterfowl. The wetlands have been designated as a Ramsar Site, but are otherwise unprotected.
Physical features: Gavekhoni (Gavkhouni) Lake is a large, shallow, saline lake in an enclosed drainage basin on the western edge of the deserts of Iran's Central Plateau. The lake is fed almost entirely by the Zaindeh Rud, a large river rising in the northern Zagros Mountains and passing through the city of Isfahan about 100 km upstream of the lake. Flooding occurs in winter and early spring, but the extent of flooding varies widely from year to year and the lake is often almost completely dry by the end of the summer. There are about 1,000 ha of "delta" marshes at the mouth of the river, but otherwise the lake is largely devoid of vegetation other than algae. The substrate is rich alluvial soil, silt and mud.
The marshes of the lower Zaindeh Rud comprise a chain of freshwater marshes and floodplain wetlands stretching for about 60 km along both banks of the river and ending at the delta marshes at Gavekhoni Lake. These wetlands are fed both by flooding from the river itself and several irrigation canals. The flooded areas often freeze over in winter, and in most years, the marshes are almost completely dry by late spring or early summer. Very little natural marsh vegetation remains, the main flooding now occurring on degraded steppe and land cultivated for wheat and rice.
Ecological features: The marshes at the mouth of the Zaindeh Rud are dominated by *Phragmites* with some *Tamarix* scrub. Elsewhere around the lake, the vegetation is very sparse and confined to halophytic species. The remnants of natural marsh vegetation along the Zaindeh Rud are dominated by *Phragmites* and *Typha*. The adjacent land consists of degraded steppe and irrigated cultivation (rice and wheat).
Land tenure: Public (Government).
Conservation measures taken: No legal protection. Gavekhoni Lake and a large portion of the marshes of the lower Zaindeh Rud (43,000 ha in total) were designated as a Ramsar Site on 23 June 1975. The wetlands have been identified as an "Important Bird Area" by BirdLife International (Evans, 1994).
Conservation measures proposed: None known.
Land use: Parts of the floodplain are used for agriculture, grazing of livestock and wildfowl hunting. The salt lake is relatively inaccessible and undisturbed, although there is some grazing, hunting and cutting of brushwood for fuel in the marshes at the mouth of the river.
Possible changes in land use: None known.
Disturbances and threats: The principal threats are water-borne pollution from the city of Isfahan and other urban centres upstream along the Zaindeh Rud, and diversion of river water for irrigation purposes and domestic and industrial supply. There is almost no control of the area by Department of the Environment personnel.
Hydrological and biophysical values: No information.
Social and cultural values: No information.
Noteworthy fauna: An important wintering area for a variety of waterfowl, notably *Phoenicopterus ruber, Anser anser, Tadorna ferruginea, T. tadorna*, surface-feeding ducks and some shorebirds. Mid-winter waterfowl counts in the 1970s seldom exceeded 10,000 birds in total, but numbers have been much higher in recent years, with peak counts of Anatidae

including 1,740 *Anser anser*, 3,280 *T. ferruginea*, 11,300 *T. tadorna*, 4,560 *Anas penelope*, 6,600 *A. strepera*, 41,500 *A. crecca*, 7,960 *A. platyrhynchos*, 13,250 *A. acuta*, 8,370 *A. clypeata* and 225 *Aythya ferina*. Other wintering waterfowl have included up to 35 *Phalacrocorax carbo*, 25 *Egretta alba*, 21 *Ardea cinerea*, 69 *Platalea leucorodia*, 1,720 *Phoenicopterus ruber*, 1,700 *Fulica atra*, 51 *Grus grus*, 286 *Himantopus himantopus*, 146 *Recurvirostra avosetta*, 115 *Vanellus vanellus* and 30 *Gallinago gallinago*. *Ciconia nigra*, *Cygnus olor* (maximum 6) and *Ceryle rudis* have occurred as scarce winter visitors. Most of the marshes dry out in summer and are of negligible importance for breeding waterfowl. Wintering raptors have included *Haliaeetus albicilla* (up to 5), *Circus aeruginosus* (up to 5), *Aquila heliaca* and *Falco cherrug*. *Aegypius monachus* regularly occurs in the area.
Noteworthy flora: No information.
Scientific research and facilities: Annual mid-winter waterfowl censuses have been carried out by the Ornithology Unit, Department of the Environment, since 1969 (with aerial surveys in 1973, 1974 and 1975).
Management authority and jurisdiction: The Ramsar Site is administered by the Department of the Environment.
References: Carp (1980); Evans (1994); Mansoori (1984); Ramsar Convention Bureau (1993); Scott (1976a, 1976c, 1980); Vahedi (1982); WCMC (1990).
Reasons for inclusion: 1a, 3a & 3c. Gavekhoni Lake and the marshes of the lower Zaindeh Rud are good representative examples of a shallow saline lake and seasonal riverine marshes characteristic of Iran's Central Plateau. The wetlands regularly hold over 20,000 waterfowl in winter, including over 1% of the regional populations of *Anser anser*, *Tadorna ferruginea*, *T. tadorna* and five species of dabbling ducks (*Anas* spp.).
Source: Derek A. Scott.

Dorudsan Dam (40)

Location: 30°15'N, 52°20'E; on the Kur River about 70 km north-northwest of Shiraz, Fars.
Area: Unknown.
Altitude: c.1,800 m.
Overview: A reservoir in the central Zagros Mountains, important for wintering waterfowl. Unprotected.
Physical features: Dorudsan (Dorodzan) Dam is a large water storage reservoir on the Kur River in the Zagros Mountains north of Shiraz. The reservoir is situated in a broad valley, and is surrounded by arable land.
Ecological features: No information.
Land tenure: No information.
Conservation measures taken: None. The site has been identified as an "Important Bird Area" by BirdLife International (Evans, 1994).
Conservation measures proposed: None known.
Land use: Water supply for domestic, industrial and irrigation purposes.
Possible changes in land use: None known.

Disturbances and threats: No information.
Hydrological and biophysical values: No information.
Social and cultural values: No information.
Noteworthy fauna: An important wintering area for grebes, ducks and coots, with up to 1,200 *Podiceps cristatus*, 7,400 *Anas platyrhynchos*, 10,000 *Anas acuta*, 600 *Aythya ferina*, 1,820 *A. fuligula* and 670 *Fulica atra*.
Noteworthy flora: No information.
Scientific research and facilities: Annual mid-winter waterfowl censuses have been carried out by the Ornithology Unit, Department of the Environment, in most years since 1972.
Management authority and jurisdiction: No information.
References: Evans (1994).
Reasons for inclusion: 3c. Dorudsan Dam regularly supports over 1% of the regional populations of *Podiceps cristatus* and *Anas acuta* in winter.
Source: Derek A. Scott.

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Kaftar Lake (41)

Location: 30°34'N, 52°47'E; on the north slope of the Zagros Mountains, about 105 km north-northeast of Shiraz, Fars.
Area: 4,700 ha.
Altitude: c.2,300 m.
Overview: A semi-permanent freshwater lake in the central Zagros Mountains, important primarily as a staging area for migratory waterfowl during spring and autumn. Unprotected.
Physical features: Kaftar Lake is a shallow, freshwater lake at high altitude in the Zagros Mountains north of Shiraz. The lake is generally frozen over during the winter months, and can dry out completely during dry summers. It is situated in a region of high rolling steppic plains.
Ecological features: Marshy areas on the eastern side of the lake are dominated by *Butomus umbellatus* and *Sparganium* sp.; grasses are predominant on the western side of the lake. The natural vegetation of the surrounding plains is *Artemisia* steppe, but large areas have now been converted to wheat cultivation.
Land tenure: No information.
Conservation measures taken: None. The lake has been identified as an "Important Bird Area" by BirdLife International (Evans, 1994).
Conservation measures proposed: Kaftar Lake has been proposed for designation as a Ramsar Site.
Land use: No information.
Disturbances and threats: A proposal by the Ministry of Jihad to utilize the waters of the lake for irrigation purposes was blocked by the Department of the Environment, because of the importance of the site as a staging area for migratory waterfowl. However, there is now a new proposal to build an earthen dam which would result in a loss of half the surface area of the lake. In recent years, large-scale die-offs of waterfowl have been reported during the breeding and migration seasons. In some years, the mortality may be as high as 10,000. The reason for

the die-offs is unknown, but disease (perhaps botulism) has been suspected.
Hydrological and biophysical values: No information.
Social and cultural values: No information.
Noteworthy fauna: A very important staging area for geese, ducks and *Grus grus*, and occasionally also a very important wintering area, but usually frozen over during mid-winter. In mild winters *e.g.* 1975/76, large numbers of birds remain throughout the winter; peak counts have then included 1,000 *Anas strepera*, 10,000 *A. crecca*, 8,000 *A. platyrhynchos*, 15,000 *A. acuta*, 30,000 *A. clypeata*, 6,000 *Aythya fuligula* and 1,200 *Grus grus*. *Haliaeetus albicilla* has occurred in winter. During the spring and autumn migration seasons, the lake can hold as many as 120,000 migratory waterfowl, including up to 12,000 *Phoenicopterus ruber* (in August) and 2,000-3,000 *Grus grus*, as well as smaller numbers of *Pelecanus onocrotalus*. The lake occasionally dries out in summer and appears to be of relatively little importance for breeding waterbirds.
Noteworthy flora: No information.
Scientific research and facilities: Mid-winter waterfowl censuses have been carried out by the Ornithology Unit, Department of the Environment, in most years since 1975, and several ornithological surveys have been undertaken at other times of the year.
Management authority and jurisdiction: No information.
References: Evans (1994); Scott (1976a); Scott & Smart (1992).
Reasons for inclusion: 1a, 3a & 3c. Kaftar Lake is a good representative example of a freshwater lake characteristic of the highlands of western Iran. The lake regularly holds over 20,000 waterfowl during the migration seasons and in winter, including over 1% of the regional populations of *Phoenicopterus ruber*, *Anas acuta*, *A. clypeata*, *Aythya fuligula* and *Grus grus*.
Source: Derek A. Scott.

Haft Barm (42)

Location: 29°40'N, 52°10'E; in the rolling uplands of the high Zagros Mountains about 65 km west-northwest of Shiraz, Fars.
Area: 70 ha.
Altitude: 2,200 m.
Overview: A group of small freshwater lakes set in rolling uplands in the southern Zagros Mountains, of some importance for breeding, passage and wintering waterfowl including *Marmaronetta angustirostris*. Unprotected.
Physical features: The Haft Barm (Seven Lakes) are a group of seven small, slightly saline lakes some 2-3 metres deep, lying in hollows in broken undulating country to the east of Kuh-i Anar. The lakes are fed by local run-off, principally in the form of snow-melt in spring, and are generally frozen over for some weeks in mid-winter. The southern five lakes generally dry out completely during the summer months.
Ecological features: The two largest lakes (in the north) are surrounded by belts of *Phragmites* reeds with patches of the flowering rush *Butomus* sp.; the other smaller lakes are almost barren of vegetation except for green algae and some small patches of *Butomus*. The surrounding

rolling uplands support tragacanthic steppe communities and some dry wheat farming.
Land tenure: Public (Government).
Conservation measures taken: None. The lakes have been identified as an "Important Bird Area" by BirdLife International (Evans, 1994).
Conservation measures proposed: None known.
Land use: The lakes are used by the local nomadic tribes for watering their flocks, washing and reed-cutting.
Possible changes in land use: None known.
Disturbances and threats: There is a considerable amount of human disturbance at the lakes.
Hydrological and biophysical values: No information.
Social and cultural values: No information.
Noteworthy fauna: Up to 200 *Marmaronetta angustirostris* have been recorded in summer (in 1971), and the species has probably bred at the lakes. *Oxyura leucocephala* has been recorded in winter (36 in January 1986). Up to 630 *Tadorna ferruginea* and 5,000 *Fulica atra* have been recorded on passage in autumn. The lakes are usually frozen over in winter and are of little importance for wintering birds. Peak counts in mild winters have included over 34,000 *Anas crecca*, 400 *A. platyrhynchos*, 150 *A. clypeata*, 50 *Netta rufina*, 500 *Aythya fuligula* and 850 *Fulica atra*. *Tachybaptus ruficollis*, *Anas platyrhynchos* and *Tringa totanus* probably breed at the lakes. *Haliaeetus albicilla* has occurred in winter.
Noteworthy flora: No information.
Scientific research and facilities: Mid-winter waterfowl censuses have been carried out by the Ornithology Unit, Department of the Environment, on a number of occasions since 1975, and several ornithological surveys have been undertaken at other times of the year.
Management authority and jurisdiction: No information.
References: Anstey (1989); Cornwallis (1968b); Evans (1994); Green (1993); Scott (1976a).
Reasons for inclusion: 1a & 2a (possibly also 3a). The Haft Barm (Seven Lakes) are good examples of small spring-fed lakes characteristic of the highlands of western Iran. Two threatened species of waterfowl occur at the lakes, *Marmaronetta angustirostris* and *Oxyura leucocephala*, and the former probably breeds. The lakes occasionally hold over 20,000 waterfowl in autumn and winter.
Source: Derek A. Scott.

Dasht-e Arjan and Lake Parishan (43)

Location: Dasht-e Arjan 29°37'N, 51°59'E; Lake Parishan 29°31'N, 51°48 'E; in the Zagros Mountains, 40-80 km west of Shiraz, Fars.
Area: Dasht-e Arjan 2,200 ha; Lake Parishan 4,000 ha. Ramsar Site 6,600 ha (Dasht-e Arjan 2,400 ha; Lake Parishan 4,200 ha).
Altitude: Dasht-e Arjan 2,000 m; Lake Parishan 853 m.
Overview: A largely seasonal freshwater lake and marsh at 2,000 m elevation in the Zagros Mountains (Dasht-e Arjan), and a permanent brackish to saline lake at 853 m in the Zagros foothills (Lake Parishan); extremely important for breeding and wintering waterfowl of a wide

variety of species, including *Pelecanus crispus*, *Marmaronetta angustirostris* and *Oxyura leucocephala*. Both lakes are protected within the Arjan Protected Area, and have been designated as a Ramsar Site.

Physical features: Dasht-e Arjan and Lake Parishan are two very different wetlands situated only about 15 km apart within the Arjan Protected Area in the Zagros Mountains west of Shiraz. Dasht-e Arjan is a shallow, eutrophic, freshwater lake with extensive reed-beds. The lake lies in an enclosed basin and is fed by two large springs on its western side and local run-off from winter rainfall and snow-melt. It is unusual in that it drains out through a group of swallow-holes at its southeast corner. The wetland varies widely in size from year to year depending on rainfall, reaching about 2,400 ha after wet winters and decreasing to only a few hundred ha in years of drought. Most of the basin dries out in summer, but two large springs on the west side maintain some permanent marsh throughout the year. Much of the wetland freezes over in winter, and deep snow cover is not unusual. Good rainfall in recent years has resulted in a considerable expansion in the area covered by tall reeds.

Lake Parishan is a shallow, oligotrophic, brackish to saline lake surrounded by eutrophic marshes with halophytic vegetation. It lies in an enclosed drainage basin of 29,000 ha in a broad valley between Zagros ranges, and is fed by a number of permanent springs and several seasonal watercourses. The salinity varies widely according to the size of the lake. At maximum extent, the lake covers about 4,200 ha and is then almost fresh. During the dry years of the early 1970s, water levels were low, the lake was brackish to saline, marsh vegetation was confined to the western and eastern ends of the lake, near freshwater inflow, and there were large areas of bare salt flats in the southwest bay. Throughout much of the 1980s and in the early 1990s, however, water levels have remained high; the water is now almost fresh and there are very extensive reed-beds of *Phragmites* and *Typha* in many parts of the lake.

The physiography of the region is of great interest. Oligo-miocene ("Asmari") limestones form spectacular escarpments, generally aligned as parallel ridges enclosing broad valleys with open oak woodland. The climate is characterized by hot dry summers and mild or distinctly cold winters, depending on altitude. The average annual rainfall is in the range 400-500 mm, falling mainly in winter and largely as snow on high ground. Temperatures at Lake Parishan range from 22 to 40°C in summer and 5 to 15°C in winter; at Dasht-e Arjan, from 15 to 35°C in summer and -10 to +15°C in winter.

Ecological features: The permanent marshes at Dasht-e Arjan comprise extensive reed-beds of *Phragmites australis* and *Typha* sp. with fringing areas of *Juncus* spp. and other aquatic plants. The surrounding flat lands are usually covered by terrestrial grasses or remain as bare baked mud, but in wet years sedges (*Carex* sp.) predominate. Lake Parishan also supports extensive reed-beds of *Phragmites australis* and *Typha* sp, as well as halophytic vegetation dominated by species of *Salsola*, *Kochia*, *Camphorosma* and *Halocnemum*. Large areas of the semi-arid steppe around Lake Parishan have been converted to wheat fields. Nearby mountain sides are still covered with forests of oak (*Quercus brantii*), while the lower slopes are partially covered with steppic forest of almonds, hawthorn, hackberry *etc.* In much of the area, the shrub-like "Arjan" tree (*Amygdalus erioclada*) is conspicuous. The Arjan Protected Area incorporates a wide spectrum of Zagros habitats from high peaks at over 3,200 m and rolling uplands down through the Zagros oak forest zone to the acacia woodlands and date gardens of Iran's southern coastal zone.

Land tenure: Public (Government).

Conservation measures taken: A National Park of 65,750 ha was established in March 1972. The original plans to establish the reserve as an international park (under the control of an international committee) were never implemented, and following the revolution, the reserve was downgraded to Protected Area and reduced in size to 52,800 ha. Lake Parishan and Dasht-e Arjan were designated as a Ramsar Site on 23 June 1975. The Ramsar Site is in two parts and comprises only the wetland areas: Lake Parishan (4,200 ha) and Dasht-e Arjan (2,400 ha). The area of the original National Park (65,750 ha) was designated as a UNESCO (MAB) Biosphere Reserve in June 1976. The Arjan Protected Area has been identified as an "Important Bird Area" by BirdLife International (Evans, 1994).

Conservation measures proposed: A Ramsar Monitoring Procedure Mission to the wetlands in January 1992 made the following recommendations (Scott & Smart, 1992):

(i) Both portions of the Ramsar Site (Lake Parishan and Dasht-e-Arjan) should be clearly demarcated on the ground, with some publicity given to the fact that they are Ramsar wetlands (*e.g.* by conspicuous sign-boards).

(ii) Both portions of the Ramsar Site and other appropriate sections of the Arjan Protected Area should be upgraded to the status of Wildlife Refuge.

(iii) Any further drainage of marshes at Lake Parishan should be strictly prohibited, and the possible negative impacts of the present drainage ditch from the northwest corner of the lake should be investigated.

(iv) Studies should be carried out on the changes which are taking place in the aquatic vegetation at Lake Parishan.

(v) The problem of increased disturbance from fishing activities at Lake Parishan should be investigated. A possible solution might be the establishment of one or more no-fishing zones.

(vi) The location of the Game Guard Station on a peninsula overlooking the western part of Lake Parishan would be an ideal site for a Visitor Centre for day visitors to the lake.

(vii) The possibility of re-routing the high-tension power lines across the Ramsar Site at Dasht-e-Arjan should be investigated, as these severely compromise the scenic beauty and "naturalness" of the area, and may cause considerably mortality to waterfowl.

Land use: There is some reed-cutting at both wetlands, and the marshy plain at Dasht-e Arjan is extensively grazed by domestic livestock. Some fish ponds have been established at the west end of Lake Parishan. The plains to the south and west of Lake Parishan are cultivated for wheat and other crops, and there are several small settlements with orchards and gardens in the general area.

Possible changes in land use: None known.

Disturbances and threats: Lake Parishan is under considerable threat from a variety of sources, while Dasht-e-Arjan remains in reasonably good condition. Some 20 hectares of marsh at the extreme northwest corner of Lake Parishan were drained for agriculture by the Ministry of Jihad shortly after the revolution. Elsewhere around this lake, wet meadows have been replaced by cultivated fields which in places extend to the water's edge. A small area of fish ponds was established on the plains to the west of the lake in the early 1980s, and it is reported that three species of carp have been introduced into the lake. There has been a considerable increase in fishing activities, and the widespread use of outboard motor boats (instead of traditional reed boats) has resulted in much more disturbance to waterfowl populations. Poaching remains a problem, and there are reports that significant numbers of waterfowl are

accidentally killed in fishing nets. Eutrophication may become a problem in the future, especially if this is being accelerated by inflow of domestic sewage and fertilizers, and some control of the spread of *Phragmites* may become necessary.

Poaching also remains a problem at Dasht-e Arjan, despite the presence of a small Game Guard Station in the nearby village of Dasht-e Arjan. It is estimated that some 500-1,000 birds are poached annually. Two sets of high-tension power lines have been constructed across the basin, both crossing over the western side of the marshes. Apart from being an eye-sore in an otherwise region of great scenic beauty, the power lines present a considerable hazard to waterfowl flighting into and out of the marshes. One of the power lines (from a nuclear power station under construction in Bushire) was erected in the late 1970s and is still not in use. The other transports electricity to Shiraz from a conventional power station in Khuzestan.

Hydrological and biophysical values: No information.

Social and cultural values: The region is renowned for is spectacular scenery.

Noteworthy fauna: Both Lake Parishan and Dasht-e Arjan are extremely important for wintering waterfowl of a wide variety of species, and are also of considerable importance for breeding waterfowl, notably *Pelecanus crispus*, *Marmaronetta angustirostris*, *Aythya nyroca* and *Oxyura leucocephala*, especially in wet years. *P. crispus* is present year-round; 5-10 pairs breed at Lake Parishan and the species has bred at Dasht-e Arjan. There are usually about 60 in winter, but peak counts of 100 were recorded in the 1970s and 185 in recent years. There is a large breeding population of *M. angustirostris* at Lake Parishan in years when conditions are suitable, *e.g.* in 1976 and 1977, when there were thought to be some 200-300 pairs. The species also breeds in small numbers at Dasht-e Arjan in wet years. Large numbers winter at the wetlands, with up to 2,000 at Lake Parishan and 40 at Dasht-e Arjan in the 1970s, and up to 5,500 in the late 1980s and early 1990s. *Aythya nyroca* occurs in small numbers year-round, with a few pairs breeding at Dasht-e Arjan in wet years. *Oxyura leucocephala* is also present year-round; several pairs breed at Lake Parishan, and up to 93 wintered on this lake in the 1970s, but after a high count of 455 in 1988, numbers have been low (maximum 25). The numbers of most other ducks and *Fulica atra* at Lake Parishan in recent years have also been well below the numbers in the 1970s (an average of 25,000 ducks and 120,000 *F. atra* in the four winters 1972/73 to 1975/76). This decline may be a result of the greatly increased disturbance from fishermen in high-speed motor boats. However, improved agriculture to the south of the lake now provides better feeding habitat for *Anser anser* and *Grus grus*, and numbers of both of these species have been much higher in recent years than in the 1970s, *e.g.* numbers of *G. grus* have increased from a maximum of 350 in the 1970s to a maximum of 2,200 in recent years. The extensive reed-beds now support large breeding colonies of herons, egrets, *Plegadis falcinellus* and *Platalea leucorodia*, and the small population of *Pelecanus crispus* has shown a slight increase. *Porphyrio porphyrio* colonized the area in the 1980s (presumably from the wetlands of Khuzestan), and is now common in the reed-beds. Breeding birds in the marshes at Dasht-i Arjan include *Rallus aquaticus* and *Porzana pusilla*, and in wet years, up to 20 pairs of *Podiceps nigricollis* have bred at this site. *Botaurus stellaris* is a regular winter visitor in small numbers, and may breed at Dasht-e Arjan. *Anser erythropus*, *Eudromias morinellus* and *Gallinago media* have occurred as scarce passage migrants. Peak counts of some waterfowl are given in Table 17.

Haliaeetus albicilla is a regular winter visitor, mainly to Dasht-e Arjan, where up to four have been recorded. Other wintering raptors include *Circus aeruginosus* (maximum 40), *Aquila*

heliaca (maxima of 3 at Dasht-e Arjan and 4 at Lake Parishan), *A. clanga* (maximum 5), *Falco cherrug* and *F. pelegrinoides*. There is a breeding colony of 10-15 pairs of *Falco naumanni* at Dasht-e Arjan. Other breeding birds include *Francolinus francolinus*, *Halcyon smyrnensis*, *Ceryle rudis*, *Acrocephalus melanopogon* and *A. stentoreus*. Wintering passerines include *Motacilla citreola* and *Luscinia svecica*. The great range of habitats within the Protected Area supports almost the full range of species typical of the montane steppe, pistachio-almond forest, oak forest and wetland systems of the central and southern Zagros mountains, as well as some species more typical of the Gulf coastal lowlands. At least 263 species of birds have been recorded in the reserve.

Forty-four species of mammals have been recorded in the reserve including Wolf (*Canis lupus*), Golden Jackal (*Canis aureus*), Red Fox (*Vulpes vulpes*), Brown Bear (*Ursus arctos*), Striped Hyaena (*Hyaena hyaena*), Caracal (*Lynx caracal*), Jungle Cat (*Felis chaus*), Leopard (*Panthera pardus*), Wild Boar (*Sus scrofa*), Goitred Gazelle (*Gazella subgutturosa*), Persian Ibex (*Capra hircus aegagrus*) and Wild Sheep (*Ovis ammon*). The Persian Lion (*Panthera leo persica*) is known to have survived in the area until about 1940.

Noteworthy flora: No information.

Scientific research and facilities: Annual mid-winter waterfowl censuses have been carried out by the Ornithology Unit, Department of the Environment, since 1967 (with aerial surveys in 1973, 1974 and 1975), and many ornithological surveys have been undertaken at other times of the year. A large number of herons, egrets, ibises and spoonbills were ringed at the breeding colonies in the mid-1970s, along with smaller numbers of other waterfowl. Over 180 wintering *Grus grus* were marked with wing-tags at Dasht-e Arjan in the late 1970s, in a joint project between the Department of the Environment and International Crane Foundation. Accommodation for visiting researchers is available at a small guest house maintained by the Department of the Environment at the Game Guard Station on a hill overlooking the western end of Lake Parishan.

Management authority and jurisdiction: Department of the Environment.

References: Anstey (1989); Argyle (1975b); Carp (1972, 1980); Cornwallis (1968b); Division of Research and Development (1972); Evans (1994); Farhadpour (1987); Firouz (1974); Firouz & Ferguson (1970b); Green (1993); Mansoori (1984); Ramsar Convention Bureau (1993); Savage & Firouz (1968); Scott (1973c, 1976a, 1976c, 1978a, 1980); Scott & Smart (1992); Vahedi (1982); WCMC (1990).

Reasons for inclusion: 1a, 2a, 2b, 2c, 3a & 3c. Dasht-i Arjan and Lake Parishan are outstanding examples of freshwater and brackish to saline wetlands characteristic of the highlands of western Iran. They support an extremely diverse wetland fauna and flora, and thus play an important role in maintaining the genetic and ecological diversity of the region. Both wetlands support large breeding colonies of Ardeidae and Threskiornithidae, and regularly hold over 20,000 waterfowl in winter. Five threatened species of birds occur in appreciable numbers: *Pelecanus crispus*, *Marmaronetta angustirostris*, *Aythya nyroca*, *Oxyura leucocephala* and *Aquila heliaca*. During the breeding season, the wetlands support over 1% of the regional populations of *Plegadis falcinellus* and *Platalea leucorodia*; during the migration seasons, over 1% of the regional population of *Podiceps nigricollis*; and in winter, over 1% of the regional populations of *Pelecanus onocrotalus*, *Phoenicopterus ruber*, 11 species of Anatidae, *Fulica atra*, *Grus grus* and *Larus ridibundus*.

Source: Derek A. Scott.

Lake Maharlu (44)

Location: 29°30'N, 52°48'E; in an intermontane basin in the Zagros Mountains about 20 km southeast of Shiraz, Fars.
Area: 21,600 ha at maximum extent of flooding.
Altitude: 1,480 m.
Overview: A large salt lake with extensive spring-fed marshes in a broad valley in the southern Zagros Mountains, important for breeding and wintering waterfowl including *Marmaronetta angustirostris*. Unprotected.
Physical features: Lake Maharlu is a large, shallow, saline lake at the centre and lowest part of the Shiraz basin. The maximum depth is about 3 m. The lake is fed by run-off which enters the lake in numerous small ephemeral wadis, the Pul-i-Fasa stream which enters in the west, and numerous small springs around the shores of the lake. Much the largest perennial springs are at Barmishur at the northwest corner of the lake and at Ab-e Paravan on the north shore. Both of these springs create pools about 2 m deep which overflow into extensive permanent marshes. At maximum extent, the Barmishur marshes cover about 150 ha and those at Ab-e Paravan 250 ha. The level of the lake varies widely with the irregularities of the rainfall regime. During prolonged droughts, the entire lake dries out except for the small permanent spring-fed pools at Barmishur and Ab-e Paravan. The lake is bounded by limestone hills to the north and dry steppe to the east and south. Land to the west (towards Shiraz) is largely under irrigated cultivation for rice, wheat, barley, melons, cotton and sugar beet.
Ecological features: The shores of the lake support halophytic plant communities which include *Tamarix*, *Suaeda* and *Salicornia* as dominants. Freshwater and brackish marsh communities occur at points where fresh water enters the lake. The spring pools at Barmishur and Ab-e Paravan support reed-beds of *Phragmites* and *Typha* as well as open marsh communities dominated by sedges, rushes and *Chara* sp.
Land tenure: No information.
Conservation measures taken: None. The lake has been identified as an "Important Bird Area" by BirdLife International (Evans, 1994).
Conservation measures proposed: None known.
Land use: The lake is used for salt production and there are numerous large salt pans, particularly in the eastern portion of the lake. There is some livestock grazing and reed-cutting in the Barmishur and Ab-e Paravan marshes.
Possible changes in land use: None known.
Disturbances and threats: Lying close to the city of Shiraz, the Barmishur Marshes are subjected to relatively heavy hunting pressure at weekends and holidays. Water-borne pollution from Shiraz is also reported to be a problem.
Hydrological and biophysical values: No information.
Social and cultural values: The lake is very important for salt production.
Noteworthy fauna: Lake Maharlu is important for a wide variety of resident and migratory waterfowl, notably surface-feeding ducks, geese, flamingos, cranes and some shorebirds.

Breeding species include about 10 pairs of *Marmaronetta angustirostris*, a few pairs of *Rallus aquaticus* and *Porzana pusilla*, 25 pairs of *Himantopus himantopus*, 25 pairs of *Vanellus leucurus* and 10 pairs of *Sterna albifrons*, as well as *Ceryle rudis*, *Acrocephalus melanopogon* and *A. stentoreus*. Wintering waterfowl have included up to 70 *Pelecanus onocrotalus*, 400 *Anser anser*, 570 *Tadorna ferruginea*, 460 *T. tadorna*, 6,500 *Anas crecca*, 37 *M. angustirostris*, 230 *Grus grus*, 260 *Himantopus himantopus*, 220 *Recurvirostra avosetta* and 160 *Vanellus leucurus*. Peak counts during the migration seasons have included 1,500 *Phoenicopterus ruber*, 2,200 *T. ferruginea* and 16,500 *A. crecca*. *Anser erythropus* was a regular winter visitor in small numbers (maximum 102) in the 1970s, and *Pelecanus crispus*, *Botaurus stellaris*, *Anser albifrons* and *Oxyura leucocephala* have been recorded in small numbers in winter. Peak counts of some waterfowl are given in Table 18. Two or three *Haliaeetus albicilla* and *Aquila heliaca* are usually present in winter, along with up to six *A. clanga* and the occasional *Falco cherrug* and *F. pelegrinoides*. There is a small breeding colony of *Falco naumanni* on the cliffs to the north of the lake (about 20 birds), and up to 100 have been observed in the marshes during spring passage. Wintering passerines include *Motacilla citreola* and *Luscinia svecica*.

Noteworthy flora: No information.

Scientific research and facilities: Annual mid-winter waterfowl censuses have been carried out by the Ornithology Unit, Department of the Environment, since 1968 (with aerial surveys in 1973, 1974 and 1975), and many ornithological surveys have been undertaken at other times of the year.

Management authority and jurisdiction: No information.

References: Carp (1972); Cornwallis (1968b); Evans (1994); Firouz & Ferguson (1970b); Fotoohi & Scott (1975); Green (1993); Savage & Firouz (1968); Scott (1976a, 1976c).

Reasons for inclusion: 1a, 2a & 3c. Lake Maharlu is a good representative example of a saline lake with associated spring-fed marshes, characteristic of the highlands of western Iran. Two globally threatened species of birds occur in appreciable numbers, *Marmaronetta angustirostris* and *Aquila heliaca*, and three others, *Pelecanus crispus*, *Anser erythropus* and *Oxyura leucocephala*, have occurred in small numbers. In winter, the lake regularly supports over 1% of the regional populations of *Tadorna ferruginea*, *T. tadorna*, *Anas strepera*, *Grus grus*, *Himantopus himantopus* and *Larus ridibundus*.

Source: Derek A. Scott.

Lake Bakhtegan, Lake Tashk and Kamjan Marshes (45)

Location: 29°40'N, 53°30'E (Kamjan Marshes 29°40'N, 53°05'E); in a large intermontane basin in the eastern Zagros Mountains, 50-160 km east of Shiraz, Fars.

Area: Lake Bakhtegan and Lake Tashk 136,500 ha; Kamjan Marshes 5,250 ha. Ramsar Site 108,000 ha.

Altitude: Lake Bakhtegan and Lake Tashk 1,525 m; Kamjan Marshes 1,540 m.

Overview: Two very large salt lakes in the southeastern Zagros Mountains, their extensive "delta" and spring-fed marshes, and a large area of permanent, freshwater marshes and seasonally flooded plains along the lower Kur River to the west (Kamjan Marshes); extremely

important for breeding and wintering waterfowl of a wide variety of species, including *Marmaronetta angustirostris*. Both lakes are protected within the Bakhtegan Wildlife Refuge, but the Kamjan Marshes are unprotected; the lakes and Kamjan Marshes have been designated as a Ramsar Site.

Physical features: Lake Tashk and Lake Bakhtegan are highly astatic, salt lakes situated in an internal drainage basin (the Neiris, Niriz or Neyriz Basin) in the southeastern Zagros Mountains. The catchment area of 26,440 sq.km is formed where the folded ridges of the Zagros Mountains, which trend predominantly from northwest to southeast, impinge upon the buckled edge of the central plateau. Lake Tashk is fed by overflow from the Kamjan Marshes at the west end and a large permanent spring at Gumoon, in the northwest. Lake Bakhtegan receives the bulk of its water from the main channel of the Kur River, which enters at the west end. Only in winter and spring does any river water reach the lakes, since in summer this water is totally utilized for irrigation. Water levels in the lakes fluctuate widely according to rain and snow-fall in the Zagros. The two lakes are normally separated by narrow strips of land at their western and eastern extremities, but may become temporarily joined during very wet winters to form a single expanse of water over 70 km long and covering up to 181,000 ha. After a number of years of low rainfall, both lakes may dry out completely except in the vicinity of the main springs (Gumoon Spring at the northwest corner of Lake Tashk and Sahlabad Spring on the south shore of Lake Bakhtegan). This is known to have occurred in 1933/34 and again in 1971. The average depth of Lake Bakhtegan has been reported as 50 cm, and the maximum as 110 cm. In summer, water temperatures regularly exceed 30°C, and may reach 40°C in very shallow areas. Both lakes are noted for their extraordinary range of salinities, especially Lake Bakhtegan. In 1956, Cl- values in Lake Bakhtegan ranged from less than 10 gm/l in the west to over 70 gm/l in the east; in Lake Tashk, the extremes were 39 and 52 gm/l. At this time, Lake Bakhtegan was oligohaline at its western end and hypersaline in its eastern sector (Loffler, 1968). The lakes have comparatively low alkalinity values. The lake bottoms are covered by alluvial mud, sapropel, silt and some sand, deposited mainly by the river and flood waters.

Kamjan Marshes formerly comprised about 10,000 ha of permanent and seasonal, eutrophic, freshwater marshes, mainly reed-beds, along the lower Kur River. Drainage of wetlands for rice cultivation began as early as 1967, and much of this area has now been converted to agricultural land. However, although the marshes have been extensively modified by the drainage canals, much wetland habitat remains, including expanses of wet mudflats, stands of *Phragmites* and other emergent aquatic vegetation along canals and ditches, and large areas of rice fields. Furthermore, a large portion of the "reclaimed" land remains uncultivated, partly because of a shortage of water for irrigation, and partly because of the high salt content of the soils. Some of the irrigation canals are already becoming silted up, and parts of the drained land are reverting to marsh. In addition, new areas of marsh have developed at the mouths of the two main drainage canals where they enter the western end of Lake Tashk.

The climate is characterized by hot, dry summers and mild winters. The Neiris Basin lies to the east and in the rain shadow of the Zagros Mountains, and receives low winter rainfall which varies greatly from year to year, but is generally in the range 100-400 mm. The great bulk of the rain falls between December and February. Frosts are rare, and heavy snowfalls are exceptional.

Ecological features: The lakes are oligotrophic and support a dense submerged vegetation of *Chara canescens*, *Lamprothamnium aragonensis*, *Ruppia maritima* and *Althenia filiformis*, especially in areas with relatively low salinity. Amongst the abundant phytoplankton, diatoms

are the most significant, with *Nitzschia loffleri* being the predominant species in hypersaline areas. The shoreline vegetation is dominated by species of *Tamarix*, *Suaeda*, *Cressa* and *Salicornia*. Kamjan Marshes support an emergent marsh vegetation dominated by sedges (*Carex* sp.), *Phragmites* reed-beds and species of Chenopodiaceae and grasses. This vegetation also occurs at the mouth of the Kur River in Lake Bakhtegan, and around Gumoon and Sahlabad springs. Parts of the Kamjan Marshes have been reclaimed for rice cultivation. On the adjacent plains of the lower Kur Valley, the land is either under cultivation for wheat, barley, cotton, sugar beet and fruit, or remains as heavily-grazed semi-desertic steppe. The area between the lakes consists of sparsely vegetated mountain ranges with some *Pistacia-Amygdalus* woodland and steppic plains dominated by *Artemisia* sp. and *Astragalus* sp.

Land tenure: Lakes Bakhtegan and Tashk are under public (Government) ownership; Kamjan Marshes are privately owned.

Conservation measures taken: Lake Bakhtegan, Lake Tashk and the intervening hill ranges were first protected as the Bakhtegan Protected Region (310,438 ha) established in December 1968. This reserve was given the status of Wildlife Refuge in the early 1970s, and increased in size to 327,820 ha. However, the reserve does not include either the Gumoon springs area or most of the marshes at the mouth of the Kur River. Kamjan Marshes are also unprotected. Both lakes and the Kamjan Marshes were designated as a Ramsar Site on 23 June 1975. The Ramsar Site (108,000 ha) includes the regularly flooded portions of the two lakes, the Gumoon area, all the marshes at the delta of the Kur River and Kamjan Marshes, but excludes the terrestrial portion of Bakhtegan Wildlife Refuge between the lakes. The Iranian national reports to the Regina Conference in 1987 and Montreux Conference in 1990 reported that the Kamjan Marshes had been deleted from the Ramsar List, but neither the Convention Depository (UNESCO) nor the Convention Bureau received official notification of deletion, and the Kamjan Marshes have therefore remained as part of a Listed Site (Ramsar Convention Bureau, 1993). The entire Bakhtegan Wildlife Refuge and Kamjan Marshes have been identified as an "Important Bird Area" by BirdLife International (Evans, 1994).

Conservation measures proposed: A proposal to upgrade part of the Bakhtegan Wildlife Refuge to National Park has recently been approved by the relevant ministries, and is likely to be implemented in the near future. The National Park would include the greater portion of the two lakes and a range of hills to the north of Lake Bakhtegan.

A Ramsar Monitoring Procedure Mission visited the wetlands in January 1992, and made the following recommendations (Scott & Smart, 1992):

(i) The boundaries of the Ramsar Site and Wildlife Refuge should be clearly demarcated on the ground, especially in the west where encroachment and poaching are most likely to cause a problem.

(ii) The proposal to construct an all-weather road through the Wildlife Refuge and Ramsar Site should be critically reviewed and alternative routings investigated, since the proposed road could affect the hydrology of the system and lead to increased encroachment and poaching in the reserve.

(iii) Studies should be carried out at Gumoon Marshes to determine to what extent these marshes have been destroyed by development, and whether or not any restoration might be possible. A decision should then be taken as to whether this small unprotected portion of the Ramsar Site should be maintained on the List and managed accordingly, or deleted.

(iv) The Kamjan Marshes should be retained on the Ramsar List, and restored and managed as a buffer zone for the Wildlife Refuge. The Department of the Environment should establish a presence in the marshes (*e.g.* by constructing a Game Guard Station on the isolated hill near the east end of the marshes), and should prepare a comprehensive management plan for the wetland in collaboration with local communities. While there might be no restrictions on sound agricultural development in the region, the use of fertilizers and pesticides should be carefully controlled, and all or part of the area closed to hunting. Parts of the marsh which prove unsuitable for agriculture, such as the large saline areas in the east, should as far as possible be restored to their former condition and might be given special protection, *e.g.* as part of an enlarged Bakhtegan Wildlife Refuge. The Department of the Environment should negotiate with the Ministry of Power and local authorities to ensure that an adequate supply of water is available to maintain the most important areas of marsh during dry years.

Land use: Livestock grazing in Kamjan Marshes and around the margins of the lakes; rice-growing in Kamjan Marshes. The whole basin is used as grazing grounds by nomadic tribes, while the settled population lives in nucleated villages associated with agricultural areas.

Possible changes in land use: Conversion of wetland to agricultural land, especially in the Kamjan Marshes, and expansion of fish ponds at Lake Tashk. The construction of a paved road between Lake Tashk and Take Bakhtegan, as currently proposed, would be likely to accelerate agricultural development and settlement in the area.

Disturbances and threats: The construction of a large water storage reservoir on the Kur River (Dorudsan Dam) in the 1970s and various other irrigation projects in the upper reaches of the river have reduced the flow of water into the lakes. In 1981, the Ministry of Jihad embarked upon a major programme of drainage in the Kamjan Marshes and Kharameh Marshes (the marshy plain to the south of the Kur River) to provide land for agriculture, principally rice, wheat and cotton. Two large drainage canals were constructed through Kamjan Marshes, emptying into Lake Tashk, and one through Kharameh Marshes, emptying into Lake Bakhtegan. Both marshes are now criss-crossed with canals and ditches, and much of the permanent marsh vegetation has been destroyed. As much of the water entering Lake Tashk passes through Kamjan Marshes, agricultural activities in these marshes could have a profound effect on the quality of the water entering the lake. Most of the spring-fed marshes at Gumoon have also now been drained for agriculture or converted into aquaculture ponds.

There are plans to construct an all-weather road through the centre of the Wildlife Refuge linking villages to the east of Lake Tashk with the asphalt highway to Shiraz from the west end of Lake Bakhtegan. This would involve the construction of a causeway across the low-lying flats between the two lakes, and could have a significant effect upon the overall hydrology of the system. It would also greatly facilitate access to the central hilly portion of the Wildlife Refuge - an area which until now has remained remote and relatively undisturbed. Some poaching occurs at the west end of Lake Bakhtegan, and it is feared that with improved access to the interior of the Wildlife Refuge, this problem could become serious.

Hydrological and biophysical values: No information.

Social and cultural values: No information.

Noteworthy fauna: Lake Tashk and Lake Bakhtegan regularly hold huge numbers of waterfowl in winter (*e.g.* 120,000-140,000 surface feeding ducks and 50,000 *Phoenicopterus ruber* in January 1992). The large wintering population of flamingos apparently constitutes the

bulk of the Lake Uromiyeh breeding population. Flamingos apparently bred in the early 1960s, but do not appear to have done so since then. Other waterfowl occurring in large numbers in winter include *Ciconia ciconia, Plegadis falcinellus, Anser anser, Tadorna tadorna, Grus grus* and some shorebirds. *Pelecanus crispus* was an occasional winter visitor in the 1970s (maximum 3), but has become more frequent in recent years, with up to 67 present. *Anser erythropus* was a regular winter visitor in small numbers in the early 1970s, with a maximum of 90, but there have been no records of this species in recent years. *Marmaronetta angustirostris* is present year-round; good numbers breed in wet years (*e.g.* at least 100 pairs in 1970), and up to 5,000 are present in mid-winter. A wide variety of waterfowl occur on migration, and several species including *Porzana pusilla, Himantopus himantopus, Recurvirostra avosetta* and *Vanellus leucurus* breed. *Acrocephalus melanopogon* and *A. stentoreus* are common summer visitors to the marshes. *Podiceps cristatus* has bred at Lake Tashk. *Pelecanus onocrotalus* occasionally appears in large flocks, and is known to have bred in the 1960s. *Botaurus stellaris* and *Rallus aquaticus* are regular winter visitors in small numbers, and *Cygnus cygnus* has been recorded (maximum 4). *Gallinago media* has been observed on both spring and autumn migration. One or two *Ciconia nigra* often frequent the marshes during the summer months. Peak counts of some waterfowl are given in Table 19. There is at least one resident pair of *Falco pelegrinoides* breeding in the area, and as many as 15 *Haliaeetus albicilla* occur in winter around the lakes, along with up to 6 *Circus aeruginosus*, 2 *Aquila heliaca* and 6 *A. clanga*. *Chlamydotis undulata* is a regular non-breeding visitor to the lake margins in late summer and autumn, with a maximum of 30 in July 1974.

Despite the changes which have occurred at Kamjan Marshes, the area continues to provide ideal feeding habitat for a variety of waterfowl, notably *Ciconia ciconia, Plegadis falcinellus* and *Limosa limosa*. These marshes also constitute an important feeding area for large numbers of ducks which spend the day roosting on Lake Bakhtegan and Lake Tashk.

At least 220 species of birds have been recorded in the Bakhtegan Wildlife Refuge, the hills and plains within the refuge supporting a breeding bird fauna typical of the semi-arid eastern Zagros.

The mammalian fauna of the Bakhtegan Wildlife Refuge includes Wolf (*Canis lupus*), Golden Jackal (*Canis aureus*), Red Fox (*Vulpes vulpes*), Brown Bear (*Ursus arctos*), Striped Hyaena (*Hyaena hyaena*), Caracal (*Lynx caracal*), Jungle Cat (*Felis chaus*), Leopard (*Panthera pardus*), Wild Boar (*Sus scrofa*), Goitred Gazelle (*Gazella subgutturosa*), Persian Ibex (*Capra hircus aegagrus*) and Wild Sheep (*Ovis ammon*).

Only one species of fish, *Aphanias sophiae*, has been recorded in the lakes; this occurs throughout both lakes and in the lower sections of the inflows. The zooplankton and invertebrate fauna of the lakes have been described by Loffler (1968). Zooplankton recorded in Lake Tashk include the ciliat *Fabrea salina* and the foraminifera *Streblus beccarii*. Flagellata probably constitute most of the nannoplankton. *Brachionus plicatilis* and *Hexartha fennica* are the most typical rotifers in both lakes, although there are many other species present. Crustaceans and copepods are abundant, their distribution showing a distinct correlation to salinity, while ostracods and nematodes form the bulk of the benthic fauna. Dominant species include *Artemia salina, Apocyclops dengizicus, Diaptomus salinus* and *Eucypris inflata*.

Noteworthy flora: No information.

Scientific research and facilities: A limnological study of the lakes was carried out in the late 1950s as part of the International Biological Programme (Loffler, 1959). Annual mid-winter

waterfowl censuses have been carried out by the Ornithology Unit, Department of the Environment, since 1968 (with aerial surveys in 1973, 1974 and 1975), and numerous ornithological surveys have been undertaken at other times of the year. Cornwallis (1968a, 1968b) studied the avifauna of the lakes in the mid-1960s, and there was some ringing of waterfowl by the Biology Department at the University of Shiraz in the late 1960s. Accommodation is available for visiting researchers at the Game Guard Station in the centre of the Wildlife Refuge.
Management authority and jurisdiction: Department of the Environment.
References: Carp (1980); Cornwallis (1968a, 1968b); Division of Research and Development (1972); Evans (1994); Firouz & Ferguson (1970b); Firouz *et al.* (1970); Green (1993); Loffler (1959, 1968); Mansoori (1984); Ramsar Convention Bureau (1993); Savage & Firouz (1968); Scott (1973a, 1976a, 1976b, 1976c, 1980, 1993); Scott & Smart (1992); Vahedi (1982); WCMC (1990).
Reasons for inclusion: 1a, 2a, 2b, 3a & 3c. Lake Bakhtegan and Lake Tashk are outstanding examples of saline lakes with associated fresh to brackish marshes, characteristic of the highlands of western Iran. The two lakes and the adjoining Kamjan Marshes support an extremely diverse wetland fauna and flora, and thus play an important role in maintaining the genetic and ecological diversity of the region. The wetlands support substantial breeding and wintering populations of *Marmaronetta angustirostris,* and two other globally threatened species, *Anser erythropus* and *Aquila heliaca*, occur in winter. The lakes regularly hold well in excess of 20,000 waterfowl during the migration seasons and in winter, including over 1% of the regional populations of *Pelecanus onocrotalus*, *Plegadis falcinellus*, *Phoenicopterus ruber*, at least nine species of Anatidae, *Fulica atra*, *Grus grus*, *Himantopus himantopus*, *Recurvirostra avosetta*, *Calidris alpina*, *Limosa limosa* and *Larus ridibundus*.
Source: Derek A. Scott.

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Harm Lake (46)

Location: 28°10'N, 53°30'E; in an intermontane basin in the southern Zagros, about 35 km south-southeast of Jahrom, Fars.
Area: Unknown.
Altitude: c.900 m.
Overview: A small lake surrounded by cultivated plains in an intermontane basin in the southern Zagros Mountains, important for wintering waterfowl, especially *Grus grus*. Unprotected.
Physical features: No information.
Ecological features: No information.
Land tenure: Public (Government).
Conservation measures taken: None. The lake has been identified as an "Important Bird Area" by BirdLife International (Evans, 1994).
Conservation measures proposed: None known.
Land use: No information.

Disturbances and threats: No information.
Hydrological and biophysical values: No information.
Social and cultural values: No information.
Noteworthy fauna: An important wintering area for *Tadorna ferruginea* (maximum 1,800), *Oxyura leucocephala* (maximum 230 in January 1987) and *Grus grus* (maximum 3,246).
Noteworthy flora: No information.
Scientific research and facilities: Several mid-winter waterfowl censuses have been carried out by the Ornithology Unit, Department of the Environment, since the late 1970s.
Management authority and jurisdiction: No information.
References: Evans (1994).
Reasons for inclusion: 3c (possibly also 2a). Harm Lake regularly supports over 1% of the regional populations of *Tadorna ferruginea* and *Grus grus* in winter. Substantial numbers of *Oxyura leucocephala* (a threatened species) have been reported in recent years, and may be regular.
Source: Derek A. Scott.

Hamoun-i Sabari and Hamoun-i Hirmand (47)

Location: Hamoun-i Sabari 31°20'N, 61°20'E; Hamoun-i Hirmand 30°10'N, 61°10'E; in the Sistan Basin, northwest, west and southwest of Zabol, Sistan/Baluchistan.
Area: c.170,000 ha (Hamoun-i Sabari 101,300 ha; Hamoun-i Hirmand 65,600 ha). Ramsar Site 50,000 ha.
Altitude: Hamoun-i Sabari 475 m; Hamoun-i Hirmand 470 m. The volcanic plug of Kuh Khvajeh rises to 609 m.
Overview: Two large, semi-permanent, fresh to brackish lakes with extensive marshes at the inland delta of the Hirmand (Helmand) River, in an internal drainage basin on the border between Iran and Afghanistan; extremely important for passage and wintering waterfowl, and also, in years of high water levels, for breeding waterfowl. Parts of the two lakes are protected in the Hamoun Protected Area, and have been designated as a Ramsar Site.
Physical features: The wetlands of the Sistan Basin, on the border between Iran and Afghanistan, comprise a complex of freshwater lakes with extensive reed-beds which at times of peak flooding can cover over 200,000 ha. These wetlands are unusual in that although the three main lakes, Hamoun-i Puzak (see site 48), Hamoun-i Sabari and Hamoun-i Hirmand, lie within an internal drainage basin, they are predominantly freshwater. The system lies in an extremely arid region, and receives the great bulk of its water from the Hirmand River, Fara River and several smaller rivers rising in the highlands of central and northern Afghanistan. During long periods of drought, as occurred in the late 1960s and again in the mid-1980s, these rivers supply sufficient water to flood only the uppermost of the lakes, the Hamoun-i Puzak, which lies almost entirely within Afghanistan. However, during years of unusually heavy rainfall, as occurred in the late 1970s and again in 1989, 1990 and 1991, the floodwaters sweep through all three lakes and overflow into a vast salt waste to the southeast, flushing the salts out of the system in the process.

The Hamoun-i Sabari (about half of which lies in Iran) receives water from the Fara Rud, which enters in the northeast (in Afghanistan), and overflow from the Hamoun-i Puzak to the east. The Hamoun-i Hirmand receives water from the southern (Sistan) branch of the Hirmand River and overflow from the Hamoun-i Sabari to the north. During years of good rainfall, the lakes flood to an average depth of about 50 cm. Both lakes formerly supported extensive growths of *Phragmites*, *Typha* and various rushes and sedges during periods of flooding, but very little emergent vegetation has re-appeared since the prolonged drought of the early and mid-1980s. The water levels in the main wetlands of the Sistan Basin during the periods 1969/70 to 1977/78 and 1984/85 to 1991/92 are summarized in Table 20. Water levels have fallen again since 1992, and in the winter of 1994/95, most of the wetlands were dry.

The wetlands are bordered to the east and south by low-lying plains. Much of the land around the town of Zabol and its many satellite villages to the east of the Hamouns is under irrigated cultivation. The plains to the south consist of extensive bare salt flats and sparsely vegetated sandy plains with sand dunes areas and some tamarisk scrub. An isolated volcanic plug (Kuh Khvajeh) rises abruptly out of the marshes on the east side of Hamoun-i Hirmand, and has a very flat top about 140 m above the level of the surrounding plains. In the west, the Hamouns are bounded by a line of low earthen cliffs at the edge of a vast undulating desert plain which rises gradually away to the west.

The climate is hot and dry, with mean January temperatures of 15-20°C and mean July temperatures of 35-40°C. The average annual rainfall is about 100 mm, with most rain falling in winter.

Ecological features: Habitats include fresh to brackish lakes with extensive mudflats, reed-beds, sedge marshes and salt marshes, riverine *Tamarix* thickets, bare salt flats, and vast sparsely vegetated desertic plains. The marshes are predominantly eutrophic, with extensive reed-beds of *Phragmites australis* and *Typha* spp, and large areas of sedge marsh (*Carex* spp.) and tamarisk thicket (*Tamarix* spp.). In years of prolonged flooding, an abundant submerged aquatic vegetation develops on the floodplain. Halophytic vegetation fringes the wetland, and includes *Halocnemum strobilaceum*, *Limonium carnosum*, *Salsola* spp. and *Atriplex verruciferum*. Surrounding areas are desertic, with very few settlements and limited irrigated cultivation to the south and east.

Land tenure: Public (Government).

Conservation measures taken: The western half of the Hamoun-i Sabari and Hamoun-i Hirmand and a large area of desert to the west were designated as a Protected Region (the Hamoun Protected Region) in August 1967. The boundaries were revised in August 1969, giving a total area of 201,062 ha. The reserve was reduced in size to 193,500 ha in the early 1970s, and upgraded to Wildlife Refuge. It has since been downgraded to Protected Area. This protected area includes only the main open water areas of the two lakes and their western shorelines, and excludes the important marshes in the east. The Iranian portion of the Hamoun-i Sabari and the northern section of the Hamoun-i Hirmand were designated as a Ramsar Site of approximately 50,000 ha on 23 June 1975. Approximately 37,000 ha of the Ramsar Site lie within the Hamoun Protected Area. The wetlands have been identified as an "Important Bird Area" by BirdLife International (Evans, 1994).

Conservation measures proposed: In the mid-1970s, a proposal was made to extend the boundaries of the Hamoun Wildlife Refuge eastwards to incorporate the whole of the Hamoun-i Sabari and Hamoun-i Hirmand wetlands (including Kuh Khvajeh), as well as the Iranian

portion of the Hamoun-i Puzak. This would have enlarged the Wildlife Refuge to 329,000 ha. Considerable progress was made with this proposal, and indeed the proposed new boundaries have appeared on various Department of the Environment maps. However, these new boundaries have never been formally gazetted, and the Hamoun Protected Area remains in its original form (apart from a minor modification to the boundary in 1969).

The *Action Programme for the Conservation of Wetlands in South and West Asia*, drawn up in Karachi in 1991, includes a recommendation that "studies should be undertaken of the impact of dams on the Helmand River in Afghanistan on the flood regime in the wetlands of the Sistan Basin in Iran, with a view to resolving the long-standing dispute over the sharing of waters of this transboundary wetland and ensuring an adequate supply of water for the Ramsar Sites in Iran" (Anon, 1992).

A Ramsar Monitoring Procedure Mission to the wetlands in January 1992 made the following recommendations (Scott & Smart 1992):

(i) The Hamoun Protected Area should be extended to incorporate important wetland habitat along the eastern edge of the Hamoun-i Sabari and Hamoun-i Hirmand, and in the Iranian portion of the Hamoun-i Puzak, as proposed in the mid-1970s. The new boundaries should follow those indicated on the official map of the Hamoun-i Sabari and Hamoun-i Hirmand Ramsar Site deposited at UNESCO.

(ii) The boundaries of the Protected Area and Ramsar Site should be clearly demarcated on the ground, *e.g.* with concrete pillars set at a maximum of one kilometre apart and with conspicuous sign-posts at all major entry points.

(iii) An integrated management plan should be developed for all wetland and water resources in the Sistan Basin. The development and implementation of such a plan would require the involvement of all government agencies concerned with water resources in the basin (*e.g.* Department of the Environment, Ministry of Agriculture, Ministry of Jihad, Ministry of Power, Department of Fisheries), and would ultimately involve close cooperation with the relevant authorities in Afghanistan. The management plan would endeavour to rationalize the use of water resources in the basin of the Hirmand River by taking into account the needs of the various users (domestic and industrial water supply, agriculture, fisheries and wildlife). A "set-aside" policy would be developed to ensure that adequate supplies of water are provided to maintain the ecological character of the important natural wetland ecosystems. Mechanisms would be developed to ensure that in the design of any future dams and other water control structures on the Hirmand and Fara Rivers, due attention would be given to all possible downstream effects. In particular, full consideration would be given to the potential impact of any such projects on the ecological character of the two Ramsar Sites. This would involve close consultation and cooperation between all interested parties in Afghanistan and Iran.

(iv) A basic requisite for the development of an integrated management plan for the region would be a comprehensive ecological and socio-economic study of the wetlands and water resources of the basin. This study would include *inter alia* the following:

- a comprehensive hydrological study of the Sistan Basin, including a review of the changes in water level that have occurred during the past twenty years using satellite imagery and meteorological records;
- a comprehensive limnological study of the wetlands of the Sistan Basin,

including studies on the physico-chemical characteristics of the water bodies, water quality, sedimentation rates *etc*.

- studies on the ecological and economic impact of fish introductions, with special attention to the impact of introduced herbivorous fishes on the aquatic vegetation and its consequences for animal husbandry and wildlife;
- a study of the effects of increased disturbance from fishing activities on wildlife populations;
- a detailed study of waterfowl populations in both summer and winter, including aerial censuses of wintering waterfowl (to provide information comparable with that obtained in the 1970s);
- studies on the problem of over-grazing of aquatic vegetation by domestic livestock and excessive harvesting of vegetation for fodder;
- a study of the exploitation of aquatic vegetation for fuel, and an investigation of alternative sources of fuel (*e.g.* fuelwood plantations);
- an investigation of the environmental impacts of the new highway between the Hamoun-i Sabari and the Hamoun-i Hirmand, the canal between the south end of the Hamoun-i Puzak and the Hamoun-i Sabari, and Chahnimeh Dam and other water control structures in Iran which may have had a pronounced effect on the hydrology and ecology of the Hamoun wetlands;
- a review of irrigation and agricultural practices in the basin, with special reference to the problem of increasing soil salinity.

Land use: Livestock grazing, reed-cutting and fishing. In recent years, the lakes have been stocked with Grass Carp *Ctenopharyngodon idella*.

Possible changes in land use: A major project, the "Seistan Drainage and Irrigation Completion and Rehabilitation Project", is currently being developed for possible financing from World Bank. In November 1993, the Food and Agriculture Organization (FAO) supported a study of the possible negative environmental impacts of this project, with a view to designing mitigation plans.

Disturbances and threats: Irrigation schemes on the Hirmand River in both Afghanistan and Iran have reduced the flow of water into the Hamouns. As a consequence, the wetlands are completely filled only in very wet years and are more prone to drying out in summer. Many of the problems of drought in the Sistan Basin have been attributed to dam construction and water diversion schemes on the Hirmand River in Afghanistan. The Kajaki Dam, built some 40 years ago, was increased in capacity about 20 years ago and undoubtedly caused a considerable reduction in the amount of water reaching the Hamouns, especially during dry years. In an international agreement between the Government of Afghanistan and former Government of Iran, the Government of Afghanistan guaranteed to provide an average flow of 26 cubic metres of water per second in the Hirmand River entering Iran. It is reported, however, that the Afghani authorities chose to provide the allocated volume as a "lump sum" during the winter months, rather than as a continuous flow during the dry summer months when the water was most needed. In any event, it now seems that this agreement is no longer being honoured. However, according to recent reports from FAO in Islamabad, the exceptional floods of early 1991 destroyed the Kajaki Dam and damaged other irrigation systems on the Hirmand River in Afghanistan. Thus, for the time being at least, there would appear to be no problems of water supply in the Hirmand River. However, there is apparently in existence a proposal to build a

new dam on the Hirmand River in Afghanistan (the Kamal Khan Dam).

Despite high water levels and prolonged flooding in the Hamoun-i Sabari and much of the Hamoun-i Hirmand in each year since 1989, there was still an almost complete absence of emergent aquatic vegetation by early 1992. This situation contrasts markedly with the situation in the early 1970s, when the aquatic vegetation recovered almost immediately after the severe drought of 1970/71 (when all of the wetlands on the Iranian side of the border were completely dry). Within two months of flooding (in March and April 1972), there had been a spectacular emergence of aquatic vegetation, and by the following year, large portions of the Sabari and Hirmand were covered in reed-beds. The reasons for the present lack of vegetation are unclear. It has been argued that the great duration of the drought in the early 1980s (with some parts of the Hamoun-i Hirmand remaining dry for six years) is the principal cause, the vegetation being unable to withstand such long periods of desiccation. The digging up of tubers by the local people for use as fuel may also have contributed to the problem. However, another possible cause may have been the massive stocking of the lakes in recent years with herbivorous fishes. Chinese Carp were introduced into the lakes about 20 years ago, but presumably died out during the prolonged drought in the 1980s. However, the even more voracious Grass Carp *Ctenopharyngodon idella* was introduced about five years ago, and now supports a major fishery. Introductions continue, with some two million fishes being released into the Hamoun-i Hirmand near Kuh Khvajeh in early January 1992. It seems likely that these fishes are retarding if not preventing any natural regeneration of the emergent aquatic vegetation.

The lack of emergent vegetation is a cause of considerable concern to local pastoralists, who depend on the marsh vegetation as a source of grazing for their herds of cattle and water buffalo. Very few livestock are now present around the Hamoun-i Hirmand and Hamoun-i Sabari, the great majority having been moved to the Hamoun-i Puzak marshes on the Afghan border, where the population of livestock is reported to have increased from about 10,000 to 26,000.

Increasing soil salinity is becoming a very serious problem in the agricultural land bordering the wetlands, and is a cause of considerable concern to the agricultural sector. Much of the former agricultural land around Zabol has had to be abandoned because of salinity problems, and in many other areas, the intensively irrigated fields are now producing extremely low yields. Already there have been some problems of wind-blown salt during the summer months, and it now seems quite possible that the area could suffer the same fate as the region around the Aral Sea. At the same time, there has been a great increase in the human population of the basin during the past decade, not only as a result of the high natural population increase (about 4% per annum), but also because of the large influx of refugees from Afghanistan. At the last census in 1989, the population of the Iranian portion of the Sistan Basin was 370,000.

An asphalt highway is currently being constructed across the low-lying flats between the north end of the Hamoun-i Hirmand and the south end of the Hamoun-i Sabari. The road, which was started about five years ago and is now nearing completion, passes through the middle of the Ramsar Site and the Hamoun Protected Area. Although the road passes over several bridges, free flow of water between the two Hamouns has been impeded to some extent, with as yet unknown effects on the hydrology and ecological character of the two Hamouns. A canal, which has recently been constructed between the south end of the Hamoun-i Puzak and the Hamoun-i Sabari to accelerate the flow of water into the Sabari, will also have a major effect on the hydrology of the system.

Other recent developments in the Iranian portion of the Sistan Basin include the construction of a number of major irrigation canals taking water directly from the Hirmand River and its distributaries, and the construction of a large reservoir (Chahnimeh) in the desert east of Zabol, supplied by a feeder canal from the Parian branch of the Hirmand River. These structures clearly reduce the amount of water entering the wetlands, and must have some impact on the ecology of the system as a whole.

A major die-off of fish, pelicans, flamingos and shorebirds occurred in November 1994. Samples were taken from the corpses and analyzed in Tehran, but the cause of death could not be determined.

Hydrological and biophysical values: No information.

Social and cultural values: There is a ruined settlement of considerable archaeological interest on Kuh Khvajeh. The reed-beds play a significant role in the economy of the local inhabitants who live in villages along the shoreline. The reeds are used for a number of purposes: as forage for domestic animals, for constructing boats ("tutans" - often likened to the reed boats of Lake Titicaca in the Andes), for fabricating wind-breaks for houses and gardens, and as a source of fuel for cooking and heating. Although primarily dependent on livestock breeding, the local people are increasingly taking advantage of the rich fishery to supplement their incomes.

Noteworthy fauna: The wetlands are extremely important as a staging and wintering area for a wide variety of waterbirds, notably pelicans, herons, dabbling ducks and shorebirds, and in years of high water level, are also an important breeding area for many species (see Table 21). Comprehensive ground and aerial censuses between 1969/70 and 1975/76 indicated that the numbers of Anatidae wintering in the Iranian portion of the Sistan wetlands varied from almost nil in exceptionally dry years (*e.g.* 1970/71) to over 700,000 in wet years (*e.g.* 1972/73). It was found that aerial surveys were essential to obtain adequate coverage of the wetlands and reliable counts of the waterfowl. As no aerial censuses have been possible since 1976, it is difficult to compare the counts of the mid-1970s with those of recent years. However, regular ground counts by personnel of the Department of the Environment between 1979/80 and 1990/91 have revealed a dramatic decline in numbers of wintering waterfowl, from about 250,000-300,000 in 1980-83 to less than 20,000 in 1988-1991. This has been attributed to the prolonged drought of the early and mid-1980s and large-scale degradation of the aquatic vegetation.

Peak counts of wintering birds have included 1,300 *Pelecanus onocrotalus*, 88 *P. crispus*, 2,150 *Egretta alba*, 208 *Ardea cinerea*, 2,600 *Anser anser*, 666 *Tadorna ferruginea*, 1,600 *T. tadorna*, over 220,000 *Anas crecca*, 300,000 *A. acuta*, 4,110 *Aythya ferina*, 84 *Grus grus* and 2,860 *Larus ridibundus*. Breeding birds in years with high water levels and extensive reed-beds have included up to 20-30 pairs of *Botaurus stellaris*, many *Ixobrychus minutus*, 120 pairs of *Platalea leucorodia*, 5-10 pairs of *Aythya nyroca*, 15 pairs of *Circus aeruginosus*, 100 pairs of *Himantopus himantopus*, 150-200 pairs of *Larus genei*, several pairs of *Sterna caspia*, 300-400 pairs of *Chlidonias hybridus*, and large numbers of *Acrocephalus melanopogon* and *A. stentoreus*. *Marmaronetta angustirostris* is probably a scarce resident; one was seen in June 1973 and thought to be breeding, and small numbers (maximum 7) have been observed in winter. Scarce winter visitors have included *Cygnus cygnus* (maximum 4), *Nettapus coromandelianus* (a female shot in January or February 1973 - the first record for Iran) and *Lymnocryptes minimus*.

Raptors are common in winter, and have included up to 70 *Milvus migrans*, 13 *Haliaeetus albicilla*, 22 *Circus aeruginosus*, 10 *Aegypius monachus*, 5 *Aquila heliaca*, 5 *A. clanga*, 4 *A.*

nipalensis, and single *Falco cherrug*, *F. peregrinus* and *F. pelegrinoides*. *Chlamydotis undulata* is a regular winter visitor in small numbers to the plains around the lakes (maximum 6). *Francolinus francolinus*, *Passer hispaniolensis* and *P. moabiticus* are resident in the tamarisk scrub around the lakes, and *Hypocolius ampelinus* is a fairly common summer visitor to nearby cultivated areas. A pair of *Bubo bubo* is resident on Kuh Khvajeh. The lush "oasis" vegetation around the wetlands provides a staging area for large numbers of migratory land-birds, while the surrounding deserts support a typical desert avifauna. At least 170 species have been recorded in the area.

Mammals known to occur in the area include Wolf (*Canis lupus*), Golden Jackal (*Canis aureus*), Red Fox (*Vulpes vulpes*), Striped Hyaena (*Hyaena hyaena*), Caracal (*Lynx caracal*), Wild Boar (*Sus scrofa*), Goitred Gazelle (*Gazella subgutturosa*) and Jebeer Gazelle (*Gazella dorcas fuscifrons*).

Noteworthy flora: No information.

Scientific research and facilities: Annual mid-winter waterfowl censuses have been carried out by the Ornithology Unit, Department of the Environment, since 1970 (with aerial surveys from 1972 to 1976), and breeding-season surveys have been undertaken on several occasions. A major ecological study of the wetlands of the Sistan Basin was undertaken by a group of experts from Tehran University during the mid-1980s. More recently, the Department of the Environment has embarked upon a study of the wetlands, as a part of its nationwide inventory of wetlands. A Government Committee has been established, including representatives of the Department of the Environment, Department of Agriculture and Department of Water, to coordinate studies and centralize the collection of information. Accommodation is available for visiting researchers at the Department of the Environment's office in Zabol.

Management authority and jurisdiction: The Department of the Environment is responsible for the management of the western half of the Hamoun-i Sabari and Hamoun-i Hirmand, as well as a large area of desert to the west. This Department is also responsible for the administration of the Ramsar Site.

References: Anon (1992); Anstey (1989); Ashtiani-Zarandi (1990); Carp (1980); Division of Research and Development (1972); Evans (1994); Firouz & Ferguson (1970b); Firouz *et al.* (1970); IUCN (1992); Mansoori (1984); Ramsar Convention Bureau (1993); Savage & Firouz (1968); Scott (1975a, 1976a, 1976b, 1976c, 1978a, 1978b, 1993); Scott & Smart (1992); Summers *et al.* (1987); Vahedi (1982); WCMC (1990).

Reasons for inclusion: 1a, 1c, 2a, 2b, 3a & 3c. The Hamoun-i Sabari and Hamoun-i Hirmand are outstanding examples of semi-permanent and seasonal wetlands characteristic of the desert regions of Southwest Asia. Spanning the international border between Iran and Afghanistan, the wetlands play a substantial hydrological and ecological role in the natural functioning of a major river basin shared between two countries. They support an extremely diverse wetland fauna and flora, and thus play an important role in maintaining the genetic and ecological diversity of the region. The wetlands are important for three or four globally threatened species of birds, supporting wintering populations of *Pelecanus crispus* and *Aquila heliaca*, a breeding population of *Aythya nyroca*, and probably also a small resident population of *Marmaronetta angustirostris*. The lakes regularly hold well in excess of 20,000 waterfowl during the migration seasons and in winter, including over 1% of the regional populations of *Pelecanus onocrotalus*, *Egretta alba*, at least nine species of Anatidae, *Fulica atra* and *Himantopus himantopus*. When conditions are suitable for breeding, the wetlands can support over 1% of the regional

population of *Platalea leucorodia*.
Source: Derek A. Scott.

South end of Hamoun-i Puzak (48)

Location: 31°20'N, 61°45'E; in the Sistan Basin, 40 km north-northeast of Zabol, on the Afghanistan border, Sistan/Baluchistan. (The main portion of the Hamoun-i Puzak lies to the north in Afghanistan).
Area: 14,900 ha. Ramsar Site 10,000 ha.
Altitude: 490 m.
Overview: The extensive permanent and seasonal freshwater lagoons and marshes comprising the Iranian portion of the Hamoun-i Puzak, a large freshwater lake about two-thirds of which lies in Afghanistan; important for breeding, passage and wintering waterfowl. The wetlands have been designated as a Ramsar Site, but are otherwise unprotected.
Physical features: The Hamoun-i Puzak is a large, perennial, freshwater lake with extensive reed-beds. Most of the lake, which covers about 35,000 ha, lies in Nimroz Province of southwestern Afghanistan, and is described elsewhere in this Directory, but about 14,900 ha in the southwest lie within Iranian territory. The entire lake is very shallow, with the maximum depth probably not exceeding four metres. The Iranian portion consists of a complex of open-water areas with rich submergent vegetation and extensive reed-beds, and includes the extensive marshes around Takht-e Edalat (formerly Takht-e Shah) and Mahmoodi. The Hamoun-i Puzak receives most of its water from the Khash Rud and the Parian branch of the Hirmand River, which enters the lake in two distributaries, one in the north and one in the east. The Puzak is the first of the three hamouns in the Sistan Basin to fill during periods of flooding, and probably never dries out completely, even during the severest droughts. In the early 1990s, following a series of wet years, the wetlands were in excellent condition, with clear water, rich submergent growth of aquatic vegetation, and extensive reed-beds. Water levels in the Hamoun-i Puzak and other wetlands of the Sistan Basin during the periods 1969/70 to 1977/78 and 1984/85 to 1991/92 are summarized in Table 20. Water levels have fallen again since 1992, and in the winter of 1994/95, most of the wetlands were dry.
The climate is hot and dry, with mean January temperatures of 15-20°C and mean July temperatures of 35-40°C. The average annual rainfall is about 100 mm, with most rain falling in winter.
Ecological features: Vast reed-beds of *Phragmites australis* cover much of the Hamoun-i Puzak, and there are only relatively small areas of open water. On the Iranian side of the border, *Typha* sp. now dominates, having replaced *Phragmites* since the 1970s, apparently as a result of heavy grazing by domestic livestock. Open-water areas support a very rich growth of submerged vegetation, principally *Ceratophyllum demersum*, while the margins of the wetland are fringed with *Tamarix* thickets. There are several small villages along the edge of the marsh, and the adjacent land is degraded steppe and irrigated cultivation.
Land tenure: Public (Government).
Conservation measures taken: The Hamoun-i Puzak marshes are not legally protected,

although personnel of the Department of the Environment endeavour to maintain some control in the region, and have a small office at Gorgori near the wetland. The greater part of the wetland (10,000 ha) was designated as a Ramsar Site on 23 June 1975. The wetland has been identified as an "Important Bird Area" by BirdLife International (Evans, 1994).

Conservation measures proposed: In the mid-1970s, the Division of Research and Development in the Department of the Environment recommended that the Hamoun Protected Area (see site 47) be extended eastwards to incorporate the Iranian portion of the Hamoun-i Puzak, but this recommendation was never implemented. A Ramsar Monitoring Procedure Mission visited the site in January 1992 and confirmed the desirability of extending the Hamoun Protected Area eastwards to incorporate the Iranian portion of the Hamoun-i Puzak, as proposed in the 1970s (Scott & Smart, 1992). It was recommended that the new boundaries of the reserve should follow those indicated on the official map of the Hamoun-i Sabari and Hamoun-i Hirmand Ramsar Site deposited at UNESCO. The Mission also recommended that the boundaries of the Ramsar Site should be clearly demarcated on the ground, and that an integrated management plan should be developed for all wetland and water resources in the Sistan Basin (see also Site 47).

Land use: Livestock grazing, reed-cutting and fishing.

Possible changes in land use: A major project, the "Seistan Drainage and Irrigation Completion and Rehabilitation Project", is currently being developed for possible financing from World Bank. In November 1993, the Food and Agriculture Organization (FAO) supported a study of the possible negative environmental impacts of this project, with a view to designing mitigation plans.

Disturbances and threats: Irrigation schemes on the Hirmand River, both in Afghanistan and Iran, have cause some reduction in the flow of water into the Hamoun-i Puzak. Recent developments likely to affect the Hamoun-i Puzak wetlands include the construction of a number of major irrigation canals taking water directly from the Hirmand River and its distributaries, and the construction of a large reservoir (Chahnimeh) in the desert east of Zabol, supplied by a feeder canal from the Parian branch of the Hirmand River.

During the last decade, there has been a major change in the dominant vegetation of the reed-beds, with *Typha* having almost completely replaced *Phragmites australis*. The reasons for this change are unknown, although it is supposed that the severe drought of the 1980s and extremely heavy grazing of *Phragmites* by domestic livestock are responsible. Large numbers of livestock have been brought from the Hamoun-i Hirmand and Hamoun-i Sabari marshes to the Hamoun-i Puzak marshes, where the population of livestock is reported to have increased from about 10,000 to 26,000. The danger that this intensive grazing and the large-scale cutting of reeds for fodder could result in permanent damage to the marsh vegetation in this area is now a cause of some concern (Scott & Smart, 1992).

Hydrological and biophysical values: No information.

Social and cultural values: The reed-beds of the Hamoun-i Puzak play a significant role in the economy of the local inhabitants who live in villages along the shoreline. These Baluchi people use reeds for a number of purposes: as forage for domestic animals, for constructing boats ("tutans" - often likened to the reed boats of Lake Titicaca in the Andes), for fabricating wind-breaks for houses and gardens, and as a source of fuel for cooking and heating.

Noteworthy fauna: An important wintering area for ducks and coots and a staging area for a wide variety of species, including many shorebirds. In wet years, the wetlands may also be

important for breeding waterfowl (see Table 22). Peak counts in winter have included up to 115 *Pelecanus onocrotalus*, 82 *P. crispus*, 1,200 *Egretta alba*, 200 *Ardea cinerea*, 2,450 *Anser anser*, 440 *Tadorna tadorna*, 58,000 *Anas crecca*, 12,000 *A. platyrhynchos*, 18,000 *A. clypeata*, 30 *Aythya nyroca*, 42 *Oxyura leucocephala*, 37,000 *Fulica atra*, 450 *Grus grus*, 130 *Recurvirostra avosetta* and 5,500 *Limosa limosa*. *Cygnus cygnus* has occurred as a rare straggler (maximum 2). Breeding species include *Podiceps cristatus*, *Botaurus stellaris* (three booming in June 1973), *Ardea purpurea*, *Porphyrio porphyrio*, *Vanellus leucurus*, *Sterna albifrons*, *Chlidonias hybridus* and *Acrocephalus stentoreus*. *Marmaronetta angustirostris* is probably a scarce resident in the marshes, although there has been only one recent record (a single bird in January 1977). Wintering birds of prey have included up to seven *Haliaeetus albicilla*, 45 *Circus aeruginosus* (which also breeds), five *Aegypius monachus* and five *Aquila heliaca*. *Passer moabiticus* is a scarce resident, breeding in the tamarisk scrub.

Mammals include Golden Jackal (*Canis aureus*), Red Fox (*Vulpes vulpes*), Striped Hyaena (*Hyaena hyaena*) and Wild Boar (*Sus scrofa*).

Noteworthy flora: No information.

Scientific research and facilities: Annual mid-winter waterfowl censuses have been carried out by the Ornithology Unit, Department of the Environment, since 1970 (with aerial surveys from 1972 to 1976), and breeding-season surveys have been undertaken on several occasions. Petocz *et al.* (1976) have described the wetlands on the Afghani side of the border. A major ecological study of the wetlands of the Sistan Basin was undertaken by a group of experts from Tehran University during the mid-1980s. More recently, the Department of the Environment has embarked upon a study of the wetlands, as a part of its nationwide inventory of wetlands. A Government Committee has been established, including representatives of the Department of the Environment, Department of Agriculture and Department of Water, to coordinate studies and centralize the collection of information. Accommodation is available for visiting researchers at the Department of the Environment's office in Zabol.

Management authority and jurisdiction: The Ramsar Site is administered by the Department of the Environment.

References: Anstey (1989); Ashtiani-Zarandi (1990); Carp (1980); Division of Research and Development (1972); Evans (1994); Firouz & Ferguson (1970b); Mansoori (1984); Petocz *et al.* (1976); Ramsar Convention Bureau (1993); Savage & Firouz (1968); Scott (1975a, 1976a, 1976c, 1978b, 1980, 1993); Scott & Smart (1992); Summers *et al.* (1987); Vahedi (1982); WCMC (1990).

Reasons for inclusion: 1c, 1d, 2a, 2b, 3a & 3c. The Iranian portion of the Hamoun-i Puzak is an excellent example of a large, permanent, freshwater lake with extensive reed-beds in an extremely arid desert region. Spanning the international border between Iran and Afghanistan, the wetland plays a substantial hydrological and ecological role in the natural functioning of a major river basin shared between two countries. It supports an extremely diverse wetland fauna and flora, and thus plays an important role in maintaining the genetic and ecological diversity of the region. The wetland supports wintering populations of four globally threatened species of birds, *Pelecanus crispus*, *Aythya nyroca*, *Oxyura leucocephala* and *Aquila heliaca*, and probably also a small resident population of *Marmaronetta angustirostris*. The lake regularly holds over 20,000 waterfowl during the migration seasons and in winter, including over 1% of the regional populations of *Egretta alba*, at least six species of Anatidae, *Fulica atra*, *Grus grus*, *Himantopus himantopus* and *Limosa limosa*.

Source: Derek A. Scott.

Kharku Island (49)

Location: 29°19'N, 50°21'E; in the northern Persian Gulf, 4 km north of the island of Kharg and 60 km northwest of Bushire.
Area: 312 ha.
Altitude: Sea level to 3 m.
Overview: A small sandy island with fringing coral reefs in the northern Persian Gulf, important for breeding terns (*Sterna* spp.). Protected in the Kharko Protected Area.
Physical features: Kharku (Kharko) Island is a low-lying, sandy island with a coral-rock substrate and fringing coral reefs, situated in the northern Persian Gulf about 30 km off the mainland coast and 60 km northwest of Bushire. Surface water is lacking, but there is a freshwater well near the south end of the island.
Ecological features: Most of the island is covered in sand-dune vegetation of grasses and low shrubs. It is fringed by a sandy beach with low strand vegetation. There are a few banyan trees near the south end of the island.
Land tenure: No information.
Conservation measures taken: Kharku Island and the nearby much larger island of Kharg (Khark) were designated as a Protected Region with a total area of 2,438 ha in May 1960. The reserve was upgraded to Wildlife Refuge in the early 1970s, but the Kharg portion was de-notified a few years later leaving only the island of Kharku protected in the Kharko Wildlife Refuge (312 ha). The island has been identified as an "Important Bird Area" by BirdLife International (Evans, 1994).
Conservation measures proposed: None known.
Land use: The island was uninhabited until the late 1970s, when an airforce camp was built at the north end. The nearby island of Kharg is a major oil terminal.
Possible changes in land use: None known.
Disturbances and threats: The island was visited by egg-collectors every year during the 1970s, and the breeding success of the terns was extremely low. An airforce camp was constructed at the north end of the island in the late 1970s. This involved the construction of a substantial landing stage and a number of permanent brick buildings. There is an ever-present threat of oil pollution from the major oil terminal on the nearby island of Kharg.
Hydrological and biophysical values: No information.
Social and cultural values: No information.
Noteworthy fauna: An important site for breeding terns. Surveys in 1974 and 1977 indicated that about five pairs of *Sterna bergii*, 600 pairs of *S. bengalensis*, 2,500 pairs of *S. repressa* and 250-300 pairs of *S. anaethetus* were frequenting the island, but breeding success was minimal in both years because of egg-collecting by local fishermen.
Noteworthy flora: No information.
Scientific research and facilities: Sea-bird censuses have been carried out during the breeding season by the Ornithology Unit, Department of the Environment, and some sea-birds were

ringed in 1977. Accommodation facilities are available on the neighbouring island of Kharg.
Management authority and jurisdiction: Department of the Environment.
References: Argyle (1977a); Evans (1994); Firouz *et al.* (1970); Gallagher *et al.* (1984); Harrington (1976b); Scott (1975b, 1976a, 1976b).
Reasons for inclusion: 1a, 2c & 3c. Kharku Island is a good representative example of a low-lying island with fringing coral reefs, characteristic of the Persian Gulf. The island supports an important breeding colony of terns (*Sterna* spp.), including over 1% of the regional population of *Sterna bengalensis*.
Source: Derek A. Scott.

Delta of Helleh River (50)

Location: 29°10'N, 50°50'E; on the Persian Gulf coast, 35 km north-northwest of Bushire.
Area: 35,600 ha.
Altitude: Sea level to about 7 m.
Overview: A complex of fresh to brackish lagoons, marshes and inter-tidal mudflats in the delta of the Helleh Rud on the northern Persian Gulf coast, important for breeding and wintering waterfowl including *Marmaronetta angustirostris*. The wetlands are protected in the Helleh Protected Area.
Physical features: The delta of the Helleh (Hilleh or Halileh) Rud comprises a complex of permanent, fresh to brackish lagoons with extensive reed-beds and sedge marshes, and a large area of inter-tidal mudflats at the mouth of the river. A maximum water depth of 3.5 m has been recorded in the lagoons. The adjacent semi-desertic plains are subject to seasonal flooding. The wetland is of recent origin, having developed in the early 1970s with the blocking-off of the main river channel and diversion of river water onto the adjacent saline coastal plain.
Ecological features: Extensive reed-beds and sedge marshes, seasonally flooded plains with halophytic vegetation, and inter-tidal mudflats. The adjacent desertic plains are very sparsely vegetated.
Land tenure: Public (Government).
Conservation measures taken: The wetlands and a large area of surrounding desert (totalling 42,600 ha) were designated as the Helleh Wildlife Refuge in 1977. This was downgraded to Protected Area in the 1980s. (This Protected Area is not listed in IUCN, 1992). The entire reserve has been identified as an "Important Bird Area" by BirdLife International (Evans, 1994).
Conservation measures proposed: It has been proposed that the Helleh Delta Marshes be designated as a Ramsar Site.
Land use: Some grazing of aquatic vegetation by domestic livestock. In recent years, water has been taken from the wetland to irrigate farmland on the adjacent plains.
Possible changes in land use: None known.
Disturbances and threats: In recent years, large quantities of water have been extracted from the marshes for irrigation purposes, and as a consequence the wetland may dry out completely during the summer months. This has resulted in a decline in the numbers of breeding birds.

Hydrological and biophysical values: No information.
Social and cultural values: No information.
Noteworthy fauna: The wetland supports large numbers of breeding, passage and wintering waterfowl of a wide variety of species, and is especially important for wintering *Phalacrocorax carbo* (maximum 3,060), herons and egrets, *Platalea leucorodia* (maximum 278), *Phoenicopterus ruber* (maximum 280), *Anser anser* (maximum 7,860), surface-feeding ducks, *Grus grus* (maximum 120) and shorebirds. *Pelecanus crispus* is a regular winter visitor in small numbers (maximum 10), and small flocks of *Anser erythropus* occurred on two occasions in the 1970s (maximum 37). Other scarce winter visitors have included *Pelecanus onocrotalus* (maximum 6), *Ciconia nigra* (maximum 5), *Plegadis falcinellus* (maximum 9) and *Anser albifrons* (maximum 10). *Oxyura leucocephala* was not recorded in the 1970s, but 173 were present in January 1988. The wetland is particularly important for *Marmaronetta angustirostris*; up to 1,000 have been recorded in winter, and about 15-20 pairs breed in the marshes. Other breeding species include *Ixobrychus minutus*, *Nycticorax nycticorax*, *Ardea purpurea* (10 pairs), *Francolinus francolinus*, *Recurvirostra avosetta*, *Glareola pratincola* (25 pairs), *Charadrius alexandrinus* (40-50 pairs), *Vanellus indicus*, *V. leucurus*, *Gelochelidon nilotica* (10-20 pairs), *Sterna caspia* (5-10 pairs), *S. albifrons* (40 pairs), *Halcyon smyrnensis*, *Acrocephalus melanopogon* and *A. stentoreus*. *Ardeola ralloides* and *Rallus aquaticus* have been recorded in summer and may breed. Peak counts of some waterfowl are given in Table 23. Wintering birds of prey have included *Haliaeetus albicilla*, *Circus aeruginosus* (up to 15), *Aquila heliaca* and *A. clanga* (up to three). *Pterocles alchata* is a fairly common breeding bird on the adjacent plains. At least 111 species of birds have been recorded in the reserve.
Noteworthy flora: The wetland supports the most extensive freshwater marshes on the entire Persian Gulf coast of southern Iran.
Scientific research and facilities: Mid-winter waterfowl censuses have been carried out by the Ornithology Unit, Department of the Environment, in most years since 1974, and breeding-season surveys have been undertaken on several occasions.
Management authority and jurisdiction: Department of the Environment.
References: Anstey (1989); Evans (1994); Green (1993); Harrington (1976b); Scott (1975b, 1976a, 1976c, 1978a, 1980); Scott & Smart (1992).
Reasons for inclusion: 1a, 2a, 2b, 3a & 3c. The delta marshes and mudflats of the Helleh River are a good example of a deltaic system characteristic of the northern shore of the Persian Gulf. The wetlands support an extremely diverse wetland fauna and flora, and thus play an important role in maintaining the genetic and ecological diversity of the region. The marshes support a substantial breeding and wintering population of *Marmaronetta angustirostris*, and wintering populations of three other threatened species of birds: *Anser erythropus*, *Oxyura leucocephala* and *Aquila heliaca*. In winter, the wetlands regularly hold over 20,000 waterfowl, including over 1% of the regional populations of *Phalacrocorax carbo*, *Platalea leucorodia*, *Anser anser*, *Tadorna tadorna*, *Anas penelope*, *A. strepera*, *A. acuta*, *A. clypeata* and *Recurvirostra avosetta*.
Source: Derek A. Scott.

Bushire Bay (51)

Location: 29°00'N, 50°53'E; on the Persian Gulf coast, north of the city of Bushire.
Area: 27,000 ha.
Altitude: Sea level.
Overview: A shallow sea bay with extensive mudflats and many sand spits and low-lying islands in the northern Persian Gulf, important for sea turtles and wintering shorebirds, gulls and terns. Unprotected.
Physical features: Bushire Bay is a shallow sea bay with large areas of inter-tidal mudflats, sand spits and low muddy and sandy islets; the bay extends from the town of Bushire on a rocky peninsula in the south to the southern limits of the Helleh Rud Delta, 20 km to the northwest. The largest island, Shif Island (1,500 ha), lies near the south end of the bay, and is comprised mainly of bare mudflats with low sand dunes at the north and south ends and a small fishing village at the north end. Two small islands have recently formed as sand spits near the north edge of the bay, and there is a sandy island of 50 ha in the north-central part of the bay.
Ecological features: Inter-tidal mudflats, sand spits and low sandy islets; bare mudflats and sparsely vegetated desertic plains inland.
Land tenure: No information.
Conservation measures taken: None. The bay has been identified as an "Important Bird Area" by BirdLife International (Evans, 1994).
Conservation measures proposed: None known.
Land use: Fishing. The busy harbour town of Bushire is situated to the southeast of the wetland, and there are numerous oil industry facilities in the general area.
Possible changes in land use: None known.
Disturbances and threats: Possible oil pollution.
Hydrological and biophysical values: No information.
Social and cultural values: No information.
Noteworthy fauna: An important wintering area for shorebirds, gulls and terns. Peak counts have included 84 *Dromas ardeola*, 20 *Charadrius mongolus*, 250 *Larus ichthyaetus*, 500 *L. ridibundus*, 7,500 *L. cachinnans* and 20 *Sterna caspia*. Small numbers of terns, including 15-20 pairs of *Gelochelidon nilotica*, 50 pairs of *Sterna repressa* and 10-15 pairs of *S. saundersi*, breed on islets in the bay, and up to 300 *S. bengalensis* have been recorded on passage in May. *Pterocles alchata* is a common breeding bird on the adjacent sandy flats. The
Green Turtle *Chelonia mydas* formerly nested in small numbers on islands in the bay, but has apparently now disappeared from the area.
Noteworthy flora: No information.
Scientific research and facilities: Mid-winter waterfowl censuses have been carried out by the Ornithology Unit, Department of the Environment, in most years since 1972.
Management authority and jurisdiction: No information.
References: Evans (1994); Harrington (1976b).
Reasons for inclusion: 1a & 3b. Bushire Bay is a good example of shallow sea-bay with extensive mudflats and low-lying islands, characteristic of the Persian Gulf coast. The mudflats are known to support appreciable numbers of many species of waterfowl, particularly shorebirds, gulls and terns, but comprehensive counts are lacking.
Source: Derek A. Scott.

Monde River Delta (52)

Location: 27°50'N, 51°30'E; on the Persian Gulf coast, 100 km south-southeast of Bushire.
Area: 26,870 ha.
Altitude: Sea level to 10 m.
Overview: Riverine marshes, mudflats and sand banks at the mouth of the Monde River on the northern Persian Gulf coast, important for wintering waterfowl including *Pelecanus crispus*. The wetlands are protected in the Monde Protected Area.
Physical features: The Monde River is much the largest river entering the Persian Gulf between the Khuzestan lowlands in the west and the Khouran Straits in the east. In its lower reaches, the river meanders across a broad sandy plain and here it has created a number of long, thin oxbow lakes which support some marsh vegetation and tamarisk scrub. There are extensive sand banks at the mouth of the river, and a large creek system with extensive inter-tidal mudflats and low sandy islets to the south.
Ecological features: Wetland habitats include wide sandy beaches, inter-tidal mudflats with sand spits and low sandy islets, and patches of marsh vegetation along the river banks and around old oxbow lakes. Adjacent habitats include extensive coastal sand dunes with good sand-dune vegetation, tamarisk scrub, sandy plains with steppic vegetation, small areas of irrigated wheat cultivation, and low rocky hills almost devoid of vegetation except in gullies.
Land tenure: Public (Government).
Conservation measures taken: The wetlands and adjacent areas of coastal sand dune and desertic steppe were designated as a Wildlife Refuge of 46,700 ha in 1976. This was downgraded to Protected Area (Monde Protected Area) in the 1980s. The entire Protected Area has been identified as an "Important Bird Area" by BirdLife International (Evans, 1994).
Conservation measures proposed: None known.
Land use: There is some fishing along the coast, but otherwise the region is very sparsely populated and little disturbed.
Disturbances and threats: No information.
Hydrological and biophysical values: No information.
Social and cultural values: No information.
Noteworthy fauna: An important wintering area for *Phalacrocorax carbo* (maximum 3,600), *Platalea leucorodia* (maximum 80), *Phoenicopterus ruber* (maximum 455), *Grus grus* (maximum 122), shorebirds, gulls and terns. Peak counts have included up to 16 *Egretta gularis*, 27 *Tadorna ferruginea*, 200 *Limosa lapponica*, 22 *Tringa cinerea*, 1,000 *Larus ichthyaetus*, 1,525 *L. ridibundus*, 28 *Gelochelidon nilotica* and 80 *Sterna caspia*. *Pelecanus crispus* is an occasional winter visitor in small numbers (maximum 4). Waterfowl recorded during a survey in October included 146 *Charadrius alexandrinus*, 61 *C. leschenaultii*, 135 *Calidris alba*, 305 *Sterna bergii* and 150 *S. bengalensis*. Up to three *Pandion haliaetus* and three *Haliaeetus albicilla* have been recorded in winter, along with the occasional *Falco peregrinus* and *F. cherrug*. *Chlamydotis undulata* is a regular winter visitor to the adjacent plains, and up to 40 have been recorded in January. *Hypocolius ampelinus* has been recorded in June, and probably breeds in the area.

Some 300 Goitred Gazelles *Gazella subgutturosa* were known to inhabit the plains near the mouth of the river in the mid-1970s.
Noteworthy flora: No information.
Scientific research and facilities: Mid-winter waterfowl censuses have been carried out by the Ornithology Unit, Department of the Environment, in most years since 1972, and breeding-season surveys have been undertaken on several occasions.
Management authority and jurisdiction: Department of the Environment.
References: Evans (1994); Harrington (1976b); Scott (1975b, 1980).
Reasons for inclusion: 1a & 3c (possibly also 2a). The Monde River Delta is a good example of a deltaic system characteristic of the northern shore of the Persian Gulf. In winter, the delta regularly supports over 1% of the regional populations of *Phalacrocorax carbo* and *Larus ichthyaetus*. *Pelecanus crispus* (a globally threatened species) has been recorded in winter, and may be regular in small numbers.
Source: Derek A. Scott.

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Nakhilu, Morghu and Ummal Korm Islands (53)

Location: 27°50'N, 51°30'E; a few km offshore along the Persian Gulf coast, about 40 km southeast of the Monde River Delta and 140 km south-southeast of Bushire.
Area: 2,045 ha (Nakhilu 15 ha; Morghu 2,000 ha; Ummal Korm 30 ha).
Altitude: Sea level to 3 m.
Overview: Three small, sandy, inshore islands with extensive inter-tidal mudflats in the northern Persian Gulf, extremely important for breeding *Dromas ardeola* and terns (*Sterna* spp.), and also important for nesting sea turtles. Unprotected.
Physical features: The site comprises three small, low-lying islands a few km offshore along the Persian Gulf coast south of the Monde River Delta. Nakhilu, the westernmost of the islands and the furthest offshore, is a small, almost circular island of about 15 ha, comprised mainly of sand with some rocky shores in the south and west. The island is fringed with low sand dunes which encircle a central basin almost completely covered in dense, low scrub. There are two small brackish pools near the south end and a ruined shrine near the west coast. Morghu Island is a long narrow island (about 10 km from north to south and about 2 km from east to west), consisting of a broad expanse of bare mudflats with a chain of low vegetated sand dunes along its southwestern (seaward) margin and round the southern end. The dunes are separated by narrow tidal channels which open up into a chain of shallow lagoons on the mudflats on the landward side of the dunes. There is a small, un-manned navigation tower on one of the highest sand dunes. Ummal Korm (Ummal Karam), the easternmost island, lies less than one km off the mainland coast. It is a long, thin low island, about 1.5 km long and 200 m wide, with rocky shores in the south, sandy beaches in the north, and extensive sand dunes, particularly in the west. A system of tidal creeks drains a small *Salicornia* marsh near the east end of the island. Elsewhere in the interior, the vegetation consists of low scrub with one small patch of thorn bushes and a few stunted date palms. All three islands are devoid of fresh water and are uninhabited.

Ecological features: Small offshore islands with sandy beaches and rocky shores, well-vegetated sand dunes, low scrub, *Salicornia* flats and (at Morghu) extensive bare mudflats flooded only at the highest tides.
Land tenure: No information.
Conservation measures taken: None. The islands have been identified as an "Important Bird Area" by BirdLife International (Evans, 1994).
Conservation measures proposed: The islands of Nakhilu, Morghu and Ummal Korm have been proposed for protection as part of the Monde Protected Area (Harrington, 1976b).
Land use: There is an unmanned marine light installation on Morghu. The islands are seldom visited as they are situated off a remote stretch of coast, far from the nearest fishing villages.
Possible changes in land use: None known.
Disturbances and threats: None known.
Hydrological and biophysical values: No information.
Social and cultural values: No information.
Noteworthy fauna: A very important breeding area for *Dromas ardeola* and terns. A colony of 1,500 pairs of *D. ardeola* was discovered in the sand dunes on Ummal Korm during a survey of all three islands in June 1975. Seven species of terns were nesting on the islands at that time: *Gelochelidon nilotica* (2+ pairs on Ummal Korm), *Sterna caspia* (5-10 pairs on Ummal Korm), *S. bergii* (40 breeding pairs on Nakhilu, with an additional 40 adults on Morghu and 100 adults on Ummal Korm), *S. bengalensis* (1,000 breeding pairs on Nakhilu, with an additional 300 adults on Morghu and 50 adults on Ummal Korm), *S. repressa* (170 pairs on Nakhilu, 65 pairs on Morghu and 300 pairs on Ummal Korm), *S. anaethetus* (15,000 pairs on Nakhilu, 5,500 pairs on Morghu and 1,000 pairs on Ummal Korm) and *S. saundersi* (4 pairs on Nakhilu and 5 pairs on Ummal Korm). There was also a colony of 26 pairs of *Egretta gularis* on Ummal Korm in 1975. Small numbers of *Platalea leucorodia* (maximum 12) have been recorded on the mudflats around Morghu in winter.
Nakhilu and Ummal Korm are important breeding sites for sea turtles including the Hawksbill (*Eretmochelys imbricata*). A small viper (Viperidae) is common on Ummal Korm. In June 1975, there was a plague of small mice on Nakhilu Island.
Noteworthy flora: No information.
Scientific research and facilities: Very little work has been carried out in the area, and there are no facilities. Breeding season surveys were carried out by the Ornithology Unit, Department of the Environment, in 1975 and 1976, and brief aerial surveys were undertaken by the Ornithology Unit in the winters of 1973/74 and 1974/75.
Management authority and jurisdiction: No information.
References: Argyle (1976b); Evans (1994); Gallagher *et al.* (1984); Harrington (1976b); Scott (1975b).
Reasons for inclusion: 1a, 2a, 2c, 3a & 3c. Nakhilu, Morghu and Ummal Korm islands are good representative examples of low-lying inshore islands characteristic of the Persian Gulf. The islands support important breeding colonies of *Dromas ardeola* and terns (*Sterna* spp.), and are also important for nesting sea turtles, including *Eretmochelys imbricata* (a threatened species). The islands regularly hold over 20,000 waterfowl and sea-birds, including over 1% of the regional populations of *Dromas ardeola*, *Sterna bengalensis* and *S. anaethetus*.
Source: Derek A. Scott.

Sheedvar Island (54)

Location: 26°48'N, 53°24'E; about 2 km off the eastern tip of Lavan Island and 9 km off the mainland coast, in the central Persian Gulf.
Area: 160 ha.
Altitude: Sea level to 6 m.
Overview: A small sandy and rocky offshore island with fringing coral reefs in the north-central Persian Gulf, extremely important for breeding sea turtles (Chelonidae) and terns (*Sterna* spp.). Protected as the Sheedvar Wildlife Refuge.
Physical features: Sheedvar Island is a small rocky island surrounded by excellent coral reefs in the north-central Persian Gulf, about 2 km due east of the eastern tip of Lavan Island and some 9 km southwest of the nearest stretch of mainland coast. The island is roughly oblong in shape, relatively flat and low-lying, with a maximum elevation of about 6 m. It is composed of a coral conglomerate which is almost completely hidden, above high water mark, by an overlay of sand dunes and sandy soils. Along the southern, western and northwestern shores, the rock is exposed as low cliffs which nowhere exceed about two metres in height. In the southeast corner, the rocks have become fragmented to form a jumbled heap of boulders just above high water mark. The remainder of the shoreline consists of a narrow sandy beach which widens at the northeast corner to form a sandy promontory. There are two main areas of sand dunes stretching across the northern and southern parts of the island. There are no springs or surface water on the island. Rainfall is very low, and the island is subjected to extremely high temperatures during the summer months, with temperatures frequently exceeding 40°C.
Ecological features: The sand dunes are sparsely vegetated with a typical sand-dune plant community. The flat area across the centre of the island is densely clad with arid steppic vegetation dominated by *Atriplex* sp. which in places forms an impenetrable shrub layer up to 60 cm in height.
Land tenure: Public (Government).
Conservation measures taken: The entire island (160 ha) was designated a Protected Region in July 1971, and upgraded to Wildlife Refuge in 1972. The island has been identified as an "Important Bird Area" by BirdLife International (Evans, 1994).
Conservation measures proposed: Various recommendations were made in the 1970s concerning improved protection for the tern colonies. These included the erection of appropriate notices on the island and the stationing of Department of the Environment personnel on the island for the duration of the breeding season.
Land use: Nature protection. The island is uninhabited, although the presence of a ruined stone building at the southeast corner of the island is evidence of some human occupation in the past.
Possible changes in land use: None known.
Disturbances and threats: Egg-collecting for human consumption was a major problem in the 1970s. In 1972, it seemed that only the larger terns (*Sterna bergii* and *S. bengalensis*) were being targeted by the egg-collectors, and *Sterna repressa* was scarcely disturbed. However, egg-collecting increased in intensity enormously over the next few years, and by 1976, the *S. repressa* colony had been reduced to only about 10% of its former size. *S. anaethetus*, which

breeds under rocks or in tunnels in the dense vegetation, did not appear to have been affected by egg-collecting. Presumably this species benefits from the presence of the many poisonous snakes. There is an ever-present threat of oil pollution from the oil terminal on Lavan Island and from the many oil tankers in the nearby shipping lanes.

Hydrological and biophysical values: No information.

Social and cultural values: No information.

Noteworthy fauna: The island supports the largest known breeding colony of terns in Iran. This was believed to contain about 300,000 pairs of *Sterna repressa* and 3,000-5,000 pairs of *S. anaethetus* in 1972, along with much smaller numbers of *S. bergii* (only 3-6 breeding pairs, but up to 100 adults) and *S. bengalensis* (only 11-18 breeding pairs, but up to 1,000 adults). However, by 1976 and 1977, the population of *S. repressa* had fallen dramatically to only 25,000-45,000 pairs, almost certainly as a result of massive egg-collecting by the Lavan islanders. Numbers of *S. anaethetus* had remained stable at around 3,000-5,000 pairs, possibly because the eggs of this species, which nests in tunnels in dense scrubby vegetation or in crevices amongst boulders, are much less accessible to egg-collectors. The site also holds the only known breeding colony of *Phalacrocorax nigrogularis* in Iran, with about 50-100 pairs breeding in an area of boulders at the southeastern corner of the island. There is a small colony of *Egretta gularis* (8-12 pairs) as well as 3-4 breeding pairs of *Butorides striatus*. The discovery of *B. striatus* on Sheedvar in June 1972 constituted the first record of this species in Iran. Only two species of passerines are resident on the island: *Galerida cristata* and *Prinia gracilis*. *Pandion haliaetus* has been recorded in June, and may breed nearby.

The island is a very important nesting site for sea turtles, mainly Hawksbill (*Eretmochelys imbricata*), with smaller numbers of Green Turtles (*Chelonia mydas*) and possibly one other species. About 500 turtles were thought to be nesting in 1971. A small poisonous snake (Viperidae) is abundant and has given rise to the island's alternative name "Maru" (Snake Island). A small lizard, *Scincus conirostris*, is also present.

Noteworthy flora: No information.

Scientific research and facilities: Avifaunal surveys were carried out by the Ornithology Unit, Department of the Environment, during the breeding season in 1972, 1976 and 1977, and some sea-birds were ringed in 1976. The Department of the Environment also investigated the breeding sea turtles in the early 1970s. Accommodation facilities are available at the large oil installation on the neighbouring island of Lavan.

Management authority and jurisdiction: Department of the Environment.

References: Argyle (1976c); Cornwallis (1977); Evans (1994); Gallagher *et al.* (1984); Harrington (1976b); Scott (1972a, 1975b); UNEP/IUCN (1988).

Reasons for inclusion: 1a, 2a, 2c, 3a & 3c. Sheedvar Island is a good representative example of a low-lying offshore island with fringing coral reefs, characteristic of the Persian Gulf. The island supports an extremely important breeding colony of terns (*Sterna* spp.) and other waterfowl, and is also important for nesting sea turtles, including *Eretmochelys imbricata* and *Chelonia mydas* (threatened species). The island regularly holds well in excess of 20,000 waterfowl and sea-birds, including over 1% of the regional populations of *Sterna repressa*, *S. anaethetus* and probably also *S. bengalensis*.

Source: Derek A. Scott.

Faror Islands (55)

Location: Faror Island 26°15'N, 54°31'E; Bani Faror 26°07'N, 54°27'E; in the south-central Persian Gulf, 45 km southwest of Bandar Lengeh.
Area: 2,620 ha.
Altitude: Sea level to a peak at 142 m on Faror Island.
Overview: Two small rocky offshore islands in the south-central Persian Gulf, important for breeding sea-birds, especially terns (*Sterna* spp.). Protected as the Faror Islands Protected Area.
Physical features: The Faror Islands are two isolated rocky islands in the south-central Persian Gulf. Faror Island is 24 km off the mainland coast; it is about 6.5 km long and 4 km wide, and rises in dark volcanic hills to a peak at 142 m. The tiny rocky islet of Bani Faror is a further 16 km south-southwest of Faror.
Ecological features: No information.
Land tenure: Public (Government).
Conservation measures taken: The islands have recently been designated as a Protected Area (Faror Islands Protected Area) with a total area of 2,620 ha. They have been identified as an "Important Bird Area" by BirdLife International (Evans, 1994).
Conservation measures proposed: None known.
Land use: No information.
Disturbances and threats: None known, other than the ever present threat of a major oil spill in the Persian Gulf.
Hydrological and biophysical values: No information.
Social and cultural values: No information.
Noteworthy fauna: La Personne (in Ticehurst *et al.,* 1925) found large numbers of *Sterna repressa* and *S. anaethetus* breeding on the islands in 1923, and observed several flocks of 20-30 *Puffinus persicus* offshore. He also found *Pandion haliaetus* nesting on Faror and Bani Faror.
Noteworthy flora: No information.
Scientific research and facilities: The islands were visited by La Personne in July 1923, but do not appear to have been visited by any naturalists since then.
Management authority and jurisdiction: Department of the Environment.
References: Evans (1994); Gallagher *et al.* (1984); Ticehurst *et al.* (1925).
Reasons for inclusion: 1a, 2c & 3b. The Faror Islands are good representative examples of rocky offshore islands in the Persian Gulf. The islands are known to support large breeding colony of terns (*Sterna* spp.) and perhaps other sea-birds, but no census data are available.
Source: Derek A. Scott.

Khouran Straits (56)

Location: 26°50'N, 55°40'E; in the southern Persian Gulf between the mainland and the island

of Gheshm, about 60 km west-southwest of Bandar Abbas, Bandar Abbas Province.
Area: 100,000 ha.
Altitude: Sea level.
Overview: A vast complex of low-lying muddy islands, mangrove swamps, inter-tidal mudflats and creeks in the shallow straits between the island of Gheshm and the mainland coast, in the southern Persian Gulf; extremely important for breeding and wintering waterfowl, especially Ardeidae, shorebirds, gulls and terns. The greater part of the wetland is protected as the Hara Protected Area, and the entire wetland has been designated as a Ramsar Site.
Physical features: The Khouran Straits (formerly known as the Clarence Straits) are situated between the Iranian mainland in the region of the Mehran and Kul/Rasul (Gol) river deltas, and the large island of Gheshm (110 km from east to west and up to 20 km from north to south). Within the straits, there are some 100,000 ha of low-lying islands, mangroves, mudflats and creeks which constitute much the largest of the mangrove/mudflat ecosystems in Iran. The mangrove forests reach their greatest development around a group of low-lying muddy islands in a large bay on the north shore of Gheshm Island opposite the Mehran Delta, but there are also significant stands along the outer margins of the Mehran Delta. In these areas and in the delta of the Kul/Rasul (Gol) river to the east, vast areas of mudflats are exposed at low tide. Elsewhere along the Gheshm and mainland coasts, the shoreline consists of wide sandy beaches and sand flats. A few small fishing settlements are scattered along the shore.
The climate is tropical to sub-tropical, with summer temperatures reaching 45°C. The annual rainfall of 100-300 mm falls mainly between November and April.
Ecological features: The mangrove forests, which cover an estimated 6,800 ha, comprise monospecific stands of the Black Mangrove *Avicennia marina*. These are the most westerly mangrove forests of any size in Iran, although there is a tiny and now badly degraded stand of mangroves at Bandar Asalu, some 300 km further west along the coast. Apart from the mangroves, red and brown algae (Rhodophyceae and Phaeophyceae) constitute the dominant vegetation in shallow coastal waters. The adjacent coastal plains are mainly barren sand flats with scattered *Acacia*, *Prosopis* and other thorn trees. There are small date gardens around some of the settlements.
Land tenure: Public (Government).
Conservation measures taken: The main area of mangroves and mudflats (an area of 82,360 ha) was designated as a Protected Region in 1973. This reserve was later increased in size to 85,686 ha and upgraded to National Park status (Hara National Park). However, the park was downgraded to Protected Area in the 1980s. The entire area of mangroves, mudflats and creeks in the Khouran Straits (100,000 ha) was designated as a Ramsar Site on 23 June 1975. The reserve was designated as a UNESCO (MAB) Biosphere Reserve in June 1976. The site has been identified as an "Important Bird Area" by BirdLife International (Evans, 1994).
Conservation measures proposed: None known.
Land use: Fishing (both subsistence and commercial); also some cutting of mangroves for charcoal, and grazing by domestic livestock, especially camels.
Possible changes in land use: There is a proposal to develop a free port on Gheshm Island. The potential impact of this development on the mangroves of the Hara Protected Region is unknown. The *Action Programme for the Conservation of Wetlands in South and West Asia*, drawn up in Karachi in 1991, includes a recommendation that "national and international conservation bodies should cooperate with the Gheshm Free Area Authority to ensure that

ecological considerations are fully incorporated in the planning stages of this economic development" (Anon, 1992).

Disturbances and threats: Some illegal cutting of mangroves for fuel and grazing by domestic livestock has been reported in the reserve. The easternmost part of the site is not included within any legally protected area, and has been subjected to logging of mangroves for charcoal production. There is some disturbance from fishing activities and boat traffic in the straits. A part of the area is potentially at risk from the proposed development of a free port and tourist facilities on Gheshm. There may be some pollution from the nearby port of Bandar Abbas, and oil pollution is an ever present threat.

Hydrological and biophysical values: The mangroves and shallow inshore waters are an important breeding and nursery ground for many species of crustaceans and fishes important in the local fishery.

Social and cultural values: Fishing (commercial and subsistence) is an important activity through the Straits.

Noteworthy fauna: The mangrove forests support substantial breeding populations of Ardeidae, including at least 30 pairs of *Ardeola grayii* (the largest colony in Iran), 50 pairs of *Egretta gularis*, 25-30 pairs of *E. alba* and one or two pairs of *Ardea goliath* (single nests found in 1976 and 1977 are the only confirmed breeding records of this species in Iran). The *E. alba* belong to the South Asian subspecies *modestus*, which probably reaches the western extremity of its range in this region. This is also one of the few localities in Iran where *Butorides striatus* has been recorded; single individuals have been recorded on a number of occasions and the bird is thought to breed in the area. Other breeding birds include *Dromas ardeola* (at least 20 pairs), *Esacus recurvirostris* (several pairs), *Gelochelidon nilotica* (10-20 pairs) and *Sterna saundersi* (10-20 pairs). *Acrocephalus stentoreus* is a very common summer visitor to the mangroves. The extensive inter-tidal mudflats are an extremely important staging and wintering area for shorebirds and gulls, along with substantial numbers of *Pelecanus crispus*, *Platalea leucorodia* (maximum 442), *Phoenicopterus ruber* (maximum 611) and many other species. About 100 *Pelecanus crispus* are present in most winters, but as many as 210 were recorded in January 1975. Few ducks occur in the area, but small flocks of *Anas querquedula* have been recorded on passage, and *Mergus serrator* has occurred in winter (maximum 2). Peak counts of some breeding and wintering waterfowl are given in Table 24. *Pandion haliaetus* is a remarkably common winter visitor; a total of 52 were counted during an aerial survey in the 1970s. Other wintering raptors include *Milvus migrans* (very common, with concentrations of up to 500 recorded near Bandar Abbas to the east of the site), *Haliaeetus albicilla*, *Circus aeruginosus* (maximum 4), *Accipiter badius* (maximum 4) and *Neophron percnopterus* (maximum 35). The adjacent desertic plains with scattered thorn trees and date gardens support a typical Baluchi avifauna with several primarily Indo-malayan species. At least 93 species of birds have been recorded in the reserve.

Green Turtles *Chelonia mydas* occur in significant numbers off the coast of Gheshm Island.

Noteworthy flora: The site contains much the most extensive stands of *Avicennia marina* in Iran, although most of the trees are rather stunted compared to those further east along the coast of Persian Baluchistan.

Scientific research and facilities: Mid-winter waterfowl censuses have been carried out by the Ornithology Unit, Department of the Environment, in most years since 1970 (with aerial surveys in 1973, 1974 and 1975), and breeding-season surveys have been undertaken on several

occasions. Some ringing was carried out at the heron and egret colonies in 1975, 1976 and 1977. A marine laboratory was established in Bandar Abbas in the early 1970s, and there is a marine research station on the island of Hormoz to the east.

Management authority and jurisdiction: The Department of the Environment is responsible for management of the Protected Area and administration of the Ramsar Site.

References: Anon (1992); Argyle (1975b, 1976b, 1977b); Carp (1980); Evans (1994); Gallagher *et al.* (1984); Gretton (1991); Harrington (1976b); Mansoori (1984); Ramsar Convention Bureau (1993); Scott (1975b, 1976a, 1976c, 1978a, 1993); Summers *et al.* (1987); UNEP/IUCN (1988); Vahedi (1982); WCMC (1990).

Reasons for inclusion: 1a, 2a, 2b, 2c, 3a & 3c. The wetlands of the Khouran Straits are an outstanding example of the coastal mudflat/mangrove ecosystem characteristic of deltaic and estuarine systems in the southern Persian Gulf and along the adjacent coasts of the Gulf of Oman. The wetlands support a very diverse fauna and flora, and thus play an important role in maintaining the genetic and ecological diversity of the region. They are also important spawning and nursery grounds for many fish species, and support large breeding colonies of Ardeidae. Two globally threatened species have been recorded: *Pelecanus crispus* occurs in appreciable numbers in winter, while *Chelonia mydas* regularly feeds in the area. The mudflats regularly hold over 20,000 waterfowl in winter, including over 1% of the regional populations of *Egretta gularis*, *Platalea leucorodia*, *Haematopus ostralegus*, *Dromas ardeola*, *Numenius arquata*, *Tringa cinerea*, *Larus ridibundus* and *Gelochelidon nilotica*.

Source: Derek A. Scott.

Deltas of Rud-i-Shur, Rud-i-Shirin and Rud-i-Minab (57)

Location: 27°05'N, 56°45'E; on the north shore of the Straits of Hormoz, about 10-70 km east of Bandar Abbas, Hormozgan.

Area: 11,800 ha of wetlands. Ramsar Site 20,000 ha.

Altitude: Sea level.

Overview: A large area of inter-tidal mudflats, mangrove swamps and sandy beaches in the contiguous deltas of three rivers on the northern shore of the Straits of Hormoz at the entrance to the Persian Gulf; important for wintering waterfowl, especially shorebirds and gulls. The entire wetland has been designated as a Ramsar Site, but is otherwise unprotected.

Physical features: The deltas of the Rud-i-Shur, Rud-i-Shirin and Rud-i-Minab form a continuous strip of coastal wetlands extending for about 55 km along the northern shore of the Straits of Hormoz from the region of Bandar Abbas in the west to Khor Kolahy in the east. The wetlands include extensive inter-tidal mudflats (over one km wide at low tide), about 300 ha of mangroves at the river mouths and along adjacent creeks, long sandy beaches, low sand bars and sand spits, and two large shallow sea bays, Khor Tiab and Khor Kolahy, near the mouth of the Rud-i Minab in the east. The rivers are dry for much of the year, flowing only after erratic rainfall in the interior (usually in winter). The waters of the Rud-i-Shirin and Rud-i-Minab are fresh, but that of the Rud-i-Shur is somewhat brackish. Arid, sandy plains with open thorn woodland stretch inland from the coast. There are a few small human settlements in the area,

generally with date gardens.
The climate is tropical to sub-tropical, with summer temperatures reaching 45°C. The annual rainfall of 100-300 mm falls mainly between November and April.
Ecological features: Mangroves (*Avicennia marina*) occur at the mouths of the rivers and as fringes along tidal creeks. The mudflats are barren of vegetation except for some characteristic saltmarsh plant associations. The adjacent coastal plain supports a sparse woodland of *Acacia*, *Prosopis*, *Ziziphus* and *Tamarix* with some date palms *Phoenix dactylifera* and large areas of bare sandy flats.
Land tenure: Public (Government).
Conservation measures taken: No legal protection. The delta wetlands of the Rud-i-Shur, Rud-i-Shirin and Rud-i-Minab are included in a Ramsar Site of 20,000 ha, designated on 23 June 1975. The site has been identified as an "Important Bird Area" by BirdLife International (Evans, 1994).
Conservation measures proposed: None known.
Land use: Fishing along the coast, and some cutting of mangroves for fuel; grazing by domestic livestock on the adjacent plains.
Possible changes in land use: None known.
Disturbances and threats: Some areas of mangrove have been degraded by excessive cutting for fuel and browsing by camels. There may be some pollution from the nearby port of Bandar Abbas, and oil pollution is an ever present threat.
Hydrological and biophysical values: The mangroves and shallow inshore waters are an important breeding and nursery ground for many species of crustaceans and fishes important in the local fishery.
Social and cultural values: Fishing is an important activity.
Noteworthy fauna: An extremely important wintering area for shorebirds and gulls, notably *Haematopus ostralegus* (up to 3,500), *Limosa lapponica* (up to 5,000), *Numenius arquata* (up to 1,500) and *Larus cachinnans* (up to 3,000), along with smaller numbers of *Pelecanus crispus* (up to 19), *Egretta alba* (up to 250), *Ardea cinerea* (up to 140), *Platalea leucorodia* (up to 50) and *Phoenicopterus ruber* (up to 386). The site may also be important for breeding Ardeidae including *Ardea goliath* and *Ardeola grayii* (which have both been recorded at the site), but this has never been investigated. Wintering raptors include *Haliaeetus albicilla* (maximum 2), *Accipiter badius* (maximum 2), *Neophron percnopterus* (maximum 3) and *Falco peregrinus* (one record). *Halcyon smyrnensis* is a fairly common resident in the area. The adjacent sandy plains and thorn woodland support a typical Baluchi avifauna with several species of Indo-malayan origin occurring here at or near the western extremity of their ranges, notably *Gyps bengalensis*, *Francolinus pondicerianus*, *Pterocles exustus*, *Athene brama*, *Dendrocopos assimilis* and *Acridotheres tristis*.
Noteworthy flora: The site contains extensive stands of relatively undisturbed mangrove forest.
Scientific research and facilities: Aerial surveys were carried out by the Ornithology Unit, Department of the Environment, in 1973, 1974 and 1975, and the landward edge of the wetland has been surveyed on several occasions at other times of the year. Much of the area is, however, very difficult of access. There is a marine research station on the island of Hormoz to the southwest.
Management authority and jurisdiction: The Ramsar Site is administered by the Department

of the Environment.
References: Carp (1980); Evans (1994); Harrington (1976b); Mansoori (1984); Ramsar Convention Bureau (1993); Scott (1975b, 1976a, 1976c); Summers *et al.* (1987); Vahedi (1982); WCMC (1990).
Reasons for inclusion: 1a, 2a, 2c & 3c. The deltas of the Rud-i-Shur, Rud-i-Shirin and Rud-i-Minab contain good representative examples of the mudflat/mangrove ecosystem characteristic of the coasts of the southern Persian Gulf and adjacent Gulf of Oman. They are important spawning and nursery grounds for many fish species, and support a wintering population of *Pelecanus crispus* (a globally threatened species). In winter, the mudflats regularly hold over 1% of the regional populations of *Haematopus ostralegus* and *Numenius arquata*.
Source: Derek A. Scott.

Deltas of Rud-i-Gaz and Rud-i-Hara (58)

Location: Rud-i Gaz 26°50'N, 57°40'E; Rud-i Hara 26°30'N, 57°00'E; on the eastern shore of the Straits of Hormoz, 120 km southeast of Bandar Abbas, Sistan/Baluchistan.
Area: 15,000 ha.
Altitude: Sea level.
Overview: A large area of inter-tidal mudflats, mangrove swamps and sandy beaches at the mouths of two rivers on the eastern shore of the Straits of Hormoz, at the entrance to the Persian Gulf; important for wintering waterfowl, especially shorebirds and *Pelecanus crispus*. The entire wetland has been designated as a Ramsar Site, but is otherwise unprotected.
Physical features: The deltas of the Rud-i-Gaz and Rud-i-Hara form a continuous strip of coastal wetlands extending for about 40 km from north to south along the eastern shore of the Straits of Hormoz. The wetlands comprise a complex of tidal creeks and mudflats, an estimated 900 ha of mangrove swamps, numerous sand banks and sand bars, and several low-lying muddy islands. The rivers are dry for much of the year, flowing only after erratic rainfall in the interior (usually in winter). Arid, sandy plains with open thorn woodland stretch inland from the coast. The area is remote and very sparsely populated, with only a few tiny fishing villages nearby.
The climate is tropical to sub-tropical, with summer temperatures reaching 45°C. The annual rainfall of 100-300 mm falls mainly between November and April.
Ecological features: Extensive stands of mangroves (*Avicennia marina*) occur at the mouths of the rivers, along tidal creeks and as a broad fringe along the landward side of coastal sand bars. The mudflats are barren of vegetation except for some characteristic saltmarsh plant associations. The adjacent coastal plain supports a sparse woodland of *Acacia*, *Prosopis*, *Ziziphus* and *Tamarix* with large areas of bare sandy flats.
Land tenure: Public (Government).
Conservation measures taken: No legal protection. The deltas of the Rud-i-Gaz and Rud-i-Hara (15,000 ha) were designated as a Ramsar Site on 23 June 1975. The site has been identified as an "Important Bird Area" by BirdLife International (Evans, 1994).
Conservation measures proposed: Harrington (1976b) recommended that the many stands of

mangroves, the tidal mudflats and a stretch of about 45 km of shoreline should be protected as a terrestrial reserve, but with offshore waters encompassed within the boundaries.
Land use: Some fishing. The area is remote and very sparsely populated.
Possible changes in land use: None known.
Disturbances and threats: None known.
Hydrological and biophysical values: The mangroves and shallow inshore waters are an important breeding and nursery ground for many species of crustaceans and fishes important in the local fishery.
Social and cultural values: No information.
Noteworthy fauna: An extremely important wintering area for shorebirds, notably *Haematopus ostralegus* (up to 2,000), *Dromas ardeola* (up to 120), *Limosa lapponica* (up to 11,500), *Numenius arquata* (up to 5,000), *Tringa totanus* (up to 2,000) and *T. cinerea* (up to 100), along with smaller numbers of *Pelecanus crispus* (up to 68), *Egretta alba* (up to 57), *Platalea leucorodia* (up to 39) and *Gelochelidon nilotica* (up to 30) . The site may also be important for breeding Ardeidae including *Ardea goliath* and *Ardeola grayii*, both of which have occurred at the site, but this has never been investigated. At least one pair of *Esacus recurvirostris* is resident, and *Haliaeetus albicilla* is a regular winter visitor (maximum 6). The adjacent sandy plains and thorn woodland support a typical Baluchi avifauna including *Pterocles exustus*, *Dendrocopos assimilis* and *Calandrella raytal*.
Noteworthy flora: The patch of mangrove forest at the mouth of the Rud-i-Hara is probably the finest stand of mangroves in Iran, in terms of tree size and density.
Scientific research and facilities: Aerial surveys were carried out by the Ornithology Unit, Department of the Environment, in 1973, 1974 and 1975, and the landward edge of the wetland has been surveyed on several occasions at other times of the year. Much of the area is, however, very difficult of access.
Management authority and jurisdiction: The Ramsar Site is administered by the Department of the Environment.
References: Carp (1980); Evans (1994); Harrington (1976b); Mansoori (1984); Ramsar Convention Bureau (1993); Scott (1975b, 1976a, 1976c); Summers *et al.* (1987); Vahedi (1982); WCMC (1990).
Reasons for inclusion: 1a, 2a, 2c, 3a & 3c. The deltas of the Rud-i-Gaz and Rud-i-Hara contain good representative examples of the mudflat/mangrove ecosystem characteristic of the coasts of the southern Persian Gulf and adjacent Gulf of Oman. They are important spawning and nursery grounds for many fish species, and support a wintering population of *Pelecanus crispus* (a globally threatened species). The mudflats regularly hold over 20,000 waterfowl in winter, including over 1% of the regional populations of *Haematopus ostralegus*, *Limosa lapponica* and *Numenius arquata*.
Source: Derek A. Scott.

Khor Jask (59)

Location: 25°40'N, 57°40'E; north of Jask town in southwest Persian Baluchistan, about 225

km southeast of Bandar Abbas, Sistan/Baluchistan.
Area: 11,500 ha.
Altitude: Sea level.
Overview: A large tidal creek with an excellent stand of mangroves on the coast of Persian Baluchistan, important for passage and wintering waterfowl including *Pelecanus crispus*. Unprotected.
Physical features: Khor Jask is a large tidal creek with adjacent beaches, sand dunes and sandy plains, on the coast of southwestern Persian Baluchistan, a few km north of the fishing port of Jask. The creek extends inland for several km and contains a particularly fine stand of mangrove forest at its landward end.
Ecological features: Extensive inter-tidal mudflats, about 100 ha of mangrove forest (*Avicennia marina*), long sandy beaches and coastal sand dunes. The adjacent sandy plains are very sparsely vegetated.
Land tenure: Public (Government).
Conservation measures taken: None. The site has been identified as an "Important Bird Area" by BirdLife International (Evans, 1994).
Conservation measures proposed: None known.
Land use: Fishing. There is some cutting of mangroves for fuel and grazing by domestic livestock on the adjacent plains.
Possible changes in land use: None known.
Disturbances and threats: No information.
Hydrological and biophysical values: The mangroves and shallow waters of the creek are an important breeding and nursery ground for many species of crustaceans and fishes important in the local fishery.
Social and cultural values: No information.
Noteworthy fauna: Khor Jask is an important staging and wintering area for a wide variety of shorebirds, gulls and terns, including up to 160 *Haematopus ostralegus*, 150 *Charadrius mongolus*, 400 *Calidris alba*, 300 *C. alpina*, 250 *Numenius arquata*, 100 *Tringa totanus*, 60 *T. stagnatilis*, 100 *T. cinerea*, 50 *Arenaria interpres*, 60 *Larus hemprichii*, 245 *L. genei*, 1,200 *L. cachinnans*, 85 *Sterna caspia*, 300 *S. sandvicensis* and 880 *S. hirundo*. *Pelecanus crispus* is a regular winter visitor, with up to 42 recorded, as are *Egretta gularis* (maximum 15), *Ardea cinerea* (maximum 25) and *Platalea leucorodia* (max 18). Up to 114 *P. leucorodia* have been recorded on autumn migration, along with smaller numbers of *Phoenicopterus ruber* (maximum 46) and a *Ciconia nigra*. *Butorides striatus*, *Ardeola grayii* (maximum 3) and *Esacus recurvirostris* (one pair) are probably resident in the area, and *Ardea goliath* has been recorded in October and January (single individuals on both occasions). Wintering raptors have included several *Pandion haliaetus*, up to three *Haliaeetus albicilla*, two *Accipiter badius* and a *Falco peregrinus*. *Pterocles exustus* and *Calandrella raytal* occur on the adjacent sandy plains.
Noteworthy flora: The site contains a large stand of relatively undisturbed mangrove forest.
Scientific research and facilities: A number of mid-winter waterfowl censuses have been carried out by the Ornithology Unit, Department of the Environment, since 1971 (with aerial surveys in 1973, 1974 and 1975), and breeding-season surveys have been undertaken on several occasions. The area is readily accessible from the nearby town of Jask.
Management authority and jurisdiction: No information.
References: Evans (1994); Harrington (1976b); Scott (1976a).

Reasons for inclusion: 1a & 2a. Khor Jask is a good representative example of a large creek with mudflat/mangrove ecosystem, characteristic of the coasts of the southern Persian Gulf and adjacent Gulf of Oman. It supports a wintering population of *Pelecanus crispus* (a globally threatened species).
Source: Derek A. Scott.

Deltas of Rud-i-Jagin and Rud-i-Gabrik (60)

Location: 25°35'N, 58°20'E; on the coast of Persian Baluchistan, 45-80 km east of Jask, Sistan/Baluchistan.
Area: c.14,000 ha.
Altitude: Sea level.
Overview: A large area of inter-tidal mudflats, mangrove swamps and sand banks at the mouths of two rivers on the coast of Persian Baluchistan; important for wintering waterfowl, especially shorebirds and *Pelecanus crispus*. Unprotected.
Physical features: The deltas of the Rud-i-Jagin and Rud-i-Gabrik form a continuous strip of coastal wetlands extending for about 35 km from east to west along the Gulf of Oman coast. The wetlands comprise a complex of tidal creeks and mudflats, mangrove swamps, sand banks and low muddy offshore islands and sand bars formed at the mouths of the two rivers. The rivers are dry for much of the year, flowing only after erratic rainfall in the interior (usually in winter). Arid, sandy plains with open thorn woodland stretch inland from the coast, with dense tamarisk woodland along the watercourses. The area is remote and very sparsely populated, with only a few tiny fishing villages nearby.
Ecological features: Extensive stands of mangroves (*Avicennia marina*) occur at the mouths of the rivers and along tidal creeks. The adjacent coastal plain supports a relatively dense woodland of *Acacia*, *Prosopis* and *Ziziphus* interspersed with bare sand flats. Stands of tall *Tamarix* forest line the river banks.
Land tenure: No information.
Conservation measures taken: None. The wetlands have been identified as an "Important Bird Area" by BirdLife International (Evans, 1994).
Conservation measures proposed: None known.
Land use: Some fishing. The area is remote and very sparsely populated.
Possible changes in land use: None known.
Disturbances and threats: None known.
Hydrological and biophysical values: The mangroves and shallow inshore waters are an important breeding and nursery ground for many species of crustaceans and fishes important in the local fishery.
Social and cultural values: No information.
Noteworthy fauna: An important wintering area for *Pelecanus crispus* (up to 48), *Ardea cinerea* (up to 35), *Platalea leucorodia* (up to 26), *Phoenicopterus ruber* (up to 160) and shorebirds, notably *Dromas ardeola* (maximum 14), *Numenius arquata* (maximum 350) and *Tringa cinerea* (maximum 40). Up to five *Ardeola grayii* have been recorded in the mangroves,

where the species is probably resident. Wintering birds of prey have included several *Pandion haliaetus*, up to four *Haliaeetus albicilla* and up to six *Neophron percnopterus*. *Chlamydotis undulata* may also winter in the area. The sandy plains, thorn woodland and tamarisk forest support a typical Baluchi avifauna including *Francolinus pondicerianus, Pterocles exustus* and *Dendrocopos assimilis*.

Noteworthy flora: The site contains extensive stands of relatively undisturbed mangrove forest.

Scientific research and facilities: Aerial surveys were carried out by the Ornithology Unit, Department of the Environment, in 1973, 1974 and 1975, and the landward edge of the wetland has been surveyed on several occasions at other times of the year. Much of the area is, however, very difficult of access.

Management authority and jurisdiction: No information.

References: Evans (1994); Harrington (1976b); Scott (1976a).

Reasons for inclusion: 1a, 2a, 2c & 3b. The deltas of the Rud-i-Jagin and Rud-i-Gabrik contain good representative examples of the mudflat/mangrove ecosystem characteristic of the coasts of the southern Persian Gulf and adjacent Gulf of Oman. They are important spawning and nursery grounds for many fish species, and support a wintering population of *Pelecanus crispus* (a globally threatened species). The mudflats are known to support very large numbers of waterfowl, especially shorebirds and terns, in winter, but few census data are available.

Source: Derek A. Scott.

Pozm Bay (61)

Location: 25°23'N, 60°15'E; on the coast of Persian Baluchistan, about 40 km west of Chahbahar, Sistan/Baluchistan.

Area: 9,000 ha.

Altitude: Sea level.

Overview: A shallow sea bay with long sandy beaches, tidal creeks, coral reefs and seagrass beds, on the coast of Persian Baluchistan; important for wintering waterfowl including *Pelecanus crispus*, and probably also sea turtles. Unprotected.

Physical features: Pozm (Pozam, Pizom) Bay is a shallow sea bay with extensive coral reefs and seagrass beds, similar in many respects to the larger Chahbahar Bay to the east (see site 62). The bay is about 12 km across at its widest and 7 km from north to south, with an entrance 9 km wide between rocky headlands. Except at these headlands, the shoreline consists of a wide sandy beach backed by a broad belt of low sand dunes. There are two large creek systems with inter-tidal mudflats, one at the mouth of the Rud-i Kalar in the northwest corner of the bay, and the other at the mouth of the Rud-i Sergan in the northeast. A large area of well-vegetated sand dunes stretches away to the north.

Ecological features: Sandy beaches and tidal mudflats.

Land tenure: Public (Government).

Conservation measures taken: None. The site has been identified as an "Important Bird Area" by BirdLife International (Evans, 1994).

Conservation measures proposed: Harrington (1976b) recommended that Pozm Bay be afforded some form of protection, and considered that from the aesthetic point of view, the site would merit National Park status.
Land use: Some fishing. The area is very sparsely populated.
Possible changes in land use: None known.
Disturbances and threats: None known. Although the bay itself remains relatively undisturbed, the aesthetics of the area have been badly affected by the construction of a new port and road nearby.
Hydrological and biophysical values: No information.
Social and cultural values: No information.
Noteworthy fauna: An important wintering area for *Pelecanus crispus* (maximum 50), *Phalacrocorax carbo* (maximum 1,350), *Ardea cinerea* (maximum 150), shorebirds (notably *Haematopus ostralegus*, *Charadrius* spp., *Limosa lapponica* and *Numenius arquata*), gulls and terns. The latter have included up to 73 *Larus ichthyaetus*, 2,500 *Larus cachinnans* and 20 *Sterna caspia*. *Egretta alba*, *E. gularis*, *Platalea leucorodia*, *Phoenicopterus ruber* and *Larus hemprichii* are regular winter visitors in small numbers. Up to three *Pandion haliaetus* and two *Haliaeetus albicilla* have been recorded in winter.
Noteworthy flora: The bay contains important seagrass beds, and there is excellent sand dune vegetation to the north.
Scientific research and facilities: Mid-winter waterfowl censuses have been carried out by the Ornithology Unit, Department of the Environment, on a number of occasions since 1971 (with aerial surveys in 1973, 1974 and 1975).
Management authority and jurisdiction: No information.
References: Evans (1994); Harrington (1976b); UNEP/IUCN (1988).
Reasons for inclusion: 1a, 2a & 2b. Pozm Bay is one of the finest and least disturbed bays on the south coast of Iran, with excellent coral reefs and seagrass beds. It thus plays an important role in maintaining the genetic and ecological diversity of the region. It supports a significant wintering population of *Pelecanus crispus* (a globally threatened species), and is thought to be important for sea turtles.
Source: Derek A. Scott.

Chahbahar Bay and Khor Konarak (62)

Location: 25°25'N, 60°30'E (Khor Konarak 25°20'N, 60°20'E); on the coast of southeast Persian Baluchistan west of the town of Chahbahar, Sistan/Baluchistan.
Area: 33,500 ha.
Altitude: Sea level.
Overview: A shallow sea bay with long sandy beaches, tidal creeks, coral reefs and seagrass beds, on the coast of Persian Baluchistan; important for wintering waterfowl including *Pelecanus crispus*, and probably also sea turtles. Unprotected.
Physical features: Chahbahar Bay is an almost circular bay about 22 km across at its widest and 18 km from north to south, with an entrance 14 km wide between rocky headlands. The bay

averages about 6 m in depth, and contains extensive coral reefs and seagrass beds; the water is normally very clear. Except at the rocky headlands at either side of the entrance to the bay, the shoreline consists of a sandy beach backed by a broad belt of low sand dunes. There is a large creek with extensive inter-tidal mudflats near the small fishing village of Konarak on the west side of the bay (Khor Konarak). The much larger harbour town of Chahbahar is situated in the lea of the rocky headland at the east side of the bay.

Ecological features: The sandy beaches and tidal mudflats lack vegetation other than some algae. The coastal dunes support typical sand dune vegetation, while further inland the coastal plain supports an open woodland of *Acacia*, *Prosopis*, *Ziziphus* and *Tamarix*, with large areas of bare sand flats.

Land tenure: Public (Government).

Conservation measures taken: None. The bay has been identified as an "Important Bird Area" by BirdLife International (Evans, 1994).

Conservation measures proposed: Chahbahar Bay was proposed for protection by the Tourist-Consult Group in the early 1970s, as it is one of the few sites on the coast of Iran suitable for SCUBA diving. It was not, however, considered suitable for National Park status because of the considerable coastal development and large military installation around Chahbahar port. Harrington (1976b) also recommended protection for the site, and suggested that it might reasonably constitute a Protected Area, in which pollution and other standards could be enforced to protect the unique features of the bay.

Land use: Fishing. There is a large fishing port and military installation at Chahbahar on the east side of the bay, and a fishing village (Konarak) on the west side.

Possible changes in land use: None known.

Disturbances and threats: The principal threat is pollution from the busy harbour town of Chahbahar on the east side of the bay.

Hydrological and biophysical values: No information.

Social and cultural values: No information.

Noteworthy fauna: The site has little importance for breeding waterbirds, although at least two pairs of *Esacus recurvirostris* are resident. A small flock of *Pelecanus crispus* (maximum 48) winters in the bay, along with up to 30 *Egretta gularis*, 58 *E. alba*, 80 *Platalea leucorodia*, reasonable numbers of shorebirds and large numbers of gulls and terns. The latter have included up to 135 *Larus ichthyaetus*, 450 *L. ridibundus*, 1,400 *L. genei*, 3,500 *L. cachinnans*, 10 *Sterna caspia* and 500 *S. sandvicensis*. Wintering shorebirds include up to 50 *Charadrius mongolus*, 70 *C. leschenaultii* and a few *Pluvialis fulva* (here at the extreme edge of the species' wintering distribution) and *Tringa hypoleucos* (maximum 11). Other wintering waterfowl include up to 65 *Podiceps cristatus* and the occasional *Ciconia nigra*. Up to 77 *Larus hemprichii*, 180 *Sterna bergii* and 110 *S. bengalensis* have been recorded on spring migration. *Pandion haliaetus*, *Haliaeetus albicilla*, *Neophron percnopterus*, *Falco peregrinus* and *F. pelegrinoides* are regular winter visitors in small numbers, and *Gyps fulvus* is an occasional visitor (maximum 6). The coastal dunes, open thorn woodland and rocky hills around the bay support a typical Baluchi avifauna including *Ammoperdix griseogularis*, *Francolinus pondicerianus*, *Athene brama*, *Eremopterix nigriceps*, *Calandrella raytal*, *Hirundo obsoleta* and *Oenanthe alboniger*.

Noteworthy flora: The bay contains important seagrass beds.

Scientific research and facilities: Annual mid-winter waterfowl censuses have been carried out by the Ornithology Unit, Department of the Environment, since 1971 (with aerial surveys in

1973, 1974 and 1975), and a number of avifaunal surveys have been undertaken at other times of the year. The site is readily accessible from the nearby fishing port of Chahbahar.
Management authority and jurisdiction: No information.
References: Evans (1994); Harrington (1976b); Scott (1975b); UNEP/IUCN (1988).
Reasons for inclusion: 1a, 2a & 2b. Chahbahar Bay and Khor Konarak are an extremely good example of a large, shallow sea bay with associated creek system, characteristic of the north coast of the Arabian Sea. The bay contains excellent coral reefs and seagrass beds, and thus plays an important role in maintaining the genetic and ecological diversity of the region. It supports a significant wintering population of *Pelecanus crispus* (a globally threatened species), and is thought to be important for sea turtles.
Source: Derek A. Scott.

Lower Sarbaz River and Khor Govater (63)

Location: 25°15'N, 61°30'E (Lower Sarbaz River 25°40'N, 61°00'E; Khor Govater 25°10'N, 61°30'E); in extreme southeast Persian Baluchistan near the Pakistan border, 85 km east of Chahbahar, Sistan/Baluchistan.
Area: Lower Sarbaz River 2,900 ha; Khor Govater 11,560 ha.
Altitude: Sea level to 50 m.
Overview: The riverine and estuarine wetlands of the Lower Sarbaz River, including permanent freshwater pools and marshes, mangrove swamps and inter-tidal mudflats, and also the sandy beaches of the adjacent Gulf of Oman coast in extreme southeastern Persian Baluchistan; important for *Crocodylus porosus* [erratum; correct is *palustris*] and wintering waterfowl, notably *Pelecanus crispus*, shorebirds, gulls and terns. Protected in the Gandu (Bahu Kalat) Protected Area.
Physical features: The site comprises the lower course of the Sarbaz River, its estuary in Khor Govater (Govater Bay), and a 61 km stretch of the Gulf of Oman coast in the extreme southeast corner of Persian Baluchistan up to the Pakistan border. Erratic winter rains in the interior of Baluchistan produce some surface flow in the river in most years, and there are occasional torrential floods, but for much of the year, surface water in the river bed is confined to a series of deep, stagnant pools. There are extensive inter-tidal mudflats in the estuarine portion of the river and about 200 ha of mangrove forest. The coastline consists of long sandy beaches backed by sand dune areas, as well as stretches of high sea-cliffs. A tiny rocky islet offshore provides a roost for large numbers of sea-birds but is unsuitable as breeding habitat because it is awash during storms.
The region is generally extremely hot throughout the year, and has very low winter rainfall. However, the climate in summer is influenced by the southwest monsoon, and although heavy rainfall is unusual, the humidity remains high throughout the summer.
Ecological features: Permanent pools in the bed of the Sarbaz River support rich submerged aquatic vegetation and a narrow fringe of emergent vegetation, including some *Phragmites* sp. and *Typha* sp. Mangrove areas in the estuarine zone are mono-specific stands of *Avicennia marina*, with some very large trees. A high water table in the main valley supports open park-

like woodland of *Acacia, Prosopis, Ziziphus, Tamarix* and date palms, with stands of oleander and fan-palms along the river bed. Away from the river the vegetation is extremely sparse, and much of the area is almost devoid of vegetation except after the very infrequent rains.

Land tenure: No information.

Conservation measures taken: The wetlands are included within a Protected Area of 382,430 ha (the Bahu Kalat Protected Area), established in 1971. The boundaries have remained unchanged since then, but the reserve has been re-named the Gandu (Gando) Protected Area. The entire reserve has been identified as an "Important Bird Area" by BirdLife International (Evans, 1994).

Conservation measures proposed: None known.

Land use: Fishing along the coast, and some grazing by domestic livestock in riverside vegetation. There is a small fishing village on Govater Bay near the mouth of the Sarbaz River and several tiny villages with small areas of cultivation along the river banks, but the area is remote and most of it is very sparsely populated.

Possible changes in land use: None known.

Disturbances and threats: None known.

Hydrological and biophysical values: No information.

Social and cultural values: No information.

Noteworthy fauna: The tidal mudflats, mangroves, sandy beaches and inshore waters at the mouth of the Sarbaz River are an important wintering area for *Phalacrocorax carbo* (up to 3,500), *Pelecanus crispus* (maximum of 52 in the 1970s but up to 112 in recent years), *Platalea leucorodia* (up to 49), a variety of shorebirds (notably *Haematopus ostralegus*, *Calidris alba*, *Limosa lapponica*, *Numenius arquata* and *Tringa totanus*) and gulls. The latter have included up to 2,000 *Larus ridibundus*, 1,000 *L. genei* and 1,000 *L. cachinnans*. Scarce winter visitors have included single *Ciconia nigra* and *Pluvialis fulva*. Large numbers of terns occur on passage, including up to 2,000 *Sterna bergii*. Breeding birds in this area include *Ardeola grayii* (up to 15 birds), *Esacus recurvirostris* (at least two pairs), *Dromas ardeola* (a few pairs), *Sterna saundersi* (10-15 pairs), *Halcyon smyrnensis* (common) and *Acrocephalus stentoreus* (common). Peak counts of some waterfowl are given in Table 25.

Up to 14 *Pandion haliaetus* have been recorded in winter, and the species is thought to breed in the area. Other wintering raptors have included *Haliaeetus albicilla*, *Accipiter badius* (up to 4), *Neophron percnopterus* (up to 27), *Aquila heliaca*, *Falco cherrug* and *F. peregrinus*. *Chlamydotis undulata* is a regular winter visitor to the plains of the nearby Dasht-i Ari, in flocks of up to 11 birds.

The avifauna of the lower Sarbaz valley is typical of the lowlands of Baluchistan, and has much stronger affinities with the Indo-malayan fauna than with the Palearctic. Characteristic species include *Butastur teesa*, *Aquila rapax*, *Gyps bengalensis*, *Francolinus pondicerianus*, *Turnix sylvatica*, *Pterocles exustus*, *Athene brama*, *Caprimulgus mahrattensis*, *Dendrocopos assimilis*, *Calandrella raytal*, *Lanius vittatus*, *Saxicola caprata*, *Lonchura malabarica*, *Passer pyrrhonotus* and *Acridotheres tristis*. At least 204 species of birds have been recorded in the Gandu (Bahu Kalat) Protected Area.

The Sarbaz River is noted for its thriving population of Marsh Crocodile or Mugger (*Crocodylus porosus* [erratum; correct is *palustris*]), the westernmost population of this South Asian species. Other fauna in the Protected Area include Desert Monitor (*Varanus griseus*), Common Indian Mongoose (*Herpestes edwardsi*), Palm Squirrel (*Funambulus pennanti*),

Golden Jackal (*Canis aureus*), Striped Hyaena (*Hyaena hyaena*), Caracal (*Lynx caracal*), Leopard (*Felis pardus*), Wild Boar (*Sus scrofa*), Chinkara Gazelle (*Gazella dorcas bennetti*), Persian Ibex (*Capra hircus aegagrus*) and Wild Sheep (*Ovis ammon*). The rare Baluchistan race of the Himalayan Black Bear (*Selenarctos thibetanus*) is believed to occur in the reserve.
Noteworthy flora: The large stand of *Avicennia marina* at the mouth of the Sarbaz River contains some of the largest mangrove trees in Iran.
Scientific research and facilities: Mid-winter waterfowl censuses have been carried out by the Ornithology Unit, Department of the Environment, in most years since 1970 (with aerial surveys in 1973, 1974 and 1975), and avifaunal surveys have been undertaken on several occasions at other times of the year. The Department of the Environment has also conducted some investigations on the Marsh Crocodile population and mammalian fauna. Simple accommodation facilities are available at Game Guard Stations in the Protected Area.
Management authority and jurisdiction: Department of the Environment.
References: Evans (1994); Firouz (1974); Harrington (1976b); Scott (1975b, 1976a).
Reasons for inclusion: 1a, 2a, 2b & 3c. The wetlands of the lower Sarbaz River and Khor Govater contain excellent examples of semi-permanent riverine wetlands and estuarine mudflat/mangrove ecosystems characteristic of southern Persian Baluchistan and adjacent Baluchistan Province of Pakistan. The wetlands support a diverse fauna and flora which is primarily Indo-Malayan in affinity, and thus play an important role in maintaining the genetic and ecological diversity of the region. The lower Sarbaz River supports a substantial population of *Crocodylus porosus* [erratum; correct is *palustris*], while Khor Govater supports a wintering population of *Pelecanus crispus* (both globally threatened species). One other threatened species, *Aquila heliaca*, occurs in winter. Khor Govater regularly supports over 1% of the regional populations of *Phalacrocorax carbo*, *Larus hemprichii*, *L. genei*, *Sterna caspia* and *S. bergii* during the migration seasons and in winter.
Source: Derek A. Scott.

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Table 1: Protected Areas containing important wetlands in the Islamic Republic of Iran

Name	Province	Area (ha)
Lisar Protected Area (includes Nur Gol)	Gilan/Azerbayjan	33,050
Lavandavil Wildlife Refuge	Gilan	949
Siahkesheem Protected Area	Gilan	4,500
Selke Wildlife Refuge	Gilan	360
Amirkelayh Wildlife Refuge	Gilan	1,230
Fereidoonkenar Protected Area	Mazandaran	148
Miankaleh Wildlife Refuge	Mazandaran	68,800
Uromiyeh National Park	Azerbayjan	463,600
Bakhtegan Wildlife Refuge	Fars	327,820
Arjan Protected Area	Fars	52,800
Hamoun Protected Area	Sistan/Baluchistan	193,500
Dez Wildlife Refuge	Khuzestan	5,240
Dez Protected Area	Khuzestan	10,633
Karkheh Wildlife Refuge	Khuzestan	3,600
Karkheh Protected Area	Khuzestan	9,427
Shadegan Wildlife Refuge	Khuzestan	296,000
Kharko Wildlife Refuge	Persian Gulf	312
Helleh Protected Area	Persian Gulf	42,600
Mond Protected Area	Persian Gulf	46,700
Sheedvar Wildlife Refuge	Persian Gulf	160
Faror Islands Protected Area	Persian Gulf	2,620
Hara Protected Area	Bandar Abbas	85,686
Gandu (Bahu Kalat) Protected Area	Sistan/Baluchistan	382,430

Table 2: Population estimates for some species of waterfowl in the Islamic Republic of Iran in the 1970s

Based on waterfowl counts carried out by the Ornithology Unit, Department of the Environment, between 1970 and 1978.

	Wintering population (individuals)	Breeding population (pairs)
Podiceps grisegena	10-20	1
Podiceps cristatus	5,000-7,000	250-350
Podiceps nigricollis	3,500-4,500	150-200
Podiceps auritus	50-200*	0
Pelecanus onocrotalus	500-2,300	1,000-1,600
Pelecanus crispus	1,000-1,250	5-10
Phalacrocorax carbo	25,000-30,000	5,200-6,000
Phalacrocorax nigrogularis	unknown	50-100
Phalacrocorax pygmaeus	800-1,100	0
Ardea cinerea	2,750-3,600	90-100
Ardea goliath	15-30	3-5
Ardea purpurea	50-100	250
Egretta alba	4,500-6,500	30
Egretta gularis	700-1,000	90-100
Egretta garzetta	600-1,400	800
Bubulcus ibis	50-100	120
Ardeola ralloides	10-20	1,200
Ardeola grayii	80-100	30-50
Nycticorax nycticorax	300-500*	650-700
Ciconia nigra	50+	?<10
Ciconia ciconia	750-2,050	3,150-3,400
Threskiornis aethiopicus	50-100	?0
Plegadis falcinellus	100-200	130-200
Platalea leucorodia	700-1,200	210-390
Phoenicopterus ruber	35,000-70,000	15,000-25,000
Anser albifrons	2,500-5,000	0
Anser erythropus	4,000-7,500	0
Anser anser	15,000-32,000	5-10
Cygnus cygnus	25-900*	0
Cygnus columbianus	20-100*	0
Cygnus olor	100-550*	0
	8,500-9,000 in 1971/72	
Tadorna ferruginea	7,000-11,000	800-1,000
Tadorna tadorna	15,000-25,000	4,500-5,500
Anas penelope	100,000-150,000	0
Anas strepera	30,000-80,000	?<10
Anas crecca	800,000-1,350,000	0
Anas platyrhynchos	250,000-700,000*	several 100
Anas acuta	230,000-600,000	0
Anas querquedula	<50	?<50
Anas clypeata	25,000-120,000	?<50
Marmaronetta angustirostris	9,000-30,000	1,000-2,000
Netta rufina	500-1,000*	?<10

15,000-20,000 in 1971/72

Table 2 (continued):

	Wintering population (individuals)	Breeding population (pairs)
Aythya ferina	55,000-85,000	?<50
Aythya nyroca	200-1,000	150-300
Aythya fuligula	20,000-65,000*	?<10
Aythya marila	<50	0
Bucephala clangula	400-2,500*	0
Mergellus albellus	100-250*	0
	2,500-3,000 in 1971/72	
Mergus serrator	50-500*	0
Mergus merganser	50-100	0
Oxyura leucocephala	25-100*	20-30
	500-700 in 1971/72	
Grus grus	2,000-3,200	0
Grus leucogeranus	7-14	0
Porphyrio porphyrio	500-1,000	several 100
Fulica atra	300,000-500,000	3,000-5,000
Dromas ardeola	1,250-1,750	1,500+
Haematopus ostralegus	9,000-12,000	20
Himantopus himantopus	2,500-3,000	1,000-1,500
Recurvirostra avosetta	1,500-2,500	2,000-2,500
Esacus recurvirostris	50-100	25+
Glareola pratincola	0	1,000-1,500
Vanellus vanellus	25,000-35,000	unknown
Vanellus leucurus	1,200-1,600	300-500
Vanellus indicus	5,000+	unknown
Pluvialis apricaria	500-1,000	0
Pluvialis fulva	<50	0
Pluvialis squatarola	1,000-2,000	0
Charadrius hiaticula	2,500-6,000	0
Charadrius dubius	<50	unknown
Charadrius alexandrinus	5,000-10,000	unknown
Charadrius mongolus	2,500-5,000	0
Charadrius leschenaultii	5,000-10,000	?<20
Eudromias morinellus	500-1,000	0
Limosa limosa	10,000-15,000	0
Limosa lapponica	25,000-35,000	0
Numenius phaeopus	100-250	0
Numenius arquata	15,000-25,000	0
Tringa erythropus	250-500	0
Tringa totanus	15,000-25,000	3,000-4,000
Tringa stagnatilis	500-1,000	0
Tringa nebularia	350-750	0
Tringa ochropus	750-1,500	0
Tringa glareola	20-50	0
Tringa cinerea	2,000-3,000	0
Tringa hypoleucos	50-150	?<50

Arenaria interpres	500-1,500	0
Scolopax rusticola	5,000++	0
Gallinago gallinago	10,000+	0

Table 2 (continued):

	Wintering population (individuals)	Breeding population (pairs)
Lymnocryptes minimus	1,000+	0
Calidris alba	10,000-15,000	0
Calidris minuta	500-1,500	0
Calidris temminckii	100-250	0
Calidris alpina	50,000-90,000	0
Calidris ferruginea	10-50	0
Limicola falcinellus	500-1,000	0
Philomachus pugnax	100-250	0
Larus hemprichii	50-100	0
Larus canus	300-3,000*	0
Larus cachinnans	20,000-35,000	4,000-5,000
Larus fuscus	20-40	0
Larus ichthyaetus	800-4,000*	0
Larus ridibundus	35,000-60,000	200-500
Larus genei	35,000-55,000	4,000-5,500
Larus minutus	100-3,000*	0
Chlidonias hybridus	100-400	3,600-7,000
Gelochelidon nilotica	1,000-3,000	200-400
Sterna caspia	750-1,500	30-50
Sterna hirundo	<50	225-360
Sterna repressa	0	300,000
Sterna anaethetus	0	25,000-27,000
Sterna saundersi	unknown	130-150
Sterna albifrons	unknown	800-1,150
Sterna bergii	many 1,000s	Many 1,000s
Sterna bengalensis	many 1,000s	Many 1,000s
Sterna sandvicensis	many 1,000s	?<10

* : wintering population highly variable, depending on severity of winter in North Caspian and/or in Iran.

Table 3: Ramsar Sites in the Islamic Republic of Iran

The 18 wetlands designated for inclusion in the List of Wetlands of International Importance by the Islamic Republic of Iran at the time of ratification of the Ramsar Convention on 23 June 1975.

As listed in *A Directory of Wetlands of International Importance: Sites Designated for the List of Wetlands of International Importance* (Ramsar Convention Bureau, 1993).

	Area in ha
Miankaleh Peninsula, Gorgan Bay, Lapoo-Zaghmarz Ab-bandan*	100,000
Lake Parishan and Dasht-e-Arjan*	6,600
Lake Orumiyeh*	483,000
Neyriz Lakes and Kamjan Marshes*	108,000
Anzali Mordab (Talab) complex*	15,000
Shadegan Marshes and mudflats of Khor-al Amaya & Khor Musa*	400,000
Hamun-e-Saberi and Hamun-e-Helmand*	50,000
Lake Kobi	1,200
Hamun-e-Puzak, south end	10,000
Shurgol, Yadegarlu and Dorgeh Sangi Lakes	2,500
Bandar Kiashahr Lagoon and mouth of Sefid Rud	500
Amirkelayeh Lake*	1,230
Lake Gori	120
Alagol, Ulmagol and Ajigol Lakes	1,400
Khuran Straits*	100,000
Deltas of Rud-e-Shur, Rud-e-Shirin and Rud-e-Minab	20,000
Deltas of Rud-e-Gaz and Rud-e-Hara	15,000
Gavkhouni Lake and marshes of the lower Zaindeh Rud	43,000
Total area of sites designated	**1,357,550**

*: site wholly or partly included within a Protected Area.

Table 4: Peak counts of waterfowl at Lake Uromiyeh

	Breeding	Wintering	Passage
Podiceps nigricollis	-	-	8,225 (Aug)
Pelecanus onocrotalus	1,000-1,600 prs	-	-
Egretta garzetta	90 prs	-	-
Egretta alba	-	123	-
Ardea cinerea	-	-	52 (Aug)
Ardea purpurea	10+ prs	-	-
Plegadis falcinellus	100+ prs	-	-
Platalea leucorodia	50-100 prs	-	-
Phoenicopterus ruber	15,000-25,000 prs	19,000	-
Cygnus columbianus	-	63	-
Anser albifrons	-	118	265 (Nov)
Anser anser	several prs	4,500	-
Tadorna ferruginea	300-500 prs	3,500	-
Tadorna tadorna	4,000-5,000 prs	64,000	35,000 (Aug)
Anas crecca	-	540	-
Anas platyrhynchos	300-500 prs	1,430	-
Anas querquedula	-	-	21,200 (Aug)
Marmaronetta angustirostris	few prs	-	-
Aythya nyroca	several prs	-	-
Haematopus ostralegus	20-40 prs	-	-
Himantopus himantopus	300-500 prs	-	-
Recurvirostra avosetta	1,500-2,000 prs	-	13,600 (Aug)
Glareola pratincola	50-100 prs	-	-
Charadrius alexandrinus	250+ prs	-	-
Vanellus vanellus	500-1,000 prs	-	3,000 (Aug)
Calidris minuta	-	-	10,000+ (Aug)
Calidris ferruginea	-	-	1,000+ (Aug)
Calidris alpina	-	525	-
Philomachus pugnax	-	-	9,440 (Aug)
Limosa limosa	-	-	100 (Aug)
Tringa totanus	2,000-3,000 prs	7,080	8,330 (Aug)
Tringa stagnatilis	-	-	1,395 (Aug)
Tringa nebularia	-	-	31 (Aug)
Tringa ochropus	-	-	428 (Jul)
Arenaria interpres	-	-	152 (Aug)
Larus ridibundus	200-500 prs	-	-
Larus genei	3,000-4,000 prs	-	19,565 (Aug)
Larus armenicus	4,000-5,000 prs	-	-
Gelochelidon nilotica	20-30 prs	-	-
Sterna caspia	5-10 prs	-	-
Sterna hirundo	25-50 prs	-	-
Sterna albifrons	40-70 prs	-	-
Chlidonias hybridus	100-200 prs	-	-
Chlidonias leucopterus	-	-	1,140 (Aug)

Chlidonias niger	-	-	21 (Jul)

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Table 5: Peak counts of waterfowl at Shur Gol, Yadegarlu and Dorgeh Sangi

	Breeding	Wintering	Passage
Podiceps cristatus	20-30 prs	100	-
Podiceps nigricollis	-	-	75 (Nov)
Pelecanus onocrotalus	1,000 feeding	-	-
Ciconia ciconia	150 feeding	-	-
Plegadis falcinellus	50-75 prs	-	-
Platalea leucorodia	100 feeding	-	-
Phoenicopterus ruber	1,000 feeding	-	-
Cygnus columbianus	-	57	-
Anser albifrons	-	120	-
Anser erythropus	-	70	175 (Nov)
Anser anser	-	616	-
Tadorna ferruginea	-	2,350	1,855 (Nov)
Anas penelope	-	350	-
Anas crecca	-	2,500	45,100 (Nov)
Anas platyrhynchos	-	2,250	-
Anas acuta	-	7,000	-
Anas querquedula	-	-	1,370 (Aug)
Anas clypeata	-	-	5,500 (Nov)
Marmaronetta angustirostris	10-15 prs	10	-
Aythya ferina	-	484	15,000
Aythya nyroca	several prs	-	-
Mergellus albellus	-	238	-
Oxyura leucocephala	several prs	-	-
Fulica atra	-	2,500	120,000
Himantopus himantopus	-	-	1,500 (Aug)
Recurvirostra avosetta	-	-	500 (Jul)
Glareola pratincola	50-80 prs	-	-
Charadrius dubius	-	-	50 (Aug)
Vanellus vanellus	breeds	-	1,460 (Jun)
Calidris minuta	-	-	500 (Aug)
Philomachus pugnax	-	-	2,500 (Aug)
Limosa limosa	-	-	500 (Aug)
Tringa totanus	breeds	-	1,700 (Aug)
Tringa stagnatilis	-	-	350 (Aug)
Tringa nebularia	-	-	50 (Aug)
Tringa ochropus	-	-	22 (Aug)
Tringa glareola	-	-	200 (Aug)
Larus minutus	-	25	-
Larus ridibundus	-	-	1,000 (Aug)
Larus genei	-	-	1,030 (Aug)
Gelochelidon nilotica	-	-	20 (Aug)
Sterna albifrons	10-20 prs	-	-
Chlidonias hybridus	50 prs	-	-
Chlidonias leucopterus	-	-	1,000 (Aug)

Chlidonias niger	-	-	5 (Aug)

Table 6: Peak counts of waterfowl at Lake Kobi

	Breeding	Wintering	Passage
Podiceps nigricollis	50 prs	-	-
Nycticorax nycticorax	100 prs	-	-
Ardeola ralloides	100 prs	-	-
Egretta garzetta	100 prs	-	-
Ardea cinerea	25 prs	-	-
Ardea purpurea	30 prs	-	-
Ciconia ciconia	243 feeding	-	-
Plegadis falcinellus	100-150 prs	-	-
Phoenicopterus ruber	-	-	6,600
Anser anser	-	7,000	-
Branta ruficollis	-	16	-
Tadorna ferruginea	-	2,890	-
Tadorna tadorna	-	1,300	-
Anas penelope	-	-	600
Anas crecca	-	-	6,000
Anas platyrhynchos	-	2,000	6,300
Anas acuta	-	-	250
Anas querquedula	-	-	3,000 (Aug)
Anas clypeata	-	1,395	5,000 (Nov)
Aythya ferina	-	2,300	20,000
Aythya nyroca	several prs	-	-
Oxyura leucocephala	33 loafing	9	100+ (Nov)
Fulica atra	-	15,000	50,000 (Nov)
Himantopus himantopus	-	-	600 (Aug)
Charadrius alexandrinus	-	-	100 (Aug)
Vanellus vanellus	breeds	-	300 (Aug)
Calidris minuta	-	-	300 (Aug)
Philomachus pugnax	-	-	800 (Aug)
Tringa erythropus	-	40	-
Tringa totanus	-	-	300 (Aug)
Tringa stagnatilis	-	-	80 (Aug)
Tringa nebularia	-	-	50 (Aug)
Tringa ochropus	-	-	10 (Aug)
Tringa glareola	-	-	120 (Aug)
Larus ridibundus	-	-	300 (Aug)
Larus genei	-	-	500 (Jul)
Sterna hirundo	5-10 prs	-	-
Chlidonias leucopterus	-	-	500 (Aug)

Table 7: Peak counts of waterfowl along the South Caspian shore

	Wintering	Passage
Podiceps cristatus	8,875	-
Podiceps auritus	11	-
Podiceps nigricollis	760	-
Phalacrocorax carbo	3,500	-
Pelecanus crispus	83	-
Cygnus olor	72	-
Tadorna tadorna	63	-
Anas penelope	12,900	-
Anas strepera	3,250	-
Anas crecca	171,000	-
Anas platyrhynchos	170,000	-
Anas acuta	3,060	-
Anas querquedula	-	660 (Apr)
Anas clypeata	4,350	-
Netta rufina	2,385	-
Aythya ferina	3,185	-
Aythya fuligula	39,900	-
Aythya marila	33	-
Bucephala clangula	813	-
Mergellus albellus	113	-
Charadrius hiaticula	-	310 (Sep)
Charadrius dubius	-	20 (Sep)
Charadrius alexandrinus	220	340 (Dec)
Charadrius leschenaultii	-	146 (Jul)
Pluvialis squatarola	-	127 (Nov)
Vanellus vanellus	-	510 (Nov)
Calidris alba	90	2,070 (Sep)
Calidris minuta	-	2,300 (Sep)
Calidris ferruginea	-	800 (Jul)
Calidris alpina	-	300 (Dec)
Philomachus pugnax	-	400 (Sep)
Numenius phaeopus	-	310 (Apr)
Tringa totanus	-	200 (Nov)
Tringa cinerea	-	95 (Jul)
Arenaria interpres	-	275 (Aug)
Larus ichthyaetus	160	-
Larus minutus	700	-
Larus ridibundus	7,600	-
Larus genei	-	1,200 (Nov)
Larus canus	960	-
Larus cachinnans	900	-
Sterna hirundo	-	150 (Sep)
Sterna albifrons	-	1,100 (Aug)

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Table 8: Peak counts of waterfowl at Anzali Mordab

	Breeding	Wintering	Passage
Podiceps cristatus	20 prs	260	-
Podiceps auritus	-	6	-
Podiceps nigricollis	-	300	-
Tachybaptus ruficollis	-	460	-
Phalacrocorax carbo	-	950	4,200 (Mar)
Phalacrocorax pygmaeus	-	650	-
Pelecanus onocrotalus	-	14	-
Pelecanus crispus	-	6	-
Nycticorax nycticorax	20 prs	250	-
Ardeola ralloides	150 prs	-	900 (Sep)
Bubulcus ibis	20 prs	16	620 (Oct)
Egretta garzetta	150 prs	300	585 (Sep)
Egretta alba	-	170	200 (Aug)
Ardea cinerea	20 prs	100	110 (Oct)
Ardea purpurea	10+ prs	-	47 (Sep)
Plegadis falcinellus	-	55	-
Platalea leucorodia	-	-	30 (Apr)
Phoenicopterus ruber	-	124	-
Cygnus olor	-	2,530	-
Cygnus cygnus	-	849	-
Cygnus columbianus	-	51	-
Anser albifrons	-	500	-
Anser erythropus	-	32	-
Anser anser	-	1,500	-
Anas penelope	-	30,000	-
Anas strepera	-	14,900	-
Anas crecca	-	540,000	-
Anas platyrhynchos	-	67,800	-
Anas acuta	-	55,000	-
Anas querquedula	-	-	3,850 (Apr)
Anas clypeata	-	24,300	-
Netta rufina	-	1,275	-
Aythya ferina	-	65,000	-
Aythya fuligula	-	34,500	-
Aythya nyroca	-	51	130 (Nov)
Bucephala clangula	-	120	-
Mergellus albellus	-	382	-
Oxyura leucocephala	-	-	25 (Mar)
Porphyrio porphyrio	common	135	-
Fulica atra	-	106,400	-
Charadrius hiaticula	-	-	100 (Sep)
Charadrius asiaticus	-	-	4 (Mar)
Pluvialis apricaria	-	50	-

Pluvialis squatarola	-	-	65 (Feb)
Vanellus gregarius	-	-	8 (Apr)
Vanellus vanellus	-	5,630	-
Calidris minuta	-	-	300 (Sep)

Table 8 (continued):

	Breeding	Wintering	Passage
Philomachus pugnax	-	-	2,500 (Mar)
Lymnocryptes minimus	-	5	-
Gallinago gallinago	-	180	305 (Sep)
Galinago media	-	-	4 (Apr)
Limosa limosa	-	1,380	-
Limosa lapponica	-	-	40 (Oct)
Numenius phaeopus	-	-	112 (Apr)
Tringa erythropus	-	92	-
Tringa totanus	-	-	700 (Dec)
Tringa glareola	-	-	300 (Sep)
Phalaropus lobatus	-	-	280 (Apr)
Larus ichthyaetus	-	122	-
Larus minutus	-	1,750	-
Larus ridibundus	-	2,510	-
Larus canus	-	70	-
Larus cachinnans	-	-	300 (Sep)
Gelochelidon nilotica	-	-	20 (Sep)
Sterna sandvicensis	-	-	60 (Oct)
Sterna hirundo	several pairs	-	60 (Sep)
Sterna albifrons	-	-	50 (Sep)
Chlidonias hybridus	2,000-4,000 prs	-	-
Chlidonias leucopterus	-	-	500 (Sep)
Chlidonias niger	-	-	50 (Sep)

Table 9: Peak counts of waterfowl at Bandar Kiashar Lagoon and the mouth of the Sefid Rud

	Breeding	Wintering	Passage
Podiceps cristatus	-	340	-
Podiceps auritus	-	10	-
Podiceps nigricollis	-	340	-
Tachybaptus ruficollis	-	125	-
Phalacrocorax carbo	1,000 prs	1,250	-
Phalacrocorax pygmaeus	-	300	-
Pelecanus crispus	-	41	-
Nycticorax nycticorax	200 prs	-	-
Ardeola ralloides	10 prs	-	-
Bubulcus ibis	1+ pr	-	50 (Aug)
Egretta garzetta	30 prs	-	875 (Jul)
Egretta alba	-	644	-
Ardea cinerea	may breed	120	-
Ardea purpurea	-	-	20 (Aug)
Plegadis falcinellus	-	-	29 (Aug)
Phoenicopterus ruber	-	133	-
Cygnus olor	-	271	-
Cygnus cygnus	-	130	-
Cygnus columbianus	-	24	-
Anser albifrons	-	30	-
Anser erythropus	-	10	-
Anser anser	-	110	-
Tadorna tadorna	-	69	-
Anas penelope	-	1,270	-
Anas strepera	-	620	-
Anas crecca	-	13,200	-
Anas platyrhynchos	-	12,400	-
Anas acuta	-	360	-
Anas querquedula	-	-	127 (Mar)
Anas clypeata	-	310	-
Netta rufina	-	1,825	-
Aythya ferina	-	1,100	-
Aythya fuligula	-	1,000	-
Bucephala clangula	-	112	-
Mergellus albellus	-	38	-
Fulica atra	-	7,920	-
Recurvirostra avosetta	-	80	-
Glareola pratincola	20-30 prs	-	150 (Aug)
Charadrius hiaticula	-	-	200 (Aug)
Charadrius alexandrinus	-	-	150 (Nov)
Charadrius asiaticus	-	-	17 (Mar)
Pluvialis apricaria	-	7	-
Vanellus vanellus	-	3,500	-
Calidris minuta	-	-	300 (Aug)

Calidris temminckii	-	-	50 (Aug)
Calidris alpina	-	-	400 (Nov)
Lymnocryptes minimus	-	6	-

Table 9 (continued):

	Breeding	Wintering	Passage
Gallinago gallinago	-	-	300 (Oct)
Limosa limosa	-	-	200 (Aug)
Numenius phaeopus	-	-	58 (May)
Tringa erythropus	-	-	100 (Oct)
Tringa totanus	-	-	300 (Dec)
Tringa nebularia	-	-	80 (Oct)
Tringa ochropus	-	-	75 (Aug)
Tringa glareola	-	-	200 (Aug)
Phalaropus lobatus	-	-	50 (May)
Larus ichthyaetus	-	30	-
Larus minutus	-	150	-
Larus ridibundus	-	3,500	-
Larus genei	-	300	1,000 (Feb)
Larus canus	-	30	-
Larus cachinnans	-	1,000	-
Sterna sandvicensis	-	-	110 (Sep)
Sterna hirundo	15 prs	-	150 (Sep)
Sterna albifrons	-	-	100 (Sep)
Chlidonias hybridus	-	-	110 (Sep)
Chlidonias leucopterus	-	-	50 (Sep)
Chlidonias niger	-	-	10 (Sep)

Table 10: Peak counts of waterfowl at Seyed Mohalli, Zarin Kola and Larim Sara

	Breeding	Wintering	Passage
Phalacrocorax pygmaeus	-	100	-
Ardeola ralloides	250 prs	-	-
Bubulcus ibis	20 prs	-	120 (Sep)
Egretta garzetta	40 prs	-	300 (Sep)
Egretta alba	-	90	-
Ardea cinerea	1+ pr	-	-
Ardea purpurea	20 prs	-	-
Phoenicopterus ruber	-	965	-
Cygnus olor	-	157	-
Cygnus cygnus	-	58	-
Anser erythropus	-	359	-
Anser anser	-	630	-
Tadorna ferruginea	-	16	-
Tadorna tadorna	-	334	-
Anas penelope	-	32,300	-
Anas strepera	-	16,200	-
Anas crecca	-	86,000	-
Anas platyrhynchos	-	12,850	-
Anas acuta	-	20,400	-
Anas clypeata	-	25,000	-
Netta rufina	-	4,435	-
Aythya ferina	-	4,840	-
Aythya fuligula	-	2,000	-
Aythya nyroca	-	6	185 (Nov)
Oxyura leucocephala	-	27	-
Fulica atra	-	34,550	-
Recurvirostra avosetta	-	30	-
Glareola pratincola	30-40 prs	-	-
Pluvialis apricaria	-	115	-
Vanellus vanellus	-	1,000	-
Calidris alpina	-	300	-
Gallinago gallinago	-	60	-
Limosa limosa	-	150	500 (Mar)
Tringa erythropus	-	20	-
Tringa totanus	-	200	-
Tringa ochropus	-	-	130 (Jul)
Larus minutus	-	400	-
Chlidonias hybridus	150-200 prs	-	-

Table 11: Peak counts of waterfowl at Lapoo-Zargmarz Ab-bandans

	Wintering	Passage
Phalacrocorax pygmaeus	15	-
Ardeola ralloides	-	150 (Aug)
Egretta garzetta	-	150 (Sep)
Ardea purpurea	-	22 (Jul)
Cygnus olor	107	-
Cygnus cygnus	20	-
Cygnus columbianus	5	-
Anas strepera	1,500	-
Anas querquedula	-	320 (Aug)
Netta rufina	350	-
Aythya ferina	260	-
Aythya nyroca	5	-
Oxyura leucocephala	28	-
Fulica atra	18,600	-
Vanellus leucurus	-	13 (Sep)
Vanellus vanellus	-	500 (Sep)
Calidris temminckii	-	15 (Sep)
Philomachus pugnax	-	300 (Sep)
Gallinago gallinago	-	50 (Sep)
Limosa limosa	-	100 (Sep)
Tringa stagnatilis	-	175 (Jul)
Larus minutus	60	300 (Mar)
Sterna albifrons	-	30 (Sep)
Chlidonias niger	-	15 (Sep)

Table 12: Peak counts of waterfowl at Miankaleh Peninsula and Gorgan Bay

	Breeding	Wintering	Passage
Gavia arctica	-	5	-
Podiceps cristatus	-	3,000	-
Podiceps grisegena	-	20	-
Podiceps auritus	-	71	-
Podiceps nigricollis	-	2,000+	-
Tachybaptus ruficollis	-	60	-
Phalacrocorax carbo	-	15,000	-
Phalacrocorax pygmaeus	-	28	-
Pelecanus onocrotalus	-	-	13 (Nov)
Pelecanus crispus	-	690	-
Botaurus stellaris	may breed	1	-
Ixobrychus minutus	-	-	4 (May)
Nycticorax nycticorax	20 prs	-	-
Ardeola ralloides	200 prs	-	-
Bubulcus ibis	15 prs	-	150 (Sep)
Egretta garzetta	100 prs	15	450 (Sep)
Egretta alba	-	2,685	-
Ardea cinerea	2 prs	630	1,860 (Sep)
Ardea purpurea	40 prs	-	220 (Sep)
Ciconia nigra	-	-	21 (Aug)
Ciconia ciconia	-	-	45 (May)
Plegadis falcinellus	-	-	95 (Aug)
Platalea leucorodia	-	-	423 (Mar)
Phoenicopterus ruber	-	25,080	-
Cygnus olor	-	2,174	-
Cygnus cygnus	-	60	-
Cygnus columbianus	-	16	-
Anser albifrons	-	87	-
Anser erythropus	-	4,900	-
Anser anser	-	10,020	-
Branta ruficollis	-	19	-
Tadorna ferruginea	-	328	-
Tadorna tadorna	-	1,605	-
Anas penelope	-	61,100	-
Anas strepera	-	20,300	-
Anas crecca	-	57,000	-
Anas platyrhynchos	-	56,600	-
Anas acuta	-	30,400	-
Anas querquedula	-	-	3,640 (Aug)
Anas clypeata	-	18,200	-
Marmaronetta angustirostris	-	-	29 (Feb)
Netta rufina	-	940	-
Aythya ferina	-	22,500	-
Aythya fuligula	-	8,000	-

Aythya nyroca	-	1	9 (Aug)
Bucephala clangula	-	1,110	-
Mergellus albellus	-	144	-

Table 12 (continued):

	Breeding	Wintering	Passage
Mergus serrator	-	703	-
Oxyura leucocephala	-	453	-
Rallus aquaticus	-	12	-
Porzana porzana	may breed	-	14 (Apr)
Gallinula chloropus	-	140	-
Fulica atra	-	50,000	-
Grus grus	-	-	122 (Sep)
Haematopus ostralegus	-	75	144 (Nov)
Himantopus himantopus	-	140	938 (Apr)
Recurvirostra avosetta	-	816	-
Burhinus oedicnemus	several prs	-	17 (Sep)
Glareola pratincola	500+ prs	-	-
Charadrius hiaticula	-	22	600 (Sep)
Charadrius dubius	-	-	66 (Aug)
Charadrius alexandrinus	150-200 prs	200	1,350 (Aug)
Charadrius leschenaultii	-	10	190 (Jul)
Charadrius asiaticus	-	-	34 (Apr)
Pluvialis apricaria	-	250	-
Pluvialis squatarola	-	155	500 (Oct)
Vanellus leucurus	-	-	13 (Sep)
Vanellus vanellus	-	1,500	-
Calidris alba	-	150	4,820 (May)
Calidris minuta	-	5	2,450 (Aug)
Calidris temminckii	-	-	22 (Aug)
Calidris ferruginea	-	-	2,650 (Aug)
Calidris alpina	-	5,000	-
Limicola falcinellus	-	-	189 (Aug)
Philomachus pugnax	-	-	1,470 (Mar)
Lymnocryptes minimus	-	4	-
Gallinago gallinago	-	60	70 (Oct)
Scolopax rusticola	-	9	-
Limosa limosa	-	800	3,770 (Feb)
Limosa lapponica	-	4	100 (Nov)
Numenius phaeopus	-	-	880 (Aug)
Numenius arquata	-	157	530 (Sep)
Tringa erythropus	-	31	81 (May)
Tringa totanus	-	650	1,810 (Oct)
Tringa stagnatilis	-	-	563 (Jul)
Tringa nebularia	-	44	270 (Oct)
Tringa ochropus	-	4	53 (Aug)
Tringa glareola	-	-	174 (May)

Tringa cinerea	-	-	213 (Aug)
Tringa hypoleucos	-	-	25 (Sep)
Arenaria interpres	-	5	562 (Aug)
Phalaropus lobatus	-	-	700 (May)
Stercorarius parasiticus	-	-	21 (Dec)
Larus ichthyaetus	-	2,250	-

Table 12: (continued)

	Breeding	Wintering	Passage
Larus minutus	-	750	-
Larus ridibundus	-	5,000	-
Larus genei	-	1,330	2,950 (Nov)
Larus canus	-	400	-
Larus fuscus	-	5	55 (Mar)
Larus cachinnans	-	865	1,850 (Sep)
Gelochelidon nilotica	20 prs	4	-
Sterna caspia	-	-	31 (Aug)
Sterna sandvicensis	-	38	1,450 (Mar)
Sterna hirundo	10-20 prs	-	955 (Sep)
Sterna albifrons	300-400 prs	-	1,370 (Sep)
Chlidonias hybridus	-	-	820 (July)
Chlidonias leucopterus	-	-	7 (Sep)
Chlidonias niger	-	-	15 (Sep)

Table 13: Peak counts of wintering waterfowl at the Gomishan Marshes and Turkoman Steppes

Podiceps cristatus	800
Phalacrocorax carbo	2,330
Pelecanus crispus	334
Egretta alba	1,120
Ardea cinerea	1,120
Phoenicopterus ruber	55,000
Cygnus cygnus	256
Anser albifrons	120
Anser erythropus	1,773
Anser anser	3,200
Anas penelope	16,000
Anas strepera	13,000
Anas crecca	30,000
Anas platyrhynchos	40,000
Anas acuta	14,200
Anas clypeata	12,000
Aythya ferina	17,000
Aythya fuligula	1,800
Mergus serrator	204
Fulica atra	65,200
Himantopus himantopus	1,700
Limosa limosa	400
Tringa totanus	1,500
Larus ichthyaetus	529

Table 14: Peak counts of wintering waterfowl at Lake Alagol, Lake Ulmagol and Lake Ajigol

Egretta alba	278
Ardea cinerea	84
Phoenicopterus ruber	1,125
Cygnus olor	260
Anser erythropus	150
Anser anser	750
Tadorna ferruginea	200
Tadorna tadorna	517
Anas penelope	620
Anas strepera	2,480
Anas crecca	8,500
Anas platyrhynchos	7,300
Anas clypeata	1,600
Netta rufina	1,700
Aythya ferina	2,600
Aythya fuligula	4,000
Bucephala clangula	22
Mergellus albellus	256
Oxyura leucocephala	19
Rallus aquaticus	3
Fulica atra	50,750
Calidris alpina	150
Larus minutus	100
Larus ridibundus	2,500
Larus canus	300
Larus cachinnans	1,000

Table 15: Peak counts of wintering waterfowl in the Dez River Marshes, Karun River Marshes and Horeh Bamdej Marshes, Khuzestan

	Dez Marshes	Karun Marshes	Horeh Bamdej
Phalacrocorax carbo	590	23	5
Anhinga rufa	3	-	-
Pelecanus crispus	162	6	51
Botaurus stellaris	1	1	-
Nycticorax nycticorax	170	25	-
Bubulcus ibis	11	24	32
Egretta garzetta	115	12	335
Egretta alba	75	25	128
Ardea cinerea	95	26	267
Ardea purpurea	1	-	15
Ciconia ciconia	65	100	25
Plegadis falcinellus	-	-	110
Threskiornis aethiopicus	41	12	50
Platalea leucorodia	-	-	120
Anser albifrons	420	1,730	-
Anser erythropus	190	590	-
Anser anser	320	10,050	2,500
Branta ruficollis	1	2	-
Tadorna ferruginea	150	400	48
Tadorna tadorna	3	22	8
Anas penelope	140	2,060	5,300
Anas strepera	410	450	6,500
Anas crecca	5,130	15,300	15,850
Anas platyrhynchos	11,000	6,170	15,500
Anas acuta	30	370	250
Anas clypeata	260	3,000	4,960
Marmaronetta angustirostris	-	12	1,100
Aythya ferina	135	255	100
Aythya nyroca	11	4	7
Mergellus albellus	3	14	-
Fulica atra	2,010	1,150	23,000
Grus grus	59	1,350	3,000
Himantopus himantopus	30	80	620
Recurvirostra avosetta	2	20	125
Vanellus indicus	65	36	65
Vanellus leucurus	50	150	390
Vanellus vanellus	160	215	400
Calidris temminckii	15	5	-
Gallinago gallinago	30	20	20
Lymnocryptes minimus	8	-	-
Limosa limosa	60	2,000	980
Tringa totanus	60	50	500
Tringa nebularia	20	1	1
Larus ridibundus	20	200	25

Chlidonias hybridus	-	2	80

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Table 16: Peak counts of waterfowl at Shadegan Marshes, Khor-al Amaya and Khor Musa

	Breeding	Wintering	Passage
Pelecanus onocrotalus	-	70	-
Pelecanus crispus	1+ pr	75	-
Botaurus stellaris	6+ prs	-	-
Ixobrychus minutus	10+	-	-
Nycticorax nycticorax	1+ pr	140	-
Ardeola ralloides	100 prs	-	-
Bubulcus ibis	1+ pr	-	-
Egretta gularis	40 prs	-	-
Egretta garzetta	100 prs	350	-
Egretta alba	-	200	-
Ardea cinerea	-	670	-
Ardea purpurea	60 prs	-	-
Ciconia ciconia	-	1,340	-
Threskiornis aethiopicus	-	1	8 (May)
Platalea leucorodia	-	45	-
Phoenicopterus ruber	-	8,260	-
Anser anser	-	3,500	-
Tadorna ferruginea	-	200	-
Tadorna tadorna	-	3,720	-
Anas penelope	-	9,050	-
Anas strepera	-	10,000	-
Anas crecca	-	348,000	-
Anas platyrhynchos	-	9,500	-
Anas acuta	-	237,000	-
Anas querquedula	-	61	12,500 (Mar)
Anas clypeata	-	16,980	-
Marmaronetta angustirostris	few prs	20,000	-
Aythya ferina	-	10,050	-
Aythya nyroca	several prs	10	-
Fulica atra	-	15,600	-
Haematopus ostralegus	-	1,820	-
Himantopus himantopus	60 prs	800	-
Recurvirostra avosetta	several prs	883	-
Dromas ardeola	10+ prs	-	-
Glareola pratincola	15+ prs	-	-
Charadrius hiaticula	-	-	65 (May)
Charadrius alexandrinus	-	100	-
Charadrius leschenaultii	-	-	22 (Nov)
Vanellus indicus	-	28	-
Vanellus leucurus	60+ prs	320	-
Vanellus vanellus	-	600	-
Calidris minuta	-	100	170 (May)
Calidris ferruginea	-	-	360 (May)
Calidris alpina	-	350	-

Philomachus pugnax	-	-	355 (May)
Limosa limosa	-	750	-
Limosa lapponica	-	2,120	-

Table 16 (continued):

	Breeding	Wintering	Passage
Numenius arquata	-	950	-
Tringa erythropus	-	22	-
Tringa totanus	-	1,260	-
Tringa glareola	-	-	70 (May)
Tringa cinerea	-	70	-
Larus ridibundus	-	12,000	-
Larus genei	400-800 prs	5,000	-
Larus canus	-	90	-
Larus cachinnans	-	3,000+	-
Gelochelidon nilotica	100-200 prs	1,820	-
Sterna caspia	15-20 prs	-	-
Sterna hirundo	60-100 prs	-	-
Sterna albifrons	150-250 prs	-	-
Chlidonias hybridus	20-30 prs	270	-
Chlidonias leucopterus	-	-	290 (May)

Table 17: Peak counts of waterfowl at Dasht-e Arjan and Lake Parishan

	Breeding	Wintering	Passage
Podiceps cristatus	50-100 prs	300	430 (Oct)
Podiceps nigricollis	20 prs	-	500 (Nov)
Tachybaptus ruficollis	breeds	330	-
Phalacrocorax carbo	-	765	-
Pelecanus onocrotalus	-	800	-
Pelecanus crispus	5-10 prs	185	-
Ixobrychus minutus	15-20 prs	-	-
Nycticorax nycticorax	100 prs	300	-
Ardeola ralloides	200 prs	-	-
Egretta garzetta	100 prs	350	-
Egretta alba	-	370	-
Ardea cinerea	-	255	-
Ardea purpurea	5-10 prs	-	-
Ciconia nigra	-	12	-
Ciconia ciconia	-	59	-
Plegadis falcinellus	30-100 prs	930	-
Platalea leucorodia	50-400 prs	200	-
Phoenicopterus ruber	-	7,080	9,800 (Oct)
Anser albifrons	-	180	-
Anser anser	-	5,760	-
Tadorna ferruginea	-	4,180	-
Tadorna tadorna	-	150	-
Anas penelope	-	5,610	-
Anas strepera	-	2,200	-
Anas crecca	-	45,000	-
Anas platyrhynchos	-	14,000	-
Anas acuta	-	25,000	-
Anas clypeata	-	3,500	-
Marmaronetta angustirostris	200-300 prs	5,500	-
Netta rufina	-	90	-
Aythya ferina	-	20,000	-
Aythya fuligula	-	2,520	-
Aythya nyroca	several prs	150	-
Oxyura leucocephala	several prs	455	-
Porzana porzana	-	-	6 (May)
Porphyrio porphyrio	breeds	140	-
Fulica atra	-	172,500	-
Grus grus	-	2,204	-
Himantopus himantopus	10+ prs	100	210 (Nov)
Glareola pratincola	30 prs	-	-
Charadrius alexandrinus	20 prs	200	-
Vanellus indicus	20 prs	46	150 (Nov)
Vanellus leucurus	20+ prs	150	-
Vanellus vanellus	-	4,000	-

Calidris temminckii	-	28	-
Calidris alpina	-	220	-
Lymnocryptes minimus	-	2	-

Table 17 (continued):

	Breeding	Wintering	Passage
Gallinago gallinago	-	175	-
Limosa limosa	-	900	-
Tringa totanus	-	290	-
Phalaropus lobatus	-	-	70 (Apr)
Larus ridibundus	-	4,300	-
Larus genei	-	-	300 (Oct)
Larus cachinnans	-	-	120 (Nov)
Sterna hirundo	5+ prs	-	-
Sterna albifrons	10+ prs	-	-
Chlidonias hybridus	-	10	-
Chlidonias leucopterus	-	-	100 (May)

Table 18: Peak counts of waterfowl at Lake Maharlu

	Breeding	Wintering	Passage
Pelecanus onocrotalus	-	70	84 (Jun)
Pelecanus crispus	-	7	-
Ixobrychus minutus	-	-	21 (May)
Egretta garzetta	-	-	77 (Jul)
Egretta alba	-	25	-
Ciconia nigra	-	-	9 (Jun)
Ciconia ciconia	9 prs	-	-
Plegadis falcinellus	-	39	-
Platalea leucorodia	-	-	30 (Apr)
Phoenicopterus ruber	-	-	1,500 (Oct)
Anser erythropus	-	102	-
Anser anser	-	400	-
Tadorna ferruginea	-	6,255	-
Tadorna tadorna	-	950	-
Anas penelope	-	1,000	-
Anas strepera	-	1,405	-
Anas crecca	-	6,500	16,500 (Nov)
Anas platyrhynchos	-	8,000	-
Anas acuta	-	600	-
Marmaronetta angustirostris	10 prs	37	-
Oxyura leucocephala	-	9	-
Fulica atra	-	1,690	3,300 (Nov)
Grus grus	-	2,134	350 (Oct)
Himantopus himantopus	25 prs	260	-
Recurvirostra avosetta	-	220	-
Charadrius alexandrinus	60 prs	-	-
Vanellus leucurus	25 prs	160	-
Vanellus vanellus	-	250	-
Calidris temminckii	-	-	52 (Oct)
Calidris alpina	-	-	665 (Nov)
Lymnocryptes minimus	-	8	-
Tringa totanus	-	-	120 (Nov)
Larus ridibundus	-	5,400	-
Larus genei	-	1,350	-
Sterna hirundo	may breed	-	50 (May)
Sterna albifrons	10 prs	-	-

Table 19: Peak counts of waterfowl at Lake Bakhtegan, Lake Tashk and the Kamjan Marshes

	Breeding	Wintering	Passage
Phalacrocorax carbo	-	80	-
Pelecanus onocrotalus	bred in 1960s	-	300 (Jun)
Pelecanus crispus	-	67	-
Ixobrychus minutus	breeds	-	70 (Jun)
Nycticorax nycticorax	-	38	-
Egretta alba	-	340	-
Ardea cinerea	-	193	-
Ardea purpurea	-	-	22 (May)
Ciconia ciconia	-	550	-
Plegadis falcinellus	-	445	-
Platalea leucorodia	-	200	-
Phoenicopterus ruber	-	73,430	-
Anser albifrons	-	154	-
Anser erythropus	-	90	-
Anser anser	-	8,245	-
Tadorna ferruginea	-	13,400	-
Tadorna tadorna	-	10,700	-
Anas penelope	-	14,300	-
Anas strepera	-	8,300	-
Anas crecca	-	58,800	-
Anas platyrhynchos	-	127,500	-
Anas acuta	-	104,000	-
Anas querquedula	-	-	400 (Sep)
Anas clypeata	-	14,400	-
Marmaronetta angustirostris	100+ prs	5,000	-
Netta rufina	-	133	-
Fulica atra	-	29,300	-
Grus grus	-	3,427	-
Himantopus himantopus	35 prs	450	-
Recurvirostra avosetta	20 prs	777	1,000 (Aug)
Charadrius alexandrinus	-	-	1,000 (Nov)
Vanellus leucurus	40+ prs	29	-
Vanellus vanellus	-	800	-
Calidris minuta	-	-	500 (Aug)
Calidris temminckii	-	12	-
Calidris ferruginea	-	-	300 (Oct)
Calidris alpina	-	-	6,000 (Nov)
Limicola falcinellus	-	-	50 (May)
Philomachus pugnax	-	240	-
Lymnocryptes minimus	-	5	-
Gallinago gallinago	-	53	150 (Aug)
Limosa limosa	-	4,500	-
Numenius arquata	-	11	-
Tringa totanus	-	800	-

Tringa ochropus	-	-	40 (Aug)
Tringa glareola	-	-	100 (Aug)
Tringa cinerea	-	-	13 (Aug)

Table 19 (continued):

	Breeding	Wintering	Passage
Phalaropus lobatus	-	2	510 (Aug)
Larus minutus	-	30	-
Larus ridibundus	-	2,000	-
Larus genei	-	2,500	-
Larus cachinnans	-	54	-
Chlidonias leucopterus	-	-	40 (May)

Table 20: Water levels in the Sistan Basin - 1969/70 to 1977/78 and 1984/85 to 1991/92

Year	Hamoun-i Hirmand	H-Sabari (Iran)	H-Sabari (Afghan.)	Hamoun-i Puzak	Remarks
1969/70	Almost dry	Fairly high	High	High	
1970/71	Dry	Dry	Dry	Fairly high	
1971/72	Dry	Dry	Dry	Almost dry	Big flood in March 1972
1972/73	Fairly high	High	High	High	
1973/74	Fairly high	Fairly high	High	High	
1974/75	Fairly high	Fairly high	High	High	
1975/76	Dry	Low	Low	Fairly high	
1976/77	Fairly high	High	High	High	
1977/78	Dry	High	High	High	Exceptional flood in spring 1978
1984/85	Dry	Dry	Dry	? Dry	
1985/86	Dry	Dry	Fairly high	High	
1986/87	Dry	Fairly high	High	High	
1987/88	Dry	Fairly high	High	High	
1988/89	Dry	Dry	? Dry	?	Big flood March 1989
1989/90	High	High	High	High	Big flood in spring 1990
1990/91	High	High	High	High	Exceptional flood in Feb/ March 1991
1991/92	High	High	High	High	

Table 21: Peak counts of waterfowl at Hamoun-i Sabari and Hamoun-i Hirmand

	Breeding	Wintering	Passage
Podiceps cristatus	breeds	64	-
Phalacrocorax carbo	-	125	-
Pelecanus onocrotalus	-	1,300	484 (Jun)
Pelecanus crispus	-	88	-
Botaurus stellaris	20-30 prs	-	-
Nycticorax nycticorax	20 prs	-	-
Egretta garzetta	50 prs	-	-
Egretta alba	-	2,150	-
Ardea cinerea	40 prs	208	-
Ardea purpurea	10 prs	-	-
Platalea leucorodia	120 prs	55	-
Phoenicopterus ruber	-	-	124 (Jun)
Anser anser	-	2,600	-
Tadorna ferruginea	-	666	-
Tadorna tadorna	-	1,600	-
Anas penelope	-	5,000	-
Anas strepera	-	13,000	-
Anas crecca	-	222,500	-
Anas platyrhynchos	-	36,000	-
Anas acuta	-	300,000	-
Anas clypeata	-	10,000	-
Marmaronetta angustirostris	few prs	7	-
Aythya ferina	-	4,110	-
Aythya nyroca	5-10 prs	2	-
Mergellus albellus	-	266	-
Fulica atra	-	2,850	-
Grus grus	-	84	-
Himantopus himantopus	100 prs	-	790 (Apr)
Recurvirostra avosetta	-	100	-
Glareola pratincola	5-10 prs	-	-
Charadrius dubius	-	-	80 (Apr)
Charadrius alexandrinus	-	-	120 (Apr)
Vanellus leucurus	5-10 prs	-	126 (Mar)
Vanellus vanellus	-	760	-
Calidris minuta	-	-	650 (Apr)
Calidris alpina	-	500	-
Philomachus pugnax	-	-	400 (Mar)
Gallinago gallinago	-	-	150 (Oct)
Limosa limosa	-	300	550 (Jun)
Tringa totanus	-	350	-
Tringa stagnatilis	-	-	96 (Apr)
Tringa nebularia	-	50	-
Tringa ochropus	-	-	44 (Apr)
Tringa glareola	-	-	285 (Apr)

Phalaropus lobatus	-	-	67 (Jun)
Larus ichthyaetus	-	143	-
Larus ridibundus	-	2,860	-

Table 21 (continued):

	Breeding	Wintering	Passage
Larus genei	150-200 prs	550	-
Larus cachinnans	-	365	-
Gelochelidon nilotica	5-10 prs	-	-
Sterna caspia	several prs	-	-
Sterna hirundo	10 prs	-	-
Sterna albifrons	40-60 prs	-	-
Chlidonias hybridus	300-400 prs	-	-

Table 22: Peak counts of waterfowl at the south end of the Hamoun-i Puzak

	Breeding	Wintering	Passage
Podiceps cristatus	several prs	60	-
Pelecanus onocrotalus	-	118	240 (Nov)
Pelecanus crispus	-	82	-
Botaurus stellaris	3+ prs	-	-
Egretta garzetta	-	-	50 (Jun)
Egretta alba	-	1,200	-
Ardea cinerea	-	200	-
Ardea purpurea	breeds	5	-
Platalea leucorodia	-	15	-
Phoenicopterus ruber	-	192	-
Anser anser	-	2,450	-
Tadorna tadorna	-	440	-
Anas penelope	-	2,500	-
Anas strepera	-	4,500	-
Anas crecca	-	58,000	-
Anas platyrhynchos	-	12,100	-
Anas acuta	-	6,200	-
Anas clypeata	-	18,100	-
Netta rufina	-	1,030	-
Aythya ferina	-	8,000	-
Aythya fuligula	-	650	-
Aythya nyroca	-	30	-
Mergellus albellus	-	53	-
Oxyura leucocephala	-	42	-
Fulica atra	-	37,000	-
Grus grus	-	450	-
Himantopus himantopus	-	50	650 (Oct)
Recurvirostra avosetta	-	130	-
Charadrius alexandrinus	-	-	100 (Mar)
Charadrius leschenaultii	-	-	22 (Mar)
Vanellus leucurus	several prs	-	-
Vanellus vanellus	-	300	-
Calidris minuta	-	-	100 (Apr)
Calidris temminckii	-	15	-
Calidris alpina	-	-	300 (Mar)
Philomachus pugnax	-	-	370 (Oct)
Gallinago gallinago	-	-	120 (Oct)
Limosa limosa	-	5,500	-
Tringa erythropus	-	-	50 (Oct)
Tringa totanus	-	60	300 (Oct)
Larus ridibundus	-	350	-
Larus genei	-	-	300 (Mar)
Sterna albifrons	2 prs	-	-
Chlidonias hybridus	50 prs	50	-

Table 23: Peak counts of waterfowl at the delta of the Helleh River

	Breeding	Wintering	Passage
Phalacrocorax carbo	-	3,060	-
Pelecanus onocrotalus	-	6	39 (Jun)
Pelecanus crispus	-	10	-
Nycticorax nycticorax	10 prs	-	-
Egretta garzetta	-	80	-
Egretta alba	-	351	-
Ardea cinerea	-	582	-
Ardea purpurea	10 prs	4	-
Ciconia nigra	-	5	-
Platalea leucorodia	-	278	-
Phoenicopterus ruber	-	280	-
Anser erythropus	-	37	-
Anser anser	-	7,859	-
Tadorna ferruginea	-	750	-
Tadorna tadorna	-	1,388	-
Anas penelope	-	8,070	-
Anas strepera	-	1,915	-
Anas crecca	-	13,000	-
Anas platyrhynchos	-	8,000	-
Anas acuta	-	12,000	-
Anas clypeata	-	3,914	-
Marmaronetta angustirostris	15-20 prs	1,000	-
Oxyura leucocephala	-	173	-
Fulica atra	-	400	-
Grus grus	-	120	-
Recurvirostra avosetta	7 prs	300	-
Dromas ardeola	-	140	-
Glareola pratincola	25 prs	-	-
Charadrius alexandrinus	40-50 prs	-	-
Vanellus indicus	10 prs	-	-
Vanellus leucurus	6 prs	-	-
Limicola falcinellus	-	-	50 (Jun)
Limosa limosa	-	250	-
Tringa erythropus	-	35	-
Tringa totanus	-	250	-
Tringa cinerea	-	20	-
Larus ichthyaetus	-	50	-
Larus cachinnans	-	2,500	-
Gelochelidon nilotica	10-20 prs	-	-
Sterna caspia	5-10 prs	-	-
Sterna albifrons	40 prs	-	-

Table 24: Peak counts of waterfowl in the Khouran Straits

	Breeding	Wintering
Phalacrocorax carbo	-	680
Pelecanus crispus	-	210
Ardeola grayii	30+ prs	-
Egretta gularis	50+ prs	458
Egretta alba	25-30 prs	445
Ardea cinerea	-	400
Ardea goliath	1+ pr	7
Platalea leucorodia	-	442
Phoenicopterus ruber	-	611
Haematopus ostralegus	-	331
Recurvirostra avosetta	-	83
Dromas ardeola	20+ prs	940
Charadrius hiaticula	-	300
Charadrius mongolus	-	200
Charadrius leschenaultii	-	200
Pluvialis squatarola	-	270
Calidris alba	-	300
Calidris alpina	-	750
Limicola falcinellus	-	55
Limosa lapponica	-	2,410
Numenius phaeopus	-	39
Numenius arquata	-	5,850
Tringa totanus	-	3,000
Tringa nebularia	-	35
Tringa cinerea	-	1,000
Larus ichthyaetus	-	64
Larus ridibundus	-	20,000
Larus genei	-	1,000
Larus cachinnans	-	3,000
Gelochelidon nilotica	10-20 prs	355
Sterna caspia	-	30
Sterna saundersi	10-20 prs	-

Table 25: Peak counts of waterfowl at the lower Sarbarz River and Khor Govater

	Breeding	Wintering	Passage
Phalacrocorax carbo	-	3,500	-
Pelecanus crispus	-	112	-
Ardeola grayii	breeds	15	-
Egretta gularis	-	-	23 (Apr)
Egretta alba	-	42	-
Ardea cinerea	-	73	-
Platalea leucorodia	-	49	76 (Apr)
Phoenicopterus ruber	-	141	300 (Apr)
Anas penelope	-	50	-
Anas crecca	-	77	-
Anas platyrhynchos	-	225	-
Anas acuta	-	50	-
Aythya ferina	-	25	-
Fulica atra	-	116	-
Haematopus ostralegus	-	210	-
Recurvirostra avosetta	-	30	-
Esacus recurvirostris	2 prs	-	-
Dromas ardeola	2+ prs	-	-
Charadrius dubius	-	-	34 (Apr)
Charadrius mongolus	-	-	40 (Apr)
Vanellus indicus	-	63	-
Calidris alba	-	600	-
Calidris temminckii	-	-	41 (Apr)
Limosa lapponica	-	1,000	-
Numenius arquata	-	135	-
Tringa totanus	-	200	-
Tringa nebularia	-	-	30 (Mar)
Tringa ochropus	-	-	19 (Apr)
Tringa cinerea	-	50	-
Larus hemprichii	-	-	500 (Apr)
Larus ichthyaetus	-	30	300 (Mar)
Larus ridibundus	-	2,000+	-
Larus genei	-	1,000	1,500 (Mar)
Larus cachinnans	-	1,000+	-
Gelochelidon nilotica	-	22	-
Sterna caspia	-	-	110 (Apr)
Sterna bergii	-	-	2,000 (Apr)
Sterna bengalensis	-	-	120 (Apr)
Sterna sandvicensis	-	-	675 (Apr)
Sterna saundersi	10-15 prs	-	-

IRAQ

INTRODUCTION

Area: 434,924 sq.km.

Population: 18,920,000 (1990).

Iraq is uniquely positioned at the heart of the Middle East, between latitudes 29°27' and 37°23' North and longitudes 38°42' and 48°23' East. It is bounded by Iran in the east, Turkey in the north, Syria in the northwest, Jordan and Saudi Arabia in the west and southwest, and Kuwait and the Gulf in the south. The country's greatest axis, running in a north-northwest to south-southeast direction from the Turkish border to the shores of the Gulf, is almost 1,000 km.

Iraq is traversed by two great rivers, the Tigris and the Euphrates, both of which rise in the eastern mountains of Turkey and enter Iraq along its northwestern borders. After flowing for some 1,200 km through Iraq, these two rivers converge at Karmat Al, just north of Basrah, to form the tidal Shatt Al Arab waterway, which flows some 110 km to enter the Gulf. The Euphrates does not receive any tributaries within Iraq, while the Tigris receives four main tributaries, the Khabour, Great Zab, Little Zab and Diyala, which rise in the mountains of eastern Turkey and northwestern Iran and flow in a southwesterly direction until they meet the Tigris River. A seasonal river, Al Authaim, rising in the highlands of northern Iraq also flows into the Tigris, and is the only significant tributary arising entirely within Iraq.

Topographically, Iraq is made up of four main regions that differ slightly in climate, topography and soil. These are as follows:

(1) The mountain region
This extends from the northern and northeastern frontiers of Iraq on the borders of Turkey and Iran south to a line from Sinjar in Mosul Province to Zakho, Dohuk, Arbil, Kirkuk, Tuz, Kifri and finally Halabja on the Iranian border. Heights range from 900 to 3,660 m.

(2) The upper plains and foothills region
This steppic sub-montane belt extends from the high mountains to the foot of Jabal Hemrin, and forms a transitional area between the highland areas and the desert plains.

(3) The desert plateau region
The desert plateau comprises the largest part of Iraq (almost 57% of the total land area), and extends from the edge of the upper plains and banks of the Euphrates River to the frontiers with Syria, Jordan and Saudi Arabia. Conditions grade from semi-desert (the

upper Jazirah, especially the area between the Tigris and Euphrates below Jabal Hemrin) to a more typical sandy desert in the far south and west.

(4) The lower valley

The great alluvial plains of the Tigris and Euphrates Rivers comprise about 25% of Iraq's surface area. Topographically, this region is composed of marshlands and low-lying plains dissected by sluggish drainage channels. The whole area is extremely flat, with a fall of only 4 cm/km over the last 300 km of the Euphrates and 8 cm/km along the Tigris. Thus, the annual flooding, which may be in the order of 1.5 to 3 metres, regularly inundates immense areas of land (the highest flood ever recorded was 9 metres on the Tigris in 1954). As a result, much of the region is swampy. At the height of the flood season in spring, virtually all of the land in the triangle Basrah-Amara-Nasiriya was formerly one expanse of continuous marshland, while in the dry season there remained numerous large permanent lakes and extensive reed beds inter-connected by an intricate network of channels. In recent years, the seasonal flooding has occurred on a much smaller scale than before because of intensive water regulation by dams upstream on the Tigris and Euphrates and especially on the Euphrates in Turkey and Syria.

Iraq has two marked seasons, a dry and intensely hot summer and a relatively cold, wet winter, with spring and autumn as short transitional periods between the two. The climate is of a typical semi-arid continental type, chiefly characterized by wide diurnal and annual ranges in temperature. The maximum recorded temperature is 50°C, while temperatures of 45°C are not unusual occurrences in June, July and August. The minimum recorded temperature is -11°C. The diurnal range of temperature often exceeds 15-20°C, with daily temperatures generally ranging between 20° and 40°C in summer, and between 5° and 15°C in winter. The relative humidity is usually very low, especially in summer. The average annual rainfall ranges from about 100 mm in the south to 300 mm on the upper plains and 1,000 mm in the mountains, but there are wide variations between years.

Summary of Wetland Situation

The wetlands in the middle and lower basin of the Tigris and Euphrates Rivers in Iraq were, until recently at least, much the most extensive wetland ecosystems in the Middle East. In their lower courses, these two great rivers have created a vast network of wetlands, the Mesopotamian Marshes, covering about 15,000 sq km. These wetlands comprise a complex of inter-connected shallow freshwater lakes, marshes and seasonally inundated floodplains extending from the region of Basrah in the east to within 150 km of Baghdad in the west. Winter rains in the headwaters of the Tigris and Euphrates in southern Turkey, Syria and northern Iraq cause extensive flooding throughout Mesopotamia and fill up the lake systems in the south. Water levels reach their maximum in early spring and then fall by as much as two metres during the hot dry summer. Much the largest wetlands within this complex are: (a) the Haur Al Hammar and its associated marshes (350,000 ha) south of the Euphrates; (b) the Central Marshes (300,000 ha), a vast complex of permanent lakes and marshes north of the

Euphrates and west of the Tigris; and (c) Haur Al Hawizeh and its associated marshes (220,000 ha) extending east from the Tigris into neighbouring Iran. These wetlands eventually drain southeastwards into the Gulf via the Shatt Al Arab waterway. Iraq's very limited coastal zone consists mainly of inter-tidal mudflats backed by bare silt flats, often with an intervening narrow strip of date gardens. The most extensive mudflats occur in a huge tidal basin, Khawr Al Zubair, near the border with Kuwait, and along the north shore of Khawr Abdallah west to the region of Fao at the mouth of the Shatt Al Arab.

In central and northern Iraq, most of the natural freshwater lakes and marshes have long since been drained for agricultural purposes, although significant remnants still survive in the Haweija (Huweija) Marshes in the Little Zab Valley and around Baquba in the Diyala Valley. The valleys of the Tigris and Euphrates themselves have been extensively modified for agricultural purposes. Most of the original riverine forest which once lined the banks of these two rivers has been replaced by orchards and other cultivated land, although some significant stands of forest still exist, especially on small islands. In its undisturbed state, this forest forms dense stands of poplar (mainly *Populus euphratica*) and tamarisk (*Tamarix* spp.), with an understorey of species such at the Barbary Boxthorn. The surviving patches of forest provide important breeding habitat for a wide variety of birds, notably regional specialities such as the Grey Hypocolius *Hypocolius ampelinus*, Iraq Babbler *Turdoides altirostris* and Dead Sea Sparrow *Passer moabiticus*, and are used as staging areas by large numbers of migratory passerines during the migration seasons. Other important natural wetlands in central Iraq include two large brackish to saline lakes, Shari Lake to the east of the Tigris north of Samarra, and Haur Al Shubaicha on the plains to the east of the Tigris southeast of Baghdad. A smaller saline lake, Sawa Lake, in the desert about 25 km west of Samawa, is of interest because of its unusual physico-chemical properties. This lake is apparently fed by underground seepage from as far north as Razazah, and has no surface outlet.

All of the other large wetlands in central and northern Iraq are either man-made water storage reservoirs or wetlands which have been extensively modified by man for flood relief or agricultural purposes. Established reservoirs known to be of importance for wildlife include Samarra Lake on the Tigris and Hindiya Barrage on the Euphrates. Several huge dams have been constructed on the major rivers in recent years, while others are still under construction. These include Haditha Dam on the Euphrates, Aski Mosul (Great Saddam) Dam on the Tigris, Dukan Dam on the Little Zab River, Darbandikhan Dam on the Diyala River, and a new dam on the seasonal Al Authaim River. (Work on a proposed dam on the Great Zab River at Bakhma has stopped, and the project has apparently been abandoned). Nothing is known of the importance of these new reservoirs for wildlife, although it is likely that they are, or will become, important staging areas for migratory waterfowl and will eventually support substantial fisheries.

In the region of Baghdad in central Iraq, three large saline depressions have been converted into huge water storage basins for flood relief. Lake Tharthar, situated between the Tigris and the Euphrates northwest of Baghdad, receives floodwaters from the Tigris, while Lake Habbaniya and Lake Razazah (Bahr Al Milh), to the west and southwest of Baghdad, are fed by the Euphrates. All three of these lakes support major fisheries and are of considerable importance

for migratory waterfowl. Other significant wetlands in this region include large areas of semi-arid plains and irrigated arable land subject to winter flooding, notably the Attariya Plains east of Baghdad, the Al Musayyib area near the Euphrates south of Baghdad, and Haur Ibn Najim between the Tigris and the Euphrates southeast of Hilla.

Throughout Iraq, the level of exploitation of wetlands is high. The economy of many of the peoples living in the region has been intimately involved with wetlands for at least 6,000 years. Civilization was well established in Mesopotamia by the 4th millennium BC, and a sophisticated irrigation system developed at that time. Floodplain wetlands, river banks and lake shores are utilized for the cultivation of cereals, rice or vegetables, while the rivers and lakes themselves support intensive freshwater fisheries. In the vast reed-beds of Mesopotamia, marsh-dwelling communities are almost totally dependent on reeds for their construction needs. Large numbers of domestic livestock, particularly water buffalo, are allowed to graze on wetland vegetation, and aquatic plants are harvested to provide fodder during the winter months. Waterfowl hunting occurs commonly at wetlands throughout Iraq, and in Mesopotamia, large numbers of waterfowl are harvested on a commercial basis, providing a livelihood for hundreds of people (Alnoori, 1976; vant Leven, 1968).

Various authors have attempted to provide lists of the principal wetlands of Iraq. Savage (1968) compiled a preliminary list of wetlands of special importance for wildfowl (ducks, geese, swans and coots), and identified 27 wetlands in Iraq as being appropriate for inclusion in a proposed MAR List for Asia and the Middle East. Georg and Savage (1970b) provided a revised version of this list, and reported on the status of the sites. Carp (1980), reviewing all information available up to 1979, produced a list of 19 wetlands in Iraq which could be considered to be of international importance on the basis of the Ramsar criteria. This list was further revised by Scott and Carp (1982), who provided a list of all the wetlands in Iraq which were known or thought to have been of some importance for waterfowl (a total of 32 sites). Finally, Scott (1993) included a total of 33 Iraqi wetlands in his provisional list of wetlands of international importance in the Middle East. In a recent inventory of globally and regionally important sites for the conservation of birds in the Middle East, BirdLife International identified 42 sites in Iraq as being "Important Bird Areas" (Evans, 1994). All but eight of these sites were primarily wetland areas.

Much the most serious threat to wetlands in Iraq has been the drainage of wetlands and diversion of water supplies for agricultural purposes and, apparently also in recent years, for military reasons. Dam-building on the Euphrates in Turkey and Syria and the increasing utilization of the waters of the Tigris and Euphrates for irrigation in upper and middle Iraq have greatly reduced the extent of seasonal flooding in the wetlands of lower Iraq, and facilitated drainage of large areas for cultivation and the exploitation of oil resources. Within the last few years, major hydrological engineering activities in and around the wetlands of Lower Mesopotamia have resulted in the drying out of vast areas of wetland in the Central Marshes and Haur Al Hammar, and could eventually lead to the disappearance of these systems. The Iraqi Government has said that the reason for the recent hydrological engineering works is to increase agricultural production. However, several international analyses have argued that, whatever the agricultural benefits, the primary purpose is to control dissidents taking refuge in

the marshes. The Marsh Arabs, or Ma'dan, who have existed in the marshes for at least 5,000 years, have been particularly affected by these actions.

No measures have been taken by the Iraqi government to conserve the wetland ecosystems or their fauna and flora, and, in general, the government gives low priority to nature conservation. The few conservation laws issued by the government (*e.g.* restrictions on hunting and fishing) exist on paper only and have never been implemented or enforced. The destruction of the wetlands of Lower Mesopotamia continues at an accelerating pace, and their continued survival as one of the finest and most extensive natural wetland ecosystems in western Eurasia is now in grave doubt.

Wetland Research

A considerable amount of research has been carried out on the wetlands of Iraq, especially in the Mesopotamian Marshes. Researchers from the Iraq Biological Research Centre in Baghdad and the Museum of Natural History at the University of Basrah have been studying the limnology, ecology and aquatic fauna of the wetlands of Mesopotamia since the 1960s, and have published their results in the journals of these two institutions. The Biological Research Centre was established in 1965 and was joined by other scientific centres to form the Iraqi Research Council in the late 1970s; however, the Centre was closed down in 1989. Researchers from the University of Basrah (Department of Biology, Department of Fisheries and Aquatic Sciences, and Marine Research Centre) have also carried out work on various aspects of the ecology of the marshes, but most of this has been written up as M.Sc. theses, and relatively little has been published in the scientific literature. Some of the principal studies have included the following:

- population studies of gastropods from the Shatt Al Arab and aquatic molluscs of the Haur Al Hammar and Haur Az Zikri (Al-Dabbagh & Daod, 1985; Al-Dabbagh & Luka, 1986a & 1986b).
- studies of aquatic beetles in the Shatt Al Arab and Mesopotamian Marshes (Ali, 1976, 1978a & 1978b).
- limnological investigations and studies of the vegetation (especially algae and phytoplankton) in the Shatt Al Arab and southern parts of Haur Al Hammar (Huq *et al.*, 1978; Pankow *et al*., 1979; Al-Saadi *et al*., 1979; Maulood *et al*., 1979; Hinton & Maulood, 1980 & 1982; Al-Saadi *et al*., 1981; Maulood *et al*., 1981; Nurul-Islam, 1982; Antoine, 1984; Al-Saadi & Al-Mousawi, 1988).
- studies of seasonal variation in the quality and quantity of phytoplankton and zooplankton in Qurna Marshes (Al-Saboonchi *et al.*, 1982 & 1986).
- studies on the parasites of fish and waterbirds (Mhaisen *et al.*, 1990).
- studies on the abundance and seasonal migrations of the commercial penaeid shrimp *Metapenaeus affinis* (Salman *et al.*, 1990).

In northern Iraq, the Department of Biology at the University of Mosul has conducted research on invertebrates in rivers and canals, and is currently carrying out hydrological studies at Aski

Mosul Reservoir, while the Department of Biology at the University of Salahdinn has carried out limnological studies at Dukan Reservoir.

The Biological Research Centre carried out some research on freshwater crustaceans and fish in Central Iraq. The Centre's Department of Zoology and Aquatic Biology worked on fish ecology and heavy metal contamination of some native fish, water chemistry of the Tigris and Diyala rivers, the invertebrate fauna of the Diyala River and zooplankton. Other work of this Department included the ecology of small mammals and their control, mosquito control and bird ecology. Most of this work was published in the journal of the Iraqi Research Council, "Journal of Biological Sciences Research", which was terminated when the Biological Research Centre closed down in 1989.

There appears to have been rather little research on the native fish fauna of Iraq, other than basic inventories of species (*e.g.* Allouse, 1955b; Khalaf, 1962; Mahdi, 1962; Banister, 1980). The available Information on the fish fauna of the Tigris and Euphrates basin has recently been summarized by Banister (1994). Some fisheries research has been carried out by the Department of Fisheries and Aquatic Sciences and the Marine Research Centre at the University of Basrah, the Iraq Biological Research Centre, the Zafaraniya Fisheries Research Centre (now incorporated within the Ministry of Agriculture), and the Biological Research Centre within the Iraq Atomic Commission. However, most of the results of this research have been published in local journals, and little information is available in the international literature. Similarly, little information is available on the amphibians and reptiles of Iraq, and these are considered to be the least well known of the vertebrate groups. Some basic collecting has been carried out and check-lists of species are available (*e.g.* Schmidt, 1939; Allouse, 1955a; Khalaf, 1959). The Biological Research Centre collected and studied reptiles, and published a monograph on the Gekoniidae of Iraq, but few other studies have been undertaken, and the status, distribution and habits of most species are poorly known.

The mammals, on the other hand, are relatively well known. The Euphrates Expedition of 1835-1837 published the first annotated list of mammals in the Mesopotamian region (Ainsworth, 1838; Chesney, 1850), but with little accompanying detail on localities and on whether specimens were taken. Further annotated lists of mammals in Iraq, based on personal experience, were published by Metaxas (1891) and Kinnear (1916). The Hofmuseum of Vienna sent an expedition to Mesopotamia in 1910, which published many papers on the biological results, including one on bats (von Wettstein, 1913). The Mesopotamian Expeditionary Force of 1915-1919 was encouraged to keep records of mammals, and these were subsequently compiled and published by Cheesman (1920) and Pitman (1922). In the accounts of their extensive journeys through the Mesopotamian Marshes, Thesiger (1954 & 1964) and Maxwell (1957) made numerous references to the mammals which they encountered in the marshes, but gave few specific details. Hatt (1959) collected extensively in many parts of Iraq, including the Mesopotamian lowlands, during 1952-1953, and Harrison (1956a & 1956b) collected in the vicinity of Shu'aiba near Basrah. More recently, mammalogists at the Iraq Natural History Museum in Baghdad and Museum of Natural History at the University of Basrah have conducted investigations on small mammals in the Mesopotamian Marshes, and have described a new species of bandicoot rat (*Erythronesokia bunnii*) for science (Khajuria, 1980). The

Biological Research Centre has also collected mammals, and published an up-dated list of the mammals of Iraq in the late 1970s. Information available on the mammals of Iraq has recently been summarized by Harrison and Bates (1991).

Much the most extensive data on the fauna of Mesopotamia relate to the birds. Ticehurst *et al.* (1921-22) summarized the extensive ornithological investigations and collections made by a number of British military personnel stationed in Mesopotamia during the First World War. Their publication still constitutes the most comprehensive review of the avifauna of Mesopotamia and provides an extremely valuable historical perspective. Moore and Boswell (1956-57) made extensive ornithological investigations in southern Iraq between 1941 and 1945, and provided a detailed account of their observations along with many observations of other workers in Iraq in the 1940s. Chapman and McGeoch (1956) also made some field observations of birds in southern Iraq between August 1952 and August 1954, and provided useful information on bird migration through the Basrah area. Thesiger (1964) and Maxwell (1957) made numerous references to the huge concentrations of wintering waterfowl, and recorded several interesting species, but gave few details of their observations and no quantitative information. Marchant (1961, 1962, 1963a, 1963b & 1963c) and Macnab (Marchant & Macnab, 1963) made extensive observations of birds in central Iraq between 1959 and 1962, and visited the Basrah region on several occasions. Savage (1968) counted wildfowl at several wetlands in Mesopotamia in 1966 and 1967, and reviewed the status of Anatidae and *Fulica atra* in Iraq at that time. Georg and Savage (1970a) also summarized the status of Anatidae in Iraq, along with that of *Phoenicopterus ruber* and *Fulica atra*, while Alnoori (1976) provided general information on the country's waterfowl.

In recognition of the extreme importance of the wetlands of Iraq for wintering waterfowl, the International Waterfowl and Wetlands Research Bureau (IWRB) sponsored four mid-winter waterfowl surveys in Iraq in 1967/68, 1972, 1975 and 1979, respectively. These surveys, which were carried out jointly with the Iraq Natural History Museum in Baghdad and the Museum of Natural History in Basrah, attempted to survey wetlands throughout Iraq and obtain an estimate of the numbers of waterfowl utilizing them in mid-winter (Georg & Vielliard, 1968 & 1970; Koning & Dijksen, 1973; Carp, 1975a & 1975b; Carp & Scott 1979; Scott & Carp, 1982). These surveys provided the best information hitherto available on the wintering avifauna of Iraq's wetlands, and indicated that the total wintering population of waterfowl in Iraq in the late 1960s and 1970s was in the region of several million birds. The 1979 survey covered only a fraction of Iraq's wetlands, and yet recorded over 475,000 waterfowl of 81 species.

No major ornithological surveys have been carried out in the wetlands of Iraq since these four mid-winter waterfowl surveys, and very little information on waterfowl numbers has become available since then. Some waterfowl counts were made at a number of localities around the Haur Al Hammar in autumn 1979 (Ctyroky, 1987), and the bird fauna of three wetlands in Central Iraq was studied in 1988 and 1989 (Al-Dabbagh, in press). Anatidae were counted at several wetlands in the Basrah area in 1993 and 1994, and waterfowl hunting was also investigated in this region (Al-Robaae, in press). Elsewhere in the Middle East, much of the recent information on the ornithological importance of wetlands has been derived from the Asian Waterfowl Census - a programme of annual mid-winter waterfowl censuses initiated in

January 1987 and coordinated by IWRB. Unfortunately, Iraq is one of the few countries in the Middle East which has not as yet participated in this Census.

A recent environmental and ecological study of the marshlands of Mesopotamia, coordinated by the Wetland Ecosystems Research Group at the University of Exeter, U.K., has summarized available information on the faunal, floral, ecological, economic and cultural values of the wetlands, and has examined the changes which have taken place and are likely to take place in the wetlands as a result of engineering and other developments in the Tigris/Euphrates basin. The study attempts to assess the environmental impact of past, ongoing and proposed developments on the system, and makes a number of recommendations for the conservation of remaining wetland habitats and restoration of degraded areas (Maltby, 1994).

Wetland Area Legislation

No special measures had been taken by the Iraqi Government to conserve wetlands. There is no national conservation strategy in Iraq, and no legal protection has been given to any part of the wetlands. Legislation has been introduced to prohibit fishing during the spawning season, but no serious steps have been taken to implement this, and the seasonal prohibition on fishing is widely disregarded. The environment wildlife law of 1981 is presumed to legislate for wildlife preserves including those in existence before that date (IUCN, 1992). However, in the late 1970s, the Government introduced legislation banning all hunting in Iraq in order to conserve wildlife, particularly terrestrial game which had been heavily persecuted in the past. Nevertheless, it was clear in 1979 that these laws were being widely disregarded, at least in the case of duck-netting which was observed at many localities in the wetlands (Carp & Scott, 1979). These and later hunting restrictions have not been implemented or enforced, and sport-hunting is now organized by the Government through a "Hunting Club" (K.Y. Al-Dabbagh, *in litt.*).

At international level, Iraq is a contracting party to the World Heritage Convention, but has not designated any natural World Heritage Sites. It is also party to the Regional Convention for Cooperation on the Protection of the Marine Environment from Pollution, and to the Action Plan for the Protection and Development of the Marine Environment and Coastal Areas. There is a National Committee of the UNESCO Man and the Biosphere Programme, but no Biosphere Reserves have been established. Iraq is not a contracting party to the Ramsar, Bonn or Biodiversity Conventions.

Wetland Area Administration

Responsibility for management of the natural environment lies with the Ministry of Agriculture and Irrigation, but no major conservation plans have been developed or implemented, and no protected areas have been established at wetlands. In 1977, the precursor of the General Directorate of Horticulture and Forestry in the Ministry of Agriculture and Irrigation became responsible for wildlife protection, and established two small protected areas for the captive

breeding of gazelles (*Gazella* sp.), one near Baghdad and the other at Rutba near the Jordanian border. In 1994, both of these were reported to be practically closed down. There are many "National Parks" in Iraq, but these are mainly state-owned areas for public recreation, with no specific management for wildlife.

Organizations involved with Wetlands

Ministry of Agriculture and Irrigation

The government body responsible for management of the natural environment. The General Directorate of Horticulture and Forestry is responsible for the establishment of protected areas, legislation and enforcement of protection for individual species. The Department of Fisheries is responsible for the management of inland fisheries.

Biological Research Centre, Iraqi Atomic Commission

This is probably the only fully operational biological research centre in Iraq at the present time. The Centre has recently established a section for the study of inland waters, and particularly fish ecology.

University of Baghdad

The Iraq Natural History Museum (renamed the Natural History Research Centre in the late 1970s and early 1980s) supports a wide range of studies of Iraq's flora and fauna, and produces a series of "Publications" and "Bulletins".

University of Basrah

The Department of Biology, Department of Fisheries and Aquatic Sciences, Marine Research Centre and Natural History Museum conduct research on hydrology, limnology, ecology, fauna (particularly fish), flora and pollution in the Mesopotamian Marshes, Shatt Al Arab and northern Gulf.

University of Mosul

The Department of Biology has conducted research on invertebrates in rivers and canals in northern Iraq, and is currently carrying out studies, mostly of a hydrological nature, at Aski Mosul Reservoir.

University of Salahdinn (formerly Sulaiymania)

The Department of Biology has carried out some research, mainly limnological studies, at Dukan Reservoir.

Iraq Biological Research Centre

The Department of Zoology and Aquatic Biology conducted some studies on fish biology, invertebrate ecology and pollution in wetlands, and also general ecological studies with insects, birds and mammals. The Centre was closed in late 1989.

WETLANDS

The site descriptions have been compiled from the published literature, the results of IWRB waterfowl surveys in Iraq between 1967 and 1979, an unpublished report on the wildlife of the Mesopotamian marshlands prepared for the Wetlands Ecosystems Research Group, University of Exeter, in 1993 (Scott & Evans, 1993), and information provided by Khalid Al-Dabbagh. All 33 of the internationally important wetlands described in this inventory have been identified as "Important Bird Areas" by BirdLife International, and are described in Evans (1994).

The great bulk of the information available on the fauna, flora and ecology of the wetlands of Iraq was obtained prior to the onset of the Iran/Iraq war in 1980, when large areas of wetland, especially in Mesopotamia, remained more or less intact. Dam-building activities on the Tigris and Euphrates Rivers in recent years, both within Iraq and upstream in Turkey and Syria, are known to have resulted in the loss of much of the former wetland habitat, while major hydrological engineering works in Lower Mesopotamia within the last few years have caused, and continue to destroy wetlands on a massive scale. Almost no first-hand information is available on the impact of these developments on the ecology or wildlife of the wetlands, but it seems certain that many, if not most, of the sites described in this inventory have already been drastically reduced in size and will disappear completely in the near future. For this reason, the present inventory should be viewed more as an historical account of the wetlands of Iraq than as a review of the current status of the wetlands.

Haweija Marshes (1)

Location: 35°15'N, 43°55'E; in the valley of the Little Zab River, about 50 km west-southwest of Kirkuk, Al Ta'mim Governorate.
Area: Unknown.
Altitude: c.170 m.
Physical and ecological features: The Haweija (or Huweija) Marshes are a complex of marshes and lakes on the plains to the southeast of the Little Zab River, a tributary of the Tigris. Wheat is cultivated in surrounding areas.
Land tenure: No information.
Conservation measures taken: None. The wetland has been identified as an "Important Bird Area" by BirdLife International (Evans, 1994).
Conservation measures proposed: None known.
Land use: No information.
Disturbances and threats: No recent information is available. It is likely, however, that much of the wetland has now been drained for agriculture.
Hydrological and biophysical values: No information.
Social and cultural values: No information.
Noteworthy fauna: Haweija Marshes are reported to have been an important staging and wintering area for migratory waterfowl. Marchant and Macnab (1962) recorded a wide variety of ducks, shorebirds and other waterfowl, mostly in small numbers, on passage and in winter,

including *Botaurus stellaris* and *Marmaronetta angustirostris*. They also recorded up to 2,000 *Anser albifrons* and 75-100 *Himantopus himantopus* on passage. Savage (1968) states that *Anas crecca* wintered in "thousands", and that *Phoenicopterus ruber* and *Anas strepera* occurred on passage. *Vanellus indicus* and *V. leucurus* are said to be common breeding species.
Noteworthy flora: No information.
Scientific research and facilities: None known.
Management authority and jurisdiction: No information.
References: Evans (1994); Marchant & Macnab (1962); Savage (1968).
Reasons for inclusion: 1a, 3b & 3c. One of the few significant natural freshwater wetlands in central Iraq, known to have been an important staging and wintering area for migratory waterfowl, especially *Anser albifrons*.
Source: See references.

Tharthar Lake (2)

Location: 33°40'-34°30'N, 43°00'-43°40'E; on the plains between the Tigris and Euphrates Rivers, about 100 km northwest of Baghdad, Salah Al Din Governorate. Approximate centre at 33°55'N, 43°15'E.
Area: c.230,000 ha.
Altitude: c.100 m.
Overview: A large natural depression and former salt lake in the Al Jezira desert between the Tigris and Euphrates Rivers, now used for flood relief and water storage for irrigation purposes.
Physical and ecological features: Tharthar Lake was formerly a vast salt lake in a shallow depression between the Tigris and Euphrates Rivers. In recent decades, the basin has been used to store flood waters from the Tigris and Euphrates Rivers, and now contains a deep, oligotrophic brackish lake some 100 km long and up to 35 km wide. Initially, the lake was used to store floodwaters from the Tigris River, which entered via an inlet canal from the Samarra Dam, but in 1975 a canal was constructed to the lake from Felluja on the Euphrates. An outlet canal feeds water back into the Tigris River, and a branch from this canal reaches south to feed into the Euphrates as well. The maximum depth in the late 1960s, before the lake had completely filled, was 44 m. As the salinity of the lake has fallen, emergent aquatic vegetation has become established along parts of the shoreline, and there are now some reed-beds in the littoral zone and in shallow regions of the lake. The lake is surrounded by semi-desertic plains and low hills with a sparse vegetation of small shrubs (*Haloxylon salicornicum*, *Achillea fragrantissima*, *Artemisia herb-alba* and *Rhanterium epaposum*) and scattered *Ziziphus* trees. In spring, most of the area is covered with a thin layer of grasses and annuals.
The climate is generally hot and dry for most of the year. The average annual rainfall is about 150 mm, most of the rain falling during December, January and February. The mean annual temperature is about 20°C, and the temperature range from a minimum of 5°C in January to a maximum of 45°C in July and August (Al-Dabbagh, in press).
Land tenure: No information.
Conservation measures taken: None. The lake was listed as a wetland of international

importance by Carp (1980). The northeastern portion of the lake and a large area of adjacent desert (Mahzam) have been identified as an "Important Bird Area" by BirdLife International (Evans, 1994).

Conservation measures proposed: Al-Dabbagh (in press) considered that the eastern shore of Tharthar Lake and an adjacent strip of semi-desert about 20 km wide would be suitable for conservation purposes.

Land use: Flood relief and storage of water for irrigation. There is a considerable amount of fishing in the lake and some waterfowl hunting occurs. Much of the surrounding desert is used for irrigated agriculture, but a strip of land about 20 km wide on the northern and eastern sides of the lake is unsuitable for agriculture and is relatively undisturbed.

Disturbances and threats: Overfishing is reported to be a problem in the lake (Evans, 1994).

Hydrological and biophysical values: No information.

Social and cultural values: No information.

Noteworthy fauna: Huge numbers of waterfowl were reported to winter in the area in the 1960s, particularly *Anas platyrhynchos*, *A. crecca*, *A. penelope*, *A. acuta*, *A. clypeata* and *Fulica atra* (Savage, 1968; Georg & Savage, 1970b). Waterfowl counts in the 1970s found rather few birds, and it was supposed that the lake had lost much of its importance for waterfowl since the water storage and relief functions were enlarged some years earlier (Carp, 1980). About 4,000 waterfowl were recorded during a partial survey in December 1972, including about 900 ducks of seven species, over 2,000 *Fulica atra*, 23 *Grus grus*, 560 *Larus ridibundus* and 70 *L. cachinnans*, along with small numbers of *Podiceps cristatus*, *P. nigricollis*, *Phalacrocorax carbo* and several species of shorebirds (Koning & Dijksen, 1973). However, Al-Dabbagh (in press) observed very large numbers of waterfowl at the north end of the lake in 1988 and 1989, including up to 10,000 *Anas platyrhynchos*, 10,000 *Aythya ferina* and 10,000 *Fulica atra*, along with smaller numbers of *Phalacrocorax pygmaeus* (maximum 10), *Anas strepera* (100), *Marmaronetta angustirostris* (2), *Aythya nyroca* (10), *A. fuligula* (400), *Charadrius alexandrinus* (100), *Calidris minuta* (100), *Larus genei* (100) *Gelochelidon nilotica* (10) and *Sterna albifrons* (40). Breeding birds in 1988/89 included *Charadrius alexandrinus*, *Vanellus indicus* and *V. leucurus*, while passage migrants included up to 20 *Charadrius asiaticus*. The Black-bellied Sandgrouse *Pterocles orientalis* and Pin-tailed Sandgrouse *P. alchata* are common in the surrounding semi-desert, and come to drink at the lake in large numbers. The Houbara Bustard *Chlamydotis undulata* was still breeding in the area as recently as 1988/89 (Al-Dabbagh, in press).

Mammals known to have occurred in the area include Wolf *Canis lupus*, Jackal *C. aureus*, Striped Hyaena *Hyaena hyaena* and Goitred Gazelle *Gazella subgutturosa*. Common reptiles include the agamids *Agama agilis* and *A. ruderata*, the lacertids *Acanthodactylus boskianus* and *A. grandis*, and several snakes of the genus *Coluber*. The globally threatened Desert Monitor *Varanus griseus* is present in fairly good numbers in the semi-desert to the east of the lake, and the rare viper *Pseudocerastes fieldii* has been collected on the shore of the lake (K.Y. Al-Dabbagh, *in litt.*).

Noteworthy flora: No information.

Scientific research and facilities: Mid-winter waterfowl surveys were undertaken in 1972 and 1975 by the International Waterfowl and Wetlands Research Bureau (IWRB) in collaboration with the Iraq Natural History Museum in Baghdad and the Museum of Natural History in Basrah. Al-Dabbagh (in press) studied the bird fauna of the northern part of the lake and

adjacent desert between February 1988 and October 1989.
Management authority and jurisdiction: No information.
References: Al-Dabbagh (in press); Carp (1975a, 1975b, 1980); Evans (1994); Georg & Savage (1970b); Koning & Dijksen (1973); Savage (1968).
Reasons for inclusion: 3a & 3c. An extremely important staging and wintering area for migratory waterfowl.
Source: See references.

Samarra Lake (3)

Location: 34°15'N, 43°50'E; on the Tigris River at Samarra, 100 km north-northwest of Baghdad, Salah Al Din Governorate.
Area: c.20,000 ha.
Altitude: c.70 m.
Physical and ecological features: A small water storage reservoir, about 25 km long and up to eight km wide, created by a dam on the Tigris River. Soils are mostly alluvial, and in some parts hills reach the river forming cliffs. Elsewhere, the river banks are gravel. There is a large area of marsh extending for about five km, with beds of *Phragmites* and *Typha* and a rich growth of submerged aquatic vegetation, especially where the water depth is about 1.5 m. Riverine forest dominated by *Populus euphratica* occurs in patches along the banks and more especially on small islands. Old gravel pits in the adjacent river bed are now filled with water and surrounded by a thick growth of *Populus* and *Tamarix*. Adjacent areas of the Tigris valley have been largely converted to orchards and open agricultural fields.
Land tenure: No information.
Conservation measures taken: None. The wetland has been identified as an "Important Bird Area" by BirdLife International (Evans, 1994).
Conservation measures proposed: None known.
Land use: Water storage for irrigation and flood diversion. Parts of the river bank are used for gravel extraction. There is some grazing of lakeside vegetation by sheep and cattle. Much of the surrounding area is cultivated, mainly with date palms, wheat fields, orchards and some vegetables.
Disturbances and threats: Duck-hunting is common away from the dam, and there is a possibility of the extension of agriculture and of mineral extraction (Evans, 1994).
Hydrological and biophysical values: No information.
Social and cultural values: No information.
Noteworthy fauna: The lake has assumed considerable importance as a breeding, staging and wintering area for migratory waterfowl. Al-Dabbagh (in press) recorded 146 species of birds in the area between February 1988 and October 1989, including 61 species of waterfowl. Breeding birds included *Tachybaptus ruficollis* (20 pairs), *Nycticorax nycticorax* (20 pairs), *Francolinus francolinus* (common), *Gallinula chloropus* (common), *Porphyrio porphyrio* (20 birds), *Glareola pratincola* (50 pairs), *Vanellus indicus* (20 pairs), *V. leucurus* (50 pairs), *Sterna albifrons* (40 birds), *Ceryle rudis* and *Halcyon smyrnensis*. Possible breeding species included

Phalacrocorax pygmaeus, *Egretta garzetta*, *Ardea cinerea*, *A. purpurea*, *Marmaronetta angustirostris*, *Circus aeruginosus*, *Fulica atra*, *Sterna hirundo* and *S. albifrons*. *Tadorna ferruginea* has bred in the area in the past. The riverine thickets support large breeding populations of *Hypocolius ampelinus* (50 pairs), *Turdoides altirostris* and *Passer moabiticus*. The reservoir regularly supports over 20,000 waterfowl in winter, including up to 200 *Anas strepera*, 5,000 *A. platyrhynchos*, 1,300 *A. acuta*, 300 *A. clypeata*, 10,000 *Aythya ferina*, 250 *A. fuligula*, 15,000 *Fulica atra*, 50 *Himantopus himantopus*, 60 *Tringa nebularia*, 60 *Larus genei* and 100 *L. ridibundus*. Species recorded in smaller numbers include *Podiceps nigricollis* (maximum 10), *Phalacrocorax pygmaeus* (maximum 14), *Botaurus stellaris*, *Ardeola ralloides* (maximum 20), *Egretta garzetta* (maximum 40), *Ardea cinerea* (maximum 20), *A. purpurea* (maximum 10), *Anser anser* (maximum 105), *Marmaronetta angustirostris* (maximum 6) and *Aythya nyroca* (maximum 25). *Haliaeetus albicilla* bred on the cliffs by the river in the 1960s, but none could be found in this area in 1988/89, despite extensive searches. Up to 20 Marsh Harrier *Circus aeruginosus* have been recorded in the area in winter. The Jackal *Canis aureus* and the Small Indian Mongoose *Herpestes auropunctatus* occur in the area. The river and lake hold endemic cyprinid fish.

Noteworthy flora: No information.

Scientific research and facilities: A mid-winter waterfowl survey was undertaken in 1972 by the International Waterfowl and Wetlands Research Bureau (IWRB) in collaboration with the Iraq Natural History Museum in Baghdad. Al-Dabbagh (in press) studied the bird fauna of the lake between February 1988 and October 1989.

Management authority and jurisdiction: The lake has been reported to be under the control of one important government official for private use (Evans, 1994).

References: Al-Dabbagh (in press); Evans (1994); Koning & Dijksen (1973).

Reasons for inclusion: 2a, 2d, 3a & 3c. An important breeding, staging and wintering area for migratory waterfowl. Several globally threatened species of birds have occurred, and endemic cyprinid fish are present.

Source: Khalid Y. Al-Dabbagh and references.

Shari Lake (4)

Location: 34°22'N, 44°08'E; on the plains to the east of the Tigris River, 30 km northeast of Samarra, Salah Al Din Governorate.

Area: 5,000-8,000 ha.

Altitude: c.100 m.

Physical and ecological features: A large, natural, shallow, saline lake on the desertic plains about 30 km east of the Tigris River. The lake varies greatly in size depending on local rainfall and floodwaters from the Hemrin Hills and Al-Authaim River. At full extent, the lake is about 27 km long (from north to south) and up to 7 km wide, but large portions dry out during the summer months. There are some small reed-beds of *Phragmites* where fresh water enters the lake. The semi-desertic plains to the west of the lake are sparsely vegetated with grasses and low shrubs; extensive sand dunes occur to the east.

Land tenure: No information.
Conservation measures taken: None. The wetland has been identified as an "Important Bird Area" by BirdLife International (Evans, 1994).
Conservation measures proposed: Al-Dabbagh (in press) considered that Shari Lake would be a suitable site for a conservation area.
Land use: There is commercial salt extraction at the lake. Sheep graze around the lake, especially in spring when extra stock are brought in.
Disturbances and threats: No information.
Hydrological and biophysical values: No information.
Social and cultural values: No information.
Noteworthy fauna: The lake is an important staging and wintering area for migratory waterfowl. Al-Dabbagh (in press) recorded 34 species of waterfowl at the lake between February 1988 and October 1989, including up to 6 *Phalacrocorax pygmaeus*, 50 *Phoenicopterus ruber*, 20 *Anser albifrons*, 200 *Anas platyrhynchos*, 2 *Marmaronetta angustirostris*, 200 *Aythya ferina*, 200 *A. fuligula*, 500 *Fulica atra*, 40 *Charadrius alexandrinus*, 60 *C. asiaticus*, 40 *Calidris minuta*, 20 *Gelochelidon nilotica* and 20 *Sterna albifrons*. Breeding birds in 1988/89 included *Vanellus indicus* (20 pairs), *V. leucurus* (10 pairs), *Charadrius alexandrinus* (5 pairs) and *Gelochelidon nilotica* (4 pairs); *Himantopus himantopus* may have bred. The Wolf *Canis lupus* and Jackal *C. aureus* have been recorded in the area. Common reptiles include the agamids *Agama agilis* and *A. ruderata*, the lacertids *Acanthodactylus boskianus* and *A. grandis*, and several snakes of the genus *Coluber*. The globally threatened Desert Monitor *Varanus griseus* occurs in the surrounding desert.
Noteworthy flora: No information.
Scientific research and facilities: Al-Dabbagh (in press) studied the bird fauna of the lake and surrounding desert between February 1988 and October 1989.
Management authority and jurisdiction: No information.
References: Al-Dabbagh (in press); Evans (1994); Georg & Savage (1970b).
Reasons for inclusion: 1a & 3b. A good example of a natural, brackish to saline lake in central Iraq; an important staging and wintering area for migratory waterfowl.
Source: See references.

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Baquba Wetlands (5)

Location: 33°55'N, 44°50'E; in the Diyala Valley about 10-20 km north-northeast of Baquba and 70 km north-northeast of Baghdad, Diyala Governorate.
Area: c.2,000 ha.
Altitude: c.50 m.
Overview: The remnants of a once extensive complex of freshwater lakes and marshes in the Diyala Valley, formerly of considerable importance for passage and wintering waterfowl, but largely drained for agriculture in the early 1970s. The current status of the wetlands is unknown.
Physical and ecological features: The wetlands in the Baquba area formerly comprised a

complex of at least six shallow, freshwater lakes with extensive marshes covering an area of at least 2,000 ha in the valley of the Diyala River, a tributary of the Tigris. The principal wetlands were Haur Abu Abbas (33°50'N, 44°45'E), Haur Shaikh Sayed (33°51'N, 44°46'E) and four lakes totalling about 1,000 ha (Abdul Warid, Al Abara, Al Ahmar and Al Ugur) south of the village of Mugdadiya (34°00'N, 44°55'E). The lakes were fed partly by rain water and partly by the Mahrut River, a branch of the Diyala River. The lakes supported extensive marshes and some dense reed-beds. Mudflats were exposed at low water levels. Areas adjacent to the four northern lakes were under cultivation, with cotton, corn, palm groves and orchards. The lakes were still in excellent condition until the late 1960s, but by the end of 1972, only Abu Abbas (500-1,000 ha) remained more or less intact. Haur Shaikh Sayed had been reduced to a few ha of open water surrounded by agricultural land, and Abdul Warid, Al Abara, Al Ahmar and Al Ugur had been completely drained for agriculture (Koning & Dijksen, 1973).

Land tenure: No information.

Conservation measures taken: None. The wetlands in the Baquba area were listed as a wetland in international importance by Carp (1980), and have been identified as an "Important Bird Area" by BirdLife International (Evans, 1994).

Conservation measures proposed: None known.

Land use: The lakes were formerly used as a supply of water for irrigation during the summer months. Waterfowl market hunting occurred in winter.

Disturbances and threats: When they visited the lakes in December 1972, Koning and Dijksen (1973) found that the four lakes near Mugdadiya (Abul Warid, Al Abara, Al Ahmar and Al Ugur) had been drained and converted into agricultural land since the previous IWRB survey in January 1968. At that time, these lakes had held at least 27,500 ducks and 11,000 *Fulica atra* (Georg & Vielliard, 1970). Similarly, Haur Shaikh Sayed had been almost completely drained for agriculture. At the one remaining lake, Haur Abu Abbas, duck-hunting was occurring on a large scale, the birds being netted at night and sold in markets in Baghdad.

Hydrological and biophysical values: No information.

Social and cultural values: No information.

Noteworthy fauna: Formerly an extremely important wintering area for migratory waterfowl, notably dabbling ducks, *Aythya ferina* and *Fulica atra*, and identified by Atkinson-Willes (1976) as being of international importance for wintering *Anas acuta* and *A. clypeata*. Over 24,000 ducks of ten species were present on lakes Al Abara and Al Ahmar in January 1967, and over 39,000 waterfowl were recorded on four of the lakes in January 1968. Peak counts in the 1960s included 70 *Tachybaptus ruficollis*, 16 *Casmerodius albus*, 570 *Ciconia ciconia*, 255 *Plegadis falcinellus*, 20 *Platalea leucorodia*, 50 *Anser anser*, 30 *Tadorna tadorna*, 5,000 *Anas platyrhynchos*, 14,000 *A. crecca*, 6,000 *A. strepera*, 5,000 *A. penelope*, 5,000 *A. acuta*, 8,650 *A. clypeata*, 1,500 *Aythya ferina*, 100 *A. nyroca*, 11,000 *Fulica atra*, 80 *Himantopus himantopus*, 70 *Vanellus indicus*, 56 *V. leucurus*, 150 *Charadrius alexandrinus* and 40 *Chlidonias hybridus*. About 180 *Marmaronetta angustirostris* were found wintering at Haur Al Ahmar in January 1968 (Georg & Vielliard, 1970); this is one of the few areas in Iraq where this threatened species has been found in winter. A party of seven *Cygnus columbianus* was present in December 1966 (Georg & Savage, 1970b). Wintering birds of prey included *Aquila clanga*, *A. nipalensis*, *Circus aeruginosus* (maximum 17) and *C. macrourus*. *Anas querquedula* was reported to be common on passage, and *Porphyrio porphyrio* probably bred in the area. However, by 1972 the lakes had lost most of their importance for waterfowl; only 4,850

waterfowl of 18 species were recorded in December 1972, mostly at Haur Abu Abbas.
Noteworthy flora: No information.
Scientific research and facilities: Mid-winter waterfowl surveys were undertaken in 1968 and 1972 by the International Waterfowl and Wetlands Research Bureau (IWRB) in collaboration with the Iraq Natural History Museum in Baghdad and the Museum of Natural History in Basrah.
Management authority and jurisdiction: No information.
References: Atkinson-Willes (1976); Carp (1980); Evans (1994); Georg & Savage (1970b); Georg & Vielliard (1968, 1970); Koning & Dijksen (1973); Marchant & Macnab (1962).
Reasons for inclusion: 1a, 2a, 3a & 3c. Until recently at least, one of the few remaining groups of freshwater lakes and marshes in central Iraq, and an extremely important staging and wintering area for migratory waterfowl, including *Marmaronetta angustirostris* and *Aythya nyroca*.
Source: See references.

Attariya Plains (6)

Location: 33°25'N, 44°55'E; on the plains to the east of the Tigris River, about 45 km east-northeast of Baghdad, Baghdad Governorate.
Area: c.40,000 ha.
Altitude: c.50 m.
Overview: A complex of shallow seasonal lagoons with a deeper, permanent central pool and a large area of seasonally flooded arable land in semi-desert country on the vast plains to the east of the Tigris River; important for wintering waterfowl including geese and cranes.
Physical and ecological features: The Attariya Plains comprise an area of several hundred square kilometres of semi-desertic plains, irrigated arable land, and seasonally inundated lagoons and marshes, with a small area of permanent wetland habitat. The central, permanent wetland consists of a brackish pool, covering about 50 ha and with a maximum depth of 1.8-2.0 metres, surrounded by an extensive belt of *Phragmites* and *Typha* reed-beds. A canal takes water north from this pool to irrigated agricultural land in the semi-desert to the north. The adjacent plains are dominated by species of *Alhaji* and *Acacia*.
Land tenure: No information.
Conservation measures taken: None. The wetland has been identified as an "Important Bird Area" by BirdLife International (Evans, 1994).
Conservation measures proposed: In the early 1970s, the Iraq Natural History Museum identified the area as being suitable for the creation of a nature reserve, because of its importance for wildlife and proximity to Baghdad, but no further action was taken.
Land use: Water from the permanent lagoon is used for irrigation purposes. Waterfowl are netted for sale in Baghdad markets, and there is some recreational shooting by people from Baghdad at weekends and holidays. Sheep graze throughout the area.
Disturbances and threats: The site is threatened by drainage of the wetlands to the north from where it obtains much of its water. The area was subjected to heavy hunting pressure in the

1960s and 1970s. Waterfowl were shot from cars during the day, and netted at night for sale in Baghdad. Carp (1975a) reported that as many as 200 birds, mainly *Fulica atra*, could be trapped with clap-nets by a single team in one night, and estimated that a season's catch might amount to 10,000-20,000 birds.
Hydrological and biophysical values: No information.
Social and cultural values: No information.
Noteworthy fauna: Known to be an important wintering area for geese, *Tadorna ferruginea*, dabbling ducks, *Grus grus*, *Fulica atra* and some shorebirds in the 1960s and 1970s, but no more recent information is available. Partial counts in the 1970s included up to 70 *Pelecanus* sp., 19 *Plegadis falcinellus*, 20 *Ciconia ciconia*, 50 *Anser anser*, 412 *Tadorna ferruginea*, 6,000 *Anas crecca*, 200 *A. acuta*, 200 *A. clypeata*, 13 *Aythya nyroca*, 2,100 *Fulica atra*, 20 *Recurvirostra avosetta*, 16 *Vanellus indicus*, 15 *V. leucurus*, 2,500 *Limosa limosa*, 1,000 *Larus ridibundus*, 160 *L. cachinnans* and 20 *Chlidonias hybridus*. Two *Phalacrocorax pygmaeus* and two *Botaurus stellaris* were present in January 1975, along with an impressive roost of several million Starlings *Sturnus vulgaris* (Carp, 1975a). *Glareola pratincola* breeds on the plains, and *Charadrius asiaticus* has been recorded on migration (maximum 300).
Noteworthy flora: No information.
Scientific research and facilities: Mid-winter waterfowl surveys were undertaken in 1975 and 1979 by the International Waterfowl and Wetlands Research Bureau (IWRB) in collaboration with the Iraq Natural History Museum in Baghdad and the Museum of Natural History in Basrah. The wetland was considered by Carp (1975a) to be an excellent site for a small field laboratory for research by scientists and students from Baghdad.
Management authority and jurisdiction: No information.
References: Carp (1975a, 1975b); Carp & Scott (1979); Evans (1994); Scott & Carp (1982).
Reasons for inclusion: 3b & 3c. An important staging and wintering area for migratory waterfowl, notably *Anser* spp, *Tadorna ferruginea* and *Grus grus*.
Source: See references.

Haur Al Shubaicha (7)

Location: 33°00'N, 45°23'E; on the plains to the north of the Tigris River, about 85 km east-southeast of Baghdad, Diyala and Wasit Governorates.
Area: c.40,000 ha.
Altitude: c.35 m.
Physical and ecological features: A large saline lake (perhaps largely seasonal) with extensive brackish to saline marshes, on semi-desertic plains about 30 km north of the Tigris River. The lake is bounded to the south by a levee, and is situated within a large area of sand dunes. It is about 40 km from north to south and up to 10 km from east to west, and is fed by numerous perennial streams.
Land tenure: No information.
Conservation measures taken: None. The wetland has been identified as an "Important Bird Area" by BirdLife International (Evans, 1994).

Conservation measures proposed: None known.
Land use: No information.
Disturbances and threats: No information.
Hydrological and biophysical values: No information.
Social and cultural values: No information.
Noteworthy fauna: No information is available. Scott and Carp (1982) identified the site as possibly being of great importance for passage and wintering waterfowl, but no faunal surveys have ever been carried out.
Noteworthy flora: No information.
Scientific research and facilities: None known.
Management authority and jurisdiction: No information.
References: Evans (1994); Scott & Carp (1982).
Reasons for inclusion: 1a. A large, natural, saline lake with associated marshes, possibly of considerable importance for migratory waterfowl but very poorly known.
Source: See references.

Lake Al Habbaniya and Ramadi Marshes (8)

Location: 33°16'N, 43°30'E; on the south bank of the Euphrates near the town of Al Habbaniya, about 70 km west of Baghdad, Al Anbar Governorate.
Area: At least 20,000 ha.
Altitude: c.45 m.
Overview: A former lake in a saline depression, now used for flood relief and water storage; important as a staging and wintering area for migratory waterfowl.
Physical and ecological features: Lake Al Habbaniya was formerly a brackish to saline lake in a large saline depression to the south of the Euphrates River. Inlet and outlet canals have been constructed to connect the lake with the Euphrates River and to allow its use for flood relief and water storage. The lake is now a deep, brackish, oligotrophic lake, about 25 km in length (from east to west) and up to 15 km wide. During spring flooding in the Euphrates, water enters the lake via the inlet canal at the west end near Ramadi, where there are marshes with some reed-beds. Water is discharged back into the Euphrates during August-October through the Dhibban canal which cuts through the gypsum plateau separating the lake from the river. A third canal (the Mujarah Canal) carries any excess water 50 km south to Lake Razazah (Bahr Al Milh). The water level in the lake can fluctuate by as much as 6.0 m, depending on the size of the spring flood, with the highest levels occurring from about the end of April to August, and the lowest levels from November to March. In December 1972, when the water level was very low, all of the reed-beds had dried out and hundreds of nomads were camping on the bed of the lake (Koning & Dijksen, 1973).
Land tenure: No information.
Conservation measures taken: None. Lake Al Habbaniya was listed as a wetland of international importance by Carp (1980), and has been identified as an "Important Bird Area" by BirdLife International (Evans, 1994).

Conservation measures proposed: None known.
Land use: Flood relief, water storage for irrigation, fishing and outdoor recreation. The lake is visited by many people from Baghdad at weekends and public holidays, and there has been some tourist development in the area.
Disturbances and threats: Lake Habbaniya has probably lost much of its importance for waterfowl in recent years because of excessive disturbance from recreation activities.
Hydrological and biophysical values: No information.
Social and cultural values: The lake supports an important commercial fishery, and is a popular recreation area for people from Baghdad, only 70 km away.
Noteworthy fauna: Lake Al Habbaniya was at least formerly an extremely important staging and wintering area for migratory waterfowl, notably *Anser anser* (maximum 300), *Tadorna ferruginea* (maximum 84), *Anas platyrhynchos*, *A. crecca*, *A. clypeata*, *Mergellus albellus* (maximum 30) and *Grus grus*. Large numbers of *Platalea leucorodia* (200) have also occurred in winter. However, Koning and Dijksen (1973) found only a few hundred waterfowl in December 1972, when water levels were exceptionally low. These included 35 *Podiceps nigricollis*, 15 *Phoenicopterus ruber*, 130 ducks, 50 *Larus ridibundus*, 250 *L. cachinnans* and a few shorebirds. *Sterna hirundo* and *S. albifrons* (15 pairs) have bred on islands formed during periods of high water level; *Tadorna ferruginea* is said to breed in the area, and *Marmaronetta angustirostris* has probably bred in the marshes around the lake. A single *Oxyura leucocephala* was recorded at the lake in November 1956 (Anstey, 1989).
Noteworthy flora: No information.
Scientific research and facilities: Mid-winter waterfowl surveys were undertaken in 1972 and 1975 by the International Waterfowl and Wetlands Research Bureau (IWRB) in collaboration with the Iraq Natural History Museum in Baghdad and the Museum of Natural History in Basrah.
Management authority and jurisdiction: No information.
References: Anstey (1989); Carp (1975a, 1975b, 1980); Chapman & McGeoch (1956); Evans (1994); Georg & Savage (1970b); Koning & Dijksen (1973); Savage (1968).
Reasons for inclusion: 1a, (2a) & 3b. An important breeding, staging and wintering area for migratory waterfowl, and probably a breeding area for *Marmaronetta angustirostris*.
Source: See references.

Lake Razazah (Bahr Al Milh) (9)

Location: 32°31'-33°02'N, 43°26'-43°55'E; on the plains to the west of the Euphrates River, about 10 km west of Karbala and 80 km southwest of Baghdad, Karbala Governorate. Approximate centre at 32°45'N, 43°53'E.
Area: c.150,000 ha.
Altitude: c.45 m.
Overview: A deep brackish lake used for the storage of excess floodwaters from the Euphrates River; of great importance for breeding, passage and wintering waterfowl, but subject to extremely heavy hunting pressure in recent years.

Physical and ecological features: Lake Razazah is a deep, brackish lake with many islands, peninsulas and stretches of low cliff shoreline, surrounded by desert. The lake is approximately 60 km long (from north to south) and up to 40 km wide. It occupies the area of two former salt lakes, Bahr Al Milh and Haur Abu Dibis, in a large saline depression on the semi-desertic plains to the west of the Euphrates River. Lake Razazah was created in the 1970s as a second storage reservoir to take excess water from Lake Al Habbaniya (Site 8), diverted through the 50 km long Mujarah Canal; it is also fed by a natural spring. The salinity of the lake has been increasing since its creation, and now stands at about 2.0-2.2%. There is a small, shallow, freshwater lake (Lake Usathe or Shithathah; 32°37'N, 43°55'E) of about 100 ha in extent a few kilometres from the southeast corner of Lake Razazah. This lake, which has some emergent vegetation, provides feeding habitat for waterfowl which roost on Lake Razazah.

Land tenure: No information.

Conservation measures taken: None. Lake Razazah (Haur Abu Dibis and Bahr Al Milh) was listed as a wetland of international importance by Carp (1980), and has been identified as an "Important Bird Area" by BirdLife International (Evans, 1994).

Conservation measures proposed: None known.

Land use: Water storage basin for irrigation purposes; also fishing and waterfowl hunting.

Disturbances and threats: In the 1970s, it appeared that military activities and the use of the area for recreation might pose threats. Some shooting and netting of waterfowl was reported in the 1970s, but at relatively low levels. However, in the winter of 1991/92, over 40,000 ducks and 40,000 *Fulica atra* were estimated to have been sold in the markets of Karbala and Najaf, most of these probably having come from Lake Razazah (K.Y. Al-Dabbagh, *in litt.*). According to Al-Robaae (in press), Lake Razazah is now a major waterfowl hunting area, with birds being taken mainly by nets to supply markets as far afield as Baghdad and Hilla. Al-Robaae estimates that the total number of birds sold in Central and Southern Iraq in recent years, since the imposition of the UN embargo, exceeds 300,000 in a season; many of these birds are thought to come from Lake Razazah. Shrimp farming and the introduction of tilapia have both been proposed for Lake Razazah.

Hydrological and biophysical values: No information.

Social and cultural values: No information.

Noteworthy fauna: Lake Razazah is an extremely important staging and wintering area for a wide variety of waterfowl, notably grebes, cormorants, pelicans, flamingos, ducks, coots and gulls. Over 100,000 waterfowl were recorded during very incomplete censuses in January 1975 and January 1979. These included up to 600 *Podiceps cristatus*, 1,100 *P. nigricollis*, 3,000 *Phalacrocorax carbo*, 600 *Pelecanus onocrotalus*, 3 *P. crispus*, 50 *Casmerodius albus*, 200 *Platalea leucorodia*, 3,500 *Phoenicopterus ruber*, 730 *Tadorna tadorna*, 1,500 *Anas penelope*, 3,000 *A. strepera*, 7,500 *A. crecca*, 3,000 *A. platyrhynchos*, 2,000 *A. acuta*, 5,400 *A. clypeata*, 2,000 *Aythya ferina*, 1,600 *A. fuligula*, 1,000 *Mergellus albellus*, 102,500 *Fulica atra*, 5 *Grus grus*, 300 *Recurvirostra avosetta*, 100 *Vanellus leucurus*, 320 *Calidris alpina*, 200 *Larus ridibundus*, 200 *L. genei* and 80 *L. cachinnans*. Three *Cygnus olor* were present on Lake Usathe in January 1979. Birds of prey recorded in January 1979 included *Aquila heliaca* (2), *Circus aeruginosus* (6), *C. cyaneus* and *Falco columbarius*. The lake is also of considerable importance for breeding waterfowl. In the late 1970s, about 50 pairs of *Marmaronetta angustirostris* were breeding around Lake Razazah and at least another 20 pairs at Lake Usathe (Ctyroky, 1987). Other breeding species included *Himantopus himantopus* (100 pairs),

Charadrius alexandrinus (300 pairs) and *Vanellus leucurus* (300 pairs). *Recurvirostra avosetta* was possibly breeding.
The lake is rich in fish, and the spiny-tailed lizard *Uromastix* sp. is said to be abundant around the lake shore.
Noteworthy flora: No information.
Scientific research and facilities: Mid-winter waterfowl surveys were undertaken in 1975 and 1979 by the International Waterfowl and Wetlands Research Bureau (IWRB) in collaboration with the Iraq Natural History Museum in Baghdad and the Museum of Natural History in Basrah. Ctyroky (1987) investigated the birdlife during the breeding season in the late 1970s.
Management authority and jurisdiction: No information.
References: Al-Robaae (in press); Carp (1975a, 1975b, 1980); Carp & Scott (1979); Ctyroky (1987); Evans (1994); Georg & Savage (1970b); Scott & Carp (1982).
Reasons for inclusion: 1a, 2a, 3a & 3c. An important breeding area for *Marmaronetta angustirostris*, and an extremely important staging and wintering area for a wide variety of migratory waterfowl.
Source: See references.

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Al Musayyib Wetlands (10)

Location: 32°50'N, 44°18'E; on either side of the main Baghdad to Karbala road between the towns of Al Musayyib and Haswa, about 50 km south of Baghdad, Babil Governorate.
Area: At least 1,000 ha.
Altitude: c.45 m.
Physical and ecological features: An area of seasonally flooded semi-desertic steppe on the east bank of the Euphrates River, north of the town of Al Musayyib.
Land tenure: No information.
Conservation measures taken: None. The wetland has been identified as an "Important Bird Area" by BirdLife International (Evans, 1994).
Conservation measures proposed: None known.
Land use: No information.
Disturbances and threats: No information.
Hydrological and biophysical values: No information.
Social and cultural values: No information.
Noteworthy fauna: At least formerly an important wintering area for migratory waterfowl, identified by Atkinson-Willes (1976) as being of international importance for *Anas crecca* and *A. clypeata*. About 25,000 waterfowl were recorded in January 1968, including 27 *Egretta garzetta*, 14 *Ciconia ciconia*, 230 *Anser anser*, 55 *A. albifrons*, 14,000 *Anas crecca*, 1,200 *A. platyrhynchos*, 1,530 *A. acuta*, 6,000 *A. clypeata*, 45 *Himantopus himantopus*, 190 *Recurvirostra avosetta*, 180 *Charadrius alexandrinus* and 130 *Tringa erythropus* (Georg & Vielliard, 1968 & 1970). Birds of prey present at this time included *Aquila heliaca*, *A. clanga*, *Circus aeruginosus* and *Falco peregrinus*. No other censuses appear to have been carried out in this area.

Noteworthy flora: No information.
Scientific research and facilities: A mid-winter waterfowl survey was undertaken in January 1968 by the International Waterfowl and Wetlands Research Bureau (IWRB) in collaboration with the Museum of Natural History in Basrah.
Management authority and jurisdiction: No information.
References: Atkinson-Willes (1976); Evans (1994); Georg & Vielliard (1968, 1970).
Reasons for inclusion: 3a & 3c. Known to have been an important wintering area for migratory waterfowl, notably *Anas crecca* and *A. clypeata*.
Source: See references.

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Hindiya Barrage (11)

Location: 32°42'N, 44°17'E; on the Euphrates River 5 km south of Al Musayyib and 65 km south of Baghdad, Babil Governorate.
Area: Unknown.
Altitude: c.35 m.
Physical and ecological features: A barrage on the Euphrates River with some reed-beds and marshy areas with *Salix* patches. There are orchards, groves of date palms and vegetable gardens in the area.
Land tenure: No information.
Conservation measures taken: None. The wetland has been identified as an "Important Bird Area" by BirdLife International (Evans, 1994).
Conservation measures proposed: None known.
Land use: No information.
Disturbances and threats: The area was reported as being much disturbed by hunters in January 1968 (Georg & Vielliard, 1968). No recent information is available, but it is likely that the wetland habitats will have suffered from the decreasing flow of the Euphrates since the 1970s.
Hydrological and biophysical values: No information.
Social and cultural values: No information.
Noteworthy fauna: Reported to be an important breeding area for waterfowl, but little information is available since the 1930s, when breeding birds included *Podiceps nigricollis*, *Circus aeruginosus*, *Porphyrio porphyrio*, *Glareola pratincola*, *Vanellus leucurus*, *Larus genei*, *Sterna hirundo* and *Halcyon smyrnensis* (Moore & Boswell, 1956-57). *Marmaronetta angustirostris* was described as a "plentiful" breeding species prior to about 1920 (Ticehurst *et al.*, 1921-22), but has not been reported since then. *Botaurus stellaris* was heard booming in late May in the 1920s, and may have bred (Ticehurst *et al.*, 1926). Savage (1968) considered Hindiya Barrage to be an important staging and wintering area for *Anas platyrhynchos*, *A. crecca*, *A. clypeata* and *A. querquedula*. Waterfowl and birds of prey recorded during a survey in January 1968 included 60 *Egretta garzetta*, 40 *Ciconia ciconia*, 1 *Aquila heliaca*, 2 *A. clanga*, 6 *Circus aeruginosus*, 3,200 *Fulica atra* and 4 *Vanellus leucurus*. No other censuses appear to have been carried out in this area.

Noteworthy flora: No information.
Scientific research and facilities: A mid-winter waterfowl survey was undertaken in January 1968 by the International Waterfowl and Wetlands Research Bureau (IWRB) in collaboration with the Museum of Natural History in Basrah.
Management authority and jurisdiction: No information.
References: Evans (1994); Georg & Vielliard (1968, 1970); Moore & Boswell (1956-57); Savage (1968); Ticehurst *et al.* (1921-22, 1926).
Reasons for inclusion: 2a & 3b. Known to have been an important breeding area for *Marmaronetta angustirostris* and an important staging and wintering area for a wide variety of migratory waterfowl.
Source: See references.

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Haur Ibn Najim (12)

Location: 32°08'N, 44°35'E; on the east bank of the Euphrates, about 35 km south-southeast of Hilla, Babil Governorate.
Area: c.10,000 ha.
Altitude: c.25 m.
Physical and ecological features: Haur Ibn Najim (Ibn Najam) comprises about 100 sq.km of permanent and seasonal marshes and rice fields in a shallow depression on the east bank of the Euphrates River, about 10 km inland from the river. The depression formerly contained a large semi-permanent brackish to saline lake, up to 16 km long at maximum flooding, but most of this had already been drained and converted into agricultural land by the late 1960s. The marshes are fed by seepage water from irrigation canals and spring floodwaters from the Euphrates.
Land tenure: No information.
Conservation measures taken: None. Haur Ibn Najim was listed as a wetland of international importance by Carp (1980), and has been identified as an "Important Bird Area" by BirdLife International (Evans, 1994).
Conservation measures proposed: None known.
Land use: Agriculture (especially rice) and waterfowl hunting.
Disturbances and threats: The Haur has presumably suffered badly from the decreasing flow of the Euphrates since the 1970s. The "Third River" canal appears to pass fairly close to the haur, and there may thus be a threat of drainage (Evans, 1994). vant Leven (1968) investigated the market hunting of waterfowl at Haur Ibn Najim in the late 1960s, and found that hunting pressure was heavy throughout the winter, with the hunters using shot-guns by day and by night and also nets. He estimated that over 20,000 ducks and coots were sold in the markets of Najaf and Shamiya during the winter of 1967/68, and calculated that the hunters were accounting for about 31% of the ducks and 56% of the coots which frequented the haur.
Hydrological and biophysical values: No information.
Social and cultural values: No information.
Noteworthy fauna: Haur Ibn Najim was, at least formerly, a very important staging and

wintering area for migratory waterfowl, notably Anatidae and *Fulica atra*, and was identified by Atkinson-Willes (1976) as being of international importance for *Anas clypeata*. About 10,000 Anatidae and coots were observed during a census in January 1968, including 210 *Anas crecca*, 490 *A. acuta*, 3,270 *A. clypeata* and 5,345 *Fulica atra*. Four *Cygnus columbianus* were present in late February 1968 (Georg & Savage, 1970a).
Noteworthy flora: No information.
Scientific research and facilities: A census of Anatidae and *Fulica atra* was carried out in January 1968.
Management authority and jurisdiction: No information.
References: Atkinson-Willes (1976); Carp (1980); Evans (1994); Georg & Savage (1970a, 1970b); vant Leven (1968).
Reasons for inclusion: 3a & 3c. Known to have been a very important staging and wintering area for migratory waterfowl, especially *Anas clypeata*.
Source: See references.

The Wetlands of Lower Mesopotamia (13-31)

Location: 29°55'-32°45'N, 45°25'-48°30'E; along the lower courses of the Tigris and Euphrates Rivers, from the region of Kut and Samawa in the west to the region of Basrah in the southeast. In Al Basrah, Al Muthanna, Dhi Qar, Maysan and Wasit Governorates.
Area: Between 1,500,000 and 2,000,000 ha.
Altitude: From near sea level to approximately 30 m above sea level.
Physical features: In their lower courses, the Tigris and Euphrates rivers create a vast complex of shallow lakes and marshes variously estimated at between 15,000 sq.km and 20,000 sq.km in extent. These wetlands comprise a complex of interconnected, shallow, freshwater lakes, marshes and seasonally inundated floodplains extending from within 150 km of Baghdad in the northwest to the region of Basrah in the southeast. The principal lakes include the Haur Sa'adiyah and Haur Sanniya complex in the north, Haur Al Hammar in the south and Haur Al Hawizeh in the east. Winter rainfall in the headwaters of the Tigris and Euphrates in southern Turkey and northern Iraq cause extensive flooding throughout Mesopotamia and, under normal conditions, fill up the lake systems in the south. After passing through the marshes, the two rivers unite at Qurna to form the Shatt Al Arab which enters the Gulf at Fao some 165 km further downstream. Water levels reach their maximum in early spring and then fall by as much as two metres during the hot dry summer. Until recently, the average depth of water in the main marshes during the flood season was about 1.0-1.5 m and the maximum about 2.0-3.5 m, although a depth of approximately 6 m has been recorded in Haur Al Hawizeh (Salim, 1962). Most of the lakes and marshes are freshwater, but Haur Al Hammar, the lowest in the system and closest to the sea, is slightly brackish. Numerous artificial irrigation canals, some of great antiquity, take water from both main rivers. Noteworthy among these are the Gharraf Canal at Kut, the Butaira Canal above Amara and the Chahala and Musharra Canals at Amara - all taking water from the River Tigris. In more recent times, numerous large dams and barrages have been installed on the Tigris and Euphrates, and an elaborate network of canals has been

constructed to permit irrigation of the fertile alluvial plains between the two rivers.
The 19 most important sectors of the wetlands of Lower Mesopotamia are listed in Table 1 and described separately below (Sites 13-31). The following sections of this account refer to the system as a whole.

Ecological features: Eight major wetland types can be identified:

- Permanent freshwater lakes with a rich submergent growth of aquatic vegetation, and typically with a marginal zone of floating aquatic vegetation.
- Permanent freshwater marshes dominated by tall stands of *Phragmites*, *Typha* and *Cyperus*.
- Rivers, streams, canals and irrigation channels, typically with little emergent vegetation and steep earth or muddy banks.
- Permanent ponds, mainly man-made irrigation ponds and duck-hunting ponds, typically with a pronounced drawdown in summer and little emergent vegetation.
- Seasonal freshwater marshes dominated by rushes and sedges, typically occurring as a broad belt around the edge of the permanent marshes.
- Seasonally flooded mudflats and semi-desertic steppe.
- Irrigated land and seasonally flooded arable land.
- Shallow, brackish to saline lagoons, mostly seasonal and often with extensive areas of *Salicornia*.

An account of the vegetation of the marshes of southern Iraq has been published in Arabic by the University of Basrah (Akbar, 1985). Throughout the wetlands, the emergent vegetation is dominated by Common Reed (*Phragmites australis*), Reedmace (*Typha angustifolia*), Papyrus (*Cyperus papyrus*) and occasionally *Arundo donax*. *Phragmites* dominates the more permanent areas of marsh, and *Typha* the more seasonal areas of marsh, while *Scirpus brachyceras* dominates in temporarily flooded areas (Thesiger, 1954). The deeper, permanent lakes support a rich submerged aquatic vegetation with species such as hornwort (*Ceratophyllum demersum*; often dominant), eel grass (*Vallisneria spiralis*), pondweed (*Potamogeton lucens* and *P. pectinatus*), water milfoil (*Myriophyllum* sp.), stonewort (*Chara* sp.), naiads (*Najas marina* and *N. armata*) and water fern (*Salvinia* sp.). Water-lilies (*Nymphoides peltata*, *N. indica*, *Nymphaea caerulea* and *Nuphar* sp.), water soldier (*Pistia stratiotes*) and duckweed (*Lemna gibba*) cover the surface of the smaller lakes and quieter backwaters.
The phytoplankton is dominated by diatoms, mainly of the genera *Synedra*, *Tabellaria*, *Melosira*, *Cyclotella* and *Fragillaria*; at least 77 diatom taxa (Hinton & Maulood, 1980) and 101 non-diatom taxa (Hinton & Maulood, 1982) are known from the brackish waters of southern Iraq. Pankow *et al*. (1979) found a total of 129 algae in the marshes near Qurna (72 Bacillariophyta, 28 Chlorophyta, 26 Cyanophyta, two Euglenophta and one Chrysophyta); large numbers of Desmidiaceae were also present. Al-Saboonchi *et al*. (1982) found a total of 63 genera of phytoplankton in five major groups (Euglenophyta, Chlorophyta, Cyanophyta, Pyrrhophyta, Chrysophyta) in the Qurna marshes. Nurul-Islam (1982) documented 59 algae from Haur Al Hammar (38 Chlorophyta, 19 Cyanophyta and two Rhodophyta).

Land tenure: No information.

Conservation measures taken: None. Twelve of the wetlands of lower Mesopotamia were listed as wetlands of international importance by Carp (1980), and all 19 of the wetlands described as Sites 13 to 31 have been identified as "Important Bird Areas" by BirdLife International (Evans, 1994). BirdLife International has also identified the Mesopotamian

marshes of Iraq as an "Endemic Bird Area", *i.e.* an important concentration of bird biodiversity where habitat destruction would cause disproportionately large numbers of species extinctions (ICBP, 1992). The marshes qualify as one of only 221 Endemic Bird Areas in the world, and one of only 11 which are wholly or largely non-marine wetlands, because they support almost the entire world population of two species, the Basrah Reed Warbler (*Acrocephalus griseldis*) and Iraq Babbler (*Turdoides altirostris*).

Conservation measures proposed: An IWRB/Basrah University Expedition in 1979 made a number of proposals concerning conservation of the wetlands of Mesopotamia (Carp & Scott, 1979). Specifically, it was recommended that some form of conservation area be created at Haur Al Hammar. No further action was taken, and since that time, vast areas of the wetlands have been degraded or destroyed as a result of massive flood control and drainage schemes (see below). More recently, a report entitled "Environmental and Ecological Study of the Marshlands of Mesopotamia" (Maltby, 1994) makes a number of recommendations for the conservation of remaining wetland habitats and restoration of degraded areas.

Land use: Within the marshes, the principal activities are buffalo rearing, fishing, hunting, rice cultivation and mat-weaving. The water buffalo provide milk, butter, yoghurt, meat and dung; for most of the year, they graze in the reed-beds, but in winter they remain tethered on platforms and are fed with cut reed shoots. Fishing occurs throughout the wetlands, and accounts for over 60% of the inland fish catch in Iraq. Until recently, spear-fishing was the most widespread technique, but this has largely been replaced by netting with various types of nets. Waterfowl hunting is also very important in the local economy, with enormous numbers of waterfowl being harvested on a commercial basis each year, and providing a livelihood for hundreds of people (Alnoori, 1976; Salim, 1962; Al-Robaae, in press). Reeds are used in the construction of floating islands for villages and, when woven, provide pliable coverings used in housing, fencing and packaging. Reeds are also harvested commercially to provide pulp for a paper factory near Basrah. The elaborate network of rivers and canals is used extensively for boat transportation, and until recently provided the only means of travel between the many settlements in the marshes. Rice is cultivated in shallow wetlands, and some vegetables, especially tomatoes, are grown on artificial islands within the marshes. Reclaimed areas of marsh and the adjacent irrigated plains are widely cultivated for millet, rice, wheat, barley, sugar cane and dates.

Possible changes in land use: See under disturbances and threats.

Disturbances and threats: Prior to the onset of massive hydrological engineering works in Lower Mesopotamia in about 1991, the principal threats to the wetlands were as follows:

River control

The increasing utilization of the waters of the Tigris and Euphrates for irrigation in Turkey, Syria and northern and central Iraq has caused a considerable loss of wetland habitat in lower Mesopotamia this century. Under normal circumstances, the waters of the Mesopotamian marshlands are replenished each year during the flood season from March to July. However, in recent decades there has been a marked reduction in the extent of the flooding because of the numerous dams and flood relief systems which have been constructed upstream on the Tigris and Euphrates Rivers. Dams on the Tigris and its tributaries in Iraq include the Samarra Dam and associated Lake Tharthar, Aski Mosul Dam north of Mosul together with a new extension built just south of the main dam, Darbandikhan Dam on the Diyala River, a sunken dam on the

Diyala River near Al Sedoor (Shahraban) and Dukan Dam on the Little Zab River. A new dam is currently under construction on the highly seasonal Al Authaim River near Jabal Hemrin. Because of these many dams, there has been only one noticeable flood of the River Tigris in the last ten years. This occurred in 1988, mainly because water was allowed to by-pass the various dams and barrages upstream.

The irrigation and water storage projects currently operating on the River Euphrates within Iraq include Lake Habbaniya, Lake Razazah and the new Haditha Dam. Further upstream, there are several dams on the Euphrates in Turkey and Syria. These dams have had a pronounced effect on the level of water in the Euphrates which has been very low in recent years. Furthermore, the Turkish Government has recently initiated a project to build several major dams in the headwaters of both the Euphrates and the Tigris. It has been estimated that by 1993, existing dams and barrages upstream on the Tigris and Euphrates had caused a flow reduction of 44% in the Tigris at Kut and 21% in the Euphrates at Hindiya. When all of the existing and proposed physical developments are fully operational, the flow will be reduced by 70% in the Tigris and 60% in the Euphrates (Maltby, 1994). Very little water will be left to flow into the marshes, and the vital annual recharge with floodwaters will cease. In the case of the Tigris, the main changes are due to works in Iraq; in the case of the Euphrates, to works in Turkey.

Drainage

Wetland drainage has been taking place on a large scale since the 1950s and, by the end of the 1980s, had already resulted in the conversion of vast areas of former wetland habitat into agricultural land. Reduced flooding from the Tigris and Euphrates Rivers had led to the drying out of marsh fringes and greatly facilitated the drainage of peripheral areas. Many areas had also been actively isolated from the main marshes with dykes and then drained to create agricultural land. As early as 1954, Wilfred Thesiger expressed concern at the future of the marshes and the welfare of their human inhabitants. In an article in the *Journal of the Royal Geographical Society*, he remarked that "in the next few years the marshes will be drained and the marshmen as I have known them will disappear" (Thesiger, 1954). In January 1979, Carp and Scott (1979) found much evidence of recent drainage works at some of the smaller haurs, and found that large parts of Haur Aluwez at the southeast corner of Haur Al Hammar had been dyked and drained to facilitate the exploitation of oil resources. Spencer (1982) likewise noted that the marshes were shrinking, and visited villages in the southeast portion of the Central Marshes which ten years previously had been surrounded by water but were now surrounded by dry arable land. By 1984, it was estimated that approximately 93,000 ha of marshes had been drained in the southeastern part of the Central Marshes and eastern part of the Haur Al Hammar marshes (Maltby, 1994).

War damage

In the last 15 years, the wetlands of lower Mesopotamia and neighbouring Iran have come under considerable pressure from regional conflicts. Much of the fighting during the prolonged Iran-Iraq War (1980-88) took place in and around the wetlands, and caused considerable damage to the marsh ecosystems. Haur Al Hawizeh probably suffered the most damage of all Iraqi wetlands. Several of the greatest battles of the war took place in these marshes, and involved extensive burning, heavy bombing and shelling, and widespread use of chemical weapons. Large areas of reed-beds were deliberately destroyed by Iraqi troops in Haur Al

Hawizeh and the Central Marshes during searches for deserters; heavily armoured boats were used to crash through reed-beds, special reed-cutting machines were used, and large areas were simply set on fire. Similar methods were used after the 1991 Gulf War to search for anti-government rebels. In other respects, however, the Gulf War seems to have had relatively little impact on the Mesopotamian marshes. Wetland vegetation in the Khuzestan lowlands of neighbouring southwestern Iran was damaged by acidic "black rain" from the burning oil well-fields in Kuwait, and it seems likely that similar damage occurred in the wetlands around Basrah, only a short distance to the west. The type and magnitude of the damage is not known, but is likely to have been temporary and reversible.

Increasing salinity

During the 1980s, increasing salinity emerged as another serious threat to the wetlands, particularly in the southeast portion of Haur Al Hammar. In 1980, the salinity in the Shatt Al Arab at Qarmat Ali was around 0.5 p.p.t. This has now changed drastically, with values of more than 2 p.p.t being recorded in recent years, and the water is clearly becoming more saline. One of the contributing factors is likely to have been the linkage of the southern part of Haur Al Hammar (at Qarmat Ali) to a new canal, the "Al Basrah Canal", which runs parallel to the Shatt Al Arab into the Gulf. This canal was constructed during the Iran/Iraq War to provide a safe shipping lane between Basrah and the Gulf. Another reason for the increase in salinity is the continuous flushing of salts from irrigated land via drainage canals into the wetlands. Much of the waste water is discharged into the mouth of the Al Basrah Canal and thus enters Haur Al Hammar.

Pollution

Levels of pollution in the marshes have increased substantially in recent years. Many reports indicate that the persistent insecticide Chloridrin is or was being obtained in Iran and sold to local residents of Haur Al Hawizeh as a quick method of poisoning and catching large quantities of fish for sale. The introduction of motor boats to the deeper areas of the marshes has led to noticeable and frequent oil pollution along the heavily used waterways between the main villages.

Hunting pressure

There has been a long history of heavy hunting pressure in the marshes. Wild Boar (*Sus scrofa*) are relentlessly persecuted by the Marsh Arabs because of the damage which they cause to crops, and for religious reasons. Maxwell refers to one village which claimed to have killed 140 Wild Boar in one year, while Thesiger (1954) shot as many as 47 in a single day and 488 in two years (Young, 1989). Although the Wild Boar is still the most abundant large mammal in the marshes, numbers have declined noticeably since the 1950s, presumably because of this high level of hunting. Thesiger (1964) noted that otters (*Lutra* spp.) were widely hunted for their skins, and mentioned one person who shot 40 otters in the space of two months. No otters were recorded during four waterfowl surveys between 1968 and 1979, and it seems likely that by that time the populations of both species were becoming much depleted by the hunters.

Waterfowl hunting occurs commonly at wetlands throughout Mesopotamia. Maxwell (1957) and Thesiger (1964) gave some indication of the massive scale of the hunting in the 1950s. Maxwell estimated that shot-guns alone were accounting for about a million birds a year in

Iraq. Both he and Thesiger shot many waterfowl and noted that a wide variety of species were killed by the Marsh Arabs for food including not only huge numbers of ducks and Coots (*Fulica atra*), but also Little Grebes (*Tachybaptus ruficollis*), Pygmy Cormorants (*Phalacrocorax pygmaeus*), African Darters (*Anhinga rufa*), Goliath Herons (*Ardea goliath*), Sacred Ibises (*Threskiornis aethiopicus*), Common Cranes (*Grus grus*), Purple Swamphens *(Porphyrio porphyrio*) and godwits (*Limosa* sp.). Pelicans, although regarded as inedible, were shot or speared for their gular pouches which were used in drum-making. Thesiger (1954) noted that the Ma'dan often searched for the nests of Greylag Geese (*Anser anser*) and took their eggs to hatch them out under chickens. Clap-netting was also very widespread in the marshes, and was clearly accounting for large numbers of birds. Thesiger (1964) considered that a heavy toll of waterfowl was being taken by the professional hunters, while Maxwell (1957) noted that as many as 30 geese or 120 ducks and shorebirds could be trapped in the clap-nets at a single pull. Several of the resident breeding species such as *Anhinga rufa*, *Ardea goliath* and *Threskiornis aethiopicus* were already becoming very scarce by the late 1970s, probably because of direct persecution and increased disturbance.

In the 1970s, the Government introduced new laws banning all hunting in Iraq in order to conserve wildlife, particularly terrestrial game which had been heavily persecuted in the past. However, it was clear that these laws were widely disregarded in the marshes, at least in the case of duck-netting which was observed at many localities in January 1979 (Carp & Scott, 1979). Considerable numbers of wildfowl are still taken every year, mainly by netting, *e.g.* it has been estimated that a minimum of 40,000 ducks and *Fulica atra* were offered for sale in the markets of Karbala and Najaf in 1990 and 1991. Hunting pressure has increased markedly since 1991 because of the UN trade embargo and the unusually high prices of meat that have resulted. There are reasons to believe that netting has now become an organized business, approved by the Government. Al-Robaae (in press) investigated waterfowl hunting in Central and Lower Iraq in the 1992/93 and 1993/94 seasons, and found a total of 13 species of Anatidae on sale at 11 main markets. He estimated that about 30,000 ducks and geese were being sold each season in the Basrah market alone. The commonest species on sale were *Anas platyrhynchos* (27%), *Aythya ferina* (24%), *Anas crecca* (10%), *A. strepera* (9%), *Aythya fuligula* (8%), *Anas acuta* (5%) and *A. clypeata* (5%).

Recent developments

In the summer of 1991, the Iraqi Government embarked upon a massive programme of hydrological control and wetland drainage in Lower Mesopotamia, in an area that is roughly delineated by the triangle of Amara, Nasiriya and Basrah. The motivation behind this programme has been the subject of much speculation in the international media, while the engineering works have been described by various authors in the semi-popular literature, *e.g.* North (1993) and Pearce (1993). Officially, the engineering schemes are designed to reduce salinization problems on millions of hectares of agricultural land, to reclaim new land for food production, and to increase the amount of water available for irrigation. The largest single project, the Main Outfall Drain, or "Third River" as it is now commonly known, was first suggested by British engineers in 1951 as a means of removing highly saline irrigation drainage water from 1.5 million hectares of agricultural land between the Tigris and Euphrates in central Iraq. Parts of the Third River were begun in the 1950s and more was completed in the 1960s, but the entire project was not completed until December 1992, when the final section, linking

the seaward end to that built at Delmaj northwest of Nasiriya, was constructed. This huge canal, some 560 km in length, runs southeast from Al Mahmudiya near Baghdad down the right bank of the Shatt Al Gharraf and crosses the Euphrates just east of Nasiriya, burrowing beneath the riverbed in three large pipes. It then skirts round the southwestern edge of Haur Al Hammar, crosses the southeast corner of the haur (between raised embankments), and finally joins up with the man-made Shatt Al Basrah canal which links the southeast corner of Haur Al Hammar to the head of the Gulf via Khawr Al Zubair. Extensive drainage has occurred along the southern and southeastern shores of Haur Al Hammar following the isolation of these areas from the rest of the haur by the embanked Third River.

Aerial photography from 1990 indicates that the Third River, at that time, was being engineered to pass under the Euphrates via an inverted siphon, thereby avoiding discharge of saline water into the Euphrates and hence into Haur Al Hammar. However, a dam of earth and stones has recently been constructed on the Euphrates 10 km southeast of Nasiriya, near the route of the canal. It appears from aerial photographs taken in March 1994 that this dam is diverting most of the river's flow into the Third River and hence directly into the Gulf, thereby completely depriving Haur Al Hammar and its marshes of one of their major sources of water. Further east, a continuous high embankment has been built along the southern side of the old bed of the Euphrates to prevent water seeping south from the Central Marshes into the Haur Al Hammar marshes, and a dam has been built across the bed of the Euphrates near its confluence with the Tigris to prevent back-flow from the north-south Al Amara Canal (see below) into the Euphrates and hence into the marshes.

In late 1992 or early 1993, a second earthen dam was constructed across a major branch of the Euphrates near Samawa. This dam diverts flow from the Euphrates via a 60-km-long canal into a new lake in a depression in the desert southeast of Samawa, and thus further reduces the amount of water reaching the Haur Al Hammar system. Satellite images and infra-red photography show a vast area of flooding in this depression in June 1993 and March 1994, although there was no indication of flooding here in July 1992.

Other intensive engineering activity has been occurring along the northern and eastern edges of the Central Marshes. About 40 rivers and streams which previously flowed into the Central Marshes have been diverted by the construction of a "moat" between two embankments across the northern end of the marshes. Completed in July 1992, this moat, which is about 2 km wide, extends for 35 km from the village of Al Jandallah southeastwards to Abu Ajil, near the Qalit Salih airfield, where it joins the Al Amara Canal, a similar moat which was dug for defensive purposes during the Iran/Iraq war. The Al Amara Canal runs southwards, just west of the Tigris, for 50 km to Qurna, where it discharges into the empty bed of the Euphrates near its confluence with the Tigris. The effect of this huge moat system is to capture almost the entire flow that once filled the Central Marshes. Locks and sluice gates have been placed at the head of the Tigris distributaries in the Amara area to regulate or halt the river's flow into the distributaries, and the banks of at least seven of the main distributaries have been raised to prevent their water from entering the marshes. In addition, dykes up to 30 km in length have been constructed into the marshes west of the Al Amara Canal, thereby dividing the marshes into compartments so that remaining water can be drained more quickly or left to evaporate. As a result of these engineering works, a large part of the Central Marshes has been drained, and it is now uncertain if any water from the Tigris is allowed to enter the marshes. A Landsat satellite image showed that more than one third of the Central Marshes had dried out by August 1992, while later

reports indicated that about two-thirds of the marshes were dry by mid-1993.
There is, as yet, no indication that any attempt is being made to drain the whole of the Haur Al Hawizeh marshes, presumably because this haur is partly fed by rivers rising in Iran. However, a Landsat image taken in August 1992 reveals that large areas of the northwestern, western and southern shores of the haur have been drained, using river control and dyke-building, apparently for security reasons.
A comparison of Landsat images taken in 1984/85 and 1991/92 revealed that the area of permanent lakes and marshes, seasonal marshes and temporary marshes in Lower Mesopotamia had been reduced by over 25% from 1.94 million hectares to 1.44 million hectares during this seven-year period (Maltby, 1994). Many commentators now argue that the bulk of the evidence suggests that the immediate aim of many of these engineering works has been to drain the marshes for military and political purposes, rather than for agricultural purposes. In any event, there can be no doubt that the greater part of the Central Marshes and much of the Haur Al Hammar marshes have now been drained, with disastrous ecological, social and human consequences for the region.
Scott and Evans (1993) concluded that drainage of the wetlands of Lower Mesopotamia on this scale would almost certainly result in the global extinction of *Lutra perspicillata maxwelli* and *Erythronesokia bunnii*, the extinction in the Middle East of *Anhinga rufa* and *Threskiornis aethiopicus*, and the extinction in Iraq of *Phalacrocorax pygmaeus* and *Ardea goliath*. Loss of these wetland habitats would also cause catastrophic declines in the world populations of *Turdoides altirostris* and *Acrocephalus griseldis* and in the regional population of *Pelecanus crispus*, possibly threatening them with extinction, and would cause perhaps as much as a 50% reduction in the world populations of *Gerbillus mesopotamiae*, *Tachybaptus ruficollis iraquensis* and *Marmaronetta angustirostris*. Drainage of these wetlands would also have an adverse effect on the populations of about 40 species of birds which occur in the marshes in internationally significant numbers, and would cause major declines in the regional populations of *Pelecanus onocrotalus* (30-60%), *Ardea purpurea* (>10%), *Ixobrychus minutus* (>10%), *Plegadis falcinellus* (>10%), *Aythya fuligula* (>20%), *Circus aeruginosus* (>10%), *Porphyrio porphyrio* (>50%) and *Fulica atra* (10-20%). Migratory populations of waterfowl would be affected over a very wide area from the West Siberian tundra to southern Africa, as one of the major staging and wintering areas in the West Siberian/Caspian/Nile flyway is lost. Clearly, as far as wildlife is concerned, the ongoing drainage of the wetlands of Lower Mesopotamia constitutes an ecological catastrophe of unprecedented proportions in Western Eurasia.
Hydrological and biophysical values: The wetlands of Lower Mesopotamia support a major fishery. Several marine fish species of great economic importance are dependent on the estuarine systems and marshes for spawning, *e.g.* the pomphret *Pampus argenteus* and the saboor *Hilsa hilsa*, while the penaeid shrimp *Metapenaeus affinis* undertakes seasonal migrations between the Gulf and nursery grounds in the marshes. This shrimp is of significant economic importance to artisanal fishermen along the coasts of the northern Gulf, particularly Kuwait (Maltby, 1994). The estimated annual catch of fish in the Mesopotamian marshes in the early 1960s was 30,000 tonnes, of which 70% were species of Cyprinidae. In 1990, FAO estimated that the total inland catch of fish in Iraq was 23,600 tonnes, with over 60% of this coming from the Mesopotamian marshes. The commonest fish in the catches, in order of importance, are "bunni" *Barbus sharpeyi*, "khatan" *B. xanthopterus*, "himri" *B. luteus*, "shaboot" *B. grypus* and the introduced common carp *Cyprinus carpio*. Commercial landings of

the shrimp *Metapenaeus affinis* at the two main fish markets at Basrah during September-November 1985 averaged 1,000 kg/day (Salman *et al.*, 1990).

Social and cultural values: Lower Mesopotamia is the legendary site of the Garden of Eden, and possesses a number of ruined cities of great antiquity such as Ur and Babylon. Civilization was well established in this region by the 4th millennium BC, and a sophisticated irrigation system developed at that time. The Mesopotamian marshes have provided a home for the Ma'dan or Marsh Arabs for at least five thousand years. Their reed houses are built on artificial islands made from layers of mats, reeds and mud, and, until recently, virtually all of their needs were obtained from the surrounding lakes and marshes. The Ma'dan are primarily buffalo herders, fishermen and mat-weavers, although they cultivate a little rice. Water buffalo remain the basis of family wealth, but in recent years fishing has played an increasing role in the local economy. Traditionally spear-fishermen, catching species of barbel and carp only for their own needs, the Ma'dan have taken to using nets to catch fish for export to Basrah and Baghdad. Mat-weaving has also become an important source of income, as demand elsewhere has grown for these pliable coverings used in housing, fencing and packaging. In a region where travel is possible only by boat, the vast stretches of water and reeds have served to isolate the Ma'dan from the outside world; for this region, their culture has remained almost unchanged to the present time. The lifestyle of the Ma'dan has been described in some detail by Thesiger (1954 & 1964), Maxwell (1957), Salim (1962), Young and Wheeler (1976), Spencer (1982) and Young (1989).

Noteworthy fauna: The wetlands of Mesopotamia are sufficiently large and have been isolated from other comparable wetland areas for a sufficient length of time to allow for the evolution of several forms of animals which are unique to these wetlands. These include two species of mammals (*Erythronesokia bunnii* and *Gerbillus mesopotamiae*), one subspecies of mammal (*Lutra perspicillata maxwelli*), two species of birds (*Turdoides altirostris* and *Acrocephalus griseldis*), two subspecies of birds (*Tachybaptus ruficollis iraquensis* and *Anhinga rufa chantrei*), and several species and subspecies of fish, notably *Barbus sharpeyi*, *Leuciscus cephalus orientalis*, *Caecocypris basimi* and *Typhlogarra widdowsoni*.

Rather few species of mammals occur commonly in the wetlands. Thesiger (1964) and Maxwell (1957) make numerous references to the abundance of Wild Boar (*Sus scrofa*) throughout the marshlands, and found them to be particularly common at Haur Al Hawizeh. However, the boar have been heavily hunted by the Marsh Arabs, and although the species is still the most abundant large mammal in the marshes, numbers have declined noticeably in recent years. Two species of otters have been recorded in the marshes, the Common Otter *Lutra lutra* and the Smooth-coated Otter *Lutra perspicillata*. Both Maxwell (1957) and Thesiger (1964) saw otters on a number of occasions, and describe them as common around Haur Az Zikri in the Central Marshes and at Haur Al Hawizeh. However, otters (presumably of both species) were heavily persecuted for their skins in the 1950s (Thesiger, 1964), and are now extremely rare in the marshes, if they survive at all. The form of *L. perspicillata* occurring in the Mesopotamian marshes has been described as a distinct subspecies *maxwelli*. It was discovered at Haur Al Hawizeh in 1956 by Maxwell (1957), who obtained an otter skin and a live otter cub. There have been only two further records of *L. perspicillata* in Iraq, both in the late 1950s from the region of Al Azair in the Central Marshes, and it is possible that the endemic subspecies *maxwelli* is now extinct. Lions (*Panthera leo*) survived in riverine thickets of the marshlands into the present century, but were finally exterminated when the Marsh Arabs acquired modern

rifles during the First World War. The Leopard (*Panthera pardus*) is likewise extinct in lower Mesopotamia; there is only one record from the marshlands - an individual shot in 1945 just above Kut by the River Tigris.

Large mammals which are still regularly encountered in the marshes include the Asiatic Jackal (*Canis aureus*), Red Fox (*Vulpes vulpes*) and Small Indian Mongoose (*Herpestes auropunctatus*). Various other mammals, notably Grey Wolf (*Canis lupus*), Honey Badger (*Mellivora capensis*), Striped Hyaena (*Hyaena hyaena*), Jungle Cat (*Felis chaus*), Goitred Gazelle (*Gazella subgutturosa*) and Indian Crested Porcupine (*Hystrix indica*), have been recorded in and around the marshes in the past, but all had become rare by the 1980s, and it is thought likely that most are now extinct in the area.

Small mammals recorded in and around the marshes include a recently described species of bandicoot rat *Erythronesokia bunnii*, an endemic species of gerbil *Gerbillus mesopotamicus*, a hedgehog, three species of shrews, eight to 11 species of insectivorous bats, a jerboa, four other species of rats and mice, and three other species of gerbils and jirds. The commonest rodent in the area is the Short-tailed Bandicoot *Nesokia indica*, a species which is particularly associated with the banks of wetlands. The bandicoot rat *E. bunnii* was discovered as recently as the late 1970s in the Central Marshes at Qurna (Khajuria, 1980). Little is known about the species, but it would appear to be confined entirely to the marshlands of southern Iraq. Harrison's Gerbil *G. mesopotamiae* is known only from the vicinity of wetlands in lower Mesopotamia and adjacent Khuzestan in southwestern Iran. Formerly thought to be a subspecies of *G. dasyurus*, this highly colonial gerbil exhibits a marked degree of water-dependence for a gerbil, and is not able to survive without it. The gerbil appears to be not uncommon in the uncultivated, sparsely-vegetated fringe of the marshes and along the banks of the Euphrates. Notable among the bats is the rare and declining Long-fingered Bat (*Myotis capaccinii*), recorded at Kish on the edge of the wetlands. This species is considered to be globally threatened (Groombridge, 1993).

Domestic water buffalo are abundant throughout the marshes and are of considerable importance in the local economy. According to Maxwell (1957), there is evidence to suggest that these animals were first introduced into Mesopotamia in about 3500 BC. Hatt (1959), however, presents archaeological evidence which suggests that the species was formerly wild in the marshes, before domestication.

Of the 278 species of birds which have been recorded in lower Mesopotamia, 134 are species which are to some extent dependent on the wetland habitats and occur in Mesopotamia in significant numbers. Two of these species, the Iraq Babbler *Turdoides altirostris* and Basrah Reed Warbler *Acrocephalus griseldis*, are known to breed only in this area. *Turdoides altirostris* is confined to the lower Tigris and Euphrates valleys of central and southern Iraq and extreme southwestern Iran (Khuzestan Province). Its distribution is centred on the reed-beds of the Mesopotamian marshes, although it is also one of the commonest birds of rural habitats along rivers and irrigation canals throughout the lowlands of central Iraq (Al-Dabbagh & Bunni, 1981). *Acrocephalus griseldis* is a common breeding summer visitor to the reed-beds of Mesopotamia between Baghdad and the Shatt Al-Arab in the region of Basrah. As far as is known, the breeding range is confined to southern Iraq, along the lower Euphrates and Tigris rivers from the Baghdad area to Fao.

The populations of two species of waterfowl, almost confined to the wetlands of Lower Mesopotamia, have been described as distinct subspecies: the Little Grebe *Tachybaptus ruficollis iraquensis* and African Darter *Anhinga rufa chantrei*. *T. ruficollis iraquensis* is known

to occur only in the wetlands of Mesopotamia and in neighbouring southwestern Iran. It is a common and widespread breeding bird in the wetlands of southern Iraq, found even on small temporary pools beside main highways. *A. rufa chantrei*, however, is now confined to the marshes of Lower Mesopotamia and is probably close to extinction, if not already extinct. The species formerly bred at Amik Golu (Lake Antioch) in Turkey, but became extinct there following drainage in the 1950s. Ticehurst *et al.* (1921-22) described the bird as common and resident in the huge marshes round Qurna and east of Amara and Ezra's Tomb (Al Azair). La Personne found large numbers nesting in the Rotha Marshes (25 km from Qurna) and also a few nesting in the Medina Marshes at Bani Mansur (30 km north of Medina) in July 1921 (Ticehurst *et al.*, 1926). Maxwell (1957) and Thesiger (1964) also found it commonly in the Central Marshes and around Haur Al Hawizeh. Moore and Boswell (1956-57), however, encountered the bird only once (a single bird near Amara in November 1945), and concluded that the species was scarce and local. Large colonies were reported in 1973 near Qurna (P.V.G. Kainady, *in litt.*), but none was reported in any of the four IWRB waterfowl surveys between 1968 and 1979, and there do not appear to have been any records in Iraq since the early 1980s.

Eleven species of birds listed in the 1994 IUCN Red List of Threatened Animals (Groombridge, 1993) have occurred in the marshes of lower Mesopotamia. The Dalmatian Pelican *Pelecanus crispus* is a common winter visitor, and probably also a resident breeding species. Pelicans are known to have bred in the marshes, but it is not known which of the two species is involved, although *Pelecanus crispus* is the more likely. Thesiger (1954) observed unfledged young at Umm Al Binni in the Central Marshes, but did not attempt to identify the species. The four mid-winter waterfowl surveys between 1968 and 1979 revealed that the wetlands of Mesopotamia are an extremely important wintering area for *Pelecanus crispus*. Some 247 were recorded in January 1979, and it was concluded that the total number in Mesopotamia at that time could be as high as 1,000.

The Pygmy Cormorant *Phalacrocorax pygmaeus* was formerly a common resident, breeding in some of the marshes and moving out locally to the rivers and other marshes in winter (Ticehurst *et al.*, 1921-22). In July 1922, La Personne found the species breeding in large numbers in dense, high reed-beds at Bani Mansur in the Medina Marshes, 32 km north of Medina, and in vast numbers near Anzha in the Rotha Marshes, 25 km from Qurna (Cheesman 1922; Ticehurst *et al.*, 1926). No-one has found a colony since, and the breeding status of this bird remains obscure. The waterfowl surveys between 1968 and 1979 confirmed that the species remained fairly common in winter, with up to 100 being recorded at one locality, and it seemed likely that the total number in the marshes at that time exceeded 500.

The Lesser White-fronted Goose *Anser erythropus* was formerly a regular winter visitor, although always less common than *A. albifrons*. According to Savage (1968), the species was still found in quite large numbers in the Haur Al Shuwaija area in the 1960s. However, the species was recorded only once during the IWRB surveys: a flock of 70 at Haur Al Shuwaija in December 1972. Savage (1968) reported that several hundred Red-breasted Geese *Branta ruficollis* regularly wintered in the Haur Al Shuwaija area, but none was recorded in Mesopotamia during the four IWRB surveys between 1968 and 1979, or since then.

The Marbled Teal *Marmaronetta angustirostris* is known to breed widely in Mesopotamia (Green, 1993). Ticehurst *et al.* (1921-22) reported it to be a fairly common breeder in southern Iraq; Moore and Boswell (1956-57) found it breeding along dykes and irrigation canals in the Kut area, in the Hai area and at Haur Al Shuwaija; and Thesiger (1964) found it in the Central

Marshes during the summer months. The species remained a common summer visitor to wetlands throughout Mesopotamia during the 1970s and 1980s. However, there have been very few reports of *M. angustirostris* in Mesopotamia in winter, and none was reported during the four winter surveys between 1968 and 1979. Thus it appears that the species is almost entirely a breeding summer visitor to Mesopotamia, as concluded by Georg and Savage (1970b). The total breeding population in Iraq is thought to be at least 4,000-6,000 pairs, which represents some 40-60% of the world population of this threatened species. The White-headed Duck *Oxyura leucocephala* appears to be only a very scarce winter visitor. One was shot near Kut in 1920, and one was seen near the west end of Haur Al Hammar in December 1972 (Anstey, 1989).

The Pallas's Fish-Eagle *Haliaeetus leucoryphus* was formerly a scarce winter visitor to the wetlands of Mesopotamia, but there do not appear to have been any records since 1944 (Moore & Boswell, 1956-57). The status of the White-tailed Eagle *Haliaeetus albicilla* is uncertain. Most authors list it as a winter visitor in small numbers. Moore and Boswell (1956-57) found it to be a regular winter visitor to Haur Al Shuwaija and also observed it near Qurna and along the Shatt Al Arab. Five were recorded during the mid-winter waterfowl survey in 1968 and five during the survey in 1972, but none in the later surveys of 1975 and 1979. However, Maxwell (1957) stated that the species nested in the reed-beds. Thesiger (1964) also referred to eagles nesting in the reed-beds, but did not indicate which species was involved. The Imperial Eagle *Aquila heliaca* is a fairly common winter visitor to the Mesopotamian plains. Counts of 11, 24, 7 and 34 were obtained during the mid-winter waterfowl censuses of 1968, 1972, 1975 and 1979 respectively, and it seemed likely that the total wintering population of this species in Mesopotamia at that time exceeded 100 individuals.

The Sociable Plover *Vanellus gregarius* was formerly believed to be a locally common passage migrant and winter visitor in Mesopotamia, and was known from a number of localities (Ticehurst *et al.*, 1921-22). Kasparek (1992) has recently reviewed the old records and has shown that the evidence for over-wintering in Iraq was inconclusive. He concluded that the species was only a passage migrant in Iraq, as it is elsewhere in the Middle East. *V. gregarius* had evidently already become rare in Mesopotamia by the 1940s, as Moore and Boswell (1956-57) encountered it only once (a single bird near Kut in November 1945). Johnson (1958) observed a flock of 15 in a marshy field near Ctesiphon by the Tigris in November 1957, but there do not appear to have been any records since then. The Slender-billed Curlew *Numenius tenuirostris* was first recorded wintering in Iraq in the early part of this century. According to Ticehurst *et al.* (1921-22), "Buxton saw many on 16 December 1917 in a temporary winter lake in a hollow in the bare desert ten miles north of Amara and secured a specimen". However, 62 years elapsed before the next record, also of a small flock (six birds) on the southern shore of Haur Al Hammar on 27 January 1979 (Scott & Carp, 1982). This was followed very rapidly by a record of a single bird in the Haur Al Hammar marshes near Nasiriya in the autumn of 1979 (T. Grochowski, in Gretton, 1991). In view of the vast extent of the habitat suitable for *N. tenuirostris* in Mesopotamia and the very poor coverage of these wetlands by ornithologists, there is a distinct possibility that a significant wintering population of this endangered species continues to survive there.

The lakes and marshes of lower Mesopotamia are one of the most important wintering areas for migratory waterfowl in western Eurasia. Georg and Savage (1970a) believed that the marshes of Haur Al Hammar and Haur Al Hawizeh together "probably provide habitat for two-thirds of

the wintering wildfowl of the Middle East". Waterfowl recorded during four IWRB mid-winter waterfowl surveys in the marshes of lower Mesopotamia are summarized in Table 2. The first survey, in January 1968, visited Aziziya, Kut, Haur Al Shuwaija, Haur Umm Roij, Shaikh Saad, Ali Gharbi, Haur Auriya, Al Kumait, Haur Haushiya, Amara, Haur Sanaf, Maymuna, Chahala, Azair, Qurna and Basrah, and recorded over 59,000 waterfowl of 55 species (Georg & Vielliard, 1968, 1970). The second survey, in December 1972, visited Kut, Jassan, Amara, Maymuna, Qurna, Basrah, Chubaisah, Nasiriya, Shatra and Dawaya, and observed a total of 152,000 waterfowl of 58 species (Koning & Dijksen, 1973). The third survey, in January/February 1975, visited Kut, Amara, Suweid Marshes, Basrah, the Shatt Al Arab, Haur Aluwez, Shafi wetland and Haur Mrebsher, and recorded almost 91,000 waterfowl of 45 species (Carp, 1975a, 1975b). The most recent mission, in January 1979, was much the most extensive, visiting 46 sites in the Mesopotamian marshlands including various sections of Haur Al Hammar, Haur As Sa'adiyah, Haur Uwainah, Haur Al Shuwaija and a number of small wetlands around Basrah. Over 324,000 waterfowl of 79 species were recorded, including 3,300 pelicans, 1,850 flamingos, 2,340 geese, 155,000 ducks, 128,000 coots, 16,600 shorebirds and 13,400 gulls and terns (Carp & Scott, 1979; Scott & Carp, 1982). These counts must represent only a small proportion of the total number of birds present, as the sheer vastness of the wetlands, problems of access and shortage of time prevented the survey teams from visiting more than a tiny fraction of the wetlands. Thus, Carp and Scott (1979) noted that they had been able to visit no more than 10% of the marshes, and stressed that the true number of birds present must have exceeded their counts by many fold. They concluded that the actual number of waterfowl in Mesopotamia in January 1979 probably amounted to several million.

No accurate estimate will ever be available for the number of waterfowl which once wintered in the Mesopotamian marshlands. It seems likely, however, that the waterfowl populations must have numbered in the many millions. The earliest accounts refer to "teeming flocks" and "countless numbers", but already by the 1950s, Thesiger (1964) was expressing concern at the way the numbers of birds were decreasing. He noticed a significant decline in numbers between 1951 and 1958, and stated that "throughout the marshes, ducks and geese were becoming scarcer year by year". Although large numbers of wintering waterfowl were still present in the late 1970s, the density of birds was not particularly impressive, and it was clear that the numbers of birds were well below the levels implied by Maxwell (1957) and Thesiger (1964).

In addition to providing regular wintering habitat for waterfowl, the wetlands of Mesopotamia serve as a vitally important refuge for waterfowl during periods of exceptionally severe weather further north. In hard winters, when many wetlands in eastern Turkey and the Caspian Region freeze over, large numbers of birds may be forced to move further south and seek refuge in the wetlands of Iraq and southern Iran. Evidence of such hard weather movements was apparent in January 1979. Totals of 40,900 *Aythya fuligula* and 1,004 *Mergellus albellus* in Mesopotamia in January 1979 were far in excess of the previous maxima of 6,800 and 68, respectively, suggesting an exceptional influx from the north. Similarly the presence of three rare visitors to Iraq, *Cygnus olor, C. columbianus* and *Aythya marila,* in January 1979 suggested that an unusual invasion of birds which normally spend the winter much further to the north had occurred (Scott & Carp, 1982).

The wetlands of Mesopotamia are also of great importance for wintering birds of prey. Over a thousand raptors of 15 species were observed during the waterfowl survey in 1979. The counts included 12 *Pandion haliaetus,* 429 *Milvus migrans,* 5 *Haliaeetus albicilla,* 3 *Aegypius*

monachus, 286 *Circus aeruginosus*, 18 *C. macrourus*, 141 *Buteo rufinus*, 24 *Aquila clanga*, 12 *A. nipalensis*, 34 *A. heliaca*, 126 *Falco tinnunculus*, 7 *F. columbarius* and 6 *F. peregrinus*. Other species of birds which utilize the Mesopotamian marshlands as wintering habitat include a variety of passerines such as *Motacilla alba*, *Anthus spinoletta*, *Lanius isabellinus*, *Luscinia svecica*, *Saxicola torquata*, *Emberiza schoeniclus*, *Passer hispaniolensis*, *Sturnus vulgaris* and *Corvus frugilegus*.

The wetlands are also an extremely important staging area for a number of species of waterfowl on their way between breeding grounds in Western Siberia and Central Asia and winter quarters in eastern and southern Africa. Such passage migrants include a variety of herons and egrets (*e.g. Egretta garzetta*, *Ardeola ralloides* and *Ixobrychus minutus*), *Anas querquedula*, and a number of shorebirds (*e.g. Charadrius hiaticula*, *Numenius phaeopus*, various *Tringa* species, *Calidris ferruginea* and *Philomachus pugnax*). No systematic attempt has ever been made to document the migration of waterfowl through the Mesopotamian marshes, and it is impossible to provide an estimate of the total number of birds which might be involved.

The Mesopotamian marshes are of considerable importance for breeding waterfowl, including a substantial proportion of the world population of the rare Marbled Teal *Marmaronetta angustirostris* and the entire world population of the Middle Eastern subspecies of the African Darter *Anhinga rufa chantrei* (see above). The marshes also support isolated populations of two other primarily Afrotropical species: the Goliath Heron *Ardea goliath* and Sacred Ibis *Threskiornis aethiopicus*. According to Ticehurst *et al.* (1921-22), *A. goliath* was a not uncommon resident in the extensive swamps of Mesopotamia in the early part of the century. It was reported from the marshes between Basrah and Qurna, from the marshes near Amara and Kut, and round the Euphrates Barrage, and breeding was proved. Allouse (1953) described it as common in the southern marshes; Thesiger (1964) encountered it in the Central Marshes in the early 1950s, and Maxwell (1957) observed it in the Haur Al Hawizeh marshes. However, Moore and Boswell (1956-57) encountered the species only once - two birds at Haur Al Shuwaija in August 1943 - and none was recorded during the four waterfowl surveys between 1968 and 1979. P.V. Georg Kainady (pers. comm.) observed the bird on several occasions in the marshes near Basrah in the late 1970s, but noted that it was becoming very scarce. The last record appears to be of a bird at Haur Az Zikri in the Central Marshes in 1980.

The isolated Mesopotamian population of *Threskiornis aethiopicus* seems to have followed a similar fate to that of *Ardea goliath*. Cumming (1918) found the species to be plentiful at Fao in winter, and according to Ticehurst *et al.* (1921-22), "White Ibises certainly occur and not very uncommonly in the district from Amara to Fao". La Personne found a breeding colony of about 20 pairs together with other breeding waterfowl at Rotha marshes near Qurna in 1921 (Cheesman, 1922), and Ticehurst *et al.* (1926) noted that the species was also breeding at Abid near Qurna at about the same time. Moore and Boswell (1956-57) never encountered it, but Maxwell (1957) observed it on many occasions in the Central Marshes and in the Haur Al Hawizeh marshes in spring 1956, and implied that it was common. However, he noted that the ibis was a favourite quarry species of the local hunters and was very wary. The species appears to have become quite scarce by the late 1960s. Only one was observed during the 1968 waterfowl survey, and none was recorded during the surveys of 1972 and 1975. However, flocks of 36 and 4 were observed in January 1979, at Haur Al Rayan and Qalit Salih respectively. The species appears to have become very scarce in Iraq in recent years, and has not been reported since the early 1980s.

Other species which are known to have bred in the Mesopotamian marshes include *Tachybaptus ruficollis*, *Phalacrocorax pygmaeus*, *Ardea purpurea*, *Ardeola ralloides*, *Nycticorax nycticorax*, *Ixobrychus minutus*, *Ciconia ciconia*, *Platalea leucorodia*, *Anser anser*, *Anas querquedula*, *Porphyrio porphyrio*, *Gallinula chloropus*, *Fulica atra*, *Himantopus himantopus*, *Recurvirostra avosetta*, *Glareola pratincola*, *Charadrius dubius*, *C. alexandrinus*, *Vanellus indicus*, *V. leucurus*, *Larus genei*, *Chlidonias hybridus*, *C. leucopterus*, *Gelochelidon nilotica*, *Sterna caspia*, *S. hirundo* and *S. albifrons*. There are about eight other species, including conspicuous birds such as *Podiceps cristatus*, *Egretta garzetta* and *Plegadis falcinellus*, which might be expected to breed in the marshes, but which have never been proven to do so. On the other hand, old reports of breeding by *Glareola nordmanni* now seem likely to have been erroneous. The present status of the breeding birds of the Mesopotamian marshes is unknown as there has been almost no new information since the 1950s.

In a recent analysis, Scott and Evans (1993) concluded that in the 1970s, and perhaps even more recently, the marshlands of lower Mesopotamia were of international significance for at least 68 species of waterfowl. The apparent importance of the Mesopotamian marshlands for each of these species, up until the late 1970s, is summarized in Table 3.

Little information is available on the amphibians and reptiles of the Mesopotamian marshes. Maxwell (1957) commented on the extreme abundance of frogs, and concluded that there were several species in the marshes. A toad (*Bufo viridis*), a tree frog (*Hyla arborea*) and two frogs (*Rana ridibunda* and *R. esculenta*) are listed for Iraq by Mahdi and Georg (1969). Common reptiles in the marshes include the Caspian Terrapin (*Clemmys caspia*), a soft-shell turtle (*Trionyx euphraticus*), geckos of the genus *Hemidactylus*, two species of skinks (*Mabuya aurata* and *M. vittata*), and a variety of snakes including the Spotted Sand Boa (*Eryx jaculus*), Tessellated Water Snake (*Natrix tessellata*) and Gray's Desert Racer (*Coluber ventromaculatus*). The Desert Monitor (*Varanus griseus*) was formerly common in desert areas adjacent to the marshes, but this species has been heavily persecuted and is now rare.

The wetlands of Lower Mesopotamia provide important habitat for a wide range of fish species, many of which are of economic importance, and several of which are endemic. The presence of the Tigris-Euphrates confluence has resulted in a mingling of fauna derived from western or Syrian sources (via the Euphrates) and eastern or Zagrosian sources (via the Tigris and its tributaries). This unusually rich fish fauna has recently been summarized by Banister (1994). Cyprinids are the dominant element in the marshes, and include species such as *Acanthobrama marmid*, *Barbus canis*, *B. esocinus*, *B. grypus*, *B. longiceps*, *B. luteus*, *B. subquincunciatus*, *B. xanthopterus*, *Capoeta* spp., *Chondrostoma nasus*, *C. regium*, *Cyprinion macrostomum*, four species of *Garra*, *Leuciscus cephalus* (an endemic subspecies *orientalis*) and *L. lepidus*. Particularly noteworthy are *Barbus sharpeyi*, an endemic species which, unlike others of the genus, spawns only in the marshes in areas of shallow open water less than 75 cm deep, and two blind cave-dwelling species, *Caecocypris basimi* and *Typhlogarra widdowsoni*, known only from a sink hole close to the Sheik Hadid shrine near Haditha. Other indigenous freshwater fishes include *Glyptothorax cous* (Sisoridae), *Mystus pelusius* (Bagridae), *Silurus glanis* (Siluridae) and *Mastacembelus mastacembelus* (Mastacembelidae).

Many marine fish regularly enter the rivers and marshes of Lower Mesopotamia to feed, and form an important part of the commercial fish catches. These include *Nematalosa nasus* (Clupeidae), *Thryssa setirostris*, *T. purava* and *T. hamiltoni* (Engraulidae), *Arius thalassinus* (Ariidae), *Plotosus lineatus* (Plotosidae), *Rhynchorhamphus* sp. (Hemirhamphidae),

Strongylura strongylura (Belondidae), *Acanthopagrus berda* and *A. latus* (Spasidae), *Aryiosomus amoyensis* and *Otolithes ruber* (Sciaenidae), *Scatophagus argus*, *Liza* spp. and *Mugil cephalus* (Scatophagidae), *Eleutheronema tetradactylum* (Polynemidae), *Acentrogbius dayi*, *Scartelaos tenuis*, *Periophthalmus waltoni* and *P. weberi* (Gobiidae), and *Cynoglossus arel* and *C. lingua* (Cynoglossidae). The Bull Shark *Carcharinus leucas* (Carcharinidae) commonly enters fresh water, and has been recorded as far upstream as Baghdad.

About 12 species of fish have been deliberately introduced into the wetlands of Mesopotamia, including five species of Cyprinidae (*Acanthalburnus microlepis*, *Carassius auratus*, *Ctenopharyngodon idella*, *Cyprinus carpio* and *Hypophthalmichthys molitrix*), *Ictalurus nebulosus* (Ictaluridae), *Esox lucius* (Esocidae), *Gambusia affinis/holbrooki* (Poecilidae), *Micropterus salmoides* (Centrarchidae), *Stizostedion lucioperca* (Percidae) and *Oreochromis niloticus* (Cichlidae). *Heteropneustes fossilis* (Heteropneustidae) seems to have been a natural colonist in recent times; it appeared in the marshes for the first time in 1960 (Khalaf, 1962), and subsequently spread throughout the system.

The wetlands of Lower Mesopotamia are an important nursery for the commercially important penaeid shrimp *Metapenaeus affinis* which spawns in the Gulf and grows to maturity in the wetlands (Salman *et al.*, 1990). Immigration to the marshes starts from May/June and emigration finishes around January/February, with spawning occurring at sea immediately after emigration. The discharge of the Shatt Al Arab may be an important factor regulating recruitment.

The benthic fauna of the marshes is dominated by chironomid larvae, dragonfly larvae and worms. *Stylaria* and *Tubifex* (Oligochaeta) occur in moderate quantities, and univalve and bivalve molluscs are also present (Georg & Savage, 1970a). Al-Dabbagh and Daod (1985) found the following gastropod molluscs in the lower parts of Haur Al Hammar and Haur Al Zikri: *Theodoxus jordani*, *Melanopsis nodosa*, *Melanoides tuberculata*, *Viviparus bengalensis*, *Bulinus truncatus* and several species of *Lymnea*; bivalves included *Corbicula fluminea*, *C. fluminales* and *Unio* sp. Ali (1976) collected eleven species of water beetles of the family Haliplidae in the Shatt Al Arab and marshes of southern Iraq. These included *Brychinus elevatus*, nine species of *Haliplus* and an hitherto undescribed species of *Peltodytes*. This author (Ali, 1978a & 1978b) also lists 55 species of dytiscid water beetle (Dytiscidae) and 15 species of gyrinid beetle (Gyrinidae), mostly collected from the Shatt Al Arab and lakes and marshes of southern Iraq. A globally threatened species of libellulid dragonfly, *Brachythemis fuscopalliata*, is known only from Iraq, Israel and Turkey. It has been collected in the marshes of Mesopotamia, but no recent information is available on its status there (Groombridge, 1993).

The zooplankton in the marshes is dominated by *Cladocera* and *Rotatoria*, with *Cyclops* forming a smaller proportion (Georg & Savage, 1970a). Al-Saboonchi *et al*. (1986) found 21 genera of zooplankton belonging to three orders (Ploima, Cladocera and Copepoda) in the Qurna marshes. Maximum growth of zooplankton was found to occur in late spring.

Noteworthy flora: No information.

Scientific research and facilities: Various limnological investigations and studies of aquatic invertebrates have been carried out by researchers from the Iraq Natural History Museum in Baghdad and the Museum of Natural History at the University of Basrah since the 1960s. Researchers from the University of Basrah (College of Science, College of Agriculture and Marine Research Centre) have carried out work on various aspects of the ecology of the marshes. There appears to have been little research on the fishes of Mesopotamia, other than

basic inventories of species (*e.g.* Khalaf, 1962; Mahdi, 1962; Banister, 1980). The mammals, however, have received a considerable amount of attention, both for local biologists from Basrah and Baghdad, and from visiting international expeditions. Thesiger (1954 & 1964) and Maxwell (1957) made numerous references to the mammals and birds which they encountered in the marshes, but gave few specific details. Ticehurst *et al.* (1921-22) summarized the extensive ornithological investigations and collections made by a number of British military personnel stationed in Mesopotamia during the First World War. Moore and Boswell (1956-57) made extensive ornithological investigations in southern Iraq between 1941 and 1945, while Chapman and McGeoch (1956) made some field observations in southern Iraq between August 1952 and August 1954. Savage (1968) counted wildfowl at several wetlands in Mesopotamia in 1966 and 1967, and reviewed the status of Anatidae and *Fulica atra* on the basis of the information available at that time. Alnoori (1976) also provided some general information on the waterfowl of Mesopotamia. The International Waterfowl and Wetlands Research Bureau (IWRB) sponsored four mid-winter waterfowl surveys in Iraq in 1967/68, 1972, 1975 and 1979, respectively. These surveys, which were carried out jointly with the Iraq Natural History Museum in Baghdad and the Museum of Natural History in Basrah, visited many of the principal wetlands in lower Mesopotamia, and provided the best information hitherto available on the wintering avifauna of the southern marshlands (Georg & Vielliard, 1968, 1970; Koning & Dijksen, 1973; Carp, 1975a, 1975b; Carp & Scott 1979; Scott & Carp, 1982). Some waterfowl counts were made at a number of localities around Haur Al Hammar by P. Ctyroky in 1979 (Ctyroky, 1987), but no data on waterfowl numbers have become available since 1980.
In 1975, the Museum of Natural History in Basrah established a small field laboratory near the bridge at Shafi, approximately 30 km from Basrah on the road to Amara, and has subsequently used this as a base for research in the wetlands (*e.g.* Kainady & Al-Joborae, 1976).

Management authority and jurisdiction: No information.

References: Akbar (198?); Al-Dabbagh & Bunni (1981); Al-Dabbagh & Daod (1985); Ali (1976, 1978a, 1978b); Allouse (1953); Alnoori (1976); Al-Robaae (in press); Al-Saboonchi *et al.* (1982, 1986); Anstey (1989); Banister (1980, 1994); Carp (1975a, 1975b, 1980); Carp & Scott (1979); Chapman & McGeoch (1956); Cheesman (1922); Ctyroky (1987); Cumming (1918); Evans (1994); Georg & Savage (1970a, 1970b); Georg & Vielliard (1968, 1970); Green (1993); Gretton (1991); Groombridge (1993); Hatt (1959); Hinton & Maulood (1980, 1982); ICBP (1992); Johnson (1958); Kainady & Al-Joborae (1976); Kasparek (1992); Khajuria (1980); Khalaf (1962); Koning & Dijksen (1973); Mahdi (1962); Mahdi & Georg (1969); Maltby (1994); Maxwell (1957); Moore & Boswell (1956-57); North (1993); Nurul-Islam (1982); Pankow *et al.* (1979); Pearce (1993); Salim (1962); Salman *et al.* (1990); Savage (1968); Scott & Carp (1982); Scott & Evans (1993); Spencer (1982); Thesiger (1954, 1964); Ticehurst *et al.* (1921-22, 1926); Young (1989); Young & Wheeler (1976).

Reasons for inclusion: 1a, 1c, 2a, 2b, 2c, 2d, 3a & 3c. The vast permanent and seasonal, fresh to brackish wetlands of Lower Mesopotamia formerly comprised at least 1.5 million hectares of almost contiguous wetland habitat, and were thus the largest area of these wetland types not only in the Middle East but also in the whole of Western Eurasia. The wetlands of lower Mesopotamia play a vital role in the maintenance of biodiversity in the Middle East, primarily because of their large size, the richness of their aquatic vegetation and their isolation from other comparable systems. They are home to two endemic species and an endemic subspecies of mammal, two endemic species and two endemic subspecies of bird, and several endemic

species and subspecies of fish. They support substantial numbers of at least seven species of mammals and birds currently listed in the IUCN Red List of Threatened Animals, and are of international importance as a staging and wintering area for at least 68 species of waterfowl and nine species of birds of prey. They are also of great cultural significance, having provided a home for the Ma'dan or Marsh Arabs for at least five thousand years.
Source: See references.

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Haur Lafta (13)

Location: 31°21'N, 45°31'E; to the north of the Euphrates, about 20 km east of Samawa, Al Muthanna Governorate.
Area: c.20,000 ha.
Altitude: c.12 m.
Physical and ecological features: An isolated haur on a vast saline plain to the north of the Euphrates River, about 20 km east of Samawa. The haur is fed by floodwaters from the Euphrates, about 5 km away. There are sand dunes to the north and east.
Land tenure: No information.
Conservation measures taken: None. Haur Lafta was listed as a wetland of international importance by Carp (1980), and has been identified as an "Important Bird Area" by BirdLife International (Evans, 1994).
Conservation measures proposed: None known.
Land use: No information.
Disturbances and threats: No recent information is available. The site may have suffered major habitat degradation following the decline in the flow of the Euphrates since the 1970s (Evans, 1994).
Hydrological and biophysical values: No information.
Social and cultural values: No information.
Noteworthy fauna: Haur Lafta was listed by Georg and Savage (1970b) as an important staging and wintering area for migratory Anatidae, but no details are available.
Noteworthy flora: No information.
Scientific research and facilities: None known.
Management authority and jurisdiction: No information.
References: Carp (1980); Evans (1994); Georg & Savage (1970b); Scott & Evans (1993).
Reasons for inclusion: 1a & 3b. Known to have been an important staging and wintering area for migratory waterfowl.
Source: See references.

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Haur Delmaj (14)

Location: 32°20'N, 45°25'E; to the southwest of the Tigris River about 40 km southwest of Kut, Wasit Governorate.
Area: c.100,000 ha.
Altitude: c.25 m.
Physical and ecological features: Haur Delmaj (Dalmaj) is an isolated haur, about 50 km long by up to 15 km wide, on the west bank of the Tigris River. The haur receives overflow from irrigation canals and floodwater from the Tigris. There are extensive salt flats around the haur, and large areas of sand dunes to the south and west.
Land tenure: No information.

Conservation measures taken: None. Haur Delmaj was listed as a wetland of international importance by Carp (1980), and has been identified as an "Important Bird Area" by BirdLife International (Evans, 1994).
Conservation measures proposed: None known.
Land use: No information.
Disturbances and threats: No recent information is available. The site may have suffered habitat degradation due to flood control measures on the Tigris and expanding irrigation schemes in the area (Evans, 1994).
Hydrological and biophysical values: No information.
Social and cultural values: No information.
Noteworthy fauna: Haur Delmaj was listed by Georg and Savage (1970b) as an important staging and wintering area for migratory Anatidae, but no details are available.
Noteworthy flora: No information.
Scientific research and facilities: None known.
Management authority and jurisdiction: No information.
References: Carp (1980); Evans (1994); Georg & Savage (1970b); Scott & Evans (1993).
Reasons for inclusion: 1a & 3b. Known to have been an important staging and wintering area for migratory waterfowl.
Source: See references.

Haur Al Shuwaija (Suwayqiyah) (15)

Location: 32°42'N, 45°55'E; on the plain north of the Tigris River, 25 km northeast of Kut, Wasit Governorate.
Area: c.50,000 ha.
Altitude: c.20 m.
Physical and ecological features: Haur Al Shuwaija (Suwayqiyah, Suweicha) is a large isolated haur on arid steppic plains about 10 km north of the Tigris River. This rather shallow, eutrophic lake formerly covered about 500 sq.km at high water level, but was partially drained in the early 1940s. It is fed by floodwaters from the Tigris as well as by numerous streams that flow into the lake from the Zagros Mountains during the rainy season. The water is reported to be slightly brackish (Koning & Dijksen, 1973). Little emergent vegetation was visible in January 1968 and December 1972. The haur is surrounded by a large area of semi-arid grassy steppe and *Salicornia* flats, with some arable land to the southwest and large areas of sand dunes to the east, north and west.
Land tenure: No information.
Conservation measures taken: None. The haur was listed as a wetland of international importance by Carp (1980), and has been identified as an "Important Bird Area" by BirdLife International (Evans, 1994).
Conservation measures proposed: None known.
Land use: No information.
Disturbances and threats: No information is available on the current status of Haur Al

Shuwaija, but it would seem likely that the site has suffered habitat degradation with the expansion of irrigated agriculture throughout the region. Duck-netting was much in evidence in December 1972, the hunters using clap-nets, and is presumably still a serious problem at the site.

Hydrological and biophysical values: No information.

Social and cultural values: No information.

Noteworthy fauna: Prior to about 1945, the area was noted for its wintering geese and ducks, regularly holding large numbers of *Anser anser*, *A. albifrons*, *Anas platyrhynchos*, *A. strepera*, *A. crecca*, *A. penelope*, *A. acuta* and *A. clypeata*. *Anser erythropus* was found in quite large numbers, and there is good evidence to suggest that several hundred to a thousand *Branta ruficollis* wintered in the area (Savage, 1968; Georg & Savage, 1970a). However, no *B. ruficollis* have been recorded in the area since the winter of 1954/55. According to Savage (1968), the area probably held one of the highest concentrations of geese in the Middle East. It also occasionally held large numbers of *Phoenicopterus ruber*, and was very important for *Anas querquedula* on passage. Three surveys between 1968 and 1979 revealed that the lake was still important for flamingos and shorebirds, while the surrounding steppic grasslands and *Salicornia* flats remained very important for geese and *Tadorna ferruginea*. Peak counts included 71 *Pelecanus onocrotalus*, 3 *P. crispus*, 133 *Ardea cinerea*, 600 *Phoenicopterus ruber*, 325 *Anser albifrons*, 70 *A. erythropus* (in December 1972), 460 *A. anser*, 1,280 *Tadorna ferruginea*, 250 *T. tadorna*, 2,700 *Anas penelope*, 435 *A. strepera*, 3,450 *A. crecca*, 2,630 *A. platyrhynchos*, 2,800 *A. acuta*, 3,000 *A. clypeata*, 70 *Grus grus*, 510 *Fulica atra*, 373 *Recurvirostra avosetta*, 725 *Charadrius alexandrinus*, 37 *Vanellus leucurus*, 130 *Calidris minutus*, 2,000 *Philomachus pugnax*, 650 *Larus ridibundus*, 645 *L. cachinnans*, 6 *Gelochelidon nilotica*, 11 *Sterna caspia* and 110 *Chlidonias hybridus*. Wintering birds of prey included *Aquila heliaca* (3), *A. clanga* and *Circus aeruginosus*.

Haur Al Shuwaija is known to have been a very important breeding area for waterfowl in the early part of this century, but little new information has become available since the 1930s. Species known to have bred at the lake include *Pelecanus onocrotalus* ("thousands"), *Marmaronetta angustirostris* (up to 100 birds), *Glareola pratincola*, *Charadrius alexandrinus* (150 pairs), *Chlidonias leucopterus* and *C. hybridus*, while *Ardea purpurea*, *Plegadis falcinellus* and *Anser anser* possibly bred (Ticehurst *et al.*, 1921-22; Moore & Boswell, 1956-57). There are old records of *Ardea goliath* (2 in August 1943) and *Grus virgo* ("fair numbers") on passage.

Noteworthy flora: No information.

Scientific research and facilities: Mid-winter waterfowl surveys were undertaken in 1968, 1972 and 1979 by the International Waterfowl and Wetlands Research Bureau (IWRB) in collaboration with the Iraq Natural History Museum in Baghdad and the Museum of Natural History in Basrah.

Management authority and jurisdiction: No information.

References: Carp (1980); Carp & Scott (1979); Evans (1994); Georg & Savage (1970a, 1970b); Georg & Vielliard (1968, 1970); Koning & Dijksen (1973); Moore & Boswell (1956-57); Savage (1968); Scott & Carp (1982); Scott & Evans (1993); Ticehurst *et al.* (1921-22).

Reasons for inclusion: 1a, 2a & 3c. Known to have been an extremely important breeding, staging and wintering area for migratory waterfowl, including *Anser erythropus* and *Marmaronetta angustirostris*.

Source: See references.

Haur Umm Al Baram and Haur Al Abjiya (16)

Location: Haur Umm Al Baram 32°32'N, 46°07'E; Haur Al Abjiya 32°25'N, 46°03'E; to the south of the Tigris River and east of Shatt Al Gharraf, 20-25 km east and southeast of Kut town, Wasit Governorate.
Area: Haur Um Al Baram 5,000 ha; Haur Al Abjiya 5,000 ha.
Altitude: c.17 m.
Physical and ecological features: Two shallow, freshwater lakes with extensive marshes on the plains to the east of the Shatt Al Gharraf and south of the Tigris River. The two haurs are linked by the Dujaila Canal.
Land tenure: No information.
Conservation measures taken: None. Both haurs were listed as wetlands of international importance by Carp (1980), and have been identified as an "Important Bird Area" by BirdLife International (Evans, 1994).
Conservation measures proposed: None known.
Land use: No information.
Disturbances and threats: The site may have suffered habitat degradation due to flood control measures on the Tigris and expanding irrigation schemes in the area (Evans, 1994).
Hydrological and biophysical values: No information.
Social and cultural values: No information.
Noteworthy fauna: Haur Umm Al Baram and Haur Al Abiya were listed by Georg and Savage (1970b) as important staging and wintering areas for migratory Anatidae, but no details are available.
Noteworthy flora: No information.
Scientific research and facilities: None known.
Management authority and jurisdiction: No information.
References: Carp (1980); Evans (1994); Georg & Savage (1970b); Scott & Evans (1993).
Reasons for inclusion: 1a & 3b. Known to have been an important staging and wintering area for migratory waterfowl.
Source: See references.

Haur Al Hachcham and Haur Maraiba (17)

Location: 32°05'N, 46°12'E; on the plains to the east of the Shatt Al Gharaf, about 10 km southeast of Hai, Wasit Governorate.
Area: 8,000 ha.
Altitude: c.14 m.

Physical and ecological features: Haur Al Hachcham and Haur Maraiba are two small haurs largely overgrown with *Phragmites* reeds, on the plains to the east of the Shatt Al Gharraf and fed by water from that channel.
Land tenure: No information.
Conservation measures taken: None. The two haurs were listed as a wetland of international importance by Carp (1980), and have been identified as an "Important Bird Area" by BirdLife International (Evans, 1994).
Conservation measures proposed: None known.
Land use: No information.
Disturbances and threats: No information.
Hydrological and biophysical values: No information.
Social and cultural values: No information.
Noteworthy fauna: Haur Al Hachcham and Haur Maraiba were listed by Georg and Savage (1970b) as important staging and wintering areas for migratory Anatidae, but no details are available.
Noteworthy flora: No information.
Scientific research and facilities: None known.
Management authority and jurisdiction: No information.
References: Carp (1980); Evans (1994); Georg & Savage (1970b); Scott & Evans (1993).
Reasons for inclusion: 1a & 3b. Known to have been an important staging and wintering area for migratory waterfowl.
Source: See references.

Shatt Al Gharraf (18)

Location: 32°30'N, 45°50'E to 31°25'N, 46°10'E; from the Tigris River at Kut in the north to the region of Shatra in the south, Wasit and Dhi Qar Governorates.
Area: Unknown. Approximately 125 km in length.
Altitude: 12-15 m.
Physical and ecological features: The wetlands of the Shatt Al Gharraf comprise a series of small ponds and seasonal wetlands along the Shatt Al Gharraf waterway between Kut and Shatra.
Land tenure: No information.
Conservation measures taken: None. The wetland has been identified as an "Important Bird Area" by BirdLife International (Evans, 1994).
Conservation measures proposed: None known.
Land use: No information.
Disturbances and threats: No recent information is available. However, the "Third River" canal passes through this area, and may pose a threat through facilitating the expansion of irrigated cultivation and attendant drainage schemes (Evans, 1994).
Hydrological and biophysical values: No information.
Social and cultural values: No information.

Noteworthy fauna: This area is reported to be of particular importance as breeding habitat for *Marmaronetta angustirostris* (Savage, 1968). Birds observed during a brief survey in January 1979 included six *Aquila heliaca*, 177 *Himantopus himantopus* and 116 *Vanellus leucurus* (Carp & Scott, 1979).
Noteworthy flora: No information.
Scientific research and facilities: Some waterfowl counts were undertaken in 1979 by the International Waterfowl and Wetlands Research Bureau (IWRB) in collaboration with the Museum of Natural History in Basrah.
Management authority and jurisdiction: No information.
References: Carp & Scott (1979); Evans (1994); Savage (1968); Scott & Evans (1993).
Reasons for inclusion: 2a. Known to have been an important breeding area for *Marmaronetta angustirostris.*
Source: See references.

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Haur Uwainah (19)

Location: 31°22'N, 46°25'E; on the plains to the east of the Shatt Al Gharraf, about 20 km east and southeast of Shatra, Dhi Qar Governorate.
Area: c.32,500 ha.
Altitude: c.15 m.
Physical and ecological features: Haur Uwainah (also known as the Shatra or Chamuqa marshes) comprises a complex of large haurs and associated marshes on the plains to the east of the Shatt Al Gharraf, east and southeast of the village of Shatra. The two principal haurs are Haur Abu Ajul (31°28'N, 46°20'E; 7,500 ha) in the north, and Haur Chamuqa (31°22'N, 46°25'E; 25,000 ha) in the south (Savage, 1968; Georg & Savage, 1970b). They are fed mainly by the Shatt Al Gharraf waterway. Both haurs formerly supported extensive reed-beds, but Abu Ajul had been drained by December 1972. By 1979, this haur was completely under cultivation, while Haur Chamuqa had been somewhat reduced in size with the construction of an embankment and road around the northern perimeter. However, much of the haur remained in excellent condition with extensive *Typha* reed-beds and large areas of open water. The surrounding wet arable land and rain-fed pools provided excellent habitat for a variety of shorebirds.
Land tenure: No information.
Conservation measures taken: None. Chamuqa and the surrounding marshes were listed as a wetland of international importance by Carp (1980), and the site has been identified as an "Important Bird Area" by BirdLife International (Evans, 1994).
Conservation measures proposed: None known.
Land use: Agriculture.
Disturbances and threats: By 1979, Haur Abu Ajul had been completely drained for agriculture, and Haur Chamuqa had been reduced in size by an embankment. No new information has become available since then, but further, major habitat destruction or degradation is a probability (Evans, 1994).

Hydrological and biophysical values: No information.
Social and cultural values: No information.
Noteworthy fauna: A very important wintering area for a wide variety of waterfowl, with over 17,000 waterfowl present in January 1979. Peak counts have included 140 *Pelecanus onocrotalus*, 20 *P. crispus*, 145 *Ardea cinerea*, 110 *Tadorna tadorna*, 315 *Anas strepera*, 820 *A. crecca*, 1,160 *A. clypeata*, 9,000 *Fulica atra*, 190 *Himantopus himantopus*, 380 *Recurvirostra avosetta*, 60 *Charadrius alexandrinus*, 110 *Vanellus leucurus*, 180 *Calidris minutus*, 260 *C. alpina*, 350 *Limosa limosa*, 730 *Larus ridibundus*, 140 *L. cachinnans* and 6 *Gelochelidon nilotica*. Wintering birds of prey have included *Aquila heliaca* (up to 6), *Circus aeruginosus* (up to 12), *C. macrourus*, *Falco columbarius* and *F. peregrinus*. No information is available on the breeding birds.
Noteworthy flora: No information.
Scientific research and facilities: Mid-winter waterfowl surveys were undertaken in 1972 and 1979 by the International Waterfowl and Wetlands Research Bureau (IWRB) in collaboration with the Iraq Natural History Museum in Baghdad and the Museum of Natural History in Basrah.
Management authority and jurisdiction: No information.
References: Carp (1980); Carp & Scott (1979); Evans (1994); Georg & Savage (1970b); Koning & Dijksen (1973); Savage (1968); Scott & Carp (1982); Scott & Evans (1993).
Reasons for inclusion: 1a, 2a & 3c. Known to have been an important staging and wintering area for a wide variety of migratory waterfowl, including *Pelecanus crispus*.
Source: See references.

Haur Al Sa'adiyah (20)

Location: 32°01'-32°25'N, 46°22'-46°44'E; on the plains to the south of the Tigris River, 15 km southwest of Ali Gharbi, Wasit Governorate.
Area: c.140,000 ha.
Altitude: 14 m.
Physical and ecological features: Haur As Sa'adiyah constitutes the largest in a chain of haurs stretching for 120 km from near Ali Gharbi in the north to Haur Al Hammar (Site 28) in the south. The haur is a vast shallow lake over 50 km long and covering about 1,400 sq.km, bordered in the east by the Tigris and in the west by the Dujaila Canal. The small northwestern section of the haur is known as Haur Umm Roij (32°21'N, 46°26'E; 1,500 ha). When visited in January 1979, there was little emergent vegetation at the east end. The Dujaila Canal eventually flows into the haur at its southernmost point and this area is known as Haur Dujaila. The haur is surrounded by fertile plains mostly under irrigated agriculture.
Land tenure: No information.
Conservation measures taken: None. Haur Al Sa'adiyah was listed as a wetland of international importance by Carp (1980), and has been identified as an "Important Bird Area" by BirdLife International (Evans, 1994).
Conservation measures proposed: None known.

Land use: No information.
Disturbances and threats: The site may have suffered habitat degradation due to flood control measures on the Tigris and expanding irrigation schemes in the area (Evans, 1994).
Hydrological and biophysical values: No information.
Social and cultural values: No information.
Noteworthy fauna: Haur Al Sa'adiyah was, at least until recently, an extremely important staging and wintering area for migratory waterfowl, particularly geese, dabbling ducks, cranes and shorebirds, and was probably also an important breeding area for waterfowl. Partial counts in January 1967, January 1968 and January 1979 recorded over 15,000, 26,000 and 11,000 waterfowl, respectively. These included up to 17 *Pelecanus* sp., 920 *Phoenicopterus ruber*, 1,030 *Anser anser*, 65 *Tadorna ferruginea*, 190 *T. tadorna*, 2,850 *Anas penelope*, 5,000 *A. strepera*, 3,215 *A. crecca*, 2,500 *A. platyrhynchos*, 3,000 *A. acuta*, 760 *A. clypeata*, 30 *Aythya nyroca*, 2,600 *Grus grus*, 20 *Recurvirostra avosetta*, 7,000 *Charadrius alexandrinus*, 80 *Vanellus leucurus*, 4,050 *Calidris minutus*, 9,000-10,000 *C. alpina*, 150 *Limosa limosa* and 120 *Larus cachinnans*. Wintering birds of prey included *Haliaeetus albicilla* (2), *Aquila heliaca* (9), *A. nipalensis*, *Circus aeruginosus*, *C. macrourus* (4), *C. pygargus*, *Falco columbarius* and *F. peregrinus*. No information is available on the breeding birds.
Noteworthy flora: No information.
Scientific research and facilities: Mid-winter waterfowl counts were undertaken in 1967, 1968 and 1979 by the International Waterfowl and Wetlands Research Bureau (IWRB) in collaboration with the Museum of Natural History in Basrah.
Management authority and jurisdiction: No information.
References: Carp (1980); Carp & Scott (1979); Evans (1994); Georg & Savage (1970b); Georg & Vielliard (1968, 1970); Scott & Carp (1982); Scott & Evans (1993).
Reasons for inclusion: 1a, 2a, 3b & 3c. Known to have been an important staging and wintering area for a wide variety of migratory waterfowl and birds of prey, notably *Anser anser*, *Anas strepera*, *Aythya nyroca*, *Aquila heliaca*, *Grus grus* and *Calidris* spp.
Source: See references.

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Haur Sarut (21)

Location: 32°07'-32°31'N, 46°46'E; on the east bank of the Tigris River, east and southeast of the town of Ali Gharbi, Maysan Governorate.
Area: Unknown.
Altitude: c.30 m.
Physical and ecological features: Haur Sarut is a long narrow haur, largely overgrown with reeds, stretching for 50 km from north to south on the east bank of the Tigris River southeast of Ali Gharbi. The haur is fed by overflow from the Tigris River and seasonal streams from the hill ranges to the northeast.
Land tenure: No information.
Conservation measures taken: None. The wetland has been identified as an "Important Bird Area" by BirdLife International (Evans, 1994).

Conservation measures proposed: None known.
Land use: No information.
Disturbances and threats: The site may have suffered habitat degradation due to flood control measures on the Tigris and expanding irrigation schemes in the area (Evans, 1994).
Hydrological and biophysical values: No information.
Social and cultural values: No information.
Noteworthy fauna: Believed to be an important staging and wintering area for migratory waterfowl. Only small numbers of waterfowl, including 50 *Tadorna ferruginea*, were recorded during a brief survey in January 1968.
Noteworthy flora: No information.
Scientific research and facilities: A mid-winter waterfowl survey was undertaken in 1968 by the International Waterfowl and Wetlands Research Bureau (IWRB) in collaboration with the Museum of Natural History in Basrah.
Management authority and jurisdiction: No information.
References: Evans (1994); Georg & Vielliard (1970); Scott & Evans (1993).
Reasons for inclusion: 1a & 3b. Believed to have been an important staging and wintering area for migratory waterfowl.
Source: See references.

Haur Al Haushiya (22)

Location: 32°05'N, 46°54'E; on the east bank of the Tigris River, north of the village of Al Kumait, Maysan Governorate.
Area: Unknown.
Altitude: c.15 m.
Physical and ecological features: Haur Al Haushiya comprises a group of 14 artificial ponds (Al Kumait Ponds), constructed for wildfowl hunting, in the basin of the former Haur Al Haushiya on the east bank of the Tigris River.
Land tenure: No information.
Conservation measures taken: None. The wetland has been identified as an "Important Bird Area" by BirdLife International (Evans, 1994).
Conservation measures proposed: None known.
Land use: The ponds are used as private duck-hunting areas.
Disturbances and threats: Heavy hunting pressure was reported in the 1960s.
Hydrological and biophysical values: No information.
Social and cultural values: No information.
Noteworthy fauna: Apparently an important wintering area for migratory waterfowl, although only surveyed on one occasion. Atkinson-Willes (1976) tentatively identified the area as being of international importance for wintering *Anas clypeata*. Waterfowl observed during a survey of eight ponds in January 1968 included one *Pelecanus crispus*, 110 *Ciconia ciconia*, 40 *Phoenicopterus ruber*, 65 *Tadorna ferruginea*, 190 *T. tadorna*, 775 *Anas penelope*, 1,310 *A. strepera*, 3,200 *Anas crecca*, 1,270 *A. acuta*, 2,400 *A. clypeata*, 32 *Grus grus*, 500

Recurvirostra avosetta, 110 *Charadrius alexandrinus*, 500 *Calidris minuta*, 170 *C. alpina*, 125 *Limosa limosa* and 30 *Tringa stagnatilis*. Two *Larus minutus* were present at this time (only the second record of the species in Iraq). Birds of prey included *Aquila heliaca*, *Circus aeruginosus* and *C. macrourus*.
Noteworthy flora: No information.
Scientific research and facilities: Eight of the 14 ponds were visited in January 1968 during a mid-winter waterfowl survey by the International Waterfowl and Wetlands Research Bureau (IWRB) in collaboration with the Museum of Natural History in Basrah.
Management authority and jurisdiction: No information.
References: Atkinson-Willes (1976); Evans (1994); Georg & Vielliard (1968, 1970); Scott & Evans (1993).
Reasons for inclusion: 3b. Believed to have been an important staging and wintering area for migratory waterfowl.
Source: See references.

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Haur Chubaisah Complex (23)

Location: 31°53'N, 47°18'E; on the east bank of the Tigris River between Amara and Al Halfaya, about 20 km northeast of Amara, Maysan Governorate.
Area: c.27,500 ha.
Altitude: c.25 m.
Physical and ecological features: The Haur Chubaisah (Chubaisha) complex comprises a group of large haurs with extensive marshes on the plains to the east of the Tigris, north of Suweid Marshes (Site 29). The three main haurs, Haur Jazrah in the west, Haur Chubaisah in the centre and Haur Sanaf in the east, lie close together and merge into one another at high water levels. They are bordered in the south by the Musharra Canal. Haur Sanaf is about 20 km long and consists mainly of open water with a few reeds and extensive fringing grasslands (Georg & Vielliard, 1970). The Chubaisah wetland includes the Bani Lam Marshes listed by Savage (1968).
Land tenure: No information.
Conservation measures taken: None. Haur Chubaisah was listed as a wetland of international importance by Carp (1980), and has been identified as an "Important Bird Area" by BirdLife International (Evans, 1994).
Conservation measures proposed: None known.
Land use: No information.
Disturbances and threats: No recent information is available. However, it does not seem likely that this site has escaped some of the degradation suffered by other wetlands in southern Iraq (Evans, 1994).
Hydrological and biophysical values: No information.
Social and cultural values: No information.
Noteworthy fauna: An important wintering for migratory waterfowl, and possibly also an important breeding area. *Anhinga rufa* and *Marmaronetta angustirostris* were said to breed in

the area by Ticehurst *et al.* (1921-22), but no more recent information is available on the breeding birds. According to Savage (1968), the wetlands are particularly important for wintering *Anser anser*, *A. erythropus* and *Tadorna ferruginea*. Birds observed during very incomplete surveys in January 1968 and January 1979 included 6 *Pelecanus crispus*, 30 *Pelecanus* sp., 800 *Nycticorax nycticorax*, 18 *Casmerodius albus*, 32 *Ciconia ciconia*, 280 *Anser anser*, over 1,000 ducks, single *Aquila heliaca* and *A. clanga*, 5 *Circus aeruginosus*, a single *Falco peregrinus*, 900 *Fulica atra*, 55 *Vanellus leucurus*, 500 *Larus ridibundus*, 55 *L. cachinnans* and 27 *Ceryle rudis*. "Many" *Numenius tenuirostris* were recorded at a temporary lake in the desert 16 km north of Amara, and therefore presumably in the Haur Chubaisah area, in December 1917 (Ticehurst *et al.*, 1921-22).
Noteworthy flora: No information.
Scientific research and facilities: Brief mid-winter waterfowl surveys were undertaken in 1968 and 1979 by the International Waterfowl and Wetlands Research Bureau (IWRB) in collaboration with the Museum of Natural History in Basrah.
Management authority and jurisdiction: No information.
References: Carp (1980); Carp & Scott (1979); Evans (1994); Georg & Savage (1970b); Georg & Vielliard (1968, 1970); Savage (1968); Scott & Evans (1993); Ticehurst *et al.* (1921-22).
Reasons for inclusion: 1a & 3b (possibly also 2a). Known to have been an important breeding, staging and wintering area for migratory waterfowl.
Source: See references.

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Haur Sanniya (24)

Location: 31°55'N, 46°48'E; on the west bank of the Tigris River, 30 km west of Amara, Maysan Governorate.
Area: c.40,000 ha.
Altitude: 12 m.
Physical and ecological features: Haur Sanniya is the second in the chain of large haurs stretching from Haur Sa'adiyah in the north to the Central Marshes (Site 27) and Haur Al Hammar (Site 28) in the south. The haur receives overflow from Haur Sa'adiyah (Site 20) to the north and from the Tigris River to the east.
Land tenure: No information.
Conservation measures taken: None. The wetland has been identified as an "Important Bird Area" by BirdLife International (Evans, 1994).
Conservation measures proposed: None known.
Land use: No information.
Disturbances and threats: The site may have suffered habitat degradation due to flood control measures on the Tigris and expanding irrigation schemes in the area (Evans, 1994).
Hydrological and biophysical values: No information.
Social and cultural values: No information.
Noteworthy fauna: Haur Sanniya was listed by Georg and Savage (1970b) as an important staging and wintering area for migratory Anatidae, but no details are available.

Noteworthy flora: No information.
Scientific research and facilities: None known.
Management authority and jurisdiction: No information.
References: Evans (1994); Georg & Savage (1970b); Scott & Evans (1993).
Reasons for inclusion: 1a & 3b. Known to have been an important breeding, staging and wintering area for migratory waterfowl.
Source: See references.

Haur Al Rayan and Haur Umm Osbah (25)

Location: 31°35'N, 47°02'E; between the villages of Maymund and Salam, about 20 km south-southwest of Amara, Maysan Governorate.
Area: c.25,000 ha.
Altitude: 12 m.
Physical and ecological features: Haur Al Rayan and Umm Osbah (sometimes referred to as the Maymund and Salam marshes) are a complex of shallow lagoons and vast reed-beds with areas of sedge marsh, situated along the Shatt Al Maymunah, a distributary of the Tigris River. The southern end of these marshes lies a few kilometres to the north of Feraigat Marshes at the extreme northern end of the Central Marshes (Site 27).
Land tenure: No information.
Conservation measures taken: None. The wetland has been identified as an "Important Bird Area" by BirdLife International (Evans, 1994).
Conservation measures proposed: None known.
Land use: No information.
Disturbances and threats: No recent information is available. However, it does not seem likely that this site has escaped some of the degradation suffered by other wetlands in southern Iraq in recent years (Evans, 1994).
Hydrological and biophysical values: No information.
Social and cultural values: No information.
Noteworthy fauna: Known to be an important wintering area for a wide variety of waterfowl, notably pelicans, herons, egrets, ducks and shorebirds, and probably also an important breeding area. Birds recorded during two very incomplete surveys in January 1968 and January 1979 included 109 *Pelecanus crispus*, 750 *P. onocrotalus*, 120 *Ardea cinerea*, 36 *Threskiornis aethiopicus* (January 1979), 180 *Ciconia ciconia*, 4,000 *Anas crecca*, 2 *Haliaeetus albicilla*, 5 *Aquila heliaca*, 3 *A. clanga*, 25 *Circus aeruginosus*, a single *Falco peregrinus*, 32 *Himantopus himantopus*, 18 *Recurvirostra avosetta*, 30 *Vanellus leucurus*, 480 *Limosa limosa*, 90 *Larus cachinnans*, 29 *Sterna caspia* and 17 *Ceryle rudis*. No information is available on the breeding birds.
Noteworthy flora: No information.
Scientific research and facilities: Mid-winter waterfowl surveys were undertaken in 1968 and 1979 by the International Waterfowl and Wetlands Research Bureau (IWRB) in collaboration with the Museum of Natural History in Basrah.

Management authority and jurisdiction: No information.
References: Carp & Scott (1979); Evans (1994); Georg & Vielliard (1968, 1970); Scott & Carp (1982); Scott & Evans (1993).
Reasons for inclusion: 1a, 2a & 3c. Known to have been an important wintering area for migratory waterfowl (including *Pelecanus crispus*) and birds of prey (including *Aquila heliaca*), and probably also an important breeding area for waterfowl.
Source: See references.

Haur Auda (26)

Location: 31°33'N, 46°51'E; to the west of the Shatt Al Maymunah, about 40 km southwest of Amara town.
Area: 7,500 ha.
Altitude: 12 m.
Physical and ecological features: Haur Auda (Al Awdah) is one of the chain of haurs stretching from Haur As Sa'adiyah in the north to Haur Al Hammar in the south. It lies on the west bank of the Shatt Al Maymunah, a distributary of the Tigris River, and overflows into the extreme northwestern portion of the Central Marshes (Site 27).
Land tenure: No information.
Conservation measures taken: None. Haur Auda was listed as a wetland of international importance by Carp (1980), and has been identified as an "Important Bird Area" by BirdLife International (Evans, 1994).
Conservation measures proposed: None known.
Land use: No information.
Disturbances and threats: No recent information is available. However, it does not seem likely that this site has escaped some of the degradation suffered by other wetlands in southern Iraq in recent years (Evans, 1994).
Hydrological and biophysical values: No information.
Social and cultural values: No information.
Noteworthy fauna: Haur Sanniya was listed by Georg and Savage (1970b) as an important staging and wintering area for migratory Anatidae, but no details are available. The area is likely to have been of considerable importance for breeding, staging and wintering waterfowl, given its size and proximity to wetlands of known importance.
Noteworthy flora: No information.
Scientific research and facilities: None known.
Management authority and jurisdiction: No information.
References: Carp (1980); Evans (1994); Georg & Savage (1970b); Scott & Evans (1993).
Reasons for inclusion: 1a & 3b. Known to have been an important staging and wintering area for migratory waterfowl.
Source: See references.

Central Marshes (27)

Location: 30°50'-31°30'N, 46°45'-47°25'E; to the west of the Tigris River and north of the Euphrates River, in a triangle with Qalit Salih at the northern apex, Fuhud in the southwest and Qurna in the southeast. In Maysan, Dhi Qar and Al Basrah Governorates.
Area: c.300,000 ha.
Altitude: Mostly between 9 and 12 m above sea level.
Physical and ecological features: The Central Marshes comprise a vast complex of mostly permanent freshwater marshes with scattered areas of open water, to the west of the River Tigris and to the north of the River Euphrates. The marshes are fed by both rivers, and at maximum flooding cover an area of about 3,000 sq.km. Almost the entire area is covered in tall reed-beds of *Phragmites* and *Typha*. The marshes are bordered to the north and east by cultivated plains with extensive rice fields and sugar-cane polders. Portions of the Central Marshes which are known or thought to have been of special importance for wildlife include the following:

(a) Feraigat Marshes (31°30'N, 47°10'E). The northernmost section of the marshes, fed by floodwaters from the Tigris.
(b) Al Azair Marshes (31°17'N, 47°23'E). An area of seasonal and permanent marshes in the extreme northeast, just west of the River Tigris. The village of Al Azair is also known as "Ezra's Tomb" in the old literature.
(c) Haur Umm Al Binni Marshes (31°15'N, 47°05'E). A large area of predominantly permanent marshes around Umm Al Binni lake in the west-central part of the marshes.
(d) Fartus Marshes (31°10'N, 46°55'E), including the Sabil Al Awaidiya, along the western edge of the Central Marshes.
(e) Haur Az Zikri (31°10'N, 47°10'E). A very large open-water lake in the centre of the marshes.
(f) Chabaish Marshes (31°00'N, 47°00'E). A large area of permanent and temporary marshes, including Haur Birkat (Birkat Baghdad), in the south, flooded both from the Tigris and the Euphrates.
(g) Al Jazair Marshes (31°00'N, 47°15'E). The extensive marshes on the north bank of the Euphrates before its confluence with the Tigris.

Land tenure: No information.
Conservation measures taken: None. The Euphrates Marshes around Haur Dima, Haur Umm Al Binni, Haur Az Zikri and Haur Birkat were listed as a wetland of international importance by Carp (1980), and the entire area has been identified as an "Important Bird Area" by BirdLife International (Evans, 1994).
Conservation measures proposed: None known.
Land use: See general account of wetlands of Lower Mesopotamia.
Disturbances and threats: Almost the entire area has been drained since the mid-1980s as a result of intensive hydrological engineering activity (see general account of wetlands of Lower Mesopotamia).
Hydrological and biophysical values: See general account of wetlands of Lower Mesopotamia.

Social and cultural values: See general account of wetlands of Lower Mesopotamia.
Noteworthy fauna: Formerly, at least, an extremely important breeding, staging and wintering area for huge numbers of waterfowl of a wide variety of species. No serious ornithological investigations have been carried out during the breeding season in recent decades, and very little information is available. Species reported to breed commonly in the marshes prior to about 1960 included *Tachybaptus ruficollis iraquensis*, a species of pelican *Pelecanus* sp., *Phalacrocorax pygmaeus*, *Anhinga rufa*, *Ardea goliath*, *Threskiornis aethiopicus*, *Marmaronetta angustirostris* and *Porphyrio porphyrio* (Cheesman, 1922; Maxwell, 1957; Thesiger, 1964; Ticehurst *et al.*, 1921-22 & 1926). Thesiger (1964) noted that "occasional Greylag remain to breed". Other known and likely breeding species are described in the general account of the wetlands of Lower Mesopotamia. Feraigat Marshes are known to have supported huge concentrations of ducks in the winter months, while Haur Umm Al Binni and Fartus Marshes were said to be important wintering areas for *Aythya ferina* (Savage, 1968). Fartus Marshes were also reported to be very important for wintering geese *Anser* spp. Haur Az Zikri was said to be very important for wintering waterfowl (Savage, 1968), and *Ardea goliath* is known to have occurred in this area until at least 1980 (K.Y. Al-Dabbagh, *in litt.*). Waterfowl recorded during very incomplete surveys in January 1968, December 1972 and January 1979 included up to 413 *Pelecanus onocrotalus*, 72 *P. crispus*, 31 *Phalacrocorax pygmaeus*, 70 *Egretta garzetta*, 190 *Ardea cinerea*, 9 *A. purpurea*, 12 *Casmerodius albus*, 50 *Bubulcus ibis*, 1,020 *Nycticorax nycticorax*, 100 *Ciconia ciconia*, 150 *Plegadis falcinellus*, 4,850 *Fulica atra*, 180 *Charadrius alexandrinus*, 34 *Vanellus leucurus*, 1,100 *Larus ridibundus*, 500 *L. cachinnans* and 100 *Chlidonias hybridus*. Birds of prey included up to 73 *Circus aeruginosus*, 3 *C. macrourus*, 4 *Aquila clanga*, 2 *A. nipalensis* and 3 *A. heliaca*.
According to Thesiger (1964), otters (*Lutra* sp.) were common in the marshes in the early 1950s, particularly at Haur Az Zikri, and the endemic subspecies of the Smooth-coated Otter, *Lutra perspicillata maxwelli*, was recorded on two occasions in Al Azair Marshes in the late 1950s. For other fauna, see general account of wetlands of Lower Mesopotamia.
Noteworthy flora: No information.
Scientific research and facilities: Large portions of the marshes are difficult of access, and have seldom been visited by biologists. Thesiger (1964) and Maxwell (1957) travelled extensively in the marshes in the early 1950s, and give general accounts of the wildlife, but no thorough surveys have ever been undertaken. Mid-winter waterfowl surveys were undertaken in 1968, 1972 and 1979 by the International Waterfowl and Wetlands Research Bureau (IWRB) in collaboration with the Iraq Natural History Museum in Baghdad and the Museum of Natural History in Basrah, but only tiny portions of the marshes could be surveyed.
Management authority and jurisdiction: No information.
References: Carp (1980); Carp & Scott (1979); Cheesman (1922); Evans (1994); Georg & Savage (1970b); Georg & Vielliard (1968, 1970); Koning & Dijksen (1973); Maltby (1994); Maxwell (1957); Prentice (1993); Savage (1968); Scott & Carp (1982); Scott & Evans (1993); Thesiger (1964); Ticehurst *et al.* (1921-22, 1926).
Reasons for inclusion: 1a, 1c, 2a, 2b, 2c, 2d, 3a & 3c. See general account of wetlands of Lower Mesopotamia.
Source: See references.

Haur Al Hammar (28)

Location: 30°35'-31°00'N, 46°25'-47°45'E; south of the main channel of the Euphrates River from about 20 km east of Nasiriya in the west to the region of Basrah in the east. In Dhi Qar and Al Basrah Governorates.
Area: At least 350,000 ha.
Altitude: Mostly between 4.5 and 9.0 m above sea level.
Physical and ecological features: The Haur Al Hammar, its surrounding marshes and neighbouring haurs and areas of temporary inundation comprise some 3,500 sq.km of almost contiguous wetland habitat south of the River Euphrates and west of the Shatt Al Arab. The haur itself is the largest lake in the lower Euphrates, approximately 120 km long by up to 25 km wide. It is bordered in the north by the Euphrates, in the west by the Southern Desert and in the east by the Shatt Al Arab. The lake is eutrophic and generally shallow, with a maximum depth of about 1.8 m at low water levels in early winter and about 3.0 metres at high water levels in late spring. Large parts of the littoral zone dry out during periods of low water and banks and islands appear in many places. The temperature of the water varies between about 16°C in winter (February) and 31°C in summer (August). A pH of 8.0 has been recorded in winter, and a pH of 7.5 in summer. The main source of water is the Euphrates River, which flows along the northern edge of the marshes and joins the Tigris at Qarmat Ali, where the combined flow becomes the Shatt Al Arab. However, the lake may also receive a very substantial amount of water from the Tigris River via the Central Marshes (Site 27), and there is presumably also some recharge from groundwater. Portions of this vast wetland which are known to be of special importance for wildlife include the following:

(a) The eastern end of Haur Al Hammar near its outlet (30°35'N, 47°45'E): a vast expanse of shallow open water with fringing reed-beds and reed islands.
(b) Haur Aluwez (30°35'N, 47°35'E): a vast area of marshlands and open water in the southeast.
(c) The extensive mudflats stretching for over 50 km along the southwestern shore of Haur Al Hammar (30°40'N, 46°55'E).
(d) The extensive reed-beds and open water areas in the region of Fuhud and Hammar villages in the northwest (30°57'N, 46°46'E).
(e) Nasiriya Marshes (31°00'N, 46°25'E): a large area of permanent and temporary marshes in dead branches of the Euphrates at the western extremity of Haur Al Hammar near Nasiriya (Suk Al-Shiok)

Land tenure: No information.
Conservation measures taken: None. The entire area was listed as a wetland of international importance by Carp (1980), and has been identified as an "Important Bird Area" by BirdLife International (Evans, 1994).
Conservation measures proposed: The IWRB/Basrah University Expedition of 1979 recommended the establishment of a protected area at Haur Al Hammar, but no further action was taken (Carp & Scott, 1979).
Land use: See general account of wetlands of Lower Mesopotamia.
Disturbances and threats: Flood control, drainage and irrigation schemes upstream on the

Euphrates River in central Iraq, Turkey and Syria have been progressively reducing the amount of water flowing in the Euphrates and thus into the marshes, especially from the 1970s onwards. This has resulted in a gradual contraction in the extent of the permanent wetland area. By January 1975, a large part of Haur Aluwez in the southeast had been cut off from the main wetland by an embankment 10 km long and was being drained (Carp, 1975a & 1975b). By January 1979, much of this area was criss-crossed by a network of embankments constructed by the State Petroleum Company for oil exploration (Scott & Carp, 1982). Over 80,000 ha of marsh at the northeastern end of Haur Al Hammar had been drained by 1985 to facilitate exploitation of the West Qurna oilfield (Evans, 1994). Satellite images reveal that between 1984 and 1991/92 large areas of wetland along the southern shore of Haur Al Hammar and at its extreme eastern end near its outflow into the Shatt Al Arab were drained. The total loss of wetland habitat in the Haur Al Hammar system during this period has been estimated at over 60,000 ha (Maltby, 1994). Intensive hydrological engineering activity throughout Lower Mesopotamia since 1991 has caused further major changes to the system, and it seems likely that very little of the original wetland habitat still remains intact (see general account of wetlands of Lower Mesopotamia).

Hunting occurs on a massive scale, and has posed a serious threat to many species of wildlife since the introduction of fire-arms and efficient flight nets and clap nets early in the century. Huge numbers of waterfowl were shot or netted each year for local consumption and sale in markets in nearby towns. Resident species, notably the large breeding waterbirds, have been most seriously affected, since these have been persecuted year-round (see general account of wetlands of Lower Mesopotamia).

Hydrological and biophysical values: See general account of wetlands of Lower Mesopotamia.

Social and cultural values: See general account of wetlands of Lower Mesopotamia.

Noteworthy fauna: Haur Al Hammar and its associated marshes comprise one of the most important areas for waterfowl in the Middle East, both in terms of numbers of birds and diversity of species. The vast reed-beds of *Typha* and *Phragmites* are known to have supported large breeding populations of species such *Nycticorax nycticorax*, *Ardea purpurea*, *Marmaronetta angustirostris*, *Gallinula chloropus*, *Porphyrio porphyrio* and *Fulica atra*. *Phalacrocorax pygmaeus*, *Ardea goliath* and *Anser anser* are known to have bred in the early part of this century (Marchant, 1962; Thesiger, 1964; Ticehurst *et al.*, 1921-22). Other known and likely breeding species are described in the general account of the wetlands of Lower Mesopotamia.

In general, the large open areas of water are too deep for most species of waterfowl other than pelicans, diving ducks, *Fulica atra*, gulls and terns. The broad mud shoreline along the southern edge of the main Haur Al Hammar provides excellent habitat for shorebirds, while sedge marshes and marsh-edge habitat to the east and west of the main haur are particularly suitable for herons, egrets, *Platalea leucorodia*, *Plegadis falcinellus*, dabbling ducks and some shorebirds. Moist arable land, irrigation ponds and rain-water pools on the surrounding plains provide excellent feeding areas for geese, dabbling ducks, *Grus grus* and many shorebirds. The eastern end of Haur Al Hammar is especially important for ducks and *Fulica atra*. Over 30,000 ducks and coots were present in January 1979. Haur Aluwez, in the southeast, is especially important for pelicans, diving ducks and coots. A survey in 1975 recorded 1,300 pelicans in this area, while a survey in 1979 found over 40,000 ducks, mainly *Aythya fuligula*, and 73,000

Fulica atra, as well as large numbers of shorebirds and gulls. Over 8,000 shorebirds, mainly *Charadrius alexandrinus*, *Calidris minuta* and *C. alpina*, were recorded along a short stretch of the southern shore of the main haur in January 1979; also present were six *Numenius tenuirostris*. The extensive reed-beds and open water areas in the region of Fuhud and Hammar villages in the northwest are especially important for pelicans and dabbling ducks. The 1979 survey recorded over 1,500 pelicans and 30,000 dabbling duck in this area, along with a day roost of about 1,000 *Nycticorax nycticorax*. The Nasiriya Marshes are important for a wide variety of waterfowl, notably herons, egrets and dabbling ducks, and a single *Numenius tenuirostris* was recorded in this area in autumn 1979. The observation of *N. tenuirostris* at two locations around Haur Al Hammar in 1979 suggests that this area may be a regular staging and wintering area for this highly endangered species (Gretton, 1991).

Haur Al Hammar is known to have held internationally important concentrations of at least 13 species of waterfowl in winter. The maximum counts of waterfowl recorded during very incomplete surveys of the Haur Al Hammar area in December 1972, January 1975 and January 1979 are given in Table 4. There is almost no ornithological information from spring and autumn, but the site is likely to be as important for migratory waterfowl in these seasons as in winter.

The wetlands also provide extremely important wintering habitat for birds of prey. Thirteen species have been recorded during the mid-winter waterfowl censuses, including up to 11 *Pandion haliaetus*, 89 *Milvus migrans*, 185 *Circus aeruginosus*, 8 *C. macrourus*, 12 *Buteo rufinus*, 8 *Aquila clanga*, 1 *A. nipalensis*, 3 *A. heliaca*, 3 *Falco columbarius* and 2 *F. peregrinus*.

For other fauna, see general account of wetlands of Lower Mesopotamia.

Noteworthy flora: No information.

Scientific research and facilities: Mid-winter waterfowl surveys were undertaken in 1972, 1975 and 1979 by the International Waterfowl and Wetlands Research Bureau (IWRB) in collaboration with the Iraq Natural History Museum in Baghdad and the Museum of Natural History in Basrah. P. Ctyroky made some waterfowl counts in the area in 1979.

Management authority and jurisdiction: No information.

References: Carp (1975a, 1975b, 1980); Carp & Scott (1979); Ctyroky (1987); Evans (1994); Georg & Savage (1970b); Gretton (1991); Koning & Dijksen (1973); Maltby (1994); Marchant (1962); Savage (1968); Scott & Carp (1982); Scott & Evans (1993); Thesiger (1964); Ticehurst *et al.* (1921-22).

Reasons for inclusion: 1a, 1c, 2a, 2b, 2c, 2d, 3a & 3c. See general account of wetlands of Lower Mesopotamia.

Source: See references.

Suweid Marshes (29)

Location: 31°45'N, 47°25'E; to the east of the Tigris River, 30 km southeast of Amara, Maysan Governorate.

Area: c.15,000 ha.

Altitude: 6 m.
Physical and ecological features: Suweid Marshes (also known as Haur Om Al- Nyaj or Sudan Marshes) is a large wetland on the Al Kahala (Chahala) River, about 30 km southeast of Amara. The wetland comprises extensive *Typha* reed-beds with many areas of open water (up to 2.0 m deep) and fast-running creeks, and is partly permanent and partly seasonal. The haur lies at the northwestern extremity of Haur Al Hawizeh (Site 30), and is fed by the Al Kahala River, a distributary of the Tigris.
Land tenure: No information.
Conservation measures taken: None. The wetland has been identified as an "Important Bird Area" by BirdLife International (Evans, 1994).
Conservation measures proposed: None known.
Land use: No information.
Disturbances and threats: No recent information is available specifically for this site. However, it would appear from a satellite image taken in August 1992 that much of this area has been drained and converted into agricultural land (Evans, 1994).
Hydrological and biophysical values: No information.
Social and cultural values: No information.
Noteworthy fauna: Probably an important breeding, staging and wintering area for a wide variety of waterfowl, but poorly known. Waterfowl observed during a very incomplete survey in January 1975 included 6 *Tachybaptus ruficollis*, 12 *Pelecanus onocrotalus*, 224 unidentified pelicans, at least 100 *Phalacrocorax pygmaeus*, 3 *Ardea purpurea*, 100 *Anas platyrhynchos*, 2,500 *Fulica atra*, 114 *Limosa limosa* and 30 *Chlidonias hybridus* (Carp, 1975a & 1975b). There was a breeding colony of about 200 *Nycticorax nycticorax* on the Al Kahala River in the 1970s (Evans, 1994).
Noteworthy flora: No information.
Scientific research and facilities: A mid-winter waterfowl survey was undertaken in 1975 by the International Waterfowl and Wetlands Research Bureau (IWRB) in collaboration with the Museum of Natural History in Basrah.
Management authority and jurisdiction: No information.
References: Carp (1975a, 1975b); Evans (1994); Scott & Evans (1993).
Reasons for inclusion: 1a, 2a & 3b. Believed to have been an important breeding, staging and wintering area for waterfowl, notably *Phalacrocorax pygmaeus*.
Source: See references.

Haur Al Hawizeh (30)

Location: 31°00'-31°45'N, 47°25'-47°50'E; to the east of the Tigris River between Amara and Qurna, extending east to the Iranian border. In Maysan and Al Basrah Governorates.
Area: c.220,000 ha.
Altitude: Mostly at about 6 m above sea level.
Physical and ecological features: Situated to the east of the River Tigris, Haur Al Hawizeh (Hawaizah) and its associated marshes extend for about 80 km from north to south and 30 km

from east to west. A small portion of the haur extends over the border into Iranian territory, where it is known as Hoor Al Azim. The wetland is fed by floodwaters from the River Tigris in the west and the Karkheh river in the east; it is bordered in the north by the Musharra Canal and in the south by the Shatt Al Arab. The marsh is part seasonal and part permanent. The permanent part has extensive *Phragmites* reed-beds alternating with open sheets of water. The Nahrsabla Marshes (31°30'N, 47°35'E) are an area of predominantly seasonal marsh in the northeastern portion of the haur, near the Iranian border. The marshes on the Iranian side of the border comprise a complex of permanent and seasonal, freshwater to brackish marshes and seasonally flooded arable land on the floodplain of the Karkheh river, about 60-90 km west of the city of Ahwaz (see Site 34 in the Iran chapter).

Land tenure: No information.

Conservation measures taken: None. Haur Al Hawizeh was listed as a wetland of international importance by Carp (1980), and has been identified as an "Important Bird Area" by BirdLife International (Evans, 1994).

Conservation measures proposed: None known.

Land use: See general account of wetlands of Lower Mesopotamia.

Disturbances and threats: Reports from sources in Iraq and Iran suggest that the Haur Al Hawizeh marshes on both sides of the border were badly damaged during the Iran/Iraq war (1980-88). Several of the largest battles occurred in and around these marshes, and involved heavy bombing and shelling, extensive burning and the use of chemical weapons. Large areas of reed-bed were cut or burned in the search for rebels after the 1980-88 war and also after the 1990-91 Gulf War. A satellite image taken in August 1992 reveals that large areas of the northwestern, western and southern shores have been drained, using river control and dyke-building, apparently for security reasons. It has been estimated that the total wetland area was reduced by about 33% during the period 1984/85 to 1991/92 (Maltby, 1994). However, the haur does not appear to have been drastically affected by the recent massive river diversion projects and drainage schemes which have devastated the Central Marshes and Haur Al Hammar, since it receives much of its water from the Karkheh and other rivers rising in Iran. From the August 1992 satellite image, it would seem that the southern quarter of the marshes is now saline, since it appears to be shallow (less than 1 m deep), yet does not support any emergent vegetation. Furthermore, compared to a satellite image taken in 1984, it appears that the southern edge of the emergent vegetation (*Phragmites*) has retreated northwards by 20 km, implying that any such salinization is a recent development (Evans, 1994). Persistent pesticides are reported to have been used to kill and catch fish (Evans, 1994).

Hydrological and biophysical values: See general account of wetlands of Lower Mesopotamia.

Social and cultural values: See general account of wetlands of Lower Mesopotamia.

Noteworthy fauna: Haur Al Hawizeh was, and probably still is, one of the most important wetlands in Iraq for breeding and wintering waterfowl. Unfortunately, no proper ornithological surveys or waterfowl counts have ever been undertaken in the Iraqi portion of these marshes, and no recent information is available. Species recorded commonly in the marshes by Maxwell (1957) and Thesiger (1964) in the early 1950s, and presumably breeding, included *Phalacrocorax pygmaeus*, *Anhinga rufa*, *Ardea goliath*, *Threskiornis aethiopicus*, *Marmaronetta angustirostris* and *Porphyrio porphyrio*. Thesiger (1964) heard *Botaurus stellaris* booming. Other known and likely breeding species are described in the general account

of the wetlands of Lower Mesopotamia. According to Savage (1968), Haur Al Hawizeh provided wintering habitat for some of the largest concentrations of Anatidae in the world. Large numbers of *Anser anser*, *Anas platyrhynchos*, *A. strepera*, *A. crecca*, *A. penelope*, *A. acuta*, *A. clypeata*, *Netta rufina*, *Aythya ferina*, *A. fuligula*, *Phoenicopterus ruber* and *Fulica atra* were believed to occur in winter, while *A. querquedula* was reported to be common on passage (Georg & Savage, 1970b). The Nahrsabla Marshes were reported to be a wintering area for *Anser erythropus* (Savage, 1968).

A subspecies of the Smooth-coated Otter *Lutra perspicillata maxwelli*, endemic to the marshes of Lower Mesopotamia, was described from a skin and a live cub acquired by Maxwell (1957) in the marshes of Haur Al Hawizeh in early 1956. There are, however, no further records of this otter from these marshes. For other fauna, see general account of wetlands of Lower Mesopotamia.

Noteworthy flora: No information.

Scientific research and facilities: None known.

Management authority and jurisdiction: No information.

References: Carp (1980); Evans (1994); Georg & Savage (1970b); Maltby (1994); Maxwell (1957); Prentice (1993); Savage (1968); Scott & Evans (1993); Thesiger (1964); Ticehurst *et al.* (1921-22).

Reasons for inclusion: 1a, 1c, 2a, 2b, 2c, 2d, 3a & 3c. See general account of wetlands of Lower Mesopotamia.

Source: See references.

Shatt Al Arab Marshes (31)

Location: 31°00'N, 47°25'E to 29°55'N, 48°30'E; from the confluence of the Tigris and Euphrates at Qurna to the head of the Gulf at Fao, Al Basrah Governorate.

Area: Unknown. About 165 km in length.

Altitude: Sea level to 6 m.

Physical and ecological features: The Shatt Al Arab flows for some 165 km from the confluence of the main branches of the Tigris and Euphrates Rivers at Qurna to the head of the Gulf. Along the lower 80 km of its length, the waterway forms the international border between Iraq and the Islamic Republic of Iran. For much of its length, the river flows between steep earthen banks and supports little if any aquatic vegetation. There are, however, some significant marshes on the banks of the waterway, mainly between Qurna and Basrah. These include Haur ash Shaibah (15 km north of Basrah), Qarmat Ali wetland, Khamisiyah wetland and Shafi wetland. Shafi wetland (30°53'N, 47°31'E), the site of a small research station run by the University of Basrah, is a small reed marsh near the town of Shafi on the Basrah to Amara road, 30 km from Basrah. The lower marshes below Basrah are presumably changing their character as less fresh water is reaching the sea and there is increasing encroachment of sea water.

Land tenure: No information.

Conservation measures taken: None. The wetland has been identified as an "Important Bird Area" by BirdLife International (Evans, 1994).

Conservation measures proposed: None known.
Land use: The Shatt Al Arab is an extremely busy waterway, carrying heavy boat traffic to and from the ports of Basrah, which straddles the central section of the river, and Abadan on the Iranian shore.
Disturbances and threats: See general account of wetlands of Lower Mesopotamia.
Hydrological and biophysical values: See general account of wetlands of Lower Mesopotamia.
Social and cultural values: See general account of wetlands of Lower Mesopotamia.
Noteworthy fauna: According to Savage (1968), the marshes along the Shatt Al Arab were formerly important for wintering *Anser anser* and dabbling ducks, mainly *Anas platyrhynchos* and *A. crecca*. *Marmaronetta angustirostris* was also reported to breed in the area. The muddy shores of the Shatt Al Arab are known to be important for passage and wintering shorebirds. Birds recorded during surveys of some of the wetlands along the Shatt Al Arab in January 1968, January 1975 and January 1979 included a single *Pelecanus crispus*, 3 *Ardea purpurea*, 10 *Ardeola ralloides*, 10 *Nycticorax nycticorax*, 105 *Ciconia ciconia*, 305 *Milvus migrans*, a single *Aquila heliaca*, 50 *Himantopus himantopus*, 50 *Charadrius alexandrinus*, 50 *Vanellus leucurus*, 70 *Gallinago gallinago*, 100 *Tringa totanus*, 53 *T. stagnatilis*, 400 *Calidris minuta*, 500 *C. alpina*, 4,000 *Larus ridibundus*, 130 *L. cachinnans* and 24 *Chlidonias hybridus*.
Noteworthy flora: No information.
Scientific research and facilities: In 1975, the University of Basrah established a small research station and bird-ringing centre at Shafi wetland. Mid-winter waterfowl surveys were undertaken in 1968, 1975 and 1979 by the International Waterfowl and Wetlands Research Bureau (IWRB) in collaboration with the Museum of Natural History in Basrah.
Management authority and jurisdiction: No information.
References: Carp (1975a, 1975b); Carp & Scott (1979); Evans (1994); Georg & Vielliard (1968, 1970); Savage (1968); Scott & Carp (1982); Scott & Evans (1993).
Reasons for inclusion: 1a, 2a & 3b. Known to have been an important breeding, staging and wintering area for waterfowl, including *Marmaronetta angustirostris*.
Source: See references.

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Khawr Al Zubair (32)

Location: 30°12'N, 47°54'E; at the head of the Gulf, 30 km south-southeast of Basrah, Al Basrah Governorate.
Area: 20,000 ha.
Altitude: Sea level.
Physical and ecological features: A huge tidal inlet, over 25 km in length and up to 15 km wide, at the head of the Gulf. The inlet receives freshwater inflow from the Shatt Al Basrah (canal) at its northern end, and opens up into Khawr Abdallah (Site 33) in the southeast. Large areas of intertidal mudflat are exposed at low tide. The khawr is bordered by extensive bare dry saline flats. Tidal amplitude is likely to be high (more than 3 m).
Land tenure: No information.

Conservation measures taken: None. Khawr Al Zubair was listed as a wetland of international importance by Carp (1980), and has been identified as an "Important Bird Area" by BirdLife International (Evans, 1994).
Conservation measures proposed: None known.
Land use: No information.
Disturbances and threats: During the Iran/Iraq war (1980-88), the Shatt Al Basrah canal was constructed as a safer shipping route to Basrah, leading northwards from the Gulf directly through Khawr Al Zubair to connect with the extreme eastern end of Haur Al Hammar near its discharge into the Shatt Al Arab. This is likely to have led to a major and permanent flooding of the khawr. In addition, since December 1992 the "Third River" canal has been discharging saline water into the Shatt Al Basrah and hence into the khawr. The volume of this discharge may increase substantially in future. It is not known what impact all of these developments have had on the khawr and its wildlife (Evans, 1994).
Hydrological and biophysical values: No information.
Social and cultural values: No information.
Noteworthy fauna: Probably a major staging and wintering area for migratory shorebirds, and listed as such by Summers *et al.* (1987). However, the site appears never to have been visited by an ornithologist, and no information is available on its fauna.
Noteworthy flora: No information.
Scientific research and facilities: None known.
Management authority and jurisdiction: No information.
References: Carp (1980); Evans (1994); Georg & Savage (1970b); Summers *et al.* (1987).
Reasons for inclusion: 1a & 3b. Thought to be an important staging and wintering area for migratory shorebirds, but very poorly known.
Source: See references.

Khawr Abdallah and the Fao Area (33)

Location: 29°55'N, 48°26'-48°34'E; near the mouth of the Shatt Al Arab at the head of the Gulf, 100 km southeast of Basrah, Al Basrah Governorate.
Area: c.126,000 ha.
Altitude: Sea level.
Physical and ecological features: A large area of swampy flats (c.90,000 ha) and intertidal mudflats (c.36,000 ha) extending from the region of Fao at the mouth of the Shatt Al Arab west along the northern shore of Khawr Abdallah for at least 50 km (the southern shore of Khawr Abdallah is along the northern edge of Bubiyan Island in Kuwait). The mudflats and swampy flats are backed by a belt of date palms and then by extensive bare silt flats. Tidal amplitude is large (3 m or more). There is a major oil terminal near the site.
Land tenure: No information.
Conservation measures taken: None. Khawr Abdallah and the mudflats in the Fao area were listed as wetlands of international importance by Carp (1980), and have been identified as an "Important Bird Area" by BirdLife International (Evans, 1994).

Conservation measures proposed: None known.
Land use: No information.
Disturbances and threats: No information is available on current threats, but oil pollution is presumably a constant threat. The huge oil spills in 1991 caused by bombing of tankers and the Mina al-Bakr offshore oil terminal apparently did not have any significant impact on this coast, presumably due to prevailing winds and currents carrying the slicks away from the shore (Evans, 1994).
Hydrological and biophysical values: No information.
Social and cultural values: No information.
Noteworthy fauna: The mudflats are believed to be a major staging and wintering area for migratory shorebirds, and were listed as such by Summers *et al.* (1987), but very little information is available. Waterfowl recorded during a survey of the Fao area in January 1968 included 50 *Egretta gularis*, 30 *Ardea cinerea*, one *Threskiornis aethiopicus*, 10 *Platalea leucorodia*, 200 *Ciconia ciconia*, 35 *Phoenicopterus ruber*, 600 *Anas penelope*, 1,200 *A. platyrhynchos*, 200 *A. acuta*, 60 *Haematopus ostralegus*, 230 *Charadrius alexandrinus*, 10 *C. leschenaultii*, 13 *Pluvialis squatarola*, 510 *Numenius arquata*, 110 *Limosa lapponica*, 100 *Tringa cinerea*, 1,000 *Calidris alpina*, 16 *Limicola falcinellus*, 1,100 *Larus genei*, 700 *L. cachinnans*, 200 *Gelochelidon nilotica* and 30 *Sterna caspia*. *Phoenicopterus ruber* is reported to have nested on Bubiyan Island (Kuwait), to the south of Khawr Abdallah (Savage, 1968). *Threskiornis aethiopicus* was recorded as "plentiful" in the 1910s (Cumming, 1918), and *Dromas ardeola* was said to be a common breeding bird (Ticehurst *et al.*, 1921-22).
Noteworthy flora: No information.
Scientific research and facilities: A mid-winter waterfowl survey was undertaken in 1968 by the International Waterfowl and Wetlands Research Bureau (IWRB) in collaboration with the Museum of Natural History in Basrah.
Management authority and jurisdiction: No information.
References: Carp (1980); Cumming (1918); Evans (1994); Georg & Savage (1970b); Georg & Vielliard (1968, 1970); Savage (1968); Summers *et al.* (1987); Ticehurst *et al.* (1921-22).
Reasons for inclusion: 1a & 3b. Believed to be an important staging and wintering area for migratory waterfowl, especially shorebirds, but poorly known.
Source: See references.

New Reservoirs in Northern Iraq

In recent years, several large dams have been constructed on the Euphrates River, Tigris River and major tributaries of the Tigris in northern Iraq. Intended for water storage for irrigation purposes and generation of hydro-electric power, the reservoirs formed behind these dams are developing significant fisheries and, with the rapid loss of natural wetlands throughout the region, are likely to become important as staging and wintering areas for migratory waterfowl. The largest reservoirs to have been completed to date are:

- Haditha Reservoir (34°15'N, 42°20'E) on the Euphrates River 15 km north of the town on Al Haditha. Situated at about c.140 m a.s.l., the reservoir extends for about 60 km

upstream, and has a maximum width of about 15 km.

- Aski Mosul Reservoir (36°32'N, 42°45'E) on the Tigris River 40 km west-northwest of the city of Mosul. The reservoir, which is over 30 km long, is also known as Great Saddam Lake.
- Dukan Reservoir (36°10'N, 44°55'E) on the Little Zab River about 150 km east-southeast of Mosul and 80 km north-northeast of Kirkuk. Situated at about 500 m a.s.l., the reservoir covers about 25,000 ha, and is some 30 km long by up to 15 km wide.
- Darbandikhan Reservoir (35°10'N, 45°50'E) on the Diyala River about 130 km east-southeast of Kirkuk. Also situated at about 500 m a.s.l., this reservoir covers about 7,500 ha, and is some 30 km long by up to 10 km wide.

Other large dams currently under construction include a dam on Al Authaim River, a seasonal tributary of the Tigris, about 20-30 km northeast of Shari Lake. Work was started on the construction of a large dam at Bakhma (36°45'N, 44°15'E) on the Great Zab River, about 110 km east-northeast of Mosul, but this has apparently been abandoned.

Haditha Reservoir, in the main Euphrates valley, and Aski Mosul Reservoir, in the main Tigris valley, are situated on major bird migration routes, and are likely, therefore, to be used as staging areas by large numbers of migratory waterfowl (K.Y. Al-Dabbagh, *in litt.*). No details are, however, available. The valleys of the Great Zab, Little Zab and Diyala Rivers are known to have supported large numbers of wintering ducks in the 1960s (Savage, 1968), and any reservoirs in these valleys are also likely to be important for migratory waterfowl. Two of the dams, Dukan and Darbandikhan, and the hillsides adjacent to them, as well as the proposed Bakhma dam site have been identified as "Important Bird Areas" by BirdLife International (Evans, 1994). The Department of Biology at the University of Mosul is currently carrying out hydrological investigations at Aski Mosul Reservoir, while the Department of Biology at the University of Salahdinn (formerly Sulaiymania) has carried out some research, mainly limnological studies, at Dukan Reservoir.

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Table 1: The Principal Wetlands of Lower Mesopotamia

Wetland	Coordinates	Area in ha
Haur Lafta	31°21'N, 45°31'E	20,000
Haur Delmaj	32°20'N, 45°25'E	100,000
Haur Al Shuwaija (Suwaiqiya)	32°42'N, 45°55'E	50,000
Haur Um Al Baram	32°32'N, 46°07'E	5,000
Haur Al Abjiya	32°25'N, 46°03'E	5,000
Haur Al Hachcham & Haur Maraiba	32°05'N, 46°12'E	8,000
Shatt Al Gharraf	32°30'N, 45°50'E - 31°25'N, 46°10'E	?
Haur Uwainah	31°22'N, 46°25'E	32,500
Haur Abu Ajul	31°28'N, 46°20'E	7,500
Haur Chamuqa	31°22'N, 46°25'E	25,000
Haur Al Sa'adiyah	32°10'N, 46°38'E	140,000
Haur Umm Roij	32°21'N, 46°26'E	1,500
Haur Sarut	32°07'-32°31'N, 46°46'E	?
Haur Al Haushiya	32°05'N, 46°54'E	?
Haur Chubaisah complex	31°53'N, 47°18'E	27,500
Haur Chubaisah		?
Haur Jazrah		?
Haur Sanaf		?
Haur Sanniya	31°55'N, 46°48'E	40,000
Haur Al Rayan & Umm Osbah	31°35'N, 47°02'E	25,000
Haur Auda	31°33'N, 46°51'E	7,500
Central Marshes	30°50'-31°30'N, 46°45'-47°25'E	300,000
Feraigat Marshes	31°30'N, 47°10'E	?
Al Azair Marshes	31°17'N, 47°23'E	?
Haur Umm Al Binni Marshes	31°15'N, 47°05'E	?
Fartus Marshes	31°10'N, 46°55'E	?
Haur Az Zikri	31°10'N, 47°10'E	?
Chabaish Marshes (Chibbaish)	31°00'N, 47°00'E	?
Al Jazair Marshes	31°00'N, 47°15'E	?
Haur Al Hammar	30°35'-31°00'N, 46°25'-47°45'E	350,000
Eastern end of Haur Al Hammar	30°35'N, 47°45'E	?
Haur Aluwez	30°35'N, 47°35'E	?
Southwestern Haur Al Hammar	30°40'N, 46°55'E	?
Fuhud and Hammar	30°57'N, 46°46'E	?
Nasiriya Marshes	31°00'N, 46°25'E	?
Suweid Marshes (Haur Om Al-Nyaj)	31°45'N, 47°25'E	15,000
Haur Al Hawizeh	31°00'-31°45'N, 47°25'-47°50'E	220,000
Nahrsabla Marshes	31°30'N, 47°35'E	?
Shatt Al Arab Marshes	31°00'N, 47°25'E - 29°55'N, 48°30'E	?
Shafi wetland	30°53'N, 47°31'E	?

Table 2: Summary of Waterfowl Counts in Lower Mesopotamia

Surveys

1.	J. Vielliard and P.V. Georg Kainady	21.12.67 - 18.01.68
2.	F.J. Koning and L.J. Dijksen	19.12.72 - 29.12.72
3.	E. Carp	08.01.75 - 02.02.75
4.	E. Carp, P.V. Georg Kainady and D.A. Scott	10.01.79 - 03.02.79

	1.	2.	3.	4.
Tachybaptus ruficollis	19	2	6	32
Podiceps cristatus	-	-	-	14
Podiceps nigricollis	-	15	-	3
Pelecanus onocrotalus	440	873	34	3,004
Pelecanus crispus	119	53	1	244
Unidentified pelicans	-	426	1,573	74
Phalacrocorax pygmaeus	-	6	100	48
Phalacrocorax carbo	1	2	1	36
Egretta garzetta	17	21	7	170
Ardea cinerea	141	550	67	493
Ardea purpurea	-	6	6	35
Casmerodius albus	23	13	82	56
Bubulcus ibis	-	-	-	50
Ardeola ralloides	-	-	10	20
Nycticorax nycticorax	1	25	11	1,820
Ixobrychus minutus	-	-	-	1
Botaurus stellaris	1	-	-	1
Ciconia ciconia	656	13	226	346
Plegadis falcinellus	-	-	-	150
Threskiornis aethiopicus	1	-	-	40
Platalea leucorodia	10	175	-	59
Phoenicopterus ruber	735	874	-	1,857
Oxyura leucocephala	-	1	-	-
Cygnus columbianus	-	-	-	1
Anser albifrons	290	12	-	325
Anser erythropus	-	70	-	-
Anser anser	1,479	991	-	1,502
Unidentified geese	-	150	-	516
Tadorna ferruginea	126	38	6	1,345
Tadorna tadorna	3	37	-	975
Anas penelope	3,361	4,620	6,000	2,184
Anas strepera	21	110	-	13,074
Anas crecca	9,167	63,150	2,135	31,190
Anas platyrhynchos	3,574	15,220	875	1,623
Anas acuta	3,091	13,760	3,051	7,334
Anas querquedula	-	-	-	3
Anas clypeata	5,571	2,217	120	6,100
Netta rufina	-	-	-	7
Aythya ferina	10	70	52	1,955
Aythya fuligula	-	6,800	50	39,292
Aythya marila	-	-	-	2
Mergellus albellus	-	63	-	4
	1.	2.	3.	4.
Unidentified ducks	-	24,300	37,100	50,317
Grus grus	2,617	4	7	116
Rallus aquaticus	1	-	-	1
Porzana pusilla	-	-	-	1

Porphyrio porphyrio	-	-	-	14
Gallinula chloropus	1	2	-	155
Fulica atra	1,029	14,090	37,520	127,966
Himantopus himantopus	268	53	58	631
Recurvirostra avosetta	531	460	20	806
Pluvialis squatarola	-	-	-	6
Charadrius hiaticula	2	1	-	108
Charadrius alexandrinus	7,378	1,404	50	6,943
Charadrius mongolus	-	-	-	1
Charadrius leschenaultii	-	-	-	15
Eudromias morinellus	-	1	-	-
Vanellus vanellus	78	30	1	159
Vanellus indicus	10	++	++	79
Vanellus leucurus	45	++	80	568
Gallinago gallinago	33	3	66	122
Lymnocryptes minimus	2	-	1	1
Limosa limosa	484	280	117	880
Numenius tenuirostris	-	-	-	6
Numenius arquata	-	-	-	1
Tringa erythropus	54	187	21	114
Tringa totanus	86	++	36	514
Tringa stagnatilis	116	5	1	144
Tringa nebularia	7	9	-	70
Tringa ochropus	48	3	1	15
Tringa glareola	7	-	1	9
Tringa cinerea	-	1	-	-
Tringa hypoleucos	4	1	-	2
Calidris minuta	5,063	42	40	2,612
Calidris temminckii	18	2	-	26
Calidris alpina	9,242	126	800	2,775
Calidris ferruginea	-	-	-	10
Philomachus pugnax	2,278	-	1	16
Larus canus	-	-	-	3
Larus cachinnans/armenicus	643	265	330	2,698
Larus ichthyaetus	-	-	-	50
Larus ridibundus	343	1,060	110	9,525
Larus genei	-	++	16	464
Larus minutus	2	-	-	-
Sterna nilotica	35	35	2	65
Sterna caspia	29	22	2	109
Chlidonias hybridus	67	140	30	500

Table 3: International Significance of the Mesopotamian Marshes for Waterfowl

Key to symbols

Figures indicate the proportion (%) of the relevant flyway or regional population which utilizes the wetlands of Mesopotamia.

\+ - proportion believed to exceed 1% but no count data available
++ - proportion believed to exceed 10% but no count data available

	Wintering	Migration seasons	Breeding season
Tachybaptus ruficollis	>50		>50
Pelecanus onocrotalus	30-60	++	
Pelecanus crispus	20-30	++	+
Phalacrocorax pygmaeus	10-20		+
Anhinga rufa	>90		100
Egretta garzetta	3-5	++	
Ardea cinerea	15-30	+	
Ardea goliath	>90		>90
Ardea purpurea	+	++	++
Casmerodius albus	3-6		
Bubulcus ibis	+	++	
Ardeola ralloides		++	
Nycticorax nycticorax	30-50	++	+
Ixobrychus minutus		++	++
Ciconia ciconia	5-10	++	
Plegadis falcinellus	1-2	++	+
Threskiornis aethiopicus	50		100
Platalea leucorodia	1-2	++	+
Phoenicopterus ruber	1-2	+	
Anser albifrons	3-5		
Anser erythropus	+		
Anser anser	3-5		
Tadorna ferruginea	7-10		
Tadorna tadorna	1-2		
Anas penelope	5-10		
Anas strepera	15-20		
Anas crecca	5-10		
Anas platyrhynchos	2-5		
Anas acuta	3-6	++	
Anas querquedula		++	
Anas clypeata	8-15	++	
Marmaronetta angustirostris		++	40-60
Aythya ferina	1-2		
Aythya nyroca	1-2	++	
Aythya fuligula	>20		
Grus grus	15-20		
Porphyrio porphyrio	>50		>50
Fulica atra	10-20		
Himantopus himantopus	5-10	+	+

	Wintering	Migration seasons	Breeding season
Recurvirostra avosetta	20-40	++	+
Glareola pratincola		+	+
Charadrius dubius		+	

Charadrius alexandrinus	15-25	+	+
Vanellus indicus	+		+
Vanellus leucurus	10-20	++	++
Gallinago gallinago	+	+	
Limosa limosa	8-15		
Numenius tenuirostris	++		
Tringa erythropus	5-10	+	
Tringa totanus	2-5	+	
Tringa stagnatilis	2-5	+	
Tringa nebularia	+	+	
Tringa ochropus	+		
Tringa glareola		+	
Calidris minuta	5-10	++	
Calidris temminckii	+		
Calidris alpina	10-15		
Calidris ferruginea		+	
Philomachus pugnax	+	++	
Larus cachinnans/armenicus	5-10		
Larus ichthyaetus	1-2		
Larus ridibundus	5-10		
Larus genei	1-2		+
Sterna nilotica	1-2	+	+
Sterna caspia	2-5	+	+
Sterna hirundo		+	+
Sterna albifrons		+	+
Chlidonias hybridus	2-5	+	

Table 4: Maximum Counts of Waterfowl at Haur Al Hammar (Site 28)

Based on mid-winter waterfowl censuses in December 1972, January 1975 and January 1979.

Tachybaptus ruficollis	22	*Gallinula chloropus*	77
Podiceps cristatus	14	*Fulica atra*	121,455
Pelecanus onocrotalus	1,741	*Himantopus himantopus*	277
P. crispus	139	*Recurvirostra avosetta*	122
Phalacrocorax pygmaeus	11	*Pluvialis squatarola*	6
P. carbo	31	*Charadrius hiaticula*	40
Egretta garzetta	58	*C. alexandrinus*	6,383
Ardea cinerea	272	*C. mongolus*	1
A. purpurea	24	*C. leschenaultii*	15
Casmerodius albus	81	*Vanellus vanellus*	42
Ardeola ralloides	20	*V. indicus*	11
Nycticorax nycticorax	1	*V. leucurus*	145
Botaurus stellaris	1	*Gallinago gallinago*	79
Ciconia ciconia	79	*Lymnocryptes minimus*	1
Platalea leucorodia	175	*Limosa limosa*	355
Phoenicopterus ruber	110	*Numenius tenuirostris*	6
Oxyura leucocephala	1	*Tringa erythropus*	181
Cygnus columbianus	1	*T. totanus*	263
Anser anser	785	*T. stagnatilis*	43
Tadorna ferruginea	30	*T. nebularia*	51
T. tadorna	369	*T. ochropus*	3
Anas penelope	6,000	*T. glareola*	6
A. strepera	10,830	*T. cinerea*	1
A. crecca	59,600	*Actitis hypoleucos*	2
A. platyrhynchos	12,300	*Calidris minuta*	1,900
A. acuta	12,200	*C. temminckii*	17
A. querquedula	3	*C. alpina*	2,125
A. clypeata	2,130	*Philomachus pugnax*	2
Netta rufina	3	*Larus canus*	2
Aythya ferina	1,888	*L. cachinnans/armenicus*	878
A. fuligula	42,280	*L. ichthyaetus*	2
A. marila	2	*L. ridibundus*	1,550
Mergellus albellus	63	*L. genei*	394
Grus grus	10	*Gelochelidon nilotica*	36
Rallus aquaticus	1	*Sterna caspia*	104
Porzana pusilla	1	*Chlidonias hybridus*	356
Porphyrio porphyrio	14		

HASHEMITE KINGDOM OF JORDAN

INTRODUCTION

by Adnan Budieri

Area: 89,210 sq.km.

Population: 4,009,000 (1990).

The Hashemite Kingdom of Jordan is bordered by Syria in the north, Iraq in the northeast, Saudi Arabia in the east and south, and Israel and the West Bank in the west. The country is land-locked except for a 27 km stretch of coastline bordering the Gulf of Aqaba on the Red Sea in the extreme southwest. The majority of the population inhabits the western strip, either in the agriculturally rich Jordan Rift Valley, or in the highlands east of the Rift Valley. The desert supports only nomadic pastoralists and a few villages and settlements set widely apart.

The country consists of distinctive topographic units shaped by the Jordan Rift Valley which trends in a general south-north direction from the Gulf of Aqaba through the Dead Sea to Lake Tiberias. The elevation of the bottom of the valley ranges from sea level in Aqaba on the shores of the Red Sea to around 240 m above sea level at a distance of 80 km to the north; from there it drops gradually to about 400 m below sea level at the present shores of the Dead Sea, and to around 750 m below sea level at the bottom of the Dead Sea. To the north of the Dead Sea, the elevation of the valley rises gradually to around 210 m below sea level on the shores of Lake Tiberias. This rift valley, with a length of 375 km, is about 30 km wide in the area of Wadi Araba and narrows to around 4 km in the Lake Tiberias area.

The highlands to the east of the Jordan Rift Valley rise to elevations of over 1,000 m above sea level in the north at Ajlun and Belqa, and over 1,200 m in the Shoubak and Ras El Naqab areas. This zone ranges from 30 to 50 km in width and extends from the Yarmouk River in the north to Aqaba in the south. From the highest elevations along the edge of the rift, the land drops gradually away to the plateau in the east, but more sharply to the rift valley in the west. The mountains forming the highlands consist mainly of sedimentary rocks with deeply incised wadis draining in a westerly direction.

The steppe or plateau of Jordan developed at the eastern foot of the highlands. Maximum elevations around the edge of the plateau range from 1,000 m in the south to 700 m in the northeast; the lowest part of the plateau lies at an elevation of 500 m in Azraq Oasis. The plateau is a peneplain with hills and weakly incised wadis, but has a generally smooth topography. Surface water, if not captured by westerly wadis, discharges into desert playas or "qa", which form extensive shallow lakes in winter and dry mudflats in summer. The most southerly part of the plateau, which lies to the south of the Ras El Naqab escarpment, is

considered a different topographic unit, although it belongs to the same plateau. This is because it is separated from the plateau by the prominent topographic feature of the escarpment, because it drains to the Dead Sea, and because of its steep topography dictated by different geology consisting of sandstone and granitic basement complex. The elevation of the area is around 900 m above sea level, with a north-south width of around 300 km.

Climatically, much of Jordan can be classified as semi-desert, with only the western highlands enjoying a Mediterranean climate. Over 95% of the land area has an annual rainfall of less than 200 mm, while only 2% has more than 350 mm. Temperatures in the Jordan Valley, Wadi Araba and Aqaba region can rise to 45°C in summer, and the mean annual temperature is 24°C. In winter, the temperature in these areas falls to a few degrees above zero, and frost is a rare event. Most precipitation falls in the form of rain. Snowfall occurs generally once or twice a year over the highlands. The rainy season extends from October to April, with the peak of precipitation taking place during January and February.

Jordan is situated at the junction of three phyto-geographical regions, the Irano-turanian, Afro-subtropical and Mediterranean, and acts as a faunal and floral bridge between the continents of Asia, Africa and Europe. The resulting rich fauna includes species such as *Canis lupus*, *Mellivora capensis*, *Meles meles*, *Lutra lutra*, *Felis chaus*, *Sus scrofa*, *Gazella* spp., *Oryx leucoryx*, *Struthio camelus*, *Francolinus francolinus*, *Ketupa zeylonensis*, *Tilapia gallileae* and *Aphanius serhani*, while the flora includes *Juniperus phoenicia*, *Cupressus sempervirens*, *Pinus halepensis*, *Quercus calliprinos* and *Ziziphus spina-christi*.

Summary of Wetland Situation

Much of Jordan is desert or semi-desert with an arid climate, and as a consequence there are rather few large natural wetlands, the best known being Azraq Oasis in the Eastern Desert. This large desert oasis formerly comprised a complex of spring-fed marshes and pools adjacent to a large seasonally flooded mudflat (Qa Al Azraq) covering some 12,000 ha. However, within the last 15 years, the spring-fed marshes have suffered drastically as a result of the extraction of groundwater for water supply and irrigation purposes and consequent depletion of the aquifer. Natural flow from the two main groups of springs ceased completely in August 1992, and the once extensive marshes and pools have now dried up. The mudflat, which receives its water from surface run-off, was not affected by the exploitation of groundwater, and continues to flood during periods of heavy winter rains. However, a dam was constructed on Wadi Rajil in 1991, cutting off the single most important supply of water to the qa, with the result that winter flooding is far less extensive than was formerly the case.

Elsewhere in the country, there are a number of smaller wetlands that support a distinctive aquatic flora and fauna, and are important for migrating or over-wintering waterfowl. They include permanent spring-fed ponds and marshes, saline marshes, seasonally flooded playa wetlands, man-made water storage reservoirs and sewage treatment plants. The wetlands may be grouped into four main areas:

(1) North Jordan Valley
Wetlands of the Yarmouk River basin (including Birket Al Rais pool), Wadi El Arab and Wadi Ziglab.
(2) Middle Jordan Valley
Zarqa River and King Talal Dam, Kherbit As-Samra Sewage Treatment Plant, and wetlands in the lower Jordan River (Wadi Damia, Kibed Pool, Kafrein Dam, Shu'eib Dam and Swaimeh Pool).
(3) South Jordan Valley
Wadi Mujib.
(4) Eastern Desert
Ghadir Burqu, Qa Khana, Azraq Oasis, Qa Al Jafr and Qa Disi.

Coastal wetlands are confined to Jordan's short stretch of coastline at the head of the Gulf of Aqaba at the northern end of the Red Sea. They include sandy and rocky shorelines, coral reefs and seagrass beds.

Jordan lies on a major migration route for Palearctic waterfowl. The wetlands of Azraq Oasis formerly supported large numbers of migratory waterfowl during the migration seasons and in winter, but with the drying out of these wetlands in recent years, the majority of migratory waterfowl have shifted from the Azraq area to the Jordan Valley. Migrating waterfowl are now more widely dispersed than was formerly the case, and occur in substantial numbers at many different water bodies throughout the Jordan Valley.

The floral and faunal diversity of the wetlands has not as yet been thoroughly surveyed. Key species of wetland plants include *Phragmites communis*, *Juncus maritimus* and *Nerium oleander*, while the non-bird fauna includes 18-20 species of freshwater fishes (*e.g. Tilapia* spp., *Barbus* spp., *Aphanius* spp., *Gara rufa* and *Claris lazera*), the frogs *Rana ridibunda* and *Hyla arborea*, the Tessellated Water Snake *Natrix tessellata* and the Common Otter *Lutra lutra*.

In most parts of Jordan, water resources are scarce and insufficient to meet the growing demands of a rapidly increasing population. As a consequence, the water resources situation is now precarious and of great concern to the Government. All water bodies are looked upon as a source of exploitation for urban, agricultural and industrial uses. Many water bodies are affected by increasing salinity, pollution and eutrophication due to intensive agricultural practices. The once extensive wetlands of the Azraq Oasis have been completely destroyed be over-exploitation of groundwater and dam construction on the major wadis, while seasonal marshes in the Disi and Al Jafr areas are now deteriorating due to the cultivation of barley and wheat. Many of the wadis which once contained small wetlands fed by permanent springs and streams have been dammed for water storage, and there are plans for a joint Syrian-Jordanian dam project on the Yarmouk River. Hunting occurs commonly around wetlands and poses an additional threat to wildlife. As a result of these various detrimental factors, many aquatic species are now on the verge of extinction in Jordan, if not already extinct.

A recent inventory of Important Bird Areas in the Middle East, sponsored by BirdLife International, identified 17 sites of special importance for bird conservation in Jordan (Evans,

1994). Eight of these sites include significant wetlands and are described in the present inventory.

Wetland Research

Numerous studies have been made on the availability and quality of Jordan's water resources, and a variety of recommendations for water conservation and sound water management have been put forward, but the wetlands, with the exception of Azraq Oasis, have received relatively little attention. A considerable amount of research has been carried out at Azraq Oasis, especially in the 1960s when the wetlands were still almost intact, and the avifauna in particular has been well documented. An International Biological Research Station was established at the oasis in 1968, as part of the International Biological Programme, but this was closed down in the following year. A considerable amount of marine research has been conducted in the Gulf of Aqaba, especially on the coral reefs and seagrass beds. A small marine research station was set up near Aqaba by the University of Jordan in 1972, and a new Marine Science Station was established in 1982, to be managed jointly by the University of Jordan and Yarmouk University. Only a few studies have been made on wetlands elsewhere in Jordan. The University of Jordan conducted some studies on aquatic invertebrates and fish at certain man-made water bodies. Yarmouk University has also conducted a comprehensive study on the taxonomy and distribution of fish in Jordan. The Research and Survey Section at the Royal Society for the Conservation of Nature (RSCN) is currently conducting a survey of migratory waterfowl in Jordan.

Wetland Area Legislation

To date, no legislation exists in Jordan which specifically protects wetlands. Protection of wildlife is the responsibility of the Forestry and Range Department in the Ministry of Agriculture. Agricultural Law No.20 of 1973 (Articles 89 to 95 and 144 to 155, as amended by Act No.14 of 1974) provides the legal basis for the control of all hunting activities. The Ministry of Agriculture, lacking expertise, has delegated the control of hunting activities (as well as the establishment and management of protected areas) to a non-governmental organization, the Royal Society for the Conservation of Nature (RSCN), established in 1966 and financed by both government and private donations. In Articles 180 to 186 of the Agricultural Law No.20 (Part IV Aquatic Resources), there are declarations on marine and freshwater fishing areas, and areas and seasons in which fishing may be prohibited or specific kinds of fishing permitted. Under the same law, coral collecting and spear-fishing are prohibited. Dynamiting by fishermen has been forbidden since 1967, and legislated under the 1973 law. The 1975 Ship Act No. 25 prohibits the disposal of chemicals and toxic products, including oil, into the Gulf of Aqaba (IUCN, 1992; UNEP/IUCN, 1988). Other legislation relevant to wetlands and their wildlife includes Agricultural Regulation No.113 of 1973 (Articles 1 to 8), Water Authority Law No.18 of 1988 (Articles 1 to 32), and Jordan Valley

Development Law No.19 of 1988 (Articles 1 to 50).

The Department of Environment, established in the Ministry of Municipal and Rural Affairs and Environment in 1988, has responsibility for regulating and enforcing environmental protection measures in Jordan, including those relating to wildlife, pollution and misuse of natural resources, and for conducting environmental impact assessments. The recent National Environmental Strategy Project (1988-91), coordinated by the Department of Environment, included a review of existing environmental legislation. The National Environmental Strategy was ratified by the Government in 1992, and the proposed Law of Environment, which covers *inter alia* the protection of wetlands and wetland fauna, awaits ratification by the Government.

Wetland Area Administration

The Ministry of Water and Irrigation, created in 1987, has responsibility at national level for the study and development of water resources. The Ministry has two authorities, the Water Authority of Jordan and the Jordan Valley Authority. The Water Authority of Jordan is responsible for water resources studies, planning and allocation, as well as for the provision of water supply and sewerage services throughout Jordan. The Jordan Valley Authority is responsible for the social and economic development of the Jordan Valley, including irrigation activities.

Jordan's protected areas system was established in the early 1970s, and currently comprises three National Parks, six Wildlife Reserves and a Marine Nature Reserve, as well as a number of Grazing Reserves. National Parks are established by ministries and municipal authorities, mainly for recreation and tourism; none of those established to date contains significant wetland habitat. The Ministry of Agriculture has delegated the establishment and management of Wildlife Reserves to the Royal Society for the Conservation of Nature (RSCN). Only one of the Wildlife Reserves established to date was created specifically to protect wetland habitat, namely the Azraq Wetland Reserve (1,245 ha), first declared a reserve by Royal Proclamation in 1965 and upgraded to its present status of Wetland Reserve in 1977. Since the wetlands of Azraq Oasis have dried out, this reserve has to a large extent been abandoned. However, one other Wildlife Reserve, the Wadi Mujib Wildlife Reserve (21,200 ha, established in 1985), incorporates an interesting perennial wadi system and a section of the Dead Sea shoreline. A small Marine Nature Reserve was established by the Aqaba Region Authority near the Marine Science Station in the Gulf of Aqaba in 1985, and other marine reserves are planned for this area. The Aqaba South Coast Master Plan, which was prepared under the auspices of the Aqaba Region Authority, involved the preparation of a coastal zone management plan for the entire Aqaba region.

At international level, the Government of Jordan ratified the Convention on Wetlands of International Importance especially as Waterfowl Habitat (the Ramsar Convention) on 10th January 1977, and designated Azraq Oasis (7,372 ha) as a Ramsar Site at the time of ratification. The Department of Environment in the Ministry of Municipal and Rural Affairs and Environment is responsible for administration of the Ramsar Convention in Jordan. The

Government of Jordan ratified the World Heritage Convention in May 1975, but has not as yet designated any natural World Heritage Sites. The Government has also ratified the Biodiversity Convention and the Regional Convention for the Conservation of the Red Sea and Gulf of Aden Environment, and is a contracting party to the Convention on International Trade in Endangered Species (CITES) and the Hague Convention for the Protection of the Environment (IUCN, 1992). Jordan participates in the UNESCO Man and the Biosphere Programme through a National Committee. No Biosphere Reserves have as yet been established, but at least one is under consideration, and this (the Burqu area) includes important wetland habitat.

BirdLife International's regional office for the Middle East, established in 1994, is based at the Royal Society for the Conservation of Nature in Amman. This regional office will monitor the status of Important Bird Areas, many of which are wetlands, throughout the Middle East, and will promote the establishment of protected areas wherever possible.

Organizations involved with Wetlands

a) Government of Jordan
- Ministry of Municipal and Rural Affairs and the Environment
  - Department of Environment
    - Ramsar Convention Division
- Ministry of Agriculture
  - Department of Forestry and Soil Preservation
    - Forestry Division
- Ministry of Water and Irrigation
  - Water Resources Administration
  - Water Authority of Jordan
    - Water Resources Studies Department
    - Irrigation Division
  - Jordan Valley Authority
- Aqaba Region Authority

b) Universities
- University of Jordan
  - Water and Environment Research and Study Centre
- Yarmouk University
  - Biology Department

c) Non-governmental Organizations
- Royal Society for the Conservation of Nature (RSCN)
  - Reserves Section, Research and Survey Section
- BirdLife International Middle East Regional Office

WETLANDS

Site descriptions (except Azraq Oasis) compiled by Adnan Budieri of the Research and Survey Section, Royal Society for the Conservation of Nature. The data were collected by Adnan Dajani, Darweish Al-Shafii, Ali Al-Sutari, Taher Asfour and Walid Al-Zamil. Information on Azraq Oasis has been taken from the literature.

Yarmouk River (1)

Location: 32°44'N, 35°44'E; on the Syrian border, about 20 km north of Irbid, Irbid Governorate.
Area: c.3,000 ha.
Altitude: c.300 m above sea level to 210 m below sea level.
Physical and ecological features: The Yarmouk River, which is said to be the least polluted of Jordan's rivers, flows through a steep-sided valley running along the international border with Syria, and eventually enters the River Jordan a few km south of Lake Tiberias. The average annual flow in the river has been variously estimated at 393 million cubic metres (Ahmad, 1989) and 357 MCM (MMRAE, 1991). The river banks support lush stands of *Phragmites communis*, *Nerium oleander*, *Juncus maritimus* and other wetland plants typical of the region, while the hill slopes support remnants of native *Pinus halepensis* woodland. There is a small, spring-fed pool at Birket al Rais.
Land tenure: No information.
Conservation measures taken: None. Access to much of the area is restricted for security reasons, and this provides some indirect protection. The Yarmouk Valley has been identified as an "Important Bird Area" by BirdLife International (Evans, 1994).
Conservation measures proposed: None known.
Land use: Situated along the Syrian border, the river valley is treated as a military zone. The river is used as a water supply to irrigate farmland in the Jordan Valley. Fishing and reed-cutting occur along the river, and the adjacent land is intensively cultivated for fruits and vegetables.
Possible changes in land use: There have long been plans for a large-scale, joint Jordanian-Syrian dam across the Yarmouk River (Wahda or Unity Dam), which would potentially be a critical threat to the riverine wetlands. In the 1970s, a major environmental impact study to assess the adverse effects on the human and natural environment of this dam was completed by US-AID.
Disturbances and threats: Diversion of water to supply irrigation to intensive agricultural projects in the Jordan Valley is a critical problem along the lower course of the river. Wet areas along the banks of the river have been drained for agricultural purposes, and dynamite fishing has been reported in the river. Soil erosion is said to be a problem locally, and occasional hunting occurs. Over-exploitation of groundwater in the basin has led to a general depletion in spring flows. The Coypu *Myocastor coypus* has been introduced; its effects on riverine vegetation are unknown but may be highly destructive. The Ramtha Wastewater Treatment Plant discharges treated effluent into the river, but this is currently considered to be at an acceptable level (Ahmad, 1989).

Hydrological and biophysical values: No information.
Social and cultural values: No information.
Noteworthy fauna: Many species of waterbirds have occurred in the area during the migration seasons and in winter, including *Bubulcus ibis*, *Ardea cinerea*, *A. purpurea*, *Anas crecca*, *Gallinula chloropus*, *Vanellus vanellus*, *Gallinago gallinago*, *Tringa totanus*, *T. nebularia*, *Actitis hypoleucos*, *Larus ridibundus* and *Alcedo atthis*. *Fulica atra* breeds, and the rare Brown Fish Owl *Ketupa zeylonensis* is known to have occurred in the area as recently as 1986 (Evans, 1994). Other fauna includes the Rock Hyrax *Procavia capensis*, Jungle Cat *Felis chaus*, the frog *Rana ridibunda* and species of tilapia *Tilapia* spp. including the endemic *Tilapia gallileae*.
Noteworthy flora: No information.
Scientific research and facilities: None known.
Management authority and jurisdiction: The area lies under the jurisdiction of the Jordan Valley Authority.
References: Ahmad (1989); Evans (1994); MMRAE (1991); Pearce (1993).
Reasons for inclusion: 1a, 1c & 2b. A good example of a relatively intact riverine system along an international border, with habitat for the rare and local *Ketupa zeylonensis*.
Source: Adnan Budieri.

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Wadi El Arab (2)

Location: 32°35'N, 35°40'E; in the northern highlands and north Jordan Valley, 10-25 km west-northwest of Irbid, Irbid Governorate.
Area: 26,700 ha.
Altitude: c.300 m above sea level to 220 m below sea level.
Physical and ecological features: Wadi El Arab and its tributary wadis rise in the hills west of Irbid city and drain west into the Jordan Valley, entering the Jordan River about 10 km south of Lake Tiberias. The annual average flow in the wadi has been estimated at 28.8 million cubic metres (Ahmad, 1989) or 17 MCM (MMRAE, 1991). A dam was constructed on the main wadi in 1987, with a total capacity of 20 MCM, to collect flood water and base flows for use in irrigation in the Jordan Valley area. Since its completion, the dam has filled with water originating from within its catchment area only in the very wet year of 1991/92. In other years, water has been pumped from the King Abdallah Canal during floods to increase the stored amount of water in the dam for use during the dry season. Wetland vegetation includes *Phragmites communis*, *Nerium oleander* and *Tamarix aphylla*.
Land tenure: No information.
Conservation measures taken: None.
Conservation measures proposed: None known.
Land use: The dam is used for irrigation, and has substantial potential for fish production (Ahmad, 1989). The catchment area is under agriculture.
Possible changes in land use: No information.
Disturbances and threats: Irbid City is expanding westwards into the catchment, and this may put increasing pressure on the quality of the water collected in the dam.

Hydrological and biophysical values: No information.
Social and cultural values: No information.
Noteworthy fauna: Many species of waterbirds have occurred in the area during the migration seasons and in winter, including *Bubulcus ibis*, *Egretta garzetta*, *Casmerodius albus*, *Ardea cinerea*, *Anas crecca*, *Fulica atra*, *Tringa totanus*, *T. stagnatilis*, *T. nebularia*, *Larus ridibundus*, *Ceryle rudis*, *Halcyon smyrnensis* and *Alcedo atthis*. Other fauna includes the frog *Rana ridibunda* and the fish *Tilapia zilli* and *Claris lazera*.
Noteworthy flora: No information.
Scientific research and facilities: None known.
Management authority and jurisdiction: No information.
References: Ahmad (1989); MMRAE (1991).
Reasons for inclusion: 1a. A good example of a wadi system with perennial surface flow.
Source: Adnan Budieri.

Wadi Ziglab (3)

Location: 32°29'N, 35°40'E; in the northern highlands and north Jordan Valley, 10-25 km west-southwest of Irbid, Irbid Governorate.
Area: 10,600 ha.
Altitude: c.300 m above sea level to c.250 m below sea level.
Physical and ecological features: Wadi Ziglab rises in the hills southwest of Irbid city and drains west into the Jordan Valley, entering the Jordan River about 20 km south of Lake Tiberias. The annual average surface flow in the wadi has been estimated at 9.5 million cubic metres (Ahmad, 1989). Various springs produce a total discharge of some five million cubic metres per year, and flood waters make up the remainder. A dam was constructed in the wadi in 1966 to provide water for irrigation in the Jordan Valley area. The capacity of the reservoir is 4.3 million cubic metres. The catchment area is agrarian with natural forests and a very low human population density. Hence, the water collected in the dam is of high quality. The wetland vegetation is dominated by plant species typical of semi-arid conditions such as *Nerium oleander*, *Phragmites communis*, *Retma raetum* and *Tamarix aphylla*.
Land tenure: No information.
Conservation measures taken: None.
Conservation measures proposed: None known.
Land use: The dam is used for irrigation purposes, and has potential for substantial fish production (Ahmad, 1989),
Possible changes in land use: No information.
Disturbances and threats: None known.
Hydrological and biophysical values: No information.
Social and cultural values: No information.
Noteworthy fauna: The wetland fauna includes the frogs *Rana ridibunda* and *Hyla arborea*, and reptiles such as *Agama* spp. and *Geko* spp. Species of waterfowl recorded on migration include *Ixobrychus minutus*, *Nycticorax nycticorax*, *Egretta garzetta* and *Ardea cinerea*.

Noteworthy flora: No information.
Scientific research and facilities: None known.
Management authority and jurisdiction: No information.
References: Ahmad (1989).
Reasons for inclusion: 1a. A good example of a wadi system with perennial surface flow.
Source: Adnan Budieri.

Zarqa River and King Talal Dam (4)

Location: 32°12'N, 35°35'-36°00'E; in the northern highlands and north Jordan Valley, about 35 km north of Amman, Balqa and Irbid Governorates.
Area: Area of river basin 402,500 ha.
Altitude: c.600 m above sea level to c.300 m below sea level.
Physical and ecological features: The Zarqa River and its main tributaries rise in the highlands northeast of Amman and drain almost due west into the Jordan Valley, entering the Jordan River about 65 km south of Lake Tiberias. The annual average surface flow in the river has been variously estimated at 67.3 million cubic metres (Ahmad, 1989) and 92.0 MCM (MMRAE, 1991). A large dam, the King Talal Dam (32°12'N, 35°48'E; 300 m above sea level) has been constructed on the Zarqa River about 15 km south-southwest of Ajlun. The reservoir behind the dam is about 4 km long, and has a capacity of 85 million cubic metres. There are natural pine forests adjacent to the dam.
Land tenure: No information.
Conservation measures taken: None.
Conservation measures proposed: None known.
Land use: Although originally constructed for water storage for human consumption, the dam is now used only for irrigation purposes because of the high levels of pollution in the lake. It has been estimated that the reservoir could produce 400 tonnes of tilapia per year, but the levels of pollution are such that the fish would be unfit for human or animal consumption (Ahmad, 1989).
Possible changes in land use: None known.
Disturbances and threats: Pollution is a very serious problem in the Zarqa River and hence also in King Talal Dam, the major sources of pollution being phosphate mines, oil refineries and heavy industry in the catchment. Rare elements and heavy metals occurring at unacceptably high levels include mercury, nickel, arsenic, lead, selenium and cadmium (Ahmad, 1989). Waste water from Kherbit As-Samra Sewage Treatment Plant is discharged into Wadi Dhulayl, a tributary of the Zarqa River, adding to the pollution in the dam, with the result that King Talal Dam is now one of the most contaminated water bodies in Jordan. Elsewhere in the basin, over-exploitation of groundwater has led to a reduction in spring flows.
Hydrological and biophysical values: No information.
Social and cultural values: No information.
Noteworthy fauna: King Talal Dam is an important staging and wintering area for a wide variety of migratory waterfowl such as *Ixobrychus minutus*, *Bubulcus ibis*, *Egretta garzetta*,

Ardea cinerea, *Ciconia ciconia*, *Anas crecca*, *A. platyrhynchos*, *Fulica atra* and various shorebirds. The dam sustains large stock of fish, including both indigenous species and introduced species, notably *Tilapia* spp., *Claris lazera*, *Noemacheilus damascena* and *Aphanius* spp. A Common Otter *Lutra lutra* was observed in one of the streams near the Zarqa River in 1987, and it is reported that the Persian Squirrel *Sciurus anomalus* still survives in native pine forests on the adjacent hills.
Noteworthy flora: No information.
Scientific research and facilities: None known.
Management authority and jurisdiction: No information.
References: Ahmad (1989); MMRAE (1991).
Reasons for inclusion: 1a & 3b. A major river system and reservoir important for migratory waterfowl.
Source: Adnan Budieri.

Kherbit As-Samra (5)

Location: 32°10'N, 36°10'E; in the northern highlands, about 35 km northeast of Amman, Zarqa Governorate.
Area: 300 ha.
Altitude: c.500 m.
Physical and ecological features: Kherbit Al-Samra Sewage Treatment Plant is the main sewage treatment plant for the city of Amman; it comprises a large area of open, man-made pools in a broad depression close to Wadi Dhulayl, a tributary of the Zarqa River. Pools range from sludge to "fresh" water, with rocky shores and very little natural vegetation. The pools are surrounded by rather bare limestone desert.
Land tenure: No information.
Conservation measures taken: None. The site has been identified as an "Important Bird Area" by BirdLife International (Evans, 1994).
Conservation measures proposed: In the late 1980s, a consultant proposed various wildlife-friendly management regimes to the operators of the sewage treatment plant.
Land use: The sewage treatment plant utilizes stabilization ponds and is capable of achieving secondary treatment of up to 68,000 cubic metres of raw sewage per day (Ahmad, 1989). Some of the treated water is used to irrigate olive groves.
Possible changes in land use: No information.
Disturbances and threats: Levels of human disturbance are high, but hunting is considered to be insignificant at present.
Hydrological and biophysical values: No information.
Social and cultural values: No information.
Noteworthy fauna: An important staging and wintering area for a wide variety of migratory waterfowl, and especially important as a staging area for White Storks *Ciconia ciconia* in autumn; as many as 6,000 have been recorded roosting at the site in August. Other peak counts of migrants in autumn have included 230 *Anas querquedula*, 500 *Calidris minuta*, 110 *Tringa*

ochropus and 150 *Chlidonias leucopterus*. Breeding species include *Vanellus spinosus* (at least 14 pairs) and possibly *Himantopus himantopus*, *Charadrius dubius* and *C. alexandrinus*.
Noteworthy flora: No information.
Scientific research and facilities: None known.
Management authority and jurisdiction: No information.
References: Ahmad (1968); Evans (1994).
Reasons for inclusion: 3b & 3c. An important staging and wintering area for migratory waterfowl, notably *Ciconia ciconia*.
Source: Adnan Budieri.

Wadi Damia, Kibed Pool, Kafrein Dam, Shu'eib Dam and Swaimeh Pool (6)

Location: 31°50'N, 35°40'E; in the north-central highlands and middle Jordan Valley, about 10-40 km west-southwest of Amman, Balqa and Amman Governorates
Area: Wadi Damia 18,600 ha; Kibed Pool 50 ha; Kafrein Dam 800 ha; Shu'eib Dam 600 ha; area of Swaimeh Pool unknown.
Altitude: c.600 m above sea level to the shores of the Dead Sea at 395 m below sea level.
Physical and ecological features: A group of small wetlands including natural brackish to saline pools, water storage reservoirs and riverine marshes in the Jordan Valley and tributary wadis near the north end of the Dead Sea. The Jordan River in the west flows in a deeply incised channel, and supports *Tamarix* woodland and beds of *Phragmites* along its banks. The river is now highly saline because of inflow of water from brackish and saline springs near Lake Tiberias in the north and return flow from irrigated land throughout the valley. Savage (1968) refers to a small marsh at the head of the Dead Sea near the outfall of the Jordan River (Ein Feshka; 31°37'N, 35°38'E), but the present status of this area is unknown. Dams have been constructed on two of the principal tributary wadis: Kafrein Dam, with a capacity of 4.8 million cubic metres, in Wadi Kafrein, and Shu'eib Dam, with a capacity of 2.3 million cubic metres, in Wadi Shu'eib. Both wadis rise in the highlands to the southwest of Amman and join the Jordan River just north of the Dead Sea. Ahmad (1989) gives the average annual surface flows as 14.3 million cubic metres in Wadi Kafrein and 7.9 million cubic metres in Wadi Shu'eib. Kibed Pool is a highly saline pool. The dominant wetland vegetation is *Phragmites communis* and *Tamarix* sp., but there are some patches of *Populus euphratica*. All the sites are surrounded by irrigated cultivation, with crop fields, market gardens and orchards.
Land tenure: No information.
Conservation measures taken: None. An area of about 80,000 ha of cultivated plains along the Jordan River has been identified as an "Important Bird Area" by BirdLife International (Evans, 1994).
Conservation measures proposed: None known.
Land use: This is the main agricultural area in Jordan, and population density is relatively high. Other activities include livestock grazing, aquaculture, hunting, recreation and tourism. Kafrein Dam is used for irrigation purposes, while Shu'eib Dam is used for groundwater recharge. The

Jordan River is now too saline to be used for irrigation purposes.
Possible changes in land use: No information.
Disturbances and threats: All of the wetlands are subjected to over-extraction of groundwater, intensification of agriculture, eutrophication, salinization, unplanned urban expansion, and toxic pollution from persistent pesticides, herbicides and heavy metals. Because of increasing salinity, the River Jordan is apparently no longer fit for human use. Other less serious threats include overgrazing, hunting, the dumping of rubbish, and excessive disturbance from human activities.
Hydrological and biophysical values: No information.
Social and cultural values: No information.
Noteworthy fauna: The Jordan Valley lies on a major bird migration route, and the wetlands are of considerable importance as breeding, staging and wintering areas for waterbirds. Breeding species include *Ardea cinerea*, *Francolinus francolinus*, *Gallinula chloropus*, *Himantopus himantopus*, *Ceryle rudis*, *Halcyon smyrnensis*, *Alcedo atthis* and *Acrocephalus scirpaceus*. *Marmaronetta angustirostris* is a very scarce breeding bird (less than 10 pairs) in reed-beds along the Jordan River (*e.g.* in the Wadi Damia area). Waterbirds recorded on passage and in winter include *Pelecanus onocrotalus* (up to 350 in a day in autumn), *Nycticorax nycticorax*, *Bubulcus ibis* (up to 300 in winter), *Egretta garzetta*, *Ciconia ciconia* (up to 5,000 on passage), *C. nigra* (up to 11 on passage), *Tadorna ferruginea*, *T. tadorna*, *Anas penelope*, *A. crecca*, *A. querquedula*, *Rallus aquaticus*, *Porzana porzana*, *Fulica atra*, *Recurvirostra avosetta*, *Charadrius dubius*, *Pluvialis squatarola*, *Vanellus vanellus*, *V. spinosus*, *Eudromias morinellus* (up to 50 in winter), *Tringa nebularia*, *T. ochropus*, *Actitis hypoleucos*, *Calidris minuta*, *C. alpina*, *Larus ridibundus* and *Chlidonias leucopterus*. *Botaurus stellaris* has occurred as a rare winter visitor, and *Crex crex* and *Gallinago media* have been recorded in small numbers on passage. Ein Feshka, at the north end of the Dead Sea, was reported to be of great ornithological interest and used by waterfowl on passage (Savage, 1968). The main water bodies are inhabited by many crustaceans, notably *Gammarus* spp. and crabs, and various fish such as *Barbus canis*, *B. longiceps*, *Gara rufa*, *Tilapia gallileae* and *Aphanius* spp.
Noteworthy flora: No information.
Scientific research and facilities: None known.
Management authority and jurisdiction: No information.
References: Ahmad (1989); Evans (1994); Savage (1968).
Reasons for inclusion: 1a, 2a, 2b, 2c & 3c. The site contains a variety of wetland habitats with a diverse fauna, including globally threatened species (*e.g. Marmaronetta angustirostris*) and endemic species (*e.g. Tilapia gallileae*), and is an important staging and wintering area for migratory waterfowl.
Source: Adnan Budieri.

Wadi Mujib (7)

Location: 31°27'N, 35°35'-36°00'E; in the central highlands and south Jordan Valley, about 30 km south of Madaba, Amman and Karak Governorates.

Area: Area of wetlands unknown; area of catchment 659,600 ha.
Altitude: 400 m below sea level to 1,100 m above sea level.
Physical and ecological features: A major wadi system extending from near the summit of the eastern escarpment of the Rift Valley west for about 70 km to the shores of the Dead Sea. In their upper reaches, the main wadi and its tributaries descend through steep gorges in rocky, mountainous terrain, with cliffs and crags; in their lower reaches, the wadis cut through a broad plateau which slopes gradually down to the Dead Sea. The principal tributary wadi, Wadi Hidan, enters Wadi Mujib from the north only a few km from the shores of the Dead Sea. Perennial, spring-fed streams flow down the wadis, and are lined with a narrow strip of *Nerium oleander* shrubs. The vegetation in the wadi floor also includes beds of *Phragmites communis* and *Juncus maritimus*, and scattered *Phoenix dactylifera*. The average annual surface flow in Wadi Mujib has been estimated at 34.7 million cubic metres (Ahmad, 1989). Away from the wadi floor, the slopes are very sparsely vegetated, with semi-desertic steppe vegetation on the plateau. Groundwater seepage occurs rarely on rocky ground near the Dead Sea shore, especially at the hot springs of Zara, which support a luxuriant thicket of *Acacia*, *Tamarix*, *Phoenix* and *Nerium*. The rocks forming the catchment area consist of fractured limestone, dolomites, shales, sandstone and shert beds. The average annual rainfall in the area is about 150 mm.
Land tenure: No information.
Conservation measures taken: A Wildlife Reserve of 21,200 ha was established in Wadi Mujib in 1987, and extends to the shores of the Dead Sea. The Nubian Ibex *Capra ibex nubiana* is being bred in an enclosure for re-introduction. The Wildlife Reserve has been identified as an "Important Bird Area" by BirdLife International (Evans, 1994).
Conservation measures proposed: None known.
Land use: Adjacent slopes at higher elevations are used for livestock grazing, mainly sheep and goats. There is a temporary military camp in the southern part of the reserve.
Possible changes in land use: No information.
Disturbances and threats: Wadi Mujib is vulnerable to the effect of over-pumping of groundwater and increasing salinity. Pumping projects were started in some of the main streams in 1993. A highway is currently being built linking the Middle Jordan Valley with Aqaba, and this will create additional pressure on the wildlife of the area. Much of the steppe vegetation on higher plateaux has been destroyed by ploughing and overgrazing. The flow of water in Wadi Hidan, within the Wildlife Reserve, is potentially threatened by the planned damming of the upper reaches of the wadi (known as Wadi Wala) east of and outside the reserve.
Hydrological and biophysical values: No information.
Social and cultural values: No information.
Noteworthy fauna: The indigenous fauna of Wadi Mujib includes the fishes *Barbus* spp., *Capoeta damascena*, *Gara* spp., *Hemiggrammacopoeta nana* and *Aphanius* spp., various crabs, the frogs *Rana ridibunda* and *Hyla arborea*, lizards of the genus *Agama*, Nubian Ibex *Capra ibex nubiana*, Mountain Gazelle *Gazella dorcas*, Rock Hyrax *Procavia capensis*, Caracal *Lynx caracal*, Wolf *Canis lupus*, Red Fox *Vulpes vulpes* and Indian Crested Porcupine *Hystrix indica*. The Leopard *Panthera pardus* may still occur in the area. The White Stork *Ciconia ciconia* occurs in very large numbers during the spring and autumn migration seasons, with flocks often resting on the shores of the Dead Sea. Other waterfowl recorded on passage include *Bubulcus ibis*, *Egretta garzetta*, *Ardea cinerea*, *Plegadis falcinellus*, *Platalea leucorodia*,

Ciconia nigra, *Phoenicopterus ruber*, *Haematopus ostralegus*, *Himantopus himantopus* and *Charadrius hiaticula*. *Charadrius alexandrinus* and *Vanellus spinosus* breed along the shores of the Dead Sea. The region as a whole supports a rich breeding bird assemblage of unusually mixed biogeographical origins, including at least nine species of birds of prey (Evans, 1994).
Noteworthy flora: No information.
Scientific research and facilities: None known.
Management authority and jurisdiction: No information.
References: Ahmad (1989); Evans (1994); MMRAE (1991).
Reasons for inclusion: 1a, 2b & 3b. An outstanding example of a wadi system with rich and diverse indigenous fauna; also an important staging area for migratory waterfowl, notably *Ciconia ciconia*.
Source: Adnan Budieri.

Ghadir Burqu (8)

Location: 32°38'N, 37°57'E; in the Eastern Desert, 12 km north-northwest of the village of Muqat on the main Amman to Baghdad road, about 200 km east-northeast of Amman, Mafraq Governorate.
Area: 200 ha.
Altitude: c.700 m.
Physical and ecological features: Ghadir Burqu is a natural freshwater lake covering about 200 ha in the Eastern Desert, some 40 km south of the Syrian border. The lake is fed by springs, and seldom if ever dries out completely. The surrounding desert landscape consists of flint/chert plains (hammada) in the east, and flattish to gently rolling country covered in black basalt boulders (harrat) in the west, interspersed with silt flats and many shallow wadis. Plant cover is generally sparse, mainly limited to the shallow wadis and dominated by woody perennial herbs such as *Artemisia*, *Anabasis* and *Achillea*.
Land tenure: No information.
Conservation measures taken: A Wildlife Reserve of 95,000 ha, including the wetland and a large area of the surrounding desert, is currently in the process of being established by the RSCN. The Wildlife Reserve has been identified as an "Important Bird Area" by BirdLife International (Evans, 1994).
Conservation measures proposed: The RSCN is currently planning to carry out a survey of the area to assess its suitability as a Biosphere Reserve. Large fauna proposed for re-introduction include Ostrich *Struthio camelus*, Cheetah *Acinonyx jubatus*, gazelles *Gazella* spp. and Wild Ass *Equus hemionus*.
Land use: The lake is a major source of water for the livestock of bedouin living in a wide surrounding area. The main land use in the surrounding desert is nomadic pastoralism, and there is very little cultivation.
Possible changes in land use: No information.
Disturbances and threats: The area is subjected to very intense grazing by camels, sheep and goats. The trapping of birds of prey at the wetland is a major problem, and bird shooting is often

excessive. Water extraction by pastoralists for their flocks could have a serious impact on the lake in the near future if current trends continue (Evans, 1994).
Hydrological and biophysical values: No information.
Social and cultural values: There is a Roman/Byzantine castle at Burqu, which gives the area its name.
Noteworthy fauna: A wide variety of waterbirds and passerines are attracted to the wetland during the migration seasons and in winter, including *Ciconia ciconia* and several species of ducks *Anas* spp. As many as 100 Common Cranes *Grus grus* spend the winter in the area, and the scarce and local southwest Asian race of the Greater Sand Plover *Charadrius leschenaultii columbinus* breeds on the silt flats. The wetland is an important source of water for large numbers of birds of prey during the autumn migration season (*e.g.* up to 85 *Circus pygargus* in one day in September). The surrounding desert supports a relatively rich and intact desert bird community including *Chlamydotis undulata*, which may breed (Evans, 1994). Mammals in the surrounding desert include Goitred Gazelle *Gazella subgutturosa*, Wolf *Canis lupus*, Red Fox *Vulpes vulpes* and possibly Caracal *Lynx caracal*.
Noteworthy flora: No information.
Scientific research and facilities: None known.
Management authority and jurisdiction: No information.
References: Evans (1994); MMRAE (1991).
Reasons for inclusion: 1d, 2c & 3b. A good example of a rare wetland type (permanent freshwater lake in a desert region), of considerable importance as a staging area for migratory birds.
Source: Adnan Budieri.

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Qa Khana (9)

Location: 32°04'N, 36°35'E; in the Eastern Desert, 7 km north of the main Zarqa to Azraq highway, about 40 km east of Zarqa and 60 km east-northeast of Amman, Zarqa Governorate.
Area: c.3,000 ha.
Altitude: c.600 m.
Physical and ecological features: Qa Khana (Qa Hanna) is a seasonal playa lake, about 15 km long and up to 3 km wide, with very sparse vegetation consisting mainly of halophytes. The mudflats and surrounding saline marshes flood in years of good rainfall, and can then remain wet for several months. In some wadis, there are scattered beds of *Phragmites communis* and patches of *Juncus maritimus*, *Tamarix jordanis* and *Retma raetum*.
Land tenure: No information.
Conservation measures taken: None. Qa Khana has been identified as an "Important Bird Area" by BirdLife International (Evans, 1994).
Conservation measures proposed: None known.
Land use: A large farm has been established in the surrounding desertic steppe, and this takes irrigation water from the qa. The steppe is grazed by domestic livestock, and there is a military base near the site.

Possible changes in land use: No information.
Disturbances and threats: Threats include the expansion of agriculture and increasing use of the qa as a source of water for irrigation. Hunting is often excessive, and there is very heavy grazing pressure on the surrounding plains.
Hydrological and biophysical values: No information.
Social and cultural values: No information.
Noteworthy fauna: When flooded, an important staging and wintering area for migratory waterfowl, including *Ardea purpurea*, *Ciconia ciconia*, *Tadorna tadorna*, *Anas crecca*, *A. acuta*, *A. clypeata*, *A. querquedula*, *Aythya fuligula*, *Grus grus* (up to 200 in spring), *Charadrius alexandrinus*, *Vanellus vanellus*, *V. spinosus*, *Tringa nebularia* and *Philomachus pugnax*. The scarce and local southwest Asian race of the Greater Sand Plover *Charadrius leschenaultii columbinus* breeds around the qa. Very soon after flooding, the shallow pools develop a rich fauna of halophytic crustaceans such as *Cyclops* spp., *Triops canseriformes* and *Daphnia* spp., most probably transferred to the site by waterfowl. The toad *Bufo viridis* also becomes common after rains.
Noteworthy flora: No information.
Scientific research and facilities: None known.
Management authority and jurisdiction: No information.
References: Evans (1994).
Reasons for inclusion: 1a & 3b. A good example of a playa wetland, and an important staging and wintering area for migratory waterfowl in wet years.
Source: Adnan Budieri.

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Azraq Oasis (10)

Location: 31°44'-31°53'N, 36°48'-36°55'E; in the Eastern Desert, about 85 km east-southeast of Amman, Zarqa Governorate.
Area: c.12,000 ha.
Altitude: 500 m.
Overview: The wetlands of Azraq Oasis formerly comprised a complex of fresh to brackish pools and marshes fed by two groups of springs (Druze and Shishan) and a large seasonally flooded mudflat or playa (Qa Al Azraq) fed by surface run-off during winter and spring. Massive extraction of groundwater for water supply and irrigation, especially since 1982, has resulted in a cessation of all spring flow, and the former extensive spring-fed marshes have now almost disappeared. Some marsh vegetation survives around the main spring pools, at an artesian borehole and around a small group of fishponds, but elsewhere the marshes are now desiccated. With the construction of a dam in 1992 on Wadi Rajil, one of the main wadis emptying into the oasis, the extent of winter flooding in Qa Al Azraq has been reduced.
Until recently, Azraq Oasis was an outstanding example of an oasis wetland in an arid region, with few parallels anywhere else in the world. The oasis was especially important for migratory birds, with up to a million birds utilizing the area during the course of a single spring migration. At least 33 species of waterbirds are known to have bred in the wetlands, and as many as

347,000 waterfowl have been recorded in mid-winter. The oasis was first protected as a Reserve by Royal Proclamation in 1965. Some 7,372 ha of the wetlands were designated as a Ramsar Site in 1977, and 1,245 ha, including the main spring-fed marshes and a part of the adjacent qa, were declared a Wetland Reserve in the same year.

The RSCN and various international bodies have intervened on a number of occasions in an attempt to reduce the rate of groundwater extraction in Azraq Oasis, and a special Cabinet Committee, headed by the Prime Minister, was set up in the late 1980s to investigate the problem, but no lasting solutions were found and the condition of the spring-fed marshes continued to deteriorate. A recently initiated project funded through the Global Environment Facility will endeavour to halt further degradation of the aquatic ecosystems in the oasis and to restore as much of the wetlands as possible to a natural or near-natural condition with a view to maintaining the biological diversity of this unique wetland ecosystem.

Physical features: Azraq Oasis is located at the heart of a large internal drainage basin covering around 12,710 sq.km, most of which (94%) lies in Jordanian territory, with the remainder in Syria (5%) and Saudi Arabia (1%). The highest relief in the basin is at Tillin Town in Syria with an elevation of 1,550 m; the lowest point is at Qa Al Azraq in the Azraq Depression, with an elevation of 500 m. The catchment area is drained by a number of wadis, the principal ones being Wadi Rajil, Wadi Hassan, Wadi Asekim, Wadi Shaumari, Wadi Jesha and Wadi Ghadaf.

Until recently, the wetlands of Azraq Oasis comprised a large complex of spring-fed marshes and seasonally flooded mudflats covering about 12,000 ha. The three principal systems were as follows: (1) a small area of freshwater marshes fed by two springs near the village of Druze or North Azraq in the northwest (31°51'N, 36°50'E); (2) a large area of fresh to brackish marshes and pools fed by two large springs near the village of Shishan or South Azraq in the west (31°49'N, 36°49'E); (3) a large seasonally or intermittently flooded mudflat or playa wetland (Qa Al Azraq) in the east (31°50'N, 36°53'E). Streams carried water from the main spring pools at Shishan eastwards towards the playa, creating extensive shallow wetlands with a variety of habitats. The two main areas of spring-fed marshes have disappeared within the last ten years (see below), but the qa wetland remains, along with about 50 ha of pools and freshwater marshes fed by an artesian borehole, drilled in 1963, and about 100 ha of fishponds recently excavated in silt desert on the edge of the qa.

Qa Al Azraq covers some 6,127 ha, and is fed by surface run-off from an extensive network of wadis. The qa is partly or wholly flooded in most winters, creating a temporary fresh to brackish lake with a maximum depth of 1.25 m and broad muddy margins. Small islands are formed from the mounds of salt-workings left over from the dry season. Owing to the impervious nature of the soil and rapid evaporation, the lake usually dries up again by April or May, becoming increasingly saline in the process and finally exposing bare saline silt flats. Even during years of deep flooding, the playa is usually completely dry by the end of May.

Colonel R. Meinertzhagen visited the oasis in 1922 and described it as "a perfect paradise for birds with green meadows, pools and bushes" (Meinertzhagen, 1924). More recently, accounts of the oasis in its original condition have been given by Mountfort (1965), Dakhgan and Bandak (1970b) and Nelson (1973).

Major changes have occurred to the wetlands of Azraq Oasis in the last ten years. The two springs at Druze dried out completely in 1987; one of the large springs at Shishan ceased to overflow in 1990, and the other finally stopped discharging in August 1992. By December

1992, both main areas of spring-fed marshes were completely dry except for small stagnant pools at the two Shishan springs. The cessation of spring flow has occurred as a direct result of the massive extraction of groundwater from the Azraq aquifers for water supply to Amman and the irrigation of agricultural land around the oasis. As the water table has been lowered, the natural discharge of the springs has fallen from an estimated 14-16 million cubic metres (MCM) in the 1960s, before the extraction of groundwater commenced, to 10.5 MCM in 1981, 2.0 MCM in 1989, 0.3-0.4 MCM in 1991, and zero by the end of 1992. In March 1990, when water was still flowing from the southern springs at a rate of 1.5-2.0 MCM per year, much of the main marsh remained flooded, with some water reaching the Burgess, Monfilit and Ingilesi pools. By early June 1992, the total overflow from the southern springs had fallen to about 0.25 MCM per year, less than 2% of its original level. This overflow created a single stream which extended for about one km through the marsh and then dried up. Only the marsh vegetation around the spring pool and along the stream remained green. All other marsh vegetation was dead and brown; the Burgess, Monfilit and Ingilesi pools were completely dry, slow-burning fires were moving through the ground in areas which had formerly been deep swamp, and heavy grazing pressure from the feral water buffalo and horses in the reserve was causing considerable damage to the surviving marsh vegetation. The problem in the marshes was further compounded by the diversion of water from the Shishan springs to a complex of fishponds to the south. In June 1992, these fishponds constituted the largest area of open water in the oasis.

The playa wetland has been largely unaffected by groundwater extraction. However, the construction in 1992 of a dam on Wadi Rajil, the most important single source of water for the qa, has reduced the frequency and extent of winter flooding in the qa.

Azraq Basin belongs geologically to the East Jordanian Limestone Plateau, which is partially covered by basalt flows. The basin is surrounded by a series of hills consisting mainly of limestone deposits and basalt craters. The sedimentary rocks overlay the basement complex, found at a depth of 2,550 m in the eastern part of the basin. Three partly connected aquifer systems have been identified in the sedimentary rocks overlaying the basement: the Upper Aquifer System (Basalt/B4), the Middle Aquifer System (B2/A7) and the Lower Aquifer System (Kurnub). Natural discharge from the upper aquifer occurs at the springs at Shishan and Druze. Little information is available on the deeper aquifers, but it appears that in general the salinity increases with depth.

The pattern of water-flow indicates that most of the recharge to the upper aquifer takes place in the north-northeast and northwest, with about 50% of the recharge taking place in the Jebel El-Drouz in Syria. The velocity of groundwater flow from the recharge area in Jebel El-Drouz to the springs in Azraq Oasis is believed to be very slow. Recent studies have shown that the groundwater in the well field about three km north of the oasis is between 4,000 and 20,000 years old. Tritium has never been detected in the wells, indicating that no recent recharge to the groundwater has taken place.

The mean annual rainfall in the catchment ranges from 300 mm in the north (in Syria) to about 150 mm in the west, and less than 50 mm in the east and south. The average annual rainfall over the basin as a whole is 87 mm. The mean annual evapo-transpiration is approximately 2,000 mm. The summers are hot and dry, with temperatures occasionally reaching 44°C; the winters are relatively wet and cold, with occasional frosts.

Ecological features: The once extensive spring-fed marshes contained a variety of habitats including dense stands of *Juncus maritimus*, *Carex* sp., *Typha angustifolia*, *Phragmites*

communis, *Scirpus* sp., *Cyperus* sp. and *Arundo donax*, and shallow pools with *Ruppia* sp. *Nitraria* and *Tamarix* communities occurred in the silty dunes between the streams and pools. The permanently wet areas around the artesian borehole support a small area of *Tamarix* bushes surrounded by wet marshes and meadows. The fishponds are fringed with *Phragmites* reeds. The playa is largely devoid of vegetation, except for a fringe of succulent halophytes such as *Halopeplis* sp. and *Halocnemum* sp. When the playa is flooded, there is abundant production of zooplankton, phytoplankton and some filamentous algae. In the past, when the water level in the playa lake was high, large numbers of fish (mostly *Tilapia*) escaped from Shishan marshes into the qa.

Land tenure: Government ownership.

Conservation measures taken: Azraq Oasis was declared a Reserve by Royal Proclamation in 1965. In January 1977, the Government of Jordan acceded to the Ramsar Convention and designated the greater part of the oasis (7,372 ha) for inclusion in the List of Wetlands of International Importance. The Ramsar Site includes the whole of Qa Al Azraq and the marshes and pools fed by the southern group of springs. The southern area of spring-fed marshes and adjacent parts of the qa (an area of 1,245 ha) were declared a Wetland Reserve in 1977, and have been managed since that time by the Royal Society for the Conservation of Nature (RSCN) under an agreement with the Ministry of Agriculture. The Azraq Wetland Reserve is fenced, and there is a RSCN warden allocated to the reserve. A management plan for the reserve was prepared for RSCN under a joint IUCN/WWF project in 1979 (Conder, 1979), but only a few of the recommendations in this plan were ever implemented. The artesian pools and fishponds lie outside the Wetland Reserve and are unprotected. A three-year project for the conservation of Azraq Oasis, funded through the Global Environment Facility, was initiated in 1993 (see below).

Azraq Oasis has been identified as an "Important Bird Area" by BirdLife International (Evans, 1994).

Conservation measures proposed: Plans were put forward in 1966 for the establishment of a large Azraq Desert National Park (525,000 ha) around Azraq Oasis, and a Draft Management Plan was produced by the International Biological Programme (Hemsley & George, 1966), but the plans were subsequently abandoned. In the early 1970s, a Committee appointed by the Prime Minister recommended to the Government that all forms of exploitation which might change the area's wetland nature be prevented or stopped. In particular, the Committee recommended that grazing by camels and cows be stopped and compensation paid to their owners.

Concern over the degradation of the Ramsar Site as a result of excessive pumping of groundwater was expressed at the Third Conference of the Contracting Parties to the Ramsar Convention, held in Regina, Canada, in May/June 1987. Recommendation 3.8 of this Conference called for a proper assessment of the environmental impact of the pumping; suggested that pumping be reduced by at least 50%, at least until the environmental impact study was completed; and urged that there be established a long-term water resources plan guaranteeing the maintenance of the natural properties of the wetland. A Special Cabinet Committee was formed by the Prime Minister in 1987 to study the situation and suggest a plan to save the wetland. The Cabinet Committee approved the concept of a "safe yield" of 20 MCM of water per year, and recommended that 14 MCM be allocated for Amman water supply, 3.5 MCM for irrigation and 2.5 MCM for natural discharge from the springs. Later in the same

year, the Ministry of Agriculture issued an Agricultural Policy for the Azraq Area based on an allocation of 3.5 MCM of water per year for irrigation.

In March 1990, a Ramsar Monitoring Procedure Mission to Jordan visited the oasis and discussed the situation with Government Ministers and officials, NGO representatives and local people. The mission produced a detailed report, containing thirteen specific recommendations for action (Jones & Clarke, 1990). The mission concluded that Azraq Oasis "remains a wetland of great ecological, economic and social value", and considered that populations of aquatic plants and animals would recover rapidly if the wetlands could be restored. The National Environment Strategy for Jordan, published in 1991 and ratified by the Government in 1992, identified the rehabilitation of Azraq Oasis as one of the highest priorities in the conservation of wildlife and habitats in Jordan, and endorsed the earlier recommendations of the Ramsar Convention Bureau (MMRAE, 1991).

Between October and December 1991, missions from the World Bank and UNDP visited Jordan to assist the Government in identifying projects potentially suitable for funding through the Global Environment Facility (GEF). A project proposal was drawn up in 1992, and in 1993, the Government of Jordan approved a three-year project (Conservation of the Dana Wildlands, the Azraq Oasis and the Institutional Strengthening of the RSCN) to be funded under the Third Tranche of the GEF. Almost half of the project's budget of 6.3 million dollars has been allocated to the conservation of Azraq Oasis. The long-term goal is to establish a sustainable basis for the utilization of the water resources of the Azraq Basin for water supply and agriculture, while at the same time conserving the outstanding biodiversity values of the natural wetland ecosystems.

The Azraq project has five main components: (1) rehabilitation and management of Azraq Wetland Reserve; (2) establishment of an environmental impact assessment unit within the Department of Environment and improved implementation of the Ramsar Convention in Jordan; (3) establishment of guidelines for agricultural development in the Azraq Basin; (4) investigation of groundwater resources in the Azraq Basin and development of a water management plan for the basin; and (5) support for long-term research on the conservation and management of water resources in arid and semi-arid regions. The primary objective is to conserve the biodiversity of Azraq Oasis through the restoration and rehabilitation of the aquatic ecosystems in the Azraq Wetland Reserve and adjacent qa. The immediate problem of water supply to the reserve will be resolved through the provision of up to 2.5 MCM of water per year from wells drilled into the underlying aquifers. Management procedures will be implemented to make the fullest possible use of the limited supply of water available to halt any further degradation of the wetland ecosystems, and to preserve a viable nucleus of the animal and plant communities from which rapid recolonization of wetland habitats can occur if more water should become available in the future. A comprehensive management plan for the Azraq Wetland Reserve will be prepared and implemented. This will address the issues of grazing by domestic livestock, disposal of rubbish and other pollutants in the reserve, and hunting. Existing reserve infrastructure will be repaired; a new reserve headquarters and two ranger stations will be constructed, and a Visitor Centre will be established along with a variety of other facilities of an educational, recreational and scientific nature for both national and foreign visitors.

More generally, the Azraq project will provide substantial support for studies on the water resources of the Azraq Basin and their utilization for water supply and irrigation purposes with a view to developing a water management plan for the entire basin. It will also support long-

term research on the conservation and management of water resources in arid regions, specifically through research on the use of infiltration techniques to accelerate groundwater recharge. The project is being coordinated by an inter-ministerial Steering Committee, and is being implemented by the Royal Society for the Conservation of Nature, Department of Environment, Ministry of Agriculture, Ministry of Water and Irrigation, and Water and Environment Research and Study Centre.

Land use: Major highways from Amman and Zarqa to Iraq and Saudi Arabia transect the basin, passing through the villages of South Azraq (formerly Shishan) and North Azraq (formerly Druze) on the northwestern edge of the oasis. Both villages were founded this century (Druze after World War I and Shishan in the 1920s) and remained small until the main highways from Amman to Iraq and Saudi Arabia were re-routed past the oasis. The population of Druze then grew from 1,500 in 1975 to over 3,500 in 1990, while that of Shishan grew from a few hundreds in 1975 to over 1,000 in 1990. This rapid expansion has been closely linked to the rapid increase in heavy traffic through the oasis, with most people now being involved in the service industry rather than any traditional pastoral activities. There is also a military base on the edge of the oasis.

Traditional activities in the wetlands formerly included livestock-rearing, reed-cutting, fishing and salt extraction. Cattle, water buffalo, horses, sheep and camels were allowed to graze in the marshes, and local villagers cut *Arundo donax* and *Typha angustifolia* for mat-making. There was also some fishing of introduced *Tilapia*, carp *Cyprinus* sp. and catfish *Silurus* sp. A pilot project for breeding freshwater fish in artificial ponds was initiated by the Ministry of Agriculture in the 1970s, with the help of FAO, and some fishponds were still in operation as recently as 1992. Salt extraction remains an important economic activity in the qa, and has been unaffected by pumping activities.

Starting in about 1980, there has been rapid expansion in agricultural activities in and around Azraq Oasis, based on the extraction of groundwater for irrigation. By the end of 1991, there were approximately 1,400 ha of olive groves and orchards and 153 ha of vegetable gardens in the Azraq area. New farms are continually being established and the area under cultivation is increasing rapidly.

Duck-hunting was formerly a popular activity in winter, and a hunting lodge was built on a hill overlooking the oasis. Hunting was effectively controlled, and only took place on the margins of lakes from blinds and on two designated days each week (Fridays and Sundays) between 30 September and 31 March (Savage, 1972). Annual bag statistics reveal that in the 1968/69 and 1969/70 seasons, the total numbers of birds shot were 1,105 and 979, respectively. These were mainly *Anas crecca* (63%) and *A. acuta* (19%) (Dakhgan & Bandak, 1972). A total of 1,664 birds were shot during the 1973/74 season, mainly *Anas crecca*, *Fulica atra*, *Anas acuta*, *Tadorna tadorna* and *Anas penelope* (Qasem, 1976). However, legal hunting was finally abandoned throughout the oasis in 1985, largely because of the increasing scarcity of waterfowl.

Possible changes in land use: Restoration and rehabilitation of wetland habitats (see under "Conservation measures proposed" above).

Disturbances and threats: The ecological character of Azraq Oasis has been radically altered by man's activities in the basin during the past three decades. Some of these changes are relatively superficial and are linked to the routing of new highways through the area and rapid growth of Druze and Shishan villages. However, major changes to the wetland ecosystems have

occurred as a result of the massive extraction of groundwater from the Azraq aquifers for water supply to Amman and the irrigation of agricultural land around the oasis.

Utilization of the springs as a water supply for towns and villages in northern Jordan began as long ago as 1963, but throughout the remainder of the 1960s and during the 1970s, only small quantities of water were extracted, mainly to supply the town of Irbid, some 125 km northwest of Azraq. However, in November 1980 the then Amman Water Authority (now part of the Water Authority of Jordan) began pumping water to Amman at the rate of about 1.5 MCM per year. In 1981, the Water Authority dug 15 wells some 3-10 km northwest of the Druze springs, and in 1982 pumping from the springs was replaced by extraction from the new well field. Pumping was stopped shortly afterwards, following protestations from the RSCN, but was resumed again later in the same year. Extraction rates then rose rapidly over the next six years to a peak of about 22 MCM in 1988, and have since stabilized at about 16 MCM per year. (No figures are available for the off-take for the Military Airbase at Azraq. However, it is thought that this is unlikely to exceed 60,000 cubic metres per year, and is therefore no cause for concern).

At the same time, the extraction of groundwater in and around Azraq Oasis for agricultural purposes has increased rapidly, and has been largely uncoordinated and uncontrolled. Already by 1970, 54 unlicensed wells had been dug near the qa, and these were being used to irrigate agricultural land to the north and east of the oasis (Dakhgan & Bandak, 1972). The digging of wells for irrigation purposes was prohibited in 1971, but was resumed again in 1984. By 1990, approximately 310 shallow wells and 140 deep bore holes had been dug to provide water for irrigation, and these were extracting groundwater at an estimated rate of 22-23 MCM per year. Over 95% of these well and bore holes were unlicensed and therefore illegal. Most produce water with a concentration of dissolved solids in the range 2,000-4,000 ppm, and concern is now being expressed that the widespread use of this slightly brackish water for irrigation will soon lead to severe problems of increased soil salinity.

Natural discharge of the Azraq springs in the 1960s, before the extraction of groundwater commenced, was estimated at about 14-16 MCM per year. Extraction rates have exceeded this every year since 1983, and in 1990, an estimated 40 MCM were extracted from the aquifer, with 16-17 MCM being pumped to Amman and the remainder used for irrigation purposes in the Azraq area. The natural rate of discharge of the four main springs fell rapidly from 10.49 MCM per year in 1981 to an estimated 1.96 MCM in 1989. The two northern (Druze) springs dried up completely in 1987, and by November 1991, only one of the two southern springs was overflowing from its pool, at an estimated rate of 0.3-0.4 MCM per year. The discharge from this spring had fallen to an estimated 0.2-0.25 MCM per year by early June 1992 and ceased completely in early August of that year. By early December 1992, the entire Wetland Reserve was dry, and underground fires were spreading throughout the former marsh area.

There is now general agreement that the upper aquifer is being heavily over-exploited and that this is causing a lowering of the water table and deterioration in water quality. A study of the water resources of the Azraq Basin in 1989 (Water Authority of Jordan, 1989) concluded that if the groundwater level in the well-field supplying Amman were to fall below an elevation of 504 m (the static water level in Qa Al Azraq saline aquifer), a movement of saline water from Qa Al Azraq towards the well-field might be expected to occur. Measurements taken in January and May 1991 revealed that the groundwater level had fallen by as much as six metres below this critical level at four of the seven wells tested. There were already signs of increasing salinity in

some of the wells, and it was thought that saltwater intrusion could become a critical problem within as little as three to five years. In recognition of these problems, the Water Authority of Jordan initiated a study in 1991 to investigate the characteristics of the middle and upper aquifers in the Azraq Basin with a view to locating alternative sources of water supply for Amman.

Qa Al Azraq, which comprises the greater part of the Ramsar Site, has scarcely been affected by the extraction of groundwater, as it receives most of its water from surface run-off during winter and spring. However, the proliferation of salt pans around the qa has reduced the extent of natural mudflat. Furthermore, in 1992 a dam was constructed in Wadi Rajil about 45 km north of Azraq, in an effort to alleviate water shortages and to accelerate infiltration into the aquifer. Wadi Rajil is the single most important wadi feeding floodwaters into Azraq Oasis, providing approximately one third of the surface run-off from the catchment area. The new dam, along with two other dams on the upper reaches of Wadi Rajil in Syria, are undoubtedly reducing the frequency and extent of flooding in the qa. During the unusually wet winter of 1991/92, there was no recorded surface flow at the Wadi Rajil dam site in Jordan, and this was attributed to the presence of the two dams further upstream in Syria. The new Wadi Rajil Dam flooded in early December 1992, following heavy rains in the catchment, but no water reached Qa Al Azraq, which remained dry. Thus in the winter of 1992/93, for the first time ever, both the spring-fed marshes and the qa were completely dry, despite good rains in the catchment.

Other threats to the wetlands of Azraq Oasis have included overgrazing, burning, the dumping of rubbish and hunting. The uncontrolled grazing by domestic livestock in the marshes caused considerable damage to the wetland vegetation, especially in the late 1980s and early 1990s, as the area of permanent marshes dwindled. The aquatic vegetation was regularly burnt to promote growth for grazing. However, all domestic livestock have recently been removed from the marshes. Large quantities of rubbish have been dumped in the Wetland Reserve, particularly in recent years since the perimeter fence has fallen into disrepair. Hunting pressure was heavy in the late 1960s and early 1970s, despite being limited to two days a week, and duck numbers had already fallen to low levels by the late 1970s, before any real deterioration had occurred in the spring-fed wetlands. Conder (1979) attributed this decline in duck numbers to excessive hunting pressure, rather than to any loss of wetland habitat. Hunting was prohibited in the Wetland Reserve in 1977, and legal hunting was finally abandoned throughout the oasis in 1985. Illegal hunting continued, often at a high level, until at least 1992, and a wide variety of species, including herons and egrets, were being shot.

Hydrological and biophysical values: The Azraq aquifer is one of the principal sources of drinking water for Amman, contributing approximately a quarter of the total consumption in the Amman District in recent years. Pumping to Amman began in 1980, and in recent years has provided about 16 MCM of fresh water per year to the city.

Social and cultural values: Azraq Oasis was formerly an important watering place for nomads and their livestock. There are several important archaeological sites in the area, including a well-preserved Roman wall around one of the Shishan springs (Ain Soda), Azraq Fort near the Druze springs, and Qasr Al Amra castle by the Azraq to Amman road. There are plans to renovate the Roman wall around Ain Soda as part of the recently initiated GEF Project at Azraq Oasis.

Noteworthy fauna: In their original state, the wetlands of Azraq Oasis were one of the most important wintering areas for migratory waterfowl in the Middle East. The highest counts of

wintering waterfowl were obtained in the late 1960s and early 1970s. In February 1967, RSCN undertook an aerial survey of the wetlands and estimated the total number of waterfowl at 347,000, including 20,000 *Anas penelope*, 180,000 *A. crecca*, 2,000 *A. platyrhynchos*, 100,000 *A. acuta*, 5,000 *Aythya fuligula* and 40,000 *Fulica atra*. A series of ground counts in the winter of 1967/68 produced peak counts of 1,500 *Anas penelope*, 2,000 *A. strepera*, 4,000 *A. crecca*, 10,000 *A. acuta*, 800 *A. clypeata*, 1,500 *Aythya ferina*, 700 *A. fuligula*, 600 *A. nyroca* and 1,500 *Fulica atra*, along with up to 11 *Phoenicopterus ruber*, five *Cygnus cygnus* and 10 *Anser anser*. However, an aerial survey in February 1968 gave a rough estimate of 72,000 ducks and *Fulica atra* (Dakhgan & Bandak, 1970a). In the winter of 1973/74, following the heaviest rains for some 30-40 years, numbers of waterfowl were again very high; a ground count in February 1974 gave a total of 110,000 birds, including 400 herons (Ardeidae), 600 *Ciconia ciconia*, 100 *Anser anser*, 14,000 *Tadorna tadorna*, 70,000 dabbling ducks *Anas* spp., 200 *Grus grus* and 25,000 *Fulica atra* (Qasem, 1976).

However, numbers of wintering Anatidae then fell rapidly during the 1970s (*e.g.* only 2,325 were present in January 1979). Numbers remained low throughout the 1980s, varying between 880 (in 1986) and 3,650 (in 1989), but showed no discernible trend and seemed to be more dependent on the state of flooding in the qa, than to the condition of the spring-fed marshes. The qa was extensively flooded in the winters of 1989/90, 1990/91 and 1991/92, and a count in January 1992 produced the highest total for many years, *viz.* 12,750 waterfowl of all species, including 3,490 *Tadorna tadorna*, 100 *Anas penelope*, 4,000 *A. crecca*, 500 *A. platyrhynchos*, 1,000 *A. clypeata* and 610 *Fulica atra* (Rose, 1992). Some 2,500 Common Cranes (*Grus grus*) appeared on the qa in February 1992. No censuses were carried out in the winters of 1992/93 and 1993/94, but it is doubtful if any birds were present in these years, when both the spring-fed marshes and qa were completely dry. However, heavy rainfall in 1994/95 caused extensive flooding in the wetlands, and large numbers of birds were again present in January 1995.

Azraq Oasis is also an extremely important staging area for migratory birds in spring and autumn. Of the 300 or so species of birds that have been recorded at the oasis, the great majority are migratory species belonging to the West Palearctic-Afrotropical flyway. Estimates made in the 1960s and 1970s indicated that between several hundred thousand and a million birds were utilizing the oasis during the course of a single spring migration, with up to 50,000 birds being present at any one time. Despite the loss of most of the permanent wetland habitat during the last decade, the oasis remains important for migratory birds, particularly species of shorebirds and passerines such as swallows, wagtails and warblers. Peak counts of waterfowl on passage have included 300 *Recurvirostra avosetta*, 2,000 *Charadrius alexandrinus*, 3,000 *Calidris minuta*, 3,500 *Philomachus pugnax* and 1,500 *Chlidonias leucopterus*. Large numbers of birds of prey are attracted to drink at the pools on autumn migration, including *Pernis apivorus* (up to 14) and *Circus pygargus* (up to 66).

The wetlands are also important for breeding waterbirds. Some 28 species of waterbirds were found breeding in the 1960s, several at the extreme edge of their ranges. With the destruction of the spring-fed marshes, many of these have disappeared. However, in years of prolonged flooding, such as 1991 and 1992, the qa still supports a variety of breeding species, notably shorebirds, while a few species continue to breed around the fishponds. Five species of waterfowl were found breeding for the first time at Azraq in 1991 and 1992, including a globally threatened species, the Marbled Teal *Marmaronetta angustirostris*. *M. angustirostris* has been recorded at Azraq on five occasions since 1983 as a scarce spring migrant (in April),

and a pair bred at the fish ponds near Shishan in 1990 (Green, 1993). Other breeding species have included *Tadorna tadorna*, *Rallus aquaticus*, *Himantopus himantopus* (up to 465 pairs), *Recurvirostra avosetta* (up to 20 pairs), *Glareola pratincola* (up to 10 pairs), *Charadrius dubius*, *C. alexandrinus* (up to 25 pairs), *C. leschenaultii*, *Vanellus spinosus*, *V. leucurus*, *Gelochelidon nilotica* and *Sterna albifrons*.

Other interesting fauna in the oasis include local subspecies of the Asian Jackal *Canis aureus syriacus*, Red Fox *Vulpes vulpes arabica* and Striped Hyaena *Hyaena hyaena syriaca*, the Tessellated Water Snake *Natrix tessellata*, two amphibians *Rana ridibunda* and *Bufo viridis*, and a variety of aquatic invertebrates including the Tadpole Shrimp *Triops canseriformes* - a "living fossil" with a strangely disjunct distribution in the Middle East.

Noteworthy flora: The wetlands formerly supported a very diverse wetland plant community, of great interest in view of its isolation in a desert region. It seems likely that many species may not have survived the recent degradation of the marshes.

Scientific research and facilities: The wetlands of Azraq Oasis have been extremely well studied and well documented. The International Jordan Expedition of 1966, organized by the Conservation of Terrestrial Communities section of the International Biological Programme, compiled information on the climatology, hydrology, limnology, entomology, ornithology, mammalogy, human ecology, logistics and management of the oasis (Loffler & Bonomi, 1966; Morton Boyd, 1967). The oasis vegetation was studied in detail by Nelson (1973), and the hydrobiology by Scates (1968). The birds of Azraq Oasis have received a considerable amount of attention, especially in the 1960s and 1970s, when several international expeditions and consultants visited the site (Cameron & Cornwallis, 1966; Conder, 1981a; Mountfort, 1965; Wallace, 1982 & 1983). The importance of the oasis for wintering waterfowl has been summarized by Savage (1968), Dakhgan and Bandak (1970a & 1972), Qasem (1976) and RSCN (1982b). A list of 281 bird species recorded at the oasis is given in RSCN (1982b). In recent years, the basin has been the subject of several major hydrological and hydro-geological investigations by the Water Authority of Jordan (*e.g.* Anon, 1991; Water Authority of Jordan, 1989 & 1990). A major investigation of groundwater resources in the Azraq Basin was initiated by the Water Authority of Jordan in 1991, with funding from the EEC. The aim of this project was to investigate the characteristics of the middle and upper aquifers in the Azraq Basin with a view to locating alternative sources of water supply for Amman. The Water and Environment Research and Study Centre at the University of Jordan has conducted studies on artificial recharge of groundwater in the Azraq Basin with a view to developing new technologies to accelerate infiltration. An International Biological Research Station was established at the oasis in 1968, but was closed down in the following year.

Conservation education: Situated little over an hour's drive from Amman, Azraq Oasis has enormous potential for conservation education for school children, students and the general public. An important component of the recently initiated GEF project at Azraq Oasis is to develop this potential as fully as possible. The Visitor Centre at the nearby Shaumari Wildlife Reserve, managed by RSCN, has already become an important centre for conservation education, and includes an exhibit on the wetlands of Azraq Oasis.

Recreation and tourism: Azraq Oasis has long been popular for outdoor recreation and tourism. It is readily accessible from Amman by good asphalt highway, and is situated close to several other sites of major touristic or archaeological interest, *e.g.* Azraq Fort, Qasr Al Amra castle and the Arabian Oryx herd at Shaumari Wildlife Reserve. The GEF project at Azraq

Oasis includes activities designed to promote tourism to the oasis and will provide facilities for nature-oriented outdoor recreation.

Management authority and jurisdiction: Legal ownership of the Ramsar Site rests with the Forest Department in the Ministry of Agriculture, while the Department of Environment in the Ministry of Municipal Affairs and Environment has responsibility for matters relating to the implementation of the Ramsar Convention. The RSCN has responsibility for management of Azraq Wetland Reserve under an agreement with the Ministry of Agriculture.

References: Al-Bakheet (1989); Andrews (1991); Anon (1991); Cameron & Cornwallis (1966); Carp (1980); Clarke (1979, 1990); Conder (1979, 1981a, 1981b, 1982, 1985); Dakhgan & Bandak (1970a, 1970b, 1972); Evans (1994); Green (1993); Hemsley & George (1966); Jones & Clarke (1990); Loffler & Bonomi (1966); Luther & Rzoska (1971); Meinertzhagen (1924); MMRAE (1991); Morton Boyd (1967); Mountfort (1965); Nelson (1973, 1985); Qasem (1976); Ramsar Convention Bureau (1993); Rose (1992); RSCN (1982b, 1986); Savage (1968, 1972); Scates (1968); Scott (1993); Wallace (1982 & 1983); Water Authority of Jordan (1989, 1990); WCMC (1990).

Reasons for inclusion: 1a, 1d, 2a, 2b, 2c, 3a & 3c. Until recently, Azraq Oasis was an outstanding example of an oasis wetland in an arid region, with few parallels anywhere else in the world. The wetland supported a rich and varied aquatic fauna and flora characteristic of freshwater habitats and, as one of the few significant natural wetlands in a large arid region, was of major strategic importance for migratory birds, especially waterfowl, raptors and passerines using the Palearctic/Afrotropical flyway. It was particularly important for wintering waterfowl, regularly holding concentrations of over 100,000 birds in mid-winter. Azraq Oasis belongs to an internationally shared aquifer, and has been recognized as a wetland of international importance under the Ramsar Convention. A Mission from the Ramsar Convention Bureau in March 1990 concluded that much of the natural values of Azraq Oasis remained, and that populations of aquatic plants and animals would recover rapidly if the wetlands could be restored.

Source: Derek A. Scott.

Qa Al Jafr (11)

Location: 30°20'N, 36°20'E; in the Eastern Desert, about 45 km east of Ma'an, Ma'an Governorate.

Area: c.35,000 ha.

Altitude: c.850 m.

Physical and ecological features: Qa Al Jafr is a large, seasonal playa wetland in the Eastern Desert, consisting mainly of extensive bare saline mudflats (sabkha) and seasonal saline marshes which flood in years of good rainfall, and can then remain wet for several months. The qa is about 40 km from east to west and up to 20 km from north to south; it receives run-off from numerous seasonal streams, mostly rising to the west in the southern highlands. There are many much smaller "satellite" mudflats in the desert to the south and east. Very little is known about the flora.

Land tenure: No information.
Conservation measures taken: None.
Conservation measures proposed: None known.
Land use: The small village of Al Jafr is situated at the west end of the qa. The principal land use throughout the area is grazing, and there is very little cultivation.
Possible changes in land use: No information.
Disturbances and threats: Water salinity has increased in the basin as a result of the over-pumping of ground water.
Hydrological and biophysical values: No information.
Social and cultural values: No information.
Noteworthy fauna: Very little is known about the fauna of this area. Waterfowl recorded on passage in recent years have included *Bubulcus ibis*, *Anas acuta*, *Himantopus himantopus*, *Charadrius dubius*, *C. leschenaultii*, *Tringa ochropus*, *Actitis hypoleucos*, *Calidris minuta* and *C. alpina*. *Charadrius alexandrinus* breeds in the marshes.
Noteworthy flora: No information.
Scientific research and facilities: None known.
Management authority and jurisdiction: No information.
Reasons for inclusion: 1a (3b). An outstanding example of a playa wetland; probably an important staging and wintering area for migratory waterfowl in wet years.
Source: Adnan Budieri.

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Qa Disi (12)

Location: 29°38'N, 35°32'E; in the Eastern Desert about 10 km east of Wadi Rum and 50 km east-northeast of Aqaba, Ma'an Governorate.
Area: c.1,500 ha.
Altitude: c.800 m.
Physical and ecological features: Qa Disi is a typical playa wetland in the Eastern Desert, consisting of a large area of saline mudflats, about 8 km long by up to 2.5 km wide, and three or four seasonal pools which are flooded with rainwater during wet years. There is a rich underlying aquifer of fossil water.
Land tenure: No information.
Conservation measures taken: None.
Conservation measures proposed: None known.
Land use: The aquifer is exploited to provide water for irrigation purposes and urban consumption.
Possible changes in land use: No information.
Disturbances and threats: Over-exploitation of the aquifer.
Hydrological and biophysical values: No information.
Social and cultural values: No information.
Noteworthy fauna: The qa attracts a variety of migratory waterfowl when wet; these have included *Bubulcus ibis*, *Himantopus himantopus*, *Vanellus spinosus*, *Tringa nebularia*, *T.*

ochropus and *Actitis hypoleucos*.
Noteworthy flora: No information.
Scientific research and facilities: None known.
Management authority and jurisdiction: No information.
Reasons for inclusion: 1a (3b). A good example of a playa wetland and an important staging and wintering area for migratory waterfowl in wet years.
Source: Adnan Budieri.

Gulf of Aqaba (13)

Location: 29°22'-29°33'N, 34°58'-35°01'E; the head of the Gulf of Aqaba, from the border with Israel in the northwest to the border with Saudi Arabia in the southeast, Ma'an Governorate.
Area: Unknown; 27 km of coastline.
Altitude: Sea level.
Physical and ecological features: The coastline of Jordan extends for 27 km along the northeastern section of the Gulf of Aqaba, a long, narrow and very deep arm of the Red Sea. The town of Aqaba is situated at the extreme northeast corner of the Gulf; on its landward side, the town is surrounded by granite mountains except to the north where Wadi Araba enters the Gulf through a canyon. The coastline consists of a series of embayments in each of which a comparatively similar and wide range of communities is present, including rocky shore, reef flat, reef face, fore-reef, sandy shore, sandy bottom and seagrass ecosystems. There is a discontinuous series of fringing coral reefs and reef flats, never more than 150 m wide, over a length of 13 km. These are found mainly around the headlands, and are separated by bays, usually with seagrass beds, which correspond to the mouths of dry wadis. The largest seagrass bed occurs in Al-Mamiah Bay. Fringing reefs are better developed on the more exposed lengths of shore, and are reduced to scattered patches in sheltered areas. The coastal plain is very limited, with alluvial fans spreading from the inland mountains to the shore. Most of the coastal zone has been extensively modified by man. Freshwater springs along the coast support irrigated vegetable gardens and native palm groves, and some natural scrub vegetation survives near the Israeli border in the northwest.
Rainfall is very low, averaging only 22 mm per year. This results in an elevated salinity of about 42 p.p.t. in the Gulf. Winds blow predominantly from the north-northwest, and seem to cause a counter-clockwise current in the surface waters. There is a small tidal range, but occasional unpredictable low tides expose the reef flat.
Land tenure: No information.
Conservation measures taken: In January 1985, a Marine Nature Reserve was declared to protect a 2 km stretch of coral reef south of the Marine Science Station. As far as is known, legislation has never been approved, although fishing and other activities have apparently been banned at the site. Two other areas have been identified as being suitable for nature reserve status, and according to the National Environment Strategy for Jordan (MMRAE, 1991), were to be publicly granted reserve status "in the next two years". The Aqaba South Coast Master Plan, which was prepared under the auspices of the Aqaba Region Authority, involved

preparing a coastal zone management plan for the entire Aqaba region (IUCN, 1992). The Aqaba region and surrounding hills (an area of c.130,000 ha) have been identified as an "Important Bird Area" by BirdLife International (Evans, 1994).

Conservation measures proposed: A Marine National Park has been proposed, to cover the central third of the Jordanian coast from the Marine Science Station south to the headland north of Al-Dirrah. This National Park would incorporate the existing Marine Nature Reserve and two proposed Marine Nature Reserves. A Marine Environmental Management Zone surrounding the whole National Park has also been recommended within which partial protection would be given to marine life. It was recommended that the proposed Marine Park and Environment Management Zone should extend 0.5 to 1.0 km out to sea (UNEP/IUCN, 1988). Detailed recommendations for the implementation and management of these schemes are given in Ormond (1978). Feasibility studies for the establishment of the proposed Marine National Park are apparently still under way. It has also been recommended that a few particular sites, *e.g.* in front of some of the major hotels and at the power station at El Bordj, should be established as "sites of recreational and scientific value". Wahbeh and Mahasneh (1982) give a general description of coastal management requirements.

Land use: The head of the Gulf of Aqaba is an area of very intense human activity, both on land and at sea. Aqaba is Jordan's only port and is thus a major centre of transportation. It is also a popular holiday resort both for Jordanians and international tourists. The city is growing rapidly; estimated at 55,000 in 1990, the population is expected to reach 119,000 by the year 2000 (MMRAE, 1991). The north coast, which is fronted by a long sandy beach, is occupied by the royal palace and a string of tourist hotels. Port facilities cover much of the area from El Bordj to just north of the Marine Science Station. The area to the south is proposed as a tourist area, and industrial and military developments are planned for the area beyond this. Several sites along the coast are used by SCUBA divers, and an international diving centre was opened in late 1986 by the Aqaba Region Authority. Despite efforts to promote the fishing industry in the Gulf of Aqaba, the estimated size of the catches has been decreasing since 1955 (Ahmad, 1989), and commercial fishing is now of only minor importance in the local economy. There were about 70 licensed fishing boast in the Gulf in 1990 (MMRAE, 1991)

Possible changes in land use: As much land as possible is needed for port expansion and industrial development, and further development of the coastal zone is therefore likely.

Disturbances and threats: Port expansion and coastal development for industrial, military and touristic uses are a critical problem around Aqaba due to the lack of space. Little natural coastline will remain unless some conservation action is taken soon. Extension of port facilities has resulted in land-fill in certain areas along the coast, and this has obliterated some reef systems. Fine sediments resulting from these land-fills have spread onto nearby reefs. Phosphate dust emitted during loading operations at the phosphate terminal has produced adverse impacts on the coral reefs. Other threats to the marine habitats include: anchor damage; chemical pollution from an industrial complex in the south, a fertilizer plant, a potash plant and a plywood factory; hot water effluent from the Aqaba Power Plant; contamination with sewage; and oil spills. Some damage may have been caused by explosives used in the course of geophysical research.

Hydrological and biophysical values: No information.

Social and cultural values: No information.

Noteworthy fauna: Many waterfowl and seabirds are attracted to the head of the Gulf,

particularly during the summer months, because of the richness of the marine fauna caused by an upwelling in the area. Species known to occur regularly include *Calonectris diomedea* (up to 50), *Puffinus griseus*, *Sula leucogaster*, *Stercorarius pomarinus*, *S. parasiticus* (up to 75), *S. longicaudus*, *Larus leucophthalmus*, *L. ridibundus*, *L. genei*, *L. ichthyaetus*, *L. cachinnans*, *L. fuscus*, *Sterna caspia*, *S. hirundo*, *S. repressa*, *S. anaethetus* and *S. albifrons*. The Gulf of Aqaba lies on a major bird migration route, with many waterfowl passing through the region on their way to and from Africa. Species known to occur in good numbers include *Phalacrocorax carbo*, *Nycticorax nycticorax*, *Ardea cinerea*, *Charadrius alexandrinus*, *Calidris minuta*, *Tringa totanus* and *Chlidonias leucopterus*. The Osprey *Pandion haliaetus* is a regular winter visitor.

Although the coral reefs are near the northern limit of coral distribution and may experience water temperatures as low as 20°C, they have a relatively high diversity of corals, 98 species having been recorded (UNEP/IUCN, 1988). Similarly, they support a moderately diverse reef-fish community, including the Red Sea endemic *Paracheilinus octotaenia*, which occurs on the deep-water reefs. The garden eel *Gorgasia sillneri* occurs in the reef "gardens", and a new species of callianassid shrimp *Callichirus laurae* was discovered in 1982. It is estimated that 5% of the 1,000 species of marine fish which inhabit the Gulf of Aqaba are endemic.

Noteworthy flora: There are extensive seagrass beds in many of the embayments along the coast.

Scientific research and facilities: A small marine research station was set up by the University of Jordan in 1972, and in 1982, a new Marine Science Station was established, to be managed jointly by the University of Jordan and Yarmouk University. A considerable amount of marine research has been carried out since then, especially on the coral reefs and seagrass beds. This has been summarized by UNEP/IUCN (1988). A monitoring programme on water quality was initiated in January 1985 in the zone in front of the Marine Science Station, and a study of metal pollution in sediments has been carried out (UNEP/IUCN, 1988).

Management authority and jurisdiction: Aqaba Region Authority.

References: Ahmad (1989); Evans (1994); ISPAN (1992); IUCN (1992); MMRAE (1991); Ormond (1978); RSCN (1982a); UNEP/IUCN (1988); Wahbeh & Mahasneh (1982).

Reasons for inclusion: 1a, 2b, 2d & 3b. The site contains good examples of coral reefs near the northern limit of coral distribution, and has a diverse marine fauna including several rare and endemic species. The area is of considerable importance as a staging area for migratory waterfowl and as a feeding area for non-breeding seabirds.

Source: Adnan Budieri.

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KUWAIT

INTRODUCTION

Area: 17,820 sq.km.

Population: 2,086,000 (1990).

Kuwait is an independent oil-rich state situated at the extreme northwestern end of the Gulf between latitudes 28°30' and 30°05' North and longitudes 46°33' and 48°36' East; it is bounded to the north and west by Iraq, to the south by Saudi Arabia, and to the east by the Gulf. The State of Kuwait comprises the mainland and nine offshore islands, including the inhabited island of Failaka, the large low-lying muddy island of Bubiyan near the mouth of the Shatt Al-Arab, and seven small coral islands mostly in the south. The terrain is flat or gently undulating, rising to a height of 271 m in the extreme southwest of the country. The principal topographic features are Wadi Al-Batin, which runs along the western border with Iraq, and the Jal Az-Zor escarpment (with a maximum elevation of 145 m), which extends approximately 80 km from Atraf northeast to Al-Bahrah and borders the northern shore of Kuwait Bay. There are numerous wadi systems which drain mostly to the northeast, but surface flow occurs only after exceptional rainfall, and there are no permanent rivers or streams. The gradual sinking of the Gulf geosyncline is thought to explain the distinctive topography of northeastern Kuwait. Here, gravel-topped ridges trending in a northeast direction and rising in height to only about one metre alternate with narrow, sandy depressions. The northeast also includes extensive bare mudflats which form part of the Shatt Al-Arab delta. Most of the interior is generally stony with a very sparse cover of grasses and low shrubs. Kuwait's major landscapes and dominant vegetation types have recently been summarized by IUCN (1992) and Evans (1994).

The climate is characterized by very hot, dry summers and cool rainy winters. The average annual rainfall in Kuwait City is about 111 mm, but other parts of the country receive as little as 23 mm or as much as 206 mm. Most of the rainfall occurs as light winter showers brought about by westerly depressions. Summer temperatures are extremely high, often exceeding 45°C during July and August. In winter, temperatures often rise to over 20°C during the day, but then fall rapidly at night when frosts are not uncommon, especially inland. The humidity is generally high and often exceeds 90%. Dust and sand storms are common throughout the year.

Until the discovery of oil in the Burgan area in 1938, Kuwait's economy was based on pearl diving, seafaring, boat-building, fishing and nomadic pastoralism. Kuwait became a major oil producer in the 1950s, and by 1979, petroleum and its products were accounting for over 95% of government revenue and over 75% of national income. Industrial development is concentrated in Shuaiba, south of Kuwait City, where there are plants for the manufacture of

petro-chemicals, fertilizers, construction materials, asbestos *etc*. The Government is pursuing an active programme of economic diversification and gradually creating a post-oil, high-technology state. The capital, Kuwait City, has become an important banking and investment centre. Virtually all settlements and 90% of the population are within 10 km of the coast.

Agriculture plays a relatively insignificant role in the economy. However, attempts have been made to lessen the dependence on imported foods by expanding the cultivation of dates, citrus fruits and timber, and by increasing livestock and poultry farming. Until the 1960s, fishing was considered as the second most important source of national income after oil, but since then there has been a substantial fall in the fish and shrimp catches. This has been attributed to careless over-fishing and absence of protective regulations in regard to close seasons, mesh size, spawning areas *etc.* (Husain, 1976).

Summary of Wetland Situation

The only natural wetlands in Kuwait are marine and coastal. There are no natural lakes of any kind and no permanent water courses. The only significant freshwater wetland is a complex of shallow pools and marshes fed by sewage and other waste water in an area of sabkha near the town of Al-Jahra at the west end of Kuwait Bay.

Kuwait's coastline, including that of its islands, has been estimated at about 400 km. It is mainly sandy and muddy with very few inlets other than Kuwait Bay. The northern coast, from Doha northwards, is bordered by extensive mudflats created by the floodwaters of the Tigris and Euphrates Rivers which enter the north end of the Gulf through the Shatt Al-Arab waterway. The southern coast, from Kuwait City southward, is mainly sandy. The maximum tidal range is 3.5-4.0 m, the largest spring tides occurring during the day in winter and during the night in summer. The water temperature varies widely from 12°C in January to 34°C in July; salinities are generally high throughout most of the year, ranging from 38 to 42 p.p.t. Some of the most extensive inter-tidal mudflats occur around Kuwait Bay, particularly at Dawhat Kazima, at the west end of the bay, and in Sulaibikhat Bay, on the south side. These two sites and a group of interesting tidal inlets on the southern coast (Al-Khiran) are described in the present inventory. However, the extensive creek systems and mudflats around Bubiyan Island in the north have never been properly investigated, and it is likely that further inter-tidal areas of international importance for migratory waterfowl remain to be identified.

The largest of Kuwait's nine offshore islands, Bubiyan, is an uninhabited, low-lying, muddy island near the border with Iraq. The other islands are low sandy islands fringed by coral reefs; all except the large island of Failaka near Kuwait City are uninhabited except for police outposts, and several support breeding colonies of sea-birds. Kubbar Island, in particular, is important as a nesting site for seabirds and formerly supported nesting sea turtles. Environmental conditions for coral growth are not optimal, and the reefs are limited in extent (about 400 ha in total) and poorly developed. Isolated corals exist on rocky outcrops on the southern Kuwait mainland, but reefs are largely restricted to the small offshore islands, *e.g.* Umm al-Maradim, Qaruh and Kubbar. Large numbers of the echinoderm *Echinometra mathaei*

have caused some damage to the reefs (UNEP/IUCN, 1988).

Continuous human activities along the coastline have resulted in considerable disturbance to marine ecosystems. The extensive inter-tidal mudflats in Kuwait Bay have come under pressure from dredging and landfill for urban and industrial developments. Large quantities of sand have been removed from beaches for construction purposes. Some parts of the coastline are being destroyed by the disposal of untreated sewage, while other areas are being polluted by industrial effluents with high concentrations of ammonia, mercury and chlorine. Oil pollution as a result of accident oil spillage is a perennial threat, while pollution from the disposal of ballast water in inshore waters continues, regardless of the legislation which prohibits this (Husain, 1976). The last of Kuwait's coastal fringing reefs, which probably used to extend as far north as Ra's al-Ardh, is currently under threat from large-scale urban and industrial development. Nesting seabirds on the offshore islands are vulnerable to human disturbance, and there is a certain amount of shooting. Littering has also become a problem on some of the offshore islands because of their popularity for outdoor recreation (UNEP/IUCN, 1988).

During the Gulf War of 1990/91, an estimated 7-8 million barrels of oil were spilled into the Gulf from the Kuwait oil fields. This was by far the biggest oil spill in history. The immediate effects of the Gulf War on coastal wetlands in Kuwait have been summarized by Evans *et al.* (1991) and Pilcher and Sexton (1993). In May 1991, a survey was undertaken on behalf of BirdLife International to assess the effects of the oil spills and well-head fires on Kuwait's avifauna and environment. The survey found that despite the enormous oil spills, most of Kuwait's coastline was clear of serious pollution. Unfortunately, the worst affected areas were amongst those that are most important for waterfowl. The most heavily polluted shoreline was that of Sulaibikhat Bay, where a 10 metre wide band of oil had been deposited at the high-water mark along a 17 km stretch of coast. The most significant pollution on the southern coast was in Khor Al-Mufateh (part of the Al-Khiran system), where a 2-3 metre wide band of oil had been deposited along a 0.5 km stretch of the banks of the main creek. Elsewhere along the southern coast, there were only small, scattered deposits of oil around piers and on peninsulas. All of the offshore islands escaped serious pollution except for Bubiyan, where there were small deposits of oil along the northeast coast. In all, only about 20 km of coastline were found to have been impacted by oil, and it was concluded that 95% of Kuwait's shores were free of persisting, serious pollution from the marine oil spills. The environmental impact was far greater inland; large oil lakes, some covering several square km, had been created from sabotaged well-heads, whilst over 500 burning oil wells were pouring tens of thousands of tonnes of smoke into the atmosphere daily. At least 25% of Kuwait's desert was covered in oil or heavy deposits of acidic, oily soot. Probably 90% of Kuwait's desert surface had been compacted, churned or otherwise impacted by military activities, and desertification had been greatly exacerbated. All existing protected areas for nature conservation had been damaged during the war, and most of the fencing and gates had been destroyed (Pilcher & Sexton, 1993).

A recent inventory of Important Bird Areas in the Middle East, sponsored by BirdLife International, identified eight sites as being of special importance for bird conservation in Kuwait (Evans, 1994). Five of these sites are primarily wetlands, and include a freshwater wetland, three areas of coastal flats and a small offshore island. All are included in the present

inventory, along with an additional coastal site (Al-Khiran) in the extreme south of the country.

Wetland Research

The Kuwait Institute for Scientific Research (KISR), established in 1967, undertakes research on coastal ecosystems and provides scientific support for the oil sector. The KISR has been carrying out research on the reefs and reef environment since 1983, and has conducted studies on the value of artificial reefs to fisheries. The Fisheries Department in the Ministry of Public Works has also undertaken research on the fisheries resources and their development. The Regional Organization for the Protection of the Marine Environment (ROPME), with offices based in Kuwait, has been involved in research activities, including the monitoring of marine pollution, and has assisted in the development of regional coastal zone management plans. ROPME was instrumental in the clean-up operation of the oil spills following the Gulf War.

The Faculty of Science at Kuwait University has been involved in research in a number of wetland areas, notably in Kuwait Bay and at Al-Khiran on the southern coast. The Ahmadi Natural History and Field Studies Group is also active in studying the fauna and flora of Kuwait. This non-governmental organization was founded in 1969, under the sponsorship of the Kuwait Oil Company, to encourage field studies, maintain contact with other institutions and help disseminate knowledge. Numerous resident and visiting ornithologists have gathered a considerable amount of information on the wetlands and their birds, and mid-winter waterfowl counts have been undertaken at a total of four sites since 1987/88 as part of the IWRB/AWB Asian Waterfowl Census.

Since the Gulf War, the numerous minefields and widespread abundance of other unexploded ordnance, both on the coast and inland, have imposed certain constraints on field work (Pilcher & Sexton, 1993).

Wetland Area Legislation

Environmental policy and legislation in Kuwait have recently been summarized by IUCN (1992). Conservation of nature has been prominent in the environmental policy adopted by the Council of Ministers. The main law governing the conservation of natural habitats is Decree Law No.62 of 1980, which indicates a general policy for the protection of the environment and provides for designation of two categories of protected area, National Parks and Nature Reserves. Additional legislation or regulations on the environment include prohibition of commercial fishing of shrimp, including in important wetland areas, during the spawning season, and measures to prevent the decline in sea turtles. There are minimum size limits for a number of fish species, and mesh sizes for four different types of net are enforced. Under Decree Law No.1964, oil discharge in territorial waters extending 50 miles from land and in the internal waters of Kuwait Bay is prohibited. Hunting, however, is permitted throughout the country, except for shooting in urban areas, and there are no laws for its regulation. A special Act for nature conservation (including the designation of additional protected areas in the

future) has been drafted and is currently awaiting official ratification by the Council of Ministers

At international level, Kuwait is not yet a party to any of the international area-based conservation conventions, although it has signed the Biodiversity Convention. It is a party to the Regional Convention for Cooperation on the Protection of the Marine Environment from Pollution, and participates in the Action Plan for the Protection and Development of the Marine Environment and the Coastal Areas.

Wetland Area Administration

The Environmental Protection Council is the government body responsible for the protection of the environment in general. This Council was created by the Minister of Public Health in 1980 as a consequence of Decree Law No.62. It is empowered to suggest a general policy for the protection of the environment and to propose protected areas; it provides an advisory channel on environmental matters to the authorities, as well as funds for research.

Kuwait's protected areas system is under the management and direct supervision of the Public Authority for Agriculture and Fisheries, an active member of the Environment Protection Council. The allocation of land for any use, including parks and designated areas, is the sole responsibility of the Municipal Council, Kuwait Municipality. The Ministry of Water and Electricity has rights over the underground water resources. The Ministry of the Interior owns and controls the offshore islands and their associated coral reefs. The Kuwait Institute for Scientific Research is involved in the protection and management of the environment and, in cooperation with the Faculty of Science at Kuwait University, has been involved in developing plans for the establishment of national parks and nature reserves. The Ahmadi Natural History and Field Studies Group has also made recommendations to the Government for the establishment of reserves.

At present, the protected areas system comprises a National Park and two Nature Reserves, all of which contain wetland habitat. The Kuwait Master Plan (first drawn up in the mid-1950s and revised in 1970, 1983 and 1990) included a major proposal for the whole of the northern coast to be designated as a National Park. In 1983, a coastal conservation zone was designated covering the Doha Peninsula and the east-facing shore of Kuwait Bay as far as Subiya. However, upon designation in August 1990, the National Park was reduced in area in recognition of military requirements. The Park, which covers 25,000 ha, incorporates the Jal Az-Zor escarpment and a section of the northern shore of Kuwait Bay with coastal mudflats and associated saline marshes and sand dunes. It is intended to be a multi-purpose resort for conservation, recreation and education (Evans, 1994).

In August 1990, the Environment Protection Council designated two nature reserves, both of which are described in this inventory: the Jahra Pools Nature Reserve (250 ha) and the Doha Peninsula Nature Reserve in Sulaibikhat Bay (450 ha). There are no marine protected areas, although a proposal has been made to protect Kubbar Island and its surrounding reefs

(IUCN/UNEP, 1985).

Organizations involved with Wetlands

Environment Protection Council

Public Authority for Agriculture and Fisheries

Fisheries Department, Ministry of Public Works

Ministry of Water and Electricity

Municipal Council, Kuwait Municipality

Kuwait Institute for Scientific Research.

Faculty of Science, Kuwait University

Ahmadi Natural History and Field Studies Group

Regional Organization for the Protection of the Marine Environment (ROPME)

WETLANDS

Site descriptions compiled from the literature and information provided by Muna Faraj of the Environment Protection Council.

Al-Jahra Pool Nature Reserve (1)

Location: 29°22'N, 47°42'E; 2 km east of Al-Jahra town near the west end of Kuwait Bay, 27 km west of Kuwait City centre, Al-Jahra Region.
Area: 250 ha.
Altitude: Sea level.
Overview: A man-made wetland comprising sewage lagoons and reed-beds in an area of sabkha at the extreme western end of Kuwait Bay, remarkable for the great diversity of birds which have occurred during the migration seasons and in winter. The only significant non-marine wetland in Kuwait, protected as a Nature Reserve.
Physical and ecological features: A complex of stagnant, open, shallow pools and extensive reed-beds of *Phragmites* sp., formed by domestic sewage and other waste water from the town of Al-Jahra flowing across sandy sabkha at the extreme western end of Kuwait Bay. The pools

are shallow (average depth about 10 cm) and permanent, but show marked seasonal fluctuations in size. Overflow from the pools flows into the southwest corner of Kuwait Bay at Dawhat Kazima (Site 2). There are scattered halophytes on the sabkha, as well as some old plantations of *Tamarix* sp. in poor condition.

Land tenure: State owned.

Conservation measures taken: The area is protected as a Nature Reserve (250 ha), established in August 1990. Within the reserve, 70 ha are fenced with chain-link fencing, and signs state that this is for the protection of birds. An official management plan exists, but has not yet been fully implemented. Two full-time guards have been employed since February 1993. Military patrols expel hunters for security reasons, and thus provide some unintentional protection. The site has been identified as an Important Bird Area by BirdLife International (Evans, 1994).

Conservation measures proposed: Pilcher and Sexton (1993) made a number of recommendations concerning the rehabilitation of the Nature Reserve following the Gulf War, and recommended that a ban on all shooting be rigorously enforced.

Land use: Nature protection and outdoor recreation. Part of the site is a designated camping area.

Possible changes in land use: None known.

Disturbances and threats: Destruction of vegetation by camp-fires was common before mid-1990. Shrubs were used for firewood, and off-road vehicles damaged the sabkha crust. Hunting formerly caused a considerable amount of disturbance to waterfowl, and some illegal hunting continues. During the Gulf War (1990/91), the warden's hut was removed and the fencing was damaged, but the freshwater habitats were relatively undisturbed. Pollution from soot deposits from the well fires appears to have been slight. Some unexploded ordnance was still present in the outer zone of the reserve in May 1991 (Pilcher & Sexton, 1993).

Hydrological and biophysical values: No information.

Social and cultural values: No information.

Noteworthy fauna: As a permanently wet and green area, the wetland attracts a very wide variety of migrant birds during the migration seasons and in winter, and provides an important refuge from hunting. At least 220 species of birds have been recorded at the site. Waterfowl present in mid-winter have included up to 13 *Podiceps nigricollis*, 45 *Phoenicopterus ruber*, 150 *Gallinula chloropus*, 177 *Fulica atra* and 500 *Larus ridibundus*, along with small numbers of several species of ducks and shorebirds. *Crex crex* has occurred on migration (maximum two in May and September). The site is also important for migrating birds of prey; as many as 410 raptors of 17 species have been recorded in a single day, and an estimated 2,000-3,000 pass through the area in spring and autumn. Notable counts have included two *Aegypius monachus*, 85 *Buteo buteo*, 10 *Aquila clanga*, 343 *A. nipalensis*, 14 *A. heliaca*, 5 *Circus aeruginosus* and 28 *Falco naumanni* (Evans, 1994).

Noteworthy flora: The site contains the only significant stands of freshwater aquatic vegetation in Kuwait.

Scientific research and facilities: The bird fauna has been well documented by resident and visiting ornithologists and bird-watchers. Pilcher and Sexton (1993) surveyed the area in May 1991 to assess the impact of the Gulf War on the habitats and avifauna. Mid-winter waterfowl counts were undertaken by Prof. W.C.T. Pilcher from Kuwait University in 1988, 1990, 1993 and 1994.

Conservation education: The site has great value as a potential field study centre for all

educational levels up to university research.
Recreation and tourism: If properly zoned, the Nature Reserve could provide for a variety of recreational activities.
Management authority and jurisdiction: The Nature Reserve is managed by the Public Authority for Agriculture and Fisheries.
References: Evans (1994); Jennings (1981); Pilcher & Sexton (1993).
Reasons for inclusion: 1d & 2b. The only significant freshwater wetland in Kuwait, frequented by a very wide diversity of birds during the migration seasons and in winter.
Source: See references.

Dawhat Kazima (2)

Location: 29°23'N, 47°47'E; at the west end of Kuwait Bay, about 25 km west of Kuwait City centre, Al-Jahra Region.
Area: 1,660 ha.
Altitude: Sea level.
Overview: A shallow sea bay with inter-tidal mudflats, important as a nursery ground for crustaceans and as a staging and wintering area for migratory waterfowl.
Physical and ecological features: Dawhat Kazima is a shallow, sheltered bay, at the extreme western end of the larger Kuwait Bay system. About 890 ha of inter-tidal mudflats are exposed at low tide. A low, sandy peninsula, Ra's Kazima, extends about 2 km out into the bay from the north shore. The salinity is about 39 p.p.t., and the maximum tidal range about two metres.
Land tenure: No information.
Conservation measures taken: A close season operates for shrimp fishing. Much of the site has been inaccessible since the 1990/91 Iraqi occupation because of unexploded ordnance, and this gives some protection from human disturbance. The site has been identified as an Important Bird Area by BirdLife International (Evans, 1994).
Conservation measures proposed: None known.
Land use: Traditional fishing with fixed traps ("hadra"); also recreational fishing.
Possible changes in land use: No information.
Disturbances and threats: No serious threats are known. The mudflats escaped serious pollution during the Gulf War. There is some local pollution from power stations on the Doha peninsula, and toxic outflow from Jahra Pools destroyed extensive stands of *Salicornia* sp. in the early 1980s.
Hydrological and biophysical values: The bay is important as a nursery area for economically valuable shrimps.
Social and cultural values: No information.
Noteworthy fauna: An important staging and wintering area for migratory waterfowl. Waterfowl recorded in winter in recent years have included up to 23 *Podiceps nigricollis*, 180 *Phalacrocorax carbo*, 62 *Ardea cinerea*, one *Platalea leucorodia*, 200 *Phoenicopterus ruber*, 200 *Anas penelope*, 30 *A. crecca*, 45 *A. clypeata*, 280 *Dromas ardeola*, 30 *Haematopus ostralegus*, 70 *Recurvirostra avosetta* and 50 *Larus genei*. Several thousand waterfowl occur

during the migration seasons, but accurate counts have not been made. At least 66 species of birds have been recorded in the area.
The invertebrate fauna of the mudflats includes an endemic ocypodid crab, *Cleistostoma kuwaitense*.
Noteworthy flora: No information.
Scientific research and facilities: The area has been visited by ornithologists on several occasions, and a mid-winter waterfowl count was undertaken by Prof. W.C.T. Pilcher from Kuwait University in January 1988.
Management authority and jurisdiction: No information.
References: Evans (1994)
Reasons for inclusion: 1a, 2c & 3b. An important nursery area for crustaceans and a major staging and wintering area for migratory waterfowl.
Source: See references.

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Sulaibikhat Bay and Doha Peninsula Nature Reserve (3)

Location: Sulaibikhat Bay 29°21'N, 47°51'E; Doha Peninsula Nature Reserve, 29°22'N, 47°49'E; on the south side of Kuwait Bay, about 20-25 km west of Kuwait City centre, Al-Jahra Region.
Area: Sulaibikhat Bay 4,845 ha; Doha Peninsula Nature Reserve 450 ha.
Altitude: Sea level.
Overview: A large area of inter-tidal mudflats and adjacent sabkha with some reed-beds, important for migratory waterfowl during the migration seasons and in winter. The Doha Peninsula on the northwest side of the bay is protected as a Nature Reserve.
Physical and ecological features: Sulaibikhat Bay is a very shallow, sheltered bay on the south side of the larger Kuwait Bay system, protected to the northwest by a low-lying sandy peninsula. There are extensive inter-tidal mudflats (c.2,250 ha) along the south and west shores, reportedly the most productive mudflats in Kuwait. The salinity is about 39 p.p.t., and the maximum tidal range about two metres. A large area of sandy sabkha (450 ha) on the Doha Peninsula in the northwest is flooded by exceptionally high tides and supports some salt-tolerant vegetation. Drainage water from nearby private houses and an Entertainment Park flows across part of the sabkha and supports about 0.5 ha of *Phragmites* reeds. There is also a major outlet for seawater coolant used by the Doha power stations in this area.
Land tenure: No information.
Conservation measures taken: The sabkha on the Doha Peninsula and about three km of shoreline are protected in the Doha Peninsula Nature Reserve (450 ha), established in August 1990. The reserve is fenced with chain-link fencing on its landward sides, but some sections of fencing are broken and the gates are left permanently open. Some protection from hunters is provided on the seaward side by barbed wire defences erected during the Iraqi occupation in 1990/91. Sulaibikhat Bay and the Doha Peninsula Nature Reserve have been identified as two adjacent Important Bird Areas by BirdLife International (Evans, 1994).
Conservation measures proposed: A proposal was made in 1987 to protect the whole of

Sulaibikhat Bay from shooting, whilst allowing traditional and recreational fishing to continue. Pilcher and Sexton (1993) made a number of recommendations concerning the rehabilitation of the Nature Reserve following the Gulf War, and recommended that a ban on all shooting be rigorously enforced.

Land use: The bay is used for recreational fishing and traditional fishing with fixed traps ("hadra"). The hadra on the inter-tidal mudflats appear to be in poor repair, and may have been abandoned because of mine-laying in the area during the Iraqi occupation in 1990/91. Prior to the establishment of the Nature Reserve, the sabkha was used at weekends for outdoor recreation and picnicking. The Nature Reserve is bisected by a public track to private houses.

Possible changes in land use: In-filling of inter-tidal areas to create new land for urban and industrial development.

Disturbances and threats: Some 500 ha of mudflats were destroyed by in-filling in the early 1980s. There is some local pollution from power stations on the Doha peninsula and Mina Shuwaikh port. Hunting is common, and causes considerable disturbance to the wintering waterfowl. Sulaibikhat Bay was badly affected by oil pollution during the Gulf War, and was the most heavily polluted stretch of coastline in the country. A survey in May 1991 revealed that a 10 metre wide band of oil had been deposited at the high-water mark along 17 km of shoreline, from Mina Shuwaikh in the east to the middle reaches of the Doha Peninsula in the northwest. Fortunately, along most of this stretch, the extensive intertidal mudflats, covering some 2,250 ha, had been spared. The habitat in the Nature Reserve was seriously impacted during the war by military activities such as bunker construction, excavations and movement of vehicles. Parts of the fencing and gates were destroyed; the vegetation was badly damaged, and the shorebird roosting site was contaminated with oil. However, pollution from soot deposits from the well fires appears to have been slight (Pilcher & Sexton, 1993).

Hydrological and biophysical values: The bay is important as a nursery area for economically valuable shrimps.

Social and cultural values: No information.

Noteworthy fauna: Sulaibikhat Bay is an important staging and wintering area for migratory waterfowl. The sabkha area in the Nature Reserve provides a secure roosting site for thousands of shorebirds and other waterfowl which feed on the adjacent mudflats at low tide. The most abundant species at the roost are *Charadrius hiaticula*, *C. alexandrinus*, *C. mongolus*, *C. leschenaultii* and *Pluvialis squatarola*. Almost 25,500 waterfowl of 32 species were present in January 1994. Waterfowl recorded in mid-winter in recent years have included up to 800 *Phalacrocorax carbo*, 110 *Egretta gularis*, 270 *Ardea cinerea*, 640 *Phoenicopterus ruber*, 21 *Tadorna tadorna*, 610 *Dromas ardeola*, 200 *Haematopus ostralegus*, 86 *Recurvirostra avosetta*, 970 *Charadrius alexandrinus*, 1,000 *C. mongolus/leschenaultii*, 96 *Pluvialis squatarola*, 720 *Calidris alba*, 300 *C. minuta*, 2,500 *C. alpina*, 215 *Limosa lapponica*, 840 *Numenius arquata*, 1,200 *Tringa totanus*, 19 *T. stagnatilis*, 45 *T. nebularia*, 465 *T. cinerea*, 74 *Arenaria interpres*, 6,630 *Larus ridibundus*, 1,560 *L. genei*, 6,500 *L. cachinnans*, 48 *Gelochelidon nilotica* and 8 *Sterna caspia*. Throughout the winter of 1989/90, about 300 *D. ardeola* frequented the shorebird roost on the Doha Peninsula (Cowan, 1990). At least 70 species of birds have been recorded in the area.

The mudflats support a large population of mudskippers (Gobiidae) of three species, *Scartelaos viridis*, *Periophthalmus koelreuteri* and *Boloephthalmus boddarti*. Crabs are extremely numerous; at least 13 species have been recorded including an endemic species of Ocypodidae,

Cleistostoma kuwaitense.
Noteworthy flora: No information.
Scientific research and facilities: D.A. Clayton from Kuwait University has studied the fauna and ecology of the mudflats (Clayton, 1986). Pilcher and Sexton (1993) surveyed the area in May 1991 to assess the impact of the Gulf War on the habitats and avifauna. Mid-winter waterfowl counts were undertaken by Prof. W.C.T. Pilcher from Kuwait University in 1988, 1990, 1993 and 1994.
Management authority and jurisdiction: The Doha Peninsula Nature Reserve is managed by the Public Authority for Agriculture and Fisheries.
References: Clayton (1986); Cowan (1990); Evans (1994); Evans *et al.* (1991); Pilcher & Sexton (1993).
Reasons for inclusion: 1a, 2c, 3a & 3c. An important nursery area for crustaceans and a very important staging and wintering area for migratory waterfowl, occasionally holding over 20,000 birds including over 1% of the regional populations of at least five species (*Dromas ardeola*, *Calidris alpina*, *Tringa cinerea*, *Larus ridibundus* and *L. genei*).
Source: See references.

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Kubbar Island (4)

Location: 29°04'N, 48°30'E; in the northern Gulf, 30 km offshore and about 50 km southeast of Kuwait City.
Area: 18 ha.
Altitude: Sea level.
Overview: A small offshore island with associated coral reefs in the northern Gulf, important for breeding terns *Sterna* spp. and formerly for nesting sea turtles.
Physical and ecological features: One of a small group of coral islands and associated reefs in the northern Gulf. Part of the island is covered in salt-tolerant bushes; other areas are dominated by annuals (*Seidlitzia* sp.), and there are patches of bare ground. Beaches are mainly sandy, although there are some rocky stretches of shoreline. The island is surrounded by a coral reef with a small break at a sand spit.
Land tenure: The island and its associated reefs are owned by the Ministry of the Interior.
Conservation measures taken: None. The site has been identified as an Important Bird Area by BirdLife International (Evans, 1994).
Conservation measures proposed: Kubbar Island and its surrounding reefs were first proposed for protection in 1985 (IUCN/UNEP, 1985). In 1988, the Kuwait Institute for Scientific Research included the island together with several submerged coral reefs in a proposal for a Marine Park. More recently, the island has been included in the draft Nature Conservation Act submitted by the Environment Protection Council. Any enforcement of protective legislation would require the presence of a warden on the island, at least during the tern breeding season (UNEP/IUCN, 1988).
Land use: Uninhabited. The island is a popular recreation area at weekends, and is regularly visited by scuba divers and fishermen. A small solar energy plant provides power for a beacon

in the centre of the island.
Possible changes in land use: No information.
Disturbances and threats: Human disturbance and wilful killing of birds are major problems at the tern colonies. Tanker lanes pass close to the island. Littering is an unwelcome eyesore, and littering and anchor damage are potential problems on the coral reefs. The island and its associated coral reefs do not appear to have been badly affected by oil spills during the Gulf War (1990/91). There were no signs of beached oil in June 1991, and less than 1% of the terns at the breeding colony showed noticeable oiling (Pilcher & Sexton, 1993).
Hydrological and biophysical values: No information.
Social and cultural values: No information.
Noteworthy fauna: An important breeding site for terns, with much the largest colonies in Kuwait. Breeding birds in 1958 included *Sterna caspia* (277 nests), *S. repressa* (1,000-1,300 nests and young) and *S. anaethetus* (2,000-2,500 birds). In recent years, there have been up to 270 pairs of *Sterna bengalensis*, at least seven pairs of *S. bergii*, 285 pairs of *S. repressa* and 820 pairs of *S. anaethetus*. The breeding population of terns does not appear to have been affected by oil spills during the Gulf War. A census of the colonies in June 1991 found that numbers were similar to those during the previous censuses in 1987 and 1990 (Pilcher & Sexton, 1993). The Crab Plover *Dromas ardeola* may have bred on the island in the past (Ticehurst *et al.*, 1925). The island was formerly a nesting area for Green Turtles *Chelonia mydas* and Hawksbill Turtles *Eretmochelys imbricata*.
The most important coral species are *Porites lutea*, *Acropora eurystoma* and *A. valida*.
Noteworthy flora: No information.
Scientific research and facilities: The Kuwait Institute for Scientific Research has been carrying out research on the reefs and reef environment since 1983, and there have been several ornithological surveys during the breeding season.
Management authority and jurisdiction: Ministry of the Interior.
References: Evans (1994); Gallagher *et al.* (1984); Husain (1976); IUCN/UNEP (1985); Pilcher & Sexton (1993); Ticehurst *et al.* (1925); UNEP/IUCN (1988).
Reasons for inclusion: 1a, 2c & 3c. An important breeding site for terns, holding over 1% of the regional populations of *Sterna bengalensis* and *S. anaethetus*.
Source: See references.

Al-Khiran (5)

Location: 28°40'N, 48°23'E; near the Saudi Arabian border, 85 km south-southeast of Kuwait City.
Area: c.2,000 ha.
Altitude: Sea level.
Overview: A complex of tidal inlets and lagoons with adjacent sabkha, showing a wide range of salinities and substrate types. No information is available on the flora and fauna.
Physical and ecological features: The coastal strip of southern Kuwait is characterized by a network of natural creeks and lagoons (locally known as "khor"), from which the area takes its

name, Khiran (plural of khor). The creeks and lagoons represent a diverse ecosystem with a wide range of major physical parameters such as salinity, sediment characteristics and tidal movement. The system consists of five creeks. The two southernmost inlets, Khor Eskandar and Khor Al-Nhalm, are comparatively small and are directly open to the sea. Khor Al-A'ama, in the north, is a comparatively wide tidal creek with a maximum width of one km and a narrow channel connecting it with the open sea. Khor Al-Mufateh and Khor Al-Mamlaha comprise a branching system of creeks which are about 0.75 km wide and extend inland for 5.5 km. This system is connected to the sea by a single narrow channel; the tidal flats are relatively wide and cut by a narrow sub-tidal channel with a maximum depth of about 7 m at low tide. Tidal amplitude at the mouths of the creeks is about 1.5 metres. The substrate at the mouth of Khor Al-Mufateh is mainly sandy, but this gradually changes to muddy sand and then mud further inland. Within the khors, conditions are hypersaline because of the high rate of evaporation and low inflow of fresh water. In Khor Al-Mufateh, there is a salinity gradient from about 40 p.p.t. near the sea to as high as 120 p.p.t. at the extreme inland end of the khor.

An extensive area of sabkha surrounds both ends of the Khor Al-Mufateh and Khor Al-Mamlaha system. This sabkha is at the northernmost limit of the anhydrite-bearing sabkha evaporite belt in the Gulf (at latitude 29°N); sabkhas north of this latitude are totally devoid of anhydrite.

Land tenure: No information.

Conservation measures taken: None.

Conservation measures proposed: The Khor Al-Mufateh system has been proposed as a nature reserve (Omar *et al.*, 1986).

Land use: No information.

Possible changes in land use: No information.

Disturbances and threats: The Khor Al-Mufateh system was badly affected by oil pollution during the Gulf War (1990/91). A survey in May 1991 revealed that oil had been deposited in a band 2-3 metres wide along about 0.5 km of the bank of the main creek (Pilcher & Sexton, 1993).

Hydrological and biophysical values: No information.

Social and cultural values: No information.

Noteworthy fauna: The khors are reported to hold large numbers of shorebirds during the migration seasons and in winter, but no details are available.

Noteworthy flora: No information.

Scientific research and facilities: Kuwait University has conducted some research on the sediments and microfauna of the khors.

Management authority and jurisdiction: No information.

References: Al-Abdul-Razzak & Bhalla (1987); Al-Sarawi *et al.* (1993); Cherif *et al.* (1994); Omar *et al.* (1986); Pilcher & Sexton (1993).

Reasons for inclusion: 1a & 3b. An interesting area of tidal inlets and creeks with surrounding sabkha, at the northern limit of anhydrite-bearing sabkha in the Gulf. Probably important for migratory waterfowl, but poorly known.

Source: Muna Faraj, Environment Protection Council.

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LEBANON

INTRODUCTION

Area: 10,450 sq.km.

Population: 2,701,000 (1990).

The Republic of Lebanon is a small country on the east coast of the Mediterranean Sea, bordered to the north and east by Syria, and to the south by Israel. It is 193 km long and a maximum of 56 km wide, and has a coastline of 225 km. Beirut, the capital, stands midway along the coast.

Lebanon comprises four distinct topographic regions. The narrow Mediterranean coastal plain rises gradually east over a distance of some 30 km to the Jebel Liban (Lebanon Mountain) range. This mountain range extends almost the entire length of the country, and covers more than a third of the area; the highest peaks include Qornet es Saouda at 3,087 m and Harf Sannine at 2,628 m. The arid eastern slopes of the mountains fall abruptly to the fertile Beka'a Valley which has an average elevation of about 900 m. This valley is the source of two rivers, the Asi (Orontes), which flows north into Syria, and the Litani (Leontes), which flows south between the two mountain ranges before turning west and discharging into the Mediterranean north of Sour (Tyre). Further east, the Jebel esh Sharqi (Anti-Lebanon) range rises to peaks at over 2,600 m, and forms the frontier between Lebanon and Syria.

The climate is Mediterranean with hot, dry summers and warm, moist winters. The average annual rainfall at Beirut is 920 mm, falling mostly during the winter months when Mediterranean depressions are frequent. Average temperatures at Beirut range from 13°C in January to 27°C in July. Inland, the Beka'a Valley and the Jebel ash Sharqi range are much drier; winters are cooler than on the coast, with frequent frost and snow. In general, precipitation decreases from west to east, the Beka'a Valley having an average annual rainfall of only about 380 mm.

The western slopes of the Lebanon Mountains, up to about 300 m, support evergreen maquis, with species of *Quercus*, *Ceratonia* and *Pistacia*. Remnants of pine forest (*Pinus halepensis* and *P. brutia*) occur from sea-level to 1,200 m, and the higher slopes were formerly covered with forests of pine *Pinus nigra*, cedar *Cedrus libani* and oak *Quercus calliprinos*, but these have been reduced to less than 5% of their original extent by wars, logging, charcoal production and collection of firewood. Large springs high up in the mountains support widespread cultivation on the slopes. The alluvial plains of the Beka'a Valley, to the east of the Lebanon Mountains, were formerly mostly swamp, but are now extensively cultivated. The Anti-Lebanon range supports *Amygdalus-Pistacia* scrub and fragmented deciduous forest on its

western slopes, together with remnants of steppe-coniferous forests with *Abies cilicica*, *Cedrus libani* and *Juniperus excelsa*. Subalpine and alpine plant communities occur above 2,500 m. Overgrazing by sheep and goats and poor agricultural practices have led to severe degradation of Lebanon's remaining forests, and to widespread deterioration of the soil and vegetation cover generally (Evans, 1994).

Before the outbreak of civil war in 1975, Lebanon was considered one of the most important commercial and financial centres in the Middle East. Industries included oil refining, the manufacture of cement, textiles and chemicals, food processing and service industries. International tourism was well developed. Agriculture, which accounted for about 9% of national income, was centred on the narrow coastal plain and fertile Beka'a Valley, the chief crops being citrus fruits, grapes, bananas, sugar-beet, olives and wheat. Severe civil disorder broke out in 1975, as rival political and religious factions sought to gain control, and the ensuing civil war severely damaged the country's economic infrastructure and dramatically reduced industrial and agricultural production. It is only within the last few years that peace has been restored to the country.

Summary of Wetland Situation

In medieval times, the central part of the Beka'a Valley was occupied by lakes, swamps and seasonally flooded marshes, but during the early part of the 20th century, most of these were drained for agriculture. The once extensive swamps on the coastal plain were also drained at this time, and later planted with eucalyptus plantations. The only large natural wetland which survives in Lebanon is Ammiq Swamp, a tiny remnant of the swamps along the Litani River in the Beka'a Valley. The wetland is unprotected and under threat from drainage schemes and indiscriminate and uncontrolled shooting of migratory birds. The only other significant inland wetlands are man-made lakes, notably Qaraoun Reservoir (1,000 ha), a large storage reservoir on the Litani River which is sufficiently large to attract numbers of migratory waterfowl, and the much smaller Tanayel Lake (6 ha) in the same valley.

The Mediterranean coastline consists mostly of rocky shores and narrow sandy beaches, and there are no significant estuarine systems or other coastal wetlands. There is one group of small offshore islands, the Palm Islands, off the coast of Tripoli in northern Lebanon. These consist of three flat, rocky islands of eroded limestone pavement with a little stunted maquis-type vegetation in gullies. Formerly of considerable importance for breeding seabirds, the islands are now much disturbed by tourists, hunters and fishermen, and no longer support any breeding seabirds.

Wetland Research

Most research in Lebanon has been conducted under the patronage of the National Council for Scientific Research by independent universities or through international organizations. Most of the information available on the two main wetlands, Ammiq Swamp and the Palm Islands, was

collected before the outbreak of civil war in 1975. The Faculty of Sciences at the University of the Lebanon conducted some studies of the breeding and migratory birds of Ammiq Swamp in the early 1970s (Tohme & Neuschwander, 1974), and the Palm Islands were investigated with a view to the establishment of a Marine Park (Haber *et al.*, undated; Tohme & Tohme, 1985).

Wetland Area Legislation

Environmental policy and legislation have recently been summarized by IUCN (1992) and Evans (1994). There is no legislation specifically related to wetlands. National parks and protected areas are created in compliance with two legislative decrees, Decree No.8371 of December 1961 (Articles 17 and 19) and Decree No.1631 of April 1984 (Articles 111 and 130), and specific enabling legislation for the establishment and naming of each protected area. Ministry of Agriculture Law 121 of March 1992 was used to declare the Palm Islands Marine Nature Reserve. New bird hunting legislation was ratified in March 1993 (Decree 1/64), banning all hunting in Lebanon between 15 March and 15 September.

At international level, Lebanon is a contracting party to the World Heritage Convention, but has not as yet designated any natural World Heritage Sites. It has also ratified the Convention for the Protection of the Mediterranean Sea against Pollution (the Barcelona Convention), and has adopted the Protocol Concerning Mediterranean Specially Protected Areas. One site, the Palm Islands Marine Reserve, has been designated as a Mediterranean Specially Protected Area in accordance with this Protocol. Lebanon participates in the UNESCO Man and the Biosphere Programme and established a MAB committee in 1990. One site, Bentael National Park, has been proposed as a Biosphere Reserve. Lebanon has signed the Biodiversity Convention, but is not a party to either the Ramsar Convention or the Bonn Convention.

Wetland Area Administration

The Ministry of Agriculture and the Ministry of Environment are jointly responsible for the management of protected areas. The Society for the Protection of Nature and Natural Resources in the Lebanon (SPNL) is responsible for the management of National Parks in cooperation with the Ministry of Agriculture. The Palm Islands were declared a Marine Nature Reserve in 1992, and are under the jurisdiction of the Ministry of Environment in cooperation with local municipalities and environmental NGOs. The Ministry of Environment, SPNL, IUCN and the United Nations Development Programme (UNDP) are currently collaborating in the development of a Department of Protected Areas and Wildlife within the Ministry of Environment.

Organizations involved with Wetlands

Ministry of Agriculture

Jointly responsible (with the Ministry of Environment) for the management of protected

areas and hunting. The Department of Forests and Natural Resources is responsible for the administration and management of the remaining forests.

Ministry of Environment

Responsible for environmental issues throughout the country, and jointly responsible (with the Ministry of Agriculture) for the management of protected areas and hunting. The Environmental Protection Committee, through its councillors to the Ministry, has specific interests in environmental protection.

National Council for Scientific Research

Oversees scientific research in Lebanon, and undertakes environmental studies including research on fauna, flora and pollution.

National Hunting Council

Concerned with hunting and game management in coastal sites, deserts, forests and wetlands, as well as law enforcement.

Faculty of Sciences, University of the Lebanon

Has conducted research at Ammiq Swamp and on the Palm Islands

Society for the Protection of Nature and Natural Resources in the Lebanon

The principal non-governmental organization concerned with nature conservation in Lebanon. The SPNL was created in 1984 and officially recognized by legislation in 1986. Its main aims include conservation education, environmental planning, and the establishment and subsequent management of a system of national parks and protected areas.

WETLANDS

Site description for Ammiq Swamp compiled by Assad A. Serhal of the Society for the Protection of Nature and Natural Resources in Lebanon (SPNL); site description for the Palm Islands compiled from the literature, principally Evans (1994).

Ammiq Swamp (1)

Location: 33°43'N, 35°46'E; in the western Beka'a Valley south of the main Beirut to Damascus highway, 10 km south-southwest of Qabb Elias town and about 35 km southeast of Beirut.
Area: 280 ha.
Altitude: 865 m.
Overview: Ammiq Swamp is the only major swamp in Lebanon. As recently as 1911, the

swamp covered most of the central Beka'a Valley, but about 90% of the swamp has since been drained for agriculture. Although unprotected and subject to heavy hunting pressure, the swamp remains important as a staging and wintering area for migratory waterbirds en route between Europe and Africa.

Physical features: Ammiq Swamp is situated in the Beka'a Valley, a fertile section of the Rift Valley enriched by eroded soils from the Lebanon Mountains to the west and Anti-Lebanon Mountains to the east. It comprises the remnants of a large area of lakes, swamps and seasonally flooded marshes which formerly covered at least 3,500 ha. The swamp is fed by the El Rhabe stream which rises at a spring under the ruins of Qalaat El Moudiq (965 m) in the foothills of Jebel Barouk in the Lebanon Mountains. It is bordered to the south by the straight-cut, channelized Nahr El Riachi stream (which also rises at Qalaat El Moudiq), and to the north by the Houjier River. The El Rhabe and Nahr El Riachi streams flow into the Houjier River which almost immediately joins the Litani River to the east. The swamp is usually inundated in late December or early January. Snow-melt from the nearby mountains raises the water level in spring, and flooding reaches its maximum in March and April, when most of the fields around the swamp are also flooded, particularly to the northeast near Tell El Akhdar. The water level then falls throughout the summer, and the wetland usually dries up completely between August and November. The surface soil is alluvial, of calcareous origin, and is underlain by water-retaining clay layers through which water flows into the marsh.

The average annual precipitation was about 600-800 mm in the 1940s, but in recent years has averaged only about 400 mm. Snow falls are occasional in winter. Average temperatures range from about 0°C in winter to 30°C in summer.

Ecological features: The vegetation is dominated by reed-beds of *Phragmites* sp. and *Typha* sp. interspersed with open fields of coarse pasture. Willows *Salix babylonica*, which colonized the area in the past, had nearly died out by the late 1970s, except for a small number of trees along the roads. Poplars *Populus* sp. and cypress *Cupressus* sp. have been introduced. The surrounding area is under cultivation for cereal crops, potatoes, onions and other vegetables.

Land tenure: The swamp is privately owned by the Skaff and Edeh families.

Conservation measures taken: None. Ammiq Swamp was identified as a wetland of international importance by Carp (1980), and has been identified as an Important Bird Area by BirdLife International (Evans, 1994).

Conservation measures proposed: In the early 1970s, the University of the Lebanon proposed to the owners that the swamp be made into a Nature Reserve with a biological station and tourist facilities, but no action was taken and the proposal was shelved at the outbreak of civil war. The SPNL and sister non-governmental organizations have recently entered into negotiations with the owner concerning the establishment of a Bird Sanctuary at the site.

Land use: Although the land is privately owned, access is unrestricted. Local people and visitors from elsewhere in Lebanon use the area for outdoor recreation (*e.g.* picnicking), especially at weekends, and there is a considerable amount of hunting of waterfowl and other birds. As the wetland dries out in summer, domestic livestock, mainly sheep and goats, are allowed to graze on the marsh vegetation. There was some fishing and frog-catching in the marshes in the past. Water is pumped from boreholes to irrigate agricultural land in the surrounding area.

Possible changes in land use: Drainage for agricultural purposes (see below).

Disturbances and threats: Ammiq Swamp formerly covered most of the central and western

Beka'a Valley north to Zahle. Much of the swamp had already been drained by 1970, when a new project was launched, with the assistance of FAO, to drain the remainder for agricultural purposes. Ditches were dug to carry the water to the Litani River to the south, and part of the wetland was destroyed. Drainage operations were halted at the outbreak of civil war in 1975, but it is possible that the project will be revived now that peace has been restored. Water supplies are being diverted for irrigation purposes, and groundwater is being pumped from boreholes at an alarming rate. There is heavy overgrazing of marsh vegetation by sheep and goats during the dry season, and the trees are deliberately burnt off by farmers. Hunting and trapping of birds occur at high levels throughout the year and without restriction as to species. Other problems include the dumping of rubbish and introduction on non-indigenous flora and fauna.

Hydrological and biophysical values: No information.

Social and cultural values: The wetland is a popular area for outdoor recreation.

Noteworthy fauna: Ammiq Swamp was formerly a very important breeding area for waterbirds, and still supported populations of a number of species in the 1970s, including Little Grebe *Tachybaptus ruficollis* (6 pairs), Little Bittern *Ixobrychus minutus*, Marsh Harrier *Circus aeruginosus* (occasional), Water Rail *Rallus aquaticus*, Moorhen *Gallinula chloropus* (10 pairs) and various marsh-dwelling passerines such as Savi's Warbler *Locustella luscinioides*, Moustached Warbler *Acrocephalus malanopogon*, Reed Warbler *A. scirpaceus* and Great Reed Warbler *A. arundinaceus* (Carp, 1980: Evans, 1994). Ferruginous Ducks *Aythya nyroca* may have bred in 1974, as one or two birds were present in June. No recent information is available on the breeding birds.

The Beka'a Valley lies on one of the main bird migration routes through the Middle East, and in former times the extensive swamps were of great importance as a staging and wintering area for migratory waterbirds on their way between breeding areas in Europe and West Asia and wintering areas in Africa. The swamp remains important for waterbirds during the migration seasons, and also supports substantial numbers of wintering waterfowl, especially in late winter when the water level is high and the fields around the swamp are flooded. In the 1970s, regular wintering species included Great Bittern *Botaurus stellaris*, Little Egret *Egretta garzetta*, Great Egret *Casmerodius albus*, Grey Heron *Ardea cinerea*, Common Teal *Anas crecca*, Hen Harrier *Circus cyaneus*, Eurasian Coot *Fulica atra*, Northern Lapwing *Vanellus vanellus*, Common Snipe *Gallinago gallinago*, Jack Snipe *Lymnocryptes minimus* and Common Kingfisher *Alcedo atthis*. A Pygmy Cormorant *Phalacrocorax pygmaeus* was present in November 1954, and a Purple Swamphen *Porphyrio porphyrio* was recorded in February 1977. Regular passage migrants included Black-crowned Night Heron *Nycticorax nycticorax*, Squacco Heron *Ardeola ralloides*, Purple Heron *Ardea purpurea*, Black Stork *Ciconia nigra* (up to 7 in May), Pintail *Anas acuta*, Shoveler *A. clypeata*, Garganey *A. querquedula* (common), Spotted Crake *Porzana porzana*, Little Crake *P. parva*, Corncrake *Crex crex*, Great Snipe *Gallinago media*, Green Sandpiper *Tringa ochropus*, Wood Sandpiper *T. glareola* and Ruff *Philomachus pugnax*. Due to the swamp's position on the Rift Valley migration route, large numbers of White Pelicans *Pelecanus onocrotalus*, White Storks *Ciconia ciconia* and birds of prey pass overhead in spring and autumn.

Mammals which are still known to occur in the area include Common Vole *Microtus arvalis*, Jackal *Canis aureus*, Red Fox *Vulpes vulpes*, Wild Boar *Sus scrofa* and Common Hare *Lepus capensis*, but the Common Otter *Lutra lutra*, which once occurred in the swamp, is now locally

extinct. Reptiles and amphibians include a soft-shelled turtle *Trionyx* sp., Whip Snake *Coluber gemonensis*, Grass Snake *Natrix natrix*, Common Tree Frog *Hyla arborea*, Fire-bellied Toad *Bombina* sp., Painted Frog *Discoglossus* sp. and Marsh Frog *Rana ridibunda*. Fish include *Phoxinellus libanicus* and *Cobitis* sp. Molluscs are abundant, notably *Melanopsis* sp., *Limnaea* spp., *Bithynia tentaculata*, *Neritina fluviatilis* and *Planorbis* sp.

Noteworthy flora: The wetland still supports a diverse aquatic plant community, now rare in this part of the Middle East.

Scientific research and facilities: In 1973, a team from the Faculty of Sciences at the University of the Lebanon initiated long-term studies on the breeding and migratory birds of the area (Tohme & Neuschwander, 1974), but these studies were interrupted by the outbreak of civil war in 1975.

Conservation education: In recent years, the SPNL and other NGOs have conducted field trips to the swamp with members of school Environment Clubs.

Recreation and tourism: The swamp is a popular area for outdoor recreation, especially at weekends.

Management authority and jurisdiction: The owner, Mr George Skaff (a Member of Parliament) has control over management; the Ministry of Environment has legal jurisdiction.

References: Carp (1980); Evans (1994); Kumerloeve (1962); Macfarlane (1978); Tohme & Neuschwander (1974); Vere Benson (1970).

Reasons for inclusion: 1d, 2b & 3b. The only significant freshwater swamp between the deltas of southern Turkey and Huleh Swamp in Israel; an important staging and wintering area for migratory waterbirds.

Source: Assad A. Serhal.

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Palm Islands (2)

Location: 34°30'N, 35°46'E; 13 km offshore, northwest of Tripoli, North Lebanon.

Area: c.500 ha.

Altitude: Sea level to 6 m.

Overview: A group of three small limestone islands (Palm, Ramkin and Sanani) 13 km offshore in the eastern Mediterranean; formerly of considerable importance for breeding seabirds including the globally threatened *Larus audouinii*, but now much disturbed by tourists, hunters and fishermen.

Physical and ecological features: The Palm Islands (Iles des Lapins) are a group of three flat, rocky islands of eroded limestone pavement rising to 6 m above sea level. Palm Island (Jazirat al-Nakhl or Ile du Palmier), covering about 20 ha, is the largest, and has a sand beach on its north and east sides and a central depression where rainwater accumulates in winter. There are also some small ponds, boggy areas and stands of reeds *Phragmites* sp. Stunted maquis-type vegetation occurs in clefts in the limestone, but otherwise the islands are relatively bare except in spring when they become carpeted in flowers. Parts of the islands are flooded with seawater during storms. There is a freshwater well on Palm Island, as well as some half-built concrete buildings and ancient ruins.

Land tenure: State owned.
Conservation measures taken: The Palm Islands were declared a Marine Nature Reserve in March 1992 (Ministry of Agriculture Law 121), and the reserve has recently been designated as a Mediterranean Specially Protected Area under the Barcelona Convention. The islands were identified as a wetland of international importance by Carp (1980), and have been identified as an Important Bird Area by BirdLife International (Evans, 1994).
Conservation measures proposed: None known.
Land use: The islands are commonly visited by picnickers, tourists, hunters, school parties and fishermen. There is a lighthouse on Ramkin Island.
Possible changes in land use: There was a proposal in the early 1970s to make use of the half-built concrete buildings on Palm Island to develop the islands for tourism.
Disturbances and threats: Although declared a Marine Nature Reserve in March 1992, the law is not enforced. Critical problems include extremely high levels of disturbance to breeding birds by all visitors, direct persecution of birds by large numbers of illegal hunters, and (formerly) collection of the eggs and young of nesting seabirds for human consumption. Dynamite fishing has been frequent offshore in the last decade, and oil and garbage pollution from Tripoli are problems. Some exotic species of fauna and flora have been introduced onto the islands.
Hydrological and biophysical values: No information.
Social and cultural values: The islands are popular for outdoor recreation, and there are some ruins of archaeological interest.
Noteworthy fauna: In the 1890s, the Palm Islands supported large breeding colonies of Common Tern *Sterna hirundo* and Little Tern *S. albifrons*, and smaller numbers of Audouin's Gull *Larus audouinii* (15 pairs), Yellow-legged Gull *L. cachinnans* and Lesser Crested Tern *Sterna bengalensis* (at least two pairs). However, by 1956, the terns and *L. audouinii* had disappeared, almost certainly because of the high levels of human disturbance and persecution by hunters and egg-collectors, and only 80-90 pairs of *L. cachinnans* were still breeding on the islands. By 1975, the population of *L. cachinnans* had declined to about 15 pairs, and in April 1993, no birds were present. The globally threatened *L. audouinii* was occasionally seen around the islands until at least the early 1970s (*e.g.* 18 adults present in April 1973), but there have been no records since then. Because of their location, the islands attract a wide variety of birds during the migration seasons, although mostly in small numbers; over 300 species of migrants had been recorded on the islands by 1974 (Evans, 1994).
The globally threatened Monk Seal *Monachus monachus* is known to have occurred in the area in the past, and perhaps as recently as the 1960s. There are old records of Green Turtles *Chelonia mydas* and Loggerheads *Caretta caretta* nesting on the sandy beaches.
Noteworthy flora: Some of the wild flowers occurring on the islands are nationally endangered or extinct along the mainland coast, or otherwise unusual, *e.g. Euphorbia pithyusa* and *Cressa cretica*.
Scientific research and facilities: The avifauna of the islands was studied in the 1970s, but little information has become available since then. The islands would be an excellent site for an observatory for monitoring the large, visible migration of waterbirds along the coast, and for the observation and ringing of passerine migrants.
Conservation education: None known.
Recreation and tourism: Uncontrolled outdoor recreation on and around the islands has

seriously compromised the nature conservation values of the site. Any future developments would have to be undertaken with strict regard for the requirements of the native fauna and flora, especially the breeding seabirds, if the islands are to be restored to anything like their former state.

Management authority and jurisdiction: Ministry of Environment in cooperation with local municipalities and environmental NGOs.

References: Baccar (1977); Carp (1980); Evans (1994); Haber *et al.* (undated); Kumerloeve (1962); Tohme & Tohme (1985); Tohme & Neuschwander (1974).

Reasons for inclusion: 1a; formerly 2a, 2b and possibly 3c. One of the few groups of small offshore islands near the eastern end of the Mediterranean Sea; formerly important for breeding seabirds, notably *Larus audouinii* and *Sterna bengalensis*.

Source: See references.

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THE SULTANATE OF OMAN

INTRODUCTION

by Dr Sadiq Al Muscati *et al*.

Area: 309,500 sq.km.

Population: 2,017,591 (1993).

Oman is situated at the eastern extremity of the Arabian Peninsula, the Tropic of Cancer passing just south of the capital, Muscat.

The northern mountains, of sedimentary and igneous formations, stretch in an almost unbroken chain from the Governorate of Musandam overlooking the Strait of Hormuz (separated from the rest of Oman by part of the United Arab Emirates) nearly to Ra's Al Hadd. They rise to a height of over 3,000 m in the centre, and enclose the fertile coastal crescent of the Batinah to the east.

The central plains, mainly arid flat gravel desert but with two extensive areas of sand dunes (the Wahiba Sands and the Rub' Al Khali), form some eighty per cent of the surface area. The Southern Governorate of Dhofar is characterised by a fertile coastal plain around the city of Salalah, overlooked by sedimentary flattish-topped mountains rising to 2,000 m and extending westwards beyond the Yemen border.

The coastline extends for some 1,800 km, with a number of islands offshore, the largest being Masirah to the east of central Oman. Its physical features vary considerably, from precipitous cliffs falling to depths of over 40 m close to the shore in Musandam, to shallow sandy beaches with scattered inlets and lagoons, some of which support mangroves, along the Batinah coast, to extensive sandy beaches along the coast of Central Oman, with areas of salt flats, especially the Barr Al Hikman which joins the Wahiba Sands opposite Masirah, and extensive high cliffs with some sandy beaches and tidal inlets along the coast of Dhofar.

The climate has two distinct periods: the cooler winter months when most rain falls in Northern Oman, especially in the mountains, and the hot summer when a southwest monsoonal airflow affects most of the country, with a significant deposition of fog moisture occurring in parts of the Dhofar highlands.

The southwest trade winds begin to blow across the Indian Ocean in May, reaching the Dhofar coast as the warm moist monsoon. By July and August, these winds reach a peak of 20-30 knots parallel to the coast, setting up a strong current from Somalia to western India. Deep, cold water wells up, particularly off Dhofar, and, being several degrees colder than the air passing over it, cools the air to dew-point. A bank of fog and ragged cloud then forms over the sea and a temperature inversion tends to prevent its dispersal, though daily changes occur. Where the

Dhofar highlands face the wind, the fog and cloud press against them, riding to the top of Jebel Al Qara', but rarely over Jebel Qamar. The moisture condenses on objects (especially plants) and sometimes falls as drizzle. The upwelling of nutrient-rich cold water during the monsoon is also responsible for a rise in marine productivity, which attracts large numbers of seabirds, fish and cetaceans. The fertile mountain region of Dhofar carries a high proportion of Oman's endemic plant species.

The economy of the Sultanate is substantially dependent on a modest income from the export of oil, natural gas and mineral products, but much of this revenue is being spent on the infrastructure for diversification of the economy, now that the most pressing needs for social development since 1970 have been substantially met. Apart from new manufacturing industries, agriculture and fishing provide important sources of income to the people. A significant proportion of the land surface area has been proposed for management as nature conservation areas in some 83 sites identified by an IUCN survey in 1986, accompanied by new laws governing the conservation of wildlife.

Summary of Wetland Situation

Apart from coastal cliffs such as those in the Musandam Region, the coastline is emergent, often with a shelf reef exposed at low water, backed by small dunes of calcareous sand bound by grasses and other halophytes. Inter-tidal flats are very extensive between the Barr Al Hikman and Masirah Island, south of the Wahiba Sands, and also occur in the Duqm area and to a lesser extent in the creeks (khawrs, the mouths of wadis which flood occasionally) of which there are many. Khawrs include those that are wide, shallow and surrounded by sabkha and halophytes, and those with deep narrow channels lined with the mangrove tree *Avicennia marina* or with reeds *Phragmites*, reed-mace *Typha* and other aquatic vegetation. Some are saline and strongly tidal, but others become lagoons when sealed temporarily from the sea by a sand bar until wadi flood or tide bursts through. Their waters are partly fresh at the inland end when this is fed by sub-surface or very occasional surface flow. Examples are found along most of Oman's coastline.

Mangrove research workers have located mangroves at 15 sites on the coast of Oman, but at most of these sites, the stands are very small. Only one species, the Black Mangrove *Avicennia marina*, is present today, but there is evidence that a species of *Rhizophora* formerly occurred at some sites. Attempts have been made in recent years to replant some areas with *Avicennia* mangroves, and *Rhizophora stylosa* seedlings have been planted on experimental plots in Qurm creek and near Salalah (D'Souza, 1986).

Oman's coastal zone supports huge numbers of passage and wintering waterbirds and breeding and non-breeding seabirds. Mid-winter counts by a modest number of people covering the Sultanate's coastline give a total mid-winter population of 300,000-500,000 waterbirds of 90-110 species, with the majority of individuals being shorebirds and at a single site, the Barr Al Hikman. One recent record suggests that the globally endangered Slender-billed Curlew *Numenius tenuirostris* may winter in this area (three were present in January 1990, Uttley *et al.*,

1990). The distribution and conservation of seabirds breeding on the coasts and islands of Oman have been summarized by Gallagher *et al.* (1984).

A recent inventory of Important Bird Areas in the Middle East, sponsored by BirdLife International, identified 33 sites of special importance for bird conservation in the Sultanate of Oman (Evans, 1994). Eight of these are terrestrial sites with no significant wetlands, and nine are offshore islands and/or coastal headlands and cliffs of primary importance for their seabirds and Sooty Falcon *Falco concolor*. The remaining 16 sites are coastal wetlands. Fourteen of these are of considerable importance for waterfowl and are included in the present inventory, either individually or as a part of a larger site.

Wetland Research

A number of studies have been made which include Oman's wetlands. In 1985/86, a study of the overall flora and fauna situation was made by an IUCN team for the Diwan of Royal Court. The final report of this study, entitled *Proposals for a System of Nature Conservation Areas in the Sultanate of Oman* (IUCN, 1986), identified a number of wetland areas of conservation importance. Coastal zone management survey reports contain information on the coastal wetlands and coastal fauna of Oman (IUCN, 1986-89). Recent studies have included a study of the heron colonies in the Sultanate in 1992 (Jensen & Salm, 1992a), and a survey of the khawrs and springs of the Dhofar Governorate in 1993 (Fry & Eriksen, 1993). Mid-winter waterfowl counts have been undertaken annually since the winter of 1987/88 as part of the IWRB/AWB Asian Waterfowl Census, and by 1994, 14 sites had been counted at least once (Rose & Taylor, 1993).

The Oman Bird Group, through its volunteer membership, carries out continuous study throughout wide areas of the Sultanate. The Oman Bird Records Committee maintains the Oman Central Record on a computer database which holds some 100,000 records.

Wetland Area Legislation

Various Royal Decrees and Ministerial Decisions have been promulgated since 1970 to protect Oman's wildlife and habitats, as well as to prevent marine and terrestrial pollution. In July 1973, a Ministerial Decision was issued banning the hunting, capture and opening fire on all birds and other animals, extending protection still further.

By Royal Decree, all new development projects have to be referred to the Ministry of Regional Municipalities and Environment for the issue of environmental permits. As part of this procedure, these projects are studied by the Ministry, who may call for an independent consultant's Environmental Impact Assessment. This applies to any project anywhere in the Sultanate, but special scrutiny is made of those planned to occur within protected areas.

In 1994, a large area encompassing the highly successful Arabian Oryx Re-introduction Project

was established by Royal Decree, to protect the area, which includes the Sahil Al Jazr coastline of Central Oman, to become what is now called the Arabian Oryx Sanctuary.

Wetland Area Administration

The Directorate General of Nature Protectorates in the Ministry of Regional Municipalities and Environment is responsible for the protected areas, as well as the protection of wildlife in non-designated areas. Coastal zone management plans have been drawn up for sections of the coastline of Oman. Action is being taken now to prevent fly-tipping and unauthorized developments from taking place in the proposed protected areas. The Wildlife Ranger Force of Oman is currently being formed and trained to provide comprehensive mobile protection and surveillance of wildlife in the Sultanate. Units will be assigned to monitor activities in the wetlands. With the emphasis on good training and efficiency, together with limited available funding, it will take some time to expand this organisation to its full strength across the country.

Management organisations tailored to suit each type of wetland site will be established according to priorities and available finance.

Organizations involved with Wetlands

Ministry of Regional Municipalities and Environment

This Ministry is the main environmental protection agency in the country. It is in the process of expanding its organisation and activities, through the Directorate General of Nature Protectorates, to take full management responsibility for all protected areas and for wildlife throughout Oman.

Ministry of National Heritage and Culture

The Oman Natural History Museum, formed by this Ministry in 1985 and expanded in 1992, exhibits the natural environment of Oman in several large galleries and a small botanical garden. Firmly based on the results of scientific studies over many years, and exhibiting only Omani animals which died from natural causes, it provides the Sultan Qaboos University, schools, the general public and tourists with an authentic view of the country's natural environment and of "Conservation in Action" by the Government. The Museum manages the National Herbarium of Oman (ON), the National Shell and Coral Collections, an important study collection of insects, arachnids and other invertebrates, and an extensive collection of fossils and skeletal material. It also hosts visiting biologists.

Ministry of Agriculture and Fisheries Resources

This Ministry undertakes a number of marine research projects, mainly for the sustainable development of fishery resources, through its Marine Science and Fisheries Centre.

Sultan Qaboos University

The University's Colleges of Science and Agriculture have carried out a number of floral and faunal studies and maintain a botanical garden. The College has participated in a number of marine projects by visiting research ships. An M.Sc. course in environmental studies is expected to commence in 1995, in addition to present B.Sc. courses in Biology, Agronomy and Fisheries.

Office of the Adviser for the Conservation of the Environment, Diwan of Royal Court

This Office manages the Arabian Oryx Re-introduction Project, the Arabian Tahr Reserve and two coastal bird sanctuaries. The Office has coordinated and hosted a number of important wildlife surveys throughout the Sultanate, with the support of IUCN and WWF, and has published the results. It provides an advisory service to the Diwan of Royal Court, Ministries and other Government departments.

The Oman Bird Group

An NGO of ornithologists, represented by the Oman Bird Records Committee, which encourages this hobby, maintains a database, publishes a list of all accepted bird records, and assists and advises the Government in ornithological matters.

The Historical Association of Oman

An NGO with some 900 members, formed in 1971 to promote interest in Oman's history. Its activities were formally expanded to include Natural History in 1981. They include field trips and lectures throughout the year.

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WETLANDS

Site descriptions compiled by M.D. Gallagher (Natural History Museum), Jens Eriksen (Sultan Qaboos University), C.H. Fry (Sultan Qaboos University) and M.A.L. Cummins (National Survey Authority).

Al Batinah Coast and Khawrs (1)

Location: 24°59'N, 56°22'E to 23°40'N, 58°12'E; Khawr Kalba 24°59'N, 56°22'50''E; Khawr Shinas 24°43'N, 56°28'E; Khawr Nabr (previously also referred to as Khawr Al Liwa) 24°32'N, 56°36'E. On the north coast of Oman from Khawr Kalba on the border with the United Arab

Emirates in the northwest to the region of As Seeb in the east, Al Batinah Region.
Area: Approximately 9,000 ha of wetlands along 300 km of coast, including Khawr Kalba 100 ha, Khawr Shinas 1,200 ha and Khawr Nabr 300 ha.
Altitude: Sea level.
Overview: A long stretch of sandy beach on the coast of the Gulf of Oman, with three major mangrove-lined tidal creeks (Khawr Kalba, Khawr Shinas and Khawr Nabr) and a number of smaller creeks; important for passage and wintering waterbirds, notably shorebirds, gulls and terns, and also resident and migratory breeding species. The creeks support a resident fauna of molluscs and crustacea, and are probably nurseries for marine fish.
Physical features: About 300 km of exposed sand beach facing the Gulf of Oman, extending from As Seeb in the east to the UAE border in the northwest. Khawrs (creeks) occur at the mouths of drainage lines; most are transitory, appearing and disappearing according to the occurrence of strong tides and wadi floods.
Khawr Kalba is a large creeks system with extensive stands of old mangroves, straddling the border between Oman and the United Arab Emirates. Most of the creek system lies within the UAE (see Site 20 in UAE chapter), but about 100 ha at the southern end are in Omani territory near Khatmat Milalah. Here there is a single tidal pool (between the customs posts) and a tidal creek of alluvial mud extensively lined with mangrove and surrounded by sabkha (saline flats) and unconsolidated sand with many chenopods.
Khawr Shinas, about 30 km south-southeast along the coast, is a 6 km long tidal creek divided by deep channels. The southern part is lined with dense stands of mangroves; the northern arm of the creek is blocked by a causeway. The creek system is surrounded by a wide area liable to flooding, with many chenopods and some patches of grasses and *Cyperus* sp.
Khawr Nabr, which lies a further 25 km to the south-southeast, is a 3 km long tidal creek, divided by channels lined with mangroves. There is a single exit to the sea near the village of Sahi Harmul.
Ecological features: The three main creeks support stands of the Dwarf or Black Mangrove *Avicennia marina*. Adjacent tracts of saline coastal sands and sabkha are very sparsely vegetated, the dominant species being chenopods. There is one patch of grass and some *Cyperus* sp. at Khawr Shinas.
Land tenure: The creeks are state owned. Adjacent land is partly state owned and partly in private hands (residential housing, gardens *etc.*).
Conservation measures taken: No formal protection. A ranger force is currently being set up to increase monitoring. Action is now in hand to implement management plans and tighten control. The Batinah coast and the three main khawrs (Kalba, Shinas and Nabr) have been identified as Important Bird Areas by BirdLife International (Evans, 1994).
Conservation measures proposed: Two protected areas have been proposed for Khawr Shinas, a National Scenic Reserve and a National Nature Reserve (IUCN, 1986).
Land use: Dumping of rubbish and movement of people associated with boats and leisure. There is some browsing by camels in the mangrove areas. A graded track at Khawr Shinas facilitates driver training close to the mangroves. Action is now being taken to prevent tipping at the creeks.
Possible changes in land use: None known.
Disturbances and threats: Khawr Shinas and Khawr Nabr have been adversely affected by the cutting of mangroves (for browse and formerly for poles), the tipping of builders' rubbish,

disturbance from vehicular traffic, the parking of fishing boats, nets and vehicles, extension of built-up areas to the edge of the sabkha, and the creation of tracks to beach shelters to encourage tourism. Khawr Nabr has also become a refuge for feral dogs. Khawr Kalba remains relatively undisturbed.

Hydrological and biophysical values: The creeks are an integral part of the wadi systems draining the surrounding low-lying land during periods of heavy rainfall.

Social and cultural values: The mangroves were previously used as a source of timber for construction and boat building.

Noteworthy fauna: The open shore supports large numbers of wintering shorebirds, especially Sanderling *Calidris alba*, and roosting gulls and terns; the two latter often concentrate at the entrance to the small khawrs. Mid-winter counts along the entire Batinah coast in recent years have included up to 86 Western Reef Egret *Egretta gularis*, 67 Grey Heron *Ardea cinerea*, 325 Lesser Sand Plover *Charadrius mongolus*, 2,500 Sanderling *Calidris alba*, 800 Sooty Gull *Larus hemprichii*, 3,800 Great Black-headed Gull *L. ichthyaetus*, 35,000 Black-headed Gull *L. ridibundus*, 1,700 Slender-billed Gull *L. genei*, 7,400 Yellow-legged Gull *L. cachinnans*, 850 Lesser Crested Tern *Sterna bengalensis* and 1,080 Sandwich Tern *S. sandvicensis*. Wintering birds of prey have included Osprey *Pandion haliaetus* (maximum 9), all four species of harrier *Circus* spp., Greater Spotted Eagle *Aquila clanga* and Peregrine Falcon *Falco peregrinus*. Khawr Kalba has an endemic subspecies (*kalbaensis*) of the White-collared Kingfisher *Halcyon (Todirhamphus) chloris*, the total population of which may not exceed fifty birds. Individuals occasionally wander to Khawr Shinas and Khawr Nabr, but the species is not known to have bred there. Other breeding birds in the mangroves include Little Green Heron *Butorides striatus*, Clamorous Reed Warbler *Acrocephalus stentoreus*, Booted Warbler *Hippolais caligata rama* and possibly also Olivaceous Warbler *H. pallida*. The Batinah khawrs are one of the few breeding localities for *H. caligata* in Arabia, and are at the southern edge of the breeding ranges of *A. stentoreus*, *H. caligata* and *H. pallida*. Old nests of *Egretta garzetta* have been found at Khawr Nabr, and it is thought that the species would breed again in this area if secure from disturbance.

Noteworthy flora: The creeks contain some of the finest remaining stands of the Dwarf or Black Mangrove *Avicennia marina* in Oman.

Scientific research and facilities: Annual mid-winter waterfowl counts have been undertaken since January 1988.

Conservation education: None.

Recreation and tourism: None.

Management authority and jurisdiction: Ministry of Regional Municipalities and Environment.

References: Cowles (1980); Evans (1994); IUCN (1986). Also: Asian Waterfowl Census data 1988-94 (*e.g.* Rose & Taylor, 1993).

Reasons for inclusion: 1a, 2a, 2b & 3c. A relatively undisturbed area containing noteworthy stands of mangroves with an endemic subspecies of kingfisher and at least two species of warbler not breeding elsewhere in Oman. The region as a whole is extremely important for passage and wintering shorebirds, gulls and terns.

Source: M.D. Gallagher, Natural History Museum.

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Barr Al Hikman and Masirah Island (2)

Location: Approximate central coordinates 20°30'N, 58°30'E; about 350 km south of Muscat in the Wilayats of Mahawt and Masirah, Al Wustta and Ash Sharqiyah Regions.
Area: Barr Al Hikman 290,000 ha (coastline 160 km, greatest area of exposed mudflats at least 22,000 ha). Masirah Island 109,500 ha (coastline 170 km, greatest area of exposed mudflats 2,000 ha).
Altitude: Wetlands at or near sea level. The hills on Masirah Island reach a peak at about 280 m.
Overview: An extensive area of inter-tidal mudflats, shallow lagoons, sea bays and straits, together with a number of offshore islets, a small area of mangrove (Mahawt) and sandy beaches; of outstanding importance for passage and wintering waterbirds, especially shorebirds, for breeding seabirds, and for nesting sea turtles. Much of the site remains relatively undisturbed and has been proposed for protection in several National Nature Reserves.
Physical features: The site comprises the raised rocky limestone peninsula of Barr Al Hikman, with about 160 km of coastline fringed by extensive inland sabkha and at least 22,000 ha of inter-tidal mudflats, the large island of Masirah and associated islets some 20 km to the east, and the intervening shallow channel, the Masirah Straits. There are five tidal inlets along the mainland coast, one of which (Khawr Barr Al Hikman) at 4,000 ha is the largest khawr in Oman. In the west, the Barr Al Hikman peninsula borders on a large shallow sea bay (Ghubbat Hashish) which contains a mangrove-fringed island (Mahawt) and the richest and most extensive seagrass beds in Oman. Masirah Island is gently undulating with a central spine of hills and peripheral coastal plain. There are extensive inter-tidal mudflats along the central and northern parts of the west coast, while the east coast is exposed ocean beach. Small offshore islands include Jazirat Shaghaf, Jazirat ash Shi'inzi, Jazirat Kalban and associated islets. Jazirat Shaghaf, with an area of 753 ha, is the largest island in the whole Barr Al Hikman/Masirah area apart from Masirah Island itself. It has areas of shallow dunes and a mangrove stand at the northeastern extremity, the only one in Masirah.
An ophiolite suite of uncertain age, but which may have been introduced into the margin of Arabia during the late Cretaceous, covers most of Masirah Island, presumably forms the bedrock of the Masirah Straits and appears as an isolated outcrop in the southeast corner of Barr Al Hikman. The shallow marine limestone and marl that cover the remainder of Barr Al Hikman date from the Palaeocene or the Eocene. Soils, where present, are generally shallow and sandy and, except in one area at the south end of Masirah Island, have little agricultural potential.
The mean annual rainfall is 110 mm, but it is erratic and, since 1956, has varied from 0 mm to over four times the mean figure. The July mean temperature is 33°C; the January mean 20°C. Annual and diurnal variation is moderated by the maritime setting. Between April and September, the wind direction is predominantly southwest influenced by the southwest monsoon in the Indian Ocean. The mean July wind speed, when the influence of the monsoon is usually at its peak, is in excess of 30 km.p.h. Outside the monsoon period, winds are lighter and more variable, often with an easterly component. The mean tidal variation (MHHW to MLLW) at Rounders Bay (20°13'N, 58°38'E) is given as 1.5 metres. Tidal streams for various points in

the Masirah Straits are shown on the hydrographic charts, but are nowhere greater than one knot. Monsoonal currents are said to be less than half a knot.

Ecological features: Extensive inter-tidal and sub-littoral mudflats occur along the eastern side of Barr Al Hikman, bordering the Masirah Straits. In the Bayad Dimnah area, opposite Masirah Island, an extensive rock platform underlies the mud and sand. Here the mudflats are up to 7 km wide at low tide. Low coastal cliffs with inter-tidal and sub-littoral sand occur around the outer portions of the Barr Al Hikman peninsula. The seagrasses *Halophila ovalis, Thalassia hemprichii* and *Halodule uninervis* dominate the substrate in the Ghubbat Hashish and Masirah Straits, and there are also some isolated and fringing coral reefs in the straits. The east coast of Masirah Island has low cliffs with mostly sandy inter-tidal and sub-littoral zones. The west coast has inter-tidal and sub-tidal sand and mud, some of the fine sub-littoral substrates being dominated by seagrasses. The small island of Mahawt in Ghubbat Hashish is fringed by well developed stands of the Dwarf or Black Mangrove *Avicennia marina*, as is the northeastern extremity of the larger island of Jazirat Shaghaf, off Masirah, and there are also some small specimens of mangroves in some of the creeks on the east coast of Barr Al Hikman. Inland near the coast there are areas of sand and gravel plains with some sand dunes. The terrestrial vegetation on Masirah Island is dominated by dwarf shrubs such as *Limonium*, *Suaeda* and *Arthrocnemum*.

Land tenure: The entire area is state owned.

Conservation measures taken: The site has no formal protection. A ranger force is currently being set up to increase monitoring. Barr Al Hikman and Masirah have been identified as Important Bird Areas by BirdLife International (Evans, 1994).

Conservation measures proposed: The whole of the Barr Al Hikman area has been proposed as a National Nature Reserve (288,000 ha), apart from 2,000 ha on the west coast of Ghubbat Hashish. The main areas for wildlife on Masirah Island and part of Masirah Straits are covered by three proposed National Nature Reserves: East Masirah (4,500 ha), South Masirah (19,000 ha) and Masirah Straits (86,000 ha). The latter encompasses the west coast of the island, the eastern half of the straits and Jazirat Shagaf.

Land use: Seasonal commercial fishing of various kinds takes place all along the coast, with prawn fishing being especially important in Ghubbat Hashish. Seabirds' eggs are taken from many of the small islands. About 5,000 people live on Masirah Island; some small areas of irrigated land are farmed, and goats are grazed over most of the island. The dry areas of Barr Al Hikman are unused.

Possible changes in land use: Development of the commercial fishery continues to take place, but appears to be under reasonably tight control. It appears there is a possibility of a fishing port being constructed within the area.

Disturbances and threats: The large areas of soft inter-tidal mud and sabkha, which make access difficult, are likely in the short term to prevent disturbance of the main shorebird wintering grounds around Barr Al Hikman. However, modern four-wheel drive vehicles provide easy access to the sandy bays on the southern shore, and mopeds with an "all terrain" capability could provide a threat if control measures are not taken in time. Development of commercial fisheries could pose a threat to the seagrass beds and corals in the Masirah Straits. Egg collection and disturbance are major threats to breeding seabirds on the small islets off Masirah, some of which are accessible by vehicle at low tide. Large numbers of gull and tern eggs and gull chicks are collected for food by local people, especially from the islets of Shagaf

and Shi'inzi, and over-exploitation is now thought to be occurring, as the nesting populations of most seabirds breeding on and around Masirah appear to be declining. Human disturbance is already excessive at some of the colonies, and will increase if local tourism is allowed to develop without very strict controls.

Hydrological and biophysical values: No information.

Social and cultural values: At present, the whole seacoast and the straits are used by the local population in fishing and food gathering activities. Weekend and holiday tourism is developing with the increasing availability of reliable four-wheel drive vehicles.

Noteworthy fauna: Barr Al Hikman is of outstanding importance as a major staging and wintering area for migratory shorebirds and other waterfowl. The globally threatened Slender-billed Curlew *Numenius tenuirostris* has been identified, and is presumed to occur regularly in very small numbers. Concentrations of 28,500 Sooty Gull *Larus hemprichii* (70% of the estimated world population) and 3,000 Crab Plover *Dromas ardeola* (8% of the world population) have been recorded in mid-winter. Other species which occur in numbers exceeding 1% of the regional population include the following (peak counts in brackets): Great Cormorant *Phalacrocorax carbo* (8,200), Socotra Cormorant *P. nigrogularis* (15,000), Western Reef Egret *Egretta gularis* (1,800), Greater Flamingo *Phoenicopterus ruber* (9,300), Oystercatcher *Haematopus ostralegus* (10,700; 40% of Southwest Asian wintering population), Lesser Sand Plover *Charadrius mongolus* (5,000), Greater Sand Plover *C. leschenaultii* (800), Grey Plover *Pluvialis squatarola* (2,600), Great Knot *Calidris tenuirostris* (1,200), Sanderling *C. alba* (11,000), Little Stint *C. minuta* (16,000), Curlew Sandpiper *C. ferruginea* (17,000), Dunlin *C. alpina* (60,000), Broad-billed Sandpiper *Limicola falcinellus* (5,000; 20% of Southwest Asian wintering population), Bar-tailed Godwit *Limosa lapponica* (50,000), Slender-billed Curlew *Numenius tenuirostris* (3), Eurasian Curlew *N. arquata* (1,750), Terek Sandpiper *Xenus cinereus* (600), Ruddy Turnstone *Arenaria interpres* (1,700), Great Black-headed Gull *Larus ichthyaetus* (1,500), Slender-billed Gull *L. genei* (50,000), Yellow-legged Gull *L. cachinnans* (22,000), Caspian Tern *Sterna caspia* (1,400), Great Crested Tern *S. bergii* (4,100), Lesser Crested Tern *S. bengalensis* (3,000) and Sandwich Tern *S. sandvicensis* (45,000). Other species occurring in significant numbers in winter include Great Egret *Casmerodius albus* (340), Grey Heron *Ardea cinerea* (600), Spoonbill *Platalea leucorodia* (180), Kentish Plover *Charadrius alexandrinus* (3,500), Whimbrel *Numenius phaeopus* (950), Redshank *Tringa totanus* (13,200), Greenshank *T. nebularia* (3,200), Common Tern *Sterna hirundo* (3,000) and Saunders's Little Tern *S. saundersi* (320). An incomplete survey conducted in January 1991 recorded over 336,000 waterfowl of at least 39 species. Even larger numbers of waterfowl might be expected to occur in autumn, and numbers in spring are also likely to be very important. Birds of prey occurring in the area in winter include Osprey *Pandion haliaetus* (maximum 44), Marsh Harrier *Circus aeruginosus* (maximum 28) and Peregrine Falcon *Falco peregrinus* (maximum 8). Breeding birds in the Barr Al Hikman area include about 90 pairs of *Egretta gularis*, 75-100 pairs of *Larus hemprichii*, 10 pairs of Roseate Tern *Sterna dougallii*, 1,500-2,500 pairs of Bridled Tern *S. anaethetus* and 20 pairs of *S. saundersi*.

Masirah Island also supports very large wintering populations of herons, shorebirds, gulls and terns. Species occurring in internationally important numbers include the following (peak counts in brackets): *Egretta gularis* (420), *Haematopus ostralegus* (3,000), *Dromas ardeola* (2,000), *Charadrius mongolus* (6,400), *Pluvialis squatarola* (550), *Numenius arquata* (1,000), *Larus hemprichii* (10,400), *L. ichthyaetus* (1,000), *L. genei* (1,700), *L. cachinnans* (13,000),

Sterna caspia (170), *S. bergii* (8,700) and *S. sandvicensis* (7,200). Other species occurring in substantial numbers include *Ardea cinerea* (220), *Calidris alba* (700), *Limosa lapponica* (2,800), *Numenius phaeopus* (330) and *Arenaria interpres* (630). In addition, there is a very significant autumn passage of *Charadrius leschenaultii* (maximum 5,250), *Pluvialis squatarola* (1,600), *Numenius phaeopus* (2,000), *Tringa totanus* (2,000), Red-necked Phalarope *Phalaropus lobatus* (2,000) and White-cheeked Tern *Sterna repressa* (70,000 on one occasion in October). Wintering birds of prey include up to 60 *Pandion haliaetus* and 21 *Circus aeruginosus*. The small islets off Masirah Island, especially Jazirat Shaghaf, have breeding colonies of *Larus hemprichii* (5,200 pairs), *Sterna bergii* (300 pairs), *S. dougallii* (160 pairs), *S. repressa* (1,200 pairs) and *S. anaethetus* (15,500 pairs). Other breeding species on Jazirat Shaghaf include *Egretta gularis* (20-30 pairs) and *Dromas ardeola* (85 pairs). Concentrations of seabirds off the east coast of Masirah during July-August, when there is a cold current, include Jouanin's Petrel *Bulweria fallax*, Flesh-footed Shearwater *Puffinus carneipes*, Persian Shearwater *P. (lherminieri) persicus*, Wilson's Petrel *Oceanites oceanicus*, Pomarine Skua *Stercorarius pomarinus*, Arctic Skua *S. parasiticus*, *Sterna caspia*, Lesser Noddy *Anous tenuirostris* and Brown Noddy *A. stolidus*. The Corncrake *Crex crex* has been reported on at least ten occasions on passage on Masirah Island, and the Houbara Bustard *Chlamydotis undulata* is said by local people to be a regular passage migrant in small numbers. There is an isolated breeding population of the White-breasted (Abyssinian) White-eye *Zosterops abyssinica*, possibly of an undescribed subspecies, on Mahawt Island.

Arabian Gazelle *Gazella gazella* and perhaps Goitred Gazelle *G. subgutturosa* occur in the Barr Al Hikman area, and *Vulpes rueppellii* has been reported. The Arabian Gazelle and an endemic subspecies of Cape Hare *Lepus capensis jefferyi* occur on Masirah Island. Four species of sea turtles, Loggerhead *Caretta caretta*, Green Turtle *Chelonia mydas*, Hawksbill *Eretmochelys imbricata* and Olive Ridley *Lepidochelys olivacea*, are present in the area at various times of the year when they come ashore to nest, and a fifth species, the Leatherback Turtle *Dermochelys coriacea*, visits the area very ocasionally. Surf Beach, on the eastern shore of Masirah Island, is a nesting site of world importance for *C. caretta*, with an estimated 30,000 females coming ashore each May-September. The east coast of Masirah also provides an important nesting site for *C. mydas*, while *E. imbricata* and *L. olivacea* nest on beaches at the southern end of the island. The Straits of Masirah contain populations of the scarce endemic molluscs *Acteon eloiseae* and *Conus boschi*. Various corals occur as fringing reefs and as isolated patches offshore, and there is a vast monospecific reef of cabbage coral *Montipora foliosa* offshore.

Noteworthy flora: The three species of seagrass *Halophila ovalis*, *Thalassia hemprichii* and *Halodule uninervis* have a restricted range in Oman, and are important as a food source for turtles. There is a particularly rich growth of these seagrasses in the Ghubbat Hashish, with further beds in the Masirah Straits. Well developed stands of the Black Mangrove *Avicennia marina* fringe Mahawt Island.

Scientific research and facilities: A number of research projects are under way in connection with the development of the fisheries, and there is a geological survey of Masirah Island being carried out for the Ministry of Petroleum and Minerals. An intensive study of the hydrodynamics of the Masirah Straits area and the effect of these on the erosion and deposition of sediments around Barr Al Hikman is presently being undertaken under the auspices of the Ministry of Regional Municipalities and Environment. The birds of Masirah Island have been

well studied and documented (*e.g.* Rogers, 1988), but it is only in recent years that the full importance of the Barr Al Hikman area for wintering shorebirds has been proved (*e.g.* Green *et al.*, 1992). Annual mid-winter waterfowl counts have been undertaken at Masirah Island since January 1988 and at Barr Al Hikman since January 1989. There are no special facilities for research in the area.

Conservation education: The Ministry of Regional Municipalities and Environment has an extensive national programme of conservation education which in recent years has highlighted the importance of this area for wildlife. The west shore of Masirah Island would make an excellent site for a local field study.

Recreation and tourism: At present the area is little used for tourism, although it has considerable potential (Munton, 1986).

Management authority and jurisdiction: The management authority is the Ministry of Regional Municipalities and Environment.

References: Anon (1992); Dutton (1986); Evans (1994); Gallagher & Woodcock (1980); Green *et al.* (1992); IUCN (1986); Jensen & Salm (1992b); Moseley & Abbotts (1979); Munton (1986); Rogers (1988); Rose & Scott (1994); Sultanate of Oman (1990); UNEP/IUCN (1988); Uttley *et al.* (1990). Also: Asian Waterfowl Census data 1988-94 (*e.g.* Rose & Taylor, 1993).

Reasons for inclusion: 1a, 1c, 2a, 2b, 2c, 2d, 3a & 3c. An area of outstanding importance for passage and wintering waterbirds, holding internationally important numbers of at least 28 species; also of international importance for breeding seabirds and sea turtles, with one of the world's most important nesting sites for the Loggerhead *Caretta caretta*.

Source: M.A.L. Cummins, National Survey Authority.

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Ghubbat Quwayrat (Ad Duqm) (3)

Location: 19°42'N, 57°41'E; near the village of Ad Duqm on the south-central coast of Oman, 120 km southwest of Masirah Island, Al Wustta Region.

Area: Approximately 1,000 ha.

Altitude: Sea level.

Overview: A shallow sea bay with coastal lagoons and mudflats, important for passage and wintering waterfowl, especially shorebirds, gulls and terns.

Physical features: A shallow, sandy bay with saline coastal lagoons, extensive inter-tidal mudflats and some rocky outcrops, bordering on sand and gravel terrain of low hills, ridges and escarpments. The maximum tidal range is about one metre. There are relatively few settlements in this region, apart from the town of Ad Duqm to the south.

Ecological features: No information.

Land tenure: State owned.

Conservation measures taken: None. The site has been identified as an Important Bird Area by BirdLife International (Evans, 1994).

Conservation measures proposed: None.

Land use: Fishing and livestock grazing (mainly goats). The human population density is low.

Possible changes in land use: No information.
Disturbances and threats: The town of Ad Duqm is developing and expanding.
Hydrological and biophysical values: No information.
Social and cultural values: No information.
Noteworthy fauna: An important staging and wintering area for migratory waterfowl, notably herons, flamingos, shorebirds, gulls and terns. Over 31,400 waterfowl of 32 species were present in January 1993. Recent mid-winter counts have included up to 250 Western Reef Egret *Egretta gularis*, 30 Great Egret *Casmerodius albus*, 250 Grey Heron *Ardea cinerea*, 210 Spoonbill *Platalea leucorodia*, 3,000 Greater Flamingo *Phoenicopterus ruber*, 370 Oystercatcher *Haematopus ostralegus*, 175 Avocet *Recurvirostra avosetta*, 510 Lesser Sand Plover *Charadrius mongolus*, 500 Greater Sand Plover *C. leschenaultii*, 200 Grey Plover *Pluvialis squatarola*, 500 Bar-tailed Godwit *Limosa lapponica*, 520 Eurasian Curlew *Numenius arquata*, 1,000 Little Stint *Calidris minuta*, 1,000 Dunlin *C. alpina*, 4,700 Sooty Gull *Larus hemprichii*, 1,300 Great Black-headed Gull *L. ichthyaetus*, 5,300 Slender-billed Gull *L. genei*, 6,800 Yellow-legged Gull *L. cachinnans*, 200 Caspian Tern *Sterna caspia*, 2,300 Sandwich Tern *S. sandvicensis* and 620 Great Crested Tern *S. bergii*. Up to 15,000 Socotra Cormorants *Phalacrocorax nigrogularis* have been recorded along the coast in winter. The Osprey *Pandion haliaetus* is a common winter visitor (maximum 49).
Noteworthy flora: No information.
Scientific research and facilities: Annual mid-winter waterfowl counts have been undertaken since January 1989. Otherwise the area remains relatively poorly known.
Conservation education: None.
Recreation and tourism: None.
Management authority and jurisdiction: Ministry of Regional Municipalities and Environment.
References: Evans (1994). Also: Asian Waterfowl Census data 1989-94.
Reasons for inclusion: 1a, 3a & 3c. An extremely important wintering area for a wide variety of waterfowl.
Source: See references.

Khawr Dhirif (4)

Location: 18°56'N, 57°21'E; on the Sahil al Jazir coastal plain of south-central Oman, about 50 km west of Ra's al Madrakah, Al Wustta Region.
Area: 100 ha.
Altitude: Sea level.
Overview: A small, coastal, freshwater lagoon with submerged aquatic vegetation, important for passage and wintering waterfowl, especially ducks (Anatidae).
Physical features: A small lagoon, 900 metres long by 600 metres wide, on the Sahil al Jazir coastal plain, land-locked and predominantly freshwater, and surrounded by flat, sandy terrain including dunes.
Ecological features: The aquatic vegetation includes *Potamogeton* sp. and *Ruppia* sp. Salt-

tolerant dwarf shrubs and woody-based herbs are abundant around the site, becoming sparse away from the water.
Land tenure: State owned.
Conservation measures taken: None. The site has been identified as an Important Bird Area by BirdLife International (Evans, 1994).
Conservation measures proposed: The lagoon is part of the proposed North Jazir National Nature Reserve (15,000 ha), which is part of a proposed natural World Heritage Site (IUCN, 1986).
Land use: Fishing and livestock grazing. The human population density is low.
Possible changes in land use: No information.
Disturbances and threats: None known.
Hydrological and biophysical values: No information.
Social and cultural values: Fishing is important in the coastal people's economy.
Noteworthy fauna: An important staging and wintering area for migratory waterfowl, notably ducks, gulls and terns. Recent mid-winter counts have included up to 660 ducks of 11 species (mainly Wigeon *Anas penelope*, Common Teal *A. crecca*, Pintail *A. acuta* and Shoveler *A. clypeata*), 300 Sooty Gull *Larus hemprichii*, 140 Yellow-legged Gull *L. cachinnans*, 50 Gull-billed Tern *Gelochelidon nilotica*, 80 Caspian Tern *Sterna caspia* and 350 Sandwich Tern *S. sandvicensis*. Saunders's Little Tern *Sterna saundersi* breeds in the area (maximum 60 birds), and up to 15 Ferruginous Duck *Aythya nyroca* and 300 Great Crested Tern *Sterna bergii* have been recorded on migration. Greater Flamingo *Phoenicopterus ruber* (22) and Eurasian Coot *Fulica atra* (50) were recorded in December 1986 (M.D. Gallagher). The Houbara Bustard *Chlamydotis undulata* is a scarce winter visitor to the surrounding desert, and the Arabian Gazelle *Gazella gazella* occurs in the area.
Noteworthy flora: The terrestrial vegetation shows a high degree of endemism.
Scientific research and facilities: The site has been visited occasionally by ornithologists since 1981. Annual mid-winter waterfowl counts have been undertaken since January 1989. Otherwise the area remains relatively poorly known because of its remoteness.
Conservation education: None.
Recreation and tourism: None.
Management authority and jurisdiction: Ministry of Regional Municipalities and Environment.
References: Evans (1994); IUCN (1986). Also: Asian Waterfowl Census data 1989-94 (*e.g.* Rose & Taylor, 1993).
Reasons for inclusion: 1d, 2b & 3b. A good example of a predominantly freshwater lagoon, and the most important site for passage and wintering ducks in central Oman.
Source: See references.

Khawr Shumayr (Ghawi) (5)

Location: 18°34'N, 56°38'E; on the southeast coast of Oman, about 45 km north of Sawqirah, Al Wustta Region.

Area: Approximately 1,000 ha.
Altitude: Sea level.
Overview: A large tidal inlet with extensive mudflats, important during the migration seasons and in winter for herons, flamingos, shorebirds, gulls and terns.
Physical features: A six km long tidal inlet parallel to the coast, open to the sea at the northern end and separated from the sea by a long, sandy barrier beach. Extensive inter-tidal mudflats are mostly dry at low tide and flooded to a maximum depth of one metre at high tide. The inflow of fresh water is minimal. The wetland is sheltered by dunes with much shrubby halophytic vegetation; otherwise the surroundings are very flat and sandy. Human density is generally low in the region, although there is a small, new township (Al Kahil) nearby. The climate is generally dry and hot to very hot.
Ecological features: Extensive inter-tidal mudflats; surrounding dunes with shrubby halophytic vegetation.
Land tenure: The wetland and surrounding areas are state owned.
Conservation measures taken: The area was protected by Royal Decree in 1994, as part of the Arabian Oryx Sanctuary. The site has been identified as an Important Bird Area by BirdLife International (Evans, 1994).
Conservation measures proposed: The area is part of the proposed South Jazir National Nature Reserve (18,000 ha), which is part of a proposed natural World Heritage Site (IUCN, 1986).
Land use: Fishing in the khawr and in the adjacent sea. Some camels roam the area in a semi-wild state. There may be some recreational use by expatriates from southern oil-fields.
Possible changes in land use: None known.
Disturbances and threats: None known. The area is relatively undisturbed, partly because of its remoteness and the low human population density.
Hydrological and biophysical values: An important fishing ground for the local population.
Social and cultural values: None known.
Noteworthy fauna: An important staging and wintering area for migratory waterfowl, notably herons, flamingos, shorebirds, gulls and terns. Recent counts have included up to 100 Western Reef Egret *Egretta gularis*, 120 Grey Heron *Ardea cinerea*, 110 Spoonbill *Platalea leucorodia*, 1,000 Greater Flamingo *Phoenicopterus ruber*, 100 Avocet *Recurvirostra avosetta*, 5,000 Lesser Sand Plover *Charadrius mongolus* and Greater Sand Plover *C. leschenaultii*, 500 Grey Plover *Pluvialis squatarola*, 1,500 Sanderling *Calidris alba*, 2,000 Little Stint *C. minuta*, 4,000 Dunlin *C. alpina*, 1,000 Curlew Sandpiper *C. ferruginea*, 230 Ruddy Turnstone *Arenaria interpres*, 700 Broad-billed Sandpiper *Limicola falcinellus*, 2,000 Slender-billed Gull *Larus genei*, 500 Yellow-legged Gull *L. cachinnans*, 500 Caspian Tern *Sterna caspia* and 775 Saunders's Little Tern *S. saundersi*.
Noteworthy flora: No information.
Scientific research and facilities: Mid-winter waterfowl counts have been undertaken every years since 1989 as part of the Asian Waterfowl Census. Otherwise the area remains relatively poorly known because of its remoteness.
Conservation education: None.
Recreation and tourism: The area has great scenic attraction, and could have some potential for eco-tourism, but is currently far away from major towns and paved roads. The Greater Flamingos tend to be pinker here than anywhere else in the Sultanate.

Management authority and jurisdiction: Ministry of Regional Municipalities and Environment.
References: Evans (1994); IUCN (1986). Also: Asian Waterfowl Census data 1989-94 (*e.g.* Rose & Taylor, 1993).
Reasons for inclusion: 1a & 3c. One of the most important coastal wetlands for passage and wintering waterbirds in southern Oman. Concentrations of *Limicola falcinellus* (up to 700) and *Sterna saundersi* (up to 775) are internationally important.
Source: Jens Eriksen, Sultan Qaboos University.

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The Dhofar Khawrs and Wadi Darbaat (6)

Location: 17°02'N, 54°26'E to 16°59'N, 54°02'E; along a 45 km stretch of coastline in the extreme south of Oman, from 10 km west of Salalah to 35 km east, Dhofar Governorate. The principal khawrs are Khawr Rawri 17°02'N, 54°26'E, Khawr Hassan 17°02'N, 54°23'E, Khawr ad Dahariz 17°01'N, 54°11'E and Khawr Salalah 17°00'N, 54°04'E.
Area: Total area unknown. Khawr Rawri 1,100 ha; Khawr Hassan 300 ha; Khawr ad Dahariz 150 ha; Khawr Salalah 200 ha.
Altitude: Sea level to 200 m (in Wadi Darbaat).
Overview: A chain of 12-15 khawrs on the Salalah Plain and an associated wadi with permanent surface water, of considerable interest for their very rich and diverse aquatic fauna and flora. The khawrs are mainly impermanent embouchures of springs and seepages arising in backing mountains; they are open or closed to the sea, of varying salinity, and mostly with reed and mangroves.
Physical features: The site comprises the lower portion of Wadi Darbaat and a chain of some 12 to 15 brackish inlets (khawrs) along a 45 km stretch of coastal plain around Salalah in the Dhofar region of southern Oman. The plain is backed by the Qara Mountains. Khawrs lie at the mouths of drainage systems where groundwater comes to the surface. They are separated from the sea by a sand bar. The salinity of the water varies according to season, periodic rainfall and the strength of freshwater seepage. Generally water levels in the khawrs are higher during the monsoon, when seawater flows over the sand bar at high tides. Levels drop by about 20 cm to a minimum in winter. During floods, however, there are rapid changes in water level.
From east to west, the principal khawrs are Rawri, Hassan, Sawli, Dahariz, Balid, Salalah, West and Thet. The largest khawr, Khawr Rawri (1,100 ha), is larger than all others combined. It is about 2.6 km long and receives substantial inflow from Wadi Darbaat. Its sandbar is occasionally breached, when the lagoon becomes temporarily tidal. Wadi Darbaat is 3.5 km long, and contains a series of permanent pools up to 20 m wide. Khawr Hassan (or Khawr Taqah, 300 ha) is a complex coastal lagoon system with a substantial but variable freshwater inflow, said to be at least partly from a freshwater spring at the north end, where the shore is rocky. Khawr ad Dahariz (150 ha) is a thin coastal lagoon near Salalah town, broadening inland and fed by substantial but variable freshwater inflow from Wadi Sahnut. A gravel road crosses the sand bar which separates the lagoon from the sea, but this is still sometimes breached. Khawr Salalah (200 ha) is a predominantly freshwater lagoon, about 1.1 km long, on the

outskirts of Salalah and fed by seepage from a tributary wadi. The sand bar is occasionally breached by wadi floods.

Ecological features: The vegetation of Khawr Salalah, which has been well documented, follows a recognizable zonation. Towards the seaward side, *Ipomoea pes-caprae*, *Halopyrum mucronatum* and *Atriplex* spp. are present on the sand bar and sandy edges. In the central part of the "anchor" and along the length of the khawr, the dominant vegetation is composed of *Schoenoplectus litoralis*, *Phragmites australis*, *Arthrocnemum macrostachyum*, *Paspalum vaginatum*, *Sporobolus virginicus* and *Urochondra setulosa*. Toward the landward end, *S. virginicus* and *Cressa cretica* are dominant. A few *Acacia nilotica* trees are also present. The zonation of vegetation from the water edge outward is such that *S. litoralis* with *Paspalum vaginatum* form the first zone, behind which *S. virginicus* is present in association with *Suaeda imbricata*. In this zone, *A. macrostachyum* is present, and forms large clumps in restricted areas along the length of the khawr. This community is present on damp to wet soil. Behind the *Sporobolus-Suaeda-Arthrocnemum* community, *Suaeda* sp. and *A. macrostachyum* are replaced by *Urochondra setulosa* and *Limonium axillare*. Associated species with these are *Cyperus conglomeratus*, *Heliotropium fartakense*, *Aeluropus lagopoides* and *Cressa cretica*. *I. pes-caprae* is present in some areas where the substrate is sandy. *U. setulosa* forms the dominant vegetation, forming pure stands behind the third zone. It is normally present on mounds, and in some parts of the coast on the seaward side, clumps of *U. setulosa* form circles ranging from 1-1.5 metres in diameter.

At Khawr Rawri and Khawr Hassan, the water surface is partly open, with a dense fringe of *Juncus*, *Phragmites*, *Typha*, sedges and grasses, and there are beds of water-weed *Chara* sp at Khawr Rawri. The margins of Khawr ad Dahariz are mostly rocky and lined with dense *Phragmites*, *Juncus* and sedges, but there are also some open, sandy, grassy banks.

Open shallow water with abundant submerged vegetation has much higher oxygen levels than deeper areas. The surface water is also much richer. Khawrs shaded by mangrove trees or reeds without much submerged vegetation have the lowest oxygen values. At times of flood, the silty floodwater stirs up low-oxygen water from the bottom of the khawr. This sudden reduction in oxygen at the surface may be responsible for the fish kills observed in many of the khawrs at this time.

Land tenure: The khawrs and most of the surrounding areas are state owned, with traditional grazing rights.

Conservation measures taken: Khawr Salalah is the property of the Diwan of Royal Court and is maintained as a bird sanctuary by the Office of the Adviser for Conservation of the Environment. It is fenced, except at the seaward barrier-beach end, and public access is restricted by permit. Guards patrol the site, two hides have been constructed, a visitor centre is planned, and a management plan has been drawn up. Khawr Rawri, Khawr Hassan, Khawr ad Dahariz and Khawr Salalah have been identified as Important Bird Areas by BirdLife International (Evans, 1994).

Conservation measures proposed: Khawr Salalah has been proposed for designation as a National Nature Reserve, having great scenic, historic and wildlife value (IUCN, 1986). Once designated, it would be managed by the Ministry of Regional Municipalities and Environment. Khawr Rawri, Khawr Hassan and Khawr ad Dahariz have also been proposed as National Nature Reserves.

Land use: Grazing by cattle, camels, sheep and goats occurs all year round at the khawrs, but

pressure is greatest during the monsoon when additional animals are brought down from highland pastures in the Qara Mountains. Some cutting of reeds occurs at Khawr Hassan and possibly elsewhere. Boats are present on many of the khawrs, and there is some fishing for domestic use (with gill nets), but there is no commercial fishing. Some of the adjacent beaches (*e.g.* at Salalah Khawr) are popular picnicking areas, and there is a considerable amount of fishing along the coast. Much of the Salalah Plain has been taken over by residential housing and urban and light industrial development. Salalah is a fast developing town which has already engulfed several of the khawrs in its essentially linear growth along the coast.

Possible changes in land use: The continued expansion of Salalah town could engulf further khawrs.

Disturbances and threats: Grazing pressure is increasing as the number of pastoralists and the size of their herds increase. Increasing urban, suburban, recreational and agricultural encroachment threaten many of the khawrs. The freshwater inflow into Khawr Salalah has been controlled as part of measures to reduce flood damage in the town. Pollution from sewage has occurred at some khawrs (*e.g.* Khawr ad Dahariz), and illegal dumping of chemical and other waste still occurs, but this is under constant and increasingly effective surveillance to prevent it. There is also some seasonal bird-catching and shooting, but measures to control these illegal activities are now in hand. Local people claim that the grazing is poorer than formerly, and that water quality has deteriorated. They attribute this to intensive recreational use, expansion of urban development, construction of new paved roads, and increasing grazing pressure from domestic camels. Khawr Sawli has been fenced off following a deterioration in water quality and reports of camel deaths. As Salalah develops as a popular holiday resort for tourists from Oman and the Gulf States (mainly during the monsoon season), there will inevitably be increasing human-use impact on the more popular khawrs.

Hydrological and biophysical values: No information.

Social and cultural values: Most of the khawrs are used by local people for drinking water, grazing and watering of their livestock, and fishing for domestic use, while several are popular for outdoor recreation. There is an important archaeological site (Samharan) on the southeast bank of Khawr Rawri; it is fenced off and visited regularly by tourists with guides. There is also an important archaeological site at Khawr Balid (NNR).

Noteworthy fauna: The Salalah khawrs support a very diverse avifauna. At least 156 species of waterbirds and 133 landbirds have been recorded in the area. The coastal khawrs attract thousands of wintering waterbirds, many of which move backwards and forwards between these khawrs and Wadi Darbaat, about 6 km inland. Up to about 80 Little Grebe *Tachybaptus ruficollis* occur on Wadi Darbaat, where they breed in wet years. The Great Cormorant *Phalacrocorax carbo* is a regular winter visitor to the khawrs, and large numbers of Socotra Cormorant *P. nigrogularis* occur offshore in winter (*e.g.* up to 2,000 off Khawr ad Dahariz). Eleven species of herons and egrets (Ardeidae) occur on passage and in winter, and Little Bittern *Ixobrychus minutus* may breed at Khawr Hassan. Up to 35 Glossy Ibis *Plegadis falcinellus* and about 50 Spoonbill *Platalea leucorodia* occur in winter. The Greater Flamingo *Phoenicopterus ruber* is a common winter visitor, with peak numbers (150-300) occurring in December and January. At least 16 species of Anatidae, mainly surface-feeding ducks *Anas* spp., have occurred on the khawrs in winter, peaking at over 1,000 individuals in January, and regularly including about 30 Cotton Pygmy-geese *Nettapus coromandelianus* (especially at Khawr Salalah). Khawr Rawri is the most important khawr for wintering ducks. Up to 1,200

ducks have been recorded at this khawr in winter, including up to 30 Ferruginous Duck *Aythya nyroca*. Smaller numbers of *A. nyroca* have also been recorded on passage at Khawr ad Dahariz (maximum 16) and Khawr Salalah (maximum 8). The Moorhen *Gallinula chloropus* and Eurasian Coot *Fulica atra* breed on at least six of the khawrs, where the combined population is about 200 birds. Up to 50 Pheasant-tailed Jacana *Hydrophasianus chirurgus* occur in winter, especially at Khawr Rawri and Khawr Salalah. Large numbers of gulls and terns (Laridae) occur along the coast, and often roost on sand bars at the mouths of the khawrs, *e.g.* up to 1,330 Sooty Gull *Larus hemprichii*, 3,300 Black-headed Gull *L. ridibundus*, 920 Great Crested Tern *Sterna bergii*, 37 Roseate Tern *S. dougallii* and 500 Common Tern *S. hirundo* at Khawr Hassan, up to 1,300 *L. hemprichii*, 600 *S. bergii*, 30 *S. dougallii* and 300 *S. hirundo* at Khawr ad Dahariz, and up to 1,000 Yellow-legged Gulls *Larus cachinnans* at Khawr Salalah.

Peak counts of waterbirds in the Dhofar Khawrs in recent winters have included 100 *Tachybaptus ruficollis*, 115 *Phalacrocorax carbo*, 140 Cattle Egret *Bubulcus ibis*, 100 Western Reef Egret *Egretta gularis*, 92 Little Egret *E. garzetta*, 340 Grey Heron *Ardea cinerea*, 78 White Stork *Ciconia ciconia*, 35 *Plegadis falcinellus*, 53 *Platalea leucorodia*, 260 *Phoenicopterus ruber*, 22 *Nettapus coromandelianus*, 230 Wigeon *Anas penelope*, 190 Common Teal *A. crecca*, 290 Pintail *A. acuta*, 165 Garganey *A. querquedula*, 210 Shoveler *A. clypeata*, 380 *Gallinula chloropus*, 240 *Fulica atra*, 33 *Hydrophasianus chirurgus*, 1,700 *Larus hemprichii*, 3,200 *L. ridibundus*, 940 Slender-billed Gull *L. genei*, 2,100 *L. cachinnans*, 65 Whiskered Tern *Chlidonias hybridus* and 250 Lesser Crested Tern *Sterna bengalensis*. At least 35 species of shorebirds have been recorded in winter, mostly in rather small numbers; most notable have been up to 630 Kentish Plover *Charadrius alexandrinus*, 73 Pacific Golden Plover *Pluvialis fulva*, 130 Eurasian Curlew *Numenius arquata* and 200 Greenshank *Tringa nebularia*. Wintering birds of prey include up to 39 Osprey *Pandion haliaetus*, 17 Marsh Harrier *Circus aeruginosus*, 7 Greater Spotted Eagle *Aquila clanga*, 16 Imperial Eagle *A. heliaca* and 2 Peregrine Falcon *Falco peregrinus*. Notable counts of waterfowl during the migration seasons have included up to 63 Black-crowned Night-Heron *Nycticorax nycticorax* at Khawr Hassan, 150 *Ciconia ciconia* at Khawr Rawri, 300 Sanderling *Calidris alba* at Khawr ad Dahariz, and up to 106 *P. fulva*, 48 Marsh Sandpiper *Tringa stagnatilis* and 400 Ruff *Philomachus pugnax* at Khawr Salalah.

The fish fauna is rich and diverse. Most fish species use the khawrs as nursery grounds, and leave to breed in the sea when, and if, the sand bar is breached. Mullet mature in winter and milkfish in early spring; the other species mature in spring and summer.

The mammalian fauna of Dhofar is largely Afrotropical in its affinities, and includes Leopard *Panthera pardus*, Wolf *Canis lupus*, Honey Badger *Mellivora capensis*, White-tailed Mongoose *Ichneumia albicauda*, Genet *Genetta genetta*, Striped Hyaena *Hyaena hyaena* and a porcupine *Hystrix* sp. The hyaena and porcupine have been recorded around the Salalah khawrs in recent years, and several of the other species may also occur there.

Noteworthy flora: The freshwater khawrs, such as Khawr Salalah, support a very diverse aquatic flora, unusual in this part of Arabia. At least three species of plants on the Salalah Plain are endemic or near-endemic to Oman, and some may be present around the khawrs.

Scientific research and facilities: Numerous surveys and monitoring studies have been carried out, mainly by students of Sultan Qaboos University in 1992. These have included studies of the physical parameters of the khawrs, water chemistry, fish populations, vegetation, aquatic macrophytes, littoral micro-invertebrates, marine crustaceans, microfauna, mosquitos, birds,

socio-economic uses, freshwater snails and sand bars. Annual mid-winter waterfowl counts have been undertaken since January 1988 as part of the Asian Waterfowl Census.

Conservation education: The area has huge potential for conservation education. The results of studies made at the khawrs are already being taught in the Biological Conservation course at Sultan Qaboos University. A colour booklet "The Khawrs of Dhofar" was produced in Arabic and English in 1993 by the Technical Secretariat of the Planning Committee for Development and Environment in the Governorate of Dhofar.

Recreation and tourism: The khawrs are already used to some extent for outdoor recreation, and this is likely to increase as Salalah develops as a popular holiday resort for Arabs and others from the Gulf States.

Management authority and jurisdiction: Ministry of Regional Municipalities and Environment, and Office of the Adviser for Conservation of Environment at the Diwan of Royal Court.

References: Anon (1989, 1990, 1993); Evans (1994); IUCN (1986, 1989); Gallagher *et al.* (1980); Jensen (1991). Also: Asian Waterfowl Census data 1989-94.

Reasons for inclusion: 1a, 1d, 2b, 2c and 3c. The site contains excellent examples of various types of khawrs, including khawrs which are predominantly freshwater with rich and diverse aquatic vegetation; it also supports a very diverse bird fauna, especially in winter, with several species occurring in internationally significant numbers.

Source: C.H. Fry, Sultan Qaboos University.

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QATAR

INTRODUCTION

by Abdul Aziz Al-Midfa and Robert Nation

Area: 11,437 sq.km.

Population: 368,000 (1990).

The peninsula of Qatar projects northward for about 160 km into the western part of the Arabian Gulf and has a maximum width of 90 km. It is bounded on the south by Saudi Arabia. The population of 368,000 (1990) is concentrated in the capital city of Doha and a few smaller towns.

The land surface, which covers some 11,437 sq.km, is predominantly low-lying semi-desert, with low hills rising to a maximum elevation of 103 m in the Dukhan Heights in the west, and extensive sand dunes in the southeast. Vegetation is sparse, consisting of acacias and other scrub desert communities concentrated mostly in depressions and small wadis. Particularly in the north, pumped groundwater supports scattered farms with trees and limited crops. Elsewhere, the principal land-use activity is livestock grazing. Almost all of the interior of the peninsula has been modified or degraded by human activity. Belts of sabkha or salt flats surround much of the indented coastline, while offshore there are several small islands and numerous coral reefs and sandy shoals. The coastal waters are fairly shallow, with an average depth of less than 20 m and a relatively high salinity. These waters were not affected by any major oil slicks during the Gulf War of 1991.

Qatar has a desert climate with temperatures ranging from an average of 23°C in winter to 35°C in summer, when peaks of 49°C have been recorded. The humidity is exceptionally high, often reaching 90% in summer. Total annual rainfall is low and seldom exceeds 75 mm. Most of this rainfall occurs during the winter months, normally in the form of heavy thunderstorms. The prevailing winds are from the northwest and southeast.

Summary of Wetland Situation

Almost all of Qatar's wetlands are marine and coastal. Around the coast there are extensive coral reefs and seagrass beds, and one notable area of mangroves at Al-Dhakira on the east coast. Only one species of mangrove, the Black Mangrove *Avicennia marina*, is present. Mangrove is also being planted by the Government, but only in small local areas. Parts of the low, rocky coast have broad intertidal flats of sand or mud, but the biological productivity of

these appears to be relatively low except in certain spots, mostly on the more sheltered east coast. Extensive sabkha occurs across the base of the peninsula, and also near Zubarah in the northwest, around khors on the east and west coast, and around and south of Umm Said in the southeast. Coral reefs are shallow and of low density, but are well developed along the east coast. They are the central part of a long and broad line of reefs which extend from Bahrain down the east coast of Qatar and along the coast of the United Arab Emirates (UNEP/IUCN, 1988).

The few permanent wetlands inland are man-made, and include small water storage reservoirs, spillage from irrigation systems, sewage treatment ponds and small bodies of water created by effluent waste water from populated areas. Such artificial wetlands are locally important for invertebrate and bird diversity. The only natural surface water is in low-lying areas flooded after heavy rain, and is highly ephemeral.

Socotra Cormorants *Phalacrocorax nigrogularis*, Western Reef Egrets *Egretta gularis* and several species of terns *Sterna* spp. breed on some of the offshore islands, possibly in internationally significant numbers, but the colonies have never been properly surveyed (Gallagher *et al.*, 1984). Outside the breeding season, the coastal zone supports internationally important numbers of *P. nigrogularis*, along with substantial numbers of a wide variety of shorebirds, gulls and terns (Evans, 1994). Many species of waterbirds have been recorded at the man-made freshwater wetlands inland, especially during the migration seasons and in winter, and several species have bred, but numbers are generally low. Hawksbill Turtles *Eretmochelys imbricata* nest on at least one offshore island, but numbers are reportedly very low (UNEP/IUCN, 1988).

A national marine and coastal zone development and protection plan has been proposed for the marine resources, to control marine waste disposal, marine mining and transportation, coastal land use and marine fauna and flora resources (UNEP, 1984; cited in IUCN, 1992). Initial recommendations for protected area designation were made in 1986 for the investigation of practical arrangements for protecting sensitive coastal resources such as the mangroves at Al-Dhakira (Environmental Resources Ltd., 1986; cited in IUCN, 1992).

The recent inventory of Important Bird Areas in the Middle East, sponsored by BirdLife International, identified five sites of special importance for bird conservation in Qatar (Evans, 1994). All five are coastal, comprising three offshore islands important for breeding seabirds, and two inter-tidal areas along the mainland coast important for feeding and roosting waterbirds. One of the offshore islands, Al-Aliyah, and the two inter-tidal areas, Al Dhakira Mangroves and Khor al-Udeid, are included in the present inventory as important wetlands, along with two artificial freshwater wetlands not included in the IBA report. The IBA report stressed that much of Qatar's coastline remains poorly known, and highlighted the need for further investigation of coastal wetlands on the west coast of Qatar north of Dukhan.

Wetland Research

The Scientific and Applied Research Centre of Qatar University supports research on the flora and fauna of the country. However, virtually no work has been carried out on the wetlands of Qatar except for general avifaunal surveys by resident and visiting ornithologists. Mid-winter waterfowl counts have been undertaken annually since the winter of 1990/91 as part of the IWRB/AWB Asian Waterfowl Census. The counts, which cover a total of eight sites, have been made by members of the Qatar Natural History Group in collaboration with the Environment Protection Council.

Wetland Area Legislation

Environmental policy and legislation have recently been summarized by IUCN (1992). Administration of flora, soils and fauna falls within the responsibility of the Ministry of Municipal Affairs and Agriculture. There is no national wetlands policy or any specific legislation relating to wetlands. However, there are laws restricting the use of pesticides and covering protection and utilisation of living sea resources. The Fisheries Department in the Ministry of Municipal Affairs and Agriculture enforces fishing regulations. Responsibility for nature conservation issues rests with the Environment Protection Committee (EPC), which was established in 1981 and is attached to the Cabinet. The EPC has some power to develop environmental policy and to draft legislation and regulations, to conduct environmental assessments and monitoring, to approve development projects, and to educate the public.

At international level, Qatar is a member of ROPME, the Regional Organisation for Protection of the Marine Environment. It is a contracting party to the World Heritage Convention, but has not designated any natural World Heritage Sites. It has signed, but not ratified, the Biodiversity Convention, and is a party to the Regional Convention for Cooperation on the Protection of the Marine Environment from Pollution, and to the Action Plan for the Protection and Development of the Marine Environment and Coastal Areas.

Wetland Area Administration

No wetlands, or indeed any other natural areas, are specifically protected for nature conservation. The only protected areas as such are small game reserves and breeding stations in desert areas, set up by state authorities and by members of the ruling family to maintain stocks of large mammals such as oryx and gazelle (IUCN, 1992). However, Khor al-Udeid, a deep inlet from the sea on the southeast coast, was declared a water sanctuary by Ministerial Decree No.78 of the Ministry of Municipal Affairs and Agriculture in November 1993. Under this status, all commercial fishing is banned.

Organizations involved with Wetlands

Ministry of Municipal Affairs and Agriculture

Responsible for administration, protection and management of flora, soils and fauna; the

main public body concerned with protected areas.

Environmental Protection Committee
: Responsible for environmental policy and legislation, environmental analysis and assessment, and environmental education.

Scientific and Applied Research Centre (SARC), Qatar University
: Conducts studies on the flora and fauna of Qatar and related topics, including human impacts on the environment.

Qatar Natural History Group
: A non-governmental organisation concerned with promoting the knowledge of natural history in Qatar.

WETLANDS

Site descriptions compiled by Abdul Aziz Al-Midfa and Robert Nation.

Al-Dhakira (Adh Dhakhirah) Mangrove (1)

Location: 25°45'N, 51°34'E; on the east coast of the Qatar Peninsula, immediately to the north and east of the small town of Al-Dhakira and 7 km north of the municipality of Al Khor.
Area: 3,000 ha.
Altitude: Sea level.
Overview: A sheltered group of saltwater bays with dense stands of mangrove, broad mudflats and saltmarsh vegetation. Possibly an important spawning and nursery area for economically valuable fish and shrimp stocks. The site is important for wintering and passage waterbirds, including ducks and Greater Flamingos *Phoenicopterus ruber*.
Physical features: A roughly triangular group of three bays and small islands protected from the open Arabian Gulf to the east by a spit, and extending north for about 8 km from the village of Al-Dhakira to a point where the protective spit joins the main coastline. Longshore drift is from north to south. Part of the area (1,000 ha or less) is covered by mangroves; broad mudflats are exposed at low tide, and there are some sandy beaches. Tidal variation is normally less than two metres. The average annual rainfall in this area is about 60 mm.
Ecological features: The mangrove area consists of pure dense stands of Black Mangrove *Avicennia marina*. *Arthrocnemum glaucum* and other halophytes occur on higher ground.
Land tenure: No information.
Conservation measures taken: The site has no formal protection, although it has been protected with booms during major oil spills in the past. It has been identified as an Important Bird Area by BirdLife International (Evans, 1994).
Conservation measures proposed: The mangroves should be fenced against camel grazing.
Land use: There is some artisanal fishing in the mangroves, and some recreational boating

occurs in the general area. Camels, goats and sheep are allowed to graze in the saltmarsh and mangroves, but this is not as yet intensive. The town of Al-Dhakira extends along the southern edge of the wetland.
Possible changes in land use: Future expansion of Al-Dhakira town.
Disturbances and threats: The grazing of mangroves by camels is a problem locally, and some hunting of waterfowl has been reported. Land reclamation for housing and recreation may become a problem in the future as the town of Al-Dhakira grows to support a new industrial town to the north. Oil spills are always a threat, but the topography of the site provides fairly good protection.
Hydrological and biophysical values: Possibly an important spawning and nursery area for economically valuable fish and shrimp stocks.
Social and cultural values: No information.
Noteworthy fauna: The site has not yet been thoroughly surveyed, but is known to be important for passage and wintering waterfowl including Spoonbill *Platalea leucorodia* (maximum 22), Greater Flamingo *Phoenicopterus ruber* (up to several hundreds), various ducks, and a wide variety of shorebirds, gulls and terns. Annual mid-winter waterfowl censuses since January 1991 have recorded up to 13 *Phalacrocorax carbo*, 40 *Egretta gularis*, 5 *E. alba*, 7 *Ardea cinerea*, 65 *Phoenicopterus ruber*, 400 *Anas platyrhynchos*, 300 *Charadrius alexandrinus*, 42 *C. leschenaultii*, 52 *Numenius arquata*, 35 *Tringa totanus*, 87 *Calidris alpina*, 130 *Larus genei*, 8 *Sterna caspia* and small numbers of a further 16 species of waterfowl, mostly shorebirds. Coverage has been poor, and the site is thought to be considerably more important than these counts might suggest. Marsh Harriers *Circus aeruginosus* have been recorded in winter, and Bridled Terns *Sterna anaethetus* are common offshore in summer. No information in available on the fish and invertebrate fauna.
Noteworthy flora: Relatively undisturbed stands of the Black Mangrove *Avicennia marina*.
Scientific research and facilities: None, other than annual mid-winter waterfowl counts (since 1991) and brief ornithological surveys at other times of the year.
Management authority and jurisdiction: No information.
References: Evans (1994). Also: IWRB Asian Waterfowl Census data 1991-95.
Reasons for inclusion: 1d, 2b & 2c. This is the only extensive mangrove area in Qatar, and one of the few this far north on the south shore of the Arabian Gulf. The mangroves and associated mudflats may be very important as breeding and nursery grounds for marine species of fishes and shrimps, including a number of commercially valuable species.
Source: Robert Nation and Abdul Aziz Al-Midfa.

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Al-Aliyah Island (2)

Location: 25°21'N, 51°34'E; in the Arabian Gulf, 3 km off the east coast of the Qatar Peninsula and about 13 km north-northeast of Doha.
Area: 65 ha.
Altitude: Sea level.
Overview: A small rocky island with long sand spit and broad inter-tidal flats, important for

breeding, passage and wintering waterbirds; of special interest because of its proximity to the capital city Doha.

Physical and ecological features: A small, low, rocky island about 3 km off the east coast of Qatar, only about 5 km from the northern outskirts of Doha. The surface consists of loose, weathered limestone rock with an uneven cover of salt-tolerant bushes, especially *Zygophyllum qatarensis* and *Limonium axillare*. A sand spit extends south for about two km at low tide, and there are broad inter-tidal flats to the south and east, and coral reefs nearby.

Land tenure: Government of Qatar.

Conservation measures taken: No conservation measures have been taken, although the presence nearby of a security area restricts the number of visitors and thus provides some unintentional protection from disturbance. Visitors are also monitored to some extent by the Coast Guard at Doha, 13 km to the south. The site has been identified as an Important Bird Area by BirdLife International (Evans, 1994).

Conservation measures proposed: Formal protection for the site was suggested in 1986 (ABCS, 1986), and new proposals are now under consideration.

Land use: The island is occasionally visited by fishermen and authorized falcon-trappers.

Possible changes in land use: None known.

Disturbances and threats: Visitors to the island may cause some disturbance to breeding seabirds, and exploitation of seabird eggs may be occurring. Oil pollution is always a potential threat.

Hydrological and biophysical values: No information.

Social and cultural values: No information.

Noteworthy fauna: Socotra Cormorants *Phalacrocorax nigrogularis* bred once in the period 1991-95 (350 pairs in 1994). Surveys in 1992 and 1993 found breeding colonies of Western Reef Egret *Egretta gularis* (17 pairs), Lesser Crested Tern *Sterna bengalensis* (75 pairs), White-cheeked Tern *S. repressa* (25 pairs) and Bridled Tern *S. anaethetus* (50 pairs). Annual mid-winter waterfowl counts since January 1992 have recorded maxima of 100 *Phalacrocorax carbo*, 1,300 *P. nigrogularis*, 40 *Egretta gularis*, 11 *Ardea cinerea*, 380 *Phoenicopterus ruber*, 30 *Numenius arquata*, 225 *Calidris alpina*, 300 *Sterna bengalensis* and small numbers of a further 17 species of shorebirds, gulls and terns.

Noteworthy flora: No information.

Scientific research and facilities: None, other than a few avifaunal surveys and annual mid-winter waterfowl counts since 1992.

Conservation education: Because of its proximity to Doha, the site has considerable potential for education and research.

Management authority and jurisdiction: No information.

References: ABCS (1986); Evans (1994); Planning Department (1992). Also: IWRB Asian Waterfowl Census data 1992-95.

Reasons for inclusion: 1a, 2c & 3b. The island is the only natural offshore island close to Doha.

Source: Robert Nation and Abdul Aziz Al-Midfa.

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Salwa Road Ponds (3)

Location: 25°10'N, 51°24'E; in the desert about 3 km south of the main Doha to Salwa road, 20 km southwest of Doha.
Area: c.50 ha.
Altitude: c.30 m above sea level.
Overview: A group of freshwater pools in the desert southwest of Doha, fed by treated sewage and supporting relatively luxuriant aquatic vegetation; primarily of interest for the wide diversity of waterbirds occurring on passage and in winter.
Physical and ecological features: A group of shallow, freshwater pools formed on a substrate of hard, stony ground by the dumping of post-treatment sewage effluent, piped about 15 km from the Doha treatment plant. There are some patches of reeds *Phragmites australis (communis)* and more extensive areas of grasses and *Juncus* sp. around the edges of the pools. The maximum depth of water is about one metre. The pools are variable in extent, depending on pumping levels. Since 1991, much of the water has been diverted for irrigation purposes, and the wetland is now greatly reduced in size.
Land tenure: No information.
Conservation measures taken: None.
Conservation measures proposed: None known.
Land use: Grazing by domestic livestock, especially camels.
Possible changes in land use: None known.
Disturbances and threats: Since 1991, the bulk of the water supply has been diverted for agricultural use, and the ponds are now far less extensive than in former years. The water supply could be cut off completely if the demand for irrigation water increases. The marsh vegetation is very heavily grazed by camels, and there is relatively heavy hunting pressure on waterfowl.
Hydrological and biophysical values: No information.
Social and cultural values: None known.
Noteworthy fauna: A wide variety of waterbirds has been recorded at the site during the migration seasons and in winter, although numbers are generally very small. Annual mid-winter waterfowl counts since January 1991 have recorded up to 30 *Tachybaptus ruficollis*, 160 *Podiceps nigricollis*, 150 *Phoenicopterus ruber*, 40 *Gallinula chloropus*, 125 *Charadrius alexandrinus*, 20 *Tringa totanus* and 300 *Larus ridibundus*, as well as smaller numbers of a further 11 species of waterfowl.
Noteworthy flora: One of the few significant areas of freshwater marsh vegetation in Qatar.
Scientific research and facilities: None, other than annual mid-winter waterfowl counts (since 1991) and brief ornithological surveys at other times of the year.
Management authority and jurisdiction: No information.
References: IWRB Asian Waterfowl Census data 1991-95.
Reasons for inclusion: 1d & 2b. One of the very few freshwater habitats in Qatar.
Source: Robert Nation and Abdul Aziz Al-Midfa.

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Umm Said Sewage Pond (4)

Location: 24°58'N, 51°34'E; near the east coast of the Qatar Peninsula close to the industrial town of Umm Said, about 40 km south of Doha.
Area: About one hectare.
Altitude: Near sea level.
Overview: A man-made pond with a fringe of tall reeds, fed by effluent from a sewage treatment plant; of interest for its breeding, passage and wintering waterbirds.
Physical and ecological features: A small pond, about 150 m long by 70 m wide, formed by earth embankments and filled with post-treatment sewage effluent from an adjacent sewage treatment plant. The pond is surrounded by a tall fringe of *Phragmites* reeds, up to 6 m in height. The water level shows little fluctuation throughout the year.
Land tenure: No information.
Conservation measures taken: None.
Conservation measures proposed: None known.
Land use: None.
Possible changes in land use: None known.
Disturbances and threats: Some waterfowl hunting has been reported, but the tall reed fringe makes access difficult.
Hydrological and biophysical values: No information.
Social and cultural values: None known.
Noteworthy fauna: Little Grebe *Tachybaptus ruficollis* and Moorhen *Gallinula chloropus* breed regularly. Many species of waterfowl have been recorded during the migration seasons and in winter, including at least seven species of ducks (Anatidae), but numbers are generally very small.
Noteworthy flora: One of the few significant areas of freshwater marsh vegetation in Qatar.
Scientific research and facilities: None, other than annual mid-winter waterfowl counts (since 1991) and brief ornithological surveys at other times of the year.
Management authority and jurisdiction: No information.
References: IWRB Asian Waterfowl Census data 1991-95.
Reasons for inclusion: 1d & 2b. One of the very few freshwater habitats in Qatar.
Source: Robert Nation and Abdul Aziz Al-Midfa.

Khor al-Udeid (Khawr al-'Udayd) (5)

Location: 24°37'N, 51°20'E; in extreme southeastern Qatar, on the border with Saudi Arabia.
Area: c.12,000 ha.
Altitude: Sea level.
Overview: A large sea bay with narrow connection to the sea on the southeast coast of the Qatar Peninsula, possibly of considerable importance for marine mammals, sea turtles, waterfowl and seabirds, but very poorly known.
Physical and ecological features: A very large tidal inlet, about 15 km from north to south and

up to 12 km from east to west, on the eastern side of the Qatar Peninsula near its base. The main part of the bay is connected to the open sea by a relatively narrow channel, over 10 km in length, which passes between high sand dunes and layered rock formations to the south. The inlet contains a number of sandy and rocky islands as well as areas of inter-tidal flats, and there are patches of coral reef near the seaward end of the channel. Large areas of sabkha lie adjacent to much of the shoreline.

Land tenure: Unknown. The southern shores are now controlled by Saudi Arabia.

Conservation measures taken: Khor al-Udeid was declared a water sanctuary by Ministerial Decree No.78 of the Ministry of Municipal Affairs and Agriculture in November 1993. This placed a ban on all commercial fishing. The site has been identified as an Important Bird Area by BirdLife International (Evans, 1994).

Conservation measures proposed: None known.

Land use: Formerly commercial fishing, but this was banned in 1993. The sandy shores attract heavy weekend recreation in the cool season, but the sabkha shorelines are seldom visited.

Possible changes in land use: None known.

Disturbances and threats: There is some recreational disturbance by campers and four-wheel drive vehicles, but otherwise there are no obvious threats apart from major oil pollution.

Hydrological and biophysical values: No information is available. However, the inlet is likely to be an important breeding area and nursery grounds for crustaceans and marine fishes.

Social and cultural values: No information.

Noteworthy fauna: Breeding birds include at least one pair of Osprey *Pandion haliaetus* on a low rocky island, and Caspian Tern *Sterna caspia*. Large concentrations of wintering Greater Flamingo *Phoenicopterus ruber* have been reported in the past, but these have not been confirmed in recent years. Significant numbers of other waterbirds may also occur, including Great Cormorant *Phalacrocorax carbo*, Socotra Cormorant *P. nigrogularis*, shorebirds, gulls and terns.

Unidentified whales have been recorded, possibly *Balaenoptera edeni*, and the area may be an important feeding ground for dolphins. Sea turtles are also believed to occur, but details are lacking.

Noteworthy flora: No information.

Scientific research and facilities: None. The area is remote and has seldom been visited by scientists.

Management authority and jurisdiction: No information.

References: Evans (1994); Gallagher (1985); Gallagher *et al.* (1984).

Reasons for inclusion: 1d (2c). An unusual, largely land-locked sea bay, thought to be of importance for wildlife, but not as yet properly investigated.

Source: Robert Nation and Abdul Aziz Al-Midfa.

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KINGDOM OF SAUDI ARABIA

INTRODUCTION

by Stephen F. Newton

Area: 2,145,000 sq.km.

Population: Approximately 15 million. The population growth rate is deemed one of the highest in the region.

The Kingdom of Saudi Arabia is the largest state on the Arabian Peninsula, with extensive coastlines on both the Red Sea and the Arabian Gulf and common borders with all other Arabian countries and Jordan and Iraq in the north. Topographically, the country is very varied, with extensive mountain ranges reaching 3,000 m and limestone escarpments, vast sand deserts, lava deserts and coastal and inland sand/gravel plains. However, the basic physiographic units are well defined and, in a southwest to northeast transect across the country, the major units are the Red Sea coastal plain or Tihamah, the mountains of the Red Sea rift valley (Hejaz in the north, Asir in the south), the western plateau and northern plains including several major lava desert areas (harrats), the central and eastern sand deserts (Nafud in the north and Rub 'al Khali in the south and east) linked by other dune systems, and finally the eastern, Gulf, coastal plain (see Newton & Symens, 1994, for more details). The climate is essentially arid to hyper-arid, although the southwestern mountain ranges receive higher than average (<50 mm) rainfall (300-500 mm) and, when combined with the often persistent low cloud, effective precipitation is high enough to support evergreen juniper forest. These high orographic rainfalls are primarily supported by the Northwest Indian Ocean summer monsoon (Siraj, 1984; Tinley, 1994). As the Kingdom spans 16°-32°N and altitude ranges from sea level to 3,000 m, temperature and humidity vary greatly. Subzero nights are frequent in the north and daily summer temperatures are often in the range 35°-45°C. Humidity is highest in the summer, especially on the Gulf and southern Red Sea coastlands.

Biogeographically, the Kingdom has a unique setting. The Saharo-Sindian desert belt spans the country, with a distinctive faunal and floral assembly of its own, but this is overlain with significant Western Palearctic elements in the north, some Indo-Malaysian influence in the east and a near total Afrotropical fauna and flora present in the southwest. The latter area exhibits the highest degree of faunal endemism on the Arabian Peninsula (ICBP, 1992).

The Saudi Arabian economy is largely dependent on its oil wealth and the associated petrochemical industry. Poor oil prices and unpredictable markets in the 1990s have somewhat tempered the nation's rapid development characteristic of the preceding 20-30 years. However, other industrial and agricultural sectors are now being developed to provide the country with broader-based economic security. Despite the apparent wealth of the country, living standards

vary dramatically, with a significant component of the population away from the industrial zones around the Gulf, Riyadh and Jeddah largely dependent on pastoral and subsistence agriculture.

Summary of Wetland Situation

Although Saudi Arabia has an extremely arid climate, a wide variety of natural wetland types are located within the Kingdom, and each major physiographic unit supports some permanent wetlands as well as a plethora of ephemeral types. In recent decades, many man-made wetlands have been created, and away from the coastal zones, these are often very significant features in the landscape. Eight wetland systems were identified in the Kingdom by Tinley (1994).

- Coastal systems: include coral islands, reefs, mud-, sand- and algal-flats, mangroves, lagoons and inlets, as well as perennial freshwater marshes and artesian springs.
- Dunefield systems: include relatively minor aquifer seeps on both Red Sea and Gulf coasts and a major wetland in the Rub 'al Khali.
- Sabkha systems: extensive sabkhas (erratically flooded salt-flats) are present on both Gulf and southern Red Sea plains; additionally, much of the terrain between the lower Gulf and the Rub 'al Khali is sabkha dominated; smaller sabkhas are also present in the northern harrats and in inland drainage basins on the central plateau.
- Karst systems: of very limited occurrence, although perhaps forming the only truly permanent lakes in central Arabia *e.g.* the aquifer-fed karst crater lakelets of the Al Aflaj/Layla district.
- Mountain systems: support a range of small wetlands *e.g.* ponded pockets, other pools and seeps, especially in granite mountains and inselbergs; various seeps and marshes in volcanic/harrat areas.
- Geothermal systems: very limited wetlands confined to the southern Tihamah *e.g.* Ain Wakrah springs at Malaki Dam.
- Wadi systems: abundant features of the Red Sea escarpment mountains, although only a relatively small proportion support perennially flowing rivers. They can flow either westwards towards, though rarely reaching, the Red Sea or eastwards *i.e.* inland.
- Man-made systems: include large open expanses of water (dams and reservoirs) and linear canal systems feeding irrigated farmland or outflows from sewage treatment plants (Riyadh and Makkah water courses) or industrial areas (Gulf area).

Both inshore and coastal waters and those surrounding offshore islands support major fisheries. Until recently, most fishing was done on a subsistence basis by local communities (hereafter referred to as the artisanal fishery), which is relatively sustainable. More recently, two commercial fisheries have appeared: the state-owned Saudi Fisheries Company (industrial fishing, often with large trawlers) and Investor Fisheries where "speculators" purchase small boats and man them with cheap Asian labour. In some coastal lagoons, fish (usually prawn) farms are beginning to develop. Other activities in coastal waters yielding economic returns are the remnant pearl-fishery in the Red Sea Farasan Islands and recreational diving, especially on reefs around coastal conurbations, *e.g.* Jeddah and Yanbu on the Red Sea and the Jubail/Damman/Dhahran area on the Gulf coast.

Small-scale natural wetlands have had a pivotal role in the subsistence economics of many inland areas; such oasis areas have a long history of date palm cultivation. Saudi Arabia has recently become one of the world's major wheat growing nations. However, the majority of irrigation water comes from boreholes, and the impact of over-abstraction on wetlands in the aquifer source areas has yet to be assessed. Dams and reservoirs, both large and small, are very important to the agricultural economics in mountainous areas with high precipitation, but in most cases such water storage and distribution schemes have simply replaced ingenious small-scale systems that local communities had developed over centuries in the wise use of meagre water supplies in their cultivations.

Saudi Arabian coastal wetlands support internationally important populations of breeding seabirds, wintering shorebirds, breeding turtles, dugongs, fish and a vast array of corals and other invertebrate taxa (Abuzinada & Krupp, 1994; Gladstone, 1994a). Floristically, they show less diversity, although the Red Sea coast supports extensive mangrove forests, seagrass beds and algal-flats. These communities are also present in the Gulf, but vast reclamation projects have destroyed over 40% of inter-tidal areas and intact areas are limited to the Gulf of Salwah in the south. Until recently, inland wetlands were not a major feature of the landscape, although perennial wadis inconspicuously support a surprisingly wide variety of endemic fish and amphibians. The major man-made wetlands (dams and wastewater rivers) have altered considerably the behaviour of many waterbird species formerly only known in the Kingdom as passage migrants. Nowadays, many more overwinter in the country, and in some cases conditions are suitable for some species to breed, well to the south of their normal Palearctic limits.

With the exception of these man-made water bodies, wetlands are under severe threat in Saudi Arabia. Coastal zones are now subject to high pressure from expanding commercial and industrial fisheries, and many former fish nurseries have been lost to coastal reclamation from industrial, residential and recreational facilities. The Gulf has lost over 40% of its inter-tidal area to development, and the Red Sea 8% (Sambas & Symens, 1993). Burgeoning human populations in the Gulf and Jeddah, Jizan and Yanbu areas on the Red Sea are resulting in considerable pollution from domestic sewage and industrial discharges. Recent events have proved how vulnerable the Gulf coast is to oil pollution.

Natural inland wetlands are most at threat from over-abstraction by the expanding intensive crop growing agro-industry and to a lesser extent by inland conurbations for domestic consumption.

Wetland Research

Two governmental agencies have been responsible for the majority of pure research on wetlands and their flora and fauna: the Meteorological and Environmental Protection Administration (MEPA) in Jeddah and the National Commission for Wildlife Conservation and Development (NCWCD) in Riyadh. Industry has sponsored applied wetland research *e.g.* Saudi

Aramco (the partially state-owned oil company) and the Saudi Fisheries Company, but the results of such environmental impact assessments and fisheries monitoring are seldom available publicly. Universities, particularly those in coastal locations, have a long tradition of marine research, notably King Fahd University of Petroleum and Minerals, Dhahran, and King Abdulaziz University, Jeddah.

MEPA and NCWCD have sponsored jointly the Zoological Survey of Saudi Arabia since the early 1980s and dissemination of the results through publication of "Fauna of Saudi Arabia". This has included substantial inventories of the biodiversity of the Kingdom's wetlands, with various insect groups, corals, fish, amphibians and turtles well covered. NCWCD has more recently supported a wide range of wetland monitoring programmes, and in the aftermath of the Gulf War established the Wildlife Sanctuary for the Gulf Region in Jubail. The Kingdom has contributed to the Asian Waterfowl Census since 1990, and has funded long-running research projects on turtles, seabirds and mangroves in the Gulf. Similar marine research is now being established in the Red Sea, particularly around the Farasan Islands.

Wetland Area Legislation

Saudi Arabia is a signatory of several regional agreements (see Newton & Symens, 1994) for the protection of and pollution control in the Gulf and Red Sea areas. In view of recent events in the Gulf, such accords appear of little practical conservation value. The NCWCD "System Plan of Protected Areas for Wildlife Conservation and Sustainable Rural Development in Saudi Arabia" (Child & Grainger, 1990) provides the principal legislative framework for developing a national conservation policy through site protection. Implementation of the System Plan is an ongoing and slow process. Initially, 56 prime terrestrial and 52 marine/coastal sites (grouped into 42 units) were listed for protection, with approximately one third of the former having significant wetland interest. The Kingdom has announced its intention to become a signatory of the Ramsar Convention, but as yet ratification cannot proceed until wetland sites have been protected and declared nature reserves under national policy.

Wetland Area Administration

Ten terrestrial sites in the System Plan have received formal protection, but only two of these, the Farasan Islands and 'Umm al Qamari (both in the Red Sea) are included in this Directory. Although the latter are island archipelagos, protection currently applies only to their terrestrial fauna and flora. At the time of writing, management plans for two major marine wetlands, the Gulf Wildlife Sanctuary (including the Gulf Coral Islands and the Abu Ali-Ras' as-Zawr proposed protected areas) and the Farasan Islands marine protected area (Gladstone, 1994b) are being considered by the Government and their implementation is anticipated in the near future. Two other regional development agencies are involved peripherally in wetland protection: The Royal Commission for Jubail and Yanbu protects several mangrove areas within the Yanbu industrial area, and the Riyadh Development Authority manages the al Ha'ir wetland with support from NCWCD rangers.

Organizations involved with Wetlands

National Commission for Wildlife Conservation and Development
: Protected area management, research and monitoring.

Wildlife Sanctuary for the Gulf Region (NCWCD and European Union)
: Research and monitoring, Gulf.

National Wildlife Research Center (NCWCD)
: Research and monitoring, southwest and Red Sea.

Meteorological and Environmental Protection Administration (MEPA), Ministry of Defence and Aviation
: Water and air quality, pollution monitoring, some research.

Ministry of Agriculture and Water
: Policy, major land owner.

Food and Agricultural Organisation of the United Nations (FAO)
: Dam construction and irrigation projects, southwest.

Saudi Aramco
: Research, monitoring, environmental impact assessments, Gulf.

King Fahd University of Petroleum and Minerals, Dhahran
: Research, Gulf.

King Abdulaziz University, Jeddah
: Research, Red Sea, Makkah Waste Water River.

IUCN-The World Conservation Union
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WETLANDS

The site descriptions were compiled by Stephen F. Newton on behalf of the Wetlands and Ornithology Section, Research and Monitoring Department, National Commission for Wildlife Conservation and Development. For sites not visited on the ground by the author, the name in parentheses refers to the author of the report from which most material was abstracted.

Dawhat ad-Dafi and Dawhat al-Musallamiya (1)

Location: 27°15'N, 49°25'E; on the Gulf coast north of Jubail, Eastern Province.
Area: 20,000 ha.
Altitude: Sea level.
Overview: This site comprises the two largest, combined embayments in the northern Gulf, situated between Jubail and Abu Ali in the south-southeast and Ra's as Zawr in the northwest. The relatively sheltered waters were heavily polluted during the 1991 oil spill in the aftermath of the Gulf War. With a wide variety of supra-, inter- and sub-tidal habitats, the site was selected for detailed study on the recovery of oil impacted coastline and its fauna and flora.
Physical features: Musallamiya is the northern and ad-Dafi the southern embayment. Several large (over 5 km in length) islands are present, as well as an army of smaller ones. The embayments support a wide variety of substrates: dunes, sand sheets, sabkha and rocky outcrops on land; extensive inter-tidal mudflats, rocky shores and sandy beaches.
Ecological features: Some shores support saltmarsh type vegetation and mangrove (*Avicennia marina*) stands are locally abundant. The inter-tidal areas are often covered with blue-green algal mats. Seagrass beds are relatively extensive in some sub-tidal areas, though coral reefs are more restricted.
Land tenure: Primarily Government owned.
Conservation measures taken: The site has received considerable research effort in the joint CEC/NCWCD programme. Permanent transect lines have been established, and are monitored on a monthly basis.
Conservation measures proposed: The area was proposed as a Resource Use Area in the NCWCD System Plan for Protected Areas, but did not receive formal protection. In the aftermath of the Gulf War, the site has been included in the greater Wildlife Sanctuary for the Gulf Region, alongside Abu Ali, the Gulf Coral Islands and Sabkhat al-Fasl. A comprehensive management plan has been prepared, and rangers recruited, in readiness for its final ratification as a reserve/protected area.
Land use: Artisanal and recreational fisheries are the main occupations offshore, whilst terrestrial areas are used as rangeland for livestock, mainly camels and sheep. A cement factory and some quarries are present in the western boundary of the proposed reserve.
Possible changes in land use: None envisaged, but greater control of livestock grazing and fishing after ratification as a reserve. The military have used the area for manoeuvres and may wish to do so again, although currently the authorities have ruled in favour of nature conservation.
Disturbances and threats: Having borne the brunt of one of the largest oil spills in history, it is hoped that such an event will not recur; the continual threat of oil pollution always hangs over coastal sites in the northern Gulf.
Social and cultural values: Jinna Island in Musallamiya supports the remains of an abandoned fishermen's town; the ruins are well preserved and are one of few good examples of traditional Arabian Gulf architecture.
Noteworthy fauna: Given the intensive research, faunal diversity for the site must be one of the highest in the Gulf, especially for invertebrate groups. Green Turtles *Chelonia mydas* and

Hawksbill Turtles *Eretmochelys imbricata* feed within the embayments, and four species of cetacean have been recorded: Indo-Pacific Humpback Dolphin *Sousa chinensis*, Bottlenose Dolphin *Tursiops truncatus*, Common Dolphin *Delphinus delphis* and Finless Porpoise *Neophocoena phocoenoides*. Shorelines are now recovering rapidly, and shorebirds formerly using Sabkhat al-Fasl are now foraging preferentially in the inter-tidal zone. In forthcoming winters and passage periods, the embayments will almost certainly hold internationally important populations of many shorebird species (see Sabkhat al-Fasl). Western Reef Egrets *Egretta gularis* breed, and both Great Cormorant *Phalacrocorax carbo* and Socotra Cormorant *P. nigrogularis* forage in the offshore waters. Terrestrial habitats are important for migratory Houbara Bustards *Chlamydotis undulata macqueeni*, and also support a healthy population of Asiatic Jackals *Canis aureus*.

Noteworthy flora: Many areas of saltmarsh and mangrove appeared well and truly dead in the aftermath of the oil spill; however, many are now "returning to life", and hopefully the embayments will again support a healthy inter- and supra- tidal flora.

Scientific research and facilities: The research programme rationale was covered in above sections; the reserve is very close to extensive CEC/NCWCD marine research facilities at the Jubail Wildlife Research Center. It is envisaged that a new purpose-built marine research centre will be located within the southern border of the proposed reserve.

Management authority and jurisdiction: Royal Commission for Jubail and Yanbu and other Government departments; soon to be NCWCD.

References: Abuzinada & Krupp (1994).

Reasons for inclusion: 1a, 2a, 2b & 3b. The site is a sparsely populated area of great scenic beauty close to Jubail Industrial City. It is an important site for sea turtles, cetaceans and migratory shorebirds, at which recovery from chronic oil pollution has been monitored in detail.

Source: Stephen Newton (Peter Symens).

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Abu Ali (2)

Location: 27°20'N, 49°40'E; in the Gulf northeast of Jubail, Eastern Province.

Area: Approximately 12,500 ha.

Altitude: Sea level.

Overview: This site consists of two long, flat islands, Batima and Abu Ali, close to shore northeast of Jubail in the Arabian Gulf. They are connected to the mainland north of Jubail Industrial City by causeways. Access outside week-ends is restricted, owing to the presence of an important oil and military installation, and there is an abundance of pipelines crossing the area. The north and west coasts were affected severely by the 1991 Gulf oil spill.

Physical features: Sand and sabkha dominate the terrestrial habitats, but the northern shores are exposed, and beyond the sandy beaches there are some fringing reefs. Along the more sheltered southern shores there are inter-tidal mud- and sand-flats, surrounded by saltmarshes.

Ecological features: The sandy central areas of the islands become well vegetated with grasses and herbs following winter rains.

Land tenure: The islands are owned by the Government and Aramco.

Conservation measures taken: Inadvertently, the military protect much of the site by fencing off large areas and restricting access to most of the islands. Thus the vegetation is not grazed by domestic livestock. The islands have been identified as an "Important Bird Area" by BirdLife International.
Conservation measures proposed: The NCWCD System Plan for Protected Areas proposed the site as a Resource Use Reserve. The area is part of the extensive Marine Sanctuary for the Gulf Region, and formal Protected Area status is anticipated in the near future.
Land use: As most of the land is fenced off and access is prohibited, there is not the usual problem of overgrazing, and vegetation can flourish when rainfall permits. An accommodation compound for oil industry personnel is present. Substantial areas are given over to the petrochemical installations and pipelines.
Possible changes in land use: None anticipated.
Disturbances and threats: Some fishing camps have been established, and many recreational visitors use the site, particularly at week-ends. Jubail Industrial City continues to expand, and this may increase the numbers of visitors and thus disturbance. The coastline shape renders it particularly vulnerable to damage from oil spills in the northern Gulf.
Social and cultural values: The site is valued by fishermen and recreational visitors.
Noteworthy fauna: Asiatic Jackals *Canis aureus* are relatively common in the area, and cetaceans are frequent offshore. Comparatively small numbers of White-cheeked Tern *Sterna repressa* (120-150 pairs) and a few (c.10 pairs) of Saunders' Little/Little Tern *S. saundersi*/*albifrons* breed on the islands, but many terns congregate to moult here after the breeding season; approximately 14,000 Saunders' Little/Little Terns, in excess of 8,000 White-cheeked Terns in September, 2,000-3,000 Sandwich Terns *S. sandvicensis* and nearly 5,000 Lesser Crested Terns *S. bengalensis*. Additionally, up to 8,000 Great Cormorants *Phalacrocorax carbo* winter around the islands. A maximum of 135 Crab Plovers *Dromas ardeola* has been recorded passing through the site on migration.
Noteworthy flora: Seagrass beds, principally *Halodule uninervis*, are extensive in the area from low water mark down to 3 m.
Scientific research and facilities: The bird community has been quite well studied.
Management authority and jurisdiction: Military/oil industry.
References: Newton & Symens (1994); Symens *et al.* (1993a).
Reasons for inclusion: 1a, 2c, 3a & 3c. The islands are especially important for their large concentrations of moulting terns, and are an important research and monitoring location for NCWCD staff based at the Jubail Marine Research Center.
Source: Stephen Newton (Peter Symens).

Sabkhat al-Fasl Lagoons (3)

Location: 27°00'N, 49°40'E; on the southwest edge of Jubail Industrial City, Eastern Province.
Area: Approximately 500 ha.
Altitude: About 2 m above sea level.
Overview: These are man-made, evaporation lagoons, using organic waste water supplied from

Jubail Industrial City. The site was a key foraging and roosting site for waterbirds, principally shorebirds, displaced from oil impacted areas of the north Gulf coastline subsequent to the Gulf War. Four years after the event, it is still utilised by a wide variety of species, but many have now returned to adjacent "recovered" inter-tidal habitats as preferred foraging areas.

Physical features: The site is situated in a sabkha area that has been shaped by landfill, with banks to divide up the area. The water supply comes from excess treated sewage waste. The depth of water, at only 0-30 cm on average, is very shallow and is thus very susceptible to movement by wind, with a resultant tidal effect whenever the wind changes direction. Waste water is only supplied to the site from October to May and so the lagoons often dry up during the summer months, unless there has been some rainfall. Rainwater increases the volume of water, sometimes dramatically, and the surface can increase greatly, up to a maximum recorded of c.2,500 ha. In addition to these lagoons, three large (c.100 ha) concrete reservoirs are included in the site.

Ecological features: The treated organic water results in the production of a huge biomass of microflora and of microfauna, which in turn provide the basis of the food chain for enormous flocks of feeding birds. The concrete reservoirs and some areas of the lagoon edges are fringed with reeds *Phragmites* and *Tamarix* scrub.

Land tenure: Royal Commission for Jubail and Yanbu.

Conservation measures taken: Primarily monitoring, although researchers have successfully lobbied the Royal Commission to prevent ammonia-tainted waste being dumped in the area. The lagoons have been identified as an "Important Bird Area" by BirdLife International.

Conservation measures proposed: This site is part of the larger coastal area designated as the Wildlife Sanctuary for the Gulf Region. Ratification of the sanctuary as a Marine Protected Area is anticipated in the near future.

Land use: The area surrounding the lagoons is principally occupied by industrial and commercial properties and a golf course.

Possible changes in land use: The city boundaries may well extend further and occupy the side currently open to exposed sabkha.

Disturbances and threats: A decrease in the water supply is anticipated as Jubail Industrial City continues to expand, with a concurrent increase in the amount of water needed to irrigate urban trees, shrubs and gardens. Falcon-trapping and shooting of birds are a frequent hazard at this site. Power lines have caused considerable mortality in the past.

Social and cultural values: The educational potential of this site is enormous, with a large human population nearby who could be shown the importance of the area in general to wild birds and the value of man-made wetlands in providing much needed habitat and feeding areas in an overwhelmingly urban area.

Noteworthy fauna: The area is used by considerable numbers of shorebirds on passage, with some over-wintering and several species remaining to breed. The site supports the only breeding colony of Avocet *Recurvirostra avosetta* in Saudi Arabia, with 45 breeding pairs and up to 420 birds in winter. The Kentish Plover *Charadrius alexandrinus* is common throughout the year, with 70 breeding pairs, up to 2,800 birds in winter, and up to 3,500 birds passing through as migrants. Up to 1,800 Lesser Sand Plover *C. mongolus*, over 3,000 Curlew Sandpiper *Calidris ferruginea*, 700 Broad-billed Sandpiper *Limicola falcinellus*, more than 2,500 Ruff *Philomachus pugnax* and 650 Ruddy Turnstone *Arenaria interpres* have been recorded on spring passage; in late autumn, nearly 5,000 Little Stint *Calidris minuta* have been

recorded. Dunlin *C. alpina* pass through on migration in early autumn in huge numbers (over 11,000), but also some stay for the winter, with a maximum of nearly 6,000. Other shorebirds present in reasonable numbers on passage include Sanderling *Calidris alba* (c.650 in spring) and Marsh Sandpiper *Tringa stagnatilis* (almost 200 in early autumn). The Peregrine *Falco peregrinus* occurs regularly, both as a passage migrant (with up to 20 in one season) and winter visitor (1-3 birds). Greater Flamingos *Phoenicopterus ruber* have attempted, unsuccessfully, to breed but over-winter in large numbers, with up to 1,200 recorded. More than 5,000 ducks winter in the area, including 800-900 Common Shelduck *Tadorna tadorna* (the largest wintering concentration of this species in the Kingdom), Eurasian Wigeon *Anas penelope*, Gadwall *A. strepera*, Common Teal *A. crecca*, Mallard *A. platyrhynchos*, Pintail *A. acuta* and Shoveler *A. clypeata*. Reed Warbler *Acrocephalus scirpaceus* is suspected to breed in the areas of denser vegetation.
Noteworthy flora: None known.
Scientific research and facilities: Much information has been gathered on the ornithological importance of the area; the site is very close to the new NCWCD Marine Research Center.
Management authority and jurisdiction: Royal Commission for Jubail and Yanbu.
References: Evans & Keijl (1993a, 1993b); Newton & Symens (1994); Symens *et al.* (1993a).
Reasons for inclusion: 2b, 3a & 3c. This is an internationally important site for passage and wintering wildfowl and shorebirds.
Source: Stephen Newton (Peter Symens).

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Gulf Coral Islands (4)

Location: Harqus 27°56'N, 49°41'E; Karan 27°44'N, 49°50'E; Kurain 27°39'N, 49°50'E; Jana 27°22'N, 49°54'E; Juraid 27°11'N, 49°52'E; in the northern Arabian Gulf, Eastern Province.
Area: Approximately 190 ha, excluding surrounding reefs. (Harqus 2 ha, Karan 128 ha, Kurain 8 ha, Jana 33 ha and Juraid 20 ha).
Altitude: Sea level to 4 m.
Overview: This group is composed of five coral islands (listed above with their locations), situated about 35-90 km offshore. A sixth island, al-Arabiyah, has been excluded as all wildlife interest has been lost subsequent to the building of a coastguard station.
Physical features: The coral islands are surrounded by extensive, shallow coral reefs. Each island has wide, sand beach platforms.
Ecological features: The larger of the islands have dense vegetation, principally of *Salsola* and *Suaeda* but, following substantial rainfall, *Mesembryanthemum*.
Land tenure: Government.
Conservation measures taken: Since 1991, biologists have been present continuously on the larger islands of Karan and Jana for long periods during the summer nesting season of terns and turtles. This presence has significantly diminished and controlled disturbance from fishermen (collecting eggs) and recreational divers. The islands have been identified as an "Important Bird Area" by BirdLife International.
Conservation measures proposed: The NCWCD System Plan for Protected Areas proposed

these islands as a Special Nature Reserve and Resource Use Reserve. More recently, the islands have been included within the boundaries of the proposed Wildlife Sanctuary for the Gulf Region, which should be ratified as a Marine Protected Area in the near future. They have also been proposed as a potential Ramsar Site, but there has been no recent progress towards ratification of the Ramsar Convention by Saudi Arabia. Suggested conservation measures include strict control of access during the birds' and turtles' breeding seasons; a ban on military activity on the islands; control or eradication of introduced mice, rats and any other non-indigenous species; and the inclusion of the islands as priority sites in oil contingency plans. Monitoring of the breeding success of terns and turtles will continue, and ongoing work is assessing the importance of the islands to terrestrial migrant birds in spring.

Land use: The islands have no permanent habitation; lee shores are used for shelter by local fishermen during bad weather, and shore visits are made to collect seabird and turtle eggs in the absence of researchers or coastguards. The fringing reefs are popular recreational dive sites; such groups often use the islands for picnics *etc*.

Possible changes in land use: None anticipated.

Disturbances and threats: As the numbers of fishermen and recreational divers are increasing and the area is militarily sensitive, the threat from disturbance is difficult to alleviate unless formal management as a protected area is enforced. Fishermen commonly collect eggs, but this is not thought to constitute a major threat, unless undertaken regularly and systematically or on a commercial basis. Proposals to build a coastguard station on Kurayn and an oil plant on Jana would have disastrous consequences, with the probable loss of all breeding seabirds and turtles (as happened on al-Arabiyah, following the establishment of a coastguard station). Oil pollution is a continual threat. Introduced mammals pose a very real threat; a cat and a rat have been removed. House Mice *Mus musculus* are not so easily controlled, and the increase in visitors to the islands indicates that this will be a continuing problem (most fishing boats harbour their own populations of mice).

Social and cultural values: Recreational pursuits are the main reason for visits to these islands, with the coral reefs providing very good diving opportunities. The reefs also provide good fishing, and are thus important to the local economy.

Noteworthy fauna: The islands are important nesting grounds for both Hawksbill Turtles *Eretmochelys imbricata* and Green Turtles *Chelonia mydas*. The coral reefs surrounding the islands are probably the most diverse in the Arabian Gulf, and support a wide variety of invertebrate species. For breeding terns, the islands are unparalleled in the upper Gulf. The site is probably one of the most important sites in the world for breeding Lesser Crested Tern *Sterna bengalensis*, with approximately 24,250 breeding pairs. Approximately 34,400 pairs of Bridled Tern *S. anaethetus*, 10,400 pairs of White-cheeked Tern *S. repressa* and 3,500 pairs of Great Crested Tern *S. bergii* breed on the islands. Two to three pairs of Saunders' Little Tern *S. saundersi* breed irregularly, but up to 50 may pass through as visitors in June. On average, about 30 pairs of Socotra Cormorant *Phalacrocorax nigrogularis* breed on Kurayn, the only colony now extant north of Bahrain. Terrestrial species breeding on the islands include Crested Lark *Galerida cristata* and Lesser Short-toed Lark *Calandrella rufescens*, with Bimaculated Lark *Melanocorypha bimaculata* and Short-toed Lark *Calandrella brachydactyla* breeding sporadically. Many species of birds pass through on migration, including considerable numbers of Corncrake *Crex crex* and migrant flocks of Black-winged Pratincole *Glareola nordmanni*, while Red-necked Phalaropes *Phalaropus lobatus* use surrounding waters. Large numbers of

passerines, such as wheatears *Oenanthe* spp., Marsh Warblers *Acrocephalus palustris*, Willow Warblers *Phylloscopus trochilus* and Red-backed Shrikes *Lanius collurio*, regularly rest and feed on the islands during daylight hours.
Noteworthy flora: None known.
Scientific research and facilities: Much scientific research has been conducted on these islands, principally on breeding seabirds, nesting sea turtles and passage migrants. Research facilities are dependent on temporary camps, which are mostly erected and removed before and after each field season.
Management authority and jurisdiction: No information.
References: Newton & Symens (1994); Symens & Evans (1993); Symens & Suhaibani (1994).
Reasons for inclusion: 1a, 2a, 2b, 2c, 3a & 3c. The Gulf Coral Islands are very important because they provide breeding grounds for both seabirds and turtles and also support a viable fishing industry. Additionally, the coral reefs are probably among the best in the Arabian Gulf.
Source: Stephen Newton and Peter Symens.

Tarut Bay (5)

Location: 26°40'N, 50°10'E; on the Gulf coast east of Qatif and north of Dammam, Eastern Province.
Area: Approximately 41,000 ha.
Altitude: Sea level.
Overview: The bay is the single most important site for passage and wintering waterbirds on the Saudi sector of the Arabian Gulf coast, though continual landfill, reclamation and pollution are persistent threats. The cities of Qatif and Dammam form the backdrop to the west and south sides of the bay.
Physical features: Tarut Bay is a large, shallow, sandy and, in places, muddy bay, with one of the richest and most diverse inter-tidal habitats in the Arabian Gulf. The extensive sand- and mud-flats receive nutrients from sewage effluent and agricultural run-off from the Qatif oasis. Tarut Bay is very sheltered, and thus is not buffeted by the wind, resulting in the sedimentation of very fine particles. Oil installations and urban sprawl probably constitute the dominant landscape features. There are two islands in the bay, Za'l and Tarut; the latter is connected to the mainland by a bridge and is almost wholly developed. During low tide, many sand banks are exposed.
Ecological features: Mangroves, seagrasses and saltmarshes used to be one of the most striking features of the bay, but land-claim by man has removed most of these, so that only small patches now remain. The rich waters support an important shrimp and fishing industry, as well as providing food for the many birds that use the area.
Land tenure: Government, Aramco and private.
Conservation measures taken: Development and ensuing economic benefits dominate the management strategy for the area. Other Government ministries and municipalities probably have the right of veto over any conservation proposals. Tarut Bay has been identified as an "Important Bird Area" by BirdLife International.

Conservation measures proposed: The site has been proposed as a Resource Use Reserve in NCWCD's System Plan for Protected Areas.
Land use: Industrial and urban areas surround much of the bay, though palm groves and small farms are a significant feature near Qatif.
Possible changes in land use: The inter-tidal areas are still subject to landfill.
Disturbances and threats: Threats and disturbances are many and manifest. Firstly, there is always the very real and potent threat of oil pollution, and many small and medium-sized oil spills have already occurred. Much of the bay has been dredged, and dredging operations still take place. Landfill and reclamation of inter-tidal areas continue, with further losses of important feeding areas for the birds. The fishing and shrimp industries must surely suffer if such habitat degradation continues unchecked. Bird-trapping using mist-nests in both inter-tidal and agricultural areas is of frequent occurrence.
Social and cultural values: The industrial development of the area has no doubt contributed to the wealth and prosperity of Eastern Province.
Noteworthy fauna: Sea snakes, Green Turtles *Chelonia mydas* and Dugong *Dugong dugon* occur in the bay. Two threatened species of birds have been recorded here, both as rare winter visitors: Pallas's Fish Eagle *Haliaeetus leucoryphus* and White-tailed Eagle *H. albicilla*. Other raptors of note include Spotted Eagle *Aquila clanga*, though numbers have decreased from about 20 in 1983 to only six or so today, possibly because of the removal of mangroves. Up to 11 Osprey *Pandion haliaetus* occur in winter. Some seabirds breed in the bay, with just under 200 pairs of Western Reef Egret *Egretta gularis* including a colony on Za'l. An important colony of terns breeds on Za'l Island: 2,330 pairs of Lesser Crested Tern *Sterna bengalensis*, 2,060 pairs of White-cheeked Tern *S. repressa* and 8,900 pairs of Bridled Tern *S. anaethetus* were estimated in the summer of 1994. However, the site really assumes its importance as a wintering and passage site for waterbirds, especially shorebirds. For example, in spring 1991 more than 20,000 waterbirds were present, whilst in 1991/92, approximately 58,000 waterbirds over-wintered. Peak counts in winter have included the following: Great Cormorant *Phalacrocorax carbo* (4,850), Western Reef Egret (435), Great Egret *Egretta alba* (121), Grey Heron *Ardea cinerea* (467), Black-winged Stilt *Himantopus himantopus* (390), Kentish Plover *Charadrius alexandrinus* (2,755), Greater Sand Plover *C. leschenaultii* (900), Eurasian Curlew *Numenius arquata* (1,820), Redshank *Tringa totanus* (4,900), Dunlin *Calidris alpina* (7,800), Slender-billed Gull *Larus genei* (4,480), Yellow-legged Gull *L. cachinnans* (2,840), Gull-billed Tern *Gelochelidon nilotica* (420) and Caspian Tern *Sterna caspia* (236). Shorebirds occurring in large numbers both in winter and on passage include Grey Plover *Pluvialis squatarola* (1,700 in winter, 1,470 on passage), Lesser Sand Plover *Charadrius mongolus* (2,160 in winter, 2,580 on passage), Bar-tailed Godwit *Limosa lapponica* (1,800 in winter, 5,135 on passage), Whimbrel *Numenius phaeopus* (180 in winter, 190 on passage), Terek Sandpiper *Tringa cinerea* (1,670 in winter, 2,900 on passage), Ruddy Turnstone *Arenaria interpres* (1,100 in winter, 1,500 on passage) and Broad-billed Sandpiper *Limicola falcinellus* (645 in winter, 280 on passage). Over 100 Great Knot *Calidris tenuirostris* have been recorded on passage.
Noteworthy flora: Mangroves *Avicennia marina* and seagrasses.
Scientific research and facilities: Waterbirds are censused annually as part of the Saudi contribution to the Asian Waterfowl Census, and the tern colony on Za'l will be monitored regularly.
Management authority and jurisdiction: Multifarious.

References: Evans & Keijl (1993a); Newton & Symens (1994); Symens & Suhaibani (1994).
Reasons for inclusion: 1a, 2a, 2c, 3a & 3c. Tarut Bay is the most important bay on the Gulf coast of Saudi Arabia for wintering and passage shorebirds. Additionally, the bay is the largest shrimp nursery in the country.
Source: Stephen Newton (Peter Symens).

Al-Hasa Lagoons (6)

Location: 25°30'N, 50°00'E; near the towns of Hofuf and Abqaiq in Eastern Province.
Area: Approximately 7,500 ha.
Altitude: 100-150 m.
Overview: This, the only large freshwater system in the Eastern Province, is formed primarily from run-off from al-Hasa oasis, but is lightly enriched by sewage water from Hofuf, Abqaiq and a plethora of small towns.
Physical features: The wetland comprises a long, narrow river, flowing in an east-southeast direction from Hofuf and Abqaiq towards al-'Uqair. Often, the river goes underground beneath sand dunes for several kilometres before resurfacing. There are many pools, some of which can be quite large, up to 250 ha. Adjacent areas are composed of sand dunes in places and sabkhas and aeolian sand fields elsewhere.
Ecological features: Large reed-beds surround many of the larger river pools.
Land tenure: Complex and largely unknown.
Conservation measures taken: No conservation measures have been taken to date. Some pools are protected naturally by virtue of their inaccessibility, as they lie amidst sabkha and sand dunes. The lagoons have been identified as an "Important Bird Area" by BirdLife International.
Conservation measures proposed: The site is proposed as a Special Nature Reserve, Biological Reserve and Resource Use Reserve in the NCWCD System Plan for Protected Areas.
Land use: Much of the area surrounding the river is not subjected to agricultural developments, comprising sand dunes and sabkha.
Possible changes in land use: Intensification of cultivation is likely to occur.
Disturbances and threats: Shooting and hunting disturb the site regularly, and at week-ends the area is used heavily for recreational purposes by town dwellers for the al-Hasa region. A major threat may lie in the increased demand for sewage waste water for agricultural and other development uses, which will reduce greatly the amount of water flowing in the river.
Social and cultural values: The area is widely used for recreational pursuits and by shooters and hunters.
Noteworthy fauna: The area probably supports a fair diversity of oasis fishes, including *Aphanius dispar*, and an important population of the frog *Rana ridibunda* and the pond turtle *Mauremys caspica*. Asiatic Jackals *Canis aureus* also occur. Houbara Bustards *Chlamydotis undulata* are reputed by local people to pass through the area regularly on migration and in winter. Significant numbers of Black-winged Stilt *Himantopus himantopus* breed in the area,

and about 200 are known to over-winter. The Great Bittern *Botaurus stellaris* occurs both as a winter visitor and passage migrant, while the Ferruginous Duck *Aythya nyroca* breeds in unknown, but possibly important, numbers. It is not known whether Black Francolin *Francolinus francolinus* breeds here; if not, this species is likely to be extinct in the Kingdom. Other breeding species include Little Bittern *Ixobrychus minutus*, Ruddy Shelduck *Tadorna ferruginea*, Cream-coloured Courser *Cursorius cursor*, Moustached Warbler *Acrocephalus melanopogon* (the only known breeding site in Saudi Arabia) and, probably, Savi's Warbler *Locustella luscinioides*. During a number of aerial surveys of the area, large concentrations of wintering and migrating waterbirds have been recorded, notably 50-60 Grey Heron *Ardea cinerea*, up to 100 Little Egret *Egretta garzetta*, 10,000-15,000 ducks including 50 Ruddy Shelduck, 22 Common Crane *Grus grus* and small flocks of Ruff *Philomachus pugnax* and Black-tailed Godwit *Limosa limosa*.

Noteworthy flora: None known.

Scientific research and facilities: Apart from casual visits and aerial surveys to census wintering waterfowl, little work has been conducted at this site, and no specific research facilities exist.

Management authority and jurisdiction: Al-Hasa Irrigation and Drainage Authority.

References: Balletto *et al.* (1985); Newton & Symens (1994); Ross (1985).

Reasons for inclusion: 1d, 2b & 3b. Even though poorly understood, this waterway covers a large area and, from the information available, must hold large number of waterbirds.

Source: Stephen Newton (Peter Symens).

Gulf of Salwah (7)

Location: 25°15'N, 50°40'E; on the Gulf coast in Eastern Province.

Area: 62,500 ha.

Altitude: Sea level.

Overview: The Gulf of Salwah is a large embayment between the Saudi Gulf coast and Qatar Peninsula. The wetland under consideration here is the coast of the inner part of the Gulf and associated islands, to the south of the main Eastern Province conurbations.

Physical features: The inter-tidal area is mainly composed of sand flats and sand-rock. In places, close to the shore, some islands have formed, the most notable of which are Judhaim, Samamik and Zakhnuniyah. These tend to consist of a more muddy substrate than is found on the mainland. One island, Unaibir, to the south of the bay is composed of fossil coral rock. Inland from the mainland coast, the area is characterised by large sabkhas, elevated banks with shallow, hypersaline lagoons in-between.

Ecological features: Surrounding the bay, the coast is generally well vegetated, with date palms and reeds *Phragmites* growing to the sea's edge. In places, reeds grow in the seawater, supported by freshwater from a high water table below. Extensive seagrass and algal beds occur in the shallow waters. On the islands, salt-tolerant plants thrive and, in the more sandy areas, seabirds breed.

Land tenure: Government.

Conservation measures taken: The site as yet is not formally protected, and so no conservation measures are in force. The Gulf of Salwah has been identified as an "Important Bird Area" by BirdLife International.
Conservation measures proposed: The area is proposed as a Resource Use Reserve in the NCWCD System Plan for Protected Areas, but has not yet been declared.
Land use: See below, yet remarkably undeveloped.
Possible changes in land use: Continual southward spread of development from the Dhahran and Al Khobar area.
Disturbances and threats: Quarrying is extensive in many areas of the elevated coastline, destroying vegetation in the process. Vegetation is also being removed in some areas to improve access to the coast for recreational purposes. Some landfill has taken place near al-'Uqair, but this will be expanded if plans to create a large residential and recreational complex, with marinas and artificial beaches, proceed. Should a large oil spill occur to the north, then the bay would be in grave danger from severe pollution. Some Socotra Cormorant *Phalacrocorax nigrogularis* chicks are harvested annually by local people.
Social and cultural values: None known, except for traditional fishery and seabird harvesting.
Noteworthy fauna: An internationally important population of Dugong *Dugong dugon* lives in the Gulf. Ornithologically, the area is probably most important for supporting the largest breeding colonies of Socotra Cormorant in the country, with a minimum estimate of 30,000 breeding pairs in 1994/95 (28,000 pairs on Judhaim and 1,500-1,800 pairs on Unaibir). These birds breed in winter, and in summer thousands of terns also breed. Recent surveys have shown that the largest concentration of terns is on Judhaim, with 900 pairs of Lesser Crested Tern *Sterna bengalensis*, 9,700 pairs of White-cheeked Tern *S. repressa* and 3,100 pairs of Bridled Tern *S. anaethetus*; 800 pairs of Lesser Crested Tern also breed on Zakhnuniyah alongside the only known colonies of Gull-billed Tern *Gelochelidon nilotica* (12 pairs in 1994) and Caspian Tern *Sterna caspia* (3-5 pairs) on the Gulf coast of Saudi Arabia. About 100 pairs of Western Reef Egret *Egretta gularis* breed around the Gulf. Large numbers of waterbirds winter in the area; peak counts have included over 1,000 Great Crested Grebes *Podiceps cristatus*, 2,375 Black-necked Grebes *P. nigricollis*, nearly 500 Western Reef Egrets, 150 Grey Herons *Ardea cinerea*, almost 200 Great Black-headed Gulls *Larus ichthyaetus*, 1,260 Slender-billed Gulls *L. genei* and 2,500 Yellow-legged Gulls *L. cachinnans*.
Noteworthy flora: Seagrass and algal beds occur in the shallow water, while *Phragmites* and salt-tolerant plants abound on land.
Scientific research and facilities: The Socotra Cormorants have been studied in detail for four winters (1991/92-1994/95), and much information has been gathered on other bird species. No permanent research facilities exist in the immediate area.
Management authority and jurisdiction: Not known.
References: Newton & Symens (1994); Symens *et al.* (1993a, 1993b); Symens & Suhaibani (1994); Suhaibani & Symens (1994); Werner (1993).
Reasons for inclusion: 1a, 2a, 2c, 3a & 3c. The site is important both for the numbers of breeding and wintering birds and for its Dugong population. It is one of the least disturbed/degraded marine environments on the Gulf coast of Saudi Arabia.
Source: Stephen Newton (Peter Symens).

Uruq al-Mutaridah (8)

Location: 20°41'N, 54°42'E; in the Rub'al Khali (Empty Quarter) in Eastern Province.
Area: 40 ha.
Altitude: 150-200 m.
Overview: This is a remarkable, apparently permanent, wetland in the otherwise hyper-arid Empty Quarter, in a small part of the area known as Uruq al-Mutaridah.
Physical features: The site comprises a series of pools filling basins amongst some of the highest sand dunes in the world. The pools appear to be spring-fed. Areas of sabkha are widespread in the general area, and after good winter rains may form seasonal wetlands.
Ecological features: The site was only "discovered" in 1990, and is poorly known; *Phragmites* reed-beds appear to fringe most of the pools.
Land tenure: Government.
Conservation measures taken: None, although the area lies in a general non-hunting zone.
Conservation measures proposed: The site forms part of a larger area, listed in NCWCD's System Plan for full protection as a Resource Use Reserve and Natural Reserve, to preserve sand dunes up to 200 m high. Designation as an International Biosphere Reserve has been proposed.
Land use: Presumably none, although infrequent visits by Bedouin and their livestock may occur.
Possible changes in land use: None foreseen.
Disturbances and threats: Unauthorised hunting and oil exploration could take place in this area.
Social and cultural values: None known.
Noteworthy fauna: Knowledge of the fauna is scant; the only visit by an ornithologist took place in February 1990, so the area's real significance to migrant and breeding birds is largely unknown. At that time, at least five Water Rails *Rallus aquaticus* and four Moorhens *Gallinula chloropus* were present. Both species could be potential breeders. Water Pipits *Anthus spinoletta* were the only other waterbirds of note present.
Noteworthy flora: None known.
Scientific research and facilities: Only one basic survey has been undertaken, in February 1990.
Management authority and jurisdiction: Not known; the area is probably patrolled by Saudi Frontier Forces.
References: Pambour & Al Karrairy (1991).
Reasons for inclusion: 1d. This is possibly the only permanent wetland in the Saudi portion of the Rub'al Khali.
Source: Stephen Newton.

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Dawmat al-Jandl (9)

Location: 29°48'N, 39°53'E; on the eastern outskirts of Dawmat al-Jandl, Al-Jawf Emirate.
Area: Approximately 2,500 ha (covering the original marsh plus the new reservoir).
Altitude: 700 m.
Overview: This is one of the largest (of few) conspicuous permanent wetlands in the northern provinces of Saudi Arabia. A maximum of 10,000 birds has been recorded on the waterbody, particularly during harsh winters in the Levant.
Physical features: Once a reasonable-sized lake surrounded by a large marsh of reeds and sedges (900 ha in total), since 1983-1984 this area has now largely been drained and converted to agricultural land. The water is pumped to a reservoir of some 150 ha in a basin in the hills overlooking this lower (now agricultural) land. Only small pockets of marshland now remain, and the area is criss-crossed with irrigation channels.
Ecological features: Sedges and rushes occur in the small marshes.
Land tenure: Not known.
Conservation measures taken: The area is within a non-hunting zone which surrounds NCWCD's large northern reserves, but there is virtually no enforcement of this. The wetland has been identified as an "Important Bird Area" by BirdLife International.
Conservation measures proposed: None.
Land use: Agricultural small holdings lie between the towns and reservoir; livestock graze elsewhere in the vicinity.
Possible changes in land use: Continued agricultural development will probably occur as long as water remains available.
Disturbances and threats: Shooting is known to occur, and recreational activities on the reservoir can also disturb the birds, which now have nowhere else nearby to go.
Social and cultural values: Fish (*Tilapia* sp.) have been introduced, presumably for human consumption.
Noteworthy fauna: Rüppell's Fox *Vulpes rueppelli* occurs in the area. Large flocks of Common Coot *Fulica atra* have been recorded (1,346 out of a total of 2,294 waterbirds in January 1993), and up to 10,000 occurred in the cooler winter of 1991/92. Flocks of White-winged Black Tern *Chlidonias leucopterus* numbering over 1,000 have passed through in April. The White-headed Duck *Oxyura leucocephala* may possibly occur in cold winters, but this needs confirmation. A single specimen of Pallas's Fish Eagle *Haliaeetus leucoryphus* was found shot in January 1990, and one Saker *Falco cherrug* has been recorded in April.
Noteworthy flora: None known.
Scientific research and facilities: Occasional censuses of wintering waterfowl have been carried out.
Management authority and jurisdiction: Presumably the Ministry of Agriculture and Water and local emirate (Al Jawf).
References: Green (1984); Newton & Symens (1994).
Reasons for inclusion: 1d & 3b. The site is one of the few remaining wetlands in the northern deserts of Saudi Arabia, and is highly attractive to wintering waterfowl.
Source: Stephen Newton.

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Tabuk (King Faisal Airbase) (10)

Location: 28°23'N, 36°38'E; to the west of Tabuk City, Tabuk Emirate.
Area: Not defined.
Altitude: 770 m.
Overview: The site consists of sewage settling lagoons and a reservoir, situated within a military airbase. As at Dawmat al-Jandl, these new man-made wetlands are a poor substitute for the large natural marshland that formerly occurred in the vicinity of Tabuk. This has been almost totally lost to agricultural development.
Physical features: The man-made lakes are formed from sewage settling lagoons. There is also a reservoir of 100 ha, located at about 10 km distance from the airbase and about 5 km from Military City. Mountains surround the Tabuk area on three sides.
Ecological features: Large *Phragmites* reed-beds thrive on the lagoons, which are surrounded by sand and scrub desert, interspersed with areas of irrigated trees, mostly *Eucalyptus*, and shrubs and grasses. Outside the military training areas, much of the desert is now being cultivated intensively.
Land tenure: Ministry of Defence and Aviation.
Conservation measures taken: There is no formal protection, but as the area is within a military zone, it is in effect protected from hunting and human disturbance, other than military training manoeuvres, but these are likely to be within the greater desert area and not immediately in the vicinity of the lagoons. The wetland has been identified as an "Important Bird Area" by BirdLife International.
Conservation measures proposed: None known.
Land use: Military training area.
Possible changes in land use: Unlikely in the foreseeable future.
Disturbances and threats: If the sewage system is upgraded, as has been proposed, then the lagoons may disappear.
Social and cultural values: The area is a bird-watching site for any interested military personnel.
Noteworthy fauna: Birds recorded breeding on the sewage lagoons include, possibly Little Bittern *Ixobrychus minutus*, 4-9 pairs of Ferruginous Duck *Aythya nyroca*, Water Rail *Rallus aquaticus*, Little Crake *Porzana parva*, possibly Baillon's Crake *P. pusilla*, Little Ringed Plover *Charadrius dubius*, Clamorous Reed Warbler *Acrocephalus stentoreus* and 10-15 pairs of Desert Finch *Rhodospiza obsoleta*. In spring 1990, grebes, approximately 1,000 ducks, about 700 Common Coot *Fulica atra*, shorebirds and about 400 White-winged Black Tern *Chlidonias leucopterus* were recorded at the reservoir.
Noteworthy flora: *Phragmites* and *Tamarix* are the dominant plants around the lagoons.
Scientific research and facilities: There is no access to the site, other than for military personnel, and the area has only been visited by an ornithologist twice, both times in spring 1990.
Management authority and jurisdiction: Ministry of Defence and Aviation.
References: Newton & Symens (1994); Stagg (1989).
Reasons for inclusion: 2b & 3b. Although the site has been visited infrequently and therefore its true importance for wintering and breeding waterfowl is unknown, the numbers and species

of birds recorded indicate the potential of this area.
Source: Stephen Newton (Arthur Stagg).

Jabal Qaraqir (11)

Location: 27°27'N, 36°36'E; approximately 80 km south of Tabuk Town, Tabuk Emirate.
Area: 160,000 ha.
Altitude: 450-1,750 m.
Overview: Jabal Qaraqir is a spectacular sandstone plateau, cut by deeply incised canyons, rising abruptly from the sandy coastal plain; to the east it is overlain by lava flows. The main canyons contain perennial streams and permanent pools of considerable interest in a region with a mean annual rainfall of less than 50 mm.
Physical features: Jabal Qaraqir is composed of a sequence of three formations: the uppermost red Rumm sandstone, the middle cream to orange coloured Quweira sandstone and the lower, massive dark red Siq sandstone and conglomerates, standing on a base of eroded Pre-Cambrian rocks. The sandstone massif is deeply eroded into precipitous pinnacles and steep-walled, narrow canyons. Water comes to the surface in boulder beds forming canyon floors and from seeps along the side where impervious strata occur in the basal sandstones. Between small surface pools are riffle areas of faster running water over pebbles where small rapids and small falls (<1 m) occur. The surface water flow disappears and reappears along the course of the canyons before sinking into the body of the bedload sediments that fill the wadis. Ad Disah village occurs at the confluence of the three major canyons.
Ecological features: Reed-beds and areas with bulrushes and sedges alternate with thickets of Oleander *Nerium oleander* scrub up to 4 m high. This plant is at the southern limit of its distribution here. Open water areas support submerged aquatic plants such as *Myriophyllum spicatum*. *Acacia tortilis*, Doum Palm *Hyphaene thebaica* and *Ficus sycomorus* occur in places, and the blue form of *Capparis spinosa* has been recorded. Hanging gardens of ferns are present along canyon wall seeps.
Land tenure: Uncertain, but includes Government, tribal and private lands.
Conservation measures taken: None to date.
Conservation measures proposed: The site has been proposed as a Special Nature Reserve, Natural Reserve and Resource Use Reserve in NCWCD's System Plan, although to date it has not been ratified. The site has also been earmarked as a potential World Heritage Area.
Land use: The canyons and wetlands are relatively untouched, but there is some grazing. Irrigated cultivation is quite intensive in the vicinity of Ad Disah.
Possible changes in land use: Local residents have become aware of the conservation interest in Jabal Qaraqir and "smart" individuals are beginning to stake claims of "ownership" by developing the terrain. An example of a large bull-dozed field with 3 m bunds has recently appeared at the mouth of a lateral gorge entering one of the main canyons (Shaib Wadi Gamrah).
Disturbances and threats: See above; over-abstraction of water for cultivation around Ad Disah from the wadi bed will eventually lead to a drying out of the canyon's wetlands. Some

illegal hunting no doubt takes place.
Social and cultural values: None known.
Noteworthy fauna: This has been poorly studied, though Bonelli's Eagles *Hieraaetus fasciatus* have been recorded. The area is perhaps best known for its population of Nubian Ibex *Capra ibex nubiana*, which occur on the plateau but probably come down to the canyon wadi floors at night to graze the lush vegetation. Some adjacent wadis just to the south, for example Wadi al Jizl, are reputedly the northernmost in the Red Sea drainage to contain freshwater fish. Their occurrence in the canyon wetlands is unknown.
Noteworthy flora: No published information is available.
Scientific research and facilities: A hydro-terrain survey has been undertaken and the ibex population has been censused. No facilities are available.
Management authority and jurisdiction: Not known; probably local authorities.
References: Habibi (1994); Tinley (1994).
Reasons for inclusion: 1d (possibly also 2d). This is an area of outstanding natural beauty with sandstone canyon wetlands; the area probably supports the highest density of Nubian Ibex in Saudi Arabia outside a formally protected reserve.
Source: Stephen Newton (Ken Tinley).

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Wadi Rabigh Springs (12)

Location: 23°00'N, 39°30'E; on the Tihamah plains, Makkah and Al-Madinah Emirates.
Area: 35 ha.
Altitude: Not known.
Overview: Wadi Rabigh is a very small, permanent wetland; an unusual feature on the Tihamah plains north of Jeddah.
Physical features: The wetland is a small natural lake sustained by several permanent freshwater springs. Some cliffs lie adjacent to the springs.
Ecological features: Reeds *Phragmites* surround the lake; no other details are available.
Land tenure: Unknown.
Conservation measures taken: None.
Conservation measures proposed: The site is proposed for protection in the NCWCD System Plan for Protected Areas, though the wetland area covered here is but a small part of the overall wadi system. The springs have been identified as an "Important Bird Area" by BirdLife International.
Land use: Much of the land surrounding the lake and springs is given over to grazing, while cultivation is relatively unimportant.
Possible changes in land use: Cultivation may become more prevalent in the future.
Disturbances and threats: People using the area for recreational purposes can cause disturbance to wildlife. Hunting is known to occur on a small scale. Damming and water diversions are not a large problem at present but, should agricultural development proceed in the area, these may then pose a threat to the quality and quantity of water in the lake. Grazing and extensive wood-cutting and charcoal-making have a detrimental impact on the surrounding

habitat.
Social and cultural values: The area is primarily used for recreational purposes.
Noteworthy fauna: Baboons *Papio hamadryas*, Hyaena *Hyaena hyaena*, Wolf *Canis lupus* and Caracal *Caracal caracal* occur in the area around the lake. The lizard *Uromastyx philbyi* also occurs. The area is also important from an ornithological viewpoint with breeding species potentially including small numbers of Little Bittern *Ixobrychus minutus*, Philby's Rock Partridge *Alectoris philbyi*, Collared Pratincole *Glareola pratincola*, Little Tern *Sterna albifrons* and European Kingfisher *Alcedo atthis*. In winter, up to 14 Black Stork *Ciconia nigra* have been recorded, rendering this site nationally significant. Migrating raptors pass over this area in autumn on the way to Bab al-Mandab, with Common Buzzards *Buteo buteo* being especially numerous.
Noteworthy flora: *Acacia tortilis* is one of the dominant trees in the area.
Scientific research and facilities: No current, or proposed, research is conducted in the area, and no facilities exist.
Management authority and jurisdiction: Unknown.
References: Newton & Symens (1994).
Reasons for inclusion: 1d & 2b. This is a small permanent wetland area within easy reach of Jeddah and Yanbu, supporting an unusual waterbird community.
Source: Stephen Newton (Brian Meadows).

Al-Ha'ir (13)

Location: 24°30'N, 46°50'E; c.25 km south of Riyadh City, Riyadh Emirate.
Area: 2,500 ha.
Altitude: 450-550 m.
Overview: A perennial river became established in Wadi Hanifah when large volumes of treated sewage waste water were discharged from a sewage works on the eastern outskirts of Riyadh City. Although man-made, it follows the course of a natural wadi.
Physical features: The river course follows Wadi Hanifah for about 50 km, frequently through rocky cliffs but, especially further downstream, through flatter land where lagoons and large pools form amidst sand dunes.
Ecological features: Around the rocky river banks, vegetation is sometimes sparse but elsewhere it is lush and abundant. *Tamarix* and *Phragmites* are the most common plants. Some pivot-irrigation farms have become established, especially in the lower reaches, using water from the river.
Land tenure: Much of the land is Government owned, though presumably some has been sold to agricultural concerns.
Conservation measures taken: Since 1988, part of the river and its surrounding vegetation has been formally accorded protected area status by the NCWCD and it is patrolled by NCWCD rangers on behalf of the Riyadh Development Authority. The wetland has been identified as an "Important Bird Area" by BirdLife International.
Conservation measures proposed: Given its proximity to Riyadh, the site has considerable

potential for increasing public interest and involvement in conservation or bird-watching.
Land use: Land surrounding the river is used for grazing by goats, sheep, camels and cattle. Some areas are now irrigated by central-pivot for crop growing, principally wheat and fodder crops.
Possible changes in land use: An increase in the numbers of pivot-irrigated farms may occur in the future.
Disturbances and threats: The area is used widely by visitors for recreational and picnic purposes which, in addition to resulting in the accumulation of large amounts of litter, cause disturbance to waterfowl. Grazing may also limit the development of vegetation. Proposed plans to increase the use of water for agricultural and other developments may deplete severely the volume of water flowing down the wadi, perhaps by as much as 80%, and this will have repercussions on the number and diversity of birds using the area.
Social and cultural values: The protected area has been used for educational purposes, by NCWCD and local universities. Permanent displays do not currently exist, but would illustrate the importance of the area and increase public awareness of its conservation interest amongst those who currently use the area purely for recreation.
Noteworthy fauna: Reptiles and amphibians occur here, including the Desert Monitor *Varanus griseus*, several species of *Agama* and *Uromastyx*. Exotic, introduced fish, including *Tilapia*, are abundant, and are presumably an important food source for waterbirds. However, the area is renowned chiefly because of its rich bird community and, by 1991, 311 species had been recorded. Species occurring in regionally important numbers include: Black-crowned Night Heron *Nycticorax nycticorax*, which both breeds and winters (up to 130 have been recorded); Little Egret *Egretta garzetta*, with a maximum of 340 over-wintering; Grey Heron *Ardea cinerea*, with up to 366 over-wintering; Ferruginous Duck *Aythya nyroca*, which breeds in small numbers and over-winters (up to 70 recorded); and Black-winged Stilt *Himantopus himantopus*, with 236 recorded over-wintering. Other breeding species include Little Bittern *Ixobrychus minutus*, Squacco Heron *Ardeola ralloides*, Purple Heron *Ardea purpurea* and Reed Warbler *Acrocephalus scirpaceus*. Other wintering species of note include Black Stork *Ciconia nigra*, Spotted Eagle *Aquila clanga* and Marsh Harrier *Circus aeruginosus*. Rarer species that occur sporadically and in small numbers include White Pelican *Pelecanus onocrotalus*, Marbled Teal *Marmaronetta angustirostris*, Imperial Eagle *Aquila heliaca*, Lesser Kestrel *Falco naumanni*, Corncrake *Crex crex* and Sociable Plover *Vanellus gregarius*.
Noteworthy flora: *Tamarix* and *Phragmites* dominate the area, but lush grasses and sedges also thrive, and good stands of *Acacia* trees grow in places relatively close to the water's edge.
Scientific research and facilities: To date, the area has been surveyed for birds during the breeding, migration and wintering periods; over-wintering birds have been counted on several occasions as part of the Saudi Arabian contribution to the annual Asian Waterfowl Census. Bird ringing has been carried out, principally in spring. Portacabins are available as a base for NCWCD activities, including bird ringing. Ranger patrols occur on most days and a "security guard" lives on site.
Management authority and jurisdiction: Riyadh Development Authority and NCWCD.
References: Newton & Symens (1994); Stagg (1994).
Reasons for inclusion: 2b & 3c. An important site for breeding and wintering waterfowl, and an amenity site close to Riyadh City, with good public awareness potential.
Source: Stephen Newton.

'Uyun Layla (14)

Location: 22°15'N, 46°45'E; about 10 km south of Layla Town, Riyadh Emirate.
Area: 3,000 ha.
Altitude: 540 m.
Overview: 'Uyun Layla (also known as Layla Lakes and Al-Aflaj Lakes) are a series of small to medium sized limestone karst lakes, unique in the Arabian Peninsula. Formerly the site was well vegetated, but now it is seriously degraded owing to direct abstraction of water for agricultural irrigation.
Physical features: The site comprises a total of 23 doline and sinkhole subsidence craters, of which five are shaped irregularly, the largest at about 1,500 by 500 m, and the other four ranging in size down to 250 by 75 m. The remainder are circular in shape, of which four measure between 100 and 175 m in diameter, and four are less than 100 m in diameter. Thirteen craters are now dry. The lakes are clustered in three main groups, with one outlier at 2.7 km to the north. Each group is located within saucer-shaped depressions; additionally, in the past, deposition of fine lime sediments when the lakes used to overflow their rims led to the formation of small convex mounds. The water surfaces lie at different levels in each crater, although the waters of the main lake are connected to all the other lakes and sinkholes. Over-abstraction has caused extreme desiccation of the shallower dolines and sediments forming the crater walls and surrounding terrain.
Ecological features: Prior to 1984, the lakes had fringing reed-beds and clumps of *Tamarix*; tall grasslands of *Desmostachya bipinnata* covered the surrounding area. The remaining lakes are now almost barren; the continual fall in water level (one cm every three days) and collapse of crater walls prevent any recolonisation of fringing vegetation.
Land tenure: Unknown.
Conservation measures taken: None.
Conservation measures proposed: The site is listed in NCWCD's System Plan for Protected Areas as a proposed Natural Reserve. More recently, full restoration of the system has been advocated, and deemed feasible, although the full cooperation of the Ministry of Agriculture and Water would be necessary.
Land use: There is intensive cultivation using water abstracted directly from the crater lakes by a pumping station. The surrounding area is heavily overgrazed by domestic livestock. A tourist resort has been constructed, though never used, presumably due to the concurrent demise of the lakes.
Possible changes in land use: The restoration of the ecosystem would be an outstanding opportunity to educate people at all levels. Alternative aquifers are present beneath the agricultural area responsible for the over-abstraction.
Disturbances and threats: See above. The abundance of used cartridges in the area indicates considerable hunting pressure on waterfowl.
Social and cultural values: Presumably the area was a popular recreational area in the past, given its proximity to Riyadh and al Kharj.

Noteworthy fauna: There is virtually none left. The site was the only known locality in Arabia for the African Dragonfly *Enallagma vansomereni*, originally collected in 1981; thorough searches in 1990 failed to locate this species. Fish appear to have been introduced, with *Aphanius dispar* and Tilapiine cichlids recorded; these are known to be aggressive predators and could have a serious impact on other indigenous freshwater fauna. The area is probably still an important drinking source for sandgrouse. It was formerly a breeding site for Little Grebe *Tachybaptus ruficollis* and Moorhen *Gallinula chloropus*, with Common Coot *Fulica atra*, Little Bittern *Ixobrychus minutus*, Little Ringed Plover *Charadrius dubius* and Savi's Warbler *Locustella luscinioides* as other potential breeders. Migrant and wintering duck, including Garganey *Anas querquedula*, were presumably numerous at one time.
Noteworthy flora: Little of interest remains.
Scientific research and facilities: No serious scientific research has been undertaken, except with regard to water abstraction and engineering. A policy procedure for restoration has been prepared.
Management authority and jurisdiction: Presumably Ministry of Agriculture and Water.
References: Jennings (1985, 1987); Schneider & Krupp (1993); Tinley (1994).
Reasons for inclusion: 1d (possibly also 2d). A unique wetland ecosystem in Arabia, but on the verge of total destruction.
Source: Stephen Newton (Ken Tinley, Michael Jennings).

Makkah Wastewater Stream (15)

Location: 21°17'N, 39°41'E; southwest of Makkah City, Makkah Emirate.
Area: Approximately 300 ha.
Altitude: 100-200 m.
Overview: This is a man-made river system, created by the discharge of sewage effluent from Makkah City down wadis, including Wadi Uranah, to the southwest of the city.
Physical features: The river flows through rather flat terrain for 20-30 km southwest from Makkah, petering out in the Tihamah sandy desert. For the first 15 km or so, the river flows quite strongly, but thereafter pools and channels tend to become somewhat ephemeral, depending on the amount of effluent discharged.
Ecological features: The river and pools are surrounded by, in some places, dense stands of vegetation of which *Calotropis procera*, *Phragmites* and grasses are the most important.
Land tenure: Not known.
Conservation measures taken: This area is not protected and no conservation measures have been taken. The wetland has been identified as an "Important Bird Area" by BirdLife International.
Conservation measures proposed: None.
Land use: Most of the surrounding land is heavily grazed by Bedouin livestock.
Possible changes in land use: None apparent at present, although some land may be developed for cultivation on a small scale.
Disturbances and threats: People stopping close to the main roadside pools can locally disturb

wildfowl, and some hunters may shoot duck there, but there are thought to be no major threats to the area.
Social and cultural values: None in particular; the site is popular with expatriate bird-watchers.
Noteworthy fauna: A wide variety of waterbirds has been recorded during the migration seasons and in winter. Six pairs of Black-winged Stilt *Himantopus himantopus* breed at the site, and up to nearly 1,000 have occurred in winter on the roadside pools on the Makkah bypass. Other wintering birds include a wide variety of duck and shorebird species. Notable concentrations of birds on passage have included up to 600 Glossy Ibis *Plegadis falcinellus* and 450 Collared Pratincole *Glareola pratincola*. Both Common Crane *Grus grus* and Demoiselle Crane *Anthropoides virgo* utilise the site in small numbers on migration. The Arabian Bustard *Ardeotis arabs* occurred locally in the past, but there is probably too much disturbance in the area now for any birds to remain, and there have been no records of this species in recent years. Lichtenstein's Sandgrouse *Pterocles lichtensteinii* and Chestnut-bellied Sandgrouse *P. exustus* can be locally abundant, particularly in periods following heavy rainfall.
Noteworthy flora: None known, although *Salvadora persica* occurs in places.
Scientific research and facilities: The site was subject to systematic survey by researchers from King Abdulaziz University in Jeddah, and the area close to the Makkah bypass is surveyed most years for wintering waterbirds as part of the Asian Waterfowl Census.
Management authority and jurisdiction: Not known.
References: Felemban & Al-Banna (1993); Newton & Symens (1994).
Reasons for inclusion: 3b & 3c. The supply of water to this river is unlikely to diminish in the near future, and thus the area should continue to provide breeding, stopover and wintering habitat for a wide variety of bird species in an otherwise very arid area.
Source: Stephen Newton.

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Wadi Turabah (16)

Location: 20°30'N, 41°10'E; 80 km north of Al-Baha, Baha and Makkah Emirates.
Area: Approximately 5,000 ha.
Altitude: c.1,100-1,700 m.
Overview: Wadi Turabah is one of the largest wadi systems draining the Asir mountains. It rises near Al Mandaq, just north of Al-Baha, and follows a northeasterly course as a prominent landscape feature for over 200 km to beyond Turabah town. The 35 km section from the vicinity of Jabal Ibrahim (Batharah), fairly close to the source, to the main highway between Taif and Al-Baha is perhaps best known from a wildlife perspective, although wetland interest continues at least as far as Turabah town, but no ground work has been done to ascertain its importance.
Physical features: The wadi surrounds are dominated by mountainous terrain, including a large granite pluton (Jabal Ibrahim). The wadi frequently narrows between steep-sided gorges, alternating with more leisurely meandering sections through flatter ground, although these miniature plains are often bounded by steeply rising cliffs. Perennial running water and lush

vegetation occur along various sections of the wadi.

Ecological features: On the higher western slopes, mixed montane woodland occurs, including some juniper *Juniperus excelsa*. Along the wadi, several species of *Ficus*, *Ziziphus spina-christi* and *Phoenix caespitosa* are particularly prevalent. Rushes, *Mentha longifolia*, *Pluchea dioscoridis* and other water-loving plants grow along the water's edge in many places. Somewhat away from the water itself, in areas where the wadi floor widens out, *Acacia* scrub and woodland can be moderately extensive.

Land tenure: Land tenure is unknown, but is probably a mixture of Government and, in cultivated areas, private ownership.

Conservation measures taken: No conservation measures are in place to protect this important site. Wadi Turabah and the nearby Jabal Ibrahim have been identified as an "Important Bird Area" by BirdLife International.

Conservation measures proposed: The site (also including Jabal Ibrahim) is proposed in the NCWCD System Plan for Protected Areas as a Natural Reserve, Biological Reserve and Resource Use Reserve, but has not yet been ratified.

Land use: Grazing is the most commonplace activity, but in places settlements are becoming more permanent and some cultivation now occurs.

Possible changes in land use: As more nomadic pastoralists settle down into permanent dwellings, it is likely that the level of cultivation will increase significantly.

Disturbances and threats: This site is frequently disturbed and faces a wide array of threats. Large numbers of visitors use the area for recreational purposes, ranging from naturalists and people on picnic to parties fishing (sometimes illegally using electro-fishing tackle) and hunters who shoot a wide variety of mammals and birds. Overgrazing is a severe threat, and the huge numbers of livestock continue to denude increasingly barren slopes. Permanent dwellings mean that land is now continually grazed and cultivated, whereas previously vegetation was intermittently allowed to recover. Other threats include over-abstraction of water for the nearby city of Taif, sand and gravel extraction and a local "factory" within the wadi producing building bricks. This wadi, of nearly unparalleled natural scenic beauty and diversity, is now being destroyed at an alarming rate; the complexities of ownership only serve to exacerbate the problem as they hinder any progress with respect to ratifying the site as a protected area.

Social and cultural values: The area is widely used for recreation, and supports a denser human population than would be expected at first sight.

Noteworthy fauna: The area is important with respect to fish, amphibians, reptiles, mammals and birds. At least three species of endemic fish occur in the wadi: *Cyprinion mahalensis*, *Garra buettikeri* and *Barbus apoensis*, and there is a healthy assemblage of amphibians. Baboons *Papio hamadryas* are resident and probably still live naturally, rather than commensally on man's waste as in more urban areas. Large carnivores, including Hyaena *Hyaena hyaena*, Wolf *Canis lupus* and Caracal *Caracal caracal*, still occur, but these are heavily persecuted by man. The Hyrax *Procavia capensis* is abundant on rocky slopes, and Porcupine *Hystrix indica* and Genet *Genetta felina* both occur. Although the wetlands of the wadi hold no internationally important concentrations of birds either during the breeding season or in winter, there are several populations of national importance. The site is one of the best known breeding sites for Hamerkop *Scopus umbretta* in Saudi Arabia, with up to 50 individuals counted along a 35 km stretch and several active nests known. Also, the wintering population of around 20 Black Storks *Ciconia nigra* is nationally significant. Other breeding waterbirds

include Grey-headed Kingfisher *Halcyon leucocephala* and Moorhen *Gallinula chloropus*, whereas Little Egret *Egretta garzetta*, Grey Heron *Ardea cinerea*, Common Sandpiper *Actitis hypoleucos* and Green Sandpiper *Tringa ochropus* are regular winter visitors. Rocky slopes and lush forested areas near the source, especially around Jabal Ibrahim, hold most of the montane southwest Arabian endemic bird species; only the Yemen Warbler *Parisoma buryi*, Asir Magpie *Pica pica asirensis* and Golden-winged Grosbeak *Rhynchostruthus socotranus* have yet to be recorded. Other significant breeding species include Verreaux's Eagle *Aquila verreauxii*, Bonelli's Eagle *Hieraaetus fasciatus*, Mountain Nightjar *Caprimulgus poliocephalus* and Bruce's Green Pigeon *Treron waalia*; Cinereous Buntings *Emberiza cineracea* occur on spring passage.

Noteworthy flora: No information is available, though a high diversity of plants certainly occurs.

Scientific research and facilities: Surveys of fish, birds, reptiles and amphibians have been conducted, but no current research is underway. No specific facilities exist.

Management authority and jurisdiction: Not known.

References: Eichaker (1990); Krupp (1983); Newton *et al.* (1994); Newton & Symens (1994).

Reasons for inclusion: 1a, 2b & 2d. Wadi Turabah, with perennially running water, is an important site incorporating a wide biological diversity in several vertebrate groups and great natural scenic beauty.

Source: Stephen Newton.

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Shallal ad-Dahna (17)

Location: 18°55'N, 42°12'E; 90 km north of Abha City, just south of Tanumah village, Asir Emirate.

Area: Approximately 200 ha.

Altitude: 2,100-2,200 m.

Overview: Shallal ad-Dahna used to be one of the very few permanent mountain streams and waterfalls in Saudi Arabia, but a recently constructed dam higher up the watercourse has resulted in its demise.

Physical features: The site comprises a semi-circular cliff-line (20-30 m high) in a small, shallow wadi, close to the main escarpment, cut by a small stream. A large plunge pool used to be present at the base.

Ecological features: Juniper *Juniperus excelsa* trees grow on the slopes adjacent to the old waterfall, intermixed with *Acacia* scrub and *Buddleja polystachya*. Some wetland plants still persist in the plunge pool depression.

Land tenure: Unknown, probably Government.

Conservation measures taken: No formal protection. The stream and surrounding hills (an area of 5,000 ha) have been identified as an "Important Bird Area" by BirdLife International.

Conservation measures proposed: The site was listed in the NCWCD System Plan for Protected Areas, but one of the prime reasons for its inclusion, namely its amphibian fauna, will almost certainly be lost in the future.

Land use: Grazing occurs on the surrounding hillsides and cultivation in the valley bottom.
Possible changes in land use: Further development as a recreational (picnic) area.
Disturbances and threats: The conservation and wetland interest of this site has now been largely destroyed by damming and unsympathetic landscaping as a recreational area. Planting of exotic trees, primarily *Eucalyptus*, has added to its demise. Considerable litter accumulates, and the surrounds suffer fairly high grazing pressure. Much of the flatter wadi bottom area has been cultivated and has lost most of its botanical interest. Picnics are a favoured occupation here, and car parks and roads are being provided.
Social and cultural values: This is a popular recreational area with local people and tourists.
Noteworthy fauna: While the waterfall and pool existed, this area was totally unique in Saudi Arabia, with the sympatric occurrence of three species of anuran, one endemic and two Palearctic relicts. It is not known whether viable populations will persist, but of note were the toad *Bufo arabicus* and two species of frog *Rana ridibunda* and *Hyla savignyi*. The site was also important for harbouring the snake *Eirenis coronella fennelli* and the shrew *Crocidura russula*. The site holds no species of waterbirds, though an unconfirmed report of a Northern Bald Ibis *Geronticus eremita* in November 1993 gives further support for the hypothesis that the species may breed in southwest Arabia. Shallal ad-Dahna superficially appears to be an ideal cliff site for a colony. The general area holds a large number of the southwest Arabian endemics (Arabian Red-legged Partridge *Alectoris melanocephala*, Philby's Rock Partridge *A. philbyi*, Arabian Woodpecker *Picoides dorae*, South Arabian Wheatear *Oenanthe lugentoides*, Yemen Thrush *Turdus menachensis*, Asir Magpie *Pica pica asirensis*, Arabian Serin *Serinus rothschildi* and Yemen Linnet *Carduelis yemenensis*) and several Afrotropical species including Spotted Eagle Owl *Bufo africanus*.
Noteworthy flora: The wetland plants have mostly been lost, although damp patches under cliff overhangs may support an interesting community of moss and liverworts, where *Primula verticillata* also grows.
Scientific research and facilities: Some surveys have been conducted in the past, particularly with respect to amphibians and reptiles, and ornithological records are collected when opportunities permit.
Management authority and jurisdiction: Not known.
References: Balletto *et al.* (1985); Newton & Symens (1994).
Reasons for inclusion: 1d (possibly also 2d). Formerly a unique site in the Asir mountains; sympathetic management could restore some of the lost wildlife interest.
Source: Stephen Newton.

Wadi Lajb (18)

Location: 17°35'N; 42°54'E; near the village of Ar Rayth some 40 km northeast of Baysh Town, Jizan Emirate.
Area: Approximately 250 ha.
Altitude: 700-1,500 m.
Overview: Wadi Lajb is the southern equivalent of Jabal Qaraqir; an incredibly deep canyon

cutting through sandstone mountains in one of the upper tributaries of Wadi Baysh, a vast drainage system of the southern mountains/Tihamah. Pristine, perennial wetlands occur along the wadi floor with a rich, moist, tropical flora.

Physical features: The Wadi Lajb canyon runs southwest to northeast for about 5 km, bisecting two sandstone mountains, Jabal al-Qahar (2,041 m) to the north and Jabal Shaqra (1,946 m) to the south. Canyon walls are up to 400 m high in places, often overhanging, and the wadi is often only 3-20 m wide. The watercourse comprises streams, rapids, waterfalls and plunge pools, with canyon-wall seep-lines abundant.

Ecological features: The canyon is luxuriantly vegetated and very African in character, with *Minuscops laurifolium*, *Trichilia emetica*, the Long-stemmed Palm *Phoenix reclinata* and *Ficus* as the dominant large trees; ferns, including *Pteris vittata*, abound in the humid environment. Often "hanging" forests occur along seep-lines.

Land tenure: Not known.

Conservation measures taken: None.

Conservation measures proposed: The canyon and surrounding jabals have only recently been discovered to have high conservation interest. As the site is remote and relatively inaccessible, urgent formal protection is probably not needed for the time being.

Land use: The canyon is scarcely utilised at present.

Possible changes in land use: None foreseen.

Disturbances and threats: None known.

Social and cultural values: Not known.

Noteworthy fauna: The site probably holds important populations of amphibians and fish, including several endemics, but these have not been surveyed. Additionally, the bird fauna is not well known, but Hamerkop *Scopus umbretta* undoubtedly occurs. Arabian Serin *Serinus rothschildi* and Masked Shrike *Lanius nubicus* have been recorded in winter. The surrounding mountains hold the largest known breeding population of Asir Magpies *Pica pica asirensis*, and are possibly one of the few places where the Arabian Leopard *Panthera pardus nimr* still persists.

Noteworthy flora: An incredibly diverse flora has been recorded in the canyon and jabal (S. Collenette, pers. comm.). Other trees (not mentioned above) include *Berchemica discolor*, *Celtis africana* and *Diospyros mespiliformis*.

Scientific research and facilities: Although visited by ornithologists, botanists and hydrologists, no data have been published.

Management authority and jurisdiction: None in place, although the local tribe is apparently able to limit access to some degree.

References: Tinley (1994).

Reasons for inclusion: 1a (possibly also 1d). This is one of the most spectacular topographic features in Saudi Arabia; its plant communities are likely to be unique in the Kingdom.

Source: Stephen Newton (Ken Tinley).

Malaki Dam (19)

Location: 17°03'N, 42°58'E; 15 km east of Abu Arish, Jizan Emirate.
Area: 2,500 ha.
Altitude: 120-250 m.
Overview: Malaki Dam (also known as Malakiyah, Wadi Jizan Dam or Hakima Dam) is probably the largest and most variable expanse of freshwater habitats in the southwestern provinces of Saudi Arabia.
Physical features: The Malaki Dam structure closes a narrow gap where Wadi Jizan passes between rocky foothills; this gap is just below the point of confluence of four major wadis. It was constructed to provide year-round water for irrigation purposes and for flood control. The reservoir is supplied by water from the major wadis and has a very large catchment area, extending south into Yemen. The depth of the reservoir has been reduced following sedimentation and, in flood periods, the reservoir can cover an area of 1,000 ha. To the north of the dam are basaltic lava plains, while to the south are many rocky outcrops, some containing hot springs such as at Ain Wakrah. Close to the main reservoir and in the lower reaches of the wadis there are several marshy areas. Large quantities of silt have effectively cut off some pools and larger expanses of open water from the main reservoir; one can be regarded as an almost permanent lake of about 60 ha.
Ecological features: *Tamarix* woodland, with a lush understorey of herbs, grasses and sedges including *Cynodon dactylon*, *Cyperus alopecuroides* and *C. articulatus*, covers many of the silt-deposition banks and borders the main wadis and areas of open water. Reeds *Typha* sp. occur in places. When water levels permit, sorghum is grown on accessible lake shores and wadi beds. Palms *Phoenix reclinata* and *Hyphaene*, the succulent *Adenium obesum* and the rare *Acacia alba* grow amidst rocky outcrops. In the more open and sandy areas, *Dobera glabra* trees, *Acacia* scrub and *Salvadora persica* predominate. In some areas with shallow water, the dead remains of flooded trees are exposed and form ideal roost sites for a variety of herons and egrets.
Land tenure: The land is under a combination of private and Government (Ministry of Agriculture and Water) ownership.
Conservation measures taken: The area is not protected and no formal conservation measures have been undertaken. Malaki Dam has been identified as an "Important Bird Area" by BirdLife International.
Conservation measures proposed: The area forms part of the larger Wadi Jawwah/Juwa system, and was proposed as a Special Nature Reserve, a Natural Reserve, Biological Reserve and Resource Use Reserve in the NCWCD System Plan for Protected Areas. Ratification as a Protected Area was expected in the early 1990s, but land ownership by other Government ministries has stalled the process for the foreseeable future.
Land use: When water levels in the reservoir drop, all available land is tilled intensively, mostly for sorghum. On the surrounding slopes, goat grazing is the principal activity.
Possible changes in land use: Intensive cultivation continues to increase as the local human population expands. This is resulting in the continued loss of scrub to the bulldozer. Further development is likely along the newly built al-Arida road. Insecticide spraying against malarial mosquitoes occurs frequently, and agricultural pesticides may also be used, but their impact on wildlife and water quality are unknown.
Disturbances and threats: The increase in the local human population poses the biggest threat to the wildlife of the area as more and more land is cleared for housing and agriculture. Wood-

cutting for firewood is likely to be a major concern.

Social and cultural values: Methods of cultivation, field sizes and typical circular thatched dwelling huts give the Malaki Dam area, including nearby Wadi Juwa, a unique African character. Water from the Ain Wakrah hot springs is reputed to have special properties. The springs have now been fenced, and a spa-type resort is being developed at the site. Thus, recreational pressure is likely to increase.

Noteworthy fauna: Four anurans have been recorded, *Bufo tihamicus*, *B. dhufarensis*, *B. arabicus* and *Euphlyctis ehrenbergii*, as well as the Side-necked Turtle *Pelomedusa subrufa*. The fish fauna is likely to be of interest, though exotic species have been introduced in the area and their impact on indigenous species could be high. This wetland usually supports 5,000-10,000 waterfowl in mid-winter, but little is known of the breeding community. Wintering species present in substantial numbers include Cattle Egret *Bubulcus ibis* (over 3,000), Glossy Ibis *Plegadis falcinellus* (over 900) and Ferruginous Duck *Aythya nyroca*. The site holds the largest regular wintering populations of White Stork *Ciconia ciconia* (over 300) and Common Cranes *Grus grus* (occasionally over 100) in Saudi Arabia, and is one of the few places where Pallas's Fish Eagle *Haliaeetus leucoryphus* is regularly recorded. Many other species of waterbirds are present in nationally important numbers, notably Black-crowned Night Heron *Nycticorax nycticorax*, Little Egret *Egretta garzetta*, Spoonbill *Platalea leucorodia*, Black Stork *Ciconia nigra*, Black-tailed Godwit *Limosa limosa* and Ruff *Philomachus pugnax*. The White Pelican *Pelecanus onocrotalus* is an occasional visitor. Large roosts of harriers *Circus* spp., including most Eurasian species, are often present, and Spotted Eagles *Aquila clanga* are regular. The surrounding area of semi-natural and farmland habitats has a high diversity of predominantly Afrotropical terrestrial bird species, and includes notable populations of Arabian Helmeted Guineafowl *Numida meleagris*, Little Button Quail *Turnix sylvatica*, Grey-headed Kingfisher *Halcyon leucocephala*, White-browed Coucal *Centropus superciliosus*, Abyssinian Roller *Coracias abyssinicus* and Little Grey Hornbill *Tockus nasutus*.

Noteworthy flora: *Dobera glabra* trees used to be quite abundant here, but their numbers have dwindled as they have been chopped down for firewood, or during field construction.

Scientific research and facilities: A wide variety of surveys has been conducted, but no serious research is currently underway and no facilities exist, although the Food and Agricultural Organisation (FAO) has generously allowed NCWCD staff to use their guest house at the dam.

Management authority and jurisdiction: The Ministry of Agriculture, through the auspices of the FAO Agricultural Development Centre, manages the reservoir for water supply and agricultural priorities.

References: Newton & Symens (1994); Rahmani *et al.* (1994).

Reasons for inclusion: 2a, 2b, 3b & 3c (possibly also 2d). The site is internationally important for several waterfowl species.

Source: Stephen Newton.

Al-Wajh Bank (20)

Location: 25°35'N, 36°45'E; in the northern Red Sea, about 120 km south of Al-Wajh, Tabuk Emirate.
Area: Approximately 288,000 ha.
Altitude: Sea level.
Overview: This is a large area comprising mainland coast, shallow water and reef systems and a plethora of Red Sea islands lying offshore between Al-Wajh and Umm Lajj.
Physical features: The archipelago has approximately 50 islands, ranging in size from 1 ha to 1,100 ha. Some are sandy whereas others are rocky with low cliffs, usually of less than 5 m height.
Ecological features: Some islands support vegetation, with mangrove and salt-tolerant bushes, but elsewhere they are barren. Large beds of seagrass offshore are of interest.
Land tenure: Unknown, probably Government.
Conservation measures taken: No conservation measures have been implemented; surveys of seabirds and raptors have been undertaken in the past. Al-Wajh Bank has been identified as an "Important Bird Area" by BirdLife International.
Conservation measures proposed: The area has been proposed as a Resource Use Reserve in NCWCD's System Plan for Protected Areas.
Land use: The islands are not inhabited on a permanent basis, although they no doubt support seasonal fishing camps.
Possible changes in land use: No change is anticipated.
Disturbances and threats: Collection of seabird and turtle eggs is likely to take place, although no current information is available.
Social and cultural values: The area is important to the local artisanal fishery.
Noteworthy fauna: Dugong *Dugong dugon* and sea turtles occur in the area, the latter nesting on the islands; considerable populations of breeding Osprey *Pandion haliaetus* and Sooty Falcon *Falco concolor* occur. The islands have not been surveyed for breeding seabirds since the summer of 1982; at that time, colonies of Brown Booby *Sula leucogaster*, Sooty Gull *Larus hemprichii*, White-eyed Gull *L. leucophthalmus*, White-cheeked Tern *Sterna repressa* and Bridled Tern *S. anaethetus* were present.
Noteworthy flora: Mangrove *Avicennia marina* and the salt-tolerant bushes *Salicornia* are the most important plants on the islands.
Scientific research and facilities: No research and monitoring have been undertaken, except for Osprey; detailed surveys of breeding seabirds should be a priority. No facilities exist on the islands.
Management authority and jurisdiction: Not known.
References: Evans (1987); Gallagher *et al.* (1984); Gaucher *et al.* (1994); Newton & Symens (1994).
Reasons for inclusion: 1a, 2a & 2c. The site has a valuable and extensive reef system, and is an important breeding site for turtles and seabirds.
Source: Stephen Newton.

Yanbu Royal Commission Zone (21)

Location: 23°56'N, 38°14'E; at Madinat Yanbu al-Sinaiyah on the Red Sea coast, Al-Madinah Emirate.
Area: Approximately 700 ha.
Altitude: Sea level.
Overview: The site is composed of three areas of mangrove along the delta of Wadi Farrah, adjacent to the new industrial city of Madinat Yanbu al-Sinaiyah, which is itself located 25 km south of Yanbu al-Bahr.
Physical features: The area includes coral reefs, sandy beaches, saltmarshes and sabkha.
Ecological features: This site is important for its dense stands of mangrove *Avicennia marina* that extend along 11 km of Red Sea coastline.
Land tenure: The Royal Commission for Jubail and Yanbu manages the site.
Conservation measures taken: The three mangrove areas have been designated as Conservation Areas by the Royal Commission for Jubail and Yanbu. As such, they are afforded complete protection from disturbance and are to remain in their natural state.
Conservation measures proposed: Plans exist to build a new marine laboratory and public environmental awareness centre. The site was proposed as a Biological Reserve in NCWCD's System Plan for Protected Areas. The mangroves have been identified as an "Important Bird Area" by BirdLife International.
Land use: Nature conservation, though surrounded by the largest oil terminal in the Saudi Red Sea.
Possible changes in land use: None expected.
Disturbances and threats: Oil pollution poses the main threat to the area, though presumably contingency planning is well advanced and good clean-up and containment facilities exist.
Social and cultural values: None known, although the mangroves are an educational source.
Noteworthy fauna: The Dugong *Dugong dugon* inhabits surrounding waters. Internationally important numbers of Terek Sandpiper *Tringa cinerea* winter in the area, with up to 700 recorded. Typical mangrove birds breed here, and further studies would probably reveal more. Those species that are currently known to breed include a minimum of two pairs of Striated Heron *Butorides striatus*, two colonies of Western Reef Egret *Egretta gularis*, a maximum of three pairs of Purple Heron *A. purpurea*, three pairs of Osprey *Pandion haliaetus*, approximately 45 pairs of African Reed Warbler *Acrocephalus baeticatus* and about 10 pairs of Clamorous Reed Warblers *A. stentoreus*. Goliath Heron *A. goliath* has bred in the past. Two species of tern are also known to breed in the area: approximately 10 pairs of White-cheeked Tern *Sterna repressa* and about 30 pairs of Saunders' Little Tern *S. saundersi*. A maximum of 200 Crab Plovers *Dromas ardeola* has been recorded wintering at the site.
Noteworthy flora: Mangrove *Avicennia marina* is the dominant plant species.
Scientific research and facilities: Considerable bird recording has been conducted.
Management authority and jurisdiction: Royal Commission for Jubail and Yanbu.
References: Ash *et al.* (1989); Baldwin & Meadows (1988); Meadows (1986, in press); Newton & Symens (1994).
Reasons for inclusion: 1a, 2b, 2c & 3c. This is one of the best examples of mangrove in the northern Red Sea.
Source: Stephen Newton (Brian Meadows).

Jeddah South Corniche and Central (22)

Location: Jeddah (central) north of Port 21°30'N, 39°10'E; South Corniche 21°23'N, 39°07'E; on the Red Sea coast, Makkah Emirate.
Area: Approximately 900 ha.
Altitude: Sea level.
Overview: The site comprises two adjacent, important coastal wetlands separated by Jeddah Sea Port and a naval base; they are principally of interest for their concentrations of non-breeding waterbirds.
Physical features: The northern area consists of an embayment between the sea port and royal palaces adjacent to central downtown Jeddah. The southern area is along the South Corniche Road, south of a large military area. The latter site comprises extensive mud- and sand-flats and shallow lagoons with sandbar islands or peninsulas. Extensive sabkha stretches inland of the coast road, though it has been partitioned and in some places infilled for industrial expansion. Much of the intervening area between the two sites is fenced off as a military area, and no access is possible.
Ecological features: A high inflow of nutrients from largely untreated sewage effluent enhances invertebrate productivity and supports a large concentration of waterbirds. Coral reefs, where unpolluted, have a high diversity of fishes.
Land tenure: Government.
Conservation measures taken: None; although the military area reduces disturbance, it does not curtail pollution. The wetlands have been identified as an "Important Bird Area" by BirdLife International.
Conservation measures proposed: Part of this area has been proposed as a Natural Reserve in NCWCD's System Plan for Protected Areas.
Land use: The northern area flanks Jeddah City centre and holds the fish market. Along the South Corniche, roads have been constructed and much of the area infilled for potential industrial expansion. There is some livestock grazing and a small fishing village in this area.
Possible changes in land use: Continued industrial expansion along the South Corniche.
Disturbances and threats: Both sites are heavily visited by people, and disturbance to birds must occur. However, the best areas are either unattractive to man, such as near the sewage outfall where large numbers of birds feed, or inaccessible, including offshore islets and the military area. The threat of oil spills is ever present. An unidentified pathogen or toxic food source killed considerable numbers of Western Reef Egrets *Egretta gularis* in December 1993 along the South Corniche.
Social and cultural values: The area is much valued as a recreational resource.
Noteworthy fauna: Five species of waterbirds occur in internationally important numbers during winter: Spoonbill *Platalea leucorodia* (maximum 280), Western Reef Egret (335), Slender-billed Gull *Larus genei* (nearly 5,500), Gull-billed Tern *Gelochelidon nilotica* (372) and Caspian Tern *Sterna caspia* (120). Greater Flamingos *Phoenicopterus ruber* attempted to nest in 1990, but failed due to flooding by spring tides. Otherwise, the area harbours an interesting assemblage of waterbirds, with particularly large numbers of Little Stint *Calidris*

minuta and Ruff *Philomachus pugnax*.
Noteworthy flora: There is little vegetation in the area, although a small patch of mangrove *Avicennia marina* is present on the southern boundary of the South Corniche.
Scientific research and facilities: Waterbirds are counted annually as part of the Saudi contribution to the Asian Waterfowl Census.
Management authority and jurisdiction: Jeddah Municipality, Port Authority and Ministry of Defence and Aviation.
References: Newton & Symens (1994)
Reasons for inclusion: 1a, 3b & 3c. The site holds internationally important populations of at least five species of waterbirds in winter; relatively unspoilt areas of saltmarsh vegetation in the military base may be of interest.
Source: Stephen Newton.

Qishran Bay (23)

Location: 20°15'N, 40°10'E; on the Red Sea coast north of Al-Lith, Makkah Emirate.
Area: Approximately 40,000 ha.
Altitude: Sea level.
Overview: This is one of the largest lagoon systems on the Red Sea coast, still relatively unspoilt, with considerable tracts of mangrove on islands.
Physical features: Qishran Bay is isolated from the open sea by the presence of one long narrow barrier island and a smaller one at its mouth. Inside this shallow bay there are eight other islands. On the mainland shore, the foothills of the Asir mountain range approach very closely to the coast; this narrow lowland belt may play a role in concentrating migrant birds.
Ecological features: The islands are covered with dense vegetation, mostly the salt-tolerant succulent *Salicornia*, and surrounded by mangrove trees *Avicennia marina*. There are seagrass beds in the bay.
Land tenure: Government
Conservation measures taken: Leaflets explaining the importance of the area for breeding Sooty Falcons *Falco concolor* have been distributed to local people in an attempt to curtail the trapping of this species. Qishran Bay has been identified as an "Important Bird Area" by BirdLife International.
Conservation measures proposed: The area has been proposed as a Special Nature Reserve in the NCWCD System Plan for Protected Areas.
Land use: Artisanal fisheries; livestock grazing (camels); falcon trapping.
Possible changes in land use: None foreseen.
Disturbances and threats: Trapping of migrant falcons is conducted each autumn, with significant numbers of some species being taken each year. On average, about 30 Lanner *Falco biarmicus*, 15 Saker *F. cherrug*, 40 Peregrine *F. peregrinus* and 30 Barbary Falcons *F. pelegrinoides* are trapped for sale to falconers. It is known that some Sooty Falcons have been trapped, and at least one nest has been robbed. Increasing recreational pursuits are a potential problem.

Social and cultural values: The area is a lucrative source of high quality falcons.
Noteworthy fauna: The Dugong *Dugong dugon* occurs in the area, and both the Hawksbill Turtle *Eretmochelys imbricata* and Green Turtle *Chelonia mydas* breed here. The inner islands support the densest population of breeding Sooty Falcons in Saudi Arabia, and probably in the world, with approximately 40 pairs breeding on a handful of small islands. The falcons breed on the ground underneath the mangroves. In the region of 50 pairs of Bridled Tern *Sterna anaethetus* also breed, though a full survey of breeding seabirds has not been undertaken. The site was one of the first proven breeding locations for Pink-backed Pelicans *Pelecanus rufescens* in Arabia (8-10 pairs in 1981). The Goliath Heron *Ardea goliath* is a rare summer visitor, and the White-collared Kingfisher *Halcyon chloris* has been recorded and may breed in the area. The Crab Plover *Dromas ardeola* is present all year round and is another potential breeding species.
Noteworthy flora: Large stands of mangrove *Avicennia marina*.
Scientific research and facilities: The breeding biology of the Sooty Falcon has been studied in some detail for several years. No facilities exist in the area.
Management authority and jurisdiction: Not known.
References: Gaucher *et al.* (1994); Jennings *et al.* (1982); Newton & Symens (1994).
Reasons for inclusion: 1a, 2a & 2c. The site supports a large population of breeding Sooty Falcons nesting in a unique setting.
Source: Stephen Newton.

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Umm al-Qamari (24)

Location: 18°59'N, 41°06'E; in the Red Sea southwest of Qunfudah, Makkah Emirate.
Area: 14.7 ha.
Altitude: Sea level.
Overview: These are an example of relatively unspoilt Red Sea islands with an interesting community of terrestrial breeding birds and high vegetation cover.
Physical features: The site comprises two small flat, fossil coral islands, one of 12 ha, the second of 2.7 ha, within 5 km of the coast.
Ecological features: Dense stands of *Salvadora persica* up to 3 m in height and *Suaeda fruticosa* cover much of the islands.
Land tenure: Government (NCWCD).
Conservation measures taken: The island is a Special Nature Reserve, within the NCWCD's network of established Protected Areas. Traditional hunting laws have apparently protected the islands for a long time. The islands have been identified as an "Important Bird Area" by BirdLife International.
Conservation measures proposed: More regular wardening to safeguard breeding bird populations.
Land use: There is no established human use on the islands, but they are visited occasionally by coastguards and fishermen.
Possible changes in land use: None anticipated

Disturbances and threats: The islands are small and a fair distance offshore, and are thus difficult to warden; it is not known how many people really visit the islands or how much disturbance a visit during the breeding season entails. Hunting and egg-collecting may occur, but there is no information available to date.
Social and cultural values: Supposedly these islands are a respected non-hunting "hema".
Noteworthy fauna: The African Collared Dove *Streptopelia roseogrisea* is the single most numerous bird species, with a minimum estimate of 500 pairs. Important numbers of Cattle Egret *Bubulcus ibis* (65 pairs) and Spoonbill *Platalea leucorodia archeri* (10-15 pairs) breed on the island. The Sooty Gull *Larus hemprichii* breeds (with 50-100 pairs in two colonies) and over-winters. Small numbers of White-eyed Gull *L. leucophthalmus* roost on the beaches in winter, along with Pink-backed Pelican *Pelecanus rufescens*. Two pairs of Striated Heron *Butorides striatus*, seven pairs of Western Reef Egret *Egretta gularis* and two pairs of Osprey *Pandion haliaetus* have also bred. Graceful Warblers *Prinia gracilis* are numerous and resident.
Noteworthy flora: *Salvadora persica* and *Suaeda* form the densest, tallest thickets, with *Cyperus conglomeratus, Atriplex farinosa* and *Zygophyllum album* predominating on more open ground.
Scientific research and facilities: The islands have been visited periodically by NCWCD staff to inventory the flora and to survey birds. No facilities exist.
Management authority and jurisdiction: NCWCD.
References: Alwelaie *et al.* (1993); Newton & Symens (1994); Symens (1988b).
Reasons for inclusion: 1a, 2c & 3c. This is a unique site, holding one of the densest known breeding concentrations of African Collared Doves.
Source: Stephen Newton.

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Khawr 'Amiq (25)

Location: 18°26'N, 41°26'E; on the Red Sea coast, 30 km northwest of al-Birk, Makkah Emirate.
Area: Approximately 150 ha.
Altitude: Sea level.
Overview: Khawr 'Amiq, also known as Amq or Omq, is situated at the northern end of a predominantly mangrove-fringed coastline backed by a black lava plain (harrat) with extinct volcanic cones, extending south for about 60 km to Al Qahmah.
Physical features: The site comprises a complex of shallow, muddy and sandy saline lagoons and channels.
Ecological features: Large stands of mangrove *Avicennia marina* surround the bay, and the sub-tidal area is characterised by extensive beds of seagrass. The area supports a local fishery.
Land tenure: Not known.
Conservation measures taken: None.
Conservation measures proposed: The site has been proposed as a Resource Use Reserve in the NCWCD System Plan for Protected Areas, and has been identified as an "Important Bird Area" by BirdLife International.

Land use: Artisanal fishing; camel grazing.
Possible changes in land use: None known.
Disturbances and threats: Grazing by camels is causing extensive damage, and small-scale mangrove-cutting also threatens the site.
Social and cultural values: None known.
Noteworthy fauna: The Dugong *Dugong dugon* inhabits the coastal waters. The White-collared Kingfisher *Halcyon chloris* is probably resident (estimated minimum of 3-5 pairs). Other breeding species include Striated Heron *Butorides striatus*, Osprey *Pandion haliaetus* and possibly Pink-backed Pelican *Pelecanus rufescens* (with up to 20 wintering), Spoonbill *Platalea leucorodia*, Clamorous Reed Warbler *Acrocephalus stentoreus* and African Reed Warbler *A. baeticatus*.
Noteworthy flora: Mangrove *Avicennia marina* is the dominant plant.
Scientific research and facilities: Only a few visits have been made, primarily to monitor waterfowl and kingfishers. No facilities exist.
Management authority and jurisdiction: Not known.
References: Newton & Symens (1994); Stagg (1984a).
Reasons for inclusion: 1a (possibly also 2a & 3c). The site is a characteristic example of a largely undisturbed, mangrove-fringed lagoon of the southern Red Sea coast.
Source: Stephen Newton.

Kutambil Island (26)

Location: 17°53'N, 41°42'E; in the Red Sea northwest of Shuqaiq, Jizan Emirate.
Area: Approximately 8 ha.
Altitude: Sea level to 100 m.
Overview and physical features: Kutambil is a volcanic island situated 5 km offshore. A 100 m peak of volcanic clinker dominates the island. The south and southeast parts of the island are flat and sandy. Rich coral reefs lie offshore.
Ecological features: Salt-tolerant bushes grow in profusion along the base of the clinker mound, and a few trees are found on its slopes, growing as tall as 3 m.
Land tenure: Not known, probably Government.
Conservation measures taken: None. The island has been identified as an "Important Bird Area" by BirdLife International.
Conservation measures proposed: None.
Land use: This is an uninhabited island, occasionally visited by fishermen.
Possible changes in land use: None anticipated.
Disturbances and threats: In 1982, about 50% of eggs or young of the breeding Spoonbills were taken by humans; exploitation of other seabird species may occur.
Social and cultural values: None known.
Noteworthy fauna: In 1982, 60 pairs of Spoonbill *Platalea leucorodia* (of the scarce Red Sea race *archeri*) were counted, with small numbers of breeding Western Reef Egret *Egretta gularis*, Striated Heron *Butorides striatus*, Osprey *Pandion haliaetus* and Sooty Falcon *Falco*

concolor also recorded. In winter, hundreds of gulls and terns use the island as a roost, along with Brown Boobies *Sula leucogaster* and up to 65 Pink-backed Pelicans *Pelecanus rufescens*. Other seabird species may breed on the island.
Noteworthy flora: None known.
Scientific research and facilities: No serious research has been conducted, though the island has been visited several times by ornithologists; a more complete summer survey would be desirable.
Management authority and jurisdiction: Not known.
References: Newton & Symens (1994); Stagg (1984b).
Reasons for inclusion: 1d & 3c. This is an unusual, rocky island with an important breeding colony of Spoonbills *Platalea leucorodia archeri*.
Source: Stephen Newton (Arthur Stagg).

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Shuqaiq Mangrove (27)

Location: 17°48'N, 41°52'E; on the southern Red Sea coast, Jizan Emirate.
Area: Approximately 200 ha.
Altitude: Sea level.
Overview: A small bay with stands of mangrove and some inter-tidal mudflats, on the southern Red Sea coast; of particular interest for its breeding bird community.
Physical features: Shuqaiq Mangroves are also known as Ad-Darb in Asian Waterfowl Census reports and marked as Sharm at Ta'nah on some maps. The area comprises a fairly small embayment at a point where basaltic harrat comes down to the waterline, with some inter-tidal mudflats separating mangrove stands.
Ecological features: Mangroves line the coast, and there are extensive beds of seagrass offshore. The area supports a local fishery.
Land tenure: Government, Ministry of Agriculture and Water.
Conservation measures taken: None. The site has been identified as an "Important Bird Area" by BirdLife International, but is not included in NCWCD's System Plan for Protected Areas.
Conservation measures proposed: Recommendations for the protection and conservation of the site have been made to NCWCD.
Land use: There is a small fishing village, and the site is a very popular recreational area.
Possible changes in land use: The Ministry of Agriculture has commenced developing the area as a fish (prawn) farm, and much of the area has now been fenced off. The mudflats and sabkha inland of the mangroves have been partitioned by causeways.
Disturbances and threats: The fish farm seriously jeopardises the ecological health of the site. Recreational visitors, especially week-end fishermen, litter the area, but probably cause little disturbance. There is some disturbance by small-scale cutting of mangrove and camel grazing.
Social and cultural values: Primarily recreational.
Noteworthy fauna: The site supports perhaps the largest population of White-collared Kingfisher *Halcyon chloris* on the Saudi Red Sea coast. Clamorous Reed Warblers *Acrocephalus stentoreus* and African Reed Warblers *A. baeticatus* are also common residents.

In spring 1994, a population of white-eyes *Zosterops* sp. (possibly a new species or subspecies of *Z. abyssinica*) was discovered. The Goliath Heron *Ardea goliath* occurs, and Purple Heron *A. purpurea* is a possible breeding species.
Noteworthy flora: Mangrove *Avicennia marina* is the dominant plant.
Scientific research and facilities: Currently, standard-effort mist-netting is being conducted throughout the year to determine numbers, breeding chronology and longevity of kingfishers and other avian members of the mangrove community.
Management authority and jurisdiction: Ministry of Agriculture and Water.
References: Newton & Newton (1994); Newton & Symens (1994); Stagg (1984a).
Reasons for inclusion: 1a & 2b (possibly also 2d). Despite damaging developments, the site holds an important population of White-collared Kingfishers and other poorly known breeding passerines.
Source: Stephen Newton.

Jizan Bay (28)

Location: 16°53'N, 42°32'E; on the southern Red Sea coast, Jizan Emirate.
Area: 200 ha.
Altitude: Sea level.
Overview: This is the principal "beach" of Jizan City, highly enriched by sewage effluent and consequently supporting the largest shorebird populations on the Saudi Red Sea coast.
Physical features: The site comprises a 4 km long by about 500 m wide stretch of inter-tidal mud- and sand-flats between Jizan Port and the northern outskirts of the city. Similar habitat extends to the north, but is largely inaccessible and unsurveyed from the ground.
Ecological features: None outstanding, though invertebrate productivity must be high.
Land tenure: Government/Jizan Municipality/Jizan Port Authority.
Conservation measures taken: None. Jizan Bay has been identified as an "Important Bird Area" by BirdLife International.
Conservation measures proposed: NCWCD ornithologists have on several occasions asked senior management to approach the Jizan Municipality/Emirate with a request to slow down or stop the continual loss of mudflats to reclamation for housing or garbage disposal.
Land use: Urban; the bay is used as mooring area by artisanal fishermen, and there is a fish market nearby.
Possible changes in land use: Further landfill and urbanisation; a new breakwater harbour appeared under construction in January 1995, through the middle of prime mudflats.
Disturbances and threats: The site is much disturbed and faces a multitude of threats. Pollution by oil, sewage effluent and rubbish and extensive land reclamation for further urbanisation all threaten the site, the latter reducing the area of inter-tidal flats available for feeding waterbirds. Human disturbance to birds using the area is high.
Social and cultural values: None; in most people's eyes, the land is there to be developed.
Noteworthy fauna: The site regularly holds between 6,000 and 20,000 waterbirds in winter, with at least six species occurring in internationally important numbers: Crab Plover *Dromas*

ardeola (maximum 480), Lesser Sand Plover *Charadrius mongolus* (maximum 1,125), Grey Plover *Pluvialis squatarola* (maximum 2,232), Dunlin *Calidris alpina* (maximum 3,160), Broad-billed Sandpiper *Limicola falcinellus* (maximum 311) and Gull-billed Tern *Gelochelidon nilotica* (maximum 294). Several others approach significance, for example Bar-tailed Godwit *Limosa lapponica* (2,740) and Terek Sandpiper *Tringa cinerea* (418).
Noteworthy flora: None.
Scientific research and facilities: The area is censused annually as part of the Saudi contribution to the Asian Waterfowl Census.
Management authority and jurisdiction: Jizan Port Authority.
References: Newton & Symens (1994).
Reasons for inclusion: 1a & 3c. The site supports an internationally important wintering shorebird population.
Source: Stephen Newton.

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Khawr Wahlan (29)

Location: 16°45'N, 42°40'E; on the southern Red Sea coast, approximately 35 km south of Jizan, Jizan Emirate.
Area: Approximately 1,000 ha.
Altitude: Sea level to 3 m.
Overview: The site comprises a representative stretch of southern Red Sea coastline with a wide diversity of marine habitats (lagoon, mudflats, sabkha, mangroves) and a unique fresh to brackish water wetland. The latter is known locally as Sawarma Marsh.
Physical features: The coastal zone is composed of two inlets and a small island. The latter has now been connected to the mainland by a causeway across the sabkha. At low tide, rich mudflats are exposed. The marsh occurs inland of the southern inlet (Khawr Wahlan), where springs arise by lateral seep from an adjacent dune plateau aquifer or artesian leakage from a buried geological fault line.
Ecological features: Stands of the mangrove *Avicennia marina* occur on the inland parts of both inlets; some seagrass beds are present close to the shoreline. The fresh to brackish marsh is predominantly covered by a short sward of the sedge *Cyperus laevigatus*.
Land tenure: Not known.
Conservation measures taken: None. Khawr Wahlan has been identified as an "Important Bird Area" by BirdLife International.
Conservation measures proposed: The coastal part of the site is proposed as a Special Nature Reserve in NCWCD's System Plan for Protected Areas, though at the time the significance of the freshwater marsh was apparently not known.
Land use: Khawr Wahlan is used as an anchorage by local fisheries and a small harbour has been constructed. The whole area is heavily grazed by camels and goats.
Possible changes in land use: None identified.
Disturbances and threats: Camels regularly bathe and wallow in the wet area, causing extensive damage to the marshland vegetation. A fairly large garbage dump is present on the

northern edge of the marsh.
Social and cultural values: None known.
Noteworthy fauna: The site regularly holds 2,000-3,000 waterfowl in winter, though no species are present in internationally significant numbers. In a national context, the site holds Saudi Arabia's only known wintering population of Pacific Golden Plover *Pluvialis fulva* and good numbers of Pintail *Anas acuta*, Crab Plover *Dromas ardeola*, Lesser Sand Plover *Charadrius mongolus*, Curlew Sandpiper *Calidris ferruginea*, Bar-tailed Godwit *Limosa lapponica* and Redshank *Tringa totanus*. A flock of 75 White Stork *Ciconia ciconia* was present in February 1993. All four Eurasian species of harrier have been recorded in winter (Marsh *Circus aeruginosus*, Hen *C. cyaneus*, Pallid *C. macrourus* and Montagu's *C. pygargus*), and this is one of the few coastal sites where Bateleur *Terathopius ecuadatus* occurs.
Noteworthy flora: The freshwater marsh flora has yet to be described in detail.
Scientific research and facilities: The shorebirds of the area have been surveyed in several winters by ornithologists as part of the Saudi contribution to the Asian Waterfowl Census.
Management authority and jurisdiction: Not known; the coastguard service controls access to the causeway and fishing harbour.
References: Newton & Symens (1994); Tinley (1994).
Reasons for inclusion: 1a, 1d, 2b & 3b. The site contains a unique freshwater marsh, holding the only known wintering population of Pacific Golden Plover in Saudi Arabia.
Source: Stephen Newton.

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Farasan Islands (30)

Location: 16°20'-17°20'N, 41°24'-42°26'E; in the southern Red Sea, Jizan Emirate.
Area: The main archipelago lies within an area of 75 by 50 km; the site includes approximately 70,000 ha of land with 605 km of coastline; the proposed Marine Protected Area covers 331,000 ha.
Altitude: Sea level.
Overview: The Farasan Island group is a large archipelago of Red Sea coral islands lying 40 km offshore from Jizan.
Physical features: The proposed Marine Protected Area includes 128 islands, one coral cay and 18 shoal areas. The islands were formed by uplift from a rising salt dome beneath the area. The extant coral reefs are about 7,000 years old. The archipelago includes two large islands connected by a bridge, Farasan Kebir and Segid, the former being over 50 km in length. Nowhere on the islands lies further than 3 km from the sea. The islands are situated on a broad, shallow shelf 125 km wide.
Ecological features: Marine biotopes include coral-dominated fringing and patch reefs, algae-dominated fringing and patch reefs, coral-algal fringing reefs, platform reefs, pavement, shoals, mudflats and sub-tidal sand expanses. Sheltered coastal areas support extensive stands of mangrove *Avicennia marina*, and northeast Farasan Kebir supports the largest patch of another mangrove species, *Rhizophora mucronata*, in the Saudi Red Sea. Above the inter-tidal zone, beaches usually have a wide or narrow band of *Suaeda monoica*, *Halopeplis perfoliata*,

Limonium axillare and several species of *Zygophyllum*. Inland, vegetation cover is sparse except in gullies between fossil coral outcrops, but supports a *Commiphora-Acacia-Salvadora* scrub community with occasional thickets of *Euphorbia fractiflexa*.

Land tenure: Government.

Conservation measures taken: The terrestrial area forms an established NCWCD Reserve, including an overall non-hunting zone, and several Special Nature Reserves and Natural Reserves. A ranger force is employed to prevent poaching of gazelles. The Farasan Islands have been identified as an "Important Bird Area" by BirdLife International.

Conservation measures proposed: A large part of the archipelago has been proposed as the first Red Sea Marine Protected Area in Saudi Arabia. Ratification is expected in the near future, and marine rangers will be recruited to supervise fishing activity according to a predetermined zonation and to control other detrimental activities such as the collection of seabird eggs.

Land use: The human population is in the region of 5,000, mostly restricted to one large town on Farasan Kebir and several villages on this and Segid. Only one smaller island is inhabited permanently (Qummah). The principal occupation is fishing, though herds of goats and camels are grazed in the vicinity of villages. Several small areas are cultivated with date palm plantations or sorghum. Small fishing camps are occupied intermittently on many of the smaller islands. Continuously manned coastguard stations occur both on the main island and several smaller ones, such as Zifaf and Rumain.

Possible changes in land use: The industrial and investor fisheries sectors are likely to increase. Few changes are expected on land, although a large part of southeastern Farasan Kebir has been earmarked for a naval base.

Disturbances and threats: Development of the naval base could have disastrous consequences for the terrestrial and marine wildlife of the area, especially shorebirds, coral reefs and loss of a prime gazelle area. Uncontrolled and intensive fishing causes considerable damage to reefs, from anchors, and threatens the viability of the traditional artisanal fishery. It appears that seabird eggs are collected widely for sale or personal consumption. This practice and the abundance of introduced predators, notably feral/domestic cats and rats, probably severely limit the reproductive success of the species concerned (White-cheeked Tern *Sterna repressa* and Bridled Tern *S. anaethetus*). Human visitation to Brown Booby *Sula leucogaster* breeding colonies can cause premature fledging of young into the sea; some of these have difficulty in returning to their colonies on cliff-lined islands. On some islands, migrant passerines, especially shrikes (Lanidae), are trapped in spring for rendering their fat into cooking oil. The annual harvest may take over 30,000 birds.

Social and cultural values: The traditional harvest of passerines is mentioned above; in addition, the harvest of inshore spawning parrotfish at one locality on Farasan Kebir is the scene of another spring festival, the "harrid". The Farasan Islands are the last locality in the Saudi Red Sea in which pearl fishing is still practised.

Noteworthy fauna: In total, 231 species of fish and 49 species of reef-building coral have been recorded in the Farasans. Both Green Turtle *Chelonia mydas* and Hawksbill Turtle *Eretmochelys imbricata* are common and widespread in and around the archipelago, though there has been no recent census or inventory of nesting beaches. A remnant population of endangered Dugong *Dugong dugon* persists, but only one or two individuals have been sighted in recent years. They appear to be confined to the extensive seagrass beds in Khawr Ma'adi between Farasan Kebir and Segid. Three species of dolphin frequent coastal waters: the

Bottlenose *Tursiops truncatus*, Indo-Pacific Humpback *Sousa chinensis* and Long-snouted Spinner *Stenella longirostris*, though the latter is only seen in relatively deep water (over 20 m). During recent surveys, Bryde's Whales *Balaenoptera edeni* have been recorded in both summer and winter; these are the first records for the Red Sea and suggest the species may be resident in the area. The islands hold large numbers of breeding seabirds; preliminary surveys in the summer of 1993 counted a total of 8,300 White-cheeked Terns *Sterna repressa* and 12,150 Bridled Terns *S. anaethetus*. Common Noddies *Anous stolidus* nest on a small number of better vegetated islands: the largest colony is on Abu Shugar, where 500 individuals were seen in 1993. Around 4,700 Brown Boobies have been recorded during summer, though most probably breed in winter on a small number of islands. The Farasans are the only known confirmed breeding site for Crab Plover *Dromas ardeola* on the Red Sea coast of Arabia (three colonies known), and the *Rhizophora* mangroves support perhaps the largest breeding colony of Pink-backed Pelican *Pelecanus rufescens* in the whole Red Sea (90 active nests in January 1995). Other breeding waterbirds include Western Reef Egret *Egretta gularis*, Goliath Heron *Ardea goliath*, Spoonbill *Platalea leucorodia*, Sooty Gull *Larus hemprichii*, Caspian Tern *Sterna caspia*, Lesser Crested Tern *S. bengalensis* and Saunders' Little Tern *S. saundersi*. Populations of breeding Ospreys *Pandion haliaetus* (40-50 pairs) and Sooty Falcons *Falco concolor* (20-40 pairs) are also of considerable importance in a Red Sea context. In winter (September to late April), large numbers of shorebirds are present on southeast Farasan Kebir and around Khawr Abu Tuq Island (just off the north tip of Segid), notably Crab Plover, Lesser Sand Plover *Charadrius mongolus*, Ruddy Turnstone *Arenaria interpres* and Saunders' Little Tern. Although not dependent upon Farasan wetland resources, the islands hold the largest wild population of gazelles in Saudi Arabia; an endemic subspecies of the Mountain Gazelle *Gazella gazella farasani*.

Noteworthy flora: The *Rhizophora mucronata* stand is of interest in a national context; seven species of seagrass occur.

Scientific research and facilities: Considerable research and monitoring have been conducted on both fauna and flora in marine and terrestrial habitats. No specific facilities exist, but accommodation is available at the ranger camp for visiting scientists.

Management authority and jurisdiction: NCWCD (for Protected Areas), Farasan Port Authority, coastguard services (for fishery monitoring).

References: Alwelaie *et al.* (1993); Gladstone (1994a, 1994b); Goldspink *et al.* (1995); Jennings (1988); Newton & Symens (1994); Symens (1988a).

Reasons for inclusion: 1a, 2a, 2b, 2c, 3a & 3c. The Farasan Islands are a large Red Sea archipelago with a high diversity of marine biotopes and many internationally important vertebrate groups including breeding turtles and seabirds and wintering shorebirds.

Source: Stephen Newton.

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SYRIAN ARAB REPUBLIC

INTRODUCTION

Area: 185,180 sq.km.

Population: 12,530,000 (1990).

Syria is situated on the eastern shore of the Mediterranean Sea, and is bordered in the north by Turkey, in the east by Iraq, and in the south by Jordan, Israel and Lebanon. Behind the narrow Mediterranean coastal plain, the Jabal al-Nusayriyah (Jebel el-Ansariyah) range rises to about 1,500 m, then drops steeply to the Asi (Orontes) river valley to the east. In the southwest of the country, the Jebel esh Sharqi (Anti-Lebanon) range rises to 2,814 m at Jesh Sheikh (Mount Hermon) on the Lebanese border. The only other major area of highland is the Jabal ad Duruz southeast of Damascus on the Jordanian border. East of these mountain ranges, the land slopes gently northeast towards the Euphrates river valley, which cuts in a northwest-southeast direction across the eastern half of the country. The vast eastern region consists mainly of open steppe and desert, with conditions becoming progressively more arid towards the border with Iraq in the east and southeast.

The climate of the coastal plain is Mediterranean, with hot, dry summers and mild, wet winters. Rainfall increases with altitude in the coastal mountain ranges, and snow is common in winter. In the dry steppe and open desert country east of the mountains, a marked continental climate prevails, with high summer temperatures and relatively cold winters, with many nights of frost. Over most of this region, which covers approximately 60% of the country, the average annual rainfall is less than 250 mm. In spring and autumn, the hot and dusty "khamsin" wind, blowing from the east and southeast, may cause temperatures to rise as high as 43-49°C. Damascus, situated east of the coastal mountain ranges, has a mean annual rainfall of 225 mm and average temperatures ranging from 7°C in January to 27°C in July.

The natural vegetation comprises Mediterranean, Irano-Turanian and Saharo-Sindian elements. However, virtually all natural vegetation has long since been altered and degraded by human activity. The surviving vegetation includes oak maquis on the narrow coastal plain and foothills, remnant coniferous forests on the slopes of the Jabal al-Nusayriyah and along the Anti-Lebanon range, Irano-Turanian steppe on the central and eastern plains, and subalpine and alpine communities above 2,000 m in the southern mountains. Syria's major landscapes and dominant vegetation types have recently been summarized by IUCN (1992) and Evans (1994).

Agriculture has traditionally been the mainstay of the economy. Much of the agriculture is concentrated in the ancient "Fertile Crescent" which extends in an arc from the inner rim of the coastal mountains, through northern Syria and down the Euphrates Valley into Iraq. The main

crops are cotton, wheat, barley, rice, olives, millet, sugar-beet and tobacco. The rearing of livestock, particularly sheep and goats, remains important in the semi-desert areas where irrigation water is scarce. The huge Asad Dam on the Euphrates River, begun in 1968 and finally inaugurated in 1978, has permitted a major expansion in the area of arable land in central Syria, and further dam projects and irrigation schemes, notably on the Yarmuk River, are planned or under way. Syria's industrial sector was traditionally based on the cotton industry, but in recent years phosphate mining and manufacturing have become more important. Since 1974, oil has been Syria's most important source of export revenue. The country is divided into 14 governorates, with Damascus (Dimashq) as the capital.

Summary of Wetland Situation

With its mountainous terrain in the west and arid climate in the east, Syria possesses rather few major natural wetlands other than the Euphrates River itself. Furthermore, most of those wetlands which did exist have been degraded or destroyed by drainage for agriculture and diversion of water supplies for irrigation purposes. There are 180 km of coastline on the Mediterranean, but most of this is rocky with narrow sand beaches. The few offshore islands are small and rocky, the best known being Arwad off Tartus. Numerous permanent streams and rivers flow down from the coastal ranges onto the narrow coastal plain, but virtually all of the former wetlands in this area have been drained for agriculture, except perhaps at Buhayrat al-Laha near the Lebanese border in the south.

Until the late 1960s, there was a large area of small lakes and permanent marshes along the meandering course of the Asi (Orontes) River in the Al-Ghab depression at the eastern foot of the Jabal al-Nusayriyah. The Ministry of Agriculture and Agrarian Reform proposed a part of this area, Ghab Lake, as a site for conservation under Project AQUA (Luther & Rzoska, 1971). However, all of the wetlands in this area were drained between 1954 and 1968 and replaced with irrigated cultivation, livestock farms and fish-farms. Permanent wetlands in this area are now confined to irrigation and drainage channels with small patches of *Phragmites*, although some winter flooding may still occur in places. The Asi River itself is heavily utilized for irrigation purposes, and now almost runs dry in summer.

Further east, there are several shallow basins fed by winter rains which tend to dry out in summer or turn into disconnected salt lakes. The most important of these, Sabkhat al-Jabbul, is a large shallow salt lake near Halab (Aleppo), renowned for its Greater Flamingos *Phoenicopterus ruber*. Recent changes in the hydrology of the lake have resulted in a lowering of the salinity and colonization by aquatic vegetation. Other notable salt lakes include Sabkhat Muh near Tadmur (Palmyra), and a group of small lakes in the Jabal Sis area in the south.

The River Euphrates (Al-Furat) flows for some 420 km through Syrian territory and is joined by two important tributaries, the Balikh and Khabur rivers, which enter it from the northeast. Although large areas of former floodplain wetland have been converted to agricultural land, islands in the river continue to support remnants of the native riverine woodland, while oxbow lakes, quiet backwaters and riverine marshes remain important for migratory waterfowl. In the

extreme northeast of the country, a series of large springs formerly supplied water to a number of small lakes and marshes which eventually drained into the Khabur, Balikh and Jaghjagha rivers. Most of these wetlands have been drained for agriculture or had their water supplies taken for irrigation, but at least one lake, Buhayrat al-Khatuniyah, remains, although now much reduced in size. Vast areas of natural steppe in this region of Syria have now been converted to intensive irrigated cultivation.

The loss of natural wetlands in Syria has to some extent been compensated for by the creation of a number of large water storage reservoirs, some of which have become important for migratory waterfowl. A large section of the Euphrates Valley was dammed and flooded in the 1970s, creating Buhayrat al-Asad (Lake Asad). This huge reservoir, covering over 63,000 ha and much the largest water body in the country, now supports very large numbers of waterfowl in winter. However, with the greatly increased availability of water for irrigation, more and more of the arid eastern region is being brought under cultivation, leading to a dramatic decline in the area of natural steppe and massive consequences for the environment as a whole. Other important man-made lakes include Baath Lake, behind a dam on the Euphrates River downstream from Lake Asad, and Bahrat Homs (Lake Qattine), created by a barrage on the Asi River dating from Roman times. Bahrat Homs is particularly important as a wintering are for the White-headed Duck *Oxyura leucocephala*. Smaller reservoirs, such as Al-Rastan and Maharda on the Asi River and Al-Shahba on the Quin River, may support substantial numbers of waterfowl during the migration seasons and in winter.

A recent inventory of Important Bird Areas in the Middle East, sponsored by BirdLife International, has identified 22 sites as being of special importance for bird conservation in Syria (Evans, 1994). Six of these sites are wetlands and a further ten contain significant tracts of wetland habitat. It was believed that all of the permanent and seasonal wetlands that are most important for waterbirds had been included in the inventory, but it was acknowledged that coverage of coastal habitats was inadequate. Twelve of the wetland areas described in Evans (1994) are included in the present inventory. The others have been excluded either because they are of only local, rather than international, significance, or because they have already been degraded or destroyed.

Wetland Research

Very little research has been carried out on the wetlands of Syria. The Ministry of Agriculture and Agrarian Reform conducted a preliminary survey of Syria's wetlands in the late 1960s for Project AQUA, part of the International Biological Programme (Luther & Rzoska, 1971). Four sites were nominated by the Ministry of Agriculture for conservation under this project. The Department of Zoology at the University of Damascus has undertaken surveys to identify important nature conservation areas, and in particular worked with the UNEP Specially Protected Areas Task Force in a coastal resources survey in 1989 to identify possible marine and coastal protected areas (Jeudy de Grissac, 1989). The International Waterfowl and Wetlands Research Bureau (IWRB) sponsored waterfowl counts at a total of seven wetlands in December 1971 and December 1972 (Dijksen & Koning, 1972; Koning & Dijksen, 1973).

Macfarlane (1978) investigated the birdlife of Bahrat Homs (Lake Qattine) in 1976 and 1977, and Bottema (1985) visited Waz Gol in the northeast in 1982. Biologists from the Faculty of Agriculture at the University of Aleppo have participated in the International Waterfowl Census, organized by IWRB, since 1993, and carried out mid-winter waterfowl counts at nine wetlands in January 1993 and January 1994.

Wetland Area Legislation

Current nature conservation legislation, which concerns forest protection, protection of aquatic life, hunting and general care of the environment, has been summarized by IUCN (1992). The Law on the Protection of Aquatic Life (Legislative Decree No.30 of August 1964) includes articles which cover the protection of public waters and the regulation of fishing in sea water extending 12 miles from the coast. The Law on Hunting (Legislative Decree No.152 of July 1970) contains various acts including designation of the Hunting Council and areas where hunting is restricted. In Legislative Decree No.50 of April 1979, all hunting was banned for a period of five years as a measure to preserve wildlife (IUCN, 1992). The Ministry of State for Environmental Affairs is currently drafting a nature conservation law (Evans, 1994).

At international level, Syria is a contracting party to the World Heritage Convention, but has not as yet designated any natural World Heritage Sites. It has also ratified the Convention for the Protection of the Mediterranean Sea against Pollution (the Barcelona Convention), and has adopted the Protocol Concerning Mediterranean Specially Protected Areas. Designation of seven Mediterranean Specially Protected Areas in accordance with this Protocol is currently under consideration by the Government. Syria participates in the UNESCO Man and the Biosphere Programme and has created a National Committee, but has not as yet established any Biosphere Reserves. It is not, however, a party to either the Ramsar Convention or the Bonn Convention, nor has it signed the Biodiversity Convention.

Wetland Area Administration

The main governmental body concerned with the environment is the Ministry of Agriculture and Agrarian Reform, established in 1967. The Ministry is responsible for agriculture, water pollution, hunting, fishing and management of protected areas. The Fisheries Office within this ministry is concerned with inland waters and marine matters (IUCN, 1992). There is a system of protected forests and rangelands which includes Enclosed Rangeland Reserves administered by the Directorate of Rangeland and Countryside in the Ministry of Agriculture and Agrarian Reform, and State Forest Protection Zones, administered by the Directorate of Forests and Afforestation in the same ministry, but only a few of these have been established to date, and none includes any significant wetlands.

The Ministry of State for Environmental Affairs in the Prime Ministry is primarily concerned with the impact of air, water, chemical and noise pollution, although it has interests in fauna, forest vegetation, coastal areas, deserts, proposed wildlife areas, botanical gardens and zoos. It

undertakes research on the future establishment of protected areas, preservation of individual species and environmental legislation. The Ministry of Public Works and Water Resources has interests in water conservation and the construction of dams, and has responsibility for the control of water pollution and in the drafting of legislation for the control of water pollution. The Ministry of Local Administration implements projects including the drainage and reclamation of swamps and pools. There is also a Ministry of the Euphrates Dam with its own special funds (IUCN, 1992).

Organizations involved with Wetlands

Ministry of Agriculture and Agrarian Reform
    Fisheries Office, Directorate of Forests and Afforestation, and Directorate of Rangeland and Countryside
Ministry of State for Environmental Affairs
    General Commission for Environmental Affairs
Ministry of Public Works and Water Resources
Ministry of Local Administration
Ministry of the Euphrates Dam
Ministry of Higher Education
    Directorate of Scientific Research
Faculty of Sciences, University of Damascus
    Department of Botany and Department of Zoology
Faculty of Agriculture and Forestry, University of Aleppo
    Department of Animal Production
Syrian Biologists' Society
    A non-governmental organization based at the University of Damascus.

WETLANDS

Site descriptions compiled from the literature, principally Evans (1994), and material submitted for the International Waterfowl Census by Dr Ibrahim Hanna and colleagues at the Faculty of Agriculture, University of Aleppo.

Wadi al-Radd (1)

Location: 36°35'N, 41°30'E; near the Iraqi border, 60 km south-southeast of Al-Qamishli, Al-Hasakah Governorate.
Area: Area of wetlands unknown; entire region 48,000 ha.
Altitude: c.400 m.
Overview: A steppic basin subject to winter flooding in the extreme northeast of Syria, now

largely converted to agricultural land; formerly (and perhaps still) of importance as a staging and wintering area for migratory waterfowl.
Physical and ecological features: A steppic basin, some 60 km long by 10 km wide, in the Jazirah region of northeastern Syria, formerly subject to extensive winter flooding. Numerous small seasonal streams descending from Jabal Sinjar in Iraq and from the Turkish mountains to the north caused flooding in winter and spring, the extent depending on the season's rain and snowfall. The basin drains west into a tributary of the Khabur River which eventually joins the Euphrates. By December 1971, the entire basin had been converted into intensive cultivation (wheat and cotton), and there was no standing water apparent in that year. No information is available on the present status of this area, but it is thought that parts of the original area are still liable to winter flooding in years of good rainfall, and are then likely to be important for passage and wintering waterfowl.
Land tenure: No information.
Conservation measures taken: None. The site has been identified as an Important Bird Area by BirdLife International (Evans, 1994).
Conservation measures proposed: None known.
Land use: Most of the area is under cultivation for wheat and cotton.
Possible changes in land use: Any surviving natural wetland is likely to be drained and converted into agricultural land.
Disturbances and threats: Wetland drainage and the large-scale conversion of steppe into agricultural land have destroyed most of the natural vegetation. Hunting is apparently widespread and uncontrolled.
Hydrological and biophysical values: No information.
Social and cultural values: No information.
Noteworthy fauna: The basin is known to have attracted large numbers of ducks during the migration seasons, and may have been an important wintering area for waterfowl (Savage 1968). However, Dijksen and Koning (1972) found little wetland remaining in December 1971 and only small numbers of ducks *Anas* spp. Greater Flamingos *Phoenicopterus ruber* have been recorded in the basin in the last few years, indicating that relatively deep and prolonged flooding may still occur. No other information is available on the fauna.
Noteworthy flora: No information.
Scientific research and facilities: Mid-winter waterfowl counts were undertaken by an IWRB mission in December 1971 (Dijksen & Koning, 1972).
Management authority and jurisdiction: No information.
References: Dijksen & Koning (1972); Evans (1994); Savage (1968).
Reasons for inclusion: 3b. Possibly still an important staging and wintering area for migratory waterfowl, but poorly known.
Source: See references.

Buhayrat al-Khatuniyah (2)

Location: 36°24'N, 41°14'E; 6 km from the Iraqi border, 45 km east-southeast of Al-Hasakah,

Al-Hasakah Governorate.
Area: 800 ha (formerly 1,200 ha).
Altitude: 452 m.
Overview: A small freshwater lake in a region of semi-desertic steppe, now much reduced in size and surrounded by cultivation, but probably still important for migratory waterfowl.
Physical and ecological features: Buhayrat al-Khatuniyah (also known as Khatounia Lake, Bahrat Hatuniya or Buhayrat al-Hul) is a natural, mesotrophic, spring-fed lake of about 800 ha, surrounded by "clay" desert between the small settlements of Khatuniyah and Al-Hul. Luther and Rzoska (1971) give the area of the lake as 1,200 ha and the mean depth as 8 m; it drains west into a tributary of the Khabur River which eventually joins the Euphrates. The lake is apparently now much reduced in size, and has been partly converted into fish-ponds. The vegetation includes *Tamarix articulata*, *Poa bulbosa* and *Aleuropus littoralis*.
Land tenure: State owned.
Conservation measures taken: None. The lake has been included in a much larger site (80,000 ha) identified as an Important Bird Area by BirdLife International (Evans, 1994).
Conservation measures proposed: Khatounia Lake was proposed as a site for conservation under Project AQUA by the Ministry of Agriculture and Agrarian Reform in the late 1960s (Luther & Rzoska, 1971).
Land use: The lake is used for fishing, hunting and recreation. Shoreline vegetation is grazed by domestic livestock, and surrounding areas are under cultivation.
Possible changes in land use: No information.
Disturbances and threats: Parts of the lake have been converted into fish-ponds, and very large areas of the surrounding steppe have been converted into agricultural land. Waterfowl hunting is widespread and uncontrolled. Over-fishing is also reported to be a problem in the lake, and the surrounding area is heavily grazed by feral donkeys. *Tilapia* fish have been introduced into the lake.
Hydrological and biophysical values: No information.
Social and cultural values: No information.
Noteworthy fauna: Small numbers of geese and ducks are present in winter, *e.g.* 200 *Anser anser* and 200 *Anas* sp. were recorded in January 1994. The Houbara Bustard *Chlamydotis undulata* is reported to be a resident in the surrounding semi-desert, and Pin-tailed Sandgrouse *Pterocles alchata* is common. Mammals said to occur in the area include Wolf *Canis lupus*, Red Fox *Vulpes vulpes*, Badger *Meles meles canescens*, Hyaena *Hyaena hyaena*, Wild Cat *Felis sylvestris tristrami*, Wild Boar *Sus scrofa*, Goitred Gazelle *Gazella subgutturosa*, Cape Hare *Lepus capensis syriacus* and Crested Porcupine *Hystrix indica*.
Noteworthy flora: No information.
Scientific research and facilities: Mid-winter waterfowl counts were undertaken by biologists from the Faculty of Agriculture, University of Aleppo, in January 1993 and January 1994.
Management authority and jurisdiction: No information.
References: Evans (1994); Luther & Rzoska (1971).
Reasons for inclusion: 1a & 3b. One of the few remaining natural freshwater lakes in eastern Syria.
Source: See references.

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Tual al-'Abba (3)

Location: 36°25'N, 39°20'E; 70-100 km north-northeast of Al-Raqqah, Al-Raqqah Governorate.
Area: Area of wetlands unknown; entire region c.30,000 ha.
Altitude: 300 m.
Overview: Various small permanent and seasonal lakes and marshes in a large area of steppe in the Balikh Valley, now much modified by agricultural activities but perhaps still important as a staging and wintering area for migratory waterfowl.
Physical and ecological features: The site comprises a large area of steppe with scattered permanent and seasonal lakes and marshes, to the east and southeast of Skiro village and bounded in the west by the Balikh Valley. Up until the early 1980s, there was a small, shallow, freshwater lake, Waz Gol (36°31'N 39°01'E; 25 ha) and some 25 ha of permanent marsh in the Balikh Valley. The main source of water for the lake was the spring of Ain al-Arus; the marshes to the north of the lake were fed directly by branches of the Balikh River. However, in the autumn of 1984, the lake was completely dry, and by 1992, the lake, marshes, spring and river itself were all dry because of diversion of water for irrigation on the Anatolian Plateau in Turkey and pumping of groundwater for irrigation in Syria. Other wetlands in this area in the 1960s and 1970s included a complex of seasonally inundated fresh and saline marshes at Ali Bajiliyah in the Balikh Valley 100 km north of Al-Raqqah, extensive reed-beds and some areas of open water at Skiro, and Al-Sharkrak pond (c.1 ha) about 10 km north of Skiro. No information is available on the present status of these wetlands or any others in the area, and their continued existence is in doubt. The vegetation at Waz Gol, and probably at wetlands elsewhere in the valley, consisted of *Salix* trees and stands of *Phragmites*, *Lythrum*, *Carex* and *Luzula*.
Land tenure: No information.
Conservation measures taken: None. The site has been identified as an Important Bird Area by BirdLife International (Evans, 1994).
Conservation measures proposed: None known.
Land use: The majority of the steppe is under cultivation for cereals and cotton or very heavily grazed by domestic livestock. Waterfowl hunting is widespread and uncontrolled.
Possible changes in land use: Continued drainage of wetlands and conversion to agricultural land.
Disturbances and threats: The drainage of wetlands in the Balikh valley and the conversion of steppe to rain-fed and irrigated farmland, with associated intensification of agriculture, use of agrochemicals and increased levels of human disturbance, are critical problems. Hunting pressure on waterfowl and gamebirds, including the Great Bustard *Otis tarda*, is apparently very heavy and uncontrolled. *Phragmites* reed-beds are burned to encourage re-growth for cattle grazing.
Hydrological and biophysical values: No information.
Social and cultural values: According to biblical legend, Ain al-Arus was the spring at which Jacob met Rachel.
Noteworthy fauna: An important staging and wintering area for a wide diversity of waterfowl

(including *Anser albifrons* and *Grus grus*) until at least the early 1980s. Ducks were reported to occur at Ali Bajiliyah in summer, and large numbers were said to be present in winter (Savage, 1968). Over 1,380 waterfowl of 19 species were recorded in this area during a brief survey in December 1971, including one *Pelecanus* sp., 21 *Podiceps cristatus*, 89 *Anas penelope*, 275 *A. crecca*, 280 *A. platyrhynchos*, 532 *Aythya ferina*, 90 *Fulica atra* and small numbers of a variety of shorebirds (Dijksen & Koning, 1972). Passage migrants at Waz Gol in October 1982 included up to 200 *Tachybaptus ruficollis*, one *Phalacrocorax pygmaeus*, 20 *Ardea cinerea*, 30 *Anser anser*, 100 *Anas crecca*, 20 *Marmaronetta angustirostris*, 5 *Netta rufina*, 300 *Aythya ferina*, 20 *A. nyroca*, one *Oxyura leucocephala*, 400 *Fulica atra*, one *Vanellus gregarius* and four *V. leucurus* (Bottema, 1985). Known and probable breeding species in the Balikh Valley in the 1970s included *Marmaronetta angustirostris, Gallinula chloropus, Himantopus himantopus, Glareola pratincola* and *Sterna albifrons*. The Great Bustard *Otis tarda* was probably a regular winter visitor to the area in the 1970s (maximum 16 in March 1976), and may have bred in the past. No recent information is available on the avifauna, and it is not known if waterfowl continue to visit the area in significant numbers.

The terrapin *Clemmys caspia* was reported to be very common at Waz Gol in the early 1980s.

Noteworthy flora: No information.

Scientific research and facilities: Mid-winter waterfowl counts were undertaken by an IWRB mission in December 1971 (Dijksen & Koning, 1972). Macfarlane (1978) visited the Skiro and Al-Sharkrak areas on several occasions in the 1970s, and Bottema (1985) surveyed the Waz Gol area in the early 1980s.

Management authority and jurisdiction: No information.

References: Bottema (1985); Dijksen & Koning (1972); Evans (1994); Macfarlane (1978); Savage (1968).

Reasons for inclusion: 3b. Possibly still an important staging and wintering area for migratory waterfowl, but poorly known.

Source: See references.

Euphrates River (4)

Location: From 36°49'N, 38°02'E at the Turkish border to 34°29'N, 40°56'E at the Iraqi border, Halab, Al-Raqqah and Dayr al-Zawr Governorates.

Area: Unknown; c.420 km of river.

Altitude: From c.520 m at the Turkish border to c.185 m at the Iraqi border.

Overview: The Euphrates River and associated wetlands from the Turkish border in the northwest to the Iraqi border in the southeast, including oxbow lakes, riverine marshes, wooded islands, gravel pits *etc.*; now much modified by agricultural development and with greatly reduced seasonal flooding as a result of dam-building upstream in Turkey, but still of great importance as a staging and wintering area for migratory waterfowl.

Physical and ecological features: The site comprises the River Euphrates (Al-Furat) and associated wetlands from its entry from Turkey to its exit into Iraq, except for the two reservoirs, Buhayrat al-Asad and Baath Lake, which are described separately as Sites 5 and 6,

respectively. For almost its entire length, the river flows in a valley varying in width from 2 to 12 km, and with the valley floor some 80-250 m below the surrounding plains. In many places, the river divides into two or more channels, creating numerous islands, many of which support dense thickets. There are also numerous meanders, oxbow lakes, gravel pits and silted old water courses covered in reed-beds. Much of the river bank consists of low alluvial cliffs. The water level was formerly some 3-4 m higher in spring than in autumn, due to snow-melt in the Turkish uplands, but with the completion during the last decade of several large dams in Turkey, this annual flood is now greatly reduced. The natural vegetation includes riverine thickets of *Populus euphratica*, *Tamarix articulata*, *Salix* sp., *Glyzyriza glabra* and *Lycium barbarum*, and reed-beds of *Phragmites* sp. and *Typha* sp. The river banks are intensively cultivated; there are vast areas of irrigated cotton and cereals, as well as orchards and plantations of *Populus* and *Pinus halepensis*. The heavily cultivated steppe of the Jazirah region lies to the east and the Syrian Desert to the southwest.

Three areas which appear to be of special importance for waterfowl are as follows: (1) Halabiyat Zulbiyat (35°37'N, 39°50'E; 50 ha), an area of marsh and fish-ponds on the right bank of the river about 40 km northwest of Dayr al-Zawr; (2) Al-Shumaytiyah (35°28'N 39°59'E; 10-50 ha), an oxbow lake about 20 km northwest of Dayr al-Zawr, sandwiched between the Al-Raqqah to Dayr al-Zawr road and a 50 m cliff; and (3) Huwaijat al-Mayadin (35°00'N 39°28'E; 100-300 ha), a low-lying island in the middle of the Euphrates with *Populus*, *Tamarix* and *Salix* thickets and seasonally inundated marshes, near the town of Mayadin, 45 km southeast of Dayr al-Zawr.

Land tenure: Partly state owned and party private.

Conservation measures taken: None. The Euphrates River valley was listed as a wetland of international importance by Carp (1980), and has been identified as an Important Bird Area by BirdLife International (Evans, 1994).

Conservation measures proposed: None known.

Land use: Gravel extraction occurs locally along the river. There is a considerable amount of fishing and waterfowl hunting, and the riverine woodland is exploited for firewood.

Possible changes in land use: The size of the annual flood and dry-season flow in the Euphrates will be further reduced when all of the dam-building schemes and associated irrigation projects planned along the river, both in Syria and upstream in Turkey, have been completed and are fully operational.

Disturbances and threats: The river flow has been greatly reduced in recent years as new dams constructed upstream in Turkey continue to fill. Threats at Halabiyat Zulbiyat, Al-Shumaytiyah and Mayadin include the continuing conversion of floodplain wetlands into agricultural land, overgrazing of marsh vegetation, and high levels of human disturbance. The riverine woodland is heavily exploited for firewood, despite the law forbidding this, and waterfowl hunting is widespread and uncontrolled.

Hydrological and biophysical values: No information.

Social and cultural values: There are interesting archaeological sites at a number of locations along the river, *e.g.* at Halabiyat Zulbiyat.

Noteworthy fauna: The Euphrates Valley is a major migration route for waterbirds, providing a narrow wetland corridor between the important wetlands of southern and central Turkey and the vast wetlands of Mesopotamia in Iraq. A wide variety of species has been recorded during the migration seasons and in winter, and several species are known or thought to breed. Some

3,400 waterfowl were observed on three small oxbows east of Al-Raqqah in December 1972, including 105 *Tachybaptus ruficollis*, 1,380 *Aythya ferina* and 1,750 *Fulica atra* (Koning & Dijksen, 1973). In recent years, large numbers of waterfowl have been found wintering at Halabiyat Zulbiyat (18,470 in 1993, 16,090 in 1994), Al-Shumaytiyah oxbow lake (4,980 in 1993, 3,500 in 1994) and Mayadin Pool (3,080 in 1993, 2,375 in 1994). The most abundant species were *Podiceps cristatus*, *P. nigricollis*, *Tachybaptus ruficollis*, *Anser albifrons* (up to 400 at Mayadin), *A. anser* (up to 650), dabbling ducks *Anas* spp., *Fulica atra* and gulls *Larus* spp. Smaller numbers of *Pelecanus crispus* (up to 60 at Halabiyat Zulbiyat), *Ciconia ciconia*, *C. nigra*, *Phoenicopterus ruber* and *Tadorna tadorna* were also present. The wetlands also support good numbers of wintering birds of prey such as *Circus aeruginosus, C. cyaneus, C. macrourus* and *Asio flammeus*.

Common passage migrants include *Ciconia ciconia*, *Himantopus himantopus*, *Glareola pratincola*, *Tringa stagnatilis*, *T. hypoleucos*, *Philomachus pugnax*, *Sterna hirundo* and *Chlidonias hybridus*. There are also indications that the valley is a very important migration route for many other species of birds such as the Turtle Dove *Streptopelia turtur*, which is said to gather in hundreds of thousands on islands in the river in spring and autumn.

Common breeding birds include *Tachybaptus ruficollis*, *Francolinus francolinus*, *Gallinula chloropus*, *Fulica atra*, *Charadrius dubius*, *Vanellus spinosus*, *V. leucurus*, *Chlidonias hybridus*, *Sterna albifrons*, *Ceryle rudis*, *Merops superciliosus* and *Riparia riparia*. *Phalacrocorax pygmaeus* was reported to be common and possibly breeding around Dayr al-Zawr in the 1980s, and has been noted in small numbers elsewhere along the river. *Marmaronetta angustirostris* is probably a widespread breeding species in the valley, although there are very few records (*e.g.* one was observed on two dates in June 1975 at Shumaytiyah). The Pin-tailed Sandgrouse *Pterocles alchata* is common on the adjacent plains, and visits the river in large numbers to drink.

Mammals known to have occurred in the area include Wolf *Canis lupus*, Red Fox *Vulpes vulpes arabica*, Badger *Meles meles canescens*, Common Otter *Lutra lutra*, Hyaena *Hyaena hyaena syriaca*, Wild Cat *Felis sylvestris tristrami*, Jungle Cat *F. chaus*, Wild Boar *Sus scrofa lybicus*, Goitred Gazelle *Gazella subgutturosa*, Cape Hare *Lepus capensis syriacus* and Crested Porcupine *Hystrix indica*.

Noteworthy flora: No information.

Scientific research and facilities: Mid-winter waterfowl counts were undertaken by IWRB missions in December 1971 and December 1972 (Dijksen & Koning, 1972; Koning & Dijksen, 1973), and by biologists from the Faculty of Agriculture, University of Aleppo, in January 1993 and January 1994.

Management authority and jurisdiction: No information.

References: Carp (1980); Dijksen & Koning (1972); Evans (1994); Koning & Dijksen (1973); Luther & Rzoska (1971); Macfarlane (1978); Scott (1993).

Reasons for inclusion: 1c, 2a, 2b, 3a & 3c. One of the major rivers of the Middle East; a vitally important internationally-shared water resource and a major migration route for migratory waterbirds. The wetlands provide breeding and/or wintering habitat for at least three globally threatened species, and support large numbers of wintering waterfowl of a wide variety of species.

Source: See references.

Buhayrat al-Asad (5)

Location: 35°47'-36°20'N; 38°02'-38°34'E; 40 km west of Al-Raqqah, Al-Raqqah and Halab Governorates. Approximate centre: 35°55'N, 38°20'E.
Area: 63,000 ha.
Altitude: 308 m.
Overview: A huge water storage reservoir on the Euphrates River, completed in the 1970s and now of considerable importance as a staging and wintering area for migratory waterfowl.
Physical and ecological features: Buhayrat al-Asad (Lake Asad) is a huge reservoir of about 63,000 ha created by a dam on the River Euphrates (Al-Furat) near the town of Al-Thawra. The reservoir extends for about 80 km up the valley, and averages 8 km in width. Work began on the dam in 1968, and construction was completed in the early 1970s. The shores are mainly steep and rocky, and the water is very clear and without sediment. A large island, Jazirat al-'Ayd (also known as Jazirat al-Thawra) is linked to the mainland by a causeway with a gate. Much of the land around the reservoir is dry, stony, and almost devoid of vegetation. However, the Ministry of Agriculture and Agrarian Reform has recently afforested large areas on the southern shore of the lake, on the island of al-'Ayd and around Al-Thawra with *Pinus halepensis*, *Robinia pseudoacacia*, *Populus euphratica*, *Olea* sp., *Cupressus* sp., *Eucalyptus* sp., *Nerium oleander* and *Amygdalus* sp.
Land tenure: State owned.
Conservation measures taken: Jazirat al-'Ayd is protected by the Government; unauthorized entry of vehicles or people is not allowed, and there is a guard at the gate. Management of the island is geared primarily towards public recreation; the island is being established as a nature park with a tourist centre and a network of vehicle tracks. Hyaenas *Hyaena hyaena* have been introduced, and there are plans to introduce Goitred Gazelles *Gazella subgutturosa*. The reservoir has been identified as an Important Bird Area by BirdLife International (Evans, 1994).
Conservation measures proposed: None known.
Land use: The dam is used for hydro-electric power generation, and there is some fishing and outdoor recreation. Sugar-cane and cereals are cultivated in the southeast. Hunting is common in the surrounding area.
Possible changes in land use: None known.
Disturbances and threats: Some hunters enter the area illegally, and hunting pressure is heavy in the surrounding area. Over-fishing may also be a problem.
Hydrological and biophysical values: No information.
Social and cultural values: There is an important historical site, Jabbar Castle, on the east side of the lake near the dam.
Noteworthy fauna: Since its completion in the 1970s, the reservoir has become a very important staging and wintering area for migratory waterfowl, and also supports some breeding birds. Areas found to be of particular importance for waterfowl in the 1970s included the west bank of the reservoir at the northern end, 30 km southeast of Manbij, and the southeast corner 8 km southwest of the dam. Huge numbers of waterfowl winter in the area, with many birds flighting out to feed on the surrounding steppe and roosting at the lake. Some 1,200 *Anser*

albifrons were observed in the area in January 1975. Counts in recent years have included up to 150 *Podiceps cristatus*, 100 *P. nigricollis*, 140 *Phalacrocorax carbo*, 40 *Pelecanus crispus*, 100 *Egretta garzetta*, 100 *Casmerodius albus*, 225 *Ardea cinerea*, 30 *Platalea leucorodia*, 300 *Anser albifrons*, 150 *A. anser*, 50 *Tadorna tadorna*, 300 *Anas penelope*, 2,000 *A. platyrhynchos*, 700 *A. clypeata*, 800 *Aythya ferina*, 150 *A. fuligula*, 10,000 *Fulica atra*, 20 *Larus ichthyaetus*, 2,000-3,000 *L. cachinnans* and 3,000 small gulls *Larus* spp. Other species which have been recorded in substantial numbers on passage include *Ardea purpurea*, *Ciconia ciconia*, *Anas querquedula*, *Grus grus*, *Recurvirostra avosetta*, *Calidris minuta*, *Tringa erythropus*, *T. nebularia*, *Philomachus pugnax* and *Gelochelidon nilotica*; scarce passage migrants have included *Phalacrocorax pygmaeus* (one in April 1993), *Pandion haliaetus* (singles in March and September 1976) and *Vanellus gregarius* (40 in September 1974). Breeding birds include *Tachybaptus ruficollis*, *Larus genei* (on the island of Tell al-Abyad near the dam), *Sterna hirundo*, *S. albifrons* and *Ceryle rudis*. *Larus melanocephalus* has been recorded in summer (20 adults in June 1975), and may breed.
Mammals said to occur in the area include Wolf *Canis lupus*, Red Fox *Vulpes vulpes arabica*, Badger *Meles meles canescens*, Hyaena *Hyaena hyaena syriaca* and Wild Cat *Felis sylvestris tristrami*.
Noteworthy flora: No information.
Scientific research and facilities: Mid-winter waterfowl counts were undertaken by biologists from the Faculty of Agriculture, University of Aleppo, in January 1993 and January 1994.
Management authority and jurisdiction: No information.
References: Evans (1994); Scott (1993).
Reasons for inclusion: 2a & 3a. An extremely important staging and wintering area for migratory waterfowl including at least one globally threatened species (*Pelecanus crispus*).
Source: See references.

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Baath Lake (6)

Location: 35°52'N, 38°38'E; about 30 km west of Al-Raqqah, Al-Raqqah Governorate.
Area: c.100 ha.
Altitude: c.250 m.
Overview: A small water storage reservoir on the Euphrates River, of importance as a staging and wintering area for migratory waterfowl.
Physical and ecological features: A shallow lake, about 10 km long, formed by a dam on the Euphrates (Al-Furat) at Mansurah, 10 km downstream from the main dam of Buhayrat al-Asad at Al-Thawra. The upper reaches of the lake are shallow with a number of islands fringed by *Phragmites* reed-beds.
Land tenure: State owned.
Conservation measures taken: Hunting is prohibited around the reservoir. The site has been identified as an Important Bird Area by BirdLife International (Evans, 1994).
Conservation measures proposed: None known.
Land use: The reservoir is used as a source of water for irrigation.

Possible changes in land use: No information.
Disturbances and threats: No information.
Hydrological and biophysical values: No information.
Social and cultural values: No information.
Noteworthy fauna: The lake is reported to be an important roosting and loafing area for waterfowl during the migration seasons and in winter, especially ducks (Anatidae). Waterbirds present in November 1992 included 100 *Ardea cinerea*, 800-1,000 *Anser anser*, 900 *Anas penelope*, 700 *A. strepera*, 200 *A. crecca*, 100 *A. clypeata*, 5,000 *Fulica atra*, 30 *Tringa nebularia*, 1,000-2,000 *Larus* sp., 40 *Alcedo atthis* and 40 *Ceryle rudis*. Mammals said to occur in the area include Wolf *Canis lupus*, Red Fox *Vulpes vulpes arabica* and Hyaena *Hyaena hyaena*.
Noteworthy flora: No information.
Scientific research and facilities: An ornithological survey was carried out in November 1992. No other information seems to be available on the fauna.
Management authority and jurisdiction: No information.
References: Evans (1994).
Reasons for inclusion: 3b. An important staging and wintering area for migratory waterfowl.
Source: See references.

Sabkhat al-Jabbul (7)

Location: 36°04'N, 37°30'E; 30 km east-southeast of Halab (Aleppo), Halab Governorate.
Area: 37,500 ha; maximum extent of flooding in recent years c.10,000 ha.
Altitude: 307 m.
Overview: A large, permanent saline lake in semi-arid steppe, recently increased in size by the inflow of surplus irrigation water and apparently now developing emergent aquatic vegetation; important for salt production and as a staging and wintering area for migratory waterfowl, notably *Phoenicopterus ruber*.
Physical and ecological features: Sabkhat al-Jabbul (Jabbul Salt Lake) is a large, shallow salt lake in an enclosed basin of about 37,500 ha, immediately to the south of Jabbul village. In the 1970s, the lake was fed entirely by local run-off in winter and spring, and its extent was highly variable from year to year. In wet years, the maximum area of open water was about 3,000 ha, and the lake apparently seldom dried out completely. A levee on the east side of the lake prevented flooding of the extensive salt flats in the eastern part of the basin. However in 1988, large new irrigation projects on the nearby steppic plains began discharging surplus water into the lake on a substantial scale. This appears to have resulted in higher and more stable water levels and lower salinities than in the past. The lake currently measures up to 20 km in length and 5 km in width, and at high water levels contains two large islands. In the 1970s, the muddy and sandy shores of the lake supported little or no marginal vegetation, but there are now extensive *Phragmites* reed-beds along parts of the southern and south-eastern shores and perhaps elsewhere. The surrounding steppe is dominated by species such as *Aleuropus littoralis*, *A. lagopoides*, *Atriplex leucoclada*, *A. halimus*, *Anabasis setifera*, *Calligonum*

comosum, *Salsola vermiculata*, *Stipa barbata* and *Popaver rhoeas*, with scattered *Haloxylon* and *Artemisia* shrubs.

Land tenure: State owned.

Conservation measures taken: None. Sabkhat al-Jabbul was listed as a wetland of international importance by Carp (1980), and has been identified as an Important Bird Area by BirdLife International (Evans, 1994).

Conservation measures proposed: None known.

Land use: The lake is used for salt production on a large scale. Nomadic pastoralists graze their livestock, mainly sheep and goats, on the surrounding steppes, and there is a considerable amount of hunting in the area. In the 1970s, the bare salt flats to the east of the lake were used as an artillery firing range.

Possible changes in land use: No information.

Disturbances and threats: The long-term impact of the changes to the lake's hydrology on its value for waterfowl and other wildlife is unclear. Waterfowl shooting is intense throughout the winter, and bag limits and hunting seasons are not enforced; however the large size and openness of the lake give some natural protection.

Hydrological and biophysical values: No information.

Social and cultural values: No information.

Noteworthy fauna: Sabkhat al-Jabbul is an important staging and wintering area for migratory waterfowl, and also supports some breeding waterbirds. Large numbers of wintering waterfowl were recorded in the 1970s, with "tens of thousands" present in some years, but the numbers of waterfowl varied widely according to water level. In recent years, the lake appears to have been supporting even larger numbers of waterfowl, presumably because of the higher and more stable water level. The lake is particularly important for Greater Flamingos *Phoenicopterus ruber*; between 500 and 1,000 are regularly present at most times of the year, and some 6,000-8,000 were recorded in January 1975. Other wintering species include *Casmerodius albus* (15), *Platalea leucorodia* (50), *Ciconia ciconia* (30), *C. nigra*, *Cygnus olor*, *Anser albifrons* (2,030 in December 1972), *A. anser* (600), *Tadorna ferruginea* (300), *T. tadorna* (500), *Anas crecca* (thousands), *A. platyrhynchos* (600), *A. acuta* (1,000), *Fulica atra* (10,000), *Grus grus* (155 in December 1972), *Eudromias morinellus* (72), *Vanellus vanellus* (380); *Calidris minuta* (many hundreds) and *Ceryle rudis* (200). *Branta ruficollis* has been recorded by hunters, and is presumably a rare winter visitor to the area. Waterfowl recorded on spring migration (in April) have included up to 100 *Podiceps nigricollis*, 70 *Platalea leucorodia*, 400 *Tadorna ferruginea*, 200 *Himantopus himantopus*, 3,000 *Calidris minuta*, thousands of *Philomachus pugnax* and 100 *Larus genei*. *Marmaronetta angustirostris* and *Oxyura leucocephala* have occurred on passage in April, although only in very small numbers.

Confirmed or probable breeding species include *Himantopus himantopus*, *Recurvirostra avosetta*, *Cursorius cursor*, *Charadrius alexandrinus*, *C. leschenaultii columbinus*, *Gelochelidon nilotica*, *Sterna caspia* and *S. albifrons*. According to local people *Phoenicopterus ruber* sometimes breeds; at least 700 were present in April 1993. *Glareola nordmanni* was formerly a summer visitor to the area, but has not been recorded in recent decades.

Mammals said to occur in the area include Wolf *Canis lupus*, Red Fox *Vulpes vulpes arabica*, Hyaena *Hyaena hyaena syriaca*, Goitred Gazelle *Gazella subgutturosa*, Cape Hare *Lepus capensis syriacus*, Crested Porcupine *Hystrix indica* and Lesser Mole Rat *Spalax leucodon*.

Noteworthy flora: No information.
Scientific research and facilities: Mid-winter waterfowl counts were undertaken by IWRB missions in December 1971 and December 1972 (Dijksen & Koning, 1972; Koning & Dijksen, 1973) and by biologists from the Faculty of Agriculture, University of Aleppo, in January 1993 and January 1994.
Management authority and jurisdiction: No information.
References: Bodenham (1944); Carp (1980); Clarke (1924); Evans (1994); Hollom (1959); Savage (1968); Scott (1993).
Reasons for inclusion: 1a, 3a & 3c. The largest permanent salt lake in Syria and an extremely important staging and wintering area for migratory waterfowl, occasionally holding over 1% of the regional population of Greater Flamingos *Phoenicopterus ruber*.
Source: See references.

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Sabkhat Muh (8)

Location: 34°28'N, 38°20'E; several km south and southeast of Tadmur (Palmyra), Hims Governorate.
Area: c.20,000 ha.
Altitude: 403 m.
Overview: A seasonally flooded saline lake in the Syrian Desert, of some importance for migratory waterfowl and a possible breeding area for *Charadrius leschenaultii columbinus*, but poorly known.
Physical and ecological features: Sabkhat Muh is a seasonally flooded salt-lake, up to 25 km long and 10 km wide, in an enclosed drainage basin surrounded by limestone and marl hills. There are some scattered *Tamarix* bushes around the margins of the lake. The surrounding desertic steppe is sparsely vegetated with perennial tussock-grass, Chenopodiaceae and *Artemisia* sp., and there is an isolated oasis to the north of the lake with extensive date-palm gardens.
Land tenure: No information.
Conservation measures taken: None. Sabkhat Muh is part of a larger site (45,000 ha) identified as an Important Bird Area by BirdLife International (Evans, 1994).
Conservation measures proposed: None known.
Land use: The main land use in the surrounding area is livestock grazing.
Possible changes in land use: No information.
Disturbances and threats: The lake is relatively remote and probably under little threat. However, the surrounding desertic steppe is increasingly coming under pressure from grazing by domestic livestock, as the use of water bowsers becomes more widespread.
Hydrological and biophysical values: No information.
Social and cultural values: Tadmur (Palmyra), to the north of the lake, is famous for its Roman ruins.
Noteworthy fauna: Little information is available. Waterfowl recorded at the salt lake in autumn and winter have included *Phoenicopterus ruber* (90 in November 1974) and *Grus grus*.

Eudromias morinellus appears to be a common winter visitor to the surrounding plains; flocks totalling 200 have been observed in the area in November. The scarce and local Southwest Asian subspecies of Greater Sand Plover *Charadrius leschenaultii columbinus* has been observed displaying in spring, and probably breeds in the area. The oasis to the north of the lake provides the only substantial shelter for migrating birds for 150 km to the north and west and for much further to the south and east. It appears to be especially important for migrating raptors such as *Pernis apivorus, Buteo buteo, Milvus migrans, Circus macrourus* and *C. pygargus*. The Houbara Bustard *Chlamydotis undulata* apparently breeds in the surrounding desert, along with a characteristic assemblage of desert species.
Mammals reported to occur in the area include Wolf *Canis lupus*, Caracal *Lynx caracal* and Goitred Gazelle *Gazella subgutturosa*.
Noteworthy flora: No information.
Scientific research and facilities: None known, other than preliminary ornithological surveys.
Recreation and tourism: The ruins at Tadmur are much visited by tourists.
Management authority and jurisdiction: No information.
References: Evans (1994); Macfarlane (1978).
Reasons for inclusion: 1a & 3b. A good example of a natural salt lake of importance for migratory waterfowl.
Source: See references.

Bahrat Homs (Lake Qattine) (9)

Location: 34°38'N, 36°35'E; 12 km southwest of Hims (Homs), Hims Governorate.
Area: 5,300 ha.
Altitude: 500 m.
Overview: A very old water storage reservoir on the Asi (Orontes) River, of considerable importance as a staging and wintering area for migratory waterfowl, notably *Marmaronetta angustirostris* and *Oxyura leucocephala*, both of which may breed.
Physical and ecological features: A semi-artificial, eutrophic reservoir (also known as Lake Qattine) just west of Qattine town, formed by impoundment of the Asi River, the original dam dating back to Roman times. The lake is about 12 km long and up to 4 km wide. The shores of the northeastern half are steep, while those along the southwestern half are very flat. In summer, the lake shrinks to about 3,000 ha, exposing large areas of mudflat in the southwest; in winter, the seasonal rainfall and snow-melt fill the lake to its maximum extent of about 5,300 ha. The water depth is 4-8 m. There is one small permanent island, Tell et Tine, but at high water levels, several other knolls, Tell es Seghir, Tell el Kebir and Tell es Seur, on either side of the Asi River where it flows into the lake, become islands for a few months, and Moudane, normally two km from the water's edge, itself becomes almost an island. The lake supports little aquatic vegetation, and the shores are mainly bare mud, although there are some patches of *Tamarix tetendra, Salix alba, Nerium oleander, Phragmites communis, Typha latifolia, Vitex agnus, Elaeagnus angustifolia* and *Scilla maritima*. To the south of the lake, the land is fertile and cultivated, but to the north there is a large area of lava flow. Villages are scattered around the

lake shore.
The average annual rainfall in the area is about 450 mm, and the mean annual temperature 15.9°C.
Land tenure: The lake and surrounding shores are state owned.
Conservation measures taken: None. The site has been identified as an Important Bird Area by BirdLife International (Evans, 1994).
Conservation measures proposed: The lake was proposed as a site for conservation under Project AQUA by the Ministry of Agriculture and Agrarian Reform in the late 1960s (Luther & Rzoska, 1971).
Land use: The lake is used to provide water for irrigation purposes; there is some fishing and a considerable amount of waterfowl hunting. Farming is the principal activity in adjacent areas. There are several large factories (including cement, phosphate and urea factories) at the east end of the lake near Qattine.
Possible changes in land use: No information.
Disturbances and threats: There is some pollution from the phosphate and urea factories near Qattine, and levels of disturbance are high, especially from recreational use (water sports) and fishing activities. Over-fishing is reported to be a problem, and there is heavy hunting pressure on waterfowl, especially on Fridays and public holidays. Common Carp *Cyprinus carpio* have been introduced into the lake.
Hydrological and biophysical values: No information.
Social and cultural values: No information.
Noteworthy fauna: An extremely important staging and wintering area for migratory waterfowl, regularly supporting over 20,000 waterfowl in mid-winter. Macfarlane (1978) observed "tens of thousands" of *Fulica atra* on the lake in the winter of 1976/77, along with perhaps as many as 10,000 ducks and 300 *Anser albifrons*. Over 22,400 waterfowl were recorded on the lake in January 1993, and over 15,100 in January 1994. These included up to 220 *Podiceps cristatus*, 300 *P. nigricollis*, 30 *Pelecanus onocrotalus*, 100 *Egretta garzetta*, 150 *Casmerodius albus*, 700 *Anser* sp., 150 *Tadorna tadorna*, 700 *Anas strepera*, 200 *A. crecca*, 300 *A. acuta*, 20 *Marmaronetta angustirostris*, 250 *Netta rufina*, 7,000 *Aythya ferina*, 8,000 *A. fuligula* and 9,000 *Fulica atra*. *Oxyura leucocephala* appears to be a regular winter visitor; 57 were present in February 1976, 100 in February 1977, 30 in January 1993 and 35 in January 1994. This species has been recorded in small numbers in summer, and may breed. Other possible breeding species include *Podiceps cristatus*, *Marmaronetta angustirostris* and *Porphyrio porphyrio*. Counts of waterfowl on passage have included up to 100 *Ardea cinerea*, 4,000 *Anas crecca*, 40 *A. querquedula* and several hundred marsh terns *Chlidonias* spp. *Botaurus stellaris* and *Plegadis falcinellus* have been observed in November. Up to 4,000 shorebirds have been recorded in autumn and in winter, including *Vanellus vanellus* (up to 130), *Limosa limosa*, *Numenius arquata*, *Tringa erythropus* (up to 500), *T. totanus* (up to 400), *Gallinago gallinago* (up to 100), *Calidris minuta* (common), *C. temminckii* and *C. alpina* (common).
Mammals said to occur in the area include Wolf *Canis lupus*, Red Fox *Vulpes vulpes arabica*, Badger *Meles meles canescens*, Hyaena *Hyaena hyaena syriaca*, Wild Boar *Sus scrofa lybicus* and Cape Hare *Lepus capensis syriacus*.
Noteworthy flora: No information.
Scientific research and facilities: Mid-winter waterfowl counts were undertaken by an IWRB

mission in December 1971 (Dijksen & Koning, 1972) and by biologists from the Faculty of Agriculture, University of Aleppo, in January 1993 and January 1994. Macfarlane (1978) carried out a number of avifaunal surveys at the lake in 1976 and 1977.
Management authority and jurisdiction: No information.
References: Evans (1994); Kumerloeve (1967-1969); Luther & Rzoska (1971); Macfarlane (1978).
Reasons for inclusion: 2a, 3a & 3c. An extremely important staging and wintering area for migratory waterfowl including two globally threatened species, *Marmaronetta angustirostris* and *Oxyura leucocephala*.
Source: See references.

Buhayrat al-Laha (10)

Location: 34°41'N, 36°00'E; south of Hamidiyah near the Lebanese border, 25 km south-southeast of Tartus, Tartus Governorate.
Area: c.50 ha.
Altitude: Near sea level.
Overview: A small area of wetlands on the Mediterranean coast near the Lebanese border; thought to be of importance for migratory waterfowl but very poorly known.
Physical and ecological features: Buhayrat al-Laha, only about 2 km north of the Lebanese border, is the only remaining natural coastal wetland in Syria. The coast is low and predominantly sandy, with some permanent rivers rising in the coastal ranges; settlements are few and small.
Land tenure: No information.
Conservation measures taken: None. The site has been identified as an Important Bird Area by BirdLife International (Evans, 1994).
Conservation measures proposed: The site was proposed as a reserve for nature conservation by a Task Force of the UNEP Regional Activity Centre for Mediterranean Specially Protected Areas in 1989 (Jeudy de Grissac, 1989).
Land use: No information.
Possible changes in land use: No information.
Disturbances and threats: The site is threatened by drainage for cultivation, pesticide run-off and hunting.
Hydrological and biophysical values: No information.
Social and cultural values: No information.
Noteworthy fauna: The site is said to be very important for migratory birds, but no details are available.
Noteworthy flora: No information.
Scientific research and facilities: None known.
Management authority and jurisdiction: No information.
References: Evans (1994); Jeudy de Grissac (1989).
Reasons for inclusion: 1d & 2b. Apparently the only surviving natural coastal wetland in Syria

and one of very few wetlands on the entire east coast of the Mediterranean Sea.
Source: See references.

Jabal Sis Lakes (11)

Location: 33°18'N, 37°22'E; about 100 km east-southeast of Damascus and 55 km south of the main road from Damascus to Iraq, Dimashq Governorate.
Area: Unknown.
Altitude: c.600 m.
Overview: A group of small rain-fed lakes and pools in and around an extinct volcanic crater in the Syrian Desert; probably an important breeding area for *Charadrius leschenaultii columbinus*, but very poorly known.
Physical and ecological features: The site comprises a group of small, mostly seasonal lakes and associated bare flats in and around the extinct volcanic crater of Jabal Sis (Sies), the largest of many such craters within the huge basalt lava field which covers much of southern Syria and northern Jordan. The crater lies near the eastern edge of the basalt, and rises about 100 m above the surrounding plain. Rainfall in winter and spring creates small lakes and pools in scattered pans of impermeable clay, and there is a rain-fed lake at the foot of Jabal Sis itself. Vegetation is sparse.
Land tenure: No information.
Conservation measures taken: None. The wetlands have been included within a much larger site (40,000 ha) identified as an Important Bird Area by BirdLife International (Evans, 1994).
Conservation measures proposed: None known.
Land use: Nomadic pastoralists graze their flocks in the area in spring and early summer. The terrain is impassable to vehicles except along tracks, of which there are few.
Possible changes in land use: No information.
Disturbances and threats: The area is too remote and inhospitable to be under much threat, although the bringing in of water in barrels has increased grazing pressure in the area, and there is some shooting of sandgrouse *Pterocles* spp. in winter.
Hydrological and biophysical values: No information.
Social and cultural values: No information.
Noteworthy fauna: Probably an important breeding area for the scarce and local Southwest Asian subspecies of the Greater Sand Plover *Charadrius leschenaultii columbinus*. About 100 *C. leschenaultii* were seen around the rain-flooded pans in late May 1976, and 14 birds were again present in this area in March 1977. *Cursorius cursor* is a common breeding bird in the surrounding desert. The sandgrouse *Pterocles orientalis* and *P. alchata* occur in good numbers in winter and spring, and the Houbara Bustard *Chlamydotis undulata* probably breeds in the area.
Noteworthy flora: No information.
Scientific research and facilities: None known, other than preliminary ornithological surveys.
Management authority and jurisdiction: No information.
References: Evans (1994); Macfarlane (1978).

Reasons for inclusion: 1d & 3c. An interesting group of permanent and seasonal pools and clay pans in a basalt lava area, and probably a breeding area for over 1% of the world population of *Charadrius leschenaultii columbinus*.
Source: See references.

Yarmuk Valley and Lake Muzayrib (12)

Location: 32°44'N, 35°52'E; in the extreme southwest of Syria, on the Jordanian border, Dar'a Governorate.
Area: Yarmuk Valley 20,000 ha; Lake Muzayrib 50 ha.
Altitude: Lake Muzayrib at 500 m.
Overview: A perennial river system on the Jordanian border with relatively undisturbed riverine vegetation, and a small freshwater lake on the adjacent plateau. The fauna and flora are characteristic of the upper Jordan Valley.
Physical and ecological features: The Yarmuk River runs along part of the border between Syria and Jordan at the southern end of the Golan Heights, and eventually joins the Jordan River a few km south of Lake Tiberias (see Jordanian Site 1). Major tributaries on Syrian territory include the Nahr al-Allan, entering from the north, and Wadi al-Thahab, entering from the east. The watercourses lie in steep, narrow wadis cutting through a plateau with well-watered farmland, and although the sides of the valleys are barren, the bottoms are full of lush vegetation including stands of *Phragmites communis*, *Nerium oleander* and *Juncus maritimus*. The average annual flow in the Yarmuk River is in the region of 360-400 million cubic metres. Lake Muzayrib (32°42'N 36°01'E) lies in a shallow depression on the plateau (Wadi al-Thahab), just west of Al-Muzayrib village and about 12 km northwest of Dar'a. It is a natural, spring-fed, mesotrophic lake of about 50 ha, with a mean depth of 2.5 m and banks of grazed turf. There is at least one *Phragmites* reed-bed. The lake is surrounded by agriculture and many houses.
Land tenure: Lake Muzayrib is state owned.
Conservation measures taken: None. The Yarmuk Valley has been identified as an Important Bird Area by BirdLife International (Evans, 1994).
Conservation measures proposed: Lake Muzayrib was proposed as a site for conservation under Project AQUA by the Ministry of Agriculture and Agrarian Reform in the late 1960s (Luther & Rzoska, 1971).
Land use: The lake is used for irrigation purposes, fishing, fish-farming and recreation (picnicking, *etc.*). The adjacent plateau is mostly under cultivation, mainly for wheat.
Possible changes in land use: There have long been plans for a large-scale, joint Jordanian-Syrian dam across the Yarmuk River (Wahda or Unity Dam), which would potentially be a critical threat to the riverine wetlands.
Disturbances and threats: Fish (*Cyprinus carpio* and *Tilapia* sp.) have been introduced into Lake Muzayrib, where intensification of fish production was cited as a potential threat in the late 1960s (Luther & Rzoska, 1971). There is some hunting locally.
Hydrological and biophysical values: No information.
Social and cultural values: No information.

Noteworthy fauna: Breeding birds include *Halcyon smyrnensis*, *Acrocephalus melanopogon*, *A. stentoreus*, *A. arundinaceus*, *Cisticola juncidis* and *Passer moabiticus* (at Lake Muzayrib). *Remiz pendulinus* and *Passer hispaniolensis* have been recorded in winter. A wide variety of waterfowl have been recorded at Lake Muzayrib in small numbers on passage, including *Nycticorax nycticorax*, *Ardeola ralloides*, *Ardea purpurea*, *Ciconia ciconia*, *C. nigra*, *Aythya nyroca*, *Fulica atra* and several species of shorebirds. The Common Otter *Lutra lutra* and Jungle Cat *Felis chaus* are reported to occur in the area. Fish include *Tilapia gallileae*, a species endemic to the Jordan Valley.
Noteworthy flora: No information.
Scientific research and facilities: None known, other than preliminary ornithological surveys.
Management authority and jurisdiction: No information.
References: Evans (1994); Luther & Rzoska (1971); Macfarlane (1978).
Reasons for inclusion: 1c & 2b. A good example of a relatively intact riverine system along an international border.
Source: See references.

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UNITED ARAB EMIRATES

INTRODUCTION

by Simon Aspinall

Area: c.83,000 sq.km.
Population: Approximately 2,200,000 (1994 estimate).

The United Arab Emirates (UAE), created in 1971, is a federation of seven former Trucial States situated in the southernmost part of the Arabian Gulf. The country includes part of the northern Hajar Mountains and also an 80 km stretch of the Gulf of Oman/Arabian Sea coastline directly facing the Indian Ocean. The Arabian Gulf coast of the UAE is about 450 km long, excluding the large collection of islands. The seven separate Emirates are of unequal size, Abu Dhabi being the largest by far at around 67,000 sq.km and Ajman the smallest at 260 sq.km. None of the Emirates is landlocked, such is the importance both historically and at the present time of access to, and exploitation of, the sea.

Trade with other Gulf states and Indian Ocean nations relies heavily on transport by sea. Nowhere in the country is further than 200 km from the sea. Pearl (lulu) fisheries formerly contributed greatly to the wealth of the inhabitants of the southern Gulf. However it is for the huge onshore and offshore oil reserves that the UAE is justifiably famous and to which modern-day life in this country, with its high standard of living, is owed. Development has been rapid since the status of the seven Emirates being "in treaty relations" with Britain ceased in 1971, which itself post-dated the discovery of oil.

The nation's wealth, coupled with its stability, has lent to the success and emergence of the federation in international politics and world affairs. Nonetheless, much of the traditional way of life still survives, blended with state of the art technology and large-scale development for which financial resources are very large. The communication network is modern, fast and efficient, often lying side by side but in marked contrast to traditional seagoing dhows, souqs, bedu camps, camel herds and other typical Arabian sights.

The topography of the UAE is characterised by rapid changes between the sand and gravel desert which dominates most of the south and west of the country (and extends inland to the high dune systems of the Empty Quarter, or Rub al Khali, of Arabia), a gravel savannah plain (with *Acacia tortilis*) of varying width abutting the western side of the Hajar Mountains, and the arid, jagged and shattered Hajar Mountains themselves, which rise rapidly to over 1,300 metres, and then, once over the watershed, steeply down to the coast of the Gulf of Oman/Arabian Sea. The corresponding gravel plain on the East Coast is patchy and small, and widest in the south, but for the most part separates the mountains from the sea with resulting few cliffs (except where faulted). Rather, there are numerous sandy beaches. The elevated Musandam Peninsula

extending to the Strait of Hormuz is Omani territory.

By contrast the Arabian Gulf littoral of the UAE is an exemplary development of active coastal sabkha, recognised as the biggest and best in the world. It is some 300 km long and of variable width but extending continuously 20 km or more inland in places. Isolated sabkha outliers, otherwise surrounded by dune and gravel desert, also exist inland in Abu Dhabi (in particular), more so in the Western Region than elsewhere.

The Gulf coast is extraordinarily shallow and gently shelving with numerous inshore and nearshore islands, most of which are simply part of a formerly more extensive and continuous sabkha invaded and dissected by post-Quaternary Shamallic storms and thence inundated by a sea level rise. There are some small, entirely man-made islands, and few areas remain completely unaffected by reclamation, dredging, tipping or other development or usage. Much of such development has been for recreational purposes. Mangrove, represented by a single species, *Avicennia marina*, covers extensive areas although not continuously. It is known to have been more extensive both historically and in the recent past, the reduction in area generally accepted as having been due to clearance (primarily for charcoal, as fodder or other uses) as well as to natural dieback or disease. In recent years, however, extensive planting of mangrove has been undertaken, often with considerable success.

The larger offshore islands are mostly the higher parts of a diapiric surface, the clearest evidence for which is where the migrating salt has erupted through to the surface to form distinctive and obtrusive looking hills. Other islands are anything from tiny sandy and shelly shoals to those larger ones of raised coral and outcropping limestone which are mostly covered with drift deposits.

The climate can only be described as hot; humid on the coast, especially in summer, but far drier inland where the temperatures are even higher. With the Tropic of Cancer passing through the south of the country, summers are long and hot. In any given year, it usually rains in the winter months, most often in February or March, but occasionally prior to this. The rainfall often takes the form of torrential frontal rain which, in the Hajar Mountains, runs off rapidly into wadis and thence onto the down-washed gravel plains, perhaps reaching the sea on the east coast but invariably braiding widely and soaking rapidly into the desert on the west side. Further west and along the coast, rainfall is often trapped on the sabkha surface until evaporated. Inland, surface water seldom remains for long, rarely more than a day or two, except where artificially ponded or dammed. Mainly localised thunderstorms occasionally reach the UAE in summer (with the annual frequency varying widely), and are generally over the mountains of the south and east of the country, these being convective downpours breaking away from the southwest monsoon affecting southern Arabia.

Biogeographically, the region has previously fallen into a no-man's-land, but it is clearly Palearctic; in reality, the whole of Arabia except extreme southwestern Oman, southwestern Saudi Arabia and Yemen should be considered as such. The Arabian Gulf is a staging and wintering area of considerable importance on a major Eurasian-African flyway for shorebirds and some other groups of waterfowl. In the UAE, there are internationally important seabird

colonies, namely of Socotra Cormorant *Phalacrocorax nigrogularis*, Sooty Gull *Larus hemprichii*, Great Crested Tern *Sterna bergii*, Lesser Crested Tern *S. bengalensis*, White-cheeked Tern *S. repressa* and Bridled Tern *S. anaethetus*, and smaller but nonetheless important numbers of other species such as Western Reef Heron *Egretta gularis*, Osprey *Pandion haliaetus* and Crab Plover *Dromas ardeola*. The bulk of the world population of Socotra Cormorants breeds between the UAE and eastern Saudi Arabia.

Quite apart from the avifauna, there are also known to be sizeable populations of Dugong *Dugong dugon*, at least two breeding species of sea turtle and an extensive, mainly undisturbed, development of coral reef and its associated fauna. All of these can be regarded as being of conservation importance equal to that of the avifauna. Coral reef is also present along the Gulf of Oman coast, and is reportedly richer and more diverse than that found inside the Arabian Gulf.

The economy of the UAE is founded on oil revenue and resulting profit from sound investment both at home and offshore. Throughout the Emirates, commerce and trade thrive, but the respective capitals are clearly the major centres, particularly Abu Dhabi and Dubai, for banking and commercial interests. The wealth of the individual emirates varies enormously, but the Federal Government invests in public works throughout the Federation. The UAE represents a Middle Eastern hub for sea and air travel and transport. The six international airports handle considerable long-haul traffic, especially on the major west-east route from Europe to the Far East. The attractive freeport facilities for shipping draw in container traffic on a large scale, and oil tanker traffic is similarly profuse, although much of the latter remains outside the Gulf where it is attracted by reduced insurance costs and the modern port facilities at Fujairah and Khor Fakkan.

Summary of Wetland Situation

Despite being envisaged as an entirely desert state by many who have never visited the region, the UAE does, in fact, possess a wide variety of habitats including a range of wetland types.

Freshwater wetlands

Permanent wetlands are naturally scarce inland, although ephemeral rain-fed freshwater pools and flashes often appear, even if not usually remaining for long. Running water that persists through the summer is limited to very few sites, although deep pools may remain in river-beds. Springs and wells provide similar habitats, although the former are naturally restricted to the foot of the Hajar Mountains and occasional outlying, often limestone, blocks. The wildlife is adapted to the vagaries of a system such as this. Invertebrate groups such as dragonflies (Odonata) are poorly known, but many species are invariably present near any freshwater source. Similarly toads (there are no frogs in the UAE) and fish have colonised and live in surprisingly isolated localities (and/or are possibly therefore relict populations). The distribution of many species and groups, including even birds, have yet to be accurately and comprehensively mapped in the UAE, and considerable subspeciation seems likely. This is

likely to be especially true of the flora and fauna inhabiting wetlands in isolated wadis.

Groundwater abstraction and the subsequent lowering of the water-table have depleted many natural springs and wells, and some are now lost altogether or unusable due to salt-water incursion. Certainly, desalination of contaminated groundwater is difficult to achieve. Protection of fossil groundwater, or its more frugal use for irrigation, for example, should be given serious consideration. Lowering of the water table is also thought to have caused vegetation to die off, at least locally. There should also be concern over the depletion of aquifers, which are doubtfully replenished by present day input. Other than these remaining natural freshwater systems, there are many man-made water bodies. These are typically those associated with urban life and purpose designed, such as sewage treatment and water purification works, fish farms and soakaway surplus run-off pools.

Occasionally a wetland is created for ornamental or landscaping purposes or even, more rarely, primarily for wildlife. In any case, any one of these, with or without riparian vegetation, may act as a magnet for wildlife, especially when nutrient enriched. The construction of dams in the mountains of Fujairah, the Sharjah East Coast enclaves and Ras al Khaimah have been large-scale civil engineering works that now require an unlikely amount of rainfall to fill, although the primary purpose of some such dams is for flood control and prevention. Only two or three presently hold back what might be termed a reservoir, and although these have attracted several species of waterbird, they are otherwise unsurveyed. Many so-called "freshwater" wetlands are in fact brackish to begin with, and their salinity increases progressively through evaporation during the summer. Reed-beds, a rare commodity in most of the Arabian peninsula, have developed in many of these sites. *Phragmites australis* occurs widely but seldom covers a sizeable area. Reedmace *Typha domingensis* is also present, but has not colonised most of what might appear to be suitable wetlands. Only where the wetlands are sewage-enriched do stands of reeds support reasonable populations of breeding or wintering birds, and it appears that many invertebrates (even the winged Pterygotes) colonise more slowly if at all. Pterydophytes (ferns) occur very locally in damp spots.

Sabkha

All other wetlands in the UAE are saline or brackish. The sabkha coastline, lying principally within Abu Dhabi Emirate, is recognised as being the best developed and largest example of this geomorphological landform anywhere in the world. Said by geologists to be entirely less than 7,000 years old, the sabkha is quite unique, and is continuing to grow seaward and infill. Barring dredging works, many shoals would have already coalesced. Sabkha or salt flats, despite the high salinity (often hypersaline) and stark appearance, are biologically very productive for micro-organisms. Sabkha can extend many kilometres inland; Sabkha Matthi in western Abu Dhabi continues for 100 km inland crossing into Saudi Arabia for a further 100 km. Isolated patches of sabkha exist inland, individually covering a small area, generally 25 sq.km or less, whereas Sabkha Matthi covers many hundreds of sq.km.

The hydrology of sabkha systems varies. At coastal sites, the post-autumn equinoctial storms and gales may force or "pile up" seawater on the shallow and gently shelving southern Gulf

shores, thus inundating extensive areas of sabkha. Alternatively, there may be a subterranean connection. The sabkha may remain flooded for many months, and the water table certainly remains high into the summer. In many areas, the subsequent water loss must be almost entirely through evaporation, since an impermeable layer, principally of gypsum or anhydrite and up to 15 cm thick, is often present at or beneath the surface. These layers are the product of the salty brine being drawn upward by capillary action until saturated, at which point crystallization occurs. Inland sabkha sites are generally unaffected by sea-water, except where a sub-surface flow percolates landward, but rather are influenced by winter rainfall. Such rainfall is prevented from soaking in by the presence of either an impermeable evaporitic layer which forms in the way described above, or by the underlying solid geology. Clearly, fluctuations in winter precipitation determine whether these sites are wet or not in any one year or season. Coastal sabkha is mostly underlain by solid strata.

Small flat sabkha areas surrounded by higher areas of wind-blown sand are a common inland sight in the UAE desert. Biologically, they are highly impoverished, whereas the coastal sabkha is often coated in a stromatolitic algal mat with a gleyed reducing layer below. These mats are a cocktail of cyanophytes, diatoms and bacteria which, as they dry, become a characteristic cracked and peeling layer extending over many square kilometres. Pools are a notable feature of sabkha; these often have a subterranean connection to the sea and thus fluctuate tidally. Their flora and fauna may be entirely microbial.

Inter-tidal flats

Moving into inshore coastal waters and the littoral zone, the tidal regime becomes extremely unpredictable, although it is not actually very complex. The shallowness of the southern Gulf means that minor variations in both the wind direction and speed and the barometric pressure cause the predicted tides to remain either "out" or to advance several kilometres further "in". Seasonal variations follow a more defined pattern, with inundation of many otherwise "inter-tidal" areas, *e.g.* large areas of sabkha, not being witnessed until late autumn (post-equinox). The inter-tidal area of the UAE is extensive. Even several kilometres from the shoreline, the latter itself a bit of an arbitrary boundary, the sea is often less than six metres in depth at low tide and thus a considerable area is available to qualify for inclusion in the current inventory. The invertebrate biomass varies enormously, probably largely in relation to substrate and nutrient loading. Strings and carpeting of bivalves are somewhat localised, and crustacea appear to dominate in many sites, particularly sand-rolling crabs (*e.g. Cleistostoma* spp.). The distribution and abundance of invertebrates, especially annelids, warrants examination in relation to the distribution of shorebirds, or vice versa.

Saltmarsh

Saltmarsh communities, as opposed to halophytic communities, are locally well developed along the littoral fringe of the mainland and on some islands, although the total area is relatively small. Typical floral associations are of *Halocnemum strobilaceum, Halopeplis perfoliata, Suaeda vermiculata, Arthrocnemum macrostachyum, Salicornia europaea* and *Limonium axillare*. *Anabasis setifera* and *Salsola* spp. are close associates.

Khors

Khors (or khawrs) are a peculiarity of Arabia, exemplified in the Gulf. They are tidal inlets, estuarine in nature but lacking any permanent surface freshwater inflow. Those khors close to the mountains (*e.g.* Site 20), may receive sub-surface freshwater input at least seasonally. They vary in shape and size, and are often modified into waterways and sheltered harbours. Some can accommodate large dhows or other seagoing vessels, whereas many are undredged and remain natural, and can be less than a metre or two in depth at high water. Undisturbed areas of the former may remain of considerable importance for shorebirds, mangroves and saltmarsh *etc*. As with estuarine systems in western Europe, introduced nutrients such as sewage inflow have increased the biological productivity of several khors, and bird populations may have increased accordingly. The hydrological regime of some of the so-called khors, particularly in the Northern Emirates, may be considered lagoonal rather than estuarine. The shallow waters and khor-side mangrove woodland, where present, may be vital to sustain fisheries.

The khors and other inter-tidal and coastal areas of the UAE are estimated to support up to 300,000 shorebirds and other waterbirds at any one time during the migration periods. Allowing for turnover, more than a million and perhaps two or even three million individual birds may pass through the southern Gulf in autumn.

Mangrove

Mangrove reaches its northern limit in Asia in the Arabian Gulf, and is represented by a single species, *Avicennia marina*. Its distribution is patchy; most areas of mangrove are relatively small in size and only a few extensive mangals exist (see site accounts). Mangrove is known to have been more extensive both historically and in the recent past, the reduction in area generally accepted as having been due to clearance (primarily for charcoal, as camel fodder or other uses), as well as to natural dieback or disease. Landfill has also disposed of some areas.

The trees appear ancient in at least two sites, namely Khor al Beidah (Site 12) and Khor Kalba (Site 20), but they have yet to be aged. The White-collared Kingfisher *Halcyon chloris* has successfully colonised a single site (or remains as a relict population), and is dependent on holes in the old mangroves for nesting.

In recent years, the establishment of mangrove nurseries and artificial propagation and planting have increased the area of mangrove substantially and with some considerable success. Planting continues to be practised on a large scale. In some instances, this extensive planting of mangroves has been detrimental to migrant shorebird populations. Some inter-tidal sites valuable for wildlife have probably been irreversibly damaged, even if the desired aesthetic improvement, which is generally the purpose of planting in the first place, has been achieved. In other instances, mangrove planting will "improve" the biological capital or increase or restore the biological diversity of an area, and may thus be seen as beneficial. Provision of extra suitable habitat for fish spawning and as a nursery for both fish species and shellfish (molluscs) is a case in point. The full importance of mangrove communities to commercial fisheries in the

Gulf has yet to be assessed, although study is under way. In the meantime, there would seem to be a good case for protecting all existing mangrove areas. National guidelines and policy, which do not presently exist, should be drawn up as soon as possible to provide a national planning atlas for the use of coastal areas.

Seagrasses

Seagrasses, from a wildlife point of view, provide a very valuable commodity. The term is ecological and not phylogenetic, as it embraces an assemblage of unrelated species. Seagrasses grow readily in water up to a depth of 10 metres, and in far deeper water with good clarity (exceptionally to 90 m). As the Gulf is rather turbid, seagrass lawns are somewhat restricted in their distribution. As stated previously, however, much of the UAE coastal waters are less than 10 m deep, thus providing a large area of suitable habitat able to support a sizeable population of Dugong *Dugong dugon*. There are four species of seagrass occurring in the Gulf: *Halodule uninervis*, *Halophila stipulacea*, *H. ovalis* and *Syringodium isoetifolium*. *Halodule uninervis* is undoubtedly the dominant species of seagrass and, in the UAE at least, probably forms the major food-plant taken by grazing dugong. *Halophila stipulacea* is widespread in the west (Abu Dhabi Emirate), but its status and relative abundance, together with that of the other two species, is poorly known and needs mapping. Seagrasses occur in some inter-tidal areas where a resultant food chain proceeds through grazing and breeding molluscs to overwintering shorebirds and their predators.

Islands

The Gulf possesses many islands, some rocky or of a relatively "solid" geology, but more being sandy shoals of low elevation. All are arid, and most lack permanent fresh water. Dalma (Site 5) certainly supports springs. The islands vary in size from a few tens of square metres to tens of square kilometres. The two largest are Sir Bani Yas and Abu al Abyadh at 220 and over 500 sq.km respectively. Abu Dhabi island lies between these two large islands. Little is known of submarine sedimentary movement and migration. Many inter-tidal banks exist, and the flats exposed at low tide can be important feeding grounds for migrant and over-wintering shorebirds. Some of the larger inshore islands are essentially an extension of the coastal sabkha, having been separated by post-Quaternary Shamallic storms cutting or forcing channels into and round behind sizeable chunks of land *e.g.* Khor al Bazm. Many offshore islands are typified by one or more rocky extrusions forced up by salt diapirism. Few uninhabited islands remain, despite being desert islands. Even shoals may now have permanent buildings and a resident human population. Freshwater is delivered along with fuel, and a four-wheel drive car is often landed, even on the smallest of islands. Sensibly enough, comfort and air-conditioning prevail, although for wildlife the presence of a resident human population regularly spells a creeping death knell. Hardly an uninhabited island exists that has not had irrigation installed and trees or palms planted on it. Feral cats regularly abound, and cause havoc amongst breeding seabirds. Rats are also well established on many islands, as are house mice, the former, along with cats, certainly spelling disaster for breeding birds.

Coral

Although some studies have been conducted on the coral communities of the UAE, no comprehensive survey has as yet been carried out. The coral formations are best known off the eastern, Gulf of Oman coast, which belongs to Fujairah and Sharjah Emirates. Reef development in the Gulf is variously classified as fringing reef, patch reef or as submerged banks/cays, and these are well developed. Gulf coral communities, of which there are apparently just five, include a healthy and diverse faunal assemblage of molluscs, crustacea, reef fishes and reptiles (sea-snakes and turtles). Coral cover is high if not diverse compared to, say, the Red Sea. As the coral reefs of the UAE have already been described in the UNEP/IUCN inventory of coral reefs of the world (UNEP/IUCN, 1988), no further specific reference will be made to them except where they occur in a site of importance for other flora or fauna.

All marine habitats and their associated flora and fauna, from littoral to planktonic and benthic communities, are described fully in Sheppard *et al.* (1992). The UAE falls within the Western Indian Ocean faunal province (Hayden *et al.*, 1984). The oceanography of the Arabian Gulf is also detailed in the former publication. Both salinity and temperature exhibit large seasonal ranges, and it is estimated that it takes between three and seven years for a complete changeover of Gulf waters.

Threats to wetlands

Large-scale losses of inter-tidal area have been brought about either by dredging or by burial *i.e.* reclamation. Gains include wholly new islands of very limited value to wildlife, at least initially, and extension to existing islands or along the mainland coast. It is mostly sabkha that has suffered from alteration, although various khors have been lost (in their entirety in the case of Khor Khan, Sharjah, and Khor al Mamzar, Dubai), or reduced to some extent. This is in addition to "losses" or changes brought about by mangrove planting as outlined above. One further ecologically significant change is the connection of former islands to the mainland by causeways across the intervening sabkha or shallow waters. The net effect of allowing predatory mammals onto sites holding ground-nesting birds or other wildlife needs no expansion or explanation here.

The list of threats to sites of importance to wildlife includes, in no particular order of importance: vehicles (destruction of vegetation/bird nests and disturbance), introduction of cats and rats (accidental or otherwise), development and disturbance, mismanagement of natural areas (*e.g.* overzealous mangrove planting on important mudflats), erosion, dredging, pollution, persecution (*e.g.* shooting of Socotra Cormorants), unsustainable harvesting (*e.g.* of turtle or tern eggs) and introduction of alien species. Possibly no site exists that has not already been altered or presently receives no form of adverse human activity or development. This is true of all mainland and island sites thus far surveyed or visited. Even areas which have already been identified as Important Bird Areas and notified to the appropriate authority continue to be mismanaged or mistakenly "improved", for example by planting and irrigation schemes. The apparent view of wildlife is that so long as it occurs in abundance, then there is no cause for concern. This applies even to completely alien or introduced species; thus sites in the UAE

often bear the appearance of open-air zoos, whilst the native flora and fauna recede. Furthermore, with ownership of land goes the right to develop it, and this has led to major losses of wildlife, particularly of seabirds on some offshore islands. In many instances, this has been deliberate, but in some, where advice could have been given, conflict might have been avoided and mutual coexistence guaranteed. Even the internationally important site of Khor Dubai has been mismanaged, against ecological advice, to "improve" it for wildlife, and thus make it aesthetically more pleasing. Similarly, the site of the first mainland Arabian breeding attempt by Greater Flamingos *Phoenicopterus ruber* (in 1993) was subsequently filled in against a specific directive from high authority, and when elsewhere in the UAE attempts have been made to encourage flamingos to breed. Beliefs, superstition and folklore, as well as attitudes, all also play their part, and have contributed to the demise, persecution or discouragement of several species.

Wetland fauna

Particularly important breeding birdlife includes several seabird species. Seven particular islands or island groups hold the bulk of the UAE's breeding seabirds. Cumulatively, the islands of the UAE hold respectively over 25% and 40% of the Arabian Gulf populations of Great Crested Tern *Sterna bergii* and Lesser Crested Tern *S. bengalensis*, about 5% of the world population of White-cheeked Tern *S. repressa* and over 30% of the regional population of Bridled Tern *S. anaethetus*. The UAE colonies of Socotra Cormorant *Phalacrocorax nigrogularis* are especially noteworthy. Despite having a larger breeding population than any other seabird in the Gulf, this species is restricted to only 12-14 colonies worldwide, seven of which survive in the UAE. All of these colonies are under threat from development, disturbance or direct persecution, and their prospects look bleak.

Also worthy of note is the large breeding population of Ospreys *Pandion haliaetus*. This population, concentrated at high density on islands in western Abu Dhabi, possibly exceeds that in the entire remainder of the Arabian Gulf. Two further breeding birds are of particular importance, namely the White-collared Kingfisher *Halcyon chloris* and Booted Warbler *Hippolais caligata*, both of which are found in mangroves at a single site in the UAE, Kalba Creek (Site 20). The former is of an endemic subspecies, *kalbaensis*. The species itself is common and widespread across southern Asia and throughout Oceania south to Australia, and occurs as far west as the Red Sea coast of Ethiopia and Sudan in Africa. Some 49 subspecies have been described. The population of the subspecies *kalbaensis* was censused completely in May 1995 with a minimum of 44 pairs/territories being located, and it is thus one of the rarest subspecies of bird in the world. As for Booted Warbler, Khor Kalba is possibly the only regular breeding site for this species in the Arabian Peninsula (it is considered to be a casual breeder on the Batinah Coast of Oman). The site is therefore of considerable significance in an Arabian context, even if the species is abundant over a wide area of west and central Asia. The taxonomic affinity of the breeding population in Arabia is presently uncertain.

Amongst visiting waterfowl, no fewer than 25 species, and possibly several more, are recognised as occurring in regionally important numbers either on migration or in winter. These are primarily species of shorebird (14 species), together with several seabirds (four species of

gull) and herons and their allies (seven species). Each is named in the appropriate site account below. About 250,000 waterfowl overwinter in the UAE, while similar or larger numbers may be present at any one time during spring and autumn migration seasons. As stated earlier, allowing for turnover, between one and three million waterfowl may utilise inter-tidal areas annually.

Other species or groups of species which are of outstanding conservation value due to their present rarity, or to the still sizeable populations surviving in the UAE, include Green and Hawksbill Turtles *Chelonia mydas* and *Eretmochelys imbricata*, Dugong *Dugong dugon*, some marine fishes *e.g.* Scaridae, Labridae, Acanthuridae and Pomacanthidae, and sea-snakes Hydrophiidae. The population sizes and distribution of most of these are poorly known, as are their regional breeding and feeding ecology and seasonal movements.

As stated previously, mangroves may be important as fish spawning grounds or as nursery areas for fry and alevin, and for molluscs and crustacea (amongst others). Crabs are vital for the survival of both the White-collared Kingfisher and the Crab Plover. The latter feeds extensively on the black mangrove-dwelling crab *Metopograpsus messor* at one of its two UAE breeding sites.

The fauna of freshwater habitats in the UAE remains poorly known. The two toads, Arabian Toad *Bufo arabicus (orientalis)* and Dhofar Toad *Bufo dhofarensis*, occur in wadi pools along with dragonflies (Odonata), many swimming and diving invertebrates *e.g.* Coleoptera, and the larval stages of terrestrial adult insects as well as entirely aquatic forms. Freshwater gastropods are very poorly known, and clearly need further study. Aquatic macrophytes and the riparian flora of freshwater wetlands have yet to be studied in depth. Fish are able to survive and breed in wadi pool systems, even those that dry out completely in summer. Some studies of wadi fishes have been completed, but the results remain to be publication. The Wadi Racer *Coluber rhodorachis* is a riparian snake, frequent in wadis and preying on fish and amphibians.

Marine plankton, primarily of diatom species, has a low diversity in relation to the remainder of the Indian Ocean, with large seasonal variations in abundance. Biomass is high, however. Local nutrient enrichment or eutrophication causes algal blooms, and may contribute to "red tides", a natural phenomenon resulting in the death of many fish and lower taxa through decay and release of toxins and de-oxygenation of the surface waters. Mammals and birds are apparently unaffected, although some dolphin deaths could be indirectly related. Other plant life in the Gulf, such as seagrasses, is in need of study and particularly of mapping. Seaweeds have been dealt with by Basson *et al.* (1977), and are not described here.

There is sparse information available regarding some other faunal groups, but the reader should refer to Sheppard *et al.* (1992) and their bibliography for a general overview of the marine biogeography, community structure and ecosystems of the Arabian region. Endemism is relatively high; for example, 12% of echinoids are endemic to the Arabian Gulf. Most lower forms might be expected to range almost throughout the Arabian Gulf, and are clearly not confined within political boundaries. Molluscs (*e.g.* see Smythe, 1979) and crustacea are reasonably well documented, not least because of their commercial value, whereas groups such

as annelids and other inter-tidal and sub-tidal invertebrates require further study. Three new species of mollusc have recently been described from Fujairah (see Site 18). The greatest diversity of molluscs is in Ras al Khaimah, and the lowest in Dubai.

There are several hundred species of fish in the Gulf, of which some 125 are reef fishes. Less than about a third of the latter may occur in the UAE. As with many other groups, the overall diversity appears to be low (although over 500 fish species occur around Arabia), but endemism is high. With regard to commercially valuable fishes, over-exploitation and degradation of breeding grounds through trawling are reducing stocks, as is the case with shrimp stocks. Over-exploitation is especially serious in the selective fishing of predatory species particularly favoured for human consumption and commanding high prices. Coral reef fishes are described in many previous publications and need not be dealt with here. The Whale Shark *Rhincodon typus* has been recorded in UAE waters along with typical reef sharks *e.g.* the Black-tip *Carcharinus melanopterus.*

Nine or ten species of sea-snake occur in the Gulf, some being abundant. Records are few, but they are certainly common enough around offshore islands and coral areas when they appear attracted to the lights of boats. The Yellow-bellied Sea Snake *Pelamis platurus*, Arabian Gulf Sea Snake *Hydrophis lapemoides*, Reef Sea Snake *H. ornatus* and probably Shaw's Sea Snake *Lapenis curtus* all occur in the UAE. Other species from different genera or other species from the three genera named above may also occur.

The Green Turtle *Chelonia mydas* and Hawksbill Turtle *Eretmochelys imbricata* both breed in the UAE, the former being numerous. There are serious threats to many breeding beaches, primarily from development, and still an unknown level of egg-collecting and capture of individuals. Loggerhead *Caretta caretta* and Leatherback Turtles *Dermochelys coriacea* occur but do not, or are not known to, breed. The status of the Olive Ridley Turtle *Lepidochelys olivace*a is unknown, but it may simply be a rare visitor to the UAE Gulf of Oman coast and rarer still (if at all) inside the Arabian Gulf. Much of the mainland coast of the UAE was formerly used by nesting turtles, particularly, it seems, that of the Northern Emirates (Dubai to Ras al Khaimah). Jebel Ali was one such important site which now supports a freeport container complex.

Up to twelve species of cetaceans have been recorded in the Arabian Gulf. However, only the Bottle-nosed Dolphin *Tursiops truncatus* and Indo-Pacific Humpback Dolphin *Sousa chinensis* are at all common in UAE waters, and particularly so west of Abu Dhabi, although equal effort in recording them has not been applied throughout the country. Substantial healthy populations of both species probably exist. The Finless Porpoise *Neophocoena phocoenoides* possibly occurs, with Common Dolphin *Delphinus delphis* in deep waters offshore. Whales are occasionally noted in Gulf waters, although most records concern dead animals washed ashore or live strandings. These include False Killer *Pseudorca crassidens*, Bryde's Whale *Balaenoptera edeni* and Humpback *Megaptera novaeangliae* (Sei and Blue Whales have also been reported). The shallow waters of the Gulf must very largely preclude the regular occurrence of whales in UAE territory.

Populations of the Dugong *Dugong dugon* in the Gulf are of particular importance. The total population has been estimated at 7,310 +/- 1,300 (Preen, 1989), with many still to be found in western Abu Dhabi (see Site 2) and perhaps in other Emirates. Individuals were still occasionally caught off Umm al Qaiwain in the mid-1980s (P. Hellyer pers. comm.).

Economic values

Among natural wetlands, direct economic benefit comes only from marine areas. This is principally from the substantial commercial pelagic and demersal fisheries. A wide variety and large tonnage of fish are caught annually (97,000 tons in 1993), with some particularly sought after species, such as the Hamour or Brown-spotted Grouper *Epinephelus tauvina*, commanding high prices. Most, if not all, of the catch is consumed locally. Water-sports are widely pursued by both residents and tourists, and the revenue so derived is sufficient to sustain a large and competitive service, supply and training sector. Diving for sport and the use of motor-craft are especially popular activities. The pearl-diving industry, once of paramount importance to trade and wealth in the Gulf region, has been defunct for several decades (a rapid decline began in about 1929), and seems unlikely to be revived, even though free-range pearls undoubtedly still exist. Where present, coastal sabkha prevents flooding and erosion, and is thus economically valuable.

Wetland Research

The principal institute conducting research on wetlands in the UAE is the Desert and Marine Environment Research Centre housed at the Emirates University in Al Ain. At federal level, the fisheries section within the Ministry of Agriculture based in Umm al Qaiwain (and jointly run with the preceding institution) monitors fishery stocks and recruitment. The Ministry of Agriculture also coordinates operations and mobilises manpower for oil spills, fish die-offs and other natural or man-made events or happenings. The procedures are, however, little more than an *ad hoc* arrangement, and usually result in foreign expertise being flown in. The Ministry's jurisdiction extends from high-water to the territorial limit. Mangrove and fishery research are ongoing and collaborative between the two organisations already named. Funding of much of these comes from commercial sponsorship.

The UNEP/IUCN inventory of coral reefs summarised known information on reef development in the UAE, although it is evident from this that detailed surveys are lacking from all, or almost all, areas. No known professional studies are under way. The assistance of amateur enthusiasts and the many diving schools might be enlisted to achieve some form of descriptive survey and species listing.

The National Avian Research Center (NARC), a research and conservation organisation based in Abu Dhabi, conducts breeding bird surveys (particularly of seabirds) within Abu Dhabi, and coordinates national counts (including the IWRB international waterfowl census) of migrant shorebirds and other waterbirds. Most marine environmental issues, from a species to a community level, are now tackled by NARC. At an individual level, many amateurs from

different disciplines make useful field observations and provide valuable wildlife records. A database of vertebrates and some invertebrate groups is maintained jointly by the Emirates Natural History Group and National Avian Research Center. The former organisation lobbies over environmental issues. The bias is still very much toward Abu Dhabi and Dubai and primarily to birds, with some notable exceptions, *e.g.* Arabian Leopards *Panthera pardus nimr* and other cat species in the Northern Emirates.

The presence of internationally important sites for waterfowl in the UAE has been recognised since the mid-1970s at least, *e.g.* see Carp (1976). Calls for a protected area network for waterfowl have been made and continue to be made both from within and outside the country.

The UAE report for the BirdLife International project on Important Bird Areas (IBA) in the Middle East, submitted in mid-1993, identified fourteen wetland sites and seven or more terrestrial sites important for their avifauna. These sites were described by the Emirates Natural History Group, Colin Richardson and staff at the National Avian Research Center. Since that time, the latter organisation has undertaken extensive field surveys, and has identified many new internationally important sites, mainly wetlands. The present report provides the first written accounts of these sites and, as a more recent publication, will complement the IBA book (Evans, 1994) which was published in August 1994. All IBAs are named in the following wetland site accounts.

Wetland Area Legislation

Legislation covering marine wetlands has still to be introduced. The regulating authorities include the Ministry of Agriculture (Fisheries Section) and the Federal Environmental Authority. Environmental impact assessments (EIA) are mandatory, but not always implemented. The Abu Dhabi National Oil Company (ADNOC), of which the Abu Dhabi Government is the majority shareholder, certainly conducts EIAs, and has commissioned independent coastal environment surveys and mapping projects.

Legislation has been proposed previously but none has been enacted. Unofficial and informal calls continue to come regularly from a variety of organisations. The Federal Environmental Authority will be the body to draft such legislation in discussion with interested parties, including other government departments.

UAE federal law (Federal Decree-Law No.9 for 1983) regulates hunting of wild and marine birds of all species, including specifically "doves and orioles". The law also prohibits the collection or destruction of birds' eggs, with the exception of those of the Socotra Cormorant, the adults of which are shot and young harvested. The Socotra Cormorant was purposely not included in the law because of pressure from fishermen. The habitat itself remains unprotected, other than under individual Emirate or private arrangements as described below.

The Gulf is declared, on paper, a Special Area under Annexes I and V of the MARPOL treaty. The UNEP Regional Seas Programme also has an interest in the region. The UAE is, along with

other Gulf states, a signatory to the Kuwait Action Plan, drawn up by the Regional Organisation for Protection of the Marine Environment (ROPME). This Action Plan was developed to prevent and control pollution from ships *etc.*, to establish national standards, and to research and monitor all types of pollution.

A number of other regional and international agreements or organisations exist, and any may prove a suitable vehicle for improving standards and establishing protected marine areas. These include the Gulf Cooperative Council (GCC), Arab Declaration on Environment and Development, Gulf Area Oil Companies Mutual Aid Organisation, and even the European Union. The Saudi Arabian governmental Meteorological and Environmental Protection Administration (MEPA) has proposed international research and protection measures ostensibly for Dugong, but this might easily be applied across the board *i.e.* for all taxa and shared resources.

The UAE is not party to any major conservation convention other than the Convention on International Trade in Endangered Species of Fauna and Flora (CITES).

Wetland Area Administration

Ownership of land within the UAE is often difficult to ascertain. The various municipalities and members of the Ruling Family in each Emirate hold, or at least control, most land, although certainly in much of the desert, bedouin are allowed to continue traditional usage. A protected area network has yet to be established. Even so, two areas nationally important for wildlife receive formal protection, *viz.* Khor Dubai Wildlife Sanctuary (for Greater Flamingos and shorebirds) and Jebel Hafit Tahr Reserve (although the Tahr is probably now extinct in the area). The former is guarded round the clock. Hunting preserves have also been set up, primarily in desert areas and for falconry purposes. The Ministry of Agriculture has the power to apply certain restrictions at designated turtle beaches, but these are not enforced. A precedent has, however, been set at Al Jazeerah khor, where the beach and land up to 400 m above high water and up to four km offshore is privately protected for turtles (see Site 14).

It may be possible for sites to be individually designated by the government of a single Emirate. However, to date, among recognised nationally or internationally important wetland sites, only Khor Dubai has received any protection (violators subjected to penalties by a Local Order No.61/91). The Eastern Lagoon of Abu Dhabi (part of Site 4), containing mangrove and mudflats, is protected under the direction of the UAE President.

Organisations involved with Wetlands

The Federal government, in the form of various departments and ministries (including the Federal Environmental Agency), and the respective governments of the seven individual Emirates are all administratively involved in wetland use. Across the Federation, standardisation may ultimately be achieved through the work of the FEA, which replaced the

former Higher Environmental Council in 1993.

a) UAE Government

The UAE government relies on the Department of Fisheries within the Ministry of Agriculture to report on matters relating to marine areas. Independent consultants are often called in to undertake environmental assessments.

Ministry of Agriculture

The Ministry has jurisdiction over matters concerning wildlife conservation and the environment. The Fisheries Department undertakes research on coastal and marine issues of commercial concern. Mangroves feature prominently (erosion prevention, aesthetics, fish and shellfish nursery). Fish stocks and recruitment are monitored in Gulf waters.

Federal Environmental Agency

The FEA took the place of the former Higher Environmental Authority in 1993 (by Federal Law No.7, 1993).

b) Individual Emirate Governments

Ruler

Each Emirate has its own Ruling Family, the head of which is the Ruler. Each Ruler is a member of the UAE seven member Federal Supreme Council. The offices of the immediate family of the Ruler may retain the services of a professional "wildlife adviser", or may employ independent consultants or request external advice on environmental issues.

Municipality

Public works are carried out in each Emirate by their respective Municipality, *e.g.* Abu Dhabi Municipality, Dubai Municipality. The city of Al Ain is large enough to possess its own Municipality. Many large towns or towns distant from the central Municipality for that Emirate also possess their own Municipality or sub-office (37 are listed). Public works affecting wetlands, including groundwater supplies, include reclamation (primarily coastal/sabkha), sewage and waste-water treatment and disposal, irrigation and drainage. In July 1994, the Executive Council of Abu Dhabi Emirate approved the establishment of an Environmental Protection Committee to oversee protection of areas falling under the jurisdiction of Abu Dhabi Municipality. Its terms of reference deal mainly with pollution.

c) Universities

The Emirates University (UAE University)

The Desert and Marine Environment Research Centre is housed at the Emirates University based in Al Ain. The Marine Environment Research Section deals with research independently and in collaboration with the Ministry of

Agriculture. The oil company Shell has provided funds for mangrove and turtle studies.

d) Non-governmental organisations

National Avian Research Center

The NARC is a research and conservation organisation whose work relates primarily to falconry and Houbara Bustards *Chlamydotis undulata*, but also to all other wild bird populations and their conservation and sustainable use in the UAE.

Emirates Natural History Group (including the affiliated but autonomous Al Ain branch)

This organises lectures and field excursions, promotes conservation and awareness of issues concerning the wildlife and cultural heritage (particularly archaeology) of the UAE, and publishes the bi-annual journal "Tribulus".

Dubai Natural History group

Much as the Emirates Natural History Group (above).

Emirates Environmental Group

A body lobbying and campaigning on environmental issues throughout the UAE. The Group also has an educational role.

Arabian Leopard Trust

A voluntary body concerned with the conservation of indigenous Arabian wildlife, specifically the large montane predators, but also endangered marine and desert mammals.

Emirates Bird Records Committee

This voluntary body coordinates national surveys and maintains a database of bird records which can be used to provide ecological advice to governmental and other bodies, both nationally and internationally.

e) Others

Abu Dhabi National Oil Company (ADNOC)

This oil company has a stated environmental commitment applicable to all its operations and those of the Group it controls. Independent consultants are often called in to undertake environmental assessments on the company's behalf, in advance of development or other operations.

Other oil companies

No information is available regarding any environmental undertakings of other oil companies in the UAE.

Individuals

A number of individuals privately pursue various conservation goals in the UAE.

International conservation organisations

Several international wetland and bird conservation organisations *e.g.* International Waterfowl and Wetlands Research Bureau, Asian Wetlands

Bureau, BirdLife International and Ornithological Society of the Middle East, already maintain or intend to appoint a regional or national representative or census coordinator for the UAE.

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WETLANDS

Site descriptions compiled by Simon Aspinall of the National Avian Research Center, Colin Richardson on behalf of NARC, and Peter Hellyer. Information is sparse for many islands and for some lower plant and animal groups in particular. The inventory includes several sites from which seabird colonies or other species of conservation concern have been displaced by human activities, since there is every possibility that restoration attempts, were they to be allowed, would be successful. The entire sea and land area is given for Sites 1-5, even though the water depth in intervening areas (separating many of the islands) may exceed six metres.

Abu al Abyadh/Dhabbiyah/Abu Dhabi Island Coastal Wetlands (1)

Location: Approximate central coordinates 24°20'N, 54°08'E. On the Arabian Gulf coast of Abu Dhabi Emirate, from Abu Dhabi Island in the east to Abu al Abyadh in the west.
Area: 263,000 ha.
Altitude: Sea-level to 6 m below and c.20 m above.
Overview: A vast area of low-lying islands, coastal sabkha and inter-tidal sand and mud flats with some native mangrove and extensive mangrove plantations, along the central Gulf coast of Abu Dhabi Emirate. Much of the site has been affected by urban and industrial development, and this is continuing, especially in the west and south. The area is one of high biological productivity, and supports internationally important numbers of waterfowl, notably migratory shorebirds, Crab Plover *Dromas ardeola* and terns *Sterna* spp.
Physical features: The site comprises the large area formed collectively by the islands of Abu Dhabi, the mudflats and mangroves around Dhabbiyah, and the intervening areas as far west as, and including, Abu al Abyadh island, the largest island in the UAE. The other principal islands are Futaisi, Bahrani and Bu Khushaysha. This vast area of low-lying coastal sabkha and islands with patchy but mature stands of mangrove and large expanses of inter-tidal flats is treated as a single unit on ecological grounds. The inter-tidal flats are predominantly of sand in the east, but

more muddy and organically rich in the west. A considerable amount of dredging has modified the area, more so between Dhabbiyah and Abu Dhabi itself than west of the former, and many new islands have been created. Much of the area has been developed, and this has been primarily at the expense of sabkha. Residential properties are all that is to be found in many sites, islands being distinctly preferred. Abu Dhabi island has little room left for industrial or other expansion, and new developments are now taking place further west at Dhabbiyah or to the south at Mussafah. Accessibility to some areas can be a problem, either because of physical difficulties or for reasons of security.

Ecological features: Apart from the extensive sabkha and inter-tidal flats, there are natural and planted mangrove, much of it mature. Only one species of mangrove, the Black Mangrove *Avicennia marina*, is present. Many islands, including some of those newly created, are now vegetated, *e.g.* particularly by various halophytic Chenopods, and some have been colonised by terns. Some reduced areas of coral persist, these having suffered from a fatal increase in turbidity.

Land tenure: Most of the mainland is owned or administered by the Abu Dhabi Municipality. Abu al Abyadh is owned by H.H. Crown Prince Sheikh Khalifa bin Zayed. Ownership of the many small islands is unclear, but appears to be resolved by permission being given to take up occupation or build a house.

Conservation measures taken: Only on the island of Abu al Abyadh have any conservation measures been taken. This island has been identified as an Important Bird Area (IBA) by BirdLife International; the wetland site includes the IBA in a much larger unit. The Crab Plover colony has been fenced off, and its protection has been assured by H.H. Crown Prince Sheikh Khalifa bin Zayed.

Conservation measures proposed: The size of this area and many existing land uses prevent emplacement of any major restrictions over much of it. A sensible land use policy and future structure plan should be developed. A tiered grading of conservation importance should be produced in map form. Particular areas may be designated as protected areas. Environmental impact assessments should meet stringent standards and be open to independent assessment. Mangrove planting needs to avoid areas holding significant shorebird populations. An atlas of important areas is to be prepared, and further survey work is to be conducted on breeding bird populations. Inclusion of the entire area as a site in this Directory and the island of Abu al Abyadh as an IBA will be brought to the attention of various appropriate individuals and organisations. A "leave alone" management policy would be appropriate for much of the area.

Land use: Residential building, recreation, mangrove planting and dredging for navigation are the principal activities. There is some industrial activity associated with oil support facilities and a small amount of fishing. There has been some recent exploration for onshore oil reserves.

Possible changes in land use: Development of sabkha and inter-tidal areas for commercial, residential and industrial purposes is likely to continue around Dhabbiyah in particular and between there and Abu Dhabi. There is increasing development on some small islands west of Abu Dhabi city, some of which are wholly or partly reclaimed.

Disturbances and threats: Dredging, mud-pumping and reclamation of inter-tidal and littoral areas are carried out without any consideration for wildlife (as at Dhabbiyah presently). Local eutrophication and pollution (including by oil) are clearly both serious threats. Wholesale mangrove planting following initial preparation of inter-tidal flats is reducing valuable feeding areas for shorebirds. Physical disturbance from the presence of humans is an increasing threat.

Unregulated illegal egg-collecting is commonly practised. The proliferation of introduced Egyptian Goose *Alopochen aegyptiacus* is not desirable ecologically, although they remain immensely popular and continue to be released widely. An "aquaculture" scheme is presently (autumn 1994) being planned west of Abu al Abyadh on the mainland, although the environmental consequences may or may not receive due consideration.

Hydrological and biophysical values: The area is one of high biological productivity and important for fish nurseries. Many molluscs and shellfish rely on this habitat to complete part or all of their life cycle.

Social and cultural values: The area has high social and cultural values on account of its history and long period of human habitation from at least early Islamic times to the present.

Noteworthy fauna: The area was formerly important for Dugong *Dugong dugon*, but this is now very rare or just a casual visitor (two were drowned in a net off Futaisi in December 1994). Cetaceans regularly recorded close inshore include Bottle-nosed Dolphin *Tursiops truncatus* and Indo-Pacific Humpback Dolphin *Sousa chinensis*. Green Turtle *Chelonia mydas* is numerous in the west of the area and may breed here (or in adjacent parts of Site 2). Over 20,000 waterfowl winter in the area, including internationally important numbers of at least four species of shorebird, namely Kentish Plover *Charadrius alexandrinus*, Lesser Sand Plover *Charadrius mongolus*, Whimbrel *Numenius phaeopus* and Redshank *Tringa totanus*. 40% (c.8,500 individuals) of the total shorebird numbers are on Abu al Abyadh alone, and this includes the bulk of the Whimbrel and Redshank numbers. Dhabbiyah supports over 5,000 shorebirds in autumn and mid-winter. Several thousand *Charadrius* plovers are present between Dhabbiyah and Abu al Abyadh inclusive. There is also, probably resident, an internationally important breeding and wintering number of Western Reef Heron *Egretta gularis*. Little Green Heron *Butorides striatus* also breeds here fairly commonly. During migration periods, Saunders's Little Tern *Sterna saundersi* gather at Dhabbiyah and on Abu al Abyadh; peak numbers in late autumn (4,000+) exceed 10% of the estimated Middle Eastern population. (Some Little Terns *S. albifrons* may be present in these aggregations). Dhabbiyah is important for Crab Plover *Dromas ardeola* during passage periods (before and after breeding on Abu al Abyadh), and the species is occasional there in summer.

Breeding bird populations include c.300 pairs of Crab Plover (on Abu al Abyadh), 100+ pairs of Saunders's Little Tern, several hundred pairs of White-cheeked Tern *Sterna repressa* and Bridled Terns *Sterna anaethetus*, and unknown but certainly significant numbers of Kentish Plover *Charadrius alexandrinus*. Three breeding pairs of Osprey *Pandion haliaetus* are known, but more may exist in unsurveyed areas.

Noteworthy flora: Extensive areas of mangrove. Some seagrass on inter-tidal areas in the west, sub-tidal areas and probably elsewhere.

Scientific research and facilities: Some research has been completed on mangroves, in a study sponsored by Shell (Al Ghais, pers. comm.). Breeding, wintering and migrant bird surveys have been conducted by the National Avian Research Center (NARC). Shorebird feeding ecology and ringing studies began in autumn 1994 under the aegis of NARC.

Management authority and jurisdiction: Not applicable.

References: Evans (1994). Also: NARC unpublished internal reports, other unpublished information, and personal observations and communication.

Reasons for inclusion: 1a, 2a, 2b, 2c, 3a, 3c.

Source: Simon Aspinall.

Sir Bani Yas and Satellites/Merawah/Khor al Bazm Sabkha, Coast and Islands (2)

Location: Approximate central coordinates 24°20'N, 53°05'E. On the Arabian Gulf coast of Abu Dhabi Emirate, from the region of Selaha Island in the east to Sir Bani Yas in the west.
Area: 478,000 ha, including sea area.
Altitude: Sea level to 6 metres below and a maximum of 10 m above.
Overview: A vast area of low-lying islands and islets, coastal sabkha, inter-tidal mudflats with native mangroves and saltmarsh vegetation, and shallow inshore waters with extensive seagrass beds, along the west-central Gulf coast of Abu Dhabi Emirate, immediately to the west of, and abutting, Site 1. Part of the site has been affected by urban and industrial development, but far less so than areas to the east. Biological productivity of the mangroves and mudflats is high, and the site supports internationally important numbers of migratory shorebirds, Crab Plover *Dromas ardeola* and breeding terns *Sterna* spp. The area is also important for cetaceans, Dugong *Dugong dugon* and sea turtles.
Physical features: The site comprises the sabkha coast and nearshore islands of Bu Tinah, Juneina, Merawah, Selaha, Sir Bani Yas, Umm Amim and 'Ushsh, along with a collection of mainly low sandy shoals and rocky islets. All are arid and sparsely vegetated. The inter-tidal areas include an extensive coastal sabkha edge and a large area of mudflats extending eastward from Merawah Island. This site is arbitrarily separated from Site 1 as far as present knowledge allows, although the division is reasonable for wintering shorebirds and breeding seabirds. Different authors, from differing fields, might well have proposed differing boundaries. In any case, this is not important as the two areas abut and there is no administrative or other confusing factor to contend with. Ownership between the two areas is different, however.
Ecological features: Much of the area remains in a natural state. Small islands are vegetated principally by Chenopods. The larger islands and some of the smaller ones have areas of well developed saltmarsh plant communities. Mangrove *Avicennia marina* occurs naturally on Merawah, Bu Tinah, Liffiyah and Bazm al Gharbi. Productivity along the mainland coast apparently lessens westward. The widespread coral development is still mainly in good condition. The two common seagrasses *Halophila uninervis* and *H. stipulacea*, as well as *H. ovalis*, appear to be particularly abundant around Merawah and Bu Tinah, and grow in water 1.5 m or less in depth, *H. uninervis* even surviving exposure at low water.
Land tenure: Most of the islands are privately owned by members of the Abu Dhabi ruling family or other dignitaries or VIPs, whereas the mainland coast falls mainly under the control of Abu Dhabi Municipality.
Conservation measures taken: Some island owners have been approached and informed of the numbers and value of the wildlife on their property. The owner of Bu Tinah, H.H. Sheikh Hamdan bin Zayed, has a strict protectionist policy toward the islands which he enforces. This extends not only to breeding birds, but also to nesting turtles. Fishing by means of gargour or fixed nets is also prevented in inshore waters. The island of Umm Amim and the three Sir Bani Yas "satellite" islands of Umm Qassar, Umm al Kirkum and Ghasha have been identified as

two separate Important Bird Areas (IBAs) by BirdLife International.

Conservation measures proposed: Inclusion of the entire area as a site in this Directory and designation of Umm Amim and the three Sir Bani Yas "satellite" islands as IBAs will be brought to the attention of various appropriate individuals and organisations. Representation is to be made to the Federal Environmental Agency and, as with Site 1, it is to be recommended that a sensible land use policy and future structure plan should be developed as a matter of priority. Formal recognition of the area is required. A "leave alone" management policy would be appropriate for much of the area.

Land use: House-building, some mangrove planting and dredging for new land are the principal activities. There are three sizeable and viable offshore oilfields present in the sea area included within, or overlapping, the boundary of the site. There is a large oil refinery at Ruwais and some industrial activity associated mainly with oil support facilities. A certain amount of fishing takes place.

Possible changes in land use: An increase in housing on both the coast and islands is likely. Reclamation is always possible. There is also likely to be an increase in cultivation and woodland plantations which are mostly not damaging to wildlife.

Disturbances and threats: Commercial, residential and industrial development. Ongoing dredging and reclamation of inter-tidal and littoral areas are being carried out without any consideration for wildlife. This has recently been the case off Mirfa, where extensive sub-tidal areas, including coral and seagrass areas, have been reclaimed, with resulting occlusion of neighbouring areas by sediment. The installation of irrigation and tree planting on arid islands is resulting in the destruction of seabird colonies, *e.g.* on 'Ushsh. Uncontrolled illegal collection of birds' eggs and possibly turtle eggs (and sometimes even of tern chicks) is a serious threat. Overfishing and the risk of oil pollution are further threats. Introduced and feral cats predate breeding seabirds. Feral pigeons *Columba livia* occur in very large numbers, and occupy nest sites which would otherwise be used by Bridled Terns *Sterna anaethetus*. The proliferation of the introduced Egyptian Goose *Alopochen aegyptiacus* is not desirable ecologically, although the birds remain immensely popular and continue to be released widely.

Hydrological and biophysical values: Important commercial fisheries. The area is one of high biological productivity and important for fish nurseries. Many molluscs and shellfish rely on this habitat to complete part or all of their life cycle.

Social and cultural values: The area has a long history of human occupation. Some outstanding archaeological sites have been examined and documented.

Noteworthy fauna: A herd of Dugong *Dugong dugon* is regularly reported between Merawah and Bu Tinah. Its exact size is unknown, but certainly numbers a few tens of individuals (personal observation, 1994). Bottle-nosed Dolphin *Tursiops truncatus* and Indo-Pacific Humpback Dolphin *Sousa chinensis* are regularly recorded, with many different groups or herds of both, the latter being the more numerous. Green Turtles *Chelonia mydas* breed on several of the islands, and there is a particularly large feeding concentration known around the Bu Tinah shoals. Merawah alone supports over 10,500 waterfowl in winter, including at least four species of shorebirds in internationally significant numbers, namely Crab Plover *Dromas ardeola* (495-528), Lesser Sand Plover *Charadrius mongolus* (1,145), Grey Plover *Pluvialis squatarola* (700-900) and Great Knot *Calidris tenuirostris* (300-600 on passage). The occurrence of the last-named is exceptional. Many of these birds roost on Merawah and feed both there and elsewhere, including on inter-tidal banks. Numbers of shorebirds in other sites

are mostly unknown, but may be very high, *e.g.* 1,500 *Charadrius mongolus* were counted on Bu Tinah in January 1995, a rarely visited site. The number of passage shorebirds exceeds those over-wintering.
Breeding birds include internationally important numbers of Lesser Crested Tern *Sterna bengalensis* (454 pairs), White-Cheeked Tern *S. repressa* (c.7,000 pairs) and Bridled Tern *S. anaethetus* (c.9,000 pairs). Several different sites are individually important, namely Ghasha, Selaha, Umm Amim, Umm Qassar and and 'Ushsh. Thirty pairs of Crab Plovers breed on Umm Amim. Saunders's Little Tern *Sterna saundersi*, Western Reef Heron *Egretta gularis*, Little Green Heron *Butorides striatus* and Kentish Plover *Charadrius alexandrinus* also breed widely, but population estimates are lacking. Three small colonies of Socotra Cormorants *Phalacrocorax nigrogularis* are known, two near Sir Bani Yas and the other close to Merawah, with 150, 300 and 80 pairs respectively in 1994/95. Seven or more pairs of Osprey *Pandion haliaetus* breed.
Coral communities are widespread and remain healthy.
Noteworthy flora: The mangrove areas and saltmarsh development are of particular interest. Seagrass beds are extensive above and below low-water.
Scientific research and facilities: Little or none other than archaeological and ornithological surveys. Shorebird feeding ecology and ringing studies began in autumn 1994.
Management authority and jurisdiction: Not applicable.
References: Evans (1994); Hellyer (1990). Also: unpublished internal NARC reports and data, and personal observations.
Reasons for inclusion: 1a, 2a, 2c, 3a & 3c.
Source: Simon Aspinall.

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Western Abu Dhabi Border Islands (3)

Location: Approximate central coordinates 24°20'N, 51°45'E. In the Arabian Gulf in western Abu Dhabi Emirate, extending to the borders with Saudi Arabia and Qatar.
Area: 455,000 ha, including sea area.
Altitude: Sea level to 6 m below low water and a maximum of 15 m above.
Overview: A collection of arid, sparsely vegetated rocky or sandy islands of variable size in the Arabian Gulf in western Abu Dhabi. Seabird numbers are of international importance.
Physical features: The site comprises a large number of predominantly rocky islands or island groups lying close to the Qatar or Saudi Arabian borders. The principal islands are the Yasat group, Ghagha, Muhaiyimat, Umm al Hatab, Jazirat Na'Itah, Kafai and Makhasib. Most sit on coral platforms and have raised beaches. Shell sand overlies most of the lower islands. Some of the islands, not necessarily the largest, have permanent habitation and a small resident human population, mostly border police.
Ecological features: Typical sparsely vegetated arid islands. A halophytic plant community is well developed. The widespread coral development is still mainly in good condition. There is a small plantation of mangrove on South Yasat.
Land tenure: Mainly state owned or belonging to members of the Abu Dhabi ruling family.

Access to several is restricted for reasons of military security.
Conservation measures taken: None. Yasat and Ghaghah have been identified as Important Bird Areas (IBAs) by BirdLife International.
Conservation measures proposed: Formal recognition of the area is required. Representation is to be made to the Federal Environmental Agency and, as with Sites 1 and 2, it is to be recommended that a sensible land use policy and future structure plan should be developed as a matter of priority. A "leave alone" management policy would be appropriate for much of the area.
Land use: State security and border policing, some commercial fishing, and egg-collecting in season.
Possible changes in land use: None of major significance, excepting the possibility of oil related developments.
Disturbances and threats: Human disturbance. Feral cats are already a problem on some islands, *e.g.* Kafai. The uncontrolled illegal collection of birds' eggs and possibly turtle eggs is a serious threat. Overfishing and the risk of oil pollution are further potential threats.
Hydrological and biophysical values: Important commercial fisheries.
Social and cultural values: The area has a long history of human occupation. Some archaeological sites, described as being of considerable significance, have been examined and documented. The area is also a strategic national frontier zone.
Noteworthy fauna: Green Turtles *Chelonia mydas* breed on several of the islands, although population estimates are not available. Dugong *Dugong dugon* may still occur. Herds and families of Bottle-nosed Dolphin *Tursiops truncatus* and Indo-Pacific Humpback Dolphin *Sousa chinensis* are numerous. The two species often consort. Numbers of several breeding seabirds are of international importance, and include 6,000-7,000 pairs of Socotra Cormorants *Phalacrocorax nigrogularis* in two colonies (1994/95 survey) and a single colony of terns with 4,050 pairs of Lesser Crested Terns *Sterna bengalensis*, c.6,000 pairs of White-cheeked Terns *S. repressa* and c.9,500 pairs of Bridled Terns *S. anaethetus*. A single pair of Caspian Terns *S. caspia* was found breeding on Jazirat Na' Itah in January 1995, the first proven breeding record for the UAE. Over forty pairs of Osprey *Pandion haliaetus* are known. Shorebird numbers are unknown, but are likely to be small. Western Reef Herons *Egretta gularis* breed on the ground on many of the islands.
Coral communities are intact and widely developed throughout the area. Many good examples exist.
Noteworthy flora: No information.
Scientific research and facilities: None, other than ornithological and archaeological surveys.
Management authority and jurisdiction: Not applicable.
References: Aspinall (1994); Evans (1994). Also: unpublished internal NARC reports and data.
Reasons for inclusion: 1a, 2a, 2c, 3a & 3c.
Source: Simon Aspinall.

Abu Dhabi's Offshore Islands (4)

Location: Five offshore islands in the Arabian Gulf in western Abu Dhabi Emirate: Dayyinah (24°56'N, 52°24'E); Qarnein (24°56'N, 52°52'E); Arzanah (24°47'N, 52°34'E), Zirku (24°53'N, 53°05'E) and Das (25°09'N, 52°52'E).
Area: 380,000 ha, including sea area.
Altitude: Sea level to 6 m below and c.160 m above. The maximum altitudes on the five islands are: less than 5 m on Dayyinah, 37 m on Das, 58 m on Qarnein, 66 m on Arzanah, and 160 m on Zirku.
Overview: A group of five small islands in the Arabian Gulf in western Abu Dhabi, separated from each other by relatively deep water. Three of the islands formerly held breeding colonies of Socotra Cormorants *Phalacrocorax nigrogularis*, but only that on Dayyinah still remains. The islands continue to hold internationally important breeding colonies of terns *Sterna* spp. The Red-billed Tropicbird *Phaethon aethereus indicus* still breeds on three islands, but in much reduced numbers on two of these. The likelihood of interchange between colonies is sufficient justification for lumping the islands together as a single site.
Physical and ecological features: Dayyinah is a low sandy and shelly island surrounded by pristine coral patches and platform. The other islands are all characterised by one or more hills or a central hilly core which have been punched up through the younger sedimentary rocks by salt diapirism. The hills on Qarnein are the most pronounced. Dayyinah and the low parts of Qarnein are vegetated by halophytic scrub, principally *Suaeda* and *Salsola*. Arzanah and Zirku have classic radial drainage features, although both are arid. Vegetation is sparser on the latter two islands. Das is similar to Qarnein. Coral development is widespread, and remains in good condition around Dayyinah and Qarnein at least (information lacking from the other three islands).
Land tenure: The oil company ZADCO, part of the ADNOC group, owns Zirku and Arzanah; H.H. Sheikh Hamdan bin Zayed owns Qarnein; Das is an oil and gas terminal also controlled by the ADNOC group; and Dayyinah seems to be unclaimed.
Conservation measures taken: The owner of Qarnein, H.H. Sheikh Hamdan bin Zayed, has a strict protectionist policy toward the island which he enforces. This extends not only to breeding birds but also to nesting turtles. Fishing by means of gargour or fixed nets is also prevented in inshore waters. Qarnein has been identified as an Important Bird Area (IBA) by BirdLife International. Apparently no specific measures have been taken on other islands.
Conservation measures proposed: Formal recognition of the conservation values of the islands is required. Representation is to be made to the Federal Environmental Agency and, as with Sites 1, 2 and 3, it is to be recommended that a sensible land use policy and future structure plan should be developed as a matter of priority. Restoration of the Socotra Cormorant and Red-billed Tropicbird colonies is a possibility, and perhaps of other species as well. A "leave alone" management policy would be appropriate for the undeveloped islands. Complete removal of cats (and rats) from all sites is recommended, and would be essential if the breeding colonies of seabirds are to be restored.
Land use: A resident human population is found on all of the islands except Dayyinah; that on Qarnein is usually less than twenty, whereas on the other three, numbers range from several hundred to 6,000 or more (on Das). Arzanah and Zirku are oil producing and off-loading islands. Qarnein is privately owned and used for recreation and holidays. Dayyinah is visited solely by egg-collectors or occasionally by fishermen during bad weather or for other reasons. Das is an oil-processing island. Four sizeable offshore oilfields exist within the boundary of the

site.

Possible changes in land use: The three oil islands have been largely developed, and the only possible change would be for the oil companies to leave. Qarnein is likely to be protected in perpetuity. Dayyinah lies on the border with Qatar, and is strategic yet undeveloped, possibly for that reason.

Disturbances and threats: Continued egg-collecting, release of cats or accidental introduction of rats. Cats are numerous on Zirku and Arzanah. Development on Zirku, Arzanah and Das has been at the expense of the breeding seabird populations and other wildlife, *e.g.* turtles. Oil pollution is an ever present threat. Hawksbill Turtles *Eretmochelys imbricata* have to be rescued from the seawater intake basin on Das. Rubbish on beaches may physically prevent turtles from coming ashore to lay their eggs.

Hydrological and biophysical values: None specifically described.

Social and cultural values: Archaeological sites exist on all the islands, although only those on Qarnein and Das have been investigated to date.

Noteworthy fauna: The islands support very large breeding colonies of seabirds. The breeding populations on Qarnein and Dayyinah total c.21,500 pairs of Bridled Terns *Sterna anaethetus*, 7,600 pairs of White-cheeked Terns *S. repressa*, 20,000 pairs of Lesser Crested Terns *S. bengalensis*, 1,200 pairs of Great Crested Terns *S. bergii*, 235+ pairs of Sooty Gulls *Larus hemprichii* (215+ on Qarnein and 20+ on Dayyinah), 50-60 pairs of Red-billed Tropicbirds *Phaethon aethereus* (Qarnein) and up to 8,000 pairs of Socotra Cormorants *Phalacrocorax nigrogularis* (Dayyinah). Bridled Terns and White-cheeked Terns nest on both islands, the former under halophytic scrub and the latter on the bare ground, while the Great Crested Terns and Lesser Crested Terns nest in a single colony on Qarnein. Red-billed Tropicbirds still survive and breed on Arzanah and Zirku; a single pair was located on the former and a maximum of 17 individuals recorded on the latter in January 1995. Red-billed Tropicbirds are known to have attempted to breed on Das, and may in fact do so successfully. Zirku held a colony of at least 15,000 pairs of Socotra Cormorants in 1972, but this colony has since been extirpated (since 1981), and the island has lost much of its seabird interest, *i.e.* all breeding terns. All the islands except possibly Das possess one or more pairs of breeding Ospreys *Pandion haliaetus*. Up to 1,600 *Larus hemprichii* have been recorded on Qarnein in mid-winter, and at least 365 Great Black-headed Gulls *Larus ichthyaetus* were found on Dayyinah in January 1995, an important concentration of this species.

Green Turtles *Chelonia mydas* breed on at least three of the islands, and Hawksbill Turtles *Eretmochelys imbricata* are reported to have nested on Dayyinah (Ross & Barwani, 1981).

Noteworthy flora: None especially notable, although the relatively luxurious *Salsola*/*Suaeda* community on Qarnein is well developed and well preserved.

Scientific research and facilities: Principally ornithological, botanical and archaeological surveys, with a limited amount of study of other groups.

Management authority and jurisdiction: See "Land tenure" above.

References: Emirates Natural History Group (1989); Evans (1994); Foxall (1985); Fraser (1981); Heath (1989); Reaney (1986); Ross & Barwani (1981). Also: unpublished records of the Emirates Bird Records Committee, NARC internal reports and unpublished data.

Reasons for inclusion: 1a, 2a, 2c, 3a & 3c.

Source: Simon Aspinall.

Dalma (5)

Location: 24°30'N, 52°18'E. In the Arabian Gulf about 40 km northwest of Jebel Dhana on the mainland coast of Abu Dhabi Emirate.
Area: 3,500 ha. The site excludes that part of the island which is developed.
Altitude: Sea level to 93 m above.
Overview: A small, hilly, offshore island in the Arabian Gulf, formerly of considerable importance for breeding seabirds, but now extensively modified, especially in the east and south, by reclamation, development and cultivation.
Physical features: Dalma is a "salt-dome" island with a central hilly core. The arid rocky landscape consists of undulating, mostly bare, hillocks and mounds with water-worn gullies and small crags up to 5 m in height. Sea cliffs in the west of the island have been cut off from the sea by road construction. Land in the extreme southern part of the island is under cultivation or has been developed, except for a narrow two km long reclaimed limb.
Ecological features: A typical arid Gulf island with sparse natural vegetation. Much of the island has been extensively modified by man, and there are large areas of irrigated cultivation and tree plantations.
Land tenure: Abu Dhabi Municipality.
Conservation measures taken: Dalma has been identified as an Important Bird Area (IBA) by BirdLife International, although not on account of its wetland values.
Conservation measures proposed: Protection of key areas of the undeveloped northwestern quarter of the island is desirable. An attempt should be made to restore the former seabird colonies.
Land use: Cultivation in the south of the island. A large commercial fishing fleet of traditional craft is housed here. There is also some usage for military purposes. A large oilfield is situated just to the east of Dalma.
Possible changes in land use: Further large-scale modification of the island landscape through reclamation and bulldozing of natural terrain for urban, industrial and agricultural development.
Disturbances and threats: Dredging and pumping to reclaim seabed off the east side of the island have destroyed much marine life including coral. Increased turbidity droguing downstream (eastward) away from island has doubtless affected the ecology further afield. No consideration has been given to the native wildlife, perhaps mainly because of a lack of awareness.
Hydrological and biophysical values: No information.
Social and cultural values: The island has a long history of occupation, dating back to at least 5,000 B.C.
Noteworthy fauna: Saunders's Little Terns *Sterna saundersi* continue to breed on reclaimed land. Socotra Cormorants *Phalacrocorax nigrogularis* roost and feed close to the island, and formerly bred in large numbers. This colony might be restorable. One pair of Osprey *Pandion haliaetus* breeds. Important non-wetland species include Sooty Falcon *Falco concolor* (five breeding pairs).
Noteworthy flora: None known.

Scientific research and facilities: Archaeological excavations were carried out in 1992-1994, and several ornithological surveys have been undertaken.
Management authority and jurisdiction: Abu Dhabi Municipality.
References: Evans (1994). Also: unpublished personal observations.
Reasons for inclusion: 1a & 2b (formerly 3c). Of importance for its shallow-water marine community and associated seabird avifauna.
Source: Simon Aspinall.

Eastern Abu Dhabi and Ras Ghanada Coastal Wetlands (6)

Location: 24°36'N, 54°33'E. On the Arabian Gulf coast of eastern Abu Dhabi Emirate, extending to the border with Dubai Emirate.
Area: 99,500 ha.
Altitude: Sea level to six m below and a maximum of 10 m above.
Overview: An extensive complex of islands, inter-tidal sand flats, mangroves and saltmarsh on the Arabian Gulf coast in eastern Abu Dhabi. The area is one of high biological productivity, and supports a rich and diverse avifauna.
Physical features: The site comprises a maze of islands and shallow water areas with mature mangroves and, on its landward side, an extensive sabkha. The principal islands are Sadiyat, Bal Ghelam, Ghanada, Ghurab, Hayl, Jubayl and Ramhan. Saltmarsh is well developed in places, and extensive sand flats are exposed at low water. Much of the area is undeveloped, although reclamation and dredging have altered much of the original mainland and inter-tidal areas. Some islands are now irreparably altered.
Ecological features: The western part of the area supports an extensive and relatively undisturbed natural mangrove formation with monospecific stands of the Black Mangrove *Avicennia marina*. Low sandy and shelly shoals and islands throughout much of the remainder of the site support scrubby halophytes.
Land tenure: Much of the land is state owned or occupied by state run companies. Some is in private ownership (mostly islands).
Conservation measures taken: H.H. Sheikh Zayed bin Sultan al Nahyan has ordered that part of the Eastern Lagoon immediately adjacent to Abu Dhabi island be protected.
Conservation measures proposed: Formal recognition of the area is required. Representation is to be made to the Federal Environmental Agency, and it is to be recommended that a sensible land use policy and future structure plan should be developed as a matter of priority. A "leave alone" management policy would be appropriate for much of the area.
Land use: Residential and industrial development locally.
Possible changes in land use: Continued development is likely.
Disturbances and threats: Reclamation and land use changes are the most likely threats along with the risk of pollution, particularly by oil. A power station at the site has unknown, but perhaps unimportant, effects on the area.
Hydrological and biophysical values: The area is one of high biological productivity and important for fish nurseries. Many molluscs and shellfish rely on this habitat to complete part or

all of their life cycle.
Social and cultural values: The area has a long history of human occupation.
Noteworthy fauna: The typical mangrove bird community includes unknown, but large, populations of Western Reef Heron *Egretta gularis*, Little Green Heron *Butorides striatus*, Kentish Plover *Charadrius alexandrinus* and Clamorous Reed Warbler *Acrocephalus stentoreus*; Booted Warbler *Hippolais caligata* may also occur. Wintering waterfowl include large numbers of roosting gulls (Laridae) and smaller numbers of shorebirds (Charadriidae and Scolopacidae). The higher salt flats and saltmarsh have breeding Lesser Short-toed Lark *Calandrella rufescens*, one of only two such sites known in the UAE (see also Site 13). The mangrove areas have large shellfish stocks and are doubtless important nursery areas for molluscs, fish and crustacea. The Indo-Pacific Humpback Dolphin *Sousa chinensis* occurs, while Green Turtles *Chelonia mydas* may breed in the east of the area, around Ras Ghanada.
Noteworthy flora: The extensive natural mangrove formations in western parts of the site remain relatively undisturbed.
Scientific research and facilities: Some studies and mapping of mangrove areas have been completed (Al Ghais, pers. comm.). Some archaeological survey work has been carried out (P. Hellyer, pers. comm.), and a number of avifaunal surveys have been undertaken.
Management authority and jurisdiction: Abu Dhabi Municipality and private landowners.
References: Personal communication and personal observations.
Reasons for inclusion: 1a, 2c & 3b. Large stands of mangrove, coastal protection and importance as a nursery area for shellfish and fin-fish.
Source: Simon Aspinall.

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Al Ghar Lakes (7)

Location: 24°15'N, 54°42'E. 40 km southeast of Abu Dhabi, in Abu Dhabi Emirate.
Area: At least 3,000 ha.
Altitude: Less than 20 m above sea level.
Overview: A group of enriched playa lakes on sabkha, partly maintained by bunding. The site is an important breeding, staging and wintering area for several species of shorebirds and terns, and was the site of a breeding attempt by Greater Flamingos *Phoenicopterus ruber* in 1993.
Physical features: A flat area of sabkha, variously flooded throughout the year and subject to rapid changes brought about by diversion of water, cutting off of water supply and realignment of bunds. The salinity and temperature increase to summer highs. Some surface water remains year-round, but only because of artificial bunding. The maximum depth is two metres. A new lake was formed in 1994 from treated effluent from a new sewage plant, and this is proving attractive to waterfowl.
Ecological features: Algal growth is prolific in the lakes, but elsewhere, the vegetation cover is almost non-existent. Sewage inflow, now cut-off or allowed to flow only intermittently, formerly greatly enriched the site.
Land tenure: Abu Dhabi Municipality.
Conservation measures taken: Hunting (shooting) is not allowed.

Conservation measures proposed: Proposals have been put forward to develop the site for wildlife by management of appropriate water levels, enforcing protection and preventing disturbance. Fencing off would be desirable and is now partially completed. A variety of compatible recreational pursuits are to be promoted along with the above proposal. Restoration of the lakes here or close by is quite feasible and plans are already afoot.
Land use: The area is regarded as "wasteland", and is frequently visited by bulldozers and lorries variously removing or delivering sand.
Possible changes in land use: Some building development is likely. Factories, engineering workshops and repair works could easily spring up locally. These can shift site or arrive from other areas. Landfill may be brought on site.
Disturbances and threats: Landfill for development is the principal threat. Much of the site was infilled in autumn 1993 against directions by a member of the Abu Dhabi ruling family. Persecution of wildlife and human disturbance continue to cause problems. Groundwater contamination from toxic waste is a possibility.
Hydrological and biophysical values: No information.
Social and cultural values: The lakes are the only known site in mainland Arabia where the Greater Flamingo has attempted to breed. This species has considerable appeal amongst both nationals and expatriates living in the Gulf.
Noteworthy fauna: Greater Flamingos *Phoenicopterus ruber* bred unsuccessfully in 1993 (Aspinall & Hirschfeld, 1993). This breeding attempt was the first such attempt in the Arabian peninsula since the species bred on Bubiyan Island off Kuwait in 1922. The site supports regionally important numbers of breeding Black-winged Stilts *Himantopus himantopus* (60-100 pairs annually and possibly over 200 pairs in 1992 and 1993; P. Hellyer pers. comm.). This is one of the two largest concentrations of the species in the UAE (see also Site 10). Other breeding birds include 100+ pairs of Kentish Plover *Charadrius alexandrinus*. Large numbers of shorebirds, notably *Calidris* spp. and marsh terns *Chlidonias* spp., occur on spring and autumn passage and in winter. Particularly significant populations are of Kentish Plover (c.1,400) and Little Stint *Calidris minuta* (c.1,200). The Monitor Lizard *Varanus griseus* and Red Fox *Vulpes vulpes* occur in the area. Chironomid larvae and other aquatic invertebrates occur in profusion.
Noteworthy flora: None known.
Scientific research and facilities: None, other than occasional avifaunal surveys.
Management authority and jurisdiction: Not applicable as such. The Abu Dhabi Municipality would presumably continue to run the site under direction.
References: Aspinall & Hirschfeld (1993). Also: unpublished data held by the Emirates Bird Records Committee (including IWRB waterfowl census data).
Reasons for inclusion: 1a, 2b & 3c. A possible breeding site for the Greater Flamingo (the only such site in mainland Arabia), and an important breeding, passage and over-wintering site for several species of shorebirds.
Source: Simon Aspinall.

Sir Abu Nu'air (8)

Location: 25°13'N, 54°14'E. In the Arabian Gulf, 75 km from the mainland coast of Abu Dhabi, Abu Dhabi Emirate.
Area: 1,500 ha.
Altitude: From sea level to 81 m.
Overview: A small, rocky, offshore island in the Arabian Gulf, uninhabited until the early 1980s and, at least formerly, of considerable importance for breeding seabirds. Much of the island has recently been developed as a military base, and it is feared that many of the breeding seabirds have been displaced, but no detailed avifaunal surveys have been carried out since the 1970s.
Physical features: Approximately 4 km in diameter, the island of Sir Abu Nu'air is almost-pear-shaped with a protruding spit to the south. The mountainous central area, described geologically as a salt dome, includes some igneous rocks criss-crossed by small ravines, wadis and rocky outcrops which run down to the sea along most of the shoreline. There are, however, some areas up to 300 metres wide of less-sloping, flat, open areas of stony ground, with isolated clumps of low-thorny scrub. These provide suitable habitat for nesting seabirds of several species. The island has no natural water, and there is very low annual rainfall. The stony surface of the mountains does not absorb water, and all rain quickly runs off into sea, although some may drain into surrounding sand and gravel, giving rise to a richer flora.
Ecological features: The flora is at a peak in winter, and can be seen at its best following rain. Low cliffs on the south side are dominated by *Suaeda vermiculata*, which forms a thick barrier up to one metre high and impenetrable in places. This species forms a belt overhanging the cliff ledge and stretching inland irregularly for some ten metres. Where the limestone ledge gives way to gravels and rougher terrain, the vegetation is less thick and annuals are conspicuous, including *Malva parviflora* up to 20 cm tall in relatively sheltered spots. Large patches of *Argyrolobium roseum* occur on softer sand, and there are distinct but small clumps of *Lotus schimperi* and *Lotonis platycarpa*. The whole area is interspersed with tiny patches of *Zygophyllum simplex*, occasionally linking to form larger mats. Further inland, the ground is rougher with a series of clefts and jagged-sided mini-wadis aligned radially from the centre of the island to the sea. The major plant associations are *Salsola* (*S. baryosma*, *S. schweinfurthii* and *S. tetranda*) along with minor patches of *A. roseum* and *Z. simplex* (this latter only in sand and wadi beds). The broken mini-plateau between these fissures is dominated in this zone by *Capparis spinosa*, with individual shrubs up to one metre across and 50 cm high, and even more so by *Reseda aucheri* up to 90 cm high, especially in more open areas. Numerous *Zygophyllum mandivillei* are in evidence with their twisted gnarled stems. In this same zone, but less prolific, are a number of individual specimens of *Convolvulus cf. prostratus*, and dotted among these are small patches of *Polycarpea repens*. Towards the north coast of the island are the remains of an old stone cistern, full of tall grasses and shaded by the only tree on the island, a 4 metre tall *Zizyphus spina-christi*, presumably planted to provide shade. This immediate locality remains a small catchment area for water run-off. The western and northern sides of the island are comparatively bare with occasional clumps of *S. vermiculata* and rare patches of annuals. The projecting sand spit to the south is generally bare but for a few *Salsola* spp. dotted here and there (Western, 1983).
Land tenure: Administered by the Emirate of Sharjah.
Conservation measures taken: None.

Conservation measures proposed: Future development and encroachment on any remaining seabird habitat or areas of important flora should be discouraged, and measures to restore natural areas should be encouraged. Restoration of seabird colonies should also be attempted.
Land use: The island was still uninhabited, except for some fishermen's shacks, in December 1983 (Western, 1983). Rapidly developed since 1983, the island now holds a military base, with asphalt roads providing easy access to most parts of the island.
Possible changes in land use: Not known, but likely to be further developed *e.g.* for national security.
Disturbances and threats: Although strategically located adjacent to one of the world's busiest shipping lanes, with loaded tankers carrying oil from the adjacent oil-rich states, the island did not become a target for development until the early 1980s. However, it is now believed that the island has been changed considerably due to military development, and may already have lost most if not all of its indigenous fauna and flora and some of its original coastline. Levels of human disturbance are high, and the building of roads, runways and various military installations has displaced seabird colonies. Egg collectors have also reduced breeding success of the larger terns such as Lesser Crested and Great Crested Tern (see below). Western (1983) reported that the island had mice, presumed to be the House Mouse *Mus musculus*, and possibly feral cats.
Hydrological and biophysical values: None known.
Social and cultural values: There is evidence of earlier occupation and some archaeological artifacts, although much has been lost as a result of development.
Noteworthy fauna: Several species of seabirds were recorded nesting on the island in 1970 and 1971, and one internationally threatened species, the Socotra Cormorant *Phalacrocorax nigrogularis*, was still found to be nesting in 1987. The present situation is unknown, but it seems likely that many of the seabirds have deserted the island as a result of disturbance and destruction of their nesting grounds by recent development. The following species have been recorded breeding on the island:

Red-billed Tropicbird *Phaethon aethereus*: One bird was incubating its single egg in a pile of rocks on the north of the island on 10 June 1971.

Socotra Cormorant *Phalacrocorax nigrogularis*: A colony was still using the island in autumn 1987. The population was estimated (from photographs) at several thousand birds in November 1983. The island is also an important roosting site for the species outside the breeding season.

Sooty Gull *Larus hemprichii*: Scattered pairs at the north end; six nests were found in June 1971, but the exact number of pairs was not known.

Great Crested Tern *Sterna bergii*: 2,000 pairs counted on 19 June 1970. The colony was not present in June 1971, and is presumed to have been disturbed by egg-collectors who were on the island at the time.

Lesser Crested Tern *S. bengalensis*: 300-400 pairs present in June 1970. None in June 1971.

White-cheeked Tern *S. repressa*: 30-40 pairs June 1970 and June 1971.

Bridled Tern *S. anaethetus*: "thousands" breeding all over the island in June 1970 and June 1971.

Noteworthy flora: See "Ecological features" for all flora noted on the island in December 1982 (Western, 1983)
Scientific research and facilities: Much of the available information on the island's flora and

fauna comes from visits by amateur naturalists in 1969, 1970, 1971 and 1982. Information on its condition in the 1990s has been obtained from visiting expatriates and local fishermen. Attempts are under way to gain permission to revisit the island in 1995 in order to assess its current condition.
Management authority and jurisdiction: Government of Sharjah.
References: Cowley (1971); Morris (1969); Western (1983).
Reasons for inclusion: 1a, 2b, 2c & 3c. The island was (and may still be) one of only three or four sites in the UAE where the Red-billed Tropicbird nests. It is also one of only three known breeding sites for the Sooty Gull and Great Crested Tern in the UAE. Socotra Cormorant, a species endemic to Arabia, is now having great difficulty in finding safe islands for nesting, and may face extinction unless islands such as this are adequately protected.
Source: Colin Richardson.

Khor Dubai and Zabeel Water Treatment Plant (9)

Location: 25°12'N, 55°20'E. On the outskirts of Dubai city, Dubai Emirate.
Area: Approximately 2,000 ha.
Altitude: Sea level.
Overview: The tidal creek and extensive mudflats of Khor Dubai are well-known as one of the most important wetlands in the Emirates, regularly supporting hundreds of Greater Flamingos and thousands of other waterbirds. At least nine species of birds occur in internationally important numbers, including Lesser Sand Plover *Charadrius mongolus*, Kentish Plover *C. alexandrinus* and Broad-billed Sandpiper *Limicola falcinellus*. Formerly, there was no natural vegetation at the Khor, but in late 1993, several thousand mangrove shoots were planted by the local authority, without thought for the possible detrimental effect this may have on the ecology of the site. The four large ponds at Zabeel water treatment plant are an important feeding area for birds which also use Khor Dubai.
Physical features: The site known as Khor Dubai is an area of shallow mudflats at the head of a curved tidal creek, some 10 km long, which penetrates seven km inland from the Arabian Gulf through the city of Dubai. The tidal range is 1.0 to 1.5 metres. About 150 ha of tidal mudflats are exposed at low water; at high water, the tidal lagoon has a maximum depth of about two metres. Flat sabkha (saturated salt flats) surrounds the inter-tidal area; there is some halophytic scrub above the high-water mark, and some *Tamarix* in disturbed areas. About 50% of the inter-tidal zone was planted with mangroves in 1993/4, and this area is now carpeted with young mangrove shoots. The inter-tidal zone supports an abundant macrobenthic fauna of low diversity. There is nutrient enrichment from irrigation run-off and sewage effluent, and a permanent flow of piped "super" saline water from a groundwater pumping system. The adjacent area of Zabeel is a prehistoric extension of the estuary, and consists of saturated salt flats with interspersed sand dunes. A water treatment plant with four large ponds has been built around some of the higher dunes. Fresh water is allowed to overflow from the irrigation ponds (which are also stocked with fish) on to the surrounding sabkha. This has allowed a small forest of trees and a substantial reed-bed to form, increasing the diversity of birds and other creatures.

The whole site, including Zabeel water treatment plant, spans a main road and is bounded by two other main roads and an industrial area.

Ecological features: Large patches of *Lippia nodiflora* are found at pond edges, while the surrounding dunes have congregations of *Cynomorium coccineum* and *Cistanche tubulosa*. Naturally occurring Ghaf *Prosopis cineraria* is the largest tree to be found, while the largest bush is *Pluchea ovalis*. Introduced mesquite *Prosopis juliflora* grows rapidly, and is regularly cleared by the authorities. The dunes support a number of grasses and small shrubs, while salt-tolerant halophytes have colonised the sabkha. The reed-beds at Zabeel water treatment plant contain *Phragmites australis* and *Typha domingensis*.

Land tenure: The land is owned by the country's Defence Minister and Crown Prince of Dubai, H.H. General Sheikh Mohammed Bin Rashid Al Maktoum.

Conservation measures taken: Khor Dubai is protected from intrusion by a Police Guard. Signs have been erected by Dubai Municipality who now recognise the site as a Bird Sanctuary under local Decree. However, full power regarding any decision to change all or part of the site is retained locally, *i.e.* outside Municipality control. The water treatment plant is rather erratically managed (*i.e.* gardened and tidied), partly with the birds in mind, but will remain as an important site for as long as the treatment plant is in use. There are no immediate plans to close it. The only wild species of tree on the site, *Prosopis cineraria*, is protected by law, although many are pruned annually as the cuttings are of nutritional value to camels. The entire site, including Zabeel, has been identified as an Important Bird Area (IBA) by BirdLife International.

Conservation measures proposed: Various proposals have been made to the owner concerning management of the site, but none of the recent proposals has been implemented. A "leave alone" management policy would be appropriate for much of the area.

Land use: Private land currently with no development, except for the owner's Palace. The Khor is used for water-skiing and some boating. Fishing has recently been banned near the Bird Sanctuary.

Possible changes in land use: There are unconfirmed development plans for a leisure complex around the eastern boundary of the site. No other development plans have been announced for the area within the site boundary.

Disturbances and threats: The threats to Khor Dubai include human disturbance, especially at weekends, when visitors sometimes walk onto the mudflats to approach the flamingos. Four-wheel drive vehicles are regularly driven onto the mudflats, and the occupants occasionally shoot at birds when the police are absent. The biggest threat is currently the mangrove plantation and associated earthworks, which have damaged much of the inter-tidal zone and inhibited the natural tidal flow. The risk of serious pollution is high because of the proximity of the site to Dubai city and enclosed nature of the water body.

Social and cultural values: The mouth and seaward end of the khor are of major importance for dhow traffic and trading of anything from fruit and fish to dishwashers and other electrical goods.

Noteworthy fauna: Khor Dubai is an extremely important staging and wintering area for migratory waterbirds. The open mudflats with slack tides and nutrient enrichment have contributed to make the site important feeding grounds for Arctic shorebirds and a major winter roost for gulls. There are large concentrations of herons, which often commute between the Khor and the water treatment plant, where an abundant supply of introduced *Tilapia* may help

purify the water. Of species which occur in numbers exceeding 1% of the region's wintering population, Grey Heron *Ardea cinerea*, Greater Flamingo *Phoenicopterus ruber*, Kentish Plover *Charadrius alexandrinus*, Greater Sand Plover *C. leschenaultii*, Lesser Sand Plover *C. mongolus*, Redshank *Tringa totanus*, Grey Plover *Pluvialis squatarola* and Black-headed Gull *Larus ridibundus* are the most common at Khor Dubai. The site attracts up to 20% of the known Fenno-Scandinavian population of Broad-billed Sandpiper *Limicola falcinellus* in autumn. It hosts the largest wintering populations of Mallard *Anas platyrhynchos*, Pintail *A. acuta*, Common Teal *A. crecca* and Wigeon *A. penelope* in the UAE, and a wider variety of birds of prey than anywhere else in the country. Twenty different species of raptor have been recorded at Zabeel water treatment plant, including Imperial Eagle *Aquila heliaca*, Spotted Eagle *A. clanga* (regularly 2-3, maximum 6) and Lesser Kestrel *Falco naumanni*, while 11 species of heron and 13 species of duck, including Ferruginous Duck *Aythya nyroca* (maximum 3) are likely to be found in the course of each year. The overgrown area of trees and reeds adjacent to the fish ponds is a regular breeding site for Little Grebe *Tachybaptus ruficollis*, Moorhen *Gallinula chloropus* and Black-crowned Night Heron *Nycticorax nycticorax* (one of only two breeding sites in Arabia). The reed-beds also hold several breeding pairs of Reed Warbler *Acrocephalus scirpaceus*, which is known to breed at only four other sites in Arabia. Stone Curlew *Burhinus oedicnemus* occurs (and is often hunted) in the dune area within the site, and Houbara Bustard *Chlamydotis undulata* has been reported nearby. A total of 185 species of birds has been recorded at the site in the last twenty years.

Noteworthy flora: Zabeel water treatment plant is the only known site in the UAE for *Heliotropium ?aurassivorum*.

Scientific research and facilities: Numerous waterfowl counts and shorebird surveys have been carried out at the site, and the non-breeding population of Greater Flamingos has been the subject of special study.

Management authority and jurisdiction: H.H. Sheikh Mohammed bin Rashid al Maktoum.

References: DSP (1987); Evans (1994); Jongbloed (1987); Moser (1985); Richardson (1990a, 1992); Smart *et al.* (1983); Uttley *et al.* (1988); Western (1989). Also: IWRB (Asian Waterfowl Census) Counts 1990-94.

Reasons for inclusion: 1a, 2b & 3c. Khor Dubai has a unique natural ecology and attracts internationally significant numbers of several species of waterfowl, notably Broad-billed Sandpiper. The Zabeel water treatment plant is a migrant trap for most Palearctic wetland species occurring in the UAE, and attracts a wide selection of rare birds of prey and passerines.

Source: Colin Richardson.

Ramtha Lagoons (10)

Location: 25°22'N, 55°27'E. 5 km inland, on the border between Sharjah and Ajman Emirates, adjacent to the main coastal highway to Ras al Khaimah, Sharjah Emirate.

Area: c.250 ha.

Altitude: Sea level to 10 m.

Overview: A group of sewage ponds and seepage lagoons with some marsh vegetation, near

the coast in Sharjah Emirate; very important for breeding, passage and wintering waterfowl.
Physical features: The site comprises a group of four large man-made septic ponds which seep into a large area of saturated salt flats at low level, enriching them and creating a complex of running streams and small to large lagoons, some of which are bordered by reeds and mesquite trees. Scrub-covered sand dunes, up to 10 m in height, occur towards the inland end of the site, where sludge tankers dump their waste. Liquid waste has been dumped since the early 1980s, with the quantity increasing as Sharjah expands. The largest lagoon, bounded by a main road, is now 1,000 m by 800 m in size.
Ecological features: Seepage from the four large polluted ponds feeds extensive beds of *Phragmites australis (communis)* and copses of *Prosopis juliflora*.
Land tenure: Government of Sharjah.
Conservation measures taken: None, other than private discussions with the office of the Ruler (see below), and recognition of the site as an Important Bird Area (IBA) by BirdLife International.
Conservation measures proposed: Proposals were made to H.H. Dr Sheikh Sultan bin Mohammed Al Qassimi, the Ruler of Sharjah, in 1993 regarding the importance of the site as a wetland habitat, and the possible creation of a bird sanctuary for scientific and educational purposes. Unfortunately, on inspection of the site (where there are very large amounts of builders' rubble and discarded scrap), this recommendation was unacceptable or at least not favoured.
Land use: The site is used for the disposal of sewage and as a rubbish dump.
Possible changes in land use: At present, water does not drain away because of the high water table. The accumulation of polluted water adjacent to a main road is considered to be a nuisance and a health hazard. The Sheikh's engineer has suggested that a hydrological survey might be undertaken to find ways of draining the water or re-using the water for irrigation purposes. It is also rumoured that the land will be sold to developers when an alternative dumping site is found, in which case the site is likely to be used for private housing.
Disturbances and threats: Currently shooting, oil and chemical pollution, and bulldozing by municipal workers.
Hydrological and biophysical values: None known.
Social and cultural values: None.
Noteworthy fauna: Ramtha Lagoons are remarkable for their extremely rich and diverse birdlife. A total of 118 species of birds has been recorded at the site. The wetland supports one of the two largest breeding colonies of Black-winged Stilts *Himantopus himantopus* in the UAE, with 60-80 pairs (see also Site 6), and is one of the few nesting sites in the UAE for Moorhen *Gallinula chloropus* and Reed Warbler *Acrocephalus scirpaceus*. Little Grebes *Tachybaptus ruficollis* first bred in 1990 and are now resident in the area. Over 10 pairs of Red-wattled Lapwing *Vanellus indicus* are also resident. The largest lagoon usually hosts a non-breeding flock of up to 80 Greater Flamingo *Phoenicopterus ruber* throughout the year, but as many as 400 have been recorded. This lagoon also holds about 100 Black-necked Grebe *Podiceps nigricollis* in winter, and over 50 Whiskered Tern *Chlidonias hybridus* and White-winged Black Tern *C. leucopterus* on migration. The wetland also holds large wintering concentrations of Western Reef Heron *Egretta gularis* (up to 150), Great Egret *E. alba*, Shoveler *Anas clypeata* and Ruff *Philomachus pugnax*, along with smaller numbers of wintering Black-crowned Night Heron *Nycticorax nycticorax* (up to 40), Glossy Ibis *Plegadis*

falcinellus, Pochard *Aythya ferina*, White-tailed Plover *Vanellus leucurus* (up to 13), Green Sandpiper *Tringa ochropus*, Temminck's Stint *Calidris temminckii*, Common Kingfisher *Alcedo atthis* and Citrine Wagtail *Motacilla citreola*. In autumn, over 120 Saunders's Little Terns *Sterna saundersi* congregate to feed and roost. The reed-beds are favoured by hundreds of hirundines on autumn and spring passage, and are an important site for some of the shyer species of waterfowl, there being regular records of Little Crake *Porzana parva*, Baillon's Crake *P. pusilla* and Spotted Crake *P. porzana*, as well as Little Bittern *Ixobrychus minutus* and Water Rail *Rallus aquaticus*. A White-breasted Waterhen *Amaurornis phoenicurus* wintered in the area in 1992/93, and an Intermediate Egret *Egretta intermedia* wintered there in 1994/95; both were first records for the UAE. The large size of the site regularly attracts rare vagrants, including Sacred Ibis *Threskiornis aethiopicus*, Greylag Goose *Anser anser*, Ruddy Shelduck *Tadorna ferruginea*, Red-crested Pochard *Netta rufina*, Sabine's Gull *Xema sabini*, Pied Kingfisher *Ceryle rudis* and White-breasted Kingfisher *Halcyon smyrnensis*. Marsh Harrier *Circus aeruginosus* and Spotted Eagle *Aquila clanga* (as many as 3 or 4) regularly overwinter or occur during the passage periods. Imperial Eagle *A. heliaca* is occasionally recorded. Other fauna noted at the site includes Arabian Red Fox *Vulpes vulpes arabica*. An Arabian Wolf *Canis lupus arabs* or wolf/feral dog hybrid was reportedly seen there in about 1990. The seepage lagoons and streams support small fish (species unknown).

Noteworthy flora: None known.

Scientific research and facilities: Numerous bird surveys and waterfowl counts have been carried out at the site.

Management authority and jurisdiction: Sharjah Municipality, Drainage and Sewerage Department.

References: Evans (1994); Richardson (1990a, 1991).

Reasons for inclusion: 1d, 2b & 3c. The site holds a greater variety of waterbirds than any other wetland in the UAE, and is the only regular wintering area for many of these. It regularly holds over 1% of the regional breeding population of Black-winged Stilt, and has one of the largest non-breeding populations of Western Reef Heron in the country.

Source: Colin Richardson and Simon Aspinall.

Khor Ajman and Khor Zawra (11)

Location: 25°23'N, 55°26'E. On the Arabian Gulf coast in Ajman Emirate, north of Sharjah Emirate.

Area: Approximately 3,000 ha.

Altitude: Sea level.

Overview: A series of relatively small, undeveloped connected khors snaking inland approximately 4 km from the Gulf coastline. Western Reef Heron *Egretta gularis* and Greater Flamingo *Phoenicopterus ruber* are regular, but fringing sand dunes inhibit many migrant shorebirds from staying long on passage.

Physical features: A typical Gulf "khor" with a low tidal range (mean 1.4 m), exposing up to 150 ha of inter-tidal mud. The depth of the khor various from 5 m at is mouth to less than 2 m at

its inland side. Young mangroves dot the mean tide line, and the khor is fringed by halophytic scrub. Coastal sand dunes rise to a height of 10 m around the inland edge of the khor. Khor Ajman is an arm of Khor Zawra, and together these encircle and isolate a large, low, flat island with sparse vegetation.
Ecological features: A mesotrophic tidal inlet, typical of the Gulf coastline. The typical salt-flat flora includes *Cornulaca monacantha*, *Heliotropium kotschyi*, *Zygophyllum mandivillei*, *Halopeplis perfoliata*, *Anabasis setifera* and *Halocnemum strobilaceum*.
Land tenure: Government of Ajman.
Conservation measures taken: None.
Conservation measures proposed: Part of the site should be set aside as an undisturbed wildlife sanctuary. An undisturbed area should be set aside for breeding turtles.
Land use: Building development is approaching the area from the city of Ajman which is only two km distant.
Possible changes in land use: As elsewhere in the UAE, reclamation or dredging are possible.
Disturbances and threats: There is some persecution of the Green Turtles which come ashore near the Khor mouth.
Hydrological and biophysical values: No information.
Social and cultural values: No information.
Noteworthy fauna: An important staging area for migratory shorebirds. Some 5,000-6,000 shorebirds were recorded in February 1975 (Carp, 1976). Only about 100 shorebirds, mostly *Charadrius* plovers, Eurasian Curlews *Numenius arquata* and *Calidris* sandpipers were present in October and November 1986. In September 1987, there were 582 shorebirds and a roost of 233 terns (mostly *Sterna sandvicensis*). Green Turtles *Chelonia mydas* come ashore east of the khor mouth.
Noteworthy flora: The site is well-known locally for "faqut" or truffles, which benefit from the presence of *Helianthemum lippii*.
Scientific research and facilities: Some archaeological surveys have been undertaken to the east of the area.
Management authority and jurisdiction: Government of Ajman.
References: Carp (1976); Jongbloed (1987); Uttley *et al.* (1988); Western (1989). Also: Emirates Bird Records Committee files.
Reasons for inclusion: 1a & 2b. One of the few creeks in the UAE that is practically untouched by man's activities.
Source: Colin Richardson.

Khor al Beidah (12)

Location: 25°32'N, 55°38'E. On the Arabian Gulf coast east of Umm al Qaiwain city and on the landward (southeast) side of Sinaiya Island, Umm al Qaiwain Emirate.
Area: 5,000-7,500 ha.
Altitude: Sea level.
Overview: A large area of mudflats, islands and mangroves, bounded by desert to the south and

east and by low-lying islands to the seaward side. Khor al Beidah holds the country's largest wintering flock of Crab Plover *Dromas ardeola*. Some of the smaller islands have dense mangrove, where Western Reef Heron *Egretta gularis* and possibly White-cheeked Tern *Sterna repressa* and Clamorous Reed Warbler *Acrocephalus stentoreus* nest.

Physical features: Khor al Beidah comprises a vast complex of lagoons, 20 km long by an average of 4 km wide, with about 25 low sandy islands, each of less than 50 ha in extent except for the three mangrove-covered round islands of Jazirat al Ghubbah (Ghallah), which are between one and two km in diameter. The khor is sheltered by the peninsula of Umm al Qaiwain and Sinaiya Island to the seaward side (northwest). Large portions of the extensive mudflats and adjacent soft saturated salt flats are inaccessible on foot, and remain poorly known. The site does not include Sinaiya Island, which is described separately as Site 13.

Ecological features: Virtually the whole lagoon and island complex is in good, original condition, with no signs of pollution or intrusion by development. The mangrove *Avicennia marina*, Ghaf *Prosopis cineraria* and several species of perennial and annual halophyte are the dominant plants.

Land tenure: Government of Umm al Qaiwain.

Conservation measures taken: None, other than recognition of the site as an Important Bird Area (IBA) by BirdLife International.

Conservation measures proposed: The importance of the site should be drawn to the attention of local officials, and representation should be made via the Federal Environmental Agency on potentially damaging activities. A management plan should be drawn up at the earliest possible opportunity for the entire site and neighbouring Sinaiya Island (Site 13). A "leave alone" management policy would be appropriate for much of the area.

Land use: The lagoons are important fishing grounds for the fishermen of Umm al Qaiwain. The mud is dug up and crabs (or other kinds of shellfish) are collected by local people at weekends. There is currently no building development nearby, except for the Ruler's palace, which has been built at the south end of the lagoon. The area is used for various recreational pursuits, including water sports, at weekends.

Possible changes in land use: None known.

Disturbances and threats: Some builder's spoil has been pushed onto the mudflats near the Ruler's palace at the south end of the lagoon. The area is regularly overflown by micro-lite aircraft and military helicopters which cause considerable disturbance to the birds, and there is also some disturbance from speed boats. Shooting of birds by local people has been a problem in the past, but no shooting has been reported in the last two years. The uncontrolled driving of vehicles over the dunes and mudflats is a constant problem, and has caused some damage to the fragile ecology of the area. However, much of the area is still relatively undisturbed by people as it is far enough away from major centres of population (*e.g.* it is one hour from Dubai).

Hydrological and biophysical values: No information.

Social and cultural values: Falcon trapping, crab fishing and picnicking. There are important archaeological sites nearby.

Noteworthy fauna: Khor al Beidah is an important area for wildlife. About 85 species of birds have been recorded. Over 10,000 shorebirds were recorded on migration in 1986 (Uttley *et al.*, 1988), including 1,300 Eurasian Curlews *Numenius arquata*. There is a major influx of shorebirds from late July, when the most common species are Kentish Plover *Charadrius alexandrinus*, Lesser Sand Plover *C. mongolus*, Greater Sand Plover *C. leschenaultii*, Curlew

Sandpiper *Calidris ferruginea*, Bar-tailed Godwit *Limosa lapponica* and Redshank *Tringa totanus*. The site is also favoured by wintering Oystercatcher *Haematopus ostralegus*, Great Knot *Calidris tenuirostris*, Whimbrel *Numenius phaeopus*, Ruddy Turnstone *Arenaria interpres* and Terek Sandpiper *Xenus cinereus*. A few Oystercatchers remain throughout the summer. It is the most important site for Crab Plover *Dromas ardeola* in the Northern Emirates, with hundreds present from August to March. The most important area for shorebirds is in the southwestern portion of the lagoons (Khor Umm al Qaiwain), where up to 550 wintering Crab Plovers roost and several thousand other shorebirds feed and roost. The Crab Plovers may be from Iranian colonies rather than from Abu al Abyadh (Site 1), as was formerly supposed. Up to 100 Cream-coloured Coursers *Cursorius cursor* are regular on the shoreline in summer. Western Reef Herons *Egretta gularis* nest amongst the mangroves on the islands in the lagoon, along with Little Green Herons *Butorides striatus* and Clamorous Reed Warblers *Acrocephalus stentoreus*. Up to 170 Western Reef Herons have been recorded outside the breeding season. Terns and gulls are common, particularly Gull-billed Terns *Gelochelidon nilotica* and Caspian Terns *Sterna caspia*. Great Crested Terns *Sterna bergii*, Lesser Crested Terns *S. bengalensis*, White-cheeked Terns *S. repressa* and Saunders's Little Terns *S. saundersi* also occur in autumn and spring. Slender-billed Gulls *Larus genei* are common and the Great Black-headed Gull *Larus ichthyaetus* is regular in late winter. Amongst birds of prey, Spotted Eagles *Aquila clanga* (one or two), Pallid Harriers *Circus macrourus* and Marsh Harriers *C. aeruginosus* are regular in autumn and winter. Ospreys *Pandion haliaetus* can be found at most times of the year. Hoopoe Larks *Alaemon alaudipes* and Crested Larks *Galerida cristata* nest on the dunes, and Black-crowned Finch Larks *Eremopterix nigriceps* gather near the shoreline in late summer after nesting. The site is one of the few places in the UAE where Lesser Short-toed Larks *Calandrella rufescens* can be found in winter, and the species breeds on one of the nearby islands. Short-toed Larks *C. brachydactyla* are common on passage, and the dunes also attract migrant wheatears *Oenanthe* spp., pipits *Anthus* spp. and warblers (Sylviidae).

The open shoreline apparently holds a good invertebrate population which provides a plentiful supply of prey for the Palearctic shorebirds which are abundant from July to April. Small mud-dwelling crabs are abundant in Khor Umm al Qaiwain and are fed on by several species of shorebirds. Tiny gastropods are ubiquitous. The worm fauna is undescribed.

Noteworthy flora: The site contains some good stands of mangrove *Avicennia marina*.

Scientific research and facilities: Extensive archaeological excavations have been undertaken on the mainland shore and on some islands in the lagoon, with many notable finds having been made. Many ornithological surveys have been carried out, but surveying is extremely difficult, especially at low tide, and much of the area remains poorly known.

Management authority and jurisdiction: The Government of Umm al Qaiwain.

References: Evans (1994); Richardson (1990a); Uttley *et al.* (1988).

Reasons for inclusion: 1a, 2b & 3c. Khor al Beidah is especially important for its large and diverse populations of migratory shorebirds. It holds the second largest wintering flock of Crab Plover *Dromas ardeola* in the UAE, after Merawah (see Site 2). Two other species, the Western Reef Heron *Egretta gularis* and Eurasian Curlew *Numenius arquata*, have also been recorded in internationally significant numbers (1% of the regional population).

Source: Colin Richardson.

Sinaiya Island (13)

Location: 25°36'N, 55°37'E. On the seaward side of Khor al Beidah and northeast of the Umm al Qaiwain peninsula, Umm al Qaiwain Emirate.
Area: 1,000-1,500 ha.
Altitude: Sea level.
Overview: A low, sandy, sparsely vegetated island, about 11 km long, with a long sandy beach on its seaward side, and mudflats and mangroves on its landward side. The island holds the largest known breeding colony of Socotra Cormorants *Phalacrocorax nigrogularis* in the UAE, with birds present for most of the winter months but entirely absent in summer. About 60 gazelles have been introduced and are free-ranging over the island.
Physical features: A long, thin, low, sandy island, almost pointed at each end, with an 11 km northwest-facing beach along the Gulf coast, and an average width of about 800 metres. The inland side of the island, which forms the outer edge of Khor al Beidah (Site 12), is fragmented, with long fingers of coral and mangrove interspersed with shallow lagoons. The island is uninhabited except for two private dwellings belonging to the ruling family of Umm al Qaiwain.
Ecological features: Typical estuarine and sand-dune ecology. Mangrove *Avicennia marina* is confined to the sheltered southeast side of the island, and lines most of the shallow lagoons. The sandy island has a sparse covering of salt-tolerant tamarisk (*Tamariscinum*) scrub and grasses on the dunes, and there are large areas of low salt flats in the central area covered mostly with halophytes, including sparse *Halopeplis* bushes. Other species include *Zygophyllum qatarense*, *Atriplex leucoclada*, *Limonium axillare*, *Helianthemum lippii*, *Arnebia hispidissima*, *Sporobolus arabicus*, *Cyperus conglomeratus*, *Anabasis setifera* and *Halocnemum strobilaceum*. There are no native trees other than mangroves on the island, but irrigated plantations of introduced species have recently been established in some areas.
Land tenure: Owned by the ruling family of Umm al Qaiwain, Ruler, H.H. Sheikh Rashid bin Ahmed al Moalla.
Conservation measures taken: The Ruler of Umm al Qaiwain has declared that the island is to be treated as a nature reserve, and no-one is allowed on the island without permission. However this does not necessarily mean that the wildlife will be protected, as the owner has already built at least one house on top of one of the Socotra Cormorant colonies. The island has been identified as an Important Bird Area (IBA) by BirdLife International.
Conservation measures proposed: Official representation is to be made to the Ruler seeking a cessation of building activities, tree-planting schemes and other developments on the island. Restrictions should be imposed on the movement of vehicles about the island during the Socotra Cormorants' breeding season.
Land use: The island is used by the ruling family for recreation and as a private zoo.
Possible changes in land use: None likely.
Disturbances and threats: The breeding colonies of Socotra Cormorants appear to have suffered much disturbance in recent years due to the building of houses at each end of the island. Overflying by micro-lite aircraft and the movement of vehicles about the island cause disturbance to the bird colonies, as do visiting fishermen. The island is very close to mainland,

and is often visited by expatriate picnickers in small boats. An extensive grid of irrigation piping has recently been installed, and tree plantations have been established at the expense of the arid sparsely vegetated habitat, thereby reducing the area of habitat suitable for breeding seabirds. Proliferation of the introduced gazelle population could become a problem in the future.

Hydrological and biophysical values: No information.

Social and cultural values: The site has some archaeological interest. No other information is available.

Noteworthy fauna: Sinaiya Island holds one of the world's largest breeding colonies of the Socotra Cormorant *Phalacrocorax nigrogularis*, with 15,555 pairs in 1994/95. Prior to the recent disturbance from building activities, there were at least three sizeable sub-colonies of the cormorants. The birds nest up to 100 metres from the shoreline, often in extensive flat areas, and some parts of the colony may not be visible when viewed from the sea. The island is one of only two known breeding sites for the Lesser Short-toed Lark *Calandrella rufescens* in the UAE (see also Site 6). Other breeding species include Western Reef Heron *Egretta gularis*, Little Green Heron *Butorides striatus*, Palm Dove *Streptopelia senegalensis*, Black-crowned Finch-lark *Eremopterix nigriceps*, Crested Lark *Galerida cristata*, Clamorous Reed Warbler *Acrocephalus stentoreus* and Graceful Prinia *Prinia gracilis*. There is evidence that the 11 km beach facing the Gulf is important for nesting Green Turtles *Chelonia mydas*, and possibly also Hawksbill *Eretmochelys imbricata* and Leatherback *Dermochelys coriacea*. Dorcas Gazelles *Gazella dorcas (?saudiya)* have been introduced on to the island, and presently number over 100.

Noteworthy flora: The island supports extensive stands of mangrove *Avicennia marina*, along with a wide variety of grasses and salt-tolerant shrubs.

Scientific research and facilities: Extensive archaeological excavations have been undertaken in the area, and many notable finds have been made. Some ornithological surveys have been carried out, but no proper census of the Socotra Cormorant colony has ever been made.

Management authority and jurisdiction: One or more members of the ruling family of Umm al Qaiwain.

References: Evans (1994); Howe (1989); Jongbloed (1987); Richardson (1990a, 1993); Symens *et al.* (1993); Uttley *et al.* (1988); Western (1989). Also: unpublished observations.

Reasons for inclusion: 1a, 2a, 2c, 3a & 3c. The island supports one of the world's largest breeding colonies of Socotra Cormorants.

Source: Colin Richardson and Simon Aspinall.

Al Jazeerah Khor (14)

Location: 25°43'N, 55°49'E. North of the village of Jazirat al Hamra, Ras al Khaimah Emirate.

Area: 4,600 ha.

Altitude: Sea level to 6 m below.

Overview: A complex of shallow tidal lagoons and inter-tidal mudflats on the Gulf coast, with areas of higher ground covered with halophytic scrub. The site is an important feeding and

resting area for Palearctic shorebirds, and the low scrub-covered islands in the northern lagoon host large roosts of seabirds in autumn and winter.

Physical features: The wetland comprises a group of shallow, coastal lagoons and areas of inter-tidal mudflats adjacent to the old abandoned village of Jazirat al Hamra. The village sits on a promontory which divides the wetland into two main systems. There are some mudflats south of the village and an expanse of shallow lagoons to the north. The expanse of shallow lagoons is partially enclosed by a long mud bank, which supports some halophytic scrub above the high-water mark. About 200 ha of mudflats are exposed at low tide, while at high tide, the depth of the lagoons does not exceed two metres. The most important part of the site, Al Jazeerah Khor, consists of a complex of shallow tidal lagoons adjacent to the main coast road to Ras al Khaimah. A line of high sand dunes runs parallel to this khor, and provides an excellent vantage point for views of the wetland.

Ecological features: An estuarine site with typical salt-tolerant shrubs above high-water mark. The mudflats support a good diversity of invertebrates, and provide prime feeding habitat for shorebirds.

Land tenure: Owned by the Government of Ras al Khaimah.

Conservation measures taken: Some representations have been made by the Marine Section of the Desert and Marine Research Centre at Al Ain University and by private individuals. A three km stretch of beach has been set aside for breeding turtles by H.H. Sheikh Saqr bin Mohammed al Qasimi, the Ruler of Ras al Khaimah.

Conservation measures proposed: A "leave alone" management policy would be appropriate for much of the area.

Land use: Commercial fishing and outdoor recreation. Goats are allowed to graze in the adjacent dunes.

Possible changes in land use: Further destruction of the dunes by building development.

Disturbances and threats: There is some shooting of waterfowl by local people. Dumping of sewage effluent and solid waste along the shoreline is routine. The dunes are being developed, and several large houses have been built on the top of the dunes.

Hydrological and biophysical values: The lagoons are of value as a nursery area for juvenile fish, which probably include a number of commercially valuable species.

Social and cultural values: No information.

Noteworthy fauna: The wetland is an important staging and wintering area for migratory waterbirds. Large numbers of shorebirds are present throughout much of the year, including thousands of *Charadrius* plovers and *Calidris* sandpipers. The most abundant species are Greater Sand Plover *Charadrius leschenaultii*, Lesser Sand Plover *C. mongolus*, Curlew Sandpiper *Calidris ferruginea*, Dunlin *C. alpina*, Terek Sandpiper *Xenus cinereus* (745 in September 1987), Bar-tailed Godwit *Limosa lapponica* and Redshank *Tringa totanus*. Less common are Whimbrel *Numenius phaeopus*, Ruddy Turnstone *Arenaria interpres* and Oystercatcher *Haematopus ostralegus*. Some 3,500 shorebirds were counted at the site in October 1986. Hundreds of herons feed in the shallows, including Great Egret *Egretta alba*, Little Egret *E. garzetta*, Western Reef Heron *E. gularis* and Grey Heron *Ardea cinerea*. There are always up to 100 Greater Flamingos *Phoenicopterus ruber* in winter, and Spoonbills *Platalea leucorodia* are regular. Thousands of Lesser Crested Terns *Sterna bengalensis*, Sandwich Terns *S. sandvicensis*, Saunders's Little Terns *S. saundersi* and White-cheeked Terns *S. repressa* rest on the outer sand spit in winter and early spring, with smaller numbers of Great

Black-headed Gulls *Larus ichthyaetus*, Great Crested Terns *Sterna bergii* and Caspian Terns *S. caspia*. The site also attracts important numbers of Gull-billed Terns *Gelochelidon nilotica*, and holds the largest roosts of Slender-billed Gulls *Larus genei* in the UAE (over 750 birds in January 1992). Ospreys *Pandion haliaetus* are present throughout most of the year, and one or two Spotted Eagles *Aquila clanga* and Marsh Harriers *Circus aeruginosus* usually overwinter. Flocks of Socotra Cormorants *Phalacrocorax nigrogularis* (over 10,000 together) regularly feed close inshore. Over 90 species of birds have been recorded in the area. The site is also reported to be an important nesting area for sea turtles, probably only *Chelonia mydas*.
Noteworthy flora: The dunes adjacent to the Khor have many very old Ghaf trees *Prosopis cineraria*, which provide nest holes for, amongst other species, Hoopoe *Upupa epops* and Indian Roller *Coracias bengalensis*.
Scientific research and facilities: Numerous bird surveys have been carried out at the site, and a three km section of the beach has been given over to the Marine Research Centre of Emirates University for the conservation, monitoring and study of breeding turtles.
Management authority and jurisdiction: Government of Ras al Khaimah.
References: Richardson (1990a); Uttley *et al.* (1988). Also: IWRB (Asian Waterfowl Census) Counts 1990-94.
Reasons for inclusion: 1a, 2a, 2c & 3c. The site regularly supports over 1% of the regional wintering population of Terek Sandpipers *Xenus cinereus*.
Source: Colin Richardson.

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Dhayah, Rams, Ghalilah and Hulayla Island (15)

Location: 25°50'N, 55°59'E. On the Gulf coast between Ras al Khaimah and Ghalilah, Ras al Khaimah Emirate.
Area: 19,550 ha.
Altitude: Sea level to 6 m below.
Overview: A series of shallow coastal lagoons, mangrove swamps, areas of inter-tidal mudflat and low sandy islands along a 20 km stretch of coast on the western side of the Musandam Peninsula, north of Ras al Khaimah. The mangroves and 500 ha of mudflats between Dhayah and Hulayla Island are the most important areas for waterbirds, providing habitat for thousands of herons, flamingos, migratory shorebirds and gulls. In winter, the lagoon and marshes at Dhayah host a good selection of wintering ducks and a wide variety of birds of prey.
Physical and ecological features: The site comprises a series of wetlands along a 20 km stretch of coastal plain, extending northwards from Ras al Khaimah and bounded to the east by the Ras al Jebel, the mountains of Musandam, which rise to over 2,000 m. In this region, the coastal plain is about five km wide. The wetlands include the mangrove swamps within Ras al Khaimah Khor in the south, older stands of mangrove and up to 100 ha of reed-beds and *Juncus* marshes with freshwater springs at Dhayah, and a number of sheltered harbours at Rams and Ghalilah. There are also undisturbed beaches and breakwaters at Marid, Rams, Ghalilah and Hulayla Island. The latter is a 10 km long sandy island connected to the mainland by a causeway. The mangroves in Ras al Khaimah Khor remain in good condition, but have never

been properly explored.
Land tenure: Government of Ras al Khaimah.
Conservation measures taken: None.
Conservation measures proposed: A "leave alone" management policy would be appropriate for much of the area. The area known as Dhayah, with its extensive mangroves, reed-beds and *Juncus* rushes, would make a good bird sanctuary as it already supports a varied breeding bird fauna.
Land use: There is some industrial development, *e.g.* at Ghalilah, where a harbour has been built and a large stone quarry dominates the scene, but otherwise the area is mostly undeveloped. An oil installation has been built on Hulayla Island, and access is restricted, although there are numerous fishermen's shacks on the seaward side of the island. After good rain, the island becomes quite green and is grazed extensively by camels.
Possible changes in land use: More residential and industrial development is likely in the future.
Disturbances and threats: The principal threat is uncoordinated and ill-considered development of the area. A causeway, one km long, is currently being bulldozed across to Hulayla Island, and this will certainly restrict, if not totally cut off, the tidal flow to the inland channel. The long-term effects of altering the hydrological regime in this way are unknown.
Hydrological and biophysical values: No information.
Social and cultural values: The area has a long history of human occupation. Many of the valuable archaeological sites have yet to be excavated and dated, but it is known that some date back to the pre-Islamic period.
Noteworthy fauna: The site is especially noteworthy for the great abundance and diversity of its birdlife. Thousands of shorebirds, gulls and terns use this section of coastline annually, the most notable in recent years being the selection of terns on spring and autumn passage to and from their Gulf breeding sites. White-cheeked Tern *Sterna repressa*, Lesser Crested Tern *S. bengalensis*, Great Crested Tern *S. bergii*, Bridled Tern *S. anaethetus* and Saunders's Little Tern *S. saundersi* are common, while Common Tern *S. hirundo*, Caspian Tern *S. caspia*, Little Tern *S. albifrons* and Gull-billed Tern *Gelochelidon nilotica* are regular in smaller numbers. In winter, several thousand Black-headed Gulls *Larus ridibundus*, Yellow-legged Gulls *L. cachinnans* and Great Black-headed Gulls *L. ichthyaetus* are often to be found loafing on the mudflats. Pomarine Skuas *Stercorarius pomarinus* and Arctic Skuas *S. parasiticus* are regular inshore. Small parties of migrant Cream-coloured Coursers *Cursorius cursor* and Caspian Plovers *Charadrius asiaticus* have been recorded on Marid and Hulayla Island in spring and autumn. Crab Plovers *Dromas ardeola* are reported to have bred on Hulayla Island in the past, and the habitat certainly appears to be suitable, but heavy grazing by camels and increased human disturbance would now make nesting impossible. Crab Plovers were reported on Marid in the winter of 1972/73 (S. Tyler, pers. comm.). Over 4,500 migratory shorebirds were counted in the area during limited surveys in the autumns of 1986 and 1987 (Uttley *et al.*, 1988). The extensive mangrove swamps and *Juncus* marshes at Dhayah support breeding Little Green Herons *Butorides striatus*, Moorhens *Gallinula chloropus*, Red-wattled Lapwings *Vanellus indicus* and Clamorous Reed Warblers *Acrocephalus stentoreus*, while Reed Warblers *Acrocephalus scirpaceus* and Grey Herons *Ardea cinerea* may breed. In winter, the lagoon at Dhayah hosts a good selection of wintering ducks. Up to 15 Marsh Harriers *Circus aeruginosus*, three or more Spotted Eagles *Aquila clanga*, and one or more Steppe Eagles *A.*

nipalensis and Long-legged Buzzards *Buteo rufinus* are regular in this area in winter, and as many as 12 *A. clanga* have occurred on passage. Common Kingfishers *Alcedo atthis* also occur in good numbers in winter. Hulayla Island is a migrant trap in spring, attracting several species of migrant larks (Alaudidae), pipits *Anthus* spp. and wheatears *Oenanthe* spp.
The shallows around the mangrove areas are one of the best places in the UAE to find mudskippers *Periophthalmus* sp.
Noteworthy flora: Mangroves at Ras al Khaimah and Dhayah, and an unusual community of as yet unidentified grasses, rushes and reeds at Dhayah.
Scientific research and facilities: Some archaeological investigations have been undertaken, as well as regular ornithological surveys during the winter months. The mangroves are relatively unexplored.
Management authority and jurisdiction: Government of Ras al Khaimah.
References: Jongbloed (1987); Richardson (1990a); Uttley *et al.* (1988); Western (1989). Also: IWRB (Asian Waterfowl Census) Counts 1990-94, and
OSME Sites Register for Marid and Dhayah (S. Tyler and F.E. Warr).
Reasons for inclusion: 1a, 2c & 3b. The wetlands support diverse and sizeable bird populations.
Source: Colin Richardson.

Dibba Bay (16)

Location: 25°37'N, 56°17'E. To the north of the village of Dibba, on the east coast of the UAE in Fujairah and Sharjah Emirates, and straddling the border with Oman. The greater part of the site lies in Oman, but is readily accessible without border controls from the UAE. The following account applies to the whole site, as this has regularly been covered by researchers from the UAE, but is remote and difficult of access for researchers from Oman.
Area: 27,780 ha. About half of the site lies in UAE territory, the remainder being in Oman.
Altitude: Sea level to six metres below sea level. The centre of the bay exceeds this depth.
Overview: A sheltered, deep water bay with a long, fairly undisturbed, sandy beach. The bay is popular with fishermen, and several species of gulls and terns are regular throughout the year. The beaches are used by seabirds for roosting, and probably also by sea turtles for nesting.
Physical features: Dibba, the most northerly village on the east coast of the UAE, faces a deep semi-circular bay, approximately 15 km in diameter, located in the Gulf of Oman. A three km sandy beach shelves steeply into the deep waters of the bay. One end of the bay is guarded by the beginning of the Musandam cliffs, which stretch a further 50 km northwards to the Straits of Hormuz. A small wave-cut platform to the south of Ras Dibba is a rare and unusual geomorphological feature in the UAE.
Ecological features: No information.
Land tenure: The southern half of the bay is owned by the Government of Fujairah (Dibba Municipality), the northern half by the Government of the Sultanate of Oman (Musandam Development Committee), and a central "pocket" (Dibba al Hisn) by the Government of Sharjah, UAE.

Conservation measures taken: None. The Dibba-Bayah plain, including a part of Dibba Bay, has been identified as an Important Bird Area (IBA) by BirdLife International.
Conservation measures proposed: None.
Land use: Fishing and recreation.
Possible changes in land use: Development of the bay as a deep water port with associated facilities is a possibility.
Disturbances and threats: Fishermen, and probably also other local people, still disturb birds and persecute turtles. Holiday chalets are presently being built, and leisure activities and associated disturbance will doubtless increase accordingly.
Hydrological and biophysical values: No information.
Social and cultural values: Recreational usage. Dibba has been a seaport for at least 3,000 years.
Noteworthy fauna: Dibba Bay is an important feeding area for at least 16 species of gulls, terns and other seabirds. The bay is sheltered and used as a night time roost by gulls. Sandwich Terns *Sterna sandvicensis* and Yellow-legged Gulls *Larus cachinnans* are common in winter, while Lesser Crested Terns *Sterna bengalensis* and White-cheeked Terns *S. repressa* are common in early spring. Bridled Terns *S. anaethetus* are abundant offshore from May to October. Smaller numbers of Armenian Gulls *Larus armenicus*, Common Terns *Sterna hirundo*, Little Terns *S. albifrons*, Saunders's Little Terns *S. saundersi* and Great Crested Terns *S. bergii* are also present. Sooty Gulls *Larus hemprichii* are regular from April to September, and Persian Shearwaters *Puffinus (lherminieri) persicus* are regular offshore in summer. Other species likely to occur include Wilson's Storm Petrel *Oceanites oceanicus*, Pomarine Skua *Stercorarius pomarinus*, Arctic Skua *S. parasiticus* and Great Black-headed Gull *Larus ichthyaetus*. Crab Plovers *Dromas ardeola*, probably from breeding colonies in Iran, use the beach as a roost in spring. Sooty Falcons *Falco concolor* have been seen regularly in late spring, and may breed on the nearby cliffs. Green Turtles *Chelonia mydas* are regular on the beach (mostly dead individuals), and may breed irregularly. Successful breeding is, however, considered unlikely.
Noteworthy flora: No information.
Scientific research and facilities: None, other than a number of avifaunal surveys and some preliminary archaeological investigations.
Management authority and jurisdiction: See "Land tenure".
References: Evans (1994).
Reasons for inclusion: 1d. An interesting shallow sea bay which rapidly deepens towards the centre; an unusual configuration in this region. The proximity of relatively deep water in the Gulf of Oman attracts pelagic seabirds close inshore, a phenomenon not witnessed elsewhere in the UAE.
Source: Colin Richardson and Simon Aspinall.

Wadi Shih Reservoir (17)

Location: 25°20'N, 56°20'E. In the Hajar Mountains 10 km inland from Khor Fakkan town,

Sharjah Emirate.
Area: c.500 ha.
Altitude: 350-400 m.
Overview: A small water storage reservoir with some *Phragmites* reeds and breeding Little Grebes *Tachybaptus ruficollis*.
Physical features: A man-made dam and reservoir surrounded by steep, desolate mountains which rise to peaks at 900 m. When filled, the water area occupies about 150 ha, and has an average depth estimated at 3-7 metres. The edge of the reservoir has been fenced off to prevent intrusion by visitors.
Ecological features: The shoreline supports minimal vegetation because of the rather steep banks. Small patches of *Phragmites* grow in the shallower areas. The adjacent hillsides support a variety of perennials and annuals typical of the region. *Nerium mascatense* forms conspicuous stands, with *Forsskaolea tenacissima*, *Trichodesma* sp. and *Sida urens*. Species also likely are *Adiantum capillus-veneris*, *Bacopa monnieri*, *Oxalis corniculata* and the tiny fern *Onychium divaricatum*.
Land tenure: Government of Sharjah.
Conservation measures taken: None.
Conservation measures proposed: None.
Land use: Water storage for domestic and agricultural use.
Possible changes in land use: None known.
Disturbances and threats: None known.
Hydrological and biophysical values: No information.
Social and cultural values: Water supply for human consumption and irrigation purposes.
Noteworthy fauna: The reservoir holds at least four breeding pairs of Little Grebes *Tachybaptus ruficollis*, and Moorhens *Gallinula chloropus* possibly breed. Some 25-30 species of birds have been recorded in the area, including breeding species such as Bonelli's Eagle *Hieraeetus fasciatus* (a pair in the surrounding hills), Sand Partridge *Ammoperdix heyi*, Grey Francolin *Francolinus pondicerianus*, Desert Lark *Ammomanes deserti*, Pale Crag Martin *Hirundo obsoleta*, Hume's Wheatear *Oenanthe alboniger* and House Bunting *Emberiza striolata*. Blue Rock Thrush *Monticola solitarius*, Desert Lesser Whitethroat *Sylvia minula* and Plain Leaf Warbler *Phylloscopus neglectus* are regular in winter. The reservoir supports a good population of fish, and toads are to be found in the shallower areas. Terrapins of an unknown species have been introduced.
Noteworthy flora: None known.
Scientific research and facilities: None, other than some avifaunal surveys.
Management authority and jurisdiction: Government of Sharjah (Khor Fakkan Municipality).
References: Jongbloed (1987); Western (1989).
Reasons for inclusion: 2b. One of country's largest perennial reservoirs, with associated developing ecosystem.
Source: Colin Richardson.

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Wadi Safad (18)

Location: 25°15'N, 56°18'E. In the Hajar Mountains of Fujairah Emirate. The mouth of the wadi is on the Arabian Sea coast at Qurayyah, 10 km north of Fujairah town and immediately to the north of Fujairah Port.
Area: Unknown.
Altitude: Sea level to c.500 m.
Overview: A typical mountain wadi system with permanent water in a series of wadi pools and an interesting deltaic fan at its mouth on the Arabian Sea coast. The wadi has considerable archaeological, historical and cultural values, and supports a relatively undisturbed fauna and flora typical of the region.
Physical and ecological features: Wadi Safad is a classic mountain wadi, approximately 15 km in length and with permanent standing water in a series of pools which persist throughout the year. It is situated inland from the Arabian Sea coast in the Hajar Mountains, and terminates in a deltaic fan at its seaward end at Qurayyah. The coastal fan, bay bar, spit and lagoonal system at the seaward end of the wadi comprise an unmodified geomorphological development (up to one km wide and about six km long) unique in the UAE, with mainly pristine saltmarsh and saltflat plant communities. Water bodies in the wadi range from freshwater, through brackish to saltwater. Ghaf *Prosopis cineraria* and dense mesquite *Prosopis juliflora* occupy drier ground, particularly around Qurayyah. Parts of the valley continue to be cultivated under the traditional falaj system. The upper reaches of the wadi are narrow and rock-walled, and are inaccessible by motorised transport.
Land tenure: Government of Fujairah and local farmers.
Conservation measures taken: The biological and archaeological values of the site are currently being evaluated.
Conservation measures proposed: It has been recommended that Wadi Safad be conserved as a good example of an undisturbed and unmodified wadi system.
Land use: Low intensity pastoral use and traditional cultivation.
Possible changes in land use: No major developments are planned, and some of the cultivated areas are falling into disuse.
Disturbances and threats: Construction of a road for eight kilometres along the wadi will bring increased human disturbance and will damage part of the traditional agricultural system. Oil pollution must be a serious risk in the lower, tidal part of the site. The port facilities of Fujairah already use some reclaimed land and impinge on the present southern boundary of the site. Further housing development is a potential threat.
Hydrological and biophysical values: Permanent standing water is a rare commodity anywhere in the UAE. Storm water dissipates rapidly over the braided lower course of the wadi, thus preventing damage to fields, buildings and the main coast road. Coastal development and the storm berm protect Qurrayah from marine incursion.
Social and cultural values: There are important archaeological sites in the wadi, and the traditional lifestyle of the local people is of considerable historical and cultural interest. There is an important local fishery along the coast, with fishing boats putting out from the beach near the wadi mouth.
Noteworthy fauna: The coastal lagoons attract regionally important numbers of Great Black-headed Gull *Larus ichthyaetus* in winter, many terns *Sterna* spp. on passage, and a variety of

other waterfowl including Western Reef Heron *Egretta gularis* (resident), Grey Heron *Ardea cinerea* (passage migrant) and Greater Flamingo *Phoenicopterus ruber* (non-breeding visitor). Kentish Plovers *Charadrius alexandrinus* breed near the coast. The Arabian Toad *Bufo arabica* is abundant in the wadi, and three new species of mollusc have recently been collected and described from the inter-tidal flats: *Nanhaia safadensis* (so named after the site), *Hiatula mirbahensis* and *Caecella qeratensis* (Morris & Morris, 1993). A fourth species of mollusc, *Laternula erythraea*, has also been described from this site. Fish populations and most invertebrate groups are, however, very poorly known.

Several rare mammals are reported to survive within the catchment, notably Wolf *Canis lupus arabs*, Lynx *Caracal caracal schmitzi*, Arabian Gazelle (Idhmi) *Gazella gazella arabica*, and possibly Ibex *Capra ibex* and Wild Goat *C. aegragus*. The terrestrial avifauna is typical of the mountains of northeastern Arabia, and includes Desert Lark *Ammomanes deserti*, House Bunting *Emberiza striolata* and Indian Silverbill *Euodice malabarica*, which regularly visit the wadi to drink. The Grey Francolin *Francolinus pondicerianus* is common around cultivation.

Noteworthy flora: The wadi presents a good example of typical mountain wadi flora and associations. The mainly pristine saltmarsh and saltflat plant communities at the seaward end of the wadi are especially noteworthy, and represent the best undisturbed examples of these floral associations in the UAE.

Scientific research and facilities: Surveys of the flora, fauna and archaeology of the area are currently ongoing, at the Ruler's request.

Conservation education: There has been education of some residents in the area as to the value of the traditional agricultural methods and the importance of the site as a now rare example of an unspoilt mountain community in harmony with the local wildlife. The significance of, and external interest in, this wildlife may result in the site being maintained as an example of a typical mountain community with immense value for its outstanding natural heritage.

Management authority and jurisdiction: Government of Fujairah.

References: Morris & Morris (1993). Also: unpublished personal observations.

Reasons for inclusion: 1a & 2b. An excellent example of a mountain wadi with permanent water. Natural plant communities in the deltaic system remain largely unmodified and are of considerable interest.

Source: Peter Hellyer and Simon Aspinall.

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Wadi Hayl (19)

Location: 25°05'N, 56°13'E. In the Hajar Mountains of Fujairah Emirate, about 20 km from Fujairah.

Area: Approximately 500 ha (including the main wadi system, cultivated areas and village).

Altitude: 100-300 m.

Overview: A typical mountain wadi system with permanent water and characteristic perennial wadi flora and fauna, including amphibians, fish, reeds, cultivated fruit trees and date palms.

Physical features: Wadi Hayl is situated in a shallow-sided ravine of 20-200 metres in width.

Water flows throughout the year, except during periods of severe drought. Areas of traditional cultivation flank the water course, and pumps feed a falaj system. The cultivation and settlement at Hayl, located around an old palace (now derelict but due to be restored), is situated 10 km up the wadi.

Ecological features: The perennial water has created a healthy freshwater ecosystem. *Nerium mascatense* is common, as in other wet wadis of this type, along with *Forsskaolea tenacissima*, *Trichodesma* sp. and *Sida urens*. Species also likely to occur are *Adiantum capillus-veneris*, *Bacopa monnieri*, *Oxalis corniculata* and the tiny fern *Onychium divaricatum*. Fruit trees, including mango, papaya and banana, and date palms line the watercourse, and other vegetables and animal fodder are grown on levelled platforms along the wadi side.

Land tenure: The Ruler of Fujairah and private citizens.

Conservation measures taken: The Ruler has requested that a conservation assessment be carried out on the wadi and the summer palace.

Conservation measures proposed: Proposals for the conservation of the area are currently in preparation. Because of its heritage values, the site is likely to be retained in its relatively natural state.

Land use: Agriculture.

Possible changes in land use: There have been discussions on the possible mining of mineral ore in the upper catchment area. This would involve the construction of large access roads through the wadi, with resulting highly detrimental changes to the system. The discussions are currently in abeyance, but if a decision to mine is eventually taken, advice should be sought by the owner on the possible routing of quarry access in such a way that damage to the ecosystem can be kept to a minimum.

Disturbances and threats: See under "Possible changes in land use".

Hydrological and biophysical values: Water supply for local agriculture.

Social and cultural values: The old palace and adjacent village and cultivation are of historical importance and interest to the Ruler. Other archaeological finds have also been documented from the area (*per* P.Hellyer).

Noteworthy fauna: Twenty-five species of birds have been recorded to date, including most resident birds characteristic of the region and notably the Bonelli's Eagle *Hieraeetus fasciatus*. Mammals include a gazelle *Gazella* sp. and Arabian Red Fox *Vulpes vulpes arabica*. The Dhofar Toad *Bufo dhofarensis* and Arabian Toad *B. arabicus* are plentiful, fish breed in the permanent pools, and insects are abundant.

Noteworthy flora: The wadi contains a good example of the flora typical of wet wadis in this region.

Scientific research and facilities: None.

Management authority and jurisdiction: The Ruler of Fujairah, H.H. Sheikh Hamad bin Mohammad al Sharqi, through Fujairah Municipality.

References: Unpublished personal observations.

Reasons for inclusion: 1b & 2b. A perennial wadi system with a rich fauna and flora and traditional system of cultivation.

Source: Colin Richardson.

Khor Kalba and Fujairah Beach (20)

Location: 24°59'N, 56°22'E. On the Gulf of Oman coast, straddling the border between the UAE and Sultanate of Oman; partly in Sharjah Emirate, partly in Fujairah Emirate, and partly in Omani territory.
Area: 7,750 ha.
Altitude: Sea level to 3 m above sea level.
Overview: A shallow tidal inlet and adjacent sandy beach on the Gulf of Oman coast, with exceptionally fine stands of mangrove and rich associated fauna. Particularly important for its endemic subspecies (*kalbaensis*) of the White-collared Kingfisher *Halcyon chloris*, which numbers only some 10-20 pairs.
Physical features: Khor Kalba is a small, shallow, tidal inlet with ramifying channels formed by the outlet of Wadi Rumh. Tall stands of old mangroves line the channels. The site also encompasses inter-tidal flats, sabkha, former mangrove areas now dead from isolation from tidal influence, and halophytic vegetation. The inter-tidal area within Khor Kalba itself is small (less than a few tens of hectares). The beach separating the khor from the sea is mainly sandy with gravel in places. Fujairah beach facing the town of Fujairah to the north is a typical seafront beach.
Ecological features: Mangal development with typical faunal associations. Stands of the Black Mangrove *Avicennia marina* include trees up to 8 m in height, and are possibly the oldest in the UAE. Most appear still to be in a healthy condition. *Limonium axillare*, *Suaeda* sp. and *Atriplex leucoclada* grow above the high-water mark. *Heliotropium kotschyi* is abundant above the beach line, along with a variety of species of Caryophyllaceae.
Land tenure: Khor Kalba is an outlying part of Sharjah Emirate, and is overseen by a local representative. The southern part of the site lies in Omani territory at Khatmat Malahah. Fujairah beach falls under Fujairah Municipality.
Conservation measures taken: Khor Kalba has been identified as an Important Bird Area (IBA) by BirdLife International. Kalba Municipality has been instructed by the Ruler of Sharjah to take "necessary measures" to protect the wildlife.
Conservation measures proposed: Direct or indirect representation is to be made to the Ruler of Sharjah and his local representative regarding the conservation importance of this site. Restoration and extension of the mangrove woodland is desirable, in order to increase and protect the integrity of the site. The erection of nest-boxes in younger mangroves may allow the White-collared Kingfisher population to increase. Cooperation with Oman is required to restore the southern part of the site, which is drying out. A management plan should be drawn up promptly.
Land use: Crabs and fish are netted for human consumption, and camels are allowed to graze in the mangroves. The area is popular for outdoor recreation, but this is largely confined to the beach side of the main channel, which is relatively unimportant for wildlife. Fishing takes place along the beach and in the inter-tidal channels.
Possible changes in land use: Encroachment of recreational facilities and perhaps agriculture is a possibility and would be detrimental to the site. Reclamation is also a possibility in places. A recent proposal to construct a desalination plant on the side of the khor would require an environmental impact assessment (EIA) before being allowed or prevented.

Disturbances and threats: Human activities cause disturbance to wildlife, and there is some direct persecution and trapping of birds and turtles. Fujairah beach is heavily used by fishermen and for recreation, as is the seaward side of Khor Kalba. Four-wheel drive vehicles damage the beach-top vegetation, and cause erosion. Pollution is clearly a threat throughout the site. Fire and the cutting of mangroves are localised. Grazing by camels in the mangroves is not deemed a threat.
Hydrological and biophysical values: The only such khor on the Gulf of Oman coast of the UAE, and thus unique.
Social and cultural values: Traditional grazing and harvesting in the mangroves.
Noteworthy fauna: The mangroves of Khor Kalba support the entire world population (44 pairs/territories in May 1995) of the subspecies *kalbaensis* of the White-collared Kingfisher *Halcyon chloris*. The birds nest in natural holes in mangrove trunks and branches. The mangroves are also the only known breeding site in the UAE for the Booted Warbler *Hippolais caligata*, with 10-20 pairs. This is a rare breeding species elsewhere in Arabia, perhaps occurring only on the Batinah coast of Oman. Other breeding species in the mangroves include Little Green Heron *Butorides striatus*. The Indian Pond Heron *Ardeola grayii* occurs regularly in winter, Khor Kalba being the only regular site for this species in the UAE. Large numbers of Sooty Gulls *Larus hemprichii* occur annually on the beach in April/May (usually 500-800, but over 3,000 were present in May 1995). Green Turtles *Chelonia mydas* and Hawksbill Turtles *Eretmochelys imbricata* are regularly seen feeding in the Khor or along the outside of the beach, and may also nest. Unfortunately, the 4WD vehicles driven by fishermen along the beach reduce the likelihood of any young surviving. Many large specimens of Green Turtles are caught in fishing nets and drown, or are turned over and left to die above the high-water mark.
Noteworthy flora: Khor Kalba contains the oldest and best preserved stands of Black Mangrove *Avicennia marina* in the country, with individual trees reaching 8 m in height. The advanced age of the mangroves allows natural holes to form, a feature absent from any other mangrove stand in the UAE and vital for the White-collared Kingfishers.
Scientific research and facilities: None, other than some avifaunal surveys.
Conservation education: None as yet, but possibly soon to change.
Management authority and jurisdiction: Kalba Municipality oversees the site.
References: Cowles (1981); Evans (1994); Jongbloed (1987); Richardson (1990b); Western (1989).
Reasons for inclusion: 1a, 2a, 2b, 2d & 3c. Khor Kalba contains the finest stands of mangroves in the UAE, and has an endemic subspecies of the White-collared Kingfisher *Halcyon chloris*.
Source: Simon Aspinall and Colin Richardson.

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Wadi Ghayl (21)

Location: 25°27'N, 56°09'E. On the western flank of the Hajar Mountains in Fujairah Emirate.
Area: 200 ha.
Altitude: Less than 500 m.
Overview: A typical, narrow, rock-sided wadi in the Hajar Mountains, with permanent surface

flow in most years and rich associated fauna and flora.
Physical features: Wadi Ghayl is a small, narrow wadi carved out of solid rock and high-sided in places. The floor consists of gravel and pebbles, and there are several waterfalls. Much of the water is intercepted for cultivation, and the wadi dries out completely in some summers.
Ecological features: The wadi apparently supports a typical flora, but much of this has not as yet been identified.
Land tenure: The area is under the control of village chiefs or local families, with authority devolved by the Government of Fujairah Emirate.
Conservation measures taken: None.
Conservation measures proposed: Probably none required. Because of its high heritage values, the wadi is likely to remain in its relatively natural state.
Land use: Some abstraction of water for irrigation and domestic consumption, and small-scale cultivation of salad plants, vegetables, dates and other fruits.
Possible changes in land use: None likely.
Disturbances and threats: The principal threat is the excessive use of water for irrigation and domestic supply at the expense of the wadi system. The possible effects of this are not known. There is some shooting of sandgrouse (presumably only Lichtenstein's Sandgrouse *Pterocles lichtensteinii*), but this is not thought to be a serious threat.
Hydrological and biophysical values: No information.
Social and cultural values: Town water and irrigation supply.
Noteworthy fauna: Toads (*Bufo* spp.) and fish are abundant in several of the pools, as are dragonflies and a wide variety of other aquatic insects. Common Kingfisher *Alcedo atthis* and Grey Wagtail *Motacilla cinerea* occur along the stream in winter. Desert Lark *Ammomanes deserti*, Pale Rock Sparrow *Carpospiza brachydactyla* and House Bunting *Emberiza striolata* breed locally, and visit the wadi to drink. Bonelli's Eagle *Hieraeetus fasciatus* and Griffon Vulture *Gyps fulvus* were recorded in the area in late summer 1993.
Noteworthy flora: No information.
Scientific research and facilities: None.
Management authority and jurisdiction: Not applicable.
References: Unpublished personal observations.
Reasons for inclusion: 1d & 2b. A rare example of a wadi pool system which persists year round.
Source: Simon Aspinall.

Hatta Lakes (22)

Location: 24°48'N, 56°09'E. Opposite the entrance to Hatta Fort Hotel, on the western side of the Hajar Mountains in an enclave of Dubai Emirate.
Area: Over 800 ha.
Altitude: c.200-300 m.
Overview: A group of small reservoirs and pools on the western slope of the Hajar Mountains, of some importance for wildlife.

Physical features: A group of man-made reservoirs and ephemeral pools in a wide gravel depression in a low-level pass surrounded by mountains. The wetlands are seasonal and entirely dependent on winter rains. The site extends some eight km down Wadi Hatta to the Oman border and beyond.
Ecological features: No information.
Land tenure: Hatta Municipality.
Conservation measures taken: None.
Conservation measures proposed: Management of the site, including regulation of water levels, should be considered for recommendation to the appropriate authority.
Land use: Water supply for agriculture and domestic consumption, and local recreation.
Possible changes in land use: Alternative development is a possibility.
Disturbances and threats: Removal of the retaining banks and disturbance are the principal possible threats.
Hydrological and biophysical values: No information.
Social and cultural values: There are some important archaeological sites nearby, dating from the third millennium BC.
Noteworthy fauna: An important site for sandgrouse (Pteroclidae) coming in to drink in the morning and at dusk. Little Grebe *Tachybaptus ruficollis*, Little Ringed Plover *Charadrius dubius* and Black-winged Stilt *Himantopus himantopus* have bred or still breed, depending on the water level, and a variety of other waterbirds are occasional visitors.
Noteworthy flora: None known; the vegetation is sparse and appears to be unremarkable.
Scientific research and facilities: None.
Management authority and jurisdiction: Hatta Municipality.
References: Richardson (1990a). Also: Emirates Bird Records Committee files.
Reasons for inclusion: 1d. An example of a wetland type (freshwater dams and pools) rare in this part of Arabia.
Source: Simon Aspinall and Colin Richardson.

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Ayn al Faydah (23)

Location: 24°05'N, 55°42'E. On the plain to the west of, and immediately adjacent to, Jebel Hafit, and south of Al Ain, eastern Abu Dhabi Emirate.
Area: c.1,400 ha.
Altitude: Less than 300 m.
Overview: A natural spring system much modified by excavation and now with a small permanent lake; of considerable importance for breeding and wintering waterbirds, and with an interesting community of aquatic invertebrates. The site is a rare example of a semi-natural inland wetland.
Physical features: A natural spring system exposed by mechanical excavation and much modified and canalised. A small lake has been created, and water is now generally present year round, although in the summer of 1994, perhaps for the first time ever, the site was completely dry. Planted shrubs and trees such as mesquite *Prosopis juliflora* are maintained by drip-fed

irrigation. A feeder canal takes water from the main lake to a boating lake complex. Jebel Hafit, to the east of the site, rises to a peak at 1,300 m.

Ecological features: Reeds *Phragmites australis* and tamarix shrubs *Tamarix passerinoides* grow around the permanent lake and along the main canal, and there is a small area of seasonally wet *Juncus* marsh isolated by a bund. The dominant native species elsewhere include *Zygophyllum mandavillei*, *Salsola baryosma* and *Salsola rubescens*.

Land tenure: Al Ain Municipality.

Conservation measures taken: None.

Conservation measures proposed: Under sympathetic management and with adequate control of visitors, the wetland could be developed as a valuable wildlife sanctuary and educational site.

Land use: Outdoor recreation, including shooting. Water from the springs is used to supply a boating lake complex. An ornamental waterfowl collection and a goose farm have been established at the site, and there is a sewage treatment plant and overspill lake on the edge of the site.

Possible changes in land use: Further development, especially for recreational pursuits, is likely.

Disturbances and threats: Drought and human interference with the hydrological regime are the principal threats. The entire wetland dried out in the summer of 1994, perhaps as a direct consequence of conflicting requirements. This is apparently the first time that this has happened. Zealous "tidying up" of riparian vegetation could reduce the value of the site for waterbirds. Botulism may be exacerbated by *Clostridium* nurtured in local refuse. Wildfowl and shorebirds are occasionally shot for sport.

Social and cultural values: The site has considerable historical value.

Noteworthy fauna: Breeding birds include Moorhen *Gallinula chloropus*, Black-winged Stilt *Himantopus himantopus*, Little Ringed Plover *Charadrius dubius*, Red-wattled Lapwing *Vanellus indicus* and Graceful Prinia *Prinia gracilis*. Many species of waterfowl have occurred in the area on migration and in winter, including at least eight species of heron (Ardeidae). Some 500-600 ducks, mostly Mallard *Anas platyrhynchos*, can be found in winter. This is the largest inland concentration of ducks anywhere in the UAE. Two or more Bonelli's Eagles *Hieraeetus fasciatus* overwinter, attracted by the waterfowl. Several rare waterfowl in the UAE have been recorded in this area in recent years, including Great Crested Grebe *Podiceps cristatus*, Indian Pond Heron *Ardeola grayii* and Black Stork *Ciconia nigra*. Several species of freshwater invertebrates with relict and restricted distributions have been collected here.

Noteworthy flora: The wetland is an unusual inland site for *Cynomorium coccineum* and *Cistanche* sp. ("Desert Candle" or "Desert Hyacinth"), and also has *Limonium stocksii*, a species which normally grows on sabkha.

Scientific research and facilities: The avifauna has been well documented year round. Some invertebrate collections have been made, but the results have yet to be published.

Management authority and jurisdiction: No information.

References: Jongbloed (1987); Western (1989).

Reasons for inclusion: 1d & 2b. Presently a unique site within the UAE, with a very diverse avifauna and interesting invertebrate fauna.

Source: Simon Aspinall, Colin Richardson and Marijcke Jongbloed.

Ruwais Reed-beds (24)

Location: 24°04'N, 52°40'E. Part of the Ruwais housing complex of Abu Dhabi National Oil Company (ADNOC), in western Abu Dhabi Emirate.
Area: 1,500 ha.
Altitude: Less than 50 m above sea level.
Overview: A group of man-made pools and reed-beds fed by treated sewage and run-off. The site contains the largest area of reed-beds in the UAE, and supports a very diverse avifauna.
Physical features: A man-made wetland comprising several isolated reed-fringed ponds and reed-beds enriched with treated sewage and run-off water. The ponds are brackish to almost fresh or completely fresh, depending on input. Adjacent sabkha areas exhibit a natural seasonal hydrological regime; they are flooded in winter and become hypersaline in summer.
Ecological features: Large portions of the wetland are covered in reed-beds *Phragmites* sp.
Land tenure: ADNOC.
Conservation measures taken: None.
Conservation measures proposed: The site should be managed sympathetically for its wildlife.
Land use: Presently treated as wasteland and virtually unused. Some reeds are cut by local people, but the use to which they are put is unknown.
Possible changes in land use: Housing or other development is possible in the future. Reclamation would see the disappearance of most of the site.
Disturbances and threats: The main threat, other than the cutting off of the water supply, is from infilling. Several pools were reclaimed in 1994, and this seriously reduced the value of the area for wildlife. Biting insects are controlled by fumigation, and chemical contamination could therefore easily occur, either accidentally or deliberately.
Hydrological and biophysical values: Natural water purification and filtration.
Social and cultural values: None known.
Noteworthy fauna: The reed-beds are known to harbour many Reed Warblers *Acrocephalus scirpaceus* and Clamorous Reed Warblers *A. stentoreus* on passage and in winter, and both species may breed. Spotted Crakes *Porzana porzana* and Water Rails *Rallus aquaticus* have been recorded as non-breeding visitors, and the latter may nest undetected. Black-winged Stilts *Himantopus himantopus* probably breed. A variety of ducks and shorebirds occur on autumn passage and in winter, and the Common Kingfisher *Alcedo atthis* is found in winter. Single Ferruginous Ducks *Aythya nyroca* have occurred in winter. The reed-beds provide a valuable roosting site for hirundines and wagtails *Motacilla* spp. Although only limited bird surveys have been carried out, no less than 140 species of birds have already been recorded in the area. Information on other faunal groups is to be collected in future surveys.
Noteworthy flora: The extensive *Phragmites* reed-beds comprise the largest area of reed-beds in the UAE.
Scientific research and facilities: None, other than a number of brief avifaunal surveys.
Management authority and jurisdiction: ADNOC.
References: Unpublished personal observations.
Reasons for inclusion: 1d & 2b. The only freshwater wetland of any consequence in the

western UAE, and the most extensive reed-bed community in the country.
Source: Simon Aspinall.

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OTHER SITES

It is unlikely that all important wetland sites in the UAE have been identified in this inventory. Wildlife surveys have barely begun in many areas, and much remains to be discovered, even in some of the best known sites. Only birds are reasonably well known. Considerable subspeciation is considered likely amongst both invertebrate and vertebrate groups. The flora may also yield similar results once studied thoroughly. This is particularly likely to be the case in the numerous wadi systems of the northern Hajar Mountains, which run north-south through the east of the country. Sites 18, 19 and 21 simply represent the best known (and most easily accessible) wadi systems at the present time. There is a need to protect all wetland sites in the UAE, if for no other reason than to prevent contamination of groundwater and the subterranean aquifers. The National Avian Research Centre and Emirates Natural History Group will be able to supply information on any new sites and any additional survey material on established sites as this becomes available.

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REPUBLIC OF YEMEN

INTRODUCTION

Area: 531,000 sq.km.

Population: 11,500,000 (1990).

In 1990, the Yemen Arab Republic (North Yemen) and the People's Democratic Republic of Yemen (South Yemen) were unified to form the present Republic of Yemen. Situated in the south of the Arabian Peninsula, the Republic of Yemen is bounded to the west by the Red Sea, to the south by the Gulf of Aden, to the east by the Sultanate of Oman, and to the north by Saudi Arabia. The narrow desert plain of the Tihamah bordering the Red Sea rises abruptly to a mountainous interior. These mountains, which are heavily terraced for agriculture, attain heights of between 3,000 and 3,500 m, and include the highest mountain in Arabia, Jabal al-Nabi Shu'ayb, with a peak at 3,666 m. Further east, the mountains fall away in a series of precipitous steps to the fringes of the arid Rub al-Khali (Empty Quarter). In the south, the narrow coastal plain along the coast of the Gulf of Aden is backed by a range of steep mountains rising to almost 2,500 m. North of these mountains, a high plateau falls away gently to the northeast to merge with the Rub al-Khali basin. Numerous large wadis with permanently flowing water in their upper reaches descend from the mountains towards the coastal plains, the most important in terms of surface flow being the Mawr, Surdud, Siham and Zabid in the Red Sea drainage and the Hadramawt in the Gulf of Aden drainage. During the past 20 years, there has been a drastic drop in the water table on the plateau in the central highlands, and this is now of considerable concern to agriculturalists. The fall in water levels has been attributed to excessive pumping of groundwater from boreholes, and reduced water retention because of the widespread collapse of ancient terraces.

Although part of the Republic of Yemen, Socotra Island and its neighbouring islands of Al-Ikhwan (The Brothers) and Abd al-Kuri in the Indian Ocean are geographically a continuation of the Horn of Africa. Socotra lies about 800 km east of Aden and 350 km from the nearest mainland coast of Yemen. This predominantly limestone island measures about 110 km from east to west and 30 km from north to south, and attains an altitude of 1,500 m.

The climate along the Red Sea coast is hot and humid, with a mean annual temperature of 29°C. Precipitation is very low, the average annual rainfall at Al-Hudaydah being 85 mm, with rain falling on only about 11 days a year. The climate along the south coast is similar, with maximum temperatures exceeding 40°C in July and August. Average temperatures at Aden range from 24°C in January to 32°C in July, and the average annual rainfall is 46 mm. Despite the low rainfall, the humidity is very high. By contrast, the highlands are mild with summer maxima around 29°C. Winters can be cold and frosts are not uncommon. The average annual rainfall over much of the highlands is 380-500 mm, decreasing to less than 120 mm in the east.

Most of Yemen's population of about 11.5 million are concentrated in the western highlands and locally along the coast, and large parts of the country are sparsely populated, especially in the east and south. Cultivated land covers only about 6% of the country, mainly on the highland terrace system and on the Tihamah. Some 30% of the land area is said to be grazed and 10% is classified as "woodland", with the remaining 54% being largely desert or barren, rocky hills. Yemen's major landscapes and dominant vegetation types have recently been summarized by IUCN (1992) and Evans (1994).

Agriculture is the mainstay of the economy. Most farming is at a subsistence level, the staple crops being millet, sorghum, wheat, barley, pulses, dates, fruit and vegetables. Cotton is widely grown on the coastal plains as a cash crop. Fishing is also a major industry, particularly in the south. The industrial sector is small and is based on the manufacture of cotton textiles, cement, aluminium products and handicrafts. Oil is now the chief export. Yemen is divided into 16 provinces or Governorates, ten in former North Yemen and six in former South Yemen. Sana'a, the capital, is situated at about 2,300 m elevation in the western highlands.

Summary of Wetland Situation

The relatively high annual rainfall in the western and southern highlands feeds a large number of rivers and streams which descend rapidly in steep-sided wadis towards the coastal plains. Many of these have permanently flowing water in their upper reaches, and retain water throughout the year in deep pools along their middle and lower reaches, but in most cases, surface flow only reaches the sea during periods of exceptionally heavy rainfall. In some wadis, this may be as infrequently as once in 50-100 years. The seven most important wadi systems in the western highlands, from north to south, are Wadi Mawr, Wadi Surdud, Wadi Siham, Wadi Rima, Wadi Zabid, Wadi Rasyan and Wadi Mawsa. Scholte (1992) gives details of the major hydrological characteristics of these wadis, all of which drain west into the Red Sea. Major wadi systems draining south into the Gulf of Aden and Arabian Sea include Wadi Warazan, Wadi Jahr, Wadi Hajar and the impressive Wadi Hadramawt. The latter, which is some 240 km in length, is the largest natural permanent river in Arabia, and contains five of the nine indigenous freshwater fishes of the Arabian Peninsula, including three of the six Arabian endemics.

There are no natural freshwater lakes in Yemen and few permanent freshwater marshes of any size, due partly to the precipitous terrain and partly to alterations in the landscape by agriculture over many millennia. In a few areas, notably in Wadi al-Malih and Wadi Warazan, sub-surface seepage feeds grassy marshes in valley bottoms. The Wadi al-Malih marshes near Ta'izz are of special interest as they regularly hold small numbers of the critically endangered Northern Bald Ibis *Geronticus eremita*. The only other significant sites for waterfowl in the interior of Yemen are man-made wetlands, notably Ma'rib Dam, a water storage reservoir on Wadi Ma'rib, and the extensive sewage lagoons near Ta'izz. At the latter site, treated waste water has created a system of small lakes and marshes which regularly support 2,000-3,000 waterfowl in winter. There are also small water storage reservoirs in Wadi Mawr and Wadi Hajar.

Much of Yemen's coastline, both along the southern Red Sea (450 km, excluding islands) and along the Gulf of Aden (over 1,250 km), is low-lying, with high energy sandy or gravelly beaches backed by sand dunes and low cliffs. Inter-tidal flats of mud or sand occur widely along the Red Sea coast, and to a lesser extent along the Gulf of Aden coast. The richest coastal mudflats are found at the mouths of the main wadis, where sub-surface seepage creates richer habitats compared to intervening stretches of coastline. Mangroves are widespread on the Red Sea coast and on some islands, particularly north of Al-'Urj. Well developed mangrove is found along 84 km or 12% of the Red Sea coast, and less well developed mangrove along a further 38 km (5%). The mangrove communities are extremely simple, consisting of only one species of mangrove, *Avicennia marina*. Locally, there are coastal lagoons and large areas of intermittently inundated salt flats (sabkha).

Coral reef formations in the Red Sea have been described by UNEP/IUCN (1988). Fringing coral communities have developed on remnant fossil reef rock substrates in some areas, mainly immediately north of Al-Mukha and between Al-Mukha and Dhubab. However, unlike further north in the Red Sea, raised reef rock features and other consolidated substrates are rare, and in general coral reefs are limited in extent. Seagrass beds are also limited in extent because of a relative paucity of sheltered locations and the strong seasonal winds. The diurnal tidal range in the Red Sea is about 0.5 m, and the seasonal variation from 1.33 m in January to 1.03 m in July.

Yemen's coastal waters are rich in fish and crustaceans of commercial importance including the lobster *Palinurus* sp. and the swimming crab *Portunus pelagicus*, and support an important artisanal fishery (Loulou, 1976). The great productivity of the Arabian Sea, Gulf of Aden and southern Red Sea, caused by upwellings of cold, nutrient-rich waters during the summer monsoon, together with the presence of numerous offshore islands, create ideal feeding and breeding areas for many seabirds, notably *Bulweria fallax*, *Puffinus persicus*, *Phaethon aethereus*, *Sula dactylatra*, *S. leucogaster*, *Phalacrocorax nigrogularis*, *Phalaropus lobatus*, *Larus hemprichii*, *L. leucophthalmus*, *Sterna bergii* and *S. repressa* (Evans, 1994).

Wadi systems throughout Yemen are being adversely affected by severe degradation of the catchments as a result of deforestation for fuelwood and the charcoal industry and overgrazing by domestic livestock. Land-use changes, as a consequence of increasing mechanization of agriculture, have led to serious problems of erosion through deep ploughing on former rangelands and of pollution from pesticides and fertilizers. The Ta'izz marshes are critically threatened by excessive extraction of groundwater and conversion to agriculture. Relatively few of the coastal wetlands are subject to severe and immediate problems or are currently undergoing major changes, but mangroves are under threat locally from coastal development, *e.g.* around Al-Hudaydah. Oil exploration is occurring off the northwest coast, and there are potential threats from pollution.

Preliminary lists of important wetlands in the Republic of Yemen have been given by Al-Safadi (1993) and Scott (1993). A recent inventory of Important Bird Areas in the Middle East, sponsored by BirdLife International, has identified 57 sites as being of special importance for bird conservation in Yemen (Evans, 1994). Sixteen of these sites are primarily wetlands or

contain significant tracts of wetland habitat, 12 in the coastal zone and four inland. All of these sites are included in the present inventory, along with two additional inland sites, Al-Hudaydah Sewage Lagoons and Wadi Warazan. Rocky offshore islands and marine areas important for pelagic seabirds have been excluded from the present inventory as they can scarcely be classified as wetlands and have already been well covered in the inventory of Important Bird Areas.

Wetland Research

The Faculty of Science at the University of Sana'a conducts research on biological resources, and the University of Aden has undertaken limited studies related to the environment. Preliminary work has been undertaken on coastal zone management plans for the Red Sea coast, including comprehensive surveys of ecosystems (TMRU, 1987). The Department of Fisheries carries out investigations on the marine fisheries, and has undertaken marine biological and oceanographic investigations in the Red Sea in collaboration with FAO. A small Marine Biological Laboratory was established at Al-Hudaydah in the 1970s, and a Marine Science and Resources Research Centre was established by the Government of the former Yemen Arab Republic in 1983, with the assistance of UNESCO.

Biologists from the University of Sana'a have investigated the freshwater molluscs, freshwater crustaceans and dragonflies (Odonata) of Yemen, and have studied the macrofauna of stagnant freshwater bodies (Al-Safadi, 1990a, 1990b, 1991a & 1991b). Various collections of freshwater fishes have been made, the largest of these being collections from Wadi Hadramawt in the 1940s, and a collection by Dr I.G. Dunn from several localities in Yemen in 1976 (summarized by Banister and Clarke, 1977). Numerous resident and visiting ornithologists have gathered a considerable amount of information on the birds of Yemen, particularly under the auspices of the Ornithological Society of the Middle East since 1979, and have surveyed a number of important wetlands, especially along the Red Sea coast and at Ta'izz. Scholte (1992) studied the avifauna of Wadi Rima, one of the major wadis in western Yemen with permanently flowing water. M.M. Al-Safadi from the Department of Biology, University of Sana'a, has participated in the IWRB/AWB Asian Waterfowl Census since the winter of 1990/91, and has provided information on a total of 11 sites, six of which are included in the present inventory.

Wetland Area Legislation

Prior to unification, there was no specific wildlife conservation nor protected areas legislation in either of the two republics. In the former People's Democratic Republic of Yemen, legislation concerning the environment included laws on hunting and Law No.13 (1976) which established the National Environment Council. In the former Yemen Arab Republic, environmental legislation included Law No.13 (1975), which relates to various aspects of marine pollution and identifies the protocol for forbidding discharge of oil, ballast, rubbish and other harmful substances into the marine environment, and Law No.20 (1978), which relates to fisheries and bans the use of explosives or harmful substances. A Prime Ministerial Decree (No.7) in 1987

established the Environmental Protection Council as a cross-ministerial group. A Forest Law was adopted in the Yemen Arab Republic in 1986, but this had not been ratified at the time of unification. In the mid-1980s, the Ministry of Agriculture of the Yemen Arab Republic proposed major wildlife conservation legislation relating to species and areas, but this was rejected by the People's Constituent Assembly on the grounds that it was outside the development priorities of the Government (IUCN, 1992).

No effective legislation on any aspect of wildlife conservation has been introduced since unification (Rands, 1992). Wildlife legislation exists in draft form, but until it is ratified by Parliament, there is no governmental system for site protection.

At international level, the Republic of Yemen is a contracting party to the World Heritage Convention, but has not as yet designated any natural World Heritage Sites. It participates in the Programme for the Environment of the Red Sea and the Gulf of Aden (PERSGA), and has ratified the Regional Convention for the Conservation of the Red Sea and the Gulf of Aden Environment. It has signed, but not ratified, the Biodiversity Convention. It participates in the UNESCO Man and the Biosphere Programme, but has not as yet designated any Biosphere Reserves, although the island of Socotra is currently being considered for nomination. The Republic of Yemen is not a party to either the Ramsar Convention or the Bonn Convention.

Wetland Area Administration

Since unification, the main ministry concerned with wildlife conservation, fisheries and forestry has been the Ministry of Agriculture and Water Resources, combining the former YAR Ministry of Agriculture and Fisheries based in Sana'a and the former PDRY Ministry of Agriculture and Agrarian Reform based in Aden. A Department of Fisheries was established in the YAR Ministry of Agriculture in the 1970s to plan, develop and monitor the fisheries resource and to frame legislation for administering fisheries. The Environmental Protection Council, established in the YAR in 1987, has continued after unification to develop and coordinate environmental policy throughout the entire country. It undertakes a variety of tasks including the preparation of wildlife laws, development of policy for the control of pollution and pesticide contamination, and the setting up of a general framework for an environmental education programme.

None of the wetlands included in this inventory is legally protected for nature conservation purposes, although some may be covered by traditional resource-use reserves or "mahjur", and several have been officially considered for legal protection measures in the past. Traditional forms of protected area in rangelands (mahjur) and areas protected by religious institutions have been described by IUCN (1992). Land rights are not at the national level, but at the level of traditional land owners. The only large government-owned area which is of importance for nature conservation is the mangrove coastline, which is under the jurisdiction of the army. The Government of the Yemen Arab Republic studied the possibility of establishing marine parks in the Red Sea in the 1970s and 1980s, and IUCN has identified 16 sites along the mainland coast of the Red Sea as deserving special management or protection. Various other lists of priority

areas for conservation have been drawn up, but there are still no nationally designated protected areas in Yemen (IUCN, 1992; Evans, 1994).

Organizations involved with Wetlands

Environmental Protection Council

Ministry of Agriculture and Water Resources
- Directorate of Forests and Range
- Directorate of Fisheries

Faculty of Science, University of Sana'a

Nature and Ornithological Society of Yemen
- A small, expatriate-based group of mostly ornithologists, with very limited resources; the only non-governmental organization involved with nature conservation in Yemen.

WETLANDS

Site descriptions compiled from the literature, principally Evans (1994), and from information provided for the International Waterfowl Census by Dr Mousa Mohamed Al-Safadi at the Department of Biology, University of Sana'a. Omar al-Saghier and Richard F. Porter provided unpublished information on the birds recorded at four sites in March 1995.

Red Sea Coast: Midi to Al-Luhayyah (1)

Location: 16°21'N, 42°47'E to 15°33'N, 42°41'E; on the Red Sea coast from the Saudi Arabian border near Midi south for about 90 km to Al-Luhayyah, 105 km north-northwest of Al-Hudaydah, Hajjah and Al-Hudaydah Governorates.
Area: 30,000 ha.
Altitude: Sea level.
Overview: A 90-km stretch of the Red Sea coast near the Saudi Arabian border, with well developed mangrove fringe and extensive sand bars and mudflats.
Physical and ecological features: The site comprises about 90 km of very flat sabkha coastline with extensive offshore sand bars and inter-tidal mudflats, especially at Al-Luhayyah in the south, some sandy beaches around Midi in the north, and occasional sand dunes and cliffs, especially in the northern half. There is a small, rocky hill at Al-Luhayyah (Jabal al-Humara). Reef-rock rubble patches are frequent offshore in the southern half, but there are no significant coral reefs. More than 60 km of the coast is fringed by well-developed mangrove *Avicennia marina*, which becomes very dense between Midi and Buhays; these are the most extensive

stands of mangrove in Yemen. Seagrass beds are few except around Buhays. There is little terrestrial vegetation along the coast, this consisting mainly of salt-tolerant spiny grass.

Land tenure: No information.

Conservation measures taken: None. The site has been identified as an Important Bird Area by BirdLife International (Evans, 1994).

Conservation measures proposed: None known.

Land use: Fishing is the main human activity, centred on Al-Luhayyah, Midi, Habl and Buhays. Tourism and recreational use occur at low levels.

Possible changes in land use: No information.

Disturbances and threats: Occasional dredging of the shipping channel to Al-Luhayyah may damage mudflats locally. Shrimp-farming is said to be increasing in Yemen, and if so would gravely threaten mangrove habitat.

Hydrological and biophysical values: No information.

Social and cultural values: Al-Luhayyah is a classic Red Sea port of great cultural, archaeological and historical interest.

Noteworthy fauna: An important staging and wintering area for migratory waterfowl, especially shorebirds, and possible also an important breeding area for several species. *Pelecanus rufescens* (maximum 100) and *Ardea goliath* (maximum 3) have been recorded throughout the year and probably breed in the mangroves. Other possible breeding species include *Egretta gularis* (maximum 35), *Ardea purpurea*, *Pandion haliaetus*, the endemic Red Sea subspecies of the Collared Kingfisher *Todiramphus chloris abyssinica*, *Acrocephalus stentoreus* and *A. baeticatus*; *A. stentoreus* is certainly common in winter and spring. Counts of passage migrants and/or winter visitors have included up to 10 *Ardea cinerea*, 90 *Platalea leucorodia*, 200 *Dromas ardeola*, 20 *Recurvirostra avosetta* (October), hundreds of *Charadrius alexandrinus* and *C. leschenaultii*, 1,000 *C. mongolus* (October), 100 *Limosa lapponica*, hundreds of *Numenius arquata* (October), 25 *Tringa nebularia*, 200 *T. cinerea* (October), 100 *Calidris alba*, hundreds of *Limicola falcinellus* (October), 5 *Larus leucophthalmus* (November), 86 *L. genei*, 20 *Gelochelidon nilotica* and 60 *Sterna caspia* (November). *Sterna repressa* is a common passage migrant (*e.g.* 120 in November), and may breed on offshore sand bars.

The Dugong *Dugong dugon* and Green Turtle *Chelonia mydas* occur in inshore waters along the coast.

Noteworthy flora: The site contains the most extensive stands of mangrove in Yemen.

Scientific research and facilities: None, other than brief avifaunal surveys. The mangrove has not been surveyed during the breeding season.

Management authority and jurisdiction: No information.

References: Brooks *et al.* (1987); Evans (1994); Phillips (1982); TMRU (1987).

Reasons for inclusion: 1a, 2a & 3c. A relatively undisturbed stretch of coastline, important for migratory waterfowl especially shorebirds (notably *Charadrius mongolus*), and providing habitat for at least three globally threatened species (*Chelonia mydas*, *Larus leucophthalmus* and *Dugong dugon*).

Source: See references.

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Islands off the Northwest Coast (2)

Location: 15°28'-16°02'N, 42°17'-42°42'E; in the southern Red Sea north and northwest of Kamaran Island, about 90-140 km north-northwest of Al-Hudaydah, Al-Hudaydah Governorate.
Area: c.5,000 ha.
Altitude: Sea level to 36 m.
Overview: A group of over 30 small, mainly low-lying, sandy islands in the Red Sea, 10-45 km off the northwest coast of Yemen; several are formed from upraised coral and at least two support some mangrove vegetation.
Physical and ecological features: The site comprises a loose archipelago of at least 31 small islands on the northern Red Sea shelf, from Buhays in the northeast to Al-Badi off the north coast of Kamaran in the south. (The large island of Kamaran is included as part of Site 3). The islands lie between 10 km and 45 km off the mainland coast. Most are low, flat and sandy, elevated only a few metres, but a few of the largest are formed from upraised coral and are higher, rising to a peak at 36 m on the largest island, Tikfash (2,990 ha). Most islands have a fringing coral reef, and usually also have a sandy beach, allowing access at least at high tide; the most extensive beaches are on the east coast of Humar and the north coast of Tikfash. Vegetation is sparse on all islands, with thin grass and low, salt-tolerant bushes. There are small areas of mangrove *Avicennia marina* on Tikfash and Humar; Kitamah has a well, surrounded by succulent *Euphorbia* vegetation. Patches of seagrass and reef-rock rubble occur off most islands.
Land tenure: No information.
Conservation measures taken: None. The site has been identified as an Important Bird Area by BirdLife International (Evans, 1994).
Conservation measures proposed: The establishment of marine parks has been considered in the past. A baseline census of the breeding birds, education of fishermen and navy personnel, the erection of signs at key landing points, and the extermination or control of introduced rodents have all been recommended as highly desirable measures (Evans, 1994). Many of the islands are in pristine condition, with little sign of human interference, and thus any projects to open them up for tourism (*e.g.* for diving) should carefully consider the interests of wildlife conservation (R.F. Porter, pers. comm.).
Land use: None of the islands is permanently inhabited. However there are temporary fishing camps, occupied seasonally, on Buhays, Zakhah, Zurbat, Juwa, At Talawin, Humar, Zabin, Al-Murk, Hataban, 'Ukban and perhaps many of the other islands. A small tourist camp has recently been established on the largest island, Tikfash, and small numbers of tourists, mainly from Italy, are now visiting the islands for the diving.
Possible changes in land use: No information.
Disturbances and threats: The islands of Zurbat, Kitamah and possibly Zuraymah are infested with rats *Rattus* sp., while Juwa and Hataban are infested with mice *Mus* sp. Tern and turtle eggs are taken by fishermen. Extraction of sand for the local building trade has occurred on the beach on Humar, and may be continuing with attendant disturbance. Plastic rubbish is common on all the islands, as it is on the mainland.
Hydrological and biophysical values: No information.
Social and cultural values: There are graves on Juwa, Hataban and especially Uqban, where

there are also traces of former settlement.
Noteworthy fauna: Breeding birds include *Phaethon aethereus* (10+ pairs on Kitamah), *Sula leucogaster* (1,200 birds on Kutman in March 1995), *Butorides striatus* (at least one pair on Tikfash), *Egretta gularis* (10 pairs on Qusur), *Ardea goliath* (one pair on Qusur and probably at least one pair on Tikfash), *Platalea leucorodia archeri* (six pairs on Humar in 1979), *Pandion haliaetus* (at least five pairs on Tikfash, five pairs on Qusur, two pairs on Hataban and one pair on Kutman), *Falco concolor* (at least one pair on Kitamah), *Charadrius alexandrinus* (50+ pairs on Tikfash), *Larus hemprichii* (15 pairs on Kutman), *Sterna caspia* (five pairs on Qusur) and *S. saundersi* (15+ pairs on Tikfash and three pairs on Ba Baryd). Fifteen *Pelecanus rufescens* were observed in suitable breeding habitat in mangroves on Tikfash in March 1995. Other species possibly breeding on the islands include *Dromas ardeola*, *Larus leucophthalmus*, *Sterna bengalensis* and *Acrocephalus baeticatus* (singing in the mangroves on Tikfash in March 1995). Small colonies of terns, probably *Sterna repressa*, are reported to nest on the low sandy islands of Juwa, At Talawin and Hataban.
Birds recorded during a brief survey of Kitamah and Hataban in October 1979 included four *Pelecanus rufescens*, 100 *Sula leucogaster*, small numbers of *Dromas ardeola*, 70 *Arenaria interpres*, 300 *Larus hemprichii*, 210 *L. leucophthalmus*, 20 *Sterna caspia*, 100 *S. bergii*, 1,000 *S. bengalensis* and 100 *S. repressa*. Migrants observed during a survey of Tikfash in March 1995 included 50 *Dromas ardeola*, 140 *Charadrius mongolus*, 100 *Limosa lapponica*, 80 *Calidris ferruginea*, 100 *Arenaria interpres*, 21 *Larus ichthyaetus* and 200 *Sterna bergii*.
Records of dolphins, including Bottle-nosed Dolphin *Tursiops truncatus* and Indo-Pacific Hump-backed Dolphin *Sousa chinensis*, and whales, probably including *Balaenoptera edeni*, are frequent, and Dugongs *Dugong dugon* are said by fishermen to be particularly common. Sea turtles including *Chelonia mydas* and *Eretmochelys imbricata* nest, probably in important numbers. The coral reefs are particularly diverse.
Noteworthy flora: No information.
Scientific research and facilities: Cartographic surveys were undertaken in 1977 and 1979. Phillips (1982) carried out brief avifaunal surveys on Kitamah and Hataban in 1979, and Omar al-Saghier and R.F. Porter investigated the birds of Tikfash, Qusur, Ba Baryd and Kutman in March 1995.
Management authority and jurisdiction: No information.
References: Evans (1989, 1994); Phillips (1982).
Reasons for inclusion: 1a, 2a & 3c. A group of uninhabited and relatively undisturbed islands with breeding seabirds and sea turtles, important also for passage and wintering Laridae (notably *Larus leucophthalmus* and *Sterna bengalensis*). The surrounding waters are important for *Dugong dugon* and cetaceans.
Source: See references.

Bahr Ibn Abbas, Ra's Isa and Kamaran Island (3)

Location: 15°11'-15°28'N, 42°32'-42°48'E; about 60 km north-northwest of Al-Hudaydah, Al-Hudaydah Governorate.

Area: c.35,000 ha.
Altitude: Sea level to 24 m (on Kamaran Island).
Overview: A large inshore island, a sandy headland and a shallow sea bay with extensive mudflats and mangrove vegetation, well developed coral reefs and seagrass beds, on the northern Red Sea coast of Yemen.
Physical and ecological features: The site comprises the large island of Kamaran (15°22'N, 42°35'E, 10,000 ha), Ra's Isa headland on the mainland coast to the southeast, and the adjacent shallow, sheltered bay, Bahr Ibn Abbas, north of Ra's Isa. Kamaran is a low, flat, rather bare island, separated from the mainland by a channel 2.5 km wide and less than 100 m deep. It is about 20 km long (from north to south) and up to 8 km wide. The south coast of Ra's Isa is a steep, sandy storm-beach, backed by several old, raised beaches of coral debris and with occasional sand dunes, low cliffs and patches of sabkha; there is a fringing coral reef close inshore. The north coast of Ra's Isa and the coast of Bahr Ibn Abbas are very flat and dominated by bare sabkha, broken only by a coral outcrop at the port of Al-Salif and occasional areas of sand dunes. There are extensive inter-tidal mudflats and sandflats as well as some coral reef off Al-Salif and Al-Khawbah. About 10 km of well developed mangrove *Avicennia marina* fringe a sheltered bay on Kamaran and areas north and south of Ibn Abbas, where appreciable freshwater seepage also supports groves of *Phoenix* and *Hyphaene* palms inland. Seagrass beds are frequent in Bahr Ibn Abbas, especially south of Al-Khawbah. There are a few salt-tolerant bushes, including *Limonium* sp., growing on sandy areas on Ra's Isa.
Land tenure: No information.
Conservation measures taken: None. The site has been identified as an Important Bird Area by BirdLife International (Evans, 1994).
Conservation measures proposed: The establishment of marine parks has been considered in the past, and the area was recommended for special management by a PERSGA survey team. The southwest coast of Ra's Isa is considered a suitable site for a Marine Park, being convenient for tourists and for scientists from the marine laboratory at Al-Hudaydah.
Land use: Al-Salif is a modern container port, and is the Red Sea terminus for a major oil-pipeline. The other major human activity is fishing: Al-Khawbah is a major fishing port and Ibn Abbas is a major fishing village. Kamaran Island is inhabited, and is grazed by a sizeable herd of camels.
Possible changes in land use: No information.
Disturbances and threats: The impact on habitats caused by the construction of the oil terminal at Al-Salif in the late 1980s is not known. Associated development of the Al-Salif area in the future is probably the greatest potential threat to the site, through expansion of industry and housing leading to reclamation of land, high levels of disturbance and pollution. Breeding colonies of waterbirds in the mangroves may be threatened by human disturbance, deliberate persecution, exploitation of eggs and the cutting of trees for wood and fodder. Because of its clear, rich seas and accessible coral reefs, the Ra's Isa area is a strong candidate for development of tourism in the future, with potentially major impacts on the fauna.
Hydrological and biophysical values: No information.
Social and cultural values: No information.
Noteworthy fauna: Known to be an important area for a variety of waterfowl and seabirds, but little precise information is available. The only known breeding colony of *Pelecanus rufescens* in Yemen is in mangroves near Ibn Abbas, but numbers appear to be small (maximum 12,

October). *Ardea goliath* has been recorded in the area in February, and may also breed in the mangroves. *Dromas ardeola* is present year-round in small numbers (maximum 34, January), and may breed. At least one pair of *Pandion haliaetus* breeds, and *Falco concolor* is probably a non-breeding summer visitor from nearby islands. Other notable species include *Limicola falcinellus* (passage migrant), *Larus hemprichii* (common non-breeding visitor, maximum 140), *L. leucophthalmus* (passage migrant, maximum 30), *Sterna caspia* (passage migrant, maximum 100) and *Sterna repressa* (non-breeding summer visitor, maximum 125 birds). Non-breeding summer visitors to the rich seas offshore include *Sula leucogaster* (100), *Sterna bergii* (20), *S. bengalensis* (180) and *Anous stolidus* (two). Some of these may well breed on nearby islands.
A species of gazelle *Gazella* sp. formerly occurred on Kamaran, but there have been no records since a horn was found in 1979. Feeding whales and dolphins (*e.g. Sousa chinensis*) are frequent offshore, and a population of Dugong *Dugong dugon* occurs in Bahr Ibn Abbas. The area is probably an important feeding ground for sea turtles.
The coral reef along the southwest side of Ra's Isa, near Al-Salif, is probably the best developed reef on the Yemen mainland, and is reported to support profuse *Porites* growth.
Noteworthy flora: The site contains extensive stands of mangrove and seagrass beds.
Scientific research and facilities: None, other than brief faunal and floral surveys. The area is extremely poorly known.
Management authority and jurisdiction: No information.
References: Evans (1994); UNEP/IUCN (1988).
Reasons for inclusion: 1a, 2a & 3c. A relatively undisturbed stretch of coastline, important for breeding, passage and wintering waterfowl (notably *Pelecanus rufescens*, *Larus leucophthalmus* and *Sterna caspia*), *Dugong dugon* and sea turtles.
Source: See references.

Wadi Surdud (4)

Location: 15°13'N, 43°20'E; 15 km northeast of Bajil and about 65 km northeast of Al-Hudaydah, Al-Hudaydah and Al-Mahwit Governorates.
Area: Unknown.
Altitude: c.250-400 m.
Overview: A large wadi in the foothills of the Red Sea escarpment, with permanently flowing water and deep pools; one of the seven largest wadis in western Yemen.
Physical and ecological features: The site comprises a section of Wadi Surdud where its leaves the rocky foothills of the Red Sea escarpment and flows onto the adjacent silt plain of the western Tihamah, north and northeast of Bajil. Wadi Surdud is one of the largest wadis along the west coast of Yemen. The upper reaches of the wadi contain permanently flowing water, while the lower reaches retain some water throughout the year in large, deep pools. Surface flow only reaches the sea during the rainy seasons (March-April and July-September). The wadi parallels the main Sana'a to Al-Hudaydah highway for about 12 km in a narrow gorge before opening out onto the Tihamah plain. A fine parkland of *Dobera glabra* trees covers much of the plain (especially north of Al-Kadan) and extends into the foothills, where there are also

scattered trees of *Acacia mellifera*, *A. etbaica* and *Ziziphus*, shrubs (*Anisotis*, *Berchemia*, *Sageretia* and *Carissa*) and succulents (*e.g. Adenium*, *Caralluma*, *Opuntia*), all often festooned with *Cissus* and other climbers. The vegetation is denser along wadi banks and in hollows, where these trees and shrubs form thickets, together with occasional *Trichilia* and *Tamarindus* trees up to 10 m high. The wadi floor supports dense thickets of native shrubs and trees, as well as many gardens, orchards and palm groves.

Land tenure: No information.

Conservation measures taken: None. Wadi Surdud has been included within a larger site (Al-Kadan, c.6,000 ha) identified as an Important Bird Area by BirdLife International (Evans, 1994).

Conservation measures proposed: None known.

Land use: Most of the Tihamah plain is cultivated traditionally for rain-fed sorghum and millet, but there are also some large-scale irrigation projects. The foothills are predominantly uncultivated and are grazed by goats, sheep, camels and cattle.

Possible changes in land use: No information.

Disturbances and threats: The water table is being lowered by over-pumping of groundwater for irrigation purposes, and the *Dobera* parkland is being destroyed by the expansion of intensive irrigated agriculture.

Hydrological and biophysical values: No information.

Social and cultural values: No information.

Noteworthy fauna: *Scopus umbretta* and *Ciconia abdimii* breed in the wadi. The pools and marshy areas along the wadi provide wintering habitat for small numbers of a variety waterbirds. Mid-winter waterfowl counts in Wadi Surdud since 1991 have included up to 8 *Butorides striatus*, 180 *Bubulcus ibis*, 16 *Egretta gularis*, 8 *E. garzetta*, 16 *Ardea cinerea*, 24 *Ciconia abdimii*, 8 *Tringa ochropus* and 8 *Actitis hypoleucos*. *Nycticorax nycticorax* has also been recorded in the wadi, and a Black-headed Heron *Ardea melanocephala* was present in January 1994. The Northern Bald Ibis *Geronticus eremita* is a very rare but possibly regular non-breeding visitor; one was present in November 1984, and 5-6 were present in May 1985. Small numbers of *Ciconia ciconia* occur on passage (maximum 23) and *C. nigra* has been recorded. Many other passage migrants are attracted to rest and feed at irrigated farmland on the adjacent plains, including large numbers of raptors. The lush wadi vegetation, open woodland and sandy plains support a very diverse breeding bird fauna including most of the Afrotropical species characteristic of this region of southwestern Arabia. Several pairs of Black-winged Kites *Elanus caeruleus* breed in the area, and up to seven Arabian Bustards *Ardeotis arabs* have been recorded on the adjacent plains.

Mammals include the Hamadryas Baboon *Papio hamadryas*, endemic to southern Arabia. The terrapin *Pelomedusa subrufa*, two amphibians endemic to Arabia, the toad *Bufo tihamicus* and the frog *Euphlyctis ehrenbergii*, and a freshwater fish endemic to Southwest Arabia, *Barbus arabicus* (Cyprinidae), occur in permanent pools along the wadi.

Noteworthy flora: No information.

Scientific research and facilities: Several ornithological surveys have been carried out in the area, and mid-winter waterfowl counts have been undertaken by the Department of Biology, University of Sana'a, each year since 1991. I.G. Dunn collected fish in the wadi in 1976, and Al-Safadi (1990c) studied breeding *Ciconia abdimii* in 1989.

Management authority and jurisdiction: No information.

References: Al-Safadi (1990c); Banister & Clarke (1977); Brooks *et al.* (1987); Cornwallis & Porter (1982); Evans (1994).
Reasons for inclusion: 1a, (2a) & 2d. A good example of a large wadi system with permanently flowing water, supporting endemic amphibians and fish, and possibly a regular staging area for the endangered Northern Bald Ibis *Geronticus eremita*.
Source: See references.

Red Sea Coast: Al-'Urj to Al-Hudaydah (5)

Location: 14°55'N, 42°55'E; on the Red Sea coast north from the city of Al-Hudaydah to Al-'Urj, Al-Hudaydah Governorate.
Area: Unknown.
Altitude: Sea level.
Overview: A 30-km stretch of the Red Sea coast north of Al-Hudaydah, with extensive inter-tidal flats, mangrove vegetation and a tidal inlet protected by a barrier-beach. The southern part of the coast is sheltered by the Ra's al-Kathib peninsula.
Physical and ecological features: The site comprises about 30 km of coastline from just north of the city of Al-Hudaydah in the south to the fishing village of Al-'Urj in the north, and includes a large, shallow sea bay protected from the open sea by Ra's al-Kathib, a 15-km long sandy peninsula protruding in a northwesterly direction from the mainland coast about 5 km north of Al-Hudaydah. The bay contains extensive inter-tidal mudflats with small patches of stunted mangrove and a number of small sandy islets. Overflow from Al-Hudaydah sewage lagoons (Site 6) enters the bay via a small stream in the southeast. Further north, towards Al-'Urj, much of the coastline is a steep sandy beach, backed by sand dunes and areas of bare salt flats (sabkha). About 5 km south of Al-'Urj, the beach is broken by a tidal inlet about one km long, at the mouth of a dry wadi. This inlet is protected by a shell-sand barrier-beach, and contains some 5-10 ha of well-developed mangrove and extensive inter-tidal mudflats and sand flats. The substantial seepage of fresh groundwater at the tidal inlet feeds several brackish wells and small ponds, and supports an extensive coastal fringe of doum palms *Hyphaene* sp. and groves of date palms *Phoenix* sp. (c.200 ha), as well as *Odyssea*/*Aeluropus* spiny-grass pastures on the sabkha by the tidal inlet. In this area, the coast is backed by a raised alluvial silt and gravel plain with associated coastal cliffs, about 3 m high. Offshore there is a fringing coral reef, and seagrass beds are moderately common. The coastal silt plain is sparsely vegetated with *Suaeda* dwarf-shrubland, grading into sparse *Panicum* grassland further inland.
Land tenure: No information.
Conservation measures taken: None. The Al-'Urj area in the north (1,500 ha) has been identified as an Important Bird Area by BirdLife International (Evans, 1994).
Conservation measures proposed: The establishment of a marine park has been considered in the past, and the Al-'Urj area was recommended for special management by a PERSGA study team in 1985.
Land use: The large port of Al-Hudaydah is situated at the south end of the bay. The main human activity is fishing, but the area is also regularly used for recreation (*e.g.* camping) by

expatriates and urban Yemenis. In 1990, there were plans to build a tourist hotel near Al-'Urj. The doum palm woodland is highly valued by local fishermen for building and thatching materials. The mangrove and spiny-grass flats are grazed by goats and camels.

Possible changes in land use: No information.

Disturbances and threats: The bay is subject to considerable levels of pollution and disturbance from Al-Hudaydah port in the south. It is not known whether the planned hotel at Al-'Urj has been built, and if so, to what extent destruction of habitat, depletion of freshwater supplies, pollution through waste disposal, and excessive disturbance of wildlife have been avoided. Campers' fires have burned down areas of the *Hyphaene* palm woodland near Al-'Urj.

Hydrological and biophysical values: The bay and the mangrove-lined tidal inlet near Al-'Urj are probably important spawning grounds and nursery areas for shrimps and fish.

Social and cultural values: No information.

Noteworthy fauna: The mangrove and doum palms support an interesting breeding avifauna, including *Butorides striatus*, *Milvus migrans*, *Pandion haliaetus* (one pair), *Cypsiurus parvus*, *Acrocephalus stentoreus* (probable), *A. baeticatus* (probable), *Ploceus rueppelli* and *Lonchura cantans*. *Dromas ardeola* is present throughout the year (maximum 166 in April) and probably breeds; at least 24 pairs were observed feeding on mudflats near Al-'Urj in June. *Sterna saundersi* also probably breeds (10-20 pairs). A very wide variety of waterfowl occur on passage and in winter; counts since 1986 have included up to 90 *Pelecanus rufescens*, 14 *Egretta gularis*, 20 *Platalea leucorodia*, 400 *Phoenicopterus ruber*, 1,250 *P. minor* (March 1995), 20 *Tadorna tadorna*, 400 *Himantopus himantopus*, 90 *Recurvirostra avosetta*, 300 *Charadrius hiaticula*, hundreds of *C. alexandrinus*, 50 *C. mongolus*, 100 *Limosa limosa*, 29 *L. lapponica*, 240 *Numenius phaeopus* (April), 26 *N. arquata*, 200 *Tringa totanus*, 50 *T. cinerea*, 150 *T. glareola*, 100 *Calidris alba*, 220 *C. minuta*, 45 *Arenaria interpres*, 56 *Limicola falcinellus*, 150 *Philomachus pugnax*, 400 *Larus hemprichii*, 100 *L. leucophthalmus*, 50 *L. genei*, 120 *L. ridibundus*, 200 *L. fuscus*, 200 *L. cachinnans*, 30 *Gelochelidon nilotica*, 20 *Sterna caspia*, 100 *S. bergii*, 300 *S. bengalensis*, 100 *S. sandvicensis*, 150 *S. saundersi* and 80 *Chlidonias leucopterus*. The area has never been properly surveyed, and these counts are likely to represent only a small proportion of the birds present. Scarce migrants have included *Ardea goliath* (April 1979), *Vanellus leucurus* and *Larus ichthyaetus*.

The genet *Genetta felina* occurs in the area, and dolphins, probably including *Tursiops* sp., are frequent offshore. The Green Turtle *Chelonia mydas* is common offshore, and Leatherback *Dermochelys coriacea* has been recorded.

Noteworthy flora: The site contains a 5-10 ha stand of well developed mangrove.

Scientific research and facilities: The area has been visited on a number of occasions by ornithologists and bird-watchers, and mid-winter waterfowl counts have been undertaken by the Department of Biology, University of Sana'a, each year since 1992.

Management authority and jurisdiction: No information.

References: Brooks *et al.* (1987); Cornwallis & Porter (1982); Evans (1994); Phillips (1982).

Reasons for inclusion: 1a, 2a & 3c. An important stretch of coastline for passage and wintering waterfowl, notably shorebirds, gulls and terns; especially important for *Pelecanus rufescens*, *Larus hemprichii* and *L. leucophthalmus*. Also important for sea turtles.

Source: See references.

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Al-Hudaydah Sewage Lagoons (6)

Location: 14°49'N, 42°57'E; on either side of the main coastal highway about 10 km north of Al-Hudaydah city, Al-Hudaydah Governorate.
Area: c.50 ha.
Altitude: Near sea level.
Overview: A group of sewage lagoons on coastal sabkha north of the city of Al-Hudaydah, remarkable for the diversity of migratory waterbirds which has occurred there.
Physical and ecological features: A complex of small lagoons and marshes created by overflow from a sewage treatment plant between sandy desert and coastal sabkha near the northern outskirts of Al-Hudaydah. A short stream takes water from the marshes across a narrow strip of sabkha into the adjacent shallow sea bay where there are extensive inter-tidal mudflats and small patches of stunted mangroves. There are a few scattered *Acacia* trees and date palms around the lagoons.
Land tenure: No information.
Conservation measures taken: None.
Conservation measures proposed: None known.
Land use: None, other than occasional livestock grazing in the surrounding area. A major highway and road bridge cross the site.
Possible changes in land use: No information.
Disturbances and threats: The wetland is particularly vulnerable to any improvements in sewage treatment and/or diversion of water for other uses, *e.g.* irrigation.
Hydrological and biophysical values: No information.
Social and cultural values: No information.
Noteworthy fauna: An important staging and wintering area for migratory waterfowl, regularly attracting freshwater species, such as dabbling ducks *Anas* spp., which are scarce elsewhere in Yemen. At least 70 species of waterfowl have been recorded since the early 1980s, including up to 60 *Tachybaptus ruficollis*, 13 *Podiceps nigricollis*, 40 *Bubulcus ibis*, 100 *Plegadis falcinellus* (winter visitor), 400 *Phoenicopterus ruber*, 500 *P. minor* (November 1993-March 1994), 32 *Anas crecca*, 42 *A. acuta*, 60 *A. clypeata*, 30 *A. querquedula*, 117 *Himantopus himantopus*, 40 *Recurvirostra avosetta*, 60 *Vanellus spinosus*, 100 *Tringa totanus*, 15 *T. stagnatilis*, 12 *T. nebularia*, 30 *T. glareola*, 200 *Calidris minuta*, 12 *C. temminckii*, 82 *C. ferruginea*, 40 *Philomachus pugnax*, 150 *Larus ridibundus*, 50 *L. genei* and 68 *Chlidonias leucopterus*. The Demoiselle Crane *Grus virgo* appears to be a regular winter visitor in small numbers; small flocks were recorded in three of the four winters from 1991 to 1994, the largest flock being 36 in February 1991. A Slender-billed Curlew *Numenius tenuirostris* was present in early January 1984. Other unusual passage migrants or winter visitors have included *Threskiornis aethiopicus* (maximum 4, probably a regular visitor in small numbers), *Tadorna ferruginea* (maximum 8), *Aythya nyroca* (maximum 6), *Vanellus leucurus*, *Gallinago stenura*, *Limosa limosa* (maximum 8) and *Motacilla citreola*. About ten pairs of *Vanellus spinosus* breed on the surrounding flats, and *Himantopus himantopus* has bred.
Noteworthy flora: No information.
Scientific research and facilities: The area has been visited on a number of occasions by

ornithologists and bird-watchers, and mid-winter waterfowl counts have been undertaken by the Department of Biology, University of Sana'a, each year since 1991.
Management authority and jurisdiction: No information.
References: Brooks *et al.* (1987); Gretton (1991),
Reasons for inclusion: 2b & 3b. One of few large freshwater wetlands on the coastal plain of the southern Red Sea, attracting a great diversity of migratory waterfowl including several species rare elsewhere in southern Arabia.
Source: See references.

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Red Sea Coast: Nukhaylah to Wadi Nakhlah (7)

Location: 14°38'N, 42°58'E to 13°53'N, 43°13'E; on the southern Red Sea coast, 20-110 km south of Al-Hudaydah, Al-Hudaydah Governorate.
Area: c.12,500 ha.
Altitude: Sea level.
Overview: A 90-km stretch of Red Sea coast with a variety of habitats including inter-tidal flats, tidal inlet, coastal lagoon, mangroves, sabkha, spring-fed marshes, seagrass beds and coral reefs, along with the lower portion of Wadi Zabid, one of the seven largest wadis in western Yemen.
Physical and ecological features: The site comprises about 90 km of coast from the village of Nukhaylah, 20 km south of Al-Hudaydah, south to the mouth of Wadi Nakhlah, 10 km north of Al-Khawkhah, as well as the lower section of Wadi Zabid which reaches the sea at the village of Al-Fazzah (14°07'N, 43°06'E). The coast is flat, with exposed sandy beaches, large areas of sabkha, especially west of Ghulayfiqah, and patches of inter-tidal mudflats in the more sheltered areas, *e.g.* just north of Nukhaylah (c.350 ha) and at Ghulayfiqah. A small tidal inlet at Nukhaylah supports a fringe of patchy mangrove *Avicennia marina*, about 2 km long. There is a small lagoon, about 200 m long, at Al-Fazzah, separated from the sea by a narrow belt of sabkha. Substantial seepage of freshwater occurs at many places along the coast, supporting extensive grassy pastures, *Typha* beds with *Juncus* sp., *Pandanus* thickets and open, shallow, brackish pools on the coastal flats. There are about 80 ha of doum palms *Hyphaene* sp. and grassy flats at Nukhaylah, and extensive plantations of date palms *Phoenix* at Nukhaylah, Ghulayfiqah, Al-Mujaylis and Ra's al-Buqa. Coastal sand dunes are common behind the beach, especially around Al-Fazzah. Salt-tolerant bushes such as *Suaeda* sp. and *Zygophyllum* sp. grow in sandy areas above the high water mark. Seagrass beds are particularly well developed and widespread offshore, and there are small amounts of coral reef, especially in the north. The narrow, sandy promontory of Ra's al-Shi'b in the north (14°30'N, 42°58'E) juts 25 km out into the Red Sea and is tipped by two flat, sandy islands. There is a small area of reef-rock off Ra's al-Buqa in the south (14°04'N, 43°06'E).
Wadi Zabid is one of the largest wadis along the west coast of Yemen. The wadi always contains some water in deep pools, and surface flow occasionally reaches the sea during the rainy season (July to September). The wadi floor supports dense thickets of native shrubs and trees, as well as many gardens, orchards and date palm plantations.

Land tenure: No information.
Conservation measures taken: None. The site has been identified as two adjacent Important Bird Areas (Nukhaylah-Ghulayfiqah, 9,000 ha, and Al-Fazzah, 3,500 ha) by BirdLife International (Evans, 1994).
Conservation measures proposed: None known.
Land use: The major human activity along the coast is artisanal fishing. The coastal grassy flats are grazed by domestic livestock.
Possible changes in land use: No information.
Disturbances and threats: Overgrazing by domestic livestock may be a problem on the grassy flats.
Hydrological and biophysical values: No information.
Social and cultural values: There is a deserted Turkish fort 2 km north of Nukhaylah.
Noteworthy fauna: An important staging and wintering area for a wide variety of migratory waterfowl. Surveys have been brief and very incomplete, but there is good reason to expect that numbers of several waterfowl species exceed 1% of the regional populations in winter and/or during the migration seasons. Waterfowl counts between October and February have included up to 29 *Pelecanus rufescens*, 31 *Egretta gularis*, 33 *Platalea leucorodia*, 586 *Anas penelope*, 100 *A. acuta*, 35 *A. clypeata*, 32 *Recurvirostra avosetta*, 500 *Charadrius alexandrinus*, 60 *C. hiaticula*, 200 *C. mongolus*, 55 *C. leschenaultii*, 70 *Pluvialis fulva*, 400 *Calidris minuta*, 100 *C. alpina*, 200 *C. ferruginea*, 140 *Limosa lapponica*, 300 *Tringa totanus*, 15 *T. stagnatilis*, 46 *T. nebularia*, 200 *T. cinerea*, 35 *Larus leucophthalmus* (Al-Fazzah, November), 32 *Gelochelidon nilotica*, 120 *Sterna repressa* and 127 *S. saundersi*. *Threskiornis aethiopicus* is a scarce winter visitor; 2-4 have been recorded on a number of occasions between October and March. Other unusual passage migrants and winter visitors have included *Grus virgo* (one, November), *Charadrius asiaticus* (one, January), *Vanellus leucurus* (three, December), *Calidris canutus* (19, January) and *Rhynchops flavirostris* (one, November 1979). Mid-winter waterfowl counts inland along Wadi Zabid since 1991 have included up to 414 *Bubulcus ibis*, 6 *Scopus umbretta*, 80 *Ciconia abdimii*, 8 *Gallinula chloropus*, 7 *Hydrophasianus chirurgus* and 4 *Tringa ochropus*. *Vanellus spinosus* breeds around Nukhaylah (up to 9 birds), at Al-Fazzah (up to 26 birds) and in Wadi Zabid; *Ciconia abdimii* breeds in Wadi Zabid.
Fish, amphibians and the terrapin *Pelomedusa subrufa* occur in permanent pools in Wadi Zabid.
Noteworthy flora: The site contains many grassy flats and brackish marshes maintained by underground seepage of fresh water, and there are extensive, well developed beds of seagrasses offshore.
Scientific research and facilities: Various parts of the coast have been visited on a number of occasions by ornithologists and bird-watchers, and mid-winter waterfowl counts have been undertaken in Wadi Zabid by the Department of Biology, University of Sana'a, each year since 1991.
Management authority and jurisdiction: No information.
References: Brooks *et al.* (1987); Evans (1994); Phillips (1982).
Reasons for inclusion: 1a, 2a, 2b & 3b (probably also 3c). A diverse and relatively undisturbed stretch of coastline with natural brackish marshes and extensive seagrass beds, important for passage and wintering waterfowl (notably *Pelecanus rufescens*, *Threskiornis aethiopicus* and *Larus leucophthalmus*). Wadi Zabid is a good example of a large wadi system with permanently flowing water.

Source: See references.

Red Sea Coast: Al-Khawkhah to Al-Mukha (8)

Location: 13°48'-13°19'N, 43°14'-43°18'E; on the southern Red Sea coast between Al-Khawkhah and Al-Mukha, about 80 km east of Ta'izz, Ta'izz Governorate.
Area: c.7,000 ha.
Altitude: Sea level.
Overview: A 60-km stretch of the Red Sea coast with inter-tidal flats, mangroves, sabkha, salt pans, seagrass beds and coral reefs.
Physical and ecological features: The site comprises about 60 km of coastline along the southern Red Sea between the towns of Al-Khawkhah in the north and Al-Mukha in the south, and includes the fishing villages of Mawshij, Yakhtul and Al-Ru'ays. The northern coast is dominated by narrow sand beaches, the southern coast by large areas of bare salt flats (sabkha) with some salt pans. At Al-Ru'ays, there is a stretch of inter-tidal mudflats associated with underground freshwater seepage which supports 10-15 ha of mangrove *Avicennia marina* and about 100 ha of palms (*Phoenix* sp. and *Hyphaene* sp.). Salt-tolerant bushes (*Suaeda* sp. and *Zygophyllum* sp.) and grasses (including *Odyssea* sp.) are very common along most of the coast, especially on low dunes and fringes of sabkha. *Salvadora* bushes are locally common inland, and seagrass beds and coral reefs occur offshore, particularly in the south. There are some plantations of date palms along the coast north of Yakhtul.
Land tenure: No information.
Conservation measures taken: None. The site has been identified as an Important Bird Area by BirdLife International (Evans, 1994).
Conservation measures proposed: The establishment of marine parks has been considered.
Land use: Artisanal fishing is widespread along the coast, and pelagic fisheries are based at Al-Mukha and Al-Khawkhah; there are also active salt-pans and a power station on the coast at Al-Mukha.
Possible changes in land use: No information.
Disturbances and threats: The area is currently relatively undisturbed. Any major depletion of the water table, caused by the damming of wadis or unsustainable pumping of groundwater for irrigation projects inland on the Tihamah, would probably have severe consequences for the mudflat, mangrove and palm-grove habitats and for the associated fishing communities.
Hydrological and biophysical values: No information.
Social and cultural values: No information.
Noteworthy fauna: The inter-tidal mudflats are an important staging and wintering area for a wide variety of migratory waterfowl, particularly shorebirds. Large numbers of gulls and terns (Laridae) roost at Al-Mukha and Al-Khawkhah, associated with the fisheries there. Waterfowl observed during the migration seasons and/or in winter in recent years have included up to 38 *Platalea leucorodia*, 130 *Dromas ardeola*, 100 *Charadrius mongolus*, 46 *Pluvialis fulva*, 44 *Tringa cinerea*, 16 *Limicola falcinellus*, 200 *Larus hemprichii*, 900 *L. ridibundus*, 200 *L. fuscus*/*cachinnans*, 140 *Sterna bengalensis*, 120 *S. sandvicensis*, 50 *S. hirundo*, 170 *S. repressa*

and 40 *S. saundersi*. The globally threatened Slender-billed Curlew *Numenius tenuirostris* is possibly a very rare passage migrant or winter visitor; two were observed at Al-Mukha and at Al-Khawkhah on consecutive days in October 1988. *Larus leucophthalmus* is a regular non-breeding visitor throughout the year, with numbers reaching a peak in spring (100 in April). *Puffinus persicus* is a regular non-breeding visitor offshore (maximum 100, April); up to 30 *Sula leucogaster* and 100 *Sterna anaethetus* have also been recorded offshore in spring. *Pandion haliaetus* occurs in winter, and *Falco concolor* is a scarce passage migrant in summer. Breeding species in the palm groves and mangroves include *Butorides striatus* and *Acrocephalus stentoreus*.
The seagrass beds are important foraging areas for Green Turtles *Chelonia mydas* and possibly also Hawksbills *Eretmochelys imbricata*.
Noteworthy flora: The site contains at least one 10-15 ha stand of mangroves.
Scientific research and facilities: None, other than preliminary faunal and floral surveys.
Management authority and jurisdiction: No information.
References: Brooks *et al.* (1987); Cornwallis & Porter (1982); Evans (1994); Gretton (1991); TMRU (1987).
Reasons for inclusion: 1a, 2a & 3b (probably also 3c). A relatively undisturbed stretch of coastline, important for passage and wintering shorebirds, gulls and terns (notably *Larus leucophthalmus*) and also for sea turtles.
Source: See references.

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Dhubab Flats (9)

Location: 12°55'N, 43°25'E; about 30 km north-northwest of the headland overlooking the entrance to the Red Sea (Bab al-Mandab), Ta'izz Governorate.
Area: 100-200 ha.
Altitude: Sea level.
Overview: An area of coastal lagoons and saline flats on the Red Sea coast near the extreme southwestern tip of Yemen.
Physical and ecological features: A stretch of at least 3 km of coastal lagoons and saline flats (sabkha) extending south from the village of Dhubab and possibly continuing to the Bab al-Mandab area. To the east, a relatively undisturbed succession of semi-natural vegetation extends from the coast to the foothills across the stony Tihamah plain, with extensive dwarf-shrubland, grassland and *Acacia-Commiphora* bushland.
Land tenure: No information.
Conservation measures taken: None. Dhubab Flats have been included in a much larger site (Bab al-Mandab-Mawza, c.100,000 ha) identified as an Important Bird Area by BirdLife International (Evans, 1994).
Conservation measures proposed: None known.
Land use: No information.
Possible changes in land use: No information.
Disturbances and threats: An undisturbed area due to military security. There is no evidence

of oil pollution being a problem on the flats, but a small rise in sea-level would probably cause their disappearance.
Hydrological and biophysical values: No information.
Social and cultural values: No information.
Noteworthy fauna: The lagoons and salt flats appear to be a good area for shorebirds notably *Dromas ardeola*, *Tringa cinerea* and *Limicola falcinellus*; *Dromas ardeola* may breed. A comprehensive survey of the whole complex would doubtless show the Dhubab flats to be one of the richest coastal wetlands in Yemen. Offshore there are major migrations of seabirds (notably *Puffinus persicus* and *Oceanites oceanicus*), shorebirds (notably *Numenius phaeopus* and *Phalaropus lobatus*) skuas *Stercorarius* spp., gulls *Larus* spp. and terns (notably *Sterna bergii* and *S. bengalensis*). *Larus leucophthalmus* is a regular passage migrant offshore (maximum 45).
The Green Turtle *Chelonia mydas* occurs offshore and may nest on the beach.
Noteworthy flora: No information.
Scientific research and facilities: None, other than one very brief ornithological survey of a small part of the area.
Management authority and jurisdiction: No information.
References: Evans (1994).
Reasons for inclusion: 1a, (2a) & 3b. Probably a very important staging and wintering area for migratory waterfowl including *Larus leucophthalmus*, and possibly an important area for sea turtles, but very poorly known.
Source: See references.

Ta'izz Sewage Lagoons and Marsh (10)

Location: 13°39'N, 44°00'E; about 10 km north of Ta'izz city, Ta'izz Governorate.
Area: c.250 ha.
Altitude: c.1,250 m.
Overview: A group of sewage lagoons and a series of natural spring-fed marshes in a wadi system in the southern highlands near the city of Ta'izz, of great importance for passage and wintering waterfowl, and a regular wintering area for a small population of the globally endangered Northern Bald Ibis *Geronticus eremita*.
Physical and ecological features: Ta'izz Sewage Lagoons comprise a group of three sewage settling (evaporation) ponds covering about 8 ha. The ponds were created in the early 1980s by shallow dams across Wadi al-Malih, and are filled with semi-treated effluent from Ta'izz. There are extensive stretches of shallow, open shore with scattered grass tussocks and *Tamarix* bushes, but little other marginal vegetation. A few drowned, dead trees remain standing in the ponds. The water-level remains relatively constant throughout the year. There is a good supply of groundwater in the area, and locally in valley bottoms there are permanently wet marshes of grasses and *Juncus* (close-cropped by cattle) with small stands of *Typha* sp., up to 2 ha in extent, in the wettest areas. The principal marshes are Al-Haima Marsh in Wadi al-Malih, just below the lowest of the three sewage lagoons (13°40'N 44°00'E, c.200 ha), and at the site of a

former reservoir, the Imam's Reservoir (13°38'N 44°00'E, 2 ha), the dam of which burst in April 1986. The marshes have a deep, blackish soil layer, resembling peat and apparently saline. A third large *Typha* marsh and area of wet grassland at Hidhran, in Wadi Dabab (13°36'N 43°56'E, 25 ha), about 10 km west of Ta'izz, dried up in the mid-1980s, presumably because of groundwater depletion further up the wadi. No trace of this marsh remained in early 1994. The vegetation on the surrounding stony hillsides is dominated by dense, low thickets of succulents (including species of *Euphorbia*, *Caralluma*, *Aloe*, *Adenium* and *Cissus*) set in sparse *Acacia-Commiphora* bushland, with frequent *Anisotis* shrubs. Sorghum cultivation is extensive in wadi bottoms, with fields often being lined with pollarded *Acacia* and *Ziziphus* hedges, and there are some groves of date palms.

Land tenure: No information.

Conservation measures taken: None. The wetlands have been included in a much larger site (Ta'izz Wadis, 11,000 ha) identified as an Important Bird Area by BirdLife International (Evans, 1994).

Conservation measures proposed: None known.

Land use: Human population density is high, with numerous small villages and isolated homesteads throughout the area. The groundwater is heavily exploited to supply Ta'izz. Surrounding hills are heavily grazed by sheep and goats, and the *Acacia-Commiphora* bushland is a major source of fuelwood for the region. The main Ta'izz rubbish dump lies immediately north of Hidhran.

Possible changes in land use: The sewage settling ponds were built in about 1982 and are likely to disappear if further water treatment works are built in order to re-use the waste-water, *e.g.* for irrigation.

Disturbances and threats: The close presence of the expanding city of Ta'izz is placing severe pressure on the natural resources and biodiversity of the site. Lowering of groundwater levels due to excessive pumping has already led to habitat destruction: boreholes in Wadi al-Malih supply nearby factories, and also possibly drinking water to the Ta'izz region. The large *Typha* marsh and permanent stream at Hidhran dried up between September 1984 and August 1985, for reasons that are unclear, but which presumably relate to water extraction higher up in the watershed. More than 30% of the grassy marsh in Wadi al-Malih (a feeding area for *Geronticus eremita*) has been deep-ploughed for conversion to cultivation since 1985, even though the soil appears to be saline. Large areas of succulent shrubland on hillsides have been, and are being, cleared due to the high regional demand for fuelwood and agricultural land. Harvesting of the remaining *Commiphora* trees for fuelwood appears to be at unsustainable levels. However, direct persecution of waterbirds does not appear to be a problem; most birds, including *Geronticus eremita*, are relatively approachable and apparently untroubled by human presence.

Hydrological and biophysical values: The pools may be providing some local groundwater recharge, albeit possibly polluted.

Social and cultural values: No information.

Noteworthy fauna: Ta'izz sewage lagoons and marshes comprise the most extensive area of freshwater wetlands in Yemen, and as such support a greater diversity of waterfowl than any other site inland. The wetlands are particularly important as a staging and wintering area for migratory waterfowl, but also support resident breeding populations of several species, including *Tachybaptus ruficollis* (up to 158 birds in August), *Bubulcus ibis* (possible), *Scopus umbretta*, *Ciconia abdimii* (up to 16 in March), *Gallinula chloropus* (common) and *Fulica atra*

(bred in 1985). The Spotted Thick-knee *Burhinus capensis* was found nesting near the lagoons in 1993. A pair of *Podiceps nigricollis* was observed nest-building in 1985, and *Aythya nyroca* and *Porphyrio porphyrio* have been recorded in summer and may breed. The Arabian Waxbill *Estrilda rufibarba* (an Arabian endemic) is a common resident around the marshes, occurring in hundreds.

The lagoons and marshes regularly support over 2,000 waterfowl during the migration seasons and in winter. At least 86 species of waterfowl have been recorded, including up to 10 *Podiceps nigricollis*, 340 *Tachybaptus ruficollis*, 520 *Bubulcus ibis*, 22 *Egretta garzetta*, 152 *Plegadis falcinellus*, 750 *Ciconia ciconia* (March), 15 *C. nigra* (October), 52 *Phoenicopterus ruber*, 100 *Anas penelope*, 11 *A. strepera*, 530 *A. crecca*, 140 *A. platyrhynchos*, 600 *A. acuta*, 800 *A. clypeata*, 50 *A. querquedula*, 150 *Aythya nyroca*, 70 *A. fuligula*, 400 *Gallinula chloropus*, 420 *Fulica atra*, 450 *Himantopus himantopus*, 49 *Recurvirostra avosetta*, 10 *Vanellus spinosus*, 21 *Gallinago gallinago*, 14 *Tringa erythropus*, 50 *T. nebularia*, 60 *T. ochropus* (August), 40 *T. glareola*, 125 *Actitis hypoleucos* (August), 50 *Calidris minuta*, 15 *C. temminckii*, 45 *Philomachus pugnax*, 50 *Larus ridibundus* and 45 *Chlidonias leucopterus*. Other wetland birds occurring regularly on passage and/or in winter include *Anthus cervinus* (maximum 12, March), *Motacilla flava* (common) and *M. citreola* (maximum 10, March). Scarce migrants have included *Botaurus stellaris*, *Casmerodius albus* (maximum 8), *Ardea melanocephala*, *Phoenicopterus minor*, *Tadorna ferruginea*, *Grus grus*, *G. virgo* (maximum 8), *Porzana porzana*, *P. parva*, *P. pusilla*, *Hydrophasianus chirurgus*, *Glareola pratincola*, *Charadrius asiaticus*, *Pluvialis fulva*, *Gallinago stenura*, *G. media*, *Lymnocryptes minimus*, *Calidris acuminata* (one in December 1982), *Phalaropus lobatus*, *Larus ichthyaetus*, *L. armenicus* and *Chlidonias niger*.

The grassy marshes adjacent to the sewage lagoons are extremely important as the only known regular wintering area for the eastern population of the globally endangered Northern Bald Ibis *Geronticus eremita*. Bald Ibises were first discovered in the area in April 1985 (one on 14 April); numbers then built up through the summer and by autumn there were 14 birds, including two juveniles. Most of these remained throughout the winter, and were last seen in mid-February 1986 (11 birds). Smaller numbers of ibises have been recorded in most winters since then. At least four (and possibly eight) were present in January 1987. No information is available for the next three winters; however, there were five in December 1990, two in January 1992, three (two adults and an immature) from at least October to December 1992, six in January 1993, and four in January 1994. In recent years, the ibises have apparently stayed only a short time at the marsh, and have left by mid- or late February. Parts of the grassy marshes favoured by the birds have been destroyed since 1986, and this may account for the decline in numbers of ibises appearing at the site and the reduced length of their stay.

The area is very rich in birds of prey. The wetlands and the rubbish dump at Hidhran attract large numbers of post-breeding, migrant and wintering raptors to feed, drink and roost, including *Milvus migrans* (maximum 610), *Circus aeruginosus* (maximum 7), *Aquila clanga* (maximum 10), *A. heliaca* (maximum 12), *A. rapax* (maximum 106), *A. nipalensis* (maximum 150) and *Falco cherrug* (maximum 3). Breeding species include *Melierax metabates*, *Aquila rapax*, *Falco biarmicus* and *F. pelegrinoides*. The wadis in the Ta'izz area support a large proportion of the Afrotropical land-birds characteristic of southern Arabia.

All specimens of the Queen of Sheba's Gazelle *Gazella bilkis* of known provenance came from this area during the 1950s. The species is certainly now extinct at this site, and may well be

globally extinct. Reptiles includes the endemic chameleon *Chamaeleo calyptratus*; fishes include the Cyprinid *Garra tibanica*.
Noteworthy flora: No information.
Scientific research and facilities: Numerous bird surveys have been carried out by visiting ornithologists and bird-watchers since 1985. Mid-winter waterfowl counts were undertaken by M.I. Evans in 1986 and 1987, and have been undertaken by the Department of Biology, University of Sana'a, in each year since 1991.
Management authority and jurisdiction: No information.
References: Brooks *et al.* (1987); Evans (1994); Morris (1993).
Reasons for inclusion: 1d, 2a, 2b & 3c. One of very few large freshwater wetlands in the interior of southern Arabia, with a good example of natural freshwater marsh, a rare and threatened habitat in Arabia. Very important as a wintering area for the globally endangered Northern Bald Ibis *Geronticus eremita*, and remarkable for the great diversity of waterfowl occurring on migration and in winter.
Source: See references.

Wadi Warazan (11)

Location: 13°25'N, 44°15'E; about 8 km southeast of Ad Dimnah and 30 km southeast of Ta'izz city, Ta'izz Governorate.
Area: 90 ha.
Altitude: c.1,200 m.
Overview: A small, natural marsh fed by seepage in a large wadi in the southern highlands.
Physical and ecological features: A water-logged wadi bottom with a permanently wet grassy marsh. The dominant plant cover is dense coarse rhizomatous tussocky grasses, heavily grazed by cattle. The soil is deep, black and peaty, and slightly saline. There are several small patches of *Typha* scattered throughout the marsh. Water levels are highest between July and September when the main wadi stream is up to 30 cm deep. The wadi rises in the mountains to the south of Ta'izz, and flows southeast to reach the sea at Aden.
Land tenure: No information.
Conservation measures taken: None.
Conservation measures proposed: None known.
Land use: Domestic livestock, mainly cattle, graze in the marsh.
Possible changes in land use: No information.
Disturbances and threats: Grazing pressure is heavy, but otherwise there were no obvious threats to the area in 1986.
Hydrological and biophysical values: No information.
Social and cultural values: No information.
Noteworthy fauna: The wadi and marsh support a variety of waterfowl in winter, mainly in small numbers. Mid-winter counts between in 1986 and 1994 have included up to 50 *Bubulcus ibis*, 7 *Egretta garzetta*, 16 *Ardea cinerea*, 16 *Scopus umbretta*, one *Ciconia nigra*, 12 *Gallinula chloropus*, 16 *Hydrophasianus chirurgus*, 50 *Tringa ochropus* and two *Lymnocryptes minimus*.

Noteworthy flora: No information.
Scientific research and facilities: Mid-winter waterfowl counts have been undertaken in Wadi Warazan by the Department of Biology, University of Sana'a, each year since 1991.
Management authority and jurisdiction: No information.
Reasons for inclusion: 1d. A good example of a natural freshwater marsh (a rare ecosystem in Arabia) in a large wadi system with permanently flowing water.
Source: See references.

Aden Mudflats and Marsh (12)

Location: 12°45'N, 45°02'E; immediately to the west of the city of Aden, Aden Governorate.
Area: c.10,000 ha.
Altitude: Sea level.
Overview: Coastal mud-flats, salt pans, sandy beaches and a freshwater marsh fed by treated sewage, around the city of Aden on the Gulf of Aden coast.
Physical and ecological features: The site comprises coastal wetlands around the town and harbour of Aden, including inter-tidal mudflats, salt pans, a stretch of sandy beach at Khor Maksar, and a large area of marsh created by a long-established sewage outflow at Hiswa. The outer harbour is over 10 m deep at low tide. Steep, rocky, rather barren hills flank either side of the harbour, and reach a peak at about 540 m. There is a refuse tip at Dar Musabein.
Land tenure: No information.
Conservation measures taken: None. The site has been identified as an Important Bird Area by BirdLife International (Evans, 1994).
Conservation measures proposed: None known.
Land use: Little is known about present human activities and uses of the area apart from as a harbour for shipping; possible uses are artisanal fishing, aquaculture, salt production and recreation.
Possible changes in land use: No information.
Disturbances and threats: No current information is available. The inter-tidal and shallow sub-tidal areas are presumably threatened by reclamation and dredging, and water pollution is likely to be a problem. An introduced population of the House Crow *Corvus splendens* underwent a population explosion during the 1970s and early 1980s, eventually numbering hundreds of thousands and becoming a public health hazard and a major nuisance; a control programme has been partially successful.
Hydrological and biophysical values: No information.
Social and cultural values: No information.
Noteworthy fauna: An important staging and wintering area for migratory waterfowl, especially shorebirds, gulls and terns. The most important feeding area for shorebirds is the mudflats at Khor Maksar. Species recorded on passage and/or in winter have included *Pelecanus rufescens* (150, July), *Egretta gularis* (300, November), *Plegadis falcinellus* (135, November), *Platalea leucorodia* (170, September), *Phoenicopterus ruber* (several thousands, November), *Dromas ardeola* (300, September), *Recurvirostra avosetta* (100, November),

Himantopus himantopus (300, November), *Charadrius mongolus*/*leschenaultii* (1,200, August), *Pluvialis squatarola* (250, November), *Calidris ferruginea* (1,500, January), *Limosa limosa* (200, November), *Tringa totanus* (500, August), *Limicola falcinellus* (125, May), *Larus hemprichii* (abundant), *L. leucophthalmus* (small numbers), *Gelochelidon nilotica* (200, winter), *Sterna caspia* (200, November) and *S. bergii* (1,300, August). Huge flocks of *S. bergii* have been recorded in March, most likely concentrations of pre-breeding birds from the very large colony on the Saba islands (Djibouti) southwest of the Bab al-Mandab. There has been at least one record of wintering or passage *Grus virgo* in the 1980s (40 at Hiswa). Rare passage migrants have included the globally threatened Asian Dowitcher *Limnodromus semipalmatus*.
Neophron percnopterus is a common non-breeding visitor all year round; numbers have greatly declined since the end of last century, when as many as 1,350 roosted on the hills above the town in October. *Aquila clanga* (maximum 15-20, November) and *Aquila heliaca* (maximum 5, March) are regular passage migrants and winter visitors.
Reptiles include the Arabian endemic *Pristurus ornithocephalus*.
Noteworthy flora: No information.
Scientific research and facilities: The avifauna of the Aden area has been well documented by expatriate ornithologists resident in the area, particularly during the 1950s.
Management authority and jurisdiction: No information.
References: Ash (1984); Evans (1994); Smith (1956); Yerbury (1896).
Reasons for inclusion: 2a & 3c. An important staging and wintering area for a wide variety of migratory waterfowl, notably shorebirds, gulls (including *Larus leucophthalmus*) and terns, with at least six species occurring in numbers exceeding 1% of the regional population.
Source: See references.

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Wadi Jahr (13)

Location: 13°58'N, 46°23'E; north of the Lawdar to Habban road, about 60 km east of Lawdar and 80 km southwest of Ataq, Abyan Governorate.
Area: c.500 ha.
Altitude: 600 m.
Overview: A large wadi in the hills of southern Yemen, with permanent or near-permanent surface flow and permanent deep pools; one of the largest wadis in the Gulf of Aden drainage.
Physical and ecological features: A deep rocky wadi up to 1,000 m wide running east to west at the edge of a rather bare, stony, silt plateau. Surface water flow along the wadi bed may be permanent, and there are some large pools with beds of *Typha* sp. The gravel floor of the wadi is dominated by *Tamarix* bushes, with some *Acacia* sp. and *Commiphora* sp., locally in dense clumps. The plateau vegetation is dominated by *Acacia*/*Commiphora* bushland, with the herb *Aerva javanica* as the dominant ground cover.
Land tenure: No information.
Conservation measures taken: None. The site has been identified as an Important Bird Area by BirdLife International (Evans, 1994).
Conservation measures proposed: None known.

Land use: There is some rain-fed agriculture, and honey production is an important activity. The whole area is thinly populated.
Possible changes in land use: No information.
Disturbances and threats: None known.
Hydrological and biophysical values: No information.
Social and cultural values: No information.
Noteworthy fauna: The wadi supports a range of bird species typical of the vegetated areas of interior southern Yemen. *Scopus umbretta* breeds. *Estrilda rufibarba* occurs here at the eastern edge of its range and is associated with the *Typha* beds. Considerable numbers of migrant passerines occur in spring.
The terrapin *Pelomedusa subrufa* is present in the slower moving waters of the wadi. The toad *Bufo arabicus* and the frog *Euphlyctis ehrenbergii*, both Arabian endemics, occur in large numbers, and Wadi Jahr is clearly an important breeding locality for these two species.
Noteworthy flora: The wadi supports relatively luxuriant vegetation in the otherwise barren landscape of interior southern Yemen.
Scientific research and facilities: None, other than preliminary faunal and floral surveys.
Management authority and jurisdiction: No information.
References: Evans (1994).
Reasons for inclusion: 1a, 2b & 2d. A good example of a large wadi system with permanently flowing water and relatively luxuriant vegetation; the wadi supports large populations of two endemic amphibians.
Source: See references.

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Wadi Hajar (14)

Location: 14°06'N, 48°42'E; near the Gulf of Aden coast, about 70 km southwest of Al-Mukalla, Shabwa Governorate.
Area: 50-100 ha.
Altitude: Near sea level.
Overview: A large wadi with permanent surface flow, dammed near its mouth to create a small lake which supports some marsh vegetation; one of the largest wadis in the Gulf of Aden drainage.
Physical and ecological features: A sandy wadi with permanently running water that drains into the Gulf of Aden southwest of Al-Mukalla. The river has been dammed 3-4 km from its mouth and extensive *Typha* beds have developed. The whole wadi system and its associated sandy fringes have been stabilized by the planting of the introduced shrub *Prosopis juliflora*, and there is much agriculture in the surrounding area.
Land tenure: No information.
Conservation measures taken: None. The site has been identified as an Important Bird Area by BirdLife International (Evans, 1994).
Conservation measures proposed: None known.
Land use: There appears to be extensive clearance of native trees for firewood and agriculture,

and the wadi is much used for local water supply and washing.
Possible changes in land use: No information.
Disturbances and threats: While the wadi continues as a permanent running water system, the threats to this area are relatively low. The damming of the river 3-4 km from the mouth has not so far reduced the flow to a level of concern, and indeed may have enhanced the wadi through the creation of *Typha* beds. Agricultural intensification away from the wadi banks is not a serious threat but clearance of native trees may be. Disturbance from human activities is high but the impenetrable nature of the *Prosopis juliflora* scrub mitigates this.
Hydrological and biophysical values: No information.
Social and cultural values: No information.
Noteworthy fauna: The wadi has an unusually diverse flora and fauna, being one of the few permanently running freshwater streams in southern Yemen. The Malachite Kingfisher *Alcedo cristata* apparently breeds in the wadi (the only known site in Arabia) and the White-breasted Waterhen *Amaurornis phoenicurus* has been recorded in habitat which appears suitable for breeding. There are high densities of many bird species typical of the south Yemen lowlands, and the wadi is clearly an important resting and feeding area for migrants, especially warblers (Sylviidae).
Mammals include Ruppell's Fox *Vulpes ruppelli*; its occurrence here represents a significant southerly range extension of this little known species. Leopard *Panthera pardus*, Wolf *Canis lupus* and Nubian Ibex *Capra nubiana* are said to occur in the surrounding hills. The most notable reptiles present are two species with very restricted ranges, the semaphore gecko *Pristurus ornithocephalus* endemic to south and west Yemen, and a gecko *Stenodactylus pulcher* confined to the coast of southern Yemen. The toad *Bufo dhuforensis* and the frog *Euphlytis ehrenbergii*, both Arabian endemics, are present in the wadi.
Noteworthy flora: The rare endemic Bankouale Palm *Livistona carinensis* is known only from Madi in the upper reaches of Wadi Hajar.
Scientific research and facilities: None, other than preliminary faunal and floral surveys.
Management authority and jurisdiction: No information.
References: Evans (1994).
Reasons for inclusion: 1a, 2b & 2d. A good example of a large wadi with permanently flowing water and an unusually diverse flora and fauna including several species of reptiles and amphibians endemic to southern Arabia; the only known breeding site for the Malachite Kingfisher *Alcedo cristata* in Arabia.
Source: See references.

Qishn Beach (15)

Location: 15°26'N, 51°45'E; near the village of Qishn on the Gulf of Aden coast, about 60 km west-southwest of Ra's Fartak, Al-Ghayda Governorate.
Area: c.100 ha.
Altitude: Sea level.
Overview: A 6-km stretch of gently shelving beach on the Gulf of Aden coast, especially

important for Sooty Gulls *Larus hemprichii* and possibly a nesting site for Green Turtles *Chelonia mydas*.

Physical and ecological features: A gently shelving, sandy beach, about 6 km in length, backed by sand dunes and, near Qishn village, by cultivated fields and groves of date palms. There are a few small pools between the beach and the sand dunes. The track to Ra's Fartak runs along the ridge of the dunes.

Land tenure: No information.

Conservation measures taken: None. Qishn Beach has been identified as an Important Bird Area by BirdLife International (Evans, 1994).

Conservation measures proposed: None known.

Land use: No information.

Possible changes in land use: No information.

Disturbances and threats: None known.

Hydrological and biophysical values: No information.

Social and cultural values: No information.

Noteworthy fauna: Qishn Beach is probably the most important stretch of coast in Yemen for non-breeding *Larus hemprichii*; over 7,800 have been recorded in spring. The beach is probably also an important staging area for migratory shorebirds, especially *Calidris alba* (maximum 300). *Gelochelidon nilotica* appears to be an abundant passage migrant in autumn (September-December). The seas offshore are very important for gatherings of *Phalacrocorax nigrogularis* with concentrations of up to 30,000 feeding and roosting along the coast in winter; it is not known whether or not these are local breeding birds.

Indo-pacific Hump-backed Dolphins *Sousa chinensis* are common in inshore waters, and Green Turtles *Chelonia mydas* possibly nest along the beach.

Noteworthy flora: No information.

Scientific research and facilities: None, other than preliminary faunal surveys.

Management authority and jurisdiction: No information.

References: Evans (1994).

Reasons for inclusion: 3c (possibly also 2a). A very important area for non-breeding *Larus hemprichii* (up to 20% of the world population), and possibly also an important nesting site for *Chelonia mydas*.

Source: See references.

Abdullah Gharib Lagoons (16)

Location: 16°21'N, 52°20'E; on the Arabian Sea coast, 20 km northeast of Al-Ghayda, Al-Ghayda Governorate.

Area: c.50 ha.

Altitude: Near sea level.

Overview: A group of brackish to saline lagoons on the Arabian Sea coast, especially important for gulls and terns (Laridae).

Physical and ecological features: A complex of large, brackish to saline coastal lagoons

situated on either side of the village of Abdullah Gharib. The lagoons are separated from the sea by sand dunes; they are surrounded by extensive fringes of saline mud, and are set in a dusty sand and gravel plain with a poor cover of halophytic plants.
Land tenure: No information.
Conservation measures taken: None. The Abdullah Gharib lagoons have been identified as an Important Bird Area by BirdLife International (Evans, 1994).
Conservation measures proposed: None known.
Land use: No information.
Possible changes in land use: No information.
Disturbances and threats: The only likely threat to the lagoons is excessive disturbance of wildlife by human activity.
Hydrological and biophysical values: No information.
Social and cultural values: No information.
Noteworthy fauna: An important feeding and roosting area for gulls and terns (Laridae), and to a lesser extent shorebirds. Counts in spring have included over 1,700 *Larus hemprichii*, 1,700 *Sterna bergii* and 600 *S. sandvicensis*. Smaller numbers of other terns occur, notably *S. caspia*. This coast attracts very large numbers of migrant gulls in autumn, with 30,000 (80% *Larus fuscus*) counted along a 50 km stretch of coast in November.
Noteworthy flora: No information.
Scientific research and facilities: None, other than preliminary ornithological surveys.
Management authority and jurisdiction: No information.
References: Evans (1994).
Reasons for inclusion: 1a, 3a & 3c. A good example of a coastal lagoon system and an extremely important feeding and roosting area for gulls and terns (Laridae), with at least three species occurring in numbers exceeding 1% of their regional populations.
Source: See references.

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Qalansiya Lagoon (17)

Location: 12°42'N, 53°30'E; near the village of Qalansiya on the northwest coast of Socotra Island, 55 km west of Hadiboh, Aden Governorate.
Area: c.100 ha.
Altitude: Sea level.
Overview: A tidal inlet (formerly a brackish lagoon) on the northwest coast of Socotra Island; probably the most important wetland on Socotra but very poorly known.
Physical and ecological features: A coastal wetland, said to be a brackish lagoon in 1964 and apparently then sealed off from the sea by a sand bar, but now used as a bad-weather harbour for fishing boats and presumably, therefore, a tidal inlet open to the sea. Inland, there is a lowland plain with *Croton* shrubland which was reported to be relatively thick and tall in 1964.
Land tenure: No information.
Conservation measures taken: None. The lagoon has been identified as an Important Bird Area by BirdLife International (Evans, 1994).

Conservation measures proposed: The island of Socotra is currently being considered for nomination as a Biosphere Reserve under the UNESCO Man and the Biosphere Programme.
Land use: The lagoon is used as a harbour for fishing boats during bad weather. The local fishery is mainly for sprats and shellfish.
Possible changes in land use: No information.
Disturbances and threats: No information.
Hydrological and biophysical values: No information.
Social and cultural values: No information.
Noteworthy fauna: A variety of waterfowl were recorded during a brief survey in November 1993, including *Egretta gularis*, *Ardea* sp., ducks, shorebirds, gulls and terns. *Larus hemprichii* was common, and at least 1,500 gulls *Larus* spp. were seen coming into roost at sunset. No other information is available on the fauna.
Noteworthy flora: No information.
Scientific research and facilities: None; the area is very poorly known.
Management authority and jurisdiction: No information.
References: Evans (1994).
Reasons for inclusion: 3b (possibly also 1a & 3c). One of the few wetlands on Socotra Island, apparently important for migratory waterfowl, but poorly known.
Source: See references.

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