*Wetland Ecosystem Series 5*

# Fauna of Asan Wetland

## (Dehra Dun Valley : Uttaranchal)

ZOOLOGICAL SURVEY OF INDIA

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*Edited by the Director, Zoological Survey of India, Kolkata*


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# FAUNA OF ASAN WETLAND : AN OVERVIEW

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## INTRODUCTION

Wetlands occur extensively throughout the world in all climatic zones and are estimated to cover about 06% of earth's surface They include a wide variety of habitats, which exhibit major differences in their characteristics and have supported the mankind since historical time. They provide us a variety of resources such as food, fodder, fiber, fuel etc. One of the wetland plant, the rice was domesticated and is today the staple food of more than half of world's human population (Gopal, 1995). These waterbodies are of immense use to mankind both economically and ecologically. They are unique habitats that sustain substantial biodiversity. A large number of animal and plant species are restricted only to wetlands, their survival depending totally on the existence of these habitats. If managed with appropriate conservation measures, coupled with generation of sufficient public awareness, the wetlands can become productive and useful ecosystems.

## HISTORICAL RESUME

The directory of wetland prepared by Ministry of Environment and Forests, Govt. of India (MOEF, 1990) reveals 2,175 natural and 65,254 artificial wetlands in the country, located in different geographical regions.

The species richness in wetlands varies depending upon the period of flooding (hydrology) and transporation of chemicals in the systems. Diversity in Indian wetlands as estimated recently (Alfred and Nandi, 2001) includes 34 groups of animal kingdom, comprising nearly 17,853 species.

It is only in the last few decades that the role & value of wetlands are recognised as they support a wide range of functions that are essential for plant, animal & human life for maintaining quality of environment. They can also work as ground water chargers, as filters for sediments & pollutants, and as breeding and/or nursery grounds for aquatic fauna in general and for waterfowl in particular (Tak *et al.*, 1997).

From the faunal resources point of view, the interest on Indian wetlands is quite recent and in fact very little information is available (Biswas, 1974; Gopal, 1982; Trisal and Zutshi, 1985; Fernandes, 1987; Ghosh, 1989; Balakrishnan Nair, 1989; Anonymous, 1989; Ramakrishna, 1990).

This information is too inadequate to understand their ecological significance; socio-economic relation and conservation values. Realizing the importance of wetlands in the ecology of any area the Zoological Survey of India carried out an inventorisation of the faunal resources of Asan reservoir and its environs.

## PHYSIOGRAPHY

*Location :* The Asan reservoir is a man-made wetland of ca 3.2 sq. km area, located 40 km west of Dehra Dun (Uttaranchal), on Dehra Dun-Paonta road. Geographically, it is situated between latitude 30° 24'-30° 28' N and longitude 77° 40'-77° 44' E, near confluence of the rivers

Asan and Yamuna. The barrage is 287.5 m long and the river bed is 389.4 m above sea level, with minimum and maximum water levels at 402.4 m and 403.3 m asl respectively.

*Profile* : The Asan reservoir exists throughout the year and is fed by the river Asan and the discharge channel of Yamuna through Dhalipur Power House (Maps 1, 2 & 3). Although the water lavel is controlled, it often goes down, and swampy islands in the middle become visible, attracting a variety of marsh-loving birds like egrets, herons, lapwings, etc.

The different hydrological parameters recorded during the study period are summarized (Table 1) below.

*Biogeographic province* : Indian wetlands have been biogeographically categorized by Hussain & De Roy (1993). They include Asan wetland in the biogeographic province 4.8.4 (Indo-gangetic monsoon forest).

*Wetland type* : Asan wetland belongs to Type 17 (water-storage reservoirs, dams) (Hussain & De Roy, 1993).

*Climate* : North Indian monsoon climate with distinct summer and winter months. Temp. summer, max. 38°C, min. 14°C; winter, max. 21°C, min. 2°C; average rainfall 250 cm; sw monsoon during June to September.

*Vegetation* : The aqatic vegetation of the reservoir consists of *Eichhornia crassipes*, *Photamogeton pectinatus*, *Typha elepantina*, and *Ceratophyllum demersum*. The surrounding bushes include *Xanthium strumarium*, *Eclipta prostrata*, *Ipomoea fistulosa*, *Cyperus* spp., *Ocimum sanctum*, *Euphorbia* sp., *Mimosa pudica*, *Achyrantus aspera*, *Polygonum glabrum*, *P. lanigerum*, *Aeschyonomene* sp., *Ageratum conyzoides*, *Phyllanthus* sp., *Monochoria hastata*, *Mosla dianthera* and *Lantana camara*. On the southeren side, the reservoir is sorrounded by agricultural fields. Further south there is mixed forest in Siwaliks comprising principally *Shorea robusta*, *Anogeissus latifolia*, *Lannea coromandelica*, *Dalbergia sissoo*, and *Bombax ceiba*.

## MATERIAL AND METHODS

Field observations and collection were made from the reservoir and its environs during the years 1994-97. A total of 31 intensive and 5 extensive

**Table 1**

| Months | Water Temp. (0° C) | Transparency (cm) | DO (mg/lit) | Free $CO_2$ (mg/lit) | pH |
|---|---|---|---|---|---|
| May | 25.0 | 31.0 | 11.7 | 2.8 | 8.5 |
| June | 26.0 | 35.5 | 11.9 | 3.8 | 9.0 |
| July | 25.8 | 36.5 | 12.0 | 3.9 | 9.0 |
| August | 25.5 | 36.0 | 11.1 | 4.0 | 9.0 |
| September | 23.0 | 38.0 | 10.8 | 3.8 | 8.0 |
| October | 24.0 | 35.0 | 10.9 | 3.3 | 8.0 |
| November | 20.5 | 34.5 | 10.2 | 3.7 | 8.0 |
| December | 11.5 | 35.0 | 09.5 | 3.9 | 8.0 |
| January | 09.0 | 36.0 | 08.2 | 3.9 | 7.0 |
| February | 12.1 | 38.0 | 09.9 | 4.1 | 8.0 |
| March | 18.2 | 35.0 | 11.9 | 4.0 | 8.0 |
| April | 22.0 | 33.0 | 11.2 | 3.8 | 9.0 |

*Source* : Amit Mitra, 1999

surveys were conducted in the area. Data on some environmental and hydrological parameters (vegetation, temperature, pH, dissolved oxygen etc.) were noted.

Collections were made by using nets (insect net, water net, cast net, drag net etc.) as well as by hand picking. Both dry and wet specimens were preserved in the appropriate laboratory reagents such as 4% Formalin and Rectified Spirit. Identification of such specimens were carried out at the respecitive laboratories of the Zoological Survey of India.

Observations on vertebrates, *viz.*, mammals, birds and reptiles were made with the aid of prismatic field binoculars(7x35, 10x50 and 20x60). Information on animals using the wetland and its environ were gathered through observations as well as local inquires. Field data thus collected were recorded in the data sheets and were later analyzed at leisure.

A photographic record of the above activities was maintained throughout the study with the aid of slr cameras of Ashai Pentax, Canon and Nikon make, having normal (50mm), wide angle (28mm) and telelens (80-230 mm zoom, 300, 500 and 1000 mm Qestar). A 2x converter was also used as and when required.

## FAUNAL ANALYSIS

Wetland fauna are herein considered those animals residing permanently or temporarily in and around the wetlands or aquatic ecosystems for food, shelter and/or roosting. Most of them are aquatic and live in water, while some others live on land or trees or both, and depend on the wetlands for fishes and other aquatic organisms as their food. Still some others are associated with wetlands as marsh dwellers, reed dwellers living/staying on marshes, on ground or vegetation. All these three categories of wetland fauna viz. (i) aquatic, (ii) wetland dependent and (iii) wetland associated are included to have a complete and precise picture of the faunal composition in wetland scenario (Nandi *et al.*, 1993).

The fauna of Asan wetland exhibit a considerable diversity comprising nine groups of invertebrates and vertebrates. A total of 238 species belonging to 159 genera and 71 families have so far been recorded from the wetland (Table 2).

**Table 2.** Faunal diversity of Asan wetland

| Sl. No | Group | Families | Genera | Species |
|---|---|---|---|---|
| | **Invertebrata** | | | |
| 1. | Odonata | 7 | 29 | 43 |
| 2. | Coleoptera | 3 | 6 | 9 |
| 3. | Annelida | 3 | 8 | 12 |
| 4. | Mollusca | 8 | 10 | 14 |
| | | **21** | **53** | **78** |
| | **Vertebrata** | | | |
| 5. | Pisces | 10 | 25 | 40 |
| 6. | Amphibia | 3 | 3 | 4 |
| 7. | Reptilia | 1 | 1 | 1 |
| 8. | Aves | 19 | 59 | 95 |
| 9. | Mammalia | 17 | 18 | 20 |
| | | **50** | **106** | **160** |
| | **Total :** | **71** | **159** | **238** |

Of the 238 species (78 invertebrates and 160 vertebrates) belonging to nine animal groups, the invertebrate faunal groups comprise Odonata (43 species), Coleoptera (aquatic) (9), Annelida (12) and Mollusca (fresh water-14), while the vertebrates include Mammals (20 species), birds (95), Reptilia (1), Amphibia (4) and Pisces (40). Among invertebrates insects show maximum diversity having 52 species (Odonata 43 species and Coleoptera 09), followed by Mollusca (14 species) and Annelida (9 species).

The insects constitute one of the major faunal component of wetland ecosystems. They play a very vital role in the trophic structure of freshwater wetlands in converting plant food into animal protein of insectivorous animals in the ecosystem.They also play a significant role as consumers of organic wastes in the freshwater habitats and even serve as a source of natural food for fishes. But they are known to compete for food with the fingerlings sharing the same habitat and often cause much damage to hatchery. Therefore, they are considered crucial in ecology and management of wetland ecosystems. Though they are a diversified group comprising about eleven orders which are known to spend at least part of their life cycle in water, only water bugs and water beetles inhabit the water.

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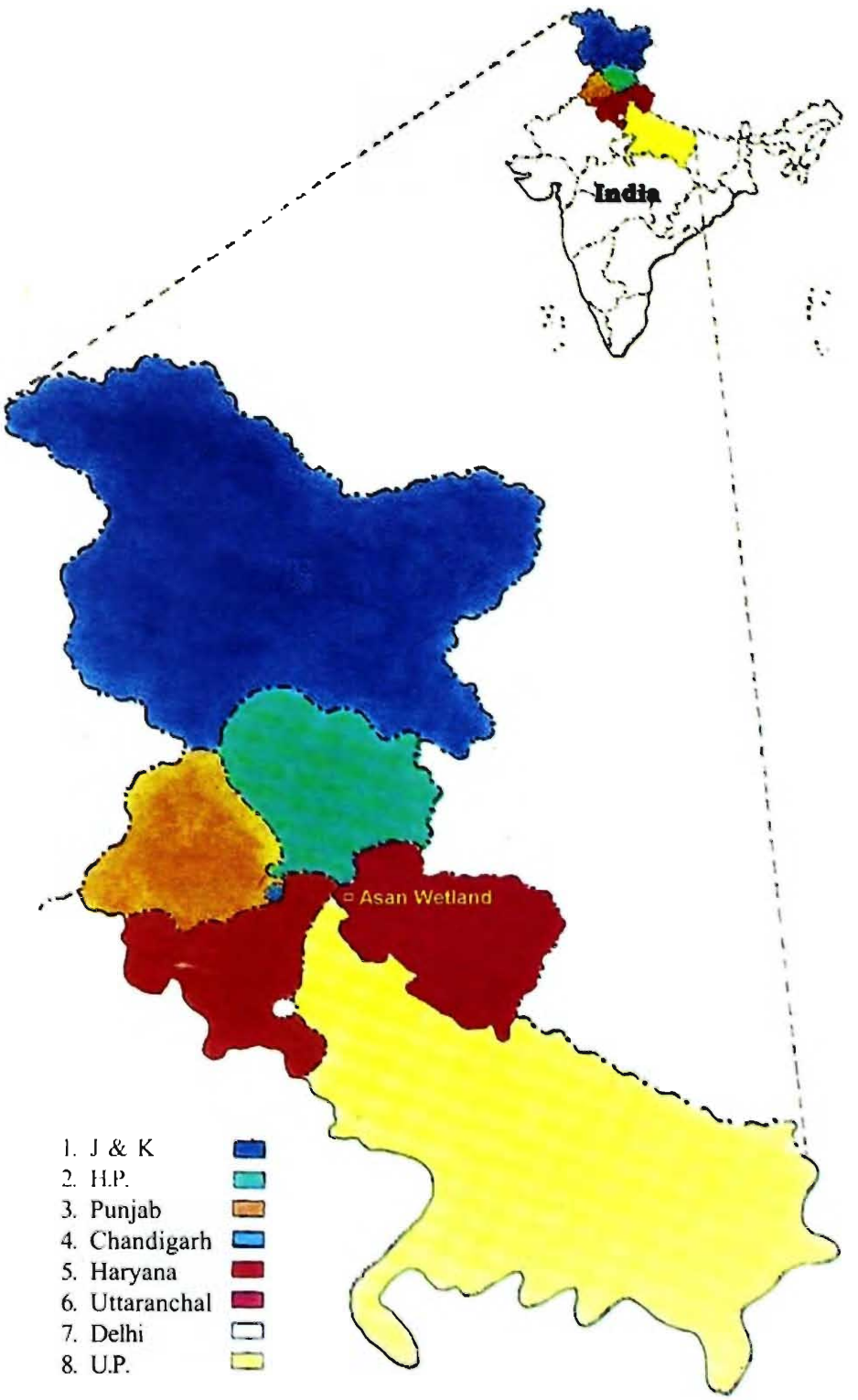
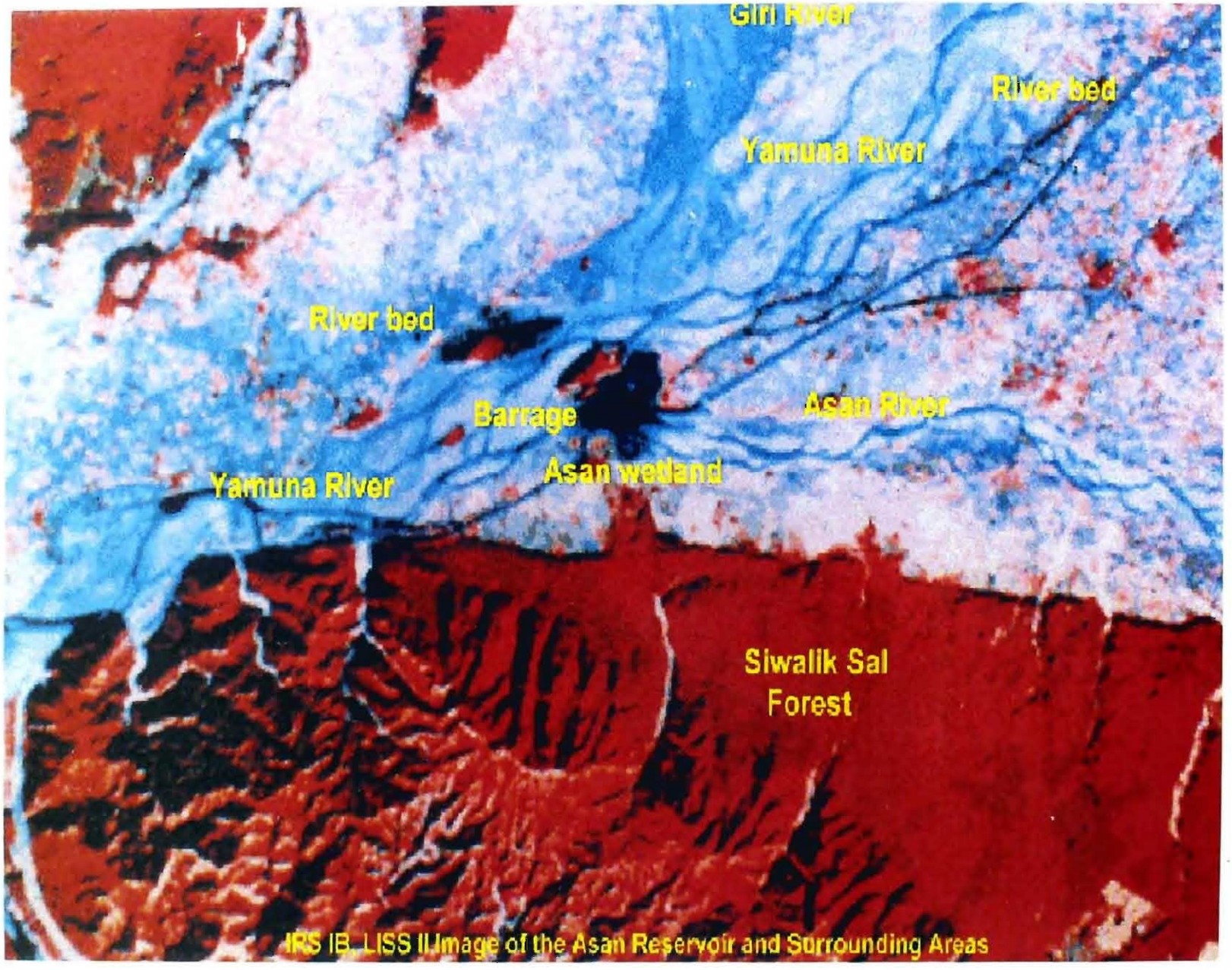
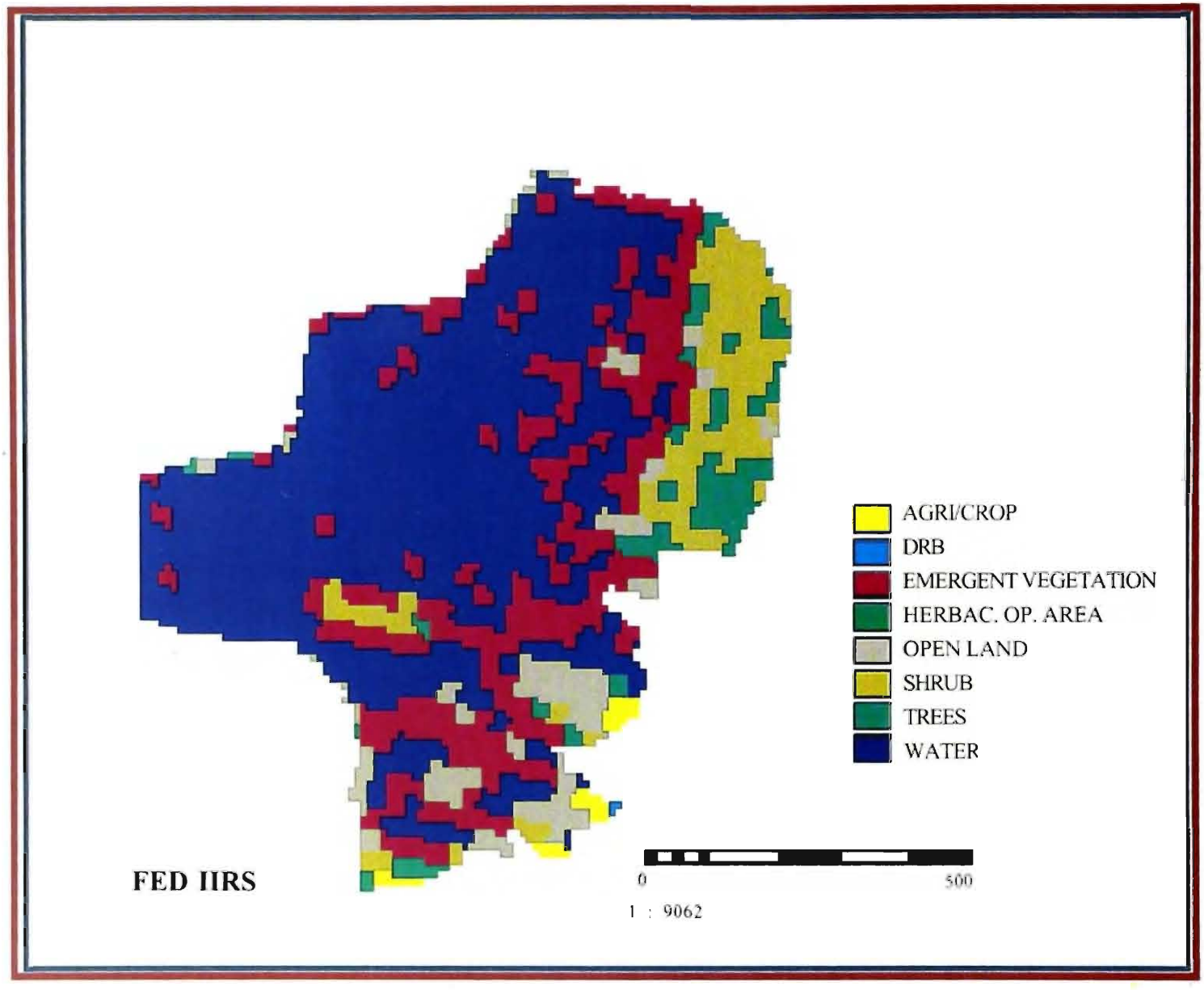



**Map 1:** Map of Northern India with inset showing location of Asan Wetland.




**Map 2:** Satellite Imagery IRS1B LISS-II of Asan Reservoir and surrounding areas




**Map 3:** Habitat Map of Asan Reservoir using supervised classification of LISS II bands 4, 3 and 2 (1996)

A view of Asan reservoir

Asan reservoir having waterfowls in foreground

Asan wetland having emergent vegetation and Shiwailk range at background

Great Crested Grebe,
*Podiceps cristatus*

Mixed flock of
Little Cormorant,
Great Cormorant and
Cattle Egret.

Little Egrets at feeding
at the confluence of
Asan River & Barrage.

Large Egret and Large Pied Wagtail at the bank of Asan River.

Indian Pond - Heron, *Ardeola grayii*, in breeding plumage.

Black-crowned Night-Heron, *Nycticorax nycticorax*

Painted Stork,
*Mycteria leucocephala*

Asan Openbill-Stork,
*Anastomus oscitans*

Black Ibis, *Pseudibis papillosa*

Greylag Goose, *Anser anser*

Barheaded Goose, *Anser indicus*

Flock of Brahminy Shelduck, *Tadorna ferrugina*

Flock of Brahminy Shelduck with other waterbirds

Gadwall,
*Anas strepera*

Spot-billed Duck
*Anas pocilorhyncha*
with chicks

Northern Shoveller, *Anas clypeata*

Common Teal, *Anas crecca*

Flock of Red crested Pochard, *Rhodonessa rufina*

Tufted Pochard,
*Agthya fuligula*

Flock of Common
Coot, *Fulica atra*

Common Moorhemn,
*Gallinula chloropus*

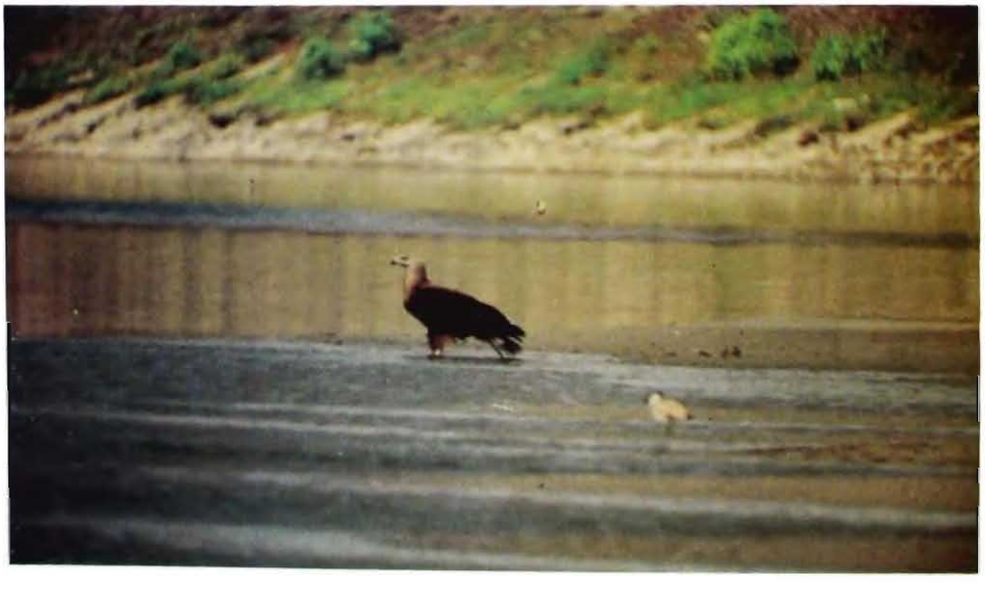
Pheasant-tailed Jacana, *Hydrophasianus chirurgus*

Northern Lapwing, *Vanellus vanellus*

Red-watted Lapwing, *Vanellus indicus*

White-breasted Kingfisher, *Halcyon smyrensis*

Lesser Pied Kingfisher, *Ceryle rudis*



Pallas's Fish - Eagle, *Haliaeetus leucoryphus*

*Zool. Surv. India*
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# ANNELIDA

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## INTRODUCTION

Annelids of Uttaranchal comprise the Class Oligochaeta and the Class Hirudinea. Oligochaetes are divided into two convenient groups : Microdrili and Megadrili. Microdriles are small and mostly freshwater forms while megadrils, the earthworms, are larger and mostly terrestrial with some of their aquatic representatives. The worms belonging to the class Hirudinea are the leeches and they are mostly the inhabitants of freshwater environment though some are terrestrial.

Earthworms play an important role in enhancing soil fertility. Freshwater oligochaetes are capable of improving the quality of detrious accumulated in the bottom of freshwater bodies while some are good indicators of organic pollution. The non-venomous leeches may be used as remedies in throat and inflamatory swellings and in blood pressure due to the presence of their property of sucking blood in excess. Moreover, like other faunal and floral components in the food chain of aquatic ecosystem freshwater oligochaetes, earthworms and leeches are of great importance in maintaining ecological balance.

Our knowledge on the taxonomy of annelid fauna of Uttar Pradash is confined to the contributions of Michaelsen (1909), Stephenson (1916, 1923) and Julka (1995) on freshwater oligochaetes : Bourne (1889), Fedarb (1898), Michaelsen (1907,1909), Stephenson (1914, 1916, 1922, 1923), Gates (1945 a & b, 1947, 1951, 1956, 1960, 1972), Soota (1970), Soota & Halder (1980) and Julka (1988,1995) on earthworms; Harding & Moore (1927), Bhatt & Bhatia (1958), Bhatt (1960, 1961), Bhatia & Bora (1973) and Chandra (1983, 1991) on leeches and Halder & Ghosh (1997) on earthworms and leeches.

The present report is based on the wetland survey collection of earthworms and leeches made from Asan reservoir and its environs. The material comprises nine species of earthworms and three species of leeches including one of each group determined up to generic level.

## SYSTEMATIC ACCOUNT

Class OLIGOCHAETA

Order HAPLOTAXIDEA

I. Family MEGASCOLECIDAE

1. ***Amynthas diffringens*** (Baird)

*Distribution* : India : Uttaranchal (Bhim Tal, Landsdown, and Naini Tal); Arunachal Pradesh; Assam; Manipur; Meghalaya; Sikkim; West Bengal; Himachal Pradesh; Jammu & Kashmir; Karnataka; Tamil Nadu. *Elsewhere* : Widely distributed, cosmopolitan species.

*Remarks* : This is peregrine species originated from China and has colonized successfully in the Himalayas and other high altitude regions of India.

2. ***Metasphire birmanica*** (Rosa)

*Distribution* : India : Uttaranchal (Almora, Chamoli, Dehra Dun-Timli, Naini Tal, Pauri). *Elsewhere* : Myanmar.

*Remarks* : This peregrine species is very rare in India and is so far known to occur in the western Himalayan region of Uttar Pradesh (now Uttaranchal).

3. ***Metaphire houlleti*** (Perrier)

*Remarks* : Gates (1972) recognized seven morphs within *Houlleti* complex. The specimens of *houlleti* recorded here from Asan reservoir and its environs belong to smaller Hp morph.

***Metaphire houlleti smaller*** Hp morph

*Distribution* : India : Uttaranchal (Bhim Tal, Dehra Dun); Andaman Islands; Meghalaya. *Elsewhere*: Sri Lanka, Myanmar, Thailand, Malay Peninsula, Java, Philippins, Fiji Island, U.S.A., South America.

*Remarks* : This peregrine species, originated from southeast Asia, is rare in India.

4. ***Perionyx simlaensis*** (Michaelsen)

*Distribution* : India : Uttaranchal (Dehra Dun) Uttar Pradesh (Saharanpur), Himachal Pradesh.

*Remarks* : This is a very rare endemic species.

5. ***Perionyx*** sp.

*Remarks* : The specimens, being immature, could not be identified up to species level.

II. Family OCTOCHAETIDAE

6. ***Dichoqauster bolaui*** (Michaelsen)

*Disrtibution:* India : Uttaranchal (Dehra Dun, Tehri), Uttar Pradesh (Allahabad, Bara Banki, Fatehpur, Jhansi, Lucknow, Moghul Sarai, Saharanpur), Andaman & Nicobar Islands, Andhra Pradesh, Arunachal Pradesh, Delhi, Goa, Gujarat, Himachal Pradesh, Karnataka, Kerala, Madhya Pradesh, Maharasthra, Meghalaya, Orissa, Rajasthan, Sikkim, Tamil Nadu, West Bengal. *Elsewhere* : Widely distributed cosmopolitan species.

*Remarks* : Though the original home of this peregrine species is southeast Asia, it is widely distributed in India.

7. ***Eutoiphoeus orientalis*** (Beddard)

*Distribution* : India : Uttaranchal (Dehra Dun), Uttar Pradesh (Buzru Kurme, Chhitauni, Katwari Bazar, Mowaie), Bihar, West Bengal.

*Remarks* : This endemic species is common in Uttar Pradesh, Bihar & West Bengal.

8. ***Lennogaster pusillus*** (Stephenson)

*Distribution* : India : Uttaranchal (Almora, Naini Tal, Pauri-Tanda Falls), Uttar Pradesh (Allahabad, Chunar, Faizabad, Manikpur Junction, Robertsganj, Varanasi), Himachal Pradesh, Karnataka, Madhya Pradesh, Orissa.

*Remarks* : This endemic species is common in Uttar Pradesh and is recorded for the first time from Asan reservoir and its environs, Dehra Dun, Uttaranchal.

9. ***Octochaetona beatrix*** (Beddard)

*Distribution* : India : Uttar Pradesh (Allahabad, Barabanki, Chakia, Fatehpur, Faizabad, Jonghai, Jhansi, Lucknow, Madho Singh, Manikpur Junction, Mirzapur, Pratapgarh, Rae Bareli, Robertsjung, Saharanpur, Sohagi, Tanda falls, Varanasi), Uttaranchal (Dehra Dun, Naini Tal, Pauri), Chandigarh, Goa, Gujarat, Himachal Pradesh, Jammu & Kashmir, Karnataka, Kerala, Madhya Pradesh, Maharasthra, Orissa, Punjab, Rajasthan, West Bengal. *Elsewhere* : Pakistan, Nepal, Myanmar, Malay Peninsula, Philippines.

*Remarks* : This endemic species is widely distributed in India.

Class HIRUDINEA

Order ARHYNCHOEOELLAE

III. Family HIRUDIDAE

10. ***Poecilobdella manillenasis*** (Lesson)

*Distribution* : India : Uttaranchal (Landaur), Assam, West Bengal, Maharashtra, Karnataka, Kerala. *Elsewhere* : Pakistan, China, Sri Lanka, Myanmar, Borneo, Malaysia, Philippines.

*Remarks* : This is a common aquatic leech.

11. ***Poecilobdella granulosa*** (Savingny)

*Distribution* : India : Uttar Pradesh (Agra, Baharaich, Mathura), Uttaranchal (Kumaon), Andhra Pradesh, Assam, Bihar, Delhi, Gujarat, Himachal Pradesh, Jammu & Kashmir, Kerala, Madhya Pradesh, Manipur, Orissa, Pondicherry, Punjab, Rajasthan, Sikkim, Tamil Nadu, West Bengal. *Elsewhere* : Nepal, Sri Lanka, Myanmar.

*Remarks* : This is a common aquatic medicinal leech widely distributed in India. It is recorded here for the first time from Dehra Dun District of Uttaranchal.

12. ***Poecilobdella*** sp.

*Remarks* : Immature specimens with indistinct seperation of gonopores and hence could not be determined at the species level.

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# INSECTA : ODONATA

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## INTRODUCTION

The study of Odonata diversity surrounding Asan reservoir area reveals 43 species spreading to 29 genera under seven families. Out of these, 16 species (37%) under 13 genera are Oriental, one species (2%) under one genus is Palaearctic, 16 species (37%) under six genera are Tropical, two species (5%), under two genera are Ethiopian four species (9%) under three genera are Australian and four species (9%) under four genera are Cosmopolitan in distribution. *Anax parthenope, Diplaccodes lefebvrei* and *Urothemis s. signata* have been recorded for the first time from Dehra Dun valley where as the latter two are new records from the western Himalaya as well (Mitra, 1999).

The most important ecological phenomenon is the presence of both stream species as well as the standing water species, which indicates that the both ecosystem are properly maintained. The running water breeding species like, *Calicnemia eximia, Neurobasis ch. chinensis* were much more abundant at the confluence of the river Asan with the reservoir. The inlet channel coming from Dakpathar barrage is deep and with unstable or altered ecological conditions that hardly any dragonfly species is able to breed there and, therefore, its surrounding remained somewhat barren except some species from the reservoir occasionally visiting the area.

Classified list of 43 species of dragonflies, including 14 species of Zygoptera and 29 Anisoptera available at Asan reservoir is given below. The scientific name of each species is followed by the name of the authority and year of the original description of species.

The habitat preference study revealed seven stream breeding species (16%) and 13 reservoir (standing water) breeding species (30%) whereas 23 species (54%) were common in both the habitats. Interestingly all the 43 species are breeding residents at the Asan reservoir and contiguous areas.

## SYSTEMATIC ACCOUNT

Order ODONATA
Suborder ZYGOPTERA
Superfamily COENAGRIONOIDEA
Family COENAGRIONIDAE
Subfamily PSEUDAGRIONINAE

Genus ***Ceriagrion*** Selys, 1876

1. ***C. cerinorubellum*** (Brauer, 1865)
2. ***C. coromandelianum*** (Fabricius, 1798)

Genus ***Pseudagrion*** Selys, 1876

3. ***P. rubriceps rubriceps*** Selys, 1876
4. ***P. decorum*** (Rambur, 1842)

Subfamily COENAGRIONINAE

Genus ***Cercion*** Navas, 1907

5. ***C. calamorum*** (Ris, 1916)

Subfamily ISCHNURINAE

Genus ***Enallagma*** Charp, 1840

6. ***E. parvum*** Selys, 1876

Genus ***Ischnura*** Charp, 1840

7. ***I. aurora aurora*** (Brauer, 1865)

8. ***I. forcipata*** Morton, 1907

Genus ***Rhodiscurna*** Laidlaw, 1919

9. ***R. nursei*** (Morton, 1907)

Subfamily AGRIOCNEMIDINAE

Genus ***Agriocnemis*** Selys, 1877

10. ***A. pygmaea*** (Rambur, 1842)

11. ***A. clauseni*** Fraser, 1922e

Family PLATYCNEMIDIDAE

Subfamily CALICNEMIDINAE

Genus ***Calicnemia*** Strand, 1926

12. ***C. eximia*** (Selys, 1863)

Superfamily LESTOIDEA
Family LESTIDAE
Subfamily LESTINAE

Genus ***Lestes*** Leach, 1815

13. ***L. praemorsa praemorsa*** (Selys, 1862)

Superfamily CALPTERYGOIDEA
Family CALOPTERYGIDAE
Subfamily CALPTERYGINAE

Genus ***Neurobasis*** Selys, 1853

14. ***N. chinensis chinensis*** (Linnaeus, 1758)

Suborder ANISOPTERA

Superfamily AESHNOIDA

Family GOMPHIDAE

Genus ***Buragomphus*** Williamson, 1907

15. ***B. sivalikensis*** Laidlaw, 1922

Subfamily ONYCHOGOMPHINAE

Genus ***Onychogomphus*** Selys, 1854

16. ***O. duaricus*** Fraser, 1924

Genus ***Paragomphus*** Cowley, 1934

17. ***P. lineats*** (Selys, 1850)

Subfamily LINDENIINAE

Genus ***Ictinogomphus*** Cowley, 1934

18. ***I. rapax*** (Rambu, 1842)

Family AESHINAE
Subfamily AESHINAE

Genus ***Anax*** Leach, 1815

19. ***A. guttatus*** (Burmeister, 1839)

20. ***A. parthenope parthenope*** (Selys, 1839)

Superfamily LIBELLULOIDEA
Family LIBELLULIDAE
Subfamily BRACHYDIPPLACTINAE

Genus ***Brachydipla brauer***, 1868

21. ***B. sobrina*** (Rambur, 1842)

Subfamily LIBELLULINAE

Genus ***Orthetrum*** Newman, 1833

22. ***O. luzonicm*** (Brauer, 1868)

23. ***O. pruinosum neglectum*** (Rambur, 1842)

24. ***O. sabina sabina*** (Drury, 1770)

25 ***O. taeniolatum*** (Schn., 1845)

26. ***O. triangulare triangulare*** (Selys, 1878)

Subfamily SYMPATRINAE

Genus ***Brachythemis*** Brauer, 1868

27. ***A. panorpoides panorpoides*** Rambur, 1842

Genus ***Brachythemis*** Brauer, 1868

28. ***B. contamiata*** (Fabr., 1793)

Genus ***Crocothemis*** Brauer 1868

29. ***C. servilia servilia*** (Drury, 1770)

Genus ***Diplacodes*** Kirby, 1889

30. ***D. lefebvrei*** (Rambur, 1842)

31. ***D. neblsa*** (Fabricius, 1793)

32. ***D. trivialis*** (Rambur, 1842)

Genus ***Neurothemis*** Brauer, 1867

33. ***N. fulvia*** (Drury, 1773)

34. ***N. tullia tullia*** (Drury, 1773)

Subfamily TRITHEMITINAE

Genus ***Trithemis*** Brauer, 1868

35. ***T. aurora*** (Burmeister, 1839)

36. ***T. festiva*** (Rambur, 1842)

37. ***T. pallidinervis*** (Kirby, 1889)

Subfamily PALPOPLEURINAE

Genus ***Palpopleura*** Rambur, 1842

38. ***P. sexmaculata sexmaculata*** (Fabr., 1787)

Subfamily TRAMEINAE

Genus ***Rhyothemis*** Hagen, 1867

39. ***R. variegata variegata*** (Linn., 1763)

Genus ***Pantala*** Hagen, 1861

40. ***P. flavescens*** (Fabr., 1798)

Genus ***Tramea*** Hagen, 1861

41. ***T. virginia*** (Rambur, 1842)

Genus ***Tholymis*** Hagen, 1867

42. ***T. tillarga*** (Fabr., 1798)

Subfamily UROTHEMISTINAE

Genus ***Urothemis*** Brauer, 1868

43. ***U. signata signata*** (Rambur, 1842)

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# INSECTA : COLEOPTERA (AQUATIC)

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## INTRODUCTION

Of the 18 families of aquatic Coleoptera known from the world, representatives of 13 families spreading over all the four sub orders are known from India (Biswas, Mukhopadhyay and Saha, 1995.) Among them the family Gyrinidae, Dytiscidae and Hydrophilidae are the dominant families.

Present study includes a total of nine species under six genera belonging to three families like Gyrinidae, Dytiscidae and Hydrophilidae. Besides this, a systematic list of the species, key to the families with references recorded from Dehra Dun have also been included.

### Key to the families of aqatic Coleoptera (Gyriidae, Dytiscidae and Hydrophilidae recorded from Asan reservoir and its environs

1. Hind coxae immovably fused to metasternum completely dividing first visible abdominal segment; prothorax with distinct notopleural suture. Maxillary palpi not larger than antennae ..... 2

   Hind coxae not immovably fused to metasternum. Prothorax never with distinct notopleural suture. Maxillary palpi longer than antennae ..... Hydrophilidae

2. Eyes divided by side of the head appearing as dorsal and ventral pair; antennae short and stout; middle and hind legs short and flattened, tarsi folding, fanwise ..... Gyrinidae

   Eyes not divided; antennae elongate and slender; hind legs modified for swimming; tarsi flattened and usually fringed with long hairs ..... Dytiscidae

## SYSTEMATIC ACCOUNT

### Family GYRINIDAE

The members of the family Gyrinidae are commonly known as 'whirling beetles' because of their habit of whirling movement while swimming in groups on the surface of ponds and quiet streams. They are aquatic both in adult and larval stages. The major workers who dealt with the group are Fabricius (1781), Regimbart (1882-83), Vazirani (1977, 1984) and recently Biswas, Mukhopadhyay and Saha (1995).

1. ***Dineutes spinosus*** (F.)

*Distribution* : India : West Bengal, Bihar, Assam, Meghalaya, Orissa, Uttar Pradesh. *Elsewhere*: Bangladesh, Myanmar, Thailand, Malayasia, Laos, Vietnam.

### Family DYTISCIDAE

The members of this family are commonly known as 'predaceous diving beetles' and most perfect adapted to aquatic life. They form one of the main constituents of insect fauna of aquatic biota. They are very active swimmers, preying on all other small water life. Their larvae may destroy fingerlings of commercial fishes. Both adults and

larvae of this group are carnivorous and preys on molluscs, worms, insects and small fishes. Of the total 4000 species from the world, 223 species are recorded from India.

2. ***Hydaticus vittatus*** (Fab.)

*Distribution* : India : West Bengal, Rajasthan, Gujarat, Uttar Pradesh, Tamil Nadu. *Elsewhere* : Myanmar, Sri Lanka, Pakistan, Nepal, Bangladesh, China, Formosa, Japan, Indonesia.

3. ***Hydaticus fabricii*** MacLeay

*Distribution* : India : Uttar Pradesh, Rajasthan, Goa, Tamil Nadu, Andamans Is. *Elsewhere* : India: Indonesia, Vietnam, Philippines.

4. ***Cybister convexus*** Sharp

*Distribution* : India: West Bengal, Asam, Manipur, Uttar Pradesh. *Elsewhere* : China, Yunnan.

5. ***Cybister sugillatus*** Erichson

*Distribution*: India: West Bengal, Assam, Manipur, Sikkim, Orissa, Madhya Pradesh, Uttar Pradesh, Maharashtra, Tamil Nadu. *Elsewhere* : China, Japan, Tibet, Indonesia, Philippines.

6. ***Cybister tripunctatus asiaticus*** Sharp

*Distribution* : India : Sikkim, Tripura, Gujarat, Rajastan, Uttar Pradesh, Tamil Nadu. *Elsewhere*: Sri Lanka, Myanmar, Nepal, Pakistan Afghanistan, Bangladesh.

Family HYDROPHILIDAE

The family Hydrophilidae belongs to the superfamily Hydrophiloidea of the suborder Polyphaga of the order Coleoptera. The members of the family are commonly known "Water Scavenger Beetle" They vary in size from small to large and can be easily distinguished by its size of maxillary palpi being conspicuously large and bigger than antennae in length and due to extended palpi, the group is also called Palpicornia. Majority of them are truly aquatic and form an important constituent of fresh water ecosystem. Both the larvae and adults of some species are predaceous on small fish and other aquatic animals.

7. ***Sternolophus rufipes*** (F.)

*Distribution* : India : West Bengal, Bihar, Punjab, Mahashtra, Kashmir, Uttar Pradesh. *Elsewhere* : India : Tropical Asia, Sunda Islands, Myanmar, Philippine, Japan, Formosa, Indonesia, F.M.S., Indo-china, Sri Lanka.

*Remarks*: This species recorded for the first time from Uttar Pradesh.

8. ***Hydrophilus olivaceus*** Fabricius

*Distribution* : India : West Bengal, N. India, Gujarat, Uttar Pradesh, Maharashtra.

*Remarks* : This species is recorded here for the first time from Uttaranchal.

9. ***Regimbartia attenuata*** (F.)

*Distribution* : India : West Bengal, Bihar, Sikkim, Uttar Pradesh. *Elsewhere* : Sri Lanka, S. Asia, Philippines. Sunda Is, Australia, Japan, Formosa, Indonesia, Cambodia, Cochin-China, Anam.

*Remarks* : This species is recorded here for the first time from Uttaranchal.

## SUMMARY

This study is based on a collection made by different survey parties of Northern Regional Station, Zoological Survey of India, Dehra Dun from the wetlands of Doon Valley during 1995 to 1997. This includes a total of nine species under six genera belonging to three families like Gyrinidae, Dytiscidae and Hydrophilidae.Of these twc species, *viz.*, *Sternolophus fufipes* (F.) and

*Hydrophilus olivaceus* F. of the family Hydrophilidae are recorded for the first time from Uttaranchal. Besides this, Key to the families have also been provided. Distributional data of each species has been given from the published records as well as the actual study of the specimens.

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# MOLLUSCA (FRESHWATER)

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## INTRODUCTION

Out of the five classes on Indian Molluscs, Freshwater molluscs belong to the two classes, viz., Gastropoda and Bivalvia. Consolidated taxonomic works on Indian freshwater molluscs, in general, was done by Preston (1915) and more recently by Subba Rao (1989). Different aspects of freshwater molluscs like, habitat, distribution, zoogeographical significance, etc., including their medical and veterinary roles were dealt by Subba Rao (1993).

Freshwater molluscs from the state of Uttaranchal have not been worked out separately. Devis *et al.* (1986) made a detailed study of the Asian hill-stream genus *Tricula*, from Naini Tal district.

As a whole, freshwater molluscs play a very important role in the aquatic ecosystem. While the smaller species serve as food for many of the birds, fishes etc., majority of the larger species are regularly consumed by people in many parts of the country. Shells of some of the species are widely used in lime and button industries and also for manufacturing of poultry feeds. Pearls are produced by two of the most common Indian freshwater mussels, *Lamellidens marginalis* and *L. corrianus*.

On the other hand, a number of freshwater gastropods serve as intermediate host for trematode parasites causing diseases in livestocks.

The classification followed here is after Subba Rao (1989).

**Key to the families of freshwater molluscs of Asan reservoir and its environs**

1. Shell with single valve ..... (2)

   Shell with two valves ..... (6)

2. Shell without operculum ..... (3)

   Shell with operculum ..... (5)

3. Shell discoidal with depressed spire ..... Planorbidae

   Shell elongate with an elevated spire ..... Lymnaeidae

4. Shell globose to globosely conical, smooth (5)

   Shell elongate-turreted, distinctly sculptured ... Thiaridae

5. Shell smaller, less than 10 mm in length; operculum with spiral growth lines ..... Bithynidae

   Shell larger, above 10 mm in length, Operculum with concentric growth lines ..... Viviparidae

6. Shell small, thin, hinge curved ..... Pisidiidae

   Shell large, thick, hinge not curved ..... (7)

7. Shell ovately trigonal with coarse concentric Striae, ligament external ..... Corbiculidae

   Shell, subrhomboid or transversely elongate without concentric striae, ligament internal ..... Amblemidae

## SYSTEMATIC ACCOUNT

Class GASTROPODA

Order MESOGASTROPODA

Family VIVIPARIDAE

1. ***Bellamya bengalensis*** f. ***typica*** (Lamarck)

*Distribution* : India : Common throughout. *Elsewhere* : Bangladesh, Myanmar, Sri Lanka.

*Remarks* : Spire and bodywhorl equal in height, whorls tumid, rounded, apex pointed; broad and narrow spiral bands irregularly arranged.

f. ***mandiensis*** (Kobelt)

*Distribution* : India : Common throughout north western India, from Allahabad to Punjab and west to Mumbai.

*Remarks* : Shell more conical and narrower than f. *typica*, aperture not so broad but more projecting, umbillicus broader.

Family BITHYNIIDAE

2. ***Gabbia orcula*** (Frauenfeld)

*Distribution* : India : Assam, Bihar, Maharashtra, Punjab, Rajasthan, Uttar Pradesh, West Bengal.

*Remarks* : Shell smooth, imperforate, globosely conical, whorls four, slightly rounded with a swollen body whorl; outerlip thin, columellar margin a little reflected.

3. ***Digonistoma pulchella*** (Benson)

*Distribution* : India : Throughout. *Elsewhere*: Malaya Archipelago, Myanmar.

*Remarks* : Shell conically elongate; spire longer than body whorl; sutures impressed, umblicus almost closed; aperture oval, outer a little thickened.

Family THIARIDAE

4. ***Thiara*** (*Thiara*) ***scabra*** (Mueller)

*Distribution* : India : Throughout, except Kashmir. *Elsewhere* : coasts of Indo-Pacific, Zanzibar to New Hebrides, North to the Philippines, Pacific Islands.

*Remarks* : Shell thick, elongate, sculptured with rows of ribs bearing and spiral striae, whorls shouldered above.

5. ***Thira*** (*Melanoides*) ***tuberculata*** (Mueller)

*Distribution*: India : Throughout, except Kashmir. *Elsewhere* : South east Assia, China, Malaysia, Malaya Achipelago, North Australia, Pacific Islands, Japan, New Hebrides.

*Remarks* : Shell variable, elongately turreted, whorls rounded, spire long, coarsely sculptured, with vertical ribs and spiral striae, dark red brown and streaks irregularly arranged.

Order BASOMMATOPHORA

Family LYMNAEIDAE

6. ***Lymnaea*** (*Pseudosuccienea*) ***acuminata*** f. ***typical*** Lamarck

*Distribution* : India : Throughout. *Elsewhere* : Bangladesh, Myanmar.

*Remarks* : Shell ovately elongate, bodywhorl inflated, spire very short and pointed; aperture wide.

f. ***rufescens*** Gray

*Distribution* : India : Common throught. *Elsewhere* : Bangladesh, Myanmar, Pakistan.

*Remarks* : Narrower and more elongate than in *typica*, spire longer, aperture uniformly less expanded.

7. ***Lymnaea*** (*Pseudosuccinea*) ***luteola***
f. ***typica*** Lamarck

*Distribution* : India : Common throught. *Elsewhere :* Bangladesh, Myanmar, Nepal, Pakistan.

*Remarks* : Shell ovate, spire well-formed, apex blunt, body whorl not much inflated and laterally compressed.

f. ***australis*** Annandale and Rao

*Distribution*: India: Common throghout. *Elsewhere* : Bangladesh, Myanmar, Pakistan, Sri Lanka.

*Remarks* : Shell smaller than in *typica*, body whorl rounded but less inflated than in f. *ovalis*, sutures shallow.

f. ***ovalis*** Gray

*Distribution* : India : Throughout. *Elsewhere* : Myanmar, Sri Lanka.

*Remarks* : Shell rather thick, subglobose with a short and pointed spire; body whorl inflated and well rounded.

f. ***succinea*** Deshayes

*Distribution* : India : North and South

*Remarks* : Shell rather narrowly elongated, spire well produced and gradually tapering, penultimate whorl equals more than half of total length of spire.

8. ***Lymnaea*** (*Radix*) ***persica*** Issel

*Distribution* : India : Andhra Pradesh, Uttar Pradesh, Delhi, Himachal Pradesh, Punjab, Kashmir. *Elsewhere* : Baluchistan, Persia.

*Remarks* : Shell small, thin, spire short but sharply pointed, body whorl but not much inflated; aperture large and oval, outer lip sharp and broadly arched, extends beyond the whorl posteriorly. Columella straight with a well developed callus. Annandale and Rao (1925) referred to *L. parsika* as the only palaearctic species of the genus penetrating into peninsular India.

Family PLANORBIDAE

9. ***Indoplanorbis exustus*** (Deshayes)

*Distribution* : India : Through out the plains. *Elsewhere* : Indonesia, Malaysia, Myanmar, Pakistan, Sri Lanka, Thailand, Vietnam.

*Remarks* : Shell large, more than 5 mm., thick, discoidal with sunken spire, whorls rounded, aperture ear shaped.

10. ***Gyraulus convexiusculus*** (Hutton)

*Distribution*: India: Common throughout. *Elsewhere*: Iran to the Philippines.

*Remarks*: Shell small (5 mm) disc like, umbilicate, semitransparent, whorls 4-5, body whorl angulate at the periphery; aperture obliquely oval.

11. ***Gyraulus labiatus*** (Benson)

*Distibution* : India : Madhya Pradesh, Maharastra, Tamilnadu, Uttar Pradesh, West Bengal. *Elsewhere* : Myanmar.

*Remarks* : Shell small less than 5 mm, whorls 3.5, obliquently striate suture impressed; aperture oblique, heart shaped, whitish rib within the aperture.

Class BIVALVIA

Order UNIONOIDA

Family AMBLEMIDAE

12. ***Parreysia*** (*Radiatula*) ***caerulea*** (Lea)

*Distribution* : India : Assam, West Bengal, Bihar, Orissa, Uttar Pradesh, Punjab. *Elsewhere* : Myanmar.

*Remarks* : Variable, scultured throughout in young ones, but restricted on umbonal region in adult, posterior umbonal carina very distinct.

Order VENEROIDA

Family CORBICULIDAE

13. ***Corbicula striatella*** Deshayes

*Distribution* : India : Common throughout, *Elsewhere* : Myanmar, Pakistan.

*Remarks* : Shell tumid, triangularly ovate, dorsal margin more arched anteriorly; umbone prominent; striae regular, concentric and raised into ridges; pallial line with a trace of sinus; muscles scars well developed.

Family PSIDIIDAE

14. ***Sphaerium*** (*Sphaerium*) ***indicum*** Deshayes

*Distribution* : India : Throughout plains and Himalayas.

*Remarks* : Inequilateral; right valve with single well developed cardinal, second one reduced, lateral well developed.

## SUMMARY

This molluscan fauna of Asan wetland includes 8 families, 10 genera and 14 species. Gastropods comprise 11 species under 7 genera and 5 families. Among the gastropods, 3 species, *viz.*, *Bellamya bengalensis* (Lamarck), *Lymnaea acuminata* Lamarck and *L. leuteola* Lamarck are represented by a number of infra-specific forms each. Though based on minor shell characters, these forms are fairly constant and were recognised by Subba Rao (1989). All these species usually occur in freshwater bodies with aquatic weeds. Bivalves are represented by 3 families, 3 genera and 3 species. *Lamellidens corrianus* (Lea), *Corbicula striatella* (Deshayes) the two larger bivalves occur on soft muddy substratum in rivers, ponds, lakes etc. *Spharium indicum* Deshayes, the small bivalve usually inhabit stagnant waters, among vegetations. All the species studied are among the most common freshwater molluscs of India and as such there is no special significance from the distribution point of view. One of the gastropod, *Lymnaea persica* Issel, is a palaearctic species essentially occurring in north-western India but was recorded from Secunderabad in Andhra Pradesh by Annandale and Rao (1925).

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# PISCES

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## INTRODUCTION

The fish fauna of natural waterbodies of Dehra Dun and around has attracted the attention of various workers (Hora & Mukerji, 1936; Das, 1960; Lal & Chatterjee, 1963; Singh, 1964; Grover, 1970; Tilak & Husain, 1973, 1976, 1977, 1978, 1990; Husain, 1995) during the past but no serious attempt was made to explore the fish life in Asan reservoir and its vicinity which has become a great attraction to the tourists and nature lovers. In view of this the present study was undertaken and the area was surveyed thoroughly for 2-3 years with the collection of forty species. The studies were conducted in Asan reservoir and its confluent water bodies. Of the forty species, *Barilius bendelisis* was found to be distributed in all the locations. However, not a single specimen of catfish, *Glyptothorax dakpathari* Tilak & Husain 1976 reported from the vicinity (river Yamuna below Dakpathar Barrage) and seen earlier in Asan river near its union with Yamuna has been collected.

### SYSTEMATIC LIST AND OCCURRENCE OF SPECIES

| Sl. No. | Species | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| | Class OSTEICHTHYES | | | | | |
| | Order CYPRINIFORMES | | | | | |
| | Family CYPRINIDAE | | | | | |
| | Subfamily CYPRININAE | | | | | |
| 01 | *Chagunius chagunio* (Hamilton-Buchanan) **Pathal** | | + | | | + |
| 02 | *Labeo dero* (Hamilton-Buchanan) **Kalabans** | | | | | + |
| 03 | *L. dyocheilus* (McClelland) **Boala** | | | | | + |
| 04 | *Puntius carletoni* (Fowler) **Phuti** | | | + | | |
| 05 | *P. chola* Hamilton-Buchanan **Phuti** | | | + | | |
| 06 | *P. conchonius* Hamilton-Buchanan **Phuti** | + | + | + | + | |
| 07 | *P. sophore* Hamilton-Buchanan **Phuti** | + | + | + | | |

| Sl. No. | Species | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 08 | *P. ticto* Hamilton-Buchanan **Phuti** | + | + | + | + | |
| 09 | *Tor chelynoides* (McClelland) **Kali-machhi** | | | | + | + |
| 10 | *T. putitora* (Hamilton-Buchanan) **Mahseer** | | | + | + | + |
| 11 | *T. tor* (Hamilton-Buchanan) **Makhni** | | | | + | + |
| | Subfamily RASBORINAE | | | | | |
| 12 | *Aspidoparia morar* (Hamilton-Buchanan) **Chal** | | | + | + | |
| 13 | *Barilius barna* (Hamilton-Buchanan) **Childi** | + | | + | + | |
| 14 | *B. bendelisis* (Hamilton-Buchanan) **Chilwa** | + | + | + | + | + |
| 15 | *B. vagra* (Hamilton-Buchanan) **Chalra** | + | + | + | + | |
| 16 | *Brachydanio rerio* (Hamilton-Buchanan) **Dharidar** | + | + | + | + | |
| 17 | *Danio devaoir* (Hamilton-Buchanan) **Chand** | + | + | + | + | |
| 18 | *Esomus danricus* (Hamilton-Buchanan) **Chal** | + | + | + | + | |
| 19 | *Parluciosoma daniconius* (Hamilton-Buchanan) **Bhuri** | + | + | + | + | |
| | Subfamily SCHIZOTHORACINAE | | | | | |
| 20 | *Schizothorax richardsonii* (Gray) **Asela** | + | | | | + |
| | Subfamily GARRINAE | | | | | |
| 21 | *Crossoocheilus latius latius* (Hamilton-Buchanan) **Saknera** | | | + | + | + |
| 22 | *Garra gotyla gotyla* (Gray) **Dhanaura** | + | | | | + |
| | Family BALITORIDAE | | | | | |
| | Subfamily NEMACHEILINAE | | | | | |
| 23 | *Nemacheilus beavani* Gunther **Gadera** | + | + | + | | |
| 24 | *N. botia* (Hamilton-Buchanan) **Gadera** | + | + | + | + | |
| 25 | *N. corica* (Hamilton-Buchanan) **Gadera** | + | + | | + | |
| 26 | *N. doonensis* Tilak & Husain **Gadera** | | + | | | |

| Sl. No. | Species | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| | Family COBITIDAE | | | | | |
| | Subfamily COBITINAE | | | | | |
| 27 | *Lepidocephalus coudofurcatus* Tilak & Husain **Ghiwa** | | + | | | |
| 28 | *L. guntea* (Hamilton-Buchanan) **Ghiwa'** | + | + | + | + | |
| | Order SILURIFORMES | | | | | |
| | Family BAGRIDAE | | | | | |
| 29 | *Mystus bleekeri* (Day) **Kater** | | + | | | |
| 30 | *M. vittatus* (Bloch) **Tenngan, Tengara** | | + | + | + | |
| | Family AMBLYCIPITIDAE | | | | | |
| 31 | *Amblyceps mangois* (Hamilton-Buchanan) **Singhi** | + | + | + | + | |
| | Family Bagridae | | | | | |
| 32 | *Bagarius yarrellii* Sykes **Goonch** | | | | | + |
| 33 | *Glyptothorax pectinopterus* (McClelland) **Patharchatti** | + | | + | | |
| | Family HETEROPNEUSTIDAE | | | | | |
| 34 | *Heteropneustes fossilis* (Bloch) **Singhi** | + | + | | | |
| | Order CYPRINODONTIFORMERS | | | | | |
| | Suborder EXOCOETOIDEI | | | | | |
| | Family BELONIDAE | | | | | |
| 35 | *Xenentodon cancila* (Hamilton-Buchanan) **Sua** | + | | + | + | |
| | Order PERCIFORMES | | | | | |
| | Suborder PERCOIDEI | | | | | |
| | Family NANDIDAE | | | | | |
| | Subfamily BADINAE | | | | | |
| 36 | *Badis badis* (Hamilton-Buchanan) **Chiri, Kali** | + | + | + | + | |
| | Suborder CHANNOIDEI | | | | | |
| | Family CHANNIDAE | | | | | |
| 37 | *Ophiocephalus gachua* (Hamilton-Buchanan) **Dawla** | + | + | + | + | |
| 38 | *O. punctatus* (Bloch) **Sauli** | | | | + | |

| Sl. No. | Species | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| | Suborder MASTACEMBELIDAE | | | | | |
| 39 | *Mastacembelus armatus* (Lacepede) **Bam** | + | | + | + | |
| 40 | *Macrognathus pancalus* Hamilton-Buchanan **Bam** | + | + | | + | |
| | **Total** | 24 | 23 | 25 | 25 | 11 |

Note : 1=Asan Reservoir, 2=Seepage Nala, 3=Asan River above Kunja Grant 4=Asan River below barrage, and 5=River Yamuna.

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# AMPHIBIA

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## INTRODUCTION

The Amphibian fauna of Dehra Dun and around in general, has attracted the attention of some workers (Boulenger, 1920; Tilak & Husain, 1997; Tilak & Ray, 1985; Ray and Tilak, 1995; Ray, 1995, 1999). During the present study on Asan reservoir, four species of frogs and toads were collected of which *Rana cyanophlyctis*, the Skipping Frog and *R. limnochaisr* were the commonest. *Uperodon systoma*, a microhylid frog, though occurring in nearby area (Badshahi Bagh) and other parts of Dehra Dun (Tilak & Husain, 1977; Ray, 1999), was not collected during the present study, may be due to its burrowing habits.

## SYSTEMATIC LIST AND OCCURRENCE OF SPECIES

| Sl. No | Species | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| | Class AMPHIBIA | | | | | |
| | Order ANURA | | | | | |
| | Family RANIDAE | | | | | |
| 1. | *Rana cyanophlyctis* Schneider **Skipping Frog** | + | + | + | + | |
| 2. | *R. limnocharis* Boisduval **Cricket Frog** | + | + | + | + | |
| | Family MICROHYLIDAE | | | | | |
| 3. | *Microhyla ornata* (Dumeril & Bibron) **Ornate Frog** | + | | | | |
| | Family BUFONIDAE | | | | | |
| 4. | *Bufo melanostictus* Schneider **Common Toad** | + | + | | + | |
| | **Total** | **4** | **3** | **2** | **3** | |

Note : 1= Asan Reservoir, 2= Seepage Nala, 3= Asan River Above Kunja Grant, 4= Asan River below barrage, and 5= River Yamuna.

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# REPTILIA

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## INTRODUCTION

The snakes of Dehra Dun and around has attracted the attention of various workers (Bhatnagar, 1996; Joshi & Kumar, 1970; Gupta & Sinha, 1978; Sanyal *et al.* 1979; Singh & Gupta, 1979 a,b; Upadhyaya & Upadhyaya, 1980, Osmaston & Sale, 1989; Husain & Ray 1993, 1995; Husain & Tilak, 1995) during the past. During the present study the emphasis was laid on aquatic species but in spite of the best efforts only *Xenochrophis piscator*, the cheekered keelback was collected and seen around. However, another water snake *Elaphe radiata*, reported from Dehra Dun is likely to be found in the area.

## SYSTEMATIC LIST AND OCCURRRENCE OF SPECIES

| Sl. No. | Species | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| | Class REPTILIA | | | | | |
| | Order SERPENTES | | | | | |
| | Family COLUBRIDAE | | | | | |
| 1. | *Xenochrophis piscator* (Schneider) **Cheekered Keelback** | + | + | + | + | |

Note: 1=Asan Reservoir, 2=Seepage Nala, 3=Asan River above Kunja Grant,4=River below barrage, and 5=River yamuna.

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# AVES

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## INTRODUCTION

In the recent past, a number of ornithological studies particularly on waterbirds have been carried out at and around Asan reservoir. Among the more important being by Osmaston, 1935; Mohan, 1989; Narang, 1990, 1994; Narang and Lamba, 1981; Singh, 1991, 2000; Gandhi and Singh, 1995; and Tak *et al.*, 1996,1997 & 1999 etc. to quote a few. These studies revealed that a total of 95 species and subspecies (as tabulated below) of wetland birds, comprising waterbirds (66 species), wetland dependent birds (14) and reed dwellers (15) have so far been recorded from the reservoir area (Plates). The 66 species of waterbirds belong to 39 genera, 13 families and six orders. Of these, 30 species are winter visitor (WV), one summer visitor (SV) and 35 resident (19 R and 16 R/LM). They constitute about 27% of the total inland waterbird diversity of India (66 out of 245 waterbirds species and subspecies); 37% of the northren India (180); and 74% of Dehra Dun valley (90). The nomenclature followed here is after Ali & Ripley (1968-1978).

The waterbirds generally include swimmers, divers and waders.The former two belong to the following four families, viz., Podicipedidae, Phalacrocoracidae, Anatidae and Laridae. While the waders (marsh birds) belong to the following families, viz., Ardeidae, Ciconiidae, Threskiornithidae, Gruidae, Rallidae, Jacanidae, Charadriidae, Recurvirostridae and Burhinidae. Among waterbirds, the waders, perhaps, represent the greatest species diversity. The members of family Anatidae (Ducks, Geese and Swans popularly known as waterfowls) usually excel, in number, when compared with the remaining waterbird species. The marsh bird like egrets, pond herons, night herons, grey and purple herons, ibises and avocets etc. wade through the shallow waters and occasionally probe along dry margins of the wetland. Every year from October onward to March a large number of waterbirds arrive to the Asan reservoir/wetland.

The wetland dependent birds such as kites, eagles and vultures inhabit around the reservoir. They built their nests usually on lofty trees preferably near water. In winter they prey on a variety of waterfowls. The other wetland dependent birds being Kingfishers (Alcedinidae), are commonly represented by West Himalayan Pied Kingfisher, Indian White-breasted Kingfisher and Indian Small Blue Kingfisher.

The reed and bush dwellers birds are represented by babblers, warblers, wren-warblers, flycatchers, white-eyes and weavers, where as the ground birds by mynas, munias, sparrows and bluethroat.

A wide variety of passerine and non-passerine birds visiting Asan and its environs in different seasons are members of the families, *viz.*, Phasianidae (pheasants), Columbidae (pigeons and doves), Psittacidae (Parakeets), Cuculidae (koel and cuckoos), Strigidae (owls), Apodidae (swifs), Meropidae (bee-eaters), Coraciidae (rollers or blue jays), Upupidae (hoopoes), Bucerotidae (hornbills), Capitonidae (barbets), Hirundinidae (swallows), Laniidae (shrikes or 'butcher birds'), Dicruridae (drongos or king crows), Sturnidae (mynas), Corvidae (crows, magpies and jays), Pycnonotidae (bulbuls), Muscicapidae (babblers, flycatchers, warblers, thrushes and chats), Paridae (tits or titmice), Motacillidae (wagtails), and Zosterospidae (white-eye).

## SYSTEMATIC LIST OF BIRDS OBSERVED

| Avifaunal records | Residential Status | Abundance Status |
|---|---|---|
| **A. Waterbirds :** | | |
| I. Order PODICIPEDIFORMES | | |
| 1. Family PODICIPEDIDAE : Grebes | | |
| 01. (3) *Podiceps cristatus cristatus* (Linnaeus) Great Crested Grebe | WV | Lc |
| 02. (4) *Podiceps nigricollis nigricollis* Brehm Blacknecked Grebe | WV | Lc |
| 03. (5) *Podiceps ruficollis capensis* Salvadori Little Grebe or Dabchick | R | C |
| II. Order PELECANIFORMES | | |
| 2. Family PHALACROCORACIDAE : Cormorants and Darter | | |
| 04. (26) *Phalacrocorax carbo sinensis* (Shaw) Large Cormorant | R/LM | Vc |
| 05. (28) *Phalacrocorax niger* (Vieillot) Little Cormorant | R/LM | A |
| 06. (29) *Anhinga rufa melanogaster* Pennant Darter or Snake-bird | R/LM | Occ |
| III. Order CICONIIFORMES | | |
| 3. Family ARDEIDAE : Herons, Egrets, Bitterns | | |
| 07. (36) *Ardea cinerea rectirostris* Gould Estern Grey Heron | R | Lc |
| 08. (37) *Ardea purpurea manilensis* Meyen Eastern Purple Heron | R/LM | Lc |
| 09. (42) *Ardeola grayii grayii* (Sykes) Indian Pond Heron or Paddybird | R | Lc |
| 10. (44) *Bubulcus ibis coromandus* (Boddaert) Cattle Egret | R | C |
| 11. (46) *Ardea alba modesta* J.E. Gray Eastern Large Egret | R/LM | Lc |
| 12. (47,48) *Egretta intermedia intermedia* (Wagler) Smaller or Median Egret | R/LM | Lc |
| 13. (49) *Egretta garzetta garzetta* (Linnaeus) Little Egret | R/LM | A |
| 14. (52) *Nycticorax nycticorax nycticorax* (Linnaeus) Night Heron | R/LM | C |
| 15. (56) *Ixobrychus cinnamomeus* (Gmelin) Chestnut Bittern | R/LM | Lc |
| 16. (59) *Botaurus stellaris stellaris* (Linnaeus) Bittern | WV | Occ |

| Avifaunal records | Residential Status | Abundance Status |
|---|---|---|
| 4. Family CICONIDAE : Storks | | |
| 17. (60) *Mycteria leucocephala* (Pennant) Painted Stork | R/LM | C |
| 18. (61) *Anastomus oscitans* (Boddaert) Openbill Stork | R/LM | Lc |
| 19. (62) *Ciconia episcopus episcopus* (Boddaert) Whitenecked Stork | R/LM | Lc |
| 5. Family THRESKIORNITHIDAE : Ibises | | |
| 20. (70) *Pseudibis papillosa papillosa* (Temminck) Indian Black Ibis | R/LM | Lc |
| IV. Order ANSERIFORMES | | |
| 6. Family ANATIDAE : Ducks, Geese, Swans | | |
| 21. (81) *Anser anser rubrirostris* Swinhoe Eastern Greylag Goose | WV | Lc |
| 22. (82) *Anser indicus* (Latham) Barheaded Goose | WV | Occ |
| 23. (88) *Dendrocygna javanica* (Horsfield). Lesser Whistling Teal or Tree Duck | R | Occ |
| 24. (90) *Tadorna ferruginea* (Pallas) Ruddy Shelduck or Brahminy Duck | WV | A |
| 25. (91) *Tadorna tadorna* (Linnaeus) Common Shelduck | WV | Occ |
| 26. (93) *Anas acuta* Linnaeus Pintail | WV | A |
| 27. (94) *Anas crecca crecca* Linnaeus Common Teal | WV | A |
| 28. (97) *Anas p. poecilorhyncha* J.R. Foster Spotbill Duck | R | C |
| 29. (100) *Anas platyrhynchos* Linnaeus Mallard | WV | A |
| 30. (101) *Anas strepera strepera* Linnaeus Gadwall | WV | A |
| 31. (102) *Anas falcata* Georgi Falcated or Bronzecapped Teal | WV | Occ |
| 32. (103) *Anas penelope* Linnaeus Wigeon | WV | A |
| 33. (104) *Anas querquedula* Linnaeus Garganey or Bluewinged Teal | WV | Lc |
| 34. (105) *Anas clypeata* Linnaeus Shoveller | WV | A |

| Avifaunal records | Residential Status | Abundance Status |
|---|---|---|
| 35. (107) *Netta rufina* (Pallas) Redcrested Pochard | WV | A |
| 36. (108) *Aythya ferina* (Linnaeu) Common pochard | WV | A |
| 37. (109) *Aythya nyroca* (Guldenstadt) White-eyed Pochard or Ferruginous Duck | WV | Lc |
| 38. (111) *Aythya fuligula* (Linnaeus) Tufted Duck | WV | A |
| 39.(114) *Nettapus c. coromandelanus* (Gmelin) Cotton Teal or Quacky-duck | R | Occ |
| 40. (117) *Clangula hyemalis* (Linnaeus) Longtail Duck or Old Squaw | WV/Va | Occ |
| V. Order GRUIFORMES | | |
| 7. Family GRUIDAE : Cranes | | |
| 41. (323) *Grus antigone antigone* (Linnaeus) Inian Sarus Crane | R/LM | Occ |
| 8. Family RALLIDAE : Rails, Coots | | |
| 42. (343) *Amaurornis phoenicurus chinensis* (Boddaert) Chinese Whitebreasted Waterhen | R | Occ |
| 43. (347) *Gallinula chloropus indica* Blyth Indian Moorhen | R | Vc |
| 44. (349) *Porphyrio porphyrio poliocephalus* (Latham) Indian Purple Moorhen | R | Occ |
| 45. (350) *Fulica atra atra* (Linnaeus) Coot | WV | A |
| VI. Order CHARADRIIFORMES | | |
| 9. Family JACANIDAE : Jacanas | | |
| 46. (358) *Hydrophasianus chirurgus* (Scopoli) Pheasant-tailed Jacana | SV | Lc |
| 10. Family CHARADRIIDAE : Plovers, Sandpipers, Snipes | | |
| Subfamily CHARADRIINAE : Plovers | | |
| 47. (364) *Vanellus vanellus* (Linnaeus) Peewit, Lapwing or Green Plover | WV | Lc |
| 48. (366) *Vanellus indicus indicus* (Boddaert) Redwattled Lapwing | R | Lc |
| 49. (369) *Vanellus spinosus duvaucelii* (Lesson) Spurwinged Lapwing | R | C |
| 50. (370) *Vanellus malabaricus* (Boddaert) Yellow-wattled Lapwing | R | Occ |

| Avifaunal records | Residential Status | Abundance Status |
|---|---|---|
| 51. (380) *Charadrius dubius jerdoni* (Legge) | | |
| Indian Little Ringed Plover | R/LM | Lc |
| Subfamily SCOLOPACINAE : Curlews, Sandpipers, Snipe, Woodcock | | |
| 52. (392) *Tringa erythropus* (Pallas) | | |
| Spotted or Dusky Redshank | WV | Occ |
| 53. (396) *Tringa nebularia* (Gunnerus) | | |
| Greenshank | WV | Occ |
| 54. (397) *Tringa ochropus* Linnaeus | | |
| Green Sandpiper | WV | Lc |
| 55. (401) *Tringa hypoleucos* Linnaeus | | |
| Common Sandpiper | R/LM | Lc |
| 56. (417) *Calidris temminckii* (Leisler) | | |
| Temminck's Stint | WV | Occ |
| 11. Family RECURVIROSTRIDAE : Stilts, Avoceta, Ibisbill | | |
| 57. (430) *Himantopus h. himantopus* (Linnaeus) | | |
| Indian Blackwinged Stilt | R | Lc |
| 58. (432) *Recurvirostra avosetta* Linnaeus | | |
| Avocet | WV | Occ |
| 59. (437) *Esacus magnirostris recurvirostris* (Cuvier) | | |
| Great Stone Plover | R | Occ |
| 12. Family BURHINIDAE : Stone Curlews, Thick-knees | | |
| 60. (444) *Glareola lactea* Temminck | | |
| Small Indian Pratincole or Swallow-Plover | R | Occ |
| 13. Family LARIDAE : Gulls, Terns | | |
| 61. (454) *Larus brunnicephalus* Jerdon | | |
| Brownheaded Gull | WV | Lc |
| 62. (455) *Larus ridibundus ridibundus* Linnaeus | | |
| Blackheaded Gull | WV | Lc |
| 63. (458) *Chlidonias hybrida indica* (Stephens) | | |
| Indian Whiskered Tern | R | Occ |
| 64. (463) *Sterna aurantia* J.E. Gray | | |
| Indian River Tern | R | Lc |
| 65. (470) *Sterna acuticauda* J.E. Gray | | |
| Blackbellied Tern | R | Occ |
| 66. (475) *Sterna albifrons albifrons* Pallas | | |
| Littli Tern or Ternlet | WV | Occ |

| Avifaunal records | Residential Status | Abundance Status |
|---|---|---|
| **B. Wetland dependent birds** | | |
| VII. Order FALCONIFORMES | | |
| 14. Family ACCIPITRIDAE : Kites and Eagles | | |
| 67. (135) *Haliastur indus indus* (Boddaert) Brahminy Kite | R | Occ |
| 68. (174) *Haliaeetus leucoryphus* (Pallas) Ringtailed or Pallas's Fishing Eagle | R | Lc |
| 69. (203) *Pandion haliaetus haliaetus* (Linnaeus) Osprey | R | Occ |
| VIII. Order CORACIIFORMES | | |
| 15. Family ALCEDINIDAE Kingfishers | | |
| 70. (717) *Ceryle lugubris continentalis* Hartert West Himalayan Pied Kingfisher | R | Lc |
| 71. (723) *Alcedo atthis bengalensis* Gmelin Indian Small Blue Kingfisher | R | Occ |
| 72. (736) *Halcyon smyrnensis fusca* (Boddaert) Indian Whitebreasted Kingfisher | R | Lc |
| IX. Order PASSERIFORMES | | |
| 16. Family HIRUNDINIDAE : Swallows | | |
| 73. (916) *Hirundo rustica rustica* Linnaeus Western Swallow | R/AM | A |
| 74. (921) *Hirundo smithii filifera* Stephens Indian Wiretailed Swallow | R/SV | C |
| 17. Family MUSCICAPIDAE : Chats | | |
| 75. (1679) *Rhyacornis fuliginosus fuliginosus* (Vigors) Plumbeous Redstart | R/AM | Lc |
| 76. (1716) *Chaimarrornis leucocephalus* (Vigors) Whitecapped Redstart or River Chat | R/AM | Lc |
| 18. Family MOTACILLIDAE : Wagtails | | |
| 77. (1883) *Motacilla citreola calcarata* Hodgson Blackbacked Yellowheaded Wagtail | WV | Lc |
| 78. (1884) *Motacilla caspica caspica* (Gmelin) Grey Wagtail | WV | C |
| 79. (1885) *Motacilla alba dukhunensis* Sykes Indian White Wagtail | WV | A |
| 80. (1891) *Motacilla maderaspatensis* Gmelin Large Pied Wagtail | R | C |

| Avifaunal records | Residential Status | Abundance Status |
|---|---|---|
| **C. Reed dwellers** | | |
| 19. Family MUSCICAPIDAE : Babblers, Warblers | | |
| 81. (1230) *Chrysomma sinense hypoleucum* (Franklin) | | |
| Western Yellow-eyed Babbler | R | Lc |
| 82. (1478) *Cettia pallidipes pallidipes* (Blanford) | | |
| Indian Palefooted Bush Warbler | R | Lc |
| 83. (1498) *Cisticola jauncidis cursitans* (Franklin) | | |
| Streaked Fantail Warbler | R/LM | Lc |
| 84. (1502) *Prinia hodgsonii rufula* Godwin-Austen | | |
| Northern Ashy-grey Wren Warbler | R | C |
| 85. (1506) *Prinia buchanani* Blyth | | |
| Rufousfronted Wren-Warbler | R | Lc |
| 86. (1508) *Prinia gracilis lepida* Blyth | | |
| Indian Streaked Wren-Warbler | R | Lc |
| 87. (1510) *Prinia subflava terricolor* (Hume) | | |
| Northwestern Plain Wren-Warbler | R | Lc |
| 88. (1515) *Prinia socialis stewarti* Blyth | | |
| Northen Ashy Wren-Warbler | R | Lc |
| 89. (1519) *Prinia sylvatica gangetica* (Blyth) | | |
| Gangatic Jungle Wren-Warbler | R | Occ |
| 90. (1535) *Orthotomus sutorius guzuratus* (Latham) | | |
| Indian Tailor Bird | R | C |
| 91. (1548) *Megalurus palustris toklao* (Blyth) | | |
| Striated Marsh Warbler | R | Lc |
| 92. (1556) *Acrocephalus dumetorum* Blyth | | |
| Blyth's Reed Warbler | WV | C |
| 93. (1957) *Ploceus p. philippinus* (Linnaeus) | | |
| Indian Baya | R | C |
| 94. (1964) *Estrilda amandava amandava* (Linnaeus) | | |
| Red Munia or Avadavat | R | C |
| 95. (1974) *Lonchura punctulata* (Linnaeus) | | |
| Indian Spotted Munia | R | Lc |

Note : R= Resident, R/LM = Resident and Local Migrant, R/AM = Resident and Altitudinal Migrant, WV = Winter Visitor, WV/Va = Winter Visitor but Vagrant, SV = Summer Visitor, R/SV = Resident and Summer Visitor, A = Abundant (>100 birds), Vc = Very common (51-100), C = Common (11-50), Lc = Less common (1-10), Occ = Occasional (one or more stray birds spotted once in a while).

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# MAMMALIA

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## INTRODUCTION

The book 'Wildlife of Dehra Dun and adjacent Hills' by Osmaston and Sale (1989) reported 39 species of mammals from Dehra Dun and adjacent hills. Sinha (1995) listed 64 species of mammals from Dehra Dun in a document on 'Fauna of Western Himalaya' As far as the mammalian fauna of Asan wetland is concerned, there is no specific report available so far. During the present study 20 species of mammals were recorded by direct and indirect observations, including local inquiries from the Asan reservoir and it's environ. These species use the wetland either for food or water frequently or occasionally. The 20 species reported here belong to eight different orders, *viz.*, Chiroptera, Primates, Carnivora, Proboscidea, Artiodactyla, Pholidota, Rodentia and Lagomorpha. On the basis of number of sightings/ observations, they have been categorized in to the following three broad categories :

A. The species commonly seen at the wetland and its environ were the Rhesus Monkey, Hanuman Langur, Indian Pangolin, Small Indian Mongoose, Northern Palm Squirrel, Indian Crested Porcupine, Lesser Bandicoot Rat and Large Bandicoot Rat.

B. The species occasionally seen at the wetland and its environ were the Asiatic Jackal, Small Indian Civet, Leopard, Wild Boar, Indian Black-naped Hare, Sambar, Chital, Barking Deer, Goral and Indian Elephent

C. The arboreal species commonly sighted at the wetland and its environ were the Indian Flying Fox and Indian Pipistrelle.

## SYSTEMATIC ACCOUNT

I. Order CHIROPTERA
1. Family TEROPODIDAE

1. ***Pteropus giganteus*** (Brunnich)

*Common name* : Indian Flying Fox

1782. *Vespertillio gigantean Brunnich, Dyrenes Historie.* **1** : 45.

*Type locality* : Bengal, India.

*Distribution* : India : Throughout the country including Andaman Island. *Elsewhere* : China, Nepal, Myanmar, Sri Lanka, Maldive Islands, Thailand.

2. ***Pipistrellus coromandra*** (Gray)

*Common name* : Indian Pipistrelle

1838. *Scotophilus coromandra* Gray, *Mag. Zool. Bot.* **2** : 498.

*Type locality* : Pondicherry, India.

*Distribution* : India : Widely distributed in peninsular India, north to Jammu and Kashmir, East to northeastern states and also in Car Nicobar Island. *Elsewhere* : Afghanistan, Bhutan, Bangladesh, China, Nepal, Pakistan, Sri Lanka, Myanmar, Thailand, Vietnam.

II. Order PRIMATES
2. Family CERCOPITHECIDAE

3. ***Macaca mulatta*** (Zimmermann)

*Common name* : Rhesus Macaque

1870. *Ceropithecus mulatta* Zimmermann, *Geoge. Gesh. Mensch. Vierb. Thiere,* **2** : 195.

*Type locality* : India.

*Distribution* : India : Whole of North and Northeast India to South up to 15$^0$. *Elsewhere* : Afghanistan, Bangladesh, China, Nepal, Pakistan, Sri Lanka, Myanmar, Thailand, Vietnam.

4. ***Semnopithecus entellus*** (Duffresne)

*Common name* : Hanuman Langur, Langur, Entellus Monkey

1797. *Simia entellus* Duffresne, *Bull. Soc. Philom. Paris,* (1) **7** : 49.

*Type locality* : Bengal, India

*Distribution* : India : Throughout except western part of Gujarat. *Elsewhere* : China, Nepal, Pakistan, and Sri Lanka.

III. Order CARNIVORA

3. Family CANIDAE

5. ***Canis aureus*** Linnaeus

*Common name* : Asiatic Jackal

1758. *Canis aureus* Linnaeus, *Syst. Nat. 10th ed.* **1** : 40.

*Type locality* : Laristan, Southern Persia, Iran.

*Distribution* : India : Throughout. *Elsewhere* : Afghanistan, Central South western and South Asia, North and East Africa, Southeastern Europe, Iran, Nigeria, Tanzania, Thailand, Sri Lanka.

4. Family FELIDAE

6. ***Panthera pardus*** (Linnaeus)

*Common name* : Leopard

1758. *Felis pardus* Linnaeus, *Syst. Nat. 10th ed.*, **1** : 41.

*Type locality* : Egypt.

*Distribution* : India : Throughout. *Elsewhere* : Afghanistan, Algeria, Arabia, Angola, Botswana, Cameroon, Centrel Africa, Egypt, China, Iran, Iraq, Kenya, Korea, Laos, Malawi, Morocco, Mozambique, Myanmar, Malaysia, Namibia, Nigeria, Nepal, Pakistan, Sri Lanka, Thailand, South Africa, Somalia, Tanzania, Turkey, Uganda, CIS countries, Vietnam, Zaire, Zambia, Zimbabwe.

5. Family HERPESTIDAE

7. ***Herpestes javanicus*** (Geoffroy)

*Common name* : Small Indian Mongoose

1818. *Ichneumon javanicus* Geoffroy, *Descrip. Egypte*, **2**: 138.

*Tupe locality* : Java, Indonesia.

*Distribution* : India : Throughout. Afghanistan, Bangladesh, Bhutan, Cambodia, China, Indonesia, Malaysia, Nepal, Pakistan, Thailand, Vietnam.

6. Family VIVERRIDAE

8. ***Viverricula indica*** (Desmarest)

*Common name* : Small Indian Civet, Rasse

1817. *Viverra indica* Desmarest, *Nouv. Dict. N.H.* **7** : 170

*Type locality* : India.

*Distribution* : India : Throughout. *Elsewhere*: Bangladesh, Combodia, China, Hong Kong, Indonesia, Laos, Malaysia, Myanmar, Pakistan, Sri Lanka, Taiwan, Thailand, Vietnam.

IV. Order PROBOSCIDEA

7. Family ELEPHANTIDAE

9. ***Elephas maximus*** Linnaeus

*Common name*: Indian Elephant

1758. *Elephas maximus* Linnaeus, *Syst. Not. 10th ed.*, **1** : 33.

*Type locality* : Sri Lanka.

*Distribution* : India : Along the base of Himalaya as far west as Dehra Dun and in forested areas between river Ganges and Krishna, Kerala, Northeastern states, Western Ghats. *Elsewhere* : Bangladesh, China, Combodia,

Indonesia, Laos, Malaysia, Myanmar, Sri Lanka, Thailand, Vietnam.

V. Order ARTIODACTYLA

8. Family SUIDAE

10. ***Sus scrofa*** Linnaeus

*Common name* : Wild Boar.

1758. *Sus scrofa* Linnaeus, *Syst. Nab. 10th ed.* **1** : 49.

*Type locality* : Germany.

*Distribution* : India : Throughout. *Elsewhere* : Australia, China, Central and South Amarica, Fiji Islands, Europe, Galapagos, Hawaii Islands, Indonesia, Mauritius, Norway, New Guinea, South Russia to Middle east Asia, Sri Lanka, Sweden, South Africa, USA, West Indies.

9. Family CERVIDAE

11. ***Axis axis*** (Erxleben)

*Common name*: Chital or Spotted Deer

1777. *Cervus axis* Erxleben, *Syst. Regn. Anim*, 312.

*Type locality* : Bank of Ganges Bihar, India.

*Distribution* : India : Andaman Islands, Bengal, Peninsula, Sikkim, Uttaranchal. *Elsewhere* : Nepal, Sri Lanka.

12. ***Cervus unicolor*** Kerr

*Common name* : Sambar

1792. *Cervus unicolor* Kerr, *In.* Linnaeus Anim. Kingdom : 300.

*Type locality* : Sri Lanka.

*Dristribution* : India: Bengal, Bihar, North and Northeastarn States, Peninsula, Tamil Nadu, Uttaranchal, Uttar Pradesh.

13. ***Muntiacus muntjak*** (Zimmermann)

*Common name* : Barking Deer.

1780. *Cervus muntjak* Zimmermann, *Geogr. Gesch. Mensch. Vierf. Thiere.* 2 : 131.

*Type locality* : Java.

*Distribution*: India: North Peninsula, Bengal, Deccan Plateau, Maharashtra, Karnataka, Tamil Nadu, Uttar Pradesh, Uttaranchal. *Elsewhere* : Bangladesh, Bhutan, China, Indo-China, Indonesia, Malaysia, Nepal, Pakistan, Sri Lanka.

10. Family BOVIDAE

14. ***Nemorhaedus goral*** (Hardwicke)

*Common name* : Goral

1825. *Antilope goral* Hardwicke, *Trans. Linn. Soc. London*, **14** : 518.

*Type Locality:* Nepal Himalaya.

*Distribution* : India : Himachal Pradesh, Kashmir, Kumaon, Assam, Sikkim. *Elsewhere* : Siberia, Manchuria, Korea, China, Tibet, Myanmar, Nepal, Bhutan and Pakistan.

VI. Order PHOLIDOTA

11. Family MANIDAE

15. ***Manis crassicaudata*** (Gray)

*Common name*: Indian Pangolin

1827. *Manis crassicaudata* Gray, in Griffith's Anim. Kingd. **5** : 282.

*Type locality* : India.

*Distribution* : India : Bihar, Gujarat, Karnataka, Kerala, Madhya Pradesh, Mahataratra, Orissa, Tamilnadu, West Bengal, Uttar Pradesh, Uttaranchal. *Elsewhere* : China, Pakistan and Sri Lanka.

VII. Order RODENTIA

12. Family SCIURIDAE

16. ***Funambulus pennanti*** Wroughton

*Common name* : Northern Palm Squirrel

1905. *Funambulus pennanti* Wroughton, *J. Bombay Nat. Hist. Soc.* **16** (3) : 411.

*Type locality* : Surat, India.

*Distribution* : India : North, Northeast and Central India. *Elsewhere* : Afghanistan, Iran, Nepal and Pakistan.

13. Family MURIDAE

17. ***Bandicota bengalensis*** (Gray and Hardwicke)

*Common name* : Lesser Bandicoot Rat, Indian Mole Rat.

1833. *Arvicola bengalensis* Gray and Hardwicke, *Illus, Indian Zool.*: **2**, pl.21.

*Type locality* : Bengal, India.

*Distribution* : India : Throughout. *Elsewhere* : Bhutan Duar, Indo China, Indonesia, Myanmar, Nepal Pakistan and Sri Lanka.

18. ***Bandicota indica*** (Bechstein)

*Common Name* : Large Bandicoot Rat

1800. *Mus indicus* Bechstein, *Ueber Vierf. Thiere.*, **2**: 497.

*Type locality:* Pondicherry, India.

*Distribution* : India : Assam, Bihar, Delhi, Gujarat, Goa, Haryana, Karnataka, Kerala, Madhya Pradesh, Maharashtra, North-eastern India, Orissa, Punjab, Rajasthan, Tamilnadu, Uttar Pradesh, Uttaranchal, Indian Peninsula. *Elsewhere* : Bangladesh, China, Indonesia, Sri Lanka, Nepal, Pakistan, Taiwan, Thailand and Vietnam.

14. Family HYSTRICIDAE

19. ***Hystrix indica*** Kerr

*Common name*: Indian Crested Porcupine

1792. *Hystrix indica* Kerr, In Linnaeus, *Anim. Kingdom*, 213.

*Type locality* : India.

*Distribution* : India : Throughout. *Elsewhere* : Israel, Nepal, Pakistan and Russian Turkestan, Sri Lanka.

VIII. Order LAGOMORPHA

15. Family LAPORIDAE

20. ***Lepus nigricollis*** Cuvier

*Common name:* Indian Black-naped Hare

1873. *Lepus nigricollis* Cuvier, *Dict. Sci. Nat.*, **26** : 307.

*Type locality :* Tamil Nadu, India.

*Distribution :* India : Throughout. *Elsewhere* : Bangladesh, Bhutan, Indonesia, Pakistan, and Sri Lanka.

## General Remarks

During the surveys, it was observed that the species such as rhesus monkey, hanuman langur, small Indian mongoose and northern palm squirrel frequently visited the wetland for water, where as the species like, lesser bandicoot rat and large bandicoot rat used the wetland for both food and water. Species like, Asiatic jackal, small Indian civet, leopard, wild boar, Indian black-napped hare, sambar, spotted deer, barking deer, goral and Indian elephant were occasionally reported to use the wetland specially during pinch period to meet out their water requirement. Two species of bats, Indian flying fox and the pipistrelle were commonly seen visiting the fruiting trees near the wetland.

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# SPECIES RICHNESS AND SEASONAL POPLULATION CHANGES IN WATERFOWLS

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## INTRODUCTION

The term 'waterfowl' applies to the members of the family Anatidae, popularly known as Swans, Geese and Ducks, the smallest of which are called Teals (Delacour, 1974). A total of 149 species of waterfowl are known to occur throughout the world, of which 62 from Asia (Sonobe & Usui, 1993) and 41 from India (Ali & Ripley, 1978).

It is known that every waterfowl is a waterbird, but every water-bird is not a waterfowl. In the recent past, the term waterfowl has been frequently used in a broader perspective covering waterbirds as well. However, the present study deals with species of family Anatidae.

Waterfowls are of immense interest and great value all over the world because, i) Man has used them for food, for sports, and as a source of aesthetic pleasure (Austin and Singer, 1968), ii) They are bio-indicators of wetlands' health, and iii) They exhibit mass seasonal migration (north-south), which are often spectacular.

On a conservative estimate, more than three million waterfowls migrate to inland wetlands of India from Eurasia and across the Himalaya during every winter (Oct-Mar) (Lopez and Mundker, 1997).

As detoriation and/or destruction of natural wetlands continue unabated, the man-made wetlands in form of barrages, reservoirs, tanks, etc. serve as alternative habitats for supporting considerable biodiversity.

Since more than 85% winter population of waterbirds of Asan reservoir comprise waterfowls, and as a prerequisite to waterfowl conservation the authors undertook a study on species richness and population changes of waterfowl at this reservoir.

## METHODOLOGY

Field data on waterfowl of Asan reservoir were collected every month from July, 1994 to February 1999. The identification, counts and photography were carried out by using the following equipments: 7x35 prismatic field binoculars, tally-counter, 50-1000 mm telelens with 35 mm Nikon slr camera, and pictorial guides. The entire area of the reservoir was covered on each visit with the help of a jeep, using peripheral roads. Paddlers provided by Garhwal Mandal Vikas Nigam (GMVN) were used to reach every nook and corner of the reservoir, Identification of the vegetation was done by the Botanical Survey of India, Dehra Dun.

## OBSERVATIONS AND RESULTS

As already stated 149 species of waterfowl are known to occur throughout the world, of which 62 from Asia and 41 from India. The Asan reservoir attracts 50% (20 species out of 40, excluding the Pinkheaded Duck, *Rhodonessa caryophyllacea*), of the Indian waterfowl diversity.

**Species richness** : A brief account of these species including status, species reported by earlier workers, and species which were not

recorded by other workers are presented in Table–1. Of these 20 species, 17 are winter visitors (WV) and remaining three are residents (R).

Among winter visitors, 11 out of 17 are regular WV, four occasional WV, one rare WV, and one vagrant WV. Falcated and Bluewinged Teal were first recorded by Mohan (1989); Old Squaw and White-eyed Pochard by Singh (1991), the former was reported from India after a gap of 52 years; Greylag and Barheaded Geese by Tak *et at.* (1997); while common Shelduck and Nakta are added here for the first time from the reservoir (Table 1).

**Habitat types** : The area of the reservoir can broadly be classified into four habitat types, *viz.*, open water, shallows/swamps, shores and mudflats. The species observed in open water were Gadwall, Redcrested, Common and Tufted Pochards. Shallows and shores were usually inhabited by Pintail, Mallard, Wigeon, Greylag Goose, etc. Mudflats were mostly occupied by Brahminy Duck and Common Teal, often accompanied by Barheaded Goose.

**Peroid of stay** : Neither all the species nor all individuals of these winter visitors arrive at a time. They arrive in succession. For example- Brahminy Duck, Common Teal, Greylag Goose, Mallard and Common Pochard are among the first to arrive in October. While Gadwall, Wigeon, Redcrested and Tufted Pochards follow. Whereas Pintail and Shoveller are the late arrivals by December.

Almost all of them leave the reservoir by late March or early April, though sometimes when the winter is little prolonged some species were observed to leave by April-end, e.g. Brahminy, Mallard, Shoveller, Redcrested and Common Pochards stayed till the end of April in 1995 (Table 2).

**Use of reservoir** : Atleast 10 species (Brahminy Duck, Pintail, Common Teal, Mallard, Gadwall, Wigeon, Shoveller, Redcrested, Common and Tufted Pochards) use the reservoir as winter home, as they arrive with commencement of winter (Oct), and stay throughout the winter (October–March) at the reservoir and depart with the onset of summer. While Greylag Goose, visiting in 2-45 numbers, use the reservoir as a resting place/stop over enroute to both its winter and summer homes. Whereas the sighting(s) of rare Falcated Teal and vagarant Old Squaw is, perhaps, an indication towards the tranquillity of the reservoir.

**Potential** : Waterfowl diversity of Asan reservoir compared with that of the six Ramsar sites in India reveals that 50-95% (10-19 out of 20 species) diversity of the reservoir is common [Wular Lake (J&K): 12 species; Harike (Punjab): 17; Keoladeo (Rajasthan): 19; Sambhar (Rajasthan) : 10; Loktak (Manipur): 14; and Chilika (Orissa): 17] (Table 3).

**Population Changes**: Earlier workers [Mohan (1989), Narang (1990), Singh (1991), and Gandhi & Singh (1995)] did not provide any population counts on the waterfowl of the reservoir. However, Singh *et al.* (*pers. com*), who conducted mid-winter waterfowl census on 19th January, 1991 gave a combined population of 419+ birds for 11 species of Anatids from Asan.

**Trends** : Since 1991, the combined population of the ten regular winter visitors has risen to 1982 birds in 1994-95; 2213 in 1995-96; 3094 in 1996-97; 4240 in 1997-98 and 3230 in 1998-99 (Table 4). The study indicate a distinct rise in population of two species, *viz.*, Brahminy Duck (from 400 in 1994-95 to1150 birds in 1998-99 and Gadwall (from 150 in 1995-96 to 600 in 1998-99). While Mallard and Redcrested Pochard exhibited a stable trend of 400 birds in 1996-97, 97-98 and 98-99; and 500-550 in 94-95, 96-97 and 97-98 respectively, the remaining six species (Pintail, Common Teal, Wigeon Shoveller, Common Pochard and Tufted Pochard) do not show any fixed pattern (Fig. 1).

**Counts** : Monthwise population counts, population size etc. made for 17 waterfowl species for five successive years (1994-1999) are summarised below:

1. ***Eastern Greylag Goose*** : Only two birds were seen between November, 1995 to November

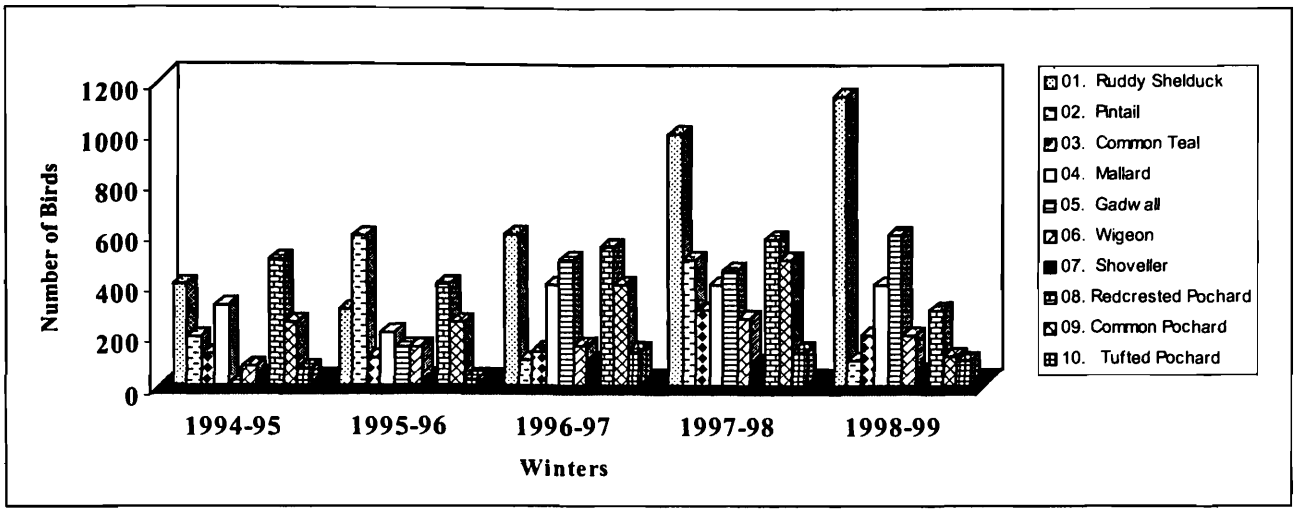


**Fig. 1.** Peak population of ten regular winter visitor at Asan reservoir (1994-1999)

1997. However, as many as 8 and 45 were recorded in March, 1997 and 1998 respectively.

2. ***Barheaded Goose*** : A lone bird was sighted among a small flock of Brahminy Duck along the Asan river from December'96 to February'97. In March 97, it shifted to the reservoir. However, the species was not observed during the winter of 97-98. But again a single bird appeared at the reservoir from November to December '98.

3. ***Brahminy Duck or Ruddy Shelduck*** : The most dominant species at Asan, it was regularly sighted in five successive witners (1994-99), with an increasing trend. The population size ranged from 45 in October 1995 to 1150 in January 1999. However, some individuals overstayed till in June 1997.

4. ***Common Shelduck*** : A single bird was observed among a flock of Brahminy Duck on a mud flat in the reservoir from January to March 98, and in January 99.

5. ***Pintail*** : The species occur regularly at the reservoir from December to March. The population size ranged from 30 in December 97 to 595 in January '96. Once, four individuals were seen as early as in November 97 and seven as late as in June'98.

6. ***Common Teal*** : The species exhibited a dual population trend. In the first three winters (1994-97) it was seen irregularly in lesser numbers, while in last two winters (1997-99) 200-300 birds stayed at the reservoir throughout winter (November–March).

7. ***Spotbill Duck*** : One to 60 individuals of this resident duck were seen round the year at the reservoir. Sighting of juveniles in late summer (June) confirms its breeding in the reservoir.

8. ***Mallard*** : The species use the reservoir as winter home, two to 400 birds were counted from November to March. Maximum population was recorded during February. A flock of 16 and two birds arrived as early as in October'95 and 96 respectively.

9. ***Gadwall*** : Two to 600 birds were recorded from November to March. Once 24 birds arrived in October'98 and two birds overstayed till June in 98.

10. ***Falcated Teal*** : A solitary male bird of this rare winter visitor to north India was recorded twice in full breeding plumage from the reservoir on 25th February'95 (Mohan,1989) and on 22nd February'97 (Tak, *et al.*, 1997).

11. ***Wigeon*** : Eight to 270 individuals of this dabbling duck were seen from October to March. A flock of seven and two birds overstayed till June in 97 and 98 respectively.

12. ***Shoveller*** : This species occur in relatively small numbers (4-104) from December to March. A flock of five birds overstayed till June in 98. Usually it arrives a little late (December), however, once, two birds arrived as early as October in 95.

13. ***Redcrested Pochard*** : This diving duck was regularly sighted at the reservoir from October to March. Its population size ranged from 2-580 birds. A flock of 22 birds overstayed till June in 98.

14. ***Common Pochard*** : The species was regularly sighted at Asan reservoir from October to March. The population size ranged from 04 to 500 birds. Two birds overstayed till June in 98.

15. ***Tufted Pochard*** : This diving duck was regularly sighted at the wetland from October to March. The population size varied from 10-140 birds. Only four birds overstayed till June 98.

16. ***Cotton Teal***: Only two individuals of this resident duck were sighted in March 1995.

17. ***Nakta or Comb Duck***: A single female bird was seen on mudflat of the reservoir in June 1998.

However, Garganey (Mohan 1989), White-eyed Pochard (Singh, *Pers. Com.*) and Longtail Duck (Singh 1991) were not sighted during the present study.

**Average peak population** : The analysis of monthly counts of ten regular winter visitors for the entire study period (1994-99) reveals that the average peak winter population of Brahminy Duck, the most dominant species at Asan was 690 birds, Redcrested Pochard (466), Mallard (346), Gadwall (342), Common Pochard (304), Pintail (297), Common Teal (176), Wigeon (172), Tufted Pochard (96) and Shoveller (62) (Fig. 2).

**Percent composition** : The percent composition of ten regular winter visitors as occured during the winter of 98-99 reveals that the most dominant species, i.e. Brahminy or Ruddy Shelduck constitutes 36%, while Gadwall 19%, Mallard 12%, Redcrested Pochard 09%, Common Teal and Wigeon 06% each, Common Pochard 04%, Pintail and Tufted Pochard 03% each, and Shoveller was 02% of the total waterfowl population (3230 birds) (Fig. 3).

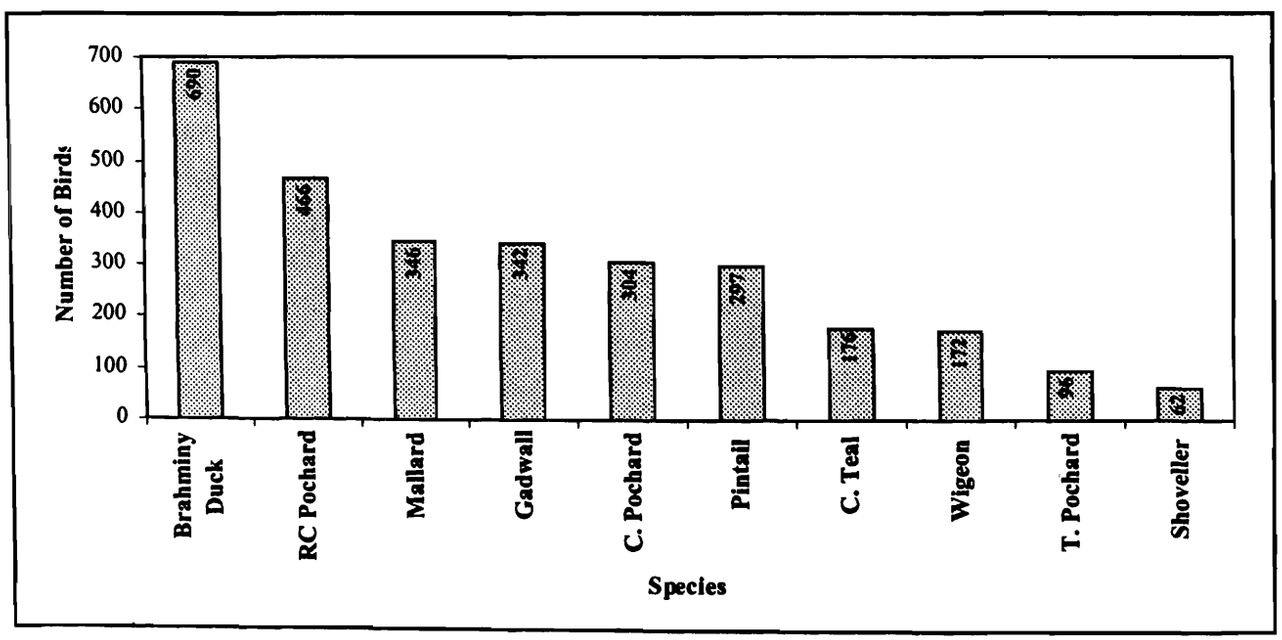


**Fig. 2.** Average peak winter population of ten regular visitors 1994-1999.

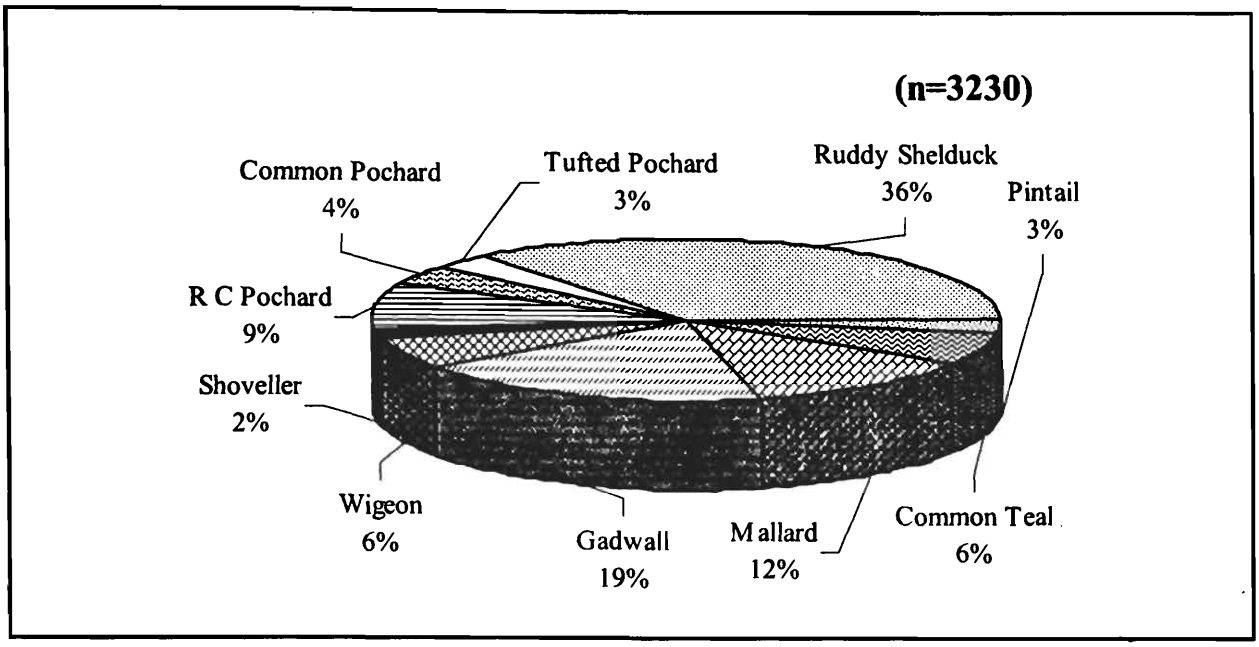


**Fig. 3.** Percent composition of ten regular winter visitors during the year 1998-99.

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**Table 1.** Species diversity of Waterfowl at Asan Reservoir as recorded by various workers from 1989-1999

Class AVES
Order ANSERIFORMES
Family ANATIDAE

| Sl. No. | HBI No | Species | Status | Mohan 1989 | Narang 1990 | Singh 1991 | Singh et al 91 pers com | Gandhi & Singh 95 | Tak et al 1997 | Present Study |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | (81) | *Anser anser rubrirostris* Swinhoe | | | | | | | | |
| | | **Eastern Greylag Goose** | WV | | | | | | + | + |
| 2 | (82) | *Anser indicus* (Latham) | | | | | | | | |
| | | **Barheaded Goose** | OWV | | | | | | + | + |
| 3 | (90) | *Tadorna ferruginea* (Pallas) | | | | | | | | |
| | | **Ruddy Shelduck or Brahminy Duck** | WV | + | + | | + | + | + | + |
| 4 | (91) | *Tadorna tadorna* (Linnaeus) | | | | | | | | |
| | | **Common Shelduck** | OWV | | | | | | | + |
| 5 | (93) | *Anas acuta* Linnaeus | | | | | | | | |
| | | **Pintail** | | WV | + | + | | | + | ++ |
| 6 | (94) | *Anas crecca crecca* Linnaeus | | | | | | | | |
| | | **Common Teal** | WV | + | + | | + | + | + | + |
| 7 | (97) | *Anas p. poecilorhyncha* J.R.Forster | | | | | | | | |
| | | **Spotbill Duck** | R | | | | | | + | + |
| 8 | (100) | *Anas platyrhynchos* Linnaeus | | | | | | | | |
| | | **Mallard** | | WV | | + | + | + | + | ++ |
| 9 | (101) | *Anas strepera strepera* Linnaeus | | | | | | | | |
| | | **Gadwall** | | WV | + | | + | + | + | ++ |
| 10 | (102) | *Anas falcata* Georgi | | | | | | | | |
| | | **Falcated or Bronzecapped Teal** | Rare WV | + | | | | | + | + |
| 11 | (103) | *Anas penelope* Linnaeus | | | | | | | | |
| | | **Wigeon** | | WV | + | | | + | + | ++ |

Note: WV = Winter Visitor, R = Resident, OWV = Occasional Winter Visitor

Class AVES
Order ANSERIFORMES
Family ANATIDAE

| Sl. No. | HBI No | Species | Status | Mohan 1989 | Narang 1990 | Singh 1991 | Singh et al 91 pers com | Gandhi & Singh 95 | Tak et al 1997 | Present Study |
|---|---|---|---|---|---|---|---|---|---|---|
| 12 | (104) | *Anas quesrquedula* Linnaeus | | | | | | | | |
| | | **Garganey or Bluewinged Teal** | OWV | + | | | | | | |
| 13 | (105) | *Anas clypeata* Linnaeus | | | | | | | | |
| | | **Shoveller** | WV | + | | | + | + | + | + |
| 14 | (107) | *Netta rufina* (Linnaeus) | | | | | | | | |
| | | **Redcrested Pochard** | WV | + | + | | + | + | + | + |
| 15 | (108) | *Aythya ferina* (Linnaeus) | | | | | | | | |
| | | **Common Pochard** | WV | + | + | | + | + | + | + |
| 16 | (109) | *Aythya nyroca* (Guldendtadt) | | | | | | | | |
| | | **White-eyed Pochard** | OWV | | | | + | | | |
| 17 | (111) | *Aythya fuligula* (Linnaeus) | | | | | | | | |
| | | **Tufted Duck** | WV | + | + | | + | + | + | + |
| 18 | (114) | *Nettapus c. coromandelianus* (Gmelin) | | | | | | | | |
| | | **Cotton Teal or Quacky-duck** | R | | + | | | | + | + |
| 19 | (115) | *Sarkidiornis m. melanotos* (Pennant) | | | | | | | | |
| | | **Nakta or Comb Duck** | R | | | | | | | + |
| 20 | (117) | *Clangula hyemalis* (Linnaeus) | | | | | | | | |
| | | **Longtail Duck or Old Squaw** | Vagrant WV | | | + | + | | | |
| | | Total Species | | | 11 | 8 | 3 | 11 | 10 | 16 | 17 |
| | | Exclusive Species | | | 1 | | 1 | 1 | | 2 | 2 |

Note: WV = Winter Visitor, R = Resident, OWV = Occasional Winter Visitor

**Table 2.** Monthwise population counts for five successive years (1994-1999)

| Sl. No. | Common Name | Year | July | Aug | Sept | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01. | Estern Greylag Goose | 1995-96 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | 1996-97 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 2 | 8 | 0 | 0 | 0 |
| | | 1997-98 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 45 | 0 | 0 | 0 |
| 02. | Barheaded Goose | 1996-97 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 |
| | | 1997-98 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | 1998-99 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 03. | Ruddy Shelduck | 1994-95 | 0 | 0 | 0 | 150 | 170 | 200 | 100 | 300 | 400 | 250 | 0 | 0 |
| | | 1995-96 | 0 | 0 | 0 | 45 | 300 | 300 | 220 | 220 | 250 | 0 | 0 | 0 |
| | | 1996-97 | 0 | 0 | 0 | 60 | 235 | 500 | 600 | 560 | 320 | 0 | 7 | 1 |
| | | 1997-98 | 0 | 0 | 0 | | 970 | 600 | 1000 | 900 | 700 | 0 | 0 | 3 |
| | | 1998-99 | 0 | 0 | 0 | 66 | 505 | 1015 | 1150 | 1000 | 0 | 0 | 0 | 0 |
| 04. | Common Shelduck | 1997-98 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 |
| | | 1998-99 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| 05. | Pintail | 1994-95 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 192 | 0 | 0 | 0 |
| | | 1995-96 | 0 | 0 | 0 | 0 | 0 | 35 | 595 | 192 | 140 | 0 | 0 | 0 |
| | | 1996-97 | 0 | 0 | 0 | 0 | 0 | 40 | 40 | 100 | 18 | 0 | 0 | 0 |
| | | 1997-98 | 0 | 0 | 0 | 0 | 4 | 30 | 0 | 180 | 500 | 0 | 0 | 7 |
| | | 1998-99 | 0 | 0 | 0 | 0 | 0 | 100 | 70 | 100 | 0 | 0 | 0 | 0 |
| 06. | Common Teal | 1994-95 | 0 | 0 | 0 | 0 | 0 | 0 | 20 | 0 | 0 | 0 | 0 | 0 |
| | | 1995-96 | 0 | 0 | 0 | 110 | 50 | 0 | 2 | 25 | 6 | 0 | 0 | 0 |
| | | 1996-97 | 0 | 0 | 0 | 0 | 0 | 100 | 0 | 140 | 2 | 0 | 0 | 0 |
| | | 1997-98 | 0 | 0 | 0 | 0 | 200 | 300 | 300 | 200 | 270 | 0 | 0 | 0 |
| | | 1998-99 | 0 | 0 | 0 | 120 | 18 | 200 | 200 | 200 | 0 | 0 | 0 | 0 |
| 07. | Spotbill Duck | 1994-95 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10 |
| | | 1995-96 | 10 | 10 | 0 | 0 | 50 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | 1996-97 | 7 | 30 | 30 | 5 | 0 | 13 | 50 | 34 | 10 | 0 | 1 | 14 |
| | | 1997-98 | 4 | 11 | 30 | 25 | 11 | 27 | 1 | 42 | 25 | 0 | 0 | 60 |
| | | 1998-99 | 11 | 11 | 35 | 25 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| 08. | Mallard | 1994-95 | 0 | 0 | 0 | 0 | 0 | 0 | 30 | 320 | 2 | 12 | 0 | 0 |
| | | 1995-96 | 0 | 0 | 0 | 16 | 4 | 210 | 22 | 0 | 0 | 0 | 0 | 0 |
| | | 1996-97 | 0 | 0 | 0 | 2 | 24 | 40 | 100 | 400 | 40 | 0 | 0 | 0 |
| | | 1997-98 | 0 | 0 | 0 | 0 | 2 | 170 | 300 | 400 | 100 | 0 | 0 | 0 |
| | | 1998-99 | 0 | 0 | 0 | 0 | 4 | 80 | 2 | 400 | 0 | 0 | 0 | 0 |
| 09. | Gadwall | 1995-96 | 0 | 0 | 0 | 0 | 2 | 150 | 60 | 2 | 0 | 0 | 0 | 0 |
| | | 1996-97 | 0 | 0 | 0 | 0 | 30 | 30 | 500 | 520 | 130 | 0 | 0 | 0 |
| | | 1997-98 | 0 | 0 | 0 | 0 | 140 | 160 | 140 | 460 | 300 | 0 | 0 | 2 |
| | | 1998-99 | 0 | 0 | 0 | 24 | 225 | 265 | 250 | 600 | 0 | 0 | 0 | 0 |
| 10. | Falcated Teal | 1996-97 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |

| Sl. No. | Common Name | Year | July | Aug | Sept | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 11. | Wigeon | 1994-95 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 30 | 80 | 0 | 0 |
| | | 1995-96 | 0 | 0 | 0 | 20 | 40 | 70 | 16 | 150 | 100 | 0 | 0 | 0 |
| | | 1996-97 | 0 | 0 | 0 | 0 | 8 | 40 | 40 | 160 | 120 | 0 | 0 | 7 |
| | | 1997-98 | 0 | 0 | 0 | 0 | 44 | 110 | 30 | 100 | 270 | 0 | 0 | 2 |
| | | 1998-99 | 0 | 0 | 0 | 8 | 0 | 12 | 100 | 200 | 0 | 0 | 0 | 0 |
| 12. | Shoveller | 1994-95 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 40 | 4 | 18 | 0 | 0 |
| | | 1995-96 | 0 | 0 | 0 | 2 | 0 | 10 | 18 | 18 | 16 | 0 | 0 | 0 |
| | | 1996-97 | 0 | 0 | 0 | 0 | 6 | 10 | 40 | 104 | 36 | 0 | 0 | 0 |
| | | 1997-98 | 0 | 0 | 0 | 0 | 0 | 30 | 20 | 90 | 16 | 0 | 0 | 5 |
| | | 1998-99 | 0 | 0 | 0 | 0 | 0 | 20 | 0 | 60 | 0 | 0 | 0 | 0 |
| 13. | Redcrested Pochard | 1994-95 | 0 | 0 | 0 | 14 | 0 | 0 | 20 | 500 | 55 | 10 | 0 | 0 |
| | | 1995-96 | 0 | 0 | 0 | 2 | 20 | 400 | 80 | 170 | 20 | 0 | 0 | 0 |
| | | 1996-97 | 0 | 0 | 0 | 0 | 120 | 550 | 520 | 420 | 10 | 0 | 0 | 0 |
| | | 1997-98 | 0 | 0 | 0 | 0 | 26 | 520 | 500 | 580 | 20 | 0 | 0 | 22 |
| | | 1998-99 | 0 | 0 | 0 | 0 | 0 | 16 | 140 | 300 | 0 | 0 | 0 | 0 |
| 14. | Common Pochard | 1994-95 | 0 | 0 | 0 | 40 | 120 | 200 | 150 | 100 | 250 | 60 | 0 | 0 |
| | | 1995-96 | 0 | 0 | 0 | 80 | 100 | 250 | 70 | 100 | 30 | 0 | 0 | 0 |
| | | 1996-97 | 0 | 0 | 0 | 4 | 70 | 140 | 400 | 340 | 120 | 0 | 0 | 0 |
| | | 1997-98 | 0 | 0 | 0 | 0 | 120 | 500 | 380 | 310 | 250 | 0 | 0 | 2 |
| | | 1998-99 | 0 | 0 | 0 | 30 | 26 | 120 | 120 | 120 | 0 | 0 | 0 | 0 |
| 15. | Tufted Pochard | 1994-95 | 0 | 0 | 0 | 0 | 22 | 0 | 70 | 0 | 46 | 0 | 0 | 0 |
| | | 1995-96 | 0 | 0 | 0 | 20 | 12 | 10 | 20 | 30 | 14 | 0 | 0 | 0 |
| | | 1996-97 | 0 | 0 | 0 | 0 | 12 | 110 | 80 | 140 | 20 | 0 | 0 | 0 |
| | | 1997-98 | 0 | 0 | 0 | 0 | 30 | 50 | 140 | 100 | 70 | 0 | 0 | 4 |
| | | 1998-99 | 0 | 0 | 0 | 100 | 14 | 40 | 12 | 80 | 0 | 0 | 0 | 0 |
| 16. | Cotton Teal | 1994-95 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 |
| 17. | Nakta or Comb Duck | 1997-98 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |

**Table 3**. Comparison of Waterfowl species of Asan Reservoir with those of Six Ramsar sites in India

| Name of the Ramsar Sites | Wetland type | Area km2 | Altitude (m) | Co-ordinates | |
|---|---|---|---|---|---|
| Wular Lake (J&K) | Natural | 1530 | 120 | 34°21' N | 70°42' E |
| Harike Lake (Punjab) | Man-made | 218.83 | 58 | 31°13' N | 75°42' E |
| Keoladeo National Park (Rajasthan) | Man-made | 173 | 9 | 27°07' N | 77°12'E |
| Sambhar Lake (Rajasthan) | Natural | 360 | 190 | 26°52' N | 74°54'E |
| Loktak Lake (Manipur) | Natural | 768.5 | 55 | 24°25' N | 94°46' E |
| Chilika Lake (Orissa) | Natural | 0-2 | 1165 | 19°28'N | 85°06'E |
| Asan Reservoir (U.P.) | Man-made | 389.5 | 3 | 30°24' N | 77°40'E |

| Species recorded | Wular | Harike | Keoladeo | Sambhar | Loktak | Chilika | Asan |
|---|---|---|---|---|---|---|---|
| 01. Eastern Greyleg Goose | + | + | + | + | + | + | + |
| 02. Barheaded Goose | – | + | + | + | + | + | + |
| 03. Ruddy shelduck | + | + | + | + | + | + | + |
| 04. Common Shelduck | – | – | + | – | + | + | + |
| 05. Pintail | + | + | + | + | + | + | + |
| 06. Common Teal | + | + | + | + | + | + | + |
| 07. Spotbill Duck | – | + | + | + | + | + | + |
| 08. Mallard | + | + | + | – | – | – | + |
| 09. Gadwall | + | + | + | – | + | + | + |
| 10. Falcated Teal | – | + | + | – | – | – | + |
| 11. Wigeon | + | + | + | – | + | + | + |
| 12. Garganey | + | + | + | – | + | + | + |
| 13. Shoveller | + | + | + | + | + | + | + |
| 14. Redcrested Pochard | + | + | + | + | + | + | + |
| 15. Common Pochard | + | + | + | + | + | + | + |
| 16. White-eyed Pochard | – | + | + | – | + | + | + |
| 17. Tufted Duck | + | + | + | + | – | + | + |
| 18. Cotton Teal | – | – | + | – | – | + | + |
| 19. Nakta or Comb Duck | – | + | + | – | – | + | + |
| 20. Old Squaw | – | – | – | – | – | – | + |
| **Total species** | **12** | **17** | **19** | **10** | **14** | **17** | **20** |

**Table 4**. Peak population of ten regular winter visitors at Asan reservoir from 1994 to 1999

| Sl. No. Common Name | 1994-95 | 1995-96 | 1996-97 | 1997-98 | 1998-99 |
|---|---|---|---|---|---|
| 01. Ruddy Shelduck | 400 | 300 | 600 | 1000 | 1150 |
| 02. Pintail | 192 | 595 | 100 | 500 | 100 |
| 03. Common Teal | 130 | 110 | 140 | 300 | 200 |
| 04. Mallard | 320 | 210 | 400 | 400 | 400 |
| 05. Gadwall | 0 | 150 | 500 | 460 | 600 |
| 06. Wigeon | 80 | 150 | 160 | 270 | 200 |
| 07. Shoveller | 40 | 18 | 104 | 90 | 60 |
| 08. Redcrested Pochard | 500 | 400 | 550 | 580 | 300 |
| 09. Common Pochard | 250 | 250 | 400 | 500 | 120 |
| 10. Tufted Pochard | 70 | 30 | 140 | 140 | 100 |
| **Total** | **1982** | **2213** | **3094** | **4240** | **3230** |

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# ASSESSMENT AND MONITORING OF MIGRATORY WATERFOWL HABITAT USING REMOTE SENSING TECHNIQUES

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## INTRODUCTION

Waterfowl, popularly known as ducks, geese and Swans, comprise about 145 species of which 41 are found in India. Waterfowls create a lot of interest and are of great value all over the world due to their mass seasonal (north-south) movements which are often spectacular and spread over all types of inland waters throughout the country.

On a conservative estimate more than three million waterfowl migrate into our country from across the Himalaya from Eurasia during winters (November to March) every year. Monitoring and management of their population, distribution and habitats is very important to check depletion in their numbers.

It is imperative to recognize that populations are subject to varations resulting from reproductive success or changes in their "homing" grounds. Therefore, one of the very important functions the wetlands perform is to provide suitable habtat for the breeding of residential waterbirds and wintering grounds for migratory waterfowl populations. Since the migration is essential for survival of these species, availability of suitable habitats, both on migratory routes as feeding /moulting areas, as well as on the final destinaton as wintering sites, is critical to migratory waterfowls.

However, these ecologically vital ecosystems are under constant threat due to ever increasing anthropogenic pressures, such as agriculture, sedimentation, overgrowth of vegetation, overgrazing, poaching, fishing and weed infestation, which have made wetlands the most threatened habitats all over the world.

A realization of the importance of wetland in waterfowl conservation, as well as their spectacular global migration led to two important global conventions, namely, "Convention on wetlands of International Importance Especially as waterfowl Habitat (1971)" having 93 countries as contracting parties and "Convention on the Conservation of Migratory species of Wild Animals (CMS) (1979)" having 51 member countries worldwide. The contracting parties in the convention undertake to protect the migratory species of African-Eurasian waterbirds and conserve wetlands within their territories with particular reference to waterfowls.

In view of the above, the author undertook the present study for monitoring a waterfowl habitat in Dehra Dun valley using IRS data since the year 1996. An attempt has also been made to understand the co-relation between trends in increase in waterfowl population with the change in land cover, i.e., waterfowl habitat parameters.

## STUDY AREA

Asan Reservoir came into being in the year 1967 due to the construction of a barrage at the confluence of Asan River and the outlet channel from Dhalipur Power House. It falls in the geographical co-ordinates of $30^0$ 25'-26' N and

77° 40'-41' E and its net geographical area is 3.2 km². The barrage is 287.5 m long, the riverbed being 389.4m asl, with minimum and maximum of pond levels between 395.95 m and 401.50 m asl. It falls in biogeographic province 4.8.4 (Indo-gangetic monsoon forests) and belongs to wetland type 17 (water storage reservoir, dams). The area has north Indian monsoon climate with distinct summer and winter months. Temp. summer: 38°C, min. 14°C winter: max. 21°C, min. 2°C; average rainfall 250 cm, SW monsoon during June to September. Chief aquatic vegetation of the wetland comprises *Eichhornia crassipes*, *Photamogeton pectinatus*, *Typha elephantine* and *Ceratophyllum demersum*. Surrounding bushes include *Ipomoea fistulosa* and *Lantana camara*. On the southern side agricultural fields surround the reservoir.

There is mixed forest plantation on the eastern and northern fringes of the wetland, while further south there is mixed forest of Siwaliks comprising principally *Shorea robusta* and *Anogeissus latifolia*.

## SATELLITE DATA USED

Cloud free data of IRS-LISS-II and IRS-IC, LISS-III of path 96 and row 50-3 acquired in November' 96, February'97 and March'98 were used for the study of temporal changes in the wetland. Ground truth about land cover classes and waterfowl population was done during the years 1997 & 98 corresponding with the orbital calendar of IRS-IC with a repeat cycle of 25 days.

## ANCILLARY INFORMATION

Detailed field studies were made during 1994-98 to estimate the seasonal ecology, homing months, population dynamics, etc., of waterbird species at Asan Reservoir. It was recorded that the peak winter population of migratory waterfowl at Asan is during the months of January and February. Altogether these birds are present at the wetland predominantly between November and March.

The average total water bird counts in the month of February, during the years 1996, '97 and '98, was 1161, 3174 and 3741 exs. respectively, of which nearly 90% of the population belonged to the commonest migratory waterfowl species. The relative abundance of the migratory waterfowl species at Asan reservoir generally followed the pattern as below-

1. Brahminy Duck,
2. Pintail,
3. Red Crested Pochard,
4. Common Pochard,
5. Wigeon,
6. Mallard,
7. Gadwall,
8. Coot,
9. Common Teal,
10. Tufted Duck, and
11. Shoveller

Analysis of the periodical data of the water birds indicates that 21 species are winter visitors, 13 local migrants and 13 residents. Of these, 13 species are abundant (>100), four species are very common (51-100), nine species are common (11-50), 13 species are less common (1-10) and eight species are occasional.

## DIGITAL ANALYSIS

The digital analysis of the satellite data pertaining to wetland was carried out using image processing module of Integrated Land and Water Information System (ILWIS 2.1 for Windows) at Indian Institute of Remote Sensing, Dehra Dun. The steps followed were as below :

1. Geo-registration and extraction of data,
2. Generation of multi temporal signature,
3. Classification of landcover, and
4. Change detection in landcover from 1996 to '97 and 1997 to '98.

First step undertaken was the generation of standard FCC (using LISS-II & III, bands 4,3

and 2) and the unsupervised classification. It was followed by the selection of control points on the image and the 1:50,000 scale SOI toposheet for map to image registration.

All three extracted subimages (1996,1997 and 1998) were digitally classified through maximum likelihood classifier and ground truth collected infield. These classified images were further analyzed in detail for habitat change analysis during 1996-1997-1998.

## ANALYSIS OF LAND COVER IN ASAN RESERVOIR

Based on spectral variations in the images and subsequent digital analysis, following eight classes were identified :

1. Water,
2. Emergent vegetation,
3. Herbaceous vegetation,
4. Shrubs,
5. Trees,
6. Open land,
7. Dry bed and
8. Agriculture

1. **Water** : The whole extent of open water within the reservoir was considered under this class. It was found to be most uniform and major class comprising an area of 1.8079 km$^2$ (1996), 1,6693 km$^2$ (1997) and 1.4285 km$^2$ (1998).

2. **Emergent vegetation** : This class comprised the dominant vegetation species like *Typha, Ipomoea, Polygonum* and *Eichhornia*, which are growing in shallower parts of the reservoir. Their growth is very rapid and is converting the reservoir into a marsh at an alarming rate. The area of the emergent vegetation was found to be 0.7233 km$^2$ (1996), 0.6250 km$^2$ (1997) and 1.1082 km$^2$ (1998).

3. **Herbaceous Vegetation** : Comprise patches of young *Polygonum* and other grasses, which occur sporadically at the periphery of the reservoir in between the emergent vegetation and shrubs.

4. **Shrubs** : Adjoining the periphery of the reservoir, especially on the southeastern side bushes like *Lantana*, *Eclipta* and *Ipomoea* are encroaching into the reservoir at an alarming rate. The area of the shrub within the reservoir was estimated as 0.2998 km$^2$ (1996), 0.5069 km$^2$ (1997) and 0.31088 km$^2$ (1998).

The reduction in shrub area in March 1998 has been due to large-scale eradication of Lantana bush in January' 98 by Irrigation Department.

The remaining classes of trees, open land, dry bed and agriculture do not form a significant component of the wetland.

## CHANGE ESTIMATION OF LAND COVER IN ASAN RESERVOIR

The change analysis in Asan Reservoir was done from 1996-'97 and 1997-'98, i.e., with respect to following five major land cover classes.

1. Water to herbaceous
2. Water to emergent vegetation
3. Herbaceous to emergent vegetation
4. Emergent vegetation to shrub
5. Shrub to tree, and
6. No change (comprising remaining classes which did not show change)

The total area of the wetland estimated as 3.2640 km$^2$ out of which no change was observed in 2.8118 km$^2$ during 1996-97 and 2.6649 km$^2$ in 1997-98, implying that the changes were restricted to 0.4522 km$^2$ area in 1996-97 and to 0.5991 km$^2$ in 1997-98. Water to emergent vegetation class showed maximum change, i.e., 0.3130 km$^2$ in 1996-97 and 0.3556 km$^2$ in 1997-98, which was about 69% in 1996-97 and 59% in 1997-98 of the total changed area during the respective periods.

## CHANGE ESTIMATION OF MIGRATORY WATERFOWL POPULATION IN ASAN RESERVOIR

The change estimation of the peak winter population of the waterfowl species shows a distinct upward trend.

It is worthwhile to note that out of eleven migratory species, two species have shown more than 30% increase in their population, while five species have shown an increase of more than 200%, two species have increased by more than 100%, while one species, i.e., Coot has show no appreciable change in population. When the peak population of all the above species are merged together there is an overall increase of about 193% in the population of the migratory waterfowl at Asan Reservoir between the years 1994-98.

## CORRELATION BETWEEN WATERFOWL POPULATION TRENDS AND CHANGE IN LAND COVER IN ASAN RESERVOIR

To study the above relationship all the land cover classes other than water were merged into land cover category to study the ratio between land cover and water and the relationship between water-land cover ratio and migratory waterfowl population.

The ratio between water and land cover was obtained as 1.2415 (considering land cover as 1) (water 55%, land cover 45%) during 1996, it decreased to 1.0467 (water 51%, land cover 49%) in 1997 and further depleted to 0.7783 (Water 44%, land cover 56% ) in 1998. During the same period the winter population trends of five selected species of herbivorous migratory waterfowl were also studied which showed a definite upward trend. During the period between 1996 to 1998 the population of Brahminey duck increased by more than 250%, that of Red Crested Pochard by 145%, Common Pochard by 200%, Wigeon by 180%, by Gadwall 306%, while that of Coot by 125%, a species which feeds on animal material as well. Thus a positive relationship is so far indicated between the vegetation cover and waterfowl population, which is generally acceptable in the ratio of 50:50 to 30:70, where the value of the land cover is 70.