

## Information Sheet on Ramsar Wetlands

1. Date this sheet was completed/updated: 27 August 2001

2. Country: Mexico

3. Name of wetland: Ría Lagartos

4. Geographical coordinates:

21° 22' – 21° 38' North latitude  
87° 30' – 88° 30' West longitude

5. Altitude: 0–2 metres above sea level

6. Area: 60, 347.82 hectares

7. Overview: This wetland has a wide diversity of environments that provide habitat for a significant number of species and subspecies of fauna and flora in various states of conservation. It is a good representative example specifically characteristic of the climatic area. High biological productivity, ranging from conditions of marine salinity to hypersensitivity in a karst environment, makes the wetlands of Ría Lagartos unique in the world.

8. Wetland type: B, I, J, K, Zk(a)

9. Ramsar criteria: 2, 3, 4, 5 and 6

Criteria that best characterize the site: 6

10. Map of site included? Please tick yes -or- no

11. Name and address of the compiler of this form:

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12. Justification of the criteria selected under point 9, on previous page:

Criterion 2: This wetland has a significant number of species or subspecies of vulnerable or endangered plants or rare animals. This is the case of the Muscovy duck (*pato real mexicano*) (*Cairina moschata*) and an orchid, *Rhyncholaelia digbyana*, among many other species.

Criteria 3, 4, 5 and 6: This wetland is habitat to a great number of nesting birds (80 per cent) of a biogeographical population of a species or subspecies of aquatic birds, in this case the American flamingo (*flamenco rosa del caribe*) (*Phoenicopterus ruber ruber*). In 2002, a total of 32,364 specimens were reported for the site (see annex). This wetland represents a particularly good example of a type of community characteristic of the climatic area in which it is found. High biological productivity under conditions of marine to hyper salinity in a karst environment makes the wetlands of Ría Lagartos a unique example in the world.

Criteria 5 and 6: The wetland regularly sustains a population of more than 20,000 aquatic birds and 1 per cent of the specimens of a population of a species or subspecies of aquatic birds (see paragraph 18).

### 13. General location:

This wetland is located in the extreme eastern part of the Yucatan coast. The northern limit is the Gulf of Mexico, to the south the municipios of Río Lagartos, San Felipe and Tizimín; to the west the state of Quintana Roo and to the west the municipio of San Felipe. It is located 270 kilometres from the city of Mérida and 50 kilometres from Tizimín. Within this area, there are four communities with a total population of 7000 inhabitants.

### 14. Physical features:

This area is part of Quaternary formations composed of materials from the Pleistocene and Holocene of less than one million years old.

Structural geology: In the southeastern part of the wetland, there are approximately 19 faults that form two fault systems: one oriented northwest–southeast and the other northeast–southwest, which may be linked to lower Pliocene orogenesis. Dolinas (*cenotes*) are usually found in these faults or at their intersections. The rocks form part of a large calcareous bank practically without deformation that was deposited during evolution of the Yucatan platform.

### Geological units:

Limestone from the Upper Tertiary – This unit is formed from compact limestone with a laminate structure and with moderate-to-thick beige and white strata located in the central-eastern part of the reserve.

Quaternary limestone – This unit is formed from limestone composed of poorly consolidated shells with a cover of between one and two metres thick. It contains

fossilized molluscs and is located in the southern part of the settlement of Río Lagartos towards the southern part of La Angostura.

Quaternary coast – This is formed by sands of various composition and size in which are found minerals such as oolite and a smaller amount of fragments of various marine organisms. This unit is represented in the reserve by the coastline, including the coastal dunes and the area of contact with the lacustrine unit up to the extreme eastern part of the marsh.

Quaternary lacustrine – This unit is composed of sediments of fine sand, calcareous mud and organic material in decomposition. It is exposed along the coastline and the widest parts of the marsh in the form of a plateau and in the extreme eastern part, including the mouth of the Chipepté swamp (Valdés et al., 1992).

#### 15. Hydrological values:

The peninsula is formed by a sedimentary platform of porous limestone rock, which gives it unique hydrological characteristics. There is no system of permanent surface freshwater streams, but a very specific flow of groundwater because of the easy infiltration of rainwater through the limestone rock. When the surface limestone is dissolved by the effect of water, causing collapse of the overhead that covers it, it creates dolinas (*cenotes*) (Lesser and Weidie, 1998).

The Ría Lagartos swamp is oriented west-northwest to east-southeast. There are three connections to the sea, one natural connection through the mouth of the San Felipe and two artificial canals: the San Felipe and Río Lagartos. The width of the river varies between 25 metres and 3.5 kilometres, and it is approximately 74 kilometres long. The northern border is formed by a barrier island resulting from sand sedimentation caused by marine action.

The water covers 9,371 hectares to a depth ranging between 0.5 and 3 metres. The volume of water is approximately 130 million cubic metres and because of the narrow communication with the sea the water is not fully renewed. In addition, it receives limited fresh water from internal springs, runoff and rainwater.

The Ría Lagartos system has a series of basins: Río Lagartos, Las Coloradas and El Cuyo, linked by natural streams. The limited exchange with seawater and the fact that evaporation is greater than precipitation makes the relatively immobile water of the strait increase in salinity over time. In one of the basins, salinity reaches levels of more than 100 grams per kilo of water (100 parts per thousand of salinity).

In the area of the wetland reserve, there are topographic irregularities that vary between one and three metres. In these places, there are freshwater springs of very low salinity (2 parts per thousand), which make possible the establishment of highly diverse communities or islands of vegetation (*petenes*). There are also other bodies of water known as *aguadas*, which are temporary bodies of water.

## 16. Ecological features:

Ría Lagartos has numerous species of affinity with Central American species, with a geographical distribution that extends from the Central American countries and the southern Mexican states to the Yucatan Peninsula. Among the flora, are numerous species common to the Caribbean area, some of which are found in Mexico only in the states that border the Caribbean Sea, Yucatan and Quintana Roo.

Furthermore, the reserve has a wide diversity of plant communities. There are ten types of vegetation. Among these types are the moderate sub-perennial forest, moderate sub-deciduous forest, low deciduous forest, low thorny deciduous forest, low floodable forest, mangroves, low mangroves, matorral of the coastal dunes, floodable grasslands and vegetation of the marine grasslands (*seibadal*). There are also communities of floating hydrophytes, emergent hydrophytes and several formations characteristic of the coastal areas of the Yucatan peninsula called *petenes*.

The submerged plants are represented by the *Dyctiota*, *Euchema*, *Halimeda*, *Sargaso* and *Thalassia* genera and are the source of food for several marine species such as turtles and fish. Some of these grasses are accumulated on the beach and can serve as refuge for small invertebrates, useful in the diet of crabs and shore birds. An example of exotic species is the *pinito de mar* (*Casuarina equisetifolia*).

Coastal dunes: The vegetation of the coastal dunes is found on the bar that extends from San Felipe to the Chipepté swamp. The width of vegetation is very variable and is related to the width of the bar. This community is made up of tropical xerophytes, dominated by small palms and large succulents (figure 1). The characteristic species are sisal (*Agave sisalana*) sea grape (*uva de mar*) (*Coccoloba uvifera*), *nakax* (*Coccoloba readii*), *palma chit* (*Thrinax radiata*) *kuká* (*Pseudophoenix sargentii*), *anacahuita* (*Cordia sebestena*), *nopal* (*Opuntia dillenii*), cactus (*Acanthocereus tetragonus*) and *sikil-ha'xiu* (*Lantana involucrate*). The *kuká*, *chit* and *nakax* palms are classified as endangered species. *Nakax* is indigenous to the region.

Mangrove: Mangrove is a type of arboreal vegetation found at saline and brackish sites. It covers large areas, especially in swamps where seawater penetrates. In this area, there is strip mangrove and low mangrove. The strip mangrove grows on the edges of channels, at the mouth of the river and in the southern and southeastern parts of the swamp. This type of vegetation is permanently flooded by seawater. It is a very dense community, with an average height of ten metres. The most common species are *Rhizophora mangle*, *Avicennia germinans* and *Conocarpus erectus*. Although less abundant, there is white mangrove (*mangle blanco*) (*Laguncularia racemosa*) (figure 2). It is recognized as a very important community for maintenance of the lagoon's productivity. The low mangrove is found in very extreme environments with high salinity, poor soils, strong winds and constant flooding. It is formed by the same mangrove species, however, there are numerous species of Cyperaceae that mix with them. Its distinctive characteristic is its height, which barely reaches one to two metres. This type of vegetation is found mainly in the eastern part of the reserve and in the southern part of the lagoon near the settlement of Río Lagartos. Distribution of the

mangrove is determined by soil characteristics, runoff and physio-chemical requirements. Distribution of mangrove in the swamp is broken up. It is associated with other ecosystems such as the *tular-pastizal-carrizal*, with low deciduous forest, coastal dune vegetation and *petenes*. The interactions between the mangrove and these systems promote an increase in the diversity of plants and animals (Andrade, 1997).

**Low deciduous forest:** The low deciduous forest is a highly dense arboreal community in which the trees forming the upper canopy grow to 8 to 12 metres in height, forming a relative uniform roof of convex or flat crowns. A large number of the species have trunks with exfoliating bark and without leaves. The colour of the foliage is light green in contrast to the dark green of the sub-perennial forests. The legumes are the plant family best represented in this type of community, both because of the number of species and because of the number of specimens in each species. The Cactaceae are well represented in this type of vegetation (figure 3). A low deciduous forest with candelabriform cacti grows on El Cuyo up to the altitude of Sisal, where abrupt changes occur, becoming a low deciduous forest with thorny legumes. In the low deciduous forest with canelabriform cacti, species such as *Acanthocereus tetragonus*, *Cephalocereus gaumeri*, *Nopalea gaumeri* and *Pterocereus gaumeri* are regularly interspersed.

**Tular, carrizal and grasslands:** The range of distribution of this association is wide, because it needs only flat soils subject to flooding and the amount and presence of water can vary. In the reserve, the association of *Cladium jamaicensis*, *Phragmites australis* and *Typha domingensis* is very common. It covers large areas of marsh, flooded areas, slow-moving streams and swamp. It is mixed with mangroves, low deciduous forest and *petenes*. The alternation of flooding and drying out causes changes in this association in the conditions for its distribution and composition of the fauna in that habitat, such as Rallidae and migratory birds that feed or rest there. The abundant plants in this association are *Cladium jamaicensis*, *Eleocharis cellulose*, *P. australis*, *Scirpus lacustris* and *Typha domingensis*.

**Petenes:** In the southeastern part of the reserve, there is a wide area of *petenes* of various sizes, occupying the tidal floodplains. Their form varies from round to oval with a raised centre in relation to the edges and can be associated with springs or in some cases with *cenotes*. They are particularly abundant in the eastern part of the *ría* and in the south and southeast. *Petenes* are small islands of concentric groves of trees, which implies a gradual transition from inland dry land to the flooded tidal areas. In the *petenes*, the floristic composition is more diverse than in the surrounding vegetation and rises to heights of 18 to 25 metres. The structural complexity of each *petén* increases depending on its size. The zonation of the *petenes*, from the centre outward, consists of tall species in the *Ficus*, *Manilkara*, *Metopium*, *Plumeria* and *Sabal* genera. Towards the edges, there is *Haematoxylon campechianum* and other species characteristic of the moderate, sub-perennial forest subject to flooding. In the middle area, there is a ring of *Acoelorrhaphae writhii* and *Conocarpus erectus*. On the periphery, there is a ring of *tular*, *carrizal* and grassland, defined by species such as *C. jamaicensis*, *P. australis* and *Typha* spp., which extend over the tidal floodplain (figure

4).

17. Noteworthy flora:

A total of 627 species of phanerogamic plants have been recorded, belonging to 401 genera and 96 botanical families. This represents a little more than 27 per cent of the plant species recorded until now for the Yucatan Peninsula. In this area, there are 56 of the 168 species of endemic plants recognized for the Yucatan Peninsula.

Flora of the coastal dune

Family	Scientific name	Common name	Status
Aizoaceae	<i>Sesuvium portulacastrum</i>	sisal	
Amaryllidaceae	<i>Agave sisalana</i>	bab-ki	
	<i>A. angustifolia</i>		
Boraginaceae	<i>Tournefortia gnaphalodes</i>		
	<i>Cordia sebestena</i>		
Cactaceae	<i>Opuntia stricta</i>	nopal	
	<i>Mammillaria gaumeri</i>	pol-tsakam	
	<i>Opuntia dillenii</i>		
	<i>Acanthocereus tetragonus</i>		
Compositae	<i>Ambrosia hispida</i>		
Convolvulaceae	<i>Ipomoea pes-caprae</i>	riñonina	
Euforbiaceae	<i>Croton punctatus</i>	hierba de jabalí	
	<i>Euphorbia buxifolia</i>		
Gramineae	<i>Sporobolus virginicus</i>		
	<i>Distichlis spicata</i>	pasto salino	
Leguminosae	<i>Canavalia rosea</i>		
	<i>Cassia sp.</i>	salché	
	<i>Pithecellobium keyense</i>		
Malvaceae	<i>Malvaviscus arboreus</i>	bizil	
Orquidaceae	<i>Cyrtopodium punctatum</i>	orquídea	
	<i>Schomburgkia tibicinis</i>	flor de mayo	
Palmae	<i>Coccothrinax readii</i>	nakax	Vulnerable
	<i>Thrinax radiata</i>	palma chit	
	<i>Pseudophoenix sargentii</i>	kuká	Vulnerable
Poligonaceae	<i>Coccoloba uvifera</i>	uva de mar	Vulnerable
	<i>Atriplex canescens</i>	herbácea	
Solanaceae	<i>Suaeda linearis</i>		
Surianaceae	<i>Lycium carolinianum</i>		
	<i>Suriana maritima</i>		
	<i>Cakile lanceolata</i>		
	<i>Scaevola plumierii</i>		
Teofrattaceae	<i>Bumelia retusa</i>	chaksik	

Verbenaceae	<i>Jacquinia aurantiaca</i>	sikil-ha'xiu	
	<i>Lantana involucrate</i>		

### Representative Flora of the Mangrove

Family	Scientific name	Common name	Status
Aizoaceae	<i>Sesuvium portulacastrum</i>	--	
Anarcadiaceae	<i>Metopium brownie</i>	chechem negro	
	<i>Monanchochole littoralis</i>	pasto salino	
	<i>Salicornia virginica</i>	salicornia	
Batidaceae	<i>Batis maritime</i>	saladillo	
	<i>Laguncularia racemosa</i>	tsakol-kon	
	<i>Conocarpus erectus</i>	botoncillo	
Gramineae	<i>Distichlis spicata</i>	pasto salino	
Malvaceae	<i>Hibiscus clypeatus</i>	hibiscus, hol	
Moraceae	<i>Ficus tecolut</i>	matapalo	
Chenopodiaceae	<i>Suaeda linearis</i>		
Rhizophoraceae	<i>Rhizophora mangle</i>	mangle rojo	Special protection
Typhaceae	<i>Typha domingensis</i>	tular	
Umbelliferae	<i>Hydrocotyle ranunculoides</i>	ombligo de Venus	
Vervaceae	<i>Avicennia germinans</i>	mange negro	Special protection

### Representative Flora of the Low Deciduous Forest

Family	Scientific name	Common name	Status
Acanthaceae	<i>Bravaisia tubiflora</i>	hooloop	
Anacardiaceae	<i>Metopium brownei</i>	chechén negro	
Bignoniaceae	<i>Parmentiera edulis</i>	pepino de árbol	
	<i>Ebeguia chysantha</i>	makuilis	Vulnerable
Bombocaceae	<i>Ceiba aesculifolia</i>	ceiba or yaxché	
Boragraceae	<i>Cordia dodecandra</i>	siricote	
Burseraceae	<i>Protium copal</i>	copal	
	<i>Busera simaruba</i>	chacáh	
Cactaceae	<i>Cephalocereus gaumeri</i>	cactus	
	<i>Pterocereus gaumeri</i>	cactus	Rare
	<i>Nopalea gaumeri</i>	tsacam	
	<i>Selenicereus testudo</i>	pitahaya	
Combretaceae	<i>Leucaena leucocephala</i>	ihuatsim	
Ebenaceae	<i>Diospyros digyna</i>	tanch-ya	
Leguminosae	<i>Enterolobium cyclocarpum</i>		

	<i>Bauhinia jennigssi</i>	pata de vaca	
	<i>Haematoxylon campechianum</i>	tinta	
	<i>Caesalpinia gaumeri</i>	kitinche	
Liaceae	<i>Beaucarnea pliabilis</i>	mechuda	
Moraceae	<i>Brosimum alicastrum</i>	ramón	
	<i>Cecropia peltata</i>	guarumo	
Apocynaceae	<i>Plumeria obtuse</i>	sak-nicte	
	<i>Plumeria rubra</i>	sak nicte	
Orchidaceae	<i>Phyncholaelia digbyana</i>	orquídea	
Palmae	<i>Acoelorrhaphe wrightii</i>		
Zigophyllaceae	<i>Guaiaacum sanctum</i>	guayacán	Special protection

### Representative Flora of the *Petén*

Family	Scientific name	Common name
Annonaceae	<i>Annona glabra</i>	palo de corcho
Burseraceae	<i>Bursera simaruba</i>	chacá
Malvaceae	<i>Malvaviscus arboreus</i>	bizil
Moraceae	<i>Ficus tecolutensis</i>	alamo, amate
Palmae	<i>Sabal yapa</i>	sabal
Sapotaceae	<i>Manilkara achras</i>	chicle
	<i>Manilkara zapota</i>	chocozapote

### 18. Outstanding fauna

The terrestrial fauna is intimately linked to the primary and secondary vegetation. The large number of microenvironments formed by this vegetation and the physical environment promote a large diversity of fauna in the reserve. In contrast to the vegetation, the fauna does not usually require exogenous means of dispersion. Recolonization of the wildlife of the reserve depends mainly on the dispersal capacity of the wildlife and regeneration of the habitat. The diversity of the region is represented by species of the five groups of vertebrates. The 554 species recorded so far in the reserve include 142 endemic species to Mesoamerica, of which 15 are endemic to Mexico and one to Yucatan. Using the ecological criteria of NOM-059-ECOL-1994, published in the Federal Diario Oficial on 16 May 1994, the reserve includes species and subspecies under the following protection status.

Legal definition	Mammals	Birds	Reptiles	Amphibians	Fish
Endangered	6	5	4		2
Vulnerable	1	20	6		2
Rare	1	23	11	2	
Special protection		8	6		
Endemic		1	16	2	

Mammals: Among the species of mammals, 55 species are known of which the



following are endangered: black-handed spider monkey (*mono araña*) (*Ateles geoffroyi*), jaguar (*Panthera onca*), ocelot (*Leopardus pardalis*), tree ocelot (*Leopardus wiedii*), eyra cat (*Herpailurus yaguarondi*) and the northern tamandua (*Tamandua mexicana*). The habitat of these animals corresponds to the low and medium deciduous forest that has been reduced from 24 per cent of the reserve to 5 per cent. In this ecosystem, bats in the Phyllostomatidae family are also numerous and are represented by six species. The white-tailed deer (*venado cola blanca*) (*Odocoileus virginianus*) and the middle American red brocket (*temazate*) (*Mazama americana*) are hunted by the local inhabitants for subsistence.

Birds: Within the reserve, there are 333 species of birds (177 resident, 142 migratory and 14 resident-migratory). Most important is the American flamingo (*Phoenicopterus ruber ruber*), which has a large nesting site in the El Cuyo basin, which led to the legal protection for Ría Lagartos in 1979. The Phalacrocoracidae (cormorants), Ardeidae (herons), Ciconiidae (storks), Rallidae (*gallinas de agua*) and the Alcedinidae (kingfishers) families are also representative because they live in the system of coastal wetlands in the protected nature area. The *gallito de mar* (*Sterna maxima*), the *gaviota de playa* (*Larus atricilla*) and the *golondrina de mar* (*Sterna sandvicensis*) of which there is a total estimated population of 10,000 specimens actively nest in the reserve. The pélicano café (*Pelecanus occidentalis*), the cormorant (*Phalacrocorax auritus* and *P. olivaceus*), the *tijereta* (*Fregata magnificens*), the *garza tigre* (*Tigrisoma mexicanum*), the *garza garrapatera* (*Bubulcus ibis*), *grullita* (*Aramus guarauna*), kingfisher (*Chloroceryle* spp. and *Ceryle* spp.) and *ibis blanco* (*Eudocimus albus*) use the marsh as a feeding area. Other outstanding birds are the *garza cuchara* (*Cochlearius cochlearius*), *garza blanca* (*Casmerodius albus*), *garcita blanca* (*Egretta thula*), *paloma de alas blancas* (*Zenaida asiatica*), toucan (*Pteroglossus torquatus*), *xtakay* (*Tyrannus melancholicus*) and the *yah* (*T. tyrannus*). It is estimated that between November and February more than 300,000 migratory waterfowl arrive in the northern part of the Yucatan Peninsula. They use the Ría Lagartos and Celestún reserves as well as the state reserves of Dzilam de Bravo and El Palmar as wintering spots. The populations are basically in the Charadriidae family (*chorlos*) and Anatidae (ducks), represented by species such as the *cerceta canela* (*Anas cyanoptera*), *cerceta de alas azules* (*Anas discors*), *cerceta de alas verdes* (*Anas crecca carolinensis*), *pato golondrino* (*Anas acuta*), *pato pinto* (*Anas strepera*), *pato boludo chico* (*Aythya affinis*), *pato bocón* (*Anas clypeata*) and the *pato chalcuán* (*Aythya americana*). The population of *gallareta* (*Fulica americana*) is very large, with an estimated 100,000 specimens on the peninsula during the winter months. The resident ornithological fauna is represented by the *chachalaca* (*Ortalis vetula*) and several species of pigeons in the *Columba* and *Zenaida* genera.

Reptiles and amphibians: The reptiles includes 95 recorded species that are abundant in the area, including the *nauyaca* (*Agkistrodon bilineatus*), boa (*Boa constrictor*) and the snakes in the Colubridae family. There are four species of marine turtles that visit the coast to lay eggs: hawksbill turtle (*tortuga carey*) (*Eretmochelys imbricata*), loggerhead (*tortuga caguama*) (*Caretta caretta*), green turtle (*tortuga verde*) (*Chelonia mydas*) and leatherback turtle (*tortuga laud*) (*Dermodochelys coriacea*). These species are endangered, because they have difficulty adapting modified environments and are

very sensitive to human disturbance. There are two species of crocodile: the American crocodile and Morelet's crocodile (*Crocodylus acutus* and *C. moreletii*). Among the reptiles and amphibians are the frogs in the genus *Bufo*, which are abundant in the shallow mangroves. There are also species in the *Agalychnis*, *Bolitoglossa*, *Leptodactylus*, *Rana*, *Rhinophrynus* and *Tripion* genera.

Fish: So far, 71 species of fish have been recorded, among which are four species of *elasmobranchios*. Among the most frequent are the *Strongylura nota* (Belonidae), *Florydichtys carpio* (Cyprinodontidae), *Sphoeroides testudineus* (Tetraodontidae) and *Eucinostomus argenteus*. The wide distribution of these species within the *ría* is because of its euryhaline capacity, which makes it possible for them to live in very saline areas (130 parts per thousand) and in water with salinity near that of sea water. In the swamp, there are several species, such as catfish (*Arius melanopus*), *postá* (*Archosargus rhomboidalis*), *mojarra prieta* (*Cichlasoma urophthalmus*), *armado* (*Orthopristis cryoptera*), *lisa* (*Mugil* sp.) and *robalo* (*Centropomus ronchus*). The fish that live in the dolinas of the reserve include endemic species *Ophisthernon infernale* and *Typhliasina pearsei*.

Commercially important species: Among the most important commercial species are the *mero* (*Ephinephelus morio*), *huachinango* (*Lutjanus* sp.), shark (*Carcharinus* spp.), *mojarra* (*Gerres* sp. and *Calamus* sp.), *chac-chi* (*Haemulon plumieri*), *carito* (*Scomberomorus cavalla*), *jurel* (*Caranx* sp.), *robalo* and *corvine* (*Cynoscion* spp.).

Invertebrates: The most important commercial species are the octopus (*Octopus maya* and *O. vulgaris*), lobster (*Panulirus argus*) and shrimp (*Panaeus* sp.). There are also characteristic land crabs (*Gecarcinus lateralis*), snails in the *Donax* genus and the *cacerolita de mar* (*Limulus polyphemus*), which is an endangered species with limited distribution on the Mexican beaches. Its distribution is from the northern part of the Yucatan Peninsula to Isla del Carmen in Campeche. It uses the sandy beaches and part of *Ría Lagartos* for breeding. Some of the eggs return to the sea where they hatch and others are eaten by marine birds. There are bivalves: *Anomalocardia auberiana*, *Carditamera floridana*, *Tellina tampaensis* and the gasterpode *Cerithidae pliculosa*. As for the insects, studies have been made of the Coleoptera, Dermaptera, Dytioptera, Hemiptera, Homoptera, Hymenoptera, Lepidoptera, Neuroptera and Orthoptera orders.

#### 19. Social and cultural values:

The use of natural resources in the area of the marsh is very old. This area of the reserve belonged to the head of the Ecab during the pre-Hispanic period up after the fall of Mayapán, recognized as the main capital of the Peninsula. Yucatan is divided into provinces and autonomous chiefdoms, which frequently have conflicts for control of the most important resources, especially salt. The reserve is in the former province of Chikinchel, one of the most populated and richest in the area because it controlled salt exploitation in the area. The existence of the ruins on Isla Cerritos are proof of this. This small island of 200 metres in diameter, located 500 metres from the coast and 5 kilometres west of San Felipe, contains the remains of a Mayan port complex,

which had been occupied for a considerable time. In the area of the Ría Lagartos reserve, 18 archaeological sites have been found of the 1,585 identified in Yucatan. These sites belong to several hierarchical categories designated by the Instituto Nacional de Antropología e Historia, according to their importance for the general structure of the pre-Hispanic societies of Yucatan and its priority in the conservation programme. The categories are called levels. Among the sites at level III, which are those that have a secondary regional importance, is the site near El Cuyo. It is important to point out that construction of an access road to El Cuyo stones from this site were used to build an access ramp.

#### 20. Land tenure/ownership of:

There are six types of land tenure in the area: private property (7510 hectares), land belonging to the national government (16,837 hectares), communal (*ejidal*) land (22,315 hectares), the federal maritime-terrestrial area (480 hectares), federal land granted for salt production (5,000 hectares) and nine *ejidal* population centres. The area located south of the marsh is land belonging to the federal government. In the area of El Cuyo, San Felipe and Río Lagartos, there is *ejidal* land. The settlement of Las Coloradas began when the owner of the salt company gave land and houses to the workers.

#### 21. Current land use:

Productive activities such as fishing, grazing, agriculture, extraction of salt and tourism take place.

Fishing is the most important activity for the economically active inhabitants living in this area. The main type of fishing is shore and small-scale fishing from small outboard boats and in areas of the Gulf of Mexico near the coast. Fishing takes place all year round. When the weather prevents boats from leaving, fishing takes place in the marsh on an average of 100 days a year.

Agriculture is a very limited activity in the area. The *milpa* is the most important traditional production system in the area. It has been used for 2000 years by the Mayas and their descendents. This system is based on clearing, felling and burning of the vegetative cover. This method dates from the pre-Hispanic period and has been preserved almost intact, except for some farming tools recently introduced. Mainly maize, beans, squash and peppers are grown in the *milpas*. The use of fertilizers is very reduced, and there are practices to control pests.

This wetland is very close to the grazing area in that state. Cattle-raising is an important activity in two forms: *ejidal* and private. The *ejidal* form produces little profit because meat is not widely consumed in the area and many owners use the *ejidal* land for grazing. Economically, private grazing is more productive because of the availability of inexpensive land, the low cost of building installations and because of the use of cleared areas. Pressure for expansion of grazing creates pressures for breaking

up *ejidal* land. The largest grazing areas are located in the southern part of the marsh floodplain. The raising of pigs and chickens is limited to self-consumption.

The karst nature of the Yucatan limestone, where there is no surface rivers that dilute the saline water of the coastal lagoons practically prevents transportation of soil sediment, making the gathering of clean salt easier. The original concession granted for exploitation of the saltpans took place at the end of the 1930s. However, salt has been exploited intermittently from the colonial period. The concession covers an area of approximately 1000 hectares that is between 16 and 20 kilometres long. There is an industrial plant for salt extraction, the second largest in Mexico. It occupies a large area of evaporation and crystallization tanks.

Currently, the salt industry uses a new production technique. Management of the physical-chemical-biological parameters has allowed use of all the components of the brine and improved output. In 1995, production reached the levels of production before Hurricane Gilbert in 1988. A dock has been constructed for loading loose salt in deep-draft ships in order to make marketing more dynamic. The company creates employment for 100 families in the area.

Tourism is an activity that fishermen have recently embraced as an alternative activity and several groups are now fully occupied in this activity.

22. Factors (past, present or potential) adversely affecting the site's ecological character, including changes in land use and development projects:

Cutting of native vegetation: The coastal lagoon has been transformed by the establishment of coconut plantations and by extraction of salt, which has modified the slope and natural sedimentation processes. In addition, demographic pressure has contributed to deforestation of the coastal dune. One of the main threats is the clearing of large areas to be used for extensive grazing. Grazing is a problematic productive activity because its ecological cost is high because it destroys large areas of forest, while yields are low.

Fragmentation of the habitat: Construction of breakwaters, dykes and roads breaks up the habitat and alters natural processes. Construction of roads and dykes has changed the flow of water in the mangrove.

Decrease in aquatic species: The Ría is an important area for fish, especially during the periods of north wind. The capture of several species has decreased considerably, leading to permanent bans on certain species such as the *caracol blanco* (*Strombus costatus*) and other species such as the shark, *lisa* (*Mugil cephalus*) and *cayo de hacha* (*Atrina* spp.), whose natural populations have dropped, threatening its survival. Other species, such as mero, *cangrejo moro* (*Menipe mercenaria*) and the octopus (*Octopus maya*) are being over-exploited because of the use of unauthorized equipment (Arreguín-Sánchez, 1987). The fishing of certain species is not regulated, such as *maxkil* and the crab. Another important aspect is illegal fishing by Mexican trawlers at a depth of 15 to 20 fathoms when 40 metres is the authorized depth.

Decrease of mammal and bird populations: There has been a decrease in feline species such as the jaguar (*Panthera onca*), ocelot (*Leopardus pardalis*) and the eyra cat (*Herpailurus yaguarondi*), classified as endangered species. Several birds, such as the zopilote rey (*Sarcoramphus papa*), the jabiru (*cigüenña jabirú*) (*Jabiru mycteria*) and the keel-billed toucan (*Ramphastos sulfuratus*), have practically disappeared from the reserve, primarily as a result of loss of habitat, caused by deforestation and to a lesser extent by poaching (García-Barron, personal communication). A decrease in pavo ocelado (*Agriocharis ocellata*) and white-tailed deer (*venado cola blanca*) (*Odocoileus virginianus*) has been caused by poaching and subsistence hunting. There is poaching and subsistence hunting all year round, especially in the reserve.

Decrease in timber-producing trees: Clearing for extraction of timber and grazing has been the chief cause of a decrease in the following species: zapote (*Manilkara zapota*), chechem (*Metopium brownie*), piich (*Enterolobium cyclocarpum*) and the amates (*Ficus* spp.). This problem is now occurring on the border with the state of Quintana Roo.

Changes in the flow of water: Changes in the factors that control the regime of salinity can produce changes in the composition of associations of plant species and lead to rapid mortality. The mangroves are very sensitive to any change in tides and backing-up of surface water. The backing-up of water changes the exchange of gases by the roots, leads to an accumulation of toxins and salts and promotes sedimentation (Olmsted and Durán, 1993). Construction of roads without viaducts and dykes perpendicular to the coast interrupt the normal flow of water.

Chemical pollution: No study is being carried out on the level of hydrocarbons in the ría, however, fishing results in oil and fuel waste because of the malfunctioning of engines, maintenance or washing activities. A threat to the future could be the possible spill of fuel through boat accidents, because the marine area is one of the main routes for ships transporting petroleum.

Organic and solid-waste pollution: An important impact on the mangroves is urban development because the largest settlements have gain land by filling in the swamp with solid waste for building houses. There is currently no adequate system for the collection and disposal of waste because in most communities waste is thrown into the water causing pollution and an outbreak of sever gastrointestinal diseases.

Siltation: Two artificial channels have been opened for motorboats, which has led to the silting in of the first water basin of the ría. This has created a need to maintain the channels and disposal of the material produced by dragging the channel constantly.

Changes in salinity: Sudden changes in salinity, which can accidentally occur by discharge of water from the saltpans, could be serious for several species of birds. Likewise, changes in the physical-chemical conditions can be caused by the opening of artificial channels that join with the sea.

Eutrofication: There is currently no sewage or drainage systems toward the ría, however, growth of the urban area is expanding toward the areas subject to flooding, which communicate with the ría. Special emphasis should be placed in the future on the water used for large-scale aquaculture projects because wastewater usually contains a large amount of nutrients.

Decrease in mangrove populations: The effect caused by exploitation of several mangrove populations is less evident and perhaps less severe than that caused by other human activities. This can be the result of intense exploitation, which is in response to social demand for that resource (Olmsted and Durán, 1993).

Disturbance of birds: The main impact on the flamingo population occurs because tourists move too close to the bird colonies in order to take good photographs. Studies made on the behaviour of flamingos show that 48 per cent of their time is spent on feeding (Galicia, 1995) and if they are constantly disturbed by boatloads of tourists, their time feeding is decreased. An important impact on the flamingos, although less frequent, is caused by low flights of small aeroplanes and helicopters. Collision of specimens with electric cables because of an absence of buoys or lights on posts is a cause of mortality that could be avoided.

Decrease in the underwater vegetation: The importance of the sub-aquatic vegetation as habitat, refuge and source of food for a large variety of fish, crustaceans and molluscs and as primary producers has been well documented. However, the increase in the number of motorboats providing services to the tourists in the ría causes a negative impact by cutting away vegetation, especially in the shallowest areas.

### 23. Conservation measures taken:

This wetland is located deep in the Ría Lagartos biosphere reserve, which was declared on 21 May 1999 by presidential order with a management programme agreed on and accepted by order of 12 April 2000, which was prepared specifically for this area, its natural resources and use. The reserve has six nuclei, in which management and use of resources are very restricted. It is characterized by a high degree of biological representativeness and a low degree of disturbance with ecological vulnerability, low land use and natural vocation. The advantages and uses of this wetland located within a protected area lie in the greater capacity for attracting funding for conservation, management and restoration projects.

### 24. Conservation measures proposed but not yet implemented:

Various strategies have been used for conservation of the wetland and its areas of influence, which are included in a management programme for short-term, medium-term and long-term activities.

### 25. Current scientific research and facilities:

A hydrological survey is being carried out in order to learn about the hydrodynamics of the ría, which has been changed by artificial openings, the extraction of salt and the construction of means of communication. A survey has been made of aquatic birds and indicator bird species in order to evaluate the health of ecosystems, mainly through the composition of aquatic and terrestrial communities within the nucleus areas. The reserve has two field stations with accommodations, kitchen and multiple-use rooms.

#### 26. Current conservation education:

An environmental education programme is beginning carried out based on the methodology of the RARE centre “proudly promoting conservation of natural resources”. This programme is based on the question of management of garbage. It is aimed in the first stage at schoolchildren and has an environmental library and videos available to the public, the training of teachers and presentations for children. There are also display boards located in settlements, in which various themes related to resources and activities carried out in the reserve are displayed. In the settlements, the anniversary of the naming of this site as a Ramsar site of international importance and the Flamingo Festival is celebrated with the participation of local inhabitants, municipios, schools and organizations.

#### 27. Current recreation and tourism:

Tourism is an activity that the fishermen have recently adopted as an alternative activity. Several groups have been formed oriented only for tourism. The ría and the channels through the mangrove offer a spectacular landscape for local, national and foreign visitors. It is estimated that each year about 30,000 persons visit this area during the tourist season.

#### 28. Jurisdiction:

Territorial jurisdiction falls under the federal government, and administrative jurisdiction falls under the National Commission for Protected Nature Areas

#### 29. Management authority:

Dirección de la Reserva de la Biosfera Ría Lagartos  
Calle 62, No. 325, between 37 and 39 Col., Centro  
C.P. 97000 Mérida, Yucatán, Mexico  
Tel./Fax: (52 99) 920 5155 and 925 4392

#### 30. References: