Protected Natural Areas in Mexico

#	Category	Area (ha)	Percentage (%)
31	Biosphere Reserves	9,046,477	71.3
68	National Parks	1,433,469	11.3
5	Natural Monuments	13,023	0.1
10	Protected Areas for Flora and Fauna	1,623,198	12.8
5	Protected Areas for Natural Resources	48,272	0.4
4	Other Area under Re-categorization	292,861	2.3
3	Protected Forest Zone	232,916	1.8
126		12,690,216	100

Source: CONANP. 2001.

The definitions of each protected area are as follows.

Biosphere reserve

Biosphere reserves are the federal level bio-geographical areas that are not significantly altered by human activities. The areas are designated for preservation and restoration in sake of the habitat of biodiversity of the nation, which are considered to be endangered or threatened. The reserves are divided into the core zone and buffer zone. In the core zone, human activities such as ecological education and scientific investigation that do not change the ecosystem are only allowed. In buffer zone, sustainable use of resources are allowed with participation of local community

National Park

National parks represent the national level bio-geographical areas, which have beautiful scenery and/or scientific, educative and recreational value for flora/fauna and tourism development. The activities allowed in the park must be in line with protection of natural resources, flora and fauna such as investigation, recreation, and ecological education.

Natural Monument

Natural monuments are the places that have exceptionally interesting objects with esthetic, historical or scientific value created by natural phenomena. Preservation, scientific investigation, recreation and ecological education are only allowed to use the monuments.

Protected area of natural resources

Protected areas of natural resources are designated for protection of watershed (soil and water)

on forestland. The activities with preservation, protection and sustainable use such as investigation, recreation, tourism and ecological education are allowed based on the management program.

Protected areas of flora and fauna

Protected areas of flora and fauna are the areas where habitat of flora and fauna are largely influenced by the development of the area. Sustainable use of natural resources are allowed based on the laws of hunting and fishing.

Sanctuaries

Sanctuaries are areas where fauna and flora have considerable values with valleys, plains, caves, cenotes, creeks, etc. Investigation, recreation, and environmental education are only allowed in the areas.

State nature reserve

State nature reserves are created by the state government. Federal government supports to set up these areas.

b) National advisory committee of natural protected areas

LGEEPA prescribes that national advisory committee of natural protected areas (CTA: Consejo Technico Asesor) can be organized by SEMARNAT with representatives of federal administration, academic institution, center of investigation, user groups of producers, private companies, and non governmental organizations. Organizing CTA is one requirement to be part of SINANP.

2) Law of wildlife

In order to conserve wildlife, law of wildlife defines management unit for conservation of wildlife: (UMA). The unit can be intensive (e.g. cultivation, gene bank, etc.) or extensive (e.g. habitat management) manners. Management plan needs to be formulated with specific objectives, sampling methods, the way of habitat management, etc. Extensive management with low investment is recommended by SEMARNAT. Funding support for formulation of management plan is available. The species under water are induced only for the species listed on NOM-059-ECOL-094.

3) NOM (Norma Official Mexicana)-059-ECOL-1994.

The species under special protection are listed by the official norm, NOM-059-Ecol-1994. The

norm has four classifications: namely, species in endanger, threatened, rare and special protection. Rare species indicate biologically viable, but naturally rare species due to the reduced distribution or the very specific original habitat, while species with special protection are limited or prohibited to use due to the restricted distribution or needs of recovery for associated species. 1420 species of vertebrate are specified in the list.

3-1-2. Institutional framework of nature conservation in Mexico

At present, protected nature reserves are managed by CONANP, decentralized organization of SEMARNAT through administrative offices of reserves with collaboration of PROFEPA for vigilance and CAN for water quality monitoring. These agencies are briefly explained here.

1) SEMARNAT (Secretaria de Medio Ambiente y Recursos Naturales)

SEMARNAT is federal government organization in charge of natural resource management and environment. SEMARNAT has four sub-secretaries (planning and environmental politics, management for environmental protection, dissemination and environmental control), and has six decentralized organization: namely, National Commission of Water (CNA), Mexican Institute of de Water Technology (IMTA), National Institute of Ecology (INE), Federal Procuratorial authority of Environmental Protection (PROFEPA), National Commission of Natural Protected Area (CONANP), and National Commission of Forestry (CNF) (Annex 1). Fishery department was transferred to SAGARPA from SEMARNAT in November 2000.

2) CONANP (Comisión Nacional de Areas Naturales Protegidas)

In order to improve management of natural protected areas, CONANP was founded in June 2000 separated from INE as one of the decentralized organizations under SEMARNAT. Currently CONANP is an organization with 433 staffs (173 staffs at headquarter) and annual budget of approximately 133 million pesos for 2001. Among the 119 federal nature reserves, technical staffs of CONANP are stationed at 56 natural protected areas and 37 of them are under SINANP. 18 regional sustainable development programs are undertaken. Organizational structure of CONANP is showed in Annex 2.

3) Administrative offices of Protected Natural Areas (PNA)

Each PNA can have administrative office under CONANP in order to coordinate reserve management activities. The major activities of administrative offices of protected areas are: development and implementation of the management program, supervision of activities by

SEMARNAT, promotion of sustainable development program, and other legal coordination related to management of protected areas (e.g. collaboration with PROFEPA for inspection and vigilance in the reserve).

Administrative offices of natural protected areas are established to manage the protected area in line with the management program. The main activities of the office are: supervise actions for protection and conservation, intervene the actions to change the border of land use in national land and induce real estate development to follow conservation, promote legal instruments to public, social and private sectors and investigation of the ecosystems, produce information system with biological, social and economic data, etc[5]. The PNAs under SINANP have management program, CTA, permanent staff (at least five) and financial plan.

4) PROFEPA (Procuraduría Federal de Protección al Ambiente)

PROFEPA is one of the decentralized organizations of SEMARNAT to conduct inspections against activities, which influence environment. PROFEPA check industries, business or other potential polluters and judge the level of compliance base on the specific laws, regulations and standards. In the PNA, vigilance is under jurisdiction of CONANP and inspection is under PROFEPA.

5) CNA (Comision Nacional del Agua)

CNA administrates water resources of the nation by issuing concession for water use. In the RCBR, CNA measures water quality every six months and has a plan to set up a monitoring center.

3-2 Present situation of wetland conservation and reserve management in the target area

3-2-1 General Characteristics of Northern Yucatan

Northern Yucatan peninsula has wetland vegetation from the north to the northwestern side of the peninsula. Although the climate is drier in the western part of the coast of the peninsula (Annex 4), larger mangrove forests are found because of it receives large amount of underground fresh water flow toward the western coast of the peninsula, Ría Celestún and los Petenes biosphere reserves. In RCBR and los Petenes biosphere reserves, mangrove can be found even land interior behind the low flooded forest (Annex 5).

The landscape can be divided into four zones: as going to land interior, 1) coastal waters, 2) beach

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[5] Articlo 101, Regulamiento Interior de la Secretaria de Medio Ambiente y Recursos Naturales.

and dunes, 2) coastal estuaries and swamps, and 4) mangrove, wetland, savanna and forest. The coastal areas have shallow sea level where marine fishing and recreation activities are undertaken. Among the marine resources, octopus has large economic value in the region. Discharge of urban effluent makes serious contamination causing a red tide near Progreso port.

In this area, coastal dune has originally unique endemic vegetation, however, large areas of coastal dune in RCBR was destroyed by coconut plantation, most of which are already abandoned due to the yellowing disease. While beach on the northern coast receive mass tourism especially in Progreso, coastal estuaries are potential sites of eco-tourism by tourists attracted by flamingos and other migratory birds. At western part of peninsula, RCBR and los Petenes biosphere reserves, mangrove forests are excellently conserved, while the northern coast has higher pressure to change the land use from farming activities.

Indicative characteristics and land/water uses in Northwest YUCATAN

Landscape zone	Characteristics	Land/water uses
Near coastal waters	Shallow sea over the continental shelf Resources include octopus grouper and many other species. Abundant sea glasses	Marine fishing Water recreation Drainage and feeding of coastal lagoons Discharge of urban effluent
Beach and dunes	White sandy beaches and dunes, both variable in width Dunes 2-3 m above mean sea level Unique dune vegetation Specific fauna including birds and protected animals such as flamingo, sea turtles and crocodiles.	Fishing port Human settlement Tourism and beach recreation Treatment and abandonment of coconut plantation
Coastal estuaries and swamps		Artisanal fisheries Hunting* Road construction and residential development Solar salt production Eco-tourism
Mangrove wetland, savannas and forest	Deep mangrove forest Savanna (wet grassland) Low semi-deciduous forest Many springs and ponds surrounded by freshwater based flora (Petenes)	Collection of forest products (wood, leaves etc.) Hunting (e.g.deer) Limited agriculture and cattle ranching

*Palmar state nature reserve.
(Modified from World bank. 2000.)

3-2-2 Ecological characteristics and zoning of Ría Celestún

Ría Celestún Biosphere Reserve (RCBR) is located on the coastal area of the western side of

Yucatan state facing to the Mexican gulf. RCBR has an estuary, a large coastal lagoon of brackish water formed by the mixing of ocean and freshwater from underground water flow. The reserve is comprised of nearly 80 thousand hectares of varying ecosystems: ocean, beach, coastal dune, estuary, mangrove, salt flat, tropical forest, savanna and mangrove hummocks. RCBR is considered to be one of the 52 most important wetlands in Mexico.

According to the data from 1952 to 1997, RCBR has average annual temperature of 26.5 ^{0}C and annual precipitation of 767mm with severe dry season from November to April (Annex 6). Compare to Ría Lagartos, RCBR has more rainfall with drier climate in the land interior.

Although water availability from climatic conditions is limited in RCBR, underground freshwater flow to the RCBR is abundant because it is located at the edge of one of the two large flows of underground water on the northern Yucatan peninsula resulting in the extension of large low mangrove vegetation inside the land. The map of concentrated cenotes towards the RCBR shows the underground water flow (Annex 7).

In general, the salinity of the estuarine lagoon increases by entering inside the lagoon. However, in Ría Celestún the salinity decreases as entering the lagoon due to the freshwater flow from the spring.

1) Flora and Vegetation

For its geographic location, RCBR with the extension of coast, estuarine lagoon and swamps makes the diverse mosaic vegetation such as coastal dune communities, mangrove swamps, petenes[6], low swamp forest, wet grassland, low semi-deciduous forest and sub-aquatic vegetation (Annex 8). The coastal mangroves are found at the border of the estuarine lagoon and petenes are found in the area of wet grassland and low mangrove swamp. Vegetations are kept under excellent grade of conservation.

The vegetation of reserve is dominated by low mangrove, wet grassland, shrub of coastal dune and low flooded forest. The denuded areas with small vegetation are called blanquizales.

From the floristic points of views, the vegetation of the reserve is different from the other part of the Mexican gulf presenting the Caribbean vegetation and endemic specie of Yucatan Peninsula. The vegetation has 549 species (Leguminosae 79, Gramineae 34, Euphorbiaceae 33 Compositae 30 Cyperaceae 16, Malvaceae 16 and Convolvulaceae 14). RCBR has 45 endemic species and 14 species (4 endangered, 7 threatened, 3 rare species including 5 endemic species) are listed on the

[6] Springs and ponds surrounded by fresh water based flora.

NOM –059-1994.

Coastal dune vegetation

Two types of coastal vegetations (pioneer and shrub zones) are found in the reserve depending on the salinity level, species composition and stability of the understory vegetation.

Pioneer zone: the vegetation is developed in sandy beach with mobile sands in pioneer zone. The major species are herbaceous tolerant against winds, high salinity and wave. The common species are ts'ayka (Sesuvium portulacastrum), t'saypek (Suaeda linearis), hawayche' (Ageratum littoralis), etc. The majority of these species grow horizontally rather than vertically.

Shrub zone: the vegetation is developed in two phases: 1) windbreak trees with thick foliages in front of beach such as Suriana maritime, Tournefortia gnaphalodes, Ernodea littoralis, Scaevola plumieri, and 2) higher vegetation (3-5m in height) interior to the dune with immobile sand such as hulub (Bravaisia berlanderiana), akits (Thevetia gaumeri), uva de mar (Coccoloba uvifera), anacahuita (Cordia sebestena), Sideroxylon americanum, Jacquinia aurantiaca, etc.

Mangrove swamps

The mangrove forests cover large area of the reserve especially in the swamp around the coast. There are two types of mangrove forests in the reserve: coastal mangrove and low mangrove swamp (mangle chaparro). Coastal mangroves (approximately 12-14 m in height) cover the coast from the north to the south border. The width is less than 200 m occupying 31,512 ha. Red mangroves (Rhizophora mangle) are found on the coast and white mangrove (Laguncularia racemosa) interior. Low mangrove swamp (less than 1.5-3m in height) are located where higher salinity, poorer soils, stronger wind and more frequent flooding. Species composition is same as coastal mangrove except for combination with grasses. Epiphytes such as orchids are found. Mangrove forests are exploited for various use: red mangrove for post of the house, white mangrove for thin stick, botoncillo (Conocarpus erectus) for fuelwood.

Low flooded forest

Low flooded forest is located at the eastern edge of the estuarine lagoon where seasonally flooded. Height of the trees are 5 –7m in height lowing to 2m where close to the mangroves. This vegetation is only found in the Yucatan Peninsula and few studied are undertaken. Major species are: Haematoxylum campechianum, Cameraria latifolia, Metopium brownie, zapote, Bursera simaruba, Ceiba aesculifolia, etc.

Wet grassland

Wet grasslands occupy large part of the land interior of the swamp. The characteristics of the wet

grassland are domination by pastures (gramineas and ciperaceas) with some dispersed trees. The areas are flooded during the rainy season since the areas contain deeper soils with high clay contents. Major species are: Cladium jamaicensis, Phragmites australis, Eleocharis culllulosa, E. caribaea, Rhynchospora cephalotes, Rhynchospora colorata, Scleria bracteata, Paspalum fasciculatum Cyperus rotundus, Hymenochallis littoralis. The only trees found are: nance agrio (Brysonima bycudaefikua) and jicaro (Crescentia cujete). In the dispersed trees, palma tasiste (Acoelorrhaphe wrightii) can be found.

Tule swamp

Tule swamp is vegetation dominated by tule (Typha dominguensis). Tule swamp is Often found around the petenes 20-30m in width around spring with very low salinity (1-30 %). Vegetation is mixed with pastures (ciperaceas and gramineas).

Petenes

Petenes are islands of trees around the freshwater springs surrounded by shallow swamp vegetation. The flow of freshwater are maintained fundamentally by the vegetation. The petenes in Celestún are classified as little stratified and diversified. The trees found in Petenes are: chicle (Manilara zapota), mangle rojo (Rhizophora mangle), mangle blanco (Laguncularia racemosa), matapalo (Ficus tecolutensis), roble de sabana (Tabebuia rosea), sabal (Sabal sp.), nebular (Nymphaea ampla), etc. Wood of Petenes are extracted for furniture, construction of house, art wood products. Main species for exploition are: zapote, caoba, chechemm piich, amatesm, palo de tinte.

Low deciduous forest

Low deciduous forests are distributed at eastern part of RCBR. In the dry season all the trees fall the leaves for 5 - 6 months when many of them are in bloom. In general, the communities are dense with trees as high as 8 to 12 m with thin stems less than 20 cm in diameter. Trees ramify near the bottom and epiphytic plants especially Tillandsias are abundant where humidity is high (e.g. near the cenotes).

Sub-aquatic vegetation

Macrophytes occupy 80% of the area. The characteristics of RCBR are that the rate of biomass of the vegetation are dominated by macroalgae (more than 70%) with low rate of marine pastures (only 10%).

2) Fauna

The diverse fauna is found in RCBR due to its microclimate created by the vegetation and physical environment. However, the ecosystems found in RCBR are considerably vulnerable. More than

600 vertebrates species are registered (140 fish, 13 amphibians, 64 reptiles, 304 birds, and 79 mammals). Among these, 115 species (18 endangered (2 endemic species), 37 threatened (4 endemic species), 48 rare (6 endemic species) and 12 special protection species) are listed under NOM-059-ECOL-94 (Annex 10).

Crustacens

Camaron (penaeus aztecus), cangrejo (Emirita sp.) Jaiba azul (Callinectes sapidus) and Hammarus sp are found near the mouth of lagoon.

Fish

Large interaction between mangrove ecosystems and marine pastures accommodate large number species (140 species with 18 orders, 54 families) in RCBR. 70 species are young, mangrove associated fish-eating species with seasonal populations. The common species are Scianidae, Sparidae, Gerreidae and Lutjanidae. The species with special protection status are: an endangered (ichiilasoma uropthalmus) and one threatened (Poecilia velifera). Both are endemic species in the estuarine lagoon.

Amphibians and reptiles

In RCBR, among 164 species of amphibians and reptiles in the Peninsula, 13 amphibians (12 frogs and toads and one salamander) and 64 reptiles (one crocodile, 7 turtles, 20 geckos and lizards and 36 snakes) are reported. The species with special protection status under the NOM-059-ECOL-94 are: 3 rare and one special protection species of amphibians, and 3 endangered, 7 threatened, 12 rare and 4 special protection species of reptiles. Four rare species of reptile are endemic.

Birds

271 species (including 102 migratory birds) covering 53 % birds in the peninsula are reported. 14 birds are endemic. 64 species (8 endangered, 21 threatened, 27 rare and 8 with special protection) are listed in NOM-059-ECOL-94.

American Flamingo (Phoenicpterus ruber ruber) is a symbolic bird for tourism of RCBR. The study of PRONATURA shows that 95% of tourists come to RCBR to see flamingos.[7] The population of American Flamingo had reduced dramatically by the hurricane Girberto in 1988 (approximately 18,000 individuals), however the population was recovered in 1990s by the protection of hatching site in Ría Lagartos. The northern part of estuarine lagoon in RCBR is the most important feeding site during the summer (December to February). Other important birds for tourism is double crested cormorant (Phalacrocorax auritus). White pelican (Pelecanus erytrhrorynchos), Blue winged teal (Anas discors), Boat-billed heron (Cochlearius cochlearius) and white ibis (Eudocimus

[7] Caracterización temporal de la actividad tourística in la Ría Celestun. PRONATURA. 1999.

albus), Osprey (pandion haliaetus) reproduce in RCBR.

Mammals

There is no species list specifically for RCBR. 79 species (33 chiropteras, 16 rodents and 16 carnivores) are reported in the area.

Common hunting species are ocelot (Felis pardalis), jaguar (Panthera onca), leopard (Herpailurus yagouarundi), wild boar (Tayassu tajacu), paca (Agouti paca), white deer (Odocoileus virginianus yucatanensis), rabbit (Sylvilagus floridanus), armadillo (Dasypus novemcinctus), and gray fox (Urocyon cinereoargenteus). The species listed in the NOM-059-ECOL-94 are 9 endangered, 7 threatened, 5 rare species. Among these species jaguars cause conflict with the local community because they attack cows of the farms located near RCBR. A group of farmers killed a jaguar in 2000.

3) Zoning

According to the management program, RCBR is divided into core zone (37% of the total area) and buffer Zone (63%) (Annex 9). Total area of RCBR is 81,482 ha. Buffer zone is divided into four sub-zones based on the objectives of uses: namely, sub-zones of sustainable use of natural resources, restricted use, human settlement, public use and restoration. Core zone is inaccessible area well conserved where scientific investigation and environmental education are only allowed. These areas are very important for maintaining the hydrological process that provide water for mangroves, petenes and estuary ecosystems.

Core Zones

RCBR has two separated core zones in the north and the south.. The northern core zone occupies 23 % of the zone located at the northern edge of the reserve attaching to the PALMAR state nature reserve. In side the area is very well protected with mangrove and petenes covering the northern edge of the estuarine lagoon where considered to be the most important area for feeding water migratory birds including American flamingos. The southern core zone covering 77 % of the zone occupies the mangrove and low flooded forest with excellent conditions of conservation representing feeding and nesting habitats of many migratory birds.

Buffer zones

In the buffer zone, educational, investigative, recreational, and productive activities are allowed to be conducted under restriction for conservation. The zone is divided into five categories.

Sub-zone of sustainable use of natural resources: the areas that occupy 82 % of the zone located on the coastal dune and around the core zone and roads functioning for protection of the core zone. In

the sub-zone, resource use by local population for domestic consumption such as logging, and commercial activities (eco-tourism, salt farm, fishing) are allowed as far as they do not damage the ecosystems. The areas are divided into terrestrial and aquatic areas.

Sub-zone of restricted use: occupies 8.4% of the reserve around the estuarine lagoon and 200m into the interior from the mangrove on the coast.

Sub-zone of human settlement occupies area where original ecosystems are disappeared by urban development of two communities: Celestún and Isla Arena.

Sub-zone of public use: these areas are mainly utilized for recreation where many visitors can be accepted as far as under the limit of the environmental capacity. There are two areas: the beach of Celestún port (600m2) and the bridge on the estuarine lagoon (2,400m2).

Sub-zone of Restoration: the area where mangrove vegetations are altered by impeding hydrologic water flow (around the road to Celestún (135 ha) and western side of the road to Isla Arena (3447 ha)).

Zoning of RCBR

Category	Area (ha)	%
Core Zone	30,291.0	37.2
Northern Core Zone	7,035.0	8.6
Southern Core Zone	23,255.4	28.5
Buffer Zone	51,191.2	62.8
Sub-zone of sustainable use of the natural resources	43,130.6	52.9
Sub-zone of restricted use	4,322.8	5.3
Sub-zone of human settlement (Celestún and Isla Arena)	154.9	0.2
Sub-zone of public use (Beach and Estuary)	0.3	0.0
Sub-zone of Restoration	3,582.6	4.4
Total	81,482.2	100.0

Source: Management program, RCBR. 2001.

3-3. Problems related to the wetland conservation in the target area

Lack of management capacity of the reserve office and potential for environmental education and eco-tourism

The administrative office RCBR was newly established in 1998 with a few staff. At present, their main activities are vigilance, coordination with local community and strengthening political base etc. Improvement of the capacity of the reserve office is essential in order to integrate available scientific information, develop information system, improve vigilance system and disseminate environmental education through awareness program.

In fact, Celestún is complex community with complicated social structure caused by the recent immigrants who had lost jobs in sisal cultivation. PRONATURA has been working with the community since the end of 1980s. However, they cannot realize actions to the community without political authority. Taking advantage of PRONATURA's experience, the reserve office can be strengthened to effectively utilize available information and develop strategies to promote participation of local residents through environmental education. It should be noticed that participation of local residents in reserve management is the essential part of environmental education. Moreover, with the new mayor, the reserve office can work more closely to the municipality.

The target of environmental education can be local residents, boatmen, tourists, fishermen, etc. The study of PRONATURA indicates that 60 % of tourists are foreigners. However, local villagers can also have tour to Celestún to enjoy nature. Currently the price of boat tour is too expensive for local people in Yucatan Peninsula. Foreign tourists come to Ría Celestún only at the tourist season. During low season of foreign tourism, the project can promote and organize an eco-tourism tour to Ría Celestún for local people with lower price of the boat. The proposed training center can be utilized for the activities.

Uncontrolled Development of Tourism Activities

While eco-tourism can be promoted as a tool of environmental education, rapid development of uncontrolled tourism activities are large threat for the reserve. The number of tourists in 2000 (approximately 40,000 tourists) is double of that of 1998. Mundo Maya program[8] which takes the Maya ruin, Uxmal as a part of the tourist route may contribute to improve the road connection between Uxmal and Celestún in order to bring tourists to RCBR. Considering number of tourists in Uxmal (approximately 500,000 persons/year), potential threat of tourism development by the program is enormous. It should be noticed that Ría Celestún is biosphere reserve, not national park.

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[8] Tourism development program in Maya culture covering Mexico, Guatemala, Belize, Honduras and El Salvador.

The primary concern should be conservation not tourism development. Political arrangement as well as practical coordination with travel agencies will be necessary to restrict the number of tourists.

Vanishing original ecosystems caused by urban development

Although urban area in RCBR is rather small (approximately 200 ha), more than 60% of the houses are constructed on temporary flooded areas filling the salt marsh with solid waste. Conservation of vegetation is very important in Celestún because of its vulnerable environment located on low sand dune surrounded by the ocean and estuarine lagoon. Although exploitation of wood for domestic use is allowed, currently there is no system to control the exploitation. Originally vegetation of sand dune, although most of them were already removed by coconut plantation, are important not only for nature conservation but for life security of local people. Original vegetation of coastal sand dune with endemic palm trees can be found in Ría Lagartos. Unfortunately vegetation of coastal sand dune areas are largely burned in Celestún to expand the residential area especially near the village. These burning should be controlled with providing alternative residential areas outside the reserve.

Valuable ecosystem with high endanger and endemic level

In the RCBR, approximately 600 species of vertebrate are registered (140 fish, 13 amphibians, 64 reptiles and 304 birds and 79 mammals). Among these, 115 species are species listed in NOM-059-ECOL-1994 including 12 endemic species (2 fish, 4 reptile, 3 birds and 3 mammals) with possible danger of extinction. Especially among 64 reptiles in the reserve (1 crocodile, 7 turtles, 20 lizards, and 36 snakes), 32.8 % of them are listed (4 species for protection special, 11 rare, 6 threatened species).

Water contamination in the estuary and lagoon

Water of the estuarine lagoon is contaminated by motorboats, uncontrolled sewage system of Celestún community. In fact that only 50 % of the residents have toilets. The study by CNA in April, 2001 showed the high level of nitrate at the Celestún side of the bridge. Water quality of the lagoon in the village with full of solid waste without the connection to the sea is under serious condition. The sewage and drainage system should be improved with appropriate facilities and campaign with local residents.

Damage of aquatic community by the Traditional Fishing Method

In Celestun, many fishermen are engaged in the traditional method called Chichorro. Chinchorro uses dragnets and takes out all the livings on the seashore including sea grass. According to the study by CINVESTAV, at present sea grass covers 60 % of the area where 90% was covered 15 years ago. The advantage of Chinchorro is that it does not need a big boat since conducted on the

shallow seashore. The fishermen have special permission to conduct Chinchorro that was given years ago as a countermeasure to provide jobs to the immigrants who had lost jobs in Sisal cultivation. Sea grass is the important food source for small aquatic community such as fish and shrimps. Fishing resources is getting scarce due to the damage of aquatic community.

Disconnection of water flow by road and bridge construction

Construction of road and bridge damage the original ecosystem of the reserve by halting fresh water flow. The road construction to Isla Arena caused serous damage on mangrove forest. The bridge of Celestún (100 m long) was constructed with the construction of 500m long solid road impeding water flow of the estuarine lagoon to the ocean. In Isla Arena, the bridge was also constructed by the same way that 70% of that does not have water flow to the sea.

Hunting by lead bullet in the Palmar state nature reserve

Hunting activities are allowed in the Palmer state nature reserve by UMA.[9] The new wildlife law in 2000 allows the hunting of waterfowls only by the use of iron bullet. However, the deaths of flamingos caused by toxicities of lead bullets are found in RCBR. Since there is no sign to show the border of the reserve, hunters are not aware of entering the Ría Celestún reserve (actually the lagoon is connected). The area with illegal hunting is the core zone of the reserve.

[9] 15,700 birds are allowed to be hunted annually. Considering the 35 grams of lead in rifle 12 with munitions #6, 2.74 tons of lead are put in the reserves annually (D. E. Alonzo. DUMAC.)