



PARKS WATCH

Strengthening Parks to Safeguard Biodiversity

Park Profile – Mexico Ría Celestún Biosphere Reserve

Date of most recent on-site evaluation: April 2002

Location: North of Yucatan State in Campeche State

Year Created: 1979

Area: 81,482 hectares

Ecoregions: Dry forest of Yucatan and Mexican mangroves

Habitats: Petenes mangroves, coastal sand dunes, grasslands, tular, low flooded forests and marine plant communities.



Summary

Description

Ría Celestún Biosphere Reserve was created July 19, 1979 and covers an area of 81,482 ha. The reserve contains much of the underground watershed on the northwestern Yucatán Peninsula. The reserve, together with El Palmar State Reserve in Yucatán and Los Petenes Biosphere Reserve in Campeche, possesses part of the best-preserved coastal wetlands regions in the western stretch of the Yucatán Peninsula.

Biodiversity

The reserve is home to 587 plant species, 42 of which are endemic. The fauna found in the reserve include many birds. There are 304 species, including the Mexican pink flamingo (*Phoenicopterus ruber ruber*), least tern (*Sterna antillarum*), Jabiru (*Jabiru mycteria*), king vulture (*Sarcorampus papa*) and Greater white-fronted goose (*Anser albifrons*). There are also 75 mammal species, including the anteater (*Tamandua mexicana*), spider monkey (*Ateles geoffroyi*), tayra (*Eira barbara*), jaguar (*Panthera onca*), tapir (*Tapirus bairdii*) and manatee (*Trichechus manatus*). There are 64 species of reptiles, such as the Caguama turtle (*Eretmochelys imbricata*), Carey turtle (*Caretta caretta*) and swamp crocodile (*Crocodylus moreletii*). To date, researchers have registered 13 species of amphibians, and a total of 140 fish species in 18 different families.

Threats

Ría Celestún Biosphere Reserve is an endangered area, making it a necessity to take measures to protect and maintain the area's biodiversity. The main threat to the area is the lack of personnel in the reserve. Furthermore, the communities existing within the borders of the protected area do not have a good relationship with the reserve's administration. The communities do not have information about the reserve, and there is major pollution in the urban area and in the reserve's natural eco-systems. In recent years, Celestún has seen its population increase sharply, resulting in a disorganized urban sprawl.



Flamingos feed on small crustaceans in the shallows of Ría Celestún

Description

Physical Description

Ría Celestún Biosphere Reserve covers an area of 81,482.33 ha and lies in the municipalities of Celestún, Maxcanú, Yucatán and Calkini in Campeche (INE 2000). The area is bordered to the east by the Gulf of Mexico, to the west by Celestún and the municipalities of Maxcanú, Yucatán, and Calkini in Campeche, to the north by El Palmar State Reserve in Yucatán and Los Petenes Biosphere Reserve en Campeche. The altitude varies from 0-8 meters above sea level and average annual temperature is 79° C, with annual average precipitation of 30 in. The area enjoys a warm and dry climate and is subject to the tendency of rain seasons in the region. The dry season runs from March-May, while the rainy season is from September-October, coinciding with the hurricane season. The months from November-February are called a season of *Nortes*, because of the shifting masses of cold damp air from the north. The humidity-laden winds sparked by this phenomenon can gust up to speeds of 50 mph, and produce a large amount of the area's annual precipitation. (Gómez-Pompa *et al.* 1995; CONANP 2000; DUMAC website 2002).

The coastal strip is almost entirely bereft of topographical contrasts; the Yucatán Peninsula lacks surface bodies of water. This means water filters quickly through the substrata and feeds the underground water table, which in turn wells up in springs, streams and lagoons (Chávez *et al.* 1988; INE, 1993). The vegetation is complex and different from the coast of Gulf of Mexico. The area features a mixture of halophyte species, underwater plant life and dry tropical forest, with the influence of flora from the Antilles and the Florida Peninsula. The hillock vegetation has a round or oval shape and grows near streams or springs. The local plant life has been described as islands of concentric clumps, with a rich composition of flora, growing up to heights of 60-100 feet (Espejel 1984).



Springs such as the above are tourist attractions and swimming sites

Ría Celestún represents the mangrove and dry forest ecoregion of Yucatán, and the marine ecoregion in the Gulf of Mexico. Characteristic habitats include mangroves, hillocks, coastal sand dunes, the savanna and underwater vegetation (Sullivan & Bustamante 1999).

There is evidence the Mayas inhabited the area, as pottery shards have been found at Punta Cambalam. Given the fact the area is close to urban centers, the area was probably used to supply fish and salt.



Close up map showing Ría Celestún Biosphere Reserve

Biodiversity

Ría Celestún stands out for its rich ecosystems, communities and species found in a relatively small area. These are relevant in conservation terms as they are located in an inter-dependent coastal environment: the shallow marine continental shelf, coastal sand dunes, mangroves, coastal lagoons, swamps, hillocks, flooded pastures, the flooded lowland forest, and a type of lowland dry forest in a prime state of conservation (Tun *et al.* 1998; Rzendowski 1986).



Mangroves are found throughout Ría Celestún

Endemic plant species in the coastal sand dunes of Celestún include: *Matelea yucatanensis*, *Exostema caribaeum* and *Spermacoce confusa*. Other noteworthy endangered species include palm trees: chi'it (*Thrinax radiata*), nakax (*Coccothrinax readii*), kuka (*Pseudophoenix sargentii*) and *Sabal gretheridae*, which is classified as rare. Of the agavaceous family: *Beaucarnea pliabilis* is considered endangered on a region-wide scale (Tun *et al.* 1998).

The wide diversity of fauna in Ría Celestún includes 304 bird species, including resident and migratory (García & Vigilante 1989). Of this group, coastal and swamp species include egrets (Ardeidae), ducks (Anatidae), gulls and a variety of migratory species such as sandpipers that fly south from the North American continent (the United States and Canada) during the winter. The region is a resting, feeding and nesting area for the pink flamingo (*Phoenicopterus ruber ruber*), similar to Ría Lagartos Biosphere Reserve, where it tends to nest (Espino-Barros 1989; Espino-Barros 1989; Hernández & García 1976). There are around 28,000 flamingoes that have been counted during December and February in their natural grounds along the Yucatán Peninsula (Espino-Barros 1989).

According to the 1994 Official Mexican Ecology Regulation 059 (NOM-059-ECOL-1994) which lists birds in endangered categories (1994 Official Gazette), in Ría, seven species are considered in need of special protection, 21 are rare, 18 are endangered and five on the verge of extinction, including the royal teal (*Cairina moschata*), lesser sea petrel (*Sterna antillarum*), Jabirú (*Jabiru mycteria*), king vulture (*Sarcoramphus papa*) and the white-fronted goose (*Anser albifrons*). Endangered species include the Yucatán parrot (*Amazona xantholora*), rufous egret (*Egretta rufescens*), lesser yellow-headed vulture (*Cathartes burrovianus*), wood stork (*Mycteria americana*) and the peregrine falcon (*Falco peregrinus*), also listed in CITES Appendix I. The International Union for the Conservation of Nature (IUCN) lists (*Charadrius melodus*) as vulnerable. Endemic species include the Yucatan wren (*Campylorhynchus yucatanicus*), which appears to depend on the coastal sand dune clumps, where it is more numerous than in any other kind of vegetation, and the Mexican Sheartail (*Calothorax eliza*) (Birdlife International 2001; IUCN 2002).

Some 75 mammal species have been registered to date, broken down in 11 orders and 26 families. Chiropters account for most of these species, followed by rodents and carnivores. This group is rarely endemic, and only rodents (*Peromyscus yucatanicus*) are found throughout the peninsula. According to the NOM-059-ECOL-1994 list, five of these species are rare, including the shrew (*Cryptotis mayensis*), cacomistle (*Bassariscus sumichrasti*) and the kinkajou (*Potos flavus*); eight species are endangered, including the anteater (*Tamandua mexicana*) and jaguarundi

(*Herpailurus yagouarundi*); and seven species are on the verge of extinction: the spider monkey (*Ateles geoffroyi*), the tayra (*Eira barbara*), ocelot (*Leopardus pardalis*), margay (*L. wiedii*), jaguar (*Panthera onca*), tapir (*Tapirus bairdii*) and the manatee (*Trichechus manatus*) (Batllori 1986; Herrera & Trejo 1991; IUCN 2002).

In terms of amphibians and reptiles reported in the reserve, there are 13 species of amphibians in seven families and 64 reptile species in 18 families, 36 species of which are snakes. Four of these species qualify for special protection, 12 are considered rare, six are endangered, and three are in danger of becoming extinct (NOM-059.ECOL-1994). The hawksbill turtle (*Eretmochelys imbricata*) and Carey turtle (*Caretta caretta*) are other species on the verge of extinction (IUCN 2002; Rodríguez & Durán 1993), and a rare species is the swamp crocodile (*Crocodylus moreletii*). There are 15 endemic species which are fairly common throughout the peninsula, plus a Caribbean species that has only been found on the coast of the Yucatán in Mexico.

In Ría Celestún, 140 fish species have been registered, divided into 18 orders, 48 families of teleosteam and one suborder with six families of elasmobranchia. The Scianidae, Sparidae, Gerreidae and Lutjanidae families are the most representative as they are the most numerous of species. Some species are endemic, such as *Gambusia yucatanana* and others are subject to special protection, such as *Poecilia velifera* and *Cichlasoma urophthalmus* (NOM-059-ECOL-1994).

The reed marshes of Ría Celestún are an important haven, breeding, and feeding grounds for a wide variety of fish, mollusks and crustaceans, which are the basis of fishing, one of the principal productive activities in the area. Some key species for trading purposes are shrimp (*Farfantepenaeus spp.*), octopus (*Octopus maya*), blue crab (*Callinectes sapidus*), Mayan cichlids (*Cichlasoma urophthalmus*), catfish (*Arius melanopus*) and mullets (*Mugil spp.*). Species such as sea bass (*Epeniphelus morio*), durophagous stone crab (*Menippe mercenaria*) and octopus (*Octopus maya*) are being over-extracted using unapproved equipment and failure to follow established fishing bans (Gío 1996).

The macrocosmic ecological importance of the region where the reserve is located stems from the fact it defines a biological corridor split in relatively narrow strips between the eco-systems represented by Pantanos de Centla Biosphere Reserve in Tabasco; Laguna de Términos Flora & Fauna Protection Area and Los Petenes Biosphere Reserve in Campeche; the Ría Celestún, Campeche and Yucatán Biosphere Reserves; and El Palmar State Reserve in Yucatán (Herrera-Silveira 1991; Contreras 1993).

Management

Ría Celestún Reserve is run by the National Commission of Natural Protected Areas (CONANP), a decentralized entity of the Secretary of the Environment & Natural Resources (SEMARNAT). The reserve was created by decree in July 1979, which declared Ría Celestún a Fauna Refuge Zone. In 1988, this category was replaced by that of a Special Biosphere Reserve covering an area of 59,130 ha, although no new decree was issued. Finally, on February 28, 2000, the Official Federation gazette issued a decree for Ría Celestún Biosphere Reserve, covering an area of 81,482 ha. The reserve lies between Latitude 20° 59' 33.72'' and 20° 81' 37.74'' N and Longitude 90° 14' 23.10'' and 90° 31' 13.14'' W.

Management in charge of the reserve has a basic staff consisting of a director, a subdirector, an administrative employee, a department head, and an operative technician (CONANP 2001). The area has been assigned an \$80,000 federal budget by CONANP for operating expenses and salaries. A draft version of the management program was put together in the Year 2000, and is currently being revised. The program is broad based, tackling issues such as a description of the reserve in its physical, social and cultural components and an analysis of social problems and productive activities. Other issues include biodiversity, eco-systems, management programs and zoning of the protected area.

The management program considers two core zones, defined as the Northern Core Zone (7,035.75 ha.) and the Southern Core Zone (23,255.43 ha.), with a total area of 30,291.18 ha. The buffer zone is subdivided into 5 heterogeneous units which depend on ecological and social conditions, infrastructure or services, which will be subject to productive activities, defined as Controlled Use Subzones (Sustainable Use of Land-based Natural Resources in an area of 20,048.15 ha.), Aquatic Use (Sustainable Use of Water-based Natural Resources in an area of 22,779 ha.), Restricted Use in an area of 4,323 ha., Settlements in an area of 155 ha. and a Recovery Zone in an area of 3,886 ha. Only regulated scientific research and environmental education are permitted in the core zone. The idea of the core zone is to conserve ecological and hydrological processes in the reserve and preserve representative vegetation such as mangroves and grassy hillocks (CONANP 2000 draft).

The buffer zone aims to protect the core zone from exterior impact by regulating productive, recreational, educational, and research activities.

Human Influence

Today there are two communities legally established within the boundaries of the reserve: Celestún with 8,000 people, which is the headwaters of the Celestún Municipality in the State of Yucatán; Isla Arena with 500 people, which forms part of the municipality of Calkini, Campeche. Celestún's population began growing, swollen by migrants from nearby valleys, and the town was founded in 1718. At around this time, Isla Arena had just a floating population who used the area as a camp. In the mid-1940s, the fishing trade took off in the area. The area was linked up to the electricity grid in 1971, the roads were paved in 1977, and investment in the fishing sector consolidated fishing as the main source of income for the community. The main economic activities in the reserve are fishing, tourism, grass-roots salt mining, and extensive cattle-ranching and traditional subsistence agriculture in surrounding areas (CONANP 2000 draft; Andrews *et al.* 1998).



The town of Ría Celestún



Electrification in Celestún

Access to the reserve is via the Mérida state highway to Celestún, some 50 mi from the city of Mérida. Another way to get there is via the Calkini road to Isla Arena. There is also access by sea from the port of Celestún. Infrastructure in the town of Celestún includes a church, a municipal palace, a market, lighthouses for shipping and a few buildings near the beach. Celestún has a pier and a tourist look-out point with a waiting room and locales that sell arts and crafts. The town also has electricity and street lighting along the beach. Celestún's fishing industry features 749 small craft with outboard motors, and 2,292 fishermen. Isla Arena, meanwhile, has 245 small fishing craft and a group of 277 associated fishermen (Andrews *et al.* 1998).

Tourism mainly revolves around bird-watching tours in Ría, mainly to spot pink flamingo (*Phoenicopterus ruber ruber*). Tourism began as an economic activity 15 years ago. Some of the fishermen founded the first boatmen's associations to run tours of Ría, but received no training or information (DUMAC 2002 website). Today, routes have been established for the boat tours to protect the flamingo population, but these routes are not always observed (Andrews *et al.* 1998). Currently, the Yucatán Peninsula Bird Conservation Association (CAPY) is carrying out training workshops to prepare local certified eco-tourist guides. Barbara McKinnon runs the workshops.

Celestún Expeditions is a tourist agency that specializes in natural history and is staffed by naturalist guides trained by the Rare Center, Friends of Pronatura and Pronatura Yucatán Peninsula. The various eco-tourist activities being run in Ría Celestún include crocodile watching, jungle treks, kayaking, cycle tours, and conch and snail identification. Tourist services include a large-scale tourist hotel, three economic hotels and four lodges. It also features a tourist inn, 7 restaurants and a travel agency. An outside bus service covers the two routes that run to Mérida. In addition to the buses, there are also private vans that run a transport service for the local population. Today there are pharmacies and a health post. (DUMAC 2002 website; Andrews *et al.* 1998).

Conservation & Research

Conservation projects run by the management include restoration of the mangroves, protection of bird species, signposting, inspection, and patrolling. The patrols are run in coordination with the

Federal District Attorney's Office in charge of the environment (PROFEPA), but the lack of presence by both entities is evident, due partly to lack of personnel. Civil associations such as PRONATURA and Children and Offspring run the environmental education program, which includes workshops for eco-tourist guides and children, with backing from the reserve. PRONATURA runs several environmental education programs as well as treatment of garbage and organic waste. PRONATURA also helps start up training and environmental education programs run by CAPY (Andrews *et al.* 1998). The civil association BIOCENOSIS runs a training program to manage intensive cattle ranching in areas bordering the reserve.

There are several entities in charge of research projects within the reserve, such as the Center of Research & Advanced Studies at the National Polytechnic Institute (CINVESTA) which is currently running hydrology studies on the area, headed by Dr. Eduardo Batllori, mangroves ecology studies by Dr. Jorge Herrera, human ecology by Dr. Maria Eugenia Vega, and Social Aspects by Dr. Julia Fraga. Yucatán Autonomous University (UADY) runs monitoring of birds and land-based vertebrates, headed by Dr. Juan Chablé at the Zoology Department. At Ducks Unlimited de México A.C., David Alonso monitors birds and runs studies to gauge the effects of legal hunting and poaching on ducks, both in Celestún and El Palmar (state protected natural area), and the CICY (Yucatán Scientific Research Center) is working on lists of plant life and monitoring of endemic species, headed by Dr. Rubén Durán and Dr. Larqué.

Threats

Some of the foremost threats to the conservation of biodiversity in Ría Celestún Biosphere Reserve include:

- Lack of personnel at the reserve and PROFEPA
- Poor community relations
- Lack of information
- Uncontrolled tourism
- Approval of the management program
- Population growth in Celestún
- Pollution
- Roads and bridges blocking water flow
- Extraction of wildlife species
- Extensive livestock ranching

Lack of personnel at the reserve and PROFEPA

- The reserve basically has a workforce of five, including the director and administrator. The number of personnel assigned to Ría Celestún does not guarantee its protection, nor any control of activities that go on inside the reserve. PROFEPA, meanwhile, has a single inspector for the entire area (which also includes the protected natural areas “Ría Lagartos” and “Los Petenes”), meaning PROFEPA virtually has no presence in the reserve. Celestún townspeople have attacked inspectors, thereby aggravating the problem. (See Poor community relations (reported in the daily La Jornada on August 1, 2002, Mexico).

Poor community relations

Although there are only two towns inside the reserve, the government has long had a conflict-ridden relationship with the community of Celestún. The town suffers from a host of social problems such as alcoholism, drug addiction, family violence, lack of education (the average level of education is fourth grade of elementary school, including municipal authorities who never finished elementary school) and the population in general has a reputation of being aggressive. PROFEPA inspectors have been attacked on several occasions when attempting to sanction illegal fishing. There have also been confrontations with the people of Punta Arena over fishing rights. The lack of presence of personnel at the reserve has sparked ill feelings amongst the local population, and many inhabitants feel reserve workers are not interested in working with them. The local townspeople tend to create politically separate groups to solve their conflicts, and the people are accustomed to the protectionist attitude of the government and the help it provides.

Lack of information

Despite the fact the local population is aware they live within a protected natural area, they are unaware of the objectives, regulations, and borders of the reserve. Lack of education is due in some cases to the scant interest in the reserve, and in others to the failure of personnel to get the information across. In 1998, the state government, through the CULTUR foundation built a tourist inn at Celestún which provides services such as a waiting room and shops, but lacks an information office for the reserve. The lack of awareness about this information means that tourists and duck hunters in areas bordering the reserve where these activities are authorized, cross the reserve's northern borders where the park borders with El Palmar State Reserve, in some cases without even realizing it. Tourists exploring Ría are unaware of the measures needed to conserve the area, which is why often the regulation goes unheeded (for example, minimal established distances from where to look at the flamingoes).



These flamingos are startled because a group of boats have approached too close.

Uncontrolled tourism

Tourism in Celestún has become one of the area's main sources of income. Growth of tourism has been uncontrolled, and although efforts have been made to organize them into groups, such efforts have failed. Today, there are four Social Solidarity Societies that have received credit from the state government, but there are internal disputes among them, which have spurred them to work independently, competing with each other to serve tourists. As stated above, there is little tourist information, and today most tourism is channeled into boat rides around Ría, bringing major pressure to bear on the pink flamingo



Along the beach, unregulated tourism grows.

population (which is disturbed if boats draw too near, and by the sound of the engines).

Approval of the management program

Ría Celestún's management program is being revised for future approval. This process has been the source of conflict as the program contains regulations and norms that the local population does not agree with and claims it was not consulted about beforehand. In early 2002, a local newspaper published an article claiming Celestún's inhabitants had not given their approval for the management program. Like in the past, this problem has given rise to political movements amongst the fishermen. Some groups are in favor fishing regulations imposed by the management program, while others oppose them. The same conflict arises over the definition of octopus fishing grounds between the community of Punta Arena in Campeche and Celestún in Yucatán. The community of Punta Arena, which is somewhat isolated from the rest of the state, is urging Celestún inhabitants to respect its fishing grounds. Differences arising between fishing communities and the regulations proposed by the program are giving rise to groups who oppose the reserve.

Population growth in Celestún

The town of Celestún has grown a great deal in recent years due to migration and growing tourism. The main problem, however, is that this growth has lacked planning. The towns grew without either an urban development plan or ecological zoning. The area today has shantytowns and lacks investment in municipal services such as garbage collection, drinking water and sewage services. As a result, both the environment and living standards of the local inhabitants have been affected.



Illegal squatters set up settlements such the one above.



New settlements bring pollution to the estuary.

Pollution

Pollution is one of the most serious problems in the reserve. The quality of the air in the town of Celestún is poor due to the fact garbage is dumped in the open air, and fecal matter is exposed. Garbage disposal is a major problem and stems in part from the uncontrolled growth of the population, lack of urban services such as drainage, garbage collection, and a lack of environmental awareness amongst the population. The community of Isla Arena also lacks urban services such as drainage, drinking water and garbage collection, but to date pollution is under control due to the low population.



Much of the reserve is contaminated.



In the above photo, a pipe with untreated black water flows directly into Ría Celestún waters.

Roads and bridges blocking water flow

Roads and dikes built inside the reserve block water flow, killing off large areas of mangrove as the marshes stagnate. The northern area of the marshes has a serious stagnation problem caused by a bridge that crosses the river to the town of Celestún. The bridge does not allow the water to flow properly, directly affecting the flamingo population, as the northern stretch is a key feeding ground. The northwest area of the mangroves is drying up at a fast rate due to road construction from the southern border to the town of Punta Arena.

Extraction of wildlife species

The lack of park wardens and PROFEPA personnel enables poachers and wildlife extractors to carry out illegal activities such as chopping down trees (*Rhizophora mangle*, *Laguncularia racemosa*, *Ficus tecolutensis*, *Tabebuia rosea*), poaching (*Odocoileus virginianus*, *Tayassu tajacu*, *Ateles geoffroyi*, *Tapirus bairdii*), the capture of decorative and song birds, excessive hunting of crocodiles, adult turtles and their eggs. Plants are also illegally extracted, palm trees being the most common.

Extensive livestock ranching

One of the economic activities around the reserve is cattle ranching, which has become a threat due to the fact forest within the reserve is being cut down to make for grazing pastures. Grazing areas were opened up through harvesting trees for construction and fuel. Other areas used for livestock rearing are the result of slash and burn techniques. Fortunately, these areas are small due to the humidity and flooding in the region.

Recommended solutions

Lack of personnel at the reserve and PROFEPA

The lack of operating and financial capacity of the reserve management means it is unable to undertake the proper fieldwork needed for the conservation of the reserve. Some inhabitants, anxious to conserve their natural heritage, have expressed their discontent with personnel working at the reserve. Stronger links need to be forged between the community and personnel at the reserve. First, stronger links are needed in order to achieve consensus and thereby be able to approve the management program that would enable management in charge of the reserve to apply for alternative sources of financing, such as the Global Environment Fund (GEF), to hire more park guards. The reserve administration urgently needs to foment dialogue with the communities, as well as develop workshops, conferences, and question & answer sessions to provide more information on the specific objectives and goals of the reserve. These sessions could help curb doubts about the regulations and norms that govern the protected area and even achieve greater community participation. In addition, dialogue attempts could represent a way of getting entities such as PROFEPA to talk about their work and avoid conflicts with the local population.

Poor community relations

ParksWatch believes the first step towards changing attitudes amongst the communities is to start approach them, using strategies of social participation and collaboration between the reserve, PROFEPA and the members of the community. One strategy that could be applied is that of the institutions which have backed sound eco-tourist practices such as Yucatán Peninsula Bird Conservation (CAPY) and Celestún Expeditions. These entities have made the most progress approaching the communities and being accepted by them.

Lack of information

It has not been easy to spur dialogue between management and the communities due to the local fishing industry's economic interests and the political pressure that fishermen's associations can place on the state apparatus. Management in charge of the reserve needs to do more work to make the inhabitants more aware, promoting objectives, goals, and the norms of the protected area. Agreements are also needed with NGOs so that together they can run programs and strategies that need to involve the local inhabitants.

Uncontrolled tourism

Tour guides within the reserve need more training and a certification system. Tourism activities need to be diversified, as tourism is currently over-exploiting Ría and wasting the vast potential the areas has to offer for other recreational activities which do not endanger the area's biodiversity, such as hiking, cycling, bird watching and observation of other animals, or snorkeling and diving. The park also needs to upgrade signposting to make all visitors aware of the area's norms and regulations, particularly when large groups come to the area from other tourist areas. CAPY, meanwhile, is organizing workshops to train fishermen as tourist guides.

Approval of the management program

The management program is a basic tool to enable protected natural areas to function properly. An agreement with the local population is needed to publicize and implement the program. These agreements need to be coordinated by management in charge of the reserve and government institutions such as the governments of the states of Yucatán and Campeche, municipal authorities, CONANP, and civil organizations such as Pronatura and CINVESTAV. In order to get inhabitants of the reserve to give the management program their backing, it needs to be seen as a management tool and not a threat. Management needs to directly address the many social problems that affect the communities within the reserve, and the reserve's conservation.

Population growth in Celestún

The increase in Celestún's population is a result of increased economic opportunities in fishing, salt production and tourism. During the octopus fishing season, which runs from August to December, the population increases due to seasonal workers migrating to the port. Similarly, the salt mining season contributes to the flow of immigrants to Celestún. Tourism is a growing activity that is attracting migrants looking for jobs and who are demanding urban services. To handle inhabitants' problems, more investment is needed in municipal services, plus an urban development plan and ecological zoning. To ensure this, municipal authorities need to coordinate with management in charge of the reserve.

Pollution

Environmental education and proper information on the objectives and goals of the reserve could be the solution to solving the problems of pollution in the reserve. Although the municipality has attempted to take measures, such as hiring a group of women to sweep the town streets in the morning, the town lacks garbage containers, and the waste merely piles up. Stray dogs rip apart plastic garbage bags and spread the waste around, making all clean-up efforts a waste of time. Basic urban services are needed such as garbage collection and disposal, plus drainage to prevent pollution of surface and underground water supplies, due to waste dumped by the fishing industry and fecal waste left exposed. PRONATURA is currently running a program to build latrines in the community.

Roads and bridges blocking water flow

Work needs to continue on projects to rescue the mangroves and create canals to reestablish water flow. It is also crucial to consolidate the collaboration of authorities in charge of building roads and bridges. Management in charge of the reserve is now working on a mangrove restoration program and is looking to open up canals along the bridge to reestablish water flow. DUMAC, meanwhile, it is running a project to upgrade the mangrove swamps along the Remate-Punta Arena road northeast of the municipality of Calkini, Campeche. Here, the road blocked natural drainage, and restoration work plans to build five culverts 4 meters long in areas of faster drainage.

Extraction of wildlife species

The Celestún reserve currently lacks financing apart from its budget assigned by the Federal government, which means it is unable hire park wardens. The park could, however, copy a model implemented in other reserves to protect their natural resources. In these reserves, people from the community have formed patrols, but it is essential the inhabitants should develop an interest in protecting their resources, in order to ensure these measures work. This is why it is very important to foment awareness among the local inhabitants of the looming ecological crisis, the consequences and the alternatives left to them. PRONATURA has already launched several efforts to protect sea turtles, setting up beach patrols, collecting nests, researching and providing environmental education.

Extensive livestock ranching

The civil association Biocenosis has worked over the past six years on various fronts, with projects designed to change extensive ranching for intensive ranching. The association aims to help stop the burning of forestland for the spread of pastures, which have been brought under control.

Projects like Biocenosis need continuity to impose new concepts on intensive cattle ranching. Information is needed to describe the area and to teach people who live on the outskirts, so as to have them identify the borders of the reserve and to make them aware of the corresponding regulations, as well as development alternatives.

Conclusions

Celestún Biosphere Reserve is one of the best-conserved and largest mangroves in the Gulf Mexico and one of the most important wetlands on the Yucatán Peninsula. Together with El Palmar State Reserve in Yucatán and Los Petenes Biosphere Reserve in Campeche, the coastal corridor will make it possible to permit connectivity between types of coastal plant life on the western section of the Yucatán Peninsula.

The main challenge for management in charge of the reserve is to gain the trust of the communities and forge solid relations with the people of Celestún, opening up new means of dialogue and improving already existing ones.

More work is needed to shore up the component of inspection and patrols, as this service is deficient and its failure means that activities such as flora and wild fauna extraction continue unpunished. It is also urgent that residents heed the law that sets fishing bans for commercial species such as octopus, shrimp and blue crab caught on the edge of the reserve.

Pollution is a problem that affects the area on several levels, ranging from the urban problems in the town of Celestún, to garbage dumpers on the beach and mangroves, plus waste dumped by the fisheries industry. It is indispensable that institutions such as PRONATURA, Children & Offspring continue to run environmental education programs with schoolchildren, as well as spur the creation of groups of young conservationists (Celestún Ecological Group).

On the issue of tourism, management needs to promote research projects on the area's capacity to refill water tables, and the impact of tourism on the area's biodiversity, particularly the population of pink flamingo. Preliminary PRONATURA studies indicate that the number of fishing craft operating in the area has reached a ceiling, with up to 100 boats counted in a single day.

The management program is a basic tool for the proper functioning of protected natural areas, which means its publication and implementation should be made a priority.

References

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