



Park Profile - Mexico Pantanos de Centla Biosphere Reserve

Date of most recent on-site evaluation:

January 2003

Date of publication: August 2003

Location: State of Tabasco

Year created: 1992

Area: 302,706 hectares

Ecoregion: Tehuantepec humid forest (of Mexico, Guatemala, Belize)

Habitat: freshwater and saltwater marshes, mangrove, and medium and low semi-evergreen forest



Summary

Description

Pantanos de Centla Biosphere Reserve is located in the northeastern corner of the Mexican state of Tabasco and spans three municipalities: Centla, Jonuta, and Macuspana. The reserve is part of three basins: the north-central part of the reserve is part of the Usumacinta river basin, the eastern sector belongs to Laguna de Terminos basin, and the south-west portion is part of the Grijalva river basin. Overall, the area is part of one of the most important hydrological watersheds of Mesoamerica due to the incredible volume of water, the extent of the marshes and wetlands, and its wetland flora richness. The reserve was included in the list of *Wetlands of International Importance* in 1995 (RAMSAR).

Biodiversity

Pantanos de Centla is biologically rich and contains almost 12% of all of Mexico's aquatic and sub-aquatic vegetation. Experts consider the area the most important example of this type of flora and fauna in Mesoamerica; there are 569-recorded species. Some species include common cattail (*Typha latifolia*), dotleaf waterlily (*Nymphaea ampla*) and coontail (*Ceratophyllum demersum*). Some species under special protection include red mangrove (*Rhizophora mangle*), mahogany (*Swietenia macrophylla*) and *Vatairea lundelli*. There are 255 birds present in the reserve, including many migratory birds. There are 104 mammals, 68 reptiles, 52 fish, and 27 amphibian species. Species like jabiru (*Jabiru mycteria*), the muscovy duck (*Cairina moschata*), jaguar (*Panthera onca*), West Indian manatee (*Trichechus manatus*) and the Central American river turtle (*Dermatemys mawii*) are endangered species.

Threats

ParksWatch determined that Pantanos de Centla Biosphere Reserve is **critically threatened**, meaning that urgent solutions are needed to protect and maintain biological diversity. The most serious threats include: repercussions from designating core zones in areas with human settlements and petroleum installations, lack of personnel dedicated to vigilance, contamination, habitat destruction, widespread cattle ranching, unregulated fishing, poaching, and wildfires.



Mangroves along the Cometa Lagoon within the reserve, photo: Juan C. Bravo

Description

Physical description

Pantanos de Centla Biosphere Reserve is located in the northeastern corner of Tabasco. It is part of the Usumacinta and Grijalva river deltas. Its northern border is formed by the mouth of the San Pedro and San Pablo rivers as they spill into the Gulf of Mexico and the city of Frontera; its eastern border is the state of Campeche; the union of the Bitazales River with Grijalva River marks the southern limit; and it is bordered by the Porfias stream and the Villahermosa – Ciudad del Carmen highway to its west. Pantanos de Centla Biosphere Reserve is 302,706 ha (making up 12.27% of the state of Tabasco) and spans three municipalities: Centla (225,108 ha), Jonuta (65,651 ha) and Macuspana (6,280 ha) (Sánchez *et al.* 1988; INE, 2000).



Geographic location of Pantanos de Centla Biosphere Reserve, map modified from CONANP 2002.

The reserve is located in the Grijalva-Usumacinta hydrological region. The major rivers in the reserve are the Grijalva, with an annual volume of 27,013 million cubic meters, and the Usumacinta, with 55,832 million cubic meters. The Usumacinta River is Mexico's largest (INE, 2000). There are also several tributaries throughout the reserve, including Palizada, San Pedrito, San Pedro and San Pablo (Gómez-Pompa *et al.* 1995; Vásquez *et al.* 2000). Because of its discharge amounts, the Usumacinta – Grijalva Delta is considered one of the most important hydrological systems in Central and North American and is the 7th most important worldwide (Sánchez *et al.* 1988). There are several coastal lagoons in the reserve: Cometa Lagoon drains into the San Pedro and San Pablo Rivers; Coco Lagoon drains into the Grijalva; and the Corcho flows into Santa Anita Lagoon. These are small lagoons, yet they play an important role in the water cycle and are important for marine and freshwater species.

Soils in the reserve have been influenced by three factors: 1) the accumulation of alluvial sediments, 2) water over-flow from the rivers because of high precipitation in the upper basin, and 3) vegetation types (INE, 2000).

The reserve's climate is hot humid and sub humid, with high precipitation during the rainy season. There are two dry season, the first is during March and April and the second during July and August. The average annual temperature is 25.9°C. The topography is flat, varying from zero to seven meters above sea level (INE, 2000).

Biodiversity

Flora

Biodiversity within Pantanos de Centla has not been completely documented. The studies completed, however, do show that Pantanos de Centla is biologically rich and an important conservation site. Flora within the reserve responds to the distribution of water, geologic formations, soil type, and climatic conditions. Several studies have registered 569 plant species, from 118 families, grouped in eight major associations: (1) aquatic plant communities that occupy 68.1% of the reserve; (2) medium semi-evergreen forests dominated by black olive (*Bucida buceras*) that cover 6.4%; (3) low semi-evergreen forest of logwood (*Haematoxylon campechianum*) covering 0.3%; (4) mangroves covering 2% of the reserve; (5) matorral of Aztec rosewood (*Dalbergia brownii*) covering 1.8%; associations of (6) paurotis palm (*Acoelorrhapha wrightii*) and Texas palm (*Sabal mexicana*); (7) riparian vegetation covering 5.8%; and (8) crops and pasture 15.6% (Lot y Novelo, 1988; Lopez-Portillo, 1982, INE, 1997; Sol *et al.* 1993).



The aquatic communities are subdivided into three major vegetation types:

1. **Emergent aquatic vegetation** Characterized by pure stands of cattails (*Typha latifolia*), which generally grow between 1 to 3 m tall, sawgrass (*Cladium jamaicense*) and jointed flat sedge (*Cyperus articulatus*). Within the reserve, this plant community is impacted by the expansion of agricultural activities, water retention, and wildfires;
2. **Floating aquatic vegetation** This type of vegetation is concentrated in boggy lake environments where it exists with cattails. Species include: water hyacinth (*Eichornia crassipes*), common duckweed (*Lemna minor*), dotleaf waterlily (*Nymphaea ampla*, *N. odorata*) and water snowflake (*Nymphoides humboldtiana*), among others;
3. **Submerged aquatic vegetation** The primary species are coontails (*Ceratophyllum demersum*) spineless hornwort, (*C. echinatum*) and bladderwort (*Utricularia sp.*) and they are found in the swamps and marshes. This type of vegetation is the least studied within the reserve, and it seems to be diminishing (Lot y Novelo 1988; Sol *et al.* 1993).

Fauna

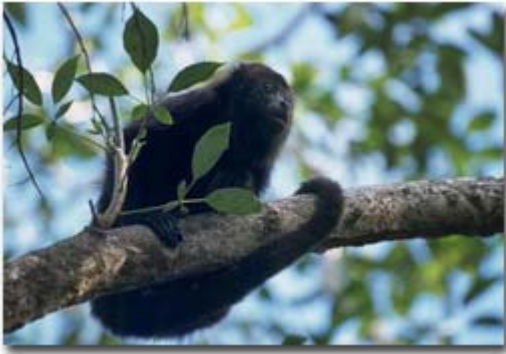
It is estimated that the reserve is habitat for 255 bird species, 104 mammal species, 68 reptile species, 52 fish species and 27 amphibian species (INE, 2000). All terrestrial vertebrates are represented in the reserve, thanks to the range of ecosystems. Focusing on the birds, there are both residents and migratory species, as well as aquatic and terrestrial species. Among the birds, the jaribu (*Jabiru mycteria*), the wood stork (*Mycteria americana*), Muscovy duck (*Cairina moschata*), peregrine falcon (*Falco peregrinus*) and the osprey (*Pandion haliaetus*) are found within the reserve (Correa y luthin, 1988; Martínez, 1988; Brazda, 1998; Ogden *et al.* 1988; Arriaga *et al.* 2000; Berlanga *et al.* 2001).



A migratory species finding refuge in the reserve

Among the mammals, there are West Indian manatees (*Trichechus manatus*), the paca (*Agouti paca*), white-tailed deer (*Odocoileus virginianus*), jaguar (*Panthera onca*), ocelot (*Leopardus pardalis*), mantled howler monkey (*Alouatta palliata*), among others. These are hunted mostly when the water level of the river rises because the animals migrate to the higher elevated zones to avoid the floods (Álvarez *et al.* 1988; INE, 2000.).

Different species of fish are found in the various aquatic habitats, the type of species usually depends on the salinity of the water body. There are also resident fish species and migratory fish species. Commercially important species include snook (*Centropomus sp.*), cichlids (*Cichlasoma fenestratum*, *C. urophthalmus*, *Petenia splendida*, *Tilapia sp.*) and the tropical gar (*Atractosteus tropicus*) (Chávez *et al.* 1988).



Mantled howler monkey (*Alouatta palliata*)
photos: Juan C. Bravo



Morelet's crocodile (*Crocodylus moreletii*)

Reptiles in the reserve include the Central American river turtle (*Dermatemys mawii*), white-lipped mud turtle (*Kinosternon leucostomum*), red eared slider (*Pseudemys scripta*), Mexican cross-breasted turtle (*Staurotypus triporcatus*), snapping turtle (*Chelydra serpentina*), iguana (*Iguana iguana*), black iguana (*Ctenosaura similis*), furrowed wood turtle (*Rhinoclemmys areolata*) and Morelet's crocodile (*Crocodylus moreletii*). There are also snakes, such as the Mexican vine snake (*Oxybelis aeneus*) and fer-de-lance (*Bothrops asper*) (Cabrera, 1988; Plata, 2002; Arriaga *et al.* 2000; Mazotti, 1988).

The amphibians are represented by a large diversity of frogs and toads, including *Rhinophrynus dorsalis*, *Bufo horribilis*, *B. valliceps*, *Rana pipiens*, and *R. Palmipes*.

Among the crustaceans are freshwater prawns (*Macrobrachium acanthurus*) and big claw river shrimp (*M. carcinus*) that are found in freshwater; blue crabs (*Callinectes* spp) and fiddler crabs (*Uca* spp) are found in the estuaries (either freshwater or marine); and white shrimp (*Penaeus setiferus*) in estuary and marine environments as well as coastal lagoons where it spends part of its life. Species of commercial value and ones that are intensely harvested include the white shrimp and freshwater prawns. These species are of great economic importance for the region (INE, 2000).



Fiddler crab (*Uca* spp)

Fauna of the reserve represent a source of protein for the locals. Although no studies have been completed to determine the populations of flora or fauna within the reserve, comparing the various studies with the Official Mexican Norms list, it appears that 199 species are threatened or vulnerable because of habitat loss or over harvesting.

Management

Pantanos de Centla was declared a biosphere reserve August 6, 1992 and encompasses a total of 302,706 hectares. Its management program was published in February of 2000. It is a complete document that includes biological, physical and socioeconomic information as well as diverse management and administration components.

The National Commission of Natural Protected Areas (CONANP), which is part of the Ministry of the Environment and Natural Resources (SEMARNAT), is responsible for administering and managing the reserve. CONANP has assigned five people to the reserve: a director, sub-director, an administrator, a departmental chief and an operations technician. There are also six park guards assigned to the area who carry out patrols. These guards are supplied by the non-governmental organization called “*Espacios Naturales y Desarrollo Sostenible*” (ENDESU, Natural Spaces and Sustainable Development) and lack legal authority to sanction any infractions (CONANP 2000, CONANP 2001). ENDESU also provides one technician.

The reserve’s central station is located at a place called, *Tres Brazos*, or three arms, and it is where the Usumacinta, Grijalva, and San Pedrito Rivers converge. *Tres Brazos* is accessible by land or water. The station is equipped to support reserve activities. There is space for 32 people involved in research or training activities. There is a laboratory, a multiple use room, and an administrative office with a small reference section. There is also a storage room and a dock. There are also two observation towers that are used for fire detection and bird monitoring activities. Finally, there is an interpretation center called *Casa del Agua* with educational information about the swamps and ecosystems of the reserve.



The reserve's decree divides the area into two core zones and a buffer zone. Core Zone I is located in the southern part of the reserve and covers 57,738 hectares. Core Zone II is in the northern portion and covers 75,857 hectares. The law states that within these core zones, certain activities are prohibited. Among the prohibited activities are private or public works; interrupting water flow; filling or draining the wetlands; hunting or collecting flora and fauna. The buffer zone encircles the core zones and covers 169,111 hectares (INE, 2000). This area has less restrictions, but it should be noted that the law prohibits establishing new population and states that any natural resource use (i.e.: use of flora and/or fauna) is to be done according to SEMARNAT regulations.

Legal limits are between 17° 57' 53", and 18° 39' 03" north latitudes and 92° 06' 39", and 92° 47' 58" western longitudes.

Human influence

According to the 1995 population census, there are 16,293 habitants living within the reserve. Sixty-eight percent of them living in Centla Municipality, 20% in Macuspana, 12% in Jonuta Municipality. All of the habitants are legal (INEGI, 1996). The human population is spread out in 72 communities, some of which have less than 500 habitants. Forty-six percent of the population is indigenous who mostly live in 19 communities, including Tres Brazos, Chichicastle, and Quintín Arauz. Their predominate language is Maya-Chontal. It is estimated that 4,159 people are engaged in productive activities such as fishing and agriculture.

Ownership of reserve land is split between various entities. Community lands, called "ejidales" occupy 53.1% of the reserve (distributed in both the core and buffer zones). The Mexican government owns 20.6% of the land (national land), and represents most of the core zones. Fifteen percent of the reserve is private property, with approximately 800 private owners. Federal zones cover 6.8% of the land, and the encircling zone covers 2.1% of the protected area. The remaining 2% of the reserve remains untitled (or at least, unaccounted for in the study that compiled the data) (Sánchez *et al.* 1988; INE, 2000).

Human settlements, in general, are found along the beaches, along the rivers, and littoral fringe. Private landowners are usually ranchers who also cultivate small gardens, gather coconuts, grow corn for autoconsumption, and fish. Settlements along the rivers usually engage in productive activities like fishing, harvesting fruit trees, raising chickens, growing gardens and agriculture. Settlements along the littoral fringe, or the transitional area between the marsh and the beach, usually ranch, harvest coconuts, fish, and cultivate corn for familiar use.



Home along the river, photo: Juan C. Bravo

Human health within the reserve is affected mostly by sub-standard sanitary conditions in which people drink untreated river water, lack a waste disposal system for both garbage and human waste, and home conditions promote infectious disease. Common illnesses include respiratory infections, gastro-intestine infections, dermatitis, ear infections, and yeast infections. Poverty is evident in the reserve as is child malnourishment (of children between 1 and 5 years). Within the reserve, there are 10 health centers and three “health homes” distributed in the three municipalities. Each health center has one doctor, one nurse, a health-care promoter and a chauffeur that serves as an educator as well. Despite the existence of health services, because of lack of staff and/or necessary equipment, in times of emergencies, the health system within the reserve is usually insufficient (INE, 2000; Orozco *et al.* 1988).

Federal Highway Number 180 provides access to the reserve: from Villahermosa to Frontera and to Ciudad del Carmen, the road runs along the western and northern parts of the reserve. The road from Villahermosa to PEMEX and Jonuta runs along the reserve’s perimeter in the south and east. One of the main roads is the 100 km, mostly paved highway from Frontera to Jonuta, which passes through the reserve from northeast to southeast along the right side of the Usumacinta River. Another access route is the highway between Villahermosa and Boca de Chilapa, which is mostly paved and runs parallel to the Grijalva River (Vásquez *et al.* 2002; Gómez-Pompa *et al.* 1995; INE, 2000)

Mexican Petroleum (PEMEX) has also constructed roads to access its exploration centers within the reserve. One such road, called “La Pera” extends 15 km within Core Zone II in the northern part of the reserve. Rivers are no longer used as main transportation routes, although families still use them to access certain plots of land or to get to the nearby roads.

Tourism

There is very little tourism in Pantanos de Centla Biosphere Reserve. There has been no investment in tourism infrastructure nor development of tourism companies in the area. The reserve’s center does not have any information regarding the number of tourists that do arrive. The reserve does not charge any entrance fees and does not directly earn money from tourism. There are two tourism cooperatives that serve as operators, made up of fishermen: *Servicios Turísticos Boca Tres Brazos* and *Servicios Turísticos Nueva Esperanza*. These fishermen offer boat rides through the marshes and serve as the tour guides during the rides. The closest hotels are located in Villahermosa, which offers a wide array of accommodations, including 5-star hotels. There are some more economical choices in Frontera and Jonuta (CONANP, 2003; Plata, 2002; INE, 2000).



Local fisherman guiding a tour of Pantanos de Centla Biosphere Reserve

Conservation and research

There is a lack of biological research in Pantanos de Centla, and many of the flora and fauna remain unstudied despite the importance of the Usumacinta and Grijalva River Basins and despite being the largest wetland in Mesoamerica. PEMEX, the Mexican Petroleum company, has carried out several studies, mostly because of its oil interest in the region.

Dr. Alejandro Novelo and Antonio Lot studied the aquatic vegetation in the past. Gordon Thayer studied mangroves as habitat and refuge for fish. Jorge Correa and Barbara Mackinnon studied migratory birds within Pantanos de Centla wetlands, as the wetlands serve as important resting, feeding and breeding grounds (INIREB-T y Gob. del Estado de T, 1988).

Reptiles, including Morelet's crocodile (*Crocodylus moreletii*) were studied during the 1980s by Alejandro Cabrera and Frank Mazzotti. Studies on the marine mammal, manatee, were initiated by Carlos Álvarez, Anelio Aguayo and Lisa Johnson. There have also been studies analyzing the economic and environmental impact on the ecosystem by natural resource exploitation, such as forestry and oil extraction. For example, Mario Ortiz conducted a geomorphological study of the littorals using aerial photographs; Raul Lopez and Joel Zavala studied impacts from the petroleum industry in flood zones; and Ariel Martinez studied ecological reserves and regional development (Gómez-Pompa *et al.* 1995).

The University of Tabasco (Universidad Juárez Autónoma de Tabasco) and private organizations like the Investigation System of the Gulf of Mexico (Sistema de Investigación del Golfo de México—SIGOLFO) and PEMEX, have carried out several important research projects in various disciplines, such as the effects of pesticides on humans, evaluation of the aquatic habitat, waste water treatment, aquatic fauna inventories, and water quality monitoring (UJAT Website, 2003)

The Nature Interpretation Center is called “UYOTOT-JA,” which is a Chontal expression meaning House of Water (La Casa del Agua in Spanish), and is located at the confluence of the Grijalva and Usumacinta Rivers. It was opened to the public in 2002 and its mission is to

increase visitor awareness on the wetland ecosystem and help stimulate ecotourism. Within the center, there is information on environmental services, wetland functioning, and biodiversity. The wetland trail highlights charismatic animals like crocodiles, manatees, and eagles. The center is co-operated by the reserve's management, the NGO Espacios Naturales, and the tourism cooperatives. The center was financed in part by PEMEX.

Threats

- The reserve's zoning
- Human settlements in the core zones
- Petroleum activity
- Lack of vigilance personnel
- Pollution
- Poaching
- Unregulated fishing
- Habitat destruction
- Ranching
- Wildfires

The reserve's zoning

The reserve's management program has not been clear and within the program there are serious contradictions between what is actually permitted in the core zone and what should be permitted according to the law. According to the General Ecological Equilibrium and Environmental Protection Law (LGEEPA), biosphere reserves should have core zones in which all natural resource use, and any alteration to the ecosystems, flora and fauna is prohibited. But, in Pantanos de Centla Biosphere Reserve, PEMEX oil extracting installations are located within the core zone as are communities that carry out fishing and hunting (López y Zavala, 1988). Allowing these activities in the core zone goes against the very definition of a biosphere reserve and is a constant source of weakness for the protected area.

Human settlements in the core zones

The existence of communities within the protected area, especially within the core zones, provides evidence of the growing populations of nearby cities, such as Frontera and Quintín Arauz. This unregulated urban sprawl makes providing basic human services (like clean water, electricity, and waste disposal) practically impossible. In addition, the natural environment is severely impacted. Taking the law into account, the human settlements are actually illegal within the core zones. It is clear that human settlements within a biosphere reserve core zone is unacceptable and will only threaten the very existence of the protected area.

Petroleum activity

Oil exploration and extraction has occurred in the region since before the reserve was declared. Core zones were declared in areas where PEMEX worked: within the reserve's core zones there are 18 oil exploration camps, 31 oil wells, and supporting infrastructure! Although there are no studies comparing changes in ecosystem function or structure since PEMEX began working in the region, there are studies showing the extremely damaging effects of accidents associated with oil extraction. It is also possible to compare pristine areas—ones without deforestation, without water-flow alterations, and without direct contamination—to Pantanos de Centla to show that the area is being negatively impacted by oil extraction. And, potential accidents could destroy Pantanos de Centla entirely.



PEMEX boats, photo: Juan C. Bravo

Lack of vigilance personnel

The park guards before mentioned are part of a NGO program and do not have legal status to enforce environmental laws. The Federal Environmental Protection Procurator's Office (PROFEPA) does have one inspector assigned to the protected area, but one is simply not enough to make a difference in this reserve where environmental laws are not followed, and possibly not even known. Miscommunication between federal authorities and local authorities also adds to the overall lack of control of illegal activities within the protected area.

Pollution

As was mentioned earlier, PEMEX operates in the reserve. Some of its infrastructure and wells are over 40 years old and require constant maintenance. During maintenance operations, leaks are common and threaten public health and ecosystem health. In addition to contamination from oil activity, fishing also contaminates the area—many of the fishing boats dump waste into the wetlands and rivers. The communities also contaminate the reserve by dumping and burning garbage.

Poaching

The most sought after species are the white-tailed deer, paca, armadillo, and manatee. These and other species are usually hunted when flood waters cause the rivers to rise, because that is when the animals move to higher ground. This fact is well known by locals who take advantage of flooding to easily hunt these animals.

Reptiles such as Morelet's crocodile, Central American river turtle, and the iguana are hunted and consumed, mostly as a source of protein. The white shrimp and big claw river shrimp are intensely fished, as they can reap high prices and are main economic income for the region. It is unknown if these species have been over fished because of lack of baseline data, but their populations are surely impacted by the intensity of their extraction.

Raccoons (*Procyon lotor*) and porcupines (*Coendou mexicanus*) are also hunted, but not for consumption. These animals are considered pests that can destroy local small-scale farmers' crops and are therefore killed.

Unregulated fishing

Fishing is the most important economic activity in the region. Habitants fish for subsistence and as a source of income. The smaller sizes of the fish caught are evidence that this resource is under heavy pressure and has probably passed the sustainable yield threshold. There are no fishing regulations in place regarding fishing techniques, fishing seasons, or size restrictions and there are no monitoring activities whatsoever. Within the reserve, in the core and buffer zones, there are 43 fishing organizations made up of 2000 fishermen, that have authorization to fish in the reserve.



Rural fisherman

Habitat destruction

Many vegetative associations within the reserve are seriously threatened by anthropogenic activities. Aquatic vegetation is burned during the dry season in order to prepare the area for pastureland and to increase pasture land holdings. The remaining forested areas are deforested to harvest the timber for use in home construction and to clear new areas for agriculture. Logwood (*Haematoxylon campechianum*) has typically been harvested for commercial purposes, previously for industrial purposes and currently in home construction. Mangroves are also being deforested in an attempt to create more pastureland, to build roads, and for its wood—mangrove wood is used in charcoal production and in home construction.

Cattle ranching

Cattle ranching is an increasingly popular activity. It is also destroying the swamps and wetlands. Turning swamps into pastureland is a common trend and is considered one of the most damaging human impacts within the reserve. Currently, pastureland covers 15% of the reserve's total area (INE, 2000).

Wildfires

During the dry season, the fires are caused by local habitants looking to expand their land holdings. The locals burn parts of the swamp in order to turn it into pastureland for their cattle grazing. Fires are also caused by burning agricultural fields and trying to extend those fields into areas dominated by aquatic vegetation. Finally, fire is used during hunting to drive out the animals. All of these uses are destructive and tend to get out of hand, creating larger-scale wildfires.



Cattle within Pantanos de Centla



A fire within the reserve photos: Juan C. Bravo

Potential future threats

Construction of the hydroelectric dam: Boca del Cerro

Pantanos de Centla Biosphere Reserve is threatened by the construction of the hydroelectric dam called Boca del Cerro in Tenosique. This hydroelectric dam project has been in the works for more than 10 years; now it is part of Vicente Fox's **Plan Puebla Panamá** (PPP) for southeastern Mexican and Central American development. Until now, the plan has remained out of public eye, but some media sources and conservation organizations report that work related to the dam's construction has begun, including technical and prospecting studies. Without doubt, constructing a dam at Boca del Cerro is a serious threat to the reserve as it could destroy much of the reserve and its biodiversity. Some simulation models suggest that many Mayan archeological sites, including Yaxchilan in Chiapas and Piedras Negras in Guatemala, could be destroyed and lost under water as well.

Recommended solutions

Reserve zoning

Zoning within the reserve does not make sense. It creates a situation in which protection and conservation within the core zones is not possible because of extractive resource uses. First of all, 46% of reserve habitants are indigenous communities and are probably not familiar with the National System of Natural Protected Areas conservation models. So, creating a reserve where almost half of the inhabitants have no information about biosphere reserves in itself is an immense disadvantage for the reserve. Second, at the time of the reserve's creation, many activities—which had been occurring for years—were all of a sudden against the law. Core zones were delineated in areas with existing communities, urban development, and well-established industrial activity (PEMEX). No wonder the reserve is threatened—the legal contradictions are obvious and overwhelming.

In addition to the poor design of the reserve, it is practically impossible to enforce the stipulation that no new infrastructure is to be built in core zones: PEMEX operates in core zones and had been operating there for years before the reserve was declared. Since there are no plans to stop PEMEX from working in the reserve, and there probably never will be, they must be allowed to maintain and/or upgrade their infrastructure, which means construction. One idea, therefore, would be to increase coordination and communication between the reserve managers and the company, so that the reserve managers would be aware of new projects and developments and could ensure that the company follow environmental regulations and comply with environmental mitigation requirements.

Human settlements in core zones

Implementing the management program is a near impossible task because of human settlements and urban centers. We at ParksWatch believe that the reserve should be re-zoned and that human settlements and industrial activities should be left out of the core zone. By excluding these major threats from the core zones, it might actually be possible to control the core zones. While there may be other ways to mitigate the threats and protect the reserve, they will most likely take many years to implement and in the meantime, the ecosystem health will deteriorate and biodiversity will be lost.

Petroleum activity

PEMEX promises to maintain and conserve ecosystem and ecosystem health where it operates and it promises to minimize adverse impacts caused by its activities by modernizing its infrastructure, utilizing innovative, safer, less-contaminating technology. It should also be noted that the company has also agreed to follow environmental regulations put forth by SEMARNAT. PEMEX has also invested financial resources to study the ecosystem and species, and for several restoration projects. Nonetheless, the environmental regulators must ensure that PEMEX is complying with the regulations and is properly using the resources to best promote conservation and social well-being.

Lack of vigilance personnel

Environmental consciousness should be instilled within the local community. A permanent information campaign is needed, including environmental education, throughout the entire region. It may be worthwhile to join forces with Laguna de Terminos Biosphere Reserve, since their wetlands are interconnected.

Another idea is to involve the locals in the protection and vigilance of the natural resources by creating community committees. Within the committees, PROFEPA should be involved in order to train the community members and provide them with the legal information they need to enforce the environmental laws for the reserve. Those engaging in illegal activities should be punished to create a precedent and hopefully make people think twice about their impacts on the reserve.

Pollution

With the fishing cooperatives, an anti-dumping campaign should be implemented and they should be better trained on fuel management (to avoid leaks and dumping). Garbage dumping also must end and the reserve should work with the respective municipalities (Centla, Jonuta and Macuspana) to implement the garbage collection, transportation, treatment, and final disposal system that is outlined in the management program. We also suggest a campaign promoting reuse and recycling.

Poaching

More research is needed regarding the population dynamics of the species that are hunted for food. Research is also needed to evaluate the feasibility of implementing a regulated, sustainable use plan possible through the Management and Sustainable Use Governmental program (UMAS). Like, for example, are there going to be enough officers available to actually implement such regulated hunting, and what is the sustainable harvest of the species in question? These questions are difficult ones that must be answered before an UMAS program attempted, otherwise it will just be another failed attempt at protecting this reserve.

Unregulated fishing

Fishing must be regulated, both traditional auto-consumption style fishing and commercial fishing, according to the water bodies' capacity. First, allowable fishing tackles and techniques need to be determined and then fishing seasons decided. Temporary fishing bans should be implemented at certain times of the year (i.e. during reproduction) and in certain areas that are over fished. Regulating fishing within the reserve should include a rotating system, in which certain areas of the reserve are closed so that local fish populations can recuperate and then reopened. Catch sizes should also be determined and regulated. Aquaculture, using native species, could be promoted as could repopulating over-exploited species.

Habitat destruction

There are no legal forestry activities within the reserve, but it is well known that locals cut trees all the time. It seems that reserve authorities accept this auto consumption and consider it low-impact. As was explained before, the mangrove is cut for various uses, and is even commercialized. Therefore, stopping mangrove deforestation should be a priority. The focus should be on those people and industries cutting mangroves for commercial, money-making purposes. Actually, the law states that anyone engaged in illegal extraction or harming of wetlands, mangroves, swamps and lagoons found within protected areas are subject to 10 years in prison. The law should be enforced.

Authorities should also pay attention to those people making charcoal and regulate their activity, as they utilize mangrove trees in charcoal production. The management program actually mentions some of the sites and people involved in this economic activity.

Cattle ranching

Traditionally, raising cattle in this zone has been low-intensity, of low financial investment: usually cattle are just released to go graze on the public lands. This has also led to relatively low yields. In order to reduce their impacts on native vegetation in the reserve, one idea is to work with governmental and private creditors to help ranchers and farmers gain access to finances in order to intensify their production. This way, the cattle use less space, people do not have to convert natural areas to pasture lands and native vegetation is conserved, and the cattle are ready for market sooner. It is important to note, however, that intense management of cattle brings with it other environmental considerations that could also impact their area and this option should be considered only as a last resort if other ideas, like removing the cattle from the area, turn out to be impossible.

Another idea is to move from cattle ranching to raising other farm animals, which can be kept on smaller land plots, such as pigs, chickens, and ducks. The Secretary of Agriculture, Ranching and Rural Development (SAGARPA) could coordinate efforts with SEMARNAT in order to promote such a production change. Again, environmental impacts of these farm animals (such as waste management) must be assessed before implementing such an idea. If the negative environmental/ethical impacts associated with raising these animals in confined areas prove to be more severe than wide-range grazing, they should not be implemented.

Fires

In order to prevent wildfires, a year-long information campaign is needed. This should be coordinated with the Forest Fire Prevention Program and supported by the reserve. Community promoters should be used in this campaign and should inform locals of wildfires devastating impact on the reserve. They should even encourage farmers to inform the reserve's management when they plan to burn.

Using fire for hunting should be punished by the law because this unsustainable practice could create an uncontrollable fire and cause large flora and fauna losses.

Hydroelectric dam construction at Boca del Cerro

Even though Plan Puebla Panamá (PPP) is not transparent and dam plans are not public, the conservation community must stay on top of this potential dam construction, as it threatens the most important wetland system in Mesoamerica and Mexico. The time to prepare for this development project and pressure the government is now. The federal government should be forced to comply with its international agreements to protect its natural resources, such as RAMSAR. In Chiapas and Tabasco where communities and private property will be affected, community demonstrations against the dam and PPP have already been carried out. We call on society and the conservation community in Mexico and Guatemala and those international organizations that work in these countries to let their voice be heard. Write to the Mexican government and give your opinion on the Boca del Cerro dam.

Conclusions

Pantanos de Centla along with the wetlands of Campeche form the largest wetland zone with important aquatic plant communities. Within the reserve, the aquatic vegetation is the most diverse of all Mesoamerica. In Mexico, it is the most important hydrologic basin in the country and it is among the top ten most important throughout the world because of the sheer amounts of water and its overall size. These attributes have made the Mexican government commit to its conservation by adding it to the RAMSAR list of *Internationally Important Wetlands* in 1995.

Pantanos de Centla Biosphere Reserve is **critically threatened** and urgent solutions are needed if its biodiversity and ecological integrity are to be maintained and conserved. The most serious threats are seen in the core zones and include human settlements, PEMEX oil activity, and the residents' productive activities such as fishing, hunting, ranching, and habitat destruction. At ParksWatch we believe that the current zoning situation has created confusion and lack of clarity in applying the administrative regulations. This in turn has led to a situation where resource use, flora and fauna use, and industrial development occurs and is sanctioned in the reserve's management program, which allows these uses as long as they are "regulated." In reality, the uses and activities are not regulated and instead are overused because of lack of personnel and failure to apply the laws as they were intended.

ParksWatch believes that the reserve should be rezoned and that the main threats, PEMEX and the human settlements, should be left out of the core zones. We also suggest working closely with the communities in environmental education and provide them with information regarding the reserve and zoning regulations. The other option we see is to enforce the regulations for the existing core and buffer zones. That will require intense work and negotiation with the

communities to come to a conservation agreement for the reserve. The reserve's management and PROFEPA will have to be involved on a permanent basis, providing support, additional personnel, inspections, monitoring and vigilance. They will also have to enforce the law.

Without doubt, it is also important to think about economic alternatives for local communities, in order to diversify their production habits and lessen the pressure on the local flora and fauna. Ecotourism has been mentioned in various meetings and documents, but it has yet to be developed in this reserve in a way to attract visitors. One group with ecotourism experience in Mexico is the RARE Center and they have developed ecotourism in other protected areas.



Pantanos de Centla, Cocos Lagoon, photo: Juan C. Bravo

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