



PARKS WATCH

Strengthening Parks to Safeguard Biodiversity

Park Profile– Guatemala Chocón Machacas Protected Biotope

Last field evaluation: December 2003

Publication date: December 2003

Location: Municipality of Livingston, department of Izabal

Year created: 1989

Area: 6,245 hectares

Ecoregion: Central American Atlantic moist forest

Habitat: Aquatic and riparian associations, lowland flood forest, highland forest



Summary

Description

The Chocón Machacas Protected Biotope is located in eastern Guatemala, in the municipality of Livingston, department of Izabal. Although officially declared a protected area in 1989, the University of San Carlos has been working in the biotope to preserve manatees (*Trichechus manatus*), forests and bodies of water of the Chocón River basin since 1981. One zone of the biotope is within the boundaries of Río Dulce National Park, in the northern section of a location called Golfete (“Small Gulf”). This area harbors a very complex hydrologic system that includes the sea, a lake and several rivers, all of which bestow upon it very special characteristics.

Biodiversity

Very few updated studies exist of the area; those available report 130 bird, 31 mammal, 31 reptile and amphibian, and 82 fish species for the area. Other papers report that the biotope might have a high diversity of aquatic flora. Among the most important fauna of the area, the king vulture (*Sarcoramphus papa*) and the orange-breasted falcon (*Falco deiroleucus*), are included in CONAP’s Red List. The neotropical otter (*Lutra longicaudis*) is included in CITES’ Appendix I, and three turtles, the Tabasco mud turtle (*Kinosternon acutum*), the Mexican giant musk turtle (*Staurotypus triporcatus*) and the slider turtle (*Trachemys scripta*), as well as the manatee (*Trichechus manatus*), have been included in IUCN’s Red List.

Threats

Although the biotope’s area is **critically threatened**, efforts to protect and preserve its biological diversity have not been successful. Recovery demands emergency actions. The main threats are due to permanent human intervention; invasion of the protected area; the advance of the agricultural and cattle frontier; illegal extraction, hunting and

fishing; and lack of institutional control of the area. The biotope's forest has been isolated by the fragmented surrounding habitat.



A view of the entrance to the area's operation center, in the southern portion of the area (photo © PW—Guatemala)

Description

Physical description

The Chocón Machacas Protected Biotope is located in eastern Guatemala, in the municipality of Livingston, department of Izabal. The name stems from a river that flows through the central area of the biotope. The southern zone of the biotope is within Río Dulce (“Sweet River”) National Park’s boundaries (CEMEC/CONAP, 2001), which is a protected area in itself. The northern sector is bordered by agricultural and cattle farms; Río Dulce is the southern boundary; the Cáliz community and the national park are the natural boundaries to the East, and the Ciénega river is the western boundary. Although the area is not vast, the fact that it shares the complex water system of the Río Dulce National Park is pivotal to the many species it harbors. A considerable part of the biotope is particularly fragmented, and



View of the protected area, taken from Golfete (southern border) towards the northwest (photo © PW-Guatemala)

it is surrounded by agricultural and cattle lands that are extremely deforested.

The soils of the protected area are calcareous, shallow and drain poorly (CECON, sf.) The biotope's landscape is mostly between flat and slightly rolling; the highest altitudes are found in the western bank of the Chocón River, and the many hills in the East extend into areas beyond the protected region. The lower regions are 10 m ASL; the highest can reach 280 m (CDC/CECON, 1995). Climate is warm and very moist; although seasons are not clearly marked, between January and April rainfall diminishes. Annual average precipitation is slightly over 5,700 mm, and varies between 3,000 mm and 6,000 mm (CECON, sf). The average temperature is 27° C, which rises to 9° C between maximum and minimum; during cold periods it seldom falls under 18° C (CDC/CECON, 1995).

Abundant water is one of the most evident characteristics of the Chocón Machacas Protected Biotope, which profits from the Chocón River, which flows throughout the area and divides the biotope in two distinct halves, plus seven minor rivers (locally called “creekes”) and five lagoons. The area's flat grounds are prone to flooding during parts of the year. The Ciénega River is the natural western boundary; Río Dulce is the southern limit.

Biodiversity

Flora

Per Dinerstein et al's classification (1995), the biotope belongs to the Central American Atlantic moist forest ecoregion category. The heterogeneous vegetation of the area is typical of inundated zones and is represented by several families that have adapted to the many aquatic environments. Lands prone to flooding account for more than 50% of the protected area (FUNDAECO/CECON, 2001). The most abundant habitats are lowland flood forest, highland forest and mangrove forest (Pérez *et al.*, 2001). Plant groups associated with the many bodies of water are evident in the area. One important part of the biotope is under heavy human pressure, and grasslands and agricultural lands slowly creep upon the forest. Human illegal invasions of the area are abundant.

Lowland Flooded Forest

This type of forest thrives in grounds prone to periodical flooding, in marshes that locals call “swampos”, generally around rivers and close to the lagoons in the southern area of the biotope. It is a medium-height forest, with trees between 15 and 20 m and rare individuals that project beyond the average canopy. The canopy is mostly sparse, which promotes a thick and complex understory of palm trees. The prevalent tree species, chew stick (*Symphonia globulifera*), anta María (*Calophyllum brasiliense*) and water chestnut (*Pachira aquatica*) (CONAP, sf), mix with the corozo palm (*Orbignya cohune*) and *Cyclanthus* sp understory.



Detail of the lowland forest dosel (photo © PW-Guatemala)

Highland Forest

It thrives in grounds not prone to flooding, generally in the central and eastern areas of the biotope. It develops in slopes or flat grounds, which apparently varies the flower composition (CONAP, sf). It is a well-developed and exuberant forest, with high trees and the occasional individual that projects beyond the canopy. Treetops are dense and at least three forest strata are evident: the highest up to 30m; intermediate, between 18 and 20 m, and the inferior, between 12



A view of the highland forest (photos © PW-Guatemala)

and 15 m. Although flat grounds are not prone to flooding, the slower drainage surely determines the presence of species that belong to flooded grounds, such as the water chestnut (*Pachira aquatica*) and chew stick (*Symphonia globulifera*). The understory abounds with ferns such as *Pterocarpus officinalis*. Some species, as *Pouteria* sp. and the tourist tree (*Bursera simaruba*), grow in slopes, which drain easily and faster, and are seldom found in rocky soils.

Mangrove forest, riparian and aquatic associations

There are different riparian and aquatic associations in the biotope. One of the more resilient communities is the mangrove forest, which is distributed almost exclusively in the southern part of the protected area. The canopy is very homogeneous, often of low height and does not grow beyond 5-8 meters, although some individuals protrude many meters above the average canopy. The mangrove (*Rhizophora mangle*) is the dominant species, although chew stick (*Symphonia globulifera*), Santa María (*Calophyllum brasiliense*) and water chestnut (*Pachira aquatica*) are also present (CONAP, sf). In some riparian places, there are well-established shrub formations of *Chrysobalanus icaco* (Pérez *et al.*, 2001), which are as tall as or slightly shorter than the mangrove. The dragon blood tree (*Pterocarpus officinalis*) thrives in small isolated patches. Associations of *Nymphaea ampla*, *Cabomba paleaformis*, *Ceratophyllum demersum*, *Utricularia* sp. are evident in water communities, whereas *Vallisneria americana* and *Potamogeton illinoensis* are found in other places (Pérez *et al.*, 2001).



General view of the mangrove habitat (photo © PW-Guatemala)



Detail of aquatic vegetation in one of the lagoons within the biotope (photo © PW-Guatemala)

Fauna

Although some research has been carried out in the area, a few updated studies show the biodiversity status of Chocón Machacas. Among the very scant information available on the presence of major felines, Balas and Polisar (2001) report occasional sightings of jaguars (*Panthera onca*) in the area. Updated studies of the area report 130 bird, 31 mammal, 31 reptiles and amphibian, and 82 fish species. Preliminary studies indicate that the biotope might harbor an important diversity of the total Guatemalan aquatic flora. Among the prevalent fauna, one of the most important is the manatee (*Trichechus manatus*), although area inventories indicate that they are not particularly abundant (PNUMA, 1995). The neotropical otter (*Lutra longicaudis*) is one of the most common species. The crocodile (*Crocodylus acutus*) has become extinct (CECON, sf) due to illegal hunting.

The biotope's fauna includes several birds, such as the king vulture (*Sarcoramphus papa*) and the orange-breasted falcon (*Falco deiroleucus*), which are included in CONAP's Red List. The neotropical otter (*Lutra longicaudis*) is mentioned in CITES' Appendix I, and three turtles, the Tabasco mud turtle (*Kinosternon acutum*), the Mexican giant musk turtle (*Staurotypus triporcatus*) and the slider turtle (*Trachemys scripta*), as well as the manatee (*Trichechus manatus*), appear in IUCN's¹ Red List (2003).

Management

In 1989, the Protected Areas Law Decree 4-89 established Chocón Machacas as a Protected Biotope. The Conservation Studies Center of the University of San Carlos, however, had initiated conservation efforts there in 1981 and has since managed the area (CONAP, sf). Government Agreement number 1057-92 of the Ministry of the Interior established and approved

¹ The tree turtles as LR and the manatee as VU

the geographical boundaries of the area, which is the property of the State². Institutional presence has been feeble, to say the least, since the declaration; illegal activities have never been prosecuted and have therefore become more blatant. In 1993, the boundaries of the protected area were established and efforts were made to divide up land between two communities that were inside the biotope, which might result in a reduction of some of Chocón Machacas' area in the future.

The biotope staff includes one manager, 8 stewards and 2 forest rangers. Field personnel, who work 22 consecutive days and rest during 8 days, are in charge of custodial tasks, tourist services, facilities maintenance and surveillance of the protected area. Work is carried out during the day; only one person remains in charge of the protected area during the night. There is an evident lack of control of the protected area due to the working arrangements, staff vacation and loss of employees. The staff's payroll is covered by funds provided by the University of San Carlos de Guatemala through CECON.

The biotope's management plan dates back to the time when the area was declared as protected and has not been updated to meet present needs, although CECON is currently finalizing a new master plan for the upcoming five years. Three programs –management, public use and administration– are used to manage the area. Most of the conservation objectives of the protected area prescribed in the management plan have not been met.

Area protection infrastructure is minimal: one scientific station, lodging facilities for the staff and some management facilities, as well as a meteorological station. The equipment for field personnel is very scarce, although there is a boat for water patrols. Forest rangers do not carry weapons and patrols throughout the protected area are sporadic. Due to lack of control, illegal activities abound.



The scientific station and a sign in the protected area (photos © PW-Guatemala)

The protected area's budget is approximately US \$ 39,000, an amount that covers payroll costs and almost nothing else. Funds for fuel and petty management expenses are insufficient.

² Registered as National Farm Chocón Machacas number 85, page 85, Book 165 of the Agrarian Transformation Institute.

Between 1997 and 2003 the RECOSMO project disbursed funds for planning, production project identification, tourism, improvements to administrative infrastructure and trails, visitor information, exhibits and audiovisual equipment for visitor information (RECOSMO, 1997).

Human Influence

The biotope can be reached from the “Fronteras” community in Río Dulce by navigating three hours to Golfete. It can also be reached from the Livingston municipality, by river, in approximately one hour. From the North, it can be reached through the farms in the boundaries, while the central area can be accessed through the Chocón River. The many and uncomplicated entry points to the area demand active surveillance of human activities.

Four communities exist inside the biotope: Lagunita Salvador, Puntarenas, Creek Cáliz and Coco. These communities exert severe pressure upon the protected area. Apparently, Puntarenas and Creek Cáliz existed before the area was declared as protected (Ruiz, 2003 pers. comm.), although after declaration both communities have continued to grow into the protected area. CECON states that the communities established after the declaration are illegal, but next to nothing has been done to solve the problem. Invasion and land speculation are completely out of control and have greatly depleted the biotope.



Invaded area, in this case by people with high economic possibilities from the looks of the house they built (photo © PW-Guatemala)

Threats

The Chocón Machacas biotope is **critically threatened**; efforts to protect and preserve the biological diversity have failed. Inventories carried out in the zone report exotic vegetation and species of wild animals that are typical of altered forests, which suggests that the area is under extreme human pressure (Pérez *et al.*, 2001). The main threats are due to permanent human intervention; invasion of the protected area; the advance of the agricultural and cattle frontier; illegal extraction, hunting and fishing, and the lack of institutional control of the area. The

biotope's forest has been isolated by the fragmented surrounding habitat. Emergency actions are deemed necessary for the recuperation of the biological diversity of the area.

Current threats

Permanent human intervention and lack of institutional control

This very serious problem will further threaten the biotope. The communities that have settled in the eastern and western areas of the biotope have claimed ownership of a large part of the protected area and their activities are not under control. At present, agricultural and cattle lands are creeping upon the biotope and the forest is becoming more fragmented by the minute.

The Puntarenas community, to the West, has grown almost 30% since it was originally measured in 1993 (Ruiz, 2003, pers. comm.). The fact that CECON has not been able to control the advance points out to the severity of the problem. Two families established 1 km southwest from the biotope's administrative center as the Lagunita Salvador community in 1993, and the managers did not become aware until 1996 (Ruiz, 2003, pers. comm.). This clearly indicates that the authorities of the protected area are not capable of controlling human activity. Today, the actual size of the community is unknown, and the two original families have become 24 (Anleu *et al.*, unpublished). One more problem in the protected area is that lands therein are bought and sold.

Different strategies have been implemented to deal with human intervention. Sometimes, such as in the case of Lagunita Salvador, negotiations to re-locate the illegal occupants have been initiated, but there are no results yet, mostly due to the fact that groups that defend land rights support the communities, and also because the authorities of the University of San Carlos de Guatemala have not undertaken any initiatives, mainly to avoid social conflict.



Another settled area within the biotope. This is a cattle farm along the Chocón River banks(photo © PW-Guatemala)

Other efforts include steps to improve the financial status of the populations and therefore alleviate some of the pressure upon the forest. In this sense, the RECOSMO project invested funds to identify financial alternatives, and some non-government organizations promulgate handicrafts projects among the biotope's inhabitants. In view of the present status of the protected area, it is evident that the search for financial alternatives has not succeeded, mostly because control measures, surveillance and law enforcement have not been supported. As in other protected areas of Guatemala, it is evident that integrated conservation and development projects have not been successful.

Most of the time, managers have simply forgotten that human intervention jeopardizes the protected area, which worsens the problem even more. One of CECON's shortcomings has been that it has never tried to promulgate the Protected Areas Law, which penalizes invasion of protected areas and threats to the natural heritage. For this reason, the biotope's conservation exists only in documents.

Advance of the agricultural and cattle frontier

This activity is very much linked to permanent human intervention. The advance of the agricultural and cattle frontier threatens the western half of the biotope, from the Chocón River to the Ciénega River boundary, and an important area to the northeast, from the Cáliz community to the lagoons of Río Dulce's Golfete. As in other areas, the surface directly compromised by this activity, although important, is not as significant as the fragmented forest area. Pérez et al (2001) state that by the year 2000 the biotope's forest had diminished in more than 9% in the six previous years. Satellite imagery, however, shows that more than 50% of the biotope is fragmented, a very disturbing fact.



One of the multiple areas completed deforested by permanent habitants



Detail of invaded land, showing crops and a fence used to mark the "property."



The advancing agricultural and grazing frontier and an area used for agriculture (photos © PW-Guatemala)

To the west of the Chocón River only a few large patches of original forest remain, which is also true for the northeastern area. The central area of the biotope, to the west of the Chocón River, has not been disturbed because flooded lands are not suitable for agricultural purposes. On the other hand, the cattle frontier has crept into the boundaries of the biotope and has thus isolated the area, which is connected to another fragmented ecosystem in the West. If the forest continues to be depleted, as has been the case to date, the protected area might lose most of its natural characteristics in the short term.



Cattle along the borders of the biotope (photo © PW-Guatemala)

Illegal extraction, hunting and fishing

As in other areas of Guatemala, the problem with pillaging of forest products and illegal hunting are out of control due to the fact that the established population easily access the forest areas and water bodies, and the managers do nothing to prevent it. During field visits we were able to see places where illegal logging and palm extraction were blatantly carried out. Illegal hunting and fishing occur every day and are not prosecuted. The crocodile (*Crocodylus acutus*) is one of the species that has become extinct, and it is very likely that many others will follow suit.



Locals use waters within the protected area to fish even though it is not legal (photo © PW-Guatemala)



*One of the habitants illegally extracting corozo palms (*Orbignya cohune*) for roof building (photo © PW-Guatemala)*

Invasion of exotic flora and fauna species

The biotope is being invaded by exotic flora and fauna species. Pérez *et al.* (2001) identified at least one introduced aquatic species, *Hyparrenia rufa*, to the protected area, plus another one that may be exotic, *Eichornia crassipes*, and the fish *Parachromis managuense*, which is not native. The exotic Napier grass has invaded some spots of the forest. *Hydrilla verticillata*, an aquatic invader plant, has been seen south of the Golfete (Arrivillaga, 2002), although it has not yet been reported for Chocón Machacas. There is no research about the effects of exotic species of flora and fauna on the area, and there are no exhaustive inventories of the number of species or of the characteristics of intruder populations.

Future Threats

Most of the future threats to the biotope originate from the possibility that present threats continue escalating or remain at the present levels, which might bring about the total loss of the area in a few years. There is enough evidence to support the idea that efforts to preserve the biological diversity of Chocón Machacas have failed and, that if corrective measures are not soon implemented, further investments in the biotope will be futile.



View of one of the southeastern lagoons (photo © PW-Guatemala)

Recommended Solutions

The depredation problems faced by the area's flora and fauna could be mitigated if patrols and surveillance were enforced. This requires a re-organization of the park rangers' work schedules. The re-organization would bring about the need to contract more personnel for 24-hour surveillance in the area and the settlements. True law-enforcement weapon-carrying officers should be contracted to guarantee the effectiveness of the patrols. The National Police, through the Nature Protection Service, should be able to provide this service. The constant presence of the law enforcers in the area would mean more investments in infrastructure and a mobility fund and other control and surveillance operations. Funds for care and surveillance should be increased 100%.

In regards to exotic flora and fauna species, the new master plan should make a provision for a research program to better understand the situation. The program should include short-, medium- and long-term objectives within a reasonable timeframe.

Human activities that take place in the biotope are so severe that they should be immediately addressed, lest the area completely disappear in the near future. Completely changing the methods used to date and establishing short-term objectives for voluntary or compulsory removal are the only methods to stop illegal activities. The law must be enforced and transgressors must be aggressively prosecuted.

As of the communities that had settled before the area was declared as protected, the possibility of purchasing the lands or moving boundaries should be explored. However, it is unacceptable to modify the lands that were occupied after the area was declared. This entails a new way of dealing with people, because they must be closely surveyed. Illegal activities must be subject to the full extent of the pertinent laws. The problems that CECON has placed on the back burner must be faced sooner or later.

Conclusions

The wetlands of the Chocón Machacas Protected Biotope have biophysical characteristics that make it of utmost importance for the conservation of locally- and internationally-threatened species, as is the case of the manatee (*Trichechus manatus*). The southern part of the biotope is inside the Río Dulce National Park, so its aquatic systems are connected to a large area where unique Guatemalan species thrive. Studies on the flora and fauna of the biotope report that there are threatened fauna populations therein, although there is very scant information about the degree of pressure and degradation upon them.

The biotope is **critically threatened** due to the several threats it faces, to the isolation of the area and because protection and preservation efforts of the diversity have not been successful. Emergency actions are deemed necessary to prevent further erosion of the area; future recuperation seems even more difficult. There is still time, however, to revert the situation, at least for an important part of the biotope. Continuous emergency efforts may guarantee the conservation of the biological diversity of the aquatic habitats, while restoration of most of the land habitats must be planned for a gradual recuperation of the area.

The most pressing problem that needs to be addressed is permanent human intervention, which has brought about very serious deforestation and fragmentation of the protected area, and the erosion of the flora and fauna species therein. The area has never been under the control of any institution, and the ever-growing human activities make it pivotal. The presence of exotic flora and fauna species is also worrisome. These three problems need to be urgently addressed if the biotope is to be preserved and if the losses are to be restored. It is critical to take control of the area and to implement an immediate solution to human intervention. CECON must enforce the law, especially in regards to invasions of the protected area or when the natural heritage is being tampered with. This is the only way that CECON will clearly transmit that it has the capability and is willing to preserve the area it manages.

The case of the Chocón Machacas Biotope is somehow comparable to that of the Sierra del Lacandón National Park, which was inhabited before the area was declared as protected (ParksWatch, 2003a). Although the Park tried to involve the population that was carrying out illegal activities and promoted production projects, both efforts were not enough to control the problems (ParksWatch, 2003b). In Chocón Machacas, sustainable development projects to alleviate the pressure upon the forest have been promoted, but have not produced desired results. In the event that such efforts promoting sustainable development to contribute to the conservation of a protected area fail, then ultimately those projects take away attention and investment from other priority activities needed to reduce threats in the biotope, such as control, vigilance and law enforcement.

The new master plan being carried out for the biotope must establish a program for each one of the threats identified for the area, including objectives and clear aims to revert depletion before the plan expires in five years, or at least to have achieved substantial advances in that timeframe. Success rates for each threat must be readily verifiable, to amend if needed. CONAP must comply with the established work profile and must demand that pertinent programs be included before the master plan is approved. The institution must also verify that the progress prescribed

by the master plan is reached and, if no results are evident in the biotope in the short-term, a new administrator must be hired to manage the area and to assume the responsibility of implementing changes to the law.



A view of the southeastern part of the biotope, the forested hills are seen in the background. That part is the only portion that keeps connectivity with other nearby forests (photo © PW-Guatemala)

References

- Acuerdo Gubernativo 1057-92. *Aprobación de la medida legal del terreno baldío denominado Biotopo del Manatí o Chocón Machacas*. Ministerio de Gobernación. Guatemala
- Anleu, L., N. Ordóñez, L. Ruiz y J. Ramos, sin publicar. *Plan Maestro en elaboración del Biotopo Chocón Machacas*. Centro de Estudios Conservacionistas de la Universidad de San Carlos. Guatemala
- Arrivillaga, A., 2002. *Evaluación de la presencia de Hydrilla verticillata en la región de Río Dulce y lago de Izabal. Diagnóstico general e identificación de medidas de control*. Oficina Técnica de Biodiversidad (OTECBIO), Consejo Nacional de Áreas Protegidas (CONAP) y Fondo Nacional para la Conservación de la Naturaleza (FONACON). Guatemala-
- Balas, R. y J. Polisar, 2001. *Una metodología participativa para una estimación rápida de la distribución del jaguar en Guatemala*. Wildlife Conservation Society. Proyecto Petén – Programas para Mesoamérica y el Caribe. Guatemala.
- CDC/CECON, 1995. *50 áreas de interés para la conservación en Guatemala*. Centro de Datos para la Conservación, Centro de Estudios Conservacionistas de la Universidad de San Carlos de Guatemala. Guatemala.
- CECON, sin fecha. *El Biotopo para la Conservación del Manatí Chocón Machacas*. Centro de Estudios Conservacionistas de la Universidad de San Carlos de Guatemala. Guatemala.
- CONAP, sin fecha. *Registro del Biotopo para la protección del manatí Chocón Machacas*. Consejo Nacional de Áreas Protegidas. Guatemala.
- CONAP, 2001. *Listado de especies de fauna silvestre amenazadas de extinción (lista Roja de Fauna)*. Resolución ALC 032-99 del Consejo Nacional de Áreas Protegidas. Guatemala.
- CONAP, 2001d. *Listado de especies de flora silvestre amenazadas de extinción (Lista Roja de Flora)*. Resolución ALC 028-2001 del Consejo Nacional de Áreas Protegidas. Guatemala.
- Decreto 4-89. Ley de Áreas Protegidas, reformas a la ley Decretos 18-89, 110-96 y 117-97, y reglamento. Congreso de la República de Guatemala. Guatemala.
- Dinerstein, E.; D. Olson; D. Graham; A. Webster; S. Primm; M. Bookbinder; G. Ledec, 1995. *Una evaluación del estado de conservación de las eco-regiones terrestres de América Latina y el Caribe*. Banco Mundial y Fondo Mundial para la Naturaleza. Washington.
- FUNDAECO/CECON, 2001. *Imagen de satélite del Biotopo para la Conservación del Manatí Chocón Machacas*. Sistema de Información Geográfica de la Fundación para el Ecodesarrollo y la Conservación /FUNDAECO), Centro de Datos para la Conservación (CDC), Centro de Estudios Conservacionistas de la Universidad de San Carlos de Guatemala (CECON). Guatemala

ParksWatch, 2003a. *Perfil del Parque Nacional Sierra del Lacandón*. ParksWatch Guatemala. Guatemala.

ParksWatch 2003b. *Comparación entre la situación actual del Parque Nacional Sierra del Lacandón, Guatemala, y la Reserva de la Biosfera Lacantún, México*. ParksWatch Guatemala. Guatemala.

Pérez, S., P. Herman, A. Kihn, J. Morales, N. Castillo, F. Ramírez, E. Cano, R. García, J. Ordóñez, M. Flores, A. Higueros, M. Acevedo, C. Vásquez, C. Burgos, H. Enríquez y H. Piérola, 2001. *Caracterización ecológica de los Biotopos Chocón Machacas, Izabal, y Cerro Cahuí, Petén*. Universidad de San Carlos de Guatemala Dirección General de Investigación del Centro de Estudios Conservacionistas. Guatemala.

PNUMA, 1995. *Plan de Manejo Regional para el Manatí Antillano, Trichechus manatus*. Informe Técnico del PAC No. 35. Programa de Naciones Unidas para el Medio Ambiente. Jamaica.

RECOSMO, 1997. *Hoja de vida del proyecto PNUD GUA/95/G31 y PNUD GUA/01/030*. Proyecto Región de Conservación y Desarrollo Sostenible Sarstún-Motagua (RECOSMO). Guatemala

Ruiz, L., 2003. *Comunicación personal*. Asistente jurídico del Centro de Estudios Conservacionistas.

UICN, 2003. *Red List of threatened species*. International Union for Conservation of Nature and Natural Resources. En <http://www.redlist.org>