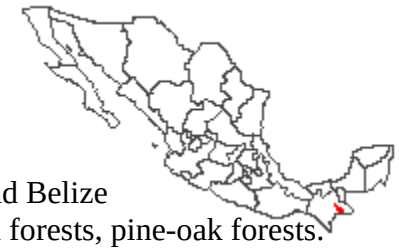
PARKSWATCH
Strengthening Parks to Safeguard Biodiversity

Park Profile – Mexico
Montes Azules Biosphere Reserve



Date of last onsite field evaluation: February 2003
Publication date: January 2004
Location: State of Chiapas, part of the Selva Maya
Year created: 1978
Area: 331,200 hectares
Ecoregion: Tehuantepec Moist Forests of Mexico, Guatemala, and Belize
Habitats: High moist evergreen tropical forests, montane tropical forests, pine-oak forests.

Summary

Description
Montes Azules Biosphere Reserve is located in southeastern Chiapas where karstic relief derived from limestone and endogenous processes dominate. There are three types of topography in the reserve: mesetas and valleys, plains and rolling hills, and alluvial relief. The Usumacinta River Basin is found in this region and it represents 30% of the country's hydrological resources. Montes Azules is part of the Selva Lacandona region and it is known as the most biological diverse center in North America and is considered a priority for conservation. The reserve has been recognized internationally as part of Unesco's Man and Biosphere Program (MAB-UNESCO) since 1979.

Biodiversity
Montes Azules, along with the greater Selva Lacandona region, are Mexico's most biologically diverse regions. Twenty-seven percent of Mexico's mammal species are found here, for a total of 114 species. Among those are the jaguar (*Panthera onca*) and tapir (*Tapir bairdi*i). There are 341 bird species, 30% of Mexico's total, including the harpy eagle (*Harpia harpyja*) and the scarlet macaw (*Ara macao*). The incomplete invertebrate registry has 1,135 species, of which 543 are butterflies. There are 112 fish species and 77 species representing the herpes: 23 amphibians and 54 reptiles, such as the crocodile (*Cocodrylus acutus*) and the Central American river turtle (*Dermatemys mawii*). Three thousand four hundred plants have been described for the Montes Azules region. Cedar (*Cedrela odorata*), mahogany (*Swietenia macrophylla*) and kapok (*Ceiba pentandra*) are all part of its moist evergreen rainforest. Researchers once documented 70 orchid species in a single tree, an indication of the area's incredible biodiversity.

Threats
Montes Azules Biosphere Reserve is **critically threatened** and urgent solutions are needed to ensure protection and to maintain its biodiversity. Recent studies indicate that the biggest threats include problems related to land ownership, land invasions, forest fires, deforestation, land use changes, and wildlife trafficking.

Description

Physical description

Montes Azules Biosphere Reserve is located in southeastern Chiapas in the region known as Selva Lacandona, which includes the Ocosingo, Las Margaritas and Maravilla Tenejapa municipalities. Its total area is 331,200 hectares and its altitude varies from 200 m along Lacantún River to 1,500 m in the northern part of the reserve. Annual precipitation varies between 2,500 and 3,500 mm on average; the annual average is 2,226 mm for the entire region. The average annual temperature varies between 24 and 25º C; the average minimum and maximum temperatures are 14 to 16º C, and 32 to 36º C respectively (Centro Nacional de Investigaciones Agrarias, 1982).

Selva Lacandona contains part of the Grijalva-Usumacinta watershed, Mexico's largest, which is 11,550,700 hectares and drains 85 trillion m^3 of water on average every year (INE, 2000).

Montes Azules is found within the Lacantún River Basin. This river, along with the Jataté and Lacanjá rivers, form the reserve's natural borders. Within the reserve there are several different bodies of waters, originating from soluble limestone hollows fed by subterranean water creating these lakes in karstic hollows. A lagoon complex, made up of the following lagoons, is located in the northern part of the reserve: Laguna Ojos Azules, Laguna Yanqui, Laguna Ocotal and Laguna El Suspiro (García-Gil y Lugo 1992). The largest lagoons are Laguna Miramar (7.906 ha) and Lacanjá (1.030 ha) and they are located in the midwestern and northwestern portion of the reserve (INE 2000).

These are the magnificent lagoons of Montes Azules: Laguna Ojos Azules, Laguna Miramar, and Laguna Ocotal, photos © Naturalia.

The soils are thin and in chromic phase, with some fine and medium-sized organic soils mixed in. They are black, reddish or red, or yellow in color. The predominant bedrock is limestone (INE 2000; Arriaga *et al*. 2000). Montes Azules dominant habitat is moist evergreen rainforest, with trees reaching heights of more than 60 meters.

This map shows the location of Montes Azules Biosphere Reserve in Chiapas, Mexico.

Biodiversity

Studies conducted in Lacantún, Chajul, Lacanjá-Chansayab, Yaxchilán, Bonampak, Marques de Comillas and Montes Azules Biosphere Reserve provide the overall biodiversity picture for the Selva Lacandona.

Fauna

The invertebrates are the least studied of all the species groups in the region. The current registry lists 1,135 species, which represents only 3% of the diversity estimated for the region (Moron 1992). Butterflies and scarabs make up almost 50% of the list as they have been studied the most. In the Boca Chajul region, scientists registered 110 coleopteron species, six of which had been registered for the first time in Mexico. Montes Azules represents the northern limit for most of these and the butterfly species, which means that the reserve is an important corridor for neotropical species. Species such as the scarab *Chaetodus lacandonicus*, belong to a genus endemic to the area.

Scientists De la Maza and De la Maza (1985), estimate that there are more than 15,000 species of nocturnal butterflies. In Chajul, they recorded 543 butterflies.

Scientist Miller (1998) registered 112 fish species for the Usumacinta River Basin, which includes Montes Azules. In a scientific article published by Rodiles *et al.* (1999), they reported 44 species just in Lacanjá River on the reserve's eastern border. Some of the species considered endemic to the Usumacinta region include: *Ictiobus meridionalis, Potamarius nelsoni* and *Cichlasoma bifasciatum*. Species with restricted distribution in the Lacanjá River include the tropical gar (*Atractosteus tropicus*), bagre lacandón (*Potamarius nelsoni*), and the cichlids (*Cichlasoma irregulare*) and (*Cichlasoma bifasciatum*). It should also be noted that in the same studies scientists discovered two exotic, commercial species in Lacanjá: tilapia (*Oreochromis niloticus*), and the grass carp (*Ctenopharyngodon idella)*. Lastly, the reported finding a rare species, *Cichlasoma urophthalmus*, that was outside of its natural (Morales-Román and Rodiles-Hernández, 2000).

Not much is known about the region's reptiles and amphibians. Seventy-seven species make up the herpefauna—23 amphibians and 54 reptiles. There are 28 snake species, 21 toad and frog species, 18 iguana and lizard species, six turtle species, and two species each of crocodiles and salamanders (Lazcano-Barrero *et al*. 1992). Scientists estimate that there are at least 118 species, and therefore only 65% have been discovered.

No species are exclusively endemic to the Selva Lacandona, although some species such as *Eleutherodactylus laticeps, Celestus rozellae* and *Bothrops asper* are endemic to Central America (Johnson 1989). It is interesting to note that 100% of the amphibians and 92% of the reptiles found in the Petén in Guatemala and Belize are also found in Mexico's Selva Lacandona. The area also harbors species that can only survive in pristine habitat such as *Anolis capito, Rhinophrynus dorsalis* and *Spenhnomorphus cherriei* (Lazcano-Barrero *et al*. 1992).

Several species listed on Mexico's endangered species list are also found here, such as the American crocodile *Crocodylus acutus*, Morelet's crocodile *C. moreletti* and the Central American river turtle *Dermatemys mawii* (NOM-ECOL-059-2002). Species given special protection because of their vulnerable state include the iguana (*Iguana iguana*), snapping turtle (*Chelydra serpentina*) and the common slider (*Trachemys scripta*), as well as the Rio Grande leopard frog *Rana berlandieri* (D.O.F. 2002; IUCN, 2003).

Montes Azules' most biologically diverse vertebrate group is the birds. González (1992) registered 341 species, which represents 55.5% of all of the birds reported in the entire state of Chiapas. Two species are considered threatened with extinction: the scarlet macaw (*Ara macao*), with only approximately 200 pairs remaining in the Lacandona region (Iñigo *et al*. 2001), and the harpy eagle (*Harpia harpyja*), which over the last three years has been rarely spotted.

The management plan includes a table by González (1992) listing 28 species endangered to some degree, two of which were categorized as threatened with extinction. We compared these data with Mexico's endangered species list (NOM-ECOL-059-2001) and since González's study, another three species have been declared threatened with extinction: the solitaire eagle (*Harpyhaliaetus solitarius*), the king vulture (*Sarcoramphus papa*) and Muscovy duck (*Cairina moschata*). Taking into account IUCN and D.O.F., there are two more species threatened with extinction: the black hawk-eagle (*Spizaetus tyrannus*) and the ornate hawk-eagle (*Spizaetus ornatus*), for a total of seven bird species threatened with extinction in Montes Azules (D.O.F. 2002; IUCN 2003).

Every single mammal order is represented in Montes Azules as are 27 of Mexico's 33 mammal families, making Montes Azules Biosphere Reserve one of the most diverse in the entire country (Medellín, 1994). There are 114 mammal species, of which 17 are Mesoamerican endemics (Arriaga *et al*. 2000). The most studied order with the highest number of species represented in Montes Azules is the Chiroptera (bats). Endemic species in the reserve are also mostly bats, such as *Tonatia evotis, Mimon cozumelae* and *Myotis elegans*, but there are even more endemic rodents, *Sciurus deppei, S. aureogaster, Tylomys nudicaudatus, Ototylomys phyllotis* and *Sphiggurus mexicanus*.

Mammals listed as threatened with extinction on Mexico's endangered species list (NOM-ECOL-059-2001) are jaguar (*Panthera onca*), ocelot (*Leopardus pardalis*), margay (*Leopardus wiedii*), Baird's tapir (*Tapirus bairdii*), river otter (*Lontra longicaudis*) and the Central American agouti (*Dasyprocta punctata*) (D.O.F. 2002; IUCN, 2003). The International Conservation Union (IUCN) includes additional mammals, such as the marsupial, water opossum (*Chironectes minimus*); the tayra (*Eira barbara*), Mexican black howler monkey (*Alouatta pigra*) y el mono Central American spider monkey (*Ateles geoffroyi*), the northern naked-tailed armadillo (*Cabassous centralis*) and Linnaeus' false vampire (*Vampyrum spectrum*) (IUCN, 2003).

Flora

Martínez *et al*. (1994) reported a total of 3,400 vascular plant species for the Selva Lacandona but they estimate at least 4,300. In Chajul, 392 woody species have been described: 194 trees, 126 shrubs, and 72 lianas. Most of Montes Azules's native vegetation corresponds to high moist evergreen rainforest and montane moist evergreen forest. There are other vegetation types, depending on the physical characteristics of a particular location (Rzedowsky, 1978; Miranda, 1975; Arriaga *et al*. 2000).

The high moist evergreen rainforest is a very dense forest whose foliage is always green. Its distribution is between the altitudes of 100 and 900 m and it is known to harbor a diversity of trees reaching 60 meters or more (Arriaga *et al*. 2000). Vines and epiphytes abound. Common rainforest species include mahogany (*Swietenia macrophylla*), Brazilian firetree (*Schizolobium*

parahybum), kapok (*Ceiba pentandra*), cedar (*Cedrela odorata*), Jutahy (*Dialium guianense*) and *Terminalia amazonia* (Gómez-Pompa y Dirzo 1995; INE 2000).

The montane seasonal evergreen forest is found in soils of limestone origin on steep slopes. On occasion, the trees of this forest could grow as tall as those in the tall forest and they share many physiognomic features. One major difference however, is that approximately a quarter of the high forest trees lose their leaves during the driest part of the year (Rzedowsky, 1978; García-Gil y Lugo 1992). Some of the medium, semidecidous forest trees include gumbo limbo *Bursera simaruba*, Mayan breadnut *Brosimum alicastrum*, Jutahy *Dialium guianense*, sapodilla *Manilkara zapota* and cedar *Cedrela odorata*. Common undergrowth species include *Swartzia guatemalensis, Protium copia, Chamaedorea oblongata* and *Nectandra sp*.

Palms also grow in association with the before mentioned forests. Palms grow in sparse groups on flat terrain throughout the forests. There are three palm types: 1) *Scheelea liebmanni*; 2) *Sabal yucatanica* and *Orbignya cohune*; and 3) *Bactris trichophylla* and *B. balainodea* (INE 2000; Castillo-Campos y Narave 1992).

The pine-oak forest is located in the northeastern section of the reserve at altitudes greater than 850 m in the area surrounding Laguna Ocotal. The pines grow up to 40 meters in height. Some of the pines include *Pinus maximinoi, P. pseudostrobus* and *P. tenuifolia*. The oaks are *Quercus peduncularis* and *Q. segoviensis*.

The mountainous cloud forest is not very common and is only found in small patches in the reserve's northwestern region. Species of this forest include *Pinus oocarpa, Quercus* sp., *Astronium graveolens, Ulmus mexicana* and *Prunus brachybotrya*.

Riparian vegetation is found along the reserve's fertile riverbanks. Riparian trees grow to between 20 and 40 meters, characteristic species include *Pithecellobium arboreum, Schizolobium parahybum, Lonchocarpus guatemalensis, Inga spuria, Castilla elastica, Cecropia obtusifolia* and *Salix humboldtiana* (Castillo-Campos y Narave, 1992).

Bambusa longifolia vegetation is found in the southern portions of the reserve, along the Lacantún River. The woody grass *Bambusa longifolia* is the dominant species and it grows in dense, exclusive communities reaching heights of 15 meters. Other species associated with this community include: *Schizolobium parahybum, Bursera simaruba, Ceiba pentandra, Pithecellobium arboreum* (Castillo-Campos y Narave, 1992).

The last vegetation type in the reserve is savannah. Trees are dispersed throughout the savannah in a wide strip between the forest and the jungle. Common trees in the savannahs do not grow very tall and include species such as *Curatella americana, Crescentia cujete, Byrsonima crassifolia, Ateleia pterocarpa* and *Acacia pennatula*.

Management

Montes Azules Reserve was created in 1978. The National Natural Protected Areas Commission (CONANP) administers the reserve and its basic staff includes a director, a sub-director, an administrator, and three project managers. The reserve's annual operative budget is US$ 118,181, provided by the national government. Other organizations financially support the

reserve including the Global Environment Fund (GEF), which according to published information donated US$ 163,651 during 2001 and 2002 and US$ 72,727 for 2003. Using this money, three park promoters and nine park guards were hired to strengthen the inspection and security program. Chiapas' state government along with the federal government created a special fund of approximately US$ 726,000 to settle land ownership problems, ecological damage, and unauthorized settlements within the reserve (Adrián Méndez, Personal Communication). The reserve is found in the municipalities of Las Margaritas and Ocosingo, its coordinates are: 16º 04' 55", 16º 57' 28" N and 90º 45' 01", 91º 30' 24" W.

After one year of negotiations, in January 2004, Chiapas State Government signed a contract with the European Union (EU) for social development projects. To carry out the agreement, the EU will provide 31 million Euros over the next four years. The inhabitants of the small towns in the Selva Lacandona's protected areas and zones of influence, including Montes Azules, are the project beneficiaries (Elvira, 2004).

Montes Azules has an extensive management plan that is supported by an advisory board made up of representatives from academic institutions, non-governmental organizations, governmental agencies, and community leaders (INE 2000).

Using participatory activities like meetings and workshops with stakeholders (producers, settlements, land owners and land holders, and the advisory board), the reserve's management led the consultative and consensus-building process in order to create its zoning (INE 2000). The following zones were created:

1) Protection Zone

This zone is located in the center of the reserve and covers 22,288 hectares. It is one of the best-conserved areas, where there is little or no human activity. Activities conducted include those aimed to protect ecosystems, their ecological processes, and their genetic reserves. Non-invasive scientific research, protection activities, and environmental education are permitted in this zone.

2) Restricted Use Zone

This is the reserve's largest zone (234,146 hectares) and it extends from the central region north and south. This zone contains the largest, most continuous, well-conserved forest in the reserve and most of the important bodies of water within the reserve's hydrological system, including the Lacanjá, Lacantún, San Pedro and Tzendales Rivers, and Ocotal and Miramar lagoons.

This zone is fundamental for ecosystem and watershed conservation. Permitted activities include research, monitoring, environmental education, ecosystem protection, and low-impact ecotourism. Other permitted activities include ecological restoration and hiking along trails. Prohibited activities include land use changes, logging, exotic species introduction, agricultural activities, fishing, and building infrastructure such as roads or human settlements.

3) Natural Resources Sustainable Use Zone (ZASRN)

Two different areas are designated as sustainable use zones, one in the northeast in Nueva Palestina region (29,298 hectares) and the other in the western region of Miramar (41,568

hectares). Most of the human settlements are found in these areas. The resident's primary economic activities in the zone include agricultural and natural resource use. In this zone, they promote small-scale farming and natural fertilizers; and develop research on integrated management and sustainable natural resource use.

4) Traditional Use Zone

This zone is located in the northeastern section of the reserve and covers 3,899 hectares. This zone was created for the Lancandona indigenous people so that they may continue to practice their traditional production methods, hunt animals, and collect non-timber products for subsistence. In addition, activities such as ethnobiological research, Lacandona traditional multicrop management and acahuales (fallowed areas with secondary tree growth) are promoted in the traditional use zone.

Montes Azules Biosphere Reserve's central office is located in Tuxtla Gutiérrez, Chiapas, another office is in Ciudad de Palenque, and there are three security houses surrounding the protected area. There are also two field stations; one is within the reserve's borders in front of the town of Chajul (the station is also called Chajul). The organization called, *Espacios Naturales y Desarrollo Sustentable A.C.* (ENDESU), which means Natural Spaces and Sustainable Development, has managed the station since 1998. They have ecotourism and they support research activities. The second field station is Ixcán located in the ejido (traditional Mexican communal village) also named Ixcán in Las Margaritas municipality. Conservation International started this station. They managed the station for six years and provided training to local Ixcán people, who took over in 2001 (I. March Personal Communication). The major focus of this field station is tourism and to a lesser degree scientific research.

Today, ENDESU is building a new field station in the Restricted Use Zone near the mouth of the Tzendales River.

In 2003, the Mexican government formed several bilateral, environmental cooperation agreements (CONANP, 2003). With the Cuban government and Guatemala's National Protected Areas Commission (CONAP), they formed sister-reserve pairing programs between Montes Azules Biosphere Reserve and Cuba's Guanahacabibes Biosphere Reserve and Guatemala's Sierra Lacandón National Park. They cooperate and exchange information on the following issues:

- Protected area planning and management
- Public use
- Financial sources
- Ecosystem restoration
- Ecosystems and species research and monitoring
- Information exchange and training
- Social development
- Inspection and vigilance
- Legal issues

Human Influence

Archeological remains found as well as historical stories indicate that the Mayas inhabited what is today Montes Azules Biological Reserve. Today the forest is inhabited by their descendents of Chiapas, Yucatán Peninsula and Guatemala. In 1960, Mexico's federal government determined that the Selva Lacandona region was appropriate for agricultural colonization, which encouraged landless, rural farmers and ranchers to move to this part of the country. Today, there are 34,000 people of different ethnic backgrounds, including indigenous choles, lacandones, tseltales, tsoltsiles, tojolobales and mestizos, living in 60 small towns and several unauthorized settlements within the reserve (INE, 2000; CI – ECOSUR 2001).

Some documents indicate that land ownership in Montes Azules is as follows: 75% corresponds to Lacandona communal land, 19% corresponds to ejido land, 4.2% is national territory, and 1.8% of the land is untitled (INE, 2000). While this land distribution appears straightforward and simple, in reality the situation is complex because of untitled properties and lack of clarity regarding agricultural rights. Complicating this situation further is uncertainty regarding the rights of Guatemalan refugees who arrived in the area in 1981, and the 1994 Zapatistas armed conflict in which the Zapatistas entered the reserve.

Conservation International's monitoring program in Selva Lancandona (link here Conservación Internacional A.C) detected 25 invasions between 1994 and 2002, affecting 1,646 hectares in Montes Azules Biosphere Reserve. The settlers engaged in subsistence activities such as wildlife hunting, and deforestation in order to plant corn and vegetables (CI, 2002). Recent observations suggest that some of these settlements now have cattle.

Historically, Selva Lacandona is divided in five units: 1) Montes Azules Subregion, which coincides exactly with the reserve's actual location and size, 2) Cañadas Subregion, 3) Zona Norte Subregion, 4) Comunidad Lacandona Subregion, and 5) Marqués de Comillas Subregion. There are 1,300 towns and 500,000 inhabitants in the entire Selva Lacandona, which represents 10% of total population in Chiapas and which has the highest population growth rate: 5.75%. Commercial activities in the region include agriculture (cultivation of jalapeño pepper, corn and coffee), cattle grazing, and forestry (INE 2000).

The largest number of human settlements is found in Miramar's Natural Resources Sustainable Use Zone (ZASRN-Miramar) including: Amador Hernández, Pichucalco, San Quintín, Nuevo Galilea, Emiliano Zapata, Benito Juárez, Miguel Hidalgo and Costilla, Tierra and Libertad,

Nueva Esperanza, Vicente Guerrero and Nueva Argentina. ZASRN-Palestina's principal settlements are Nueva Palestina, Plan de Ayutla, San Pablo and Chamizal (INE, 2000).

Aerial view of the Nueva Palestina community, part of the Lacandona Community, the true owners of a portion of Montes Azules.

There are several access routes to the reserve. The main access route is the border highway that goes from Palenque, bordering Lacantún Reserve and Montes Azules southern region, to the city of Ciudad de Comitán de Domínguez. There are three other secondary access roads off of the main highway. The first is a gravel road going from Benemérito de las Américas to Chajul, which runs parallel to the Lacantún River; the second is a small road crossing from Palestina to Chamizal; and the third goes from Maravillas to Amatitlán (INE 2000; Gómez-Pompa and Dirzo 1995; CI – ECOSUR 2001). Most of the main human settlements within the reserve's ZASRN also have gravel or dirt roads.

The first major public works project in the region was the border highway, built in 1998 that surrounds the Selva Lacandona and connects the cities of Palenque and Comitán de Domínguez, Chiapas. After this, additional public works projects have begun, such as rural electrification—which now provides service to most of the communities located in the reserve's zone of influence. For the region's residents, this service then creates additional development expectations (for example, need/desire for education, health, etc.) in Mexico's best-conserved reserve.

Tourism

A significant number of tourists that visit the reserve first stop at the community of Lacanjá. Local Lancandona people offer services for the tourists, such as basic cabanas, campsites, kayak trips, excursions to visit Mayan ruins, and guided hiking trips. Additional communities, such as Nueva Palestina, have started initiatives and have asked for help from the reserve's management and NGO's to develop ecotourism and take advantage of the natural attractions in their communities. Actually, it is not uncommon to see "overnight" tourist initiatives begin and fail, illustrating the need better regulate and guide these activities.

ENDESU's Chajul Biological Station is focused on developing ecotourism activities, taking advantage of the station and location within the reserve. They target small tourist groups and charge up to US$ 100 per person per night. Visitors now use trails originally built for scientific research. Along some of the trails, one can see small mounds of Mayan ruins that are still covered by the rainforest (ENDESU 2003).

Ixcán Station is only a few hundred meters from Montes Azules' borders. They also offer ecotourism since 1996. The station has capacity for 21 persons and it costs between US$ 15 and 25 per person per night. The accommodations are small, rustic cabanas or camping sites. Activities include hiking along rainforest trails, trips along the rivers, and visits to the Mayan ruins (CI and FDN 2000).

As was mentioned in the section on human influence, the new highway and electricity have created a favorable environment for economic development and population growth in the communities. Some of the region's rural communities, with help from the government and NGOs, have seen the potential in ecotourism and begun small-ecotourism businesses. Some of these have failed, but several like *Escudo Jaguar* in Frontera Corozal, have been progressing and growing over the years and now many people make their livings from tourism.

Along the road following Lacantún River, going from Benemérito de las Américas to Chajul, we came across the Reforma Agraria Community's ecotourism project *Las Guacamayas* that has not been as successful as Escudo Jaguar in Frontera Coroza, despite the fact that they received governmental support in 1996 to begin. Several factors have contributed to its lack luster performance including 1) very little advertising, 2) the community's isolation, and 3) the highway's terrible conditions (CI and FDN 2000). Other small-business attempts in the region of Marques de Comillas have been developed in Playón de la Gloria and Chajul with modest cabins that offer a place to sleep and a bathroom.

The most important tourist sites are Ixcán Station (21-person capacity), Chajul Station (35-person capacity), and a new rustic hotel in front of the station that has capacity for 16 visitors. In addition, *Las Guacamayas* has announced that it has received additional investment from the government and from an individual in Tuxtla Gutiérrez. With this financing, they will renovate their facilities and reactivate their services. ENDESU is building a new station in the site known as Tzendales that can hold 20 people total (visitors and staff).

Expeditions and Archeology

For centuries, explorers have adventured through the Selva Lacandona in small teams and with minimum supplies because of the area's inaccessibility. Fray Pedro de la Concepción, who traveled along the Ríos Ixcán, Jataté and Lacantún Rivers, conducted the first expeditions in 1695. Other missionaries and adventurers explored the rivers and jungle during the XVIII century. Archeologists such as Alfred Percival and Desire Chamay followed the Yaxchilán Ruins route between 1880 and 1882 (CI - ECOSUR 2001).

Many Mayan ruins within the reserve remain covered by the forest.

It wasn't until the early XIX century that topographer José Tamborrel explored the central zone of the jungle, which is now Montes Azules. From 1923 to 1925 archeologist Frans Blom conducted several expeditions throughout the Selva Lacandona describing and locating archeological ruins and indigenous communities living there. One of the greatest explorers and naturalists of the last century was Mr. Miguel Álvarez del Toro of Chiapas. He first visited the zone in 1944 and began conducting field research and making flora and fauna observations. Ultimately, he began promoting protected area creation and natural resource conservation in Chiapas (CI - ECOSUR 2001; Álvarez Del Toro 1975).

The most recent expeditions led by conservationist Ignacio March took place between 1991 and 1998. Historians, writers, and documentary filmmakers accompanied March on the explorations of the San Pedro and Tzendales Rivers following the Sac Bahlán Route in Ixcán.

Montes Azules Biosphere Reserve is one of the relatively unknown, archeologically speaking, ancient Mayan centers. Some sites, such as the Cueva del Mono sculpture, belong to the Mid-Preclassic Era (900-300 B.C.), and are located on the banks of Laguna Miramar (Rivero, 1986; CI - ECOSUR 2001). The Oxlahuntún, Tzendales, Ruinas San Pedro, San Vicente and la Constancia archeological sites are from the Late Classic Mayan Era (600-800 A.D.).

Conservation and research

Chajul Station has played an important role (if not *the* most important role) in creating scientific research and contributing to conservation in the reserve and the greater Selva Lacandona region. The federal government was in charge of its initial establishment in 1984, but they later abandoned the station. In 1989, a group of scientists interested in studying this large jungle restored the facilities, and with help from institutions such as Universidad Nacional Autónoma de México (UNAM), Conservation International and MacArthur Foundation, they began research—some of which continues to this day.

Aerial view of Chajul Station inside Montes Azules.

During most of the 1990's, Chajul station was administered jointly by Conservation International and UNAM, allowing many academic institutions from the entire country, and the world, to conduct research. Undoubtedly, it was an important time period for science in Mexico and it generated important knowledge of the region's tropical jungles (Ceballos *et al*. 2000). This research and corresponding scientific evidence led scientists to conclude that Selva Lacandona is Mexico's most biologically diverse ecosystem. Since 1998 Chajul Station has been administered by ENDESU who also promotes conservation and research, but has changed the focus to developing ecotourism.

Once ENDESU took over the station's management, cooperative agreements with governmental agencies such as UNAM or other research institutes that used to subsidize research costs have lapsed. As a result, less students/researchers are able to pay fees of $100 per day and there are not as many research projects. Scientists still indicate their intentions to conduct research at the station because of the excellent facilities, specific services, and access to the stations boats that are necessary for most field research. Most people preferred boat travel in the past, but over the last ten years it has been used less and less. The border highway has greatly reduced the time and costs associated with travel in the area.

Many institutions have conducted research in this reserve; some of the most important studies are listed below.

UNAM has had researchers in the area since the first trips into the reserve, like brothers Javier and Roberto de la Maza, who studied butterflies. Rodrigo Medellín conducted one of the longest studies in the region on bats and small mammals. Alfredo Cuarón has studied monkeys and other fauna; Miguel Martínez conducted studies on population ecology and communities of tropical flora in the region. Rodolfo Dirzo's research focused on the plant-animal interaction and tropical ecology (Mendoza y Dirzo 1999; Medellín y Gaona 1999; Martínez-Ramos *et al.* 2001).

Eduardo Iñigo is another expert in the region studying bird ecology and conservation biology, his studies on the scarlet macaw population and on birds of prey stand out (Iñigo-Elias, 1996; Iñigo-Elias *et al*. 2001; Carreón *et al*. 2001).

From the university Colegio de la Frontera Sur (ECOSUR) Eduardo Naranjo studies ecology, ungulate conservation and wildlife use (Naranjo 2002). Rocío Rodiles studies fish in the Lacantún and Lacanjá Rivers (Rodiles *et al.* 1996; Morales-Román y Rodiles 2001). Samuel Levy studies agroecological systems, such as the ones the Lacandona people practice.

Mexico's National Institute of Anthropology and History (Instituto Nacional de Antropología e Historia (INAH)) conducts archeological site inventories. One of their expert anthropologists is Alejandro Tovalin.

Conservation International (CI) has worked in the entire region, including Montes Azules, for more than ten years on projects ranging from flyover jungle monitoring, to vegetative coverage studies, to social development, to population and environment, to management training, to natural resource use. In addition, they have financed projects for priority species like the jaguar, harpy eagle, and scarlet macaw. CI has one of the region's most important information databases and it also has an important geographic information system within its Northern Mesoamerican program.

Recent CI publications include two compact discs: "La Selva Lacandona tesoro de biodiversidad en México" and "Selva Lacandona siglo XXI Estrategia Conjunta para la Conservación de la Biodiversidad" which mean "The Selva Lacandona: Mexico's biodiversity treasure" and "Selva Lacandona: 21st Century Joint Strategy for Biodiversity Conservation" respectively (CI – ECOSUR 2001; March 2003).

Actually, destruction of the Selva Lacandona and especially Montes Azules has caught the attention of a large part of the Mexican society because newspapers and television stations have been providing frequent coverage on the area and its problems. This has led to an awareness campaign directed at the general public but with a special emphasis on kids, who can win a trip to Chajul Station. Fundación Azteca, the Ford Company, la UNAM and ENDESU sponsor this campaign.

ENDESU has solicited funds from donors for firefighting programs, and security and protection programs that denounce illegal acts in the reserve to the environmental authorities.

The most recent civil society initiative began two years ago and it brings together people and institutions to discuss and develop strategies to resolve the complex problems of the Selva Lacandona, Montes Azules, and Mexico's protected areas in general. The collation is called, "La Coalición para el Rescate de la Selva Lacandona", or Collation to Rescue Selva Lacandona in English. Some organizations involved include Naturalia, A.C, ParksWatch, Mexico's Environmental Rights Center (Centro Mexicano de Derecho Ambiental (CEMDA)), Conservation International, Presencia Ciudadana, PRONATURA, A.C., ARENA, A.C. So far, the collation has denounced environmental crimes and human rights violations, held press conferences, and started to create political pressure so that authorities will consider this region a national priority.

Threats

- Land ownership
- Land invasions
- Deforestation
- Forest fires
- Poaching and wildlife trafficking
- Contamination
- Disappearance of Selva Maya's biological corridors
- Mexican army presence
- Lack of interinstitutional coordination

Potential threats

- Dam construction (Plan Puebla Panamá)
- Tourism

Land ownership

A presidential decree in 1972 endowed 614,321 hectares to sixty-six heads of family of the Lacandona Community. Later, the federal government, along with the Secretary of Agrarian Reform, continued granting property titles to other families, thereby generating conflict and land ownership insecurity. In addition, other indigenous communities with just as many rights were not recognized and to this day, this remains one of the greatest problems in Montes Azules, which was declared in 1978 on Lacandona Community lands.

Land invasions

Incursions into the reserve date back to the year of the reserve's creation in 1978, even after the land had been granted to the Lacandona Community. In 1994, the Zapatista de Liberación Nacional (EZLN) armed movement began in the region and social instability increased as families were displaced and new, unauthorized settlements sprung up in Montes Azules. Some of the families went to the reserve to escape the confrontations between the guerrilla and the Mexican army, while others went because of ideological differences between communities in the Cañadas Subregion. Some people took advantage of the area's lack of governance to invade land claiming to be part of the armed movement and using intimidation by saying that they had the EZLN's support. It is important to recognize that even though some dishonest people took advantage of the situation to get land, many indigenous people and even entire communities have suffered from the guerrilla movement and the misery and landlessness that followed.

Invasion into a site known as San Rafael: Forest destruction quickly follows in invaded sites.

A well-documented associated problem with the invasions is the presence of foreigners (including Italians, Spanish, French nationals). The foreigners play a role with these illegally settled families and communities in the reserve; according to them, they are present in solidarity with poor pueblos, they support the armed movement, they provide political advice to the communities, and help them with their declarations in the press. On several occasions, they have even confronted the federal authorities and communication means to obstruct access to the areas affected by the settlements.

Social groups, such as the Monos Blancos (Italians), have supported the Zapatistas in protest marches at the national and at the local levels based in the indigenous communities. Another national group participating from the settlements within the reserve is Centro de Derechos Humanos Fray Bartolomé de las Casas, which provides unprotected groups human rights' assistance, their headquarters are in San Cristóbal de las Casas, Chiapas. There are rural farmers groups, like Asociación Rural de Interés Colectivo Independiente y Democrática (ARIC), that promote organized work and resource management in addition to helping those settled in the reserve.

Conservation International's recent investigations show that as of 2001, there were 25 unauthorized settlements within Montes Azules' borders.

Deforestation

People looking to open up land for agriculture, grazing, and settlements cause deforestation. Of course, commercial logging of precious wood is also a cause. Actually, commercialization of precious wood has such influence that it has shaped political will in the past. Most of the commercial logging occurs illegally and there are some cases of "tala hormiga," or subsistence based small-scale logging.

Precious woods are illegally cut from within the reserve.

Deforestation mostly affects the five subregions surrounding the reserve (Zona Norte, Comunidad Lacandona, Cañadas, Marques de Comillas and Montes Azules). Without sufficient security personnel and consistent application of the law, this activity persists. Communities in the Marques de Comillas region (Loma Bonita, Chajul, Playón de la Gloria, Galaxia, López Mateos, Reforma Agraria, Pico de Oro, Quiringuicharo and Benemérito de las Américas) greatly influence the forestry activity since they illegally cut wood from within the reserve.

Forest fires

The reserve's forest fires are closely related to agricultural activities and forest clearing for new settlements. Other fires begin in an effort to expand the agricultural frontier into already disturbed areas. 1998 was a critical fire year that affected 20,000 hectares. In 2003, forest fires affected 3,186 hectares (CONANP-Frontera Sur Región X, 2003).

Poaching and wildlife trafficking

Local inhabitants, regional residents, army soldiers, and outsiders engage in poaching and commercial wildlife trafficking for the pet trade. The most threatened species include the jaguar, ocelot, tapir, white-tailed dear, peccary, scarlet macaw, double yellow-headed amazon, the great curassow, keel bill toucan, harpy eagle, the river crocodiles, iguana, and the Central American river turtle, which has been almost completely wiped out because of the demand for its meat.

Contamination

Soil and river contamination is caused by agrochemical use on crops such as hay, corn, peppers, and coffee (although to a lesser degree from coffee production, which is down because of the low world market prices). Pepper cultivation requires a lot of agrochemicals and it is one of the most extensively planted crops in the region, contaminating soils and bodies of water by filtrations and runoff.

Disappearance of Selva Maya's biological corridors

Over the last 15 years, anthropogenic activities have increased deforestation and fragmentation in the Selva Maya region. This situation has created a mosaic of forest patches where some wildlife populations are becoming isolated and others may be disappearing because of their habitat requirements. Highways, high population growth, and demand for land along roads have further contributed to loss of connectivity.

Mexican Army presence (in Yanqui Lagoon and at the mouth of Lacanja River)

Mexican army presence around and within the reserve has caused negative impacts on the fauna and vegetation because of their large encampments within conserved areas and because soldiers eventually capture and hunt wildlife.

Mexican army revision post along the border, surrounding Montes Azules.

Lack of interinstitutional coordination

Since the time of President Luis Echeverría during the 1970s, the Selva Lacandona has been the object of a lot of political interest and many poorly structured social programs have been promoted here, leaving the poor residents little choice but to rely on and overuse their natural resources. Many times programs coming from different governmental agencies, like the Secretary of Agrarian Reform (SRA), the Secretary of Communications and Transportation (SCT), Secretary of Social Development (SEDESOL), and the Secretary of Agriculture, Grazing, Rural Development, and Fishing and Nutrition (SAGARPA), contradict the purpose of protected areas' lands. For example, one agency provides incentives to rural farmers to develop extensive

grazing, another to open up forested lands for grain cultivation, or another agency will develop infrastructure.

Clearly, governmental agencies do not coordinate with SEMARNAT and CONANP to try to come up with a regional development plan that takes into account the region's high levels of biodiversity and the environmental services provided.

Dam construction (Plan Puebla Panamá)

For the last few federal administrations, infrastructure development for southeastern Mexico, and specifically Chiapas, has been a hot topic. Conservation organizations are concerned about the mega-electricity infrastructure projects proposed in Plan Puebla Panamá (PPP). The PPP recommends building six dams within the Usumacinta River Basin, some as high as 235 meters.

Dams are proposed for the Jatate, Santo Domingo, Lacantún and Usumacinta Rivers. After damming, the reservoirs will cover large expanses of the Selva Lacandona, including portions of Montes Azules Biosphere Reserve.

The hydroelectric dam project known as "Boca del Cerro" in the Usumacinta River involves the states of Tabasco and Chiapas in Mexico and Guatemala. This project is creating the most concern among the conservation community and local inhabitants because preliminary site studies have already taken place. Members of the Palenque community in Chiapas claim that people wanting to buy their land have already approached them.

Boca del Cerro Dam would be 135 m tall and as a result, Usumacinta River would flood a large portion of Mexico's and Guatemala's border territories. Important archeological sites, such as Yaxchilán in Chiapas and Piedras Negras in Guatemala, would be flooded. Some suggest moving the ruins to other sites in order to "save" them. In addition to directly impacting Selva Lacandona's ecosystem, other ecosystems could be negatively impacted by the change in the water balance, such as Pantanos de Centla Reserve that is located in the lower Usumacinta River Basin.

Tourism

There are two points of view regarding tourism in Mexico's protected areas: 1) tourism is an opportunity for communities to generate alternative economic activities while lessening their impact on the environment (with ecotourism, for example), and 2) tourism is a business whose primary goal is to make money and conservation is secondary but necessary for the business since healthy natural environments and healthy wildlife populations are essential to tourism activity.

Some tourism agencies and individuals involved in tourism do not comply with the guidelines put forth in the management plan. They do not provide any technical information about the protected area and they do not explain visitation norms or regulations or what is expected of the visitors.

Of course, not all tourism providers are like this. Some civil organizations, communities, and individuals do have excellent tourism initiatives in Montes Azules. However, there is a general

lack of training, especially among individual and small groups. Specifically, garbage generation is a problem related to tourism and could get worse as tourism grows. There are already garbage problems in communities like Nueva Palestina where there are open garbage pits.

Recommended Solutions

Land ownership

In 1999, Chiapas' Governor established an Agro-Environmental Round Table in order to search for solutions to the problems of land takings, overlapping properties, ecological damage, and possible compensation and relocation of unauthorized settlements. The following agencies are part of the Round Table: Governmental Secretary, Secretary of Rural Development, Secretary of Social Development, Secretary of Indigenous Towns, and the Institute of Natural History and Ecology, and federal agencies such as SEMARNAT, the Federal Environmental Protection Procurator's Office (PROFEPA), SRA, National Forestry Commission (CONAFOR), the reserve's superintendent, the Agrarian Procurator's Office, and the General Procurator's Office for the Republic.

Unfortunately, the results have been less than satisfactory even with this large governmental participation. On several occasions, agreements between inhabitants of unauthorized settlements and governmental institutions have dissolved because of lack of compliance with the terms of the agreement. After several governmental meetings, the members decided to cancel the Agro-Environmental Round Table in 2003 and instead they established a working group to provide integral attention to the Lacandona Community and Montes Azules Biosphere Reserve (Pérez, 2004). The government intends to give this working group more autonomy when it comes to their actions and financial decisions. The government should still act decisively and demonstrate political will in order to move ahead on this delayed land reform and resolve problems with land ownership in the reserve.

Starting in 2003, the government created a fund (US$ 724,000) to deal with land ownership problems in Montes Azules and other protected areas. In January 2004, Chiapas' Governor signed an agreement with the European Union for $31 million Euros for social development programs in the Selva Lacandona region, which as mentioned previously, suffers from serious poverty, land ownership problems, and population growth. This probably comes as good news for the people of the forest since it has the potential to improve the region's economy. It also represents a unique opportunity to use the resources wisely, without wasting them in bureaucratic slowdowns or politicking, to ensure conservation in the protected areas. We recommend transparency and oversight in the use of the funds. We also recommend involving the conservation and academic communities in conservation and biodiversity studies and environmental impact studies—all of which could help formulate the social development strategies. Finally, we recommend that the authorities responsible for carrying out laws and regulations for protected areas follow through and punish violators to the full extent of the law.

Land invasions

This problem is not easy to resolve, especially considering the increasing number of land invasions into the reserve in recent years. However, political will at every governmental level is essential to the resolution. The previous, weak, supposed solutions offered by the government cannot continue, as they have actually caused more problems. Invasions have been an increasing problem for all of Mexico's southeastern reserves; actually, they continue in all of Mexico's protected areas.

Resolving this type of threat requires additional institutional capacity and it requires strong alliances between the federal government and civil organizations to find resources and real solutions.

Deforestation

We recommend changing the government policies promoting deforestation for grazing and agriculture. Instead, the policies should promote keeping forest cover while promoting sustainable and regulated activities. We also recommend that innovative technologies be developed and adopted to sustainably harvest non-timber natural resources.

Forest fires

We recommend elaborating a permanent forest fire prevention program and fire-fighting program as soon as possible while continuing with the community programs, such as training and providing equipment to the fire-fighting corps. We also recommend that restoration work continue in previously burned areas (in 1998, 2003). CONANP and CONAFOR are responsible for this work, but the conservation community should support them and they should receive federal funds.

Because these proposed recommendations would be costly, additional human and financial resources would be needed. We recommend collaborating with other institutions; for example, partnering with the Mexican Army on the reforestation component, and partnering with CONAFOR for financial support. The reserve could also partner with organizations whose mission is fire prevention and forest fire fighting, such as FMCN's Fire Prevention and Rehabilitation Program, researchers from ECOSURE, and The Nature Conservancy.

Poaching and wildlife trafficking

We recommend using efficient methods, like radio emissions or community work with rural schools, to advertise and educate local people regarding the wildlife and endangered species regulations. We recommend strengthening the environmental authorities' capacity by increasing training, adding additional personnel and equipment, so that they can enforce the laws. Authorities should no longer tolerate environmental violations.

Contamination

We recommend that the reserve provide information and motivation regarding crop diversification. Rural farmers should receive information and training about organic farming and

its benefits. PROFEPA should be asked to investigate the companies selling or using fertilizers or other chemicals on crops like jalapeño peppers. We also recommend that local people receive information regarding the existing agrochemical regulations and the effects these chemicals can have on the environment and human health.

Disappearance of Selva Maya's biological corridors

Conservation International has population and environmental programs in some of Selva Lacandona's communities. The goal of their programs is to lessen pressures on the environment and provide alternatives for economic development. They provide information about family planning methods in order to better provide for one's children and lower the population growth rate. They also train women's groups to promote alternative projects. We believe that these types activities promoted by non-governmental organizations can help maintain connectivity between biological corridors over the long run. Their activities could be replicated in additional communities influencing Montes Azules Biosphere Reserve.

General assemblies in communities within the Marques de Comillas region have voted to designate ecological reserves in a certain percentage of their forested areas. These isolated areas, which are surrounded by pastureland, serve as refuges for many species and are also considered important in maintaining forest connectivity in Montes Azules along the Lacantún River. In addition, we recommend that alternative development projects be developed in these communities that conserve the forest instead of destroy it.

Mexican Army presence

It is undeniable that the Mexican Army provides valuable services in the area including security, helping in natural disasters, and trying to keep the EZLN armed conflict under control. However, the Army must adopt policies within its institution regulating its relation with the environment, with the understanding that they army's actions helping conservation will benefit all Mexicans.

Lack of interinstitutional coordination

There are two major consequences related to lack of interinstitutional coordination. The first is forest destruction and the second is rejection of governmental and other organizations' projects. There have been repeated contradictions between different institutions' development programs. Even the rural farmers talk about how ridiculous it is that the agencies promote projects that go against the existing land use and against their own best interests. A very basic recommendation is that the institutions need to get to know the communities and listen to their specific needs. Communication and clear collaboration are keys to success.

Dam construction (Plan Puebla Panama)

Plan Puebla Panama's energy production plan is too much for the Usumacinta River Basin. There have been no official public announcements regarding the plan's implementation, but rumors indicate that technical work has already begun in places like "Boca del Cerro" in Mexico and that electricity infrastructure studies are going on over the border in Guatemala.

The objective is to supply energy to Mexico and Central America, but to do so means altering the ecological equilibrium in Mexico's most biologically diverse region. Selva Lacandona already provides many environmental services to the region and the world, for example, it plays an important role in carbon sequestration, water production, it has important forestry resources, and potential medicinal plants, among many more.

Tourism

Tourism within the reserve should follow the regulations set forth in the management plan. The reserve's administration should regulate the activity. The economic benefits gained from tourism in the reserve should go back into conservation and management programs. We also recommend that not only should tourism be regulated within the reserve, but also in the influence zones.

The garbage problem also needs to be resolved through initiatives or programs that encourage small tourism business and the reserve's administration to participate in coordination with local leaders and municipal authorities to adopt recycling and develop proposals to manage and control garbage within appropriate disposal sites.

Conclusions

Montes Azules Biosphere is one of the biologically rich places in Mexico, it protects one of the largest genetic reserves with many species potentially important to man. Its tropical jungle provides many environmental services like carbon sequestration and soil conservation; in addition it is part of Mexico's largest water source that drains 85 trillion m^3 of water per year. Montes Azules Biosphere Reserve is **critically threatened** and urgent solutions are needed to ensure its protection and to maintain its biological diversity. Land ownership, land takings, invasions, lack of vigilance and lack of enforcing environmental laws are among the reserve's complex range of environmental, social, and political problems (WWF and IUCN, 1994-1997).

Montes Azules' situation is not unique; many of the region's protected areas face similar threats. Nonetheless, it is important to note that the Natural Protected Areas' protection system is working—only 6% of the land within Selva Lacandona's reserves has been transformed by human activities, while outside of the protected areas, 40% of the land has been transformed. This further demonstrates the need to strengthen the institutional image and Montes Azules' conservation and management programs.

There are many reasons for the reserve's ownership problems and continued invasions into its interior, all of which have given rise to instability in the region and confrontations between communities and the authorities. Advances towards reconciliation between parties are significant and share commonalities such as reaching agreements to stop invasions, relocating unauthorized settlements, and providing solutions to the land reform delay. We think that resources provided by the federal government and the financial agreement between the EU and Chiapas will strengthen initiatives that attend to the needs of the Selva Lacandona people and thereby lessening the direct pressure on the natural resources and protected areas.

Another important issue that requires special attention is environmental violations, such as illegal logging, poaching, commercial wildlife trafficking. The authorities, such as PROFEPA, cannot

continue to ignore such violations and they need to apply sanctions as stipulated in the law. The data cited earlier in the report show that the number of endangered species is increasing.

The federal government and other civilian organizations must act now to guarantee conservation of this important ecosystem.

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