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Information Sheet on Ramsar Wetlands

1. Date this sheet was completed/updated: 22 June 2000

2. Country: Nicaragua

3. Name of wetland: San Miguelito Wetlands

4. Geographical coordinates:

11° 17.32' and 11° 35.45' North latitude
84° 45.0' and 84° 59.59' West longitude

5. Altitude: 30 to 100 metres above sea level

6. Area: 43,474.64 hectares

7. Overview: According to Dugan's (1992) system of classification of wetlands, the San Miguelito Wetlands include three main types of wetlands that justify and support our proposal. Within the plant communities associated with this wetland, there are *charrales*, *tacotales*, pastures, hydrophilous vegetation and broadleaf woodlands on solid ground, generally along the shores of rivers in gallery and secondary woodlands. A large part of the socio-economic and cultural activities of the local inhabitants and the surrounding communities depends on this wetland. Local activities are ranching, agriculture, fishing, gathering of raw materials for construction of houses and food, transportation and recreation. These wetlands maintain a rich biological diversity supported by a variety of environments and niches and by a large number of native, resident and migratory species of birds, fish, reptiles and mammals. As an indirect benefit, these ecosystems play a primordial role in preventing natural disasters, purifying and recycling water from Lago Cocibolca and in creating microclimates. These functions provide many advantages that can be considered environmental services of great importance and indispensable for the existence of living species in these ecosystems.

8. Wetland type:

Inland wetlands: M, O, P, Ts, Xf, and Zg

Artificial: 3

Types of wetlands by decreasing order of importance: M, O, P, Ts, Xf, Zg and 3

In the municipio of San Miguelito, we find only the types of wetlands typical of an inland area and artificial wetlands that are the result of human activity.

Type M: Riparian systems composed of the following rivers: Camastro, Cerro Grande, Charral, Congo, Palanca, Palo Ralo, Piedras, Tepenaguazapa and Tule and their tributaries. Also included are the freshwater swamps of El Chilimoyo and Charral along with other streams. This freshwater system forms part of the Gran Cuenca of Lago Cocibolca (Lake Nicaragua), which in turn forms part of the basin of Río San Juan, which is the largest in Central America.

Type O: Lacustrine systems composed of part of Lago Cocibolca (Lake Nicaragua), including coastal areas

Type P: Paludal systems composed of the following floodplains: Bajos del Carmen, El Corozal, El Venado, Llanos El Pedernal, Llano Grande, Llano Hojachigue, Llano Marina, Puerto Viejo and Rincón del Patacón

Type Ts: Seasonal ponds

Type Xf: Flooded riparian woodlands

Type Zg: Geothermic wetlands

9. Ramsar criteria: 1, 2, 3 and 8

Criterion 1: This is an especially good example of a representative natural wetland, characterized by rivers and streams that empty into Lago Cocibolca, the largest lake on the Central American peninsula.

Criterion 2: This criterion was selected because in the San Miguelito Wetlands there are native, resident and migratory species considered vulnerable apart from the presence of ecological communities endangered by social pressure and changes in habitat. This statement is based on the Quick Ecological Assessment made in 1998 with students from the Regional Programme for Wildlife Management (PRMVS) of the Universidad Nacional de Costa Rica.

Criterion 3: In the San Miguelito Wetlands, there is a diversity of species of fauna and flora because favourable conditions in these ecosystems make possible genetic and ecological diversity in the indigenous, resident and migratory species. This condition makes the San Miguelito Wetlands a site that can be classified as a wildlife reserve.

The most significant criterion is number 3 because the wetland plays a significant biological and ecological role making possible the genetic and ecological diversity of indigenous, resident and migratory species.

10. Map of site included? Please tick yes -or- no

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12. Justification of the criteria selected under point 9, on previous page: The wetland is considered of international importance because:

Criteria of representative wetlands

Criterion 1: This is an especially good representative example of a natural wetland characterized by rivers and streams that empty into Lago Cocibolca, the largest lake on the Central American peninsula. It is also an especially good representative example of a wetland that plays a significant hydrological, biological and ecological role in the natural functioning of the hydrographical basin of Lago Cocibolca (Lake Nicaragua).

This wetland is important because it directly sustains the domestic and productive activities of San Miguelito, whose socio-economic system depends largely on these wetlands. Among the activities that depend directly on the lacustrine, paludal and riparian systems are small-scale and semi-industrial fishing, livestock-raising, agriculture, forestry activities, transportation (means of communication), religious activities, recreation, the use of species of fauna and flora as natural medicine, handicrafts and the obtaining of raw material (timber, bamboo, sand, palm, lianas and Gramineae) for building houses and other uses.

The floodplains in the area are important means for controlling flooding, retaining sediments and controlling erosion. They decrease the effect of pollution from pesticides in other parts of the wetland, acting as filters that purify and recycle the water of Lago Cocibolca and protect the vegetative cover. They maintain a good level and status of underground (freshwater aquifers) and surface water, which provides drinking water for the inhabitants of San Miguelito.

Criterion 2: In addition, it is a site that provides habitat suitable for reproduction of endangered species such as the American crocodile, sea turtles, iguanas, jaguar, puma, ocelot, *tigrillo* and *mapache*.

Criterion 3: As for ecological benefits these wetlands provide a refuge for local fauna, including migratory routes for several species of birds (Davidson and Gauthier, 1993), some of which are indicators of the values, productivity and diversity of the wetlands. In addition, it is a site that is an adequate habitat for reproduction of native and resident species such as the *gaspar*, *guapote*, *garrobo*, white-tailed deer and *caucel*.

Criterion 8: This is an area used for laying eggs of species of great commercial importance, such as the tilapia, *mojarra*, *roncador* and *róbalo* and it is of ecological importance because of several migratory fish such as the shark, sawfish, *sábalo real*, *roncador* and *urel*.

13. General location:

The San Miguelito Wetlands are located in the municipio of the same name, department of Río San Juan, 58 kilometres northwest of the city of San Carlos, the administrative centre of the department.

14. Physical features:

Soils: According to data from the presidency of Nicaragua (1987), the soils of the Lake Nicaragua basin were formed in the Quaternary. These are alluvial and fluvial deposits found mostly on the plains southeast of the lake and southwest of San Carlos. Undifferentiated alluvial Quaternary soils are also located in the basins of the Tepenaguazapa, Tule and Oyate rivers and around San Miguelito, Morrito and San Carlos. In general, their morphology is varied. In the central part, land is mainly hilly or very steep.

In these soils, high temperatures and very high humidity prevent retention of organic material by the soil because it is immediately leached by frequent rains. The soils are definitively poor, although they represent a high potential for pasture, perennial or seasonal crops and in some places for growing rice in flooded paddies. The soils north of Río Tepenaguazapa and its tributaries are flat, deep, clay, very plastic and sticky, difficult to work and black in colour, which crack during the dry season, becoming very hard, but in the rainy season are very soft with difficult drainage.

The soils south of Río Tepenaguazapa have relatively steep slopes and are well drained. The surface cover is either thick or thin. The subsoil is brown clay because of the steep slopes and high susceptibility to erosion. It is moderately steep in the north-eastern part.

From the point of view of geography, the San Miguelito Wetlands belong to the Nicaraguan depression with elevations no greater than 100 metres above sea level. San Miguelito belongs to the driest region of the Río San Juan basin located northwest of the region. Warmer temperatures have been recorded, with an annual average of 27° to 28° C. It belongs to the rainy tropical climatic area with a better-defined dry season, covering most of the basin of the Tepenaguazapa and Oyate rivers.

Climate: Rains are distributed over six to seven months of the year and annual precipitation varies between 1700 and 1800 millimetres. According to the classification system of Holdridge, San Miguelito is in the humid tropical forest life area (bht).

The coastal part of the San Miguelito Wetlands belongs to Lake Nicaragua, the second largest on the American continent, with an area of 8265 square kilometres (Martínez, 1996).

Water quality of the wetlands has not yet been studied, however, it seems to be good, although there is obvious turbidity caused by sedimentation. Other very localized effects that may affect water quality are pollution by agrochemicals from rice fields (lower part of Río Tepenaguazapa) and domestic solid waste that is dumped in several parts of Lago Cocibolca.

Depth, permanence and fluctuations of the water are directly related to the dry and rainy seasons. During the rainy season, water reaches its maximum levels, and large areas are flooded for six to seven months. It is during this period that Lago Cocibolca and the rivers reach their maximum depths that can range between 2 to 5 metres in the rivers and between 1 and 1.50 metres in Lago Cocibolca. During the dry season, the volume of the rivers decreases, most of the *llanos* and marshes empty and the depth of the water in the rivers is between 0.5 and 3 metres. The decrease in depth and level of the water is quite noticeable at the mouths of the rivers, which because of the accumulation of eroded sediments forms sandbanks, mud and detritus. Fluctuation in water level is estimated to vary between 1 and 1.7 metres between the dry and rainy seasons.

15. Hydrological values:

The most important hydrological characteristic of this area is the presence of Lake Nicaragua (Lago Cocibolca), which is the second largest body of freshwater in tropical America (8265 square kilometres). It is characterized by shallow depth and functions as a natural dam for water drained towards the tectonic basins in Nicaragua (INDES-CEDAPRODE, 1997). The area of the watershed and runoff of the San Miguelito Wetlands is based on three main rivers that are located to the north and south of the town: Tepenaguazapa, Camastro and Tule, which empty into Lake Nicaragua. This area of the San Miguelito Wetlands basin has an approximate area of 1226 square kilometres. The largest sub-basin is that of Río Tule with an area of 531 square kilometres followed by the Río Camastro sub-basin with 500 square kilometres and the Río Tepenaguazapa sub-basin with 195 square kilometres (INET, 1997).

16. Ecological features:

San Miguelito belongs to the humid tropical forest life area (bht) (CCT, 1998). Within this life area, there are three outstanding plant formations:

(A) Medium and high forest on flooded sites with moderately warm and humid areas, precipitation of 1800 to 2000 per year and temperatures of 24° to 26° C. This type of vegetation is located north and south of Río Camastro, around the shores of Lago Cocibolca.

(B) Medium and high sub-perennial forest of hot and humid areas with precipitation between 1500 and 1900 millimetres per year and temperatures between 26° and 28° C, located on the edge of Río Tepenaguazapa.

(C) Medium and high sub-evergreen forests of moderately hot and humid areas with precipitation of 1850 to 2500 millimetres per year and temperatures of 24° to 26° C, located in the rest of the area of San Miguelito including the wetlands (INDES-CEDAPRODE, 1997).

Among the plant formations of San Miguelito mentioned earlier are representative forest species, such as *cedro real* (*Cedrela odorata*), mahogany (*Sweitenia humillis*), *roble* (*Tabebuia* sp.), *guanacaste* (*Enterolobium cyclocarpum*), *genízaro* (*Phitecellobium saman*), *camíbar* (*Copaifera aromatica*), *laurel* (*Cordia alliodora*), *madero negro* (*Gliricidia sepium*), *guachipilin* (*Diphysa robinoides*), *jobo* (*Spondias mombin*), in addition to a large variety of fruit trees for example pawpaw, loquat, orange, mango, avocado, mandarin, *limón*, *nancite*, guava, granadilla, passion fruit, pear, papaya, coconut, *sonzapote*, *zapote*, tamarind, *igualtil*, *marañón*, *olosapo*, peach, *jocote guanábano*, *carao*, cacao, *anona*, *almendro* and bananas (Córdoba and López, 1998).

17. Noteworthy flora:

Important and vulnerable species

Common name	Scientific name	Family
Marillo	<i>Calophyllun brasiliense</i>	Clusiaceae
Caoba	<i>Sweitenia humilis</i>	Meliaceae
Cedro real	<i>Cedrela odorata</i>	Meliaceae
Camíbar	<i>Copaifera aromatica</i>	Caesalpiniaceae
Níspero	<i>Manilkara chicle</i>	Sapotaceae
Roble macueliso	<i>Tabebuia rosea</i>	Bignoniaceae
Guanacaste de oreja	<i>Enterolobium cyclocarpum</i>	Mimosaceae
Ceiba	<i>Ceiba pentandra</i>	Bombacaceae
Gavilán	<i>Pentaclethra macroloba</i>	Mimosaceae
Madroño	<i>Callycophyllum candidissimum</i>	Rubiaceae
Genízaro	<i>Albizia saman</i>	Mimosaceae
Guayabo lucio	<i>Terminalia oblonga</i>	Combretaceae
Lagarto	<i>Zanthoxilum belizense</i>	Rutaceae
Laurel negro	<i>Cordia alliodora</i>	Boraginaceae
Guabillo de río	<i>Inga vera</i> ssp	Mimosaceae

Important species of yet undetermined value

Common name	Scientific name	Family
Jobo	<i>Spondias mombin</i>	Anacardeaceae
Higuera	<i>Clusia</i> sp.	Clusiaceae
Papaturro	<i>Coccoloba caracasana</i>	Polygonaceae
Jagua	<i>Genipa americana</i>	Rubiaceae
Soroncontil	<i>Senna reticulata</i>	Caesalpinaceae
Jaboncillo	<i>Cupania</i> sp.	Sapindaceae
Sotacaballo	<i>Paulinia</i> sp.	Sapindaceae

Guabo	<i>Inga sp.</i>	Mimosaceae
Vainilla	<i>Vainilla planifolia</i>	Orchidaceae
Canelillo	<i>Ocotea sp.</i>	Lauraceae
Palo de plomo	<i>Zuelania guidonia</i>	Flacourtiaceae
Carao	<i>Cassia grandis</i>	Caesalpinaceae
Alacrancillo	<i>Helitropium indicum</i>	Boraginaceae
Chilamate	<i>Ficus maxima</i>	Moraceae
Chaperno	<i>Lonchocarpus sp.</i>	Fabaceae
Muñeco	<i>Cordia dentata</i>	Boraginaceae
Palanco	<i>Sapranthus nicaraguensis</i>	Annonaceae
Elequeme	<i>Erythrina fusca</i>	Fabaceae
Uña de gato	<i>Machaerium sp.</i>	Fabaceae
Espino negro	<i>Pithecellobium oblongum</i>	Mimosaceae
Espino de playa	<i>Pithecellobium dulce</i>	Mimosaceae
Cornizuelo	<i>Acacia hindsii</i>	Mimosaceae
Guasimo de ternero	<i>Guazuma ulmifolia</i>	Sterculiaceae
Trompillo	<i>Aliberta edulis</i>	Rubiaceae
Coyol	<i>Acrocomia vinifera</i>	Arecaceae
Nancite	<i>Byrsonima crassifolia</i>	Malpighiaceae
Madroño	<i>Calycophyllum candidissimum</i>	Rubiaceae
Jícaro sabanero	<i>Crescentia alata</i>	Bignoniaceae
Guachipilin	<i>Diphysa robinoides</i>	Fabaceae
Guasimo molenillo	<i>Luechea candida</i>	Tiliaceae
Tatascame	<i>Vernonia patens</i>	Rubiaceae
Mamón	<i>Melicocus bijugatus</i>	Sapindaceae
Madero negro	<i>Gliricidia sepium</i>	Fabaceae
Chocoyo	<i>Diospiros nicaraguensis</i>	Ebenaceae
Guapinol	<i>Hymenaea courbaril</i>	Caesalpinaceae
Poponjoche	<i>Pachira aguatica</i>	Bombacaceae
Balsa	<i>Ochroma pyramidale</i>	Bombacaceae
Ceibón	<i>Pseudobombax sp.</i>	Bombacaceae
Guiscoyol	<i>Bactris sp.</i>	Arecaceae
Coquito (palm)	Undetermined	Undetermined
Corozo	<i>Elaeis sp.</i>	Arecaceae
Poro poro		
Peine de mico	<i>Apeiba aspera</i>	
Malinche	<i>Delonix regia</i>	Caesalpinaceae
Mamón monterero	<i>Thalasia nervosa</i>	Sapindaceae

18. Outstanding fauna

The fauna of the Río San Juan basin is one of the most interesting in tropical America because of the lacustrine and fluvial associations (CCT, 1999; Saravia, 1996). Among the most important mammals are many endangered species, such as jaguar (*Panthera onca*), puma (*Puma concolor*), ocelot (*Leopardus pardalis*), margay (*Leopardus weidii*), eyra cat (*Herpailurus yaguaroundi*), Brazilian tapir (*Tapirus terrestris*) black-handed spider monkey (*Ateles geoffroyi*) and giant anteater (*Myrmecophaga tridactyla*). There are also species that are hunted, such as the white-tailed deer (*venado cola blanca*) (*Odocoileus virginianus*), red brocket (*cabro*

de monte; venado puco) (*Mazama americana*), spotted paca (*tepesquintle, guardatinaja* or *guilla*) (*Agouti paca*), Central American agouti (*guatuzá*) (*Dasyprocta punctata*) and *saíno* (*Tayassu tajacu*), among others (see annex 1–2) (Maffei et al., 1998).

Among the birds, there are web-footed wading birds (ducks and herons), birds of prey and others. This area is an important centre for migratory birds, especially aquatic birds from North America, which seasonally or in transit occupy the wetlands (INDES-CEDAPRODE, 1997; Chediack et al., 1998). In a preliminary inventory, the following were recorded: 144 species in 43 families, of which 48 species are migratory, 27 directly associated with the wetlands and 27 species associated with the plant communities surrounding the wetlands.

This study found that the bird life of San Miguelito represents 22.67 per cent of a total of 635 species recorded for Nicaragua by Camacho (1993). Among the endangered species found in San Miguelito (recorded by Chediack et al., 1998) are *zanate* (*clarinero*) (*Quiscalus mexicanus*), *veterano* (*galán sin ventura*) (*Jabiru mycteria*), *charrán común* (*Sterna hirundo*), pelican (*Pelecanus* sp.), *guisito* (*Empidonax virescens*) and *reinita Andarina* (*Seiurus aurocapillus*), among others. There are also records of colonies of *pato chancho* (*Phalacrocorax brasilianus*), *Casmerodius albus*, *gallinita de playa* (*Jacana espinosa*), *cuaca* (*Nycticorax nycticorax*), *cuaca de color* (*Cochlearius cochlearius*), *garza morena* (*espátula rosada*) (*Ajaia ajaja*), *gavilán colorado* (*Busarellus negricollis*), among others (see annex 1–3–1).

The most unique species of Lake Nicaragua and its wetlands are the freshwater dogfish, the *tiburón toro* (*Carcharhinus leucas*), and two species of sawfish (*Pristis pectinatus* and *Pristis peroteti*), whose special osmotic adaptation to the freshwater conditions is unique in the world (INDES-CEDAPRODE, 1997). There are also the *sábalo real* (*Tarpon atlanticus*), *gaspar* (*Atractosteus tropicus*) (INDES-CEDAPRODE, 1997) and a large variety of alimentary importance, including introduced species (exotic) such as tilapia (*Oreochromis nilotica*) (Briceño, personal communication; Directive of Fundación del Río, sector No. 4, San Miguelito, Río San Juan, Nicaragua).

For Lake Nicaragua, there is a recorded aquatic resource composed of a total of 17 families, 36 genera and 59 species of fish, of which six are migratory marine species and nine are endemic (Villa, 1982). According to Piedra and Osawua (1998), the two families of fish most representative of the lake are *Characinidae* and *Cichlidae* (annex 1–5–1). It is thought that the lake's ecosystem provides important ecological niches for development of the life cycles of several migratory species (Piedra and Osawua, 1998). As for reptiles, there are the American crocodile (*Crocodylus acutus*) and the brown caiman (*Caiman crocodilus*), both considered vulnerable (IUCN, 1998; Mandujano et al., 1998).

The freshwater turtles (*Kinosternon leucostomun* and *Kinosternon scorpiodes*) are also very abundant species in these wetlands. In the most recent national survey of lizards and *cuajipal*, completed in May 2000, a very important population was identified in the Tepenaguazapa, Palo Ralo, Piedra, Camastro, Charral, Congo and Tule rivers and on the shores of Lago Cocibolca, with an average of five specimens of *cuajipal* per lineal kilometre in the rivers north of San Miguelito and from 13 to

22.27 specimens of *cuajipal* per kilometre in the Charral and Congo rivers with higher averages and on the coastline there is an average of 4.52 specimens of *cuajipal* per kilometre (Favio Buitrago, unpublished document, 2000).

19. Social and cultural values:

San Miguelito was first known under the name of Las Aldeas, which was created east of the town. The name was given by the rubber-trappers and *raicilleros* between 1850 and 1855 (INET, 1997).

In the seventeenth century, it was of great commercial importance because of the activity that developed there related to the building of the railroad from San Miguelito to Punta Mico on the Atlantic Coast (INETER, 1997). The current San Miguelito, on the shores of Lake Nicaragua, gained importance as a lake port and livestock centre because of abundant green pastures in the surrounding wetlands, which made this site an alternative for Chontaleño ranchers who during the dry season had difficulty feeding their cattle and were forced to bring their herds from the region of Chontales and settle on the plains of San Miguelito and Morrito. Thus they solved the problem of the critical stage, which contributed to an increase in population of these municipios and the raising of livestock (Briceño, personal communication).

Tourism, although it is still only beginning, is promoted at the departmental and local levels, taking advantage of the diversity of cultural attractions and other options offered by the municipios of Río San Juan and Lago Cocibolca, (Morrito, El Almendro, San Carlos, El Castillo, San Juan del Norte, Granada, Ometepe, Archipiélago de El Nancital and other coastal towns on Lake Nicaragua). Outdoor recreation takes place primarily during Easter, on the islands closest to the community of San Miguelito and Morrito. The wetlands are also used by teachers and students from the town for educational field trips.

San Miguelito has a system of potable water, fishing production, transportation, building materials (for example thorny bamboo, sand, timber, lianas, medicinal plants, aromatic spices as condiments) and countless associated benefits.

As for the cultural values, there are four main religious celebrations observed by the Catholic population: Easter, September 29th (feast day of the patron saint San Miguel Arcángel), La Purísima and Christmas. Also the evangelists and Protestants hold ceremonies, baptize Christians in the waters of the wetlands and hold retreats, among other activities. In addition, the landscape and scenic natural beauty are considered of great importance by the local inhabitants for their recreation and inspiration of artistic works.

20. Land tenure/ownership of:

Although there are no official data for the municipio of San Miguelito, all the land surrounding the wetlands belongs to private persons and companies carrying out extensive livestock raising. It is clearly private property, except for the coastal strips and shores up to 35 metres, in accordance with existing legislation. By law, the riparian, lacustrine, paludal forests and islands belong to the Nicaraguan government.

21. Current land use:

A large part of the extensive livestock raising in the area is in the municipio of San Miguelito, and the only agro-industrial company dealing in rice is located in Palo Ralo in the municipio of Morrito in the extreme northern part of the San Miguelito Wetlands. At the present time, this firm is closed. There are only remnants of forest where cultural practices such as burning and indiscriminate cutting are decreasing soil fertility, causing water erosion and changing the scenic beauty of the many natural corridors. In general, land use surrounding the wetlands of San Miguelito is for degraded pasture (40 per cent weeds), *tacotales*, (*junquillales* and *gamalote*, which are hydrophilic Gramineae), livestock raising and low forest (INDES-CEDAPRODE, 1997). INETER (1997) identified only two types of land use in the area near the wetlands, which includes most of the municipio of San Miguelito: farming and ranching and medium forest.

22. Factors (past, present or potential) adversely affecting the site's ecological character, including changes in land use and development projects:

Among threats are deforestation for farming, creation of grazing areas and use of extractive enclaves (rubber, *raicilla*, chicle, timber, resin and wildlife). When the companies that were exploiting these resources closed and in light of the demographic growth caused by the lack of opportunities in other regions of Nicaragua, the unemployed and small farmers from other areas brought with them their culture of production and reproduced their inadequate extractive practices. A current threat in the area is the advance of the agricultural frontier and expansion of small farms (Pujol and Pujada, 1995), which has increased with the process of pacification that is now occurring in Nicaragua. This has promoted the return of small farmers to their former farms deep inland, and there is pressure from repatriated or displaced families to settle in forested areas for their exploitation, settling on small farms without regulations (INDES-CEDAPRODE, 1997).

The use of high concentrations of insecticides upstream from the wetlands together with the increase of extensive livestock activity is causing pollution, deforestation, erosion, sedimentation and loss of water quality in the river basins of Lago Cocibolca.

As for fishing, since 1983 the fish of greatest commercial importance are *sábalo real*, sea bass (*róbalo*), *roncador*, *guapote* and *gaspar*, all large carnivorous fish that live at trophic levels 3–5. In the decades before the 1980s, firms and foreign companies overexploited the species of shark and sawfish widely decimating the population of these species (Katunin et al., 1983). By the beginning of the 1980s, overexploitation of shark and sawfish had reduced their frequency of capture (Thorston, 1982). Although there are no reliable figures, it is now estimated that fishing is not being carried out sustainably. Furthermore, because of the scarcity of fish in the lacustrine waters small-scale fishing is moving into the river mouths and along the rivers in the area using nets and traps, which are fishing methods that affect all aquatic populations because they are non-selective fishing methods and their presence disturbs the habitat of species that use the wetlands as a sanctuary and refuge.

It is important to emphasize that historically settlements in the wetland have used fishing as a means of subsistence and forms part of the traditional culture, with the difference that during the past two decades traditional fishing means have been exchanged for small-scale methods that make it possible to increase the catch. Fishing constitutes one of the important activities that sustain the municipio's economy and has made it possible to provide employment and other benefits for a large number of families settled in the San Miguelito wetlands.

Threats to biodiversity (based on the criteria of Carlos De la Rosa, 1995)

A. Growth of the rural population in a subsistence economy: This is the most dynamic area in the population growth of Nicaragua, because of heavy migration since 1990 towards this area. The current semi-urban population of San Miguelito is more than 3,904, and the rural population is more than 9,600 inhabitants (INEC, 1995). This accelerated population growth has had socio-economic consequences that have direct or indirect repercussion on wetland conservation. The pressure of the agricultural frontier on these lands constitutes a weakness and a threat to their biodiversity. However, it is also an opportunity to develop farming systems that promote sustainable production processes with an emphasis on social, economic and ecological aspects that serves as a basic strategy for environmental management of this area (INDES-CEDAPRODE, 1997).

B. The loss, degradation, fragmentation and homogenization of the habitat through overuse of natural resources. Among the sources of this type of threat are the following:

1.) Poaching and illegal fishing is a widespread problem that has been very difficult to control in the mini basins and the basins crossed by the San Miguelito Wetlands despite new laws that regulate this activity. Although the tradition of hunting has been very common in the culture of the communities settled in the wetlands, it should be pointed out that by reducing wooded areas in the municipio, which form local biological corridors, and by the fact that the most important remnants of forest are located in the lower parts of the rivers that empty into Lago Cocibolca, a short distance from the centres of population, this facilitates greater social pressure on wildlife resources. This has resulted in placing many species in a vulnerable situation. The local inhabitants are also vulnerable given the poverty and resulting lack of opportunities for subsistence. This situation accompanied by a lack of education of the local inhabitants constitutes the main cause that leads to irrational use of existing natural resources in the wetlands.

2.) Exploitation of timber and deforestation is considered a harmful activity, despite agreements to exploit resources using the concept of forest management plans. In reality, the companies never prepared or carried out those plans. Also, deforestation of newly forested areas for use for farming and livestock is still quite a common practice despite regulations that prohibit changes in land use. To make the situation worse, uncontrolled burning is used as a farm management tool. In the Nicaraguan action plan for tropical forests, conservation of wetlands is not a priority (Davidson and Gauthier, 1993).

3.) Seasonal burning has been a farming tool used for farming purposes. These harmful practices for controlling weeds in pastures and the creation of areas for agriculture in San Miguelito and the rest of the grazing areas in Nicaragua have created a serious problem that has caused great ecological damage throughout the country, where forest fires destroy large areas during the dry season (summer).

4.) Erosion and sedimentation is a phenomenon caused by the effects of deforestation and livestock raising, stripping soils of their external fertile cover, which is eroded by rains to the rivers increasing the serious problem of sedimentation of the surrounding water basins, whose final destiny is the lower parts of the basins of the main rivers and Lago Cocibolca.

In San Miguelito, the colonization frontier is advancing toward the upper part of the basin along the Camastro, Piedras, Tepenaguazapa and Tule rivers and their tributaries. If protection measures are not taken against the devastation to which the protecting forests are being submitted, problems such as a low level and quality of water and sedimentation will continue to increase, and the hydro-electrical and biological potential and the ecological balance will be seriously threatened and will decrease.

An adverse factor for the conservation, management and sustainable use of many of the resources and benefits provided by the San Miguelito Wetlands has been the scarce information among local inhabitants about the multiple environmental services that these ecosystems provide and the low level of education of the local inhabitants as well as the lack of a protected area that includes inland forests, flooded forests, lacustrine, riparian and paludal systems and areas for recharging the aquifer, which would give a status of greater relevance for the inhabitants of the municipio. Among the main future threats to the wetlands is open-pit mining. There are several mining concessions nearby or within the basins of the rivers in San Miguelito whose environmental impact could be catastrophic for all the ecosystems of the wetlands once exploitation is authorized.

23. Conservation measures taken:

Currently, the San Miguelito Wetlands are not listed in a protection or management category, although in the general plans for wetlands of the working group for marine/coastal areas in Nicaragua through promotion of land use planning and use of natural resources their conservation and management for development have been included. The Ministry for the Environment and Natural Resources (MARENA) has included most of the wetlands in Nicaragua in the development strategy for sustainable management.

The Programa Regional en Conservación y Manejo de Vida Silvestre para Mesoamérica y el Caribe (PRMVS) of the Universidad Nacional de Costa Rica has carried out a preliminary survey of the wild fauna and flora. In addition, together with Fundación del Río it has organized workshops with the local inhabitants settled in the coastal areas and on the main riverbanks to discuss the main problems of the San Miguelito Wetlands and jointly formulate with the governmental and non-

governmental organizations and civil society of San Miguelito initial approaches to management and conservation. It is intended to promote at least one site with the category of wildlife refuge in the area, because of its characteristics and interrelationship with the wetlands of Los Guatuzos, on the south-west shore of Lago Cocibolca where there are similar species of bird life, reptiles and type of vegetation.

24. Conservation measures proposed but not yet implemented:

Davidson and Gauthier (1993) identified Estero El Charral as a wetland of international importance. Other types of proposals for conservation are mentioned in the study by INDES-CEDAPRODE (1997), where it is proposed to develop the following proposals:

(A) A conservation area of 9600 hectares located to the west, bordering on the municipio of Morrito;

(B) An area for development of forestry and grazing on approximately 76,000 hectares;

(C) A forested area of approximately 35,520 hectares. It is also intended to develop shrimp ranching in the Jícaro, Camastro and El Tule rivers and on the island of El Boquete south of the town of San Miguelito.

There are plans for raising iguanas, lizards and *cuajipales* and for production of anti-snakebite serums in the conservation area. In the southern part, it is proposed to promote the raising of bees and chicken farms at Migdonio Pérez (Las Palomas) and Mancha de Coyol, ecotourism throughout the coastal strip formed by the wetlands and the raising of pigs in the communities of El Congo No. 2, El Fajardo, Toro Bayo, El Espino and Migdonio Pérez. It is also proposed to develop small-scale fishing along the whole coastal strip of the municipio, in addition to the 100 kilometres of roads already mentioned, from Migdonio Pérez and Empalme de Los Sánchez to El Espino on the edge of Río Jícaro, from the town of El Tamboral to El Congo No. 2; from San Miguelito to El Tule and from Tule to El Fajardo (INDES-CEDAPRODES, 1997). All these communities are located around the San Miguelito Wetlands, which directly or indirectly influences them.

The government of Nicaragua recently created a department for environmental monitoring of wetlands in Nicaragua in order to increase the potential value of several sites and declare several wetlands as national wildlife reserves (Davidson and Gauthier, 1993).

25. Current scientific research and facilities:

Projects of the Escuela de Biología of the Universidad Centro Americana (UCA), under the direction of Msc. Martín Lezama, intend to carry out biological research in San Miguelito related to the wetlands with emphasis on species of bird life, mainly with graduate students. Also, the Peace Corps and the Universidad Autónoma de Nicaragua through the Centro de Investigación de Recursos Acuáticos (CIRA) together with Fundación del Río have decided to carry out a study on water quality in

Lake Nicaragua and the main rivers surrounding the wetlands, which are considered to be of international importance.

Infrastructure: Fundación del Río, which is the organization that is promoting and proposing the San Miguelito Wetlands as a wetland of international importance, is willing to continue providing its installations and infrastructure for development of initial management, conservation and sustainable development strategies for the wetland and future plans and projects for adequate management of the San Miguelito Wetlands jointly with other governmental institutions, private businesses and local actors.

26. Current conservation education:

At the present time, there is a project for formal environmental education in the primary schools in the area. Visits and educational activities with the inhabitants settled in the area have been organized. Obligatory ecological service has been created for students graduating from secondary schools. In coordination with PRMVS, training workshops have been organized about wetlands for teachers, youth, fishermen and farmers. Solid waste clean-up campaigns have been organized, and important environmental dates are celebrated (Wetlands Day, Earth Day, Environment Day, Tree Day, etc.).

Educational programmes are broadcast by radio. Each year in the dry season, campaigns against forest fires are carried out and there is coordination with the authorities of several institutions on joint plans for education. Educational videos are shown to farmers, teachers and students. Denunciation of infractions of environmental laws are prepared and processed regarding deforestation of headwaters, uncontrolled burning, overexploitation of forestry resources, chemical pollution and solid waste from the dairy industry, poaching and trade in wildlife species, etc. This whole series of activities is headed by Fundación del Río, the Ministry for the Environment and Natural Resources (MARENA), the Ministry for Education, Culture and Sports (MECD) and the local government, among the most important.

There is the Organización de Jóvenes Ambientalistas (OJA) of San Miguelito, which carries out theoretical and practical activities of environmental education. It has received institutional support and training from several international organizations, including a workshop organized by PRMVS on the design and creation of a wetlands interpretation centre, which began two years ago to function and little by little has grown and is improving, being of great use for students at all levels, teachers, farmers and other sectors.

27. Current recreation and tourism:

Tourism is just beginning, but paths and natural corridors are used because they are an attraction for viewing biological diversity and scenic beauty. Recreational activities are developed by the community during very specific periods of the dry season: Easter, feast days, weekends, etc. Children and young people use the coastal areas for swimming and other sports, especially during the dry season.

There is a sport-hunting club whose main targeted game is white-tailed deer, *saínos* and *piches*.

In the future, the strategy for development of tourism plans to use the system of speedboats on Lago Cocibolca to develop efficient tourism among these communities and the main urban centres of Nicaragua.

28. Jurisdiction:

The system of wetlands that we are proposing as a Ramsar site belongs to the municipio of San Miguelito in the department of Río San Juan, Nicaragua. Administration of this wetland would be the responsibility of the Dirección General de Areas Protegidas of the Ministry for the Environment and Natural Resources and the Ministry for Agriculture, Livestock and Forestry (MAG-FOR) as competent institutions to guarantee together with local interests conservation and future management of these ecosystems.

29. Management authority:

Dirección General de Areas Protegidas
Pesca y Fauna
Ministerio del Ambiente y Recursos Naturales
Kilómetro 12 ½, Carretera Norte
Managua, Nicaragua
Tel.: (505) 233 1278/1111/1112
Fax: (505) 263 2620/233 1596

30. References: