Information Sheet on Ramsar Wetlands

1. Date this sheet was completed/updated: 3 August 2000

2. Country: Nicaragua

3. Name of wetland: Deltas del Estero Real and Llanos de Apacunca

4. Geographical coordinates (coordinates of the 12 most-distant points out of 153 that define the polygon of the Estero Real site):

No.	UTM (East)	UTM (North)	Longitude	Latitude
1	487575.406	1436956.250	87°06.52.46	12°59.56.97
2	457481.938	1435005.750	87°23.31.37	12°58.52.50
3	457481.938	1435601.000	87°23.31.40	12°59.11.87
4	445300.906	1438088.000	87°30.15.90	12°00.32.14
5	446239.844	1426267.500	87°29.43.97	12°54.07.39
6	457811.688	1419739.625	87°23.19.65	12°50.35.52
7	470442.594	1421215.125	87°16.20.66	12°51.24.08
8	479077.469	1421947.250	87°11.34.19	12°51.48.17
9	485328.656	1414525.250	87°08.06.65	12°47.46.67
10	500399.156	1418593.875	86°5946.76	12.49.59.26
11	504392.438	1425350.875	86°57.34.24	12°53.39.23
12	491948.719	1431454.000	87°04.27.23	12°56.57.89

7º 25.69’ and 7º 26.40’ North latitude
43º 44.3’ and 43º 45’ East longitude

5. Altitude: Between 0 and 100 metres above sea level, according to INETER (1998)

6. Area: 81,700 hectares

7. Overview:

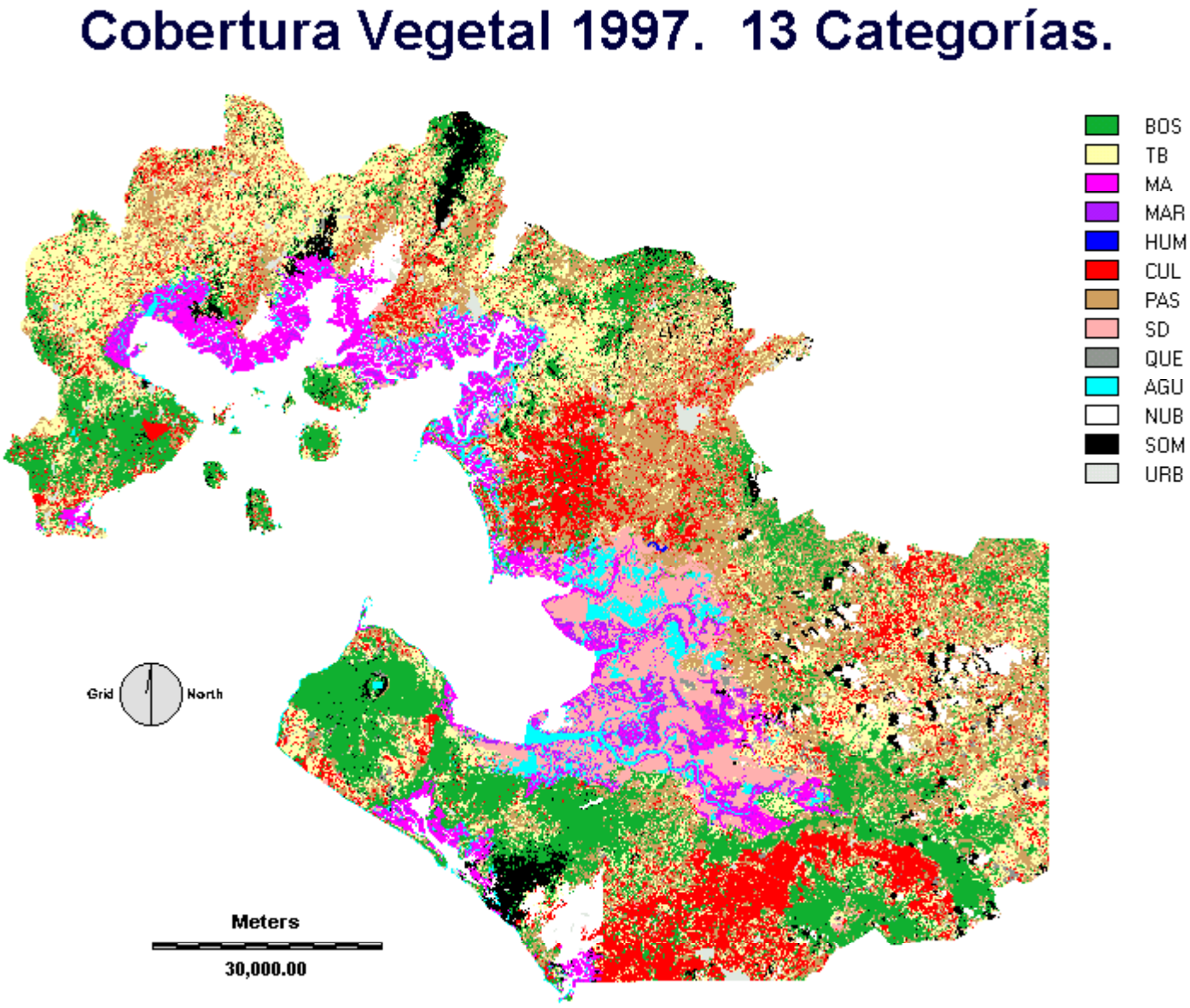
Deltas del Estero Real: The estuarine ecosystem Deltas del Estero Real belongs to a large estuarine system called the Gulf of Fonseca, which is shared by El Salvador, Honduras and Nicaragua (figures 1 and 2). This wetland is a mangrove ecosystem of more than 70,000 hectares of swamps and mangrove, where there is mainly ranching of shrimp using semi-intensive and extensive production systems, fish and agriculture. In addition to the impact of organic pollution, sedimentation and deforestation from the human settlements located there, there are the productive activities mentioned earlier (fishing and ranching of shrimp) and those external to the swamp itself such as agriculture, forestry and mining.

This wetland is located in the department of Chinandega in north-western Nicaragua. Two basic components define it.

Río Estero Real itself and its tributaries: The Estero Real estuary, which is the estuarine section of Río Estero Real, is between the juncture of the Villanueva, Tecomapa and Olmeca rivers and the mouth of Río Estero Real in the Gulf of Fonseca.

Llanos de Apacunca: Llanos de Apacunca was officially declared a protected area in the category of genetic resources reserve under Law 217 (Ley General del Medio Ambiente y los Resources Naturales) of 24 May 1996. It has an approximate area of 14 square kilometres, and its general objective, as a genetic reserve, is that of a conservation area for wild genetic resources in order to obtain selected germ plasma and maintain habitats in conditions necessary to protect and restore certain species, groups of species, biotic communities with genetic resources of commercial and scientific importance. The Llanos de Apacunca genetic reserve has the special purpose of protecting a variety of wild maize (*Zea luxurians*) as part of national biodiversity.

Figure 1. Vegetative Cover, Gulf of Fonseca, 1997. Classification in 13 categories.



Source: PROGULF (1998), map prepared by Velásquez Mazariegos (1998).

1. Forested areas (disturbed primary and secondary forests) (BOS)
2. Fallow land (TB)
3. Mangrove (MA)
4. Shrub mangrove (MAR)
5. Wetlands (HUM)
6. Pasture (PAS)
7. Annual and perennial crops (CUL)
8. Bare soil (SD)
9. Burned areas (QUE)
10. Water (AGU)
11. Clouds (NUB)
12. Shade (SOM)
13. Urban area (URB)

The proposed site has a basin of approximately 3,767 square kilometres and is characterized by an annual precipitation of 1200–2000 millimetres. Almost all precipitation occurs in the six months of the rainy season (May–November). During the dry season, the salinity of the water in the estuarine system increases, especially in the parts of the swamp farthest from the sea.

8. Wetland type: According to the Ramsar classification system of wetland types, Estero Real is a marine/coastal wetland and an inland wetland with the following special characteristics:

Marine/coastal: F, H and I

F: Estuarine waters; permanent water of estuaries and estuarine systems of deltas

H: Intertidal marshes; includes salt marshes, salt meadows, saltings, raised salt marshes; includes tidal brackish and freshwater marshes

I: Intertidal forested wetlands; includes mangrove swamps, nipah swamps and tidal freshwater swamp forests

Inland wetlands: Sp and Ss

Sp: Permanent saline/brackish/alkaline marshes/pools

Ss: Seasonal/intermittent saline/brackish/alkaline marshes/pools

9. Criteria Ramsar (reasons for inclusion)

Criterion 1: Criteria of representative or unique wetlands

The Deltas del Estero Real and Llanos de Apacunca wetland qualifies as a wetland of international importance because it is a representative or unique ecosystem that plays a significant hydrological, biological and ecological role in the natural functioning of the water basin to which it belongs. In addition, it is of great importance in the dynamics of the coastal cross-border system formed by the Gulf of Fonseca.

Criterion 3: General criteria based on fauna and flora

The Deltas del Estero Real and Llanos de Apacunca wetland qualify as a wetland of international importance because it is an ecosystem that regularly sustains large numbers of specimens of certain groups of waterfowl, which are indicators of the values, productivity or diversity of the wetlands.

The most significant criterion is number 1 by the fact that Estero Real is highly important for the functioning of the basin of that name, because it is an element fundamental in capturing rainfall that drain en the area of the water basin through freshwater rivers. It is the largest river on the Pacific coast of Nicaragua and empties into the Gulf of Fonseca, which is another ecosystem of great importance in the protection of coasts and the surrounding ecosystems. Also, from the point of view of ecology, it plays a fundamental role in the protection of animal species whose reproductive cycle depends directly on the existence of mangroves, which is found only in ecosystems of this type. In general, the site is considered to be a critical area because of reception of polluted waters from the upper part of the basin, transformation of the wetland into shrimp farms and extraction of mangrove and other species. As a result, wise use of resources is essential to the maintenance of natural biological, ecological and hydrological functions, thus guaranteeing conservation of the basin of the estuarine system of the Gulf of Fonseca, which is a cross-border site.

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

11. Name and address of the compiler of this form:

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

Criteria of representative wetlands

Criterion 1: This criterion corresponds to representative or unique wetlands that play an important hydrological, biological and ecological role for the correct functioning of a water basin or extensive cross-border coastal system. Selection of this criterion is based on the fact that Estero Real is very important for the functioning of the Estero Real basin and is a fundamental element for capturing rainwater reaching the water basin from freshwater rivers. Estero Real, like most marine/coastal wetlands, plays a basic role in protecting animal species, whose reproductive cycle directly depends on the existence of mangroves found only in ecosystems of this type. The proposed site is important because Estero Real is the largest river in the Pacific coast of Nicaragua and the larger of two water basins in Nicaragua. It empties into the Gulf of Fonseca, which is another ecosystem of great importance for protection of the coasts and surrounding ecosystems.

Criterion 3: As for the criterion based on fauna and flora, as mentioned earlier, Deltas de Estero Real and Llanos de Apacunca is a wetland that provides habitat for many animal species that are fragile during certain stages of their reproductive cycle. This habitat guarantees perpetuation of these species. The proposed area is habitat to endangered or vulnerable species such as the *garrobo* (*Ctenosaura* sp.), iguanas (*Iguana* sp.) and the boa constrictor (*Boa constrictor*), distributed throughout the whole ecosystem. The American crocodile (*Crocodylus acutus*) is considered a critical species because it is endangered and is seen frequently in the swamp (Buitrago and Torrez, 2000).

An important aspect that should be mentioned that backs up the importance of the proposed site as a habitat for endangered species is the fact that in recent studies (this year) it was determined that Estero Real and La Garita are places on the Nicaraguan Pacific Coast where the most healthy populations and relatively large of the American crocodile (*Crocodylus acutus*), which are seriously endangered.

The Apacunca genetic reserve is also important as a conservation area of wild genetic resources for selected germ plasma and as a habitat for protection and conservation of groups of species and biotic communities with important genetic resources for trade or science at the world level. The Llanos de Apacunca genetic reserve also protects a variety of wild maize (*Zea luxurians*) as part of the national biodiversity heritage.

13. General location:

Estero Real is located in the extreme south-eastern part of the Gulf of Fonseca, in the department of Chinandega, in north-western Nicaragua and belongs to the large estuarine system called the Gulf of Fonseca. It is the longest river in western Nicaragua and flows 137 kilometres from its source near El Sauce and Achuapa. It also drains 95 per cent of the rainfall of western Nicaragua. The area surrounding the proposed site is settled by several communities that subsist on a combination of fishing, extraction of products from the mangroves and small-scale agriculture. Puerto Morazán is the largest community in the area. A study in 1991 by the World Conservation Union and the Tropical Research and Higher Education Center (IUCN/CATIE) estimated that there were 1,500 persons in 200 to 250 families in Puerto Morazán. The Ministry for Fisheries Development (MEDEPESCA), the former institution responsible for regulation of fishing in Nicaragua and now the Fisheries

Administration (ADPESCA), estimated a population of 2,000 persons for 1994. Most of the inhabitants are active in fishing, shrimp farming or extraction of mangrove for firewood and tannin.

14. Physical features:

Geomorphology: In the Nicaraguan depression, which is a valley of little relief 30 to 45 kilometres wide that extends from southeastern frontier with Costa Rica to the Gulf of Fonseca in the northwest (Fenzl, 1989). In the lowest part of the basin, there are the estuarine delta flats of Estero Real, composed of wide plains with swamps, salt flats and mangroves with slopes between 0 and 2 per cent with a total area of approximately 45,938 hectares (MARENA, 1988). On the large flatlands, there are scattered hills formed from volcanic material from the Pleistocene with slopes between 30 and 50 per cent. The landscape also includes narrow valleys of colluvial origin with slopes between 2 and 15 per cent. In areas farther from the mangrove; there are very steep areas with slopes between 50 and 75 per cent.

Climate: The hydrographical basin of the proposed site is located within the tropical savannah climate region, whose main characteristic is the presence of a marked dry season during six months (November-April). Average annual precipitation in the region varies from 500 millimetres in the northeast to more than 2400 millimetres in the southwest (Tropical Research Development, 1993). Rains occur with marked seasonality in the rainy season that begins in May and ends in October. Annual evaporation is not more than 2000 millimetres. Average annual temperature is approximately 27º C, and average relative humidity is approximately 74 per cent, decreasing in the dry period and increasing in the rainy period. There is a marked dry season from November to April with only 5 per cent of annual precipitation. From December to April, evaporation increases, because of winds from the east and dry air masses. This, together with low precipitation during the dry period (4.3 per cent), causes a water deficit and drastically reduces contributions of freshwater to the system. The level of salinity increases in the summer (December–April). Winds reach an average annual velocity of 6.8 kilometres/hour and their magnitude is inversely proportional to relative humidity. Because of this, in September and October the average velocity of the winds decreases to 5.7 kilometres/hour when there is higher relative humidity. Average solar radiation is 413.8 calories/square centimetres/day, with February to May with the highest values and September to December the lowest.

Soils: In Estero Real (Marín, 1998), there are soils with textures from clay to silt with depths greater than 90 centimetres with flat to slightly wavy slopes. This is the case of the area of Campuzano, Luis Andino, Ranchería, Tonalá and part of Puerto Morazán. In El Limonal, Quebrada Honda, Tempisquiapa and Ticuantepe, the soils are clay and silt with slopes from 8 to 15 per cent with good internal drainage and apparently high fertility. In the area of the Gulf of Fonseca, Playones de Catarina, Mata de Cacao, Pueblo Nuevo and El Congo, the soils are sandy with slopes of 4 to 15 per cent. Most of the soils used for farming are on hills, and there are many rocks on the surface. There is a dominance of soils apt for forest. In the Northeast, which includes Palo Grande, Somotillo and Villa Nueva, the dominant soils are clay and the dominant vegetation is grasslands, thorny bushes, *guácimo de ternera* (*Guazuma ulmifolia*), *jícaro sabanero* (*Crescentia alata*) and areas for growing crops.

Hydrology: Nicaragua is divided into three large hydrographical regions: the Pacific watershed, the Atlantic watershed and the watershed of the large lakes. In the Pacific watershed, the main river is the Estero Real, which empties into the Gulf of Fonseca, an important geographical formation, because it protects the coastal waters. This condition promotes the establishment of mangrove ecosystems that are characteristic of transitional marine/inland areas. This gives them two hydrological dynamics: one marine, whose main element is the ebb and flow of tides that penetrate inland from the coasts through swamps, transporting marine fauna and flora that need estuarine conditions for their life cycles and another continental, whose main element is capturing rainwater draining into the area from the hydrographical basin through the freshwater rivers, transporting nutrients to the estuarine system.

Average annual precipitation ranges between 1500 and 1850 millimetres, with extreme values of 902 and 2492 millimetres. With an average of 1800 millimetres/year of rainfall, in six months the Estero Real watershed contributes up to 37.7 million cubic metres/day, without taking into account losses in the hydrological balance (Curie, 1994). In the lower part of the basin, precipitation patterns are irregular. In the upper part of the basin (Achuapa, El Sauce), the supply of freshwater in the form of runoff comes mostly from the Tecomapa and Villa Nueva rivers.

There is no study or data on the amount of freshwater supplied by the rivers in the lower part of Estero Real, but taking into account that there are more rivers in the upper part and the contribution of freshwater in the form of precipitation is 37.7 million cubic metres/day for the whole basin, precipitation is the largest contributor of freshwater in the upper part of the basin represented by water from the rivers plus water in the form of precipitation (part of the 37.7 million/cubic metres/day). As for the hydrological aspect, the tides and river discharges are clearly important, however, rainwater, surface runoff and infiltration have greater local relevance. During the period of low water, the flood tide travels over 13 to 19 kilometres and the ebb tide from 13 to 20 kilometres. During periods of flooding, the flood tide travels from 10.7 to 14 kilometres and the ebb tide from 14 to 14.5 kilometres (Curie, 1994).

As for the vertical profiles of salinity, 17–37 parts per thousand, temperature 27–31º C and oxygen 1.6–6 parts per million, according to Curie (1994), are acceptable for shrimp ranching. However, there are areas farther away from the main tributary with high salinity and a low level of oxygen. According to the analysis made by Curie (1994), oxygen levels in the swamp were lower than saturation, which is normal for this type of swamp. In areas where sedimentation is high, reduction in photosynthesis produces lower oxygen levels and bacterial respiration probably dominates. Sediment levels reduce transparency (turbidity). Sediment levels are highest upstream from Puerto Morazán.

The tide has an approximate amplitude of 2.9 metres, although its influence through Estero Real is not directly identified. Its effect can be felt at the junction of the Villanueva and Tecomapa rivers.

In the study mentioned earlier (Curie, 1994), it was estimated that the swamp takes two to three months to change its water. For Puerto Morazán, it is estimated that time for replenishment of water is two to six weeks during the rainy season. Upstream from Puerto Morazán, the time for replenishment to the Pacific Ocean can be up to four months.

Estuarine Hydrological System

The Estero Real estuarine system is composed of one main swamp, 11 primary swamps, 41 small secondary swamps and five areas of coastal lagoons formed during the rainy season by storms. All this system is interconnected with the water that reaches the Gulf of Fonseca and the surface runoff from the upper Estero Real basin. The main hydrological dynamics of the estuarine ecosystem is the flood and ebb of the tides and the flow of continental freshwater, highly influenced by processes of turbulent diffusion produced primarily by the effect of tides up to 70 kilometres upstream from the mouth of the Gulf of Fonseca. According to the studies made by Curie (1994), tides were within a range of a minimum of 8.77 feet and a maximum of 11.1 feet. As for the dynamics of the currents, it is estimated that the time for replenishment is from 30 to 45 days from Puerto Morazán to the mouth of the Gulf and more than 90 days from several points upstream from Puerto Morazán.

The range of saline gradients in Estero Real places this swamp in the category of "vertically mixed"; a category in which are included shallow estuaries where the water column is mixed homogeneously from the surface to the bottom. Distribution of dissolved oxygen shows a pattern similar to the saline gradient, decreasing gradually from the mouth of the main swamp inland. During the rainy season (May–October), concentrations of oxygen registered values of 4.0 mg/litre near the mouth of the swamp, decreasing to 1.6 mg/litre inland. In the dry season (November–April), concentrations of oxygen are higher than 3.6 mg/litre throughout the swamp. Variations in concentrations of dissolved oxygen are related to water turbidity, which is determined by the amount of suspended solid material.

According to Curie (1994), sediment loads are high upstream from Puerto Morazán, with levels recorded of up to 22 per cent in weight of sediment, contrasted to the 2 per cent detected at the mouth of the main swamp in the Gulf of Fonseca. Sediment is the result of forest degradation, conversion of forested areas for agriculture and the fragility of the soils that are farmed without conservation practices.

Inland Water System

The inland water system of Estero Real is made up of the water basin with the same name, which is the largest are on the Nicaraguan Pacific Coast, with an area of approximately 3,767 square kilometres, within which flow the Tecomapa and Villa Nueva rivers with 1,336 and 1,036 square kilometres of drainage area respectively, completing the system of 1,395 square kilometres of the basin, which has swamps and saline areas.

About 168 square kilometres in the steep parts of the Cosigüina Peninsula feed Estero Real and contribute to the drainage of the freshwater system. Evaporation in Estero Real is high (1,942 millimetres/year), exceeding annual precipitation.

Evaporation is reduced in the rainy season. Using an average of 1,800 millimetres of rainfall in six months in the basin of 3,767 square kilometres, the supply to Estero Real is up to 37.7 million cubic metres/day during the rainy season (Curie, 1994).

The hydrological system formed by the basin (Tecomapa and Villa Nueva rivers) is permanent of varying volume that increasing during the rainy season and varying with the seasonality of rains. Measurements of volume made by Curie in the dry season (1994) report volumes of 0.23 cubic metres/minute for Río Villa Nueva. There are no measurements for Río Tecomapa.

Four important rivers drain from Honduras into the Gulf of Fonseca: Río Choluteca (49 per cent of its water drains into the Gulf), Goascaran, Nacaome and Río Negro, the latter is partially in Nicaragua. The amount of freshwater that reaches the Gulf through these rivers is estimated to be 10,683 million cubic metres, representing 76 per cent of the entire volume, which is 15,312 million cubic metres. The supply to Estero Real, calculated on the basis of the area of the basin, is estimated to be 6,781 million cubic metres/year (Curie, 1994).

Hydrological zonification of Estero Real

According to hydrological dynamics and the pattern of the physical and chemical parameters of Estero Real, this can be divided into three hydrological areas:

A. Estuarine system upstream from Puerto Morazán;

B. Estuarine system downstream from Puerto Morazán;

C. System of dams or retention of rainwater. These are determined by the amount of sediment from the upper and middle basin through permanent, seasonal and irregular streams and the amount of rainfall to the system through streams and laminar runoff from the low brackish areas and the llanos.

A. Estuarine system upstream from Puerto Morazán: The main characteristics of this area are the highest sediment loads, 22 per cent in relation to specific weight (Curie, 1994). It has the lowest levels of dissolved oxygen, 3 mg/litre in the rainy season and less than 1.6 mg/litre in the dry season (Curie, 1994). Temperature and salinity are determined by a gradient based on the tidal regime and the contribution of rainfall. In this area, it is common to observe the filling-in of the swamps. Because of these factors, water productivity is lower in these areas. The Estero Real basin has 38,000 hectares with vegetation and areas apt for raising shrimp. Deforestation plays a basic role in the loss of the water balance, reducing infiltration and underground runoff that feeds the rivers and their contribution to the Gulf. In addition, precipitation drops in the summer to almost zero, creating high salinity in the upstream estuarine system.

B. Estuarine system downstream from Puerto Morazán. The main characteristics are a lower sediment load, two per cent in relation to the specific weight (Hernández, 1995), greater dissolved oxygen during the rainy season, 4 mg/litre and during the dry season 3.6 mg/litre, temperature and salinity influenced by the tides and the rate of water replenishment is highest (two to six weeks).

C. System of dams or retention of rainwater. During the rainy season, large seasonal bodies of water form coastal lagoons, where shrimp are found during part of their natural reproduction cycle. The main characteristics of these areas are formation by convergence of large beach areas bare of mangrove vegetation near the headwaters of these swamps with the intertidal areas occupied by mangrove forests. The hydrological dynamics and extension of these bodies of water depend on the levels of precipitation of each rainy season. They are areas that because of their capacity to store fresh water offer a refuge and food for fry and juveniles of many estuarine species that require brackish water of low salinity. These areas are of ecological interest because of their contribution to the maintenance of the biological diversity of the ecosystem and represent an alternative for subsistence for the inhabitants of the communities surrounding the mangrove.

There are several gaps in information provided about the volumes of water of the rivers that feed the Estero Real basin because of a lack of monitoring stations in the area. The data used are from agencies and institutions that have made studies in the area as representative samples. Collection of data taking into account the two seasons of the year over at least 10 years is needed.

15. Hydrological values:

The continental hydrological system of Estero Real is made up of the hydrological basin with the same name, which is the largest on the Pacific Coast of Nicaragua. The Estero Real basin drains 95 per cent of the rainfall in western Nicaragua and represents one of the most dynamic ecosystems because of its close relation with the Gulf of Fonseca.

16. Ecological features:

Mangrove is the dominant vegetation in the lower part of the Estero Real basin. It occupies an area of approximately 18,500 hectares not counting areas of white saltpans and shrimp farms. There has been a trend of reduction of forest areas, not only of mangrove but also of natural forests in the area of the Gulf of Fonseca. Velásquez Mazariegos (1998) in his comparative study of satellite images of the region in sequences from 1976, 1983, 1986, 1993 and 1997 shows the intensity of this change. The most dramatic result is in the category of mangroves. In 1976, they covered approximately 104,911 hectares (13.58 per cent), including mangrove and shrub mangrove, while in 1997 cover in the Gulf for these categories was approximately 73,900 hectares (9.5 per cent). This represents a clear reduction of about 4 per cent, especially of the mangrove (figures 4 and 5).

Figure 2. Vegetative cover, Gulf of Fonseca in Nicaragua. Source: PROGOLGO. Image processed and analysed by Velásquez Mazariegos (1998). 13 categories.

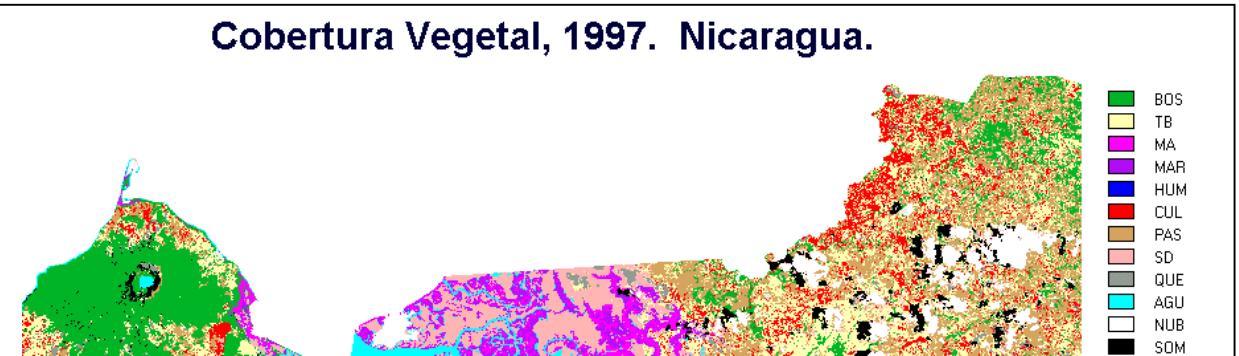
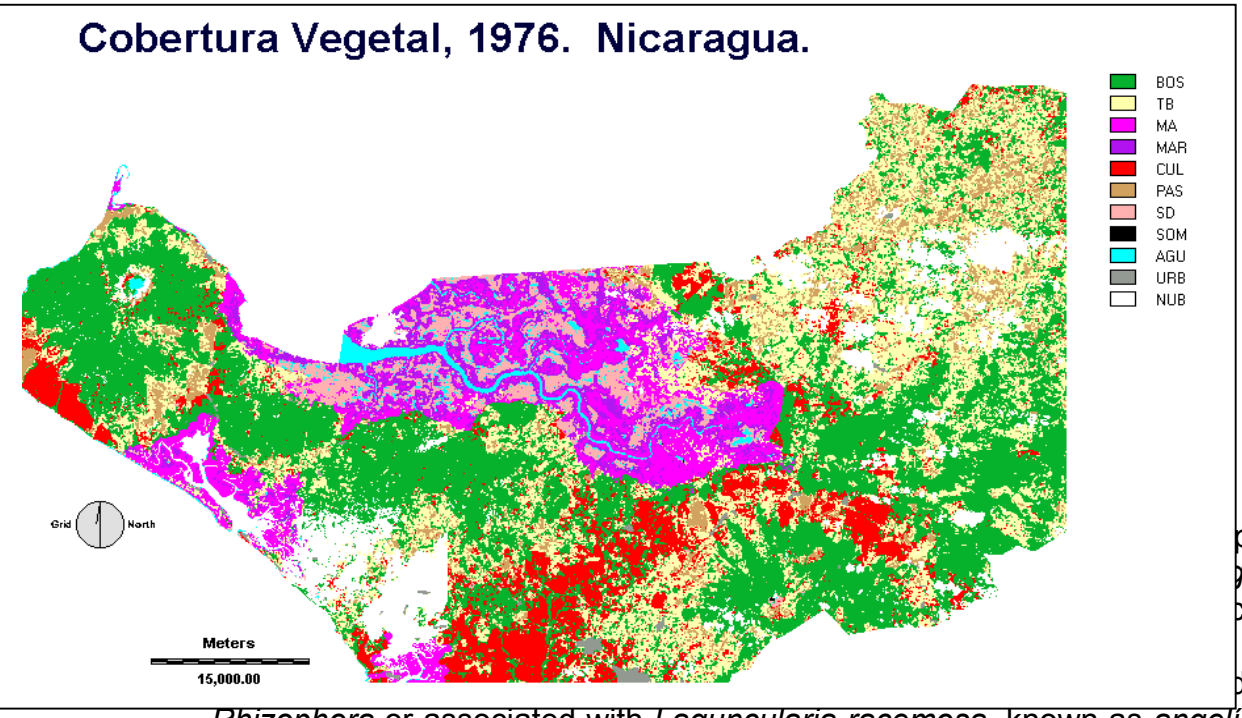


Figure 3. Vegetative cover, Gulf of Fonseca in Nicaragua. Source: PROGOLGO. Image processed and analysed by Velásquez Mazariegos (1998). 11 categories.



ped together
grove and *R.*
corded in the
are found in
d groves with
Rhizophora or associated with *Laguncularia racemosa,* known as *angelí*. Part of the area occupied by this species has been cut down to build shrimp farms.

In Estero Real, *angelí* (*L. racemosa*) is distributed throughout the swamp and its branches (IRENA, 1986). It is found in just a few places, forming pure groves or in associations with *palo de sal* (*Avicennia*) and more commonly with red mangrove (*Rhizophora*). Like *palo de sal* (*Avicennia*), it is located behind a strip of red mangrove (*Rhizophora*). In the genus *Conocarpus*, the species *Conocarpus erectus* has been identified, known as *botoncillo*. It is considered as a species associated with the mangrove that also grows in the transition to the deciduous forest (Jiménez, 1994).

Natural forests

A. Mangroves

- Pure red mangrove: This type of forest is found throughout the swamp on the shores of rivers in a strip that in some cases is 200 metres wide (Canta Gallo), and in others less than 20 metres (shores of Estero Real). The largest diameters found are 45 centimetres and heights reach 35 metres. The volumes, basal area and abundance found in Canta Gallo are 62 cubic metres/hectare, 8.7 square metres/hectare and 1,927 trees/hectare (DANIDA-Mangroves, 1993), classified as low forest (less than 7 metres), medium (between 7 and 12 metres), and tall (more than 12 metres).

- Pure *palo de sal* is found behind the strip of mangrove and sometimes on the shores, displacing red mangrove. It is located on high ground with high salt concentrations (saltpans). The strip of this forest is in some cases up to 200 metres wide. The larger diameters and greater heights recorded are 30 centimetres and 20 metres respectively. The dasometric data found in Canta Gallo are 33 cubic metres/hectare, 8 square metres/hectare and 2,613 trees/hectare (DANIDA, 1996).

- Pure *angelí* is located, like *palo de sal*, behind the strip of mangrove. This type of forest is found as pure forest only at Palomino and La Rocha. The greatest diameters and heights are found between 20–25 cm and 10–20 metres respectively. The intervention they suffer is greater than that of *palo de sal* and less than that of red mangrove.

- Pure and mixed *botoncillo* is found in the transition between dry forest and mangrove, forming small pure groves and in association with Cactaceae, *cornizuelo* (*Acacia costarricense*) and *palo de sal*. It is found in places known as Palo Solo, Lodo Podrido, Playones de Catarina and near Potosí. In addition, it is found in the transition from mangroves to deciduous forest in the Palomino swamp and near the La Palmita hill and Punta Mangroves Altos.

- Red mangrove and *palo de sal*, with a degree of mixture of 40 per cent *palo de sal* and 60 per cent red mangrove, is distributed throughout the main swamp and in most of the tributaries. Maximum diameters found are 25 centimetres with heights of 15 metres. In Canta Gallo, there is a volume of 27 cubic metres/hectare, a basal area of 8.3 square metres/hectare and an abundance of 3,992 trees/hectare (DANIDA-Mangroves, 1993).

- Red mangrove and *angelí* is represented by a mixture of 50 per cent red mangrove and 50 per cent *angelí*. It is rare throughout the swamp, but grows in the upper part of Canta Gallo, on the sides of Cerro Canta Gallo and in Palomino. Maximum diameters are 40 centimetres and a height of 15–20 metres. In Canta Gallo, the basal area is 58 cubic metres/hectare, 9.2 square metres/hectare and 2,348 trees/hectare (DANIDA-Mangroves, 1993).

- *Angelí* and fern (*Acrostychum aureum*) is found only in Palomino in a small grove. Ferns are abundant with a height of 1 to 4 metres and are considered important for later ecological studies.

The best-preserved mangrove is located in Estero Dos Aguas Grandes. In the sector known as Cuatro Esquinas, there is a combination of high and medium mangrove with dominance of high mangrove.

Distribution of mangrove vegetation

Type of Forest	Distribution	Status
Low red mangrove	From Lodo Podrido to the mouth of Palo Solo swamp and from Punta Mangrove Alto to the mouth of Torrencilla swamp	Conserved
Botoncillo	Estero Morazán to the mouth of Palo Solo swamp	Conserved
High red mangrove	Boca Estero El Chorro until Boca del Estero Dos Aguas	Moderately conserved
Medium red mangrove	Esteros El Chorro, Embudo, Cervantes and Marota Punta Manglare Alto and Estero Torrecillas From Puerto Morazán until El Cerro Palmita Esteros Canta Gallo and Canta Gallito	Degraded Conserved Degraded Moderately conserved
Medium and low *palo de sal*	Chorro, Embudo, Cervantes and Marota swamps	Conserved
Mixed red mangrove and *palo de sal*	Caleta El Tronconal and Estero Dos Agüitas	Moderately conserved

Source: Inventario Forestal 1993–1995, DANIDA-Mangroves

B. Deciduous forest

The deciduous forest, usually known as dry forest, does not make up large areas. It forms small, scattered groves, especially in the small mountain chain southwest of Puerto Morazán.

Average density: Outside the mangrove, in the areas of Cosigüina, El Congo, Palacios and Mata de Cacao, there are ecosystems of deciduous forest in regular conservation status. There are several species dominated by *guanacaste* (*Enterolobium ciclocarpum*), *pochote* (*Bombacopsis quinatum*), *cedro* (*Cedrela odorata*) and laurel (*Cordia alliodora*). Most of the deciduous forest is located on hills with slopes between 10 and 40 per cent, mainly in the southern part of the basin.

The deciduous forest is degraded and without any type of management but is used for firewood and construction wood. This type of vegetation is burned annually, especially before the first rains, because it is used for grazing. In these areas, burning should be managed and prevented because the areas serve as habitat for

many species of wildlife, in addition to their potential for construction wood. They should be managed for productive purposes.

From Puerto Morazán to Puente Real, on the southeastern shore of Estero Real, just after the strip of mangrove, there is a structurally developed and altered deciduous forest with a rich plant composition. On the northern shore until Somotillo, there are small areas of gallery forests along several parts of Río Villa Nueva and on several hills.

Scattered deciduous forest is located on the plains in the north-eastern part of the area studied. It is made up of several species of Gramineae and shrubs. Several dispersed trees have commercial value. In the eastern region, the vegetation is above all savannah, including palms, *coyol*, grasses and some scattered trees such as *genízaro* (*Pitecelobium saman*) and *malinche* (*Delonix regia*).

C. Savannahs subject to flooding

Near Somotillo, there are large plains covered with savannahs of *jícaros*, pastures, palms, *espino* and *coyol*. On the llanos, there is *jícaro sabanero* (*Crescentia alata*), where extensive ranching is practiced.

Agriculture and livestock raising

In addition to the wooded vegetation in the area, there is also farm growing groundnuts, sesame, soya, sugar cane, bananas and subsistence crops such as maize, rice and vegetables. There is also pasture for extensive grazing.

Current use of forest resources

With the decrease in the growing of cotton in the 1980s, many persons without economic alternatives to meet their basic needs moved closer to Estero Real. The number of persons that immigrated to this area is high in comparison with the previous years. This has caused heavy pressure on the resources of the mangrove, an ecosystem that has been degraded during the past ten years much more quickly than between the 1960s and the middle of the 1980s. There are now more persons that directly depend on the mangrove for extraction of firewood and construction of simple houses. There are also the shrimp firms that deforest a large number of hectares of mangrove of *palo de sal* for construction of their ponds near the large beach areas and red mangrove on the shores of streams to build canals for supplying water and drainage. Greatest degradation comes from extracting and selling firewood, despite legal restrictions on this activity imposed by the Ministry for Natural Resources (MARENA). The areas most affected by this resource are Luis Andino, Tonalá and Puerto Morazán.

The site with the highest degradation in the area is near Puerto Morazán towards the east, near Puente Real. The impact on this area can be measured by the decrease in the area occupied by red mangrove. The soil retained in the red mangrove roots is eroded from the banks of the swamp, causing its volume to increase. There is also a loss in depth, making navigation difficult. A good example of this is Estero Palo Blanco.

All the communities surrounding the mangrove of Puerto Morazán towards the Gulf of Fonseca make use of forestry resources for subsistence. The shrimp farms have affected mainly the species of *palo de sal*, greatly reducing its area but also affect the fauna associated with this species (*cangrejos zurdos*, boas). The greatest effect of the shrimp farms on the ecosystem is evident from Puerto Morazán towards the Gulf of Fonseca.

17. Noteworthy flora:

Species of trees and plants recorded by PROGULF (1997) Category: Valuable timber	
Common name	Scientific name
Caoba	*Swietenia humilis*
Pochote	*Bombacopsis quinatum*
Cedro real	*Cedrela odorata*
Laurel	*Cordia dentate*
Roble	*Tabebuia rosea*
Cedro espino	*Bombacopsis quinata*
Source: Talleres comarcales PROGULF 1997, field visits by PROGULF 1997	

Species of trees and plants recorded by PROGULF (1997) Category: Building materials/furniture	
Common name	Scientific name
Guanacaste de oreja	*Enterolobium cyclocarpum*
Botoncillo	*Conocarpus erectus*
Guanacaste blanco	*Albizzia caribaea*
Genízaro	*Phytecelobium saman*
Madero Negro	*Gliricidia sepium*
Guiligüiste	*Karwinskia calderonii*
Gavilán	*Albizia guachapele*
Cortes	*Tabebuia ochracea* spp., *Neochrysantha*
Tololo	*Guarea glaba*
Almendro macho	*Dipteryx panamensis*
Espavel	*Anacardium excelsum*
Guapinol	*Hymenea caurbal*
Guayabo	*Terminalia amasonia*
Ceiba	*Ceiba pentandra*
Pino	*Pinus oocarpa*
Mangrove rojo	*Rhizophora racemosa*
Mangrove rojo	*Rhizophora mangrove*
Mangrove rojo	*Rhizophora harrisonii*
Palo de sal	*Avicennia racemosa*
Palo de sal	*Avicennia bicolour*
Source: Talleres comarcales PROGULF 1997, field visits PROGULF 1997	

Species of trees and plants recorded by PROGULF (1997)

Category: Firewood	
Common name	Scientific name
Eucalipto	*Eucaliptus camaldulensis*
Teca	*Tectona grandis*
Quebracho	*Lysiloma seemanii*
Madroño	*Calycophyllum candidissimum*
Cornizuelo	*Acacia costarricense*
Zapotillo	*Pouteria sapota*
Sardinillo	*Tecoma stan*
Jiñocuabo	*Bursera simarouba*
Espino blanco	*Adelia barbinervis*
Aromo	*Acacia farnesiana*
Tigüilote	*Cordia* sp.
Guácimo	*Guazuma ulmifolia*
Guayabillo	*Myrcianthes fragns*
Tempisque	*Mastichodendron capiri var tempisque*
Ojoche	*Brosimum* sp.
Talalate	*Gyrocarpus americanus*
Berberilla	*Cochlospermum vitifolium*
Mangrove rojo	*Rhizophora racemosa*
Mangrove rojo	*Rhizophora mangrove*
Mangrove rojo	*Rhizophora harrisonii*
Angelí	*Laguncularia racemosa*
Source: Talleres comarcales PROGULF 1997, field work PROGULF 1997	

Species of trees and plants recorded by PROGULF (1997) Category: Medicinal and food plants	
Common name	Scientific name
Zacate limón	
Albahaca	*Ocimum basilicum*
Golondrina	*Boerhaavia erecta*
Cilantro	*Eryngium foetidum*
Verdolaga	*Portulace oleraceaetl*
Zorrillo	*Alvaradoa* sp.
Chan	
Cola de alacrán	*Acalipha alopecuroides*
Zacate valeriana	
Dormilona	*Desmanthus virgatus*
Quelite fraile	*Cnidoscolus aconitifolius*
Hierba santa	
Marango	*Moringa oleifera*
Cola de caballo	
Quina	
Hombre grande	*Quassia amara*
Higuera	*Ricinuscomunis*
Achote falso	*Thespesia populnea*
Carao	*Cassia grandis*
Jicaros (food)	*Crescentia alata*

Perejil (food)	
Uva pequeña (food)	
Nancite (food)	*Byrsonima crassifolia*
Guayaba (food)	*Psidium grajava*
Quesillo (food)	*Malvariscus atboureus*
Capulín (food)	*Muntingia* spp.
Coyolito (food)	*Bactris balanoides*
Tigüilote (food)	*Cordia alba*
Aceituna (food)	*Simarouba glauca*
Coyol (food)	*Acrocomia* spp.
Jocote jobo (food)	*Spondia purpurea*
Jocote garrobero (food)	*Spondia mombi*
Pitahaya (alimenticia)	*Cereus pentagonus*
Icacos (alimenticia)	*Chrysonalanus icaco*
Almendro (alimenticia)	*Terminalia catappa*
Source: Talleres comarcales PROGULF 1997, field visits PROGULF 1997	

Dominant Species in the Ecosystems at the Proposed Site

Red mangrove	*Rhizophora mangrove*
Red mangrove	*Rhizophora harrisonii*
Palo de sal	*Avicennia germinans*
Palo de sal	*Avicennia bicolor*
Angelí	*Laguncularia racemosa*
Botocinllo	*Conocarpus erectus*
Ferns	*Acrostychum aureum*
Guanacaste de oreja	*Enterolobium cyclocarpum*
Pochote	*Bombacopsis quinata*
Cedro	*Cedrela odorata*
Laurel	*Cordia alliodora*
Genízaro	*Pitecelobium saman*
Malinche	*Delonix regia*
Jícaro sabanero	*Crescentia alata*

18. Outstanding fauna

There is a large variety of wildlife in Estero Real because of the convergence of marine, terrestrial and estuarine ecosystems. The area near the mouth of the Gulf of Fonseca has a large number of birds. Within the Estero Real basin, fauna is relatively scarce and is represented mainly by birds, fish, crustaceans and a small number of reptiles and mammals found on the Cosigüina peninsula and to a lesser degree in the hills surrounding the mangrove. The growing environmental degradation of the region from several sources (reduction of water regime, pollution of bodies of water, cutting of forests, excessive hunting, capture of wildlife) has caused a reduction in the original diversity (IUCN, 1992).

Critical habitat during part of the life cycle of several species

Nesting birds: Birds form one of the most abundant groups of fauna. There are migratory and permanent birds and also aquatic and terrestrial. The aquatic birds are located mostly in areas where red mangrove is best conserved (Dos Aguas Grandes and Torrencillas), using them as nesting areas.

Feeding of birds in the coastal lagoons during the rainy season (temporary). The temporary lagoons feed a large number of crustaceans, especially post-larval shrimp.

Reproduction and feeding of land birds, mammals and reptiles. The species of mammals present in the area are rare. They are distributed throughout the mangrove and small areas of deciduous forests that border on the mangrove (hills). They are concentrated in these small areas and in the nature reserve of the Cosigüina peninsula. The most frequently species observed in the mangrove are *mapachín* (*Procyon lotor*) and the squirrel (*Sciurus variegatoides*).

According to field observations and community workshops carried out in the area, the hills of La Palmita, Canta Gallo, Canta Gallito and a small mountain chain southwest of Puerto Morazán have a greater number of fauna because intervention in the deciduous forest has been less.

Growth of shrimp in the coastal lagoons during the rainy season (temporary): The shrimp of temporary lagoons (*Penneaus* spp.) represent the fauna of greatest economic importance in Estero Real, although there are a large number of crustaceans throughout the main and secondary swamps. Shrimp are found in all the natural lagoons and in the swamps.

Critical species: Endangered and vulnerable species are determined by using the CITES Appendices.

Vulnerable or endangered species

Reptiles and amphibians: In the area of the mangrove, there are *garrobo* (*Ctenosaura* sp.), iguana (*Iguana* sp.) and boa (*Boa constrictor*) distributed throughout the whole swamp. The American crocodile (*Crocodrylus acutus*) is considered a critical species because it is endangered. Specimens have been recorded with regular frequency in specific areas (in the sector of the Caleta El Bocón upstream from Puente Real and the swamps of Lodo Podrido and Campuzano), but also in places near the mouth of the main swamp in the Gulf of Fonseca.

Mammals: Mammals are scarce and are found with greater frequency in the remnant deciduous forest in Somotillo, Villa Nueva and Cosigüina.

Abundance and distribution

Molluscs: Several species of found in Estero Real are scarce and restricted to a certain area in the Gulf of Fonseca. *Concha negra* (*Anadara tuberculosa*), *casco de burro* (*Grausdiarca grandis*) and *cambute* (*Strombus galeatus*) are considered critical in the area because of their scarcity and distribution (DANIDA-Mangroves, 1993). The last remaining areas of molluscs in Estero Real are found at the mouth of the Gulf of Fonseca, in association with red mangrove and where sediment is deepest.

Crustaceans: Another important group of crustaceans, crabs and *punches* (*Callinectes* spp.), are distributed throughout the mangrove, but with greater abundance where the red mangrove is best preserved.

Commercial species

Fish: The largest amount is at the mouth of the Gulf of Fonseca and in the swamps of El Chorro, Marota, Torrecillas, Dos Aguas Grandes and Dos Agüitas. The fish component is one of the most important elements of the Estero Real mangrove ecosystem.

Bird species recorded by PROGULF (1997)	
Common name	Scientific name
Chis chis ojos rojos	*Vireo divaceus*
Garza morena	*Florida caerulea*
Garza real	*Casmerodius albus*
Gaviota común	*Larus atricilla*
Tijereta	*Muscivora fortificata*
Alzaculito	*Actitis macularia*
Chis chis	*Dendroica petechia*
Paloma alas blancas	*Zenaida asiática*
Güis migratorio	*Tyrannus tyrannus*
Güis	*Tyrannus verticalis*
Güis copetón	*Tyrannus nigricans*
Güis negro	*Tyrannus nigricans*
Güis chiquito	*Myioretetes similis*
Chocoyo sapoyol	*Brotogeris jugularis*
Chocoyo catano	*Aratinga canicularis*
Loras copete amarillo	*Amazona ochorocephala*
Pericón verde	*Aratinga holochlora*
Lapas rojas	*Ara macao*
Pichardas	*Dendrocygna* spp.
Piches	*Dendrocygna autumnalis*
Pato aguja	*Anhinga anhinga*
Pelícanos	*Pelicanus occidentalis*
Perdiz	*Cryturellus cinamomeus*
Martineta	*Butorides virescens*
Garza garrapatera	*Bubulcus ibis*
Martín peña	*Tigrisoma limeatum*
Garabulón	*Mycteria americana*
Zopilote	*Coragips atratus*
Sonchiche	*Cathartes aura*
Gavilán chapulinero	*Buteo magnirostris*
Gavilán plomizo	*Buteo nitidus*
Gavilán pollero	*Buteo brachyurus*
Gavilán cola roja	*Buteo jamaicensis*
Gavilán alas redondas	*Buteo platypterus*
Gavilán come gallinas	*Parabuteo uncinatus*

Gavilán negro	*Hypomorphus urubitinga*
Guas	*Herpetotheres cachinans*
Querque	*Polyborus cheriwuay*
Gavilán patilludo	*Falco sporverius*
Cuachas	*Ortalis vetula*
Codorniz	*Colinus leucopogon*
Gallinita de playa	*Jacana spinosa*
Paloma patacona	*Columba flavirostris*
Paloma tortolita	*Scardafela inca*
Paloma San Nicolás	*Columbina talpacoti*
Cotorra	*Amazona albifrons*
Sigmonte	*Coacyzuser ythropthalmus*
Pájaro león	*Playa cavana*
Pijul	*Crotophaga sulcirostris*
Relojero	*Morococcyx erythropygus*
Esquirin	*Tito alba*
Lechuza	*Otus cooperi*
Cocoroca	*Otus cooperi*
Búho de espejuelos	*Pulsatrix perspicillata*
Manguito	*Anthracothorax prevostil*
Colibrí	*Amazilia rutila*
Calandria	*Trogon citreolus*
Viuda pecho amarillo	*Trogon citreolus*
Martín pescador	*Megaceryle torcuata*
Guardabarranco gigante	*Hylomanes momotula*
Guardabarrancos	*Eumomota superciliosa*
Urraca chinga	*Notachus macorrhynchus*
Chenge	*Centurus aurifrons*
Carpintero	*Phbcoceases guatemalensis*
Toledo	*Chiroxiphia liniaris*
Prisionero	*Taraba major*
Guarumo carraco	*Cotinga fasciatus*
Cierto güis	*Pitangus sulphuratus*
Güisito de hamón	*Empidonax hammoudii*
Ventura	*Myiodinaster luteiventris*
Golond./alambres	*Progne chalybon*
Golond./migratoria	*Hirundo rústica*
Urraca	*Cyanocitta formosa*
Guarachía	*Campylorhynchus rufinucha*
Pavito	*Thyothorus thoracicus*
Pavito grandre	*Thyothorus rufalvus*
Sinsontle	*Turdus gragi*
Brinquito	*Polioptila albifrons*
Oropéndola	*Gymnoshops montezuma*
Tordo	*Dives dives*
Sargento	*Agelaius phoeniceus*
Chichiltote	*Icterus gularis*
Chichiltote pálido	*Icterus sclateri*
Viuda chiquita	*Thraupis episcopus*

Arrocero	*Sporofila torcuata*
Retumbo	*Guarica caerulea*
Clarinero zanate	*Cassidix mexicanus*
Pasarrios	*Basiliscus vittatus*
Pancho galán	*Jabiru mycteria*
Alcaravan de water	*Botaurus pinatus*
Paloma llanera	*Zenaida macrorura*
Species recorded base on the study of fauna by IRENA (May 1983–May 1989)	

Species of mammals recorded by PROGULF (1997)	
Common name	Scientific name
Mapache	*Protion lotor*
Ardilla	*Scirus variegatoides*
Guatuza	*Dasyprocta punctata*
Pizote	*Nasua narica*
Zorro meón	*Maphites macroura*
Tigre	*Felis onca*
León	*Felis concolor*
Caucelo	*Felis tigrina*
Sahino	*Tayassu tajacu*
Ratita cosechadora	*Reithrodontromys* spp.
Zorro cola pelada	*Deidelphis marsupialis*
Cusuco	*Dasypus novemcinctus*
Mono tecolote	*Ateles gesffroyi*
Vampiro	*Desmodus rotundus*
Conejo cola blanca	*Sylvilagus floridanus*
Venado cola blanca	*Odocoileus virginainus*
Tigrillo	*Felis pardalis*
Comadreja	*Mustela* sp.
Coyote	
Gato onza	*Felis vagoaroundi*
Perezoso	*Bradypus grieseus*
Cuyuceo	*Potos flavus*
Guardatinaja	*Agouti paca*
Gato de monte	*Felis criedii*
Species recorded based on the study of fauna by IRENA (May 1983–May 1992)	

Species of amphibians and reptiles recorded by PROGULF (1997)	
Common name	Scientific name
Iguana verde	*Iguana iguana*
Garrobo Negro	*Ctenosaura similes*
Cocodrilo	*Crocodrylus acutus*
Boa	*Boa constrictor*
Lagartija	*Ameiva undulata*
Lagartija rayada	*Cnemidophorus deppii*
Escorpión	*Lepidodactylus lúgubres*
Sapito	*Physalaemus pustulosus*

Rana maculata	*Rana maculata*
Cuajipal	*Caiman crododilus fuscus*
Cascabel	*Crotalus cerastes*
Culebra ratonera	
Species recorded based on the study of fauna by IRENA (May 1983–May 1992)	

Species of fish most common recorded by PROGULF (1997)	
Common name	Scientific name
Lisa	*Mugil curema*
Róbalo	*Centropomus*
Lisa	*Mugil curema*
Lisa	*Mugil curema*
Wicho	*Arius* spp., *Ariopsis* spp.
Corvina	*Cynoscion squamipinnis*
Corvina	*Cynoscion phoxocephalus*
Corvina	*Cynoscion stolzmanni*
Corvina	*Cynoscion albus*
Corvina	*Cynoscion nannus*
Jurel	*Parapsetus panamensis*
Pargo	*Lutjanus* spp.
Mero	*Epinephelus analogus*
Tiburón	*Carcharhinus porous*
Peperechin	*Albula* spp.
Peje chancho	*Pseudobalistes* spp.
Sapa muche	*Batrachoides* spp.
Peje aguja	*Strongulura* spp.
Jurel	*Camax vincus*
Sardina	*Anchoa* spp.
Cwatercha	*Diapterus brevimanus*
Peje gato	*Polydactilus approximans*
Ruco rayado	*Anisotremus* spp.
Ruco cabezón	*Genuatremus* spp.
Ruco negro	*Pomadasys macracanthus*
Ruco dorado	*Haemulon scuderi*
Pancha corvina	*Stellifer* spp.
Babosa pinchada	*Cynoscion* spp.
Pancha	*Bairdiella* spp.
Pancha rayada	*Paraionchurus* spp.
Pancha coneja	*Menticirrhus nasus*
Macarela	*Scomberomorus* spp.
Picuda	*Sphoeroides* spp.
Pez sapo	*Sphoeroides* spp.
Cuyamel	*Jutunus pichardi*
Species recorded based on the environmental study of the Gulf of Fonseca May (1993) and reported by the DANIDA-MANGROVES project (1996)	

Species of the most common crustaceans

Common name	Scientific name
Camarón	*Penaeus vannamei*
Camarón	*Penaeus stylirostris*
Camarón	*Penaeus occidentalis*
Camarón	*Penaeus californiensis*
Camarón	*Macrobachium* spp.
Tiguacal	*Cardisorra crasum*
Jaiba	*Callinectes* spp.
Punche	*Ucides occidentalis*
Species recorded based on the study of fauna by IRENA (May 1983–May 1992)	

Species of the most common molluscs	
Common name	Scientific name
Concha negra	*Anadara tuberculosa*
Casco de burro	*Grausdiarca grandis*
Cambute	*Strombus galeatus*
Oyster	*Crassostrea iridescens*
Species recorded based on the report on fauna. DANIDA-MANGROVES Project (1996)	

19. Social and cultural values:

Fishing: In Estero Real, there are two types of small-scale fishing: one that is carried out seasonally as the result of migration of farm workers towards the coast during the summer. In the rainy season, most of these seasonal fishermen farm and carry out small-scale raising of shrimp. The other is that carried out by a few families that live off fishing permanently. These usually settle for months or years at some beach in the swamps, for example near the mouth of the Gulf of Fonseca.

According to the socio-economic information from the MARENA/CATIE-IUCN-DANIDA/MANGROVES Project in Chinandega, most of the fishing activity is concentrated in Puerto Morazán and Playones de Catarina, where it is the most important activity. There is fishing in Puerto Potosí, but to a smaller degree, and in the Gulf of Fonseca. In general, with the exception of breeding and raising of shrimp, fishing in the Estero Real is strictly small scale.

With regard to the economic importance of fishing, in Puerto Morazán is where this has greatest relevance. Playones de Catarina is another place where fishing is important because of the catching of fish and raising of shrimp. In Morazán and Playones de Catarina, fishing represents an important secondary source of economic activity. This is related to the seasonal dependence of fishing compared with farming patterns.

The species that are fished for subsistence or for sale are catfish (*Bagre pinnimaculatus*), sea bass (*róbalo*) (*Centropomus*), *corvina* (*Cynoscion albus, C. nannus, C. squamipinnis, C. phoxocephalus* and *C. stolzmanni*) and shark (*Carcharhinus*).

20. Land tenure/ownership of:

Most of the land is private property except that located in saltpans and areas where the government has sovereignty in which production can take place only under concessions granted by the municipal and government authorities.

21. Current land use:

The following description of land use in the proposed area is based on the study made from satellite images from 1997 by Velázquez Mazariego.

Wooded areas

BPI (Altered primary forest)*:* This category includes altered and heavily altered natural forests within which can be found large trees that probably existed before any type of human intervention ("primary"). During the dry season, many trees retain green leaves, which helps to identify this category but can cause confusion with fields of *marañón* and coffee. It is probable that several areas in this category are composed of relatively large trees but of secondary growth (growth after clear or partial cutting). There are cases of confusion between this category and that of secondary forests.

Secondary forests (BS): This category includes wooded areas of secondary growth composed of relatively large trees, many of which do not loose their leaves during the dry season. These areas were probably once without trees. This category can be confused with primary forests (when dominated by large trees) or with fallow land, which in ecological terms is young secondary forest.

Fallow areas

Fallow land (TB): Fallow land is farm land temporarily resting or pasture in which secondary growth shrubs and small trees have grown over at least 50 per cent of the area. There were cases in which it was difficult to decide whether the cover was pasture or fallow land. In reality, there are no definite categories but gradients with a percentage of cover of shrubs that varies between 0 and 100 per cent. Obviously, this causes difficulties when assigning a plot to a certain category and also makes taking spectral signatures difficult. Most shrubs growing on the fallow land loose their leaves during the dry months. This phenological characteristic helped us to separate the fallow land from secondary forests. However, when land has remained fallow for a long time it is probable that there are trees that remain evergreen and can be confused with the category of secondary forest.

Mangroves

Mangroves (MA): This category includes all types of mangrove that are not shrub mangrove of *Avicennia* spp. It was impossible to identify other types of mangrove because many of the training sites made with GPS were not sufficiently large to take a spectral signature. Because of the presence of water and the evergreen phenology of the species that grow in the mangroves it was possible to identify the mangroves from other categories of land cover very well. Cases of confusion could occur in the

driest parts of the mangrove (confusion with the category BPI) and in the parts where mangroves are less dense (confusion with category MAR).

Shrub mangrove of *Avicennia* spp. (MAR): The shrub species *Avicennia* spp. forms communities of low height (0.4–0.8 metres) that cover between 40 and 80 per cent of the land. The areas in which this plant community can usually be found are rather homogeneous and sufficiently large to form spectral signatures. We feel that the result of classification for this category is rather reliable. Confusion occurs when the shrubs are very developed and ground cover is very high (confusion with the category MA), or, in the opposite case, when the ground cover is very low (confusion with bare ground) or the presence of water is dominant (confusion with water).

Wetlands

Wetlands and green vegetation in bodies of freshwater and brackish (HUM): There are several special sites where this type of vegetation can be found. However, these sites are not very important–in terms of area–in comparison with other categories. The confusion of this category with the categories of mangrove (MA and MAR) and with primary forests (BPI) is very frequent. For this reason, only those areas that were expected to have this type of cover were included in this category.

Pastures

Pastures with trees (PCA): Included in this category are all the pastures in which there was a tree and shrub cover of less than 40 per cent. In many cases, tree cover is very sparse. This category was the most difficult to identify because it blends into pastures (PI) with *jícaro*–a small tree–and, when the presence of trees with green leaves is rare, with the category of pastures without trees (PSA).

Pasture with *jícaro* (PJ): In the area of the Gulf of Fonseca, there are many pastures and savannahs with *jícaro*, which, however, do not form a homogeneous category. There are cases where *jícaro* grows in a completely clean pasture and others where *jícaro* emerges from a shrub stratum composed of other species and where the *jícaro* is accompanied by other tree species of equal size. This variability of situations of the floral composition and percentage of cover caused some confusion between this category and the two other categories of pastures (PA and PSA).

Pastures without trees (PSA): Under this category are gathered all the pastures that do not have a significant cover of shrubs and trees. During the dry months, many of these pastures are covered by a layer of herbaceous plants and dry weeds just like annual crops that have not yet been cleared or ploughed. For this reason, there are cases in which there is no spectral difference between these pastures and annual crops (category CA). This category also tends to blend into the previous in cases where the cover of *jícaro* is light.

Annual and perennial crops

Annual crops (CP): In this category are included all the perennial crops found during the field visit: sugar cane, banana, *maguey*, *marañón* and coffee. Sugar cane has several spectral signatures depending on its phenological status and its stage in the

growth cycle, harvesting, burning and planting. Some of these signatures resemble those of annual crops, areas of burning and bare soils. It is possible that the crops of *marañón* and coffee fields were confused with the categories of forest, especially the category BPI.

Annual crops (CA): During the dry season, green annual crops cannot be found. Most of the areas in annual crops were not in production stage when the satellite passed overhead. These areas were in one of the following conditions: covered with creepers and dry weeds (possible confusion with PSA), ploughed (possible confusion with the category SD) or fallow (possible confusion with the category TB). In addition, there was the possibility of their having been cleaned after the passage overhead of the satellite and before our field trip. For these reasons, it is probable that some of the areas included in this category were confused with others.

Bare soil

Bare soil (SD): Bare soils (without vegetation) are usually easy to identify spectrally and therefore the results of the classifications are reliable for this category. However, in the mangroves there can be very humid soils and water with a high content of sediments that can have similar spectral signatures. In several cases, ploughed soil in areas under crops can have been classified as bare soil because spectrally there is little difference between this category and ploughed soil.

Burned areas

Burned areas (QUE): Burning is a very frequent farming practice in the world's arid places, especially during the dry months. Recently burned areas have very characteristic spectral signatures. However, after a certain time, when vegetation begins to grow, the spectral signatures are gradually change to areas covered with vegetation. Therefore, burned areas are often confused with other categories.

Water

Water (AGU): Water has a very typical spectral signature, and there are very few cases of possible confusion. In the Gulf of Fonseca, confusion can occur where the water has a high sediment load.

Urban areas

Urban areas (URB): Urban areas always are difficult to classify because they represent a mixture of type of cover (trees, shade, roofs, highways) that have a distinct spectral pattern. We decided not to take spectral signatures of urban areas and overlay on the classified image a vector of urban areas, which was digitalised from topographic maps.

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

The main source of contamination for mangrove ecosystems is runoff from nearby farmland. Contaminants from these areas reach the mangrove through laminar

water flow or through the rivers and streams (no specific source) entering the ecosystem over a wide area. A small part of the pesticides enter the system in dissolved form, but a large part is absorbed by the soil particles eroded with runoff (MARENA, 1998). Many of the substances that affect sources of surface and underground water are from farming, industrial, domestic and recreational activities. Because it is located in the lower parts of the Estero Real basin or Río Villa Nueva, the wetland is a natural site for reception of all types of pollution waste generated in the middle and upper part of the basin.

The primary effect is a loss of water quality in the surface water network through reception of tons of suspended materials that reach the wetland through erosion of farm soils and deforestation. In the same wetland, used waters from the shrimp farms with high levels of organic material from fertilizer residues and feed used in shrimp farming are very important sources of contamination and loss of water quality in the swamps.

The direct result of growing cotton is minimum. Only 210 hectares were located in the area of the Estero Real basin and it is grown in the Sureste region. But because of the high level of use of insecticides during the farm cycle, this crop represents a potential danger for the ecosystem and, therefore, for shrimp farming. The most dangerous and persistent insecticides are no longer in use (DDT has reportedly been out of use for 10 to 12 years and toxaphene from 3 to 4 years). However, modern chemicals that are replacing the organic chlorides are usually highly toxic in their concentrated form (Curie, 1994). Recently, the effect of the shrimp farms was included, Gómez and Serrano (1997) carried out a bacteriological study of organic chloride insecticides in the water between the point of entry and drainage of seven of these farms in Estero Real. The bacteriological results reflect tolerable limits for total and faecal coliforms. For insecticides, the presence of the compound lindane was found in the upper part of Estero Real with 10.01 ppb. This product has been prohibited in Nicaragua since 1991 because of its high toxicity and high residues. Another residue found by Gómez and Serrano (1997) was Hexachlorobenzene (HClB), which is a herbicide with levels of 0.35 ppb at mid range and 0.05 at the bottom of the range.

In the surrounding area, there are four commercial banana growers with a total of 850 hectares of bananas, but at the present time three of them are inactive because of marketing problems. When in full production, the banana producers extensively use fungicides and nematicides. Counter, an organic phosphorous compound, is used as an insecticide and nematicide in banana plantations. The most widespread use of biocides by banana producers is against the fungus that produces *Sigatoka negra*. Til and Bravo 720 (clorotalonil) are fungicides of greatest use during the summer. The four banana producers located in the area of influence of the swamp are El Paraíso, Candelaria, Relámpago and San Carlos. El Paraíso, Relámpago and San Carlos are far from Estero Real and present less risk, but Candelaria is located relatively close to the swamp. The small planes that spray the fields often begin or end their flight over the swamp. This represents a serious problem because pesticides spread by air fall sometimes on water in the swamp.

After the drop in the growing of large-scale cotton, most of the western part of Nicaragua has been used for raising livestock, bananas and growing of basic grains

such as rice, maize and sorghum. The western part of the Estero Real basin is used almost exclusively for extensive livestock raising, with small areas for small-scale growing of basic grains, in which the use of insecticides and other chemicals is very low; therefore their polluting effect is low.

One of the potential sources of pollutants in the area is production of groundnuts, because this crop has increased in recent years. According to the Ministry of Agriculture, it is estimated that a total of 2,400 hectares of groundnuts was planted in 1995, compared with 7,000 hectares sown in 1993–1994. In 1995, about 1200–1300 hectares were planted in the Estero Real basin. Growers of groundnuts use organophosphate pesticides, pyrethrins and Bravo 720 or Anvil, five times a year. Rice and sorghum normally receive application of Malathion and the insecticides Lorsban and Supemetrina are used regularly in the area (Curie, 1994). However, they do not represent a high level of pollution because of the small area currently under cultivation.

Areas exposed to greater pollution from coliforms and solid waste

Because the community of Puerto Morazán does not have systems of latrines, organic and solid waste is dumped directly into the water of Estero Real, thus contributing to the pollution of water by total and faecal coliforms, which affects health and the environment of the inhabitants. According to the survey carried out by the Ministerio de Desarrollo de la Pesca (MEDEPESCA) since 1994-1996, there is a high level of coliformes that varies with the seasons (data taken at the surface). The most critical levels occur from June to October because of the influence of the rainy season on increased runoff. Because of the concentration of inhabitants upstream from Puerto Morazán, the amount of coliformes increase from COPROCAM, decreasing downstream from Puerto Morazán until reaching El Chorro near the mouth of the Gulf of Fonseca.

Areas exposed to problems of water quality from pollutants produced by the shrimp farms

Several shrimp ponds are located upstream from Puerto Morazán, where the time for replenishment from the Pacific Ocean is greater and sediment loads are high. The waste that reaches the swamps remains longer in the estuarine system, although the effects that this could cause to the ecosystem in the future are still unknown. However, because of the uncontrolled administration of food, a greater amount of organic material is provided thus contributing to eutrophication of the system.

Sources of pollution

Waste from the El Limón mine, which because of runoff or drainage, is a source of pollution because of pollutants dumped in the water in order to obtain gold. This mine processes some 100 thousand tons of mineral per year. In the process, some 75 tons of sodium cyanide (NaCN) and about 750 tons of calcium oxide (quicklime) (CaO) are used. In addition, the waste has high levels of heavy metals and its final pH is strongly alkaline. However, the degree of direct pollution on Estero Real is not known.

At the socio-economic level, the two priority problems of Estero Real are poverty and insufficient and inadequate services. Poverty is manifested by low incomes (both monetary and non monetary) and insufficient and inadequate services that increase the vulnerability of the local inhabitants (health) and reduce their possibilities of leaving this situation (education, communication and infrastructure). There is a lack of profitable productive alternatives (because of low productivity, reduced business capacity, limited credit and marketing problems). There is also a lack of stable jobs because most of the population works in subsistence activities, which implies that the only cash income is from the sale of products, usually in small amounts and at very low prices.

In terms of the environment, the most serious problems are erosion and degradation of farmland. A high percentage of the total area is under farmed, which implies that the tree cover is very reduced. Although the area has little relief, soil erosion is inevitable because of annual crops and limited use of soil conservation practices. There is no concrete information on the loss of fertility from inappropriate agricultural practices. Given that these activities are of key importance for the local inhabitants and the national economy, the loss of fertility is a very relevant topic and a priority for action in the area. In addition to the problems of productivity of those farms, soil erosion within and outside the study area causes sedimentation in the swamps and winter lagoons, which leads to loss of aquatic productivity and flooding in low areas near the affected swamps and rivers.

The proposed site is being used highly used, which leads to degradation of the productive bases of the ecosystems. Forest loss because of extraction of firewood and timber is an important threat to the ecological integrity of Estero Real. In addition, changes in land use for shrimp farming and agriculture have an important negative effect on the forest area of the study area. Wooded ecosystems (brackish and freshwater) play a key role in the life cycle of several aquatic and terrestrial species. If these forests are severely affected, there is a possibility of affecting productivity of other links economically important in the Estero Real production chain. Fortunately, there is a basis for research relevant for forest management, including forest surveys, phenological studies, use impact and permanent plots for measurement of rates of growth and regeneration. These studies should continue over time in order to study the effect of the productive activities on the forest population. There are still gaps in the information on the relationship between fauna and the mangrove of Estero Real; an important relationship to establish given the high productive importance of fauna and its current and potential relevance for the economy of Nicaragua.

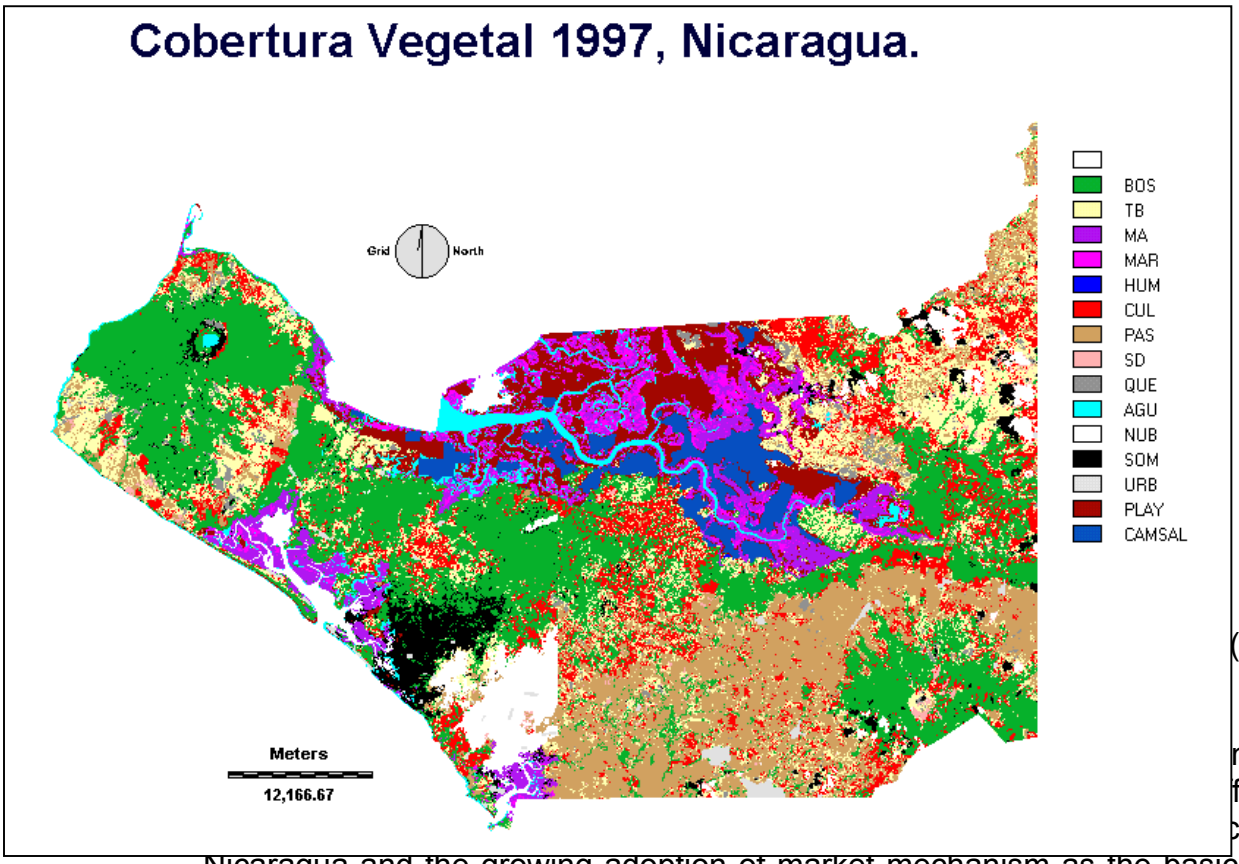
Shrimp farming

In Nicaragua, there is an accelerated development of shrimp farming in Estero Real, with a growing pressure on the surrounding areas of mangrove and processes of conversion of these ponds. Because of the speed and short life of this process, the real effects and possible negative impact that this can have on the Estero Real ecosystem and its resources is still unknown. High economic profitability that this activity generates because of the excellent environmental conditions of Estero Real for its development, together with important flows of money and employment for

Nicaragua, have converted it into the most dynamic productive activity of the Nicaraguan economy in recent years.

Data processed by Velásquez Mazariegos (1998) for PROGULF show the trend mentioned earlier. For 1997, the digital analysis of Landsat™ images of categories of vegetative cover corresponding to the shrimp farms shows an area of about 10,000 hectares. These are areas created as large ponds for raising shrimp. In the Gulf of Fonseca, Honduras and Nicaragua have a greater area used for this activity (figure 6).

Figure 4. Vegetative cover 1997, with 15 categories including saltpans and shrimp farms, Gulf of Fonseca, Nicaragua. Source: PROGULF, processed and analysed by Velásquez Mazariegos (1998).



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Nicaragua and the growing adoption of market mechanism as the basic element for use of resources are creating attitudes towards production, whose economic objectives can eventually lead to destruction of areas of mangrove with irreparable damage to the ecosystem. It is necessary to try to find a balance between wise use of these resources in order to exploit fully the socio-economic benefits that they can generate for Nicaragua or provide incentives for its full development and use of its benefits. There is now a series of restrictions on the development, growth and full use of potential shrimp farming. Among the most important environmental impacts are endogenous impacts produced by shrimp farming activities and processes in its various systems and that affect the mangrove ecosystems, water quality, soil, fauna and flora, human settlements and other sectors.

In general, the greatest negative impact of the development of shrimp farming on the mangrove ecosystem is from the cutting of mangroves in order to convert them into shrimp ponds. It is estimated that the current rate of reduction in area of the mangrove in Estero Real is about 385 hectares per year, which will lead to its extermination in fewer than 50 years.

Operation of shrimp farms, especially the semi-intensive systems used in the area, requires a system of use and replenishment of water for processing waste from the same ponds. There is a clear inverse relation between intensity of use of the area and decreasing yields because of the effects of lower water quality. This results basically because of the accumulation of sediments, hypersalinization, decrease in flow and the synergetic effects from adding waste from other sectors and activities (exogenous) such as the dumping of chemical waste (pesticides, fertilizers), heavy metals, faecal coliformes and other pathogens. This means that conversion not only decreases the areas of mangrove preventing its functioning as an ecosystem but also increases discharges into the water and soil of the reduced area of the products from the increased aquaculture activity. As a result, there are negative effects on the diversity of species that live in the mangroves. The trophic chain changes, natural mortality increases and changes in the conduct of these communities lead to their adaptation to the new conditions.

The area of Estero Real, because of its location on the Gulf of Fonseca, receives important volumes of pollution from industrial waste from El Salvador and urban waste from Honduras that enter the Gulf through Río Choluteca. In addition to these volumes, there is pollution from inland areas of Nicaragua that empty into the swamp through the tributaries to Río Estero Real. Farming and forestry activities, and to a lesser degree mining, generate waste that is washed away by heavy rains toward the tributaries of Estero Real and then finally into the swamp.

Other important exogenous factors are the Taura syndrome, which has already been identified in Honduras and Nicaragua. Because of the narrow connection of the waters from one country to another in the region of Estero Real, the situation is even more worrying.

23. Conservation measures taken:

With the expansion of crops for export, the forested areas in the region have been reduced. The natural ecosystems of the Cordillera de los Maribios remain as islands and the areas of mangroves are subjected to a process of degradation, destruction of habitat and environmental deterioration by the communities and surrounding inhabitants that use the resources of these ecosystems for subsistence and production. In order to protect these few areas, MARENA, through the Dirección General del Áreas Protegidas Pesca y Fauna, created the area of Estero Real as a nature reserve. Included in the nature reserve are land or marine coastal areas or lacustrine conserved or altered with species of fauna and flora areas of interest that generate environmental benefits of national or regional interest.

In the western region (León–Chinandega), 83 per cent of the mangrove area is located in the protected areas of Estero Padre Ramos and the Estero Real deltas. However, 94.6 per cent of the mangroves of the Pacific are without any real

protection (Cedeño, 1995). Estero Real, the largest reserve on the Pacific Coast of Nicaragua, includes parts of the municipios of Somotillo, Chinandega, Puerto Morazán and El Viejo and has an area of 55,000 hectares. Mangrove vegetation coves 33.8 per cent of the area (18,500 hectares) (Cedeño, 1995).

Estero Real has the following characteristics:

Priority areas for development of shrimp culture;
Generation of marine products with a high margin of profit;
Supply of wood for firewood and local construction.

Studies of the biodiversity are scarce and are limited to studies of fish and crustaceans of economic importance. Within the Estero Real Nature Reserve 35 species of wildlife in 17 families have been identified, and there are priority areas for the development of shrimp farming, generation of marine products of high profitability and supply of wood for firewood and local construction (Cedeño, 1995).

The Estero Real protected area is based on law 1320 of 17 September 1983, which states: “The Estero Real Delta, downstream from Puerto Morazán to the mouth of the Gulf of Fonseca, including all the tributary swamps, sandy beaches and mudflats.” The Dirección General de Area Protegidas of the Ministry for the Environment and Natural Resources (MARENA) has classified Estero Real in the category of nature reserve with its corresponding management norms and permitted and prohibited actions, designating all of Estero Real as nature reserve.

Although it is a nature reserve by law, no concrete management guidelines or use policies have yet been established. The absence of planned management based on sustained yield has led to degradation of the forest and overexploitation of the associated fauna, which is used by the communities that depend on this resource. Management of the upper and middle basin that drains toward the protected area has been fundamental for farming purposes. During the 1980s, a large number of windbreaks and soil conservation structures were built, which have been damaged or removed for use of the wood and inadequate farming techniques, which have increased sedimentation because of erosion in the area.

Growth of shrimp farming at Estero Real, although based on a national economic strategy, has created institutional, social and ecological conflicts. Furthermore, there is currently no knowledge about the carrying capacity of the ecosystem or the environmental impact that this activity will have on the ecosystem in the future. Another problem is limited intervention of MARENA for regulating and monitoring this area, because it does not have adequate means and resources. Currently, the designated category contradicts the uses established in the area. A lack of coordination between MEDEPESCA and MARENA creates problems in the granting of concessions.

One of the main problems facing the proposed site is the lack of coordination between various existing conservation policies in order to achieve changes at the global level and not individual efforts such as those that have been carried out up until now.

Management objectives

- Conserve and restore the natural ecosystems and wildlife habitats that are being reduced through intervention in the ecological environments;
- Sustainable production of goods and services for the welfare of communities in accordance with the capacity of the area, namely water, wood, wildlife, including fish and other marine products and outdoor recreation.

The protected area of Estero Real has an institutional and legal framework and an institution for promoting its conservation, MARENA, which as the governing body for natural resources through the Dirección General de Areas Protegidas regulates permitted or prohibited activities. However, this does not happen in practice because of a lack of institutional coordination between MARENA and MEDEPESCA and because concessions have been granted over a large part of the reserve, where there have been no detailed studies of biodiversity. This has led to deterioration of the ecosystem and habitat of migratory and native species and, therefore, the benefits to the local economy of the surrounding inhabitants of the proposed area.

24. Conservation measures proposed but not yet implemented:

There is no known proposed but not yet implemented conservation measure. The only conservation measure adopted has been to declare part of the proposed area as a protected area.

25. Current scientific research and facilities:

There are no known research activities underway. There is no infrastructure for research in the proposed area. Previously, there was a MARENA-Olafo-Danida research project. However, the results were more at the macro level and included a much larger region than that proposed in this document.

26. Current conservation education:

Currently, there is formal environmental education in the primary schools in the region. There are visits and educational activities involving the local inhabitants. Obligatory ecological service has been created for students graduating from secondary schools. In coordination with PRMVS, training workshops on wetlands for teachers, young fishermen and farmers have been held. Solid-waste clean-up campaigns have been organized and important environmental dates commemorated (Wetlands Day, Earth Day, Environment Day, Tree Day, etc.).

Educational programmes are transmitted by radio. Every year in the dry season, there are campaigns against forest fires, joint educational programmes are coordinated with the officials of several institutions and educational videos are shown to farmers, teachers and students. Denunciations of incidents of breaking of environmental laws are drafted and processed related to deforestation of headwaters, uncontrolled burning, overexploitation of wood, pollution from chemicals and waste from the dairy industry, poaching and trade in wildlife, etc. All these activities are under the direction of Fundación del Río, the Ministry for the

Environment and Natural Resources (MARENA), the Ministerio de Educación Cultura y Deporte (MECD) and the local government, among others.

There is the Organización de Jóvenes Ambientalistas (OJA) de San Miguelito that 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 establishment of an interpretation centre on the importance of wetlands. The centre began functioning two years ago and little by little it has been improving, becoming very useful for students at all levels: teachers, farmers and other professions.

27. Current recreation and tourism:

There is no recorded tourist activity carried out in the area. Nicaragua does not have a developed tourist sector, and there is definitely no type of activity that can be classified as tourist or recreational in the area of Estero Real. Estero Real is a shrimp-producing area, and the development of tourism has not been one of the main activities in this area.

28. Jurisdiction:

The proposed area is under the jurisdiction of the department of Chinandega and extends over five municipios in that department. The corresponding municipal government together with MARENA exercises national authority for regulation, control, monitoring and control of environmental quality, sustainable use of renewable natural resources and environmental management of non-renewable resources. It also sanctions administratively non-compliance with environmental norms.

29. Management authority:

Because of its importance and complexity, the proposed site is an area where ecological, economic and social interests exist and converge. There are organizations that take decisions at several levels affecting management of this ecosystem, and there are other organizations with jurisdiction over management of the natural resources in this area.

Among the main organizations and institutions are:

- The Ministry for the Environment and Natural Resources (MARENA) is the governmental institution responsible for the conservation and management of natural resources at the national level. Article 8, paragraph b, of law 45-93 authorizes this institution through the Servicio Forestal Nacional (SFN) to grant forest use permits, and through Article 91 of law 217 this ministry can grant a special permit for sustainable exploitation of the mangroves and other types of vegetation in the bays, coves and coastal strip. This ministry is authorized to grant a permit for the environmental impact study.

- The Ministerio de Economía y Desarrollo (MEDE), in accordance with law 16-93, is authorized to grant use licences for fisheries and aquaculture through the specialized agency ADPESCA.

- Municipal governments: The municipio is the basic unit of the administrative political division of Nicaragua (Law 40). The municipio as the level of local government exercises jurisdiction over the development and preservation of the environment and satisfaction of the needs of the local inhabitants through management and provision of services. The Instituto de Fomento Nacional (INIFON) represents the municipios at the level of the central government.

- The Ministerio de Agricultura, Ganadería y Recursos Forestales (MAGFOR) contributes and exercises influence on natural resources by regulating, promoting, classifying, inspecting and prohibiting hunting (Hunting law 206).

- The Police and army in coordination with MARENA and ADPESCA monitor and control the borders and illicit trade in wildlife as well as in the protection of natural resources.

Local organizations

Unión Regional de Cooperativas Camaroneras (URCOOCAM). This is made up of 75 cooperatives. It is the most powerful union of cooperatives and representation in the region of Estero Real. There are 66 more cooperatives that are candidates for participation in URCOOCAM (URCOOCAM, 1996).

Unión Regional de Cooperativas Productivas (URCOOP)

Asociación Nacional de Acuicultores (ANDA) represents the sector of private investors in the production of shrimp.

Cooperatives and groups of woodcutters. For extraction of firewood from the mangrove there are four groups of woodcutters, which two are cooperatives that have a legal status from the communities of Tonalá and Luis Andino.

Farming cooperatives. There are 38 cooperatives in the region with a total of 584 members. All the municipios have a broad cooperative movement in this type of production mainly for submission of requests for credit (MAS, 1995).

Consultative institutions

Several organizations in the area have played a consultative role in the process and sometimes in the management and support for concrete activities in the area. These institutions have participated through bilateral or multilateral consultations.

Comisión Nacional Forestal
Administración Forestal Estatal (ADFOREST)
Comisión Nacional de Bosques y Desarrollo Forestal
Municipal governments
Comisiones de Ordenamiento Costero of the Gulf of Fonseca (COMICO)

Decision-making

Decision-making is a process that depends on the resource to be exploited and the area to be granted. In the case of shrimp farming, when the area for authorization is greater than 200 hectares the environmental permit and use license are granted at the central level (centralized). If the area is less than 200 hectares, the environmental permit is granted at the departmental level (decentralized) and the licence for use at the level of the central government. If the resource is fishing or aquaculture, the Ministerio de Economía y Desarrollo and MARENA coordinate in taking the decision. However, if it is a forest resource MARENA authorizes at the central level and through its departmental delegations exercise decentralized and non decentralized activities. There is centralization of decision making for entering into contracts for exploitation of natural resources, and participation of the municipio is only consultative. MARENA, as the regulating and enforcement institution of natural resources and the environment, creates measures for protection and sustainable development at the central level and implements them throughout the country through its departmental delegations. However, because of its small operational capacity its influence and coverage is minimal.

30. References: