

## Information Sheet on Ramsar Wetlands

1. Date this sheet was completed/updated: 18 September 2001
2. Country: Nicaragua
3. Name of wetland: Los Guatuzos Wildlife Reserve
4. Geographical coordinates:

The northern limit of Los Guatuzos Wildlife Reserve begins at the mouth of the Río Pizote in Lake Nicaragua, at coordinates 6978 m West longitude and 12266 m North latitude. It continues east to the mouth of the Río Frío and the source of the Río San Juan, then continues along Río Frío up to where it joins the Río Medio Queso and then up this river until the border with Costa Rica at the coordinates 7546 m West longitude and 1225 m North latitude. The limit continues along the border with Costa Rica and then passes through boundary markers XII and XIII to the intersection of the Río Pizote with the Nicaragua–Costa Rica border at the coordinates 6988 m West longitude, 12213 m North. From that point north to the western limit, it coincides with the Río Pizote until arriving at the starting point of this description (Amigos de La Tierra-España/MARENA, 1996).

5. Altitude: 30 metres above sea level
6. Area: 43,750 hectares
7. Overview:

Los Guatuzos Wildlife Reserve belongs to the geomorphologic province of the Nicaraguan depression and is one of the most extensive and better-conserved lake wetlands in Nicaragua and Central America. Its ecological influence extends widely, and because of its position on the migration route of birds it takes on continental importance. Because it is geographically between the wet tropical forest and dry tropical forest, it has ecological aspects of both life areas, although the wet tropical forest dominates the reserve. This is accentuated by the fact that the area has functioned as a biological bridge, throughout its history, facilitating the genetic flow of fauna and flora among these two areas. It acts as a true 70-kilometre-long biological corridor and is possibly the habitat of a higher diversity of species than normally found in similar areas (Amigos de La Tierra-España/MARENA, 1996).

Another characteristic of the reserve is its role as transition between the land and the water of Lake Nicaragua, linking the wetland system with Solentiname Island and the protected areas of the Cordillera de Guanacaste in Costa Rica. It plays a central role

in the seasonal migrations of various land and aquatic species. The wetland is the dominant ecosystem in Los Guatuzos, in which there is a large variety of resident and migratory waterfowl, plus areas of high density of fish and nesting sites for several aquatic species from Lake Nicaragua.

## 8. Wetland type:

Los Guatuzos Wildlife Reserve has a large diversity of continental habitats, which may be broken up into the following categories, depending on the conditions in the wetland:

### 1. Continental wetlands (from most prevalent to least prevalent):

M: Rivers and permanent streams;

O: Permanent freshwater lakes (of more than eight hectares) including meanders, abandoned riverbeds, swamps and marshes;

P: Seasonal and intermittent freshwater lakes (of more than eight hectares) including lakes with floodplains;

Sp: Swamps, marshes and permanent alkaline ponds;

Tp: Swamps, marshes, permanent freshwater pools, ponds (of less than eight hectares), swamps and marshes on inorganic soils with emergent vegetation in water at least during most of the growth period;

U: Un-wooded peat bogs, including open bogs, bogs with shrubs, bogs of Gramineae and reeds and sunken bogs;

W: Swamps with shrub vegetation, including freshwater swamps and marshes dominated by shrub vegetation;

Xf: Wooded freshwater wetlands; including freshwater swampy woodlands, seasonally flooded woodlands and wooded swamps.

Types of wetlands by decreasing order of importance:

Criteria based on species and ecological communities

Criterion 2: A wetland should be considered internationally important if it supports vulnerable, endangered, or critically endangered species or threatened ecological communities.

Criterion 3: A wetland should be considered internationally important if it supports populations of plant and/or animal species important for maintaining the biological diversity of a particular biogeographic region.

Criterion 4: A wetland should be considered internationally important if it supports plant and/or animal species at a critical stage in their life cycles, or provides refuge during adverse conditions.

Specific criteria based on water birds

Criterion 5. The wetland regularly supports significant quantities of specimens of certain groups of aquatic birds, which are indicators of the value, productivity and diversity of the wetlands.

Specific criteria based on fish

Criterion 7: A wetland should be considered internationally important if it supports a significant proportion of indigenous fish subspecies, species or families, life-history stages, species interactions and/or populations that are representative of wetland benefits and/or values and thereby contributes to global biological diversity.

Criterion 8: A wetland should be considered internationally important if it is an important source of food for fishes, spawning ground, nursery and/or migration path on which fish stocks, either within the wetland or elsewhere, depend.

9. Ramsar criteria: 2, 3, 4, 5, 7, 8,

Criteria that best characterize the 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 to be of international importance because it meets the following criteria.

General criteria based on species and ecological communities.

Criterion 2. This wetland sustains a large diversity of wildlife. In the surveys and studies carried out, 401 species of birds (57 migratory species), 55 species of mammals, 214 species of amphibians and reptiles and 9 species of fish, including the

*gaspar* (*Atractosteus tropicus*), which is a prehistoric and endangered fish, were recorded (Arróliga, 2000). In addition, a study of insects is being carried out, but the results are not yet available. Just the presence of species extinct in other parts of the world justifies protection of many wildlife reserves in the world. An international convention, ratified by Nicaragua in 1977 (La Gaceta, Diario Oficial # 183), obligates Nicaragua to implement the terms of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) and limit trade in the species listed in the appendices.

Criterion 3. Because it is a wild area in excellent conservation status and because it is between two life zones, the dry tropical forest and the wet tropical forest, this wetland has ecological aspects of both life areas and functions as a biological bridge, facilitating the genetic movement of fauna and flora between these two areas. It also functions as a biological corridor for migratory species.

Criterion 4. This wetland is of vital importance for plant and animal species during critical stages of their life cycle. This is the case of high-altitude migrations of species of birds such as the *pájaro campana* (*Procnias tricarunculata*) and the *pájaro sombrilla* (*Cephalopterus glabricollis*), species that are high priority for study and conservation according to Neotropical Birds (1996). This wetland is of special importance to migratory species as a habitat during a critical period of their life cycle. It also provides sites for the dispersal and reproduction of many species of fish and crustaceans that live there. The wetland also provides refuge and food for a considerable community of species of migratory birds from North America. Until now, a total of 57 species of migratory birds have been identified, several of which stay over in these ecosystems until their departure.

Specific criterion based on waterfowl

Criterion 5. There are 54 species of aquatic birds recorded for Los Guatuzos Wildlife Reserve that use this wetland for feeding and breeding. Among the most common populations of waterfowl are the *pato aguja* (*Anhinga anhinga*) and the *pato chancho* (*Phalacrocorax olivaceus*). Flocks of up to 10,000 specimens of this species have been recorded. Among the most common ducks are the *piche* (*Dendrocygna autumnalis*), a species that reproduces on the flooded plains and forms flocks of thousands of specimens, and the *pato real* (*Cairina moschata*). The kingfisher is also very common along the rivers. A total of six species have been recorded: *Ceryle alcyon*, *Ceryle torquata*, *Chloroceryle aenea*, *C. amazona*, *C. americana* and *C. inda*. Herons are usually very common on many bodies of water in the reserve. Among them are the *garceta azul* (*Egretta caerulea*), *garza real* (*Casmerodius albus*), *garza blanca pequeña* (*Egretta thula*) and *garza morena* (*Ardea herodias*)—a migratory bird. Other species especially picturesque among this birdlife are the *patito de agua* (*Heliornis fulica*) and the *gallinita de agua* (*Porphyryla martinica*). The swallows (*Tachycineta albilinea* and *Notiochelidon cyanoleuca*) are migratory and are found along the Río San Juan (Zúñiga et. al., 1996). The presence of *Anas discors*, *A. americana* and *Aythya afinis* during the dry season shows the importance of Los Guatuzos Wildlife Reserve for migrations from North America to South America (Arróliga and Herrera-Rosales, 2000). This reserve regularly sustains significant quantities of specimens of certain groups of aquatic birds, such as those described earlier.

## Specific criteria based on fish

Criterion 7. Preliminary results obtained from a rapid ecological study of fish diversity found nine species of fish belonging to six families that contribute to the world's biological diversity (Robleto, 1996).

Criterion 8. The wetland present in this reserve serves as a breeding site for species of migrating fish, such as the *gaspar* (*Atractosteus tropicus*), a species that is endangered and that has disappeared from many natural areas in and outside the country, such as Lake Managua and Lake Xolotlán. Migrating species of fish that are captured during several months of the year in Los Guatuzos Wildlife Reserve are *róbalo* (*Centropomus parallelus*), *sábalo real* (*Tarpon atlanticus*) and *gaspar* (*Atractosteus tropicus*). These species use the Río San Juan as a migratory route (Amigos de la Tierra, 1999).

### 13. General location:

Los Guatuzos Wildlife Reserve is located in southern Nicaragua and covers the strip of land between Lake Cocibolca and the border separating Nicaragua from Costa Rica (Amigos de La Tierra-España/MARENA, 1996). It forms part of the geographic region of southeastern Nicaragua and belongs administratively to San Carlos where the main town in the department, Río San Juan, is located. The limits are: on the east, the Río Pizote and the departmental limit between the departments of Rivas and Río San Juan; to the north, Lake Nicaragua; to the east, Río Medio Queso; and to the south, the border between Nicaragua and Costa Rica. The reserve has an area of 43,750 hectares.

### 14. Physical features:

**Geology:** Los Guatuzos Wildlife Reserve belongs to the geomorphologic province of the Nicaraguan Depression and the subprovince of the eastern plain of Lake Nicaragua. Its geologic materials are composed of fluvial-colluvial and lacustrine sediments from the Quaternary whose lacustrine stratification presents approximately 5 per cent of the sediments from the Quaternary in the area of the SI-A-PAZ. In geological terms, this area belongs to the part of the continent that emerged late, which determined not only its recent geologic origin but also its special biological importance. In general terms, its relief is rather flat, both because of its tectonic orogeny as well as because its recent geological formation emerged from the Lake Nicaragua depression in the Quaternary. This area is the result of one of the last movements of continental plates and is covered by volcanic material and fluvial-lacustrine sediments from the Quaternary (CATIE-UAW-MAG, 1995).

**Geomorphology:** From the point of view of geomorphology, this area is dominated by areas of fluvial origin. The relief of Los Guatuzos Wildlife Reserve is almost uniform, flat to slightly sloping with slopes of 0–5 per cent. The only elevation of importance is Cerro Cucaracha (70 metres), known locally as Loma El Cairo. Nearby are other smaller elevations: Loma de los Perdidos and Loma de Piedra.

Origin of the wetland: Natural

Hydrology: The reserve has a well-developed water network, characterized by short rivers that begin on the northern slope of the Cordillera de Guanacaste in Costa Rica and empty into Lake Nicaragua. The complex hydrologic system is complemented by lakes, small ponds and large permanently flooded areas. During the rainy season, the flat areas become virtual sponges of water. In almost all the reserve, the water table is on or just below the surface during most of the year, and the soils almost reach total saturation. Several rivers and streams, such as the Guacalito, Estero Simoncito and La Palma, have already suffered alterations to their hydrologic regimen with the appearance of new branches and retention of flow because of the growth of aquatic plants and fallen trees. This has caused flooding and reduced navigability. The binational character of all the rivers in the reserve takes on special importance because of poor management of its basins beyond the border. The productive use of its flow directly affects the water regime and, at the same time, the delicate balance in the wetland.

Types of soil and depth of the water table: Soils in Los Guatuzos are very deep with flat relief. They have developed from organic accumulations and lake and river sediments. There are histosols (*Tropofibrist*) and entisols (*Hydraquent*) (Amigos de la Tierra-España/MARENA, 1996). These soils belong to the hydric *tropohemits* subgroup and have among their morphological characteristics an A-horizon (40–80 centimetres) of clear silt to clear clay-silt. They are black in colour and lack structure. The C-horizon, which remains almost always saturated with water and is up to 150 centimetres deep, is clear clay silt. The organic content is very high (31.9 per cent), decreasing to a little less than 8 per cent at a depth of 80 centimetres. There is a high degree of acidity (pH between 4.8 and 5.1) (Martínez and Herrera, 1999).

It is important to point out that in Los Guatuzos Wildlife Reserve, the soils are poorly drained and totally inadequate for farming. Because this area is relatively uniform, it was decided to group the soils according to internal drainage. Based on this property, the following classification was made (Martínez and Herrera, 1999).

Well-drained soils (WDS): In this type of soil, water drains easily from the surface, but the soil very slowly retains large quantities of water for growth and development of plants. These soils usually correspond to moderately fine and well-structured medium textures, which occupy approximately 10 per cent of the soils in the reserve.

Imperfectly drained soils (IDS): Water is slowly eliminated from the soil, resulting in a soil profile that remains moist during most of the year. In these soils, we usually find lumps that develop under anaerobic conditions at a depth of between 40 and 60 centimetres during part of the year. The water table fluctuates, reaching 40 centimetres below the surface. This type of soil occupies approximately 70 per cent of the area.

Poorly drained soils (PDS): These soils occupy approximately 20 per cent of the rest of the reserve, and the water is removed very slowly from the soil, which remains damp for long periods of time. The water table is on or near the surface during most of the year or part of the rainy season. This humidity is usually indicated by dark grey or yellow flecked soil, a grey horizon or a lack

of colour intensity. It is impossible to farm these soils, but plants or trees can be found that are tolerant of these conditions.

In general, the soils in the reserve correspond to three types of drainage present in the area, and their distribution throughout the reserve is associated with vegetative formations determined by the local morphology (map 8). In the eastern part, there are large flooded plains covered primarily with homogenous vegetation of *palms de yolillo* and swamp vegetation, while in the western part there is a more heterogeneous mosaic of soils and ecosystems that correspond to a large extent to areas that are not subject to flooding and having small elevations.

Fluctuations in water level and permanence of water: Fluctuations in water level are quite perceptible. During the rainy season, the water level rises up to three metres, remaining at this flood level until the beginning of the dry season in December. In the dry season of low water, the seasonal lakes remain completely dry and are covered with grasses. Fluctuation in water level on the plains and seasonal lakes attracts aquatic birds and migratory shore bird, and affects navigation in the rivers.

Climate: Temperatures registered at the San Carlos meteorology station range between 23.9° and 29.3° C. The biotemperature is estimated to be 24.5° C. The coolest period is from December to February with an average of 24° C.

Solar radiation ranges monthly between 275 and 358 cal/cm<sup>2</sup>/day, with an annual average of 307 cal/cm<sup>2</sup>/day. Evaporation is high (an annual total of 1829 millimetres), reaching a maximum between March and May (INETER, 1992).

The climate corresponds to tropical savannah of the Pacific, which includes the area of the large lakes, according to Köppen's classification (López de la Fuente, 1994). It receives an annual average of 5.1 to 6.1 hours of insolation daily. The average monthly temperature is never less than 18° C, and annual temperatures range between 24° and 30° C. There is rain nine or more months per year and the dry season lasts three to four months (Catastro, 1978).

According to L. Holdridge, this area corresponds to the life area of humid tropical forest with precipitation of 2000 to 3000 mm in a period of 9 to 10 months. Average annual temperature is 25° or 26° C with a biotemperature above 24° C. Nonetheless, we should point out that Los Guatuzos Wildlife Reserve has special importance because of its transitional character between the dry tropical and wet tropical ecosystems of Costa Rica and Nicaragua.

#### 15. Hydrological values:

All the rivers that cross Los Guatuzos Wildlife Reserve begin on the northern slope of the Cordillera de Guanacaste in Costa Rica and empty into Lake Nicaragua, circulating from south to north and forming a complex hydraulic system characterized by short rivers, lakes, small ponds and permanently flooded areas. There are 18 main rivers that cross the reserve. Among the main rivers are El Pizote, La Palma, El Cairo or Cucaracha, Papaturo, Sahino, Guacalito Viejo, Guacalito Nuevo, Zapote, Boca Ancha and Río Frío, without mentioning the many seasonal streams and creeks. The complex hydraulic system is completed by associations of swamps,

permanently flooded *yolillales* and plains that are converted into bodies of water during the rainy season.

Rivers	Longitude	Tributaries	Length
Pizote	7.5	3	17.0
unnamed	9.5	--	9.5
Caño Palma	3.5	--	3.5
París	7.5	--	7.5
Cucaracha	3.5	2	7.5
Quebrada Lagartera	6.0	--	6.0
Estero Plomo	5.0	--	5.0
Papaturro	7.5	1	14.5
Condesa	5.5	--	5.5
Guacalito Viejo	10.0	--	10.0
Guacalito	14.0	3	33.5
Zapote	11.0	4	29.5
Estero Boca Negra	2.0	1	2.5
Estero Poponjochal	3.5	--	3.5
Boca Ancha	4.5	--	4.5
Frío	11.0	--	11.0
San Juan	22.0	--	22.0
Medio Queso	3.0	--	3.0
Total	136.5	14	195.5

As for the prevailing winds, humidity, evaporation and temperature, data has only recently been collected. A meteorological station began functioning in February 2000, and environmental data is now being collected at the site.

Sedimentation in the main rivers is heavy, carrying away a large amount of sediments from the higher parts of the drainage basins, which are severely deforested and inefficiently drained. The largest contribution of sediments is produced during July, October and December, with an average of 45.5 metric tons/square kilometre coinciding with the periods of greatest precipitation in the basins (GEA/FUNDAR/ATENIC 2000).



The environmental factors that most influence the exuberant conditions of this reserve are probably topography and humidity. Both factors favour frequent flooding of this area and severely restrict its farming potential (Amigos de la Tierra, 1996). It is important to mention the role played by this wetland for capturing sediments, some pollution and nutrients that are carried by the runoff from Costa Rica.

#### 16. Ecological features:

The ecology of Los Guatuzos Wildlife Reserve is determined by climatic, soil and hydrological factors that create special conditions, promoting the presence of large numbers of fauna and flora, especially those associated with the wetland. There are plant associations that condition the existence of several dominant formations, such as *yolillales*, *marillales*, in smaller numbers in the flooded plains, several types of broad-leaved forest in the drier areas, *camibarales*, *cedrales* and gallery forests (GEA/FUNDAR/ATENIC, 2000).

An element that determines the special nature of the ecosystems in the reserve is the fact that two large biogeographic regions converge here. From the west coming from the Pacific Ocean (dry tropics), there are floodable plains in soils with better drainage conditions and plant associations in which grasses dominate, and from the east, from the region of the Nicaraguan Caribbean (wet tropics), floodable plains with poorly drained soils where *bijagua* (*Thalia geniculata*) dominates.

The area of Río Guacalito Viejo is a strip of land that acts as an ecotone, combining with an important association of riparian forest, swamps of Ciperaceae and *bijagua* that join together these two important bioregions.

In the southern part, the influence of the Cordillera Volcánica de Guanacaste is felt through constant rain that is well distributed over the area and over time, promoting biological processes. Because of the conditions of relative humidity and maintenance of a hydrological regime that keeps the wetlands and other bodies of water, such as Lake Nicaragua, stable. Lake Nicaragua plays a role in the transition between land and water, linking the systems of wetlands with the Archipelago of Solentiname and other protected areas in the Cordillera de Guanacaste in Costa Rica, which gives it an important role in the seasonal migration of various land and aquatic species (map 2) (Amigos de la Tierra-España/MARENA, 1996).

In general, the landscape has been formed by man-made action and natural factors. There are three distinct parts. In the eastern part, there is a wide floodplain covered with *yolillales*, broken sporadically with patches of gallery forest. In the second part, towards the centre of the reserve, there are larger concentrations of gallery forest, which are associated with several of the rivers that cross the reserve through this part, dominating the landscape with mixed scenarios and a mosaic of farms, combining open areas with areas interspersed with compact and scattered woody areas. The third part is the western part of the reserve, where floodplains give way to an open landscape that combines with patches of woodlands, some tall and in better conservation status than other segments, showing diverse scenario with interspersed plains, patches of forest and several farm areas in an interesting landscape mosaic. Except for El Cairo hill, the rest of the area is rather flat.

Ecological and climatic factors, such as a biotemperature above 24° C, a life area of wet tropical forest and an area of Pacific tropical savannah (Köppen), combine with the soil and drainage conditions to determine distribution of vegetation, which produces four main plant communities: lacustrine, riparian, mangrove and higher elevations (Holdridge, 1987) (Amigos de la Tierra-España/MARENA, 1996).

The criteria of plant formations associated with the wetlands and a humid tropical forest were taken into consideration and studied. These specific conditions in the reserve are directly influenced by their proximity to the ecosystems of the dry and humid tropics of Nicaragua and Costa Rica, which make the reserve a very distinct and unique area with extensive wetlands that serve as a refuge for a large variety of wildlife (GEA/FUNDAR/ATENIC, 2000).

The abundant rivers and streams form interesting sites for dispersion, feeding and reproduction of many species because of abundant sub-aquatic vegetation, including crayfish, turtles, crocodiles, amphibians and innumerable important fish. In addition, vegetation, such as the *palma yolillo* (*Raphia taedigera*), contains abundant fruit and has a high nutritive value for several wild species, such as the *guardatinaja* (*Agouti paca*). The abundant organic material that the *yolillo* supplies to the soil feeds a large number of fish, aquatic invertebrates and insects, in such a way that an extensive tropic network, including amphibians, crocodiles, bats, etc. is formed around this plant species.

17. Noteworthy flora: (Annex 1: Preliminary List of Plant Species in Los Guatuzos Wildlife Reserve)

In general terms, vegetation is conditioned by the relationship between climate, various types of soil drainage and soil characteristics. Precisely because of these conditions, the plant associations combine in different ways to form a variety of plant associations and communities that respond to the existing conditions (GEA/FUNDAR/ATENIC, 2000). Specifically, Los Guatuzos Wildlife Reserve is inside an azonal tropical plant association where medium to high forest sites are periodically or permanently flooded with fresh water on the shores of Lake Nicaragua. Within Los Guatuzos Wildlife Reserve, a series of mixed ecosystems of considerable ecological importance are found. According to field observations, the types of forest that dominate are natural primary woodlands (Pénjamo, Santa María, Esperanza Verde) and several secondary forests (Cairo, Pueblo Nuevo, Esperanza Verde) with periods of approximately 15, 25 and up to 50 years for regeneration. They form part of the landscape in addition to old cacao plantations (*Theobroma cacao*), farm areas, *tacotales* and pastures (GEA/FUNDAR/ATENIC, 2000).

As for the homogeneous ecosystems, there are areas of *yolillales* where pure *yolillo* (*Raphia taedigera*) prevails in association with vegetation of floodable land specifically dominated by Poaceae (*navajueta* and *navajuelón*, primarily), Heliconias and *tacotales* with an association of herbaceous plants, palms and pioneer plant indicators of a nascent secondary succession (Rueda and Grijalva, 1995).

These distinct associations form a unique mosaic of mixed ecosystems of major ecological importance, which guarantees the survival of greater biological diversity.

The total number of species of plants recorded for the reserve is 394 in 276 genera and 102 families (Arróliga, 2000).

### Vegetation of the wetlands

The soil conditions and presence of water in the wetlands condition the hydrophytic vegetation and the types of plant associations among which are found paludal, riparian and lacustrine vegetation. Within these classifications, there are distinct associations such as *yolillales*, permanently flooded woodlands and other vegetation on land subject to flooding.

The riparian vegetation is formed by species that require a large amount of light and humidity. Tree species found on the edges of the rivers are very important because their numerous roots help control water erosion. The riparian forest has been altered along most of the rivers in the area. Among the important components in the tree stratum are species such as *guabo* (*Inga vera*), *roble* (*Tabebuia pentaphylla*), *helequeme* (*Erythrina fusca*), *poponjoche* (*Pachira acuatica*), *cedro real* (*Cedrela odorata*), *guácimo* (*Luehea speciosa*), *chilamate* (*Ficus* spp.), *sotacaballos* (*Pithecellobium latifolium*), *espavel* (*Anacardium excelsum*), *almendro de río* (*Andira* sp.), *ceiba* (*Ceiba pentandra*), *palo de hule* (*Castilla elastica*), *guarumo* (*Cecropia* spp.), *Coussapoa* sp., *carao* (*Cassia grandis*). The presence of many Bromeliaceae (*Bromelia* spp., *Tillandsia* spp., *Aechmea* sp.), Orchidaceae (*Encyclia* spp., *Epidendrum* spp., *Schomburgkia* sp., *Myrmecophyla* sp.), Araceae (*Anthurium crassinervum*, *Phylodendrum* spp., *Syngonium* spp.) and Cactaceae (*Rhipsalis* sp., *Epiphyllum* sp.). Climbers such as *Paullinia* sp., *Sourobea sympetala* and *Tetracera volubilis* stand out in this stratum.

The lacustrine vegetation is formed primarily by annual herbaceous plants including all the aquatic plants that are entirely dependent on the aquatic environment for their life cycle.

Gallery forests are found on the edges of the rivers and are ecologically important because they serve as refuge for a large number of fauna, especially during the dry season when the flooded areas of the plains dry out seasonally. Despite their ecological importance, the gallery forests cover only one per cent (450 hectares) of the total area of the reserve.

We can identify several structures in this ecosystem in function of the degree of alteration: gallery forest on solid ground and gallery forest that is flooded a good part of the year. In these two structures, the density of trees varies depending on the degree of intervention and the composition of associations. The dominant species in these forests are *poponjoche* (*Pachira acuatica*), *helequeme* (*Erythrina fusca*), *guabo* (*Inga vera*), *roble* (*Tabebuia pentaphylla*), *chilamates* (*Ficus* sp.), *espavel* (*Anacardium excelsum*) and *guácimo* (*Luehea speciosa*).

The *yolillales* are forests dominated by the *palma yolillo* (*Raphia taedigera*), which in some cases can be formed of single species with pure clusters with closed canopy on soils flooded most of the year. On the edges and in clearings of this ecosystem, there are *gamalotales* composed of grasses and Cyperaceae (see figure 10). The largest *yolillales* in the reserve are found between Punta Alemán and Estero Boca Ancha.

## Vegetation of un-flooded land

Wooded vegetation grows on relatively high un-flooded terrain. At the present time, this is reduced to clusters, usually no larger than 50 hectares where farming activities located south of the Río Papaturre have been carried out, in the area of Valle de Guadalupe, Pueblo Nuevo, Santa María, Pénjamo, Jumuza and near Esperanza Verde (GEA/FUNDAR/ATENIC, 2000).

Among the species dominant in the forest areas are the *espavel* (*Anacardium excelsum*), *ceiba* (*Ceiba pentandra*), *cativo* (*Copaifera aromatica*), *carol* (*Cassia grandis*), *guanacaste* (*Enterolobium schomburgkii*), *tamarindo* (*Dialium guianensis*), *gavilán* (*Pentaclethra macroloba*), *zapote de mico* (*Couropita guianensis*), *jobo* (*Spondias mombin*) and less frequently *santa maría* (*Symphonia globulifera*), *cedro* (*Cedrela odorata*), *aceituno* (*Simarouba amara*) and *guayabo* (*Terminalia* spp.). The climbing plants most frequently associated with this type of forest are *zarzaparrilla* (*Smilax* sp.), *navajuela* (*Scleria* sp.), *hoja chigue* (*Tetracera* sp.), *Paullinia* sp., *Senna* sp., *Bauhinia* sp., *Souroubea sympetala*, *Chusquea* spp. and *rangallo* (*Uncaria tomentosa*). Among the most abundant epiphytes, is *Tillandsia* sp.

At the present time, the plantations of cacao (*Theobroma cacao*): these plantations, which were of great importance in the past, are now totally abandoned and full of weeds to the point that it can be said that they are in a state of secondary succession. The only function that the few trees of cacao still bearing fruit fulfil is to serve as food for wildlife in the summer.

Pastures and cultivated areas are the ecosystems that stand out in the reserve. In several cases, they are being used and even improved for livestock. In other cases, they are in weeds and a state of succession. Cultivated areas are not extensive but are limited to small plots and most of them are in a state of succession. In the sector of Papaturre and Punta El Cairo, traditional rice, beans and maize are still grown.

The species found in the natural pastures there are quite varied. There are pastures dominated by *jaragua* (*Hyparrhenia rufa*), *crin de macho* (*Andropogon bicornis*), *Paspalum* spp., *caminadora* (*Rottboelia cochinchinensis*), associated with various grasses and shrubs such as *Malachra* sp., *Croton* sp., *cola de alacrán* (*Heliotropium indicum*), *Phyllanthus* sp., *Erechtites* sp.), *flor amarilla* (*Baltimora recta*), *cinco negritos* (*Lantana costaricensis*, *Solanum jamaicensis*, *Elephantopus* sp., *Aeschynomene* sp. and *Caperonia palustris*) with very few species of trees, most of which are in various states of regeneration. Among these, the *capiroto colorado* (*Miconia elata*) and *Cassia* spp. dominate, and less frequently *mano de tigre* (*Oreopanax* sp.), *nancite* (*Byrsonima* spp.), *guanacaste* (*Enterolobium cyclocarpum*), *jobo* (*Spondias mombin*) and only two types of palms: *corozo* (*Scheelea rostrata*) and *casca* (*Astrocarium alatum*). *Bejucos* are dominated by several species of *campanita* (*Ipomoea* spp.), *hoja chigue* (*Tetracera* sp.) and *pica mano* (*Cissus* spp.).

In general, the presence of several species of palms in Los Guatuzos Wildlife Reserve, combined with tree species, shrubs, climbers and epiphytes, enhances the scenic and landscape values of the reserve. Their importance is evident primarily on the edges of the rivers and are an important vegetative cover (ecotone) in the

transition from aquatic ecosystems to terrestrial systems (GEA/FUNDAR/ATENIC, 2000). Most of these species have had an unknown value until now, but it is hoped that scientific research will make them useful and point out the comparative advantages of the tropical conditions in this part of Nicaragua.

#### 18. Noteworthy fauna: (Annex 2: Preliminary List of Species of Wildlife in Los Guatuzos Wildlife Reserve)

Numerous habitats appropriate for wildlife are found in the dense hydrological network of Los Guatuzos associated with lagoons, swamps and patches of tropical forest. The diversity of species of fauna is very high in Los Guatuzos Wildlife Reserve. In initial surveys and field studies, 679 species of fauna (of which 401 species are birds (57 migratory), 55 mammals, 214 amphibians and reptiles) have been recorded. In addition, nine species of freshwater fish have been recorded (Arróliga, 2000).

A total of 401 bird species have been recorded. This information represents 62 per cent of the species reported for Nicaragua (Arróliga and Herrera-Rosales, 2000). The number of species here is higher than in other areas of greater extension, such as the Refugio de Barra del Colorado or the Parque Nacional Tortuguero in Costa Rica. This points out the importance of Los Guatuzos Wildlife Reserve as an area of large biological diversity. Among the most common species are several herons and storks (Ciconiiformes), *pato chancho* (*Phalacrocorax olivaceus*), *pato aguja* (*Anhinga anhinga*) and a variety of *gallinetas* (Rallidae) and *gavilanes* (Falconiformes) (Amigos de la Tierra/MARENA, 1996).

New sightings of species, such as *Procnias tricarunculata* and *Cephalopterus glabricollis*, the later a new species reported for Nicaragua that had been reported only for Costa Rica and Panama, makes clear that Los Guatuzos forms part of the high-altitude migration corridor that is probably related to the Cordillera de Guanacaste in Costa Rica, the mountains closest to Los Guatuzos Wildlife Reserve. At the same time, the movement of *Jabiru mycteria* and *Mycteria americana* within Los Guatuzos suggests that this wetland forms part of a corridor for aquatic birds from northern and northeastern Costa Rica (Arróliga and Herrera-Rosales, 2000). Psittacidae are important because of their diversity. Ten species have been recorded in this group in the reserve. All these species are protected by national legislation and have a closed season set by MARENA (1999). They are also listed in Appendix II of CITES.

During the dry season (February-April) on the Pacific Coast of Costa Rica and Nicaragua and during the North American winter, Los Guatuzos wetland takes on a greater diversity of fauna because of the abundance of migratory birds, palmipedes and *zancudas* that seek refuge and food in the wet environments of the reserve (Amigos de la Tierra/MARENA, 1996).

Among the reptiles represented in Los Guatuzos are the *cuajipal* (*Caiman crocodylus*), whose presence justifies protection of this area as a wildlife reserve. The greatest density of population of this species is found in Río Papaturo inside the reserve (Buitrago, 2001). The crocodile (*Crocodylus acutus*), an endangered species, is also present in Los Guatuzos, although in smaller numbers.

There are several species of endangered freshwater turtles, primarily the *ñooca* (*Trachemys scripta*), *pecho quebrado* (*Kinosternum* sp.) and the *tortuga lagarto* (*Chelydra serpentina*), that live in the streams and in Lake Nicaragua. The *ñooca* is very appreciated for its eggs and meat. At the present time, local inhabitants collect eggs of this turtle in the reserve in order to incubate them in plots at the Los Guatuzos Ecological Centre in order to obtain economic benefits from this species and guarantee its conservation by releasing a percentage of the hatchlings into the environment.

Among the reptiles, there are abundant iguanas (*Iguana iguana*) and in lesser proportion the *garrobo* (*Ctenosaura similis*), *basilisco* (*Basiliscus* spp.), lizards and snakes. The first two are very appreciated by the local population and are hunted (Amigos de la Tierra/MARENA, 1996).

Mammals have also suffered heavy pressure from local communities and poachers from northern Costa Rica for subsistence and for sale. Several species are very sought after: *guardatinaja* (*Agouti paca*), *venado cola blanca* (*Odocoileus virginianus*), *cusuco* (*Dasybus novemcinctus*) and *saino* (*Tayassu tajacu*). Other well-known mammals in the Guatuzos are the *pizote* (*Nasua narica*), *perezoso* (*Bradypus variegatus*), *mono congo* (*Alouatta palliata*) and *mono araña* (*Ateles geoffroyi*). The presence of large mammals such as the tapir (*Tapirus bairdii*), *chancho de monte* (*Tayassu pecari*) and the *oso caballo* (*Myrmecophaga tridactyla*) has been reported. Among the felines, the jaguar (*Panthera onca*) and the puma (*Felis concolor*) are endangered or vulnerable because of the reduction of their habitats (Amigos de la Tierra/MARENA, 1996).

By protecting several shade-providing species, their habitats are protected as well as other species that require smaller habitats. In the wildlife reserve, there are several of these cases. Among the birds, there are the *Jabiru mycteria*, *pájaro sombrilla* (*Cephalopterus glabricollis*) and ducks and migratory Passeriformes. Among the reptiles, there are the *cuajipal* (*Caiman crocodylus*) and *tortuga ñoca* (*Trachemys scripta*). Among the mammals, there are the jaguar (*Panthera onca*) and the tapir (*Tapirus bairdii*).

#### 19. Social and cultural values:

The name of the reserve comes from the Guatuzo Indians, one of the indigenous groups that live in this region. The Guatuzos used to live on the southern shore of the lake and on the plains along Río Frío. This territory was also occupied by the Maleku ethnic group, whose origin is unknown in the Río Frío basin. In the Río Zapote basin, there are Zapotes, closely related to the Indians on the islands of Ometepe and Solentiname (Castillo, 1992).

In Cerro Cucaracha, remains of pre-Columbian ceramic of the southern type have been found as well as burial sites (some already opened) and a stone base for what could be a human dwelling. These pieces and burial sites have been dated by the Italian archaeologist Severo Sini as belonging to the period 500 BC–500 AD, the period of tribal societies (Amigos de la Tierra-España/MARENA, 1996). The pattern of land occupation was dispersed, forming population nuclei on the shores of the main navigable rivers. The river network was used for supplying water, food, transportation, control and territorial defence. The inhabitants were concentrated in fortified positions

(*palenques*) separated by several kilometres and located on the shores of the main navigable rivers. Between 1850 and the 1880s, with the opening of the world market for raw rubber (*hule*), Nicaraguan rubber collectors began to penetrate up the Zapote, Guacalito, Frío and Medio Queso rivers towards northern Costa Rica in search of latex extracted from *palo de hule* (*Castilla elastica*), which was then sold in San Carlos de Nicaragua. The high prices and absence of political control led to a savage and destructive exploitation until the almost total disappearance of this wild tree. Another impact of the rubber gathers (*huleros*) was the genocide and enslavement of the local Maleku population (Castillo, 1992).

Beginning in 1910, there was a second phase of immigration of Nicaraguan farmers towards this area in search of farmland and better living conditions. These immigrants brought with them a whole itinerant farming culture that promoted deforestation through slash and burn and rotation of plots for basic crops with rather long periods, 15 to 20 years, of fallow (Castillo, 1992). In the 1930s, migration began from Ometepe, Rivas, Granada and the rest of Río San Juan, creating large cattle ranches, expanding this colonization in the 1940s around economic activities such as forestry, the gathering of *raicilla* and the growing of cacao on large farms of 50 and 100 manzanas. Cacao became the economic base of the area until the beginning of World War II, leading to trade links between the area and San Carlos (Castillo and Rodríguez, 1994).

Relationships between inhabitants on both sides of the border were and are very frequently family ties. For families that became established in the area, the border was an abstract concept because there was constant migration from one side to the other, and the inhabitants lived without inconvenience in one community and farmed nearby in the other country. The fighting that took place in Nicaragua after 1979 caused an exodus of Nicaraguan small farmers from this area toward northern Costa Rica. The government of Costa Rica attempted to develop the northern border area, providing the area with basic services such as drinking water, electricity, telephone, small hospitals, health posts, roads. Between 1983 and 1986, the area of Los Guatuzos in general and more specifically the area of Papaturre was the scene of fighting, and all the inhabitants emigrated to Costa Rica.

A distinct case is the community of Jumuzá because 51 per cent of its population came from Costa Rica. Because of the confusion about the border, it was thought that this land belonged to Costa Rica, and the Instituto de Desarrollo Agrario (IDA) of Costa Rica, distributed land in the area. In 1995, after a border and diplomatic conflict, these families were relocated by the government of Costa Rica on land belonging to Costa Rica, with the resulting almost total depopulation of that community.

At the present time, the strong contrast between the development of infrastructure and services in northern Costa Rica and the complete lack of services in Los Guatuzos, together with better salaries, is generating emigration from Los Guatuzos towards nearby towns in Costa Rica, where they live while farming in Nicaragua. Seasonally, there is migration of Nicaraguans across the border at Los Guatuzos that move to Costa Rica to work in the harvesting of coffee, banana and sugar cane (Amigos de la Tierra-España/MARENA, 1996).

20. Land tenure/ownership of:

Land tenure is a frequent problem in the protected areas of Nicaragua, and Los Guatuzos Wildlife Reserve is no exception. There are two types of property: private and public. The extent of public land is not known, but it corresponds to the areas of flooded plains. Most of the private owners have a legal right to possession, however, without title that backs up this right. In addition, several have full titles. About 28 per cent of the families do not have land. Out of a total of 24023 manzanas, the largest concentrations are in Río Frío (6837 manzanas) and Medio Queso (5195 manzanas). The smallest is in Flores de Mayo with 273.5 manzanas. Of the families with land, 12.6 per cent of the families have between one and four manzanas and 19.2 per cent have between 26 and 50 manzanas. About 2.33 per cent of the families in the reserve are owners of 58.16 per cent of the area with farms of more than 1000 manzanas. Families with 50 to 99 manzanas represent 11 per cent of the population, owning 6.32 per cent of the land. The largest percentage is families with 25 to 49 manzanas, representing 48.6 per cent of the population and holding 14.73 per cent of the land. About 10 per cent of the families declare possessing title to their land, 12.5 per cent have no title and 75.4 per cent did not reply to this question, based on the assumption that they could not legally have title to their land (Amigos de la Tierra, 1998).

#### Legal instruments

Los Guatuzos wetlands was declared a wildlife reserve by Decree 527, which created protected nature areas in southeastern Nicaragua. The management plan for the reserve was prepared by Amigos de la Tierra-España and approved by MARENA, through ministerial decree 0296 of 6 December 1996.

Decree 66-99 (MARENA, 1999) declared inalienable the Áreas Naturales Protegidas del Sureste, including Los Guatuzos Wildlife Reserve. These areas are the equivalent of the land included within the limits of the protected areas. Articles 34 and 35 express the following:

Article 34 declares that the area included in the protected areas of the Southeast retain the same inalienable character, and, in accordance with Article 54 of the regulations, all public land within these areas should be registered in the name of the government.

Article 35 declares that both private and public property located within the limits of the protected areas of the Southeast are subject to the regulations on management, use and exploitation of the natural resources established in the appropriate laws. This is also the case for any complementary provisions established by the Ministro del Ambiente y Recursos Naturales.

#### 21. Current land use:

In general, land use can be broken down into the following: 4971 manzanas of farm land, 3355 of pastures, 5687 of forests and 2093.3 manzanas of non-traditional crops such as bananas, cacao and citrus fruit. There are 9048 manzanas of lowlands, which are considered infertile and usually remain flooded. Medio Queso is the community that has the largest area under agriculture (2114 manzanas). In addition,



it is the community with the largest area dedicated to non-traditional crops. El Plomo has the smallest area for agriculture (5.5 manzanas), and Río Frío is the community with greatest area of pasture (3638.7 manzanas) and largest area of forests (3638.7 manzanas). Flores de Mayo is the community with the smallest area of forest (8 manzanas). Agricultural production is approximately 1412 qq of rice, which represents a yield of 27.1 qq/manzana, 1005 qq of maize, which gives a yield of 20.9 qq/manzana and 764 qq of beans for a yield of 17.8 qq/manzana. As for livestock, 83 per cent of the families do not have cattle, 78.3 per cent do not have horses, 74.3 per cent do not have pigs and 55 per cent do not have fowl.

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

One of the most serious threats is the pressure of colonization on the vulnerable areas of the reserve. This is the case on the edges of Río Frío and in the forested areas in Santa Elena and Jumuza. This pressure comes from Nicaraguans emigrating from these areas primarily to the centre of the country. Illegal trade in fauna and flora towards Costa Rica, primarily of species protected by decree by the Nicaraguan government, such as the *cuajipal* (*Caiman crocodiles*) and parrots (*Amazona autumnalis* and *A. farinose*). Intensive and extensive farming activities are carried out in Costa Rica, where highly toxic insecticides are used that affect the aquatic fauna through transfer of the insecticides in the runoff towards Los Guatuzos Wildlife Reserve, causing the death of fish and other aquatic fauna. Poaching by persons from Costa Rica affects the population of white-tailed deer (*Odocoileus virginianus*), *sahino* (*Tayassu tajacu*) and the spotted paca (*tepesquintle*) (*Agouti paca*). Fishnets are placed, in rivers and in Lake Nicaragua near the mouths of rivers.

23. Conservation measures taken:

This is a protected area in accordance with decree 527 granting the status of wildlife reserve and is part of the Reserva de la Biosfera del Sureste de Nicaragua.

In 1996, the management plan for this reserve was approved through ministerial decree 0296 of 6 December 1996. This management plan was prepared by Amigos de la Tierra-España, which implemented it until 1999. At the present time, the Fundación Amigos del Río San Juan (FUNDAR) is responsible for its implementation.

The Ministerio del Ambiente and Recursos Naturales (MARENA) has established an administration of park wardens in Papaturre as a conservation measure in the area. This post is equipped with a 25 HP outboard motor provided by the government of Spain. Financing for six park wardens in Los Guatuzos Wildlife Reserve has been obtained.

A butterfly centre has been constructed for the exploitation of butterflies by local inhabitants in the communities around the reserve. A turtle centre has been built for incubation of river turtle eggs (*Trachemys scripta*). These turtles are exported under MARENA permit and a percentage (15 per cent) are released. This practice is good conservation and leads to sustainable exploitation of this species.

#### 24. Conservation measures proposed but not yet implemented:

The most important conservation measure proposed is revision and redefinition of the management plan for Los Guatuzos Wildlife Reserve, incorporating research and social and environmental education. Flooded savannahs and riparian forests have been placed under complete protection, because these habitats are vulnerable and necessary for the resting and feeding of migratory birds, making the reserve an indispensable site for maintaining the migratory route for aquatic birds and terrestrial passerines, (Arróliga and Herrera-Rosales, 2000).

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The following infrastructure exists in the reserve:

- An operating ecological centre;
- A butterfly breeding centre, constructed and operating;
- A turtle centre with a capacity for 12,000 turtles, constructed and operating;
- A forest guard outpost in Papaturro

26. Current conservation education:

This programme has played a basic role in the objective of conservation of the reserve and implementation of the management plan with the main aim of educating,

organizing and promoting environmental awareness among local inhabitants and visitors. Its activities have included carrying out formal and informal activities aimed at the community for promoting interest toward protection of the surrounding environment and promote the sustainability of natural resources.

At the same time, the programme has promoted the training of inhabitants to improve their capacity to implement many aspects of the reserve's management plan, non-traditional productive activities, management of wildlife and ecotourism.

Education campaigns for adults: support programme for the inhabitants of the reserve in primary education (PAEBANIC).

Workshop on environmental and community management. Activities were carried out in the context of environmental education, which has led to the training of primary teachers and trainers for adult education with whom a pilot management plan for solid waste was prepared in July 2001. This plan will be carried out in four schools: Papaturro, Santa Elena, Pueblo Nuevo 1 and Pueblo Nuevo 2, as well as with the adult educator of the Valle de Guadalupe.

Support for primary education: Construction of three primary schools in three communities: Refugio Pueblo Nuevo 1, Valle de Guadalupe and El Camíbar.

Workshop on non-wooden products. An exchange of experiences between the inhabitants of Los Guatuzos Wildlife Reserve and inhabitants in other protected areas (Monumento Histórico El Castillo de la Inmaculada).

Binational course for forest rangers to increase knowledge and technical capacity related to environmental legislation, environmental interpretation, cartography, etc.

Ornithology course to promote ornithological knowledge among inhabitants of the reserve and other areas.

## 27. Current recreation and tourism:

From February 2000 until 6 March 2001, the number of visitors recorded reached 424 persons of 21 nationalities. This seems to be a good indicator of the number of visitors to Los Guatuzos Wildlife Reserve (Díaz, 2001).

Visits by universities: An important element in the activities of the Centro Ecológico Los Guatuzos has been the participation and visit of groups from Nicaraguan universities and the Universidad Nacional de Costa Rica, which have an interest in the reserve because of its potential for academic use. The following universities that have visited the reserve are:

- UNAN-León (Universidad Nacional de Nicaragua–Núcleo León, León, Nicaragua) (see photographs);
- UPONIC (Universidad Popular de Nicaragua San Carlos/Río San Juan);
- UCA (Universidad Centroamericana–Managua);
- UNA (Universidad Nacional Heredia/Costa Rica).

The activities carried out by the students of UCA and UNAN-León in the Los Guatuzos Ecological Centre have been established by agreements. In the other cases, the participation of these students has led to the signing of agreements for development of future activities (Díaz, 2001).

Tours frequently visiting Los Guatuzos:

Solentiname Tours and Tours Nicaragua frequently visit the reserve, with a visit to the Ecological Centre. This type of visit promotes tourism to Los Guatuzos reserve and has led to the establishment of contacts with tour operators in Costa Rica; for example, Empresas de Tropenstation, La Gamba, Costa Rica, which works with groups of tourists interested in nature observation (Díaz, 2001).

Visits by important persons to the Ecological Centre

Ambassador of Spain in Nicaragua, Carlos Díaz Valcárcel;  
Minister for the Environment and Natural Resources of Nicaragua, Roberto Stadhtagen Vogl;  
Ambassador of the European Union, Giorgio Mameerto;  
Vice-Minister of INETER;  
Dr. Salvador Peris, Universidad de Salamanca, Spain;  
Mike McCoy, Universidad Nacional en Heredia, Costa Rica;  
María Hornos, Project officer for the European Union;  
Ignacio Jiménez, author of “Manatíes del Río San Juan y Tortuguero”.

Media coverage in the Nicaraguan and abroad

A television report for Canal 2 in Nicaragua;  
Two newspaper reports about conservation activities in the RVSLG in La Prensa and the Nuevo Diario (see annex);  
One television report on the programme “El escarabajo verde”, which is an environmental programme of Televisión Española.  
A television programme in the series “España en el Corazón” for the international channel of Televisión Española.

The programme for tourism has sought to promote ecotourism as a non-traditional economic activity compatible with conservation of the area, incorporating owners and inhabitants in the development of this activity. As a result of the activities of this programme, groups of tourists and scientists with interest in biological diversity have visited the reserve. Considerable effort has been made for training, education and training of the inhabitants in order to improve reception of visitors at the reserve and Ecological Centre (Díaz, 2001).

28. Jurisdiction:

Government authority:

Territorial jurisdiction over the wetland: The wetland is included in the jurisdiction of the municipio of San Carlos in the department of Río San Juan. The highest government authority in the area is the mayor of the municipio of San Carlos.

Administrative jurisdiction for conservation: MARENA through the Secretaría Ejecutiva of the Reserva de Biosfera del Sudeste.

29. Management authority:

MARENA, through the Executive Secretary of the Reserva de Biosfera del Sudeste. An administrator of Los Guatuzos Wildlife Reserve is appointed by MARENA, and there is a forest guard post in the town of Papaturo with boats with an outboard motor and horses for carrying out management and monitoring activities within the protected area.

The Fundación Amigos del Río San Juan (FUNDAR) is the organization responsible for implementation of the management plan of Los Guatuzos Wildlife Reserve, which includes the management of farms, environmental education and biodiversity studies for exploitation and protection.

30. References: