Information Sheet on Ramsar Wetlands

1. Date this sheet was completed/updated: 5 February 1996

2. Country: COSTA RICA

3. Name of wetland: Humedal Caribe Noreste

4. Geographical coordinates:

5. Altitude: between sea level and 269 metres above sea level

6. Area: 75,310 hectares

7. Overview:

This reserve is the core area of the Area de Conservación y Desarrollo Sostenible de Llanuras del Tortuguero (ACTo). The reserve has three identifiable and separate parts: 1) incorporated into the Tortuguero National Park (23,903 hectares); 2) included in the Barra del Colorado wildlife reserve (40,315 hectares); 3) included in the border reserve (Refugio Fronterizo) (11,092 hectares).

Eighty per cent of the reserve has sandy soils produced by sedimentation, which in the coastal area form parallel bars, rising several metres above the water-table, and depressions subject to variable flooding, forming lakes, grass marshes and wooded swamps. This system is maintained by high precipitation and deficient drainage. The average temperature is 25°C, with recorded lows of 18°C and a highs of 33°C. Minimum monthly precipitation is 157 mm, and total annual precipitation is approximately 6000 mm. There are more than 330 days of cloud cover per year, and this area is classified as very humid tropical forest.

The area of Lomas de Sierpe y Coronel was produced by volcanic activity. The base is formed by permeable, light grey, broken lava rocks. Overlying this are harder rocks and grey or dark grey lavas. Volcanic activity formed a group of small islands raised on the ocean floor along the eastern coast indented with traces of former bays. Later, continental erosion filled the depressions, flooding the raised volcanic cones in this area.

There are eleven types of vegetative associations (see figure 3 and appendix 1):

Major associations

Dry soil (halophytic community)
Marshes and floodable areas

Dry soil (berm)
Yolillales

Permeable and fertile soils
Wet environments (Lomas de Sierpe)
Very humid soil
Zonal or climatic associations (Mesetas de Agua Fría)

Minor associations

Dry soil (sandy sections)

Grass marshes

Herbaceous communities along canals and lakes

8. Wetland type:

A, E, F, Y, J, K, L, M, N, O, Tp, Ts, U, W, Xf, Xp, Y, 9

9. Ramsar criteria:

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

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

Pacto (MIRENEM-European Union)
Limć¢n, Costa Rica

12. Justification of the criteria selected under point 9, on previous page:

This wetland merits listing as a wetland of international importance because:

a) it is an outstanding representative of the natural wetlands characteristic of the Caribbean coast of Costa Rica. It plays an important role in supporting human communities that depend on wetlands; for example, it provides food, maintains cultural values and is the breeding area for aquatic species (fish) that sustain fisheries on the Caribbean coast of Costa Rica.

b) it supports species and subspecies of animals and plants that are vulnerable or threatened with extinction.

c) it is an obligatory stopover for migratory birds from the north. It appears that this wetland provides rest and food for more than one million birds annually.

The following families live in the wetland: Anatidae, Ciconiiformes, Falconidae, Gaviidae, Pandionidae, Pelecanidae and Sternidae.

13. General location:

This wetlands is on the northeastern Caribbean coast of Costa Rica on the border with Nicaragua, roughly 80 kilometres north of Ciudad Limón. It is in the provinces of Limón and Heredia, in the cantons of Pococí and Sarapiquí and in the districts of Barra del Colorado and Puerto Viejo.

14. Physical features:

The wetlands in ACTo have the following characteristics. Tides (less than 40 centimetres) affect the lagoons and marshes next to the marine area. The main vegetation is yolillo (*Raphia taedigera*). According to the work of Winemiller (1991) and Winemiller and Leslie (1992), the Laguna de Tortuguero has an average depth of 7.5 metres and a maximum depth of 13 metres. Salinity ranges between 8.7 and 10.5 parts per thousand (ppm) at a depth of five metres. The salinity of the surface water of the estuarine lagoons can reach 0.02 to 0.1 ppm.

The land within the core area is drained by small steams and rivers that descend from the central mountains in Costa Rica, 50 to 60 kilometres to the west of this wetland. These rivers and streams are shallower than 3 metres and their salinity never exceeds 0.1 ppm. The streams are filled with floating aquatic plants such as *Azolla*, *Eichornia*, *Hydrocotyl*, *Salvinia* and others. During the dry season, these streams are usually completely covered with this vegetation.

15. Hydrological values:

This lake system is influenced by the small tides in the Caribbean. It is a place of reproduction for the main species of fish that form the basis for subsistence fishing along the Caribbean coast of Costa Rica, and this is an area of feeding, reproduction of the American manatee (*Trichechus manatus*).

16. Ecological features:

This reserve is especially rich in biological diversity and ecosystems. The types of vegetation associations are listed in appendix 1.

This area forms part of the system of protected areas and is a corridor between Tortuguero National Park (Costa Rica) and Indio Ma¡z Biological Reserve (Nicaragua). This area was colonized by English-speaking Negroes from the islands in the Caribbean, primarily San Andrés, near Bluefields and the Cayman Islands (Lefever, 1992).

17. Noteworthy flora:

The most important flora is listed in appendix 1. The following species are the most important:

almendro	*Dypteryx panamensis*
canfin	*Protium* spp.
cocobolo	*Vatairea* spp.
galiv n	*Pentaclethra macroloba*
gamalote	*Paspalum* spp.
gu cimo colorado	*Luehea seemannii*
palma real	*Manicaria saccifera*
palmito	*Buterpe macrospadix*
par	*Brachiaria mutica*
pumpunjoche	*Pachira acuatica*
sangrillo	*Pterocarpus officinalis*
yolillo	*Raphia taedigera*

18. Noteworthy fauna:

Appendix 4 is the report of the "Survey of resident and migratory birds in Tortuguero, Costa Rica" (Hern ndez, 1996). The data in this report confirm that Tortuguero is the main flyover and entrance to Costa Rica for most of the Neotropical species of migratory birds recorded in Costa Rica (Hernández, 1996). New species have been identified in the region and the country, such as the hviolet sabrewing hummingbird (*Campylopterus hemileucurus*), which lives in forests above 500 metres on the Caribbean slopes. The pearl kite (*Gampsonyx swainsonii*) was discovered in 1984 in ACTo and is a species that is expanding northward.

A new species for Costa Rica, Chondestes gramnacus has been recorded on the beach. Its present distribution is up to southern Guatemala and sometimes Honduras and El Salvador (see appendix 4).

In 1996, the crested eagle (*Morphnus guianensis*) was recently reported in the wetlands. This species is the second largest bird of prey in Costa Rica.

Aquatic wildlife: This area is part of the fisheries area of San Juan and is characterized by the presence of large numbers of cichlids. Fishery resources are divided into two basic groups: 1) a large component of South American species (Cichlidae, Characidae and Pimelodidae) and 2) a group of marine species (Carcharinidae, Centropomidae, Lutjanidae and others). This group has euryhaline species.

Freshwater species are divided into two groups: one in which the species have no tolerance for salinity and of which the most abundant species in ACTo is the Characidae. In the second group are species with a tolerance for salinity. The families most common in ACTo are the Cichlidae and Poecilidae (Winemiller and Leslie, 1992). In studies by Winemiller and Leslie (1992), it was found that there is greater diversity in the lakes (80 species) than in the sea near the shore (42 species). This is caused by the effect of the edge of the habitat (theory of the effect of mass) (Shimida and Wilson, 1985) by which considerable structural heterogeneities exist in the lakes in the form of diversity of aquatic vegetation, fallen trees, mud, detritus and other factors. This is not the case in the coastal area of the which is characterized by a regularity of profile (straight) and a sandy bottom. One species native to this wetland is the *Atractosteus tropicus* (Lepisosteidae). This is a living fossil that is protected by Costa Rican legislation.

Another important group is the molluscs, which have not been well studied and documented (Honbrick, 1969; Robinson, 1987) (see appendix 4). In 1995, a small bivalve of the species *Mytilopsis guianensis* or sellei in the Dreissenidae family was found. Nothing is known about its biology or ecology. It is estimated that there are at least ten species of freshwater molluscs in surface surveys because North and South American species used this route for dispersion (Rafael Cruz, personal communication, 1995).

No study has been made of the populations and status of the mammals in this area. The list in appendix 5 is a revision prepared by Chavez (1991) of several random studies made in this area. Nonetheless, the studies that have been made during the past five years show that there are species common in this area from the Cebidae, Didelphidae, Mustelidae and Trichechidae families.

Among the species of reptiles and amphibians, it is common to observe *Caiman crocodilus*, *Crocodilus acutus*, *Chrysemys* spp. and *Rhynoclemis* spp. Among the amphibians, frogs in the Dendrobatidae family are common. As in the case of mammals, studies are scarce. It is suspected that there are species of salamanders (with strong endemism) that have not yet been identified.

19. Social and cultural values:

An English-speaking, Afro-Caribbean culture of inhabitants originally from San Andrés (Colombia), Bluefields (Nicaragua) and Grand Cayman predominates along the coast. Lefever (1992) and Oro (1992) have documented this culture. This area was settled at the beginning of the twentieth century, and the main activities were the cutting of timber (1920 to 1956), hunting of the Carey turtle and the selling of skins from large mammals and reptiles.

20. Land tenure/ownership of:

At least 70 per cent of the area at the site included in the proposed wetlands is property of the government of Costa Rica.

In the area surrounding the Barra del Colorado Wildlife Reserve, land is owned by both the government and private parties.

The area around the Tortuguero National Park is private property, where cattle ranching and agriculture are the main activities. In the towns of Barra del Tortuguero and Barra del Colorado, tourism and fishing are the most important activities.

21. Current land use:

There is no human settlement in the area of this site.

Surrounding area

Agriculture: The principal activities in this area are described in appendix 2. Livestock raising is extensive with an average of one head per two hectares. Local inhabitants use forest products to obtain quick money and for domestic construction. ACTo tries to meet these needs by granting limited-use permits (A-1; domestic use) primarily in the wildlife reserve. The primary source of abuse is the use of the royal palm (*Manicaria* spp.) for roofing materials by private companies or hotels.

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

At the site: A road has been built leading into the Tortuguero national park that has changed drainage in this area. Measures are being taken to remedy the situation.

In the surrounding area, deforestation by saw mills and private owners and changes in the flow of streams by the banana companies are the main problems, plus municipal, logging and banana plantation roads that change drainage and sedimentation patterns. There are projects to build a hydroelectric project in the area of Rio Reventazón and Pacuare. A new international port is planned near the town of Barra del Parismina, next to the Tortuguero National Park. There is a project for a canal joining the Pacific and the Caribbean that would pass through this area. There is prospecting for gold on the Nicaraguan side of the San Juan River. There are also gold mining concessions around San Carlos, which will inevitably affect the San Juan River and its tributary the Rio Colorado. The Rio Colorado is the main tributary of the lakes in northern part of the reserve.

The quality of the water flowing from this area has been affected by agriculture, primarily banana plantations (see appendices 2 and 3), and by human settlement. A high level of faecal coliforms has been recorded in the Tortuguero lakes (more than 2400 coliforms per 100 ml). Fishing resources have been affected.

23. Conservation measures taken:

ACTo has a strategy, entitled "Strategy for Conservation and Sustainable Development of the Tortuguero Flatlands," prepared by the Project for the Consolidation of the Tortuguero (PACTo). This was a project underwritten by the Ministry for the Environment and Energy (MINAE) and the European Union (EU), carried out by IUCN (1990-1992).

With this strategy, PACTo (MINAE-EU) continued the implementation for the conservation of the Tortuguero flatlands (1993-1996). The projects administered by PACTo are the following.

a) Program for land use: organization of land based on land use capacity, including planning at the level of territories, productive (farms), of greatest ecological interest, social infrastructure and the socio-cultural opportunities and economic advantage offered by each case and a solution to the land tenure problem.

Examples:
- registration of the land in the name of the government
- registration of land in the name of small farmers in the towns of Aldea, Barra del Colorado, Cocori and Linda Vista

b) Agro-forestry programme: contributing to the decrease of deforestation and to prevent deterioration of the socio-economic conditions of the rural population in ACTo; testing, setting up and promoting sustainable agro-forestry and grazing production systems, diversified and adapted to the ecological and socio-economic limitations and characteristics of the region. This project also develops and adapts techniques for the full and sustainable use of forestry resources, making them available to small and medium-sized producers for the creation of an economic base, stopping and reversing the current process of deforestation.

Examples:
- farms in Pueblo Nuevo for the improvement of pastures and forestry-grazing practices
- development of tropical gardens in La Aldea
- Soil conservation in Linda Vista

c) Programme of aquatic resources: conservation of aquatic resources and promotion of the conversion of these resources into an important support for sustained development in the communities in ACTo where the main beneficiairies are the local inhabitants.

Examples:
- monitoring pesticide contamination of surface water in the Tortuguero National Park
- advising fishermen at the Barra del Colorado in new fishing techniques
- experimentation in ranching schemes for iguanas and butterflies

d) Social programme: strengthening of services, content and follow-up of social programmes in ACTo and of governmental social services in the region in order to ensure integration into the local communities and optimization of their impact on the improvement of the standard of living of the local inhabitants. Incorporation of the topic of gender into the programmes promoted by ACTo in order to strengthen the participation of men and women under the same conditions.

Examples:
- formation of regional subcommittees of communities
- co-ordination and financial support of the improvement, expansion or reconstruction of the water supply to Aldea, Barra Parismina, Colorado, Pueblo Nuevo and Tortuguero
- studies and basic equipment for the management of solid waste at the community level in three towns

e) Research programme: facilitate the development of basic applied scientific social and cultural research and themes dealing with conservation and sustainable development in ACTo.

Examples:
- establishment of a documentation centre converting the region into a reference centre on knowledge about the humid tropics of the Caribbean basin
- financing of four post-graduate theses in the Master's programme in wildlife management at the National University
- monitoring of resident and migratory bird populations in Tortuguero

f) Protection programme: to protect existing natural and cultural resources within ACTo through joint responsibility, information and education monitoring and application of existing norms and legislation.

Examples:
- creation of monitoring committees local inhabitants in the ACTo for natural resources
- establishment of protection plans for the period of egg-laying by green and loggerhead turtles
- protection plans against cutting of vegetation and illegal hunting

24. Conservation measures proposed but not yet implemented:

Preparation of regulations for the public use of the Tortuguero National Park, providing for sport fishing in the marine area. This regulation was prepared in 1995 and has now been submitted for approval to the local inhabitants. It is expected to be approved soon. Inclusion of this wetland in the Ramsar list will lead to greater protection of the Tortuguero reserve.

Proposal to manage the *Machrobrachium carcinus* and *M. tenellum* in the area of the delta and Barra Colorado. This proposal was presented to the Ministerio de Ambiente y Energ¡a (MINAE) to ensure that local inhabitants use resources in a sustainable manner. Approval is expected soon.

25. Current scientific research and facilities:

There has been little research, and the research that has been done has concentrated on just a few species. As a result, very little is known about the sociological processes and interrelations among species.

The institutions that have worked in this wetland are:

Caribbean Conservation Corporation (CCC): they have worked with sea turtles for the past fifty years

University of Costa Rica: fifteen years of working with the CCC primarily supporting the work on sea turtles

Universidad Nacional: ten years of the study of birds associations of fishermen

National Museum: collection of flora and insects

Biodiversity Institute (INBIO): collection of flora and insects

Proyecto de consolidaci¢n de Llanuras del Tortuguero (PACTo): land tenure and use; studies of socioeconomic aspects of communities near ACTo; research with groups of fishermen and economic development; alternative means of agriculture production (tropical gardens and ranching schemes)

ACTo has several guard stations and protection points. While it is possible to provide accommodation at these stations, there are no research facilities. ACTo does have some basic scientific equipment for laboratory work, for example, docking facilities, small boats, a documentation centre, equipment for analysing surface water, a system of geographical information. ACTo is twinned with the Do¤ana wetlands (Spain) and its research centre where a joint research programme to prepare a proposal that will make it possible for ACTo to implement and support research programmes in the region, for example, meteorological stations and research centres.

PACTo and Paseo Pantera have contributed to the preparation of a strategy for the ACTo research programme (López, 1995).

26. Current conservation education:

ACTo has implemented a strategy of environmental education providing training for school teachers in the area through its environmental education programme because it is through them that knowledge can be transmitted to thousands of school children in the region. The next generations can create environmental awareness more effectively. This programme carries out specific activities with school children in the schools surrounding the Tortuguero National Park and the Barra del Colorado Wildlife Reserve with visits planned for the children to the park and the reserve for talks, slide shows, walks through the forest and visits to the streams and canals. It is very difficult for the teachers in these remote schools to participate in the training workshops given by ACTo.

During the green turtle egg-laying period, special protection campaigns are directed at the inhabitants living near the park and in settlements where turtle meat and eggs are eaten, plus groups involved in the observation of turtle egg-laying (groups of local guides, visitors and the general public).

27. Current recreation and tourism:

There are no human settlements in the proposed reserve. The following activities are carried out there:

Both sport and subsistence fishing take place in the lakes. Subsistence fishing is with hook and line, but in some areas (for example near Barra del Colorado) there is some illegal fishing using gill nets.

Illegal hunting is one of the main problems and occurs primarily in the area farther inland than the reserve. The hunters usually sell the game and do not live near the area. Most of them are from towns such as Siquirres and Gu piles and are usually involved in producing bananas. The most affected species are the spotted paca (*Agouti paca*), pecari (*Tayassu pecari*), Baird's tapir (*Tapirus bairdii*), white-tailed deer (*Odocoileus virginianus*) and an armadillo (*Dasypus novemcinctus*).

Another frequent activities in this region is the illegal gathering of marine turtle eggs and the hunting of adult turtles. This activity is carried out by local inhabitants and by fishermen from around Limón.

Tourism involving nature (ecotourism) is concentrated around the Tortuguero National Park which is part of the area proposed for inclusion in a Ramsar site. In 1994, approximately 30,000 tourists visited the park.

After increasing the park entrance fee to US$ 15 for foreign tourists the number of visitors dropped to 10,000, but not to the ACTo. It is estimated that 45,000 tourists visited the Barra del Colorado Wildlife Reserve (adjacent to the national park) where the entrance fee is US$1.50. The number of boats and hotels in the area is increasing.

In the surrounding area

The main activities in this area are summarized in appendix 2. Cattle ranching in the area is extensive with an average of one head of cattle per two hectares. Exploitation of forest resources is carried out by local inhabitants to obtain quick money or for construction. ACTo tries to deal with this problem by granting permits (type A-1: domestic use) mainly in the wildlife reserve. The main problems come from commercial saw mills and the owners of hotels that use the royal palm (Manicaria spp.) for roofing materials.

There is no programme of specific tourist activities in the Tortuguero Conservation Area, but these activities are regulated inside the Tortuguero National Park and the Barra del Colorado Wildlife Reserve.

Among the tourist activities regulated by ACTo is freshwater and salt water sport fishing, access by visitors to the creeks, lakes and paths for the observation of fauna and flora and the observation of the laying of eggs by the green turtle (Chelonia mydas) and the leatherback turtle (Dermochelys coriacea). ACTo organizes training activities for local tourist guides, including guides for observing of egg-laying, specific themes of biology of the turtles, workshops on fauna and flora and reception of visitors. An association of employees of ACTo has been formed for the administration of the sale of souvenirs and articles concerning the area in the guard stations of the Tortuguero National Park.

28. Jurisdiction:

Area de Conservación y Desarrollo Sostenible de Llanuras del Tortuguero (ACTo)
Sistema de Areas de Conservación (SINAC)
Ministerio de Ambiente y Energía

29. Management authority:

Sistema de Areas de Conservación (SINAC)
Ministerio de Ambiente y Energía

30. Bibliographical references:

see original

Appendix

Vegetative associations in the Tortuguero conservation and sustainable development area (ACTo)

a) Grass marshes

These are areas that have year-round surface water that prevents trees from growing. The vegetation is composed primarily of species from the Cyperaceae and Gramineae families that completely cover the surface. Among the Gramineae are gamalote (*Paspalum* spp.) and par (*Brachiaria mutica*). There is also chroreja (*Eichomia crassipes*) and a small fern that floats on the water. This association is found primarily along the southwestern edge of the Rio Colorado and in the lower portion of the former bed of the Rio Chirripó del Caribe.

b) Grass marshes with low trees

This is the more shallow of the grass marshes. Water covers the surface during almost year-round, but its shallowness and probably the existence of a short period without water makes it occasionally possible for low trees tolerant of these conditions to grow, in addition to the herbaceous species that grow in the deeper parts of the marsh. These species of trees are guaba (*Inga* spp.), sangrillo (*Pterocarpus officinalis*) and pumpunjoche (*Pachira acuatica*). These trees can reach up to 10 metres in height and 30 centimetres in diameter.

c) Areas dominated by yolillo

The yolillo (*Raphia taedigera*) forms associations of pure or almost pure stands where there is flooding during a large part of the year. The amount of water on the surface can vary according to the season, reaching in some cases more than one metre in depth or just a few centimetres or nothing in others. The ground is usually flat or concave and there are occasionally groups of small trees, primarily *Pentaclethra officinalis*, *P. acuatica* and *P. macroloba* (gavilán). The largest area of this type is along the coast in a band about 5 kilometres wide and also following the banks of the Rio San Juan.

d) Low forest with patches of yolillo

This type of forest forms a transition between the areas of yolilla and the poorly drained woodlands. It occupies flat land, where the water table fluctuates on the surface or close to it. Also included in this type of vegetation are areas of mostly flat land, broken by a large number of low hills lower than 5 metres in height. Small trees of *Dypteryx panamensis* (almendro), *P. macroloba* and *Xylopia frutescens*, grow on these hills, among others. On the flat parts, grow *Inga* spp., *P. acuatica*, *P. officinalis*, *P. macroloba* and yolillo. These woodlands are low, less than 20 metres in height and a maximum of 35 centimetres in diameter. The largest part of this area is found between Cerro Cocorí and Lomas de Sierpe.

e) Poorly drained woodlands

This is a well-developed woodlands found on alluvial soils where the water table is quite high. The ground is generally flat, but with small depressions in which water accumulates forming small marshes of several square metres that fill with decaying organic material. Tall trees grow around these patches of swamp, producing a rise in the surrounding ground that form a series of small strips of well-drained land. The trees are tall, the largest grow beyond 35 metres in height. The dominant species are *Luehea seemannii* (gu cimo colorado), *Pentaclethra macroloba*, *Prioria copaifera* (cativo), *Sickingia maxonii* and occasional specimens of *Hyronima alchomoides* (pilón). There are also many specimens of coquito (*Astrocaryum alatum*), a small

palm and many species of palms growing in the undergrowth. In some areas there is the royal palm (*Manicaria saccifera*).

f) Flat woodlands with moderate to good drainage

This ground has a flat or slightly rolling surface but the elevation (+60 cm) above the water table gives it generally good drainage, although in some places the elevation is less and drainage is less favourable. Apart from recent alluvial soils, there are areas of low hills with gradual slopes that have intermediate fertility between recent alluvial soils and those on the hills. The existing vegetation is woodlands of 35 to 40 metres in height of large diameter (some more than 1.5 metres) and high density. The species of trees are quite diverse with a predominance of *Cespedezia macrophylla* (tabacón), *C. guianensis*, *Ceiba petandra* (ceiba), *Chrysophylum* spp. (caimito), *Dyalanthera otoba* (fruta dorada), *D. panamensis*, *H. alchomoides*, *P. copaifera*, *P. macroloba*, *Simarouba amara* (aceituno), *Spondias mombim* (jobo), *Virola* spp. (fruta dorada) and an Anonaceae (anonillo). There is also a large number of *Iriatea gignatea* and a few *Buterpe macrospadix* (palmito). The largest concentration of this association is between Rio Chirripó del Caribe and Rio Tortuguero, covering the southern part of the Cocorí Hills and both banks of the Rio La Suerte. This is a rather large area.

g) Wooded hills

This includes all of the area that rises above the alluvial plan, forming low hills (less than 850 metres in altitude, isolated or broad hills, but usually compact and low such as the Lomas de Sierpe, Cerros Cocorí and Cerros Chaparrón, among others. The topography is broken and the slopes are greater than 45 degrees in some sectors. There are two types of forest, one poorly developed on the more inclined slopes and the other developed on the least favourable parts. In the well-developed forest, trees reach more than 40 metres in height. The most common species are *C. guianensis*, *D. panamensis*, *Inga* spp., *Manikara* spp. (níspero), *Protium* spp., *P. macroloba*, (canfín), *Qualea* spp., *Vatairea* spp. (cocobolo), *Virola* spp. and *Vochya feruginea* (bota rama).

Ecological associations

Major associations

a) Dry soil (halophytic community)

This type of vegetation is limited to the beach area, immediately after the sandy strip of pure sand. It is a vegetative formation spread out in a narrow band parallel to the coast. Its general appearance is that of a thick mat barely 10 to 15 metres wide, in high scrub species and the tallest trees grow to a maximum of 10 metres. There is an abundance of coconut palms, survivors from former plantations, beach almonds (an exotic species that invades clearings) and two species of guabas make it apparent that this area was uniformly influenced by humans when the coconut plantations were created. The indicator species are *Chrysobalanus icaco*, *Coccoloba* spp. and *Ipomes prescarae*.

b) Dry soil (berm)

This is another type of coastal vegetation, limited to a narrow band of up to 100 metres wide all along the coast of the park, just behind the halophytic community. The berm can be considered a transitional stage between the halophytic community and the tall forests farther inland. The species that grow here are tolerant of an arid and sterile environment, slightly saline and beyond the tides and sea breezes. The response to these more favourable conditions of less direct influence of the sea is manifest in an important increase in the number of species and sizes in comparison to the previously described association.

c) Permeable and fertile soils

This area in the entisols is a rather large vegetative community, occupying a fifth of the park's area. It is a wide band that covers all of the eastern section parallel to the coast. The soils of this association are of alluvial origin, sandy and with very good internal drainage. A high content of organic material and a complete absence of influencing saline conditions are the main reasons that this forest community has a complexity and development much more accentuated than the nearby coastal associations. In this association, the forests resemble the prototype of a humid tropical forest: a large variety of large trees, an abundance of horizontal strata and thick and varied undergrowth. The most characteristic species of these forests are almendro de agua, cedro macho, cedro maria, fruta dorada, guatil colorado, lagarto, jobo, maquenque, peine de mico, querica and tabacón.

d) Very humid soil

This is a rather extensive association in the eastern central part of the area, between Lomas de Sierpe and the association of permeable soils. This association is subject to the periodical influence of prolonged freshwater flooding, but with significant decreases in soil saturation during the months of less rainfall. This type of vegetation is always found on the edge of well defined swamps. The outstanding detail of this forest is the abundance of small palms in the undergrowth. The most abundant species are aceituno, alcanfor, casoco de venado, cativo, gavilán, jorco, llancillo, maquenque, matecansado and palma real.

e) Marshes and floodable areas

These are found in limited patches along the areas of the previous associations, but the largest patches are along the edges of the canals and lakes in the area. These forests develop on ground with a high water table or where there is permanent direct contact with water.

These forests are like dense thickets, inhospitable and with an excessively humid environment. It is difficult to move about inside the forest. There are few species of trees and shrubs, but these species are represented by a large number of specimens of similar size and development compared to other associations. The

undergrowth is composed of shrubs of average height, with few branches and sparse foliage. A very noticeable characteristic is the abundant regeneration of species such as gavil n and cativo. The soils in this association are subject to saline conditions. A significant presence of sangrillo and little variety of species can be a clear response to this saline conditions.

The characteristic species of these forests of the swamps and the areas subject to flooding are alcanfor, cativo, cedro macho, gavilán, maria colorado, palma real, palo maria, pupumjoche, quercia, sangrillo, yolillo and a curious, strictly hydrophile shrub, plumón.

f) Yolillales

This area is located in large depressions in direct contact with the water table that are a sump for higher ground. Its soils are covered with water year-round. The yolillales develop on gley soils. They are communities dominated almost completely by yolillo, but other species of trees grow there under marginal conditions. The yolillales are important communities in the succession of lowlands in the Caribbean because they contribute to the stability of the flooded soil, over which grow other types of vegetation from higher ground. They also play a very important role in protecting fauna because a large number of species find refuge there. The yolillo is a pioneer species and invaders of ground subject to permanent flooding that eliminate all other types of vegetation. Contrary to most pioneer species, the yolillo is tolerant of shade. In any land flooded and without drainage, the yolillo will be the only successional stage over time.

g) Wet environments (Lomas de Sierpe)

The Lomas de Sierpe are in the west central part of this area, parallel to the coast. They are hills of volcanic origin of rather steep relief, shallow soils and an abundance of gullies and streams. They correspond to a very wet atmosphere because it is a mountainous area that is directly exposed to moisture-laden winds coming from the Caribbean. In addition to the normal rainfall, there is rain produced by orographic effects, the result of condensation of the moist winds on these mountains. Although there are no meterological records in this area, it is certain that rainfall is greater than in any other area. Excellent drainage that prevents the formation of swampy areas does not prevent the thin soil to be permanently saturated. Vegetation of the hills is influenced by excessive humidity, rapid drainage and thin soils.

The forests of Lomas de Sierpe are not structurally different from other similar associations, but they do have a different composition of flora. Palms are not common, not even in the undergrowth. The undergrowth does have abundant shrubs and grasses belonging to species, genera and botanical families not found in other parts of the area; for example, arborescent ferns, the white palm and several specie of very strange Anonacea. There is also a characteristic pattern in the trees, because they are very tall specimens, with species that apparently are found only in this association.

Among the most abundant species of trees are cedro macho, gavilán, jabillo negro, panam , raicilla, rama roja and vainillo.

h) Zonal or climatic associations (Mesetas de Agua Fría)

The area of Agua Fría is on the plateaus located to the west and south of Lomas de Sierpe. This is an important area, because it is representative of the very humid tropical forest. The determining factor for this vegetation is the climate, because the soils and drainage are not limiting factors to the development of the forest. The plateaus of Agua Fría have a general flat relief and a slight slope. In spite of their being formed by two types of very different soils (ultisols and entosols), the vegetation is the same throughout. The plateaus have a slight slope, which permits efficient and slow drainage.

Structurally, the forests on the plateaus resemble those of the very wet soil association, but the more humid conditions of this association, whose drainage is zero, are those marked by large differences of species of trees and shrubs present in each of them.

The characteristics of the forests of this climate association are those of a more complex vegetation. It is a forest with the greatest variety of species per area and where it is common to find truly giant trees, such as the gu cimo colorado and jabillo, with diameters greater than 3 metres. Nonetheless, they are open forests, but stratified and with a low and thick underbrush formed almost entirely by small palms of many species. An abundance of forms characterizes these forests, in spite of their not being the most complex in the area. Representative trees of this association are alcanfor, capulincillo, cuajada amarilla, garrocho, gavilán, guatil colorado, jabillo, maquenque, ocora, orejón, palma real and raicilla.

Minor associations

i) Dry soil (sandy sections)

In the sand strip, is the association along the coast of the ACTo, up to 100 metres in some places. This is an association of dry soils similar to that of the halophytes and berm, but the sandy strip is a stressed xerophytic environment, where very few plants are capable of surviving and growing. These are regosols. This association is influenced by the tide, soil permeability and a strong sea breeze.

The most characteristic plants of the sand strip are completely herbaceous. The most representative are churristante, frijol de playa, lirio de playa and several species of Gramineae. Sporadically, there are arboreal species such as almendro de playa, majagua, quesillo and uva de playa, growing completely isolated and to a height of less than 50 centimetres.

j) Grass marshes

The swamps are found primarily in the lower parts of the eastern side of this area. They grow on permanently humid entisols in the bottoms of broken gullies or depressions and areas of the backwaters of large rivers. They are dense communities of large monocotyledon herbaceous plants up to two metres high that grow on highly impermeable, dark and quite loose soils with a characteristic bad smell of the soils of all swamps.

The main species of plants growing in close association are gamalotillo, hoja de lapa, palma suita, platanilla, sagitaria and sajinillo. The noticeable absence of trees and large plants in these herbaceous swamps is probably caused by the instability of the soil and an unknown type of biological barrier.

k) Herbaceous communities along canals and lakes

This is found along the rivers, canals and lakes in ACTo, usually along the edges and in contact with another type of larger vegetation, usually swamps and yalillales. These are very homogeneous communities of vegetation formed almost completely by Gramineae which float in large, compact masses. These communities are the first step in a complex process of ecological succession that consists of the colonization of rivers and canals by forests. They are always accompanied by communities of herbaceous plants in a canal or river, a clear indication of sedimentation and that the water course is filling up.

The most abundant species in these associations are caña brava, choreja, helecho de estero, papiro and three species of Gramineae.