Working With Mangroves

An ITTO project addresses the conservation and management of Colombian mangrove swamps for multiple use and development

By Heliodoro Sánchez

National Project Coordinator, Ministerio del Medio Ambiente - ACOFORE, Bogota, Colombia; Fax 57–1 2432774; Email gdesanch@impsat.net.co

Dry mangrove forest on San Andres island. *Photo: C Prebble*

Mangrove forests are found along both the Caribbean and Pacific coastlines of Colombia. They are located in areas where annual rainfall ranges from 200 mm in the Department of Guajira on the Caribbean coast to 2000–6000 mm on the Pacific coast. Nine mangrove species have been identified in the country and generally these follow a zoning from the tidal line inland.

Since the middle of this century, mangrove forest logging has taken place in Colombia to supply products required for the construction of low-cost holiday homes, including rods, beams, props and poles, as well as for electricity posts and for fuel and charcoal. In addition, almost all the 'skeletons' of canoes in the coastal region are made from mangrove wood. Until a ban was imposed in 1978, on the Caribbean coast logging took place to supply wood chips for the production of particleboard, and from 1945 to 1975 trees were felled on the Pacific coast only to obtain bark for the extraction of tannin, while the wood was left behind in the forest.

Positive impacts that have led to the growth and expansion of mangrove ecosystems include allogenic successions resulting from the colonisation of areas exposed to tidal action, particularly in the accretion areas of some river deltas. One clear example of this is the old delta of the Sinú River on the Caribbean coast where large areas covered by rice crops were colonised by mangrove forests. These are now thriving due to the change of the course of the river. This and other similar examples illustrate the invasive and positive aggressiveness of mangroves.

The major anthropogenic stress factors for mangrove forests in Colombia include the processes of tourism expansion (see Box 1), land-use changes for agricultural purposes, civil engineering works, drainage and sewerage, the building of shrimp farms, industrial activities, disposal of industrial and domestic waste and the unsustainable harvesting of resources. These cause the degradation of hundreds of mangrove forest hectares, resulting in a loss of biomass, the disappearance of ecological niches, biodiversity reduction, the creation of salt flats, a reduction in tree size and vigour, sedimentation of water bodies, and a loss of beaches and coastline due to marine erosion.

The ITTO-funded project, 'Conservation and Management for Multiple Use and Development of Mangrove Swamps in Colombia' (PD 171/91) is working to address some of the above issues and their adverse effects. The project is being implemented by the Colombian Reforestation Association (Asociación Colombiana de Reforestadores) with the support of the Ministry for the Environment, together with a number of autonomous corporations.

Considering Alternatives

The project components include research, conservation, restoration, use, management and development of mangrove ecosystems in Colombia; the aim is to improve scientific knowledge in order to develop strategies for the mangroves in consonance with the national environmental management policy and the principles of sustainable development and community participation.

The main objectives of the project are:

- to strengthen the generation of socially and environmentally sound alternatives for the sustainable utilisation of mangrove forests, ensuring their conservation and preservation, and with the communities of the Colombian coastal regions as the prime beneficiaries; and
- to monitor and control salinity, water level and laminar flow parameters as the determining factors of mangrove forest health.

Box 1: Competing with Development

Off Colombia's north coast lies the archipelago of San Andres. The remit of the ITTO project extends to these Caribbean islands, where it is working in collaboration with CORALINA (Corporacion para el desarrollo sostenible del archipelago de San Andres, Providencia y Santa Catalina), the autonomous corporation with responsibility for the sustainable development of the islands, to preserve the mangroves.

The mangroves of the archipelago, and the coral reefs surrounding, are vital for the economic survival of the islands because they provide the breeding grounds and habitats for the fish and other fauna on which the local population depends for its livelihood. If the mangroves disappear, so too will its fauna. The entire mangrove area of the islands has been designated a regional national park which protects the pockets of mangrove forest existing on the three main islands of San Andres, Providencia and Santa Catalina. However, with a population of 100,000, growing annually at four per cent, the mangroves on San Andres particularly, are coming under increasing threat, as competition with the islands' main industry, tourism, intensifies.

In recent years, the mangroves have been depleted due to land clearing for new building developments, contamination with oil and hot water from an electric plant and, additionally, the destruction of nine hectares of forest in 1993 by fire; the mangroves have also suffered from water contamination as a result of uncontrolled sewage and waste disposal. CORALINA is making efforts to reverse such effects and, as an example, successfully closed down, temporarily, one hotel which had not complied with regulations requiring it to utilise a water treatment plant.

The project has assisted with the development of guidelines for the conservation of the mangroves, including the drawing up of maps and a land use plan. Efforts are being made to establish a community nursery and generally to raise awareness about the mangroves; CORALINA has constructed an interpretive pathway through the mangroves at Bahia Hooker-Honda to encourage local interest and to educate people about the life which mangroves sustain. However on these islands, where there are few commercial incentives to encourage mangrove conservation, such as the potential for timber harvesting, and where alternative employment opportunities exist, it is not always easy to persuade communities to become involved in the long-term preservation of the mangroves.

Phase I: Diagnosis

During Phase I of the project, a diagnosis of the current status of mangrove resources and a preliminary zoning of the mangrove forests in the Caribbean and Pacific coastal regions were carried out. Mapping activities on the Pacific coast were based on INTERA radar images taken in 1992 and traditional aerial photographs, while for the Caribbean coast 1991 and 1996 Lansat TM satellite images were used, in addition to aerial photographs.

Data were also recorded on forest structure, dynamics and composition, limiting factors, stress factors, and social and cultural aspects of the mangrove forests. The number of individuals per category and species was estimated for the various sampling sectors, as well as relative density, absolute and relative frequencies, basal area, and relative dominance and significance. Based on all this information, preliminary management units were proposed (Sánchez-Páez *et al*,1997a, 1997b).

The location and characterisation of mangrove areas for both coastal regions are reflected in the 24 1:100 000 scale maps which the project has produced. It was estimated, based on these maps, that in 1996 there were 379,954 ha of mangrove forests in the coastal regions of Colombia. These comprised 87,230 ha on the Caribbean coast, distributed along the sea and estuary coastlines of the nine departments of this region, and 292,724 ha distributed throughout the four departments of the Pacific coast region.

Out of the five species identified on the Caribbean coast, *Avicennia germinans* (black mangrove) and *Rhizophora mangle* (red mangrove) are the most commonly found and used, followed by *Laguncularia racemosa* (white mangrove), *Conocarpus erecta* (zaragoza mangrove) and *Pelliciera rhizophorae* (piñuelo mangrove). The latter is not well-known in the Caribbean region, there being records of individuals in only a few places. On the Pacific coast there is a predominance of *Rhizophora* spp. (*R. mangle*, *R. harrisonii* and *R. racemosa*), followed by *Pelliciera rhizophorae*, *Mora oleifera* (nato mangrove), *Avicennia germinans* and *Laguncularia racemosa*. The species *Conocarpus erecta* is scarce and only represented by a few isolated individuals.

A total of 35 management units were demarcated on the Pacific coast, comprising preservation areas (13), rehabilitation areas (8), multiple use areas (8), and production areas (6). Zoning in the Caribbean region provided for large areas for rehabilitation and preservation purposes, as well as for multiple use areas. Rehabilitation areas are characterised by a high degree of mangrove logging and degradation, coupled with intense or continuous stress factors. Supplementary information on the mangrove flora and fauna from the two regions was also produced by the project (Sánchez-Páez *et al*,1997a, 1997b).

In addition, a preliminary description of the social organisation of mangrove forest communities and the difficulties and problems they face has been completed; and some of the complex ethno-cultural relationships between the communities and their use of mangroves have been identified, including information about the species and products harvested, and their market prices.

Phase II: Mangrove dynamics

The outputs of Phase II of the project can be classified into the following five major areas:

(a) Growth dynamics and natural regeneration

A total of 25 permanent growth plots were established in the Caribbean region. The most significant annual diameter increments found were for *Avicennia germinans*, *Laguncularia racemosa*, and *Rhizophora mangle*. Natural regeneration rates were generally found to increase moving south-westward along the Caribbean coast, from the Department of Guajira in the far north-east of the country which had

Box 2: Pilot Project Plantations

Along the Colombian Caribbean coast, only the Department of Cordoba is currently permitted to exploit its mangroves for timber. A good relationship exists between the local government and communities and the people there have learned how to manage the forests sustainably. Elsewhere in the region, efforts are being made to educate communities so that they too understand the importance of the mangroves and the potential benefits that looking after them properly can bring.

An example of this is one of the pilot projects being supported by the ITTO project. The people of Pascaballos, near Cartagena in the Department of Bolivar, are extremely poor and the majority are unemployed. Under the leadership of their community representative, a nursery has been established to raise mangrove seedlings for replanting in surrounding areas. The members of this community are now actively involved in the nursery and plantation activities.

After nine to ten weeks' growth, seedlings from the nursery are ready to be transplanted; so far, 40 hectares have been replanted at two different sites. Tests are being carried out to determine the optimum spacing for seedlings in the plantations and measurements of dbh, height and the number of leaves are all being recorded. The pilot project has focused on using red mangrove (*Rhizophora* sp.), although in the two-year old plantation site at Bahia Barbacoa, white mangrove (*Laguncularia racemosa*) is now establishing itself naturally.

A wall of a building close to the mangrove nursery at Pascaballos, illustrating the community's interest in the pilot project. *Photo: C Prebble*

The aim is that eventually it will be possible to utilise these mangrove plantations for legal exploitation, but this will depend on the community developing a sound management plan and establishing strong links with local industry to confirm that there will be a continued demand for the timber. Such an arrangement would be mutually beneficial as the timber would be supplied at a reasonable price and the community would be guaranteed work. The main job now is to ensure that the community members have sufficient knowledge to be able to continue on their own what has been started by the project.

very low rates, through the Departments of Magdalena and Bolivar where rates gradually increased, to the north-west Department of Cordoba, which had the highest rates; the abundant fructification of *Laguncularia racemosa* being the determining factor.

In the Pacific region, 27 permanent growth plots were established. In general, the most representative species in these plots was found to be *Rhizophora mangle*. In only seven months of data recording, it was determined that significant differences in the availability of *Rhizophora* spp. propagules were directly related to the seasonal fructification of this species. Seedling establishment and recruitment seemed to be more related to the presence of mature trees and, in general, this species showed a sharp decrease in seedling establishment coinciding with the most intensive rainy season in the region.

(b) Ecosystem rehabilitation

The results obtained from two rehabilitation plots in the Caribbean region have shown *Rhizophora mangle* seedling survival rates of 100 per cent and 81 per cent in nursery, and 87 per cent and 95 per cent in plantation, respectively; in another plot, 67 per cent survival was recorded for direct seeding of propagules. Generally nursery seedlings showed better development after transplanting than the plants obtained through direct seeding.

In the Pacific region, tests with nursery-produced plant material also showed more positive results than those using direct seeding methods, with survival rates of 94 per cent and 84 per cent, respectively, for *Rhizophora mangle* which performed better than the other three species tested.

(c) Establishment of temporary nurseries

In the Caribbean region, five temporary community nurseries were established, together covering a total area of 5.2 ha for about 78,000 seedlings. The production of seedlings suitable for transplanting takes up to 75 days. All these nurseries have already had two production cycles with very good results.

On the Pacific coast, three previously built nurseries were refurbished and two new nurseries were built which were located near the marsh areas to facilitate irrigation and transplanting activities.

(d) Monitoring of water in the mangrove areas

The results obtained from 19 water monitoring stations located within the permanent growth and rehabilitation plots in the Caribbean region indicated that, due to water flow deficiencies and overexposure to light resulting from a lack of vegetation, in some internal or flood waters there was a warming tendency, with extreme temperatures of 40º C. During the sampling periods at most other stations, internal waters showed more favourable conditions and non-critical levels, with temperatures averaging 29.8º C. The pH levels observed were normal. Salt concentrations in mangrove waters varied according to the location, with significant increases evident during drought periods and decreases during the rainy season. In several stations of this region, salinity levels have been

recorded that may be critical to mangrove development.

On the Pacific coast, the 16 monitoring stations in the region indicated that inter-tidal waters in the mangrove forests show variations in salinity and oxygen levels measured, depending on whether there is high or low tide, and the influence of the sea and rivers and the location of the station. In general, temperature and pH level variability was much lower. The sharpest difference in average values was recorded for surface waters. Based on these findings, the Pacific mangrove forests should have adequate conditions for development.

(e) Development of pilot production projects

Four pilot production projects have been developed in areas of the Caribbean region where the major economic activity has been mangrove product harvesting. After being trained in mangrove nursery and rehabilitation activities, local communities submitted proposals for the restoration of mangrove areas and these proposals have been technically and financially supported by the project.

The pilot projects which have been implemented to date have resulted in the planting of 40 ha with *Rhizophora mangle* on degraded lands and alluvial flats in the Canal de Dique, near Cartagena (see Box 2), with plans for the planting of an additional 50 ha. Another pilot project aims to open up sedimented channels in order to restore the water dynamics, and thus the fish resource, to mangrove areas.

Similarly, three projects have been developed for the Pacific coast. One is focused on the farming of the fish species *Mugil curema*, using the mangrove swamps; another, implemented by the Charcoal and Fuelwood Producers Association of Tumaco, involves the farming and non-industrial harvesting of shrimp; the third project involves the establishment of food crops by the local communities to provide an alternative for those previously involved in forest logging.

Partial results of this second phase of the project have been widely distributed (Bravo-Pazmiño 1998, Guevara 1998, Ulloa *et al* 1998). In cooperation with the local communities, manuals have been designed and produced for mangrove rehabilitation and forest dynamics studies.

Benefits of the Participatory Approach

The information collected by the project has been disseminated at all levels and has been found to be very useful for natural resource administration agencies and for the communities living in mangrove forests or neighbouring areas. A particularly significant project output has been the ethnographic information on the communities in the Colombian Pacific mangrove areas, including references to social and cultural diversity and traditional activities carried out by black and indigenous communities in relation to mangrove ecosystems.

It is important to stress the receptiveness of the communities to the project activities and the raised level of awareness generally in the country, regarding the need for sustainable management and mangrove rehabilitation. The experiences of the pilot production projects are helping to encourage a diversification of activities in the areas where these ecosystems are found. This has particularly benefited the local communities in the search for socially and environmentally sound alternatives for mangrove utilisation. In order to strengthen local organisations, these communities have been trained in environmental education issues and in the revival of ancestral knowledge regarding mangrove forest harvesting.

Two-year old plantation of *Rhizophora mangle* in the Canal de Dique, near Cartagena. *Photo: C Prebble.*

The following publications, as well as 19 technical and promotional documents on the activities of the project, have been published and a specialised mangrove ecosystem documentation centre has been established, including a bibliographic database containing 800 research papers:

Bravo-Pazmiño, H. 1998. Diversidad Cultural y los Manglares del Pacífico de Colombia. In: Sánchez Páez, H. and Alvarez R. (eds). Santa Fe de Bogotá DC. Ministry for the Environment, ACOFORE, ITTO.

Guevara O, Sánchez H, Murcia G, Bravo H, Pinto F. and Alvarez, R. 1998. Conservación y Uso sostenible de los Manglares del Pacífico colombiano. In: Sánchez, H, Guevara, O, and Alvarez, R. (eds). Ministry for the Environment, ACOFORE, ITTO, Santa Fe de Bogotá DC.

Sánchez-Páez, H, Alvarez-León, R, Pinto-Nolla, F, Sánchez-Alferez, A S, Pino-Renjifo, J C, Acosta-Peñaloza, M T, and Garcia-Hansen, I. 1997a. Diagnóstico y Zonificación Preliminar de los manglares del Caribe de Colombia. MINAMBIENTE/ ITTO. Santa Fe de Bogotá DC.

Sánchez-Páez, H, Alvarez-León, R, Guevara-Mancera, O, Zamora-Guzman, A, Rodríguez-Cruz, H and Bravo-Pazmiño, H. 1997b. Diagnóstico y Zonificación Preliminar de los manglares del Pacífico de Colombia. MINAMBIENTE/ITTO. Santa Fe de Bogotá DC.

Ulloa, G, Sánchez, H, Rodríguez, H, Gil, W, Pino, J C and Alvarez, R. 1998. Conservación y Uso Sostenible de los Manglares del Caribe colombiano. In: Sánchez, H, Ulloa, G and Alvarez, R. (eds). Ministry for the Environment, ACOFORE, ITTO, Santa Fe de Bogotá, DC. ■