# Wetlands Management in the Caribbean and the Role of Forestry and Wetlands in the Economy

## Proceedings of the Fifth Meeting of Caribbean Foresters at Trinidad, and the First Meeting of Ministers of Agriculture to Consider the Economic Role of Forestry at Saint Lucia

A publication of The Institute of Tropical Forestry and the Caribbean National Forest, Rio Piedras, Puerto Rico

United States Department of Agriculture

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The Fifth Meeting of Caribbean Foresters was dedicated to Gabriel Charles, the recently retired Forest Supervisor for Saint Lucia who, among many claims to fame in the Caribbean and in Saint Lucia, was the originator of the biannual meetings of Caribbean foresters. The picture shows the moment of the banquet when Gabriel received a plaque from Ariel E. Lugo, who presented the memento on behalf of all Caribbean foresters.

*Cover: A lacrimitic wetland in Guadeloupe. This is an herbaceous wetland that occurs on the rocky surfaces by waterfalls. Its curious habitat illustrates the enormous diversity of wetland types in the Caribbean islands (photo A.E. Lugo).*

# WETLANDS MANAGEMENT IN THE CARIBBEAN AND THE ROLE OF FORESTRY AND WETLANDS IN THE ECONOMY

Proceedings of the Fifth Meeting of Caribbean Foresters at Trinidad, and the First Meeting of Ministers of Agriculture to Consider the Economic Role of Forestry at Saint Lucia

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Preface

This publication contains the proceedings of the fifth meeting of Caribbean Foresters, held in Trinidad, and a record of the first meeting of Ministers of Agriculture, held in Saint Lucia. It is appropriate to combine the documentation of these two meetings because it was by initiative of the Caribbean foresters that the impetus to have a meeting of Agriculture Ministers was generated. The publication has three sections: 1) a listing of findings and recommendations and resolutions of the two meetings, 2) a section on contributed papers to the meetings, and 3) a section with appendices and list of participants. The Caribbean foresters meetings usually follow a theme approach (in this case management of wetlands) while the ministers met in Saint Lucia to take a broad view of forestry and its role in the economic development of the region. Both subjects are of great importance to island development. We feel it is very important to present them together, even if the contents of the publication may appear mix to critical readers. We have done our best to make the presentation as clear as possible. We call your attention to the first section where we present the results of the vigorous discussions that took place in both meetings. We are convinced tha the greatest value of these periodic workshops and meetings of forestry and agriculture officials is the nature of the dialogue that takes place. The statements in the first section of this publication contain a wealth of ideas, statements of alarm, and concrete recommendations that should be seriously considered by anyone interested in the sustainable development of the lovely islands of the Caribbean.

Ariel E. Lugo and Bruce Bayle
Río Piedras, September 22, 1991

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CONTENTS

# Part I - Summaries, Recommendations, and Resolutions

*Avicennia germinans*

# OVERVIEW COMMENTS
# FIFTH CARIBBEAN FORESTERS MEETING

*Ariel E. Lugo and Bruce Bayle*

The fifth Caribbean Forester's conference convened in Port-of-Spain, Trinidad, from May 21 to 26, to discuss critical issues relating to the management of wetland ecosystems on 12 different islands. Wetlands, unfortunately, have become prime areas for dumping of wastes, including toxic chemicals, as well as favored areas for landfill operations, some aimed ultimately at conversion of the areas to suburban and industrial development.

One major concern of the participants of the conference was the lack of understanding often demonstrated by the public and governments, in particular political elements, with regard to the biological and economic value of wetlands. This lack of understanding has resulted in their destruction at an alarming rate throughout the Caribbean region. The participants felt that there was an urgent need to identify leaders within resource agencies willing and capable of making political contacts to foster public awareness, interest, and involvement in the management of wetlands.

The participants also saw a need for the establishment of resource policy specifically addressing the wetlands in which their management was undertaken in conjunction with management planning throughout the respective islands. Government and public agencies need to inventory wetland areas, designate core areas that serve as habitat for rare or threatened plants and animal populations, and formulate management plans for their protection and wise use. Integration and coordination among the various public resource agencies and private entities was viewed as imperative to assure wise use of wetlands.

It was recognized that pressures to use wetlands for landfills, refuse dumping, or suburban developments would always constitute a threat to their integrity. The participants, therefore, strongly urged that any proposed use of wetlands be preceded by the drafting of environmental analyses to fully outline all of the impacts of a proposed development. The analyses, in turn, would be reviewed and criticized by the public, and by public resource agencies involved in the protection of natural resources. Planning for the modification of wetlands and other natural resources would obligate competent technical personnel in the resource agencies to state their professional concerns regarding proposed development schemes and to propose changes in development plans that would protect the resources in question.

Uncontrolled activity, haphazard development, the private use of public resources, and the lack of adequate legal framework were all seen as detrimental to the conservation and wise use of wetland resources. It is incomprehensible how a handful of private individuals with absolutely no concern for the welfare of the respective island countries can personally use, degrade, and benefit from the nation's heritage at the expense of fellow citizens. Whereas controlled use on a sustained basis would provide many of the same benefits continuously. Education of the public was seen as an urgent concern, especially education of political leaders who only too often view conservation of natural resources as the antithesis of sustained development.

The participants viewed wetland conservation on small islands as particularly important because their total area is often very limited and especially prone to destruction. The participants also considered natural resources as grossly undervalued. What took natural forces millennia to create, humans can destroy in a very short time. Permits to operate concessions in wetlands were seen as essential. Income from user fees would be earmarked for management activities, one means to foster better resource use.

The global and historical perspective of wetlands were two other points addressed by the conference participants. Many migratory waterfowl are dependent on wetlands throughout the region on their flights from one continent to another. Moreover, early cultures in the Caribbean developed in close harmony with mangrove wetlands. The need to protect areas, inventory waterfowl, monitor the impacts of activities elsewhere in the watersheds, and to provide this information to concerned resource managers was highlighted.

## RESOLUTION TO MEETING OF MINISTERS RESPONSIBLE FOR FORESTRY OF THE CARIBBEAN BASIN COUNTRIES

Castries, St. Lucia
July 1990

Recognizing:

- the fragility of Caribbean island ecosystems are continuously neglected with greater focus always being placed on continental tropical forests;

- the increasing destruction of forestry, coastal, and marine environments with consequent loss or endangering of species of indigenous plants and animals;

- the decline of agricultural production;

- the dangers posed to unique ecological systems by poor land use decisions such as, ill-planned development of airports, ports, marinas, highways, and other roads, housing, hotels, solid waste dumps, and landfills; sand mining; and misuse of prime agricultural land;

- the threats on the natural and human environments from industrial pollution, fertilizers, and pesticides used in agriculture;

- the damage to wetlands and lower watersheds caused by destruction of vegetation in upper watersheds due to uncontrolled fires, quarrying activities, squatting, slash and burn agriculture, and other unsound agricultural practices;

- the ill-effects of the overharvesting of plant, wildlife, fish, invertebrates, and other resources of wetlands and forests;

- the shortage of trained forest resource personnel in countries of the Caribbean Basin;

and recognizing:

- the need for a better educated public in the values of forestry and other natural renewable resources in sustainable development (including tourism development);

- the need for better coordination and collaboration between public and private sector agencies involved in natural resource management;

- the value of the Tropical Forestry Action Plan as a unique, vital strategy for forestry conservation and development; and

- the need to give the highest priority to the reversal of the present trend of deforestation.

The fifth Caribbean foresters meeting recommends that the Ministers responsible for forestry of the Caribbean Basin:

- support and ensure that their countries participate fully in the Tropical Forestry Action Plan;

- endorse the recommendation for the creation of the International Institute of Forestry and the Environment at the St. Augustine Campus of the University of the West Indies;

- endorse the strengthening of regional and national forestry institutions and infrastructure to ensure sustainable and optimum development of forestry and other natural resources, including restoration of damaged watersheds and endangered species habitats (including wetlands);

•consider the establishment of a Regional and/or a Sub Regional Forest Service;

•endorse the continuation of the periodic meetings of Caribbean Foresters;

•consider the expansion of forestry through the adquisition of and/or legislation to ensure wise use of private lands in critical watersheds; and

•ensure the development and implementation, as a matter of urgency, of comprehensive environmental education programs to reach citizens of all ages and walks of life (kindergarten, primary, secondary, and tertiary school students; planners; technocrats; politicians, etc.).

## RECOMMENDED ACTION ITEMS FOR WETLAND MANAGEMENT IN THE CARIBBEAN

1. Clarify or help establish the legal framework for protection and management of wetlands:

   a. Integrate and coordinate the various agencies with jurisdiction over wetlands, consider opportunities for agency consolidations.

   b. Declare wetlands as special management areas, clearly define and inventory wetlands areas.

   c. Identify areas of priority that should escape development, those to be preserved (i.e., critical habitats and unique biodiversity), and identify core and multiple use areas.

   d. Require environmental assessments (an integrated approach) for island development projects, involve interested publics from the beginning of proposed developmental projects.

   e. Reinforce island and regional resource management institutions in the enforcement of laws and land use policies.

   f. Clearly define agency responsibilities with respect to the various aspects of wetlands management including fish, salt water, fresh water, trees, soil, air, marine life, toxic wastes, sewage, etc.,

   g. Modify existing international standards/ conventions (treaties, agreements, programs, etc.) to island standards and conditions.

2. Educate governmental leaders, politicians, agency heads, and the general public on the following:

   a. Values and services of wetlands (market values).

   b. Non-market values of wetlands including social values of wetlands.

   c. Cost-benefit analyses to evaluate wetlands development proposals.

   d. Create a regional wetlands management publication.

   e. Establish a human resource bank of wetlands area specialists for the region.

   f. The types of technologies to be used in and near wetlands areas.

   g. The distinction between coastal and upland wetland areas.

   h. Development planning with an environmental component.

   l. Seek out NGO's, PVO's (local, regional, and international), and informed volunteers to work with natural resource agencies to analyze wetlands area issues, including preservation and development alternatives,

   m. Promote trust and understanding between all parties involved in wetlands management issues,

   n. Increase the emphasis of formal training of government natural resource managers in the area of wetlands management and in non-traditional subject areas such as conflict resolution.

3. Inform people of the dangers of using wetlands as landfills:

   a. Dangers of toxic chemicals, including it's threat, to plant, animal, and human health.

b. Wetlands destruction can result in: groundwater contamination, loss of groundwater recharge capacity, loss of biological diversity, loss of habitat for marine nurseries and feeding grounds, and have impacts on other ecosystems.

4. Alternatives for garbage disposal must be developed in order to protect wetlands, land, and water resources.

5. Create and establish mitigating measures for the rehabilitation and regeneration of damaged wetlands. These actions should restore part of the informal economy (income and jobs) lost with the loss of the ecosystem.

6. Promote the wise use of mangroves in a "modern" context:

   a. Low impact aquaculture (shrimps, oysters, clams, etc.)

   b. Tourism opportunities, such as the successful Scarlet ibis viewing trips into the Caroni Swamp, Trinidad as seen by workshop participants. This should be done through management systems specially designated for the use without destruction of wetlands values.

7. Be innovative in resolving wetlands conflicts - lease/purchase accord with private owners, tax relief, tax incentives, user fees for wetlands use (based on a permit system), earmark those user fees for wetlands management programs, international debt-for-nature swaps.

8. Encourage traditional/non-consumptive uses of mangrove forests, i.e., shrimping, fishing, tourism, etc.

9. These initiatives are expected to enhance the assistance and trust between islands.

10. Creation of island technical committees within resource management agencies (a cross section of agencies) to advise and present issues to agency leaders involving wetlands management.

## RECOMMENDATIONS MADE AT THE AGRICULTURAL MINISTERS MEETING ON THE FORESTRY SECTOR

Castries, St. Lucia
July 5 and 6, 1990

Main recommendations made by the entirety of the delegates present at the meeting:

1. Too much jurisdiction of government agencies over natural resources, better coordination is needed.
2. Must incorporate environmental costs at the planning stage of projects.
3. Need to prioritize land uses.
4. Mechanisms are needed to keep tourist dollars "at home".
5. Must maximize the quality of life, without resource degradation.
6. We are using nonrenewable resources, they must be appraised (valued) appropriately.
7. "Suicidal" political decisions are needed.
8. We need to rescue and conserve traditional knowledge, and/or indigenous understanding of the natural resources, this information is being lost in our modern society.
9. Must increase public awareness of forestry issues.
10. Must increase communication and exchange of ideas between island forestry departments.
11. The OECS must incorporate natural resources management in its deliberations.
12. Need to enforce existing legislation.

The following section contains the specific discussion points of each of the above twelve recommendations:

1. Too much jurisdiction of government agencies over natural resources, better coordination needed (see the related Point 11).

   a. To coordinate and list all ongoing natural resource management activities in the wider Caribbean area and capitalize on them.

   b. The forestry sector is not consulted (input lacking) in national environmental planning and in important development actions.

   c. Forestry information gathering and the dissemination of that information is lacking in the Caribbean. The Caribbean Foresters newsletter will attempt to overcome part of this issue.

   d. Land use management and the integration of land use information dissemination is often lacking. Clearinghouse efforts and official networking are lacking in the Caribbean. The question is often asked - "What are other people doing in this particular area?" There is a repetition of the same sort of studies (going round in circles).

   e. Local coordination of forestry activities and development is not functioning in many countries.

   f. Committees aren't working because ministry personnel already have a lot of work to do.

   g. Forestry becomes a sub-sector or left out altogether from land use decisions.

   h. Regular meetings of senior forestry officials and their departments need to regularly meet, especially OECS countries.

i. The need to approach forestry as a small island/OECS issue. A question of "smallness" concerning OECS countries is involved.

j. We need to reconcile the "two camps"-forestry and natural resources.

k. In discussion, often, times forestry is left out of the wider field of the environment.

l. There is a lack of long-term financial and human needs commitment in the forestry sector in the Caribbean.

2. To incorporate environmental costs at the planning stage of projects.

   a. Incorporate environmental costs at the planning stage, there are environmental costs that translate later into economic costs.

   b. Raise environmental concerns at the planning stage of projects.

   c. Need to identify issues in the planning process.

   d. The above three issues show that better and REAL environmental planning is needed.

   e. The planners need local input into development assessments.

   f. Better informed environmental decisions are needed.

   g. When large and costly projects are proposed, we need equally sophisticated environmental assessments.

   h. "Environmentalists" need to be more rational/objective in their assessments.

3. To prioritize the use of the land.

   a. No practical land-use plan exists for the agricultural sector.

   b. Difficult political land-use decisions.

   c. We need to do land-use planning on a watershed basis.

   d. We need a holistic approach in land use planning, we need to look at population, food, water, monetary costs, etc.

   e. To determine optimal land use, land capability maps are needed.

   f. Rationalize instead of optimize land uses.

   g. Complete a land-use plan for the Eastern Caribbean, homogenize inter-island land classifications.

   h. Don't take the "do nothing" alternative with regards to land allocation.

   i. The problem of intra family land subdivision is making sustainable agriculture more difficult, agriculture becomes uneconomic.

4. Mechanisms needed to keep tourist dollars "at home"

   a. The issue of 80 percent of the tourist dollars leaving the islands needs to be addressed in a positive nature.

   b. The need to move from a 80/20 split (dollars exported/dollars staying on the island) to perhaps a 50/50 split. A strategic plan is needed in this area.

   c. A matter of local tax structures, do they need to be changed?

   d. The charging for use of nature guides.

   e. Charge for the use of public recreation facilities.

   f. The money collected from recreation use fees needs to be returned (or stay with) the local forestry agencies.

g. Local ownership doesn't necessarily mean the tourist receipts will stay at home.

h. Tourists want to see and/or use the same amenities they left at home.

5. To maximize the quality of life, without resource degradation.

   a. Estimate carrying capacities for protected areas to avoid resource degradation.

   b. Coral reef nature trails are being destroyed by the visitors that we are trying to attract.

   c. Monitor the resources in protected areas, that requires proper staffing of natural resource departments/agencies.

6. We are using nonrenewable resources, they must be appraised (valued) appropriately.

   a. Tourism developments - being constructed at the expense of agricultural developments.

   b. The need to serve local foods at tourist hotels, in lieu of imported foods.

   c. Encourage local hotel operators/entrepreneurs.

   d. We begin to talk more of people management and less with regards to forest/natural resource management.

   e. Tourism is currently directed to the perimeter of our islands and not to the interior.

   f. If we invite tourists to the interior portions of our islands, how do we house them there?

   g. Develop parks to move people to the mountains, to encourage tourists staying in the interior, to increase the overall time spent in the country. Gains would be accruing to the local populations, for example - craft shops, tour guides, park employees, etc.

7. Suicidal political decisions

   a. There was a general consensus to maintain existing forest reserves.

   b. This issue ties back to issue number 2, politicians need to be provided with the "true" facts.

   c. Politicians need to be well prepared by their respective forestry departments on forestry issues.

   d. At regional higher learning institutions better training is needed to teach people evaluate the costs to the environment of different development proposals that impact natural resources.

   e. Some protected areas need to be placed into the hands of island based "trusts" or other nongovernmental institutions.

   f. The Nature Conservancy has become a custodian of certain protected lands within the Caribbean area.

   g. Tax incentives are needed to encourage people, where appropriate, to put certain sensitive lands into trusts.

   h. NGO's are as well qualified as many governmental agencies to manage some protected lands.

8. To rescue and conserve traditional knowledge, and/or indigenous understanding of the natural resources is being lost in our modern society.

   a. The Union Forestry Center, Saint Lucia, contains an excellent herb and medicinal garden.

   b. This traditional knowledge needs to be preserved for the benefit of the people within and without the Caribbean area.

   c. The goal of this program should be to conduct, save, and share "traditional" knowledge.

d. Natural products and herbal remedies are part of the Tropical Forestry Action Plan (TFAP) for the eastern Caribbean.

c. Much traditional knowledge/products will be needed for future utilization.

f. Included are traditional agroforestry techniques.

g. Increased research is needed in this area.

9. To increase public awareness of forestry issues.

a. Number one priority - environmental education.

b. Strengthen public awareness, especially concerning forestry issues.

c. Attach a "public relations" person to each island forestry department.

10. To increase communication and exchange of ideas between island forestry departments.

a. Communications and the flow of ideas between island forestry departments need to be increased.

b. The Caribbean foresters meeting held every two years is an excellent vehicle for the exchange of ideas.

c. OECS workshops and other regional workshops all help in the exchange of forestry information.

d. The need for good communications in this area needs to be addressed by the TFAP.

e. Better utilize existing information networks.

11. The OECS and natural resources management.

a. The Agricultural Ministers Meeting on the Forestry Sector needs to become a regular OECS meeting.

b. Incorporate discussions on the forestry sector within regularly scheduled OECS Agricultural or Ministerial meetings.

c. What role will the OECS play in the forestry sector?

d. Is a forestry desk at the OECS needed?

e. To try and minimize costs, the OECS tries to group natural resource issues.

f. OECS perspective - work within the TFAP.

g. What role will the OECS play in the TFAP?

h. How is the natural resources unit at the OECS linking with the TFAP?

12. To enforce existing legislation.

This topic generated little new discussion, the main feeling was that a lot of good legislation exists within each country. It was felt that weak or nonexistent enforcement was the problem and not so much that new legislation is needed. Although there are areas where new legislation dealing with the forestry sector is needed, this was of secondary importance to the nonenforcement of existing legislation.

# Part II - Contributed Papers

*Laguncularia racemosa*

## OPENING REMARKS

*Winston Ruddet*

Mr. Chairman, Ladies and Gentlemen:

I am indeed both honored and pleased to address a few remarks to you at this the opening of the fifth meeting of Caribbean Foresters.

Firstly, may I on behalf of the Government of Trinidad and Tobago extend a warm and cordial welcome to our colleagues and friends from abroad. I sincerely hope that you will not only be made to focus on the wood and the trees but will also seize the opportunity to enjoy other aspects of the environment here in Trinidad and Tobago-that is, social and cultural aspects as well.

We are particularly happy to know that participation at this meeting extends beyond our traditional Caricom neighbors and includes also Martinique, Guadeloupe, Puerto Rico, Venezuela, and the USA. The nature of the issues engaging your attention calls for this wider involvement.

We note that since 1982, foresters from 14 Caribbean nations have been meeting biennially to discuss natural resource management issues, provide direction and inputs for the development of these resources, formulate recommendations for government action, and maintain critical communication links among their forestry peers within the region. The U.S. Forest Service and U.S. AID must be commended for playing the role of lead agencies from the very inception and taking responsibility for organizing and conducting the meetings. For these occasions serve as the only forum for Caribbean foresters to meet on a periodic basis to intellectually refresh themselves and chart the course for future action. You all are to be congratulated on the formation of the Association of Caribbean Foresters.

In your short history, you have done much to focus on issues of critical importance to development in our countries. This is reflected in the themes of previous meetings: forestry management (Saint Lucia,1982); watershed management (Saint Vincent, 1984); recreation management (Guadeloupe, 1986); and wildlife management (Dominica, 1988).

The theme of this your fifth meeting, wetland management and conservation, is both relevant and timely. In fact, it is important that foresters of the region continue to expand the scope and focus of their concerns away from mere cellulose farming and take on board the wider issue of natural resource management and protection.

We island peoples of the Caribbean are essentially coastal peoples. There are growing demands on the limited land space to accommodate rapid urbanization and industrialization and locate tourism plant. Very predictably, many of these activities are concentrated along the coast. The development of ports, recreational, settlement, and industrial infrastructure in the fragile coastal zone areas impose severe strains on the environment management capacity required to mitigate impact on our natural resources and the marine resources in particular. We stand to deplete the very resources which are the basis of our attraction and comparative advantage and which hold so much potential for development.

Environmental mismanagement of land has led to the destruction of wetlands, estuaries, beaches, coral reefs, and the nearby seas. This has resulted in the elimination of fish and wildlife habitat and depletion of their populations. Small island ecosystems are very vulnerable to disturbance and exploitation. Our coral reefs in particular are susceptible to irreversible damage.

We accept that environmental boundaries are not sharp lines but zones of transition. Accordingly, coastal and inland areas and the nearby seas must be managed together, for the way we manage our land resources has decisive influence on the marine environment. It remains a source of concern that there still seems to be a pervasive view that our wetland

areas are useless areas which are available for reclamation for more "productive purposes" such as agriculture, industry, or settlements. The fact is that they are reservoirs of rich biological diversity, play a vital role in our sea defence system protecting the coastal region from storm surges, and are an important source of food for fish and marine life, waterfowl and marshland animals. They also figure in the natural cycling of chemical and biological material.

The value of wetlands to local communities as a resource is grossly underestimated. Conservation and management of these areas should start from a recognition of the great variety of human activities which already depend on them. Equally important too, are the potential opportunities for real economic benefit through nature or ecotourism where the interests are on the flora, fauna, and ecology of these areas, including birdwatching.

Building developments are irreversible and reduce the continuing stream of benefits which these areas, well managed, can provide into perpetuity. Therefore, decisions made in this regard must be very deliberate and based on the fullest understanding of the costs and benefits involved—both tangible and intangible. There needs to be a balancing of interests not only in respect of the current uses to which these resources should be put, but as between the present and the future.

We in the Ministry of the Environment and National Service are charged *inter alia* with the responsibility for ecological environment, resource management, and control. Our professional staff within the Forestry Division of the Ministry and its affiliate organization— the Institute of Marine Affairs—have been working assiduously on some of the technical issues related to wetland management. Indeed, in this regard, there has been some collaborative, scientific work on the mangrove between scientists of Venezuela and Trinidad and Tobago.

We look forward to the continued cooperation and technical exchange on this and allied areas of national and regional interest. I would urge that your meeting present findings and conclusions of existing technical work which may form the basis for action-oriented programmes focussing on the enhanced protection and management of our wetland areas.

It is in the enlightened self-interest of the coastal states of the Caribbean to be very concerned abut this matter having regard to the implications for us of global warming, climate change, and sea level rise. In this context, and arising out of our participation in the Small States Conference on Sea Level Rise in Republic of Maldives in November 1989, the Government of Trinidad and Tobago has agreed that a programme for management and conservation of mangrove areas be developed.

Other current initiatives of relevance include collaboration with FAO in the development of appropriate forestry development programmes and projects within the framework of the Tropical Forestry Action Plan and the preparation of a national conservation strategy with the involvement of the International Union for Conservation of Nature and Natural Resources (IUCN).

And so chairman, ladies and gentlemen, it is with more than a little self-interest that we of the Ministry of the Environment and National Service and indeed the government of Trinidad and Tobago are indeed very pleased to host this your fifth meeting. The theme has much significance for us. It only remains for me to wish that you have a very productive meeting and to hope that the cooperation amongst our Caribbean foresters which had its tentative beginnings in Saint Lucia in 1982, will develop and rebound to the benefit of our people. They deserve it!

Finally, Mr. Chairman, may I suggest that as natural resource managers you examine ways and means of strengthening institutional linkages amongst yourselves and with other natural resource managers. This may point the way for opportunities to develop the human resources capacity and capability within the region for dealing with the issues on your agenda. I thank you!

# PROGRAMMES, OPPORTUNITIES AND PROBLEMS FACING WETLAND MANAGEMENT IN ANTIGUA AND BARBUDA

*Everette Williams*

## *Introduction*

The state of Antigua and Barbuda is situated at a latitude range of 17°00' to 17°10'N, and a longitude range of 61°40' to 61°54'W. This country, which is located in the Leeward Chain of the eastern Caribbean, consist of a total area of 425 $km^2$ (Antigua being the largest with 270 $km^2$, Barbuda 155 $km^2$). Antigua and Barbuda are relatively flat islands with an altitude range of 0 to 405 m (0 to 1330 ft).

Because of its location, topography, and rapid deforestation, which took place during the colonial sugar and cotton era (on which Antigua and Barbuda's economy was mainly based) the country receives on average only 1143 mm (45 inches) of rain per annum. When compared to other Caribbean neighbors, such as those in the Windward Chain, Antigua, and Barbuda's rainfall supply seems trivial. Rainfall amounts, along with topography, soil type (limestone karst in most parts) justifies why Antigua and Barbuda have no perennial rivers.

During periods of heavy rainstorms, most of the runoff occurs via ephemeral streams to over 500 farm ponds, 17 medium- to large-size dams, and also to saltponds and swamplands located around coastal plains—where most of the countries wetlands are found.

This paper addresses the opportunities and problems which face wetland management in Antigua and Barbuda. Most of the information stated is applicable to Antigua, the largest and most developed of these two eastern Caribbean islands. The existing pressures placed on Barbuda lands are of a lesser magnitude than those experienced on Antigua. As a result, most of Barbuda continues to exist in its natural state and supports a larger diversity of fauna, which is unique to the eastern Caribbean.

## *Wetland Programmes*

Presently, the forestry sector, which is under the portfolio of the Ministry of Agriculture, Fisheries, Lands, and Housing, is undergoing development. The present operational staff consist of one sub-professional, one recalled retired forestry personnel and 5 forest rangers. Two other officers are currently undergoing training in forestry disciplines one at the degree level in Canada and the other at the diploma level at E.C.I.A.F in Trinidad). Because of major constraints, such as understanding, and limited legal powers, the forestry sector has not developed programmes designed for the management of wetland ecosystems in Antigua and Barbuda.

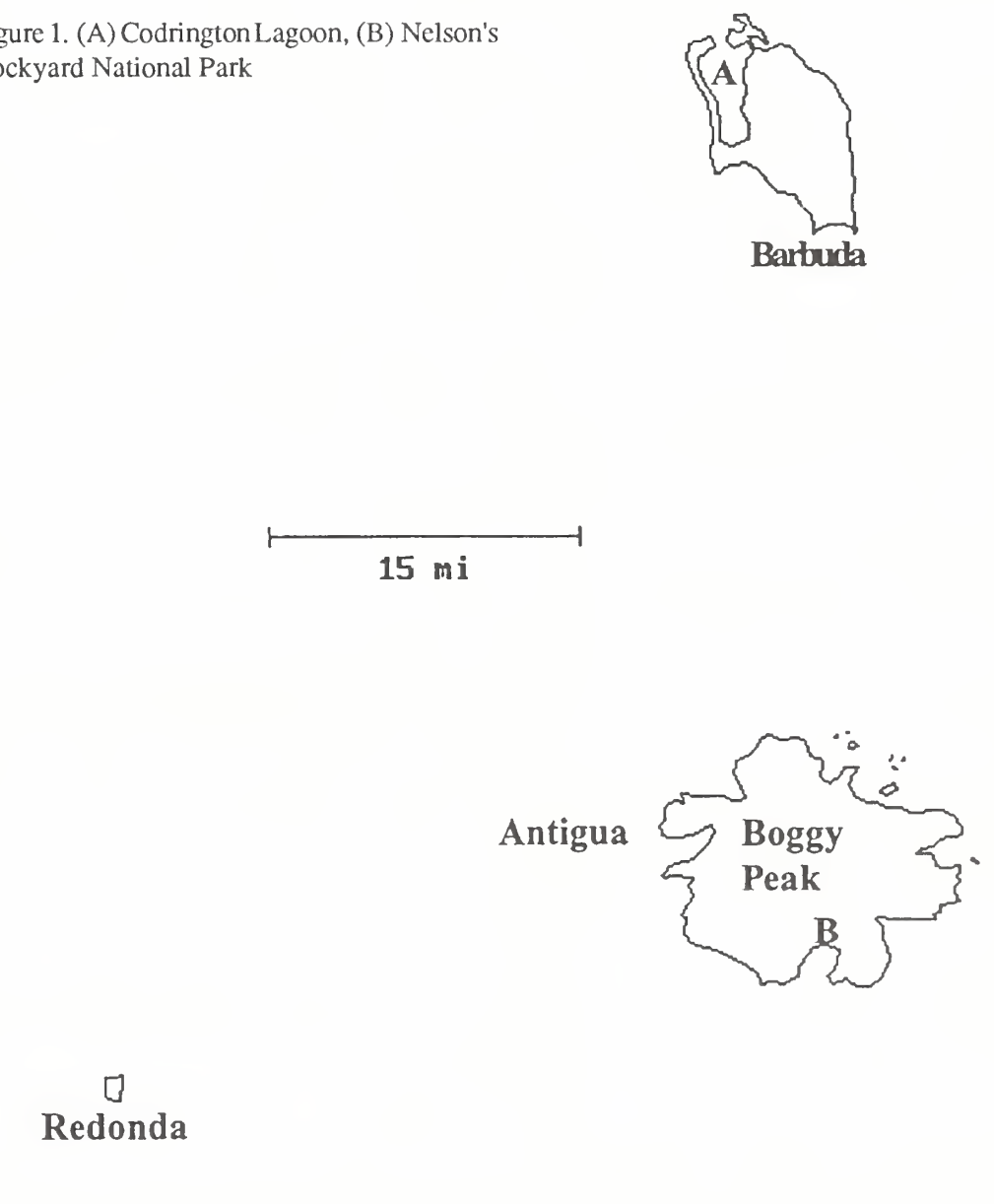
## *Wetland Opportunities in Antigua and Barbuda*

Antigua's rough coastline consists of many beaches and bays, many of which are bordered by mangrove swamps and other wetland areas (fig. 1). The existence of salt ponds in a few areas is also common to Antigua. These coastal wetland zones, especially where mangrove vegetation exist, support a number of waterfowl species which include:

| Common name | Scientific name |
|---|---|
| Cattle egret | Bubulcus ibis |
| Blue-winged teal | Anas discors |
| West indian whistling duck | *Dendrocygna arborea* |
| Great blue heron | *Ardea herodias* |

| Common name | Scientific name |
|---|---|
| Yellow-crowned night heron | *Nyctanassa violacea* |
| Black-crowned night heron | *Nycticorak nycoticorax* |
| Bahama duck | *Anas bahamensis* |

Figure 1. (A) Codrington Lagoon, (B) Nelson's Dockyard National Park



The mangrove species common to Antigua and Barbuda are: *Rhizophora mangle* (red mangrove), *Avicennia nitida* (black mangrove), and *Laguncularia racemosa* (white mangrove). These species are well adapted to brackish water conditions and usually grow to an average height of approximately 4.5 m.

The mangrove ecosystem is very complex in nature. The network of roots (mainly stilt roots of the red mangrove and pneumatophores (or gas exchange roots of the black mangrove) serve a number of functions. For example:

1. Nursery area for young fish life. They provide excellent spawning sites for nursery fish as well as adequate food material and protection from predators.

2. Environmental enhancement and protection. The mangrove root network acts as filter to water flowing to the sea. Here, the roots are capable of restraining most eroded soil particles and other debris which have entered into the watercourse. Two major advantages may be derived from this filtering process:

   a. The protection of coral reefs--Because of this filtration process, a lesser degree of soil particles and other debris enters the sea from land. Thus, coral reefs, which require optimum sunlight conditions for photosynthesis and total development, are less affected by turbid conditions. Antigua has a large wealth of coral reef resources (Fig. 1) which have benefited from this opportunity.

   b. Land building--The continual filtering process, which actually gathers eroded soil from up stream, and the accumulation of detritus material normally results in building and extension of coastal lands. Although this process takes a number of years to be completed, it is advantageous in that eroded soils may be reclaimed and put to proper use.

3. Recreational activities. Recreation is another opportunity which may be derived from the mangrove swamp and other wetland ecosystem in Antigua and Barbuda. These recreational activities may include bird-watching. Examples of this is in Barbuda where local and visitors visit the Codrington lagoon (fig. 1) to view the frigate bird. Other recreational activities include sport hunting for other wildlife, such as crabs and wild ducks.

4. Tourism. Both direct and indirect benefits may be derived from wetlands by the tourism industry. Direct benefits include recreational activities such as those mentioned above. Interested tourists involve themselves in such activities. Indirect benefits take into account the positive benefits which mangrove ecosystems have on the total environment of Antigua and Barbuda. The protection that mangrove offer to coral reefs and other marine ecosystems, which are so often used in tourism promotions and recreation, are good examples.

Other wetland zones, such as creeks and medium- to large-size dams found throughout Antigua and Barbuda, serve the population with other opportunities. Most of these dams were established in watershed areas to cater specifically to the domestic and agricultural water demands in Antigua and Barbuda, with priority given by the water authority for domestic use in times of extended droughts and other emergencies.

In addition to catering to the domestic and agricultural (crop and livestock) demands, these freshwater catchements also serve over 30 species of waterfowls, which include the pied-billed grebe *(Podilymbus podiceps)*, and the hooded warbler *(Wilsonia citrina)* with their daily water and food needs. Several freshwater fish species are also found in these wetland zones.

These dams and creeks also serve rural communities with freshwater fish when the need arises. The Pot Work Dam, Body Ponds, Collins Dam, Bethesda Dam, and Big Creek are good examples of these wetland zones.

A wetland area of great importance is the Darkwood freshwater swamp, which is located in the southwestern region of Antigua. This large savanna-type area receives runoff from the surrounding slopes and supports a wealth of aquatic animals and water fowl (residential and migratory). For example:

Over the past decade Antigua and Barbuda has been experiencing a new trend in economic development, where agriculture, the once main income earner, has taken a "back seat", with other industries; while tourism is at the "drivers seat" of the economy - contributing (directly and indirectly) to just over 60 percent of the Gross National Product (G.N.P).

| Common name | Scientific name |
|---|---|
| Common gullinule | *Gallinule choropus* |
| Brown pelican | *Pelecanies occidentalis* |
| Great egrets | *Casmerodius albus* |
| Whistling duck | *Dendrocygen arborea* |
| Blue-winged teal | *Anas discors* |
| American wigen | *Anas americana* |

In recent years a portion of the Darkwood wetland zone suffered from environmental disturbances as sand mining was carried out there to help in satisfying the high sand demand within the construction industry. Hurricane winds of Hugo also caused environmental disturbance by topping many of the tree species within the Darkwood swamp. As a result, many waterfowl suffered from stressed conditions. The Darkwood swamp is a unique ecosystem and all efforts should be made to protect its fragile condition and enhance its aesthetic, bird sanctuary, and tourism promotion potential.

### *Wetland Problems*

Prior to colonization in 1632, Antigua was heavily forested. Colonization, however, was soon followed by the boom in the sugar industry. As a result, the sugar plantocracy deforested most of the island's forest resources in their effort to produce sugar for the European market. Abolition of slavery and a fall in sugar prices welcomed the introduction of other agricultural crops which, along with sugar cane, made the agricultural industry the main income earner of Antigua and Barbuda's economy.

As shown in the past, the environment has suffered as a result of rapid sectorial development. Tourism, which has been a vital industry to the "improvement of life" in Antigua and Barbuda has had some adverse effects on wetlands environment around Antigua. This deterioration is most times caused by careless and uncoordinated planning by essential agencies and decision makers. Reports have revealed the destruction of seven major mangrove swamps and the filling of most salt ponds. Developers have converted these essential areas into hotel complexes to satisfy "the rising demands" for hotels, villas, and condominiums. A few other wetland areas have been dredged and converted to marinas in an effort to expand the tourist industry and compete with regional and international tourism markets.

The tourism industry development has caused other indirect problems to occur on wetland areas in Antigua. Because of the rapid economic development brought about by tourism, the consumption rate of Antigua and Barbuda's 80,000 people has drastically increased— giving rise to the creation of more solid waste. A recent import statistical report revealed that Antigua and Barbuda's environment must absorb 20 million containers; 1400 derelict vehicles; 75,000 quarts of oil, and 4 million other items annually.

As in other developing nations, many decision-makers in Antigua and Barbuda view mangrove areas as wasted unproductive lands and sometimes convert these areas to dumpsites; e.g, Antigua's largest dump at Cooke's. Solid waste deposition in mangroves and other wetland environments pollute these important ecosystems, thus, poisoning the existing flora and fauna.

Regionally, harvesting of seafood is linked to the mangrove ecosystem. Experts have suggested that at least two-thirds of the worlds fish harvest depends upon mangrove estuaries. Throughout the past 3 years, Antiguan fishermen have experienced a significant reduction in their fish catch. Environmentalists strongly believe that this reduction is related to the destruction of essential mangrove ecosystems in Antigua.

A reduction in local fish catch will obviously place added burdens on Antigua and Barbuda's foreign exchange powers as more food (fish) must be imported to compensate the dwindling fishing industry and to satisfy rising population. Foreign exchange used for such food imports could be used on other aspects of Antigua and Barbuda's development. Therefore, scrupulous development planning is necessary to arrest this crucial problem.

*Management of Wetlands in Antigua and Barbuda*

Presently, the forest policy objectives and strategies are not well defined, while the legislative and regulatory framework, with regards to wetland management, is very weak. One may recognize from a forestry view point that the short-staffed forestry sector has no direct legal control with the management of wetland areas. This is because the 1941 forestry legislation (Chapter 99 of 1941) does not address the idea of wetland management in Antigua and Barbuda.

There is legislation under various governmental agencies (ministries) which in some way seek the protection of wetlands and beaches around Antigua and Barbuda. These may be grouped as follows:

1. Planning and development - Town and Country Planning Ordinance - Chapter 276 of 1948 - Land Development and Control Act - No. 15 of 1977 - St. John's Development Corporation - Act No. 1 of 1986.

2. Tourism beaches
   Beach Control Ordinance - Chapter 297 of 1959
   Beach Control (Preservation of Danger) Regulations - S.R.O No. 25 of 1976
   Beach Protection (Amendment) - Act No. 1 of 1986

3. Protected areas
   The main areas (Preservation and Enhancement Regulations S.R.O. No. 25 of 1973)
   (Preservation and Enhancement) - Act 5/ 1972
   National Parks - Act No. 11 of 1984

4. Fisheries and Wildlife
   Wildbirds Protection Ordinance - Chapter 115 of 1919
   Proclamation (S.R.O No. 16 of 1937)
   Proclamation (S.R.O No. 3 of 1976)
   Fisheries Protection of Lobster Regulation S.R.O No. 3 1978
   Turtle Ordinance

5. Ports and harbours
   The Port Authority Act No. 9 of 1973

6. Water management
   Public Health Ordinance - Chapter 236 of 1957

The Canadian International Development Agency (CIDA) is presently developing a national resource management project (draft delivered to government of Antigua and Barbuda in 1988). Its objective is to protect and improve the national resources and to sustain their use as the basis for economic development in tourism and food production. Hopefully, when this project is sanctioned by the Cabinet of Antigua and Barbuda, one area of management should involve the plan and manage-

ment of the coastal ecosphere. This component will address the planning, protection, use and improvement of fresh water wetlands, mangroves, beaches, and other features of coastal zones. This plan should seek the investment of scientific interaction of flora and fauna of wetlands, marine life, and reefs as living barriers to erosion, which has much to do with the existence of beaches and wetlands.

A number of important wetlands are located within the 5 $km^2$ (2 $mi^2$) Nelson's Dockyard National Park, which contains several villages, two harbours, and agricultural and forest lands (fig. 1). The National Parks Authority (NPA) possesses all legal powers for land management within declared national park zones. Permission for development has to be approved in writing by the NPA before any construction or other development can be sanctioned by the Development Control Authority (DCA), Central Housing and Planning Authority (CHAPA) or the Port Authority (PA). The NPA is therefore the supra-zoning agency within the national parks.

The importance of the NPA becomes very apparent to the management of wetlands within its boundaries, as it functions to preserve, protect, manage, and develop the national ecological resources and historical and cultural heritage.

In managing these assets, the NPA is responsible for: (1) providing facilities for persons visiting the parks, (2) carrying on the repairs of any historic building, and constructing facilities necessary for using the sea, (3) providing accommodation, meals, refreshments, campsites, huts, roads, parking places, soil conservation works, building fences, and other things made under regulations, (4) performing as a nonprofit organization using any surplus funds for the enhancement of the park, and (5) consulting and cooperating with other governmental agencies having functions or aims related to those of the authority.

The NPA falls under the portfolio of the Ministry of Economic Development. The minister, after consultation with the chairman of the NPA, may give policy directions which should be followed by the authority as management strategy. Adequate management of critical wetland zones in Antigua and Barbuda, as a national heritage, for present and future generations is very crucial.

*Recommendations*

- A national educational programme educating nationals of the importance and benefits of wetland ecosystems should be launched by the government of Antigua and Barbuda.

- The question of wetland management should be included in the proposed forestry and wildlife policy and laws.

- Every effort should be made by the responsible governmental agencies to prioritize important wetlands in Antigua and Barbuda. These should then be properly managed, under appropriate management strategies. Example, national park, wildlife sanctuary.

- A coordinated approach toward the development of wetlands in Antigua and Barbuda should be made policy. Representatives from agencies such as the Forestry Sector, Development Central Authority, the Private Sector Association, the National Park Authority, Engineers Association, the Environmental Commission, and other appropriate agencies should be members of the committee given responsibility to make recommendations as to the development of wetland areas in Antigua and Barbuda.

- Malpractice such as dumping of solid waste in wetland areas should be discontinued.

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# AN OVERVIEW OF WETLANDS IN DOMINICA

*Arlington James*

*Abstract*

Wetlands occupy only a very small area (<1 percent) of Dominica. Freshwater wetlands occur in both coastal and montane areas of the island. There are four types of freshwater wetlands associations, three of which are forested, and one is dominated by herbaceous vegetation. Saltwater forested wetlands (mangroves) are poorly represented (small patches of a few trees). Coastal wetlands (fresh- and saltwater) are threatened by human activity, whereas those in the mountains are legally protected (located in the national park). There is great need for protective measures to be undertaken to preserve Dominica's few wetland resources.

*Introduction*

Dominica is approximately 742 $km^2$ in area, and is one of the most rugged islands in the eastern Caribbean. The island is mainly of volcanic origin, with several peaks over 1000 m high. The general topography is dominated by a chain of mountains, and a number of deep, narrow valleys and gorges, most with perennial streams and rivers. Flat land is generally scarce, even along the coast.

Only a limited area of wetlands exist on the island. Montane swamps, freshwater marshes, and freshwater swamps constitute the main wetland formations on Dominica. There are no mangrove forests on Dominica; however, trees of at least two species of mangrove *(Avicennia* and *Laguncularia)* have been found in the northern half of the island. Wetlands probably occupy <1 percent of the land area of the island, however, their real extent is not known because they have not been mapped.

Some of the wetlands occurring at the higher elevations are legally protected; i.e., they occur in a national park. However, the lowland formations are threatened by agricultural expansion, marina development, and other forms of human activity, although natural forces also contribute to the decimation of wetland plants. The few remaining mangrove trees on Dominica are threatened with extinction, as these are all located on private lands.

*Wetland Formations*

I estimate that Dominica's coastal (lowland) wetlands occupy approximately 120 ha, with two relatively large marshes in the north of the island accounting for most of this area. The upland wetlands consist mainly of small patches of marsh lands, swamp phases of the rain forest, and montane formations (fig. 1).

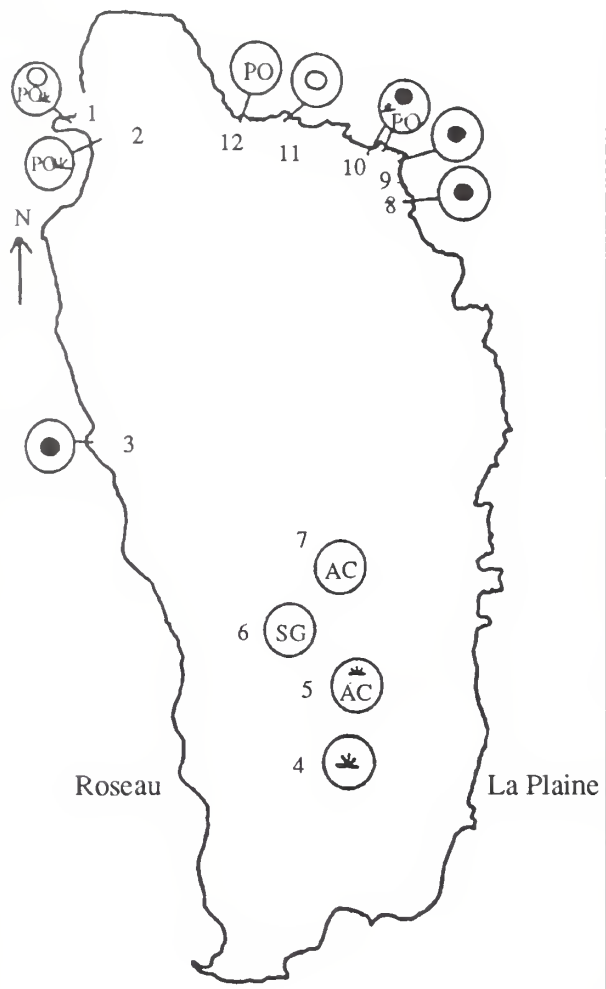
*Freshwater Wetlands*

*Symphonia globulifera Association (Rain Forest Swamp)*

This association is a special form of rain forest found in isolated pockets with high water tables. This swamp formation is undisturbed, tall and dense, and is dominated by *Symphonia globulifera,* which comprises about 75 percent of the stand (Beard 1949). The species is often mixed with *Amanoa caribaea* and a few trees of *Dacryodes excelsa, Tapura latifolia,* and *Euterpe dominicana.* Both *Symphonia* and *Amanoa* produce stilt roots, but *Symphonia* also produces hoop-shaped breathing roots covering the ground near the trees. Young *Symphonia* seedlings are common on the forest floor, but mortality is probably high because few saplings and small trees are found.

*Amanoa caribaea Association (Montane Swamp)*

At least one fairly large area of this wetland association exists in Dominica, and is located on the northern and eastern slopes of Morne Trois Pitons (fig. 1) in the national park. The site is gently sloping




1 Cabrits
2 Glanvillia/Indian River
3 Grande Savanne
4 Boiling Lake
5 Freshwater Lake
6 Middleham
7 Morne Trois Pitons
8 Wesley
9 Eden
10 Woodford Hill
11 Hampstead
12 Anse de Mai

SG - *Symphonia globulifera* association
AC- *Amanoa caribaea* association
PO - *Pterocarpus officinalis* association
-- Freshwater marsh
- Black mangrove sites
- White mangrove sites

Figure 1. Location of wetlands in Dominica.

and between 425 and 610 m in elevation. A montane thicket variant has developed on a 3,040 cm layer of highly organic soil overlaying an impenetrable iron pan.

This wetland association is dominated by *A. caribaea,* comprising about 35 percent of the trees above 10 cm dbh (Beard 1949). Other common species in this association are *Oxythece pallida* (11 percent), *Licania ternatensis* (8 percent), *Dacryodes excelsa* (7 percent), *Euterpe dominicana* (6.5 percent), *Sterculia caribaea* (3 percent), *Symphonia globulifera* (3 percent), and *Tovomita plumieri* (5 percent). A very distinctive feature of this wetland is the development of aerial roots, with about 60 percent of the trees producing them. *Euterpe dominicana, T. plumieri,* and *S. globulifera* are invariably stilt-rooted, while the normally buttressed A. *caribaea* and 0. *pallida* develop aerial roots when growing in this wetland community. *Dacryodes excelsa* also develops buttresses in this wetland type.

*Pterocarpus officinalis Association*

There are few stands of freshwater coastal swamps on Dominica, and these are mainly confined to the northeastern and northwestern regions of the island (fig. 1). These stands are located on flats which are associated with either a river or a stream. The forest stands are often tall and dense with fairly large trees. Best stand development occurs on sites which are inundated for a few months each year, but remain relatively dry for the remainder of the year.

Freshwater coastal swamps of Dominica are dominated by the heavily buttressed *Pterocarpus officinalis,* which may sometimes form more than 90 percent of the stands. On some sites *Pavonia scabra* and *Annona glabra* may be found in the understory. The species composition of any stand of this association varies according to the surrounding vegetation. Trees normally found growing in the rain forest, littoral woodland, and dry-scrub woodland have been found growing in the understory, or on the edges of freshwater swamps in Dominica. All of the major rivers in the north and northeast of the island are lined to some distance from the sea with *P. officinalis* and related species.

In most cases, very few large seedlings or saplings are found within these swamp forests, and young albino seedlings of *P. officinalis* have been found on some sites. Stranglers *(Clusia* sp., *Ficus* sp.) occur in some stands, and epiphytes, consisting mainly of ferns, anthuriums, and philodendrons, are quite common in this wetland type.

### *Wetlands in the Freshwater-Saltwater Transition*

#### *Achrosticum aureum Association*

Two relatively large coastal marshes exist on the island, and both are located in the northern one third of Dominica (fig. 1). In one area, a stand of white mangrove *(Laguncularia racemosa)* is surrounded by marsh vegetation, and in other areas the marshes are in close association with stands of *P. officinalis.*

In addition to the dominant *Achrosticum aureum,* the swamp fern, a number of sedges, including *Eleocharis* spp. and some grasses, generally occur. *Achrosticum aureum,* which normally grows in tussocks, is a pro-rooted fern with much aerenchymous tissue. This species is, therefore, well adapted to survive on sites which are constantly flooded. The most impressive areas of *A. aureum* are found in the marshes at the base of Cabrits and near Indian River (fig. 1). Dense patches of *Montrichardia arborescens* also form part of some of the marsh communities in Dominica.

*Eleocharis* spp. grows as an emergent in almost pure patches at Freshwater Lake, at the Woodford Hill Lake, and near the Boiling Lake and Valley of Desolation at 760 m in elevation (fig. 1 ).

### *Saltwater Wetlands*

There are no mangrove swamps in Dominica. However, trees from two genera, *Avicennia* and *Laguncularia,* are found on the island and were first reported in 1979 (James 1980). Six of the eight sites where these species occur are on the northeast; the others are located on the northwest, and west coast of the island (fig. 1).

Among the eight sites, only one supports a self-contained stand where white mangroves are surrounded by a marsh at the base of Cabrits (fig. 1). One small stand of black mangrove *(Avicennia germinans)* was recently reduced to only seven trees and coppices.

#### *Black Mangroves*

Black mangrove trees have been found only on five sites on the island, one of which is near a small lagoon on the west coast, and the others are near the mouth of a ravine, a river, or a stream. Only 41 trees and saplings, up to 49 cm diameter, have been found to date, probably representing past stands. Human activity and natural causes (hurricane, disease) are responsible for the reduction of the number of black mangroves on the island. Seeding and germination occurs, but a high mortality rate exists, resulting in little or no recruitment of seedlings.

At one site, black mangroves were found growing together with A. *aureum.* In most cases, black mangrove trees were associates with *P. officinalis.*

#### *White Mangroves*

White mangroves have only been found growing on three sites on the island. A complete census of white mangrove trees has not been carried out on the island, but it is expected that there are more trees of this species than there are of black mangroves.

Seedling recruitment on two of the sites is poor, and, in one area, the trees actually line the edge of a stream, making it difficult for seedling development. White mangrove trees are associated with *P. officinalis* on two of the three sites.

### *Ownership of Wetland Areas*

Some of the upland wetland areas in Dominica are located on state land. Associations of *S. globulifera* and *A. caribaea* are found in forest reserves, in the national park, and on unallocated state lands. Patches

of these wetland formations are also found on private lands. All eight sites where mangrove species occur are on private lands, usually on part of large estates, some of which are now being subdivided. Most of the freshwater coastal swamps (*P. officinalis* association) are located on private lands. Only the small stand near Cabrits is located on state land which is now legally designated as a national park.

One of the two large areas of coastal marshes (*A. aureum* association) is located on private lands. A portion of the other is also located on private lands, but the remainder of the marsh is included in the Cabrits National Park.

### *Use of Wetlands*

Although swamps and marshes are generally regarded as areas where mosquitoes and sandflies breed, local people use these areas for a number of activities. Earlier in this century, the sedge, *Eleocharis* spp., was harvested from marshy areas and used for craftwork and for filling mattresses and pillows. Firewood is sometimes collected from freshwater swamps, whereas pole wood is often harvested from the white mangrove stand. Fishing is a common activity in the open water of marshes, and hunting for birds (ducks, herons, etc.) and crabs is also a popular activity in these areas. Cattle grazing is also an annual event on the Cabrits marsh, especially during the dry season when the interior of the marsh is more accessible. This wetland is repeatedly burned to provide fresh fodder for cattle.

One river, bordered by *P. officinalis* and *A. aureum* associations, is used as a tourist attraction. Local tour guides transport visitors and locals up-river and through the marsh and forest to observe these wetland types as well as the many wild birds which inhabit them.

### *Wetland Destruction*

As noted earlier, most of the sites supporting coastal wetlands are located on private lands, over which the government has little or no jurisdiction. The only real stand of white mangroves is located on a portion of lands which was recently purchased for the development of a marina. At the time of writing, the trees are still standing, pending the next moves of the developer.

Some of the largest black and white mangrove trees on the island appeared to have been destroyed by the hurricanes of 1979 or 1980. However, the possibility of disease is not completely ruled out as some of the remaining trees are now dying back from the crown. In late 1985, a farmer trespassed on his neighbors' land and felled some of the largest remaining mangrove trees on the island. In the past, freshwater forested wetlands have been replaced by small plantations of coconuts.

### *Plan of Action to Preserve Dominica's Wetlands*

While the fate of some of the wetland sites will depend on the goodwill and discretion of the land owners and users of those area, it is thought that the following plan of action may help prolong the existence of these wetland formations, even though they exist on nonstate lands:

- -wetlands occurring in the state's forest reserve should be declared protected areas;
- -inclusion of the government-owned portion of wetlands at the base of the Cabrits in the Cabris National Park;
- -inclusion of the *A. aureum* and *P. officinalis* associations bordering the Indian River in a protected area (discussions have already begun with a view to realizing such an idea);
- -establishment of research plots in mangrove species sites (not threatened with marina development), in collaboration with the land owners; and,
- -increased public education on the value of wetlands.

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# THE STATUS OF WETLANDS IN GRENADA

*Alan G. Joseph and Gordon Patterson*

## *Introduction*

The forestry sector plays an important role in the socioeconomics of Grenada. The following are the six major objectives that relate to the forestry sector: (1) reduction of unemployment, (2) stimulation of economic growth, (3) substitution of imports by fostering the use of natural resources, (4) divestment and reprivatization of nationalized farms and promotion of private investment, (5) provision of supportive, technical, and financial assistance for increased production of private sector, and (6) the conservation of natural resources.

It is against this background that we look at the wetlands in Grenada, where there should be a balance between the development and preservation of these wetlands. In other words, our wetlands should be managed for all their values, including use by people who depend on them for subsistence income. Over the past 5 years the Department of Forestry progressed considerably through aid, both technical and financial, from external donor agencies; however, none of this funding or technical aid was devoted to the management of wetlands.

## *Location Area and Climate*

Grenada is the most southerly of the Windward Islands, and has an area of 344 km$^2$ and is located at 12°05'N. latitude and 61°40'W longitude. Grenada is a tri-island state which includes Carriacou and Petit Martinique, which are 34 km$^2$ and 2.3 km$^2$, respectively.

The tropical climate of the island is influenced by the northeast trade winds. Its measured rainfall varies from 1000 mm/yr at Point Salines on the southeast coast to 3870 mm/yr at Grand Etang in the mountainous interior. It is generally dry from January to June and wet from July to December; this pattern is considered as a dry season and a wet season. The annual average temperature is 20° C with night temperature declining to 16°-18° C from January to May. Average temperature during the rest of the year rises to 32° C when the humidity remains high. Grenada lies south of the Caribbean hurricane belt. The only recorded hurricane was Janet in 1955; although several gales were recorded before Janet.

## *Present Status of Our Wetlands*

There are three main areas on the south coast of the island where mangroves are found; they are in very small patches in the immediate vicinity of the tourist area. These areas are southern coast, lower Woburn, Fort Jeudy, and Westershall (fig. 1) all have been disturbed in the past. At present, there is evidence of dumping of solid waste, cutting of the mangrove for charcoaling and development, illegal hunting, and sand mining. In some cases, there was evidence of good regeneration of mangroves.

The perseverance mangroves (fig. 1) are the ones on the island which have suffered most; this area is used as the official solid waste dump, and already the red mangroves (*Rhizophora mangle*) have disappeared. There are a few white mangroves (*Laguncularia*) remaining.

The Pearls mangrove (fig. 1) is not seriously threatened, although it is used by locals who live in the vicinity. River Antoine's mangroves have been disturbed in the past. There is no recent cutting and there is good regeneration.

Levera area contains some unique natural resources, representative of the country and the Caribbean with different types of ecosystems such as mangroves, lagoons, and xerophitic forest. All are within an area which includes two beaches, a small lake, and many species of wildlife. The avifauna of Levera is diverse with 85 species (43 land birds, 14

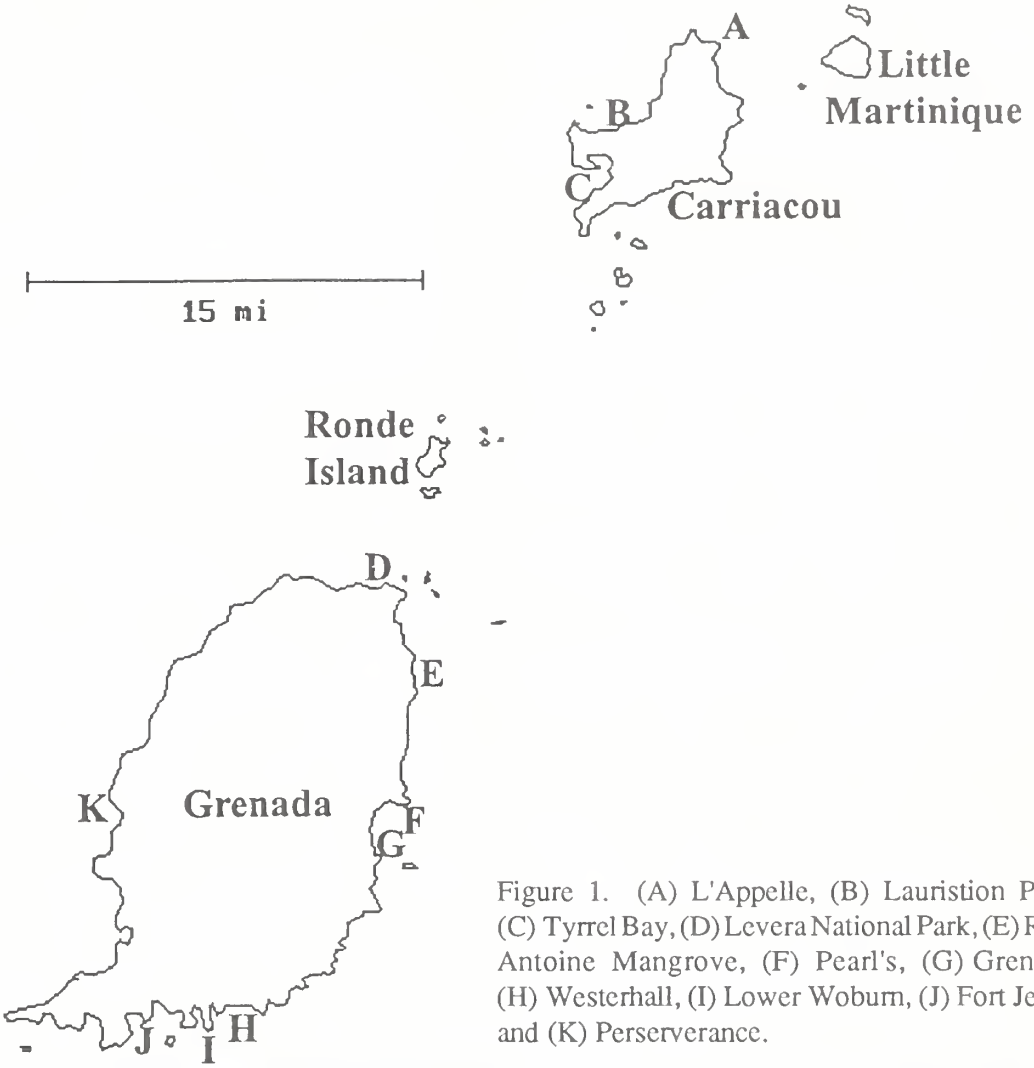


Figure 1. (A) L'Appelle, (B) Lauristion Point, (C) Tyrrel Bay, (D) Levera National Park, (E) River Antoine Mangrove, (F) Pearl's, (G) Grenvile, (H) Westerhall, (I) Lower Woburn, (J) Fort Jeudy, and (K) Perserverance.

water birds, 15 shore birds, and 13 sea birds; Vincent 1981). Other forms of wildlife like the opossum, the iguana, and the armadillo are also found in Levera. The Levera area is used by locals for fishing and crab catching. This area was used a great deal for cutting mangroves for charcoal burning. At present, cutting of the mangrove is not allowed. None of these wetlands areas are officially managed except for the Levera area, which will be developed into a national park shortly.

*Carriacou and Petit Martinique*

There are three main areas of mangrove swamps in Carriacou (fig. 1; Weaver 1989). Mangroves on the Sister Isle support ecosystems that act as a nursery for many botanical and animal species. To a lesser extent, the mangrove timber is used in the fishing industry.

*Vegetation and Area of Mangroves*

There are seven types of natural vegetation on the island (Beard 1949): (1) rainforest and lower montane rain forest, (2) montane ticket, (3) elfin woodlands and palm brake, (4) secondary rain forest, (5) dry scrub woodland, (6) littoral woodland, and (7) mangrove forests.

Various types of these forests make their contributions as areas classified as wetlands. However, in Grenada, Carriacou, and Petit Martinique the areas that are given most consideration as wetland are the coastal mangroves and brackish water swamp lands. The total area of mangrove woodland and brackish water swamp land is 5.3 $km^2$ which is 1.7 percent of the total area of the island (Weaver 1989). Although our wetlands are a small part of our total land mass, they are very important because of the role they are playing in sustaining part of the income for some of our rural people and generating revenue through tourism.

*Management of the Wetlands*

The government of Grenada and the Organization of American States prepared a comprehensive plan for parks to be implemented by the Division of National Parks within the Department of Forestry. The National Parks Division is responsible for the management of all mangrove wetlands. The focus of management of these wetland areas is the integration of different activities which share the goals of protecting nature and improving social, cultural, historical, and ethnical resources. All coastal wetlands have excellent potential for management to protect the coastline, prevent beach erosion, control beach movement, protect the avifauna that it supports, protect the marine life it supports, and harvest fish and other products on a sustained yield basis for the benefit of local people.

*Legislation*

The Forestry Soil and Water Conservation Act of 1984 does not give the Forestry Department the authority to manage coastal wetlands. However, all mangroves are below the high level watermark and therefore belong to the state.

Also, the Grenada Fisheries Act of 1986 gives the right to protect these areas under the following section of the law: "The Minister may, by the order published in the Gazette, declare any area of the fishery waters and as appropriate, any adjacent or surrounding land, to be a marine reserve where he considers that special measures are necessary.

> (a) To afford special protection to the flora and fauna of such areas and to protect and preserve the natural breeding grounds and habitats of aquatic life with particular regard to flora."

Therefore, it is important that national parks of the Forestry Department should work closely with the Department of Fisheries to achieve the common objectives of managing the wetlands. In our situation this was difficult in the past because the Department of Fisheries was with the Ministry of Education. However, at present, both Departments are in the Ministry of Agriculture. It is expected that more cooperation and communication will help us to achieve our common goals using the same law.

Wetlands should be managed also for recreation, not only for locals, but for tourists, too.

*Management of the Levera Wetlands or Levera National Park*

Levera Wetlands, which consist of 550 acres, will be the first wetland area to be managed fully by the National Parks Division. The project to manage this area will cost $3,038,000 EC and will be funded by the European Development Fund.

The main goal of the project is to bring about the conditions for an integrated development of different activities in the Levera area and to provide opportunities to local residents thereby preserving the natural resources of the area.

The specific objectives are as follows: (1) protection of ecosystems especially the mangroves,

(2) conservation of endangered wildlife species, (3) protection of some beaches and marine environments, (4) development of a new set of services for tourism based on out-door activities, and (5) promotion of tourism attractions in Grenada and their diversification.

Already, as the project is about to begin, charcoal burners who used the mangroves were displaced because the cutting of the mangroves had to be stopped so that the habitat for various animal species not destroyed. However, 50 acres of land will be forested with fast growing species of trees to meet their needs.

### *The Role of Other Organizations in Protecting and Using Wetlands*

At present there are parish groups like the St. Patricks Development Committee, which would take part in environmental projects; but, there is no strong lobby from nongovernment organizations especially on wetlands. However, the government has set up a body, "The National Environmental Conservation Council," which is responsible for the preservation of the environment. The Council is broad based and is comprised of representatives from the Ministry of Health and the Environment, Agriculture, Construction, Education, Finance, Tourism, and the private sector. It also is comprised of nongovernmental organizations like the Chamber of Commerce and the Grenada Hotel Association. The council will advise the Cabinet, through the Minister of the Environment, on ways and means of conserving and developing resources. Mangrove forests would be one of the critical areas that will be looked at with a view to conserving it by the Council.

### *Recommendations for the future of Wetlands in Grenada*

A system of ongoing research on flora and fauna in the wetland areas should be undertaken to facilitate the conservation of their ecology.

A strong public awareness programme should be implemented to sensitize the public on issues related to wetlands. Not only the mass media, but also public meetings and forums, the school system, community groups, community councils, and other groups and organizations should be used to pass the message of the importance of wetlands in the environment.

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# THE WETLANDS OF GUADELOUPE

*Daniel Imbert and Yannack Perrin*

### *Localization and Typology*

In Guadeloupe, most of the wetlands are located on the coasts. This is due to the topographic and geological characteristics of the archipelago. The great amounts of water condensing on the steep slopes of the main volcanic island, Basse-Terre, are partly recycled by the vegetation, the remaining flowing through a torrential hydrographic network. The mountain range of Basse-Terre has a rather simple structure with a main north/south axis. However, some freshwater ponds are located in the southern, more irregular part of the mountain: Grand Etang, Etang de l'As-de-Pique, Etang Zombis.

Grande-Terre, like the small surrounding calcereous islands, has few permanent ponds because of the very permeable substrate and the low seasonal rainfall. Two artificial lakes for irrigated agriculture require mention. The main, of the two in the north of Grande-Terre, will be filled in the following months; the total open water area will then be 220 ha.

Coastal wetlands are quite common and sometimes very extensive (table 1). They cover about 7,000 ha (4 percent of total land area); 85 percent are located around the Grand Cul-de-Sac Marin, which is a large bay opened to the north between Grande-Terre and Basse-Terre islands. Four kinds of wetlands can be found.

### *Mangroves*

They consist of forested areas crossed by several canals formerly used for sugar transportation with scattered lagoons and brackish ponds. Mangrove vegetation is composed of few species able to grow on salted swampy soils. Five tree species are present, forming several forest types from the seashore to the land, depending on ground elevation and freshwater input.

### *Brackish Swamps*

Some salt-tolerant herbaceous species like the saw grass, *Cladium mariscus,* or the gold fern, *Acrotichum aureum,* may cover extensive areas next to mangrove forest. Hunters often set fire to these swamps during the dry season. Frequent burning prevents tree colonization and leads to nearly monospecific herbaceous stands.

### *Swamp Forest*

This forest occurs on the landward side of the mangrove, in floodplains and along river streams; the soil is flooded by freshwater most of the year. Overstory is dominated by *Pterocarpus officinalis.* Understory floristic richness is rather high, especially in elevated zones. Several shrubs, vines, and epiphytes can be found.

Table 1. Area of coastal wetlands in Guadeloupe.

| | Mangrove | Backish swamps | Swamp forest | Freshwater swamps | Total |
|---|---|---|---|---|---|
| Area (ha) | 3131 | 993 | 2603 | 307 | 7034 |
| Percent of total area | 45 | 14 | 37 | 4 | 100 |

*Freshwater Marshes and Grasslands*

These are located between the swamp forest and cultivated areas. These marshes occur in places where the swamp forest has been removed during the three last centuries for cultivation and grazing purposes.

*The Need for Conservation*

Ecological and economic value of coastal wetlands is becoming widely recognized. These areas support rich and highly specialized flora and fauna. Many of their species are of economic importance. The nursery function of mangrove lagoons and estuaries for marine species, like fishes or shrimps, is well documented. It has been shown that the productivity of coastal marine ecosystems is linked to nutrient inputs coming from decaying organic matter produced by coastal vegetation. This vegetation, and especially mangrove forest, contributes to shore stabilization after colonization by salt-tolerent species and reduces storm-tide impact on low coasts.

Traditional use of wetland resources still has a significant economic value for nearby local populations, as it provides them with food (hunting and fishing, water cress, and *Colocasia* cultivation) and wood for several purposes: vine stakes, housing, fishing traps, charcoal, and others. Archaeological findings suggest that coastal wetlands played an important role in precolombian civilizations. Until recently, tall sedges from swamps and marshes were used for house roofing, baskets, or for making hats.

These ecosystems are affected by serious disturbances. Some date back to the beginning of European colonization when large areas of the swamp forest began to be cleared and drained for agricultural reclamation. Wood provided fuel for the sugar cane industry. Nowadays, three major disturbances can be noticed:

1. Coastal urban explosion partly due to tourism expansion. Wetlands are progressively filled and fragmented by roads and different kinds of embankments.

2. Industrial, domestic, and agricultural pollution. Several dumping areas and sewers affect coastal wetlands. They generate many kinds of substances affecting, directly or indirectly, living organisms. Part of these toxic substances are accumulated in soils, and the rest reach the coastal marine ecosystem via water transportation through the wetlands. Recent studies reveal dangerous concentrations of heavy metals and pest residues in some marine species.

3. Hunting. This traditional activity is nowadays, for most of the Guadeloupe hunters, more of a leisure activity than a feeding necessity. The pressure coming from this practice (nearly 3,000 hunters) has dramatic consequences on all the fauna, not only on the game species. Many species have disappeared from Guadeloupe in the last centuries. An example is the flamingo. Some species do not nest any more on Guadeloupean coasts. Examples are the fregata and the pelican. Other species became very rare, like sedentary ducks. Migratory wildfowl experience particularly hard trials when passing these islands.

For several years efforts have been made to reduce ecological damages on the wetlands of Guadeloupe. Three strategies have been implemented: (1) protection of endangered species, (2) conservation of the main areas of ecological importance with respect to their diversity and functional integrity, and (3) increasing public awareness on wetlands ecological, economical, and sociocultural values. One of the tools available to reach this goal is the National Reserve of the Grand Cul-de-Sac Marin (fig. 1).

*The Grand Cul-de-Sac Marin Natural Reserve*

Created in 1967, this reserve comprises roughly 2000 ha of territorial sea and 1600 ha of coastal wetlands located around the Grand Cul-de-Sac Marin bay, which is a 30 km-wide lagoon partially closed by a coral reef barrier. This reserve is managed by the National Park Service since the creation of the

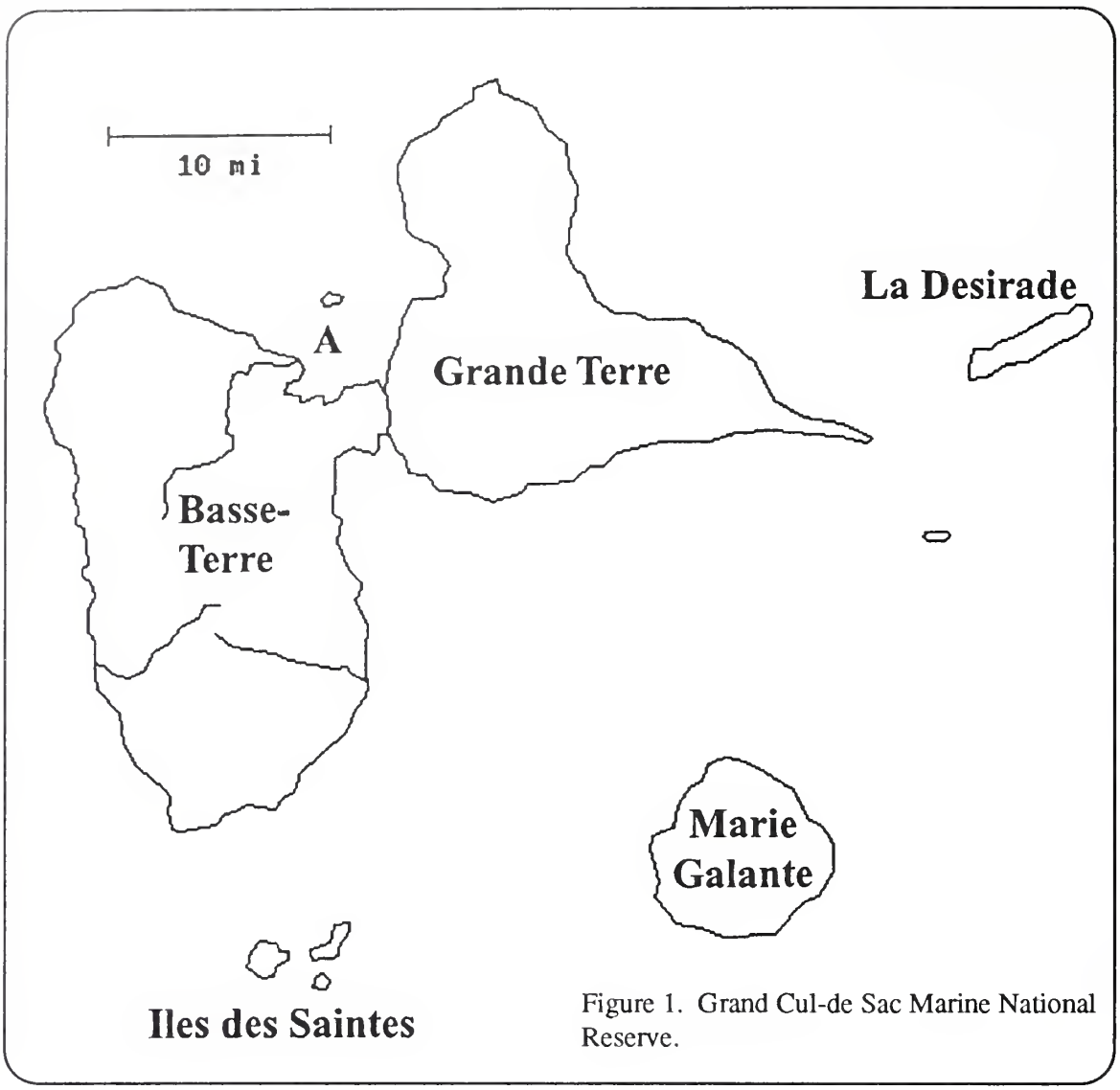


Figure 1. Grand Cul-de Sac Marine National Reserve.

National Park of Guadeloupe in 1989. This institution belongs to the French Ministry of Environment.

All activities that might disturb wildlife are forbidden and the few traditional agricultural uses that still remain in some parts of the reserve are under the control of the reserve authority. Research programs are encouraged to improve our knowledge of these ecosystem dynamics and functions (like post-hurricane recovery) and give recommendations for management. Some problems still remain. For example, pollution coming from inland areas or adjacent wetlands affects the reserve in the southern and western part, and the actual staff is not sufficient to meet the demand for educational activities. Nevertheless, we are expecting that this situation will soon get better because of the general growing awareness concerning environmental problems which may influence political decisions and because of new prospects due to the recent creation of the National Park.

Hopefully, fauna preservation in the Grand Cul-de-Sac Marin Natural Reserve will contribute to reconstitute the populations of some particularly stressed marine species like the conch *Strombus gigas*, lobsters, and coastal fishes. It will also strengthen the effort made in other Caribbean countries for the

protection of migratory birds, which are an international ownership that is shared by every North and Central American country and that, insofar, should be managed at this scale. In this way we intend to study the possibility for this natural reserve to obtain the status of biosphere reserve and to be part of the forthcoming network of specially protected areas which will be created under the UNEP control (SPAW program).

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# REGULATIONS AND ADMINISTRATIVE PROCEDURES OF THE DAMP ZONES OF GUADELOUPE'S LITORAL

*Yannack Perrin*

The vegetation of the damp zones covers, in the archipelago of Guadeloupe, 18,525 acres (7,500 ha) of which around four-fifth spread along the periphery of the Grand Cul-de-Sac Marin. The interaction of people with those fragile and vulnerable environments is quite complex. Whether it be inherited behavior, or traditional practice, or fulfillment of new economic needs, human action is often destructive--which makes it clearer the need to protect, if not preserve, those areas. The Office National des Forêts is responsible for this and other tasks. We have found great difficulties as well, and the results might clearly seem insufficient. But to better understand the current situation, it is convenient to specify the regulations and administrative procedures in effect at this French Department of the Lesser Antilles.

## *Regulations*

J. Barreau stated in a recent study on the mangrove area: "The mangrove environment, completely foreign to the natural setting on which the French law was based, would present a legal and administrative problem, a problem which has not still been resolved to our days and, which allows a better understanding of the relative ineffectuality of the Administration."

The mangrove and the damp coastal zone have not been surveyed nor measured. The demarcation is therefore nonexistent, which makes it all the more difficult to respect. Besides, the borderers trespass freely in the area and, the Administration does not always manage to punish the infringement. Moreover, these damp zones, which belong to the State, may be under two different judicial domains:

1. The *Domaine Public Maritime* for the bodies of salt or brackish waters (*mangrove maritime, marais saumâtre*).

2. The *Domaine Public Lacustre* for inland bodies of freshwater (*forêt marécageuse et prairies humides*).

These domains are ruled and protected by different judicial texts taken from: *Code du Domaine de l'Etat, Code Forestier, Code de l'Environnment,* the recent "Litoral" law which protects and defines the administrative policy with respect to the French litoral, and the *Plan d'Occupation des Sols*: guidelines on the administration of space available in almost every township of the French territory.

### *Code du Domaine de l'Etat*

The land that belongs to the *Domaine Public de l'Etat* is inalienable. No transaction or transfer of property is possible unless it responds to important public projects. The urbanization process attempts against these goals, which definitely are not unbreakable barriers. Hence, the marsh forest (*forêt marécageuse*) has yielded to the port activities of Port Autonome de Pointe a Pitre, for example, and, more recently, the project which attempts to establish an oil refinery causes some dread about the future of the mangrove area northwest of Grande-Terre.

### *Code Forestier*

The woods belonging to the *Domaine Publics Lacustre et Maritime* are subject to the *Régime Forestier.* It is a group of laws that entrusts the *Office National des Forêts* the administration and protection of the wood and its related areas.

### *Code de l'Environment*

This text leans more toward the protection of nature and different plants and animals. It also watches for different aggressions against nature; i.e., pollution, littering, etc.

*Plans d' Occupation des Sols*

This is a summary of regulations and the grounds for political decisions with respect to urban projects. It is related to the regulations of the *Régime Forestier* which applies to the land and which concerns everybody, particulars as well as groups.

The most important thing would be that these texts, which in general protect and guarantee the perpetuity of these fragile ecosystems, could be enforced and respected. Unfortunately, the administrative procedures and sociocultural patterns of the archipelago do not allow it.

*Administrative Procedures*

The administrative procedures are not much simpler nor more effective than their judiciary counterparts. The land of the mangrove, being part of the *Domaine Public de l' Etat* as it is, is administered by the *Minister de l' Equipement* (Department in charge of the territory's maintenance, the urbanization projects, and the important infrastructure works, among other duties). However, as we have already seen, the woods are subject to the *Régime forestier*, therefore, the *Office National des Forêts* administers everything related to this particular.

A shared administration between two different departments needs an effective synergy. Its absence is, unfortunately, to be deplored. Thus, the construction of a cabin using trees from the marsh forest would involve two different departments: the *Office National des Forêts* would state that cutting the trees is illegal and the *Ministere de l' Equipment* would state that construction on land belonging to the government is forbidden.

If you add to it, the jammed court's slowness, the local difficulty to enforce the court's sentence, and the unpunished precedents, you can understand the discouragement felt by the forester for the protection of these extraordinary ecosystems. Moreover, the social and cultural context do not help the forester out.

*Socio-Cultural Aspects*

At the dawn of the European colonization, the mangrove area was an area of great utility to the natives. It was a land full of fish, game, and crops, where their main activities took place. The European's perception of the mangrove area was less idyllic. These marsh extensions, colonized by crabs and mosquitoes, were immediately considered insalubrious. Then, from this negative perception came the desire to dominate that land, the desire to use it for urban projects or agriculture rather than protect it. The era of important projects started: opening of canals, clearing, embanking; yesterday the construction of Point a Pitre ... today the building of its industrial zone, Jarry. This negative perception of the mangrove area has been engraved on the collective unconsciousness and it still lingers. Besides, in these islands while there is a demographic and an economic boom, free natural areas dwindle ... in the meantime, the pressure on land keeps rising. The mangrove area is more or less perceived as a land reserve, considered for a long time as vacant and underused, thus– a candidate to be exploited. We must insist on the fact that the "aggressors" of the mangrove area belong to different social groups, business people, factory owners, and disadvantaged social groups lacking land and basic goods.

*Aggressions*

The aggressions of which the damp zones of Guadeloupe's litoral is still victim are numerous and varied. They vary according to the nature of the zone. Thus, the mangrove zone has suffered little compared to the marsh forest (*forêt marécageuse*).

The mangroves are mostly affected by large projects: airports, ports. The marsh forest is in more demand. Besides the important public projects, it is endangered by the following:

1. Housing projects. Large marshes on the litoral have been dried out and embanked in order to build housing projects. Their road systems and infrastructure have limited the

marsh forest, considerably disrupting the natural waterpaths which play a fundamental role in its biological balance.

2. Clearing for the establishment of industrial, business, and craftmantship activities. The government, facing the need to develop the economy, authorized the construction of an industrial zone (Jarry) in the *forêt marécageuse* at the *Pointoise* region; the embankment of the region followed. In their desire to expand, the companies do not hesitate to continue their quest for supplementary land even at the expense of the riverine forest. The government's policy of favoring the economy over the ecology, the absence of measuring and demarcation of the land, make it impossible for the administrative bodies to stop the attacks.

3. Clearing for agriculture (sugar cane) food crops. These are traditional habits which always find support in the disadvantaged social groups.

4. Building of cabins. The damp savannas at the forest periphery are continuously squatted on creating a precarious habitat. In this case too, the social aspect is considered more important.

5. Controlled dumping. "Controlled" dumping in the *Pontoise* region is located at the mangrove area and covers as of now, 24.7 acres (10 ha), and it extends itself every year. That garbage together with the garbage coming from urban areas of the city of Pointe a Pitre is certainly related to the alarming contamination of the Rivere Salee (residuals of heavy metals have been found).

6. Natural disasters. One of the worst calamities of Guadaloupe's environment, the mangrove area, is usually harmed when the disasters occur.

7. Other kinds of pollution. The pollution which originates from the garbage of the cities, the use of pesticides, and all the chemical and biological waste that people are capable of generating. The pollutants accumulate in the land's basin. The accumulation attains, in some cases, alarming quantities.

8. Illegal hunting. We will mention just for the record the continuous illegal hunting that takes place in the mangrove area. The degradation and contamination of the environment are particularly alarming and, despite the lacking mechanisms aforementioned, it is the forester's duty through his good judgement and service to preserve as best as possible these vulnerable and endangered ecosystems.

### *Administration Actions*

In the sociocultural and legal context aforementioned, it seems that if the forester wants to secure the perpetuity of these environments, he must adopt the following strategy: (1) inform and educate (reconcile people with the environment), (2) understand and integrate the economic, traditional and modern needs, and (3) protect.

#### *Inform and Educate*

The forester must take advantage of his daily contact with the public, but must also hold exhibitions and cultural events. The publishing of a text with good documentation, and with interesting and attractive illustrations and pictures at a reasonable price for the public could be of great help. There is a current international awareness of the importance of cleaning and preserving the Earth. These nature-oriented attitudes must be exploited.

Finally, we must teach people, sporadic or permanent inhabitant of the Antilles, to see the mangrove area not as a hostile environment anymore, but rather as an ecological mine, an advantageous curiosity. For example, a nursery for sea animals, a reserve of equally interesting animals and plants.

To inform and to educate is also the task of the recently created *Parc National de la Guadeloupe,* which is in charge of administering the *Reserve Naturelle du Grand Cul-de-Sac Marin.* This structure, confident of its national and international reputation, seemed to be the most appropriate form to evaluate certain local policies and in that way, secure an effective protection. However, we could not assure an effective protection unless we educate the decision- and policy-makers, the elected officials, the leaders of different associations, who through their decisions or echoing that of their constituency, will put into effect the ideas of preservation of the mangrove ecosystem.

*Understanding and Integration of the Social and Economic Needs*

But the politicians are also elected people and, above all, administrators who have to face a series of economic and social problems. Also, due to certain economic needs and due to the lack of a coherent policy on land use, certain decisions must be made. This is the case, for example, of the establishment of the Raizet Airport, in the industrial zone of Jarry, in the mangrove area. It is not realistic to oppose previous decisions, nor its follow-up projects (extension of the Airport, enlargement of the Industrial Zone).

In this conflict between economy and ecology, it seems that a series of concessions are in place. This interest in negotiations and commitment among the different parties leads to a conciliatory attitude on the part of the forester; to abandon the counter-attacks in order to win over and preserve other sites. It also leads to the defining of zones, ratified by the parties, where respect will finally be achieved. Now, it is urgent that the government adopt a firm attitude and take on preserving this important ecological asset.

*Protection*

The legal protection of those environments is, from now on, assured by the texts. Now it is up to appropriate mechanisms to enforce it. But, the prosecutions have always been a failure: regulations that have not gained support or that have not been understood, belated decisions leading to irreversible damage.

To reconcile people with environment does not mean to automatically exclude them from it. Thus, accepting a small peasant group to work some damp savannahs under supervision may contribute to protect the contiguous forest. In fact, the peasants who depend on those food crops are the best guardians of the share of land they cultivate, on the one hand, and of the marsh forest which they learn to respect, on the other. They appear to be the best informers for the forester and also favor the forester's early legal action.

Finally, the *Reserves Naturelles* (those of the *Grand Cul-de-Sac Marin* for example) are also effective means of protection that satisfy the modern societies' needs in terms of ecology and has gained in that respect good support.

*Conclusion*

We have arrived to the end of this quick review of the problems encountered in the administration of damp areas in Guadeloupe's litoral. Complex problems which could be however, resolved, if the inhabitants of Guadeloupe, construction companies or decision makers, industries or farmers, hunters, fishermen, islanders or visitors, express together their will to assure the future of these ecosystems. It is consensus that we are aiming for. Will this quest come up soon enough so it will not be in vain?

# WETLAND MANAGEMENT IN JAMAICA

*Roy Jones, Peter Wilson-Kelly, and Marcel A. Anderson*

*Abstract*

Jamaica's wetlands are a self-maintaining renewable natural resource. Their natural importances are far reaching and encompass areas such as flood water control, protection against coastal erosion, terrestrial sediment trapping, and marine nursery functions. Jamaica's wetlands have, in recent times, come under intense scrutiny as a potential resource base. A significant level of interest was generated when exploitable resources of peat were identified in approximately 75 percent of the total wetlands area in Jamaica. In addition, interest in the tourist value of wetlands has been created and the ecological importances of wetlands are being revealed by researchers, spawning interest in national conservation of wetland resources. It is imperative that Jamaica take steps to develop its natural resources so as to provide the base on which economic development can occur. However, such development must be designed carefully, and strictly controlled so that exploitation of natural resources, in this case wetlands, does not exceed the resource's capability to renew itself.

*Introduction*

Wetlands are often mistaken by thought to be wholly saline water features. It is often forgotten that freshwater wetlands also exist and are common in Jamaica. Wetlands can be described as the transitional areas between terrestrial and aquatic ecosystems where characteristics such as permanent or seasonal inundation of the land occurs, where the water table is at or near the soil surface, and where the soil occasionally, seasonally, or permanently supports hydrophytic vegetation, and the substrate is predominantly undrained hydric soils.

Based on this description, there are approximately 40,000 ha of wetlands in Jamaica. Differing hydrological regimes and vegetative development have resulted in major differences in the types of wetland found in Jamaica. In listing, these are: mangroves, marsh savanna, riparian swale, marsh forest, and riparian forest. These occur in various combinations or as isolated systems.

*Resource Utilization*

The resources available within wetlands, whether presently utilized or potential, can be identified as either substance or commercial resources. Both may overlap since the resource in question may be in use in both a subsistence and commercial manner. Grouped generally, resource use can be listed as: (1) the use of mangrove wood for charcoal production, fence making and dye production, (2) the use of wetland areas as a fishery for aquatic vertebrates and invertebrates, (3) the reclamation of wetlands for agricultural, residential, and industrial purposes, (4) the use of wetlands for tourism, and (5) the exploitation of peat resources for fuel and fertilizer.

*Black River Morass (Subsistence Use of Resources)*

The Black River Morass is regarded as Jamaica's largest wetland. Located in the predominantly arid parish of St. Elizabeth, its total area is approximately 14,000 ha. The Morass is traversed by four rivers, the largest being the Black River. The Morass removes nutrients from the river systems traversing it and redistributes nutrients to adjoining estuarine and coastal ecosystems. The Morass also plays an important role in river flood control. It is a habitat for the West Indian manatee and the American crocodile, two of Jamaica's endangered animal species, as well as many species of water fowl, aquatic invertebrates, fish, insects, and hydrophytic vegetation, as well as providing nursery functions for fish and invertebrates. It provides an economic base for over 20,000 people.

Human uses of the Morass can be classed as either compatible with, or deleterious to the ecosystem. The following list demonstrates not only

the importance of the Black River Morass but also the stresses being placed on it:

1. land reclamation by fire for subsistence agriculture,

2. removal of trees for timber and charcoal production,

3. mangrove bark removal for dye production,

4. harvesting of palm fronds and *Phragmites* vegetation for basket weaving,

5. construction of drainage channels and rice paddy fields within the Morass,

6. construction of channels from rivers into the morass to create habitats for shrimp rearing,

7. fishing within the Morass, and

8. small scale excavation of peat for sale as fertilizer.

Where the monetary value of such resources are concerned, examples can be quoted for the total annual gross values of fish and shrimp products which are estimated as J$800,000 and J$3,000,000 respectively.

*Negril and Black River Morasses (Commercial Use of Resources)*

In the late 1970's, both the Negril and Black River Morasses were identified as potential large scale sources of peat which could be exploited for fuel. Studies were conducted by the implementing authorities to determine the feasibility of peat extraction and the development of a peat-fired power station in Negril. It was estimated that both Morasses combined held enough peat to fuel power plants generating a maximum of 120 megawatts of energy for the next 30 years. At this time, this output corresponded to approximately 40 percent of the island's electricity demands and to a 10 percent reduction in oil imports. Environmental studies indicated that:

1. environmental effects of peat mining on adjoining beach, coral reef, and river ecosystems would be moderate,

2. subsistence fisheries and shrimperies at Black River would be adversely affected by peat extraction,

3. wetland systems in Negril would be reduced by about 80 percent while Black River's system would be reduced by 40 percent in total area. It was foreseen that wetland removal would be irreversible in human terms as regrowth would take hundreds of years,

4. the exploitation of peat in both Morasses would reduce Jamaica's wetland area by approximately 50 percent, the total area of both wetlands represents 75 percent of Jamaica's wetlands, and

5. the socioeconomic effects of peat mining on surrounding communities were deemed to be adverse.

To date there are still conflicting views on peat extraction and its potential effects and benefits.

*Wetlands Management Strategies In Jamaica*

*Existing Legislation*

At this point in time there are few comprehensive environmental laws in Jamaica, nor are there any laws that govern the use or protection of our local wetlands. However, wetlands can be protected through the interpretation of existing legislation. These are: (1) the promulgation of a tree preservation order under the Town and Country Planning Act, (2) the declaration of wetland areas and adjoining coastal waters as fish sanctuaries under the Fishing Industry Act, (3) the protection of water quality and endangered species under the Wildlife Protection Act, and (4) the regulation of foreshore encroachments by the Beach Control Act.

*Implementing Agencies*

There are several agencies in Jamaica with responsibilities influencing the use of wetland resources. The main regulatory agency is the Natural Resources Conservation Department (NRCD), which is specifically mandated with the responsibility for coastal resource management and is the implementing agency for both the Wildlife Protection Act and the Beach Control Act (administered through the Beach Control Authority). The NRCD insists on and reviews Environmental Impact Assessments (EIA's) for developmental proposals which will impact on wetlands, and thus ensures that the necessary measures are taken to minimize or eliminate the potential development impacts. The NRCD participates actively in environmental education programmes to sensitize the local population to the importance of maintaining our wetland resources for future enjoyment and to encourage controlled exploitation for future availability. The NRCD, along with other government agencies and nongovernmental organizations, (NGO's) is instrumental in the new thrust toward protected areas management which will include Jamaica's major wetland areas. Finally, the NRCD is actively involved in wetlands research, both within the agency and in partnership with the University of the West Indies and other foreign professionals, to update its knowledge of Jamaica's wetland ecology and resource base. This will lead to greater accuracy where wetlands related decisions are concerned.

*Summary of Wetlands Management Activities Conducted by NRCD*

Major activities undertaken, or being undertaken, by the NRCD with respect to wetlands management are listed below.

1. The Peat Resources Environmental Feasibility Study, Black River and Negril Morasses, 1983: Environmental impact assessment of peat mining on wetland ecosystems.

2. The Javemix Environmental Pre-audit Study, Southern Manchester (Canoe Valley) wetlands: Environmental impact assessments of bauxite mining on wetland ecosystems.

3. The Wetlands Inventory Programme, 1981-1982: Updating data on Jamaica's wetlands such as acreage, location, ownership, flora, and fauna.

4. The Portland Bight Study (Southern Clarendon Wetlands): Assessment of the ecological and economic roles of these wetlands with a view to developing management strategies for this area.

5. Development Studies and EIA Reviews: As the reviewing agency for EIA's, the NRCD ensures the safe use of wetlands resources.

6. The Wetlands Inventory Programme/ 1990-1992: A joint programme involving the NRCD, University of the West Indies, and the Normandeau Associates Incorporated (a foreign consultant), which will provide a greater knowledge of Jamaica's wetland resources to aid in its management.

7. The National Conservation Strategy, 1990: A government-devised plan whereby a clear national policy on environmental concerns will be worked out, long-term plans and projects for combating environmental damage will be designed, and public awareness programmes on environmental issues conducted.

8. The creation of the National Resources Conservation Authority (NRCA), 1990: The creation of a statutory body to incorporate all environmentally oriented government agencies into one legal body with powers of administration of a framework of environmental laws and acts.

9. The creation of national parks and protected areas: In recent times, the Jamaican government has begun to recognize both the need for and the growing international, regional, and public interest in the protection of natural resources. National parks and protected areas are seen as a way in which delicate resources can be preserved for the benefit of the Jamaican people. The concept of

"Ecotourism" represents the exploitation of the esthetics of resources as preserved in parks and protected areas and is the major argument for its inception. The Canoe Valley proposed national park site in the southern section of the parish of Clarendon is a project being conducted by the NRCD to ensure the protection of one of the most beautiful wetland ecosystems in Jamaica.

10. Public education: Through public outreach programmes, media releases, lectures, school tours, and annual exhibitions the NRCD is assisting in creating an awareness of the need to protect and conserve not only wetland resources, but other natural resources.

*Conclusion*

Wetlands management in Jamaica is not without its problems. New laws take time to be gazetted, agencies are poorly staffed, and adequate enforcement and research practices cannot be conducted. People are still ignorant of the need for wetlands management, or cannot do better as a result of economic conditions and there are those who do not care. However, the awareness is growing and one can now begin to hope for a more organized approach to wetlands management in Jamaica.

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# WETLANDS IN MARTINIQUE

*Francois Cailmail*

Martinique is a middle-sized island of the eastern Caribbean; its total area is 110,000 ha. The population is over 360,000, creating a great density in the inhabitated part of this mountainous island.

## *Wetlands in Martinique*

### *Areas and geographic distribution*

Wetlands are mainly represented by mangroves. Nevertheless, one can find several inland wetlands around the artificial Manzo Lake in the center of the island, along different rivers, and in swampy areas near Lamentin. The total mangrove area is estimated at 2,000 ha, which makes it the second in area after Guadeloupe, among the Lesser Antilles. These mangroves are mainly distributed around the south part of the island, the north part having very steep shores.

Fort-de-France Bay's mangrove is the largest, with 1,200 ha on the Caribbean Sea. The remaining 800 ha are spread in a large number of small- or medium-sized mangroves on the Atlantic coast, for example, le Robert, le Marin, and Sainte-Anne. The amplitude of the tide is small (1 to 2 feet).

It is probable that salt flats in Sainte-Anne were ancient mangroves, or a lagoon, which have been destroyed (*Etang des Salines et Anse Moustique*). Finally, Martinique has only one relic swamp forest of *Pterocarpus* (10 ha) in Trinite.

### *Types of wetlands*

Martinique bears four types of coastal wetlands. They are mainly characterized by the climate (rainfall) and the soil.

<u>Atlantic coast</u>. Rainfall (<1.5 m) and mainly sandy soil. The mangrove consist of *Rhizophora mangle* and is characterized by *Anona glabra* inland.

Rainfall (>1.5 m) on clay. Landward vegetation: *Batis maritima.*

<u>Caribbean coast</u>. Rainfall (>1.5 m) on clay and peat. Mangrove is characterized by *Acrostichum aureum* landward with *Conocarpus erecta,* and on the mainland *Tabebuia, Hypomane, Mimosa pudica,* and *Hematoxylum*. The rest of the mangrove has *Rhizophora* seaward and along the river banks. *Avicennia germinans* inward, with mixed stands of *Avicennia - Rhizophora* when salinity is over 30 parts per thousand and *Avicennia - Laguncularia* when salinity is under 20 parts per thousand. Ponds are uncommon in Martinique. Stands can reach as high as 15 m.

## *Wildlife*

Wildlife is typical of Caribbean coastal areas. One finds fish, birds, mammals, insects, crabs, lobsters, etc. This wildlife has been endangered by overfishing, hunting, and pollution. The number of bird species and their population density is thus reduced.

## *Ownership and Management*

On seawater, wetlands are state owned. *The Direction de l'Equipement* (DDE) is in charge of the land. *The Office National des Forêts* is in charge of the forest. Inland, the state owns also a strip of land 81.2 m wide, called 50 *pas du roi*, two-thirds of it being state forest, managed by *Office National des Forêts*.

Two major state agencies are, therefore, in charge of the mangrove, which has a special status known as *Domaine Public Maritime.* In theory, this land cannot be sold and special authorization is necessary for any occupation (pier, port, house, or construction). Permits are normally temporary.

The protection of these different wetlands is done through several French codes and laws, some of them being very old, e.g., *Code des Domaines, Code*

*de l'Urbanisme, Code Forestier, Code de l'Environnement, and Loi Littorale.* Fines and even prison sentences punish any violation (for example illegal tree-cutting, fishing, or shooting).

Recent laws and decrees have partly decentralized development planning. For instance, the Regional Council (*Conseil Regional*) is preparing for approval at mid 90, a general scheme known as *Shema d'Amenagement Regional* (SAR). This document also deals with the *schema de mise en valeur de la mer,* which concerns all lands near the sea. As the good use of this vulnerable and overcrowded part of the island is vital, this document must be approved both by the French Government and the *Conseil Regional.* After approval, all the local plannings (*Plan d'occupation des sols*) will have to respect the main issues of the SAR. In the case of mangrove, this is mainly protection. But, experience shows that implementation is sometimes very different.

### *Threats*

As in all the Caribbean islands, mangroves are very vulnerable, especially when they are close to urbanization. A list of threats would include: agriculture, hunting, aquaculture, charcoal, fish traps, fisheries, settlements, hotels, industrial and commercial plants, waste dumping, roads, motorways and airports, commercial ports and marinas, pollution (agriculture and chemicals), and silt and soil erosion. The consequences of such modifications, or destructions, are serious, particularly if one considers the importance of mangroves in sheltering wildlife, protecting shores trapping sediment, storaging floods, etc.

### *The Fort-de-France Bay and Mangrove*

This is the largest wetland of Martinique and the most vulnerable. More than 250,000 people live in its vicinity. Fort-de-France Bay and mangrove have been studied several times.

#### *Specially Focused Studies*

Studies have been conducted either for research or for development (table 1).

Table 1. Studies in the mangroves of Fort-de-France.

| Study | Author and date |
|---|---|
| Space dynamic of the mangrove | |
| Species (fauna and flora) | Portecop 1979 |
| Dynamic of species - tree growth | Chanteur 1980 |
| Land use and man influence | Brossard 1983 |
| Relation between soil and plant | |
| Development for agriculture uses (polder) SOGNRAH 75 | |
| General scientific study | 1989-1990 |

In order to make planning decisions, a good knowledge of the bay is needed. Therefore, the *Conseil Regional* funded an integrated study of the Fort-de-France Bay. This study is undertaken by the Antilles-Guyane University, and will deal with the whole sequence: reef barrier, lagoon, mangrove, and inland. Cost is estimated at $600,000. The study will concentrate on a better understanding of sediments, currents, fauna, flora, soil-plant relations, pollution, human uses, etc. It will serve as an example for future studies in the Caribbean islands and, therefore, it was also endorsed by UNEP program through the Caribbean Action Plan. The main goal is to help planners integrate, in this coveted part of the island, the economic development with respect to the environment. The first results were known during 1991

*Protection and Management of the Mangrove*

In densely populated islands, with very few flat areas for development, it is very difficult to maintain or protect wetlands. The pressure is even greater when towns have already spread and destroyed such areas.

Some uses of wetlands cause few changes; e.g., protection, recreation, wood production, fishing, hunting (when well controlled). Other uses alter the wetlands; e.g., agriculture and aquaculture (produce a general modification but can also lead to interesting new ecological niches). Still other uses cause partial or total destruction of wetlands. For example, urbanization, industry, roads, ports and airports, marinas, agricultural, human and chemical pollution, sand quarries, waste dumps, etc. Nevertheless, some planners and politicians are now aware of the high ecological value of wetlands, especially mangroves.

Before any land-use decisions are made, sound knowledge and an inventory of wetlands are needed. Integrated planning should generally be conducted so that in time and space, economic, and ecological values of wetlands are taken into account. In many cases, protection or sustainable uses will be the only alternative. However, when it is feared that development could affect wetlands, it is necessary to map precisely, according to their respective values. For example, areas of consideration are those areas to be entirely protected, areas to be restored or managed without fundamental changes, and those that can be abandoned.

Finally, the best way to protect these precious wetlands in the Tropics is to improve public education and dissemination of information, mainly to the children.

# WETLANDS OF MONTSERRAT

*F.A.L. Margetson*

Montserrat's miniscule wetlands are of concern to the Forestry Division of the Ministry of Agriculture, Trade, Lands and Housing and to the Montserrat National Trust. The Forestry Division, represented at this workshop by Forest Ranger John Martin, is being revitalized mainly through exposure to formal training of its forestry officer, currently at New Brunswick, Canada, forest rangers at ECIAF, Trinidad, and short attachments in forestry departments within the Caribbean region. The National Trust, which I represent, is attempting to earmark and pull together a long list of protected cultural and natural areas into a widespread and all embracing System of Parks and Protected Areas (National Parks).

Assistance has been provided to the Trust by World Wildlife Fun (UK) for the establishment of an office in Plymouth, the capital, and for the employment, until September 1990, of a secretary and a part-time national parks coordinator. We have also recently received assistance from RARE Center for tropical bird conservation, whose conservation education projects is using the national bird, the Montserrat oriole, as a center piece for an environmental awareness programme aimed at school children, the general population and, hopefully, the administration and the political directorate as well. These people, understandably, have other priorities, even in normal times.

It is hoped that these ongoing programmes will be strengthened and supported by various new or proposed legislation relevant to historic sites, monuments and artifacts, forestry and wildlife, watersheds, and national parks. It is also hoped that Montserrat, which often gets bypassed by everybody because of its size or its constitutional status, will be able to benefit from regional and subregional programmes, such as the FAO Tropical Forestry Action Plan for the Caribbean. So often we are involved in the consultation phase but the plans fade out before any finance, implementation, or action can reach us!

I referred earlier to "miniscule wetlands" of Montserrat because, in fact, we have only two wetland areas of sufficient significance to be listed in the 1985 Directory of Neotropical Wetlands compiled by Scott and Carbonless for YUAN and IRBM. These are the Foxes Bay Bird Sanctuary, which is 6 hectares in extent, and the Belham River Estuary, which supports small patches of wetland scattered over 14 hectares.

You may well ask at this point why a large delegation of two persons should need to come all this way to report on such a small segment of our proposed parks system!

First of all, you must appreciate that on a tiny island of less than 40 square miles, with fewer than 12,000 people, everything is scaled down to small size. Nature never endowed us with more than a few wetland areas, and in the wake of king cotton of the 1930-1940 decades, and the deforestation, hillside cultivation, massive soil erosion and siltation associated with that area, we have to cherish, nurture and manage these two sites, or they, too, will be lost. Simultaneously, we will lose, along with them, the unique flora and fauna, particularly the avifauna, which may exist elsewhere in the Caribbean, but nowhere else in Montserrat. We also wish to conserve and to undertake studies of the aquatic life in the brackish pond in the Foxes Bay Bird Sanctuary. No one, as far as we know, has ever assessed the ecology of this small pond, or its impact, if any, on the marine life of Foxes Bay.

We can't build the entire system on one stroke; so, wherever we can drive home a small nail, we are consolidating the slow process of putting together what will some day be our system of parks and protected areas.

*Foxes Bay Bird Sanctuary*

The Foxes Bay Swamp was leased to the National Trust in 1979, and with the support of the then tourist board, a trail was developed, a leaflet prepared, and the area was declared protected, and was promoted as a main attraction for nature-loving tourists.

Several factors have had negative impacts on the site over the last nine years:

1. Following island-wide flood rains in 1981, it appeared that there was some risk of having the pond and its contents flushed out to sea. Boulders were brought in and a bulldozer was used to block the outlet to the sea.

2. This intervention probably caused an elevation of the water level in the pond, leading to the flooding of the trail which had been established inside the perimeter of the swamp. During several years thereafter this flooding was aggravated by heavy rains, and the Tourism Department eventually ceased to promote the area as an attraction.

3. There was some dying-off of mangroves and other trees; and, samples of water sent overseas for testing for toxic levels of uric acid (from bird droppings) and other chemicals revealed no evidence of anything significant. The dying-off may have been a result of the change of water table level. This mystery remains unsolved.

4. Some of the egrets found alternative roosting and nesting sites throughout the island.

5. Structures such as the observation platform, the bridge, signs highlighting trees and the trail, deteriorated and it was impossible for the Trust, for financial and logistical reasons, to replace them.

6. Opportunistic landless livestock owners allowed cattle to roam along the trail, and to water at the pond, further degrading the area and discouraging sightseeing.

7. Increased use of the adjacent beach, Montserrat's most popular beach, brought with it increased littering, the erection of unsightly temporary picnic sheds and bars, and other abuse.

8. Inland of the swamp, the progress of a housing subdivision increased dumping, in the area, of rubble by building contractors, who also took advantage of any opportunity to remove sand illegally from the beach for construction.

9. It became a realistic possibility that with the development of houses at an elevation higher than the swamp, all forms of domestic pollution could pose a threat, if uncontrolled.

10. Then finally on September 17th, 1989, came Hurricane Hugo. It devastated the area, uprooting tamarind, manchinel, mangrove and other large trees, and where there was once a trail, Hugo left a sad, tangled mass of dead or dying trees and other vegetation, and seriously threatened the area's future as a viable wildlife sanctuary.

*The Belham River Estuary*

This wetland became a part of the Montserrat Golf Course some 25 years ago. Much of the vegetation was cleared at that time for the development of the greens and fairways which are still maintained in good condition today. Strips of trees were left along the river bank and seashore, but these were destroyed by Hugo in 1989.

While there has been a decrease in the flow of Belham River, especially during the dry season, probably as a result of watershed degradation or spring catchment, this has been compensated for by the activity of springs close to the site, which have caused water table fluctuations and soggy conditions attractive to shore birds and waders, some of which are migratory species. Attempts by golf course management to depress the water table by pumping or by surface drainage have so far had little effect on the birds, which are really part of the attraction of the

golf course. There seems to be no need for any urgent remedial action, as the site is being maintained in a stable condition, often more suitable for birds than golfers. It would be an advantage to be able to place interpretive signs and descriptive brochures for golfers and birdwatchers alike reminding all of the importance of the conservation of these gulf course "residents", many of which are apparently breeding at the site.

So what of the future for these wetlands? Happily, all is not lost. Already this year (1990), two well-known ornithologists have visited the Island to conduct wildlife censuses—Wayne Arendt, courtesy of World Wildlife Fund, USDA Forest Service, and RARE Center; and Peter Evans, courtesy of ICBP, and both have been optimistic about the future. Peter Evans observed 22 species of birds at the Foxes Bay Bird Sanctuary, and a similar number at Belham River Estuary.

In passing, let me say that our appeal for a meaningful Environmental Education Project launched at the Fourth Meeting of Caribbean Foresters in Dominica, brought us the ongoing Conservation Education Project (and we got a valuable set of bird posters as a bonus!).

This time around, we are appealing for assistance to consolidate the Montserrat National Trust as an institution, and to assist us with our educational and post-Hugo rehabilitation projects and programmes, and, certainly, the salvaging of our leading interpretive wildlife center, the Foxes Bay Bird Sanctuary, and its restoration as a leading education/recreational center and one of the island's tourist attractions.

Our thanks to the organizers of this Fifth Meeting of Caribbean Foresters and the Puerto Rico based USDA Forest Service officials, the Director and Project Leader, USAID and others who made it possible for us to attend and to participate in this workshop.

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# MANAGEMENT OF WETLANDS IN PUERTO RICO

*Diego Jiménez Carrión*

The wetland areas under the administration of Puerto Rico's Department of Natural Resources are classified into three main groups, according to management policies, objectives, and the strategies to attain the goals related to these objectives. The three groups are: state forest natural reserves, natural reserves, and wildlife refuges.

### *State Forest Natural Reserves*

The Ceiba State Forest Natural Reserve lies in the eastern coastal plains of Puerto Rico and consists of 363 acres divided into two parcels of mangrove forest described as topographically flat, with elevations ranging from sea level up to nearly five feet above sea level. Originally, the reserve consisted of 3,404 acres, but by agreements between the U.S. Government and the Commonwealth of Puerto Rico in 1941, a total of 2,466 acres was transferred for national defense purposes; and the Roosevelt Roads Naval Base was established. Another local government agreement transferred 547 acres to individuals for housing purposes.

The Piñones State Forest Natural Reserve, located in the northern coastal plain consists of 3,320 acres, most of which (60 percent) is covered with mangroves, and contains two coastal lagoons: Piñones Lagoon (180 acres) and Torrecillas Lagoon (390 acres), comprising the largest mangrove (basin type) ecosystem in the island, as well as freshwater marshes.

The Boquerón State Forest Natural Reserve is a 2,040-acre forest located in the southwest coast of Puerto Rico, and consists of salt flats, cliffs, a lagoon (Joyuda Lagoon), and mangrove forests. The Guánica State Forest, an International Biosphere since 1981, consists of 9,000 acres of upland and coastal forests, and mangrove wetlands, including several offshore mangrove islands.

The Aguirre State Forest Natural Reserve is a 2,464-acre subtropical dry forest, located in the south coast of Puerto Rico, consisting of salt flats, estuarine zones, lagoons, and mangrove forests.

### *Natural Reserves*

The natural reserves system includes the following reserves: (1) east coast - the Cordillera Natural Reserve); (2) north coast - Tortuguero Lagoon, the largest freshwater body on the island (1,274 acres); (3) southwest coast - Parguera Natural Reserve (15, 926); (4) south coast - the Jobos Bay National Estuarine Research Reserve (1,250 acres); the offshore islands of Caja de Muertos (417 acres); and the Mona Island Natural Reserve (11,667 acres) in the Passage of Mona, between western Puerto Rico and the Dominican Republic. Puerto Mosquito Natural Reserve (963 acres) is located offshore Vieques Island.

### *Wildlife Refuges*

There are two wildlife refuges: Humacao Wildlife Refuge (1,600 acres) in eastern Puerto Rico, and the Boquerón Wildlife Refuge (386 acres) in the west.

### *Historical Management*

From a historical standpoint, the outlook for management of forested wetlands is improving in Puerto Rico, in spite of past setbacks and the most recently one caused by Hurricane Hugo. In September 18, 1989 winds averaging 140 miles per hour struck the eastern and northern coastal areas.

During the late' 30's and the early' 40's, the official government policy was to convert mangroves to dry land. This practice allowed squatters to enter wetland areas, as well as for industries and residential complexes to be established in the areas that used to be important ecological ecosystems. Incidentally, our international airport and the nearby residential

complexes stand where an extensive mangrove forest existed previously. In 1974, shortly after the establishment of the Department of Natural Resources, an inventory of mangrove wetlands of the island showed a net loss of about 1,500 acres in just 2 years. Thanks to an intensive coastal zone planning effort, a government-wide policy for conservation of mangrove and other wetlands was adopted in 1978.

During the 1970's, the Department was able to add to its lands only 568 acres of mangroves from a parcel belonging to the Industrial Development Company, adjacent to the Piñones State Forest. A special appropriation from the Commonwealth Legislature allowed for the acquisition of this parcel. The Department expanded the Piñones Forest to the east, including a beautiful and highly productive stand of basin mangrove forest, adding canals for recreational boating, and protecting the shoreline and water quality of one of the largest salt water lagoons in the forest.

During the early 1990's, the Department was able to buy more mangrove lands adjacent to the Aguirre State Forest (1,250 acres) including a bioluminescent lagoon in and near the Jobos Bay in the south. The Commonwealth added as "match" the overwash mangrove islands, at the mouth of the Bay. In this way, the National Estuarine Research Reserve was set up to operate as a center for research, protection of natural ecosystems, low-impact recreation, and environmental education. Soon afterward, the department was able to lease estuarine areas in Humacao (1,600 acres) to establish the Humacao Wildlife Refuge. In 1989, the Department obtained a 25 year lease on mangrove wetlands, another bioluminescent lagoon, and valuable upland dry forest habitat from the Puerto Rico Industrial Development Company in the offshore island of Vieques. The Vieques Natural Reserve was established as a result of this negotiation.

Also, last year, the Commonwealth of Puerto Rico was able to use part of monies assigned in 1984 to the U.S. Fish and Wildlife Service by the U.S. Congress to purchase about 772 acres in and around the Cartagena Lagoon and dedicate them as a wildlife refuge. These lands, once in sugar cane and now abandoned, include wetlands once described as "the best in Puerto Rico" for migratory ducks, herons, and other waterbirds. A cooperative agreement between the Department of Natural Resources and the U.S. Fish and Wildlife Service allows for the management of these lands and waters for 50 years and to restore them as a wildlife refuge. Title to the lands remains in the Commonwealth of Puerto Rico.

To summarize wetlands purchases: in the 1970's the Department of Natural Resources obtained only about 575 acres of wetland forest. Between 1980 and 1985, the Commonwealth of Puerto Rico obtained by transfer or purchase almost 2,800 acres in Humacao and Jobos Bay. Between 1986 and the present, we have obtained nearly 1,800 additional acres, and expect this number to go up before the end of 1990. Grants from U.S. government agencies or re-orientation of existing programs have allowed the funds for wetland purchase.

*Recent Conservation Developments*

The Commonwealth of Puerto Rico Natural Heritage Program Law, passed in 1988, for the first time assigned state money to our department for the specific purpose of habitat purchase. Our Heritage Program identifies land areas of special importance because they shelter rare plant or animal species, high-value wetlands, or other endangered ecosystems. The program has identified 12 high-priority wetland areas in Puerto Rico, and these are the areas we are buying, acquiring by transfer or lease from other agencies, or hope to acquire in the immediate future.

But, not only the Department of Natural Resources has demonstrated interest towards the acquisition of wetlands. Other conservation groups like the Vieques Conservation and Historic Trust, and the Puerto Rico Conservation Trust are assisting. Just last month, the Puerto Rico Conservation Trust announced that it has just bought over 700 acres of fresh and brackish swamp forest dominated by bloodwood (*Pterocarpus officinalis*) and mangrove at a total cost of 1.2 million dollars, to create the first ever freshwater swamp forest reserve in Puerto Rico. This parcel is adjacent to the Humacao Wildlife Refuge established in the early' 80's and is part of the

largest freshwater swamp forest on the island. The Trust should soon receive about 70 acres of another freshwater swamp wetland, in exchange for partial development of the rest of a private tract.

Another practice introduced by the Department of Natural Resources is to require "mitigation" for damaged wetlands in order to repair the damages caused by private entrepreneurs to wetlands. We have just received our first "mitigation" parcel to compensate for a housing project in the metropolitan area. Rather than gamble on rebuilding an artificial swamp on part of the parcel he was developing, the builder preferred to buy up a much larger parcel of low-cost mangrove swamp and deed it to our Department. This parcel will add 55 acres to the Piñones State Forest. Besides, nongovernment conservation groups are more active than ever before in defending wetlands and demanding that their government do the same.

### *Focus of Current Programs*

As all of us know, the importance of mangrove forests, salt flats, and other associated biological communities is to provide: (1) excellent habitat for a large array of sport fishes, (2) serve as a nursery for young fingerlings of many fish species, (3) provide for nesting and roosting sites for many birds, (4) serve as a shore protection barrier, (5) provide for popular fishing activities, (6) provide raw material for small amounts of charcoal-making under the adequate supervision, (7) provide for recreational boating, including motor boats, canoes, and kayaks, and (8) provide for hunting activities (only in the wildlife refuges and under controlled circumstances).

Accordingly, our programs are focused to: (1) promote the use of public fishing facilities for the communities near the areas, (2) design and construct supporting structures such as fishing decks, boat ramps, piers, mooring aids, and picnic areas, (3) monitor and manage sport fishing populations, (4) establish programs for collecting and interpreting data on the fish and fishing activities, (5) improve the management of the natural resources within the areas, (6) curtail adhoc damage to coral reef habitat for preserving the environment of the sport fishes, (7) protect endangered species like the West Indies manatee and the sea turtles, promote research, (8) develop educational tools (brochures etc.) that contain valuable information on marine and estuarine fish species, and (9) improve coastal mangrove systems by appropriately managing special areas.

Funding from the U.S. Fish and Wildlife Service not only assists us in achieving these management objectives, but also provides for the acquisition of fish habitats and establishment of recreational boating facilities. These funds (Dingell-Johnson) have been used during the last 4 years for the above mentioned purposes, and also for surveying at least one of the State Forests where game fishes occur. We have a firm interagency commitment to use these funds to buy nearly 2,000 acres of wetlands near the Piñones Forest. We are now proposing additional wetland purchases near Tortuguero Lagoon to protect the habitat and provide access to fishermen. The sport fishing facilities are concentrated in the State Forest natural reserve System: Piñones, Ceiba, Guánica, and Boquerón; and into the other natural reserve or refuges: Mona Island, Humacao, and Boquerón. New proposals submitted this year to the U.S. Fish and Wildlife Service will make possible to extend our programs to the Aguirre State Forest.

### *Management Problems*

The local problems associated with the management of wetlands are mostly related to prosperity, urban life, and dense population. Almost all of our managers have trouble from time to time keeping popular "off-road vehicles" out of sensitive wetlands, where they can damage roots, animal burrows, and groundnesting birds. Trees and branches can be, and often, are cut by picnickers who run out of charcoal and forget that someone else will have to use the same recreational area site the next week. Illegal sand extraction is practiced once in a while, damaging the dune system. Business related to tourism and forest visitors (snack bars, restaurants, convenience stores, docks, and others) may build right outside the forest boundaries, sometimes "stealing" a little forest wetland by depositing fill a little at a time, until they have invaded the forest. Sedimentation within the mangrove forest and coral

reefs continues to be a problem. Unsound agricultural and developmental practices contribute, to great a extent. Landfilling of our wetland areas has improved impressively; nevertheless, garbage dumping by nearby residents and occasional visitors continues to be a problem to face and work out. Unlike our neighboring island of Hispañiola, we have no serious problems with cutting of our mangroves, because most people cook with bottled gas or electric stoves. Finally, as in all places, some government agencies still haven't learned that wetlands are a valuable resource. Nevertheless, in the late 1980's, as the true value of wetlands was recognized, we had more opportunities to protect wetlands, forested areas like mangroves and freshwater swamps, and herbaceous wetlands, some of which may become reforested under our management and that of other conservation groups. Stricter laws protecting wetlands and the latest requirement for repair or "mitigation" are tools available to reinforce the conservation of wetlands.

After the passage of Hurricane Hugo, our efforts are mostly concentrated in repairing and reconstructing the sites damaged by the winds at Ceiba, Humacao, and Piñones.

It appears that the tide has turned in favor of the protection of forested wetlands. In Puerto Rico, we have been fortunate: we still have large stands of mangrove and freshwater swamp forest. Now, our challenge is to find new ways to use them for recreation, tourism, and education. We are increasing our efforts to encourage "ecotourism" or "nature tourism" in our forests and recreational areas. We are building simple structures to allow better public access to the water, better facilities for sport fishermen, and more interesting brochures, trails, and signs. We hope to convert the Piñones State Forest into a "national park" in the years to come. Only if we can get people to know, use, and love our wetland forests, can we hope to keep them intact for the coming generations.

# STATUS OF SAINT LUCIA'S WETLANDS

*Brian James*

The island of Saint Lucia is predominantly volcanic in origin and covers a total area of 238 square miles. According to Deveaux (1988) the wetlands of Saint Lucia are relatively small, but they represent most wetland ecosystems. Saint Lucia once had approximately 791 acres of wetland, but the area has been reduced to 476 acres, with some areas currently under considerable stress (table 1).

The wetlands in Saint Lucia are made up of four types of systems: estuarine, riverine, palustrine, and lacustrine (Portecop and Benito-Espinal, 1985). The estuarine system is referred to as a fringing mangrove swamp, which is formed at the end of a watershed where it meets the sea. This type of wetland is considered to be the most productive and it includes mud flats or tidal flats, sea grass beds, and fringing mangroves. The riverine mangrove swamp is formed when a river or stream meets the sea at the back of a beach of sand where a lagoon has been created and mangrove abound. This is the most common wetland in Saint Lucia.

The palustrine system is a basin mangrove swamp which is formed where low lying land has a depression that can hold water. They are most often referred to as fresh- or saltwater marsh. Mangroves will not grow where the water is fresh year-round. They require salt water to form natural communities.

Table 1. Wetland types in Saint Lucia (from Deveaux 1988).

| Types of Habitat | Example |
|---|---|
| Tidal flat | Praslin |
| Fringe mangrove | Marigot |
| Riverine mangrove | Dauphin |
| Basin mangrove | Bois D'orange |
| Salt water lagoon | Canelles |
| Reed marsh | Anse La Raye |
| Reed swamp | Marquis |
| Closed canopy swamp forest | Anse Ger |
| Herbaceous swamp | Belle plaine |
| Forested wetland | Desraches |
| Fresh water marsh | Hewanorra W |
| Back swamp | Roseau |
| Inland delta | Roseau |
| Flood plain | Cul de Sac |
| Fresh water lake | Rabot |
| Dry stream thicket | Galette |
| Fresh water hole | Troumassee |
| Fish pond | Beausejour |
| Sewerage treatment pond | Hewanorra N |

The lacustrine system is formed in Saint Lucia by seismic, or volcanic, activity where a weakness in the earth's crust has caused slumping of the surface, usually resulting in the formation of freshwater lakes, commonly referred to as "sink holes" or "punch bowls." The palustrine and the lacustrine systems are an important habitat for waterbirds.

The above mentioned systems are all naturally occurring, but Deveaux (1988) made mention of artificial human-made wetlands created for the purpose of wildlife sanctuaries or other natural functions such as cattle watering ponds, fish ponds, reservoir dams, and sewerage treatment ponds. These are important types of wetlands that should be included and considered with the Island's wetland systems. Deveaux (1988) suggested that the dry stream thicket be included in the wetlands of Saint Lucia because of its diverse flora and rich avifauna. This ecosystem, he wrote, has some of the characteristics found in a wetland system such as a wooded thicket harboring many of the birds found in wetlands. Although the stream stops flowing during periods of no rainfall, it maintains a high underground water table that keeps the vegetation lush and diverse.

*Problems*

Wetlands are among the most dynamic ecosystems on the earth. As an example, the swamps of Saint Lucia have increased in size but not in quality, especially during the 19th and 20th centuries. It has been noted that total wetlands area has been reduced for a number of reasons despite the increase in swamp size. Many wetland areas in Saint Lucia have been affected by human activities. Some of these problems are deforestation, charcoal production, construction, reclamation, garbage dumping, and pollution.

Land clearing for agriculture, especially on the steep slopes, has contributed to and accelerated soil erosion. The silt transported to the coast affects the ecological balance of coastal wetlands, particularly the riverine system. Siltation causes fast-flowing rivers, fringed with mangroves, high nutrient status, and abundant aquatic life, to become a closed marigot, heavily silted with low circulation, low oxygen content, and reduced aquatic life. All this change allows the mangroves to literally cover the entire basin.

Clearing vegetation at Mankote, Esperance, Micoud, and Volet are a few examples of wetlands that are currently being exploited for charcoal production and firewood. These activities have severely disrupted the ecological processes, reduced the water table, and influenced the water regime at Esperance and Mankote especially during the dry season.

Many developers view wetlands as wastelands that nothing more can be done except to drain, fill, and reclaim them for development of some kind. These wetlands, when altered, cannot be easily replaced or rejuvenated.

The wetlands at Choc, Volet, Blackbay, and Mankote were all important garbage dump sites. With the exception of Volet, the others are no longer used as dumping sites. A new wetland site at Cul-de-Sac is now in use and is seriously under threat of severe degradation. These garbage-dump areas are seriously degraded and are contributing to pollution of the coastal waters through surface runoff and long-term leaching.

Deveaux (1988) noted that wetlands such as those at Belfond Lake, Belleplaine Wetland, Etang Lake, and Desraches have all been drained for agricultural purposes. He also commented on the fact that deforestation was the greatest single factor causing reduction in the water table, increased evaporation, and drying of lakes in Saint Lucia.

In Saint Lucia, the two types of wetland systems to have suffered the greatest lost are the lacustrine and the palustrine systems. Of the original 76.5 acres in the lacustrine system, 88 percent has been lost with only 9 acres at Rabot remaining. The palustrine system has lost approximately 66 percent with Mankote(100 acres), and two small areas of 2.7 acres are all that remains of this system (Deveaux 1988). These two wetlands systems provided Saint Lucian hunters with good hunting grounds for game birds prior to 1980. A reduction in the area covered by these two systems means that other nongame birds may become targets if, and when, hunting of wildlife is resumed in Saint Lucia.

*Progress and Management Opportunities*

Wetlands are important for a number of reasons. They are able to provide numerous benefits both direct and indirect. The importance of mangrove wetlands has been documented in numerous publications. However, in Saint Lucia the fishing industry, tourist industry, wildlife, and nature lovers all benefit immensely from the wetlands. Therefore, there is need to manage this resource.

According to Deveaux (1988), Saint Lucia has lost over 40 percent of its wetlands while 50 percent of the surviving wetlands are so degraded and under stress that they can be totally destroyed within a short period of time. Recognizing the importance of wetlands to fisheries, the Fisheries Department has been instrumental in having the government declare at least 12 mangrove areas as marine reserves (table 2).

Since 1983, the Department of Forestry, in conjunction with ECNAMP (later CANARI), initiated a pilot project in the southeastern part of the Island to establish a *Leucaena* charcoal plantation to reduce the pressure exerted by the charcoal burners on the Mankote mangrove. This project, although not entirely successful, has helped relieve some pressure on the Mankote mangrove.

The Saint Lucia National Trust, in collaboration with governmental departments, has put together an updated list of all wetlands in Saint Lucia. The majority of the sites were visited and evaluated for inclusion in the proposed Parks and Protected Area System Plan. The Plan, it is hoped, when adopted by Cabinet, will provide the kind of framework for the protection and management of the wetlands of Saint Lucia.

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Deveaux, J.R. 1988. The Wetlands of St. Lucia. Described, listed and evaluated.

Table 2. List of declared marine reserves.

| | |
|---|---|
| Esperance | Bois d'Orange |
| Mankote | Louvet |
| Savannes | Marquis |
| Praslin | Choc |
| Marigot | Grand Anse |
| Fond d'Or | Cas-en-bas |

# SAINT LUCIA BALANCED ON A KNIFE EDGE

*Gabriel L. Charles*

Saint Lucia lies midway in the necklace of islands that link the Greater Antilles to the Guyanas of South America. Small and independent, it comprises a scant 238 square miles and is home to 140,000 people, one-third of whom live in the capital - Castries - and its environs.

Its first settlers were the Amerindians - Arawaks and Caribs - who had little impact upon the Island's ecosystems because their population densities were too low and they did not practice intensive agriculture. This situation was to change with the arrival of the first European settlers; and the period from colonial times to the present can be divided into four eras (Lugo and others 1981).

*1500's - 1630*

Era of early settlers in which farming activities were not intense and habitat disturbance was confined to the low land coastal areas.

*1630's - 1880's*

The beginning of extensive monocultures with large land holdings and the importation of slaves. An expansion of population ensured an increasing influence on the environment. Forests were cut for energy and to fuel the boilers of the sugar cane industry.

*1940's - present*

Rapidly rising populations and increased energy demands see more and more forest areas converted for charcoal and agriculture. Crown releases state lands for smallholder development and with the introduction of the banana (which unlike sugar, is able to grow on steep lands), the fate of the forest is sealed.

Saint Lucia's rugged, mountainous interior, until recent years, provided a protective barrier to such agricultural developments; and its forest-clad hillsides provided catchment areas that ensured the island with a year round supply of clean, potable water.

In the years just prior to, and subsequent to, the country's independence (1979) Saint Lucia has witnessed a surge in economic development.

Aid-related projects have seen the development of literally several hundred miles of roads that have opened up previously inaccessible areas of the interior. United Kingdom price supports and the status of a protected market have ensured that the banana industry flourishes. Whilst a boom for the local economy and the nation's major employer, the banana industry has been the base of economic progress, its success has paved the way for the destruction of vast acreages of forest, particularly on private and leased state lands. A rapidly expanding population supplemented by reduced levels of outward migration and improved health facilities places further strain on our island's fragile physical resources. At a time when the country's river sources are under threat from watershed clearance, our demands upon its water are increasing. The material wealth accrued from the banana industry, and more recently from tourism that brings an estimated 100,000 tourists to our shores, has led to heightened expectations. Today the citizens of Saint Lucia, like those in other developing countries, expect a wall house and the amenities of showers, flush toilets, and washing machines.

To pay for imports, we develop hotels along the shoreline, and clear yet more land for the production of export crops; and so the vicious circle continues. It is a treadmill that one cannot stop; radical changes in agricultural policy or a slowdown in development would be suicidal politically and socially unaccept-

able to the masses for whom development has brought an improved standard of living and for whom conservation is at best an esoteric first world concept and at worst a barrier to their economic improvement. The round of destruction continues bringing the small developing territories closer to the brink - Saint Lucia remains a tourist paradise with its pristine and clear seas, but it is a paradise balanced on a knife edge.

If we were to scratch the surface, we would see a plethora of environmental problems discussed below.

### *Deforestation*

Deforestation is perhaps the most serious problem currently facing Saint Lucia and the Island is losing its forest resource at an estimated 2 percent per year and being a direct result of the continuing expansion of the banana industry that has in turn been the result of strong prices rising from EC$0.17 per pound in 1984, to EC$0.44 per pound in 1984, to EC$0.28 per pound in 1989.

The areas most affected are those in close proximity to newly constructed feeder roads such as Dennery; and it is safe to say that the only areas that remain secure are those that lie within the Island's 17,000-acre forest system. Although even here, past inadequate boundary marking and poor patrolling have led to considerable areas being cleared for cultivation. As the forest falls, so too, do the populations of wildlife that are reliant upon it, such as the endemic Sempler's warbler, now believed extinct, the Saint Lucia black finch (Me*lanospiza richardson*) and the Island's national bird, the Saint Lucian parrot (*Amazona versicolor*), which in 1977, numbered about 100, but which after a decade of conservation effort has rebounded to 250.

The dry scrub woodlands of the eroded coastal belt face the threat of indiscriminate clearing for fuel wood and charcoal, and past clearing has left massive tracts of eroded and near-useless scrub, especially on the east coast between Marquis and Micoud and on the west coast between Anse La Raye and Canaries. Forest clearance has adversely affected not only the terrestrial ecosystems, but also aquatic ones.

### *Siltation of Rivers*

Saint Lucia once prided itself on the quality of its rivers; and at the turn of the century Port Castries served as a way station for numerous ocean-bound vessels who stopped to collect coal and water. Today the islands rivers are drying up and Saint Lucia is literally running out of water. Its principal rivers, the Trounmasse Cul-de-Sac, Marquis, Dennery, and Roseau are silted and leave surrounding land prone to flood during the wet season and begging for water during the dry. During periods of heavy rain, the rivers flow brown with the forest laterite soils, carrying the nation's life blood downstream and dumping it on the reefs.

Today, out of water, so vital for its socio economic development, the government is seeking 100 million dollars to fund the construction of a dam in the Roseau Valley. Even if funds are located and the dam constructed, its life span has been estimated at 20 years, for it will face a slow death by siltation from the day it commences operation.

### *Reef Destruction*

Saint Lucia's reefs provide not only esthetic recreational areas upon which several dive centers are located, but also vital homes for several economically-viable fish species, and a natural coastal buffer to the erosive forces of the marine environment. This natural system, a symbiotic relationship between many millions of minute coral polyps and their even smaller zooxanthellae algae, is also threatened. Requiring clear water to allow the permeation of the life-giving sunlight for photosynthesis, the silt-laden waters are slowly suffocating this slow-growing ecosystem to death. The problem is exacerbated by poorly planned coastal zone developments, dynamite blasting, and the breaking of coral for sale to tourists; with the destruction of the reefs, so go the fish. Fishermen from Gros Islet in the north, to Choiseul in southwest, report reduced catches and go to great

lengths to harvest the sea's declining fish stocks. Chicken-wire fish traps litter the seabed, sucking fish out from the reef and further damaging this once sustainable ecosystem.

*Mangroves*

A second marine ecosystem under threat is the mighty mangrove, formally occuring at 12 sites around the island. Today, few remain. Despite playing a vital role in coastal zone protection and as a fish nursery, they have been cleared for marinas, hotel developments, and solid-waste disposal sites. Those scattered patches that remain are under threat from charcoal producers and are being sprayed with malathion in order to control mosquito populations. It is doubtful that any will survive the next decade.

Not content at having participated in the destruction of both Saint Lucia's terrestrial and marine environments the littoral zone is also under threat.

*Coastal Zone*

Saint Lucia's rising population is matched by increasing material demands and a boom in the construction industry - one that has traditionally used beach sand as a raw material for block manufacture. The excavation of sand has become a serious problem, denuding tourist beaches, leading to unsightly water or trash-filled hollows, increasing coastal erosion, and in the case of Grand Anse Beach, displacing nesting areas for endangered sea turtles. Housing developments and poor observance of setback limits have compounded coastal problems, as have the construction of poorly planned gabions and groynes.

Finally, Saint Lucia faces a new problem, that of disposing of the trappings of its materialism: solid-wastes disposal. Existing sites at Choc are full, and no alternative has yet been found. In the smaller villages, the answer has been to dump domestic waste either into nearby rivers or directly into the sea; this has led to pollution of waterways and in the case of some coastal areas, alarming increases in heavy metals in the sea.

Perhaps because of these problems, and certainly in an attempt to address them, Saint Lucia has a vast array of legislative acts and ordinances to protect the environment. Some, like the original Wild Birds Protection Ordinance, date back to the last century. Others, like the Litter Act, are less than 5 years old.

Over 22 national agencies have some role in environmental protection; yet, there is little inter-ministerial coordination and it was not until 1989, that Saint Lucia had a Ministry of the Environment. Even today, despite the diligent efforts of that Ministry's minister, it is still a matter of divide and conquer. Beaches or Queen's Chain are crown lands and thus in theory, come under the control of Crown Lands Section in the Ministry of Agriculture, yet are managed, albeit in theory, by a Beaches and Parks Commission which falls under the Ministry of Tourism, whilst permission for the mining of beach sand is the responsibility of the Ministry of Communications and Works. Likewise, watershed protection falls under Forestry (Agriculture), whilst water collection and treatment fall under WASA in the Ministry of Health. Attempts have been made to ensure some coordination, and in 1981, an environmental commission was approved by Cabinet. It was comprised of an ad hoc group of 22 individuals from a cross section of government, quasi-government, and NGO agencies that had some concern for, and involvement with, the wider environment. Meeting once a week and answerable to three ministers, the commission made a valiant attempt, and in just 6 months produced an agenda for action and directory of priorities. However, a change of government led to the commission's dismissal, and in its place, through an Act of Parliament, there was established a Beaches and Parks Commission. Whilst the legislature Acts gives this Commission broad powers (something the Environmental Commission lacked), it has until now concentrated its efforts on the licensing of beach vendors, litter bins on some beaches in the north, and clearing of one beach.

There remains a critical need for some forum to oversee and to act in an advisory capacity on environmental developments; today much of this power rests with the Development Control Authority.

The agency in the forefront of raising levels of environmental awareness has been the Forestry and Wildlife Department, under the direction of Chief Forestry Officer, it has developed innovative education programmes that have gone on to serve as the model for the neighboring nations of Saint Vincent and Dominica. This programme played a catalytic role in saving the Saint Lucian parrot and has raised levels of environmental awareness nationwide as was reported upon in a Man and the Biosphere document (U.S. MAB 1982).

A questionnaire survey was undertaken on four islands of the Lesser Antilles (Saint Lucia, Saint Vincent, Barbados, and St. Kitts, Nevis) and respondents were asked what they perceived to be serious environmental hazards. The report concluded:

> "It is of particular interest that 73 percent of Saint Lucian respondents described deforestation as a "very serious" environmental hazard. This proposition is far higher than in the other three countries and suggests that Saint Lucians are aware of the damage done to their environment by rapid deforestation during the past 20 years."

Through posters, billboards, bumper stickers, newspapers supplements, radio, and television the message of sound use of Saint Lucia's environment is reaching the island's people both at the level of decision makers and the population as a whole. But, it is essential that their words of support and encouragement be turned into deeds of action before it is too late.

The recent establishment of reserves, changes in legislation, and assistance rendered by international agencies augurs well for the future, but when one's fate lies in the balance we cannot afford any more mistakes.

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# THE STATUS OF MANGROVES IN ST. VINCENT AND THE GRENADINES

*Nigel J. Weekes and William D. Metz*

## *Introduction*

In 1989, the Saint Vincent Forestry Division, Ministry of Agriculture, Industry, and Labour (MAIL) began a program to evaluate the distribution of mangroves throughout Saint Vincent and the Grenadines. The object of this project was to quantify and assess the current distribution, stand structure, and ecological/social role of mangroves, as well as identify any land-use activity that may be in conflict with the Forestry Division's policy to preserve and maintain the biological diversity of the nation.

For this evaluation, a field reconnaissance was conducted during 1989 and 1990. The reconnaissance was augmented by verbal reports and information on mangrove distribution provided to the Forestry Division from various sources.

The red mangrove (*Rhizophora mangle* L.), black mangrove (*Avicennia germinans* L.), white mangrove (*Laguncularia racemosa* (L.) Gaertn. f.), and button mangrove (*Conocarpus erecta*) occur in Saint Vincent and the Grenadines. Distribution of the most significant mangrove forests are confined to Union Island and Mustique Island. Small mangrove areas (<0.4 acres) occur in Saint Vincent, Canouan, Mayreau, Bequia, and possibly Prune (Palm) Island. In most cases, these small mangrove areas are dispersed and patchy and have generally been degraded by human activities.

This report will address the three major concentrations of mangrove in Saint Vincent and the Grenadines.

## *Mustique Island*

Black mangrove is predominant in the 30 acres of wetlands in Lagoon Bay and the northwest corner of the Mustique Airport (fig. 1). Both areas have been classified as mud mangroves, which can be found in low areas inland from the ocean and characterized by the almost continual inundation of shallow fresh water. These mangrove swamps are growing inland on slightly elevated areas where tidal flooding is periodic. Soil salinities are in the vicinity of sea water (35 parts per thousand reported by B. Alexander, May 1990).

The Lagoon Bay mangrove swamp encompasses 20 acres of black and red mangrove in the southwest coast of the island. Black mangrove is predominant in the forest cover at 65 percent, while red mangrove occupies 25 percent, and Manchineel (*Hippomane mancinella* L.), Kashee-*Acacia* spp., and Mimosaceae spp. account for 10 percent of the vegetative cover. The area is characterized by a zone of black mangrove (19 acres) that encircles a freshwater inundated mud flat and a narrow belt of red mangrove (1 acre) that occupies the south and west (seaward) edges of the swamp.

The airport mangrove swamp encompasses 10 acres of black mangrove in the north-central portion of the island. It is characterized by a zone of tree and shrub-form black mangrove, with small clumps of button mangrove encircling a mud flat that is constantly inundated by shallow fresh water.

## *Union Island*

The mangrove forests on Union Island are located at the tidal interface between land and sea and are therefore, influenced by terrestrial and marine conditions (fig. 3). The Ashton Harbour and Richmond Beach mangrove areas are the most significant mangrove forests on Union Island. Other small and patchy mangrove areas can be found at the Belmont Salt Pond, Petit Bay, Clifton Bay Reserve, Miss Murray Estate, Point Lookout, and Queensbury Point. The 50-acre Ashton Harbour mangrove forest is the largest in Saint Vincent and the Grenadines . It is bordered by a 2-acre belt of red mangrove along the ocean fringe, and 48 acres of tree and shrub-form black mangrove in its interior. The Richmond Beach

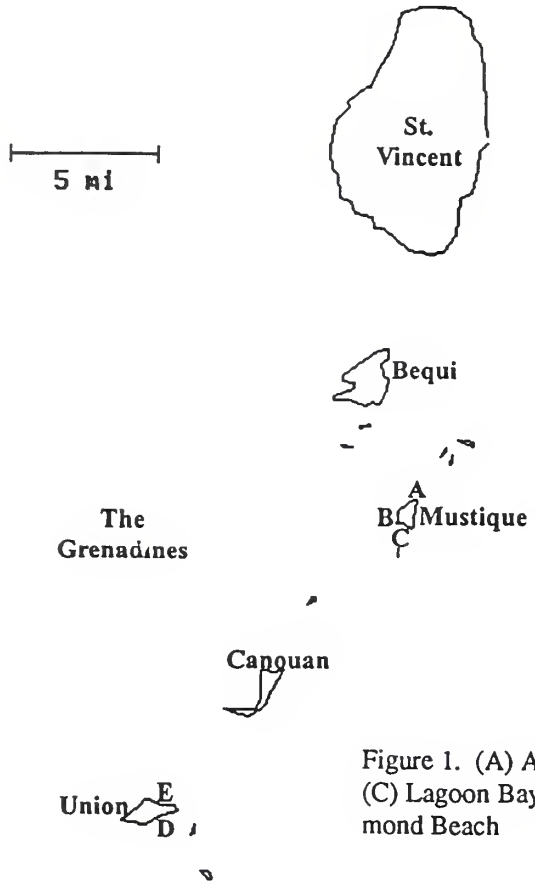


Figure 1. (A) Airport Mangrove, (B) Lovell Village, (C) Lagoon Bay, (D) Ashton Harbour, and (E) Richmond Beach

mangrove, located on the north-central coast, encompasses 14 acres of red, black, white, and button mangrove. The Clifton Bay Reserve Mangrove area is located on the southwest coast and is composed of 3.1 acres of red and black mangrove. The remaining mangrove areas on Union Island are small, patchy, and generally degraded. Union Island has the most mangrove areas, with approximately 72 acres, followed by Mustique with 30 acres. In all areas, black mangrove is dominant in almost pure stands, except in Saint Vincent, where only white mangrove is found.

### *Saint Vincent*

Only a few small patches of mangrove occur on Saint Vincent. The largest is a 0.4-acre fringe of white mangrove surrounding a pond at Milikin Bay, on the Island's south coast. Small and patchy white mangrove areas occur at the Carenage in Calliaqua Bay, Sion Hill Bay, and Almond Tree Bay at Johnson Point.

### *Utilization of Mangroves*

In the past, the people of Union Island and Mustique utilized black and red mangroves for charcoal, poles, boat building, and firewood. Consumption figures are not available, but quantities are believed to be relatively small. During the evaluation, it was evident that these activities do not appear to be a current form of utilization, as the remaining stumps and downed slash were fairly old and decomposed. There is no evidence of new cuttings in any of the areas.

The Milikin Bay white mangrove area on Saint Vincent was illegally cut in February 1990. Approximately 500 stems were cut for wattle and found hidden in the underbrush by the landowner.

### *Mangrove Flora and Fauna*

Flora diversity in all mangrove areas was low. Manchineel, tamerind (*Tamerindus indica* L.), gumbo-limbo (*Bursera simaruba*), kashsee - *Acacia* spp. and Mimosaceae spp. were found in association with most mangrove areas. These species normally occupied a zone inland and adjacent to the red mangrove, which is more elevated, has drier soils, and is less subject to tidal inundation.

Fauna diversity in all the assessed mangrove areas was high. Many fishes were observed in the red mangrove zones; however, they were not identified. Mangrove roots exposed at low tide showed the attachment of sessile organisms such as the tree snail (*Littorina angulifera*), sea worm (*Platynereis* spp.), sea cockroach (*Chiton marmoratus*), and barnacle (*Chihamalus bisinautus*). In the more consolidated muds below the red and black mangrove, the fiddler and land crabs (*Uca* spp.) are abundant. Many birds were observed in the mangrove areas. These included the tropical mockingbird (*Mimus gilvus*), green heron (*Butorides virescens*), cattle egret (*Bubulcus ibis*), mangrove cuckoo (*Coccyzus minor*) and the ground dove (*Columbia passerina*). The laughing gull (*Larus atricilla*), magnificent frigatebird (*Fregata magnificens*), and the brown pelican (*Pelecanus occidentalis*) were observed in the immediate vicinity of the mangrove systems.

### *Mangrove Land-Use Conflicts*

The mangrove habitats of Saint Vincent and the Grenadines are increasingly subjected to stress and destruction induced by the demands of development, whether it be from the nation's expanding population, increased tourism facilities, agriculture, or infrastructure developments. The susceptibility of mangrove habitats to land reclamation is due to flat topography, access to ocean frontage; and the "undesirable environmental conditions" produced in these ecosystems (i.e., mosquitoes, odors, swamps) is apparent with the degradation of existing mangrove stands and the proposed development of many of the nation's mangrove areas.

The island of Mustique is privately owned by the Mustique Company Limited. The outlook for the preservation of mangrove swamps is promising due to the company's environmental awareness and the creation of the Mustique Conservation Area in 1989. The Mustique Company Limited Act of 1989 states that the company will protect and improve the natural environment and, in particular, shall conserve the wetlands and coastal areas, including the mangrove in Lagoon Bay. The Act prohibits the destruction of any vegetation or wildlife. The airport mangrove swamp has been designated a bird sanctuary.

Unfortunately, destruction of the mangrove habitat in the Lagoon Bay area occurred before the passage of this Act, and may occur in the future, depending on the pace of the island's development. To date, the island's only salt pond bordered by a large expanse of red mangrove has been filled in and is currently being used as a garbage dump. Immediately adjacent to and within the Lagoon Bay mangrove area, land clearing has destroyed proximately 5 acres of vegetation for developmental purposes (which are not known to the investigators at this time). Future development plans tentatively propose the installation of a boat marina in the lagoon (information provided by B. Alexander, Managing Director, Mustique Company. Personal communication, May 1990 ). This activity would result in the clearing, dredging, and opening of the lagoon to the sea. The preservation of the mangrove habitat is doubtful.

It is reported that there are plans for the development of Ashton Harbour, despite being designated a marine conservation area. Illegal cutting of mangroves and the dumping of industrial waste is becoming more prevalent.

On Bequia, the development of the new airport will destroy a small mangrove stand at Paget Farm. The developer of Prune (Palm) Island has reportedly filled in several swamps containing mangrove, planted coconut trees, and poisoned the land crabs to create

"the ultimate tourist experience" (information provided by R. Teytaud, Island Resources Foundation. Personal Communication, April 1990).

## *Discussion*

### *Strategies to Preserve the Mangrove Areas*

The mangrove wetlands of Saint Vincent and the Grenadines are being degraded by developmental pressures. In an attempt to preserve and maintain these ecosystems, the Forestry Division is pursuing several strategies to mitigate the loss of these valuable wetlands.

These strategies are as follows: (1) cooperative forest agreements, (2) environmental education programmes, (3) communication and cooperation with private enterprise, (4) improved coordination between ministries, and (5) declaration of forest and wildlife reserves.

The cooperative forest agreement proposed in the Forest Resource Conservation Act presently before Parliament provides the Forestry Division and private landowners with an opportunity to work together in managing and protecting sensitive areas, including wetlands. The Forestry Division and the private landowners of the Milikin Bay white mangrove area on Saint Vincent will be entering into a 5-year cooperative forest agreement in June, 1990. The agreement is renewable and calls for the conservation and preservation of white mangrove and it's associated fauna. This is the first attempt by the Forestry Division to enter into such a formal contractural agreement, although it has been done before verbally.

Environmental education programmes are being utilized to increase public awareness of the environment. These programmes are being directed at all age groups in an effort to increase understanding of the unique environmental problems of Saint Vincent and the Grenadines, as well as the benefits that can be derived from maintaining biological diversity.

Communication and cooperation between private enterprises and the Forestry Division has proven to be a valuable method of addressing environmental concerns. With respect to the private ownership of the island of Mustique, the Forestry Division has no jurisdiction or regulations pertaining to land-use conflicts in the mangrove areas. By initiating a dialogue with the Mustique Company, the Forestry Division was able to express their concern over the present situation of the Mustique mangrove habitats. It is hoped that this process of communicating with private enterprise will increase the sensitivity of the Mustique Company in managing and protecting the biological diversity of the island. Improved coordination and project planning between ministries is essential for the protection and preservation of these sensitive wetlands.

Under the current Forest Ordinance (1945) the Minister of the Ministry of Agriculture, Industry and Labour is empowered to declare any area of crown land to be a forest reserve. These declarations can be implemented for any of the following reasons: (1) the sustained production of timber or water, (2) conservation of soil, (3) public recreation, and (4) the preservation of flora and fauna. This is further reinforced under the proposed Forest Resources Conservation Act. With this authority the Forestry Division will be better able to preserve and protect sensitive areas like the mangrove habitats.

## *Summary*

Despite the limited land area that mangrove occupy in Saint Vincent and the Grenadines, we feel that these areas should be protected. The mangrove wetlands offer a critical feeding and nesting habitat for many species of birds and support complex food chains that culminate in fish and wildlife utilized by the people of Saint Vincent and the Grenadines. They provide flood control, dissipate storm-wave energy, maintain shorelines, and build land. In addition, the mangroves are a source of valuable forest products. Careful examination of any proposed development plans, in or adjacent to mangrove ecosystems, is essential for maintaining the biological diversity of Saint Vincent and the Grenadines.

# MANGROVES OF THE CAROLINE ISLANDS

*Leonard A. Newell*

## *Geography and Recent History*

The Pacific Ocean area has three main language groups: Polynesian, Melanesian, and Micronesian. The distances between the islands of the Pacific are much greater than between Caribbean islands. As an illustration of this, it is six time zones–or one quart of the circumference of the globe–between Hawaii and Trinidad. It is five time zones from Hawaii to Palau, and six to Manila. The entire Caribbean Sea has two time zones.

In this paper I will concentrate on two islands in Micronesia which have both large mangrove components and a close political relationship to the United States: the Islands of Pohnpei (also spelled Ponape) and Chuuk (Truk) in the Federated States of Micronesia (FSM). These and many other Micronesian islands were colonies of Japan from 1914 until the early 1940's, when World War II made them battlegrounds between American and Japanese forces. In 1947, the United Nations made the United States a trustee of the war-torn islands, with a charge to help them rebuild infrastructure and economies. The U.S. Forest Service has been working with the forestry agencies in the islands since the early 1960's (Nelson 1989). In 1987, the FSM achieved independence under a Compact of Free Association with the United States (Office of the President of the United States 1987). Under the Compact, certain United States government agencies, the Forest Service included, have authority to continue technical assistance at the request of the FSM government.

The Forest Service Institute of Pacific Islands Forestry (IPIF) delivers both research and extension (State and Private Forestry Program) services to these islands. My role is to provide the latter, including grants, training, organizational development, assistance with drafting legislation, and general management assistance.

## *Pohnpei*

At 35,500 ha (87,693 acres; MacLean and others 1986), Pohnpei is the largest island-state of the FSM. Rainfall ranges from nearly 10,000 mm (393 in) at the highest points (791 m, or 2595 ft) to about 4,950 mm (195 in) at sea level (Ashby 1983). In a visit to Pohnpei in June 1989, Ariel Lugo observed that "the whole island could be called a wetland." Pohnpei is completely encircled by a fringing reef and by a thick mangrove forest that varies in width from a few meters to over a kilometer. The mangrove occupies about 16 percent of the area of Pohnpei (MacLean and others 1986)

The human population is growing at about 4 percent per year, including local births and in-migrations from Chuuk–the most densely-populated FSM state–and elsewhere. There is a "frontier mentality" operating on the Island of Pohnpei, and people are constantly moving upslope onto state-owned forest land to homestead, or into the mangrove to establish homes.

In response to these pressures, Pohnpei's legislature passed, and Governor Resio Moses, signed the "Pohnpei Watershed Forest Reserve and Mangrove Protection Act" in 1987 (State of Pohnpei 1987). This law establishes a "no settling" zone on soils classified as "highly erodible" or "very highly erodible" by the USDA Soil Conservation Service (1982). The law also recognizes the many values of mangrove forests and prescribes protection for them, as well. From latter June until latter August of 1990, the Forest Service provided two cadastral surveyors to lead local field crews in establishing the boundaries of the Watershed Forest Reserve in the Pohnpei uplands. Mangrove reserves and other designations will be delineated in the near future.

A most important determinant of mangrove forest characteristics in Micronesia is the fact that there is high rainfall at sea level. This allows an abundance

of epiphytes to grow on the trees, and contributes to high productivity. Species diversity is also high (Fosberg 1947). Species present on Pohnpei include: *Rhizophora apiculata, R. mucronata* and *Sonneratia alba* at the seaward fringes and often within the stands; *Bruguiera gymnorhiza, Xylocarpus granatum* and *Lumnitzera littorea*, all prized woods that tend to grow on the landward side of the mangroves. These three genera are absent from the Caribbean area. *Xylocarpus* is particularly valuable: carpenters make furniture and doors from its boles, and carvers from the Atoll of Kapingamorangie fashion lifelike fish, sharks, turtles, rays, and other sea animals from its branches and limbs for sale to visitors and, lately, duty-free shop buyers.

All of these species tend to grow most robustly in Pohnpei's riverine mangrove stands, less so in the fringe types, which are lower in nutrients.

In 1988 and 1989, hundreds of *Lumnitzera* were logged from the *Ohd Powe* and *Nan Lukop* areas, along the lower *Pillap en Lohd* River in Madolenihmw Municipality, to build a new hotel near the airport. Although seedlings were observed on the drier parts of the logged site in June 1989, there were no management actions aimed at reforestation. No foresters were involved in planning or administering the work. The municipality received a low value for the wood, and there was no concern for sustained yield (Newell 1989a).

In fact, little is known about the volume of wood in Pohnpei's mangroves, or about its growth rate. An inventory (Petteys and others 1986) based on six plots measured in 1983, provides an estimate of total volume, but no locative information. Pohnpei's mangrove stands are being given a closer look by a Forest Service led inventory crew in July of 1990.

Another use made of Pohnpei mangroves is direct disposal of sewage. Up to a point, this is efficient resource use, as the nutrients are absorbed by the ecosystem and add to its productivity. If the sewage inputs become too large, however, or if waterborne diseases such as cholera were to be introduced (as happened in neighboring Chuuk in 1983), then mangroves would become very dangerous for the many people who come into frequent contact with the mangroves (such as crabbers, other fishermen, children who swim in the lagoons and in the open water areas adjacent to mangroves), and mangrove dwellers who wash clothes and have other contacts with the water.

Unique to Pohnpei is another use made of mangroves. The ancient ruins of Nan Madol, which carbon-dating evidence indicates was occupied in 1200 AD, were constructed on a fringe reef off Temwen Island near Madolenihmw Harbor by a prehistoric people. They used tens of thousands of large lengths of columnar basalt, at least one estimated at 50 tons and many others weighing several tons, to construct about a hundred islands of various sizes, some up to almost a hectare in area. The largest vertical structure made of these great stones is on an island called Pohnwi, and rises more than 15 m above the sea. The scale of this enormous site, which covers about 31.5 ha, indicates that thousands of people worked for more than a hundred years and perhaps hundreds of years to quarry the columns, raft them to the site, and place them (Ashby 1983).

Nan Madol is a mysterious world of prehistory. Pohnpeians have a thousand legends about it. They ascribe its complexity and enormity to the magical powers of their forbears. Haunting questions remain: why did they do it? Why was it all done on a site that could only have been mangrove, instead of on dry land? Perhaps the answer to the latter question lies in another Pohnpeian legend, which says that two brothers travelled to Pohnpei "from the west" and planted the mangroves of Pohnpei; and that without the mangroves Pohnpei would not have been formed into an island (Phillip 1989). This high regard for mangroves from earliest times bodes well for Pohnpei's mangroves under the pressures of modern development, provided that modern ideas of sustainable natural resources management can be made to prevail in the economic climate of today.

### *Chuuk*

The six main high islands of Chuuk Lagoon have significant mangrove components, as the following table shows.

| Island | Total area (ha) | Mangrove area (ha) | Mangrove area (% of total) |
|---|---|---|---|
| Tol | 3,900 (est) | 805 (est) | 20 |
| Moen | 1,858 | 149 | 8 |
| Fefan | 1,254 | 88 | 7 |
| Dublon | 1,009 | 69 | 7 |
| Other Islands | 457 (est) | 32 (est) | 7 |
| Total (all islands) | 8,478 | 1143 | 13.5 |

Data from Soil Conservation Service (1983) and from Falanruw and others (1987); figures indicated with (est) are author's estimates.

These and the smaller high islands of Chuuk Lagoon are the peaks of a large volcanic mountain that has sunk into the ocean so that only its highest points and ridges remain above the sea as islands. A barrier reef and atolls surround the entire lagoon, which averages about 48 km (30 mi) wide. This reef absorbs the force of the open ocean waves and allows the calmer water conditions necessary for mangroves to grow. Occasional typhoons (as hurricanes are called when they occur west of the International Date Line and north of the Equator) damage the mangroves and other coastal features. The most recent typhoon struck in November 1987.

The mangroves of Chuuk are dominated by *Rhizophora apiculata* and *R. mucronata*. Other species present in small numbers are *Bruguiera gymnorhiza, Sonneratia alba,* and *Xylocarpus granatum* (Fosberg 1975).

An event that had repercussions for mangroves then and now occurred on February 16 and 17, 1944. In those days, American naval forces surprised about 50 Japanese ships, the remnant of a much larger fleet, and sank all of them. Elderly Chuukese today recall the oil slicks that resulted, and claim that the mangroves of today in many places are much smaller than those that existed before the Battle Of Chuuk Lagoon (Newell 1989b). Meanwhile, the "ghost fleet" of sunken ships, now encrusted with corals and inhabited by dozens of species of fish, attracts recreational divers from all over the world. It is the major tourist attraction of Chuuk State, and is thus a major source of economic pressure for shoreline development which impacts mangroves.

The largest and widest mangroves in Chuuk are on the Island of Tol. This island is relatively undeveloped and its High Chief does not generally welcome visitors, but made an exception in June of 1989, for a U.S. Forest Service mangrove workshop, of which the author was a member. Around Leomotol Bay between the Pata and Polle portions of Tol, the mangroves comprise more than 50 percent of the land area. One would expect such an area to be heavily populated with fish, and a grim anecdote bears this out. A week before the 1989 workshop, a local fisherman fell out of his boat in this bay and was drowned. Two local men told the author that the rescue team from Moen found him a few days later, and all of the flesh had been eaten from his body, except for his upper trunk and head, by the fish (Newell 1989b).

On Tol, the main uses made of the mangroves are for obtaining fuel and building materials, as fishing grounds and as locations for some of the villages such as Etin in western Pata. These uses are sustainable and have minor impacts on the mangroves at the current level of use.

On Moen, however, the main use of mangrove forests for the past several decades has been as landfill areas, to create additional dry land for building along the shoreline. Unlike Pohnpei, Chuuk State law recognizes private ownership of intertidal areas,

so the fate of the mangroves is entirely at the pleasure of the landowner. An open refuse dump of several hectares on the west shore of Moen is planned as a building site by its owner when it is filled in enough. There is no management of the filling, nor any control over the kind of refuse dumped. Apparently, most, or all, of the waste oil and other toxic refuse from Moen, which is the Capitol of Truk and the island with the highest population in the FSM, goes into this former mangrove. From there, it can be easily transported via tides and freshwater throughflow to any part of Truk Lagoon.

We who understand both the values of mangroves and the dangers that such uses pose to everyone, need to develop arguments, backed up by sound scientific documents, as to why such uses are unwise. A paper on research opportunities has been prepared (Lugo 1990) to guide the scientific work. Meanwhile, management plans must proceed in the absence of complete data if mangroves are to be conserved. In some cases it may be necessary to fill in mangroves; in those cases, the sites should be carefully chosen, the filling properly designed, and the plans carefully implemented. Only by doing these things can sustainable shoreline development be achieved.

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*Mario Sanoja*

### *Mangrove Forests: Home of Early People in the Caribbean*

The impact of postglacial conditions in the life of social groups of hunters-gatherers of the Caribbean, manifested itself during early Holocene in many ways. One of those was the continual rise of sea level that modified the coastal relief, at the same time that changed the floral, faunal, and environmental conditions where human life developed.

The study of sea level changes in the New World has been approached by several authors through the establishment of curves and models designed to demonstrate either the Diachronic or early and middle Holocene. Such are the proposals made by Fairbridge (1976), Farrel and Clark (1976) and many other authors working on that subject. In my opinion, the accuracy of the curves and models in attempting to explain the dynamic of sea level has been hampered, particularly in the Caribbean, by the lack of more regional information on the history of coastal relief and coastal ecosystems, as well as in the history of the social behavior of the early human populations that inhabited the coastal areas.

### *The Early Coastal Archaeological Sites*

In the Caribbean, like the other tropical and subtropical coastal areas, the history of wetland ecosystems has been tied to the origin of coastal nuclei of human populations of gatherers, fishermen, and hunters. They were attracted by the positive conditions for settled life offered by the coastal formations of mangrove. The populations established themselves in those areas since very early times, and developed shell gathering and fishing as most their characteristic processes of food procurement.

In Caribbean wetland ecosystems, the changes in natural conditions brought about by the broader postpleistocene climatic transformations, became intersected by the dynamics of social life around 9000 to 8000 years BP, as can be observed in the far distant site of Banwari Trace (Harris 1976) in the western coast of Trinidad, and Monkey Point, located on the Caribbean coast on Nicaragua (Veloz Maggiolo and Pantel 1980). Of the two sites, the best archaeologically documented one is Banwari Trace, located on the coastal lagoon of Oropouche, Trinidad. It refers to an early stage of human occupation related to hunter and gatherer populations that inhabited the interior areas of northeastern South America, prior to the separation of Trinidad from the mainland, and exhibits a chronological sequence divided into three periods.

#### *Banwari III (6,780 + 70 to 7,180 ± 80 BP)*

Natural environment related to estuarine condition with brackish waters; predominance of the *Crassostrea virginica gmelina*, considered a species closely related to the *Crassotra rhizophora* (Warmke and Abbot 1962: 173). Equally present are other species like the *Melongena melongena*, a saline to hypersaline species, *Thaistrinitatensis*, and occasionally *Neritina* and fresh water species like *Marisa cornuaretis* and *Pomacea*. Taking into consideration Fairbridge (1976), the Banwari I Period would correspond with last part of the period I, as well, with the Alexandro Submergence proposed for the coast of Brazil, and the data proposed by Van Andel (1967). At the same time, we could possibly relate this period with the changing conditions in the coastal environment that led to the stabilization of mangrove forests.

#### *Banwari II (6,100 ± 90 A to 6,190 ± 100 BP)*

Recollection of brackish water bivalves and gastropods like *Ostrea* sp, *Nerita virginica*, *Nerita reclivata, and* occasionally, *Marisa cornuaretis* and *Pomacea glauca*. Fishing seems to become a more important activity in the appropriation of food resources.

*Banwari I (2,550 ± 100 BP)*

Predominance of fresh or brackish water and terrestrial gastropod sand bivalves species like *Nerita virginica, Marisa cornuaretis, Pomacea glauca,* and occasionally, *Ostrea* sp. and *Codakia* sp.

By the time of Banwari II, 6000 to 5000 years BP, the sea level probably reached its highest point, culminating a process that had started 18,000 years earlier. The date of 6000 to 5000 years BP, also known as the optimum of the Holocene in terms of paleoclimatic conditions, also represents the moment when coastal relief became stabilized, sea level reached some 2 m over present, and mangrove forests began to expand in many areas of the Caribbean littoral. At the same time, Trinidad became isolated from the mainland, also isolating their early populations from those inhabiting the northeastern part of Venezuela.

Between 6000 and 5000 BP, early human populations, possibly coming from the interior, occupied the mouth of rivers descending from the Sierra de Paria or sites located in its foothills at a height between 10 and 20 m over present sea level. At that time the ancient shoreline seems to have been running at the base of the Sierra, forming a coastal relief characterized by steep escarpments enclosing the ancient estuary that the rising of the sea level formed at the Gulf of Paria. This coastal zone was covered in many areas by mangrove formations. The analysis of sediment strata at the site of Guayana shows that the fluvial sediment strata formed by the Guayana River, where the human groups initially settled around 5600 BP, rest on a layer of bluish marl of undetermined thickness. This might be related to the bluish marl layer associated by Van Andel (1967) with the beginning of the transgressive sequence signaled by the Gulf of Paria and the formation of the Orinoco Delta circa 9510 ± 400, that antedates the initial human occupation of the Banwari site in Trinidad, (Sanoja 1989b).

The former situation leads us to think that the fluvial deposition in the coast of the Paria estuary accentuated toward 6000 to 5000 BP, when the marine transgression began to be stabilized at its optimum point and allowed the formation of mangrove forest in the ancient shoreline. A similar process has been hypothesized by Widmer (1988, p. 187) for the coast of south Florida. According to that author, "the rapidly rising sea level from a position about 100 m below its present position at about 18,000 BP, did not result in stable coastlines which would permit the establishment of mangrove forests. Mangrove trees had only eighteen years to become established and grow before they were inundated by the rising sea. Also, because little or no surface water was flowing from the interior at this time, no organic sediments could be trapped behind barrier sand bars and beachridge complexes."

The culture of human groups that inhabited the mounds of the Gulf of Paria is characterized by a rustic lithic industry of fractured pebbles, flake scrapers, hammers and mortars, prismatic nucleis, as well as some flaked ungulated and piramidal scrapers and small cutting tools of serpentine. The whole has been designated by our project as the Paria Lithic Tradition.

The analysis of shellfish collected by human groups that inhabited the coastal sites of Guayana and Ño Carlos reveals a predominance of species like *Melongena melongena* Linne, *Pugilina, Ostrea frons*, as well as other species like *Thais, Murex, Nerita, Anomalocardia, Modiolus*, etc. At the Guayana site, are also common the remains of rays (*Rajidae*) that were hunted in the muddy bottoms of the estuary. Bones of deer, monkeys, and small carnivores are present in the early period of Guayana, but estuarine fishing and shellfish collection dominates the medium and late periods of occupation. At both sites, the fishing and hunting of estuarine and mangrove related species like *Centropomus* sp. and *Mugil* sp., as well as sharks and cetaceans, were important complements to the daily diet.

The rising of the sea level in northeastern Venezuela also provoked the formation of an ancient estuary in the vally of the San Juan River, one of the main affluents to the Orinoco Delta, around 5300 years BP. The mass of brackish water, possibly pushed by tidal action, must have reached some 100 km upstream, where it was enclosed between the slopes of the Caripe Mountains, surrounded by formations of mangrove forests that possibly disappeared

around the end of the second millenia BC, when estuarine condition ceased to exist. Like Guayana, the people of the Remigio Site, located at the foothills of the mountains, built their campsites on the alluvial formations formed by the Caño Cruz at the foothills of the mountains, already covered by mangrove forests. In the bottom layer of the shell mound we also find possible bones of deer, but later the collection of *Ostrea* sp., *Melongena* sp., and *Modiolus* sp., as well as fishing, and the hunting of marine mammals, dominated by the subsistence activities of the group until they abandoned the site. Their lithic industry is also related to the Paria Tradition, although stone slabs and mortars are more common in this particular site.

The extent of the dispersal of mangrove forests along the Caribbean coast of Venezuela and the shifting of terrestrial human populations toward the coast, is also attested to by the presence of preceramic archaeological sites of mangrove shellfish collectors and fishermen at the coastal lagoon, located at the Tucacas area, Falcon State (Cruxent and Rouse 1961). Around 5550 to 5190 BP, a date that correlates with the possible changes of sea level and the establishment of mangrove forests in northeastern Venezuela, a general process of eustatic changes may have begun that affected the Atlantic as well as the Caribbean coasts of northern South America.

### *Importance of Mangrove Ecosystems in the Process of Sedentarization*

Mangrove oyster is not only abundant but easily obtained; it also recovers from overexploitation in about five years. Thus, a community that exhausted this resource in one locality could either focus on another resource or move to another location until the productivity of the previous one had recovered. This kind of shifting exploitation, which occurred in many parts of the Caribbean, is comparable to the use of soil by slash-and-burn agriculturalists and may have had on influence in the development of the agricultural rationality that characterized this kind of agricultural system among the aboriginal cultivators of later times (Veloz Maggiolo 1976).

For these reasons, the mangrove ecosystem played a significant role in the process of sedentarization and consequent social changes among gatherers communities between 5000 and 4000 years BP. The mangrove's system of complex interrelationship in the foodchain was exceptionally important to such societies. It constitutes an extraordinary source of raw materials–wood, resins, fibers, paints, as well as extensive protein resources, especially several species of mollusks, fishes, reptiles, and birds dependent on its waters. It also contributes to the formation and fixation of soils rich in organic sediment (Chapman, 1977, Lugo and Snedaker 1974, West 1977). This set of natural conditions offered a resource base for several forms of extraction and favored certain incipient forms of cultivation of indigenous edible plants.

### *Coastal Lagoons: The Focus of Early Cultivation Processes*

#### *The Unare Coastal Lagoon*

Between 4600 and 4340 years BP, the raising of sea level seems to have also affected the ecology of coastal lagoons in eastern Venezuela. By that time, the transgressive phase of the sea had already affected the Caribbean shores, determined the flooding of the lands surrounding the Unare Coastal lagoon, formed at the mouth of the Unare River, Anzoategui State. The results of a project sponsored by the Faculty of Sciences of the Universidad Central de Venezuela, under the guidance of Professor Pedro Roa (1990), showed the presence of a stratigraphical sequence at the maritime plain surrounding the lagoon, marked by a deep strata of dark slime containing remains of *Crassotrea* sp. and *Melongena melongena.* That bottom strata was $C_{14}$ dated at $4340 \pm 40$ BP. Compared with data obtained of other sites in eastern Venezuela, through our Paria Project, we could state that mangrove forests already existed between the present border of the lagoon and the foothills of the Cordillera de la Costa. The present marshy areas located around the Unare lagoon, where campsites of late groups of shellgatherers have been found, might be relicts of that ancient marine transgression.

Other $C_{14}$ dates of 3940 ± 960 BP, 2170 ± 60 BP, and 1860 ± 80 BP, mark the regressive stage of sea level (Roa and others 1990). Although Roa's team of biologists did not look for archaeological sites, the date of 2170 ± 60 BP, is consistent with the one of 2450 ± 90 BP obtained by Cruxent and Rouse (1961) for the sites of Pedro García and Cerro Burro in the same area of Unare, which we have considered as representative of the dissolution of the society of gatherers-fishermen-hunters of eastern Venezuela (Sanoja and Vargas Arenas 1990) .

*The Campone Coastal Lagoon: Gulf of Cariaco*

Possibly around 6000 to 5000 years BP, communities of shellgathering-fisherman-terrestrial hunters, established in the El Bajo Site, located at the northwest border of the Canmpona coastal lagoon, Gulf of Cariaco. Their lithic industry relates them to the coarse percussive tradition of the Gulf of Paria. Although they gathered gastropods and bivalves like *Melongena*, *Lucina*, *Chiona*, *Ostrea*, *Modiolus* and *Marissa*, the presence of bone projectile points and the marked interest for the hunting of deer and wild pigs, allowed us to consider them as a variant of the way of life of marine gatherers that qualifies the early inhabitants of northeastern Venezuela.

At 4600 ± 70 BP, human groups, possibly related to El Bajo initial population, established Las Varas Site. Soon after that date, the crude stone tools characteristic of the Parialithic Tradition began to be replaced by tools manufactured by abrasion and/or percussion, a stoneworking technique that was already present from the early times of Banwari I. At the same time, relatively abundant projectile points and harpoons, made either in wood or bone, began to appear. Additionally, rustic axes, adzes, conical pestles, knives, scrapers, polishing tools, stone hammers, stone bowls and dishes, hematite nucleis with fiber impressions, net sinkers of different sizes, and male and female representations carved in micaschist appeared, indicating substantial changes that might be related to the development of what we call the "marine mixed way of life" (Sanoja 1989).

Axes, adzes, and conical pestles were manufactured from pebbles of chlorite-schiste, a new kind of raw material used instead of the sandstone characteristic of the old Patria Lithic Tradition, modeled through abrasion together with pecking or flaking. Cutting tools, as well as the stone bowls, were usually manufactured with serpentine. Stone platters and net sinkers were made out of mica schist.

The wear pattern of lithic artifacts suggest an early functional differentiation: some axes were possibly used as sickles to clear brush, others have marks on both sides and splintering only along the edge, indicating percussion against hard, fibrous material. Adzes, differentiated by their asymetric edges, also have striated areas along the longitudinal axis of the artifact (Sanoja 1989b.).

The gathering activity is represented mainly by gastropods like *Melongena* sp., and bivalves like *Chione* sp. and *Lucina* sp. Minor species represented are *Ostrea*, *Modiolus*, *Marissa*, *Anadara*, etc. Ocassionally, fragments or entire specimens of *Cassis* sp. are found in the upper layers of the site. On the other hand, terrestrial and aquatic hunting is represented by *Mazama* sp., *Odocoyleus* sp., *Tayassu*, rodents, possibly manatees or dolphins and sharks, and birds. Different species of crabs were also intensively collected.

We have no direct evidence of the plants cultivated by the people of Las Varas, except the presence of several indigenous edible plants that are cultivated and collected by the modern peasants inhabiting the area, like "ocumo" (*Santosoma sagittifolium*), Lairen (*Callatheaalluia*) and a variety of cannacea, possibly *Canna edulis*, known locally as "pericaguare" that produces edible tubers. The plant is mentioned by the Spanish chronichlers of the sixth century as widely consumed by the Indians of the Caracas Province. The fact that the plant does not reproduce by seeds like the "capacho", another local species of *Canna*, but by stakes or bulbs, has led several botanists helping us with the analysis of "periguare", to think that the plant may have lost its capacity of reproducing by seeds as a result of an early process of domestication (Sanoja and Vargas Arenas 1990).

The archeological deposit of Las Varas Site, contrary to the characteristics of the earlier ones, is associated with black, dusty soil, rich in organic

matter. This is possibly the result of mangrove forest formation on the borders of the Campoma lagoon, where the site is located, that resulted in an extraordinary reservoir of predictable and accessible resources for daily subsistence.

Since the early moments of Las Varas occupation, people started to build rectangular dwellings with an inclining roof along the slope of the terrace facing the lagoon. Sedentary life seems to have been the condition for the exploitation of the several ecosystems centered on the Campoma lagoon, as well as for the intensification of cultivation measured in terms of the proliferation of agricultural tools versus the abandonment of the ones manufactured with the old fractured stone technique of the Paria Lithic Tradition.

The analysis, still in process, of human remains found at Las Varas Site, indicates the presence of possible cannibalism. The bones pertaining to four adults, three men, and one woman, points to the presence of very robust individuals measuring possibly 1.50 m in height (Sanoja and Vargas Arenas 1990).

We have no terminal date for Las Vaeas, but according to the presence of shell gouges and pendants characteristic of the Manicuare Site, Cubagua Tradition, $C_{14}$ dated by Rouse and Cruxent (1963) in $3570 \pm 130$ and $3050 \pm 80$BP in the upper layer of Las Varas. We may assume that the occupation of the Las Vaeas lasted until the first millennia BC, when the regressive stage of the sea started and modified the natural conditions of the coastal lagoons and estuaries that had favored the expansion of mangrove forest in the eastern coast of Venezuela since 6000 to 5000 years BP.

Today, around the site of Las Varas, remain the relicts of extinct mangrove forests, represented by *Rhizophora* and *Avicennia*, located on what was supposed to be the ancient shallow bottom of the Campoma lagoon, associated with grasses and marshy plants like *Cyperus* and *Eichornia*.

*The early Coastal Sites in the Caribbean Coast of Colombia*

More to west, at the mouth of the Magdalena River, in Colombia, another archeological site with an early dating of 5300 + 80 BP. Monsu (Reichel Dolmatoff 1986) shows the occupation of possibly ancient mangrove ecosystems that existed on land in the lower part of the Magdalena River. The archeological record suggests the presence of people with a gathering-fishing-hunting economy, and a rustic technical complex of fractured stone stools very much like the other contemporary early shell gathering-fishing-hunting communities of the Caribbean coast, except by the presence of pottery. Indirect proof of cultivation of *Manihot esculenta* Crantz, under the form of clay griddles to roast the cassava flour, appear toward the middle part of the millenia BC.

A series of shellmound sites of habitation associated with pottery, are dispersed in the interior areas of the coast along the Magdalena River. They give support to a continous process of human occupation of the area, that ended with the full sedentary populations of the Malambo Phase (Angulo 1981), around 3050 BP (1100 BC). The expansion of manioc cultivation is a process that indicates the achievement of their organization of society (hunters-gatherers); it is associated with a lesser emphasis of mangrove collection and fishing, a process that may have been also related to the regression of the sea level that had started at that moment in many areas of eastern Venezuela and the correlative modification on wetland ecosystems.

*Wetland Ecosystems and the Management of Cultural Heritage in the Caribbean*

Wetland ecosystems, as we have seen before, presented excellent conditions for the inception of the seminomadic, or sedentary, ways of life that characterized the early human occupations of the Atlantic and Caribbean coast of northern South America. In modern times, wetland ecosystems continue to be very attractive for people to carry social and economic activities that, if not well planned, may endanger or destroy them.

Because of their natural beauty, the shores covered with mangrove forests represent prime locations for urban developments, tourist resorts, and aquatic sports. In many cases, the lagoons and coastal marshes where mangroves subsist are filled with trash and drained to extend the surface of suitable land for building. In other examples, coastal lagoons with archeological sites and reliefs of mangroves that can provide important information to reconstruct the history of the utilization of wetland ecosystems by humans, are destroyed or remodeled to house fishing enterprises, shrimp cultivation projects, and the like. In cases like Laguna Chica, Gulf of Cariaco, the lagoon is used for the maintanance of fishing vessels so that the contamination by fuel is killing the mangroves. In some cases, the Venezuelan National Park Institute has created coastal parks to protect the mangrove ecosystem, but has not planned to investigate the history of the biosphere and the kind interaction between people and their natural environment represented by wetland ecosystems.

One of the most common approaches to conservation in our country, as well as in many others of the area, is to view nature in a purely biological context. Modern human activities, except the contemplative and recreatives ones, are forbidden in the parks, but the social activities of ancient people, be it prehispanic or posthispanic, are also excluded from the interest of conservationist, as well. For those reasons, landscapes are not considered as a cultural resource that has historic meaning for the people that live around it, or uses the landscape for recreation.

Recreation is also education in the most ample way, not only environmental education. Landscape conservation must be approached with an integrative concept of the environment, representing a natural construction that is given meaning, molded, and modified by human action in the course of time. In that sense, we have to study and preserve the cultural systems that express the human imprint on the natural environment, as well as ones that represent conditions that have housed human life.

The management of wetland ecosystems must be based on the concept that they are endangered by their nonrational utilization. Mangrove forests, as we have seen, are able to reproduce when not exploited to extermination. They are useful to people and should not be, in every case, preserved as a museum. But where wetland ecosystems can explain part of the history of the different societies, the responsible institutions should organize projects of archeological and biological research, education, interpretation, and recreation. If mangrove forests cannot become museums, it is possible to "musealize" them, to signal their different historical, cultural, and biological components in order to allow people to recreate, to enjoy the landscape, and learn the message of integrative conservation.

In a previous study (Sanoja and Vargas Arenas 1989), I stated that environmental education should be organized to teach those individuals that make up society that they are living within a dynamic complex of interrelated systems, of which they are an integral part. This means that there must be a focusing on the ecosystem for the management of natural and cultural resources based on: 1) a physical relationship between society and its surroundings; and 2) the levels of political decision making; the quality and quantity of socioeconomic development, and the cultural heritage which determine this relationship.

Living with the ecosystemic approach, i.e., the biosphere concept, means living in harmony not only with the natural environment but with the cultural ecosystems people have created over the ages. This attitude needs an educational vehicle for mass dissemination of these ideas: the ecological museum. I am not referring to a building, but to a system of communication, education, and recreation that may function in the open air, with the aim of making people perceive, analyze, and understand the components of the natural-cultural environments functioning as a system. This would make possible for the student community, young people, and the public at large to contemplate in all its diversity the totally and the infinite variety of ecosystems models, and at the same time appreciate the dynamic relationships defined by space and time, from the earliest, or more simple, to the most recent interventions on the part of people in the natural environment, combining in a single message the preservation of the cultural, as well as of the landscape heritage. Wetland ecosystems have the potential to develop projects of this kind, with a positive social impact and the capacity

to produce economic reward either to the government agencies or to private enterprise through the development of cultural tourism programs.

I propose a regional program for the Caribbean that allows the evaluation and investigation of wetland ecosystems and their cultural systems in order to select those most suited for their preservation, management, and rational utilization in cultural programs. In this proposal, it is also necessary to develop research programs on the history of wetland ecosystems and their users. Specifically, in those areas where mangrove forests once existed and disappeared as a result of the environmental changes of the Holocene and became the home of ancient societies of hunters, gatherers, and cultivators. The results of joint programs of research by archeologists, biologists, geomorphologists, etc., could be communicated to the public via different media (books and articles) to be used for school teachers, students, and the public at large; video programs for massive diffusion through the TV in the different countries of the area; and programs for international scientific and educative cooperation that stimulate the exchange of informations and results as well as intercultural experiences through scientist, teachers, students, etc.

These results could be also incorporated into the programs of education, recreation, and interpretation organized to fulfill the aims of the ecological museums:

1) to understand the different ways of how, through ages, people intervened and disturbed the organic world, converting its natural elements into resources for their own survival; how social activities have altered the surface of the earth, its soils, its water resource, its plants and animals, and how minerals have been extracted from it;

2) to understand and analyze how the activities of urban life changed the original ecosystems, creating new social relationships between people, space, and the biological and natural elements that surround them (Sanoja and Vargas Arenas 1989).

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# WETLANDS MANAGEMENT IN TRINIDAD AND TOBAGO

*Carol James*

## *Introduction*

Trinidad and Tobago is blessed with a variety of natural ecosystems which contribute to this country's growing reputation as a naturalist's paradise. Wetlands of Trinidad and Tobago are relatively extensive, and support a vast array of flora and fauna, the most famous of all being the spectacular scarlet ibis and the endangered manatee. Mangroves around both islands contribute to coastline stability, particularly on the windward east coast of Trinidad; provide a livelihood for a vast array of citizens, from fishermen, through tanners to tour guides; contribute to rich offshore fisheries in the Gulf of Paria, off the east coast of Trinidad and Tobago; and provide scenic relief from urbanization along the major highway arteries east and west of Port of Spain, and southwest of San Fernando.

The country has been spared many of the irreversible negative impacts so many countries around the world have experienced as a result of misuse or mismanagement of their wetlands. Forest reservation legislation from the turn of the century in this country included mangrove forests and other wetlands, and the national land-use policy recommended in 1979, that all swamp lands are best left under natural vegetation.

This, however, does not mean that there have been no negative activities in the country's wetland areas. Schemes to drain wetlands in the north and south of Trinidad for agriculture (notably rice production), for use in housing development, solid-waste disposal, mining, port development, development of marinas, for airport runway expansion, and more recently for aquaculture and for proposed hotel developments, have all taken their toll on these natural ecosystems. Pressures from an expanding human population will continue to stretch to the absolute limits current efforts for sustainable use of the country's wetland ecosystems.

## *Geographical and Socio-Economic Features of Trinidad and Tobago*

### *Country Location and Size*

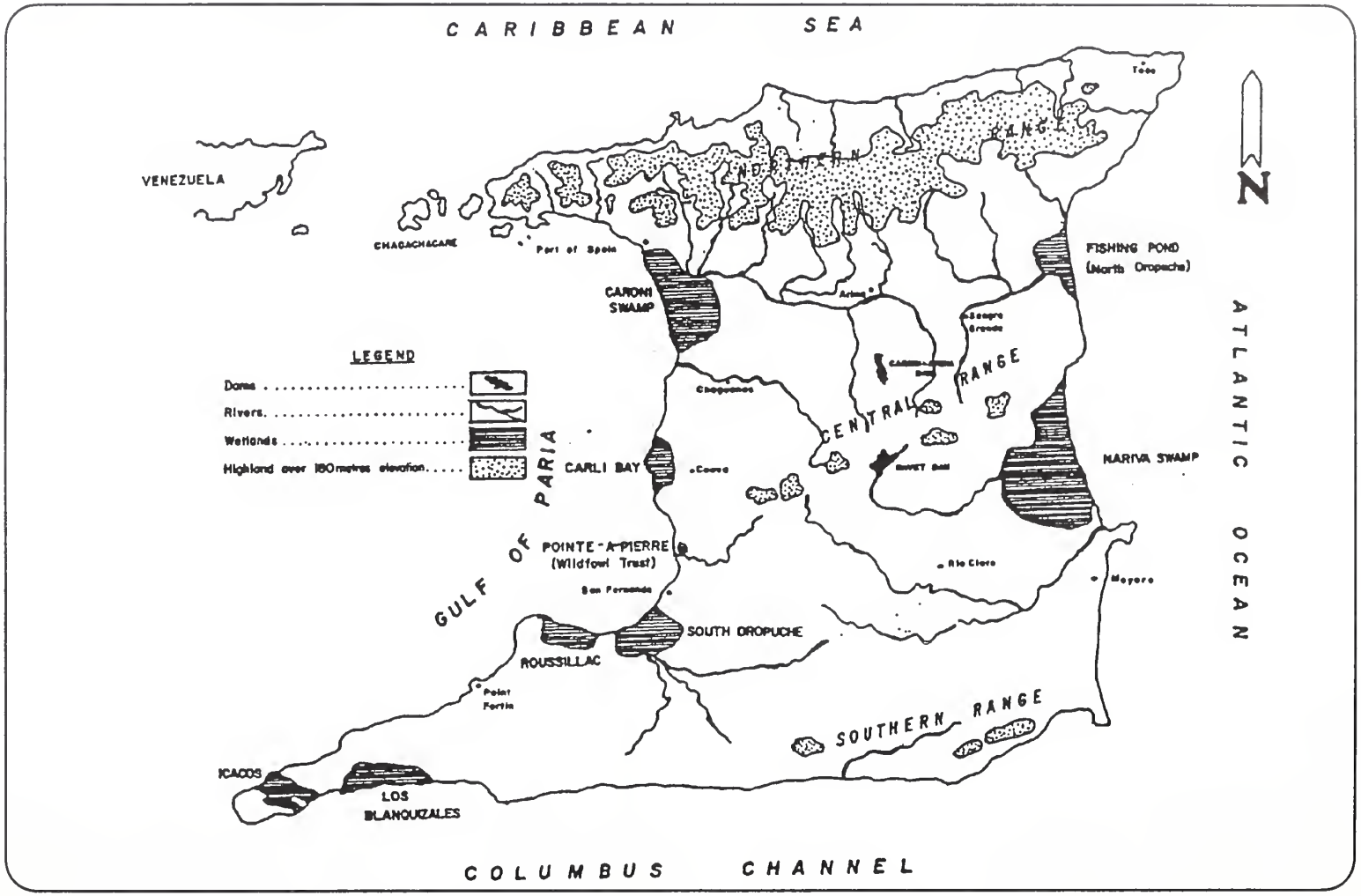
Trinidad is the fifth largest island within the Caribbean Sea and together with Cuba, Hispaniola, Puerto Rico, and Jamaica possess most of the wetlands of significance in the Antillean Caribbean. Trinidad and Tobago are the most southerly islands of this Antillean chain, with Trinidad lying close to the Orinoco Delta of mainland South America (approximately 12 km) and Tobago lying 34 km north east of Trinidad (fig. 1). The twin islands comprise an area of 5123 $km^2$ of which Trinidad is approximately 4828 $km^2$. The country lies between 10 1/2° to 11° latitude and 60° to 61 1/2° longitude.

### *Physical Features*

Trinidad is roughly oblong in shape and its relatively flat relief is interrupted by three mountain ranges extending across its north, central, and southern sections. The Northern Range extends from east to west across the entire width of the island and is comprised of numerous ridges which attain a maximum altitude of 940 m. The Central Range runs diagonally across the island and is comprised of more gradually sloping hills with a maximum altitude of 307 m. The Southern Range is comprised of a series of undulating hills, with the highest rising in the centre of the range to an elevation of 248 m. Numerous rivers which drain these ranges traverse alluvial plains and end in coastal swamps, marshes, or lagoons (fig. 2).

Figure 1. Regional location map of Trinidad and Tobago.

Figure 2. Wetlands and mountain ranges in Trinidad.



In contrast to that of Trinidad, the topography of Tobago is rugged with a main mountain ridge running for nearly two-thirds of the length of the island in a northeasterly, southwesterly direction. The Main Ridge, as it is known, attains a maximum elevation of 576 m. The flat coastal plain to the southwest contains the only wetland ecosystems of the island (fig. 3). Coastal islands exist off of both Trinidad and Tobago, and the largest, Chacachacare, off the north western peninsula of Trinidad, contains a small wetland and salt lagoon (fig. 2).

*Climate*

The climate of Trinidad and Tobago is typically wet tropical, with year-round high temperatures averaging 31.9°C daytime and 22.9°C night-time. Relative humidity is close to 100 percent and daily sunshine averages 7.5 hours (1988 data from Central Statistical Office [CSO]). Rainfall is generally heavy in excess of 2000 mm, but varies considerably with location (1750 mm in the west and south of Trinidad and 2400 mm in north Trinidad and in parts of Tobago). Two main seasons exist: 1) a long rainy-season from May to December, interrupted by a short dry season (the petit careme), in September or October; and 2) a dry season from January to April/May.

Although the country lies on the border of the hurricane zone, only three storms or hurricanes struck the islands during the last two centuries. Hurricane Janet struck Trinidad during the 1950's, Hurricane Flora struck Tobago in 1963, and tropical storm Alma struck Trinidad in 1974. Influences from other storm systems and hurricanes are often experienced on both islands, the most recent being storm-induced damage on the east coast of Trinidad by Hurricane Hugo in 1989. Wind speeds around both islands usually range between 3 to 15 km per hour.

*Soils, Economic Geology, Land-use, and Population Characteristics*

Land-use decisions in Trinidad and Tobago are influenced, as expected, principally by soil quality, topography, mineral deposits, access to urbanization, and transportation. The National Physical Development Plan (1989) sets the policy framework for landuse in the country and recommends uses that are compatible with the principles of conservation and long-term sustainability.

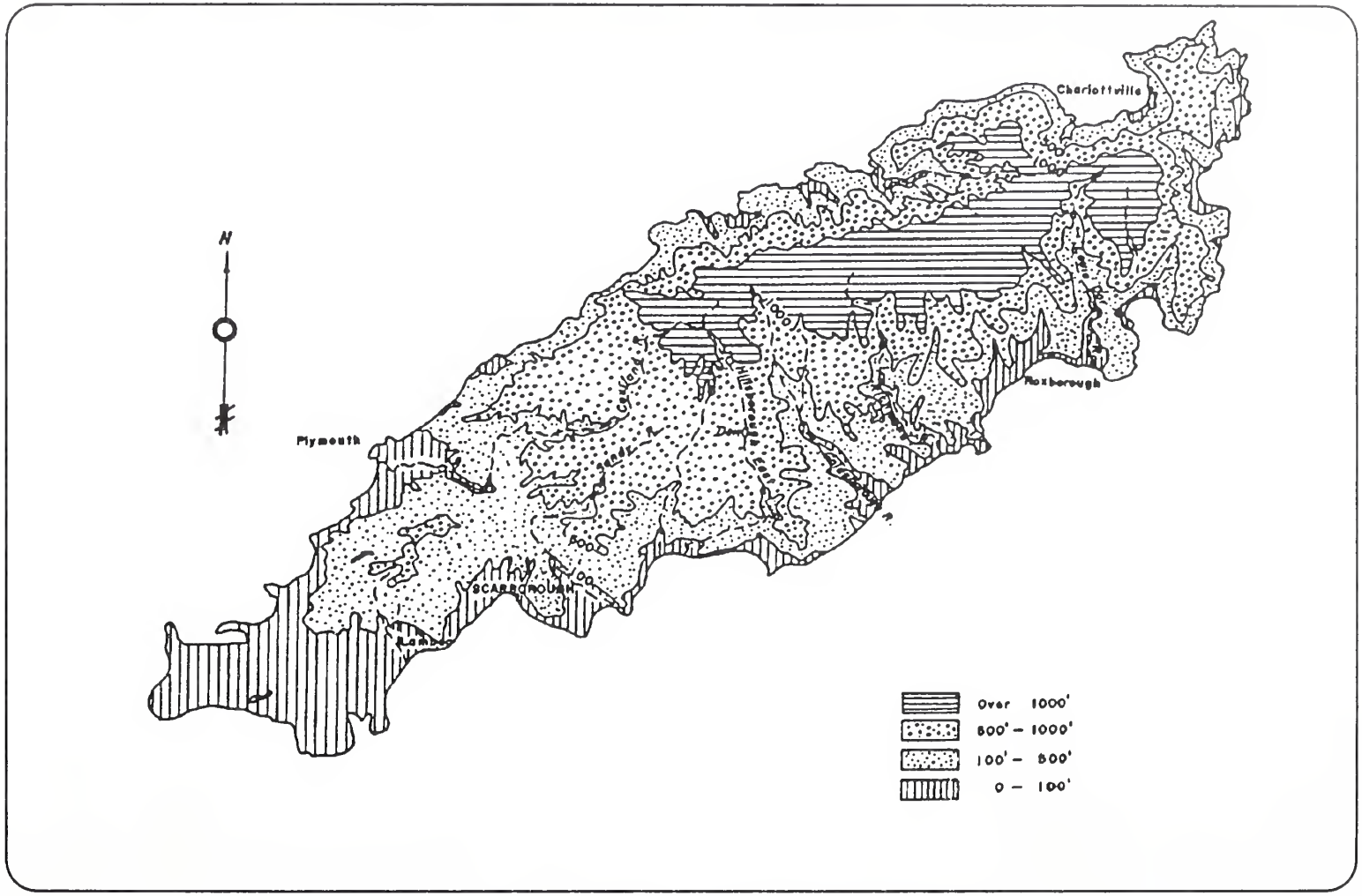
Historically, the location of mineral deposits in Trinidad has influenced industrial landuse and settlement patterns in the island. Economically significant deposits of oil and natural gas exist in the southern lowlands, in the Gulf of Paria, and off the south and east coasts. Significant deposits of asphalt (45 ha) are also located in the south at La Brea.

Economic deposits of clays in west central Trinidad; of limestone and other stone suitable for the construction industry in the Northern and Central Ranges, in offshore islands and in Tobago; of sand and gravel countrywide, but notably in north and central Trinidad; and of porcellanite in southwest Trinidad, have all been exploited. Such exploitation has not always been mindful of the serious negative impacts upon the biological resources of the country and major wetlands in south Trinidad have been affected by pollution from the oil industry.

Soil quality has been the other major influence upon landuse and settlement patterns. Soil classifications based upon agricultural capability guide policy for use of land for agriculture. Areas of both islands with good agricultural lands have attracted nearby human settlements and unfortunately, many major settlements have been developed upon Class I agricultural lands. Wetlands have been classified as having Class VI soil types unsuitable for agriculture and have been recommended to be left under indigenous growth. This land-use policy has been under constant stress within recent times as proposals for swamp reclamation for agriculture, aquaculture, and other purposes are made regularly.

The relative composition of the land area of Trinidad and Tobago based upon land-use is roughly as follows: 1) forest and natural vegetation - 58 percent, 2) agriculture - 30 percent, 3) industrial development - 5 percent, and 4) human settlements - 7 percent.

Figure 3. Relief and drainage of Tobago.



This is a mere approximation since an accurate evaluation and assessment is required of state lands and private agricultural lands which have been plagued by extensive squatting and shifting agriculture. Thus, categories 1, 2, and 4 above may be altered significantly. Because of the squatting situation, it is likely that forest cover and indigenous vegetation of Trinidad and Tobago may have been reduced to an area nearer to 50 percent of the total land area of the country.

The population of Trinidad is concentrated in the west coastal area around the Gulf of Paria and in Tobago, in the southwest. Total population rose from 1.08 million in 1980 (1980 Census CSO) to 1.24 million in 1988 (CSO 1988 mid-year estimates), and over 60 percent live in settlements classified as urban. Constant in-migration to urban areas from rural areas has expanded urban sprawl in the northwest peninsula of Trinidad along the foothills of the Northern Range in the east, and around the major town centers of Chaguanas, Couva, and San Fernando. Urban pressure has influenced landuse on the periphery of these areas and has already accounted for the loss of wetlands at Westmoorings, Cocorite, Mucurapo, Sea Lots, Laventille, and La Romain. Ninety percent of the population of Trinidad live and work in the west coastal area of the island.

Wetlands have also been converted for industrial development at Point Lisas in central Trinidad, where industries have been set up to provide jobs for the expanding population of west central Trinidad. A similar impact of population pressure on wetlands in Tobago has not been observed, but threats based upon the need to develop southwest Tobago are real.

Population growth over the last decade has taken its toll on available land, and the situation is frightening if projections for a total population of 1.7 million is realized by the year 2000. It may be impossible to withstand the pressure for use of wetlands and forests at that time.

*Other socio-economic factors*

A good road network, water distribution to most areas, extensive electrification, and an excellent telephone system link, or efficiently service, all areas of the country. All towns are readily accessible by road and there is mass daily movement to the capital of Port of Spain, where most people work. Daily and weekly commuting by air and sea to and from Tobago is also common.

The population is highly literate with over 98 percent attaining at least a full primary education and the labour force is comprised of over 476,000 persons (1988 C.S.O. data). Unemployment is high (over 22 percent in 1989), and this situation exerts considerable pressure on land resources since a significant number of those unemployed engage in slash-and-burn agriculture in an attempt to feed themselves and their families. Such squatting by unemployed persons has exerted significant pressure on wetlands, one example being a major proportion of the Nariva Swamp.

Economic forecasts for the next 3 to 5 years are not very promising, and further unemployment or underemployment are likely outcomes. It is not difficult to predict the impact of increased unemployment on landuse, and on the use of major wetlands such as the Nariva Swamp, and the South Oropuche Swamp if the present rate of squatting is allowed to continue unabated.

Strategies to convert the considerable human effort made by people who squat into a more sustainable effort must underlie land development policies of the government. The excellent infrastructural network throughout the country and the highly literate population are tremendous national assets. Every effort should be made to utilize these assets to focus on ways and means of developing self-help and self-employment programmes for unemployed persons and squatters in order to deflect the observed increase in their unsustainable use of land.

*Wetland Distribution and Composition*

Wetlands in Trinidad and Tobago occur in areas with impeded or imperfect drainage. Some are characterized by low-lying areas in which tidal action prevents a net outflow of water from the land, while others form in areas where the normal

percolation of water through the soil is either prevented or reduced by impervious subsoil layers. Most wetlands in Trinidad and Tobago fall into the former category and are located in the low-lying mouths of rivers, along their floodplains and along low-lying coastal areas (figs. 2 and 3).

Examples of the latter are the Aripo Savannas and the Erin Savannas in north-central and southwestern Trinidad, respectively. Several small examples of both types of wetland occur throughout both islands, but the most interesting and unique small wetland of significance occurs on Chacachacare Island (fig. 2). A mangrove wetland and a small salt lagoon occur at the "waist" of this island.

Artificial wetlands exist on both islands. Several reservoirs for potable water supply, sewage treatment lagoons, dams and ponds for industrial or agricultural use, and rice fields further diversify the natural landscape.

The major brackish water swamp is Caroni, whilst all others identified in figure 2 are freshwater wetlands. Artificial wetlands of great significance for wildlife are dams of the Point-a-Pierre Wildfowl Trust, Hollis Reservoir, Navet Dams, Caroni Arena Dam, Hillsborough Reservoir, Sewage Lagoons at Laventille, Ricefields at Caroni, Nariva, Fishing Pond, and South Oropouche.

*Location and Size*

Table 1 summarizes data on the major wetlands of Trinidad and Tobago and figure 2 shows their distribution. Numerous small fringing wetlands along most of the low-lying west coastal region of Trinidad have not been studied in any detail (except for recording birds). However, they provide valuable coastal protection services, act as short stopover points for migrant birds and fish, and provide valuable supplementary feeding habitat for bird fauna of the other major wetlands of Trinidad. Historical wetlands which have been converted to other uses have not been listed, as well as the many dams in the oil fields and rice lagoons which are utilized extensively by waterbirds.

*Vegetation*

Table 2 summarizes the principal vegetation types which exists in the major wetlands of Trinidad and Tobago. Mangrove forests make up a substantial proportion of most wetlands except for manmade lakes and inland savannas. Nariva has the most varied vegetation with distinct zones of swamp forest vegetation, palm swamp vegetation, herbaceous swamp vegetation, and mangrove woodlands. Substantial areas of herbaceous swamp vegetation also occur in South Oropuche, Rousillac, Cedros, Los Blanquizales, and Fishing Pond, whilst relatively little exists at Caroni.

*Fauna*

Wetlands of Trinidad and Tobago host a wide variety of fauna, especially bird species. Several species of herons are residents; and several migrant herons, ducks, raptors, and shorebirds visit in large numbers to overwinter annually and may breed before returning to temperate climates.

Table 2 lists birds, mammals, reptiles, amphibians, fish, and invertebrates that are common in each wetland, or which are scientifically important visitors or rare residents. Although Caroni Swamp receives over 100 migrant species, numbers are not as abundant as in the Nariva and South Oropuche Swamps; so most uncommon species are omitted from these tables. Extensive records have been kept of wetland fauna by the Wildlife Section since 1983 and a more detailed analysis than is possible for this report is ongoing.

The species richness of Caroni Swamp is impressive, but population levels of most migrants are generally lower than at Nariva and South Oropuche. For example, migrant populations of dickcissels (*Spiza americana*) can be several thousand in Nariva. The highest populations of scarlet ibis are at Caroni, although they are seen regularly in all other wetlands; especially at South Oropuche where they feed in flocks of 2 to 300. As expected, the richest populations of any fauna found in all wetlands of Trinidad and Tobago are the invertebrates, especially crabs and insects.

Table 1. Wetlands of Trinidad and Tobago. Wetlands at Chacachacare, Carli Bay, and Hollis Reservoir not included as detailed surveys are not yet implemented.

| Wetland | Area (ha) | Existing land-use | Recommended land-use | Present status | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | Forest reserve | Wildlife sanctuary | Prohibited area | State lands | Private lands |
| | | | | (ha) | | | | |
| Caroni Swamp | 5611 | Swamp - 100 | National Park | 3197 | 197 | 2094 | 1540 | 874 |
| Nariva Swamp | 6234 | Swamp - 85<br>Forest - 10<br>Agriculture - 5 | National Park | 40 | 1544 | 1536 | 4633 | 6.1 |
| Fishing Pond | 1220 | Swamp - 80<br>Agriculture - 5<br>Forest - 10 | Remain under indigenous growth | 939 | Nil | | Nil | 322 |
| South Oropouche | 5642 | Swamp - 50<br>Agriculture - 40<br>Agriculture - 10<br>Forest | Remain under indigenous growth | 92 | proposed | proposed | 5550 | Nil |
| Kilgwyn Swamp | 12 | Swamp - 50<br>Land fill - 50<br>(solid waste and earthfill from Airport runway) | Remain under indigenous growth | Nil | proposed | proposed | Nil | 12 |
| Rousillac Swamp | 496 | Swamp - 60<br>Forest - 10<br>Agriculture - 30 | Remain under indigenous growth | 443 | proposed | Nil | Nil | 34 |

Table 1. (cont'd).

| Wetland | Area (ha) | Existing land-use | Recommended land-use | Present status | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | Forest reserve | Wildlife sanctuary | Prohibited area | State lands | Private lands |
| | | | | (ha) | | | | |
| Icacos Basin | 330 | Swamp - 90<br>Agriculture - 10 | Remain under indigenous growth | Nil | proposed | proposed | 330 | Nil |
| Los Blanquizales | 1085 | Swamp - 70<br>Forest - 8<br>Agriculture - 22 | Remain under indigenous growth | Nil | proposed | proposed | 1085 | Nil |
| Bon Accord Lagoon | 34 | Swamp - 75<br>Agriculture - 25 | Remain under indigenous growth | Nil | proposed | Nil | Nil | 34 |
| Aripo Savannas | 1800 | Savannas - 25<br>Forest - 75 | Natural Reserve<br>Scientific Reserve | 1550 | Nil | 1800 | Nil | 250 |
| Erin Savanas | 40 | Savannas - 45<br>Forest - 45<br>Pine Plantation - 10 | Scientific Reserve | 25 | Nil | Nil | 15 | Nil |
| Caroni-Arena DAm | 688 | Man-made lake forest (variable size depending upon reservoir levels) | No recommendation | Nil | Nil | Nil | 688 | Nil |

Table 1. (cont'd).

| Wetland | Area (ha) | Existing land-use | Recommended land-use | Present status | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | Forest reserve | Wildlife sanctuary | Prohibited area | State lands | Private lands |
| | | | | (ha) | | | | |
| Navet Dam | 348 | Two man-made lakes forest (variable sizes depending upon reservoir levels) | No recommendation | Nil | proposed | Nil | 348 | Nil |

Table 2. Vegetation and fauna of wetlands in Trinidad and Tobago. Scientific names are only given the first time a species is listed.

| Major vegetation types | Common or important bird species | Mammals | Reptiles and amphibians | Fish | Other |
|---|---|---|---|---|---|
| **Caroni Swamp** | | | | | |
| Mangroves<br>Red-*Rhizophora mangle*<br>Black-*Avicennia germinans*<br>White-*Laguncularia racemosa*<br>Sedges and grasses (various species) | Scarlet ibis *(Eudocimus ruber)*<br>Cattle egret (*Bulbucus ibis)*<br>Little blue heron *(Egretta tricolor)*<br>Green-backed heron *(Butroides striatus)*<br>Olivaceous cormorant *(Phalacrocorax olivaceus)*<br>Black bellied whistling duck *(Dendrocygna autumnalis)*<br>Great blue heron *(Ardea herodias)*<br>Osprey *(Pandion haliaaetus)*<br>Spoonbill *(Ajaia ajaia)*<br>Brown pelican *(Pelecanus occidentalis)*<br>Yellow crowned night heron *(Nyctiicorax violaceus)* | Crab eating racoon *(Procyon cancrivorous)*<br>Two toed anteater *(Cyclopes didactylus)*<br>Woolly opposum *(Calouromys philander)*<br>Rats (various spp)<br>Mice (various spp)<br>Bats (various spp) | Caiman *(Caiman sclerops)*<br>Iguana *(Iguana iguana)*<br>Cascabel *(Boa endryris cookii)*<br>Mangrove snake *(Liophis cobola)*<br>Lizard (various spp)<br>Snakes (various spp)<br>Frogs (various spp)<br>Toads (various spp) | Sharks<br>Tarpons<br>Grouper<br>Mullet<br>Snapper<br>Tilapia<br>Catfish<br>Small fresh water fish | Fiddler crab *(Uca thayeri)*<br>Blue crab *(Cardisoma guanhumi)*<br>Hairy crab *(Ucides cordatus)*<br>Mangrove crab *(Aratus pisonii)*<br>Oysters *(Crassostrea rhizorphorae)*<br>Mussels *(Mytilus* spp)<br>Barnacles<br>Portugese man-of-war<br>Jelly fish<br>Termites<br>Sandflies<br>Mosquitoes<br>Polychaete-worms<br>Snails |
| **Nariva Swamp** | | | | | |
| Mangrove woodland<br>Red mangrove<br>Swamp forest<br>Swamp bloodwood *Pterocarpus officinalis* | Cattle egret<br>Black bellied whistling duck<br>Green backed heron<br>Limpkin *(Aramus guarauna)*<br>Wattled jacana *(Jacana jacana)* | Red howler monkey *(Alouatta seniculus)*<br>Manatee *(Trichechus manatus)*<br>Capachin monkey *(Cebus albifrons)* | Caiman<br>Anaconda or hurille *Eumectes murinus*<br>Iguana<br>Matte *(Tupinambis negropunctatus)* | Guabine *(Rivulus hartii)*<br>Coscorob *Polycentrus schomburgkii* | Blue crab<br>Fiddler crab<br>Hairy crab<br>Fresh water conch *Melongena melongena* |

Table 2. (cont'd).

| Major vegetation types | Common or important bird species | Mammals | Reptiles and amphibians | Fish | Other |
|---|---|---|---|---|---|
| Crappo *(Carapa guianensis)*<br>Palmiste palm *(Roystonea oleracea)*<br>Roseau *(Bactris major)*<br>Palm swamp<br>Palmiste palm<br>Moriche palm *(Mauritia setigora)*<br>Roseau<br>Bloodwood<br>Crappo<br>Seaside mahoe *(Pariti tillaceum)*<br>Grigri *(Desmoncus major)*<br>Giant sedge *(Cyperus giganteus)*<br>Giant avoid *(Montrichardia arborescen)*<br>Wild cane *(Gynerium saggittatum)*<br>Cascadoux grass *(Leersia hexandra)* | Anhinga *(Anhinga anhinga)*<br>Great egret *(Casmerodus albus)*<br>Great ani *(Crotophaga major)*<br>Pied water-tyrant *(Fluvicola pica)*<br>White-headed marsh tyrant *(Fluvicola leucocephala)*<br>Yellow hooded blackbird *(Agelaius icterocephalus)*<br>Great blue heron<br>Snowy egret *(Egretta thula)*<br>Purp le gallinule *(Porphyula martinica)*<br>Savanna hawk *(Buteogallus meridionalis)*<br>Yellow-headed caracara *(Milvago chimachima)*<br>Blue and yellow macaw *(Ara ararauna)*<br>Dickcissel *(Spiza americana)* | Rats (various spp)<br>Manicou *(Calouromys philander)*<br>Mice (various spp)<br>Lappe *(Agouti paca)*<br>Two-toed anteater<br>Crab eating racoon<br>Agouti *(Dasyprocta agouti)* | Mangrove snake<br>Pipa toad *(Pipa pipa)*<br>Morocoy *(Geochelone denticulata)*<br>Mata mata turtle *(Chelys frimbriata)* | Catfish (various spp)<br>Cascadura *(Hoplosternum littorale)* | Mangrove crab |
| | | **Fishing Pond** | | | |
| Red mangrove<br>Black mangrove<br>*Eleocharis mutata*<br>Ferns *(Acrostichum aureum)* | Greater ani<br>Tricolored heron<br>Wattled jacana<br>Little blue heron<br>Cattle egret | Manatee<br>Lappe<br>Agouti<br>Manicou<br>Rats | Anoconda<br>Caiman<br>Matte<br>Leatherback turtle *Dermochelys coriacea* | Catfish guabine<br>Coscorob<br>Cascadura<br>Salmon | Fiddler crab<br>Mangrove crab<br>Blue crab |

Table 2. (cont'd).

| Major vegetation types | Common or important bird species | Mammals | Reptiles and amphibians | Fish | Other |
|---|---|---|---|---|---|
| | Ruffescent tiger heron *(Trigrisoma lineatum)*<br>Yellow headed caracara<br>Southern lapwing *(Vanellus chilensis)*<br>Green back heron<br>Ruddy turnstones *(Arenaria interpres)*<br>Semi-palmated plover *(Charadrius semipalmatus)*<br>Semi palmated sand pipes *(Calidris pusilla)* | | | | |
| | | **South Oropouche** | | | |
| Red mangrove<br>Black mangrove<br>White mangrove<br>Sea grape *(Cocoloba uvifera)*<br>*Eleocharis mutata* | Purple gallinule<br>Black-bellied whistling duck<br>Fulvous whistling duck *(Dendrocygna bicolon)*<br>Cattle egret<br>Great egret *(Casmerodus albus)*<br>Snowy egret<br>Wattled jacana<br>Tricolored heron<br>Yellow-hooded blackbird<br>Osprey<br>Scarlet ibis<br>Spotted sandpiper *(Actitis macularis)*<br>Great yellowlegs *(Tringa melanoleuca)*<br>Lesser yellowlegs *(Tringa flavipes)* | Rats | Caiman | Cascadura<br>Guabine<br>Cascarob<br>Catfish | Blue crab<br>Fiddler crab |

Table 2. (cont'd).

| Major vegetation types | Common or important bird species | Mammals | Reptiles and amphibians | Fish | Other |
|---|---|---|---|---|---|
| | Least sandpiper *(Calidris minutilla)*<br>Pied water tyrant<br>Common moorhen<br>Limpkin<br>Magnificient frigate bird *(Fregata magnificens)*<br>Clapper rail *(Rallus longirostris)*<br>Long billed dowitcher *(Limnodromus scolopaceus)*<br>American Bittern *(Botaurus lentiginosus)*<br>Common black hawk *(Buteogallus anthracinus)*<br>Ringed kingfisher *(Ceryle torquata)*<br>Olivaceous cormorant<br>Southern lapwing<br>Wimbredl *(Numerius phaeopus)*<br>Willet *(Catoptrophorus semi-palmatus)*<br>Black-necked stilt *(Himantopus mexicanus)*<br>Yellow-crowned night heron | | | | |
| | | **Kilgwyn** | | | |
| Red mangrove<br>White mangrove<br>Salt tolerant grasses | White checked pintail *(Anas bahamensis)*<br>Green backed herons<br>Cattle egrets<br>Yellow crowned night heron<br>Little blue heron | | | | Blue crab<br>Mangrove crab<br>Fiddler crab |

Table 2. (cont'd).

| Major vegetation types | Common or important bird species | Mammals | Reptiles and amphibians | Fish | Other |
|---|---|---|---|---|---|
| | | | **Rousillac** | | |
| Red mangrove<br>Black mangrove<br>White mangrove<br>*Nymphaea ampla* | Cattle egrets<br>Great egret<br>Purple sallinude<br>Common black hawk and sprey<br>Magnificient fridate bird<br>Fulvous whistling duck<br>Black bellied whistling duck<br>Wattled jacona<br>Tricoloured heron | | Caiman | Catfish<br>Cascadura | Hairy crab |

Invertebrates are the main food sources of most bird species in wetlands in the country and are also fed upon directly by a number of swamp and marine fishes. Two mammals, found mainly at Caroni and Nariva, which have exploited this rich resource almost exclusively are the crabeating racoon (*Procyon cancrivorus*) and the silky anteater (*Cyclopes didactylus*), their common names indicate their principal food sources.

Fish fauna are also abundant at Caroni, Nariva, South Oropouche, and in fringing mangroves along the Gulf of Paria. Substantial catches of cascadura (*Hopolosternum littorale*) are taken annually from the Nariva Swamp and this activity supports many fishermen. Smaller sized fish are very abundant in the Caroni Swamp and the larger sizes, which were caught historically (e.g., 60 to 80 kg groupers) are extremely scarce today due to unsustainable fishing practices.

Overharvesting of oysters has similarly resulted in the dwindling of this once abundant resource at Caroni.

The leatherback turtle *(Dermochelys coriacea)* is not truly a wetland species, but it nests by the hundreds annually in the sandy beaches which fringe the mangrove woodland at Fishing Pond. A considerably reduced level of poaching continued after declaration as a prohibited area for the current 1990 season.

By far the most famous true residents of wetlands in Trinidad are the scarlet ibis at Caroni, the manatee (*Trichechus manatus*), and the blue and yellow macaw (*Ara ararauna*) at Nariva. These species are all endangered, the former locally and the latter two internationally. Sadly, remnant populations of the blue and yellow macaw at Nariva have had to be downgraded by the Wildlife Section in recent years to the category of extinct since population levels are too low to be selfsustaining. Only ten birds have been seen since 1986 and even those are under threat through habitat destruction and disturbance of nesting. Unsustainable harvesting of palmiste palms in which they nest for use of the palm heart in curries has been the main negative impact after poaching of nests for flightless young birds. Similarly, the manatee population at Nariva and moreso at Fishing Pond is under threat from habitat abuse and pollution.

The scarlet ibis populations are high (approximately 11,000 birds), but since they do not breed and migrate *en masse* during the breeding season, there is some likelihood that they may not return to roost if better locations are found elsewhere. Populations have fluctuated between 11,000 and 1,000 annually since 1984.

Table 1 shows the conservation status of the wetland resources of Trinidad and Tobago and it should be noted that those wetlands of high wildlife value, which are not yet protected, have been proposed as wildlife sanctuaries and prohibited areas by the wildlife section.

Breeding and release programmes for endangered waterfowl by the private nonprofit Point-a-Pierre Wildfowl Trust has contributed to maintaining some wetland populations. Their use of dams formerly used in the oil industry for wetland conservation is an excellent example of NGO collaboration.

### *Wetland Conservation*

A satisfactory legislative and administrative framework exists in Trinidad and Tobago for wetland conservation. Those mangrove woodlands, palm swamp vegetation, herbaceous swamp, swamp forest, and savannas which have been zoned as forest reserves or state lands, have in large measure remained under natural vegetation. Those which have been lost were mainly under private ownership–such as the former savannas in Arima, Mausica, Piarco, and Saint Joseph and former wetlands at Cocorite, Westmoorings, Mucurapo, and La Romain.

Fortunately, although both wetlands in Tobago are owned privately, they still exist. However, conversion and threats of conversion are ever present.

### *Legislation and Reservation*

Three main pieces of legislation govern the management of wetlands in Trinidad and Tobago.

These are: 1) the Forests Act, Chapter 66:01; 2) the Conservation of Wildlife Act, Chapter 67:01; and 3) the State Lands Act, Chapter 57:01.

Under the Forests Act, protection for vegetation is enforced, and this act also includes important provisions for restricting access to special areas. Areas may be declared prohibited areas under this act. Such action was taken for four important wetlands of Trinidad namely: 1) the Caroni Swamp Prohibited Area: Legal Notice #141 of 1987, 2) the Aripo Savannas Prohibited Area: Legal Notice #113 of 1987, 3) the Bush Bush Prohibited Area: Legal Notice #155 of 1989, and 4) the Fishing Pond Prohibited Area: Legal Notice #28 of 1990.

The principal intention of prohibition at 1, 2, and 4 was to protect unique wildlife species and habitat namely: the scarlet ibis, forest-bird and mammal habitat, and leatherback turtles. Prohibition at 2 was intended to safeguard scientifically unique fragile savanna ecosystems.

The Conservation of Wildlife Act provides for the protection of wildlife species in wetlands, including migratory and marine species which enter the land. Unfortunately, the limited definition of "wildlife" under this act covers only mammals, reptiles, and birds so the valuable invertebrate, amphibian, and fish species are not covered. Recommendations have been made for several years for broader protection for all wildlife species, including, flora and it is hoped that action will be forthcoming soon.

The State Lands Act permits developmental activities in state lands only with the permission of the subintendent of state lands. This provision is not enforced and squatting on state lands is a chronic national problem, including on wetlands at Nariva, the Cedros Basin, and South Oropuche. This Act was utilized to grant leases for substantial portions of South Oropuche, Fishing Pond, and Nariva for rice production.

Table 1 summarizes the legal status of wetlands covered in this report. Although most of the major wetlands comprise areas of forest reserve, two are partially wildlife sanctuaries and four are prohibited areas; most have not been granted special conservation status and none have been managed substantially.

*Jurisdiction*

Administrative responsibility for wetlands which are forest reserves fall under the direct jurisdiction of the Forestry Division, but there are areas of uncertainty as to which agency is responsible for management of state lands. The State Lands Section of the Lands and Surveys Division, Ministry of Planning and Mobilization, does not undertake active management of wetlands which are state lands. The Forestry Division's involvement is limited to patrols and wildlife data collection.

Enforcement action against squatters in wetlands is referred to the State Lands Section for follow-up, but none of the serious offenses committed in the Nariva Swamp have been completed after several years of adjournments in court.

*Management Activities*

*Resource Protection.* Management of wetlands focuses largely on resource protection under the Forests Act, the Conservation of Wildlife Act, and the State Lands Act. However, this has not been altogether successful and encroachment by squatters is prevalent in Nariva and Cedros. Offenses taken to court are usually related to wildlife poaching and very little action is taken against squatters. Substantial portions of Nariva Swamp have been clearfelled for rice and watermelon production with little official success to stem the tide of resource destruction. Indeed, such squatting is encouraged in some official quarters for the sake of producing food, even though such agriculture is unsustainable and unproductive lands are constantly abandoned after a few years in favour of newly cleared lands. Resource protection has been reasonably successful at Caroni although some poaching for the scarlet ibis and waterfowl still exists. Protection of savannas at Aripo and Erin have not always been successful and squatting and illegal timber removal are problems of these two wetlands.

*Resource Utilization.* Mangroves have been the natural resource most desired for utilization from wetlands in Trinidad and Tobago. Wood for fuel in bakeries, bark for tanning leather, and poles for construction have been the principal uses in Trinidad. Sales of mangroves were stopped from 1989 in order to develop a better programme for more sustainable utilization of this resource.

The tanning industry requested approximately 143 tons of mangrove bark per annum to meet their needs. One tree of 1 m girth at breast height yields approximately 136 kg of bark and most trees in Trinidad are considerably smaller in girth (0.3 to 0.6 m). Thus, large numbers of trees are required to satisfy this industry. The process is wasteful of resources since trees must be sacrificed and the wood is not utilized.

Since sales have ceased, there is tremendous illegal felling of trees or stripping of standing trees in the Nariva Swamp for use in tanneries. Recommendations have been made for import substitution utilizing other imported tanning chemicals, and towards this end the Director of Forestry recommended foreign exchange approvals be given to tannery operators. Areas of the Caroni Swamp earmarked for cutback for creation of wildlife feeding basins have been zoned for sales of bark to tanneries, but were not acceptable since trees were not considered large enough.

Demand for fuelwood, although historically significant, has fallen considerably and no longer poses a threat to the resource. So, too, has the demand for construction wood. However, there is still illegal cutting for use as support poles in agriculture.

Hunting and fishing is very common in all wetlands and there is a high degree of poaching of ducks during closed hunting season. Unsustainable harvesting of crabs and oysters have severely hampered the productivity of parts of the Nariva and Caroni Swamps. Overfishing for cascadura in Nariva is prevalent, as some fishermen create artificial dams in which they horde thousands of fish as a holding facility until weekend market day.

Conversion of wetlands for rice at Nariva, South Oropuche, and Fishing Pond has been beneficial for birds as ricelands now support thousands of individuals (residents and migrants).

Aquaculture projects have been developed successfully (for Cascudara) at Nariva but have failed at Caroni (shrimp), causing irreversible damage to 35 ha of mainly privately owned swampland south of the Caroni Reserve. Acidity and pest damage contributed to the problems of this shrimp farm. Many proposals are being considered to expand aquaculture in the Nariva and South Oropuche Swamps.

Recreation and tourism based on the scarlet ibis is the major focus of resource use at Caroni. Thousands of local and foreign visitors view roosting ibises annually and substantial numbers of school children are taken on tour by the Wildlife Section for lessons in ecology and natural history appreciation. Other swamps of high recreational value are South Oropuche and Bon Accord, but these have not been developed to accommodate wide public use.

*Resource Development.* Substantial resource development has not taken place in any of the country's wetlands. Basic infrastructure for administering resource protection, facilitating bird viewing, camping, and picnicking has been developed at Caroni. However, this is inadequate to meet the needs of all users and does not foster the full realizement of the true economic and recreational potential of this outstanding resource.

Proposals for development of park headquarters, game warden patrol centers, more broad walks, interpretation and education facilities, have been accepted and implementation was initiated on a phased basis from this year.

Proposals for capturing the considerable attributes of South Oropouche have not yet been accepted, but it is hoped that basic infrastructure can be provided to increase the positive human experience of this resource.

Recommendations have also been made for development of Bon Accord Lagoon for nature-based tourism and it was suggested that the proposed 400-room hotel be scaled down to small guest houses and cabanas which are more reflective of the ambience nature lovers look for and which would be more compatible with environmental safeguards for the area. Unfortunately, the very enthusiastic landowner died before his dream was realized and it is uncertain whether his relatives will proceed in this direction. Plans to construct another large hotel on Chacachacare Island would ruin the natural attributes of that island, including the salt lagoon and mangrove wetland. Small guest houses are preferable. A rational basis for wetland development has not been developed by government and it is hoped that a wetland management plan can be formulated to guide agencies in the direction of sustainable development.

*Threats to Wetlands*

Major threats to wetlands come from pollution, poor land-use decisions, unplanned fires, from unsustainable timber removal, and wildlife poaching. Table 3 summarizes threats to major wetlands of Trinidad and Tobago.

*Pollution.* Many of the pollution problems in wetlands of Trinidad and Tobago arise outside of the boundaries of wetlands and in some cases from several kilometers away from the particular wetland. Waterborne industrial pollutants are major threats to the Caroni, South Oropuche, and Rousillac Swamps. Heavy metals and toxic waste in factory effluents pour into the Caroni River from industrial plants along the East-West Corridor, and silt from inefficient quarry operations have devastating impacts upon fauna at Fishing Pond and to a lesser extent Caroni.

Oil pollution from chronic leaks throughout the entire southern third of the island is a way of life. Over 1600 "pumping jacks" dot the southland and the majority have been abandoned because harvesting of oil from these outdated wells is no longer economical. They cannot be shut down for reasons that are difficult to accept. Many rusted pipelines are broken and as a result oil seeps continuously into the environment. Oil accumulated during the dry season drains into the South Oropuche river system during the rainy season and into the South Oropuche Swamp (fig. 2). At the start of every rainy season, wetland birds and invertebrates are visibly affected by oil, and mangrove roots and herbaceous vegetation are covered. The long-term impact of this pollution may be significant. Substantial quantities of used motor vehicle oil are also discharged into waterways, and most end up in wetlands (e.g., oily waste water from a state owned bus garage at Laventille).

Pesticides and other agrochemical pollution from agricultural land run off at El Socorro, along the banks of the Caroni River; and in the Nariva, Fishing Pond, Caroni, and Oropuche rice projects are also poisoning wetland ecosystems. Tests done on shrimp harvested at Carli Bay showed unacceptably high levels of pesticide pollutants.

Toxic waste which is comprised of principally heavy metals, fouls the Caroni River system. All factory effluents tested in a major study ten years ago showed unacceptably high levels of dangerous pollutants, some of which do not degrade for decades. A more recent study on heavy metals in the upper reaches of the Caroni System showed no appreciable changes in poisonous effluent discharges. Regular monitoring and control is still at the stage of proposals. Solid waste which is comprised mainly of floating debris from garbage disposed indiscriminately into waterways throughout the country is visible in all wetlands during the early part of the rainy season and formalized dumping is permitted in two major wetlands.

Organic waste from livestock and vegetable farms are either disposed of directly into watercourses which all drain into wetlands (fig. 2), or solid organic matter is often carted away for disposal into swamps. Poultry entrails and feathers and coconut shells from the waternut trade are commonly seen in all wetlands. Floating carcasses of livestock are also observed occasionally in the Caroni, South Oropuche, and North Oropuche rivers.

Table 3. Threats to wetlands.

| Wetland | Major Threats |
|---|---|
| Caroni Swamp | Solid-waste land-fill facility leachate likely to affect groundwater, flora, and fauna. |
| | Chemicals from industry and agriculture. |
| | Silt from quarrying; sewage pollution. |
| | Soil from deforestation in the Northern Range. |
| | Poaching of scarlet ibis and ducks and disturbance by boats. |
| | Overfishing. |
| Nariva Swamp | Conversion of land for agriculture, aquaculture, and marijuana cultivation. |
| | Squatting. |
| | Overfishing for cascadura and crabs. |
| | Illegal felling of palmiste trees for curried palm hearts. |
| | Slaughter of manatee through blocking of water courses for fishing. |
| | Pollution from agricultural chemicals. |
| | Destruction of mangroves through stealing of bark for tanning. |
| Fishing Pond | Pollution by excessive silt from quarries along the North Oropuche River. |
| | Destruction of manatee through blocking of watercourses for fishing. |
| | Poaching of the leatherback turtle. |
| | Over grazing by livestock. |
| | Over fishing for cascadura. |

Table 3. (cont'd).

| Wetland | Major Threats |
|---|---|
| | Over harvesting of crabs. |
| | Organic waste and Chemicals from agriculture. |
| | Squatting. |
| South Oropouche | Indiscriminate solid waste disposal. |
| | Oil pollution from broken pipelines especially during the start of the rainy season. |
| | Bush fires in the dry season. |
| | Overnighting during the open season and illegal hunting during the close season of water fowl. |
| | Unsustainable crab-harvesting. |
| | Over fishing. |
| | Squatting. |
| | Coastal erosion. |
| Kilgyn Swamp | Unmanaged solid waste disposal facility. |
| | Livestock orvergrazing. |
| | Total conversion from proposed airport runway extension. |
| Rousillac Swamp | Squatting. |
| | Overhunting and illegal hunting. |
| | Over-harvesting of crabs. |
| | Over fishing. |
| | Oil pollution particularly during the start of the rainy season. |

Table 3. (cont'd).

| Wetland | Major Threats |
|---|---|
| | Overgrazing by livestock. |
| Icacos Basin | Coastal erosion. |
| | Overgrazing by livestock. |
| | Bush fires. |
| | Illegal hunting/overhunting. |
| Los Blanquizales | Organic and chemical pollution form agriculture. |
| | Overhunting/illegal hunting, overfishing. |
| | Squatting. |
| Bon Accord Lagoon | Overgrazing by livestock. |
| | Hotel development. |
| | Sewage pollution. |
| Caroni-Arena and Navet Dams: Hollis Reservoir | Litter from campers. |

Sewage pollution from malfunctioning treatment plants poses serious problems in Caroni and at Bon Accord in Tobago. Silt from quarries at the foothills of the Northern Range drain into the Caroni and North Oropuche River systems and at times the lower reaches of both rivers become saturated with thick yellow water. The impact of silt pollution has been devastating at Fishing Pond where vegetation normally consumed by manatee have been destroyed, putting this endangered species under further stress. Expensive dredging schemes at the mouth of theCaroni River were undertaken twice over the last seven years without any real success.

*Land-use decisions.* Several wetlands in Trinidad situated close to urban centres have been converted to other uses. Those in the northwestern peninsula, such as the former wetlands at the mouth of the Diego Martin River, have been filled in for extensive housing developments and the lower course of the river has been paved. The Diego Martin wetlands supported a very productive fishery and was an important wintering ground for several migrant birds. Upper-income housing now exists on this wetland in a residential development called Westmoorings, as well as a large shopping mall.

Marina development at Chaguaramas has also been responsible for the conversion of fringing mangrove woodland. Port development consumed most of the former wetlands along Port-of-Spain and Sea Lots; and more recently a controversial decision by

the Port Authority to lease a piece of one of the last remaining mangrove woodlands south of the capital city for the establishment of a cultural centre, the Mecca, was pursued with vigor by the combined efforts of local environmental non-government organizations. Substantial sums have been spent by the organizers to build the centre and they have refused to relocate unless their request for $6 million TT compensation has been met. Planning approval had not been received for this development.

Other port development at Point Lisas in central Trinidad converted substantial mangrove woodland and mud flats. Industrial development also occupies most of this area, whose contribution to Gulf of Paria fisheries is lost forever.

Landfills have occupied substantial portions in the north and south of the Caroni Swamp, and at the South Oropuche Swamp. Those in the Caroni Swamp are managed officially by the Solid Waste Management Company Limited (SWMCOL) as sanitary landfills and receive upwards of 400 tons of waste daily. The landfill at South Oropouche is merely an insanitary dump. Strong concern has been expressed about the Beetham sanitary landfill in the northern part of the Caroni Swamp. A decision was taken by Cabinet in 1986, based upon the advice of an advisory committee to the Minister responsible for local government, to cease all operations at the Beetham by 1991, since the long-term impact of this activity in a wetland could be disastrous.

Despite assurances by the SWMCOL that adequate management through the use of leachate traps, etc., was in place, the committee felt that the risk of permanent irreversible damage to groundwater, marine life, and wildlife which utilize surrounding wetlands was too great to be ignored, and that the present generation was merely postponing long-term serious problems for the next generation of citizens. Alternative strategies for dealing with solid waste, although initially more costly, would safeguard human health and dignity. These were namely: 1) separation of waste at source before collection to enable recycling, 2) encourage entrepreneurship to develop industry from waste glass and recycling paper, 3) export metal and other recyclables that cannot be utilized economically to countries that recycle, 4) compost organic perishables for use in agriculture, and 5) incinerate nonusable fractions of solid waste. Relocation to areas other than wetlands is not a real solution, since the finite land space of Trinidad and Tobago is already under tremendous pressure.

Historically, agricultural development has been responsible for drainage of the coastal areas of Caroni plains and resulted in the channelization of the Caroni Swamp. Rice was the target species and was grown extensively on the landward side of the swamp. This was replaced by sugar cane and has recently been replaced once again by rice.

Rice cultivation was also developed extensively at Nariva, Fishing Pond, and South Oropuche. These areas have unintentionally contributed to the diversification of feeding habitat for high populations of waterfowl, raptors, and wetland birds, and are highly prized wildlife areas. Extensive squatting for watermelon and rice cultivation has converted substantial areas at Nariva and clearing continues at an unsustainable rate daily.

Aquaculture has been developed in Caroni unsuccessfully and more successfully at Carli Bay and Nariva. Freshwater prawns are grown at Carli Bay and cascadura at Nariva. Proposals are submitted on a regular basis for conversion of substantial areas of Nariva and it is hoped that environmental impact assessments are undertaken before any further decisions for conversion of pristine swamp land is undertaken. A new proposal for prawn culture at South Oropuche is currently being reviewed by the Wildlife Section.

*Fires*. Fires have been serious in all wetlands of Trinidad, especially in those with substantial areas of herbaceous swamp. Burning is annual in the Caroni "reeds" area, South Oropuche at Fishing Pond at Icacos, and at Nariva. This affects feeding habitat for wading birds and invertebrate and fish populations are devasted. Some fires are set deliberately by squatters to clear the land for rice or watermelon cultivation.

*Dredging and Drainage Schemes*. Proposals are often made for conversion of "wasteland" into

"productive agricultural land", especially for the Nariva and South Oropuche swamps. Environmental impact assessments are strongly recommended for all such proposals.

*Destructive uses of Wetland Resources.* Destructive uses of wetland resources range from unsustainable timber harvesting to poaching. Recently, excessive stealing of mangrove bark for use in the tanning industry has placed valuable mature mangrove woodland at Nariva, Manzanilla, and Guayaguay area on the east, southeast coastlines under severe stress. Extensive damage is evident along the Nariva River where a 1 km stretch of mature trees had either been felled or stripped standing, and valuable red howler monkey habitat had been disrupted.

Harvesting of palmiste palms at Nariva and Manzanilla for use of their tender palm "hearts" (meristem) for curries in Hindu weddings is unsustainable. Six to twelve trees are cut to supply adequate food for each wedding. The situation at Nariva and Manzanilla is so chronic that natural regeneration of this species is no longer apparent. The few mother trees which are left are insuficcient to produce adequate seeds to meet the needs of wildlife which feed on them and for dispersal of excess seeds by wildlife. The macaw is also affected, since it was formerly dependent upon these palms for nesting and as a food source.

Destructive fisihing practices have been reported at Nariva and Fishing Pond where fishermen string nets across rivers to trap fish. Desired species are taken and the socalled trash species are discarded. Sadly, manatee trapped by these nets down, impacting significantly upon already stressed populations. Clearfelling of extensive patches of the Nariva Swamp forest for marijuana plantations is a serious chronic problem which has grown substantially over the last 8 years and continues to grow.

*Future Options*

A concerted effort is required to streamline the conservation status of wetlands in Trinidad and Tobago if the benefits of wetlands are to be realized fully. Recommendations of the National Physical Development Plan for wetlands with Class IV soils (soils unsuitable for cultivation) to remain under indigenous growth are often ignored when proposals are up for consideration.

The natural history attributes of Trinidad and Tobago are enhanced considerably by the contributions of the wetlands components of the country's rich array of natural ecosystems. These assets need to be harnessed for the public good and for their tremendous potential contribution to overall national development. Unfortunate perceptions that wetlands are wastelands still exist at the public and official levels in this country. As human population pressure for space and food increases over the next decade or so, pressure for conversion of wetlands for food production, for human settlements, and for industrial development, will increase significantly. Strategies must be developed to tap the potential of wetlands for economic aand social growth and to educate the populace about such contributions. Short-term conservational measures are required almost immediately for some wetlands and the strategy of declaration as prohibited area ought to be utilized for same.

The major recommendations of this report is that Nariva Swamp should be proposed for listing as a Ramsar Site under the Convention for the Protection of Wetlands of International Importance (Ramsar Convention). It is hoped that Caribbean foresters would support Trinidad and Tobago's application.

# THE ROLE OF EVALUATION IN CARIBBEAN WETLANDS MANAGEMENT

*Peter R. Bacon*

## *Introduction*

In a study of development in the Turks and Caicos Islands, Wager and others (1988) concluded that wetlands were among the most commonly impacted ecosystems and that they showed sensitivity to a wide range of impacts. These authors had analyzed a variety of developments taking place or proposed for Providenciales and neighboring Caicos islands into their component activities and demonstrated that the majority of these activities involved modification or perturbation of wetland environments.

Studies by the author in Saint Lucia, in association with the Caribbean Environmental Health Institute, and in Tortola, for the government of the British Virgin Islands, showed a similar relationship between development activity and wetland loss or modification in these e
astern Caribbean islands. Earlier, Hudson (1983), Bacon (1987a) and Williams (1990) described considerable losses of wetland habitat in Jamaica, Barbados, and other areas of the insular Caribbean, particularly as a result of developments in the tourism industry. It can be assumed in these cases that the planners and developers attached a low value to wetland environments and considered the loss of wetland goods and services acceptable in order to improve tourism infrastructure.

In one particular development, however, the government of the Turks and Caicos Islands questioned the advisability of reclaiming a wetland area for resort development and sought to establish its natural value. The ecosystem was analyzed and an assessment made, using the approaches described below; but this case study illustrates the problems encountered frequently in the Caribbean when attempting to calculate the value of wetlands, particularly those on small islands.

## *Case Study 1 - Parrot Cay, Turks, and Caicos Islands*

Some 343 ha of saline wetland occupied the central and eastern part of the 548 ha Parrot Cay and contained six plant communities but a sparse fauna. In seeking to provide a rationale for protecting these wetlands from development, the following became apparent:

1. The major part of the mangrove vegetation was poorly developed, being dwarf *Rhizophora* and *Avicennia* scattered across saltmarsh or bordering extensive barren salinas. The site was a saline wetland of low productivity.

2. There were few channels giving restricted tidal flushing; this meant that interactions with neighboring marine systems were limited. The classic function of organic matter export to associated reef and seagrass environments appeared to be minimal.

3. Parrot Cay wetlands represented a minute fraction of the 64,669 ha present nationally (C. Floyd in Scott and Carbonell 1986) and were in no way thought to be different from, or more valuable than other areas.

4. This did not appear to be important habitat for aquatic fauna or resident or migratory waterfowl. No species was confined to, or totally dependent on this particular area of wetland habitat.

5. Few species of current or potential commercial importance were present; those that were recorded, such as oysters and sea turtles, occurred in very small numbers.

Further to these findings was the proposal before the host government to declare a large area of the Caicos Islands a Ramsar Site (Clarke and Norton 1988). If the neighboring, larger area were to be protected under the Ramsar Convention, it was thought that loss of this small wetland could be permitted.

Thus, it proved difficult to justify the protection of the patches of wetland on a small cay when their value was assessed (a) relative to the gains expected from the proposed resort development and (b) in comparison with larger, more productive wetlands elsewhere in the country. Such reasoning, if applied widely, could result in the gradual erosion of national wetland resources, particularly the smaller sites, under pressure from developers. Conservation effort would be focused then only on larger or more productive areas, or on those areas not desired for development. The key problem here concerned how to make an accurate estimate of the value of an isolated wetland area in relation to the overall, long-term development of a country.

*The Process of Wetland Evaluation*

Evaluation plays a central role in the process of wetlands management, as it does in natural resource management generally. Any evaluation must be based on accurate resource inventory, that is, the description of the location, size, components, and characteristics of the resource; so, inventory work must be conducted in such a way that it facilitates evaluation.

A great diversity of wetland types exists in the Insular Caribbean; for example, Borhidi and others (1979) identified 45 wetland plant associations in Cuba, half of which were forest associations, and Bacon and others (1979) described 15 plant communities in a single Trinidad site, the Nariva Swamp. There is now general agreement on what ecosystems, habitats and plant communities should be included in any inventory of Caribbean wetlands, from the work of Gleason and Cook (1926), Beard (1944) and Borhidi and others (1979), as summarized by Lugo and Brown (1988).

The extent to which insular Caribbean wetlands have been inventoried varies from one country to another. General descriptions of all the major Caribbean sites are contained in the Directory of Neotropical Wetlands (Scott and Carbonell 1986), but many countries have only sketchmaps and avifauna-biased biological descriptions of their other wetland areas. Mapping needs to be fine scale for management purposes and descriptions should not be confined to lists of species, as is often the case. Forest structure and mensuration, plant growth rates and stock densities, animal population sizes and dynamics, including seasonality, and a detailed knowledge of ecosystem forcing functions such as tidal cycles, riverine drainage, sedimentation rates, and microclimatology is essential.

Mangroves dominate coastal wetlands throughout the region, but mangrove forest structure and productivity are known in detail only from Guadeloupe, Jamaica, Martinique, and Puerto Rico. Further to this, few islands have identified, let alone quantified, their national wetlands resource capital; that is to say, the range of directly exploitable components and indirectly valuable functions and attributes, as suggested by Barbier and Burgess (1989). The current inadequacy of many national wetland inventories hinders accurate evaluation for management and development purposes.

The methodology for wetlands evaluation has evolved considerably in recent years. Early methods used in the Caribbean islands involved simple sectoral calculations, such as those of Ramdial (1975) who calculated the overall value of Caroni swamp, Trinidad, from direct fisheries production and visitor use through opportunity costs. A similar method had been used by Browder (undated), who valued Florida mangroves by comparing their carbon fixation in primary productivity with coal-equivalent costs.

A complex scheme developed by Adamus (1983) for the U.S. Army Corps of Engineers, and based on assessment of functional values, was reviewed by Lugo and Brown (1988), who considered it generally applicable for use in the Caribbean, but far too complex. Barbier and others (1989) suggested an approach to economic valuation of Caribbean Region wetlands based on ranking the structural

components, functions, and attributes of a site and using market price, opportunity cost, cost of substitutes, and of damage avoided, with time horizon and discounting procedures. They concluded, however, that the data base is seriously deficient and generally hinders application of even the simplest economic valuation technique, particularly for the more complex wetland systems.

*Case Study 2 - Mangrove areas, British Virgin Islands*

A simpler evaluation scheme, under development by the OECS/GTZ-Natural Resources Management Programme and tested in the British Virgin Islands (Blok-Meeuwig 1990), derives indices of value from a set of ecological and economic criteria. This permits ranking of wetlands of any island according to their ecological, economic or combined values and aids in the selection of important sites for protection or management.

However, a number of problems arise when this type of evaluation scheme is applied because:

1. A priority listing, by identifying important wetlands, relegates others to the status of "less important" or even "unimportant" nationally, when they might be performing locally important hydrologic or ecologic functions.

2. The "values" calculated appear as relative indices, rather than actual or equivalent dollar values.

3. When equivalent dollar values are calculated, these are generally low. This means that the values of wetland areas become noncompetitive in development planning.

4. Some, often several, wetland areas will be found to be "valueless". This is particularly true of salinas and degraded mangrove areas which support few organisms, or sites which dry out seasonally.

Evaluation schemes of the type used by Barbier and others (1989) and the OECSGTZ Programme (Blok-Meeuwig 1990) make no attempt to rank the assessment criteria themselves. This begs the question which of the criteria take precedence. Are "goods" more valuable than "services", and these more valuable than "attributes" ? Is the value of a wetland for wildlife conservation greater than its value in subsistence fishing or as national heritage ? Changes in land-use and conservation activity in one Trinidad wetland can be used to comment on the consequences of this dilemma.

*Case Study 3a - Caroni Swamp, Trinidad*

As appreciation grew for the important ecological roles carried out by Caribbean wetlands, particularly the mangals (Pool and others 1979; Ogden and Gladfelter 1983), concerned individuals and NGO's pressured governments to protect them. Caroni Swamp was recognized early on for its productive mangrove forests and rich wildlife (Bacon 1970, ffrench 1966), and was accorded a high priority rating by James and others (1986). Supported by persuasion and funding from international conservation agencies (FAO, IUCN, WWF, IWRB), protected area status was given to Caroni Swamp and the vegetation and fauna, particularly the birds, began to enjoy a much needed respite from deleterious human impacts. Today the Caroni Reserve is a model of conservation management and the site of an economically important wildlife tours industry (see James in this volume).

Interestingly enough, the protection of the swamp proceeded to the detriment of some wetland resource users, particularly those with dependence at the subsistence level. Hunting, fishing, wood cutting, bark stripping for tannin, charcoal burning, and oyster collecting were all reduced; although many of these activities continued illegally. The Trinidad Forestry Division, which administers the country's system of parks and protected areas, had apparently chosen to rank wetland services higher than wetland goods for management purposes. It seems that their evaluation was based on an either-or approach. This has had

some unfortunate social consequences, as it resulted in economic benefits to a few tour guides and economic losses for a larger number of subsistence users.

Solitary voices have been raised against this lack of attention to human uses of, and interactions with, wetland systems (Díaz and Zelwer 1985, Bacon 1987b) and the criteria for selecting sites of international importance under the Ramsar Convention (Ramsar 1971) have been revised recently to include resource values. One of the problems that lies behind the ease with which conservation values are appreciated but difficulties arise in assessing human uses is the paucity of research and data on such aspects as waterfowl hunting, subsistence fishing, charcoal burning, and seasonal cultivation in Caribbean island wetlands. Waterfowl hunting is assessed only for Guadeloupe (Benito-Espinal 1982); there is some work on subsistence fishing in Jamaican morasses (Aiken, 1984); mangrove use for charcoal is being quantified in St. Lucia (ECNAMP 1983); and seasonal cultivation is described for one Trinidad swamp (Bacon and others 1979). Imperfections in this aspect of inventory hinder evaluation of a significant, and sensitive, area of wetland resource economics.

Furthermore, as the importance of wetland conservation gained acceptance and protected areas proliferated in the region, there has been renewed conflict with developers. This occurs increasingly, as pressures for economic development intensify in the region, particularly from the tourism and agricultural sectors. Wildlife conservation interests often appear to be negative when compared with proposals for more obviously economically advantageous uses of wetlands.

*Misconceptions in Current Evaluation Methods*

Most attempts to carry out resource accounting for wetland evaluation are flawed because they start from the wrong premise. Values are derived for the wetland at the current base year and using current conditions; that is to say, calculations are made for existing goods, services or attributes "as is, where is". In addition, the evaluation is restricted within the framework of current market and nonmarket values, but in isolation from national development policy and planning or projected changes in resource use. Furthermore, the product of many evaluation procedures is a ranking for various wetland sites in terms of their relative values, when it might be better for development purposes to calculate their value irrespective of the attributes of another site. Some examples from recent studies in the Caribbean can be used to illustrate these points.

*Case Study 3b - Caroni Swamp Re-examined*

Ramdial (1975) calculated the value of the fishery harvest from Caroni Swamp. He reported that 178 full-time and 52 part-time oyster collectors and fishermen took 1,589,170 lbs annually with a net value of TT$981,450. Similarly, 31 full-time and 5 part-time crab collectors took 313,508 lbs valued at TT$215,904, and 3 full-time shrimpers took 61,360 lbs valued at TT$45,760.

In valuing the swamp fisheries at just over TT$1 million annually no account was taken of the status of the resources. Caroni Swamp has been altered considerably by attempted reclamation and diversion of freshwater inputs. Deonarine (1981) identified 15 types of industry discharging effluents in to the swamp and some 25 types of pesticides in use in the Caroni River catchment area. Following years of unregulated harvesting, with damage to habitat and pollution stress, the fishery resources were not in optimum condition at the time of the assessment. Therefore, the evaluation was not a true reflection of resource potential. It is almost certain that, if the fisheries were to be managed correctly in a pollution-free environment, supported by stock rearing and possibly mariculture, greatly increased yields could be expected; and, the estimation of resource value of the Caroni Swamp would be correspondingly higher.

Similarly, estimates of mangrove timber stocks (timber, garden sticks, charcoal) based on tree density, diameter at breast height (dbh), trunk height, and forest area in Caroni swamp, or elsewhere, would not give a true estimate of forestry production unless account was taken of forest status, previous history and current stressors. With the exception of small stands near Vieuxfort, St. Lucia, being managed for

charcoal production (ECNAMP 1983), mangrove forest resources, and swamp forest resources also, are not managed actively to maximize production. It is common practice in Malaysia and Thailand to clean and thin mangrove stands and cut in rotation, followed by replanting with the more desirable species; and these factors are taken into account when estimating potential timber crops from which the forestry values of mangrove wetlands can be calculated.

It is instructive, also, to consider how the value of the Caroni Swamp for recreation and wildlife tours has changed. Ramdial's (1975) evaluation was based on actual visitor use (opportunity costs) during 1974. Had his evaluation been made ten years earlier when only hunting parties sought recreation in the swamp, a low value would have been given to the swamp. There is no doubt that active wildlife management and upgrading of tour operations have increased the values of the services provided by Caroni Swamp in recent years, so its recreational value is much higher than originally estimated. This suggests that the value of a wetland, or component resource, is related as much to its potential as to its current condition, as can be illustrated by a second Turks and Caicos Islands site.

*Case Study 4 - Eastside Salina, West Caicos*

The two largest wetlands on West Caicos are Lake Catherine and the Eastside Salina. The Lake supports a rich marine algal and invertebrate community and provides habitat for a variety of waterbirds, including the roseate flamingo (Clarke and Norton, 1988). Scenically, it is very attractive and has been declared a national park. In contrast, Eastside Salina is largely dry, with a border of scrub mangroves and scattered saltmarsh herbs, supports few invertebrates or birds, and has none of the esthetic appeal of the adjacent lake. Ecological evaluation would place this salina system low on the scale and provide little reason to resist development pressures.

However, opening up the abandoned canals which linked the salina to the sea when it was modified for salt production could transform this barren area and return it to the status of a productive wetland. As developers have realized, flooding Eastside Salina could provide also for a marina and boating area, lakeside villa sites and vistas that would enhance real estate values. An evaluation of the salina in its current state would be very different from one projected to its potential state.

There are many cases where apparently low-value coastal wetlands have been enhanced by engineering and other types of development activity. For example, Turtle Cove in Providenciales was a small, marshy salina isolated from the sea. Its transformation into a marina has permitted entry by adult and juvenile fish and invertebrates and it is used by resident and migratory waterfowl on a year-round basis. Its value for fish nursery and wildlife habitat has been enhanced, as have its socioeconomic values. The Great Salt Pond, Jamaica, was an ephemeral salt pond, drying seasonally with widespread mortality of its fish and invertebrate fauna and restricting use by waterfowl (Reeson 1971). The channelization of this pond has led to increased growth of fringing mangroves, year-round use by fish, invertebrates and water birds, year-round fishing and opportunities for mariculture and watersports (McCain and Bacon 1989). Similarly, excavation of a canal system for waterside villas on Parrot Cay, in the development scheme mentioned above, has increased greatly the ecological value of a once poorly productive environment in addition to economic gains associated with the resort development.

*Conclusions*

The value of many wetlands in the Caribbean Region has been underestimated, and there is need to develop an evaluation system that recognizes "potential value" under different development scenarios. If engineering manipulation and active resource management can improve the types and quantities of goods, services and attributes of Caribbean wetlands, the evaluation cannot be based solely on current conditions at the site.

Wetlands, more so than other natural systems like coral reefs or seagrass beds, can be managed and manipulated to provide a desired mix of goods and services. Consequently, managers should move from

the security of protective conservation schemes and explore the role of wetland sites in socioeconomic development. They must safeguard the basic structure and forcing functions of wetland system dynamics, and keep development options open for the future, of course; but, managers must actively manage the systems under their control to maximize the value to society. Evaluation is the central activity in wetland conservation; and it must be done accurately and with imagination.

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# THE ROLE OF CARIBBEAN FORESTS IN THE WELFARE OF CARIBBEAN ISLANDS

*Ariel E. Lugo*

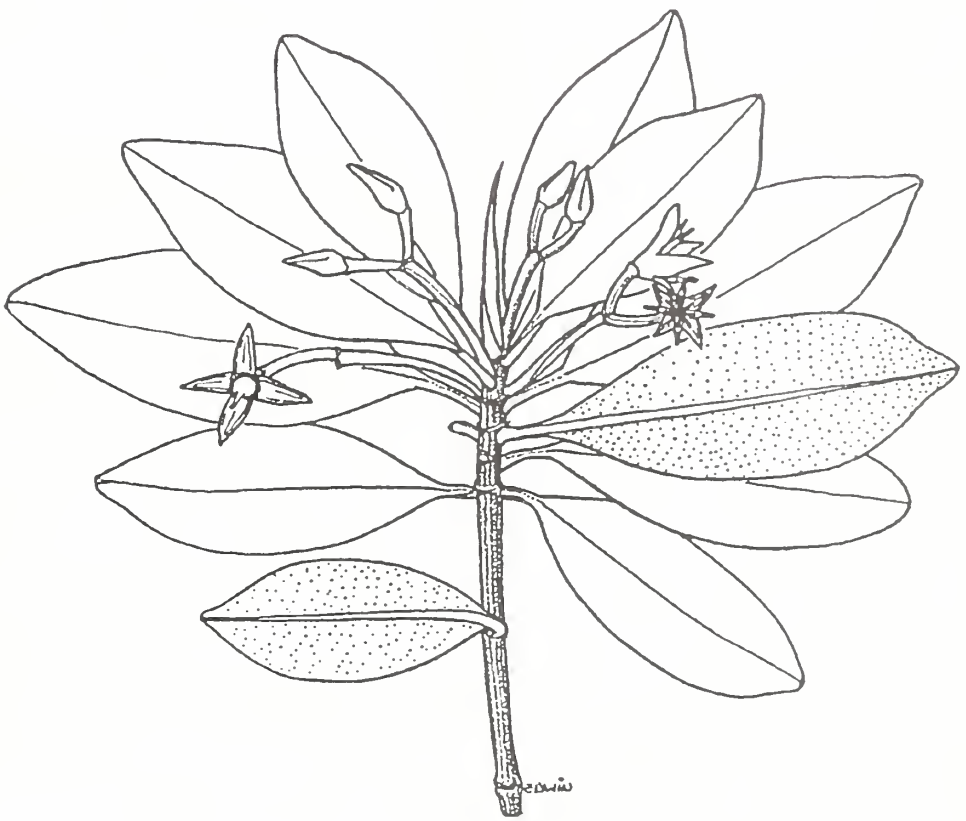
It's an honor and a great responsibility to be here given that this meeting is the result of the productive 10 years of Caribbean Foresters Meetings. My job here is to discuss the importance of the forestry sector to island life and the economy. My intention is clear: to make the point that the forestry sector is a forgotten partner in the island economy and it's time to give it its due. Without a healthy forestry sector, island development will suffer. Just to give you an idea of the wide ranging influence of forestry, I listed 16 contributions of the forestry sector to island development before I had to use the word "wood".

The two big issues with regard to coupling forestry and development are: 1) the danger of over development, and 2) matching development to the carrying capacity of the land. Overdevelopment means that the natural resource base of the island has been damaged by development to such an extent that it can no longer supply free services to society. Examples would be the loss of soil fertility due to erosion, loss of clean water due to pollution, loss of wildlife due to extinction or overexploitation, loss of forests due to conversion, loss of sands due to over extraction, loss of fisheries due to excessive harvesting or pollution, etc. When the free services of living ecosystems are lost, the economy has to pay for these amenities at prices that overburden island budgets. Overdevelopment is very oppresive because it is very difficult to reverse its negative trends. The solution, while we have time and resources, is to develop in harmony with nature and within its limits. This is the essence of sustainable development. The reason these issues are so important to us is because our islands are small and fragile. Should we make a serious mistake, the consequences can be onerous because islands are generally isolated and it's up to us to solve our problems.

Let's think of the critical subsidies to human economic activity in the Caribbean that are rooted in the forest: 1) tourism; 2) water - potable, irrigation uses, industrial uses, power production, quality, annual variation, floods; 3) recreation - developed and dispersed; 4) energy-hydrological, woody, biomass, and charcoal; 5) indigenous (subsistence) farming; 6) artisanal activity; 7) forest extractives; 8) medicinal plants; 9) animal grazing; 10) soils - fertility, protection from sedimentation of reservoirs, and landslides; 11) fishing - sedimentation impacts to coral reefs, freshwater for estuaries; 12) education; 13) culture; 14) wildlife; 15) jobs - farming, hunting; 16) buffer to natural catastrophes - periodicity of processes, and 17) commercial wood products.

Small islands get little attention in global and economic affairs and are most vulnerable to external influences. Once an island environment is destroyed, its economy collapses and there is social unrest. The island is forgotten as economic activity moves elsewhere in a highly competitive world, and will receive little help to regain its environmental and economic health. It is therefore, critical to know what resources are available to support development and their status. With regards to forest management in the Caribbean, current critical issues are: delimiting boundaries of public lands, conducting inventories, solving encroachment problems, dealing with poor water supplies in the dry season, wildlife populations are low, forest plantations are poorly managed, absence of research, wasted wood, lack of rehabilitation of degraded sites, under pricing of wood, little or no training of forestry personnel, facilities need improvement, etc. Gentlemen, forestry needs help so it can help the economy! I hope this meeting contributes to this goal.

# Part III - Appendices



*Rhizophora mangle*

# AN UPDATE ON THE FAO TROPICAL FORESTRY ACTION PLAN FOR NINE CARICOM COUNTRIES

*W.S. "Dan" Chalmers*

The Prime Minister's masterly statement on forestry in his welcome address this morning summarized perfectly the reasons and justification for the existence of the FAO Tropical Forestry Action Plan (TFAP) - namely the global forestry crisis, which is just as acute in the Caribbean as it is in Brazil and Indonesia. About 5 years ago, as a direct consequence of that crisis, FAO, the World Bank, the World Resources Institute, UNDP, and a number of major donor countries got together and designed a strategy, which has since become known as the TFAP, to combat the crisis. In the light of on-going experience the basic ideas have been amended to meet new circumstances.

In deference to our distinguished chairman and his colleagues, I think it would be remiss of us to overlook a number of political initiatives in the fairly recent past in connection with pushing the case for forestry in the region. It was in fact the CARICOM Standing Committee of Ministers of Agriculture that was directly responsible for nine CARICOM countries taking part in the TFAP exercise which I am now coordinating. The countries were Antigua/Barbuda, Barbados, Dominica, Grenada/Carriacou, Montserrat, St. Kitts/Nevis, St. Lucia, St. Vincent, and the Grenadines, Trinidad and Tobago.

In addition separate TFAP exercises have been completed already for Belize, Guyana and Jamaica. Furthermore, my own terms of reference include the consideration of regional issues arising from these twelve country exercises within the Caribbean region. In all, 73 countries are now involved in some stage of the FAO TFAP.

Another significant political achievement is the CARICOM initiatives on the environment which culminated in the May 1989 meeting in Trinidad of regional Ministers responsible for the environment and whose efforts resulted in the signing of the Port-of-Spain Accord. The Accord constitutes a major step forward in focusing attention on critical environmental issues. The CARICOM Forum on the Environment envisages, interalia, the establishment of a number of task forces with specific responsibilities and it is significant that the FAO CARICOM TFAP has been delegated the responsibility for reporting on forestry and related matters.

The TFAP in general has five specific priority areas and four target groups and these are described briefly below.

## *Priority Areas*

Forestry in land use - i.e., in reforestation, watershed management, national parks, in relation to wildlife; in the interface between forestry and agriculture as a means of ameliorating the harmful effects of some agricultural practices for example through judicious use of agroforestry techniques involving timber trees, fruit-trees and, livestock.

Utilization of products from the forest - not only large timber trees but minor forest produce such as fruits, nuts, vines, handicraft materials; including more efficient/less wasteful harvesting of raw material and innovative ways of utilizing existing waste material.

Fuelwood and energy - the demand for firewood and charcoal, is much less than it was 20 to 30 years ago, but it is still quite considerable, though not accurately quantified. With fossil fuel supplies and prices still susceptible to sudden dramatic changes this is still an important area for forestry.

Conservation of tropical forestry ecosystems - in view of the current massive scale of forest destruction the very highest priority is given to conserving existing tropical forestry ecosystems. This does not

mean that the forest should not be utilized, on a sustained yield basis, as a source of raw materials, but every effort should be made to avoid clear felling of existing natural forests. Certain ecosystems, e.g., mangroves and wetlands are already under serious threat in certain Caribbean countries.

Institutional aspects - this embraces all the other things that need to be done or to be put in place to make the national TFAP a success - i.e., adequate forest policies and legislative support systems; adequate staffing, equipment and funding and above all a national policy, for example, in terms of fiscal or other incentives and appropriate land tenure systems, to encourage forestry/agroforestry development in the private sector.

*Target Groups*

The four target groups are: (1) rural populations; (2) non-governmental organizations involved in rural development activities; (3) women - who have always played and continue to play a major role in rural development; and (4) the private sector, which is encouraged to take a major role in helping to develop all aspects of the forestry sector - from the small allotment holder to the large estate owner; from the landless livestock owner to the small- or large-scale entrepreneur who wishes to get involved in agroforestry development for which there is so much potential in the region.

The TFAP should be seen essentially as a major "self-help" project to develop all aspects of the forestry sector and it is clearly recognized that the ultimate success of the project depends on the target groups indicated above and their wholehearted commitment to, and involvement in, all aspects of the TFAP process - from the planning stages onwards.

Between November 1989 and the end of February 1990 I completed an FAO TFAP preparatory mission to the nine countries involved and my report has been sent to the Governments concerned, to the donor agencies operating in the region and to other interested parties. I think it would be accurate to say that the recommendations in the report received strong support at the technical and political levels.

Each country has accepted in principle the need to implement the following steps as part of the ongoing TFAP exercise:

1. set up a small TFAP Secretariat headed by a professional (ideally a forester) who will serve as the national coordinator (NC);

2. establish a National Coordinating Committee (NCC) to ensure that all the appropriate government ministries and appropriate non-government agencies are fully involved in the TFAP from the planning stages;

3. one of the key functions of the NCC will be to determine the priority areas to be dealt with under the TFAP; and

4. set up multidisciplinary project teams to identify specific projects and prepare project profiles in advance of the arrival of the TFAP Country Mission Team (CMT).

In addition, perhaps the overwhelming responsibility and challenge for each government is to start work immediately in creating the ideal environment to foster forestry/agroforestry development on a national scale. Two key areas in this respect are (a) fiscal and/or other types of incentives to stimulate such development and (b) solving the problems of land tenure/land leasing to assist in tackling the critical issues of indiscriminate squatting and uncontrolled grazing of livestock.

Later this year individual CMT's will visit each participating country. The teams will consist of international and regional specialists working, whenever possible, with local counterpart staff - not to impose their "outside" views - but working jointly to: (1) complete a review of the forestry sector; (2) prepare a 20-year (TFAP) forestry development plan; and (3) identify key specific project proposals worthy of inclusion in the TFAP for funding, over the first 5 years, and the preparation of project profiles for these projects.

When completed, the national TFAP should be scrutinized by all sections of the community by means of a socalled "national roundtable confer-

ence" organized by the government. This review should include technical, human and environmental aspects of the national TFAP in general and of the specific project proposals in particular.

Once the national TFAP has been accepted by both the Government and FAO the stage is the set for the organization of an international roundtable conference which is essentially concerned with the provision of funds to implement different aspects of the national TFAP. Of course the timing of the national and international roundtable conference will depend entirely on the progress of the TFAP exercise in each country.

Earlier in this meeting we heard someone query the commitment of politicians and economists/ planners to forestry development in the region.

In response, and without wanting to be unduly optimistic, I am heartened by developments at two recent meetings involving Caribbean countries. At the World Bank's Caribbean Group for Cooperation in Economic Development (CGCED) meeting in April (1990), in Washington, virtually every head of delegation stressed the importance being given to environmental issues in their funding programmes and by the end of the meeting the FAO/TFAP for nine CARICOM countries was specifically included in the CGCED's work programme for 1990/91. This was a major breakthrough because it is the first time forestry has been singled out by the CGCED.

Subsequently, at a conference in Jamaica in May 1990, on "The Public Policy Implications of Sustainable Development in the Caribbean Region" the Deputy Prime Minister of Jamaica, Mr. P.J. Patterson, drew attention to the considerable sum set aside by the EEC under Lome IV to assist with funding projects with an environmental bias, and he issued a stern warning to finance ministries in the region to take advantage of this opportunity.

Later in the same meeting, one of the region's leading economists, Mr. William Demas, now governor of the Central Bank of Trinidad and Tobago, in opening the final plenary session stressed five key issues in relation to regional development. One of these was the vital importance of forestry development and the need for governments in the region to recognize this by allocating funds specifically for forestry projects.

Some important areas will be studied outside the ambit of the specific CMTs, these are: (1) mangroves; (2) natural products (i.e., herbal remedies, bush teas) derived from the forest; and (3) handicraft materials.

The intention here is that a single experienced specialist will undertake each of the above studies in all nine countries and report to the respective CMT.

One important development is the likelihood that the Caribbean Development Bank, under its Technical Cooperation programme to the OECS, will fund the services of an experienced regional forester to assist Antigua/Barbuda, Montserrat and St. Kitts/Nevis in the essential preparatory work that has to be completed before the arrival of the CMTS.

I mentioned earlier that consideration of important regional forestry issues will fall within the ambit of the CARICOM TFAP exercise. During the course of my preparatory mission, a number of issues were raised and the main ones are summarized below:

1. the scope/need for a regional or sub-regional forestry service;

2. education, research, training, extension - the Caribbean is the only "region" in the world without a facility to train foresters to the first degree level. There has been an enthusiastic response to the proposal for an International Institute for Forestry and the Environment at the St. Augustine Campus of the University of the West Indies. (The CDB 1983 Regional Forestry Sector Study had earlier recommended a Department of Forestry within the Faculty of Agriculture - but this never materialized);

3. review and development of the regional timber trade;

4. preparation of media and school public education/awareness programmes concerning forestry and the environment;

5. standardization of statistical and other data related to forestry in the region.

In an effort to stimulate awareness and interest in the TFAP in the schools, it is hoped to organize national and regional essay competitions, and, hopefully, a commemorative stamp issue in each country.

Finally, I would like to end with a special appeal to all donor agencies. Since starting work on this exercise I have been amazed at the amount of unnecessary duplication of effort by different agencies on various aspects of the environment. My appeal is this - please let us communicate more and duplicate less - and wherever possible let our efforts in relation to solving environment problems be channelled through the TFAP.

# BACKGROUND INFORMATION ON THE AGRICULTURAL MINISTERS MEETING ON THE FORESTRY SECTOR

*Bruce Bayle*

The idea for the meeting began in December 1988 when the Minister of Agriculture, F.A. Henry, wrote Dr. Vaughn Lewis, Director of the Organization of Eastern Caribbean States (OECS), requesting that St. Lucia host the meeting. The OECS was identified as the organization that would organize the meeting. The meeting was first planned for July 1989, it was postponed at that time for various reasons. It was again planned for November 1989, once again it was postponed for various reasons. At that time the meeting was set up to occur in the spring of 1990. The idea lay dormant during the winter of 1989/90, and during the better part of the spring of 1990. In the late spring of 1990, the OECS resurrected the meeting and set it for July 5 and 6.

The OECS, with the assistance of the Regional Forestry Advisor/Caribbean arranged the meeting. The Minister of Agriculture, Honorable Ferdinand A. Henry and his Permanent Secretary, Mr. Cosmos Richardson, pledged their full support to the meeting. The OECS Conference Coordinator contacted all of the OECS Ministers to ascertain their participation in the meeting. Unfortunately, few of the ministers were able to give a 100 percent guarantee that they would come, although the majority of the eight OECS ministers said they would come.

## *Narrative of the Agricultural Ministers Meeting*

One of the main objectives of the meeting was to discuss the importance of the forestry sector to the long-term development of eastern Caribbean countries. The meeting was executed very well. The one big disappointment of the long-planned meeting was the small turnout of agricultural ministers–one to be exact, Mr. Ben Jones of Grenada. Prior to the meeting, the OECS Conference Coordinator indicated that the majority (out of eight) of the ministers of agriculture would be attending the meeting. Many of the ministers attended a trade ministers meeting in Antigua during the same time period.

The meeting was opened by the Prime Minister of St. Lucia; he succinctly summed up the status of the forestry sector in St. Lucia and gave his analysis of the status of the forestry sector within the eastern Caribbean. Dr. Vaughn Lewis followed the Prime Minister; he stated the OECS perspective of the forestry sector.

The following is a brief narrative of the five invited speakers. The lead-off speaker for the meeting was Dr. Ariel Lugo of the Institute of Tropical Forestry. He gave an excellent presentation of the importance of forests to island ecosystems and economies. Following Dr. Lugo was Ms. Alison Hess, project director, Office of Technology Assessment for the US Congress. Her presentation dealt with the importance of tropical forestry from the perspective of the Congress; she discussed the importance that Congress places on tropical forests and the various bills now pending in Congress. Mr. Gabriel Charles, retired director of forestry for Saint Lucia, gave a presentation titled "Saint Lucia, Balanced on a Knife's Edge", and formally presented the resolution formulated at the Fifth Caribbean Foresters Meeting in Trinidad. His presentation opened with a historical overview of Saint Lucia's forests and progressed into their serious and worsening condition today. Mr. Dan Chalmers, FAO Tropical Forestry Action Plan (TFAP) coordinator for the eastern Caribbean, then gave a presentation of the upcoming TFAP for the eastern Caribbean. Following Mr. Chalmers, Mrs. Ivonne Bell, nature tourism consultant from Kingston, Jamaica, gave a presentation that was cowritten by Dr. Gina Green, The Nature Conservancy, Kingston. Her presentation was excellent and dealt with the situation in Jamaica

and specifically USAID's Protected Area Resource Conservation (PARC) project there; she is a consultant to that project.

During the morning of the second day all participants of the meeting had the opportunity to visit St. Lucia's new forestry center northeast of Castries. The center is near completion, Canadian International development Agency (CIDA) funding is being utilized for its construction. Adjacent to the new forestry center is the Union Nature Trail (with a fine example of quality secondary forest), Saint Lucia's forest tree nursery, and a traditional medicine/herb garden. Women in natural resource management are talked about widely today; the St. Lucians have put that into practice; the director of the nursery/herb/garden/nature trail complex is a woman; they have a female environmental education specialist, and numerous other female forestry employees.

The reminder of the formal meeting was devoted to making "ministerial" recommendations on the forestry sector. Mr. Ben Jones moderated that session; Mr. Jones' strong leadership skills are greatly appreciated by all. Recommendations were made with 12 categories; each subject was discussed at length. The 12 subject areas are included in these proceedings.

The recommendations made at the meeting were done in draft form and then circulated among all OECS agricultural ministers for additions, corrections, and comments.

Many of the participants stated that having the meeting was a beginning, or a first step, in the continuing process to conserve the forest resources on the eastern Caribbean islands.

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## ATTENDEES AT THE AGRICULTURAL MINISTERS MEETING HELD IN CASTRIES, ST. LUCIA

JULY 5-6, 1990

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|---|---|---|
| Honorable Ben Jones | Grenada | Minister of Agriculture, Forestry, Lands, & Fisheries |
| Mr. Cosmos Richardson | St. Lucia | Perm. Secretary, Ministry of Agr., Lands, Fisheries Forestry, & Cooperatives. |
| Mr. Bruce A. Bayle | Puerto Rico | USDA/Forest Service & USAID |
| Dr. Ariel Lugo | Puerto Rico | USDA/Forest Service/ITF |
| Mr. Gabriel Charles | St. Lucia | Retired St. Lucia For.Dept. |
| Ms. Alison L. Hess | USA | US Congress, OTA |
| Mrs. Yvonne Bell | Jamaica | Planning Consultant |
| Mr. Dan Chalmers | Barbados | E. Carib. TFAP Coordinator |
| Mr. George A. Vincent | Grenada | Manger, Natl. Parks & Wildlife |
| Mr. Henry Mills | St. Kitts | Forestry Officer |
| Mr. Gerald A.L. Gray | Monserrat | Forestry Officer |
| Mr. Felix Y. Girard | St. Lucia | Planner, Min. of Agriculture |
| Mr. Albert st. Clair | St. Lucia | Coor. for Traditional Crops |
| Mrs. Yasmin Karim | Canada | Editor, Jacquot Magazine |
| Mr. Rodrigue Coulombe | Canada | CIDA St. Lucia Manager |
| Mr. Howard Powles | Canada/Brbds. | CIDA Nat. Res Specialist |
| Mrs. Deirdre Jessamy | OECS Sec. | Res. & Conference Officer |
| Mr. Stephen Fontinelle | St. Lucia | Asst. Secretary, Min. of Agr. |
| Mr. Terrence Scott | St. Lucia | Ministry of Agriculture |
| Mr. Brian James | St. Lucia | Chief, Department of Forestry |

| | | |
|---|---|---|
| Mrs. Rufina Paul | St. Lucia | Chief Agr. Planner, Ministry of Agriculture |
| Mr. M. Shingleton Smith | St. Lucia | President, St. Lucia Plant Growers Association |
| Mr. Horace Walters | St. Lucia | Dept. of Fisheries, Min. Agr. |
| Mr. Eldridge Poyotte | St. Lucia | Ministry of Health |
| Mr. Felix Gregoire | Dominica | Chief, Forestry Department |
| Mr. Abul Alam | B.V.Islands | Dept. of Agr., Min. of Nat. Resources |
| Mr. Brian Challenger | St. Lucia | OECS Nat. Res. Mgmt. Unit |
| Mr. Brian Johnson | St. Vincent | Chief, For. Division, Min. of Agr., Industry, and Labor |
| Mr. Paul Butler | St. Lucia | RARE Center for Tropical Bird Conservation |
| Mr. Ronald Pilgrim | St. Lucia | CARDI |
| Mr. Michael Smart | Barbados | FAO Representative |
| Mr. Kenneth Greenn | St. Lucia | Consultant, Nat. Res. Mgmt. |

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