

Environmental Status Report and Guidelines for Development

Prepared for the

UNITED NATIONS

NATIONS UNIES

UNDP - Physical Planning Project - St. Lucia

Antigua
Barbuda
British Virgin Islands
Cayman Islands
Dominica
Montserrat
St. Kitts and Nevis
St. Lucia
St. Vincent
Turks and Caicos

ISLAND RESOURCES FOUNDATION

Caribbean Headquarters

RED HOOK BOX 33, ST. THOMAS
U.S. VIRGIN ISLANDS 00802
(809) 775-6225

Washington, D.C. Office

1718 P STREET, N.W., SUITE T4
WASHINGTON, D.C. 20036
(202) 265-9712

ENVIRONMENTAL SURVEY AND STATUS REPORT OF SELECTED CARIBBEAN ISLANDS

1974

Final Draft Report
UNDP-Contract 133/73

PREFACE

With only sixty man days to visit eight island states or territories, embracing twenty major islands, it was physically and fiscally impossible for the teams of environmental specialists to carry out either a detailed inventory or undertake elaborate, site specific evaluations of major development activity (except in only rare cases and on request from the UNDP/PPP Project Director).

Rather, the objective was to rely on the extensive experience of the staff professionals in Caribbean tropical insular systems to selectively focus on specific types of environmental problems in any given island and to identify key problem areas for primary study in the limited time available.

Hence, there is considerable variation, from island to island, on what has been the nature of our emphasis. Also, the same time constraints have required our heavy reliance on local expertise in the matter of species check lists, and suggested preserves, parks, natural areas, wildlife habitats, etc. It was, of course, impossible to visit all sites having potential either as problem zones, environmentally speaking, (given any projected development activity) or as special land or sea areas requiring protection and special resource management constraints.

The following report is in part a recommended plan of action in the environmental sector. If the actions recommended herein are not taken expeditiously, and the environmental principles and guidelines not integrated into the planning process, the slow insidious deterioration of these island environments will accelerate beyond all imagination in the decade ahead.

It is not a question of development or environmental quality. It is a matter of development and environmental quality. And this is largely a function of development planning methodology.

Therefore, emphasis has been placed on zones of resource use conflict, heavy pollution, and environmental problems shared by all of the project islands. The "Guidelines" are designed to add a stronger environmental dimension to resource management and development planning.

Table of Contents

PART I	UNDP/PPP ISLAND SELECTIONS
1a.	Antigua.....
1b.	Barbuda.....
2.	British Virgin Islands.....
3.	Cayman Islands.....
4.	Dominica.....
5.	Montserrat.....
6.	St. Kitts-Nevis.....
7.	St. Lucia.....
8.	St. Vincent and St. Vincent Grenadines.....
9.	Turks and Caicos.....
PART II	GENERAL GUIDELINES FOR ISLAND ENVIRONMENTAL MANAGEMENT
Sections	
1.	Tourism.....
2.	Amenity and Aesthetic Resources.....
3.	Cultural Resources
4.	Conservation of Natural Areas
5.	Oil Pollution.....
6.	Soil Disturbance
7.	Dredging

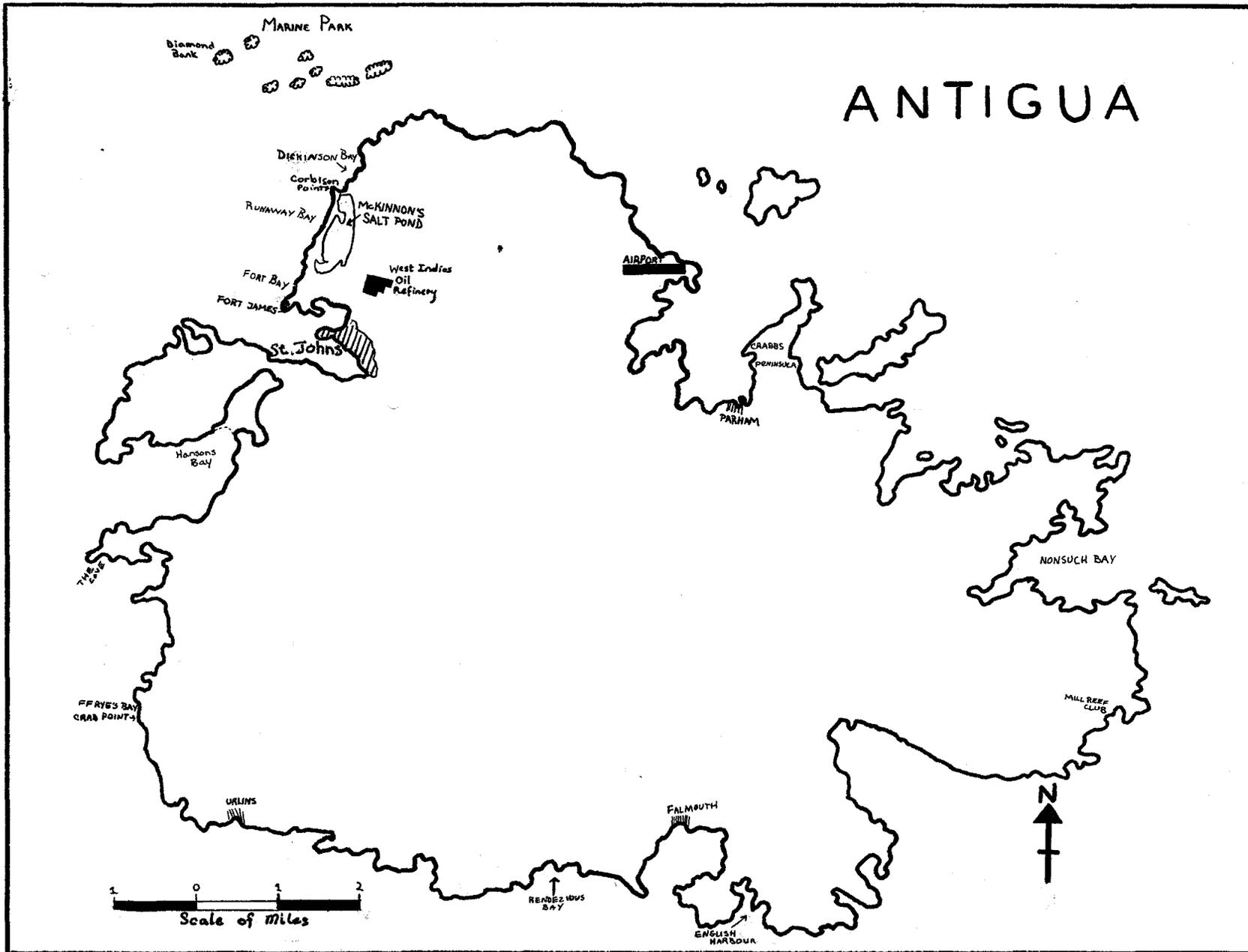
Sections

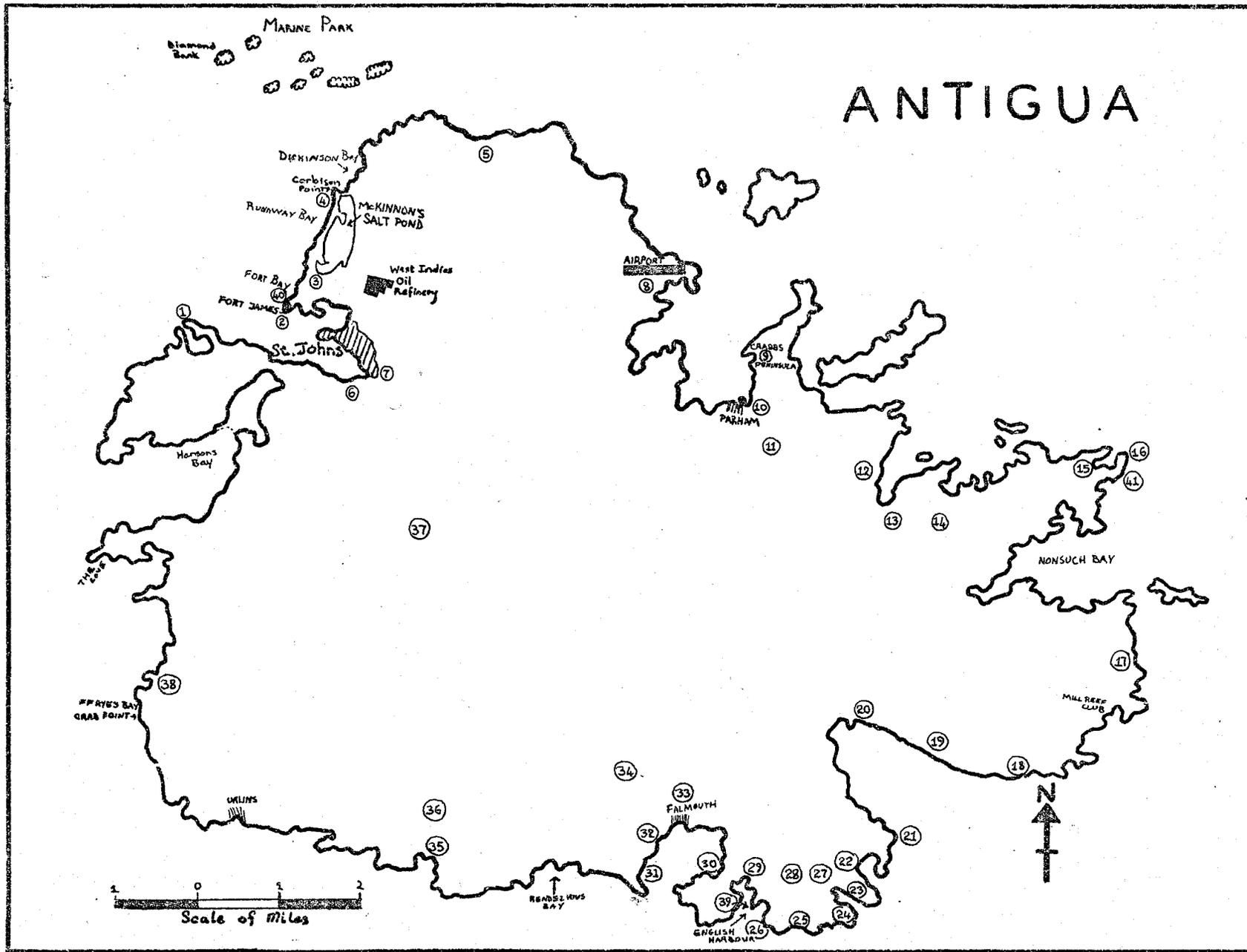
- 8. Wetland Drainage and Fill
- 9. Marinas
- 10. Waste Disposal
- 11. Conservation of the Lobster
- 12. Conclusion

ANNEXES

- A. Information Needs of Government When Judging Permit Applications for Projects That Would Alter or Modify Shorelines or Submerged Lands.
- B. Some Effects of Dredging on Water Quality and Coral Reef Ecology.
- C. Proposed Guidelines for Establishment of Marine National Parks.
- D. List of Participants.

- I. INTRODUCTION.....
- 1.1 Fieldwork Scheduling and Contract Terms of Reference
- II. DEVELOPMENT AND ADVERSE ENVIRONMENTAL IMPACTS..
- 2.1 Existing Development Impacts
- 2.2 Potential Development Impacts
- 2.3 Other Impacts
- III. CAUTIONARY GUIDELINES FOR DEVELOPMENT PROJECTS...
- 3.1 Guidelines
- 3.2 Priorities for Supplementary Detailed Investigations of Environmentally Critical Areas
- IV. POSITIVE ENVIRONMENTAL INITIATIVES.....
- 4.1 Projects with Potential to Confer Environmental Benefits
- 4.2 Local Contacts in the Environmental and Development Fields





- | | | | | |
|----------------------------|--------------------------------|--------------------------|------------------------------|------------------------------|
| ① Fort Barrington | ⑧ St. Georges Church | ⑮ Indian Town (arch.) | ⑳ Marmora Site (arch.) | ⑳ Clarence House |
| ② Fort James | ⑨ Crabs Peninsula Site (arch.) | ⑯ Devils Bridge (fort) | ㉑ Indian Creek (arch.) | ㉑ Fort Cuyler |
| ③ Fort Hamilton | ⑩ Parham Church | ⑰ Mill Reef Site (arch.) | ㉒ Fort Charlotte | ㉑ Blake Island Fort |
| ④ Old Fort Corbison Point | ⑪ Parham Hill House | ⑱ Fort William | ㉓ Shirley Heights (fort) | ㉑ St. Paul's Church |
| ⑤ Santa Maria Hill (hist.) | ⑫ Mercers Creek (bldg) | ⑲ St. Philip's Church | ㉔ Freeman's Bay Site (arch.) | ㉑ Monks Hill, Fort Monks |
| ⑥ Green Bay Church | ⑬ Betty's Hope House | ㉘ Fryes Estate (arch.) | ㉕ Bats Cave (fort) | ㉑ St. Barnabas Church |
| | | | | ㉑ St. Mary's Church |
| | | | | ㉑ Claremont Site (hist.) |
| | | | | ㉑ Green, Castle Site (hist.) |
| | | | | ㉑ Valley Church |
| | | | | ㉑ Nelson's Dockyard |
| | | | | ㉑ Fort Bay Park |
| | | | | ㉑ Long Bay Park |
| | | | | ㉑ Shirley Heights |

Antigua

I. INTRODUCTION

1.1 Field work Scheduling and Contract Terms of Reference

The Island Resources Foundation survey team visited Antigua/ Barbuda November 12-16, 1973, with a subsequent effort December 10-12, focussing on McKinnon's Salt Pond, Antigua. The McKinnon's Salt Pond report appears as an Annex. As with the other study islands, field work in Antigua considered the areas specified under section 3.01 of the UNDP-IRF contract. With reference to this specific island, investigations focussed on physical development projects in association with beaches, mangroves and other wetland areas, and on park planning. As the WHO/PAHO Liquid and Solid Waste Management Study will commence within a few months, the Island Resources Foundation team did not review coastal water quality problems except as they relate to the McKinnon's Pond coastal area referred to above.

II. DEVELOPMENT AND ADVERSE ENVIRONMENTAL IMPACTS

2.1 Existing Development Impacts

Sand mining with government approval is taking place at Ffryes Beach. (See guideline on "Soil Disturbance", Part II, Section 6).

2.2 Potential Development Impacts

Potential severe environmental impacts are associated with marina, oil refinery and tourism development projects.

2.21 Nonsuch Bay:

There are plans to fill the mangrove area at the head of Ayres Creek (the westernmost extremity of Nonsuch Bay). Also in a part of Nonsuch Bay, a marina has been proposed for Brown's Bay. This marina would involve the possible blasting of a channel through the Nonsuch reef system. Extreme caution is recommended.

2.22 Oil Refinery at Rendezvous Bay: One potential site for a proposed new oil refinery has been noted at Rendezvous Bay, located southwest of Falmouth. Our concern does not rest with the location chosen, but the fact that no prior ecological survey was made at this suggested site.

2.23 Hotel and Condominium Development: With the expansion of hotel and condominium construction along the "golden tourist mile" (north of McKinnon's Pond), attention must be paid to coastal water quality. This is especially true, given the government attitude of lowering or waiving environmental protection requirements. It is recommended that the WHO/PAHO study pay close attention to the sewage treatment facilities that these projects plan to emplace.

Condominiums, beginning at 60 units, are to be constructed by Heyl and Patterson. These will be between the Anchorage Hotel and

Antigua

Buccaneer Cove Hotel on Dickinson Bay.

The Caribbean Development Bank is funding a project at the Fort Bay. The plan calls for a beach bar, tennis courts, and water sport facilities. This public resort area is specifically designed to attract cruise ship tourists. A potential social conflict lies in the fact that residents of St. John's have traditionally used the Fort Bay beach for recreational purposes.

2.3 Other Impacts

A problem not uncommon to other eastern shores of Caribbean islands is that of oil arriving on the high seas. In the case of the Mill Reef Club, they have experienced oil pollution on their beaches at various times during the year.

III. CAUTIONARY GUIDELINES FOR DEVELOPMENT PROJECTS

3.1 Guidelines

The guidelines of relevance to Antigua are found in Part II of the report as they also relate to other eastern Caribbean islands in the study area. Reference should be made to the guidelines on "Wetlands" (Section 8), "Marinas" (Section 9), "Natural Area Conservation" (Section 4) and "Soil Disturbance" (Section 6).

3.2 Priorities for Supplementary Detailed Investigations of Environmentally Critical Areas.

The following suggested investigations do not represent an overall recommendation of what is necessary. Judgment of the environmental aspects of Antiguan development would require access to Antigua's five-year development plan recently unveiled. We only had indirect access to this document and therefore cannot judge the environmental aspects of the many development projects that this 5-year development plan proposes.

3.21 Wetland Investigations: The first priority is to carry out a detailed inventory, including an ecological description of Antigua's wetlands. (This was mentioned in context of the McKinnon's Salt Pond report, an example where an adverse use of wetland has had an irreversible impact). The major mangrove wetlands to be investigated are located at Hanson's Bay, The Cove (north of St. John's Harbour), Crabbs Peninsula (east of Parham), and the small mangrove area at Urlins.

3.22 Sewage Plant: Investigations should be carried out into the sewage treatment plant siting for St. John's. Emphasis would have to be on the offshore current circulation throughout the year as a guideline for emplacing the ocean outfall. This is particularly critical given the tourist use of the nearby beaches at James Bay, Runaway Bay and Dickinson Bay. Presumably, this investigatory work will be undertaken by the WHO/PAHO study team.

IV. POSITIVE ENVIRONMENTAL INITIATIVES

4.1 Projects with Potential to Confer Environmental Benefits

The team visited Diamond Reef and was favourably impressed by the site, and the efforts that have been made in establishing this park by the Honourable Robert Hall, Deputy Premier and Minister of Agriculture, Lands and Fisheries, in association with Mr. Dave Ferneding, of Marine Development Company, Ltd. In contrast to the proposed park off the south coast of Barbuda (see Barbuda report, Section 4.1) we are in general agreement with the plans for Diamond Reef National Park.

The size of the Diamond Reef Park is approximately 2,000 hectares. This more than meets the minimum 1,000 hectares required for inclusion in the United Nations list of National Parks and Equivalent Reserves. Given the limited resources at the disposal of the Ministry of Agriculture, Lands and Fisheries, we suggest that the operational and management budget be concentrated on the Diamond Reef Park and not be spread to include the Palaster Reef Park. Furthermore, it is suggested that initially some funds be set aside for the purpose of producing a master plan for Diamond Reef. This would include operational and management details, interpretive programs, and a plan for making a detailed inventory of marine floral and faunal resources, including underwater mapping. The use of water penetration film, such as the experimental Kodak SO-224 (currently being used by the Foundation) would be of great utility in carrying out such a survey.

Antigua

A further aspect of the park plan would be to set aside the land area, which would be the headquarters of the park administration, and, as interpretive programs are developed, which would also house a museum. In addition, it is not unreasonable to have a fee schedule to charge park visitors. This could be scaled in such a way that locals would not be excluded from participation. In Mexico, archaeological sites and national park areas have a fee schedule instituted on weekdays which tend to be the days favoured by tourists, and a relaxation of fees on the weekends to enable locals to visit the area without cost or at a reduced schedule of user fees.

In the event that a budget is allocated for operation of Diamond Reef Park, concession contracts could be made with local licensed dive operators to offer services in the area. Specific attention should be paid to the fee schedules, so that locals would not have to pay international diving rates. For example, throughout the eastern Caribbean, international diving tourist rates are \$17 to \$20 for a one tank, half day dive. Clearly, few Antiguans could afford this kind of expenditure. In a section of the contract, group rates could be specified. Revenues derived could be used for policing, management, regulations, waste collection, etc.

A master plan for the park should be prepared specifically covering management objectives, resource use, physical development, and interpretive programs. Also, of particular significance are questions of

Antigua

marine access, related on-shore visitor facilities, and regional factors which may influence park management.

Management responsibilities of the park would include an annual report that would include operational statistics, necessary for proper park management, and especially, for future planning. Statistics required are visitors' statistics, and park income and expenditures. With regard to visitor management, relevant aspects are:

- (1) Mooring points for boats
- (2) The question of an underwater trail within the park
- (3) Feasibility of operating glass-bottomed boats
- (4) The response to anticipated solid waste and litter problems
- (5) The frequency of marine patrols
- (6) Penalties for infractions.

4.2 Local Contacts in the Environmental and Development Fields

Mr. C. J. Blackstone
c/o Friends of English Harbours
P. O. Box 159
St. John's

Mr. Haji Dawood
(An amateur archaeologist and historian, Mr. Thompson at Public Works has his address)

~~Dave Ferneding~~
Marine Development, Ltd.
P. O. Box 422
St. John's

Antigua

Mr. MacKay
Parliamentary Secretary
Ministry of Education, Health and Culture

Mr. D. V. Nicholson
Curator of the Museum of English Harbour

Mr. Fred Olsen
(Archaeologist)
The Mill Reef Club

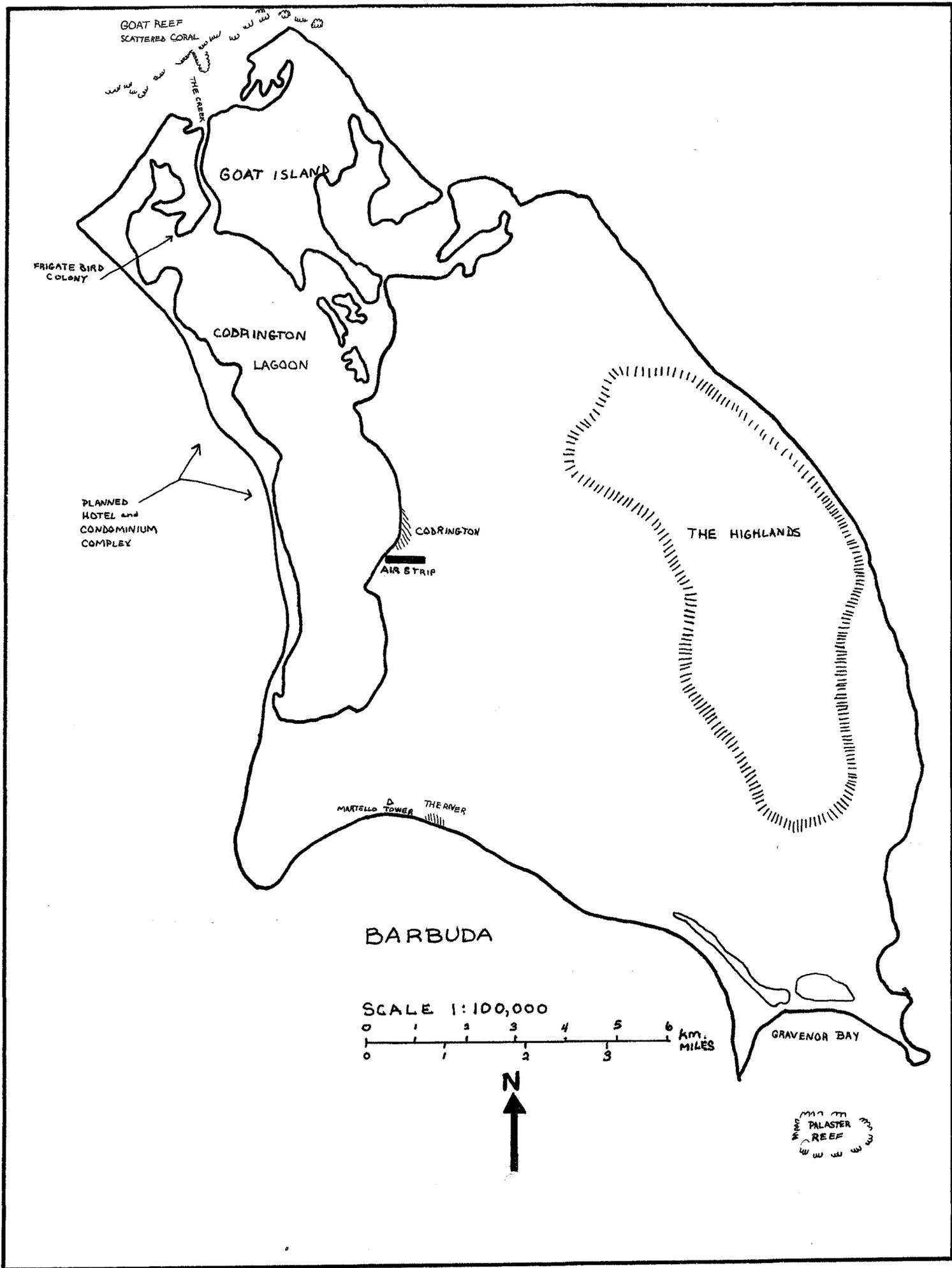
Mr. Nigel Peacock
(Marine Biologist)
Department of Fisheries
Antigua Government

Mr. Barney D. Thompson
Director of Public Works and
Vice President, Caribbean Conservation Association
St. John's

BARBUDA

Page

I.	INTRODUCTION.....	
1.1	Field work Scheduling and Contract Terms of Reference	
II.	DEVELOPMENT AND ADVERSE ENVIRONMENTAL IMPACTS...	
2.1	Potential Development Impacts	
III.	CAUTIONARY GUIDELINES FOR DEVELOPMENT PROJECTS....	
3.1	Guidelines	
3.2	Priorities for Supplementary Detailed Investigations of Environmentally Critical Areas	
IV	POSITIVE ENVIRONMENTAL INITIATIVES.....	
4.1	Projects with Potential to Confer Environmental Benefits	
4.2	Opportunities to Enhance Environmental Assets	



I. INTRODUCTION

1.1 Field Work Scheduling and Contract Terms of Reference

Antigua/Barbuda was initially visited November 12-16 by three of the field team for a total of thirteen man-days with six man-days spent in Barbuda. The areas examined in Barbuda included: Palaster Reef; inshore reefs of Gravenor Bay; the Martello Tower at The River; the Codrington Lagoon; the Creek mangrove association and frigate bird rookery at Cuffy Creek; and the southern patch reefs off Goat Reef.

Given the short time at our disposal and the specific nature of Barbuda, we concentrated our efforts on faunal resources of the Codrington Lagoon area, the Creek mangrove association, and park and preserves priorities.

II. DEVELOPMENT AND ADVERSE ENVIRONMENTAL IMPACTS

2.1 Potential Development Impacts

Our investigations were focussed on the potential environmental impacts of a planned offshore oil facility and the planned hotel and condominium complex on the western coast.

2.11 Offshore Oil Facility: A consortium of European and Arabian oil

firms are planning to build an offshore oil facility. The attractiveness of the Barbuda site for an underwater oil storage depot rests with the fact that the Barbudian banks extend out for a distance of at least 10 miles from the western part of the island for a depth of under 15 fathoms. The extensive plans at present call for emplacement of large concrete storage tanks which would be constructed ashore then towed on site and subsequently sunk in place. Oil, presumably from West Africa and the Middle East, would be brought in large supertankers, discharged into the submarine tank facilities and stored, before being loaded onto smaller vessels for transshipment to the American gulf ports and the Northeast. The construction and emplacement of the transshipment facilities represent phase I of the project; phase 2 would consist of a shore-based refinery.

A potential adverse impact from this development would be the possibility of a massive oil spill at sea. The oceanic currents trend from the southeast to the northwest making the islands of St. Barthélemy, St. Martin, and Anguilla vulnerable to oil pollution on their eastern and southeastern shores.

Other potential adverse impacts are (1) the impact resulting from the supporting shore facility servicing the offshore oil transshipment depot, and (2) any subsequent refinery development emplaced on the island. It is likely that one of the key attributes of a Barbudian site for the oil related facilities would be the absence of stringent environment regulations. As is indicated in section IV "Positive Environmental Initiatives", our

greatest concern lies with the maintenance of the Codrington Lagoon ecosystem.

2.12 Hotel and Condominium Complex: The second development which could spawn adverse impacts is the planned hotel and condominium complex, which is slated for construction on the western coast of Barbuda by the Anchorage Hotel interests of Antigua. Initial plans call for this to be constructed on the beach berm area that defines the western boundary of Codrington Lagoon. There are two potential impacts associated with this development: (1) the negative effects that this development could have on the frigate bird rookery at the north end of Codrington Lagoon, and (2) the aesthetic disfigurement of the Barbudan landscape by poorly designed and inappropriately styled structures. Details of the frigate bird rookery and the mangrove association appear under Section 4.2, "Opportunities to Enhance Environmental Assets".

III. CAUTIONARY GUIDELINES FOR DEVELOPMENT PROJECTS

3.1 Guidelines

General guidelines relating to the proposed hotel complex, the offshore oil transshipment center, the jetty to be built at the River, and the lobster fishery are presented in Part II of the report, for these same guideline areas have relevance for other eastern Caribbean islands.

3.2 Priorities for Supplementary Detailed Investigations of Environmentally Critical Areas

Detailed investigations should be directed at:

- (1) Offshore current patterns regarding the oil transfer port, with shore-based investigations concerning the ecological impact of the shore facilities;
- (2) An ecological impact study of the hotel and its operational characteristics on the frigate bird colony, with special attention being paid to the nesting season;
- (3) The proposed jetty to be built at The River. Here a clam shell dredge would be used to deepen the channel to provide access to vessels making a landfall at The River.

IV. POSITIVE ENVIRONMENTAL INITIATIVES

4.1 Projects with Potential to Confer Environmental Benefits

In the last year, there has been a legislative initiative to create national marine parks in both Antigua and Barbuda (see Annex C). In the case of Barbuda, the park area would encompass Palaster Reef, which we dived as part of our terms of reference to examine reef areas, and to indicate park and preserve priorities. The "Palaster Reef Marine Reserve" is located two miles south of Gravenor Bay off the southeast tip of Barbuda (see map). It is a shallow reef, between one and two fathoms in depth,

dominated by Acropora palmata. The area, as presently demarcated in the legislation, measures under 500 hectares.

Inasmuch as the national park movement is laudatory from a conservation standpoint, it does not follow that creation of parks will automatically confer protection on floral and faunal species and their habitats. There is now ample evidence to show that it is far easier to create a park on paper through legislation, than to create and manage one effectively year in and year out. Regarding the status of Palaster Reef, it is apparent that the "Park", as presently envisioned, would not meet the criteria for inclusion on the U. N. List of National Parks and Equivalent Reserves, as it is well below the defined minimum size of 1,000 hectares, and it is not adequately staffed or budgeted to provide for management, maintenance and protection. Accordingly, in terms of the most recent International Union for Conservation of Nature and Natural Resources (IUCN) System of Classifications, Palaster Reef should be categorized as a "Strict Natural Area". The purpose of such an area is "to protect nature in an undisturbed state in order to have it available for scientific study, aesthetic interest, or for the contribution it can make to the value of other areas. In such an area natural processes are allowed to take place in the absence of a direct human interference". Reserve status is thus more feasible in practical terms and certainly no less effective in conservation terms.

4.2 Opportunities to Enhance Environmental Assets

4.21 The Codrington Mangrove Association: An opportunity to enhance the environmental assets of Barbuda would be to secure the Mangrove Association at the north end of the Codrington Lagoon against development impacts. This mangrove forest, bordered to the east by Goat Island, is the only one in Barbuda and covers some 800 acres (325 hectares). It has now been clearly established elsewhere in the Caribbean and in the State of Florida that mangroves play an essential ecologic role in the life histories of coastal and off-shore fish. The abundance of fish and spiny lobster (Panulirus argus) in Barbuda is directly linked to the existence of this mangrove nursery area. Studies in Florida show that at least 30 species of the most popular commercial and sports fish use the mangrove as a nursery area (Robas, 1970). The detritus from the mangrove trees contributes a major energy input into the fisheries ecosystem

4.22 The Martello Tower: One opportunity to enhance the cultural heritage of Barbuda is to partially restore the inner workings of the Martello Tower, located at The River. Martello Towers were military structures built for coastal defense, commonly 30 to 40 feet high, with thick walls, and with restricted access by way of a ladder to the second story. Guns were emplaced on a platform, while a powder magazine, and living quarters for troops were located in the base of the tower. The photo (Figure 2) shows the overall aspect of the structure as it appears presently.

This site is in excellent condition and is worthy of being included on the Barbuda tourist itinerary. To make the site meaningful, however, an interpretative program (at the minimum, a descriptive flyer) would have to be derived that would tell visitors what the Martello Tower is, how it was used, and the historical circumstances surrounding its being established in Barbuda at The River. From the standpoint of the UNDP Planner, an exploratory survey should be made with regards to integrating this preservation use with the proposed new jetty to be built at The River.

BRITISH VIRGIN ISLANDS

- I. INTRODUCTION.....
 - 1.1 Fieldwork Scheduling and Contract Terms of Reference

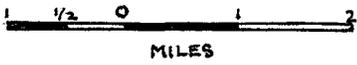
- II. DEVELOPMENT AND ADVERSE ENVIRONMENTAL IMPACTS....
 - 2.1 Historical Impacts
 - 2.2 Existing Development Impacts
 - 2.3 Potential Development Impacts

- III. CAUTIONARY GUIDELINES FOR DEVELOPMENT PROJECTS....
 - 3.1 Guidelines
 - 3.2 Priorities for Supplementary Detailed Investigations of Environmentally Critical Areas

- IV. POSITIVE ENVIRONMENTAL INITIATIVE
 - 4.1 Projects with Potential to Confer Environmental Benefits

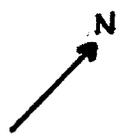
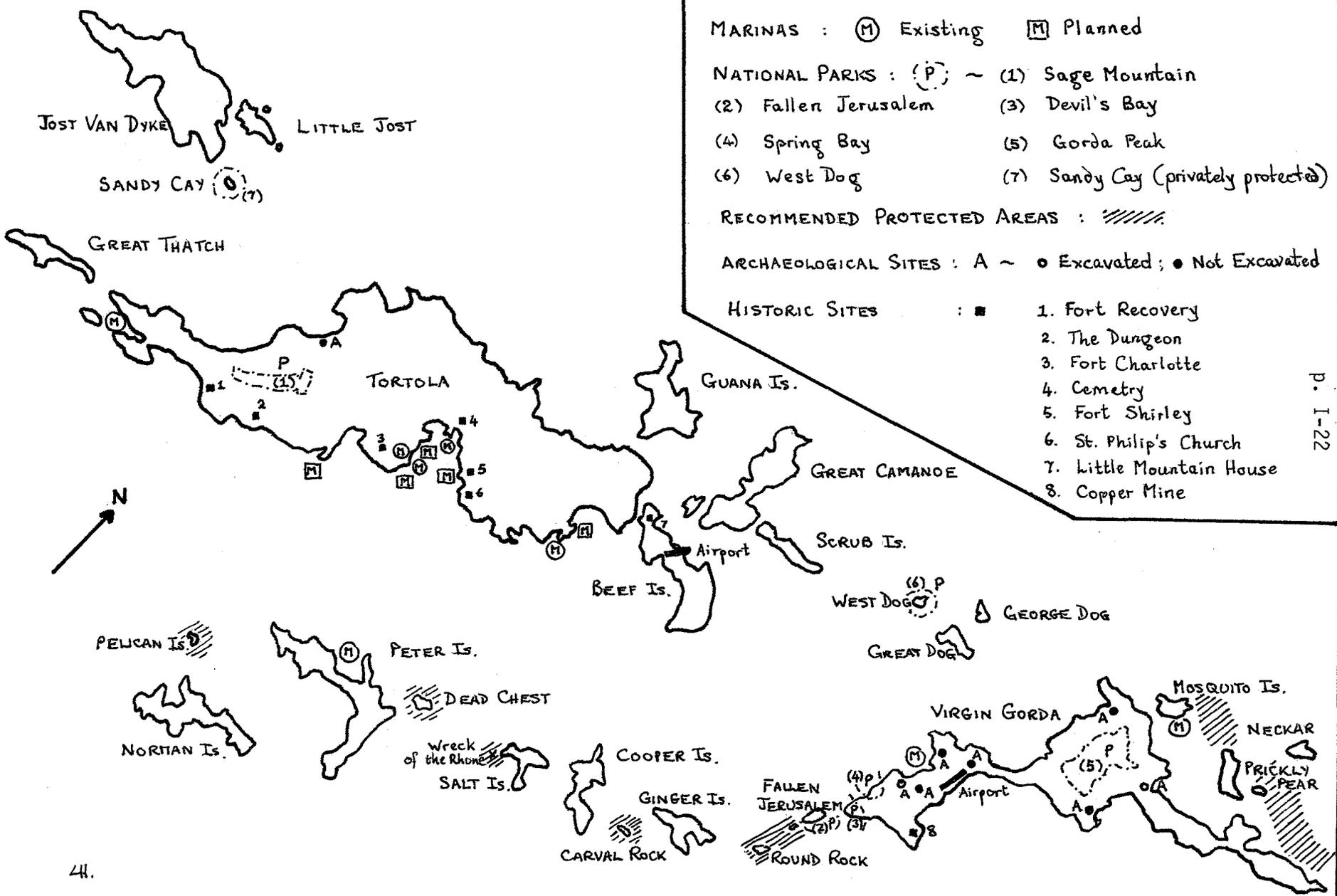


THE TOBAGOS



BRITISH VIRGIN ISLANDS (SOUTHERN SECTION)

- MARINAS : (M) Existing (P) Planned
- NATIONAL PARKS : (P) ~ (1) Sage Mountain
 (2) Fallen Jerusalem (3) Devil's Bay
 (4) Spring Bay (5) Gorda Peak
 (6) West Dog (7) Sandy Cay (privately protected)
- RECOMMENDED PROTECTED AREAS : //
- ARCHAEOLOGICAL SITES : A ~ ● Excavated ; ● Not Excavated
- HISTORIC SITES : ■ 1. Fort Recovery
 2. The Dungeon
 3. Fort Charlotte
 4. Cemetery
 5. Fort Shirley
 6. St. Philip's Church
 7. Little Mountain House
 8. Copper Mine



BRITISH VIRGIN ISLANDS

I. INTRODUCTION

1.1 Fieldwork Scheduling and Contract Terms of Reference

As a consequence of their proximity and easy access, the British Virgin Islands were visited by project staff members on a regular basis between August, 1973 and March, 1974 for a total of 10 man days in Anegada, 4 in Virgin Gorda, 10 in Tortola, plus 6 days of effort, at the special request of the BVI government, to carry out a survey of marine habitats for a proposed system of marine parks. As this latter study is still underway, it is not included as part of this report.

II. DEVELOPMENT AND ADVERSE ENVIRONMENTAL IMPACTS

2.1 Historical Impacts

2.11 At least three decades of exporting sand removed from selected beaches, in response to the recurring construction sand shortages in the U.S. Virgin Islands, has impoverished a number of beaches in various locations.

2.12 The waters of the British Virgin islands have traditionally been open to the extensive cruising sail boat fleet based in St. Thomas, and a major industry of several hundred boats has grwon up utilizing the island/beach/aquatic resources of the British Virgin Islands.

British Virgin Islands

2.13 The collapse of the Bates-Anegada development scheme was and still is an important factor in how local persons perceive the development process and its implication. There is a tendency to "weigh" new proposed projects against the historical "standard" of the Bates plan or experience. In general, this is a most unsatisfactory criterion for a variety of reasons.

2.14 The historical inter-relationship of the U. S. and the British Virgin Islands has been well documented elsewhere and does not need be treated here, but it is apparent that there is a significant increase of interest and development activity coming from the U. S. Virgin Islands.

2.2 Existing Development Impacts

Principal development pressures are currently derived from sand mining schemes, hotel and marina development and charter yacht activity. Virgin Gorda Sound is the focal point for a significant portion of this development activity and warrants close observation as an "environmentally critical" area along with the Anegada Reef area.

2.3 Potential Development Impacts

2.31 Sand mining, black coral harvesting, salt pond dredging, mangrove removal and excessive lobstering, if present growth continues, will all result in environmental damage or an economic disbenefit. Each deserves special planning considerations.

British Virgin Islands

2.32 Additional impacts can be expected from solid waste discarded by cruising yachts and damage to coral from repeated anchoring activities by large numbers of yachts. Road Harbour, in particular, required special attention. In addition to the existing marinas, two more presently are being constructed and one other envisaged. Because of the Harbour's location in relation to prevailing currents and winds, it has little natural flushing capacity and the active use of waste pumping dock facilities should be enforced rigorously.

2.33 Fortunately, most of the current and potential impacts are well understood by the resident UNDP/PPP Planner in the British Virgin Islands, and his record there has been a true credit to the United Nations. His Road Town and Territorial Master plans both offer some real protection against environmentally damaging schemes.

III. CAUTIONARY GUIDELINES FOR DEVELOPMENT PROJECTS

3.1 Guidelines

3.11 General Guidelines: Specific detailed guidelines for dredging (similar to Annex A) have already been provided at the request of the government. Similarly, guidelines on ecological aspects of the Inter-bank proposal for Anegada were also, upon request provided directly to the government.

British Virgin Islands

3.12 One of the more serious existing environmental impacts in the British Virgin Islands stems from the lack of an operative solid waste management plan; as elsewhere, salt ponds are often used as dumps (e.g. Duff's Bottom, Tortola) and scattered litter and private road-side "trash disposal" areas can be seen everywhere. Junk cars are an increasing eyesore. (See guidelines on Waste Disposal, Part II, Section 7).

3.2 Priorities for Supplementary Detailed Investigations of Environmentally Critical Areas

The following environmental projects should be undertaken: (a) Inventory of existing sand resources, with consideration in mind for the protection of good beaches and offshore reefs. (b) An environmental plan for Virgin Gorda Sound, to maintain its present intrinsic terrestrial and marine quality. (c) A solid waste management plan, both for urban areas and harbours. (d) An historic site inventory and protection plan. Within Tortola, historic ruins have been built upon for private residences and hotels, as well as crudely "renovated" - to the detriment of the building (e.g. Fort Recovery). In general, however, no heed as to the conservation of historic sites is taken. A particularly striking instance is that of the Copper Mine, in Virgin Gorda, which is falling rapidly into an advanced stage of decay. (e) A marine park master plan. One of the outstanding assets of the Territory, and which should be preserved with care, is its marine environment. Non-enforcement of spear fishing and general marine biota collecting already has resulted in the impoverishment of cer-

British Virgin Islands

tain reefs. In the two adjoining maps for the Territory, eight areas have been recommended for protection, either for the excellence of their reefs (e.g., Horse Shoe Reef and Virgin and Gorda Sounds), or for their historic value (wreck of the Rhone). Other sites not mentioned - including mangrove areas - should be considered for such protection. (f) Yacht and marine areas control ordinances.

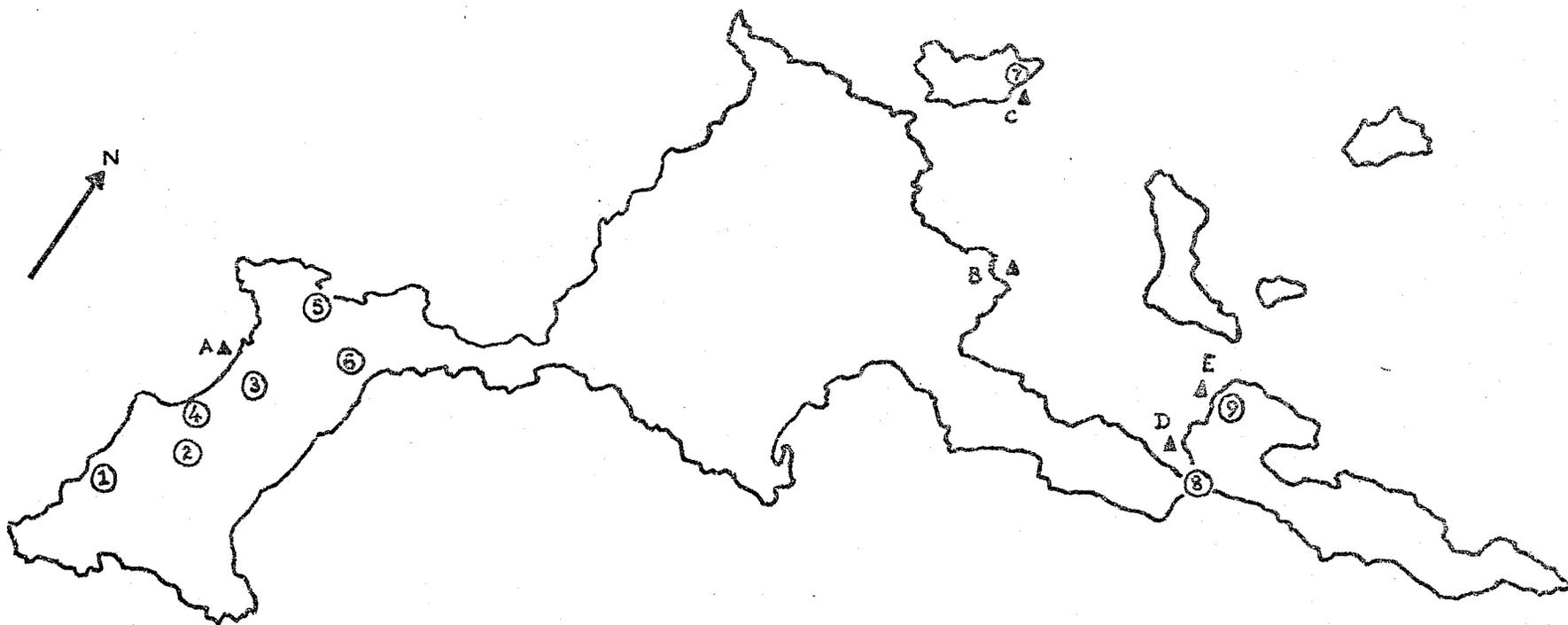
IV. POSITIVE ENVIRONMENTAL INITIATIVE

4.1 Projects with Potential to Confer Environmental Benefits

4.11 Little Dix Hotel, operated by Rockresorts, continues to set a high standard of environmental compatibility with the surrounding landscape and biological systems.

4.12 Properly managed and controlled, the sand exporting business could not only provide a new "cash crop" but can probably be carried forward with a minimum of environmental effect as long as the dredging activity is kept offshore away from the reefs and beaches, and prior environmental impact studies are undertaken.

VIRGIN GORDA -- TOURIST ACCOMMODATIONS



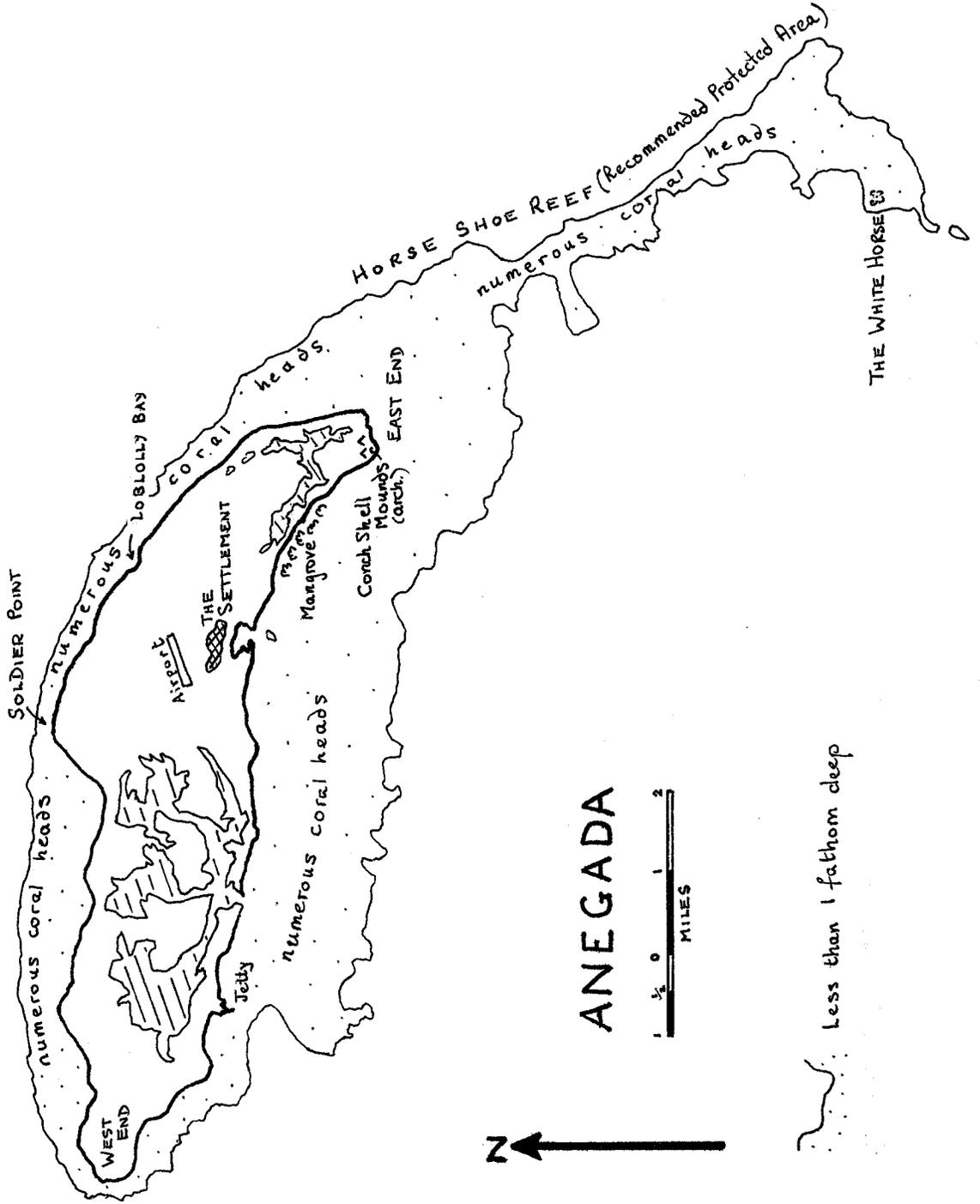
HOTELS	BEDS
1. Guavaberry Spring Bay	20
2. Lord Nelson Inn	10
3. Ocean View Hotel	24
4. Fischers Cove Beach	16
5. Little Dix Bay Hotel	132
6. Olde Yard Inn	18
7. Drakes Anchorage	24
8. Biras Creek	60
9. Bitter End Yacht Club	18

TOTAL: 322

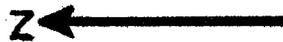
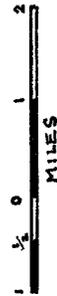
MARINAS	BERTHS
A. Virgin Gorda Yacht Harbour	60
B. Leverick Bay Estates	20
C. Drakes Anchorage	20
D. Biras Creek	25+
E. Bitter End Yacht Club	20?

TOTAL: 140+

TOTAL BEDS AND BERTHS: 462+



ANEGADA



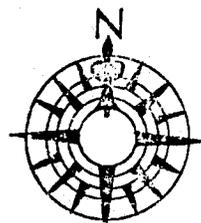
Less than 1 fathom deep

DOMINICA

- I. INTRODUCTION.....
- 1.1 Fieldwork Scheduling and Contract Terms of Reference
- II. DEVELOPMENT AND ADVERSE ENVIRONMENTAL IMPACTS..
- 2.1 Historical Development Impacts
- 2.2 Existing Development Impact
- 2.3 Potential Development Impacts
- 2.4 Other Impacts
- III. CAUTIONARY GUIDELINES FOR DEVELOPMENT PROJECTS..
- 3.1 Guidelines
- 3.2 Priorities for Supplementary Detailed Investigations of Environmentally Critical Areas
- IV. POSITIVE ENVIRONMENTAL INITIATIVES.....
- 4.1 Opportunities to Enhance Environmental Assets
- 4.2 Local Contacts in the Environmental and Development Fields

Guadeloupe Channel

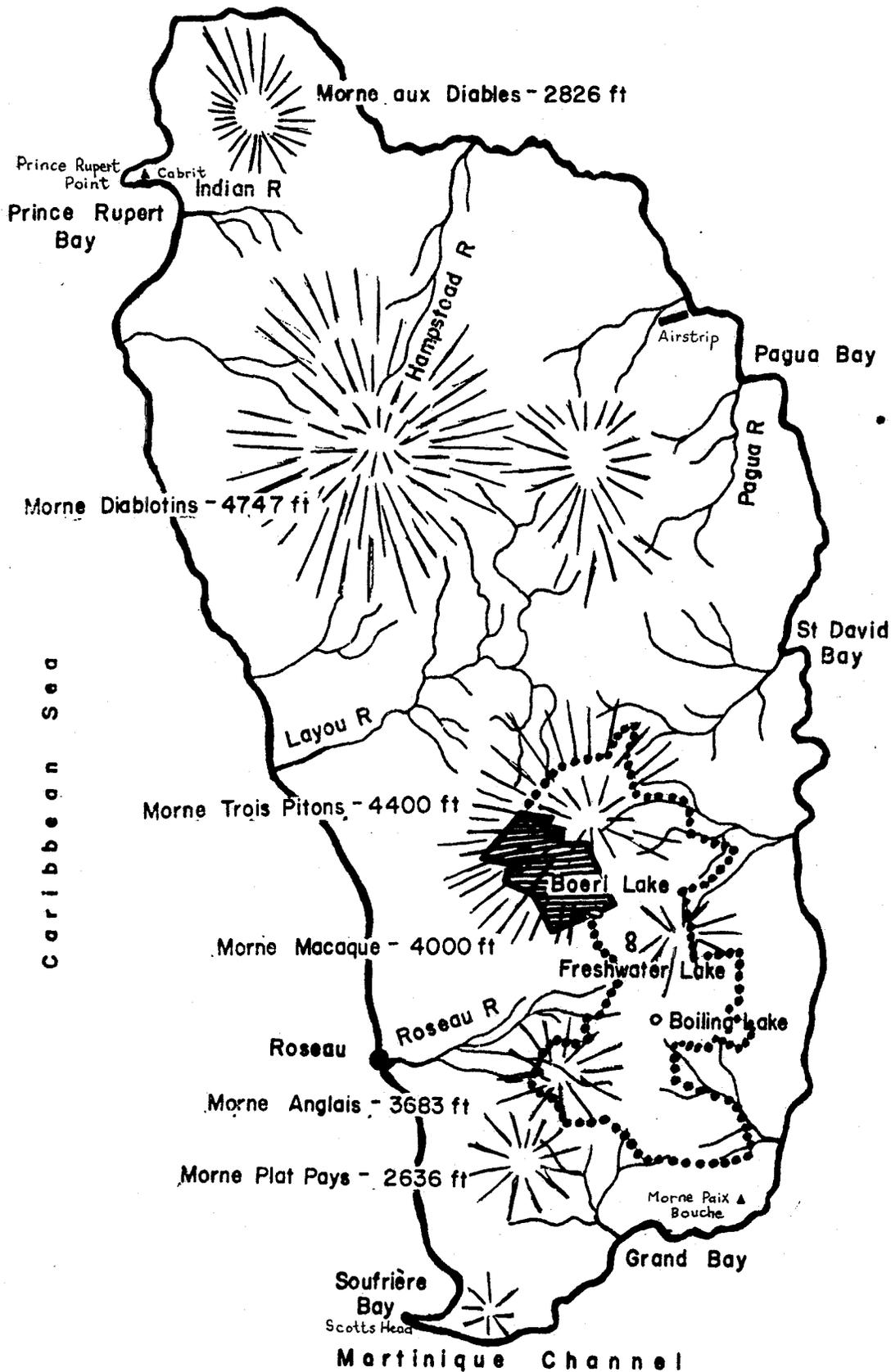
DOMINICA



0 1 2 3 miles



..... Proposed park boundary



I. INTRODUCTION

1.1 Field Work Scheduling and Contract Terms of Reference

The field work for Dominica took place between October 1-3 inclusive for a total of eight man-days. Section 3.01 of the UNDP-IRF contract encompasses the topics of "Scenic Amenities, Historic Sites, and Monuments" (Item 6), and "Park and Preserve Priorities and Planning" (Item 9). Field work in Dominica focussed on these topics in response to high governmental interest.

II. DEVELOPMENT AND ADVERSE ENVIRONMENTAL IMPACTS

2.1 Historical Development Impact

2.11 Logging: The most recent development impact occurred as a result of the timbering operations of Dom-Can Timbers Ltd. The final chapter of the Dom-Can lumbering operation concluded the end of March, 1973, when logging and mill equipment was sold at auction to the highest bidder. The original contract, let in 1967 to a Canadian firm, had a 21-year exclusive concession on 150,000 acres. The first site was unique in that relatively pure stands existed in the concession area. The contract specified practices favoring maximum exploitation over a short period of time and provided for the reforestation of crown lands by Dom-Can "accord-

Dominica

ing to the best Canadian practices". The contract terms of reference were inimical to the interest of Dominica in three respects:

- (1) Clear cutting occurred throughout large areas.
- (2) Access roads to the forest area were built in a haphazard way so that they scarred the hillside permitting massive erosion in this high rainfall area(exceeding 200 inches per year).
- (3) It is doubtful that Canadian reforestation practices would be applicable to tropical forests, and it is unlikely that Dom-Can had any commercial interest in reforestation and the long-term viability of Dominica's forest resources. In sum, the expected economic return to the Government for the sale of the trees, and for the employment benefits to the economy proved small compared to the universal loss of a unique natural forest.

2.2 Existing Development Impact

2.21 Solid Waste: Compared with previous visits in 1970 and 1971 by one of the field team, Dominica appears to be losing ground in the problem of accommodating solid waste. Both rivers and shorelines have become common dumping grounds. The Roseau Rivermouth is an obvious example. Photo "5" shows a small dump located next to the eastern approach of the Cabrit.

2.3 Potential Development Impacts

2.31 Agricultural Development on Forest Slopes: In an address on September 29, 1973, to the Caribbean Conservation Association meeting, the Minister for Agriculture, Trade and Natural Resources, Mr. Thomas Etienne, mentioned the movement among farmers towards utilizing steeper slopes for the cultivation of citrus and other orchard crops. There is a continuing heavy demand for crown lands in areas which are inaccessible and of difficult terrain. These areas are mostly at higher altitudes, fall within the heavy rainfall belt of the island, and come close to overlapping portions of the mountain forest which conservationists and the Government seek to allocate for national park use. In this context, the value of restraint is the benefit gained from guarding against needless foreclosures of future options and misallocations, through spontaneous unplanned development. The secondary effects are soil erosion and deterioration of water supplies due to accelerated run-off and compaction.

2.32 Tourism Development in the Cabrits Area:

Recently an agreement was signed between the Government of Dominica and Val-Ha-La Limited to undertake joint tourist and industrial development projects in the Cabrits area and in other parts of the island. The project slated for the Cabrits area is estimated to cost U.S. \$10 million and would include a yacht marina, an international hotel, and a golf course.

Val-Ha-La Ltd. is comprised of Hamner Enterprises, located in St. Croix, and Valiant Enterprises which is based in the United States. The company's agreement with the Government of Dominica is said to include infrastructural investments for improvement of the airport and the construction of various access roads.

The IRF field survey preceded the announcement of this project, and so we were unable to pass judgment on the environmental ramifications of this development. However, our greatest concern centers on the potential for this development to detract from the cultural integrity of the Cabrit at Prince Rupert Point.

III. CAUTIONARY GUIDELINES FOR DEVELOPMENT PROJECTS

3.1 Guidelines

General guidelines with relevancy to development projects in Dominica, appear in Part II of this report.

3.2 Priorities for Supplementary Detailed Investigations of Environmentally Critical Areas

Within the context of Val-Ha-La's development plans, the Cabrit and the wetlands to the east are important areas for supplementary studies.

IV. POSITIVE ENVIRONMENTAL INITIATIVES

4.1 Opportunities to Enhance Environmental Assets

4.11 The Cabrits: The Buisseret and Clark Report (1971) states that the Cabrits has a Caribbean significance comparable with that of English Harbour in Antigua or Brimstone Hill in St. Kitts. Their recommendation, and we concur with it, is that the whole of the Cabrits should be set aside as a national historic site.

The Cabrits is a massive series of fortifications constructed between 1780 and 1790. The fortification consists of gun platforms, barracks, a citadel which was known as Fort Shirley, and the landing stage on the south side of the peninsula, which then had a paved ramp leading up to a gateway lying somewhat northeast of the headquarters buildings.

The Buisseret Report mentions that the restoration problems of this site are immense, a first task being to halt the structural deterioration due to damage by encroachment of large trees growing over the site. Photo "6" illustrates one of the headquarters buildings partially damaged. The concern of the Foundation is not this ongoing damage but rather the potential threat resulting from the recently launched Val-Ha-La Development nearby. The importance of the Cabrit is its role in a series of maritime wars between England and France from the date of its construction until 1805.

Dominica

Mr. Etienne in his speech before the Caribbean Conservation Association suggested the possibility that the Cabrits be placed within the national parks system.

4.12 Other Cultural Assets: Mr. Chris Maximea, Chief Forest Officer points out that there are other assets in Dominica in addition to the national park area presently being designed, which merit inclusion within a national park system such as historical areas, national monuments, and military monuments; examples being the Cabrits, Scottshead, and Morne Pais Bouche. Also mentioned were recreational areas where specific individual assets are worthy of preservation.

Although the park feasibility survey is now well in hand, further efforts are required to bring other assets into the park system. It is felt that for these other cultural considerations, such as national monuments and battlefields, additional Caribbean expertise would be of value to the park system development.

4.2 Local Contacts in the Environmental and Development Fields

Mr. Graham Bell
Forestry Division
Department of Agriculture

Dominica

Mr. Cuthbert R. Julian
The Forestry Division
Department of Agriculture
Roseau, Dominica

Mr. Chris Maximea
Forestry Officer
Forestry Division
Department of Agriculture
Roseau

Mr. Peter Mallalieu
Archbald Plantation
P.O. Box 21
Roseau

Telephone, Office: 3074

Mr. J.A. Robinson
Chief surveyor
Land and Survey Department
Roseau

Mr. Rory Walsh
Department of Geography
Cambridge University
(Mr. Walsh is currently working in Britain on an ecological
study of Dominica and will return in the future.)

MONTSERAT

I. INTRODUCTION.....

- 1.1 Fieldwork Scheduling and Contract Terms of Reference.....

II. DEVELOPMENT AND ADVERSE ENVIRONMENTAL IMPACTS

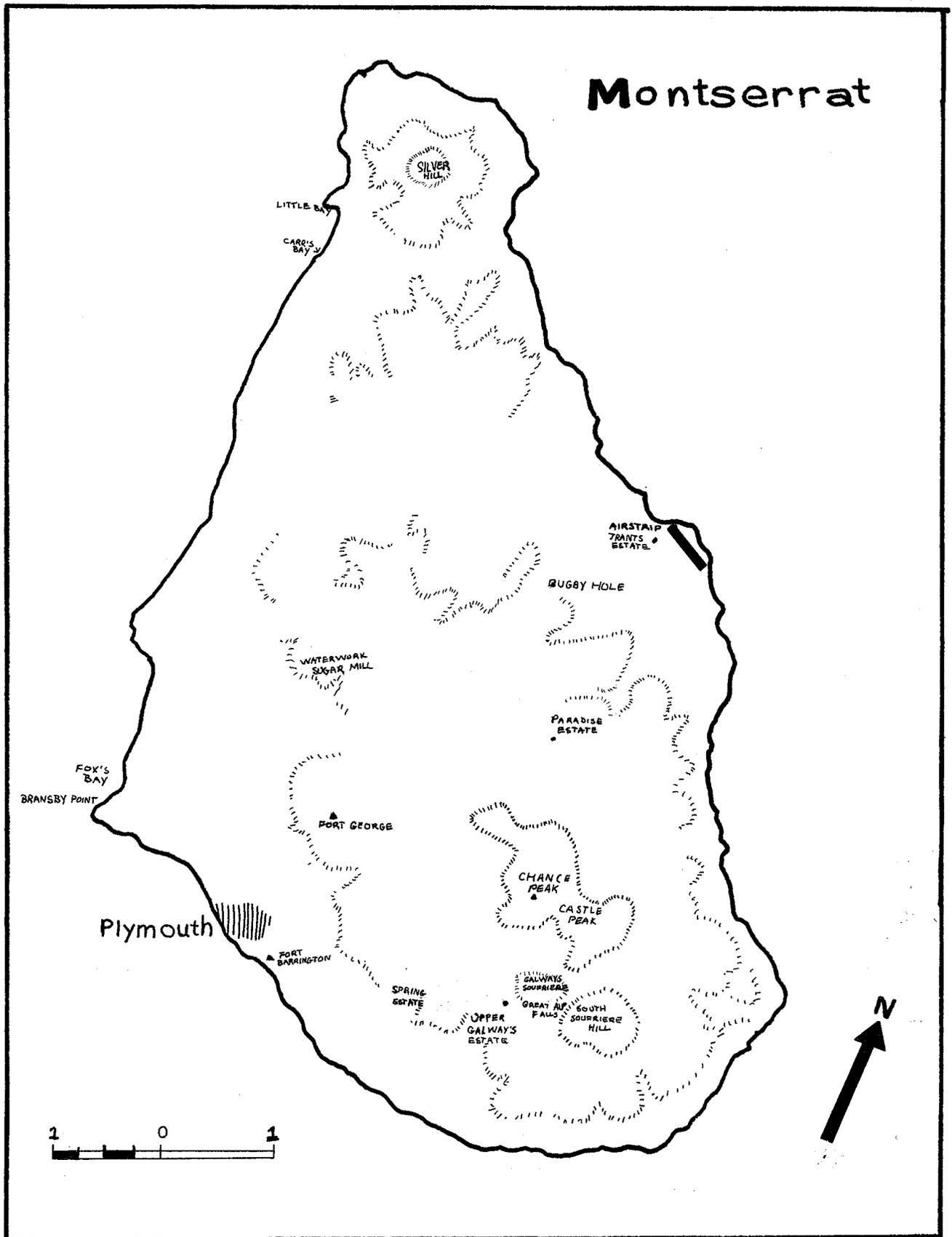
- 2.1 Existing Development Impacts.....

III. CAUTIONARY GUIDELINES FOR DEVELOPMENT PROJECTS

- 3.1 Guidelines.....
- 3.2 Priorities for Supplementary Detailed Investigations of Environmentally Critical Areas.....

IV. POSITIVE ENVIRONMENTAL INITIATIVES

- 4.1 Projects with Potential to Confer Environmental Benefits.....
- 4.2 Opportunities to Enhance Environmental Assets..
- 4.3 Local Contacts in the Environmental and Development Fields.....



I. INTRODUCTION

1.1 Field Work Scheduling and Contract Terms of Reference

Two members of the survey team visited Montserrat October 4-6 for a total of six man days. Contacts in Montserrat included Government Officials and members of the Montserrat National Trust. Historic sites and monuments, and park and preserve priorities and planning represented the prime focus of the fieldwork.

II. DEVELOPMENT AND ADVERSE ENVIRONMENTAL IMPACTS

2.1 Existing Development Impacts

Impacts occurring in Montserrat pertain more to the natural deterioration of existing historical structures than to the threat from development pressures. In the context of nature preservation, the habitat under greatest stress are the few wetlands along the coast of the island.

2.11 Wetlands: Montserrat is fortunate in that conservation areas were formally established in five parts of the state. These conservation areas, having their boundaries at the fifteen hundred foot contour, were set aside as watersheds. No such protection was afforded the state's few wetlands, however. These areas are under greatest stress for the reason that flat, coastal land is in high demand for tourist developments, both hotels and resort homes.

The wetland at Fox's Bay is under strong development pressure as it is surrounded by a new real-estate project. Other wetlands occur further north along the west coast between Little Bay and Carr's Bay.

2.12 Silver Hill: An existing development impact affecting the conservation area at Silver Hill is the uncontrolled grazing by goats and sheep. A reforestation scheme will be necessary to return this area to its former state prior to the phase of cotton cropping. The concern for the conservation area at Silver Hill rests with the fact that privately owned animals graze the one hundred and fifty acres of river and bottom land.

III. CAUTIONARY GUIDELINES FOR DEVELOPMENT PROJECTS

3.1 Guidelines

As the guideline areas apply to other study islands, general guidelines with relevance to Montserrat appear in Part II of the report.

3.2 Priorities for Supplementary Detailed Investigations of Environmentally Critical Areas

Supplementary investigations should be undertaken in the following areas:

- (1) A study of Montserrat's existing wetlands
- (2) An inventory of Montserrat's cultural artifacts and national monuments.

- (3) A feasibility study for establishment of Montserrat's first national park at Upper Galway's Estate. (reference to section 4.1, "Projects with Potential to Confer Environmental Benefits.")

IV. POSITIVE ENVIRONMENTAL INITIATIVES

4.1 Projects with Potential to Confer Environmental Benefits

4.11 The Proposed National Park at Galway's Estate: The Island Resources Foundation feels that the area for conservation focus should be the Soufriere Mill area, crown land above the fifteen hundred foot contour and the area of Galway's Soufriere which is an active and accessible geothermal area of high natural interest. This site also has additional artifacts of interest, particularly the ruined towers at Upper Galway's Estate, the church, and the natural Great Alp falls which lie south of the ruined towers. The private contribution of the property of Eva Lee on which is located an exceptional sugar mill (see photos "7" and "8") could be used to spur a crown land donation for a national park.

As part of the feasibility study, an interpretative program could be developed which would effectively treat all these different assets. Although no single asset by itself would justify a national park or national monument status, the fact that three or four of these assets occur in proximity, favor this site for Montserrat's first national park.

The Montserrat National Trust could supervise the interpretation and maintenance of the cultural monuments. Reference should be made in Part II to the guidelines on conservation of natural areas (Sections 4 and 8), and cultural resources (Section 3).

4.2 Opportunities to Enhance the Environmental Aspects

Given below is a list of possible areas to be included within a national park system, and a list of suggested national monuments. In the case of each of these suggested sites, opportunities do exist for further conservation measures. First on the agenda would be to rank these sites so that the limited funds available could be directed to those places most worthy of inclusion within the national park system or preservation within national monuments.

4.21 Areas Suggested for National Park Preserves and National Monuments

- (1) Galway's Area - including the forest, Galway's Soufriere and the Great Alp Waterfall.
- (2) Chance Mountain and Castle Peak which is part of the Soufriere Hills.
- (3) Paradise Mountain and Spring.
- (4) Buggy Hole - this is an area that potentially can be rehabilitated or re-forested. The valley bottomlands are currently owned by Dannebord Farm but the upper heights of the hill-

sides could be utilized for watersheds conservation.

- (5) Historic sites and buildings of Plymouth.
- (6) Windmill tower at Upper Galway's Estate.
- (7) Waterwork sugar mill
- (8) Windmill tower at Lower Galway sugar mill.
- (9) Trants Estate area and Pelham Valley area (Carib or Arawak settlement).
- (10) The Old Depot
- (11) Fort George
- (12) Carr's Bay Fort
- (13) Kinsole Fort
- (14) Bransby Point Fort
- (15) Magazine of 1664 of the Prison

4.3 Local Contacts in the Environmental and Development Fields

Marva Jackman
Secretary
Montserrat Tourist Board
P. O. Box 7
Plymouth

Telephone: 2230

Mr. George R. E. Cabey
Premanent Secretary
Ministry of Communications and Works
P. O. Box 344
Plymouth

Telephone: 2522 or 2521

Montserrat

Mr. J. E. Sturge
P.O. Box 291

(Possesses early historical documents of Montserrat)

Mr. Norman Griffin
P.O. Box 212
Richmond Hill Telephone: 2505
(A consecutor to the Montserrat National Trust)

Mr. Ted Lucas
Senior Surveyor
c/o Ministry of Agriculture
Plymouth

Mr. Randy Rhodes
Forestry Division
Department of Agriculture
Box 272
Plymouth

Mrs. S. P. McChesney
Secretary
Montserrat National Trust

Mr. John Stanley Weekes
President
Montserrat National Trust
P.O. Box 277
Plymouth

Mr. Jim Bass
Permanent Secretary
Department of Agriculture

Miss Sybil Taylor
Public Library
Plymouth

- I. INTRODUCTION.....
- 1.1 Fieldwork Scheduling and Contract Terms of Reference
- II. DEVELOPMENT AND ADVERSE ENVIRONMENTAL IMPACTS.....
- 2.1 Existing Development Impacts
- 2.2 Potential Development Impacts
- 2.3 Other Impacts
- III. CAUTIONARY GUIDELINES FOR DEVELOPMENT PROJECTS
- 3.1 Guidelines
- IV. POSITIVE ENVIRONMENTAL INITIATIVES.....
- 4.1 Projects with Potential to Confer Environmental Benefits.....
- 4.2 Opportunities to Enhance Environmental Assets
- 4.3 Local Contacts in the Environmental and Development Fields

St. Kitts-Nevis

I. INTRODUCTION

1.1 Fieldwork Scheduling and Contract Terms of Reference

Field investigations of St. Kitts were carried out by the Island Resources Foundation team from March 19 to 22, for a total of 5 man-days. Nevis had been visited previously on January 30th by one member of the team.

The work in St. Kitts-Nevis centered on physical development projects associated with reefs, salt ponds, beaches, ports and marinas, park and preserve priorities and planning, and scenic amenities, historic sites and monuments, in accordance with the UNDP-IRF contract.

II. DEVELOPMENT AND ADVERSE ENVIRONMENTAL IMPACTS

2.1 Existing Development Impacts

The most serious existing environmental impact in St. Kitts and Nevis stems from the lack of any overall waste management plan. As we found in the other study islands, wetlands are increasingly used as depositories for garbage. Scattered dumps exist around both islands have developed spontaneously as a matter of convenience rather than as the result of any planning effort. In many areas, open sewers empty across beaches into the ocean. The problem will be magnified as develop-

ment pressures increase, necessitating a comprehensive, systematic planning approach to waste management (see guideline on "Waste Disposal", (Section 10).

Environmentally critical areas in St. Kitts are Limekiln Bay and Conaree Dump. At Limekiln Bay, an open sewerage outfall from the hospital and the nearby residential area flows across the beach. The result is that the water quality of the Bay has seriously deteriorated through contamination. As St. Kitts has a dearth of good beaches, especially near Basseterre and its hotels, the deterioration of this Bay is a good example of an unnecessary loss of a resource through lack of foresight and planning.

At the Conaree Dump, north of the Conaree Estate area, garbage is scattered, open burning takes place, and a strong odor is present. Dumping occurs in the wetland area surrounding Greatheeds Pond. Some of the garbage finds its way toward Conaree Beach, where tourist cabins are located.

2.2 Potential Development Impacts

Our interest in potential environmental effects of development projects extends to impacts associated with the Frigate Bay Development, the industrial areas, and the proposed deep water harbour.

St. Kitts-Nevis

2.31 Frigate Bay Development: The major potential adverse impacts of the Frigate Bay Development would be problems associated with sewerage systems, marina construction and the drainage system of the surrounding hills.

The proposed hotel development plots are in environmentally critical areas on the Atlantic coast side. The reefs on this side, among the island's best, represent a major tourist attraction for the development by offering good swimming, snorkeling and diving. The sewerage plan should be designed to protect these values. It would be feasible for an initial hotel to employ a septic system, but as the capacity of the environment to absorb waste is limited, additional hotels would require some form of treatment plant. This added capital expense would be justified by the number of visitors generated.

On the Caribbean side is a small salt pond which is scheduled to be developed as a small boat marina. Steps to insure adequate flushing should be taken (see guideline on "Marinas", Section 9).

The runoff from the hills to the west and east flows into the area currently being developed as a golf course. Management of this drainage system should be considered in the planning of the hillside residential area to avoid flooding of the golf course.

2.32 Industrial Area: Both industrial areas, Bird Rock and Ponds Pasture, are situated up-wind and at times, up-current of Basseterre. This fact requires that careful attention be paid to any industry with potential to alter the environmental quality of Basseterre through increased air and water pollution. Of particular importance would be the impact of a proposed rum distillery at Bird Rock.

2.33 Deep Water Harbour : Potential impacts of the proposed deep water harbour relate to the environmental conditions of Basseterre Bay and the surrounding terrestrial areas, the project construction and operations, socio-cultural factors, health impacts, and future development projects relating to the harbor.

Planners should be alerted to the potential impact of port construction on the pre-development coastal sedimentation and current patterns, as well as to consider the source of landfill and rock materials needed for construction. Also important is the determination of to what extent dredging operations will be necessary and how the dredging spoils will be disposed of (see "Dredging", Part II, Section 7, and Annex A and B)

2.4 Other Impacts

Certain exogenous environmental impacts were noticed. Three major beaches visited on the Atlantic coast of St. Kitts, Conaree, Frigate

St. Kitts-Nevis

Bay and Sand Bank Bay all showed signs of oil contamination and litter washed up from the ocean.

2.5 Priorities for Supplementary Detailed Investigations

In St. Kitts-Nevis, detailed investigations should be focussed on

- (1) The existing adverse environmental impact of sewage on Limekiln Beach,
- (2) The potential impacts of the Frigate Bay Development on the reef, beach and drainage systems,
- (3) The effects of dumping at Conaree Dump on the surrounding wetlands, and
- (4) if a distillery is planned at Bird Rock, an environmental impact study should be carried out.

Planning solutions would be explored to determine a set of specific recommendations, including technical feasibility and cost data.

III. CAUTIONARY GUIDELINES FOR DEVELOPMENT PROJECTS

3.1 Guidelines

A few general guidelines relate to the development activities mentioned in Part II, covering waste management and harbour construc-

St. Kitts-Nevis

tion. Other, more specific guidelines, appear in latter portions of Part II. Among others, those most pertinent to St. Kitts-Nevis, are those guidelines on "Dredging" (Section 7), "Wetlands" (Section 8), "Marinas" (Section 9), and "Waste Disposal" (Section 10).

3.11 Deep Water Harbour: In this case, offshore currents should be examined in light of seasonal variations for the effect that these currents will have on transporting suspended silt.

3.12 Limekiln Bay: It is suggested the feasibility of re-routing the sewage, which now flows across Limekiln Beach, toward Basseterre Bay be examined. An alternative would be to extend an outfall pipe into the sea a distance, depending upon offshore current patterns. It must be recognized, however, that these recommendations are not a solution to the problem, but only stopgap measures. Coastal areas of islands are not suitable for the disposal of untreated sewage, particularly from a hospital. Strict maintenance of water quality standards requires that sewage be treated or discharged into environmentally "safe" areas offshore.

3.13 Conaree Dump: It is recommended that Conaree Dump consolidate its waste disposal practices into a strictly managed sanitary landfill operation. Prohibitions against open burning and random dumping are desirable. Until environmentally safe methods of oceanic disposal are devised--deep

St. Kitts-Nevis

ocean dumping of baled refuse may prove feasible in the future--sanitary landfill is a simple and effective method.

IV. POSITIVE ENVIRONMENTAL INITIATIVES

4.1 Projects with Potential to Confer Environmental Benefits

An ongoing survey of buildings of historical interest (in downtown Basseterre) is being conducted by Peter Lind Jans, the UNDP/PPP Planner. This project has been supported by photographic documentation.

This project is an important extension of the survey of historic landmarks of St. Kitts and Nevis carried out by George and Carolyn Tyson, Island Resources Foundation Research Associates. (This report appears as Annex F).

4.2 Opportunities to Enhance Environmental Benefits

Opportunities exist within St. Kitts-Nevis for UNDP/PPP personnel to aid and abet in projects designed to enhance environmental and historical assets.

4.21 Basseterre Historic District: Visitors to St. Kitts during the recent National Trust Cruise for Conservation and Preservation singled out Basseterre as a unique opportunity to establish a historic district

St. Kitts-Nevis

in the downtown area. This opinion is based on the fact that Basseterre was destroyed by fire in 1867 and by flood in 1880 and since then has retained its unique late 19th century architectural characteristics on a broad scale. The establishment of a historic district in conjunction with a museum and additional small gardens such as that opposite the Custom House, would significantly enhance the environment of Basseterre and increase its attractiveness to tourists.

4.22 Park and Preserve Potential: With 10,000 acres of forest reserve and 2,500 acres of specially protected ecosystems, the Government of St. Kitts-Nevis has requested the assistance of the Caribbean Conservation Association in developing a master conservation plan for the islands. One aspect of the study involves recommendations for terrestrial and marine parks, reserves, and a management plan for wildlife and habitat protection. Potential park areas would include the mountain forests of Nevis and St. Kitts and the southeast peninsula of St. Kitts. Of special interest are the colonies of green monkeys, the turtle nesting beaches of the peninsula, bird habitat, scenic natural amenities, and the reefs on the Atlantic coasts of the islands.

Recreational opportunities that exist in these areas include water-sports, hiking, riding, wildlife viewing and nature walks. A priority would be the development of existing mountain paths, one to the crater

St. Kitts-Nevis

on Mt. Misery and the second (the Old English Military Road) across St. Kitts from Old Road Town to Nichola Town. Though the Government must be commended for its interest in a natural resources survey and conservation plan for the State, it is unlikely that it can be done thoroughly without outside assistance.

4.3 Local Contacts in the Environmental Development Fields

Dr. and Mrs. Ervin
Behaviour Science Foundation
(Green Monkey)

Evelyn Campbell
(Forestry, Flora, Fauna)

Morris Friesner
Henry Goinhas Liamuiga
Aquatic & Development
(Watersports, diving)
c/o Holiday Inn

George R. Gear
(Agricultural Advisor-CIDA)
c/o Department of Agriculture
Basseterre

A. L. Lam
President, St. Kitts-Nevis Hotel
(Tourism-History)

Capt. Jack Wigley
(Fauna)

St. Kitts-Nevis

Kit Wigley
(Agriculture)

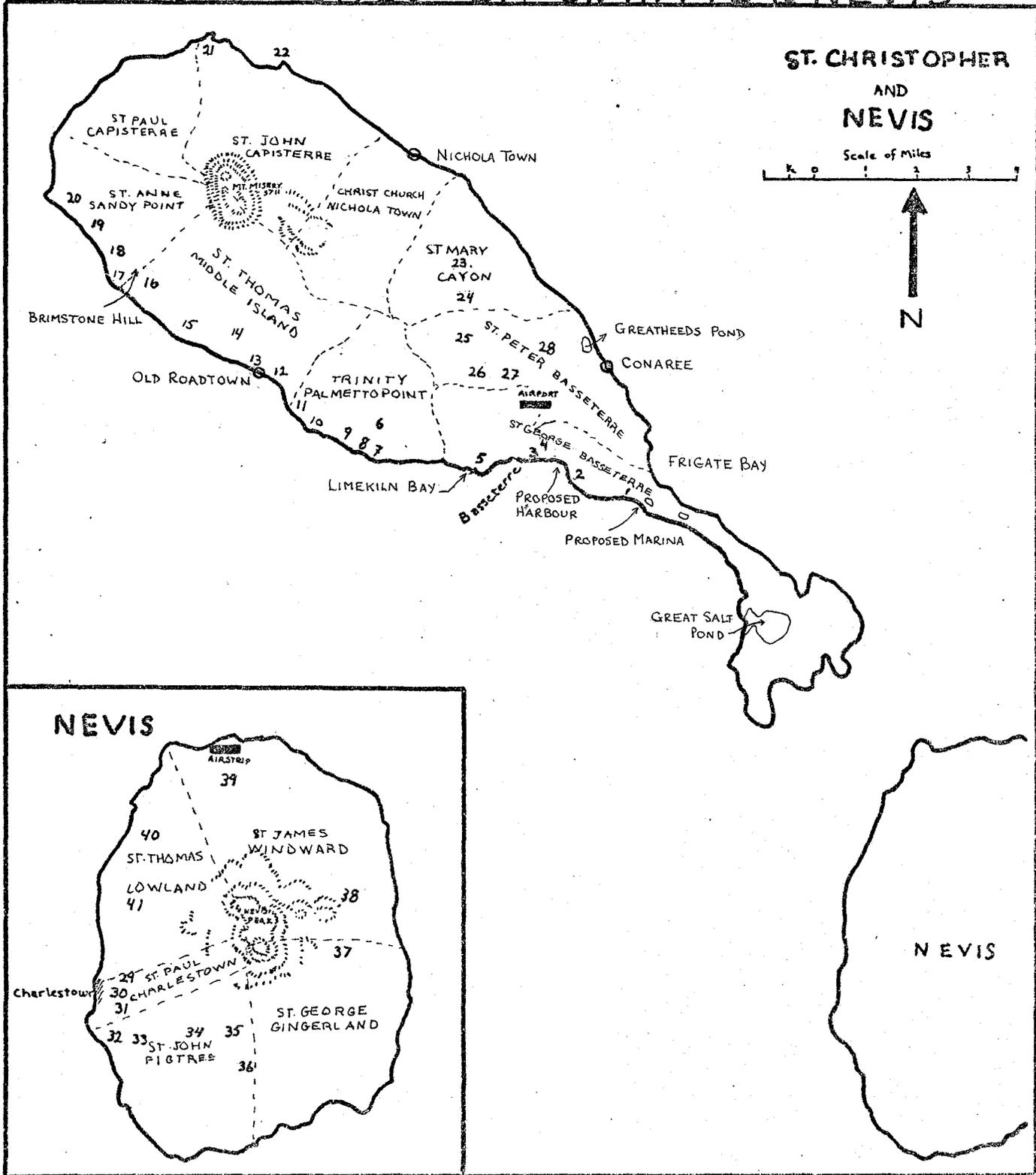
Rosemary Wigley
(Architecture, Archaeology)

Douglas Yearwood
(Sugar)

Telephone: 2151

R. Yearwood
(Flora)

HISTORIC SITES OF ST. KITTS & NEVIS



Site numbers refer to numbered text.

St. Kitts - Nevis

Numbered text for site numbers on preceeding map.

1. Fort Tyson
2. Fort Smith
3. Archives Office, Government Headquarters
4. St. George Anglican Church
5. Fort Thomas
6. Fairview Inn
7. Palmetto Point Fort
8. Palmetto Point Methodist Church
9. Willits Gut (Palmetto Bay)
10. Bloody Point
11. Stone Fort
12. Old Road Town
13. St. Thomas Anglican Church
14. Wingfield Estate Petroglyphs
15. New Guinea Estate
16. Brimstone Hill
17. Charles Fort
18. St. Anne Anglican Church
19. Sandy Point Town
20. Fig Tree Fort
21. Gibson's Pasture
22. Sandy Bay
23. St. Mary Anglican Church
24. Greenhill Estate
25. "The Fountain" (De Poincy's Chateau)
26. "The Glen"
27. St. Peter Catholic Church
28. Stapleton Estate
29. Hamilton House
30. Jewish Cemetery
31. Jewish Synagogue
32. Fort Charles
33. The Baths
34. Fig Tree Church
35. Morningstar Nelson Museum
36. Montpelier Estate
37. New River Estate
38. Eden Brown Estate
39. Cottle Church Ruins
40. Fort Ashby
41. St. Thomas Anglican Church

ST. LUCIA

- I. INTRODUCTION.....
 - 1.1 Fieldwork Scheduling and Contract Terms of Reference

- II. DEVELOPMENT AND ADVERSE ENVIRONMENTAL IMPACTS...
 - 2.1 Existing Development Impacts
 - 2.2 Potential Development Impacts
 - 2.3 Other Impacts

- III. CAUTIONARY GUIDELINES FOR DEVELOPMENT PROJECTS...
 - 3.1 General Guidelines
 - 3.2 Priorities for Supplementary Detailed Investigations of Environmentally Critical Areas

- IV. POSITIVE ENVIRONMENTAL INITIATIVES.....
 - 4.1 Opportunities to Enhance Environmental Assets
 - 4.2 Under the auspices of the St. Lucia Archaeological and Historical Society, Mr. Robert Devaux of St. Lucia has prepared a detailed and comprehensive list of natural areas and historic sites worthy of preservation and requiring special protection against adverse development impacts. The list is as follows:
 - 4.21 Natural Areas in St. Lucia Worthy of Preservation
 - 4.22 Suggested List of Archaeological Sites, Historical Buildings and Monuments in St. Lucia Worthy of Preservation
 - 4.3 Local Contacts in the Environmental and Development Field

I. INTRODUCTION

1.1 Fieldwork scheduling and Contract Terms of Reference

The Island Resources Foundation survey team visited St. Lucia from September 24 to 28 for a total of 7 man-days. Field investigations were carried out into the areas specified by the UNDP-IRF contract, with an emphasis on extractive processes, the impact of physical development projects on the coastal zone, and natural area preservation.

II. DEVELOPMENT AND ADVERSE ENVIRONMENTAL IMPACTS

2.1 Existing Development Impacts

Existing development impacts in St. Lucia relate to the adverse environmental effects of the causeway constructed to Pigeon Island at Rodney Bay, the indiscriminate mining of sand from beaches, the impacts of certain fishing methods and marina construction (Photo 9).

2.11 Pigeon Island Causeway: The causeway at Pigeon Island represents a misguided, continental plan applied to an island, without sympathy to one of St. Lucia's most significant historical sites. Adverse environmental effects of the causeway construction have been (1) rapid erosion of the beach on the southeast coast of Pigeon Island (the beach has retreated 20 feet in

St. Lucia

the space of six months), (2) the obliteration of the conch and lobster fishery in Rodney Bay (with direct economic loss to fishermen in Gros Islet, as the result of habitat destruction due to the dredging of Rodney Bay for causeway material), (3) the destruction of a historic shipwreck in Rodney Bay by the dredge, and (4) an apparent increase in rate of erosion of the southern portion of DeGrasse Beach. (The impact of the interruption of the littoral current by the causeway construction and its relationship to beach dynamics of Rodney Bay is not understood.)

2.12. Beach Mining and Erosion: The widespread, indiscriminate mining of sand from the island's beaches has greatly diminished their recreational value and has upset the physical stability of the coastline resulting in severe localized erosion and shoreline retreat. With sand currently selling for \$3/cubic yard plus transport, there is an active trade in excavating this material, notwithstanding a government permit system which has failed to protect the public interest. Vigie and Choc beaches are classic examples of a mismanaged resource, for these beaches (especially Vigie) have been prime recreational sites for the inhabitants of Castries. Photo 10 shows the site of beach sand mining at the north end of Choc Beach. Beaches used for sand mining are, on the east coast - Choc Beach, Vigie Beach, and L'Anse La Rae Beach, and on the west coast - Anse La Chaloupe Beach, Fond D'or Beach, and Grande Anse Beach.

A detailed analysis of beach erosion problems in St. Lucia and several other islands will be found in the four-volume study, Eastern Caribbean Coastal Investigations, by Deane, Thom, and Edmunds (British Development Division, 1970-1973).

2.13 Coastal Fishing: Another adverse impact is associated with St. Lucia's fishing industry. Use of dynamite, a small mesh size for nets and pots, and trammel nets have all contributed to depletion of St. Lucia's coastal fishing populations. Dynamite is used directly on the reefs or can be used amidst baitfish at the surface. In the latter case, the floating schools of dead fish attract other fish which, in turn, are dynamited. Dynamite is particularly wasteful of the resource as it destroys habitat, and precludes sustained yields.

Nets and pots are made with 3/4 inch size mesh, although fish of commercial importance could be caught with 1½ inch mesh. Trammel nets, used widely by Martinique fishermen who fish St. Lucia's waters, are similarly wasteful of the fish resource. These nets also catch indiscriminately, and when emplaced beyond a six-hour period, lead to spoiling of the initial catch. In theory, properly fished trammel nets should be set at 6:00 P.M., lifted at midnight, then reset and lifted again at 6:00 A.M.

2.2 Potential Development Impacts

2.21 The Marina at Rodney Bay: The potential impact of the marina at Rodney Bay stems from the fact that its entrance is constricted, which reduces flushing. It is likely that water in the marina will be overloaded by land and boat generated wastes. For a discussion of the relevant aspects, see the guideline sections on "Dredging" (Section 7) and "Marinas" (Section 8).

2.22 Maria Island: Maria Island (Photo 11), lying one and one half miles east of Vieux Fort and measuring $\frac{1}{4}$ mile x $\frac{1}{8}$ mile, provides testimony to the fact that islands are unique, fragile systems, which often have an environmental importance extending far beyond their physical dimensions. The island is a refuge for two endemic species of ground lizard (one of which is unique in global terms) and one species of snakes. The animals are endangered because their isolation may soon be transgressed. In St. Lucia, mongoose, cats and dogs have lead to the extinction of these species, while the isolation of Maria Island has conferred protection from these predators.

The potential impacts relate to anticipated use of Maria Island by weekend groups from the Halcyon Hotel, and to the possible importation of dogs to the area. Goats are now left to graze on Maria Island. These activities, in conjunction with man's traditional use of fire to spur vegetative regrowth, could easily cause the demise of the ground lizards and snakes.

St. Lucia

In this context, planners should avoid building causeways to coastal islands in the name of improved access.

2.3 Other Impacts

The International Union for Conservation of Nature and Natural Resources (IUCN: Morges, Switzerland) has listed four species of St. Lucia birds on the global list of "Rare and Endangered Species": St. Lucia Parrot, St. Lucia Wren, St. Lucia White Breasted Thrasher, and Semper's Warbler. Of these, the wren and warbler could now be extinct. Two species of mammals, the Manicou and Agouti, are also under pressure and in need of protection.

III. CAUTIONARY GUIDELINES FOR DEVELOPMENT PROJECTS

3.1 General Guidelines

The discussion of the guideline areas which relate to St. Lucia appears in Part II of the report. Among others, those particularly pertinent to St. Lucia are the sections on "Dredging" (Section 7), Marinas (Section 9), "Waste Disposal" (Section 10), "Conservation of Natural Areas" (Section 4), and "Cultural Resources" (Section 3).

3.2 Priorities for Supplementary Detailed Investigations of Environmentally Critical Areas

Specific detailed planning studies should concentrate on mapping out a strategy for natural areas and cultural resources preservation. High

St. Lucia

on the list would be Maria Island and other areas supporting the IUCN list of endangered species. With modification, Section 4.1 can form the basis for an overall plan for the environmental sector. A list of historic sites has been compiled by Robert Devaux of the St. Lucia Archaeological and Historical Society. It is further suggested that close liaison be established with the St. Lucia National Trust and their conservation program.

IV. POSITIVE ENVIRONMENTAL INITIATIVES

4.1 Opportunities to Enhance Environmental Assets

Annex G covers the Pigeon Island National Park development plan, which is no less valid today than it was at the time of the Caribbean Conservation Association's survey in 1971. Pigeon Island will form a basic cornerstone in St. Lucia's efforts to preserve her cultural heritage.

4.2 Under the auspices of the St. Lucia Archaeological and Historical Society, Mr. Robert Devaux of St. Lucia has prepared a detailed and comprehensive list of natural areas and historic sites worthy of preservation and requiring special protection against adverse development impacts. The list is as follows:

St. Lucia

4.21 Natural Areas in St. Lucia Worthy of Preservation

<u>Beaches</u>	Vigie Strip	(Castries)
	Anse de Sable	(Vieux Fort)
	Cocodan	(Vieux Fort)
	Anse des Pitons	(Soufriere)
	Pigeon Island	(Gros Islet)
<u>Cemeteries</u>	Riverside	(Castries)
	Military	(Morne)
	Military	(Pigeon Island)
<u>Canyons</u>	River Dorée	(Choiseul)
<u>Craters</u>	Extinct Belfond	(Soufriere)
	Sulphur Springs	(Soufriere)
<u>Forests</u>	Reserve at Mt. Cimie	
	Reserve at La Sorciere	
	Reserve at Bar do L'Isle	
	Reserve at Mt. Grand Magazine	
<u>Historic Sites</u>	Pigeon Island	(Gros Islet)
	The Morne	(Castries)
	La Toc	(Castries)
	Vigie	(Castries)
<u>Islands</u>	Rat	(Castries)
	Maria	(Vieux Fort)
	Scorpion	(Micoud)
	Praslin	(Micoud)
	Dennerly	(Dennerly)
	Rouche	(Dennerly)
	Ramier	(Dennerly)
	Lapins	(Gros Islet)
<u>Marshes</u>	Aux Coin	(Gros Islet)
	Bois D'Orange	(Gros Islet)
	Savannes	(Vieux Fort)
<u>Mountains</u>	The Pitons	(Soufriere)
	Mt. Souf	(Soufriere)
	Mt. Gimie Massif	

St. Lucia

4.21 (cont.)

Open Spaces

Causeway	(Gros Islet)
Choc Cemetery	(Castries)
Bois D'Orange Bridge	(Gros Islet)
Pigeon Island	(Gros Islet)
Vigie Light House	(Castries)
Tapion Rock	(Castries)
Point Sable	(Vieux Fort)
Coco Dan	(Vieux Fort)
Vierge Point	(Micoud)
Moules Chique Point	(Vieux Fort)

Parks

Columbus Square	(Castries)
George V	(Castries)
Pigeon Island	(Gros Islet)

St. Lucia

4.22 Suggested List of Archaeological Sites, Historical Buildings,
and Monuments in St. Lucia Worthy of PreservationGros Islet District

Pigeon Island	Rodney's Lookout, numerous ruins of barracks and gun emplacements, tomb stones, Amerindian sites.
Cap	Ruins of old Estate House, out buildings and slave cell.
Dauphin	Foundations of pre-Revolution Church, petroglyphs and rock basins.
Paix Bouche	Ruins of Tascher de la Pageria House.
Esperance	Site of old fort and guns, Amerindian site.
Lavoutte	Amerindian site.
Grand Anse	Amerindian sites.
Comorrette	Middens.
Reduit	Middens.
Morne Giraud	Old cane windmill

Dennery District

Louvet	Old estate buildings, Carib sites.
La Caye	Old mill and other ruins.

Micoud District

Patience	Middens.
Praslin	Ruins of pre-Revolutionary Church, old oven, slave cell.
Vierge Pt.	Amerindian site.
Micoud Bay	Middens.

St. Lucia

4.22 (cont.)

Troumassee	Ruins of old factory, Amerindian site.
Anse Capitaine	Rock cut basins.
Mascare	Middens.
Anse Ger	Rock cut basins and pot holes
Canelles	Amerindian site.
Vieux Borg	Ruins of old building, Amerindian site.

Vieux Fort District

Pointe de Caille	Amerindian site.
St. Aubain	Middens.
Beane Field	Ruins of old sugar factory. Middens.
Point Sable	Old estate house, Amerindian site.
Moule-a-Chique	Light House.

Laborie District

Banse	Rock cut basins.
Mont Lezard	Amerindian site.
Certrine	Rock Cut basins.
Black Bay	Middens.
Laborie	Old home of Chief Justice O'Riley (Sir Lennox)

Choiseul District

Des Gatiere	Ruins of estate house and slave cell.
Morne Lezard	Amerindian site.
Ravine Chute	Amerindian Site.
Choiseul	Old mills, petroglyphs, rock cut basins.

St. Lucia

4.22 (cont.)

Point Caribe	Middens
Park Estate	Ruins of old buildings.
<u>Soufriere District</u>	Sulpher Sprints (Qualibou)
	Old baths, sulphur mine.
Diamant	Remains of old baths Old mills and sugar factories, old estate houses
Anse Mamin	Ruins of water mill, old estate house.
Union Vale	Old mill and water wheel, old estate house.
<u>Canaries District</u>	Old factory near village.
<u>Anse La Raye District</u>	
Anse Galet	Old buildings and water sheel.
Anse Massacre	Amerindian site.
Roseau	Slave cells.
<u>Castries District</u>	
Choc Bay	Mideens, ruins of old factory.
Rat Island	Amerindian site.
Morne Dudon	Rock cut basins.
Ciceron	Old fort.
Morne Fortune	Military cemetery, powder magazine, cells and guard room, ruins of Government House, iron barracks, apostles battery, abutments of old railway (some only), Inniskilling Monument and environs.
La Toc	Huge gun at Ridgeway, Half Moon Battery and shot oven.

St. Lucia

4.22 (cont.)

Tapion Rock (Old fort) Amerindian site.

Castries Columbus Square, Police Headquarters and prisons.

Vigie Mr. J.Q. Charles' House (200 years old), forts, gun sites (3), St. Mary's College building, Married women's quarters (Goddard), Light house and environs, Government House and environs, Riverside Cemetery (very old).

4.3 Local Contacts in the Environmental and Development Field

David J. Moore
 Forest Supervisor
 Ministry of Trade, Industry, Agriculture and Tourism
 Castries, St. Lucia

Mr. Cadet
 Fishery Officer, Department of Agriculture
 Ministry of Trade, Industry, Agriculture and Tourism
 Castries, St. Lucia

St. Lucia

Helmut Scheider
Associate Planner
Town and Country Planning
P.O. Box 749
Castries, St. Lucia

Mr. Charles Cadet
Permanent Secretary
Ministry of Development and Planning

Mr. William G. Lang
Former Chief Forestry Officer
c/o Mrs. Lang
Barclay's Bank
Bridge St. Castries, St. Lucia

Mr. Martin Elwin
Permanent Secretary
Ministry of Trade

John Standley
Amateur ornithologist
(Telephone Directory)

Sir Allan Lewis
Chairman
National Development Corporation
Castries, St. Lucia

Mr. Ian McKee
Chief Technical Officer
Town and Country Planning Department
P.O. Box 709
Castries, St. Lucia

St. Lucia

Mr. Leo St. Helene
Technical Officer
Town and Country Planning Department

Robert J. Devaux
General Secretary
St. Lucia Archaeological and Historical Society
P.O. Box 525
Castries

Mr. Julian Hunte
Box 64
Castries, St. Lucia

NATURAL AREAS IN ST. LUCIA WORTHY OF PRESERVATION

<u>BEACHES</u>	Vigie Strip	(Castries)
	Anse de Sable	(Vieux Fort)
	Cocodan	(Vieux Fort)
	Anse des Pitons	(Soufriere)
	Pigeon Island	(Gros Islet)
<u>CEMETERIES</u>	Riverside	(Castries)
	Military	(Horne)
	Military	(Pigeon Island)
<u>CANYONS</u>	River Doree	(Choiseul)
<u>CRATERS</u>	Extinct Belfond	(Soufriere)
	Sulphur Springs	(Soufriere)
<u>FORESTS</u>	Reserve at Mt. Gimie	
	" " La Soufriere	
	" " Bar de L'Isle	
	" " Mt. Grand Magazine	
<u>HISTORIC SITES</u>	Pigeon Island	(Gros Islet)
	The Horne	(Castries)
	La Toc	(Castries)
	Vigie	(Castries)
<u>ISLANDS</u>	Rat	(Castries)
	Maria	(Vieux Fort)
	Scorpion	(Micoud)
	Fraslin	(Micoud)
	Denmery	(Denmery)
	Rouche	(Denmery)
	Hamier	(Denmery)
	Lapins	(Gros Islet)
<u>MARSHES</u>	Aux Coin	(Gros Islet)
	Bois D'Orange	(Gros Islet)
	Savannes	(Vieux Fort)
<u>MOUNTAINS</u>	The Pitons	(Soufriere)
	Mt. Souf	(Soufriere)
	Mt. Gimie Massif	
<u>OPEN SPACES</u>	Causeway	(Gros Islet)
	Choc Cemetery	(Castries)
	Bois D'Orange Bridge	(Gros Islet)
	Pigeon Island	(Gros Islet)
	Vigie Light House	(Castries)
	Tapiou Rock	(Castries)
	Point Sable	(Vieux Fort)
	Coco Dan	(Vieux Fort)
	Vierge Point	(Micoud)
	Moule a Chique Point	(Vieux Fort)
<u>PARKS</u>	Columbus Square	(Castries)
	George V	(Castries)
	Pigeon Island	(Gros Islet)

SUGGESTED LIST OF ARCHAEOLOGICAL SITES, HISTORICAL
BUILDINGS AND MONUMENTS IN ST. LUCIA WORTHY OF
PRESERVATION

GROS ISLET DISTRICT

Pigeon Island	Rodney's Lookout, numerous ruins of barracks and gun emplacements, tomb stones, Amerindian sites.
Cap	Ruins of old Estate House, out buildings and slave cell.
Dauphin	Foundations of pre-Revolution Church, petroglyphs and rock basins.
Paix Bouche	Ruins of Tascher de la Pagerie House.
Esperance	Site of old fort and guns, Amerindian site.
Javoutte	Amerindian site.
Grand Anse	Amerindian sites.
Comorrette	Middens.
Reduit	Middens.
Morne Giraud	Old cane windmill.

DENNIERY DISTRICT

Louvet	Old estate buildings, Carib sites.
La Caye	Old mill and other ruins.

MICOND DISTRICT

Patience	Middens
Praslin	Ruins of pre-Revolutionary Church, old oven, slave cell.
Vierge Pt.	Amerindian site.
Micoud Bay	Middens.
Troumassee	Ruins of old factory, Amerindian site.
Anse Capitaine	Rock cut basins.
Mascare	Middens.
Anse Ger	Rock cut basins. & Pot Holes
Canelles	Amerindian site.
Vieux Borg	Ruins of old building, Amerindian site.

VIEUX FORT DISTRICT

Pointe de Caille	Amerindian site.
St. Aubain	Middens.
Keane Field	Ruins of old sugar factory. Middens.
Point Sable	Old estate house, Amerindian site.
Moule-a-Chique	Light House.

LABORIE DISTRICT

Bense	Rock cut basins.
Mont Lazard	Amerindian site.
Getrine	Rock Cut basins.
Black Bay	Middens.
Laborie	Old home of Chief Justice O'Riley (Sir Lennex)

CHOISEUL DISTRICT

Des Gatiere	Ruins of estate house and slave cell.
Horne Lazard	Amerindian site.
Ravine Chute	Amerindian site.
Choiseul	Old mills, petroglyphs, rock cut basins.
Pointe Caribe	Middens.
Park Estate	Ruins of old buildings.

SOUPRIERE DISTRICT

	Sulpher Sprints (Qualibou)
	Old baths, sulphur mine.
Diamant	Remains of old baths Old mills and sugar factories, old estate houses.
Anse Mamin	Ruins of water mill, old estate house.
Union Vale	Old mill and water wheel, old estate house.

CANARIES DISTRICT

	Old factory near village.
--	---------------------------

ANSE LA RAYE DISTRICT

Anse Galet	Old buildings and water sheel.
Anse Massacre	Amerindian site.
Roseau	Slave cells.

CASERIES DISTRICT

CASPIES DISTRICT (Cont.)

Rat Island	Amerindian site.
Terre Dudon	Rock cut basins.
Cicéron	Old fort.
Morne Fortune	Military cemetery, powder magazine, cells and guard room, ruins of Government House, iron barracks, apostles battery, abutments of old railway (some only), Inniskilling Monument and environs.
La Toc	Huge gun at Ridgeway, Half Moon Battery and shot oven.
Tapion Rock	(Old fort) Amerindian site.
Catries	Columbus Square, Police Headquarters and prisons.
Vigie	Mr. J. A. Charles' House (200 years old), forts, gun sites (3), St. Mary's College building, Married Women's quarters (Goddard), Light House and environs, Government House and environs, Riverside Cemetery (very old).

* * * * *

ST. VINCENT

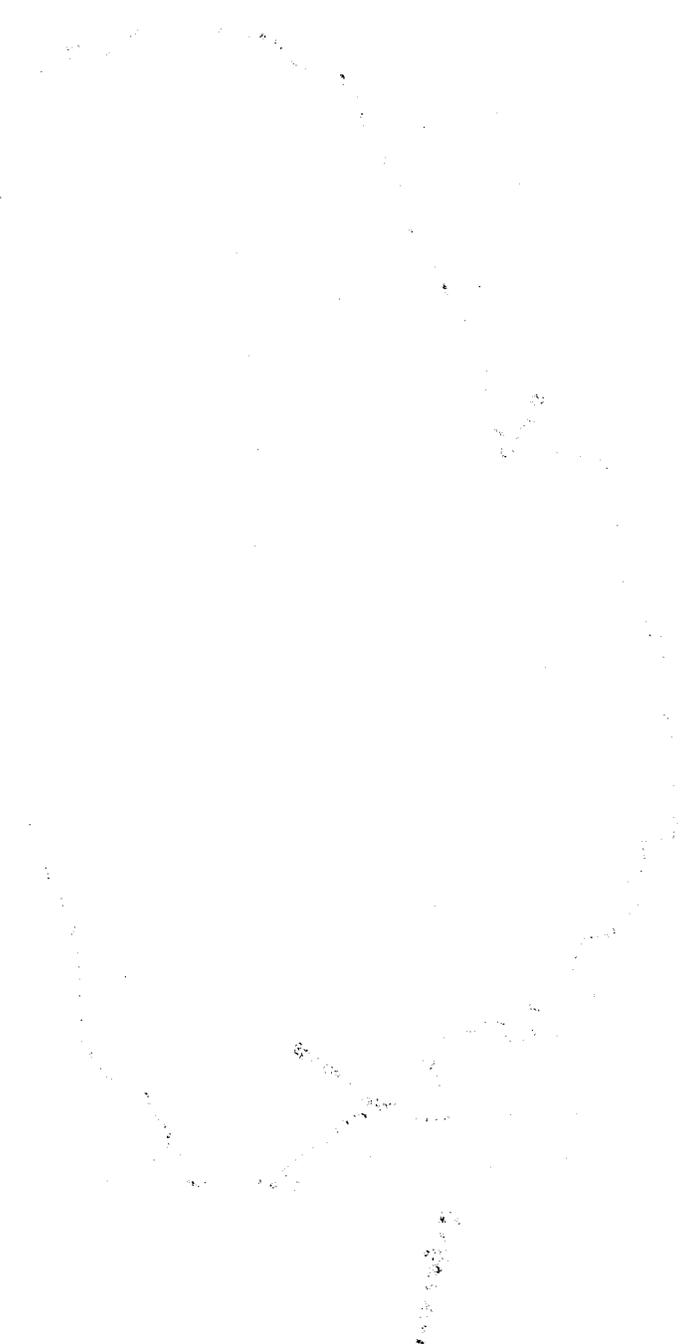
- I. INTRODUCTION.....
 - 1.1 Fieldwork Scheduling and Contract Terms of Reference

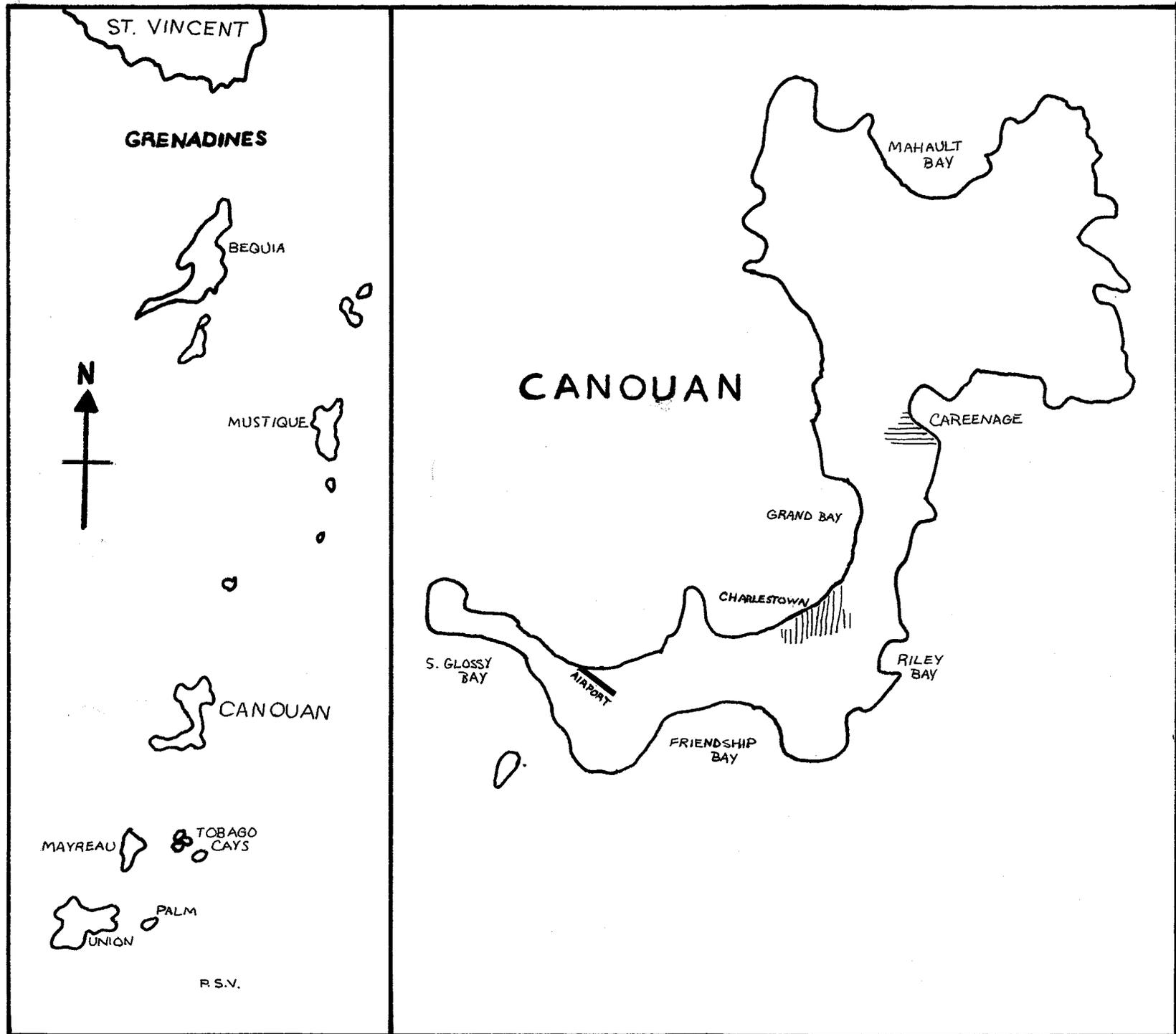
- II. DEVELOPMENT AND ADVERSE ENVIRONMENTAL IMPACTS.....
 - 2.1 Existing Development Impacts
 - 2.2 Potential Development Impacts

- III. CAUTIONARY GUIDELINES FOR DEVELOPMENT PROJECTS.....
 - 3.1 Guidelines (As the guideline reference applies to two or more of the study islands, general guidelines will appear in Part II)
 - 3.2 Priorities for Supplementary Detailed Investigations of Environmentally Critical Areas

- IV. POSITIVE ENVIRONMENTAL INITIATIVES.....
 - 4.1 Projects with Potential to Confer Environmental Benefits
 - 4.2 Local Contacts in the Environmental and Development Fields

1911





ST. VINCENT

I. INTRODUCTION

1.1 Fieldwork Scheduling and Contract Terms of Reference

The fieldwork consisted of a visit between February 18-21, 1974, in addition to several prior visits. As St. Vincent has experienced little of the development that has affected other islands of the Eastern Caribbean, fieldwork focussed on faunal resource depletion, beaches and beach access, and marina developments. Other areas investigated in St. Vincent were historic sights and monuments, and priorities for park and preserve planning. Coastal water quality has been omitted as it is being handled within the context of the WHO/PAHO survey of selected Caribbean islands.

II. DEVELOPMENT AND ADVERSE ENVIRONMENTAL IMPACTS

2.1 Existing Development Impacts

Our survey of existing development impacts centered on beach access, mining of sand and coral, the lobster fishery and marinas. The sewage problem of Kingstown was omitted due to the fact that the WHO/PAHO study will cover St. Vincent in addition to Antigua, Dominica, and St. Lucia in the context of a liquid and solid waste management project.

St. Vincent

2.11 Beach Access: Limited access to beaches is a problem that is increasing in St. Vincent. According to the Planner, Oswald Sergire, of 64 beaches, 32 have access blocked by private holdings. The following are examples of beaches having limited or no access:

1. Griffith Beach, north of Georgetown, on the east coast.
2. Grand Sable Beach, just south of Georgetown.
3. The beaches at North Union Bay and South Union Bay;
4. On the west coast, the beaches at Anse Bonaventure and Byahaut.

2.12 Sand and Coral Mining: Another impact encountered in St. Vincent is sand mining of the beaches for construction aggregate. Sand is mined on various beaches on the island, particularly in the south-eastern part at Brighton Bay. There is no legislation prohibiting sand mining of beaches, but it is widely felt that legislation, if it existed, would not be enforced anyway. Private landowners who control access to the beach, which is a public resource, commonly charge an access fee to those who wish to mine sand and transport it through their property.

The beach that fronts Camden Park Bay used to be an excellent swimming beach. Now, however, as the result of sand mining and possibly natural erosion, the beach has virtually disappeared.

St. Vincent

In the Brighton Bay area, large sand dunes form the berm of the beach. This area of sand mining also extends south beyond Milligan Cay around to Prospect.

Another dimension of this has been the mining of live coral. A year ago, an extensive area of staghorn reefs was mined north of the Young's Island in front of the Mariner's Inn. Mining of the coral directly conflicted with use of the offshore reefs by the Mariner's Inn for scuba diving and snorkling. According to the dive master, Hugh Ettles, extensive destruction was sustained. Mariner's Inn, as a result of this, has noticed two impacts beyond the aesthetic loss of the reef itself. First, the shore area experiences greater swells especially during the summer, which formerly had been broken up on these reefs. Secondly, there has been some erosion of the beach on the adjacent property of Mrs. Dun.

2.13 Depletion of Spiny Lobster: The Grenadines in the Grenadines shelf is a favored area for spiny lobster harvesting. Currently the market for lobster is booming and production is at a very high level in St. Vincent and in the St. Vincent Grenadines. Increased catches of undersized lobsters suggest over-exploitation of the lobster, which will lead to rapid depletion of the resource and reduction of sustained yield in total pounds. Currently, there is a complete lack of management of the lobster fishery. There are no export statistics, for, as the law reads, total lobster catches under 500 lbs. need not be registered. The reason for concern is that local

fishermen have now taken to scuba diving which dramatically increases their dive time and range. The fishermen using scuba are entirely self-sufficient as they have portable compressors on board. Current prices for lobster are \$2.50 E. C. per lb., while five years ago it was sixty-five cents E. C. per lb., Lobsters within the Granadines are taken to Palm Island where they are flown out to destinations including Martinique, Barbados and St. Lucia. An aspect for future concern is the possibility of their resorting to night diving with lights, an activity which is strictly illegal in other organized lobster fisheries.

2.14 Marinas: Presently, a marina is under construction at the Careenage in Calliagua Bay. This marina is being built by Caribbean Sailing Yachts and, to date, has only involved the minor clam shell dredging for dockage facilities in the bay. There has been no adverse impact from the dredging on surrounding reefs or waters. Another project in Calliagua Bay is the Johnson Point jetty which may or may not be realized. It is suggested that planners keep an eye on the construction aspects of this jetty.

A possible marina site is north of Johnson Point near the Ottley Hall ruins.

St. Vincent

2.2 Potential Development Impacts

Canouan Island has been slated for extensive tourism development with most tourist facilities being placed on the eastward coast. The British Development Division is responsible for the infrastructure, roads, a jetty which would be on the west coast of Grand Bay, and the airport now under construction on the peninsula of the southwestern end of the island. A potential concern is the possibility of an oil transshipment facility to be built by General Crude by the airport. General Crude Company is presently exploring, using seismic instruments throughout the Grenadines area. A possible marina may be constructed on the east coast in Canouan.

Another area of potential concern is the Camden Industrial Park site on the western coast of St. Vincent. This twenty-five acre industrial park is given over to secondary manufacturing and as yet, no comprehensive waste treatment facility is planned. Given the slow growth probability of the industrial park, it is feasible at the moment to consider sewage treatment by a septic system on a development basis rather than in a comprehensive fashion.

III. CAUTIONARY GUIDELINES FOR DEVELOPING PROJECTS

3.1 Guidelines

In St. Vincent, where very little development activity is under way, general guidelines are given in Part II. Of particular relevance are those

sections on: "Dredging" (Section 7), "Soil Disturbance" (Section 6), as it relates to the mining of sand, "Marinas" (Section 9), "Conservation of Lobster" (Section 11), and "Amenity and Aesthetic Resources" (Section 2).

3.2 Priorities for Supplementary Detailed Investigations of Environmentally Critical Areas

Supplementary investigations in St. Vincent and the St. Vincent Grenadines should focus on the possible adverse impacts of development activities on Canouan Island.

IV. POSITIVE ENVIRONMENTAL INITIATIVES

4.1 Projects with Potential to Confer Environmental Benefits

A list of scenic amenities and park and preserve priorities is being compiled by Dr. Earle Kirby for the UNDP/PPP office.

4.2 Local Contacts in the Environmental and Development Fields

Mr. Tim Burgess
Bequia, St. Vincent

Mr. John Caldwell, concerning the Palm Island Development

Mr. Dalrymple
Department of Public Works.
He is involved with sewage treatment.

St. Vincent

Mr. Hugh Ettles
St. Vincent Marina Yacht Company, Ltd.
Box 346
Kingstown, St. Vincent Telephone: 84388

Mr. A. Eustace
Secretary of the St. Vincent Development Corporation
P.O. Box 841
Kingstown, St. Vincent Telephone: 71358

Mr. Oswald A. Fereira

Dr. Earle Kirby
Department of Agriculture
Kingstown, St. Vincent

Mr. Stoeken
Resident Manager
Caribbean Sailing Yachts
Blue Lagoon Telephone: 84308

Mr. P. M. Velox
Permanent Secretary
Department of Trade, Agriculture, and Grenadine Affairs

TURKS AND CAICOS

- I. INTRODUCTION.....
 - 1.1 Fieldwork Scheduling and Contract Terms of Reference
- II. DEVELOPMENT AND ADVERSE ENVIRONMENTAL IMPACTS.....
 - 2.1 Historical Impacts (where applicable)
 - 2.2 Existing Development Impacts
 - 2.3 Potential Development Impacts
 - 2.4 Other Impacts
 - 2.5 Priorities for Supplementary Detailed Investigations of Environmental Critical Areas
- III. CAUTIONARY GUIDELINES FOR DEVELOPMENT PROJECTS.....
 - 3.1 Guidelines
- IV. POSITIVE ENVIRONMENTAL INITIATIVES.....
 - 4.1 Projects with Potential to Confer Environmental Benefits
 - 4.2 Opportunities to Enhance Environmental Assets
 - 4.3 Local Contacts in the Environmental and Development Fields

TURKS AND CAICOS ISLANDS

I. INTRODUCTION

1.1 Fieldwork Scheduling

Field investigations were carried out by John McEachern, resource planner of the Foundation, over a six day period from January 23 to 28 inclusive, with departure from the islands on the following day.

The islands visited were: Grand Turk, South Caicos, North Caicos, and Providenciales. Salt Key was indirectly surveyed by aerial reconnaissance coupled with firsthand interviews of Salt Key residents.

1.2 Contract Terms of Reference

The work in Turks and Caicos concentrated on physical development projects associated with reefs and salt ponds, mangroves, port and marinas, and park and preserve priorities and planning. These subject areas are outlined in section 3.01 of the basic UNDP - IRF contract, "Contractor Investigations".

II. DEVELOPMENT AND ADVERSE ENVIRONMENTAL IMPACTS

2.1 Historical Impacts

The terrestrial fauna of Turks and Caicos is impoverished in both species and numbers. This is mainly due to the extensive habitat changes that occurred because of the island's salt industry. Historically, from the colonial period into the 20th century, Turks' island salt had an important place in American commerce, its popularity based on its use in food processing. In order to abet evaporation, and reduce rainfall (or so it was believed), the woodlands were systematically felled. Vestiges of the original fauna probably exist on East and Middle Caicos, and on the cays, extending SSE of Grand Turk: East Cay, Pear Cay, Long Cay, and Gibb's Cay. These Cays are noted for their iguana populations and nesting birds. No visit was made to these islets to inventory the fauna, however.

The cultural artifacts of Turks and Caicos are similarly of little interest in comparison to those found elsewhere in the Eastern Caribbean. The few monuments which might be of interest are in an advanced state of deterioration. These are listed in Carleton Ray's report and will not be discussed here.

2.2 Existing Development Impacts

Most of the development impacts that have occurred in recent years in the Eastern Caribbean have not as yet affected Turks and Caicos. Two minor environmental problems which are in evidence, however, are (a) litter, and (b) a miasma which rises off the salt ponds, or Town Salinas, during periods of still air.

The litter problem is at its worst in Grand Turk, particularly the area adjacent to and east of Cockburn Town. Litter also occurs in the salt pans below the catchment at the south end of Town Pond, along the berm of White Sand Beach (the only beach located at the southern tip of the island) and by the mangroves at The Sound. Solid waste collection and disposal on Grand Turk is haphazard and ineffectual for much evidence exists of wetlands, salt ponds, and mangrove areas being used as solid waste dumps. There appears to be no organized pickup and disposal service, nor is there evidence of outdoor collecting points for garbage and litter.

The miasma rising off the salt ponds owes its origin to the fact that water impounded in the salt pans becomes stagnant and at

certain times of the year, results in the formation of hydrogen sulphide, as the organic debris begins to decay. The solution to this problem would involve either (1) landfilling the salt pond, or (2) improving the water mass exchange sufficiently to preclude formation of stagnant water.

2.3 Potential Development Impacts

Three development activities are of concern to us: First, potential adverse impacts of causeway construction; second, the plan to build a harbor in South Caicos; and finally, marina construction projects associated with resort developments. Turks and Caicos Islands currently undeveloped should not be completely ignored for in future they may be selected as candidate areas. There is a rumor - based more on wishful thinking than on substance - of a possible associated territorial status with Canada. Although this will not come to pass, there is nevertheless awakening outside interest in Turks and Caicos. The 50% appreciation in land values over the last two years reflects this interest.

2.31 Proposed Causeways - At various times, causeways have been proposed to link the Caicos Islands. The most recent articulation of this notion appeared in the Shankland & Cox Outline Development Plan. They state that one of two future objectives for the roads program should be the creation of an island spine road connecting South to North Caicos. The report fails to consider any

undesirable environmental consequences that could follow from such a road-building program.

The southern portion of the causeway program calls for the inter-connection of the three cays lying between East and South Caicos: Nigger Cay, Middle Creek Cay, and Plandon Cay. An optional route, proposed by a Canadian developer (in return for a free hand in developing East Caicos), would conjoin East and South Caicos via Sail Rock Island. In all these schemes, no mention is made of the impact of a causeway on the marine flora and fauna of the environs.

The area to be trafered by the causeway is shallow water (4 feet) and lays claim to being among the most productive bone fishing areas in the Caribbean. As bone fishing is potentially an important tourist asset, alteration of this habitat is of more than biological interest. The bonefish, Albula vulpus, grows to more than 12 pounds, but on the average, weighs less than 5. It is a bottom feeder, concentrating on mollusks (especially clams and crabs) and is considered to be a great sporting fish on light tackle. It should be noted, that the exclusive Southern Cross Club resort on Little Cayman Island owes its founding to the unsurpassed bone fishing of the adjacent waters.

In the case of the southern causeway, it is desirable to maintain scoured tidal cuts of Plandon and Middle Cays leading to the Stake Bank shallows, as they are obviously interrelated and crucial to ecologic stability of the bank. If the causeway were to impede or block the water flow through these cuts, the life of the bank would be dramatically altered. Faunal impoverishment through reduced food supply can be expected by such a blockade. These cuts provide the channels through which tides equalize waterflow between the Turks Island Passage to the east and the shallow Stake Bank area to the west. The aesthetic value of these cuts has been described by Ray (1971, p. 15).

The causeway development most likely to materialize is the one that would link North and Middle Caicos Islands. The plan, as it exists in the Department of Public Works, calls for a short causeway to be built across the salt pond lying one-half mile east of Readymoney Settlement. The major construction, however, is represented by the 3700' section traversing Homer Channel, between North and Middle Caicos. The plan calls for two culverts, the main culvert being wide enough to allow boat traffic. This culvert will be located 400 feet from the western terminus of the causeway, and will be 25 feet wide and bridged. A subsidiary

culvert will consist of three side-by-side, 6 feet diameter tubes, located 2,300 feet from the eastern causeway terminus. The design deficiency of this project rests with the fact that in 4,700 feet of causeway, a mere 43 feet will be open to tide-water flow. This is less than 1% of the total length. The result will be to effectively block the north-south water exchange through Homer Channel. It is essential that, prior to construction, some drift/tide studies be made with particular attention being paid to the ecology of Bottle Creek Channel, and its dependence upon tidal exchange.

As suggested above, the habitat of the bonefish is protected shallow banks. Availability of food is related to unimpeded water flow for the organisms on which bonefish feed arrive on the flood tide. The entire sublittoral zone along the southern margins of North, Middle and East Caicos, including their myriad channels, provide an ideal habitat for this fish.

- 2.32 The Harbor Plan - This development is tentatively scheduled to begin mid-summer, 1974, and will be located in South Bay, South Caicos. The island is economically depressed, with few development prospects for the future. The new harbour would be the single exception and, at the moment, has not advanced beyond the discussion stage. The site of the deepwater harbour is 500 feet east of the Admiral Arms Hotel, the only resort now operating in

South Caicos. If approved by the British Development Division, the project would involve dredging of the bay in addition to jetty construction. Our concern lies with the potential adverse impacts of sediment loading of the surrounding water during the dredging phase, and the effect this could have on the hotel's diving business. SCUBA is a recreational activity offered by the hotel, and requires clear water and the presence of healthy, well-developed reefs.

Briefly, bucket and clamshell dredging causes turbidity of the water due to the "fines" of particulate matter that goes into suspension. Turbidity not only reduces light penetration, which adversely affects the algae symbionts of coral, but physically can smother it where the silt drops out of suspension and blankets the living coral polyps. Further discussion of the potential hazards of dredging, appears in the dredging guideline (p. ___).

At the Admiral Arms, the prevailing ocean currents pass between Long Cay and South Caicos flowing southeast to northwest around Dove Cay. According to the hotel dive master, superior dive localities exist in three areas on the north end of Long Cay and on the north and south sides of South Cay. Looking beyond the needs of the hotel itself, it is fair to say that degradation of the marine environment is not to be accepted lightly, as South Caicos has few of the tourist

assets of her sister Caribbean islands. Water quality is perhaps the unique marine asset. Diving in the waters of South Caicos and in the rest of Turks and Caicos is excellent, characterized by pellucid water with visibility frequently exceeding 100 feet. Of added interest is the presence of an oceanic dropoff where the sublittoral bottom plunges from 10 to 1,000 fathoms in the space of 4 miles. This oceanic dropoff can be found on the west coasts of Grand Turk and Salt Cay, and off the south coast of South Caicos in front of the hotel.

It is to be noted, that the Admiral Arms Hotel advocates and supports the original Carleton Ray proposal (See Parks and Conservation in the Turks and Caicos Islands) to make the reef systems associated with Long Cay and Dove Cay part of a Marine National Park system.

- 2.33 Marinas - As yet it is premature to judge if these protected marinas will incur adverse environmental impacts. However, with the construction of more resorts it is probable that some of these new marinas will fail from the standpoint of water quality maintenance. Marina developments are now underway, or are proposed in association with future resort developments, on the islands of Providenciales, North Caicos, and Salt Cay.

The most ambitious marina development is the Turtle Cove Development of Provident Ltd. This company has on the drawing boards three large residential projects slated for Providenciales at: (i) Turtle Cove, (ii) Long Bay Hills, and (iii) Grace Bay. Another development on the island, independent of Provident Ltd., is known as "Leeward-Going-Through" and is backed by Bill Kemp of Bermuda.

Taken together, the three Provident Ltd. developments consist of 4,000 acres and 4,500 house lots. At Turtle Cove, the most advanced of the three projects, 35 private homes have been built to date while some 1,100 lots have been sold. Of environmental interest, is the plan to extensively dredge existing salt ponds and channel areas at Turtle Cove. To date, only a few test channels have been dredged. It is too soon to determine if the marinas will, in fact, be built and if so the degree to which they will prove to be sumps for contaminated groundwater and boat-generated oil and sewage pollution.

The potential danger of septic field overflow from the Turtle Cove development remains an unknown. As presently designed, the housing density will be one house per acre, but without knowledge of the soil infiltration rate a judgement cannot be made as to the suitability of relying on septic tanks for all housing units.

A marina development which is further along in the construction stage is the one associated with the Seven Keys Development at the north tip of North Caicos Island. At present, the Seven Keys Development consists of the Prospect of Whitby Hotel sited at the northwestern end of Whitby Salina. A dredge cut has been made here through to the sea, and plans call for the construction of a marina by dredging the rest of the Whitby Salina in a phased expansion program. The salt pond, in its natural configuration, is cut off from the sea and is several feet deep. As demand for marina space escalates, first a quarter, then a half, then the entire salt pond would be dredged to accommodate additional slips and boats. Given the fact that the neck of land between the salina and the ocean has been set aside for dense residential housing, there is always the possibility of septic tank effluent contamination of the salt pond marina to the south or the ocean shoreline to the north.

Salt Cay may also host marina development. There appears to be preliminary interest by the developers Jack Gold and Jim Pepperdine who proposed a three-phase development plan for the Cay. The first phase involves a North Bay property consisting of an 8000 foot coastal strip, 400 feet deep. A 50 room hotel and 40 houses are to be built along the ridge line, with plans for a waste treatment

plant, a desal plant for producing fresh water, and a power plant. The second phase of their development program would be at South Point where 20 high income houses are planned. The proposed marina would be the final phase, to be built in South Creek which is a lagoon along the southeastern coast of the Cay. The concern over the proposed marina in Salt Cay rests with dredging impacts that might affect the nearby reef systems located along the south and southeast coasts.

No development activity is programmed for Big Sand Cay lying south of Salt Cay, and Cotton Cay located 3 miles northeast of Salt Cay. The former Cay has a substantial beach on the west coast which is frequented by hawksbill turtles (Eretmochelys imbricata). Offshore, in the Turks Island Passage, are to be found seasonal migrations of sperm and humpback whales. Cotton Cay is owned by TIMCO (Turks Islands Merchants Company). A small mangrove stand occurs here which is worth keeping intact. Both Big Sand and Cotton Cays are best viewed within the context of natural preservation use.

Another potential development impact in Turks and Caicos is oil pollution associated with a refinery or oil transshipment facility. At one time Salt Cay was proposed as a candidate refinery site. This choice has been supplanted by the West Caicos project a move to be applauded on environmental grounds.

Esso Interamerica has development option on West Caicos until 1976. In terms of the direction prevailing oceanic currents, the latter site is preferred over Salt Cay, for any oil spills would be carried in a northwesterly direction away from the Turks and Caicos.

2.4. Other Impacts

Oil is already a problem although no refineries have yet been built. The relative isolation of the cays has not given them immunity from this impact. The eastern shores of the Turks Islands (Sand Cay, Salt Cay, and Grand Turk), South Caicos Island, and East Caicos have all received oil slicks at one time or another. Oil which is dumped at sea by tankers cleaning their bilges, drifts in through the Turks Island Passage from the Atlantic and blankets large portions of the coastline. To a lesser degree some of the islands' northward-facing beaches (such as at the Prospect of Whitby Hotel) also suffer from oil contamination. There is seldom an oil problem further east on Providenciales as the island lies in the lee of the prevailing easterly winds and currents.

2.5 Priorities for Supplementary Detailed Investigations of Environmentally Critical Areas

Within Turks and Caicos, detailed investigations should focus on (1) the potential adverse impact resulting from the causeway project; (2) the deep-water harbor project and associated dredging in South

Caicos; (3) a close look at the marina developments, particularly at Turtle Cove, Providenciales Island. Finally, (4) if the Exxon option to build a refinery on West Caicos Island is exercised, an environmental impact study of the development is called for.

III. CAUTIONARY GUIDELINES FOR DEVELOPMENT PROJECTS

3.1 Guidelines

A few specific guidelines are mentioned here in addition to three general guidelines appearing in the conclusion of the report.

These latter guidelines relate to development activities that occur in two or more of the study islands. For example, development guidelines appropriate to Turks and Caicos and to other study islands are: "Dredging", "Marinas", and "Oil".

Specific guidelines concern the causeway program, harbor project, and several of the marinas.

3.10 Causeways

Prior to construction, baseline data on physical and biological characteristics of the site are needed so that impacts of proposed causeway construction can be anticipated through reference to the engineering plans. Topics of interest would include circulation patterns, wave activity, coastal geomorphology, (sand transport, etc.), and an inventory of biota and their habitats.

3.11 Harbor: The same recommendation holds true in relation to the South Caicos deepwater harbor. In this case the focus on offshore current circulation should be examined in light of the effect that these currents will have on transporting suspended silt, arising from the dredging operation, westward of coral reefs located in front of the Admiral Arms Hotel.

3.12 Marinas: It is suggested that the Seven Keys Development Co., explore the feasibility of excavating a channel at the northeast end of Whitby Salina through to the sea, in addition to the southwest channel now being dredged. The opening up of both ends of the salina will induce a drift of water from NE to SW in response to prevailing easterly winds.

Concerning the proposed Marina development at Turtle Cove, it is recommended that the UNDP Planner monitor the evolution of the project preferably on a quarterly basis. The Island Resources Foundation has strong reservations about the adequacy of the water exchange in this marina development, for it is unlikely that the expected pollution load will assimilate or disperse within the confines of the area as it is now projected. Regardless of the outcome of this large-scale, multi-channel, development, it can provide a case example of an elaborately engineered development based on a pre-

existing lagoonal area.

IV. POSITIVE ENVIRONMENTAL INITIATIVES

4.1 Projects with Potential to Confer Environmental Benefits.

It has come to the attention of the survey team that certain projects underway, or planned for the future, have potential to bring environmental benefits to the residents of the Turks and Caicos. These projects are listed to alert UNDP planners to environmental useful projects, and if monitored can provide models for other developing Caribbean islands.

4.11 Windmills and Salt pan: The salt industry historical artifacts.

Salt Cay is the last remaining island within the Turks and Caicos which has an operating salt industry, located in the southern end of the Salinas east of the town. The TISCO (Turks Island Salt Company) operation is all that remains of a once flourishing nineteenth century salt industry throughout Turks and Caicos. Without Government sub-

side, the TISCO operation would have disappeared some years ago.

The developers Gold and Pepperdine have discussed plans to maintain a skeleton salt industry, including the wood windmills which are still used as a means of paddling water along the channels between join the salt pans. Preservation of this industrial activity (a form of industrial archaeology) would not only be a prime tourist attraction, but also of historical and cultural relevance to the islanders themselves.

- 4.12 Mariculture: Another development activity which may occur on Salt Cay and worth monitoring is the proposed Mariculture Project for Pilchard Hole Salina. The consultant of this project is John T. Hughes of the Massachusetts Research Station, Marthas Vineyard, Massachusetts, U.S.A. The idea is to commercially raise the brine shrimp (Artemia) for human consumption. This project has the backing of Stewart Beck of Minéola, Westchester County, New York.

4.2 Opportunities to Enhance Environmental Assets

Opportunities exist within the survey islands for UNDP/PPP personnel to enhance environmentally the environment, in addition to rationalizing specific project plans. The example below,

to aid and abet establishment of National Parks in Turks and Caicos, is a case in point.

- 4.21 National Parks Creation: Several years ago Major John Wainwright who was then head of the National Park Committee, was instrumental in bringing Carleton Ray and Alexander Sprunt to the Turks and Caicos to report on the ecology of the islands with particular emphasis on the impact of development on the natural environments. Their report on Parks and Conservation in the Islands received wide support from individuals representing both the development and conservation sectors.

Upon submission of the report, the National Parks Commission and the Legislature of the Turks and Caicos accepted the conclusions and the National Park boundaries demarcated within it. Since then nothing has been accomplished, although interest for these conservation measures remains widespread. The step which is holding up acceptance of the National Parks program is drafting of the legislature. This is entrusted in the overworked hands of Mr. Ernest Howard in drafting who is the legal advisor to States Council. In the Turks and Caicos the administration submits all bills and their legal advisor must draft them. The opportunity exists for the UNDP physical planner Lars Ibsen to assist Mr. Howard in drafting the necessary legislation. With this objective in mind, model marine park legislation is included in as Appendix B of the report. Further,

information on the parks can be obtained from those previous government and private individuals composing the National Parks Committee. Among these were Liam Maguire, Norman Saunders and John Wainwright. Furthermore, almost all persons listed in Appendix A under "Local contacts" expressed the hope that National Parks would be created.

- 4.22 Natural Area Preservation: Areas not falling within national parks are also of interest. It would be useful for the UNDP planner to inventory existing mangrove associations with a view to placing them in a preservation status. The guideline on "Mangroves" (v. Conclusion) describes their importance in both ecologic and economic terms to Caribbean islands. In Grand Turks, mangrove is found along the shores of South Creek, on both sides of the Sound, and on the neck of land between them. In Providenciales an excellent mangrove stand exists to the south of the Well Creek Fishing camp and further south around Frenchmans Creek. The excellent fishing in this part of the island doubtless is due to the interdependency between offshore waters and the mangrove associations. Of similar importance is the red mangrove (Rhizophora mangle) fringe along the southwest shore of East Caicos, coupled with extensive areas of black mangrove (Avicennia sp.). As the Ray (1971) report has indicated, the littoral and sublittoral zones of East Caicos

are as near as any area within the Caribbean to a natural state.

Although the Island was formerly inhabited - prior to 1911 sisal and cotton were grown - there is now only wild cattle, secondary scrub, and marine habitats which have remained as pristine as they have always been.

The limits to development in East Caicos have been lack of infrastructure and the severe mosquito problem. This lack of prior development presents planners with an option largely foreclosed in other parts of the Caribbean. Park Planning and establishment of Marine Sanctuaries has traditionally occurred in the Caribbean in response to the imminent threat of development. Park boundaries as a result have largely been circumscribed by what has already been developed, rather than by ecologically sound criteria. The undeveloped nature of East Caicos allows the planner the luxury to demarcate ecologically viable areas for preservation use. Accordingly, we suggest a close look at the coastal and offshore assets of East Caicos with a view to preserving an extensive representative portion of this landscape in its natural state.

A list of local individuals concerned with the environment is provided, in order to assist UNDP PPP planning efforts. These individuals represent both the conservation and development constituencies. This list appears as Appendix A.

GRAND TURK

Mr. Charles Been - Government development officer.

Mr. Ivan Buchanan - Public Health Officer; his domain includes sewage, and litter.

Mr. and Mrs. Dough Gordon - The Salt Raker Inn, P.O. Box 1, Grand Turk. Dough Gordon is also Secretary of the Turks and Caicos Hotel Association. The TCHA arose from the CHA meeting held in Turks and Caicos, January 7-9, 1974.

Mr. David Hill - building supervisor, Department of Public Works.

Mr. John Housman - Editor of the Conch News.

Mr. Ernest Howard - Legal Advisor to State Council.

Mr. Bill Hutton - Chief Secretary of Turks and Caicos.

Mrs. Daphne James - Turks and Caicos Tourist Board, Grand Turk.

Also runs Turks Head Inn.

Mr. David Keith - Chief Engineer of Public Works.

Mr. A. G. Mitchell - Governor of the Turks and Caicos, appointed from Britain.

Mr. Phil Pruss - Owner of Grand Turk Scuba Dive Business.

Mr. Peter Smith - he is in charge of roads and marine developments
for Public Works Department.

NORTH CAICOS

Mr. Derrick Hawkins - Manager of Prospect of Whitby Hotel. This
hotel is a development of Seven Keys Limited, Churchill Building,
P. O. Box 21, Grand Turk.

Mr. Charles Misick - State Council representative for North Caicos;
and an agent for TCA.

Mr. Peter Proutings - "The Prospect of Whitby Hotel."

Mr. Colin Tomlins - Seven Keys development, in charge of marketing.
Resident in Grand Turk.

Major John M. E. Wainwright, project manager - manager of Seven Keys
Development Ltd, Box 11, Grand Turk. Formerly head of the
National Parks Committee. He was instrumental in bringing
Carleton Ray to the Turks and Caicos.

Mr. Tom Whitting - Managing Director, The Seven Keys Development.

PROVIDENCIALES

Mr. Kip Dupont, Turtle Cove Development

Mr. Bill Kemp - Turtle Cove Development

Mr. Fritz LUddington, Turtle Cove Development

Mr. Tim Nicholl - Ex-government fisheries officer.

Ms. Vicki Ringer - Owner of the Provo Trading Post near the airport.

Mr. Jim Sautelle

Mr. Bengt Soderquist - Land Supervisor for Provident Ltd.

Ms. Donna Wolfe - Manager, Third Turtle Inn, Providenciales.

SOUTH CAICOS

Mr. Tony Forrest - Dive Instructor for Admiral Arms Hotel.

Mr. A.G. Malcolm - the District Commissioner for South Caicos.

Mr. Rony Rae - the Turks and Caicos Government Fisheries Advisor.

Mr. Norman Saunders - Chairman, the Turks and Caicos Tourist Board.

State Council representative for South Caicos.

Mr. Richard Stevens - Fisheries Officer and marine biologist.

SALT CAY

Mr. A. S. (Sandy) Leggatt - Resident Manager, "The Brown House".

Mr. James Morgan - General Manger, TISCO (Turks Islands Salt Company).

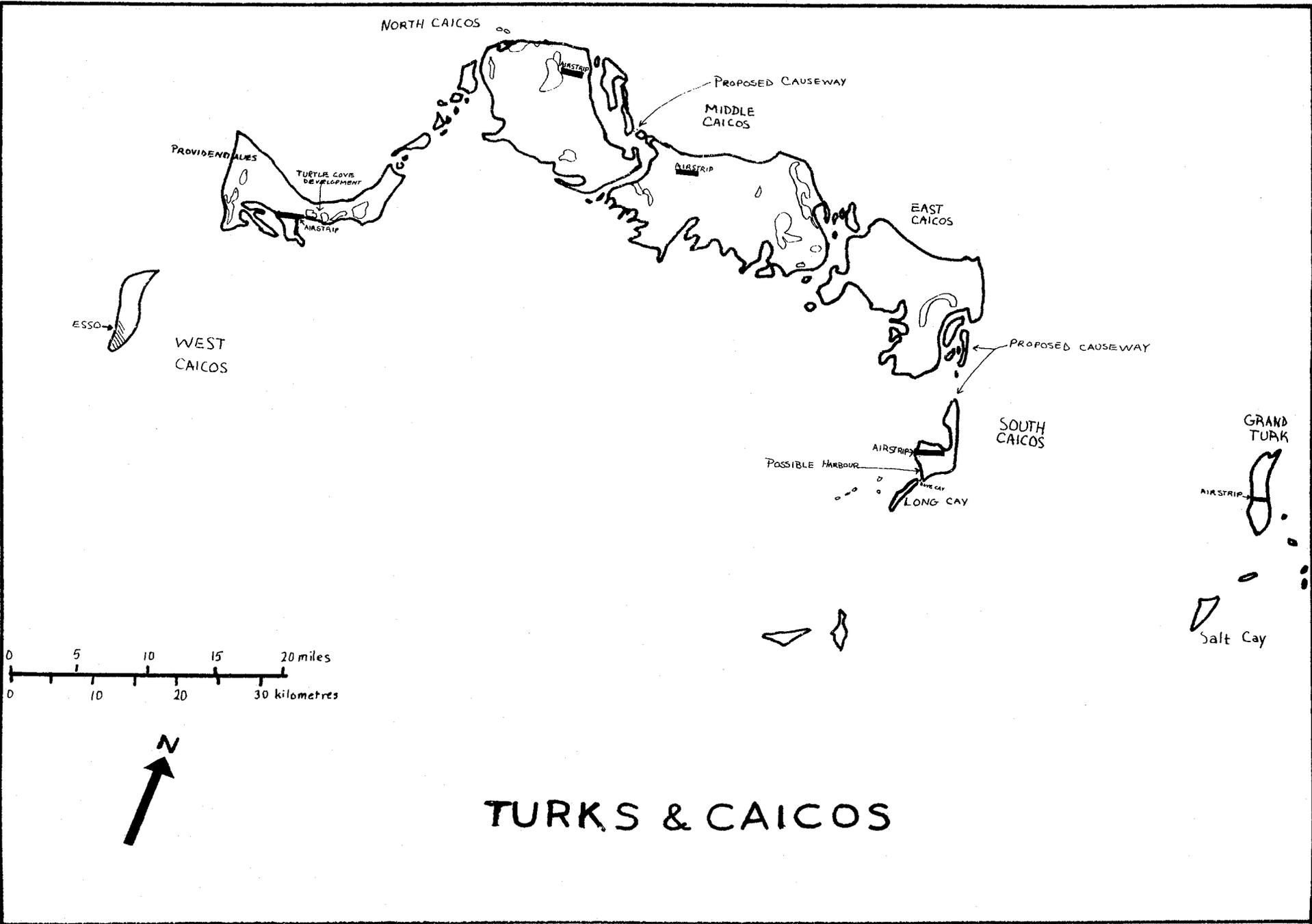
PARROT CAY

Ms. Helen Czernin

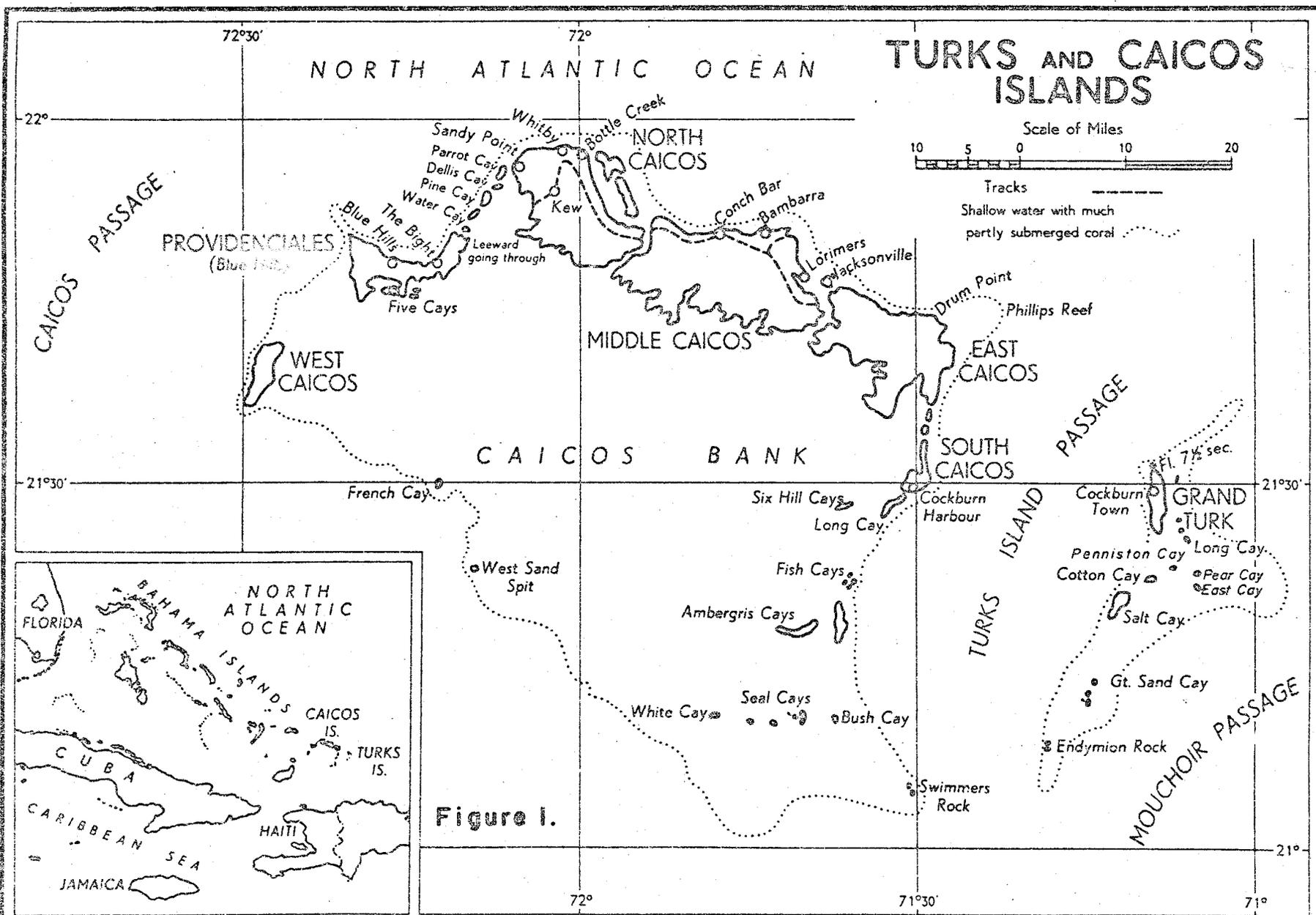
Mr. Tommy Coleman

PINE CAY

Mr. Liam Maguire, The Meridian Club.



TURKS & CAICOS



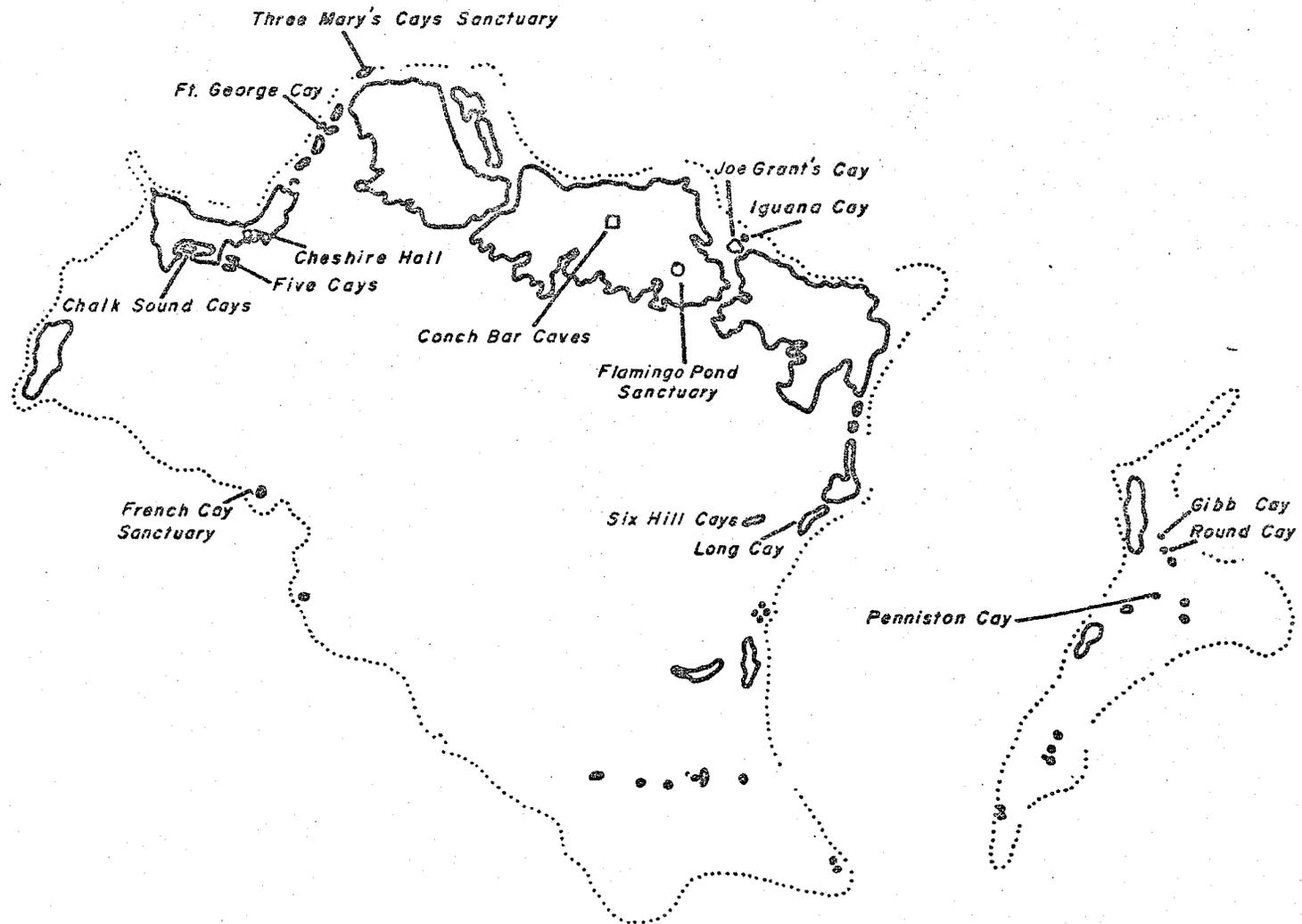


Figure 2. Parks and Sanctuaries Designated by the National Parks Committee.

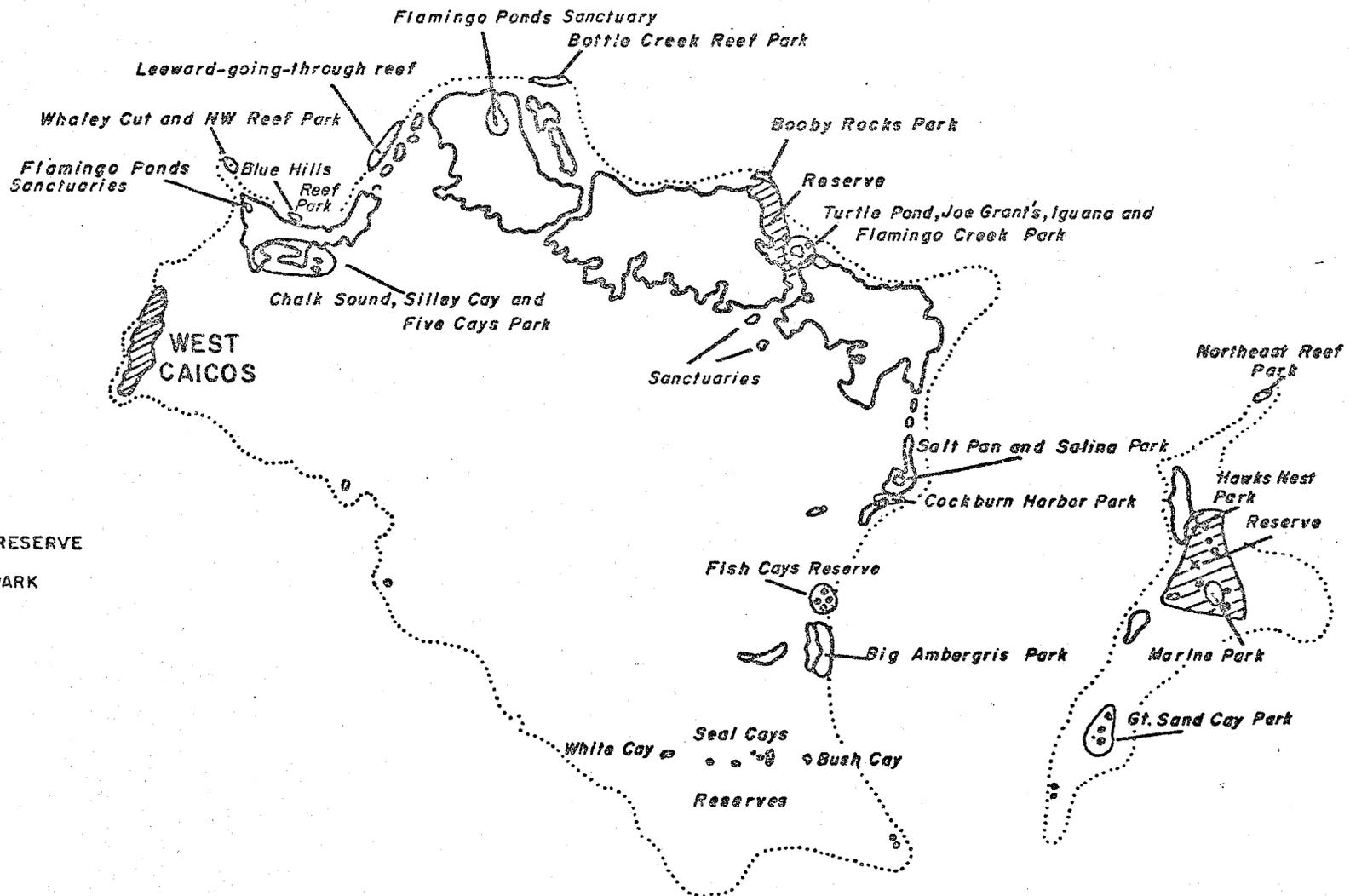


Figure 3. Additional Suggestions for Parks, Reserves and Sanctuaries.

PART II.

GENERAL GUIDELINES FOR ISLAND
ENVIRONMENTAL MANAGEMENT
(to minimize adverse development impacts
and protect certain resources)

ISLAND RESOURCES FOUNDATION
U. N. D. P. ENVIRONMENTAL
SURVEY
Contract 133/73

PART II. GENERAL GUIDELINES FOR ISLAND ENVIRONMENTAL
MANAGEMENT (to minimize adverse development
impacts and protect certain resources)

Sections	Page
1. Tourism.....	II-3
2. Amenity and Aesthetic Resources.....	II-6
3. Cultural Resources.....	II-9
4. Conservation of Natural Areas.....	II-11
5. Oil Pollution.....	II-16
6. Soil Disturbance.....	II-21
7. Dredging.....	II-23
8. Wetland Drainage and Fill.....	II-26
9. Marinas.....	II-31
10. Waste Disposal.....	II-34
11. Conservation of the Lobster.....	II-38
12. Conclusion.....	II-41

II. GENERAL GUIDELINES FOR ISLAND ENVIRONMENTAL MANAGEMENT (to minimize adverse development impacts and protect certain resources)

In keeping with the objectives of the status survey, the aim of Part II of the report is to assist the UNDP/PPP and government planning units in establishing a sound set of environmental guidelines for use in its planning activities in each territory or island (cf. Contract, Sect. 3.04c). As we have seen, the impacts under consideration are caused by a fairly standardized range of physical activities that then to be replicated in most of the study islands. In general, the guidelines which emerge are justified by the need to redress imbalances that arise from economically viable, but environmentally damaging, aspects of these activities. The price of progress in one sector may have to be declining quality of life in another sector, but the purpose of guidelines is to ensure that gains and losses are correctly evaluated and that decisions leading to net adverse balance-sheet are avoided.

Guidelines can help this purpose by alerting decision-makers to problem areas. They also provide a basis for broadening the criteria of project analysis to include environmental impact considerations, which was called for by Recommendation 63 of the U. N. Conference on the Human Environment (Stockholm, 1972).

The scope of our study is severely limited in that 60 contracted man-days of work had to be allocated between some 20 islands. If one follows the customary practice of spending half the time in the field, and half in data analysis, evaluation, literature search and report preparation, then an average of $1\frac{1}{2}$ days of fieldtime for each island is what the contract specified.

It is important, therefore, to appreciate from the outset that within the limited scope of our study it has proved impossible to develop prescriptive and detailed site-specific guidelines covering all development projects and activities. For example, to translate the guiding principles referred to under one of the headings discussed below, namely 'Amenity and Aesthetic Resources', into specific measures for a given coastal development such as the proposed Val-Ha-La Ltd. project in Dominica, a complete subset of standards and procedural guidelines would have to be devised to cover all the tasks and responsibilities involved. These might include caveats on shoreline structures, their height, location and density; land uses compatible with the aesthetic, ecological and cultural values of Prince Rupert Bay and the Cabrit and, where necessary, the areas that should be reserved because of their special suitability for maintaining these values; any other zoning or land-use regulations required; and appropriate policies for the promotion and

guaranty of public use rights to coastal resources (fishing and beach access). Field work alone would require several weeks of effort.

However, the most that can reasonably be attempted within the compass of the contract is to give more general guidance, based on the problems that have been identified as being generic to the various island systems, and only where possible make reference to specific developments if they promise to be especially disruptive of the environment.

1. Tourism

Because of its multi-dimensional character and overlap or interaction with many of the other land-use activities commonly pursued in islands under development, the planning and promotion of tourism should be undertaken at the highest governmental levels and viewed as a component part of an integrated, comprehensive, insular resource management spurred on by venture capital and private interest "planning" that may ultimately bring more vexations than visitors and more problems than profits.

The infrastructure of the tourist industry, unless very carefully designed, involves a high risk of diminishing and eventually destroying the natural balance of island resources. This has not yet happened in the study islands, but is taking place in other parts of the Caribbean.

Guidelines would stress the need for forethought about the precise kind of tourism desired and the strategy to be employed in fostering its growth. Does one pursue mass tourism? Or a blend of unconventional tourism, cruiseship tourism, or hotel, condominiums, or local "cottage" or guest house tourism? These questions are prerequisite to assessing the industry's impact on environmental values, on alternative resource developments, and in mounting an anticipatory planning strategy. In islands, tourism has too often evolved out of a series of unrelated, single project allocation decisions, made by outsiders insensitive to an island's distinctive characteristics. These projects individually and collectively may ill-serve the basic needs of society.

Experience in the Eastern Caribbean shows that the tourist industry is rarely charged the true and full cost of the additional public services its development entails. The growth of tourism always generates increased loading of essential public services such as water supply, sewage and solid waste disposal, power generation, transport and communications, and may also lead to over-loading of public recreational facilities. As a further guideline it can therefore be stated that a commensurate expansion of basic services should be mandatory where expansion of the tourist sector is planned. Otherwise, residents may expect a quantitative and qualitative decline in shared services and a

precipitous increase in their cost. In this context, a policy on infra-structural cost allocation should be created for those services which clearly benefit the tourist industry but are subsidized by government. According to a recent study, the Caribbean tourism income multiplier is much lower than has been traditionally assumed - say in the order of .6 to .8.*

Reverting to the matter of planning and design it can further be stated that it is almost always desirable, especially in smaller islands, to lay down the standards for both small- and large-scale resort developments. These standards would cover the usual impact of structures, (style, location, density and height) and the extent to which encroachment on other assets is permitted (i. e. cultural, in the case of Rodney Bay and the village of Gros Ilet). Other standards would logically cover the treatment of sewage and the control of litter, the preservation of open spaces, and as a specific measure, the promotion of public use and access to beaches. Resort or large residential projects (i. e. Turtle Cove, Providenciales Is.) likely to affect the marine environment would require special permits in which conditions for use are based on the contribution of the development to total impact on the resources concerned. There is a clear need for governments in the study islands to view tourist developments within a regional context.

*Bryden, John M., Tourism and Development, A Case Study of the Commonwealth Caribbean. Cambridge: 1973, p. set. req.

There are countless examples of impacts of one activity spilling over to adversely affect other activities. The discharge of untreated sewage from town sites directly into coastal embayments used for recreational activities is a common situation (v. St. Kitts). Finally, an intrinsic weakness in most island tourism development plans has been the lack of an explicit statement, included as an integral feature of the plan, of the level at which further growth of tourism would be limited and how this would be done. Preservation of the "quality of life" in any small island or within an insular region requires the fixing of carrying capacity ceilings. The lack of this type of limit to development on Providenciales Island promises to dramatically alter the island to an irreversible degree. Examples of single purpose controls do exist elsewhere (i. e. Bermuda) - which limit the number of cruiseships allowed to call per day and the size and number of motor vehicles allowed to be imported; but adequate controls have not yet been extended to include density restrictions on residential housing, resort hotel or condominium units. It is doubtful if such piecemeal regulations can be of much real value in the long run, however, in the absence of overall tourist density controls, which an appropriate guideline would certainly advocate.

2. Amenity and Aesthetic Resources

In previous sections of this report, with particular reference to the growing impact of tourism, it has been stated that the study islands are

exceptionally well endowed with aesthetic and recreational assets, which are just as susceptible and vulnerable to excessive pressure as the physical and biological resources with which they are often closely related. Guidelines for their protection, which because of their exceptional value is clearly a public interest and responsibility, may therefore recommend the promulgation of permitted land uses in specific areas, encouragement of buffer zones in which land use is reasonably compatible with that of the more closely controlled zones they are designed to protect, and even outright proscription of certain uses that cannot be reconciled with aesthetic values or are bound to foreclose recreational opportunities. Fortunately, the majority of land-use activities which seriously conflict with this category of values are not site specific to the extent that suitable alternative sites could not be found elsewhere.

Methods to be employed by island planners to maintain aesthetic values range from tax concessions and the purchase of access rights and scenic easements to zoning and, as suggested in the section discussing the selection of conservation areas, emphasizing criteria, such as the values here under consideration, which cannot easily be quantified in monetary terms. Other regulations, which can be applied individually or together, govern the height of buildings and the distance they must be set back from the beach or waterfront, residential density, and outdoor advertising. In the Seychelles, for example, the design of seaside hotels is

controlled and their height limited to that of the surrounding trees, which should to some extent ensure that they blend aesthetically with the environment. The original plans for raising a hotel row on the Pigeon Island causeway showed only a superficial respect for the environs. The former island would have been badly outscaled.

There seems to be a considerable possibility that the demand for recreational facilities in islands will exceed current projections based on population growth. This makes it even more important to forestall a situation in which overloaded and badly sited facilities may lead to a deterioration of the values they are intended to support, as in the case of St. Thomas, U.S. Virgin Islands. A minor example of the kind of guideline this suggests would relate to the car parking facilities for a coastal resort and insist on their location well outside the beach zone. A more fundamental recommendation would require that any public or private development projects which appear to involve a significant risk of destroying or degrading amenity and aesthetic resources should always be accompanied at the planning stage by detailed and specific environmental impact assessments. Finally, close attention should be paid by planners to the recreational needs of local islanders, who for reasons of convenience favor recreational sites close to town. These may also be areas in high demand by the hotel industry. The presence of hotels can actually curtail local opportunities by the imposition of a fee schedule or simply through overcrowding.

3. Cultural Resources

St. Kitts, Dominica, Antigua, and St. Lucia have had an historical role as stepping stones for migrant peoples, trade and exploration, and are rich in cultural records, the loss of which would result in social and artistic impoverishment. As a first step towards conservation and restoration of historic monuments and protection of archaeological sites, terrestrial or marine, the place of cultural resources within the overall development strategy needs to be established. The guideline should be based on the contribution these assets could make to inculcating in island peoples a sense of identify, a better understanding of their place in history and relationship with their environment. It should also evaluate the resource as a tourist attraction and as a reference point for all students of the evolution of man's artistic heritage.* Elements of a more detailed management program would include:

- (a) Inventory of cultural resources and a priority rating for their conservation; marine wrecksites are a necessary addition to the customary list of cultural resources.
- (b) Estimation of financial and legal implications.

*This may sound like a difficult task, but the survey team was immensely impressed by the cultural heritage of the study islands consisting of such diverse sites, buildings, and monuments as Amerindian sites (St. Lucia); Forts (Charlotte in Antigua; the Cabrits in Dominica) sugar-mills (Lower Galway in Montserrat); distinctive vernacular architecture (Basseterre, St. Kitts), and even a lone Martello Tower in Barbuda. (d.f. Buisseret, 1971).

- (c) Enactment of conservation legislation and initial budgetary provisions;
- (d) Setting up an appropriate governmental or non-governmental body (e.g. National Trust, Museum Boards, Arts Councils) to advise upon or manage the resource.
- (e) Establishment or expansion of museum facilities to house collections which cannot be suitably maintained or displayed on site, and to promote the relevant artistic and historical research.
- (f) Preparation and publication of interpretative materials (history and guidebooks, reproductions, etc.) and recruitment and training of interpretative staff.

It is worth underlining the suggestion contained in item (e) above that wherever possible the physical integrity of a monument or site and its artifacts should be safeguarded. There is no doubt that this can greatly enhance the enjoyment and hence beneficial impact of cultural values, although admittedly more expensive and possibly less convenient for research than the removal of artifacts to a central repository. The management of cultural assets within the context of their physical environment does, of course, also call for additional vigilance to ensure that, as in the case of a seaside parking lot, ancillary or competing land-use

activities (i. e. a beach home or restaurant), are not allowed to detract from that environment and ipso facto from the cultural assets themselves.

Until a management program can be devised, however, the two essential guidelines applicable to the UNDP/PPP region are:

- (a) The inventory-mapping of historical and archaeological sites mentioned above under "(a)", so that cultural assets will not be razed or obliterated through a simple lack of prior knowledge, and
- (b) the subsequent development of a permit system, applicable to areas of historic and archaeological worth, that would provide for site inspection during the construction phase to ensure that artifacts were properly salvaged or assets preserved intact.

4. Conservation of Natural Areas

Conservation of natural areas is one of several ways of enhancing island resources. The elements of any systematic program for conserving, that is to say making sustainable use of, natural areas can be considered under the three headings of inventory, selection and management.

- (a) Inventory - Identification of the natural assets of an island may be accomplished as part of a general natural resources

inventory, or conducted as a single purpose program. The former approach is preferable as it enables subsequent allocation decisions to be made within the framework of competing resource demands (agriculture, fishing, mining, scientific research, recreation, education, etc.). The survey, which may well be partly presented in map form, should of course include islets, reefs, shoals, inshore waters and the marine periphery to at least the 10-fathom line. A complete natural area survey of the study islands is needed. Such a task was beyond the scope of this study given the short time allotted for each island. The scope of such an inventory should include geomorphic features, terrestrial and marine biota, details of the range, movement and abundance of species, and in addition, all natural assets of high aesthetic and recreational significance. Fortunately, the necessary groundwork for, and models of the kind of inventory required, have been completed in connection with the World Heritage Convention ⁽¹⁾ and the Check-Sheet Survey of the International Biological Program's Section on Conservation of Terrestrial Communities (IBP/CT) ⁽²⁾

⁽¹⁾ Aspects of the Convention are discussed in IUCN Bulletin, Vol. 4, No. 2, February, 1973.

⁽²⁾ G. F. Peterson. Guide to the Check Sheet for IBP Areas. IBP Handbook No. 4, Blackwell Scientific Publications, Oxford, 1970.

These are references to be consulted by planners, wishing to make broad-based and environmental inventories.

- (b) Selection - Once natural assets have been identified, catalogued and mapped, the way is open not only for soundly-based development planning and resource allocation, but also for the selection of areas which in the light of recognized criteria deserve special protection and management. The criteria will of course vary with the immediate objective, whether it be habitat preservation, wildlife protection, the provision of recreational areas for an island conurbation, or any other conservation purposes locally defined.

However, two points may be emphasized in this context: first, the criteria should not be limited to those that can be quantified in purely economic terms; and secondly, in the process of evaluation, local as well as international expertise should always be consulted. Both these provisos reflect the subjective element in selection, which is particularly associated with aesthetic values, but is also a factor in the estimation of cultural and ecological values. Inhabitants of the study islands may have their own preferences or scale values which need to be taken fully into consideration, even

though they may be modified, in making the final selection, by outsiders' advice on the degree to which particular island assets are unique, rare or endangered in global terms.

- (c) Management - The basis for effective conservation and management of natural areas, as Dasmann (1973) has persuasively argued, rests with the design of a flexible and relevant program addressed to the specific conservation tasks at hand. As already noted in discussing "Selection" criteria, the task or objective can vary enormously, at its simplest, perhaps, merely calling for the protection of a single endemic species. But it is important to appreciate that even that will undoubtedly require the protection of the nesting, breeding or growing place, which in turn can only be secured by the maintenance of the habitat, or entire biotic community of which the species is part, examples being the unique iguana (Cyclura pinguis) on Anegada, and the booby and frigate bird rookery on Little Cayman. Habitat destruction has been the direct cause of the extinction of a high proportion of Caribbean island species.

Attention to the point just mentioned is far more important in management guidelines than, for example, attempting to set lower limits on the size of conservation areas; witness the

survival of the globally unique lizard on tiny Maria Island, off St. Lucia, which owes its existence in part to man's lack of occupance and the fact that the mongoose has never been introduced there. In short, allocation of land for conservation should be determined by the specific project requirements and ignore preconceived ideas about minimum acceptable size. A national park is an exception to this rule as their purpose is so far beyond preservation of a single species (c.f. Barbuda discussion). Flexibility should also extend to the management of the resources of the ocean. Thus, ideally a marine park contiguous to the coastal zone should be backed up by a terrestrial sector, extending from the shoreline to the proximate watershed. As we have stated, erosion caused by a variety of coastal and upland activities can be just as destructive to marine biota as the direct effects of dredging itself. There are potential problems, however, in fixing the seaward boundaries of a marine conservation area. Carleton Ray (1972) has pointed out, that management should if possible be co-extensive with the entire ecosystem concerned. The difficulty, as he goes on to explain, is that marine ecosystems are often international in extent, and one has little control over the actions of one's neighbors. St. Barthélemy (France) would have

difficulty in protecting her east coast from oil spills in the event that an accident occurred at the marine oil trans-shipment facility that may be built on the Barbuda shelf.

It follows that success or failure to conserve marine areas may, in some cases, hinge on the degree of cooperation that can be mustered between islands of the Eastern Caribbean (See Annex C, marine park/reserve guidelines).

5. Oil Pollution

The ecological principles involved are implicit in the observed mortality of seabirds, marine mammals and other marine organisms, the aesthetic losses represented by beach, port and marina contamination, and, most importantly, in the inadequately understood repercussions on ecosystems as indicated by major alteration of habitats and various food chain disruptions. One reason what the study islands stand in special need of guidelines in this matter, apart from their obvious vulnerability to sea-borne pollution, is that they are seldom technologically well-equipped or in a strong position to meet or prevent the hazards accompanying the production, storage and shipment of oil. Also, the absence of an environmental constituency and legislated controls makes them attractive to multinational oil corporations which must comply with strict performance standards in North America.

The magnitude and extent of an oil pollution incident is determined by the massiveness of the spill, the toxicity of the distillate, the sensitivity of the biota, and the rate of oil removal either by human intervention or through natural means. Problems may be aggravated by the use of detergents (emulsifiers) in cleaning up oil slicks in coastal areas and these may prove ecologically more hazardous than the slick itself. The incidence of oil pollution is greatest at islands with shore-based oil installations, as we discovered on a small scale in McKinnon's Salt Pond, located by the W.I.O.C. Refinery in Antigua. Although deliberate spills from tanker cleaning are still globally more pervasive (c.f. Turks and Caicos Islands), despite the fact that the 'load-on-top' technique has shown them to be totally avoidable, they are invariably eclipsed locally by repeated mishaps occurring in the process of oil transfer, storage and refining. Shipwrecks do contribute their share of spilled oil, however. In the past few years, the Caribbean has seen large spills in the Bahamas and Puerto Rico. (Bahamas, 1968, 1,260,000 gals., General Colocotronis; Puerto Rico, 1968, 3,400,000 gals., Ocean Eagle, and again in 1973, 2 million gals. from the grounding of the Zoe Colocotronis).

The study islands conveniently located in relation to high demand markets are likely to experience an increased risk of pollution due to a transformation now underway in the oil industry. This stems from the gradual replacement of 70,000 ton or smaller tankers by VLCCs (Very

Large Crude Carriers) of 90-foot draught and 150 million gallon capacity. Offloading of these supertankers always has an element of risk in shallow continental shelf areas and therefore tends to be switched to ports or SPMs (Single Point Moorings) with direct access to deep water. Islands located near continental markets but on the edge of or beyond the shelf, have obvious advantages from this point of view: the incoming oil from major production areas, having been refined and stored, can readily be shuttled in smaller tankers when and where required. There has been in the Caribbean area, for example, increasing pressure to acquire insular sites for this purpose, aggravated by soaring demand for oil (only for the first time partially brought to its senses by the current energy crisis, and the emerging environmental resistance to coastal oil development projects in the United States. For three reasons there is great interest for locating an oil transshipment base on the Antigua-Barbuda platform and one is already being built in Bonaire. Other new or expanded facilities have thus been proposed or scheduled for the Caymans, Turks and Caicos, Mona Island and others.

The response to this situation and the consequential guidelines which may be appropriate could range anywhere from blanket rejection of exploration, storage or refining activities within an island group, to a proposal or recommendation that all such facilities should be concentrated in a particular island in the calculated belief that the economic benefits will

outweigh associated costs. In the latter case, the location of offshore SPMs (Single Point Moorings) storage terminals, refineries and dockside loading terminals should be very carefully selected to insure minimal disturbance of environmental values, and the necessary structures equally carefully designed. In order to formulate more specific guidelines, a wide range of experts such as meteorologists, oceanographers, marine and terrestrial biologists, industrial designers and of course oilmen themselves, will need to be consulted for specific projects. As a general principle, however, guidelines should:

- (a) Prohibit installations in areas of high natural biological productivity, such as estuaries, mangroves, coral reefs and oceanic upwells.
- (b) Provide for the strict operational regulations, inspections and enforcement, coupled with contingency planning, which can do much to reduce the risk of oil leaks or spills.

Elements to be included in such planning, which should be supported by a governmental policy statement and organizational directives, are:

- (a) Discovery and notification procedures of oil spills;
- (b) Methods for containing or enclosing a spill (by prompt placement of booms, etc.);
- (c) Cleanup and disposal of oil, or destruction through burning where salvage is impracticable;

- (d) Restoration of damaged sites or biota, whether above or below water; and
- (e) Enforcement.

In the last-mentioned connection, guidance should be given, where possible, as to methods of assigning liability and recovering costs of damage, control and cleanup operations. Even if it is impossible to include details of the legal means available, the relevant program should certainly put a high priority on the investigation of this aspect and, if necessary, on the enactment by island authorities of new or better legislation. For example, the latter could provide for:

- (a) The licensing of operators
- (b) Proof of financial responsibility and capability of reimbursing aggrieved parties in the event of a spill (such proof may be required to be supported by the posting of a bond, in the light of the poor accident record of vessels sailing under certain so-called flags of convenience (c.f. previously cited Puerto Rican shipwrecks) as compared with those operated by well-managed and more adequately capitalized multinational companies); and
- (c) Everything else necessary for the recognition and enforcement of strict liability.

Whether covered by legislation or otherwise guaranteed by international agreement, it is recommended that an insurance fund be established. This could be financed from oil revenues, on a national or ultimately a Caribbean-wide basis, and act as a revolving fund to underwrite the prevention, detection and cure of oil pollution, and the assessment and restoration of lost or diminished environmental assets.

6. Soil Disturbance

Guidelines on development activities involving large scale excavation and earth moving should be designed to guard against soil loss, erosion, sedimentation and silting, the ecological effects of which are the equivalent at the terrestrial level of those which occur as the result of dredging in the marine environment. The essence of any guideline must be to assess and prescribe land-use limits based on the geophysical character of the area - soil type, slope, rainfall, nature of vegetation. One method of helping to ensure that the limits recommended are observed would be provisions, such as those which have been applied in St. Thomas, U.S. Virgin Islands, for regulating earth moving by permits which specify conditions. These would focus on where the activity is carried out, how it is done, and the time period in which it must be completed. For further amplification on standards and specifications for soil erosion and sediment control practices and water conservation measures, the UNDP/PPP is

advised to consult the Environmental Protection Handbook of the Virgin Islands Soil and Water Conservation District.*

Among the specialized environments that stand to benefit most from guidelines relating to soil disturbance are coral reefs and wetlands. This is because they react badly to erosion and instability brought about by such activities as road construction, residential site development, and logging. In the case of logging, as in Dominica several years ago, wasteful forms of deforestation accompanied by road construction, is very liable to lead to wetland and reef destruction through erosion, silting and interference with the natural flow and quality of water. Appropriate guidelines would therefore be fully justified in insisting that re-establishment of the vegetative cover in such cases should be mandatory and should always be included in the direct costs of a project and budgeted for accordingly.

Mining of beach and marine sand deposits, usually for the purpose of mixing with cement, also merits special guidance, since such sand is often, for practical purposes, a non-renewable resource, the nourishment rate closely balanced by natural attrition. Mining sand from beaches and inshore banks usually should be prohibited because of the risk of

*Available from United States Department of Agriculture, Federal Experiment Station, Box 131, Kingshill, St. Croix, U.S. V.I. 00850. This Handbook gives specific details on erosion and sediment control practices related to land cleaning, protective shade trees, land grading, retaining walls, permanent vegetative cover for critical areas, diversions, sediment basins, slope protection structures, etc.

erosion, and destruction of protective functions and of amenity and biological values (e.g. as turtle-nesting ground). There are ample cases of beach erosion and attrition in St. Lucia, St. John, Antigua and elsewhere. The alternative of off-shore excavation, which is the approach under study in the B.V.I., is always worth investigation, since, if it can be achieved without serious ecological disruption, it will compensate for and help to secure the aforementioned problems.*

7. Dredging

As noted in the discussion of ecological impacts of certain activities in the Caymans, the British Virgin Islands and elsewhere, dredging operations are frequently associated with housing estates, harbor construction, marina development, and submarine mining of sand to be used in the construction industry. Because of their comparatively closed and fragile ecosystems, islands are likely to suffer from adverse consequences of these operations. The basic ecological principle involved is that unless planned and controlled with the greatest care, dredging, together with such aggravations as underwater blasting, can result not only in direct physical damage to coral reefs and other productive or protective marine communities, but also indirectly, through turbidity, silting and interference with water flow and natural sedimentation, and can extend the

*See Compton, Deane, et al. Eastern Caribbean Coastal Investigation, 1970 - 1973, 5 Vol. British Development Division in the Caribbean, 1973.

harmful effects over a far wider area. One immediate consequence may be to reduce the primary production of nutrients on which other economically desirable marine life depends.

Guidelines aimed at mitigating such impacts might be expected to begin with a general prescription on dredging, but while this may on occasion be warranted, it will usually be unrealistic and unenforceable. However, at the least, it can be recommended that all operations beyond the 15-fathom line and any within that limit which are more than of a very minor nature, should be preceded by an environmental impact statement, permit regulation and environmental monitoring. General points to be considered are:

- (a) Inventory of offshore sand resources, including a review of past insular supply and demand in order to assess alternative sites and to anticipate future needs.
- (b) Consideration of dredging methods and selection of the one likely to cause the least environmental disturbance (e.g. hydraulic suction may be preferable to the use of draglines, bucket ladders or cutterheads.)
- (c) Evaluation of excavation sites prior to dredging, which as Thompson (1973) has pointed out, should properly

include: investigation of substrate composition, distribution, stability and relationship to the overlying water column in terms of nutrient exchange, elements and minerals; data on currents and tide; benthic geomorphology; and a study of the composition and interrelationships with one another and with the total environment of the existing biotic communities.

- (d) Monitoring of the dredging activity prior to, during, and after the completion of operations. In the latter phase, this will be directed to such problems as the levelling of excavated areas (where the dredging is not concerned with the opening up of channels) and the rehabilitation of biota.
- (e) Where dredging involves the disposal of unwanted spoil, appropriate provision for placing and containing this in such a way as to minimize damage to ecological and aesthetic values.
- (f) The possibility of helping to finance monitoring, research and effective planning and control of coastal development by charging royalties not only on products or materials dredged out for consumptive purposes, but also at a flat

rate per unit volume on dumped spoil which cannot be shown to confer a positive and quantifiable benefit.

The foregoing points represent a general strategy towards offshore dredging. Annexes A and B describe a more detailed management approach and suggest minimum procedural standards, constraints, and monitoring requirements.

8. Wetland Drainage or Landfill

Insular wetlands, including their marine equivalents, have a crucial role to play in maintaining physical stability and productivity of the land/sea interface. They frequently accommodate the most biologically productive communities, and are represented by a wide variety of habitats: lagoons, depressions and salt ponds behind the seaward banks, mangroves and, less commonly, freshwater marsh and estuarine flats. Loss of these areas eliminates fish breeding and nursery areas, and decreases nutrients production and reef fish populations. An overall reduction of bird population results from elimination of or encroachment upon nesting and feeding areas.

The ecological principles involved call for guidelines whenever development activities threaten to interfere with the natural water regime flow rates, waterbody and water volume exchange, and water quality. These alterations can be expected to result in imbalance in the geomor-

phological features of the coastal zone and to have adverse secondary repercussions on shallow water communities.

Wetlands and tidal lands have traditionally had a high development priority owing to their suitability for certain types of use (e.g. estuaries, salt ponds and lagoons for harbours and yacht anchorages), low cost of land preparation, and their proximity to existing development which has usually been concentrated along the coast. An underlying feature contributing to development pressure is the prevailing belief, reflected in the market place, that marshes, mangroves and other wetlands are of low value. In the Caribbean, more than elsewhere, pressure is exacerbated by the omission of environmental accounting from the investment analysis of projects. Accordingly, private and public enterprise has long tended to utilize wetland areas, with little or no concern for possible adverse impacts on the environment. In effect, wetland "development" starting with its total drainage, has had an artificially low price attached to it. A ramification of this situation worth noting is that sites are chosen in response to cheap land rather than on an evaluation of physical and natural attributes and biological requirements of the site, an extreme case being the extensive disposal of solid waste in wetlands which we found in Antigua, Turks and Caicos, and St. Kitts. Nevertheless, the fact that so much of the coastal zone is taken up for these random "non-dependent" purposes has the result of increasing demand to use any areas that are still untouched - often mangroves or

other difficult ground - for activities which do depend on access to the coast: harbours, marinas, beach recreational facilities, and in future, such necessary activities as desalinization, etc. As scarcity drives the price of coastal land up sufficiently to exclude non-dependent uses, little land may remain undeveloped and, to make matters worse, land previously developed may have been so irreversibly changed as to make it unsuitable for redevelopment for more appropriate uses or for reversion to its original productive status.

It is for these reasons that a suitable guidelines would call for the reservation of wetlands of high productivity (mangroves and estuaries) at least on a temporary basis, until the relative merits and potential economic benefits of alternative uses have been fully explored and assessed, and until any large bays or inlets clearly suited to the development of fish or shellfish resources or other forms of mariculture or marine recreation have been reserved. A rider to such a guideline would recommend that where, as in areas of low productivity potential, it is finally decided that infilling could be of greater benefit, great care must be taken to choose materials and to design enclosing bulkheads in such a way as to exclude damage to neighboring biota through turbidity and sedimentation. The obliteration of biologically outstanding Krause Mangrove Lagoon, St. Croix, occurred because no such care was exercised.

Control of wetlands and tidal areas will require regulatory legis-

lation and a system of use permits to allow for pre-evaluation by decision-makers of anticipated development impacts. It has been the common experience in the Caribbean as in continental areas that the value of wetlands has only been realized after their disappearance (c.f. the reduction of coastal fishing in St. Croix due to the destruction of Krause Lagoon), and the loss incurred from a major reduction in the length of coastline has only been appreciated after the completion of the infilling and drainage of a bay or lagoon. An example of the latter case is the demise of fishing in Rodney Bay as a result of the Pigeon Island causeway. The points on which planners and decision-makers need guidance are how to ensure that any user, whose losses exceed his gains, can be adequately compensated and, more important, how to employ resource inventory, mapping, and other ecological evaluation techniques, before making development commitments, in such a way as to exclude or greatly reduce the risk of unpleasant surprises and unforeseen economic disbenefits.

In sum, a program of wetland management will include:

- (a) Mapping and inventorying the island's wetlands, lagoons, mangroves, salt ponds, swamps, lying below the mean high watermark.
- (b) Determining those wetlands of special worth warranting permanent preservation status.

- (c) Creating a wetlands policy that declares the importance of the selected wetlands to the nation's economic and social (recreational, aesthetic) wellbeing.
- (d) Securing their preservation against future despoilation through legislative protection and appropriate land use zoning tools.
- (e) Placing a temporary moratorium on all wetland development to allow time for
 - (i) an impact analysis to be carried out, and
 - (ii) if damaging, to allow for exploration of alternate development planning approaches more compatible with wetland preservation.

And, where it is deemed desirable to landfill a coastal area - having evaluated all other alternatives - the following guidelines are suggested:*

- (a) Landfills in the coastal zone should be located and designed so that there will be no significant damage to ecological values or natural resources, and so as not to alter local currents in

*Adopted from Guidelines for the Coastal Zone: Coastal Plains Center for Marine Development Services; North Carolina; July 1973; p. 10.

such a way that they will create a hazard to adjacent life, property, and natural resource systems.

- (b) All perimeters of fills should be provided with vegetation, retaining wall, or other mechanisms for erosion prevention.
- (c) Fill materials should be of such quality as not to cause water quality problems. Shoreline areas should not be considered for sanitary landfills or the disposal of solid waste.
- (d) Priority should be given to landfills for water-dependent uses and for public uses. In evaluating fill projects and in designating areas appropriate for fill, such factors as total water surface reduction, navigation, restriction, impediment to water flow and circulation, reduction of water quality, and destruction of habitat should be considered.

9. Marinas

Marinas can be large complexes comprising an assortment of land use activities: repair and maintenance shops, marine and hardware supply stores, launching facilities, fuel stations, car parking, restaurants, hotels, and sewage treatment facilities.

The principal impacts relate to deterioration in water quality due to pollution loading by sewage, oil, metallic toxins, and boat-activated turbidity. If allowed to go unchecked, these impacts can have adverse biological and aesthetic consequences which may directly depress the marina business itself. One example, experienced elsewhere, is the situation where noxious hydrogen sulfide is released from organic matter that builds up in an anaerobic layer on the bottom. (The by-product of anaerobic respiration is hydrogen sulfide). This happens if high bacterial activity, fueled by rich organic matter, lowers the dissolved oxygen level of the water.

Marina Guidelines relate to the selection of the site and to control of pollution.

(a) Site Selection

- (i) In planning for public marinas, sites that are near high-use or potentially high-use areas should be considered. Both island-wide and local requirements should be taken into account in selecting a location.
- (ii) Shallow-water embayments, semi-enclosed mangrove lagoons, and dredged salt ponds with poor flushing action should not be developed for mooring facilities upon the natural systems.

- (iii) Where adequate flushing exists in biologically valuable areas slated for marina development, the environmental and economic cost of destroying these areas should be taken into account in the project capital budget.
- (iv) Marinas should be designed to be aesthetically compatible with adjacent areas and suitable regulatory procedures should be devised and enforced.
- (v) Coastal areas characterized by a high natural rate of accretion of sand or silt should be avoided as marina sites, for the continuous dredging that will be necessary to maintain channel and basin depth can be environmentally damaging and expensive.

(b) Pollution Control:

- (i) Attention should be given to the design and development of operational procedures for fuel handling and storage to minimize accidental spillage and to provide cleanup capability if a spill occurs.
- (ii) To reduce toxic metal (esp. copper) contamination of the ecosystem arising from marine anti-fouling paints, provision should be made for containing wastes within

a shore area set aside for scrapping and cleaning of boat hulls.

(iii) Solid waste management requires a collecting and disposal system on shore.

(iv) Sewage pollution within the marina can be controlled by either (a) a no discharge standard applied to all boats; and/or (b) the requirement that boats be equipped with marine sanitation devices that as a minimum provide primary treatment and disinfection of the effluent. Solution "(a)" is preferable. Where people live aboard boats in areas of low flushing, it is essential that a no discharge standard be applied.

(v) Pumpout facilities for the vessels' holding tanks are needed ashore, in addition to adequate sewage treatment facilities.*

10. Waste Disposal

Experience in the Caribbean indicates that traditional laissez-faire methods of disposing of solid wastes tends to be outmoded; in the study

*Maintenance of water quality by use of marine sanitation devices fitted to each vessel is considered to be impractical because of high cost, unreliability of the units, and lack of maintenance know-how by boatmen.

islands the problem has increased dramatically as a function of population (tourist and resident), rising incomes, substitution of non-biodegradable synthetic goods and materials for organic, packaging technology and the trend towards urbanized living. Guidelines must therefore be mainly concerned with recommending ways of safeguarding environmental quality by a much less casual and disruptive approach to the management problems involved in waste disposal.

The essential elements in systematic management are:

- (a) Preliminary inventory of solid waste generation, including long-term projections of volume and point sources based on all the relevant factors (population, incomes, etc).
- (b) Investigation of public and private disposal practices.
- (c) Definition of criteria for disposal sites and their selection.
- (d) The creation of a comprehensive solid waste disposal plan.

Compatibility with environmental values is a function of disposal methods and site location. In particular, the coastal wetlands of islands, which as previously stressed are often the areas of maximum biological productivity and by no means 'wastelands', are not at all suitable as dumping sites.

An effort must be made to find solutions appropriate to the island's circumstance. One of these is the identification of alternative sites where emplacement of consolidated wastes may be beneficial, such as badly eroded areas and worked out quarries. Once located, they must be guaranteed against reallocation for other purposes until the landfill is completed.

Another possibility arises from the fact that the study islands are beginning to feel the impact of litter accumulation and abandonment of derelict vehicles which cannot economically be recycled as scrap material. Methods of meeting the problem which are worth considering include anti-litter legislation and proscription of disposable beverage containers; incorporation by statute, or agreement with the companies concerned, of a disposal fee in the purchase price of a motor vehicle, refundable at least in part when the vehicle is surrendered at the end of its operating life; and the use of such derelicts under careful control for the construction of breakwaters and artificial reefs at suitable sites. In the later context, the UNDP/PPP may find the recent Artificial Reefs Conference of interest, the proceedings of which will be published in the near future.*

Caribbean islands have the option of using both land and sea as the final repository for waste. But until environmentally safe methods of

*Artificial Reefs Conference, March 20-22, 1974, Houston, Texas, to be available from Artificial Reef Task Group, National Marine Fisheries Service, Beaufort, North Carolina, U.S.A.

oceanic disposal are devised, the selective use of terrestrial sites, that is, with strict avoidance of the areas of high biological productivity or aesthetic value, as advocated above, is certainly to be preferred. If ocean disposal is required, the area should be diked or enclosed by sheet piling and backfilled, rather than dumping directly into the sea.

Turning to sewage or liquid waste discharge, the ecological principles that have been recognized, focus mainly on interference with water quality through contamination, eutrophication and oxygen depletion. It follows that guidelines should primarily require that sewage be treated. Prohibition of the discharge of raw or partially treated effluent into sublittoral zones is usually essential if coastal environmental quality is to be maintained. Housing, hotels and urban areas must therefore be designed with appropriate facilities for treatment. Most of the study islands offer examples of recreational beaches located in proximity to outfalls.

Septic tank location should be related to soil conditions to prevent overflow and contamination of groundwater. A solution sometimes advocated is to install an ocean outfall that will transport sewage effluent and the waste water from desalinization, power and industrial plants, to areas far offshore where favorable current patterns are calculated to be capable of dispersing any haline, thermal or toxic pollutants. Where this has been done in the study islands, there is a conspicuous lack of public monitoring or information on the impacts of these outfalls (e.g.

the outfall from the W. I. O. C. refinery in Antigua is just one of many examples). The efficacy of this approach and the extent to which it may be accepted as a guideline must, however, depend entirely on the initial treatment. Primary treatment is only a stop-gap measure; secondary treatment is preferred. There can be no substitute for the removal of potentially harmful substances or toxic materials prior to ocean dumping. Even when this is assured, the utmost care needs to be taken with the preliminary oceanographic and ecological investigations in order to confirm that calculations as to the dispersal and impact of the effluent are well founded.

11. Conservation of Lobster

Several general guidelines which should be supplemented by detailed local data or scientific expertise follow:

- (a) Maintain records of catches and fishing effort through extension of pre-existing institutions. Customs records should distinguish exported fishery product by type of animal (lobster, fish, turtle), product type (frozen tails, or whole live lobsters) and net poundage. Procedures for licensing boats can be used to gather sample data on fishery methods, catch per unit effort, and geographical distribution of the fishery. Long term information of this sort is essential for identifying seasonal

and long-term changes in the resource.

- (b) Generally the capture of very small lobsters wastes the economic and biological potential of the resource. Minimum size limits are one route to reducing this catch, but involve fairly complex regulatory procedures. Often in the Caribbean, small lobsters are most abundant in quiet mangrove-fringed lagoonal areas, and prohibiting the fishery in these limited habitats may be a more feasible approach.
- (c) Because lagoons are important settlement habitats for post-larval lobsters, and serve as nurseries for many other commercially important species, any coastal development (including effluent discharge) plan which affects these biologically productive areas should carefully weigh short-term economic yields against less evident long-term losses from damage to fisheries.
- (d) Spiny lobsters (predominantly Panulirus argus) are one of the commercially important inshore fishery resources of Caribbean islands because of their high value per pound on the local or export market. Increases in lobster catches in the islands have generally come in response to access to new markets without radical changes in traditional low-capital fishery methods.

As the investment and economic dependence on this fishery in various islands grow, there is increasing concern about the stability and survival of the resource. Generally there is no management policy, and more critically no catch statistics, but fishermen almost universally report declining catches with increasing fishing effort.

- (e) The biology of spiny lobsters provides the basis for some practical guidelines, but local variables are so important (areas of various submarine habitat types, fishery methods, size and structure of lobster population, patterns of seasonal migration, market trends and the extent and character of a coastal development) that on-site studies are essential for establishment of any rational local management policy. Peacock (1974)⁽¹⁾ and Allsopp (1968)⁽²⁾ serve as examples of practical studies designed to reshape a fishery for long-term economic health. Studies conducted in the Virgin Islands⁽³⁾ have yielded basic data on the lobster ecology from which more site-specific work can proceed.

(1) Peacock, N. 1974. A study of the spiny lobster fishery of Antigua and Barbuda. Proc. Gulf and Carib. Fish. Inst. 26:117-130.

(2) Allsopp, W. H. L. 1968. Investigations into the marine fishery management, research, and development policy for spiny lobster fisheries. Report to the government of British Honduras. Rept. FAO, TA2481, 86 p.

(3) Herrnkind, W. and D. Olsen. 1971. Ecological study for the development of lobster management techniques. Caribbean Research Inst., St. Thomas, U. S. V. I. 51 p.

12. Conclusion

The very selective treatment of activity categories imposed by the confines of this study may leave the impression that maintenance of environmental quality can be achieved by piecemeal treatment of each problem area. In fact, such an approach may buy time but is unlikely to confer a full spectrum of lasting benefits. If the environmental values of the islands are to be effectively maintained, planners must:

- (a) Deal with land-use activities comprehensively;
 - (b) Make the environment an integral part of overall development planning; and,
 - (c) Portray the natural environment in a more effective manner by adding ecosystem mapping to the customary single purpose resource maps used as planning inputs. Floral and faunal habitats, marine and terrestrial are imperfectly represented by overlaying individual maps depicting soils, geology, forest, etc., because the nature of an ecosystem lies in its integrated whole. The pioneering environmental maps of the Texas and Florida coastal zone management groups provide a superb example of the type of mapping that realistically represents the natural environment.
-
-

ISLAND RESOURCES FOUNDATION
U.N.D.P. ENVIRONMENTAL
SURVEY
Contract T33/73

ANNEX A - INFORMATION NEEDS OF GOVERNMENT WHEN JUDGING PERMIT APPLICATIONS FOR PROJECTS THAT WOULD ALTER OR MODIFY SHORELINES OR SUBMERGED LANDS.

A. The following information is required with the application. For minor projects, the Government could waive one or more of these:

1. A written report of an investigation of the site and adjacent properties. The investigations will be conducted by competent professional personnel who will investigate and report on the prevailing environmental conditions, ecology, hydrogeology, and water mass transports. The report will predict probable effects of the work.
2. A complete and exact written description of the proposed site, including charts, maps, photographs, topographic charts, submerged land contours, and sub-surface profiles as required by the scope and complexity of the work at the site.
3. A complete and exact written description of the proposed work for which the permit is sought, defining the modifications, alterations, or construction and their methods. This description must include details of supervisory and control procedures and the credentials of the personnel responsible of this function.
4. A written description of the mechanism to be employed for preparation, and the submission of a final completion report to be furnished by the applicant within six months after termination of the work. The report will detail actual work accomplished, describe final site geometry and the movement of materials, as well as the environmental conditions of the site and adjacent properties after the work is terminated.

B. These guidelines are presented to the applicant as an aid in the preparation of the permit application:

1. The Government will approve the granting of a permit only in those cases clearly serving the public good.

ANNEX A - cont.

2. The applicant must clearly demonstrate that the construction, modifications, or alterations will result in the enhancement of the existing environment.
3. The applicant must demonstrate that the work proposed will be adequately supervised and controlled in order to reasonably effect B.2. above and control pollution or damages to adjacent areas.
4. The Government will evaluate the reports and data presented and will approve only those applications which are complete in detail and are prepared by professionals whose competence is acceptable to the Government. Evidence must be presented to adequately support conclusions presented. Selection of qualified experts with particular knowledge of the marine biology, geology, and hydro-geology of the islands' coastline is recommended.
5. As a general rule, only land disposal of spoil from dredging operations will be permitted and must be accomplished with adequate provision for the settling of suspended material and return to the sea of clear effluent.
6. The applicant is fully liable for all costs of the application and data preparation and environmental evaluation of the site, as well as all damages resulting from the work.
7. The applicant will continue to monitor and measure the work and will suspend operations if there is deviation from the permit terms or if there is environmental damage or water quality degradation unacceptable to the Government.
8. The permit awarded is allowed in the public interest and is not a property right, and may be terminated by the Government after hearings in the public interest at any time.
9. Special fees may be levied on the applicant for the evaluation of the application in the case where data and reports are inadequate or additional studies are required in the opinion of the Government.

ANNEX B. SOME EFFECTS OF DREDGING ON WATER QUALITY AND CORAL REEF ECOLOGY

Nature has a finite ability to tolerate changes and to maintain desirable conditions. This ability can be overtaxed and when individual organisms or whole systems are stressed beyond their tolerance limits disaster results. From this we can gain perhaps a better understanding of the word pollutant. A pollutant may be defined as any material which causes a change in the environment which is either too great to be tolerated by the system or by some individual species or which results in modifications which are undesirable. Sediment caused by dredging in the sea can be a pollutant. The purpose of this paper is to discuss some of the effects of this type of pollution resulting from uncontrolled dredging of sand from near or off-shore waters.

Coral Reefs

Living coral reefs, because of their particular sensitivities, their intimate relationships with sand production, and their general importance to Caribbean economy deserve our concerned interest. Reefs are not only scenic, but are structurally and economically important. West Indian fishing is centered largely around reef complexes.

The reef and its associated flora and fauna provide food and shelter for the young and adults of most of the regional seafood species. Sea sand, produced primarily by reef-building organisms, is in demand for making concrete, especially on smaller islands which lack terrigenous sand deposits. With increasing development in the Caribbean the demand for sand increases, but we have no reason to believe that its production in the sea is increasing. Many reefs, by their location, afford considerable protection to leeward coastal features by abating oncoming oceanic waves.

Sea sand is largely CaCO_3 , although there are regional variations in its content of weathered silicate rock and volcanic ash in nearshore deposits. This CaCO_3 is precipitated from sea water by various marine organisms as part of their natural processes to make skeletal material. When such organisms are broken, eroded, or die, the skeletal parts break down to form sand grains.

Corals, of course, are the greatest source of this material, especially in the tropics where large reef-forming stony corals abound. Calcareous algae also contribute greatly to sand deposits and in some areas extremely large volumes of coarse algal fragments have accumulated over the years.

Sand production depends on a very closely knit complex. The major contributors, corals, also provide the habitat for many of the minor contributors, including those which carry on the erosive processes. These are animals which bore into the coral to make their homes and those which eat it or other calcareous organisms. It has been estimated that fishes alone, by browsing on calcareous organisms are excreting the undigestible sand particles, contribute approximately 2.5 tons/acre/yr. of sand.

Sand therefore, is a renewable natural resource. Further, we cannot disregard the fact that it is economically valuable and can be harvested to good advantage. The problems associated with mining of sea-sand are, in a way, similar to those of logging trees, catching fish, or trawling shrimp. The rate of harvesting must not exceed the rate of production and the source of production must not be destroyed.

In the Caribbean we have had many instances of marine resources destruction caused by such operations, but only recently have begun to investigate these effects and make an effort to describe the results, mostly qualitatively, but increasingly in quantitative terms. Dredging has often been uncontrolled and not always in the best public interest. In some areas there are several miles of dead reefs and bays with impoverished fauna and flora as a result of ill-planned and ill-managed dredging operations. In these areas water quality and benthic communities have not recovered quickly because of local conditions which we do not understand. Many areas destroyed by chronic turbidity and siltation show no signs of improvement, some even after many years.

EFFECTS OF DREDGING

Turbidity

Possibly the most damaging effect of dredging in most cases is clouding of the water by very fine suspended particles disturbed by the dredging operation. Most of this suspended material will usually be CaCO_3 sand fines, but depending on local sedimentological history, beds of other materials, (e.g. terrigenous clay deposits) if present, will also be disturbed by the dredge. In all operations which we have observed, enough of these fine materials remain in suspension to noticeably reduce submarine visibility for up to 2 years after the finish of dredging.

The primary effect of chronic turbidity is to cut down the amount of light which reaches plants on the bottom. Plants are the primary producers of food. In addition to food, they provide refuge for many species of

animals. Without some minimum amount of light (the amount varies with the kind of plant), plants die and then the whole associated community is destroyed because of the loss of food and refuge. Of particular importance in these waters, however, is the effect of light loss on corals and other related reef organisms. Corals are animals, but the survival of reef building forms particularly, depends on the survival of symbiotic unicellular algae (zooxanthellae) which live within the coral tissues. There is a poorly understood nutrient relationship between the plant and animal, but it is known that when these corals lose their zooxanthellae they become unhealthy and die.

Turbidity due to fine sand sediment is usually not repulsive to the average swimmer, water skier and the like. These people are more tolerant of the chalky color than they are of the brown which results from mud caused by erosion and run-off. However, this turbid, chalky water is completely unattractive to snorkelers and SCUBA divers because one cannot see much and frequently there is nothing left to see.

The persistence of such turbidity depends on the interaction of several factors, the net result of which is surely different in each case. The settling time is primarily dependent on the size and shape of the particles and on the movement of the water which may either be slow enough to promote settling or strong enough to keep the particles in suspension and frequently continue suspending additional material from exposed beds of fines. Currents often transport plumes of such fines for great distances where they can seriously damage marine life far removed from the actual dredge site.

Siltation

Siltation is closely related to turbidity, being caused by solid particles. A great deal of siltation occurs during most dredging operations as heavier particles fall back to the bottom. Finer particles settle more slowly and siltation therefore can continue for some time after dredging and may occur at far removed sites. Its effects can be catastrophic for sessile organisms. If the rate of fallout is too great many sedentary organisms, particularly corals, are literally smothered because of their inability to cleanse themselves.

Beyond this, the coating of the substrate by silt size particles is disadvantageous to the settling of most invertebrate larvae and so recolonization is obstructed. Such surfaces are favored by some species of algae which give the advantage of stabilizing the bottom, but also effectively exclude the establishment of reef-builders. In fact, such alteration of the environment has been known to banish corals forever from an area

where they were formerly well developed.

Change in Sediment Dynamics

Until very recently, dredging elicited alarm only when it resulted in undesirable and unexpected mass transport of sand from beaches. The most often encountered case is that of a beach adjacent to a dredge hole being denuded because its sand cover has slipped out to sea and into the hole created by the dredge. Geologists have long recognized that beaches are dynamic systems constantly undergoing changes in profile especially marked on a seasonal basis. If for any reason the nearby submarine topography is changed, currents and wave action will reshuffle the surrounding bottom to reach a new dynamic equilibrium. The result could be the redistribution of sand within an entire bay.

Release of Toxins from the Sediments

Very significant harm can be done by disrupting chemically unstable deposits. This problem is usually encountered during dredging in quiet lagoons, salt ponds, swamps, or the placid headwaters of some bays. In many such places, because strong water movement does not aerate the sediment to promote rapid decomposition of detritus, the bottom sediments are largely dark, organic-rich deposits, which have a characteristic foul, sulfide odor when disturbed. Undisturbed as they usually are, however, these sediments pose no great problems and, in fact, such habitats have a rich infauna which feeds basically on the detritus. Being only partially decomposed, however, these sediments are strongly reducing, that is, they require and will remove from the water when they are dispersed, a great deal of oxygen. Suspension of such sediments, therefore, in addition to problems of turbidity and siltation, will produce dirtier water, noxious odors and significantly decrease the dissolved oxygen in the water and the results can be severe for fish and other very active animals.

Effects on Associated Fauna

Although the destructive effects of ill-managed dredging operations can be observed directly only by underwater inspection, fishermen can frequently infer such changes from lowered catches of certain formerly abundant species. While the unfavorable effects of dredging do not usually cause direct harm to motile organisms, those which are closely associated with the reef will either migrate as their food and shelter are reduced or they will starve. Demersal fish and lobster are included here.

Deep Offshore Dredging

The chances are greater offshore of encountering large expanses of sand or gravel which is largely barren of attached macroorganisms, but benthic communities, including coral reefs, do exist on island shelf areas in the depth range for the offshore dredging project (20 - 30 meters, or 66 - 99 feet). We must recognize that organisms (parts of a benthic community) on such a dredge site will undoubtedly be destroyed.

Coral Reefs, the Platform, and Sand

In the West Indies, the zone of vigorous growth of reef corals extends down to about 25 meters. Many corals extend no deeper than about 30 meters, although reef communities (in which reef corals are present but not dominant) extend to 70 meters or more in the Caribbean. The factor which limits coral growth at depth is light. In deeper waters, coral maximize their light uptake by building horizontal thin, flat colonies instead of more rounded massive types. Near the lower limit of their depth range many species (if not most) are constructed in horizontal colonies spread over large areas. Although these colonies are mechanically more vulnerable to breakage and probably more vulnerable to sedimentation (which collects more readily on a flat surface), these are apparently not significant constraints in their natural, undisturbed environment. However, these colonies may be significantly more sensitive than their shallow water counterparts to the major results of dredging, sedimentation and turbidity.

Since the lower depth limits for many species of stony corals is within the proposed dredging depth range, it is reasonable to consider the possibility that a unit decrease in light intensity or increase in sedimentation resulting from dredging may have more marked effects on deep water reefs than on shallower ones. Other reef organisms which carry symbiotic algae in their tissues may be similarly affected by light intensity decreases. It is also possible that attached deeper water organisms in general which exist in a relatively low energy, low-sediment-load environment will be less able to rid themselves of sediment resulting from dredging.

Although it is common now to think of inshore sand as a renewable resource derived principally from the coral reef community, this concept may have to be modified for the open shelf of the Virgin Islands. Garrison (1971) found that surface sand from the shelf south of St. Thomas and

St. John away from terrestrial influences was composed of mollusc shell fragments, forams, and other carbonate fragments presumed to be derived from the breakdown of the algal carbonate nodules. Thus, at least the surface sand offshore is being produced by organisms in situ (at some currently unknown rate) and is not transported by water from a more distant shallow reef. It remains to be seen whether the same is true for the sands on other open shelf areas like Anegada, Barbuda, and Turks and Caicos Islands. Also, the rate of carbonate secretion, and ultimately sand production, of the open shelf community may be less rapid than that of the coral reef.

Living reefs are often only a thin veneer of regrowth on more massive reef structures built many thousands of years ago when the sea stood at a different level. It is likely that some of the large valuable deposits of sand which probably exist on shelf zones today were produced at earlier times of more active reef growth and (1) may be largely concealed so that they will be revealed only by sub-bottom profiling and coring and (2) are non-renewable in the sense that current reef growth is less than in former times so that sand production is reduced and is occurring in different localities.

Comments on Dredging Procedures

Regarding the type of dredging, it is often assumed that suction dredging is the least likely to cause any significant direct or indirect biological effect and hopper dredging minimizes the extent of spoil-water contact, therefore the intensity of short-term effects may be high, but the duration relatively small (Boyd et al., 1972). While it is true that the mechanical damage resulting from cutterhead dredging is greater than that from suction dredging, it seems likely that these statements are more applicable to continental shores where increases in turbidity do not seriously endanger benthic communities.

Whether using a cutterhead or the suction method, any dredging operation piping into a series of large settling ponds (low energy level, long residence or settling time) is going to have less suspended sediment in the final overflow to the sea than a dredge pumping into a series of small hoppers or barges (high energy level, brief residence time). This is probably commercially advantageous in that for land fill operations any grain size will do (more or less), but for construction sand a smaller proportion of the very fine sediment is desirable. Thus, if the sediment being excavated into hoppers offshore contains a significant amount of fines, a very turbid effluent will be produced with its potential unfortunate

biological consequences. It may be that currents over the shelf are sufficiently rapid so that turbidity will not persist long in one area, but we really know nothing of the effects of various time versus intensity of turbidity combinations on various marine organisms, and it would be best to err on the conservative side and set relatively stringent effluent requirements or, more practically, define the grain size distribution of sands which could be extracted (in effect, prelimiting the effluent since the dredger's engineers should have a clear idea of what grain sizes do and do not remain in the hoppers at various pumping rates).

RECOMMENDATIONS

The relationships of progress (in terms of shoreline development) to conservation are assessments which must be made locally. However, the importance of conservative management of marine resources to insular economics, especially when tourism is a large component, should not be underestimated.

Since a continuous sand supply is required for concrete production, land fill and beach reconstruction, which needs cannot be adequately met by maintenance and improvement of port facilities, we proposed, and have begun, a program of prospecting for mineable sand deposits offshore and in areas where ecological damage would be minimal.

In addition, there are several precautions which can be taken before and during any dredge operation. Such precautions can uncover problems likely to occur and minimize undesirable effects during operation.

Each person who desires permission to dredge (and dredging should not be allowed at a developer's whim) should ideally be required to submit to appropriate local authority sufficient justification for the operation, indicating how it would be in the public welfare. Specific boundaries of the proposed dredge area must be given and an evaluation made by competent professionals of the nature of the site, its suitability for such an operation and the probable effects of the dredging on the local and surrounding environments. A fee for each cubic yard of sand taken should be paid to the local government, and it is therefore desirable to have some sort of topographic survey of the dredge or spoil areas, or both, in order to determine the volume of material removed.

During the period of work, it is necessary to have some monitoring and control of conditions and methods to ensure compliance with requirements.

Several precautions can be taken in the actual operation. These include:

1. Proper diking to prevent runoff of suspended fines and to allow settling.
2. Controlling leaks in piping to prevent spilling of fines.
3. Dumping all spoils on land or barges.
4. Limiting the steepness and depth of the cut to avoid slumping of nearby sand into the hole.
5. Avoiding, where possible, direct reef removal.
6. Consideration of tides and currents where these may extend damage to nearby reef areas.

SUMMARY

Reef communities, especially their dominant and characteristic components, the corals, are extremely sensitive to prolonged turbidity and siltation. As individuals interested in the continued existence of both healthy, attractive environment, and continued economic growth (the latter being undeniably dependent to a great and increasing degree on the former) we must apply to environmental manipulations, conservative policies and procedures which are based on available knowledge and which are designed to minimize undesirable ecological damages and so achieve the most good for all considerations. We must also strive to increase our knowledge of environmental processes so that as stresses and demands on the environment increase, as they surely will, we can more effectively avoid disasters.

NOTE: This Annex is adapted and enlarged from Caribbean Conservation Association Environmental Newsletter, Vol. I, No. 2, October, 1970.

ISLAND RESOURCES FOUNDATION
U.N.D.P. ENVIRONMENTAL
SURVEY
Contract 133/73

ANNEX C - PROPOSED GUIDELINES FOR ESTABLISHMENT OF MARINE
NATIONAL PARKS.

Considering that Island governments should give attention initially to three major aspects of conservation of marine environments:

1. To promote the establishment of a system for protection of important marine ecosystems.
2. To prepare an inventory of sites with potential for establishment as marine protected areas.
3. To prepare a list of areas particularly adaptable to marine recreation and warranting protection against intrusive uses and pollution.

In developing the inventory, the following principles apply:

1. Scientific Basis for Protection
Establishment of marine national parks should be based on sound ecological studies and interdisciplinary evaluation of potential values of the area.
2. Location
The park is to be of easy access to the public unless it is viewed as strictly a nature preserve.
3. Size
This is not of major importance as in the terrestrial parks, but for practical reasons, it is suggested that a marine park covers several hundred hectares.
4. Seaward Limits
Such limits are not usually of major importance but 15 fathoms may be the limit for significant interest. This measure would, however, depend on local circumstances.
5. Water Quality
Pollution should be avoided and the status of the water quality should be monitored, both within the park and in a buffer zone outside the park (water quality management area).

6. Legal Protection

The protected area should fall under the jurisdiction of the highest competent authority. Total protection is desirable, although some short-term tolerance of traditional fishing might be permitted.

7. Use

Marine national parks should be established for multi-purpose use including nature, scenic beauty, and tourism. Restricted navigation may be tolerable within the area. Careful consideration should, however, be given to the impact of anchoring, especially on coral reefs.

Such activities as mining, oil exploration and exploitation, nuclear power plants, commercial fishing, and such disturbing activities as spear fishing as well as the collection of species for commercial purposes should be avoided. In the short term, limited traditional fishing within the park should take place.

8. Zoning

If the marine national park is big enough, zones could be established within the area to allow for different kinds of use.

9. Management

The management should be under the national parks authority, with properly trained staff and adequate budget.

ISLAND RESOURCES FOUNDATION
U. N. D. P. ENVIRONMENTAL
SURVEY
Contract 133/73

ANNEX D - List of participants

Professional:

1. Edward Towle, Ph. D. - environmental planner
2. John McEachern, M. S. - resource planner/geographer
3. Robert Johannes, Ph. D. - bio-chemist/pollution specialist
4. Mary Lou Pressick, Ph. D. - marine biologist
5. Richard Dewey, M. S. - biologist/naturalist
6. Mahamed Hanif - wildlife specialist
7. Jonathan Blum - resource economist
8. William Rainey - zoologist/ecologist
9. Judith Fechner - historian

Supporting Technical and Clerical Staff:

1. Charlotte Blum - photograph technician
2. Karin Fiederer - secretary
3. Kathy Kappelman - administrative assistant
4. Christopher Howell - geographer/cartographer