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Parham Harbour Facilitation Project
Antigua and Barbuda
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Management Plan for the Bird Island Marine Reserve

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Acronyms

BIMR	Bird Island Marine Reserve
CANARI	Caribbean Natural Resources Institute
CARICOMP	Caribbean Coastal and Marine Productivity
CBH	Central Board of Health, Antigua and Barbuda
CEHI	Caribbean Environmental Health Institute
CFRAMP	Caribbean Fisheries Resources Assessment and Management Programme
CIDA	Canadian International Development Agency
COSALC	Coast and Beach Stability in the Lesser Antilles
CPACC	Caribbean: Planning for Adaptation to Climate Change
DCA	Development Control Authority, Antigua and Barbuda
EAG	Environmental Awareness Group, Antigua and Barbuda
EPA	Environment Protection Agency, United States
FD	Fisheries Division, Antigua and Barbuda
GBI	Great Bird Island
GEF	Global Environment Facility
GIS	Geographic Information System
GSC	Georgia Sea Turtle Cooperative
ICM	Integrated Coastal Management
JWPT	Jersey Wildlife Preservation Trust
NECMA	Northeast Coast Management Area
NOAA	National Oceanographic and Atmospheric Administration, of the US Department of Commerce
OAS	Organization of American States
OECS-NRMU	Organisation of Eastern Caribbean States-Natural Resources Management Unit
PPMU	Parham Project Management Unit
TNC	The Nature Conservancy
UNEP	United Nations Environment Programme
USNPS	United States National Park Service
VINP	Virgin Islands National Park
WIDECAST	Wider Caribbean Sea Turtle Recovery Network

Bird Island Marine Reserve MANAGEMENT PLAN

Introduction

In April 1996, the Organization of American States contracted Island Resources Foundation to provide assistance on sustainable management practices for the fragile natural resources of Antigua's North Sound within the context of the Parham Harbour Development Project. The area supports artisanal fisheries, ecotourism-centered guided tours to Great Bird Island, and is the historic gateway to the northeast quarter of Antigua.

The assignment was driven by two principal concerns:

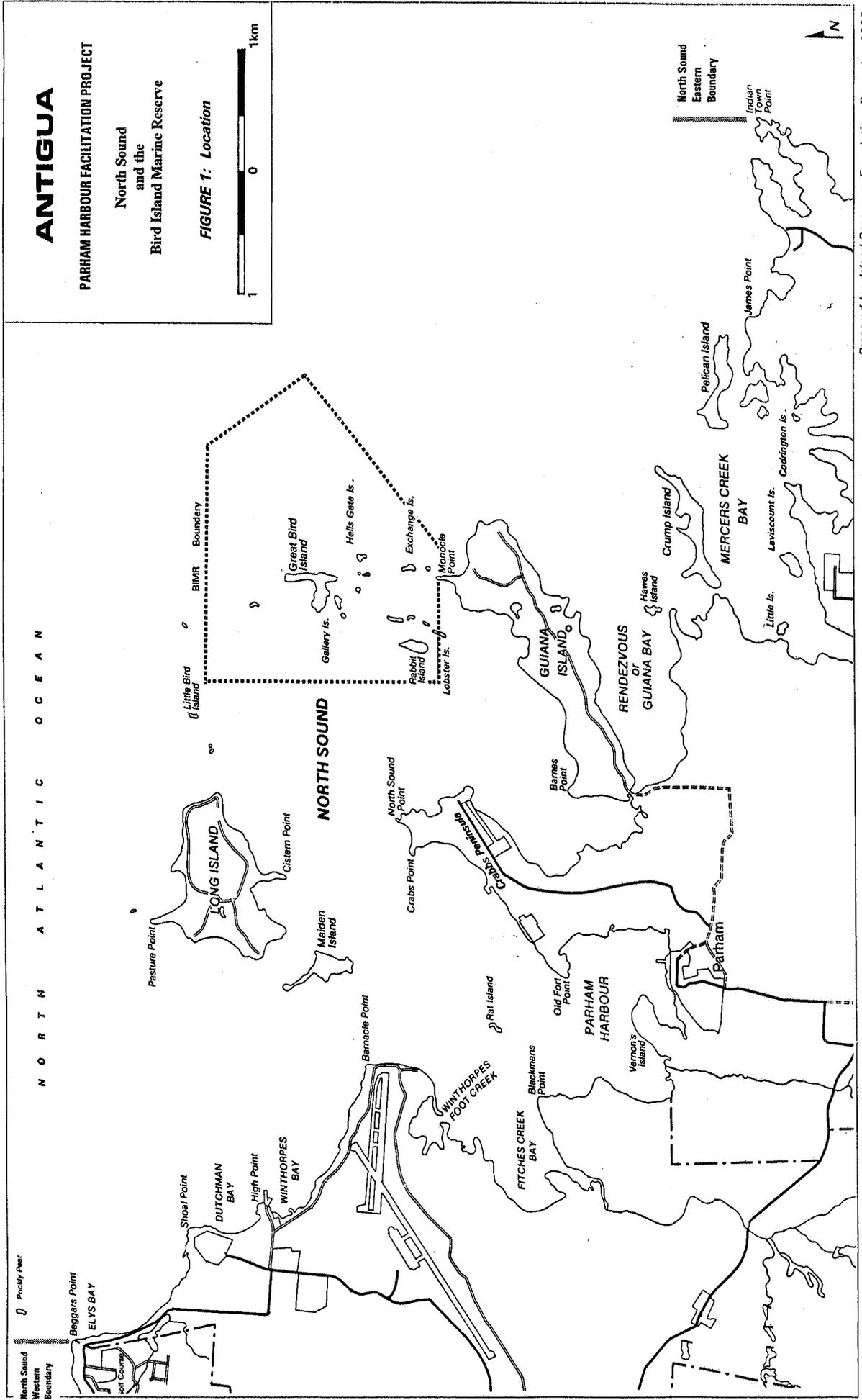
- the North Sound has the potential for contributing more to the income and future growth of Parham and its environs; and
- existing natural resources are showing signs of deterioration, in part because of stresses from increasing human use.

Island Resources began by characterizing terrestrial and marine resources of the region, and collecting information on how these were being used by major stakeholders, including fishermen, tour operators, and recreational users.

This report proposes a strategy for the management of the natural resources of the North Sound area. That strategy addresses the social and economic needs and concerns of the stakeholders while preserving the environmental values for the area. It represents one step in a cooperative process that began in 1991 between the Organization of American States and the Government of Antigua-Barbuda. The report extends the dialogue between those who use the area and those responsible for its management and protection that was summarized in the Parham Harbour Master Development Plan published in 1995.

This management plan for the Bird Island Marine Reserve specifically builds on the public-private cooperation highlighted in the Master Development Plan, with the Parham Harbour Development Company assuming the interim lead for the administration of the Reserve, with the guidance and oversight of the Bird Island Marine Reserve Advisory Committee.

Figure 1: North Sound and Bird Island Marine Reserve: Location



Background:

Parham Harbour Development Project

In 1991, the Organization of American States (OAS), at the request of the Government of Antigua-Barbuda, began a project to promote tourism development at Parham Harbour. The organizing theme for the project was to explore how best to develop the area to take advantage of the unique environmental, historic and socioeconomic setting of Parham Town and surrounding area.

The extensive background studies undertaken for the project were drawn together to form a Master Development Plan (*Development of Tourism Infrastructure at Parham Harbour, Antigua*; OAS, 1995) that continues to guide this effort (see Appendix I for background documentation on the technical studies prepared prior to publication of the Master Plan). The main goal as stated in the Master Development Plan is to provide the entire northeast coastal area with an identity and framework for an economically viable, marine-based attraction for tourist-based investment and development. The Master Plan "requires innovations in the integrated strategy to allow for an expanded role of the private sector in a long-term, government-regulated development effort."

The Master Plan's vision for the area is summarized:

As Antigua's first port, Parham Harbour will provide an historic entry to Antigua for arriving yachts and sail cruise ships, an excursion destination for boat tours, a stop-over for touring yachts, and an historic waterfront attraction for visitors who come to Parham by road. As a boating, diving, and nature area, the North Sound will serve as a key location and welcomed addition to Antigua's water-based attractions situated around the island. ... [and] unlike Antigua's current array of tourist attractions, Parham Harbour will allow visitors to experience first-hand the people, culture, and day-to-day life in a small, Caribbean fishing town. Community members will play an integral role in planning and development activities, and be encouraged to participate as small business operators ... Planned with care, [it] can become a Caribbean model for healthy coexistence of tourism with its host community. The Master Development Plan proposes that the main development be phased over a five to ten year period, which is similar to the development time frame of English Harbour, now established on Antigua's southern coast.

Managing the North Sound

The "North Sound" is a general label for the northeast coastline of the Antigua mainland plus the adjoining sea and islands. [North Sound is used interchangeably with *Northeast Coast Management Area* (NECMA) in this document. In addition, the Bird Island Marine Reserve in this report comprises the same area and general purposes as the Bird Island Marine Reserve and Wildlife Sanctuary (BIMRWS) referred to in the Master Development Plan and other documentation.] The North Sound comprises approximately 30 square miles of coastal and marine environment stretching from Beggar's Point to Indian Town Point and from the mean high tide mark along the coast to 3 nautical miles out to sea. This stretch contains one-quarter of Antigua's coastline, and a marine area that includes a substantial portion of the country's territory and resources (see Figure 1).

The *Bird Island Marine Reserve* is a critical core area of approximately 2.34 square miles (1,500 acres) within the North Sound. The Reserve centers on Great Bird Island, and includes six satellite islands and the surrounding sea, including coral reefs and other key marine and coastal habitats. Located two to three miles off the mainland, Great Bird Island is the primary destination within the North Sound for day-tour guests, visiting yachts, charter boats, and recreational users. It is also one of Antigua's most important wildlife sites, the home for one of the world's rarest snakes, and the location of Antigua's greatest concentration of nesting seabirds.

Natural Resources of North Sound and Current Uses

Marine Resources Characterization

Weiss and Multer prepared a map of Antigua's coastal and nearshore natural resources in 1988 based on aerial photos and field work from the 1970s and 1980s (Weiss and Multer, 1988). The resource categories used to describe the marine environment were:

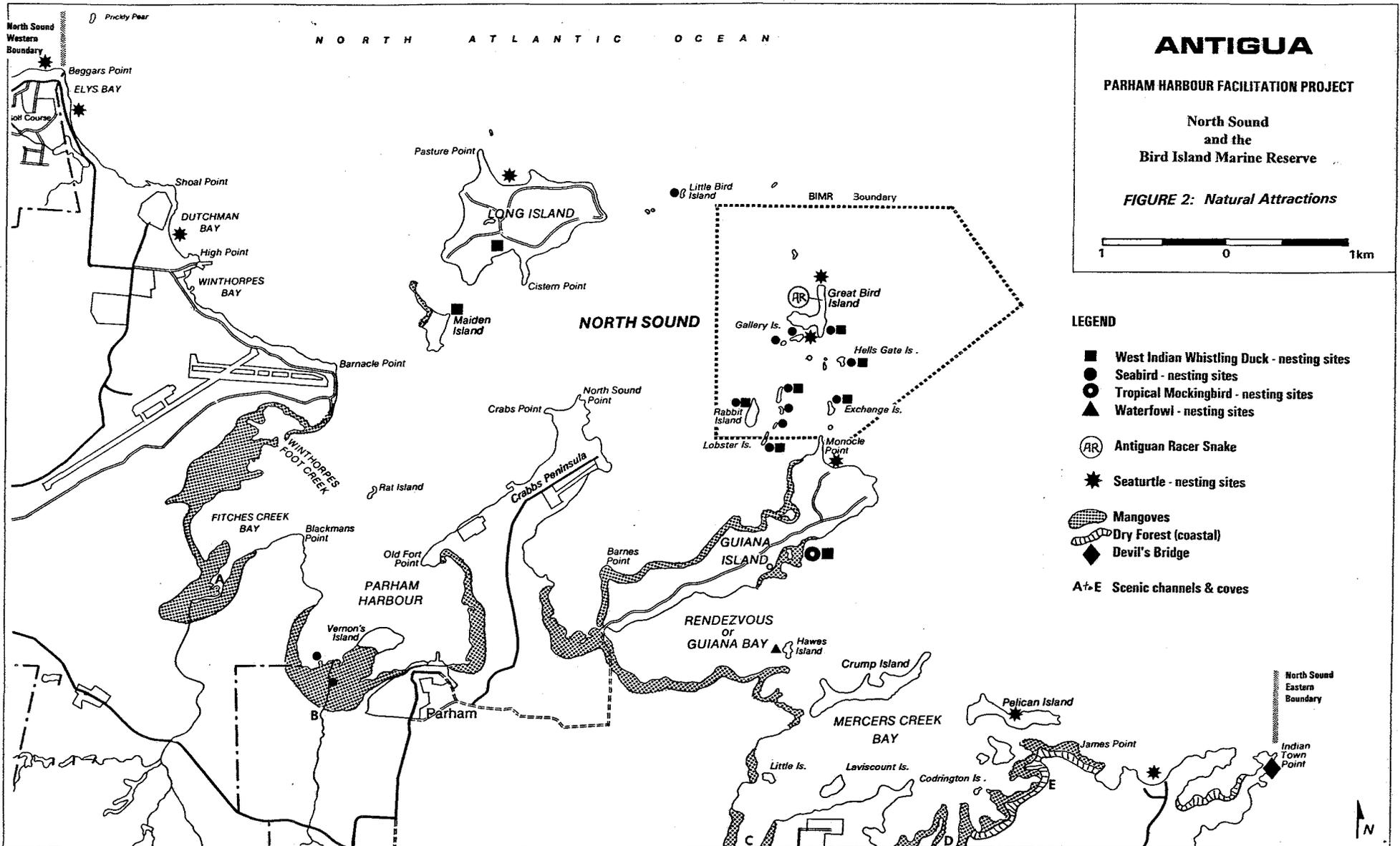
- Grass-held sediment (predominantly grass, but including grass/sand/mud mixtures)
- Linear reef
- Patch and pinnacle reef
- Deeper reef
- Sand (including sand/corals/grass mixtures)

Baseline information from these researches is important, but equally significant from the perspective of long-term management of the Marine Reserve is a clear strategy and affordable process for on-going monitoring of these marine resources. Appendix II presents a plan for environmental monitoring, with a variety of implementation tactics available depending on support from various local and regional agencies and programs. See Figure 2 for a map of natural features and attractions of the North Sound area.

Island Resources resurveyed sites in the North Sound in order to update data collected before Hurricanes Hugo (1989) and Luis (1995). In addition, the entire proposed Bird Island Marine Reserve was surveyed to provide finer detail than was available in the 1988 map, as were the marine areas surrounding those off-shore islands that might serve as visitor destinations, thereby decreasing the pressure on Great Bird Island.

The Foundation examined a total of 110 sites in 7 areas—Bird Island Marine Reserve, Prickly Pear Island, Beggars Point to Fitches Creek, Crabbs Peninsula, Maiden Island, the north side of Crump Island, and the west side of Pelican Island. The details of the existing conditions are presented in the report *Characterization of Marine Resources* (Island Resources Foundation, 1996). Several general conclusions are noteworthy:

Figure 2: North Sound and Bird Island Reserve: Natural Attractions



- *Most hard corals in shallow areas are dead.* Over 95% of the hard corals surveyed in shallow waters (30' or less) are dead. This problem is spread over a wide geographic area (all 7 areas) and occurs in both *linear* (including bank, barrier, and fringing reefs) and *patch* reefs (relatively isolated, with a characteristic ring of bare sand from fish and echinoids that inhabit the reef and clear-graze the vegetation close to it).
- *Deeper reefs tend to be healthier:* Studies confirm this relationship, one recognized by the fishermen and divers. Bunce's October 1995 post-Hurricane Luis study of several reefs at depths of 30-45' labeled them in "good" health. Other studies of reefs in Antigua and elsewhere in the Caribbean often note the better condition of corals at depths of 60' and more.
- *Changes in the resource base:* There has been significant deterioration of hard and soft corals with replacement (or overgrowth) of macro-algae and seagrass. Much of the reef recorded in the 1988 map now appears as sand/coral/sea grass. (Some former sand areas now have a lot of sea grass; but since the converse also is true, it is not clear whether there have been changes in the relative abundance of these two resource categories.)

While it is possible to show that some of the areas previously recorded as coral have deteriorated, the 1988 map does not distinguish live coral from dead coral, and therefore it is not possible to quantify the decrease in the percent of live corals over this time period. However, the few studies that do exist present an alarming picture. Multer collected some live coral coverage data from transects in the Great Bird Island area in the 1980s. Island Resources resurveyed the approximate and found 75% and more dead coral with isolated live coral heads, where Multer had recorded less than 25% dead corals (Multer, personal communication regarding unpublished data). Multer also surveyed reefs in other parts of Antigua (Nonsuch Bay, Goat Head, and Bishops Reef). He first surveyed these sites in 1983, and then resurveyed them in early 1996. In all three areas, he observed that three-quarters of the corals alive in 1983 were dead 13 years later, as summarized in Table 1, below. Soft corals showed a comparable decrease.

Table 1: Percent of Live Corals, Antigua

	1983	1996
Nonesuch Bay	35%	7%
Goat Head	20%	5%
Bishops Reef	15%	2%

Goreau and Goreau (August 1996) conducted a limited rapid ecological assessment of coral reefs off the coasts of Antigua and Barbuda. They also reported that most sites were dominated by dead coral rubble and had live coral cover of only between 5% and 20%. These figures were approximately the same as those reached by Bunce and the Fisheries Division in 1993, who based their findings on more detailed transect surveys. Equally important in this analysis is the near-universal response of fishermen and dive operators, who report the same pattern of deterioration over the past 20 years or more.

Environmental Issues

Coral reefs and seagrass beds are regularly damaged by a variety of "natural" phenomena. The most dramatic of these are of course the devastating effects of large tropical storms and hurricanes. Processes that take place over years or decades may lead to similar results. Current patterns may shift, causing changes in the shapes of shorelines, or the building and erosion of sand bars. If areas once bathed by sparkling blue seas in time become subjected to waters clouded with sediments, reefs and seagrass may be destroyed. Changes in temperatures or rainfall patterns may also create conditions that stress corals. Our ability to reduce or eliminate these sources of damage is essentially nonexistent.

In contrast, the damaging effects of humanity on inshore marine ecosystems are well within our ability to control. It is essential for managers and the public alike to be aware of the nature of anthropogenic [people-induced] threats to these resources, and ways to protect them through rational planning and management.

Several factors, possibly interacting synergistically, have been proposed to account for the deterioration of coral reefs in the Caribbean. Although their relative impacts on Antigua's reefs are not known, the following stresses are assumed to be involved:

Natural Stresses

- *Bleaching*, black line disease, white line disease, and related pathogens;
- Crowding and substrate take-over by *algae*;
- Physical *breakage* and high *turbidity*;
- *Predation* by other organisms and cannibalism by other corals;
- Long-term *climate changes*.

Human-Induced Stresses

- Nutrient-enriched *runoff and biocides* (pesticides, herbicides, and fungicides);
- *Hydrocarbons* and trace elements from terrestrial waste streams and marine products;
- *Physical damage* from anchoring, boat grounding and swimmer damage and coral removal [site-specific, and observed as a factor around Great Bird Island];
- *Suspended sediment* discharge following rainy periods from unstabilized slopes, spoil banks, construction sites, roads, ravines, etc. ;
- *Over-fishing*.

Coastline

Until the recent announcement of a proposed 1,000 unit resort development, the coastal region of the Northeast Coast Management Area has been bypassed by much of the development that has occurred in the rest of the country. A small number of hotels and condominiums are supported by its few sandy beaches, but it does not have any large-scale resort development.

Despite the presence of Bird International Airport and the industrial development on Crabbs Peninsula, most of the coastline and offshore islands remain vegetated (for more information on land-based activities impacting the North Sound, see *Pollution Stresses and Impacts* [Island Resources, 1996]. The mangrove stands, patches of forests, and rocky outcrops of the North Sound support some of Antigua's most diverse wildlife and make this area an important natural heritage of the country (see *Flora of the Offshore Islands* [Island Resources, 1996] and *Nesting Birds of the Offshore Islands and Adjacent Shorelines* [Island Resources, 1996] for more information). The highly indented coastline, with its numerous bays, creates a beautiful

landscape from the sea and could support tours that would supplement Great Bird Island as a tourist destination (see Figure 2).

Four conservation priorities warrant special attention for protection and improved management:

- mangroves, which in addition to their scenic values, provide valuable environmental services such as stabilizing the coast and serving as fish nurseries;
- the stands of the dry forests in the Mercers Creek area, that are remnants and reminders of a vegetation type that once was prevalent throughout the Caribbean;
- the "Byam's Wharf" area, in Parham Harbour, nesting habitat for the endangered Least Tern;
- the offshore islands, whose flora and fauna can be easily impacted by excessive or inappropriate human use.

Fishermen

The North Sound supports some 66 part- and full-time fishermen launching from Hodges Bay, Beach Comber Beach, Shell Beach/Fitches Creek, Parham, Seatons and Willikies. Four fishing methods are used: trap, spear, net and line. The artisanal fisheries, as described by one fisherman, is "primitive, but effective", with most of the catch going to local consumption and the occasional surpluses making it to the market in St. John's.

Virtually all of the fishermen interviewed noted a deterioration in fish stocks and corals since they started fishing. Several expressed strong support for some management of the area, including limits on mesh size, lobster and conch size, spear-fishing and number of traps on the reefs (see *Usage Patterns and the Resource Management Perceptions of Users* [Island Resources, 1996] for more details).

Day-tour Operators and Recreational Users

Great Bird Island receives most of the visitation to the nearly two dozen islands of the North Sound (only Long Island has several inhabitants; most of the other islands are uninhabited, although Guiana Island and Pelican Island each has one residence). Based on interviews in April 1996, seven day-tour operators were bringing some 14, 500 visitors to the island each year; and in recent months another tour operator has begun organizing camping trips on the island for foreigners. Frequently, a few foreign yachts anchor off the

island, and perhaps 3 to 4 Antiguan families also use the island for recreation during the weekends.

The other main areas used within the North Sound are:

- Prickly Pear Island, used by one day tour operator and for camping and picnicking by Antiguans;
- Maiden Island and the northwest coast of Guiana Island also used for camping during Easter weekend;
- Long Island, where foreign yachts anchor off the west coast and the island has a hotel and several private homes; and
- the reefs off Little Bird Island used by one dive operator.

As with the fishermen, the day-tour operators and recreational users noted their concern over the increasing human impacts and the general deterioration of the resource base. Virtually all expressed support for establishing some management measures to safeguard natural resources, including litter controls and garbage collection, holding tanks to limit sewage disposal, training for snorkeling guides, installing boat moorings, and limiting/coordinating visitation. See *Usage Patterns and the Resource Management Perceptions of Users* (Island Resources, 1996) for more details.

Environmental Risks in North Sound

One of the most difficult aspects of environmental protection is the fact that environmental risks are the cumulative effect of a multitude of apparently inconsequential actions. It is not the intent of this management plan to be alarmist about risks in the Marine Reserve or throughout the north east coast management area, but only to highlight those factors which may contribute most to increasing environmental risks without careful management.

Sedimentation

Ecological processes in marine environments may be substantially affected by things happening far inland. When land is stripped of natural vegetation through clearing and burning, there is little left to hold soils in place. Rains will then carry far greater loads of sediments directly into the sea, or into streams and rivers that eventually lead to the sea. This can be more destructive if coastal mangroves and salt are further compromised through a series of poorly coordinated development schemes.

Similar effects may be produced by activities associated with the urbanization of coastal areas. This often involves dredging boat channels, building marinas, and sometimes even the deposition of materials from newly cleared sites directly into the sea. Such activities have the capacity to quickly devastate large areas of live bottom if not properly engineered and controlled. Waters clouded with silt are detrimental to reef and seagrass growth or survival. Corals vary in their ability to rid themselves of sediments—some are able to deal with limited amounts quite well, but many are not.

Eutrophication

Another form of pollution which is especially stressful for reefs is the discharge of nutrient-rich waste waters into coastal marine environments. Under normal circumstances, a combination of nutrient limitation and grazing by plant feeders act to limit algae. But waters laden with nitrates from sewage or fertilizers may lead to explosive growth, beyond the capacity of the hungriest of herbivores to counteract. Thick algal mats may then smother the reef. Fertilizers from farms far inland may percolate for many miles through porous soils to eventually emerge in reef areas, with the same effects.

Boating and Diving

Boats may damage sensitive marine habitats directly through physical contact, either inadvertently by collision with the hull or propeller or by anchoring on live bottom. The end result is the same—organisms are crushed, and the door is thrown open to algal and bacterial infection.

Divers may directly and indirectly damage reefs in a variety of ways. Physical contact is the most obvious. Inexperienced divers often inadvertently damage corals by allowing equipment to hang unsecured. Divers often unknowingly cause sedimentation damage to corals by swimming too close to the bottom or dragging their legs—practices that cause the fins to raise clouds of sand that then settle on living nearby polyps. Other ill-advised practices are the handling or feeding of marine life. Like corals, reef fishes secrete a protective mucous layer that serves as a barrier to infection and the loss of water to the surrounding sea. Disrupting that barrier by touching the fish may subject the animal to increased risk of infection as well as increased stress in maintaining water balance. Fish are surprisingly fast learners, as well as opportunistic feeders, and efforts to feed them may lead to lasting behavioral changes that result in increased risk of falling prey themselves, or attempting to use food sources that may be harmful.

Fisheries Practices

Overfishing, particularly through the use of habitat-destructive fishing methods, has decimated reef areas and their fisheries throughout the world. In some areas explosives are used to stun and kill fish. The use of chemical poisons, including bleach and soaps, to drive marine life from the reef is common practice today in many Caribbean island areas, as well as much of the Pacific.

The continued removal by any means of excessive numbers of fishes from reef areas may have long term negative effects on reef ecology. The unregulated use of wire fish traps in living reef areas has been shown to have disastrous effects on reef fisheries. There are several serious problems associated with the use of fish traps.

- First, they are highly effective and capable of quickly removing large numbers of fishes of a wide variety of species.
- They are large, heavy solid objects quite capable of causing substantial damage when placed on live bottom through direct physical contact. Evidence of damage from this source alone has been reported at Cades Reef.
- Traps often become separated from their lines and buoys. These "ghost traps" then continue killing hundreds of fishes for long periods before finally decomposing in the sea.

The net results of unregulated wire fish trap is destruction of reef fisheries and a resultant degradation of the reef habitats that support them. For these reasons, the use of wire traps has quite wisely come under intensive regulation in many Caribbean nations. Common forms of management include limiting their use to offshore deep water areas devoid of live bottom.

Spearfishing around reef areas is a most undesirable activity from a conservational standpoint. Near "misses" frequently take large chunks out of living coral. Wounded and frightened fish will flee into the shelter of the reef, and often must be forcibly pulled out by divers braced against, and crushing, living polyps. Another serious consequence of spearfishing has to do with the highly selective nature of the activity. Typically, the game consists of the larger piscivores: grouper and snapper. The continued removal of most of the higher predators from reef areas leads to wholesale changes in community composition, with unknown long-term effects.

Port and Industrial Pollution

Corals and other inshore marine life may be highly vulnerable to a number of classes of chemical pollutants. Heavy metals, pesticides, hydrocarbons and other substances may directly kill organisms, lower reproductive rates, reduce competitive abilities, destroy food sources, and otherwise harm marine life. As these effects are often subtle and difficult to trace or identify, a wise rule-of-thumb in the development of marine protected areas is to limit industrial development in their vicinity, particularly those plants that require the direct discharge of the results of industrial processes into the sea or into land areas flushing into the sea. The desalinization plant on Crabb's Peninsula discharges into Parham Harbor and is the kind of facility which should continue to be carefully managed and monitored to prevent discharges from affecting areas of the north east coast.

Solid Waste Disposal

Unregulated dumping of solid waste along shorelines represents a serious threat to marine life. Many materials [e.g. plastics] break down very slowly in the sea, and thereby may exert negative effects for years or decades. Marine life may ingest or become entangled in solid waste, leading to death or serious injury. The sight of garbage on the sea floor detracts from the aesthetics of the marine environment, with negative impacts on tourism. Solid waste disposal problems are particularly acute on many Caribbean islands, and development of a rational plan for dealing with the problem is critical to natural resource management.

Bird Island Marine Reserve

Goals and Objectives

Improved management of the North Sound is essential in order to protect the livelihood of local fishermen, the tourism and recreational values of the area, and the wildlife that it supports. Initially, management should be focused on a core area—the Bird Island Marine Reserve—because of its income-generating potential and importance for tourism and recreation, and because protection will allow the Bird Island Marine Reserve to serve as a nursery for replenishing fisheries for commercial exploitation throughout the wider North Sound.

As developed over the past five years, the rationale for establishment of the Bird Island Marine Reserve has focused on the need:

- to increase fisheries catch outside the Reserve by providing spawning and nursery areas within the Marine Reserve as a restocking source;
- to maintain the esthetic and scenic qualities for recreation and tourism, and improve the quality of the tourism experience by reducing waste inputs and trash impacts and improving the interpretation of Antigua's natural history;
- to enhance the long-term earning potential of the Marine Reserve through activities such as land and marine tours, and camping;
- to develop the Reserve's education and research potential, especially for Antiguan youth;
- to protect and manage the marine resources of the area;
- to safeguard the terrestrial flora and fauna of the islands, in particular, the threatened endemic snakes and seabirds and migratory birds that roost and nest there.

Within this broader vision, the goals and objectives of the Marine Reserve are straight forward, as listed below.

Goals for the Bird Island Marine Reserve

- Extend and protect local source income by increasing the sustainable harvest of renewable marine resources in the general area.
- Enhance tourism opportunities and protect high priority touristic resources such as snorkeling reefs and camping and birding areas for long term use.
- Increase national income, jobs and foreign exchange earnings by implementing fees for tourist use of the Bird Island Marine Reserve.
- Demonstrate the commitment of the Parham development scheme to sustainable development of local resources, in order to reassure investors of the viability of long-term investments in tourism and other resource-dependent activities.
- Provide a management structure which prevents further degradation of marine and terrestrial wildlife, and which guides future development to protect habitat against more intensive managed use of the Bird Island Marine Reserve.

Objectives

To achieve these goals, the Parham Development Project needs to concentrate on the following objectives:

- Speedy implementation of an administrative structure within the Development Company to permit the collection of fees and the enforcement of basic management objectives through an interim management structure within 90 days.
- Dissemination and approval of implementing regulations for the proposed Marine Reserve within six months.
- Legislative approval of enabling acts to establish an autonomous Bird Island Marine Reserve Authority, which will transition from the interim management structure within a period to be determined during the interim management period (perhaps 24 months).

Underlying Principles

The Dynamic Quality of the Management Plan

All natural resource management plans are dynamic. In the case of the Bird Island Marine Reserve, the natural resource base, the demands and expectations of users, and the resources to deal with the Management Plan will vary over time. The management plan *and managers and policy makers* must be responsive to the shifting priorities required by subtle but significant alterations in both the natural and institutional environments. The value of the management plan is in both the mechanisms it proposes for reviewing and adjusting management areas, vetting revisions, and creating and demarcating new ones, and also in the specifics of the areas it lists.

Proper management is an effective mechanism for dealing with threats to the marine and coastal environment. Modern marine protected areas such as the Bird Island Marine Reserve have a common goal—partitioning and regulating resources and activities in a manner compatible with sustainable multiple uses. A primary goal of most protected areas is the preservation of biodiversity, the rich storehouse of life forms contained within the area. Another common objective is to provide a refuge for education and scientific research. Protected areas also provide a lasting opportunity for all people to see a part of the planet in a natural state, an opportunity all too quickly disappearing in non-protected areas. Other objectives may be added in particular cases—the creation of fishery reserves is an example.

The organizational arrangements and managerial/jurisdictional tasks leading to enhanced public use of sensitive public natural resources such as Great Bird Island have rarely been undertaken in Antigua. This plan recommends a deliberately scheduled, period of testing, training and experimentation (perhaps 24 months) under the direction of a development project managed directly by the Development Company. The “interim management period” is a trial-and-error process that will allow fine tuning to the institutional arrangements for the Marine Reserve as the project proceeds.

Stakeholder Participation Critical

For these tasks to be properly and fairly reviewed, and to avoid hasty implementation of an ill-considered management design, support for creation of a representative Advisory Committee will be important. Since many residents of the area do not yet feel a part of this initiative, and since the Parham Harbour Development Company has few direct links to the community at the present time, it is hoped that representatives of environmental and community-based organizations such as the

Environmental Awareness Group of Antigua and Barbuda can help to organize and present these concerns to the Advisory Committee.

As a true private-public partnership, both the Advisory Committee and the governing board for the succeeding Bird Island Marine Reserve Authority should contain representation from:

- appropriate Government agencies,
- groups associated with the overall initiative to develop the Parham area, and
- other key stakeholders in the Marine Reserve.

At the same time, this Management Plan recommends that the Advisory Committee be kept small enough to be able to function as a true board of directors, rather than a purely advisory and debating forum. It is expected that the Environmental Awareness Group of Antigua-Barbuda will work with many of the local community residents and resource users to facilitate constructive and coordinated input to the Advisory Committee.

Recommended composition would include representation from the following groups:

- Parham Harbor Development Company
- Fisheries Division
- Forestry Division
- Tourism Department
- Environmental Awareness Group, with an explicit responsibility to organize input from fishermen, and other residents of the area and users of the Reserve resources
- Tour operators
- Hoteliers

It is recommended that the design of the Advisory Committee (and the Marine Reserve Authority) should seek a balance of public and private interests, and residents and non-residents of the area.

Coordination of Public and Private Sector Input

Effective management of a common property resource like the popular Bird Island area, with its competing users and conflicting uses, requires a blend of

inputs from the public and private sectors. For example, in the absence of sufficient public funds to support an environmentally acceptable anchoring or mooring system, the Marine Reserve should seek the involvement of private investors through concessions and permits for providing mooring services, accompanied by a negotiated revenue-sharing arrangement.

Other services could be developed by private businesses operating under specified procedures and revenue-sharing arrangements for other activities, ranging from beach bars, to snorkel and beach gear rentals, campground operation, and so forth. This income flow would provide further funding for recurring administrative and regulatory expenses associated with operation of the Bird Island Marine Reserve (See Appendix III).

As discussed in the Master Development Plan, there is *not* a long-standing tradition in Antigua of public-private collaboration such as proposed here. For that reason, the Company should proceed slowly, with open negotiations at every step of the way, and with full consultation with neighboring areas where these have been successfully tried, and with involvement of all elements of the Advisory Committee.

Another source of private sector support which will be developed to fulfill this Management Plan is the solicitation of voluntary labor in the construction of key facilities for the Reserve, including trails, signs, campgrounds and offices. This support will be sought from both local interests and international student and environmental groups seeking work and study projects in the Caribbean (a service which is now organized on the Internet).

Boundaries, Zoning and Capital Development Plan

Boundaries of the Bird Island Marine Reserve

As part of the Master Plan for the Parham Harbour Development Project, a proposal was made to establish a "Bird Island Marine Reserve and Wildlife Sanctuary." Figure 1 shows the proposed location of this reserve. While there is as yet no official declaration for the Bird Island Marine Reserve, there does exist between the Government of Antigua and Barbuda and the Organization of American States (OAS), a *memorandum of understanding* to promote the Master Development Plan entitled "Development of Tourism Infrastructure at Parham Harbour, Antigua." The Master Development Plan states:

... The institutional structure for private sector participation in the development effort and specifically the private sector management of infrastructure under Government regulatory control is uniquely defined in this Master Development Plan to permit moving forward with the project today under the present circumstances

A private mixed-stock company, referred to here as the Parham Harbour Development Company, will become the lead developer. The company will provide the means for private sector provision of infrastructure, as well as business and investment promotion ...

The continued support of the Government of Antigua and Barbuda for the overall Parham Harbour Project and the establishment of the Bird Island Marine Reserve has been confirmed in a letter dated February, 1996. At the present time there is, however, no *specific* government agency committed to establishing the Bird Island Marine Reserve. (See "Implementation Strategy and Operating Plan," below.)

Geographic Boundaries

North Sound and NECMA

The northeastern coast of Antigua is generally subjected to prevailing winds and currents from an easterly direction, but there are also microscale water-movement components that must be considered. Thus, water reaching the Parham Harbor/North Sound area would generally be most strongly influenced by coastal activities and processes occurring directly to the east. However, inshore eddies and countercurrents, atypical winds, and/or tidal flushing may periodically subject specific sites anywhere within the proposed protected area to influences emanating from sites located anywhere else along the northeastern coast. The North Sound comprises approximately 30 square miles of coastal and marine environment stretching from Beggar's Point to Indian Town Point and from the mean high tide mark along the coast to 3 nautical miles out to sea. This stretch contains one-quarter of Antigua's coastline, and a marine area that includes a substantial portion of the country's territory and resources (see Figure 2).

Therefore, this management plan concurs with previous strategies for the area which concluded that for effective management of the coastal zone and marine resources of northeastern Antigua, a Northeast Coast Management Area will eventually be established. Oceanic boundaries of the Management Area are recommended to be defined as follows; lines connecting the

easternmost point of Indian Head Point with a point three nautical miles due north [Point A], the northernmost point of Beggar's Point with a point three nautical miles due north [Point B], and a straight line connecting Points A and B. The proposed boundaries of the NECMA are shown in relation to the proposed boundaries of the proposed Marine Reserve in Figure 1. The oceanward boundary roughly parallels the 20m depth contour. In general, the shoreward margin of the protected area should be defined as the maximum mean high tide line of all included land masses, perhaps increasing to a line 50 meters above the maximum mean high tide line for critical shore and beach areas. This provides a direct mechanism for the management of coastal construction, dredge and fill operations, and other shoreline activities that might-impact the coastal and marine resources of the area.

Bird Island and the Bird Island Marine Reserve

The Bird Island Marine Reserve is a critical core area of approximately 2.34 square miles (1,500 acres) comprising less than 10% of the North Sound. The Reserve centers on Great Bird Island, and includes six satellite islands and the surrounding sea, including coral reefs and other key marine and coastal habitats. Located two to three miles off the mainland, Great Bird Island is the primary destination within the North Sound for day-tour guests, visiting yachts, charter boats, and recreational users. It is also one of Antigua's most important wildlife sites, the home for one of the world's rarest snakes, and the location of Antigua's greatest concentration of nesting seabirds.

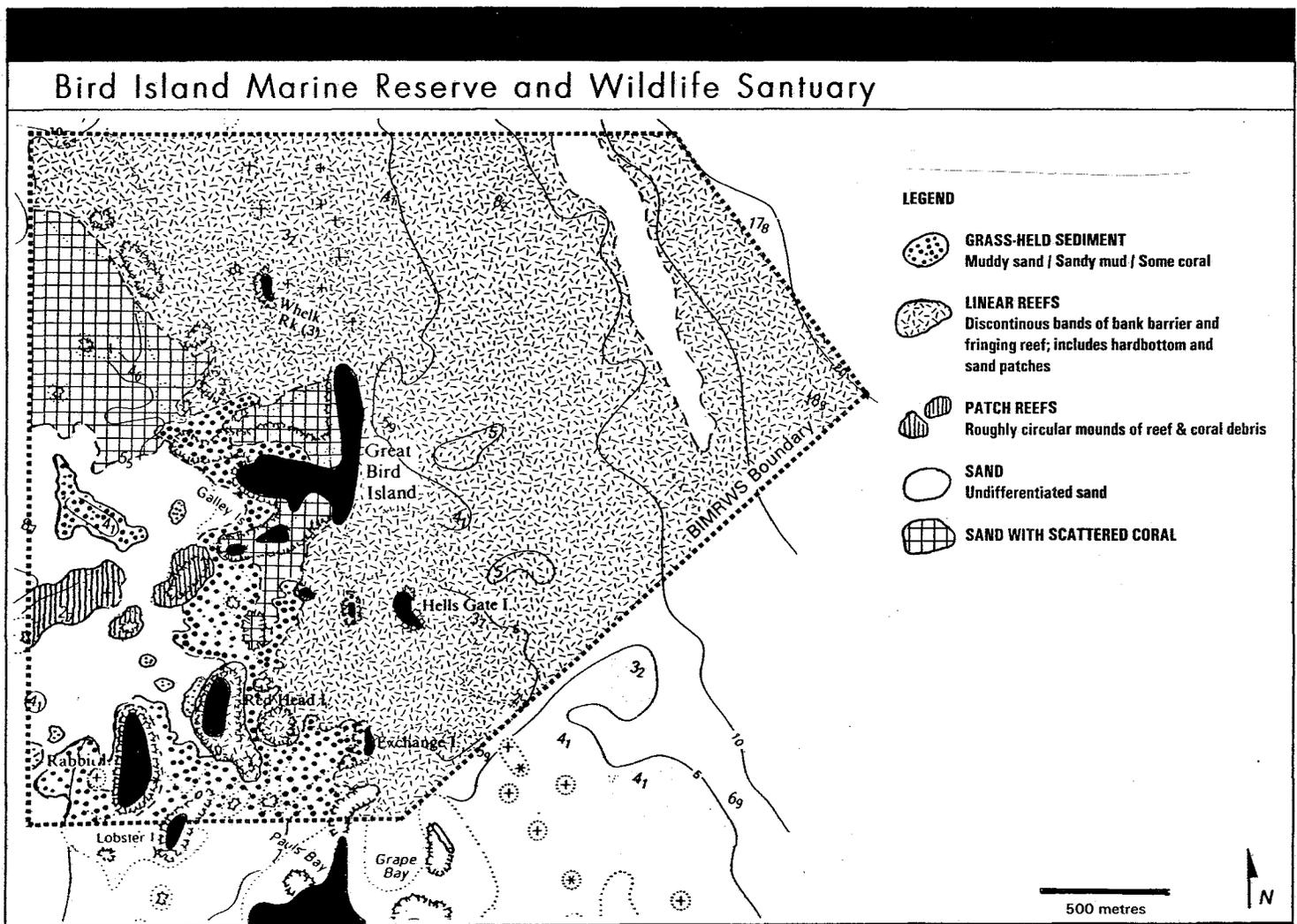
Zoning provides a mechanism that alleviates user-conflicts by providing regulation and physical separation of possibly conflicting activities [e.g. commercial fishing and tourist SCUBA diving]. A zone in this context is simply a defined geographic segment of the protected area. The first step in developing a rational zoning scheme for marine protected areas is to identify current and projected uses as well as associated user-groups. The major marine habitats and resources of the area have been mapped by Weiss and Multer [1988], and those of the proposed protected area are presented in Figure 3.

The shoreline and waters of northeastern Antigua are presently subjected to the following major uses: commercial and artisanal fishing, yachting, day-tours by local commercial operators, indigenous habitation, beachfront resorts, marinas, light and heavy industry, an international airport, and a variety of military facilities. Projected uses include expanded industrial use, increased residential use, and greatly expanded tourism-based infrastructure and activities.

The Bird Island Marine Reserve is the core area of unique biological value and high tourism value of the much larger Northeast Coast Management

Area. It will be managed as the focal point of conservation, tourism development, and intensive management. Around this small "core" is a considerably larger "buffer zone" [Northeast Coast Management Area]. The gradual extension of a managed buffer zone provides the means by which the natural resources of the entire coastal zone may be developed in a manner compatible with existing and future multiple-uses, and by which the microcosm of the Bird Island Reserve [which represents only about 1% of the larger ecosystem] may be adequately protected.

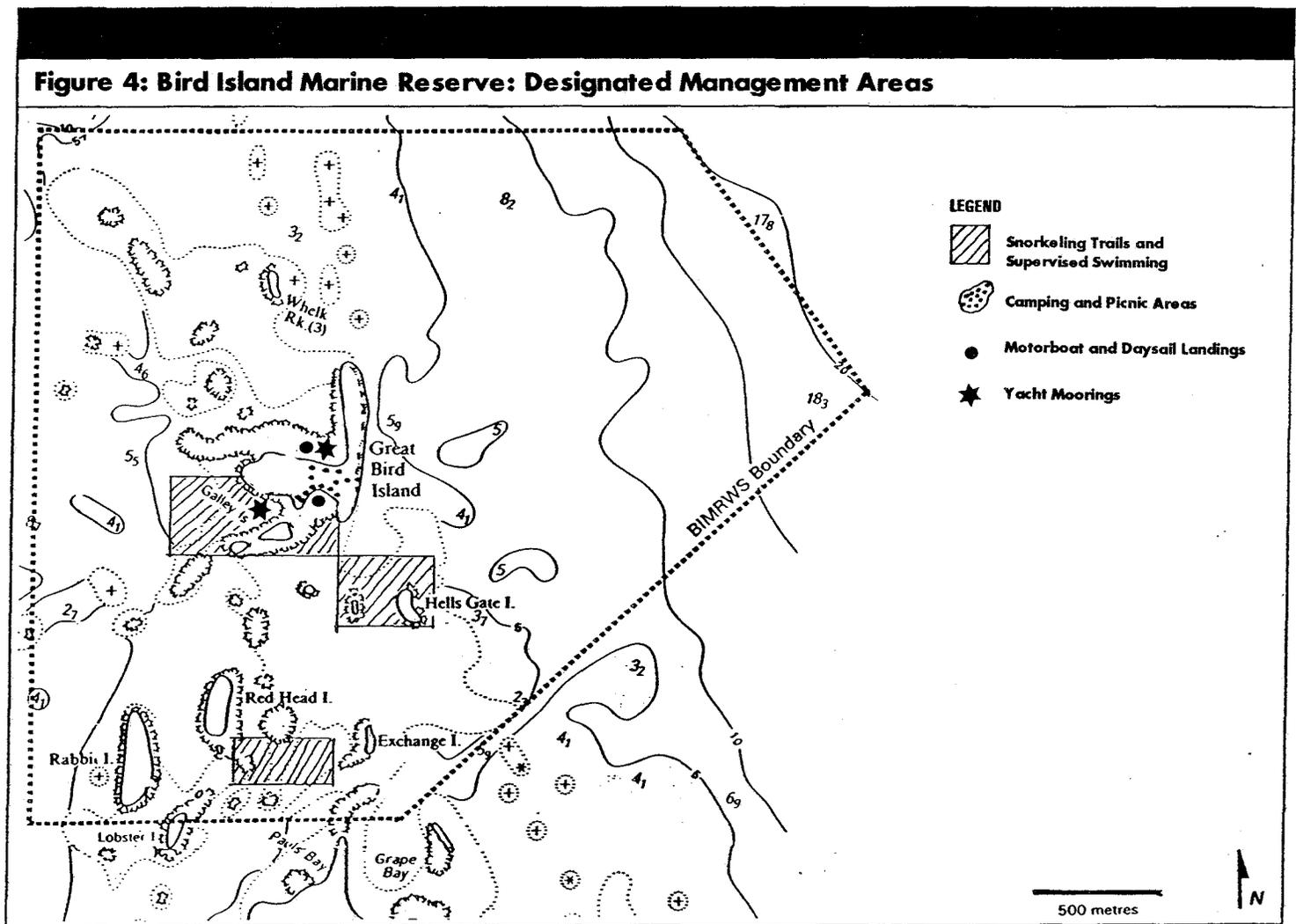
Figure 3: Bird Island Marine Reserve: Marine Resources



Additional public and government input needs to be solicited to determine the specific elements of a rational zoning plan for the northeast coast of

Antigua. Clearly, some of the currently proposed possible uses are not compatible. For example, developments that would lead to further degradation of water quality within North Sound or Parham Harbor [such as channel dredging, extensive shoreline modification, removal of large tracts of mangroves, flushing of chemical pollutants from industrial processes, *etc.*] are clearly incompatible with fishery development, biological conservation, and tourism in the area. It is a simple fact that for the proposed Marine Reserve to succeed in the long term, the firm commitment of the Antiguan government to the concept of the Management Area needs to be demonstrated to the community-at-large, so that the regulations promulgated to create and maintain the Marine Reserve will be fully respected and supported.

Figure 4: Bird Island Marine Reserve: Designated Management Areas



Capital Development Plan and Voluntary Support

The capital development plan for the Bird Island Marine Reserve is constrained by several factors:

- the small size and fragile conditions of the 1500 acre Reserve itself;
- the need to build facilities to support fund-raising functions of the reserve such as moorings and campgrounds;
- relatively rapid payback on capital investments, with a positive cashflow for the Marine Reserve over five years.

The capital development plan must rely on significant *voluntary construction and maintenance* activities in order to ensure that the limited funds available are used for the purchase of materials. The process of recruiting voluntary assistance from both Antiguan and international sources, however, is also seen as a device to increase public awareness of the general need to maintain high quality environments, and the very special investment that local communities have in the environmental conditions that tourists pay money to share.

Table 2: Estimated Five-Year Capital Investment Plan

Development	Year 1	Year 2	Year 3	Year 4	Year 5	5-Year Total
Trails and Signs	\$2,000	\$5,000	\$5,000	\$7,500	\$5,000	\$24,500
Buoys & Moorings	\$2,000	\$5,000	\$10,000	\$5,000	\$10,000	\$32,000
Office and Camp Grounds	\$2,000	\$10,000	\$25,000	\$25,000	\$25,000	\$87,000
Volunteer and Env. Education Materials	\$1,500	\$2,500	\$7,500	\$5,000	\$5,000	\$21,500
Development Costs	\$7,500	\$22,500	\$47,500	\$42,500	\$45,000	\$165,000

Investments in trails and signs, marker buoys and moorings (to be financed largely by private operators under special concessions and cost-sharing arrangements), and campgrounds are directly tied to revenue-generating aspects of the Reserve's operation. Boats and other gear will be leased until needs of the program are tested and clear. Office and storage space and office equipment will be minimal for the first years of the program and will be rented from the Development Company. Details of the revenue projections are presented in Appendix III.

Implementation Strategy and Operating Plan

At the present time it seems that both The National Parks Authority and the Fisheries Department feel that the complex objectives of the Bird Island Marine Reserve are not congruent with other, higher priority missions of their separate agencies. Given the special role in infrastructure development

projected for the Parham Harbour Development Company, this Management Plan recommends that the Ministry of Tourism, Culture and Environment (which has overall responsibility for the Parham Harbour Project) authorize the Parham Harbour Development Company (or its successor institution) to undertake the establishment of the Bird Island Marine Reserve. Such action does not preclude eventual designation of a statutory body to serve as the Reserve Authority.

This Management Plan proposes a three-part implementation strategy, involving more-or-less simultaneous actions of :

- a) interim management of the Marine Reserve area to demonstrate feasibility, begin staff training, refine operating procedures, and build infrastructure;
- b) passage of interim operating regulations, using the existing model regulations and experience from applying the interim procedures; and
- c) legislative passage of the formal Marine Reserve authorization, on an expedited basis to achieve final approval within a year.

Interim Management Period and Operating Regulations

The Company must be prepared to participate in shaping Interim Operating Regulations supplemental to those already drafted for North Sound, which will be expanded to incorporate such issues as waste management, water quality, areas of particular concern, including biologically sensitivity sites and highly stressed sites possibly requiring reduced visitor or user impact. (See also below, next section for details.)

This report proposes that the Ministry of Tourism, Culture and Environment—or any other agency of Government so empowered and committed to the program—authorize the Parham Harbor Development Company to undertake interim management of the area to be formally designated as the Bird Island Marine Reserve.

Using the Fisheries Act of 1983, Government can declare the area of the proposed reserve as a Marine Reserve for the purpose of protecting the natural resources that it contains. The Ministry could request that the Parham Harbour Development Company manage the 2.34 square mile Marine Reserve under interim provisions, with oversight by an Advisory Committee of environmental and development representatives who would be presumed to become the governing Board of the eventual Bird Island Marine Reserve.

Unlike other potential marine reserves that the Fisheries Division is in the process of identifying throughout Antigua and Barbuda, the Bird Island Marine Reserve will require intensive management because it is designed to provide **both concentrated tourism usage and protection of key natural resources**. Initially, the Marine Reserve will require three staff: a Supervisor/Reserve Manager and two Protection Officers. Their salaries, plus other operational expenses, could be covered by user and other concession fees (see Appendix III: Estimated Revenues and Costs).

The Parham Harbour Development Company needs to incorporate the following elements in its management actions for the Marine Reserve. These issues need to be resolved to the satisfaction of the Minister of Tourism, Culture and Environment prior to the Company's assumption of operational responsibility for the Marine Reserve.

Terms of Reference: Parham Harbor Development Company

Recommended terms of reference for the Parham Harbor Development Company are as follows:

- Appoint a broadly based Advisory Committee to serve as the policy board for the interim management period of the Bird Island Marine Reserve;
- Employ staff to manage the Marine Reserve;
- Arrange for the collection and accounting for fees for activities occurring in the Marine Reserve;
- Facilitate coordination and monitoring of activities in the Marine Reserve;
- Allow Marine Reserve staff to be deputized to assume the regulatory powers of the participating agencies to manage the Marine Reserve;
- Support the Advisory Committee in serving as a forum where complaints and conflicts pertaining to the Marine Reserve by the community and other players can be addressed and resolved; thereby, protecting the interests of all parties involved;
- Support the Advisory Committee in serving as a forum for disseminating information and articulating concerns about the management and development of the Bird Island Marine

Reserve and North Sound by those people and groups directly involved in the use of the resources;

- Support the Advisory Committee in serving as the primary forum where complaints and conflicts of the community and other resource users are first vetted.
- Demonstrate the commitment of the Company to the Reserve by moving to positively resolve complaints and conflicts of merit brought before the Advisory Committee—hopefully without need to seek wider involvement by public institutions.
- Find creative means of providing financial support for the Marine Reserve, using the knowledge and leverage of the private markets through conventional and unconventional financial mechanisms.

Terms of Reference: Bird Island Marine Reserve Advisory Committee

Recommended terms of reference for the Bird Island Marine Reserve Advisory Committee are as follows:

- Review and advise the Parham Harbour Development Company on candidates for Bird Island Marine Reserve staff positions;
- Set fee schedules for activities occurring in the Marine Reserve and perform independent audits (or cause to be performed) of the funds so collected;
- Establish policies for the coordination and monitoring of activities in the Marine Reserve;
- Establish Memoranda of Understanding with environmental and security agencies to permit Marine Reserve staff to be deputized to exercise the regulatory powers of the participating agencies to manage the Marine Reserve;
- Serve as an independent forum where complaints and conflicts pertaining to the Marine Reserve by the community and other players can be addressed and resolved; thereby, protecting the interests of all parties involved;

- Serve as a forum for disseminating information and receiving expressions of concern about the management and development of the Bird Island Marine Reserve and North Sound by those people and groups directly involved in the use of the resources;
- Serve as the primary forum where complaints and conflicts of the community and other resource users are first vetted.
- Design the Terms of Reference for the Bird Island Marine Reserve and such advisory groups as may be incorporated in that body.

Open Management

During the interim management period of this project, the Company should explicitly outline the ways in which it will ensure that the management process will be open and flexible, subject to an established schedule for periodic review, evaluation and revision.

Issues to be addressed include:

- gaps arising from omissions in this document;
- responsiveness to all stakeholder groups, especially during the early steps in project implementation (see Stakeholder Participation, below). Each of these interest groups offer the prospect of both partnership (where interests run parallel) and conflict (where priorities or objectives are at cross purposes). Early warning helps with conflict resolution.

Environmental Protection Plan

Working closely with public and non-governmental environmental organizations, the Company will be expected:

- 1) to identify major environmental risks expected to be encountered during the interim management period; and
- 2) to devise an environmental protection plan addressing these issues for approval by the Advisory Committee and concerned agencies (*e.g.*, Fisheries, Forestry, etc.).

Draft Marine Reserve Regulations

Partial draft regulations for the Marine Reserve are included in this Management Plan by reference as "North East Coast (Marine Park) Regulations, 1997."

These have undergone a first review by the Fisheries Division and should be reviewed by other relevant institutions that are expected to be involved in the management of the area.

The main regulations and management actions which have been drafted to date are:

No Extractive or Destructive Activities

Fishing, removal of corals, etc. will not be permitted within the 2.34 square mile area of the Marine Reserve. (This would not affect activities throughout the rest of the 30 square miles of the North Sound).

Snorkeling

Snorkeling will be restricted to specific areas as indicated on the maps in Figures 4 and 5.

Visitor Orientation

Day-tour visitors would receive an orientation to the Marine Reserve by Wardens (Protection Officers) or properly trained and monitored tour guides.

Anchoring

Anchoring of tour boats and yachts would be allowed only at designated landings and moorings shown in Figure 5.

Trails and Signage

Trails and signage will direct hiking and will restrict visitors from approaching nesting seabird areas during breeding season.

Camping

Camping would be allowed only in designated areas.

Figures 4 and 5 shows projected usage patterns and management options within the Marine Reserve.

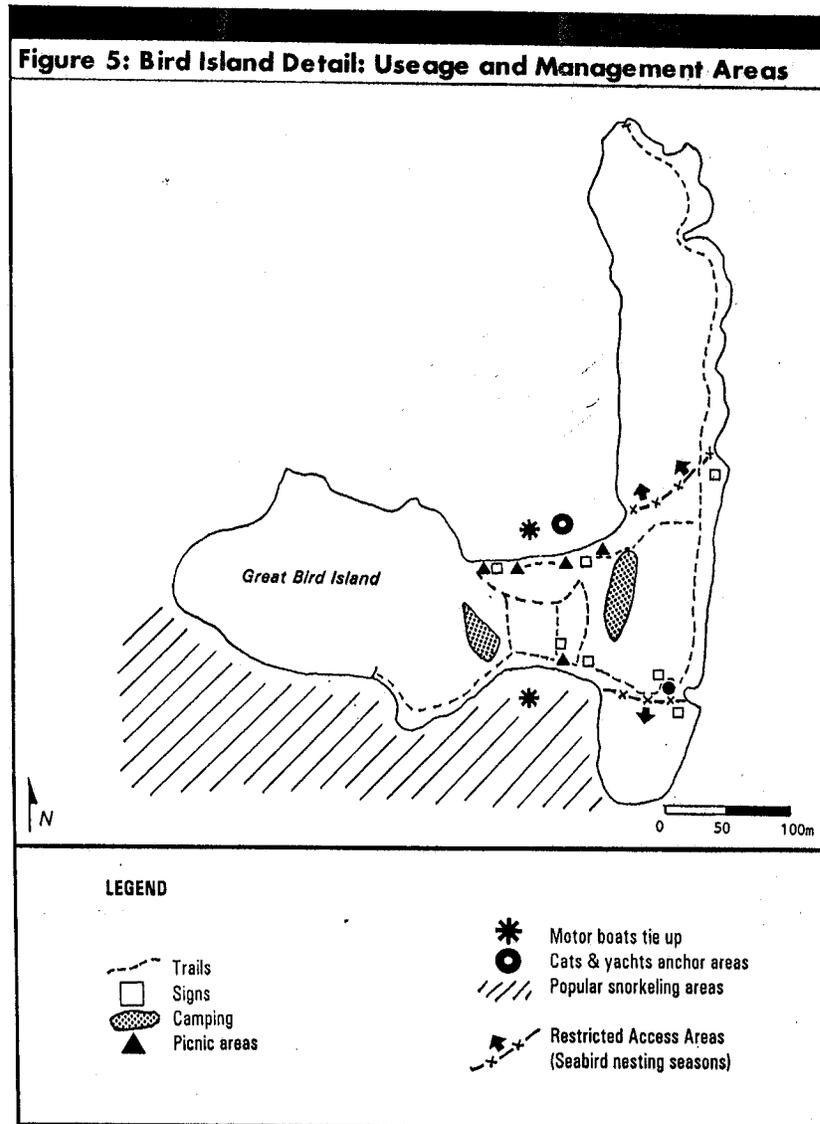
Additional Required Regulations

Additional regulations are required. These include:

Fees for Visitors to the Marine Reserve

Two-week "Visitor Permits" are recommended at a cost of EC\$15 per person, or multiple visit permits (*e.g.*, for local residents desiring to visit the area multiple times) sold for a calendar year at a cost of EC\$25. In addition, NGOs, community groups and educational organizations could secure no-cost permits for specified purposes and dates.

Figure 5: Bird Island Detail: Usage and Management Areas



Prepared by: Island Resources Foundation, December 1996

Fees for Administering Permits

In addition to the Protection Officers and the Reserve Supervisor, tour and dive operators would be deputized to collect the fees for the Visitor Permits, based on a numbered system of controlled permits. They

would be paid an amount equal to 20% of the total: for example, the 1997 fee to visitors would be EC\$15.00, netting \$12.00 to the Marine Reserve. (See Table 3, below, and Appendix III.)

Bird Island Marine Reserve Boundaries

These are generally agreed on, but they need to be precisely defined before the Marine Reserve Authorization is formally enacted.

Standards for Marking Marine Reserve Borders

The kind of markers to be placed to alert local and visiting users of the boundaries and permitted use areas (*e.g.*, snorkeling reefs) within the Marine Reserve.

Performance Standards

Oversight functions require performance standards for monitoring concessionaires and service contractors.

Recommended Regulations

These additional regulations will not be required immediately, in part because it will take time to study the issues involved or to build the infrastructure.

Anchor Fees

Day anchoring on the moorings for visiting boats to Bird Island and other authorized land visiting areas would be covered by a surcharge to the Visitor Permit, amounting to a charge of EC\$15, net of \$10.00 to the Reserve.

Overnight anchoring of yachts on appropriately-sized (and placed) moorings would be charged a "normal" mooring fee (*e.g.*, EC\$40.00, roughly equivalent to the US\$15 per night collected in the British Virgin Islands). Cost studies and negotiations with commercial mooring placement firms would be conducted during the interim management period to determine the best cost-sharing and concession licensing arrangements for such moorings. For example, the overnight mooring fee might be split: 33% for the Marine Reserve for allowing the placement of the moorings and collecting the fees, and 67% for the mooring placement firm for liability and continual monitoring of the condition of the moorings.

Camping Fees and Concessions

These should be determined in negotiation with existing operators, other guides, tourism representatives, and natural resource managers. The net revenues from camping fees in Appendix III are assumed to increase to EC\$50 per person per nite (from an initial net revenue of

EC\$10/ person/ night) over the period of the first five years of the interim management period as the facilities and infrastructure of the the campsite are developed.

Environmental Monitoring

Appendix II outlines a comprehensive monitoring program for the Bird Island Marine Reserve and adjacent areas. Regulations, based on decisions of the Advisory Committee during the interim management period, are needed to define core responsibility for coordinating the monitoring, and cost sharing arrangements among the several government groups and possible outside researchers who may be involved in the monitoring, as spelled out in Section 4.1 of Appendix II.

Waste Management System Standards

Such standards need to be provided for both solid and liquid wastes.

Special Training and Orientation

Special orientation to the Marine Reserve should be provided to snorkelers and scuba divers.

For the purposes of developing revenue and cost projections, the following schedule of fees for the Marine Reserve has been used. These fees also correspond with fee schedules tested in previous surveys of visitors, and are comparable to fees collected in other parts of the Eastern Caribbean.

Table 3: Proposed Fee Schedules (net to the Reserve).

	1997	1998	1999	2000	2001
Fees (EC\$, net to Reserve):					
2 Week Pass	\$ 12.00	\$12.00	\$16.50	\$ 16.50	\$ 16.50
Yachts					
Day	\$ 10.00	\$ 10.00	\$15.00	\$ 15.00	\$ 15.00
Nights		\$ 25.00	\$25.00	\$ 35.00	\$ 35.00
Campers (facilities)	(no facility)	(privies/ waste disposal)		(camp grounds)	
Overnite fee	\$ 10.00	\$ 15.00	\$ 15.00	\$ 50.00	\$ 50.00

Marine Reserve Authority

Based on this Management Plan and the experience of the Parham Harbour Development Company's interim management period, the Ministry of Tourism, Culture and Environment, the elements of the Parham Harbour

Development Project (*i.e.*, the Parham Project Management Unit, the Parham Community Improvement Cooperative, and the Parham Harbour Development Company), the Bird Island Marine Reserve Advisory Committee, and other interested and affected groups can begin to refine the details of the legislative designation of the Bird Island Marine Reserve Authority. This legislation should be concluded by the end of the Interim Management Period.

Task Schedule for Interim Management Period

The precise length and schedule of products during the interim management period should be determined as part of this process. An example of a short-term schedule for the steps outlined above is provided in Table 4.

Table 4: Tasks for Interim (assumes 24-months) Management Period

Approximate Month to Complete:	2	4	6	8	10	12	14	16	18	20	22	24
Decree for Interim Management Period	xx	xx	xx									
Appoint Advisory Committee	xx											
Environmental Protection Plan	xx	xx	xx									
Determine Interim Regs	xx	xx	xx	xx								
Public Hearings on Regs and Proposed Fee Schedules			xx									
Hire one Reserve Supervisor and one Protection Officer		xx										
Interim Trail /Signage Systems		xx	xx									
Start Collecting Visitor Fees			xx	xx								
Negotiate Anchoring Arrangements				xx	xx	xx						
Submit Legislative Authorization for Reserve							xx	xx	xx	xx	xx	xx
Hire Third Staff						xx						
Camping Fees Set							xx	xx				
Build Privies/Waste Systems										xx	xx	xx
Revise/Upgrade Trails											xx	xx

This task list is the first 24 months of the five-year Business Plan (attached as Appendix III) for general operation of the Marine Reserve and movement into a full-fledged, legislatively-sanctioned Bird Island Marine Reserve.

Summary of Revenues and Costs

This table of summary Revenues and Costs is excerpted from Appendix III to illustrate the feasibility of the economics for the Bird Island Marine Reserve, using conservative revenue projections based on the current levels of usage for the Marine Reserve, and fee schedules reflective of similar programs elsewhere in the Eastern Caribbean.

Over the course of the five years of the Development Plan, this summary indicates that the Bird Island Marine Reserve will inject approximately 1.2 million dollars in the Antiguan economy, most of it in the form of salary for up to four full-time employees, and the construction of Reserve infrastructure, with a net "profit" of \$46,000. These are impressive statistics for any project, and they include none of the added expenditures by tourists on other services (extra days spent in Antigua, taxis to the guided tours for the Reserve, tips to guides, etc. etc.) nor the effect of the positive public relations. (Details of the derivation of these summary costs will be found in Appendix III.)

For the first five years of the Reserve, costs for boats, motors and other gear are shown as expenses for leased gear, primarily because the rapid growth of the Reserve makes renting and leasing a preferred short-term option. In addition, rentals from local boat and equipment owners provides a series of visible, direct payments which may serve to dramatize the positive economic impact on the Parham community. Costs for environmental monitoring activities are assumed to be self-financing, based on existing monitoring program, links to a variety of new local, regional and international programs, and some short-term efforts of the full-time staff of the Reserve. This is detailed in Appendix II.

Table 5 Summary of Revenues and Costs

Bird Island Marine Reserve					
Estimated Summary Revenues and Costs (EC Dollars)					
Five Year Scenario (1997-2001)					
	1997	1998	1999	2000	2001
Revenue Streams					
Day Visitor Rev	EC\$ 84,000	\$ 180,000	\$ 272,250	\$ 299,475	\$ 329,423
Yacht Revenue	\$ 1,500	\$ 5,500	\$ 9,750	\$ 13,600	\$ 16,010
Camp Revenue	\$ 1,250	\$ 3,750	\$ 6,000	\$ 25,000	\$ 27,500
Net Revenue	\$ 86,750	\$ 189,250	\$ 288,000	\$ 338,075	EC\$ 372,933
Expenditures					
Operations					
Supervisor	EC\$ 37,969	\$ 50,625	\$ 59,063	\$ 59,063	\$ 67,500
Protect Off 1	\$ 21,094	\$ 42,188	\$ 50,625	\$ 50,625	\$ 55,688
Protect Off 2	\$ 16,875	\$ 33,750	\$ 75,938	\$ 75,938	\$ 101,250
Office Expenses	\$ 10,000	\$ 10,000	\$ 15,000	\$ 20,000	\$ 25,000
Transport (incl. boat)	\$ 10,000	\$ 25,000	\$ 35,000	\$ 50,000	\$ 65,000
Total Operating Costs	\$ 95,938	\$ 161,563	\$ 235,625	\$ 255,625	EC\$ 314,438
Development Costs	\$ 7,500	\$ 22,500	\$ 47,500	\$ 42,500	\$ 45,000
Total Costs	\$ 103,438	\$ 184,063	\$ 283,125	\$ 298,125	EC\$ 359,438
Cumulative Balance	\$ (16,688)	\$ (11,500)	\$ (6,625)	\$ 33,325	EC\$ 46,820

* becomes 2 Officers in 1999, and two-and-one-half in 2001

Organization and Structure

Simplicity is a virtue for keeping costs low and increasing accountability and responsibility for the successful implementation of the Reserve. The Bird Island Marine Reserve will have a Reserve Manager and from one to two-

and-a-half Wardens. Responsibilities are described in the job descriptions below.

Employees will be expected to work a standard 44-hour workweek, with actual work hours to vary, depending on the requirements of the Reserve's seasonal work program and the varying demands of users of the Reserve facilities. In general, Reserve staff will not be directly involved in providing direct services outside of regular work hours, but staff of concessionaires for campgrounds, mooring operations, dive and island tour operators may be involved in providing services to tourists and other users outside of normal business hours, and these activities will have to be occasionally monitored

Management Roles and Responsibilities

Staffing and Training

Job Descriptions

Position: Reserve Manager

The Reserve Manager will report to the [to be completed]. The responsibilities and qualifications will be as follows:

Responsibilities:

- To oversee and implement the development and management of the Bird Island Marine Reserve.
- To supervise Reserve staff.
- To coordinate activities within the Reserve; those involving Reserve staff as well as those of Government agencies, visiting researchers, and others.
- To coordinate efforts to sensitise and educate politicians and the general public about the Reserve.

Qualifications:

- A Bachelor's Degree in natural resource management or natural science, with preference given for training in coastal zone management or marine resource issues and a minimum of 2 years work experience at the management level (additional work experience may substitute for the Bachelor's Degree).
- Experience in project management: proposal development, project implementation, administering budgets, preparing fiscal and technical reports.

- Strong commitment to co-management of natural resources, involving the stakeholders, technicians and regulatory bodies.
- Demonstrated ability to communicate effectively in speaking and writing.
- Willingness to work flexible and seasonally changeable work schedules, without direct supervision.

To apply: Send application letter highlighting relevant experience and interest, curriculum vitae, writing sample and three references to the Company.

Position: Reserve Wardens

The Reserve Wardens will report to the Reserve Manager. The responsibilities and qualifications will be as follows:

Responsibilities:

- To patrol the Reserve to monitor its use and to ensure that visitor activities comply with regulations.
- To sensitise visitors on appropriate practices and uses of the Reserve that will sustain and enhance its natural resource amenities.
- To assist visitors to enjoy the Reserve and use it safely.

Qualifications:

- Basic familiarity with the sea and the use of an outboard motor boat. Preference given for specific familiarity with the North Sound, and for any training expected to assist in the applicant's ability to carry out job responsibilities.
- Certificates and/or training in the following areas, or a willingness to undertake training successfully: CPR; boat safety; boat maintenance; heritage interpretation; enforcement.
- Strong commitment to co-management of natural resources, involving the stakeholders, technicians and regulatory bodies.
- Willingness to work flexible and seasonally changeable work schedules, without direct supervision.

To apply: Send application letter highlighting relevant experience and interest to the Reserve Manager; Bird Island Marine Reserve.

Research, Interpretation, Education and Enforcement

Research and Assessment

Appendix II provides a detailed monitoring strategy for both the Bird Island Reserve and the wider North Sound area.

Research should be focused primarily on management needs. The major marine habitats of the management area, particularly the reefs, seagrasses, mangroves, and shorelines need to be quantitatively assessed in a manner compatible with continued long-term biological monitoring.

Water quality within the North Sound/Parham Harbor area is of vital concern to the health of the area's marine resources. A thorough analysis of sedimentation, nutrient, and pollution sources entering the ecosystem via nearby watersheds should be coupled with realistic management recommendations at the earliest opportunity.

The unique biological resources and habitats of Bird Island and the other small islets of North Sound have been assessed to provide a sound baseline for data for management. The viability of restoration of bird populations and possibly other native plants and animals should be evaluated and incorporated into early management strategies.

Building Public Support for the Reserve

Environmental Awareness Group of Antigua-Barbuda (EAG)

In addition to its designated role as a member of the Bird Island Marine Reserve Advisory Committee, the EAG is the accepted lead institution for public information and education about the organization and operation of the Bird Island Marine Reserve. A summary of information about the EAG appears in the box below.

Environmental Awareness Group

Purpose and Goals

The Environmental Awareness Group (EAG) was established in 1989 to make people more aware of the value of our natural resources, and to educate them on the threats to the environment and the need to protect it.

The goals of the organization are:

- To increase public awareness of the importance of the natural and cultural resources of Antigua and Barbuda and of the need for their conservation;
- To support and undertake projects designed to create a better understanding of the natural and cultural resources of Antigua and Barbuda, and to conserve these resources;
- To serve as a clearing house for environmental information in order to assist the Government of Antigua and Barbuda and any other governmental or non-governmental bodies to conserve the natural heritage of Antigua and Barbuda.

Activities:

- Sponsor environmental education activities to increase the public's awareness of environmental issues through the media—TV, radio, and articles in the local papers.
- Sponsor environmental events such as Earth Day and clean-up campaigns.
- Sponsor lectures and field trips on environmental topics by local researchers and concerned individuals.
- Produce quarterly newsletter.

Current Programs

The Agroforestry Committee

is presently rebuilding and restocking the EAG tree nursery which was damaged by Hurricane Luis. Recently an In-schools Tree Programme was developed to improve youth skills in tree care, propagation and maintenance.

Artificial Reef

The EAG, in collaboration with the Seatons' community have begun to develop an Artificial Reef at Mercer's Creek which will reuse more than 10,000 used tyres. The project received technical assistance and funding from the Caribbean Natural Resources Institute (CANARI). Already the reef is increasing local fisheries and improving recreational diving.

The Biodiversity Program

was conceived to preserve Antigua-Barbuda's terrestrial and marine biodiversity. Implemented in collaboration with Island Resources Foundation and with support from scientists at Fauna and Flora International (FFI), this program is entering its third year.

The Environmental Education Program

is broad based, reaching out to school children, community groups, the general public and tourists. This program is the main public outreach arm for all EAG projects.

The Wallings Reservoir Conservation Project

is jointly undertaken with the Division of Forestry, through a grant from the International Institute of Tropical Forestry of the US Department of Agriculture. The project is working to protect the largest remaining tract of moist forest in the country

The establishment of the Bird Island Marine Reserve is an exciting, but challenging, new step in the country's efforts to protect its marine resources.

The Reserve will be the first marine area to have regulations and managers, and it is to be expected that it may take some time for those that use the Reserve to adjust to the greater level of management that exists there. How quickly and how successfully this happens will depend on many factors, which are considered in the following communications strategy designed the Environmental Awareness Group (EAG) of Antigua, and many of which will depend on the publicity given to the development of the Reserve through the Development Company and the Advisory Company.

Most Antiguans are unaware of the reasons that the Reserve has been established. The Marine Reserve, through the public information program of the EAG and well publicized statements of the Development Company and the Bird Island Marine Reserve Advisory Committee, needs to explain the *benefits deriving from wise natural resource management*, and the specifics on how the Reserve can increase incomes *and* the quality of people's lives while maintaining reasonable protections for the resource base. The Environmental Awareness Group has proposed a plan for raising public awareness, including actions targeted to schools and the country's youth.

Four major issues which need to be addressed in a public outreach programme for the Bird Island Marine Reserve have been determined from information gathered from interviews with stakeholders of the Marine Reserve and documented in "Usage Patterns and the Resource Management Perceptions of Users" prepared by Island Resources Foundation. These four issues, plus the question of financing the information, education and marketing needs of the Marine Reserve and outlined below.

The Issues

- *A need to raise awareness about the objectives and goals of the planned project to create the Bird Island Marine Reserve.*

Many people are unaware of the project and why such a project is necessary for the area. What is management? Why does the area need management? What are the social and economic and environmental benefits of management.

- *A need to increase appreciation of the biodiversity and economic importance of the Bird Island Marine Reserve area.*

To gain wider acceptance of the need to manage, people need to know why this site is so significant. The large numbers of users in the area vs. The fragility of the environment needs to be highlighted so that stakeholders and the public can appreciate the need for management.

- *Lack of a clear understanding of the reasons for resource depletion or deterioration that has been seen in the area of the Bird Island Marine Reserve and North Sound.*

Many stakeholders are unclear as to how their actions and activities may have a negative impact on the environment of the BIMRWS. Recognized environmental degradation and depletion is seen as a cause of some other resource user and not related to themselves. Persons in nearby communities may not see themselves as players in the marine environment.

- *Ensure that government officials are kept informed on the findings and progress of the project.*

It is important to keep government informed at all times on the project's progress and the important aspects that will need their attention.

- *Provide funding for increased levels of information, marketing and environmental education activities tied to the Marine Reserve.*

Preliminary aspects of the information program outlined in Table 6 have been paid for under this project (OAS Performance Contract No. WSC14721), and basic production costs for most of the materials needed for the operations of the reserve have been included in the costs identified in Appendix III, and summarized in Table 5, above.

In order to implement the full range of "marketing" and environmental education programs discussed below will require an additional staff position with the EAG, and approximately EC\$20,000 per year in expenses, for a total added cost of about \$150,000 per year in costs not necessary for the direct operation of the Reserve, but extremely valuable in demonstrating the utility of the Reserve to both tourist and resident alike.

Details of the implementation of the public outreach plan are presented in the tables in the following section.

Table 6: Bird Island Marine Reserve Public Outreach Programme Plan

Issue 1. To raise awareness about the objectives and goals of the planned project to create a marine reserve and wildlife sanctuary around the Bird Island area.	
Target Audience	Message
The Antiguan public Fishermen Tour Operators Recreationalists (yachting and boat-owners)	The social, economic and environmental benefits of the Bird Island Marine Reserve Discuss similar successful parks/ reserves in other islands
	Action
	Write articles, for newspapers Write TV and radio public Service Announcements Encourage participation in the Public Forums Organize a TV talk show on ABS—Feedback or similar programme
	Time frame
	Articles to be written between early in the interim management period . Public Service Announcements (PSAs) for radio and TV to be written during 2nd and 3rd months of program operations. Talk show to be organized for month three after information gathered at the various public forums.
Issue 2. To increase public appreciation of the biodiversity of the Marine Reserve area and the area's economic importance to Antigua-Barbuda.	
The Antiguan public	The Bird Island Marine Reserve area is extremely important because of its biodiversity (information from reports on snake project, monitoring of nesting birds) Economic importance for <ul style="list-style-type: none"> • <i>tourism and</i> • <i>fisheries</i> • <i>recreation</i> (information from research on user-groups)
	Action
	Write articles in newspaper Radio and TV public service announcements
	Time frame
	Articles to be written on this topics early in the interim management period. Radio and TV PSA's to be written and broadcast early in the interim management period.

Target Audience	Message	Action	Time frame
School Children in <ul style="list-style-type: none"> • Seatons Community • Parham Community • Willikies Community 	As above	In-school slide and poster presentation at schools in these communities.	Arrange with teachers to give presentation at end of second or third month (depending on school schedule).
Persons in <ul style="list-style-type: none"> • Seatons • Parham • Willikies 	As above	Slide presentation at community meetings/ gatherings.	Arrange with communities leaders to give a presentation in third or fourth month.
Issue 3. A lack of a clear understanding of the reasons for resource depletion or deterioration that has been seen in the area of the Marine Reserve and Northeast Coast Management Area.			
Fishers Tour Operators Recreationalists The Antiguan public	Reasons for the depletion of fish stocks <ul style="list-style-type: none"> • Over-fishing • Ghost fishing • damage of fish habitat Coral life is damaged and will deteriorate because of: <ul style="list-style-type: none"> • breakage from walking on reefs, harvesting pieces of coral, and anchor damage • discharge of pollutants into marine environment. Decrease in seabirds due to	Articles in newspaper Spot on radio /TV	As above

	<ul style="list-style-type: none"> stealing of eggs; predation by rats. 		
<p>Target Audience</p>	<p>Message</p>	<p>Action</p>	<p>Time frame</p>
<p>School Children and persons of the</p> <ul style="list-style-type: none"> Seatons Community Parham Community Willikies Community 	<p>As above</p>	<p>Presentation at schools and community meetings</p>	<p>Arrange with teachers to give presentation at end of second or third month (depending on school schedule). And with community leaders early in the interim management period.</p>
<p>Issue 4. Ensure government officials are kept informed with the findings and progress of the project.</p>			
<p>Fisheries Officers</p>	<p>Not any one specific message</p>	<p>Ensure that all Government officials receive regular circulars or memos about the progress of the project.</p>	<p>Throughout the project.</p>
<p>PS of Min. of Tourism and Environment Environmental Officers</p>	<p>Information derived from the project must be made available to Government officials</p>		

Information and Education

The quality of the experience for people visiting the Reserve can be improved, and their impacts reduced, through an information and education program. A welcome sign at both landing sites will greet visitors, introduce them to the Reserve, its attractions and the basic do's and don't's. Other signs, situated along the hiking trails, will provide interpretive material on the natural history of the island and the North Sound. In addition to the signs, there should be brochures and perhaps other interpretive materials available. Guided tours of terrestrial and marine attractions can be developed with the Reserve staff, or contractees such as the EAG and others on a volunteer or commercial basis. Even if much of the interpretation is handled by contractees, the staff should receive training in heritage interpretation and dealing with the public. As discussed in the next section as well, selecting the right staff and providing them with appropriate training is important to the success of the Reserve.

Enforcing Regulations:

If the Reserve is going to be successful, "enforcement" of regulations will take place primarily through voluntary compliance promoted through the public outreach and education programs. In fact, the areas and issues that become identified as problem areas for enforcement will become priorities for those programs. In cases where regulations must be enforced, the Reserve staff should be as courteous and non-confrontational as possible. They are primarily educators, not police; and they should direct their problems to the appropriate authority at the most immediate opportunity. Staff should receive training on enforcement techniques to minimize their need to function in this capacity, and to ensure that when they are forced into this role, they handle it with sensitivity towards their primary role as hosts. An excellent way to provide staff training on a range of topics would be to offer them opportunities for short-term attachment assignments at selected marine parks and reserves within the Caribbean.

The primarily educational role of the Marine Reserve Supervisor and Wardens notwithstanding, the draft regulations in Appendix IV make clear that the staff of the Reserve will be fully deputized, and will have full authority to enforce both regulations specific to the Marine Park, and general fisheries and park regulations of the state of Antigua and Barbuda.

Marketing and Publicity

Financial self-sufficiency is essential to the long term success of the Bird Island Marine Reserve. Since the revenues generated directly by the reserve will be a function of the number of paying visitors, an effective marketing program must accompany development of the Bird Island Marine Reserve. For this, a professional should be engaged with a proven record of success in such efforts. Marketing and advertising should be aggressive, and designed to make all tourists visiting Antigua aware of the Marine Reserve and its attractions. At least some of the resorts now operating on Antigua appear to employ a deliberate strategy of attempting to keep their guests [and their money] confined to the premises.

Marketing of the Marine Reserve might include such proven tactics as:

- Full color posters placed at strategic locations throughout the island
- Brochures distributed to cruise ship passengers
- Videos shown to all incoming international air visitors
- Informational sheets on Antigua's national parks distributed to all visitors by Immigration at time of clearing
- Feature articles in dive/travel magazines

APPENDIX I

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APPENDIX II

PROPOSED ENVIRONMENTAL MONITORING PLAN FOR THE BIRD ISLAND MARINE RESERVE

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1. EXECUTIVE SUMMARY

This report details a monitoring plan for the Bird Island Marine Reserve which covers several topic areas: water quality, seagrasses, coral reefs, reef associated fishes, beaches, sea turtles and snakes. The monitoring plan covers different levels ranging from the basic to the more advanced techniques and includes costing, logistics and linkages with ongoing monitoring efforts. While it is expected that several agencies/individuals will take part in the monitoring, it is recommended that one agency undertake an overall coordination role.

2. INTRODUCTION

The purpose of this report is to prepare a monitoring plan for the proposed Bird Island Marine Reserve. This will form part of a management plan for the Marine Reserve. The specific terms of reference for this report are contained in Section 6. While the proposed Reserve is the main focus of this report, recommendations for monitoring will be placed in the context of the Northeast Coast Management Area (NECMA) and the island of Antigua as a whole.

A visit was made to Antigua by Dr. Gillian Cambers and Ms. Ginger Garrison in December 1996, in order to meet with the relevant agencies and organizations, to visit the site and to determine monitoring needs.

After describing the background to the project and discussing some general concepts regarding monitoring, the main part of this report deals with the specific subject areas/species to be monitored. These include water quality, seagrasses, corals, reef-associated fishes, beaches, sea turtles and snakes. (Wetlands have not been included in this list for their monitoring is already the subject of an existing proposal). A short background on each specific topic is followed by a description of the present status of monitoring and finally the recommended monitoring. In some subject areas, several levels of monitoring ranging from the minimum to the optimal are presented.

The goals and objective statement for the monitoring plan is as follows :

This monitoring plan aims to provide accurate and relevant information on changes in key physical and biological parameters within the Northeast Coast Management Area, which when combined with socio-economic parameters, will provide the necessary tools for effective management of the Bird Island Marine Reserve.

3. BACKGROUND

As part of the Parham Harbour Development Project, a proposal was made to establish the Bird Island Marine Reserve. While there is as yet no official declaration for the Reserve, there does exist between the Government of Antigua and Barbuda and the Organization of American States (OAS), a Memorandum of Understanding to promote the master development plan report entitled "Development of Tourism Infrastructure at Parham Harbour, Antigua." The establishment of the Reserve is a part of this plan.

While the initial Parham Harbour Project proposed extensive dredging of channels leading to the harbor, this proposal has since been scaled back so that now minimal dredging in the area west of Maiden Island is proposed.

3.1 Related Ongoing Projects

The following represents a short list of current projects which are ongoing in Antigua and Barbuda and relate to the proposed monitoring of the Reserve.

- **CFRAMP (Caribbean Fisheries Resources Assessment and Management Programme)**

This is a six year project, due to finish in 1997, and funded by CIDA (Canadian International Development Agency). A major goal has been to establish sound databases on fish catch and effort throughout the Caribbean region. In addition some general habitat assessment has been undertaken for Antigua and Barbuda, as well as other countries, using aerial photography, satellite imagery and ground truthing.

- **COSALC (Coast and Beach Stability in the Lesser Antilles)**

This regional project, which includes Antigua and Barbuda, is designed to develop local capacity to measure, assess and manage beach resources within an overall framework of integrated coastal management. COSALC is sponsored by UNESCO and the University of Puerto Rico Sea Grant College Program. Within the program regular beach monitoring has been established in Antigua and Barbuda and is conducted by the Fisheries Division (FD) and the Development Control Authority (DCA).

- **CPACC (Caribbean : Planning for Adaptation to Climate Change)**

This is a six year project due to start early in 1997, to be funded by the Global Environment Facility (GEF) and the World Bank and executed by the OAS. In Antigua and Barbuda it will include the measurement of sea level changes through the establishment of 2 tide gauges, climate monitoring, a partial resource inventory, strengthening of coastal zone management, and an economic valuation of coastal resources.

- **OECS-NRMU Coastal Resources Management Project**

One of the major components of this project will be the preparation of coastal inventories using aerial photographs, satellite imagery and ground truthing, using a similar methodology to that adopted in Anguilla (Blair-Myers *et al*, 1995). These inventories will be incorporated into each country's geographical information system (GIS). The time framework for this project is not yet confirmed.

- **UNEP Impacts and Adaptations Country Study**

This 18 month long study, which is approximately halfway through, is designed to focus on how climate change will impact several different sectors within Antigua and Barbuda, including the coastal zone and fisheries; water resources; agriculture, livestock and forests; human health; human settlements; the economy and tourism.

- **University of Georgia Sea Turtle Project**

This project monitors the nesting Hawksbill turtle population at Pasture Bay, Long Island in conjunction with the Jumby Bay Resort. Monitoring has been conducted since 1987.

4. PROPOSED MONITORING

4.1 General Concepts

Four main issues will be addressed here: information ownership, monitoring coordination, the accurate mapping of spatial data, and financing the costs of the environmental monitoring.

4.1.1 Information Ownership

It is recommended that in the first instance, Antigua and Barbuda should clearly

state the policy that all information collected within this and other monitoring programs belongs to the intellectual domain of Antigua and Barbuda. While this does by no means preclude agreements with institutions and individuals to publish such information, the ownership of this information lies with Antigua and Barbuda and copies of all information and reports must be lodged with the relevant institution(s) in Antigua and Barbuda.

4.1.2 Monitoring Coordination

The proposed monitoring outlined in this report is likely to involve several different agencies and institutions from the government and private sectors. This is advantageous since it is in keeping with the overall concept of integrated coastal management (ICM) which seeks to involve as many different stakeholders as possible. However, it is essential that one agency undertakes coordination of the proposed monitoring of the BIMR, and that copies of all data and reports be lodged with that agency. The following agencies, listed alphabetically, could perform the coordination role :

- Environment Department
- Environmental Awareness Group (EAG)
- Fisheries Division (FD)
- Parham Harbour Development Company (and/or the technical unit yet to be established).

4.1.3 Standards of Mapping Accuracy

All monitoring and sampling sites should, of course, be mapped as accurately as possible on a marine chart. In Antigua in early 1997, global positioning system (GPS) receivers have an accuracy of plus or minus 100 m. Positioning a site on a chart using compass bearings and knowledge of the area can be much more accurate than using a GPS location which has not been differentially corrected by a base station. To obtain spatial data with an error of only a few meters, minimum equipment requires two hand-held GPS units in conjunction with expensive software programs and a laptop computer. The cost would be at least US\$ 6,000. It may be possible to collaborate with the OECS-NRMU coastal inventory study (see Section 3.1) who will most likely have this equipment.

[All costs quoted in this report are in US dollars.]

4.1.4 Costs of Environmental Monitoring

This report provides accurate estimates of costs for monitoring activities, as they would cost in the Eastern Caribbean in early 1997. Each section also includes a listing of possible links to current monitoring activities at the local, regional and international level, which in some cases could help to support some monitoring costs. Financing these costs will be a complicated process of coordinating existing programs, and securing future sources of funds from public and private resources, including private activities of researchers from around the world who frequently seek to study Antiguan coastal and marine conditions.

Coordinating the various sources of monitoring information, in conjunction with securing and endorsing funding requests for gaps in the current monitoring program, will have multiple pay-offs for the long-term assessment of environmental conditions in the northeastern areas of Antigua, and probably for applying other research activities in the general region to resource management problems in Antigua. In many respects, the costs of monitoring and assessing the environment of the Bird Island Marine Reserve can be recovered by building a productive, collegial relationship with environmental scientists throughout the region (see especially the list of related programs in Section 3.1, above) and the world. This will be primarily the task of the coordinating group selected, as discussed above in section 4.1.2.

4.2 Water Quality

The water quality of the sea surrounding Antigua affects the human inhabitants, their livelihood (fishing and tourism), recreation (swimming, boating and fishing), and the marine plants and animals (e.g., seagrasses, coral reefs, conch, whelk, lobster, sea urchins, fishes, sea turtles, sea birds, whales and dolphins). Both natural events and man's activities can degrade the quality of water. By monitoring the physical, chemical and biological parameters of the marine waters, management will have the information necessary for protecting the quality of the water and the health of its citizens.

4.2.1 Present Status

The Central Board of Health started in 1996 to test periodically for fecal coliform and *Streptococcus sp.* at selected sites, none to our knowledge in the NECMA, however, our information on present marine water quality monitoring in Antigua is incomplete. Bunce (1995) recorded horizontal and vertical Secchi depths at ten coral reef sites near GBI in the Fall of 1995.

4.2.2 Recommended Monitoring

Minimum:

- (a) Sites: GBI (off both north and south beaches), Fitches Creek, and Parham Harbour (at dock).
- (b) Methodology: Temperature (thermometer), Secchi depth, pH (pH meter), conductivity (salinity) (conductivity meter or refractometer) and suspended solids (Rogers, *et al.*, 1994). Three replicates at each site would be best. However, one sample per site is better than none.
- (c) Frequency: Best - monthly for first year, then re-evaluate and possibly go to quarterly (same time as beach profiling).
- (d) Who: Field sampling could be done at the same time as the beach profiling work, at GBI and while either coming or going at Parham and Fitches Creek. Perhaps a secondary science course or college science course could use the monitoring as a practical field experiment. That would have to be coordinated through the central coordinating agency. If this was ongoing for a few years, the teacher/classes would have an interesting data set which could be analyzed and interpreted. For pH, conductivity and suspended solids, the brewery might be able to donate their time and skills to measure these 3 parameters in their laboratory (if 3 from each of 4 sites was too much, 1 would be adequate).
- (e) Person-days: One half of a person day per month.
- (f) Equipment: Thermometer (\$25 for mercury and \$50 for electronic), Secchi disk could be made from metal or wood and painted white (\$5) or bought (\$30), pH meter (\$75) and conductivity meter (\$100) or refractometer (\$30). If the brewery was kind enough to do the laboratory tests for pH, conductivity and suspended solids, Nalgene or glass sample bottles would be needed (approx. \$40). Boat, fuel and captain for GBI sampling.
- (g) Training: One day of training to teach proper sampling techniques, use of pH and conductivity meters, use of Secchi disk.
- (h) Data: Field data copied and archived at coordinating agency. Data entry and archiving by people taking measurements in the field. QA/QC by CBH on Antigua or CEHI.

Intermediate:

- (a) Sites: GBI (off both north and south beaches), Fitches Creek, Parham Harbour and Jumby Bay.
- (b) Methodology: Same as above, adding preferably *Enterococcus sp.* or fecal coliform counts (CEHI standard methods). Tests for *Enterococcus* are preferred, as that is the current US EPA and UNEP standard (not fecal coliform).
- (c) Frequency: Three replicates per site monthly are preferable. Two samples per site every other month is preferable to one sample per site per month.
- (d) Who: At Jumby Bay, Long Island, perhaps the sea turtle researchers could take the monthly field readings and take water samples which would be delivered to either possibly the brewery or CBH for laboratory analysis for pH, conductivity, suspended solids and *Enterococcus sp.* or fecal coliform. GBI could at minimum be done during beach profiling, while Parham and Fitches' Creek could be sampled from shore.
- (e) Person-days: One half day per sampling period.
- (f) Equipment: Same as above. Glass bottles for sterilization (bacterial counts). A laboratory equipped to do bacterial counts is essential, as they would need to sterilize the sample bottles between sampling periods.
- (g) Training: Same as above.
- (h) Data: Same as above

Optimal:

- (a) Sites: GBI (north and south), Parham, Fitches' Creek, Jumby Bay. If any dredging occurred, Maiden Island should be added.
- (b) Methodology: Same as above; add field measurement of dissolved oxygen, transmissivity (percent transmission of light), photosynthetically active radiation (PAR) profile of the water column (determine extinction coefficient of water), determination of nutrient concentration (nitrate, nitrite, ammonia, phosphate) and concentration of chlorophyll a and c.
- (c) Frequency: Monthly for first year; after re-evaluation, could possibly decrease to every other month or quarterly.
- (d) Who: Same as above.

- (e) Person-days: One person day.
- (f) Equipment:
- (1) A multiparameter meter (temperature, pH, conductivity, salinity, dissolved oxygen) (\$3500); pH 4 and 7 buffer capsules (\$50); KCl (\$25); 3 - 1.0 liter erlenmeyer flasks (\$30); 1 - 500 ml volumetric flask (\$25); a toploading balance (\$250-300);
 - (2) transmissometer (\$5000);
 - (3) spectroradiometer (PAR) (\$4000).
 - (4) Samples would be mailed to a laboratory for determining nutrients and chlorophyll a and c (minimum of \$25 per sample and postage of approximately \$45 per period). Minimum equipment is 40 - 250 ml Nalgene bottles and 40 75-100 ml Nalgene bottles, hydrochloric acid for rinsing sample bottles, distilled water for washing sample bottles and glassware, a 1 liter vacuum flask with filter base, 0.45 micrometer glass fiber filters and vacuum pump - approximately \$600). As another option, chlorophyll a could be determined using a flow through fluorometer in the boat (\$7000); 12 v battery and water pump are also needed for the fluorometer (see Turner Instruments documentation).
- Funds for the multiparameter meter, transmissometer, spectroradiometer and fluorometer might be available through the CPACC program.
- (g) Training: Approximately a month (depending on the person's experience) of initial training, after which the trainer would accompany the field sampling personnel for the first few sampling periods and after the first year.
- (h) Data: Entered in a standardized Quattro Pro or Lotus spreadsheet compatible with either CEHI or the U.S. water quality STORET program (spreadsheet available from Virgin Islands National Park). Copy sent on diskette annually to either CEHI or US NPS Water Resources Division, Ft. Collins, Colorado for incorporation into their database. QA/QC by CEHI or CBH.

4.2.3 Linkages with other Activities

- done at same time as beach profiling
- possibly involve secondary or college science students, which would also serve to make students more environmentally aware.

- possible cooperative effort with the brewery, CBH, Georgia Sea Turtle Cooperative (Jumby Bay Sea Turtle Project), CEHI, US NPS Water Resources Division, CPACC.

4.3 Seagrasses

Seagrass beds are important for many reasons: they produce oxygen for animals to breathe; trap and stabilize sediment runoff from land; provide the primary food for the endangered green sea turtle (*Chelonia mydas*); and are a source of food and shelter for conch and many species of juvenile and adult reef fishes (e.g. grunts, parrotfishes and porgies), including grouper and snapper which forage for the invertebrates living in the habitat. Seagrass beds in Antigua cover a large portion of the sea bottom in Fitches' Creek and Parham Harbour and occur in many other areas of the NECMA (e.g. GBI). *Thalassia testudinum* and *Syringodium filiforme* are the dominant species.

4.3.1 Present Status

To our knowledge, no monitoring or research is presently being carried out.

4.3.2 Recommended Monitoring

Seagrass beds in Antiguan waters are well developed and extensive. Monitoring the species, density and extent of the beds should be a priority.

Minimum:

- (a) Sites: GBI (south beach anchorage), Fitches' Creek and Parham Harbour.
- (b) Methodology: Random quadrats; species identified; blades per shoot and shoots per unit area counted; photos of moorings and surrounding seagrass could follow changes in or regeneration of seagrass beds. (See Rogers *et al*, 1994). A minimum of ten 20 cm by 20 cm quadrats randomly thrown at each site.
- (c) Frequency: Annually.
- (d) Who: Possibly Fisheries Division who have expressed an interest in the past in monitoring mangroves and seagrass beds, but lacked sufficient staff. Monitoring could be combined with water quality at Fitches' Creek and Parham Harbour and beach profiling at GBI. EAG at GBI when censusing racers. Secondary or college science classes as a class project. Most areas are

shallow enough to stand.

- (e) Person-days: 1 person day per site.
- (f) Equipment: 20 cm x 20 cm meter quadrats made of PVC pipe (\$10 for 6 quadrats); underwater slates, mylar paper and pencils (\$5 per field person). Mask, snorkel and fins (\$150 each, maximum). Fiberglass tape (\$25 each). If photographing, could use an inexpensive "throw-away" Kodak camera with 27 prints, rated to 12' and at a cost of approximately \$15, developing of duplicate set of photos (\$30). Or, a Nikonos V could be purchased for coral and seagrass monitoring (\$450). A strobe (SB103 - \$450) would be useful for deeper photography (over 25'). Boat, fuel and captain for GBI. Fitches Creek and Parham Harbour could easily be done from land.
- (g) Training: One day in the field; QC check at next field session.
- (h) Data: Field data sheets copied and archived at coordinating agency. Data entered by field personnel in computer spreadsheet (available from Virgin Islands National Park or CANARI). Copy of computer data to OECS-NRMU for integration into their data set for habitats inventory. QA/QC the responsibility of OECS-NRMU habitat inventory. Duplicate set of prints archived at coordinating agency.

Intermediate:

- (a) Sites: GBI (south beach anchorage), Fitches' Creek and Parham Harbour.
- (b) Methodology: Random quadrats; species of seagrass identified; blades per shoot and shoots per unit area counted; photographs of mooring pins and surrounding seagrass bed. To this would be added, groundtruthing of seagrass bed boundaries -particularly nearshore at Fitches' Creek and Parham Harbour.
- (c) Frequency: Annually.
- (d) Who: Same as above.
- (e) Person-days: 1.5 person days per site
- (f) Equipment: Same as above.
- (g) Training: Same as above.
- (h) Data: Same as above. Changes in extent of seagrass beds would be noted on maps and added to computer database. Copy to coordinating agency, which would also archive copies of field maps.

Optimal:

- (a) Sites: Same as above.
- (b) Methodology: OECS-NRMU detailed inventory of habitats around Antigua; utilizing satellite imagery, aerial photos and extensive ground-truthing. Include the above quadrat work for densities and species. Permanent transects from nearshore to farthest extent of seagrass bed. Marked with permanent stakes. A minimum of 10 quadrats censused and counted along each transect.
- (c) Frequency: Quadrat work would optimally be done annually. Habitat mapping — annually.
- (d) Who: OECS-NRMU. Same as above for density and photography field work.
- (e) Person-days: For density work, approximately 3 person days per site.
- (f) Equipment: Same as above and stakes pounded into substrate and marked with flagging tape.
- (g) Training: Same as above.
- (h) Data: Same as above. OECS-NRMU would provide detailed habitat map and inventory to coordinating agency.

4.3.3 Linkages with other Activities

- will complement Fisheries Division studies targeting seagrass and mangrove nursery areas to be designated as reserves.
- complement OECS-NRMU detailed habitat maps and inventories for the region.
- could be done at same time as beach profiling or snake surveys (EAG) at GBI.

4.4 Coral

Scleractinian corals occur in warm marine waters with low nutrient concentrations and good light penetration. The hermatypic species form reefs which protect coastlines from erosion, produce oxygen for marine and terrestrial animals to breathe, provide shelter and food for a large number of plant, invertebrate and vertebrate animals (including reef fishes and spiny lobster) and bolster the local economy by attracting visitors who snorkel and scuba dive. In the last few years,

scientists have reported declines in the amount of living scleractian coral on reefs in the Caribbean Region and a lack of recovery from damage (e.g. Hughes, 1994; Rogers et al 1996). Because the North Equatorial Current in the Atlantic is the primary source of sea water which flows past Antigua (with nutrient influxes coming from the discharge of the Orinoco and to a lesser extent, the Amazon River), monitoring the coral in Antigua could shed light on the processes negatively affecting the region's reefs.

4.4.1 Present Status

The most recent study was a Rapid Assessment by Goreau and Goreau in 1996. Bunce (1996) carried out a survey in 1995 and Reef Watch in conjunction with the University of York produced a general survey in the early 1990s. The Fisheries Division carried out a survey on Cade's Reef in the early 1990s.

4.4.2 Recommended Monitoring

Water temperature and visibility (at least Secchi depth) should be taken in conjunction with coral monitoring. If funds are available, a Ryan thermister (\$400) in an underwater case (\$300) could be attached to the bottom and left for up to 9 months, then downloaded to a computer for temperature information over the time period. The thermisters should be recalibrated before replacement.

Minimum:

Reefs in the NECMA are reported to have low coral cover (Bunce, 1996). However, large head and branching corals which are primary reef builders do exist and should be photographed over time.

- (a) Sites: GBI south and west snorkeling areas; dive sites to east and at Little Bird Island, if possible.
- (b) Methodology: Randomly photograph 36 (a roll of film) areas at each site. A quadrat or ruler should be placed in each photograph for scale.
- (c) Frequency: Annually and after major events such as hurricanes and periods of high swell from winter storms.
- (d) Who: Fisheries Division if they have sufficient staff. Secondary or college science students for class field projects.
- (e) Person-days: One half person day per site.

- (f) **Equipment:** Underwater camera: Kodak "disposable" camera can be used to 12', takes 27 prints and costs approximately \$20 to purchase and \$30 to develop duplicate set of prints; Nikonos V can take up to 36 slides or prints, can be taken to beyond monitoring depths, can be used with a strobe, costs approximately \$450, strobe (SB103) cost is \$450, film and processing \$15-30 for 36 exposures. Fiberglass tape (\$25), underwater slate, mylar paper, pencil (\$5 per field worker). Full SCUBA equipment for 2 divers (\$1500) (EAG already has SCUBA equipment). Boat, gasoline and captain for transport.
- (g) **Training:** One day training for random photos of reef.
- (h) **Data:** Set of documented prints archived at coordinating agency.

Intermediate:

- (a) **Sites:** Same as above.
- (b) **Methodology:** Same as above with addition of photographing individual *Montastrea annularis* and *Diploria labyrinthiformis* coral heads, thickets of *Acropora cervicornis* or *prolifera*, and recruiting colonies of *Acropora palmata*. To follow a colony over time it will be necessary to mark it. Cement pins or nails with numbered cattle tags in dead substrate next to large coral heads or branching coral "thickets". Photograph each coral head or "thicket" from the same direction, with the identifying tag in the photo, as well as a fiberglass tape or ruler for scale. Colonies should also be measured (maximum, ninety degrees to maximum and height) with calipers or a fiberglass tape (see Rogers, et al., 1994 for methods). Photoquadrats could be digitized and percent cover of organisms determined.
- (c) **Frequency:** Annually.
- (d) **Who:** Same as above.
- (e) **Person-days:** 2 days per site to select coral heads, drill holes and cement pins. One person day to relocate, photograph and measure colonies at each site, more time if using scuba.
- (f) **Equipment:** Same as above; copper clad survey stakes (\$5each), sledge hammer, Cattle tags (\$35/100); possibly quadrat for camera (\$50); scanner (\$1000) and computer (\$3000).
- (g) **Training:** Six to eight days to train, select coral heads and cementing pins. QC follow-up the second year. At least five days training in scanning and digitizing photos. Digitizing could initially be done off island, if scanner and computer were not available.

- (h) Data: Same as above. Coral head measurement data entered on computer spreadsheet standardized to that used by either CANARI, Virgin Islands National Park (VINP), or The Nature Conservancy (TNC). Scanned photos archived on write-to CD (off island) and digitized data entered in spreadsheet standardized with CANARI. In addition, QA/QC on photos scanned and digitized (possibly CANARI, CARICOMP or TNC).

Optimal: Video transects (analog or digital)

- (a) Sites: Snorkel and dive sites in NECMA.
- (b) Methodology: Same as minimum with the very expensive addition of video taping of random transects (100 m) on as many reefs as possible. (See Aronson et al 1994 and Carlton and Done, 1995).
- (c) Frequency: Annually
- (d) Who: Highly trained technician to maintain camera, do underwater filming, identify organisms and analyze individual frames, run software programs.
- (e) Person-days: Probably 2 sites or 4 transects/ day for filming and 2 people. Downloading and analysis requires approximately three times that number of person days per 100 m transect.
- (f) Equipment: Same as above PLUS analog (\$600) or digital (\$3900) video camera; underwater housing (\$2600); video tapes (\$10-25/transect); either a high resolution tape deck (\$1200) Or down-loading card (\$800); computer (\$3000-7000) and software (up to \$1500).
- (g) Training: minimum of a few weeks for organism species identification, camera care and maintenance, underwater video techniques, use of random dot grid/ or downloading of digital images, manipulation of images, analysis and archiving on write-to CD.
- (h) Data: Same as above. Video tapes or captured frames on CD should be duplicated and archived off island perhaps at CARICOMP or TNC as well as with the coordinating agency. QA/QC could be done by another scientist off island, using duplicate video or captured frames on CD. Spreadsheets standardized with other scientists using technique (e.g., Florida Marine Research Institute, EPA, or Aronson at University of Alabama).

4.4.3 Linkages with other Activities

- could be integrated into the Fisheries Division's proposed coral reef, seagrass

and water quality monitoring program.

- possibly done at time of seagrass, water quality and/or beach monitoring.
- partnerships possible with CANARI, possibly CARICOMP, TNC or VINP.

4.5 Reef-associated Fishes

Sixty-six artisanal fishers are reported to set fishtraps, net, spear, or line fish in the waters of the NECMA (Bunce, 1995). Knowledge of the species composition and abundance of the fishery resource is crucial for effective management of the fishery. If the Bird Island Marine Reserve is eventually designated some type of a "no-take" area, continued monitoring of the NECMA catch will be especially important if we are to assess the effects of the reserve/sanctuary on the reef fish assemblages. This is of utmost importance in gaining the support of the fishers for the reserve.

4.5.1 Present Status

Port sampling of landed catch is carried out by the Fisheries Division.

4.5.2 Recommended Monitoring

Minimum:

It is very important for port sampling by the Fisheries Division to continue. In addition to the present data collected it would be helpful if the Fisheries Officer could also determine the location from which the catch was taken. This information would help quantify the number of fishers using the proposed Bird Island Marine Reserve, the methods being used and the biomass and species harvested.

- (a) Sites: Present port sampling sites in NECMA.
- (b) Methodology: Same as present with addition of location where catch was harvested.
- (c) Frequency: Same as at present.
- (d) Who: Fisheries officers.
- (e) Person-days: No additional time.
- (f) Equipment: No additional equipment.

- (g) Training: No additional training.
- (h) Data: Same as present with addition of a column for location in the computer spreadsheet. QA/QC the same as present.

Intermediate:

Port sampling would continue. In water fish censuses would be conducted on SCUBA by trained amateurs.

- (a) Sites: GBI SCUBA and snorkeling sites.
- (b) Methodology: Recreational divers are trained by the Reef Environmental Education Foundation (REEF) to do visual underwater censuses of reef fishes (see Schmitt *et al*, 1993). Depending upon the skill of the divers, species presence/absence alone or species and abundance are recorded.
- (c) Frequency: Annually.
- (d) Who: Trained recreational divers - tourists in a dive club or Antiguans.
- (e) Person-days: Approximately 8 hours for the coordinating agency to arrange details of the five day survey with REEF and an off-island or on-island dive group.
- (f) Equipment: None for the coordinating agency. SCUBA equipment, pencils and slates furnished by census divers. Boats, gasoline, captain for transport to sites.
- (g) Training: None for coordinating personnel. The training course for REEF surveys is 10-15 hours and the field surveys are 5 days.
- (h) Data: Data are transcribed in the field to a computer-read worksheet by the census-taker. The scansheets are checked by the person leading the survey and sent to REEF where they are scanned into a computer. A copy of the scansheets should be archived by the coordinating agency. REEF should send a data summary on computer diskette and hard copy to the coordinating agency.

Optimal:

Underwater visual censuses by scientists provides valuable quantitative information on the species composition and abundance of fishes in an assemblage which cannot be obtained by port sampling or other fisheries methods. However, it is time consuming and expensive.

- (a) Sites: GBI and Little Bird Island dive and snorkel sites (shallow and at 30-40' to the east of the islands).
- (b) Methodology:
 - (1) Stationary visual point count (Bohnsack and Bannerot, 1986) for fish assemblages. A minimum of 10 censuses at each site (optimization of replicates per site determined using Bros and Cowell, 1987).
 - (2) Belt transects (Beets, 1994) for serranids (groupers), lutjanids (snappers), and lobster (*Panulirus argus*). Census entire reef area in 4 m wide transects.
- (c) Frequency: Annually is best, every few years if annually not possible.
- (d) Who: Scientists and fisheries professionals experienced in identification of Caribbean reef fishes to species and accurate estimation of length.
- (e) Person-days: A minimum of 8 person days for 10 censuses at 4 sites. Minimum cost for two scientists without grant support would be airfare, a minimum of 7 nights accommodation, meals, taxis, etc.
- (f) Equipment: Boat, fuel and captain. Full SCUBA equipment, underwater slates, mylar sheets, pencils (furnished by scientists). Rental or donation of at least 18 tanks/fills and emergency oxygen on the boat.
- (g) Training: Not applicable.
- (h) Data: Original data copied and archived by coordinating Antiguan agency. Data entry, QA/QC, summary and analysis by scientists. Copy of data summary and analysis sent on computer diskette to coordinating agency.

4.5.3 Linkages with other Activities

- Other Caribbean reef fish studies and databases.
- REEF, NOAA/NMFS southeast office, University of Miami.
- Data would be shared with OECS Natural Resource Management Unit, CFRAMP.
- Correlate reef fish data and trends with coral and water quality data.

4.6 Beaches

Beaches are very dynamic systems, often changing significantly in a matter of hours. Particularly in view of their importance for tourism and local recreation and their protective function during storms and hurricanes, their conservation is vital to the country's social, economic and cultural well-being. Regular beach monitoring is an essential part of sustainable beach management, providing at least some of the information needed to understand, predict and manage these complex systems.

4.6.1 Present Status

Beaches have been measured regularly since 1991 in Antigua and 1995 in Barbuda. Monitoring is conducted by the Fisheries Division and the Development Control Authority in conjunction with the regional programme, COSALC. Standardized methodology is used and the data are analyzed regularly to produce annual technical reports. The latest such report (Black *et al*, 1996) covers the period 1991-1995 and includes the impacts of Hurricane Luis in 1995. Some 42 profile sites are measured at 19 beaches in Antigua, three of these beaches lie within NECMA, these are: Jabberwocky, Dutchman Bay and Long Bay.

4.6.2 Recommended Monitoring

Minimum:

- (a) Sites: Two beach profile sites should be established each on the north beach and south beach of GBI. (South beach, in particular, shows serious erosion resulting from Hurricane Luis, especially at the western end where three ledges of beachrock are now exposed. Monitoring here would provide a good indication of natural recovery which could provide a control for comparison with some of the mainland sites).
- (b) Methodology: The same method as utilized by the COSALC programme is recommended whereby the profile is divided into sections based on breaks of slope and the slope and distance of each segment is measured.
- (c) Frequency: Every three months is recommended, although every six months would still provide some useful data.
- (d) Who: FD and DCA conduct the beach monitoring in Antigua, but other groups/individuals could also be trained.
- (e) Person days: 8 person days per year (4 days/year x 2, at least 2 persons are necessary for beach monitoring), plus 2 days per year for data entry and

analysis.

- (f) Equipment: Abney level (\$350), 2 ranging poles (\$75), tape measure (\$25), camera (\$100). (FD have two sets of monitoring equipment and one still camera). Computer for data entry and analysis. Boat, fuel and captain.
- (g) Training: One day, this could be provided by FD.
- (h) Data: Field data copies and archived by coordinating agency, copies to FD. QA/QC by FD and COSALC.

Intermediate:

- (a) Sites: As above, with the addition of Pasture Bay, Long Island, three profile sites to be established here. This beach is important for Hawksbill nesting and is showing signs of erosion (Fuller *et al*, 1992).
- (b) Methodology: as above.
- (c) Frequency: as above.
- (d) Who: either the same as above or perhaps as a cooperative effort with the Jumby Bay Resort.
- (e) Person days: same as above, GBI and Long Island could be monitored on the same day.
- (f) Equipment: same as above.
- (g) Training: same as above.
- (h) Data: same as above.

Optimal:

- (a) Sites: As for Intermediate, but with addition of three sites at Maiden Island, near the cut at the north end. This would provide data on the rate of infilling of this cut. The site is also near the proposed dredging site for the Parham Harbour project.
- (b) Methodology: as above.
- (c) Frequency: as above.
- (d) Who: the same as Minimum.

- (e) Person days: same as above, GBI, Long Island and Maiden Island could be monitored on the same day.
- (f) Equipment: same as above.
- (g) Training: same as above.
- (h) Data: same as above.

4.6.3 Linkages with other Activities

- collaboration with the existing beach monitoring programme.
- training could be provided by FD.
- possible cooperative effort with the University of Georgia and the Jumby Bay Resort.
- could be done at the same time as water quality monitoring, turtle monitoring.

4.7 Sea Turtles

The endangered hawksbill sea turtle (*Eretmochelys imbricata*) is known to nest on Long Island and reported to have nested on Great Bird Island (Fuller *et al* 1992). Documentation of the location, number of nests, nest success and habitat utilization of this and the other two species (green, *Chelonia mydas* and leatherback, *Dermochelys coriacea*) which may nest in the NECMA is essential for effective management of the area.

4.7.1 Present Status

The Jumby Bay Hawksbill Project (Long Island) began in 1987 and is ongoing under the direction of the Georgia Sea Turtle Cooperative of the University of Georgia (Hoyle and Richardson, 1993).

4.7.2 Recommended Monitoring (in conjunction with the ongoing work)

Minimum:

During nesting season, beaches on GBI should be checked for crawl tracks of nesting turtles and the information recorded on sea turtle observation forms.

- (a) Sites: GBI
- (b) Methodology: Beaches would optimally be walked early in the day and all crawl tracks of sea turtles would be recorded on a pre-printed Sea Turtle Observation Form. Completed forms would be turned into the coordinating agency.
- (c) Frequency: Whenever people were in the area.
- (d) Who: Tour operators to GBI, EAG volunteers when censusing snakes, and Fisheries Officers are all possible observers.
- (e) Person-days: Time commitment (person hours) would be minimal.
- (f) Equipment: No equipment costs.
- (g) Training: Minimal.
- (h) Data: Buck Island Reef National Monument has developed a form and spreadsheet which could be used, or the Georgia Sea Turtle Cooperative (GSC) and/or WIDECAS T could be consulted for a form and spreadsheet which could be incorporated into their databases. The Fisheries Division, the PPMU Technical Unit or the EAG would be the most appropriate coordinating agency. They would be responsible for distributing forms to the observers, collecting the completed forms, data entry into a computer spreadsheet and sharing the data with WIDECAS T. GSC and/or WIDECAS T would be responsible for overall QA/QC.

Intermediate:

Sea turtle observation forms would be distributed to all Fisheries Officers, tour operators, naturalists and recreational mariners who visit the NECMA. All sightings would be recorded on the form.

- (a) Sites: All waters, islands and coastal areas of the NECMA.
- (b) Methodology: Sea turtle sightings would be recorded on the forms which would be turned into the coordinating agency.
- (c) - (h) Same as above.

4.7.3 Linkages with other Activities

- concurrently with other activities: beach monitoring, fisheries sampling,

snake censuses, recreational pursuits.

- in cooperation with WIDECAST and University of Georgia study.
- provide addition information to justify the rat eradication program on GBI.

4.8 Snakes

The Antiguan racer (*Alsophis antiguae*) is endemic to GBI, Antigua and the estimated population in 1995 was 500 individuals (Bunce, 1995). Continuation of the population surveys is essential.

4.8.1 Present Status

Jersey Wildlife Preservation Trust (JWPT) in partnership with EAG are monitoring the racer populations, using tag and recapture methods.

4.8.2 Recommended Monitoring

Continuing the current study is a priority. The database should be maintained at EAG, JWPT and the agency coordinating the monitoring of NECMA. JWPT would be responsible for QA/QC.

4.8.3 Linkages with other Activities

- rat eradication on GBI could also benefit sea turtle, sea bird and whistling duck nest success.
- cooperation with JWPT.

5. CONCLUDING REMARKS

The proposed monitoring, even at the minimum level, will provide some of the vital information needed for effective management of the Bird Island Marine Reserve, such that conservation and sustainable multiple use of the area can take place together for the benefit of the people of Antigua and Barbuda.

6. TERMS OF REFERENCE

1. Assist the Island Resources Foundation project director, Bruce Horwith, and his assistant, Kevel Lindsay, with the "scoping" task to establish the institutional, geographic and inter-disciplinary, temporal and statistical boundaries of the monitoring plan initiative.
2. Assist with the identification and ranking of suggested first-stage indicators characterized as:
 - (a) useful to reserve management and possibly useful to other environmental data needs:
 - within the reserve
 - within the Northeast Coast Management Area (NECMA)
 - within the island of Antigua
 - (b) low cost, low tech and with a modest labour requirement
 - (c) capable of being combined with other "on site" activities to reduce logistical costs
 - (d) modest in the requirements for skill training and QA/QC
 - (e) amenable to supplemental accomplishment by non-government volunteers.
3. Assist in establishing an information management/ data archiving system for monitoring activities, with appropriate redundancies and QA/QC procedures.
4. Develop a rationale for the selection of monitoring targets, frequency, sample size, etc., blending a scientific need for baseline information, ambient and ecosystem process information, and risk reduction data requirements.
5. Prepare recommendations for basic initial instrumentation and facilities, including estimated cost ranges and desired minimum levels of accuracy and sampling redundancy (replicates) if any.
6. Prepare a "standards" and a goals and objectives statement for the monitoring plan.

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APPENDIX III

Bird Island Marine Reserve

Estimated Revenues and Costs

Five Year Scenario (1997-2001)

	1997	1998	1999	2000	2001
Fees (EC\$, net to Reserve):					
2 Week Pass	\$ 12.00	\$ 12.00	\$ 16.50	\$ 16.50	\$ 16.50
Yachts					
Day	\$ 10.00	\$ 10.00	\$ 15.00	\$ 15.00	\$ 15.00
Nights		\$ 25.00	\$ 25.00	\$ 35.00	\$ 35.00
Campers (facilities)	(no facility)	(privies/ waste collect)		(camp grounds)	
Overnite fee	\$ 10.00	\$ 15.00	\$ 15.00	\$ 50.00	\$ 50.00
Revenue Streams					
Day Visitors	7,000	15,000	16,500	18,150	19,965
Day Visitor Rev	\$ 84,000	\$ 180,000	\$ 272,250	\$ 299,475	\$ 329,423
Yachts					
Day	150	300	400	440	484
Nights		100	150	200	250
Yacht Revenue	\$ 1,500	\$ 5,500	\$ 9,750	\$ 13,600	\$ 16,010
Campers					
Camper-Nites	125	250	400	500	550
Camp Revenue	\$ 1,250	\$ 3,750	\$ 6,000	\$ 25,000	\$ 27,500
Net Revenue	\$ 86,750	\$ 189,250	\$ 288,000	\$ 338,075	\$ 372,933

Expenditures	1997	1998	1999	2000	2001
Salary Rates					
Supervisor	\$ 30,000	\$ 30,000	\$ 35,000	\$ 35,000	\$ 40,000
Protect Off 1	\$ 25,000	\$ 25,000	\$ 30,000	\$ 30,000	\$ 33,000
Protect Off 2*	\$ 20,000	\$ 20,000	\$ 45,000	\$ 45,000	\$ 60,000
Operations					
Supervisor	\$ 37,969	\$ 50,625	\$ 59,063	\$ 59,063	\$ 67,500
Protect Off 1	\$ 21,094	\$ 42,188	\$ 50,625	\$ 50,625	\$ 55,688
Protect Off 2	\$ 16,875	\$ 33,750	\$ 75,938	\$ 75,938	\$ 101,250
Office Expenses	\$ 10,000	\$ 10,000	\$ 15,000	\$ 20,000	\$ 25,000
Transport (incl. boat)	\$ 10,000	\$ 25,000	\$ 35,000	\$ 50,000	\$ 65,000
Total Operating Costs	\$ 95,938	\$ 161,563	\$ 235,625	\$ 255,625	\$ 314,438
Development					
Trails and Signs	\$ 2,000	\$ 5,000	\$ 5,000	\$ 7,500	\$ 5,000
Buoys & Moorings	\$ 2,000	\$ 5,000	\$ 10,000	\$ 5,000	\$ 10,000
Office and Camp Grounds	\$ 2,000	\$ 10,000	\$ 25,000	\$ 25,000	\$ 25,000
Education Mats	\$ 1,500	\$ 2,500	\$ 7,500	\$ 5,000	\$ 5,000
Development Costs	\$ 7,500	\$ 22,500	\$ 47,500	\$ 42,500	\$ 45,000
Total Costs	\$ 103,438	\$ 184,063	\$ 283,125	\$ 298,125	\$ 359,438
Cumulative Balance	\$ (16,688)	\$ (11,500)	\$ (6,625)	\$ 33,325	\$ 46,820

* becomes 2 Officers in 1999, and two-and-one-half in 2001

Five-Year Development and Capital Equipment Costs:	\$165,000
Trails and Signage	\$24,500
Bouys and Mooring	\$32,000
Office and Campgrounds	\$87,000
Education Materials	\$21,500

APPENDIX IV

NORTH EAST COAST MANAGEMENT AUTHORITY

REGULATIONS

NORTH EAST COAST (Marine Park) REGULATIONS, 1997

- Citation. 1. These Regulations may be cited as the North East Coast (Marine Park) Regulations, 1997.
- Interpretation 2. In these Regulations-
- “authorized officer” means any officer employed by the Authority and designated as such by the Authority, any member of the Security Forces, any officer designated as a Fishery Inspector under the Fisheries Act and any other public officer designated as an authorized officer by the Authority;
- “marine park” means an area designated as such under section 5 of the North East Coast Management Authority Act.
- “marine park manager” means a person appointed as such by the Authority.
- “protected area” means a protected area as designated by the Authority under section 5 of the North East Coast Management Authority.
- “security forces” means-
- (a) the Royal Antigua and Barbuda Police Force;
 - (b) the Antigua and Barbuda Defence Force to the extent that such force has been assigned to act in aid of the police;
 - © any security officer appointed by the Authority under this Act.
- “hunt” includes seeking, stalking, shooting at, pursuing, killing or capturing or attempting to kill or capture any bird, or mammal or molesting or taking a bird nest or eggs.
- “take” means pursuing shooting, killing, capturing, snaring, trapping netting or placing or using any net, traps or device for pursuing wildlife.

“wildlife” means animals of the following groups living beyond the control of man: mammals (including feral pigs), birds and their eggs thereof, frogs and their eggs thereof, reptiles and fishes, their prey and eggs and crustaceans found in fresh water streams or impoundments.

WILDLIFE PROTECTION

- Declaration For the removal of all doubt it is hereby declared that wildlife resident and migratory in nature or otherwise found in a marine park except for frogs and crustaceans impounded in private ponds are the property of the state of Antigua and Barbuda.
- Condition for taking wildlife 3. Wildlife may be taken only under conditions and in accordance with regulations made by the Minister under the North East Coast Management Authority Act and published in the *Gazette*.
- Rights of the Minister to declare wildlife reserve 4. Upon the recommendation of the Authority, the Minister may by declaration published in the *Gazette* declare any area within the marine park to be a wildlife reserve in which hunting or taking of one or more species shall be prohibited.
- Offence to hunt in wildlife reserve. 5. Any person who in a wildlife reserve hunts, or takes any mammal, bird, shrimp or crab specified as protected is guilty of an offence.
- Offence to hunt in national park or monument. 6. No person shall hunt within the boundaries of the marine park.
- Offence to import, possess or release alien wildlife. 7. (1) No alien wildlife shall be imported into or introduced, possessed, transported, or released into the marine park, except by the Division of Forestry and Wildlife, or under a permit issued to an individual by the Minister upon the recommendation of the Authority.
- (2) A person who contravenes of this section is liable on summary conviction to a fine of seven thousand dollars or to imprisonment for twelve months.

- Offence to disturb or destroy bird nests. 8. No person shall disturb or destroy the nest or eggs of any wild bird or the lair of any wild mammal in the marine park.
- Offence to deposit deleterious substances in water 9. No person shall in a marine park-
- (a) deposit or permit the deposit of a deleterious substance of any type in water frequented by fish, shrimps or crabs or in any place where the deleterious substance may enter the water.
 - (b) construct or excavate or maintain any pit for the purpose of catching or killing wildlife.
 - © engage in logging, lumbering, land clearing or other operations or permit any slush, stumps or other debris to be put into any water frequented by fish, shrimps, or crabs or into any stream or waterway that flows into such water.
- Offence to use pit to catch wildlife
- Offence to deposit slush in streams
- Keeping wildlife in captivity 10. No person shall capture or keep in captivity in a marine park any live game mammals , game birds, protected mammals, specially protected birds or protected birds except under a permit in Form 3 issued by Authority. The permit shall specify the method or methods of capture, the location where the wildlife shall be kept, and the conditions under which the wildlife shall be kept and housed.
- Exporting of live wildlife 11. No person shall export any live or dead wildlife or parts thereof except under a permit issued by the Authority in Form 5 and in accordance with conditions specified in such permit.

MARINE PARK MANAGEMENT

- Mining in marine park 12. (1) No person shall, except with the written permission of the Authority or except in accordance with the provisions of a licence granted under this or any other enactment, carry out any operation for the extraction or mining of minerals in the marine park.
- (2) A person who contravenes this section is guilty of an offence and is liable on summary conviction to a fine of ten thousand dollars or to imprisonment for a term of two years.

Removal or destruction of natural features and marine life.

- 13. (1) No person shall -
 - (a) destroy, injure, deface, move dig, harmfully disturb or remove from a marine park any sand, gravel or minerals, corals, sea, fans, shells, shell fish, starfish or other marine invertebrates, seaweeds, grasses, or any soil, rock, artifacts, stones or other materials;
 - (b) cut, carve, injure, mutilate, move, displace or break off any bottom formation or growth;
 - (c) attached any rope, wire or other contrivance to any coral, rock or other formation, whether temporary or permanent in character or use;
 - (d) use, sell or otherwise dispose of any seaweed, coral, mineral, gravel, sand or other substance or thing, knowing it to have been stolen or unlawfully removed from a marine park.

(2) A person who contravenes this section is guilty of an offence and is liable on summary conviction to a fine of twenty thousand dollars or to imprisonment for a term of two years.

Dredging, filling, excavating and building activities.

- 14. (1) No person shall in a marine park
 - (a) dredge, excavate or carry out any filling operations or deposit any material in the waters thereof; or
 - (b) erect any building or other structure or any public service facility, (without the written permission of the Authority.)

(2) A person who contravenes this section is guilty of an offence and is liable on summary conviction to a fine of twenty thousand dollars or to imprisonment for a term of two years.

Refuse and polluting substances

- 15. (1) No person shall discharge or deposit in or on the waters of a marine park any refuse, oily liquids or wastes, acids or other deleterious chemicals or any toxic or polluting substance of any kind injurious to plant or animal life.

(2) A person who contravenes this section is guilty of an offence and is liable on summary conviction to a fine of twenty thousand dollars or to imprisonment for a term of two years.

Markers

16. (1) No person shall wilfully mark, deface or injure in any way or remove or interfere with in any way any mooring, buoy, marine park sign, notice or placard, whether temporary or permanent or with any monument stake, post or other boundary marker in any marine park.

(2) A person who contravenes this section is guilty of an offence and is liable on summary conviction to a fine of five thousand dollars or to imprisonment for a term of two years.

Fishing

17. (1) No person shall fish in a marine park without the written permission of the park manager.

(2) The Authority may prohibit fishing in any area of water in a marine park during any period of time by a declaration in writing to this effect.

(3) The Authority may permit fishing in any area of water in a marine park subject to any of the following conditions:-

- (a) the kind of fish which may be caught by a person in a day;
- (b) the kind of fish in respect of which fishing is prohibited;
- (c) the number of fish that may be caught by a person in a day;
- (d) the type of fishing equipment that may be used; or
- (e) the devices which may be used for fishing.

(4) No person shall fish in an area of water in a marine park during a period in which fishing is prohibited.

(5) No person shall use in a marine park any poisonous substance, electrical charges or any other similar device for the catching or killing of fish.

(6) A person who contravenes a provision of this section is guilty of an offence and is liable on summary conviction to a fine of ten thousand dollars or to imprisonment for a term of two years.

(7) A person who contravenes any conditions imposed by the Authority under paragraph (2) is guilty an offence and is liable on summary conviction to a ~~fine of five thousand dollars or to imprisonment for a term of two years.~~

Research
and collection

18. (1) The Authority may, on such terms as it thinks fit, grant a permit for-
- (a) the carrying out of research; or
 - (b) the collection of natural objects or specimens of marine life or both, in a marine park for educational, scientific or industrial purposes.
- (2) An application for a permit under paragraph (1) shall be in writing and shall-
- (a) be transmitted through the marine park manager; and
 - (b) contain information as to-
 - (i) the type of research and the natural objects or specimens to which the application relates;
 - (ii) the methods to be employed in carrying out the research and in collecting objects and specimens;
 - (iii) the estimated cost of such research and the estimated length of time required to complete such research.
- (3) Where the Authority refuses to grant a permit under this regulation, it shall inform the applicant of the reasons for the refusal and of the right of appeal conferred by regulation 38.
- (4) A person who carries out any form of research or collects any objects or specimens in a marine park without a permit issued under this regulation is guilty of an offence and is liable on summary conviction to a fine of ten thousand dollars or to imprisonment for a term of two years.

Litter.

19. (1) No person shall, in a marine park-
- (a) deposit or leave any litter, bottle, broken glass, china, pottery, plastic articles, rubbish, refuse or other waste material, except in an area or receptacle designated or provided for that purpose;
 - (b) deposit or leave any noxious, noisome, offensive substance, matter or thing;

- © deposit or leave any offal, dead animal, dung or other filth;
- (d) deposit in any receptacle provided for litter any domestic garbage;
- (e) wilfully break any article of glass, china, pottery, plastic or other similar material.

(2) A person who contravenes this section is guilty of an offence and is liable on summary conviction to a fine of five thousand dollars or to imprisonment for a term of twelve months.

Advertising signs, etc.

20. (1) A person shall not, except with the written permission of the Authority, erect, display or cause to be displayed in a marine park any sign, slogan or marker containing any advertising or other kind of message.

(2) A person who contravenes this section is guilty of an offence and is liable on summary conviction to a fine of five thousand dollars or to imprisonment for a term of twelve months.

Explosives and dangerous weapons

21. (1) No person shall discharge or have in his possession in a marine park any air rifle or other firearm, spring gun, sling, bang sticks, spear guns, harpoons, or other weapon which is potentially harmful to fish or wild life or to the reef structure and dangerous to human safety.

(2) No person shall use or have in his possession, any explosives in a marine park.

(3) A person who contravenes this section is guilty of an offence and is liable on summary conviction to a fine of ten thousand dollars or to imprisonment for a term of twelve months.

Disorderly behaviour

22. (1) No person shall behave in a disorderly, offensive or indecent manner or use any offensive or indecent language or create any disturbance in a marine park.

(2) No person shall obstruct, disturb, interrupt or annoy any other person engaged in the proper use of marine park, nor behave in a manner likely to create any disturbance.

© abandon a conveyance or vessel or leave it in a position, condition or in circumstances so that it appears to be abandoned.

(2) A conveyance or vessel shall be deemed to have been abandoned if it is left unattended in a marine park for a period of forty-eight hours or more.

Other offences

25. (1) A person who commits an offence against these Regulations for which no penalty is provided in these Regulations is liable on summary conviction-

(a) where the offence is committed by an individual, to a fine of five thousand dollars or to imprisonment for a term of twelve months.

(b) where the offence is committed by a corporation, to a fine of twenty five thousand dollars.

(2) The Magistrate may in his discretion where a person is convicted of an offence against these Regulations impose on the offender in addition to the term of imprisonment, a period of hard labour not exceeding that term of imprisonment

Court may order payment of compensation

26. Where a person is convicted of an offence of removing any property from or causing any damage to, a marine park or any plant or animal therein, the Court before which he is convicted may, in addition to any penalty for which he may be liable under these Regulations, order him to pay to the authority the full market value of the property removed or of the damage done to the marine park or to any plant or animal therein and such value or damage or costs shall be assessed by that Court.

ENFORCEMENT

Power of seizure and forfeiture

27. (1) If an authorized officer has reasonable cause to suspect that any conveyance, vessel, article or thing is being used or has been used in the commission of an offence under these Regulations, he may seize and detain such article or thing and may-

(a) without a warrant, search such conveyance or vessel; and

(b) if such search reveals evidence that the conveyance or vessel is being used or has been used for the commission of any offence as aforesaid, seize and detain such conveyance or vessel.

(2) The Court may order the forfeiture of any conveyance, vessel, article or thing seized pursuant to this regulation where a person is convicted of an offence against these Regulations and the Court is satisfied that:-

- (i) the convicted person owns the conveyance, vessel, article or thing used in the commission of the offence; or
- (ii) the owner thereof permitted it to be used; or
- (iii) the circumstances are otherwise such that it just that the same be forfeited.

(3) On the application of the Director of Public Prosecutions before a Magistrate's Court having jurisdiction in the area where a conveyance, vessel, article or thing is seized pursuant to paragraph (1), the Court may, notwithstanding that the conditions mentioned in paragraph (2) have not been satisfied, order the forfeiture of the conveyance, vessel, article or thing if the Court is satisfied that it is other wise just to do so; or-

- (a) the conveyance, vessel, article or thing has been abandoned; or
- (b) the circumstances in which it was seized give reasonable cause to suspect that it was being used or has been used in the commission of an offence against these Regulations,

(4) Where the Director of Public Prosecutions proposes to apply for the forfeiture of a conveyance, vessel, article or thing under paragraph (3), he shall, subject to paragraph (5), give to any person who, to his knowledge, was at the time of the seizure the owner, such conveyance or vessel article or thing of notice of the seizure and of the intention, after the expiration of thirty days from the date of the notice, to apply for forfeiture thereof and of the grounds therefor.

(5) Notice shall not be required under paragraph (4) if the seizure was made in the presence of the owner or any of the owners of the conveyance, vessel, article or thing seized or any servant or agent of the owner.

(6) Without prejudice to any other form of service, a notice under paragraph (4) may be published in a daily newspaper printed and circulating in the island.

(7) Any person having a claim to any conveyance, vessel, article or thing seized under this regulation may appear before the Court on the hearing of the application and show cause why an order for forfeiture should not be made.

(8) Where, on the hearing of an application pursuant to paragraph (3), no person appears before the Court to show cause why an order for forfeiture should not be made the Court shall presume that the conveyance, vessel, article or thing has been abandoned and shall thereafter make an order of forfeiture of the same.

(9) If, upon the application of any person prejudiced by an order made under paragraph (2) or (3), the Court is satisfied that it is just to revoke such order, the Court may revoke that order upon such terms and conditions as it deems appropriate, and without prejudice to the generality of the foregoing, shall require that person, to pay in respect of storage, maintenance, administrative expenses, security and insurance of the conveyance, vessel, article or thing such charges as may be charged by the appropriate government agency and approved by the Court, not exceeding one and a half time the value thereof as determined by the Court.

(10) An application to the Court under paragraph (9) for the revocation of an order must be made within thirty days of the date of the order or within such greater time as the Court may allow, not exceeding six months after the date of the order.

Arrest
without
warrant

28. (1) An authorized officer any, without warrant, arrest any person in a marine park, where the authorized officer reasonably believes that-

- (a) the person has committed an offence against these Regulations; and
- (b) proceedings against the person by summons would not be effective.

(2) Where an authorized officer arrests a person under paragraph (1), he shall produce his identity card for inspection by that person unless it is not reasonable practicable to do so

(3) Where a person is arrested under paragraph (1), an authorized officer shall immediately bring the person or cause that person to be brought to the nearest police station.

Removal and disposal of conveyances and vessels

29. (1) A conveyance or vessel which is parked, left or abandoned, in a marine park, contrary to section 24 may be removed to an impoundment area by an authorized officer.

(2) In this regulation "impoundment area" means an area designated by the Authority for the temporary storage of conveyances or vessels.

(3) A conveyance or vessel removed to an impoundment area shall not be kept in that area for more than seven days, unless the period is extended by the Authority upon request of the owner of the same.

(4) A conveyance or vessel which is unclaimed at the end of the period referred to in paragraph (3), shall be removed to a place designated by the Authority.

Liability for loss of conveyance or vessel after impoundment

(5) The Authority shall ensure that a conveyance or vessel or its contents (if any) are protected from damage or loss while being removed pursuant and while it remains in the custody of the Authority.

(6) Where a conveyance or vessel is removed pursuant to this regulation, the authorized officer responsible for such removal shall make a report in a log provided for the purpose, which shall state-

- (a) the time of removal;
- (b) the location from which it is being removed;
- © where, the licence number, type, model and registered owner of the conveyance or vessel.

(7) The owner of a conveyance or vessel shall pay a fee of one thousand dollars for the recovery thereof and in addition a fee of one hundred dollars for each day that the conveyance or vessel remains unclaimed or until such time as it is disposed of by the Authority pursuant to regulation 21.

Disposal of abandoned conveyances or vessels

30. (1) Subject to regulation 18 and paragraph (2) of this regulation, the Authority may, if appears that a conveyance or vessel is abandoned as mentioned in regulation 17, sell or otherwise dispose of it and its contents (if any) and may apply the proceeds of any such sale in or towards satisfaction of any costs incurred in connection with the disposal thereof.

(2) The power of disposal conferred by this regulation shall not be exercisable unless the Authority has taken all reasonable and necessary steps for enabling the conveyance or vessel to be claimed by the owner thereof.

Zones

- Zones. 31. The Authority may, as it thinks fit, zone areas of the marine park and may-
- (a) assign a name or other designation for each zone;
 - (b) make provision with respect to the purposes for which each zone may be used; and
 - (c) attach conditions with regard to the use of each zone.

ADMINISTRATION

Appointment of marine park manager 32. (1) Subject to paragraph (2) the Authority may appoint a marine park manager who shall be responsible for the day to day management of the marine park under the direction of the Authority.

(2) The Authority may appoint any other person to assist the marine park manager in the performance of his functions under these Regulations.

Marine park rangers 33. (1) The Authority may from time to time, designate as marine park rangers for the purpose of these these Regulations, and on such terms and condition as it thinks fit-

- (a) a member of the staff of the Authority;
- (b) any other person who by training or experience is qualified to be so designated.

(2) The designation of a person as a marine park ranger under this regulation shall be notified in the Gazette.

Identity card. 34. (1) The chairman of the Authority shall issue to each marine park ranger an identity card signed by the chairman and containing a photograph of the marine park ranger and his signature.

- (b) the chairman of the Authority or his nominee;
- © a representative of the Fisheries Division of the Ministry of Agriculture;
- (d) a director and;
- (e) four other persons of whom one shall be qualified in marine biology.

(3) The members of the Board shall hold office for such period not exceeding two years as the Minister may determine and shall be eligible for reappointment.

(4) The Authority may appoint any person to act in place of the chairman or any other member of the Board in the case of the absence or inability to act of the chairman or other member.

(5) The meetings of the Board shall be held at such time and such places as the chairman may from time to time appoint.

(6) Four members of the Board shall form a quorum at any meeting.

(7) The decision of the Board shall be by a majority of the members and in addition, to an original vote, the chairman shall have a casting vote in any case in which the voting is equal.

(8) The functions of the Board shall be to make recommendations to the Authority on the preservation of the ecological system in the marine park and, without prejudice to the generality of the foregoing, to-

- (a) advise the Authority on matters relating to the administration; control and preservation of the resources of the marine park.
- (b) prepare a management plan for the proper operation and management of the park and to review that plan annually.
- © monitor management strategies to see whether they are achieving their desired effects; and
- (d) institute programmes to raise revenue for the park.