598-0605
PDKAW609

Agency for International Development
Washington, D.C. 20523

MEMORANDUM

February 5, 1991

TO: See Distribution

FROM: LAC/DR/E, Tom Hourigan T. Hourigan

THROUGH: LAC/DR/E, Jim Hester James Hester

SUBJECT: Project Completion Report for grant to the World Wildlife Fund for the development of an implementation plan for Les Arcadins Marine Park, Haiti (Grant No. LAC-06505-G-SS-7041-00).

Under the LAC Regional Development of Environmental Management Systems Project (598-0605), A.I.D. provided a grant of $65,000 to the World Wildlife Fund (WWF) in support of the development of an implementation plan for Les Arcadins Marine Park in Haiti. This grant was successfully completed September 30, 1990.

This grant completion report complies with the requirements under Handbook 13, Chapter 10, entitled "Closeout Procedures."

The grant to the World Wildlife Fund and its sub-contractor, Wilcox Associates, to develop an implementation plan for Les Arcadins Marine Park to protect a fragile coral reef of great biological diversity has been a success. The grant achieved its primary purpose in the production of an "Action Plan" for the establishment and management of a marine park. The project also produced a "Resource Document" that included important surveys of the biology, fisheries, tourism potential, and socio-cultural milieu of the Les Arcadins area. This Resource Document is intended to provide a baseline for management decisions in the park implementation.

Background: The 1986 Haiti Country Environmental Profile, funded by A.I.D., identified the coral reef ecological systems surrounding the three small islands of Les Arcadins as a potential marine park and protected area site. Following a USAID funded feasibility study (Wilcox 1986) that supported the importance of the site, the grant was provided to produce the implementation plan.

LAC Bureau funding over the life of the project leveraged an additional $15,000 of USAID/Haiti funds. WWF provided an additional $35,000 for this project, bringing total funding under this grant to $115,486.

Accomplishments:

1. Action Plan: This document summarizes the setting of the Les Arcadins area, its potential contribution to tourism in Haiti, and provides a plan for the establishment and management of Haiti's first marine park. This park is expected to provide ecological, social and economic benefits by preserving important areas of biodiversity, revitalizing the local economy as a major diving center for tourists, and contributing to the welfare of nearby artisanal fishing communities by improving the management of renewable fisheries resources. The Action Plan is clearly written, and sets out a workable implementation schedule. Organizations in several other Caribbean countries have expressed interest in using Les Arcadins as a model for marine park development.

2. Resource Document: This document provides:
   a) A qualitative survey of major habitat zones in the proposed park area, and a species list of important benthic organisms that contribute to the biodiversity and tourism potential of the area.
   b) A semi-quantitative survey of fish species and of fishery yields in the area. This survey concluded that fisheries yields were relatively low, perhaps as a result of overfishing. A preserve area might serve as a nursery for small fish, and thereby have a beneficial effect on surrounding fisheries.
   c) A non-quantitative survey of socio-cultural factors affecting production of the neighboring artisanal fishing community of Luly, including fishing gear and methods, fishing territories and commercial distribution of fish, and the the effects of boat ownership on catch apportionment.
   d) A study of tourism in Haiti, with particular emphasis on the Les Arcadins area, in order to assess the potential socio-economic benefits of a marine park in this area.

Areas for Improvement: The project fulfilled its major objective, the production of an Action Plan. Several work elements laid out in the "Program Description" of the grant agreement were not fully implemented. This appears to have been primarily as a result of social upheaval in Haiti following the overthrow of the Duvalier regime that occurred during the period of this project.

1. Development of an environmental education program. Existing educational materials were identified, but little further analysis of the need, audience or program was carried out.

2. Biological survey. This survey was reasonably extensive considering the level of effort expended. Its lack of quantification or replication makes it of marginal value as a baseline for evaluating the ecological effects of protection. The surveys of fishes were conducted in transect areas (10m x 1m) that were much too small to estimate abundances of most commercial species. More worrisome is the use of these surveys to support general statements about the "great biodiversity" of the area. This is intended to show the promise of this area for scuba diving and eco-tourism. These conclusions cannot be supported by the data without similar data from other areas to which they can be compared.

Continuing Actions: Although project funding ended in September 1990, the Action Plan is being implemented by the S&T Biodiversity Support Project through a buy-in from the LAC Regional Environmental Support Program. Thus the A.I.D. support is likely to lead to a successfully managed marine park.

Lessons Learned: This project provides a model for the development of future marine parks in the Caribbean region. Eco-tourism, and scuba tourism are a fast growing segment of the tourist industry, and can provide improvements to the local economy and environment if carefully managed. The project is to be commended in attempting to build a management plan based on environmental and social considerations. Similar studies could benefit from building on this background, with the following improvements:

1. A more rigorous economic analysis of the realizable returns of the proposed park. This was probably not practical given the unusual political climate of Haiti and the extremely depressed tourist economy.

2. The present biological survey is ambitious. It provides more raw information than is needed for the Action Plan (the use to which it is put), but is still insufficient for other uses. If such a survey is instituted, it would be helpful if it was rigorous enough to be used as a baseline to evaluate the results of protecting the area.

3. Some discussion of potential adverse environmental effects of increased tourism would be beneficial. In areas where new hotels might spring up near marine parks (not applicable to Les Arcadins), the environmental impact must be considered.

4. The incorporation of socio-cultural effects of the proposed park on neighboring communities is to be commended, and should be incorporated into all such studies.

Attached are the final reports, final financial report, and supporting materials provided by WWF.

Attachments: Action Plan
Resource Document
Final Financial Report

Distribution:

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FINANCIAL STATUS REPORT

(Follow instructions on the back)

1. FEDERAL AGENCY AND ORGANIZATIONAL ELEMENT TO WHICH REPORT IS SUBMITTED: A.I.D. M/FM/PAFD

2. FEDERAL GRANT OR OTHER IDENTIFYING NUMBER: LAC-0605-G-SS-7041

OMB Approved No. 80-R0180

PAGE OF PAGES

3. RECIPIENT ORGANIZATION (Name and complete address, including ZIP code)

World Wildlife Fund
1250 24th Street NW
Washington, DC 20037

4. EMPLOYER IDENTIFICATION NUMBER: 52-0782508

5. RECIPIENT ACCOUNT NUMBER OR IDENTIFYING NUMBER: 5631

6. FINAL REPORT: X YES ☐ NO

7. BASIS: X CASH ☐ ACCRUAL

8. PROJECT/GRANT PERIOD (See instructions): FROM (Month, day, year) 08/31/87 TO (Month, day, year) 10/30/89

9. PERIOD COVERED BY THIS REPORT: FROM (Month, day, year) 07/01/89 TO (Month, day, year) 10/30/89

10. STATUS OF FUNDS

PROGRAMS/FUNCTIONS/ACTIVITIES ►	(a)	(b)	(c)	(d)	(e)	(f)	TOTAL (g)
a. Net outlays previously reported	$115,973.72	$	$	$	$	$	$115,973.72
b. Total outlays this report period							
c. *Less:* Program income credits							
d. Net outlays this report period (*Line b minus line c*)							
e. Net outlays to date (*Line a plus line d*)	115,973.72						115,973.72
f. *Less:* Non-Federal share of outlays	35,973.72						35,973.72
g. Total Federal share of outlays (*Line e minus line f*)	80,000.00						80,000.00
h. Total unliquidated obligations							
i. *Less:* Non-Federal share of unliquidated obligations shown on line h							
j. Federal share of unliquidated obligations							
k. Total Federal share of outlays and unliquidated obligations	80,000.00						80,000.00
l. Total cumulative amount of Federal funds authorized	80,000.00						80,000.00
m. Unobligated balance of Federal funds	-						

11. INDIRECT EXPENSE

a. TYPE OF RATE (*Place "X" in appropriate box*) ☐ PROVISIONAL ☐ PREDETERMINED ☐ FINAL ☐ FIXED

b. RATE	c. BASE	d. TOTAL AMOUNT	e. FEDERAL SHARE
-	-		

12. REMARKS: *Attach any explanations deemed necessary or information required by Federal sponsoring agency in compliance with governing legislation.*

13. CERTIFICATION

I certify to the best of my knowledge and belief that this report is correct and complete and that all outlays and unliquidated obligations are for the purposes set forth in the award documents.

SIGNATURE OF AUTHORIZED CERTIFYING OFFICIAL: Lawrence J. Cohn

DATE REPORT SUBMITTED: Nov. 16, 1989

TYPED OR PRINTED NAME AND TITLE: Lawrence J. Cohn
Director of Finance & Adminstration

TELEPHONE (*Area code, number and extension*): 202-293-4800

269-102

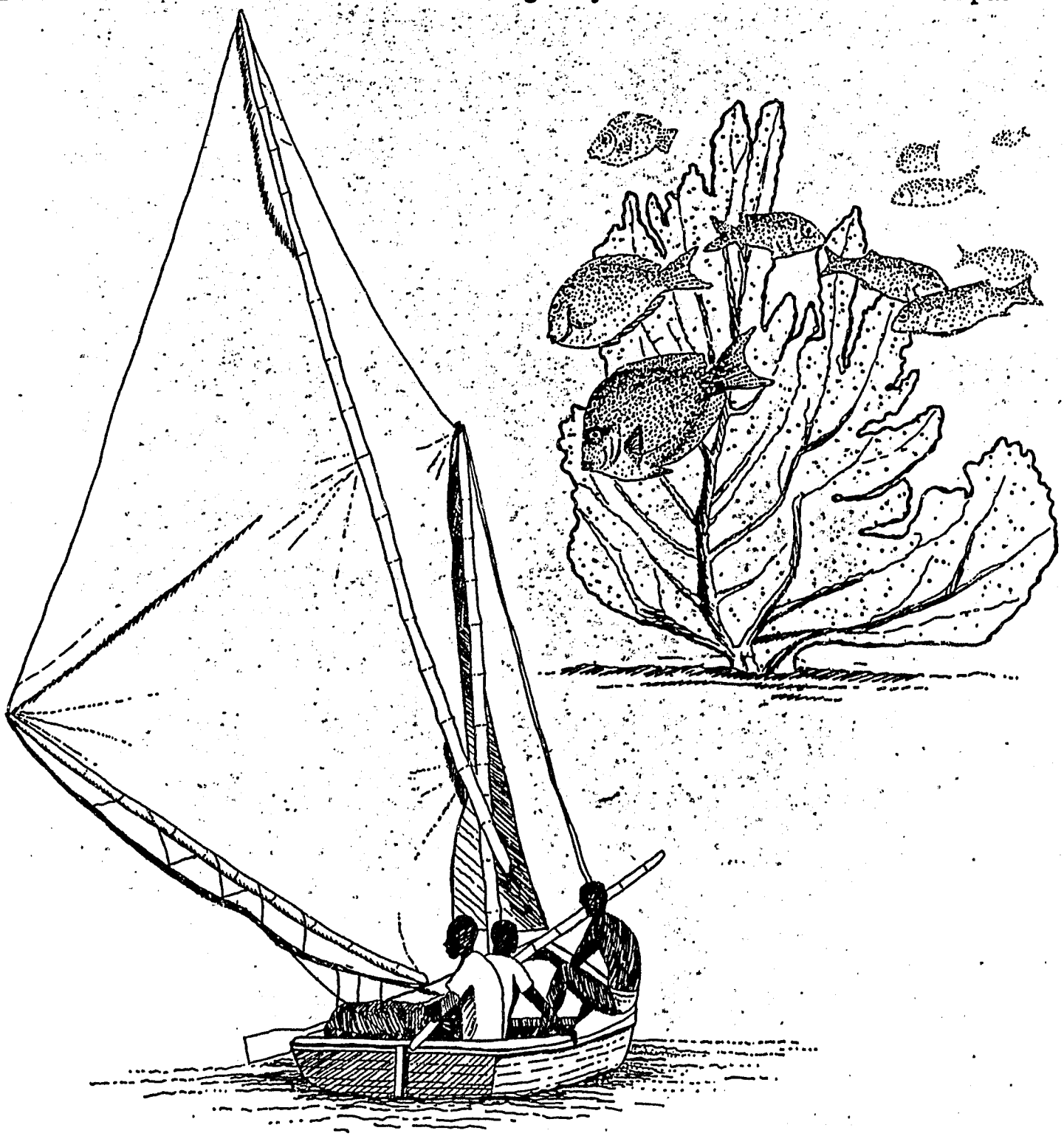
STANDARD FORM 269 (7-76)
Prescribed by Office of Management and Budget
Cir. No. A-110

Action Plan

LES ARCADINS NATIONAL MARINE PARK

Haiti

U.S. Agency for International Development



World Wildlife Fund

Wilcox Associates

HAITI

PROPOSED
LES ARCADINS NATIONAL MARINE PARK
DRAFT ACTION PLAN

PREPARED BY:

Evelyn Wilcox
Thomas Deyo
Alexis Gardella
Reni Garcia
Dennis Glick
Carlos Goenaga
Augusto Medina
Vance Vicente
Elizabeth Wilcox

World Wildlife Fund/Conservation Foundation
Wilcox Associates

For the United States Agency for International Development
Bureau for Latin America and the Caribbean
and the USAID Mission to Haiti

MAY, 1989

USAID Grant Number
LAC-0605-G-SS-7041-00

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DRAFT ACTION PLAN
LES ARCADINS NATIONAL MARINE PARK

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FOREWORD

The 1986 Haiti Country Environmental Profile identified four potential marine park and protected area sites that needed further study. They are Baie de Labadie and Baie de Cadrasse on the north coast, Les Arcadins in the Golfe de la Gonâve, Ile à Vache in the Cayes area and the Barradères, Cayemites area on the northern coast of the southern peninsula. Of the four sites, Les Arcadins held the highest immediate potential for park designation because of its proximity to Port-au-Prince, potential for tourism development, local interest in protecting the site, and its reputed diverse, underwater life.

Following a United States Agency for International Development (USAID) Mission-funded feasibility study (Wilcox, 1986) that supported the importance of the site, a two-year collaborative effort was initiated by USAID, to study the area in greater detail and prepare a Draft Action Plan for the establishment of a Les Arcadins Marine Park. The contributing institutions included USAID, World Wildlife Fund, Wilcox Associates, the Haiti Hotel Association, the Villa Creole Hotel, the Kaliko Beach Hotel, the Kaliko Dive Center, American Airlines, and the Agouée Dive Club of Port-au-Prince.

The field work and analysis, performed by a team of specialists between the fall of 1987 and the spring of 1989, provides a solid biological, social, economic and institutional basis for recommending the establishment of a marine park at Les Arcadins, in Haiti. Beyond that, the Haitian people provide the spirit and will to make their first marine park an unqualified success.

It is commonly believed that Haitians must have little understanding of the cause and effect of ecological deterioration because of their present environmental situation. The truth is that they are all too familiar with the consequences of ecologically damaging actions such as overfishing and deforestation. Haitians know that *Tout vèn touche kè*, "Every vein touches the heart"; that is to say, that nature touches every aspect of their lives and is central to their existence. They do need the means, however, to change the course of environmental decline.

The Les Arcadins project team was composed of the following specialists from World Wildlife Fund and Wilcox Associates:

Evelyn Wilcox	Project Director and Institutional Specialist
Augusto Medina	WWF Project Officer and Environmental Education Specialist

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Carlos Goenaga	Biologic Survey Team Leader and Coral Reef Ecologist
Vance Vicente	Sponge Ecologist
Reni Garcia	Fisheries Ecologist
Alexis Gardella	Cultural Anthropologist
Thomas Deyo	Socio-economist
Dennis Glick	WWF Park Specialist
Elizabeth Wilcox	Graphic Artist

Two reports were produced: the Draft Action Plan and the Les Arcadins Resource Document. Much of the team's research can be found in the Resource Document, representing a major effort to provide original data on the biological, social, economic, cultural, and institutional aspects of the area. Evelyn Wilcox organized the studies and edited the final documents.

Special thanks go to the USAID Mission in Haiti for their encouragement and interest in the project; to the staff at World Wildlife Fund for their countless hours of work on the project, particularly Carol Baker, Catherine Monaghan, and Deborah Spears. Last but not least, thanks go to Roger Dunwell of the Villa Creole Hotel, who, from the beginning, provided both inspiration and support to the project.

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EXECUTIVE SUMMARY

The marine area surrounding the three Les Arcadins islands has the potential to become an important diving area in the Caribbean region. It has a physically predictable environment where climatic conditions permit SCUBA and skin diving activities throughout the year, except during infrequent tropical storms. The water transparency surrounding the three islands is excellent; better than that found in most other marine areas in the Caribbean. The high physical heterogeneity of the substrate allows the establishment and development of both light exposed biota (corals, gorgonians and algae) and cryptic-cave dwelling species. Some deep water (more than 30 m of depth) habitats, generally accessible only to SCUBA divers, are apparently replicated here in very shallow water (5 m) allowing snorkelers to enjoy viewing deep water species in shallow water environments. (See Resource Document, Section 1, Benthic Survey and Section 2, Fisheries Survey for the complete survey findings).

From a conservationist point-of-view, Les Arcadins' uniqueness and biological diversity make it a natural resource worthy of preservation and protection. Furthermore, the establishment of a fish reserve, within the park, would, in the long term, aid in the renewal of commercial fish populations currently in serious decline due to local overfishing. This action would be directly beneficial to the local fishing-dependent human population and, from both a local and a developmental perspective, important in mobilizing local participation and encouraging the practical interest of various Non-Governmental Organizations (NGOs) on the Haitian scene.

The immediately adjacent fishing community of Luly is focused around a core of full-time fishermen who are seriously committed to maintaining their livelihood, for themselves and the next generation. They are already aware of the long-term negative effects of overfishing, but find themselves helpless to change the situation, due to primitive fishing methods, scarce capital, market domination by local and Port-au-Prince fish speculators, and increased pressure on the marine resource from local and opportunistic part-time fishermen.

Les Arcadins is a fortuitous choice for a marine park in Haiti because it already has an existing fisheries cooperative with whom park management can work. The existence of a "real" community organization ("real" in the sense that it exists a priori to outside funding) and an honest and respected community leader such as the current president of the cooperative is rare in rural Haiti, and thus suggests fertile ground for the

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development of a marine park in concert with the local community.

Although the overall decrease in tourists to Haiti, in the past few years, is due to unpredictable and uncontrollable factors such as the unfavorable AIDS publicity and the volatile political situation, the establishment of a marine park would serve to attract what many consider to be the fastest growing subsector of tourism in the Caribbean, the SCUBA diving and snorkeling industry, and stimulate investment in the local tourism infrastructure. According to visiting and local divers, diving in Haiti is good. The management at Kaliko Dive Center, in the vicinity of Les Arcadins, does mostly repeat business and considers Les Arcadins competitive with other Caribbean island sites. With sufficient promotion abroad, presumably other tourists would follow.

Like other Caribbean islands, one of Haiti's major tourist attractions is its beaches, and this strip of coast is the most accessible, most comfortable in terms of amenities and among the most beautiful sites in the country. During peak tourist years, the local economy received an estimated $1.5 million dollars annually from hotel wages and fish/seafood sales. Total hotel and direct and indirect employment generated from these tourist businesses was estimated to be about 2,200 Haitians. Government revenues were approximately $1 million from room and departure taxes. Annual foreign capital into the country, less the hotel wages and fish and seafood purchases and government revenues, was an estimated $21 million to $31 million, in the peak tourist year. This inflow of cash was further distributed throughout the region for necessary goods and services and other investments.

Clearly, the Les Arcadins region has contributed substantially to the Haitian economy. Therefore, national plans for revitalizing the tourist industry should include this region if Haiti is to realize the full economic benefits of tourism.

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MAJOR FINDINGS AND RECOMMENDATIONS

I. SETTING

Haiti

The country of Haiti is located in the mountainous, western portion of the island of Hispaniola in the Greater Antilles, bordered on the north by the Atlantic Ocean, to the west and south by the Caribbean sea and to the east by the Dominican Republic (Fig. 1). The Les Arcadins area is located close to Port-au-Prince, the nation's capital, and off the western coast of Haiti in the Golfe de la Gonâve (Fig. 2).

In contrast to the declining resource value of its forests and agricultural lands, Haiti's coastal and marine environment appears to be in relatively good condition (CEP, 1986). Well developed coral reefs fringe long stretches of coastline. (Haiti has 1500 km of coastline and an estimated insular shelf of 5000 km2). Offshore barrier and atoll-like reefs, and "walls" of coral, along the shelf edge, although largely unexplored, are reported, by some recreational divers and fishermen, to be productive, sometimes spectacular areas. Four large offshore islands: Ile de la Tortue, La Gonâve, Grande Cayemite and Ile à Vache and many smaller islands, contribute to the richness of the nearshore ecological system.

Les Arcadins

The Sea

The three small islands of Les Arcadins are the only significant land outcrops off the west coast of Haiti, up to the platform of Ile de la Gonâve. They are situated on a bank about 5 km wide that ranges in depth from 13 to 19 m (Fig. 3). The platform surrounding this bank is generally deeper than 21 m.

The closest island to shore, Ti Teal, or North Island, lies about 3.6 nautical miles in a southerly direction from Kaliko Beach. It is 110 m long and 70 m wide (Fig. 4). The largest of the three islands, Lighthouse Island, is 425 m long and 125 m wide and lies .5 nautical miles southwest of Ti Teal (Fig. 5). It derives its name from the presence of a working lighthouse on the northwestern tip of the island. Ile de Sud or South Island is 250 m long and 200 m wide and lies .2 nautical miles south of Lighthouse Island (Fig. 6). The water depths between the coast at Kaliko Beach and Les Arcadins range between 10.7 and 31.0 m.

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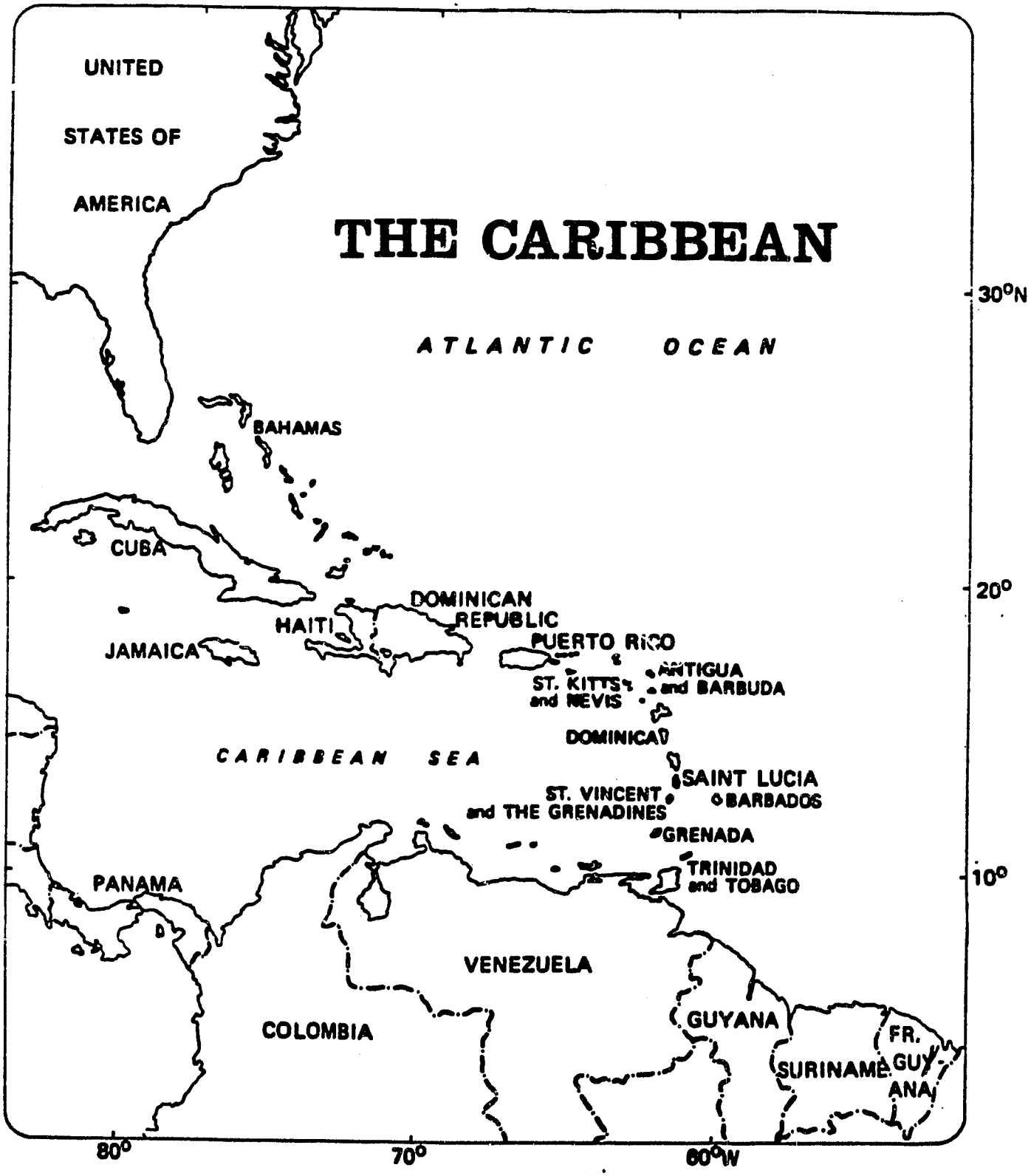

Figure 1 Map of the Caribbean

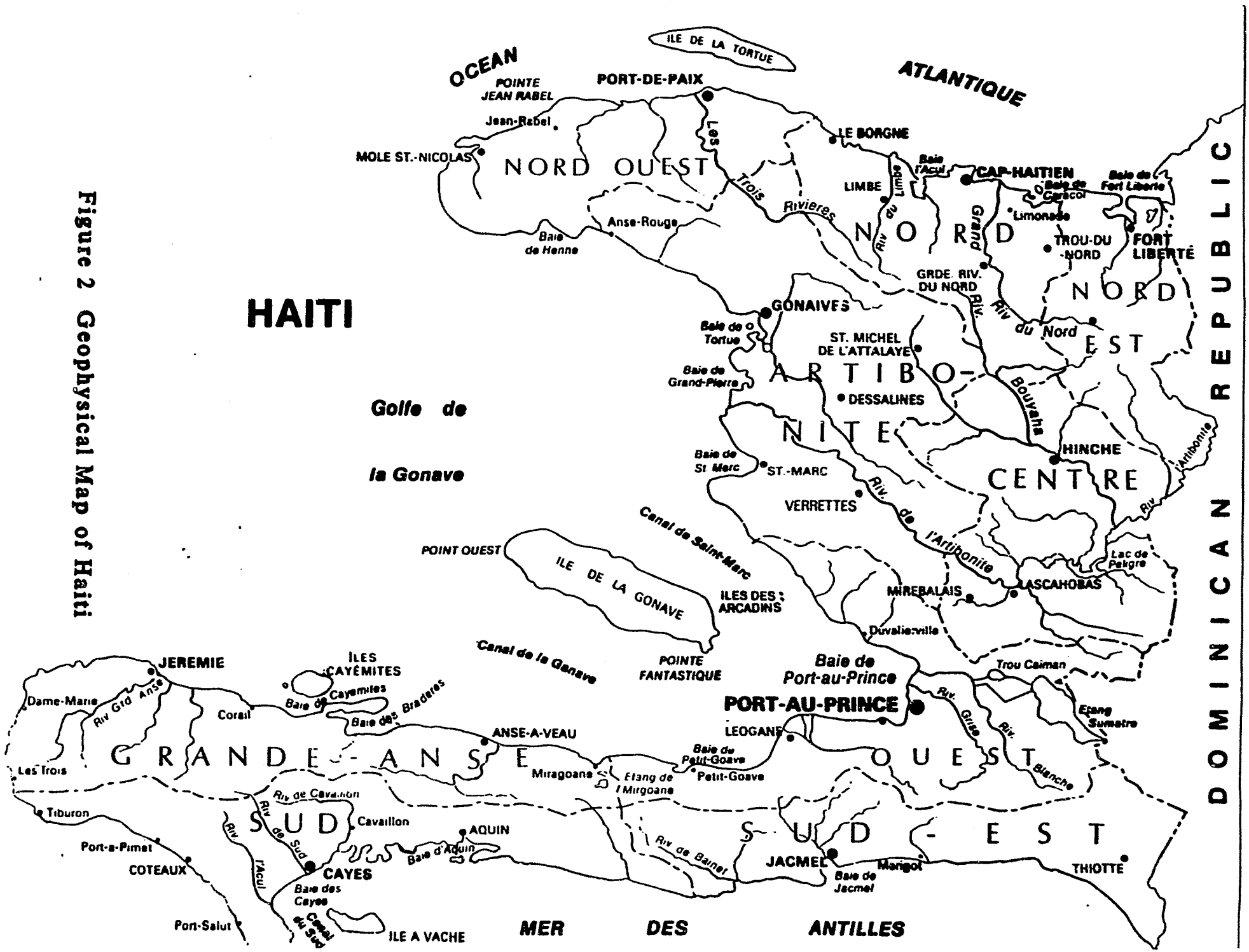

Figure 2 Geophysical Map of Haiti

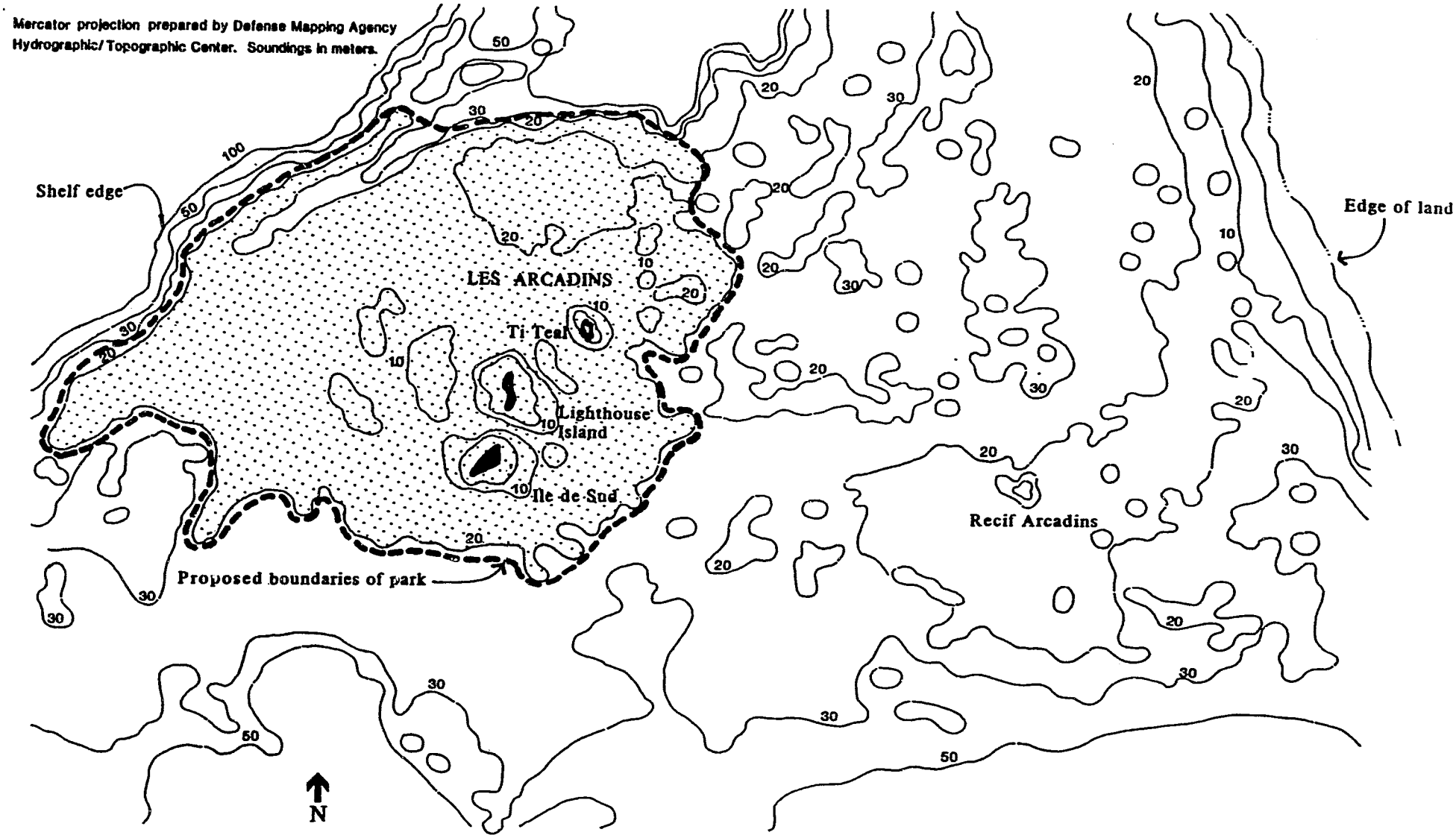

Figure 3. Location of Les Arcadins in the Golfe de la Gonave

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Figure 4. Aerial Photograph of Ti Teal

Figure 5. Aerial Photograph of Lighthouse Island

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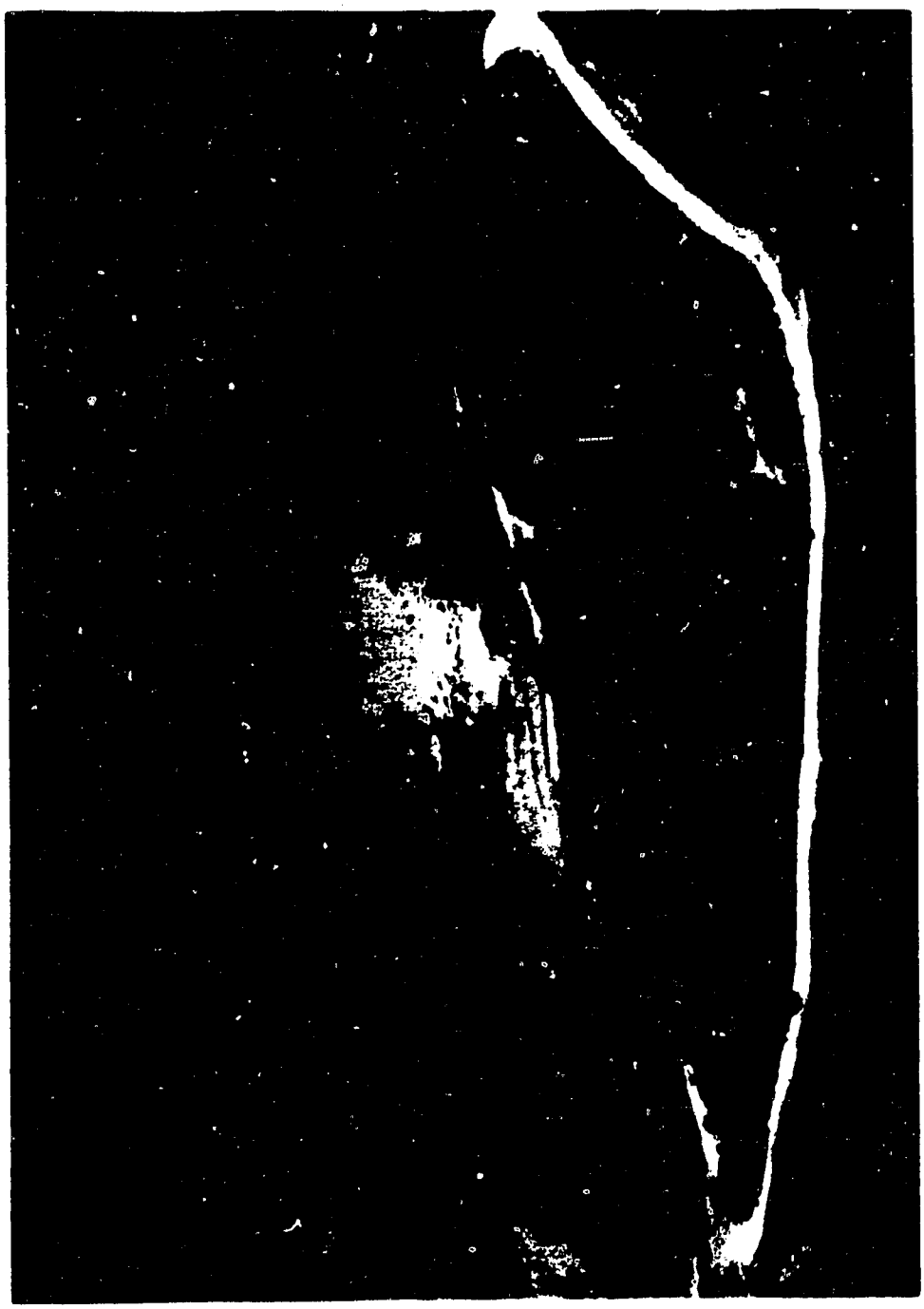

Figure 6. Aerial Photograph of Ile de Sud

Les Arcadins are surrounded by extensive coral reefs. These reefs possibly arose when the Haitian platform became inundated after the last glaciation. The islands lie between the alluvium-limestone formations to the east, along the coast, and the limestone formation of the Ile de la Gonâve, to the west (Fig. 2).

The western waters of Haiti are influenced by two major currents: the Antilles Current to the north and the Caribbean Current to the south. The Windward Passage, one of the deepest and widest connections between the Atlantic Ocean and the Caribbean, may also influence the physico-chemical properties of the region. Local currents near Les Arcadins have not been studied in any detail, but personal observations suggest that wind-induced currents and tidal flows may affect the distribution of epibenthic populations within its natural systems.

No studies of water transparency surrounding Les Arcadins were available but good cover of turtle grass (Thalassia testudinum), down to depths of 19-20 m, indicates that clear water conditions prevail. This deduction is partially based on the study of the correlation between water turbidity, as measured by Secchi disk readings, and the depth limit of turtle grass Thalassia testudinum (Vicente, 1982) and supported by the bathymetric range and morphology of Montastrea annularis, a light sensitive species, on Les Arcadins reefs. Thalassia, requiring adequate penetration of sunlight into the water column, is the most extensive benthic organism surrounding the three islands.

The rivers that empty, closer to Port-au-Prince, probably do not influence the natural environment of the islands, in view of their small size and distance from the site. However, there are at least five major rivers that discharge close to Les Arcadins. Some are dry during the dry season (e.g., Riviere Seche), but may be capable of impacting Les Arcadins by introducing terrestrial sediments into the ocean, near the area, during the wet season (personal observations Goenaga, 1988).

The Land

Nearby, the fishing village of Luly lies on the coast, facing Les Arcadins to the west, and with arid, deforested foothills and low-lying mountains at its back. The land immediately surrounding Luly has little agricultural value except during the rainy season, which has been diminishing in intensity and length for the last five years. In addition to the nearby beach hotels of Kyoná and Kaliko, much of the land surrounding Luly, especially along the beach front, is owned by wealthy Haitian elite. The beach front areas are parcelled out into residential sites for beach houses, while larger tracts of land immediately behind and to the northwest of Luly are held by

Port-au-Prince businessmen. At the present time, most of these larger tracts of land are divided into smaller plots which are rented or sharecropped by the local inhabitants for agriculture and animal husbandry. Weather conditions permitting, the local people grow different varieties of melon for sale and millet for their own consumption, but use these lands primarily for goat grazing.

This combination of arid lands with minimal agricultural value and a shoreline dotted with both beach hotels and private beach houses characterizes the area from Luly northwest to Montrouis and beyond, to St. Marc. The area southeast of Luly, stretching to Cabaret (formerly Duvalierville), is a fertile plain almost completely irrigated through the interventions of the Haitian State and various international organizations, including USAID. This area produces substantial amounts of plantain, bananas, tomatoes and other table vegetables. Although there are relatively few large tracts (100+ ha) of land held by one owner, there are numerous smaller holdings belonging to Port-au-Prince businessmen which are sharecropped by the local inhabitants. The largest regional market is the one in Cabaret which takes place twice a week. On alternate days there are more localized markets in many of the roadside communities, including Williamson, Arcahaie, Sainthard, and Montrouis.

The People

It is difficult to estimate the population of Luly. Based on the number of full-time fishermen and people working in fishing-related activities and on general population trends for rural Haiti as a whole, a reasonable estimate would be approximately 400 households, or about 1,500-2,000 individuals, with at least 50% under the age of 18. By local consensus, the demographic nucleus of Luly is the approximately 300 full-time fishermen and their families. (These numbers, as well as others cited in the text that are not otherwise referenced, were provided by the Luly Cooperative.) At the time of the field work they were the only figures available for the area. They were collected by the cooperative for its own purposes and did not seem to be biased in one direction or another.

The economic focus of Luly is the collection and distribution of fish and other marine products. In addition to fishing per se, many, if not all, economic pursuits in Luly are related to some aspect of the fishing industry. These include the purchase and marketing of fish, the cleaning and preparation of fish for wholesale buyers, and the artisanal production of fishing nets, traps, sails and boats.

Peripheral to these fishing activities are agricultural and livestock production, domestic service in the private beach houses and hotels, agricultural day labor, and petty

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entrepreneurial activities such as the sale of shells and crafts, and the providing of occasional boat trips for tourists. These are almost never full-time pursuits for any one individual.

Following the same pattern found all over Haiti, individuals in Luly pursue a livelihood strategy of minimizing economic risk by maximizing their options; engaging in a variety of economic activities or "not putting all your eggs in one basket". Even a full-time, fully-equipped fisherman will also have various economic activities on the side, such as garden cultivation and occasional wage labor when the opportunity presents itself.

The population of Luly also includes a number of displaced families from other areas, probably numbering no more than 10-15% of the total population. These displaced people come primarily from the island of La Gonâve and the area immediately surrounding St. Marc. The island of La Gonâve is almost completely deforested and frequently drought-stricken. During droughts many La Gonâve families, dependent entirely on fishing for their livelihood, move temporarily to Luly to be close to a major fish marketing center and to avail themselves of the relatively larger range of economic opportunities. When the droughts are over, most of these families move back to La Gonâve, but there are always several families who stay and make Luly their home. Likewise, the area around St. Marc is severely deforested, and during dry periods, these people must depend, to a large extent, on fishing. In the last three years or so, St. Marc fishermen have been increasingly frequenting the Luly fishing territories and marketing their fish in Luly. Some of these fishermen have moved their families to Luly permanently. There are also a few individuals who have come from areas further afield (such as Logane, Miragone, Gonaives), seeking jobs in the tourist hotels and eventually making Luly their permanent home.

Luly is a highly stratified community. Its internal ranking is gauged primarily by access to economic resources, with socio-cultural characteristics tied directly to the level of economic standing. The top of the socio-economic ladder in Luly is that group of people engaged in the wholesale distribution of fish, or the *spekilatè*. The speculators buy large quantities of better quality fish and high-priced lobster, conch, crab, and shrimp to sell to the beach hotels, local elite, and Port-au-Prince retail and wholesale dealers. Some of them are directly linked to wholesale fish exporters in Port-au-Prince, while others are more independent, selling through a variety of channels. Just below them on the socioeconomic ladder are those successful, full-time fishermen, who have a full range of fishing gear and derive the major portion of their income from fishing. More-or-less on a par with these fishermen are the various *bos*, or skilled craftsmen, manufacturing boats and related fishing gear, and the *madanm sara*, or wholesale market women. Next are the relatively less-successful full-time fishermen, the agents of the *spekilatè*

25X

(those who actually buy the fish on the beach), and people in the permanent employ of the beach hotels. Further down are the *marchans*, or local market women, who buy lower quality fish on the beach for resale on the nearby markets, the less-skilled *bos*, and domestic workers. At the bottom are the full assortment of part-time fishermen with minimal fishing gear, the displaced families from other areas, the women and men who clean and prepare fish for the wholesalers, and the many who find employment wherever and whenever they can.

It is important to note that the lower range of this socio-economic ladder is characterized by people who must shift their economic activities according to the most advantageous opportunities that present themselves. For example, the so-called "part-time" fishermen rely on fishing when other sectors of the economy are not viable. A drought, the loss of access to agricultural lands, the lack of day labor, the need to sell off livestock, and so on, are all situations where, typically, men will turn to fishing to take up the slack. Needless to say, these men have restricted access to fishing gear and limited experience and knowledge of the marine environment. Thus they are at a double disadvantage, both in relation to full-time fishermen and to others who have stable economic pursuits.

The primary rural administrative authority for Luly, the *Chef de Section*, is situated in Arcahaie. The only development project that has directly affected Luly is a potable water system funded by Banque Internationale de Développement (BID) with voluntary community participation. Luly received water at its recently-built public water fountain sometime in August, 1988. The parish priest and the main Catholic Church in the area are in Sainthard. There are countless independent Protestant sects dotting the entire area, but in Luly, the people are predominantly Catholic.

Luly's proximity to Port-au-Prince, its easy accessibility from Route Nationale #1, and the neighboring presence of numerous wealthy Haitians and foreigners, have contributed to the importance of Luly as a seafood market center. While there are many other centers of fish distribution in Haiti, notably St. Marc, Gonaives, Anse Rouge, Cap Haitien, Aquin, Les Cayes, Jeremie, and Dame Marie/Anse d'Hainault, none have the market advantages of Luly. The consequent proliferation of fish buyers of all sorts has created a sellers' market where no fish goes unsold and where prices are relatively profitable. With the exception of Luly and Dame Marie, what little information exists indicates that most of the other fishing centers are dominated by selected wholesalers and their agents through their control of transportation of fish out of the area. These market conditions create situations where the fishermen are at a distinct price disadvantage, as much as 1:100 in the wholesaler's favor in at least one case studied (CORERE 1979:5-6).

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By situating Luly in its own socio-geographical context and comparing it to other fishing centers in Haiti, one can quickly perceive that Luly is not a "normal" fishing village as commonly found in Haiti. It is neither isolated, nor severely poverty-stricken, nor dominated by a single individual or social group. The wider range of opportunities to sell fish, together with the availability of other peripheral economic options, results in a greater internal socio-economic differentiation than generally found in other fishing communities. In sum, Luly cannot be treated as a homogeneous, monolithic category of people who will react uniformly to events, constraints or pressures applied from the outside. They are aware of events occurring outside of their area, are familiar with prominent people in the world of politics and commerce, and even have knowledge of the fishing industry outside of Haiti. The activities of the State and various international development agencies in their area have also made them familiar with the nature of the "development" sector in Haiti, both from the point-of-view of project "beneficiaries" and administrators, both Haitian and expatriate.

The Tourist

The Les Arcadins area has been a recognized tourist beach area in Haiti since the late sixties. Both the Ibo Beach and Kyoná Beach resorts have been in operation for nearly three decades. At present, the Les Arcadins region includes eight hotels and resorts and encompasses the area bounded by Ibo Beach at the village of Simonette to Xuragua Hotel at the village of Deluge (Fig. 7).

The region's most successful period began in the mid-1970's and flourished until 1985. During this time six resorts opened in the area, including the industry giant, Club Mediterranean, in 1980. The presence of this world-famous chain resort provided Haiti, as well as the Les Arcadins region, with sound recognition as a legitimate Caribbean resort destination. The last resort to open in the region was the Moulin Sur Mer which began operation in 1985, at the close of the boom tourist period.

The selection of the Les Arcadins region by tourists bound for the Caribbean, results from its fine beaches, its ease of access, the marine life (i.e., Les Arcadins, La Gonâve island), and its proximity to Port-au-Prince.

The islands are a recreational feature of the resort operations of many of the hotels in the region. Nearly everyone staying at the resorts, nearest Les Arcadins, makes a trip to the islands via either a hotel operated boat or a hotel-associated, local fisherman's boat. In particular, dive packages were a growing element of Kaliko's business in the mid-80's. The Kaliko Dive Center offers SCUBA and snorkeling trips to Les

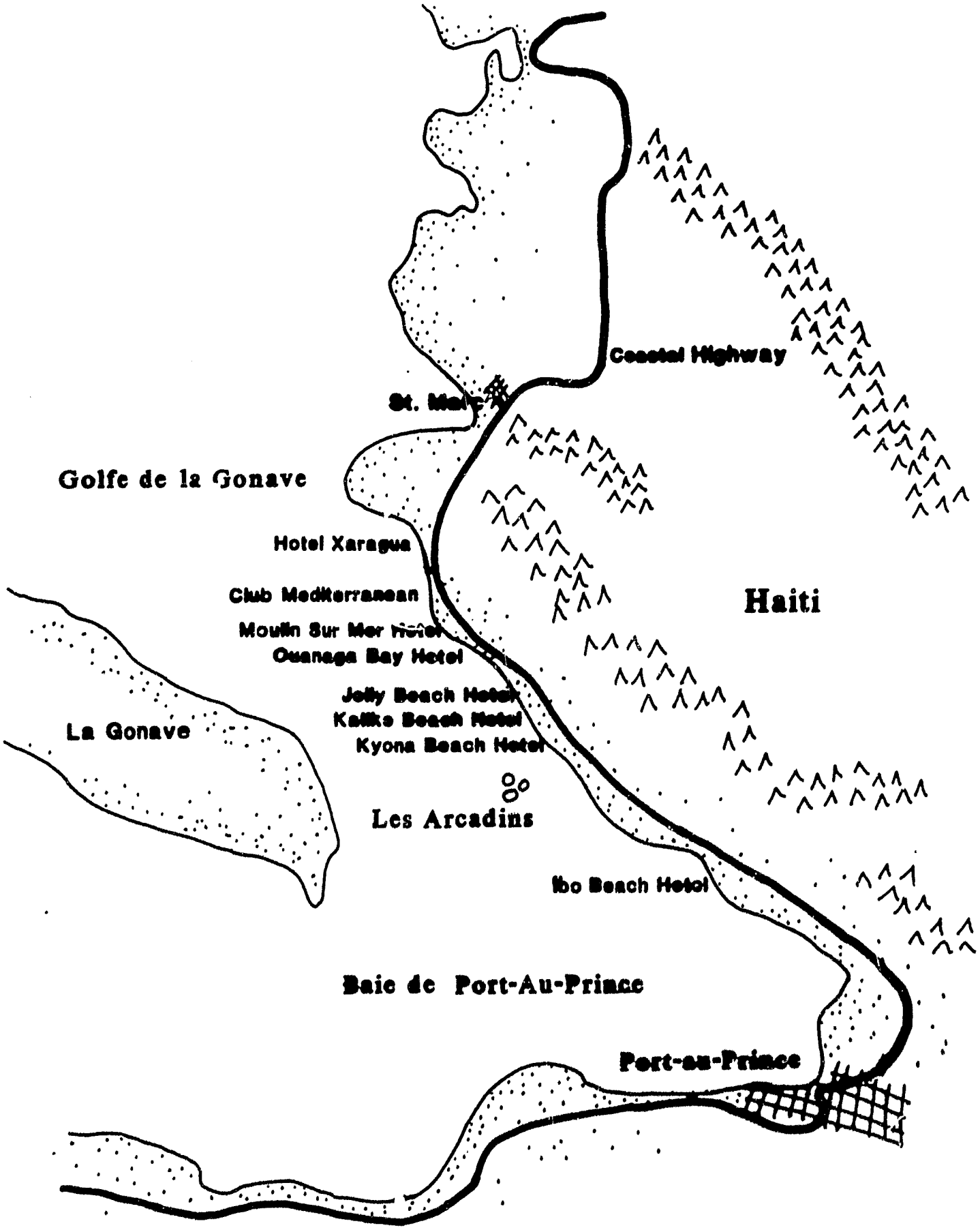

Figure 7. Hotels of the Les Arcadins Region

Arcadins almost daily. During the peak season, in the mid-1980's, about 25% of those staying at the Kaliko hotel had come exclusively for diving.

Pressure on the Marine Resource

Although Luly's socio-geographic situation provides an advantage to its fishermen in terms of access to market, it also causes increased pressure on the marine resource. First, it brings outside fishermen, i.e. men from areas outside of the Luly fishing community, into Luly fishing waters, thereby increasing the numbers of people dependent on a single marine base. Secondly, it forces indigenous fishermen to double their efforts, both because of competition with outsiders and in order to sustain acceptable yields from an increasingly overexploited marine environment.

Due to the primitive nature of fishing technology, this increased pressure is felt in the longer and more frequent fishing sorties necessary to maintain an adequate return. A normal fishing sortie starts at 4 or 5 o'clock in the morning and ends at 3 or 4 in the afternoon, at least three times a week. Furthermore, it is only the well-equipped full-time fisherman who can afford to only go out three times a week. Others must go out more often or alternate with other physically demanding labor, such as agricultural activities. (A full discussion of fishing equipment, methods fishing territories, boat ownership and commercial distribution is found Section 3 in the Resource Document, Appendices I, II, III).

There is also recent evidence of increasing shell and coral collection by those who sell to commercial exporters in Port-au-Prince. The shallow, calm nature of Les Arcadins waters make it a natural target for such collecting operations.

II. STATE OF HAITIAN TOURISM

Overview

Today, travel to Haiti by anyone except business people, Diaspora Haitians (Haitians that left Haiti during the reign of Duvalier), politicians, or consultants appears to be left only to the more adventurous tourist or vacationer. Travel industry representatives report few foreign tourists since 1987. Port-au-Prince hotels cater almost exclusively to business people and Haitian Diaspora. Beach hotels (nearly all in the Les Arcadins region) cater primarily to residents of Haiti on weekend trips to the country.

Such a depressed state of tourism is not easily discernable from a reading of government data since the Office National du

Tourisme data on tourists to Haiti includes everyone that is not a resident of Haiti. These data show a respectable number of tourists continuing to visit the country in recent years.

Data in the Office National du Tourisme statistical reports often do not correlate from one table to another and discrepancies often cannot be isolated. Further, data are compiled from embarkation cards which require all arrivals to state their name, place of residence, birth date, originating country, profession, purpose of visit, and address in Haiti. These cards are not always a true assessment of a visitor's visit nor does it reflect all their destinations in Haiti. As a result, the numbers used in this report, from the Office National du Tourisme, are employed to show an order of magnitude of tourism and do not represent a complete assessment.

The Les Arcadins tourism study defines tourists simply as foreign vacationers. Excluded from the tourist category are business people and Diaspora Haitians vacationing in Haiti. This definition differs slightly from the World Tourism Organization's definition of "leisure tourist" which would include foreigners of Haitian extraction. However, for this report it is most important to isolate the non-Haitian tourists as they historically contribute more significantly to the economy of the resort hotels. Visitors, on the other hand, refer to all non-residents coming to Haiti. Included in this category are tourists (as defined above), business people, Diaspora Haitians, and others.

Even by its own figures, however, government data show a substantial recent decline in the number of tourists visiting Haiti compared to the peak years of 1981 to 1985. Table 1 shows total 1987 visitors of 120,000. While this is about 10,000 more than 1986, it is about 40,000 below the peak year of 1981 and 20,000 below 1985, the last strong year of Haitian tourism. This 1985 to 1987 change represents a 20 percent decline in tourism over two years.

Unfortunately, the field study's estimates on tourists portray an even bleaker picture. By using the study's definition of tourists, a more accurate estimate of tourist decline is revealed. Between 1985 and 1987, Haiti suffered over a 50 per cent drop in tourists; from about 40,000 to 18,000. Many of those in the government's 1987 visitor numbers are better classified as business people or Diaspora Haitians rather than bona fide tourists. In effect, only about 15 percent of the Office National du Tourisme's 1987 visitor count could be classified as tourists under our definition; compared to over 25 percent in 1985.

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Table 1. NUMBERS OF TOURISTS AND CRUISE SHIP PASSENGERS TO HAITI, 1970, 1975 TO 1987

Year	Tourists	Passengers
1987	121,800	70,500
1986	111,650	84,650
1985	149,650	95,250
1984	144,650	92,550
1983	127,150	96,550
1982	119,450	94,700
1981	158,000	117,850
1980	136,000	159,650
1979	134,100	172,650
1978	111,650	187,550
1977	96,000	186,400
1976	85,900	201,800
1975	79,000	200,400
1970	44,900	42,500

Source: Office National du Tourisme et des Relations Publique, Haiti.

Tourist Origins

Historically, Haiti has received the majority of its visitors from the U.S., Canada, and Europe, as shown in Table 2. Visitors from the U.S. consistently account for the largest percentage and number of visitors to Haiti. American visitors have steadily increased from around half of all visitors in the late 1970's to about two-thirds in 1987.

Europeans contributed significantly to visitor counts in the late 1970's and represented about 20% of all visitors to Haiti. However, the rise in the value of the dollar in the early 1980's led to a decline in European visitors. By 1987, Europeans accounted for less than 10% of all visitors. Canadian visitor numbers have fluctuated from 10 to 15 percent of all visitors from the late 1970's to the present. They have become the second largest contingent since the decline in European visitors.

Overall, European travel to the Caribbean dropped considerably between 1980 and 1985; falling from 962,000 to 800,000. Trends similar to Haiti have been registered by other Caribbean nations such as Barbados, British Virgin Islands, Cayman Islands, and U.S. Virgin Islands. (Caribbean Tourism Research and Development Centre, 1982, 1986)

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Table 2. COUNTRY OF RESIDENCE OF ALL VISITORS TO HAITI, SELECTED YEARS BETWEEN 1975 AND 1987

Year	Total	USA	Canada	Europe
1987	121,800	78,300	14,450	9,100
1986	111,650	71,350	14,775	7,950
1985	149,650	89,750	22,100	12,300
1984	144,650	83,250	17,100	12,600
1981	158,0001/	69,350	15,500	25,700
1977	96,000	44,600	14,750	21,150
1975	79,000	41,750	9,300	13,200

Note: 1/ Approximately 30,000 tourists this year were classified as Not Specific.

Source: Office du Tourisme et des Relations Publique.

Haitians as Visitors

Diaspora Haitians returning to visit their relatives have become an increasingly larger segment of the visitor counts over the past few years, especially since the overthrow of Duvalier. In 1981, visitors of Haitian nationality were just above 10 percent of all visitors. Since Duvalier's overthrow, visitors of Haitian nationality have been over one-quarter of the visitor counts.

These visitors are not typical visitors and their inclusion in the visitor numbers distorts the clear picture of foreign visitors to Haiti. If they are excluded, the trend in foreign visitors to Haiti becomes clear. Visitors to Haiti have decreased 35% over the past two years. Table 3 illustrates what the visitor counts would be if the Haitian visitors were removed.

Table 3. PERCENT OF VISITORS OF HAITIAN NATIONALITY OF ALL VISITORS TO HAITI 1981, 1984 TO 1987

Year	Total	Total Percent Haitian	Visitors less Haitians
1987	121,800	26	90,000
1986	111,650	26	82,000
1985	149,650	18	122,700
1984	144,650	17	120,000
1981	139,000 1/	12	122,000

Note: 1/ This number accounts for all visitors of a known nationality and excludes the 30,000 visitors classified as Not Specific.

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Source: Office National du Tourisme et des Relations Publiques, Haiti

Returning Haitians should not be entirely discounted since many of these returning Haitians take rooms in hotels and contribute to the tourist industry. They, however, are not the backbone on which the tourist industry can rely, for they do not return home and convince others to make a trip to Haiti.

Vacationers to Haiti

A clearer picture of actual "tourists" to Haiti emerges if the purpose of visits to Haiti and the lodgings of visitors are examined. The following tables refine the visitor numbers in an attempt to get to our definition of tourists.

Table 4 illustrates the precipitous drop in vacationers to Haiti over the past two years. The decline in total visitors to Haiti can be linked almost entirely to the decrease in "vacationers" since business people and "other" visitors have remained fairly constant during the 1980's.

Table 4. COUNTS OF TOURISTS BY PURPOSE OF VISIT TO HAITI, 1981, 1984 TO 1987

Year	Total	Vacation	Business	Other
1987	121,800	65,950	18,900	36,950
1986	111,650	62,800	14,700	34,150
1985	149,650	91,250	19,000	39,400
1984	144,650	84,650	20,400	39,600
1981	158,000	88,000	19,900	50,500

Source: Office National du Tourisme et des Relations Publiques, Haiti

Business people, Diaspora Haitians, missionaries, and others provide benefits to the tourist industry in so much as they occupy hotel rooms and purchase crafts and other goods. The outlying tourist businesses cannot survive from these visitors' purchases, nor can many of the Port-au-Prince hotels. The growth segment of the tourist industry lies with the "vacationers", as shown above, and it is with these visitors that the tourist industry must grow and expand.

True vacationers to Haiti generally are found in the city hotels and beach hotels. According to local tourist industry representatives, pensiones and private residences are typically the lodgings of missionaries and visiting Haitians.

Thus, actual tourists to Haiti in 1987, as shown in Table 5, only totaled about 18,000. This represents only 27% of all vacationers in Haiti and only 15% of all visitors to Haiti. In contrast, 1985, the last strong season for tourism in Haiti, had nearly 40,000 vacationers staying in city hotels and beach hotels. This represented almost 45% of all vacationers and over 25% of all visitors to Haiti.

Beach hotels have experienced the severest drop in "vacationers" over the past three years; falling 200 percent from their 1985 level. Unfortunately, data were not available before 1985 on some of this information and therefore the conclusions are only conjectural. Confidence in these numbers stems from collaborating information given by tourist industry officials and hotel operators.

Table 5. COUNTS OF TOURISTS WITH "VACATION" AS PURPOSE OF VISIT AND THEIR PLACE OF STAY IN HAITI, 1985 TO 1987

Year	Total Vacationers	Hotel	City Hotel	Beach Pensione	Private Residence and Other
1987	65,950	10,850	7,250	2,750	45,100
1986	62,800	10,550	4,650	2,650	44,950
1985	91,250	17,950	22,000	3,800	47,500

Source: Office National du Tourisme et des Relations Publiques, Haiti

Revenues

Tourism is a certain revenue generator to any local economy. Many Caribbean nations rely heavily on tourism as a major component of their economies. Haiti, with a more diverse economy relies less on tourism. Its potential for expanding the current tourist contribution to its economy is an achievable goal based on its past contribution and a comparison with neighbors having similarly diverse economies.

Neglecting this segment of its economy has resulted in lost revenues and a smaller percentage share of tourist revenues than its Caribbean competitors. Tourist revenue to the Haitian economy provides an infusion of foreign capital, taxes to the government, and value-added to the local economy.

In terms of visitor expenditure as a percent of Gross Domestic Product, Haiti's position is well below that of most other Caribbean nations. According to the Caribean Tourism Research and Development Center (CTRDC), visitor expenditure in Haiti amounted to 3 percent of its 1983 Gross Domestic Product. Similarly, the Dominican Republic's was 4 percent. In contrast,

the more tourist-developed country of Jamaica with a similarly diversified economy had visitor expenditures of 18 percent of its Gross Domestic Product (Caribbean Tourism Statistical Reports: 1986).

Visitor expenditures are of potentially greater value than their face value as each expenditure ripples through the economy and adds value to the regional and local economies. Unfortunately, this value is diminished by leakage, that is, dollars sent abroad for imported goods and services and foreign assistance (Sealey, 1982). A multiplier for Haiti is not known, but based on other Caribbean country experiences this multiplier is thought to be about 1. Attaining a level above 1 would mean that each dollar spent in the local economy would add more than its face value to the local economy.

The government also stands to gain certain general revenues from the tourist industry directly from hotel room and the departure taxes, and from indirect sources, such as duties, utilities, employment taxes, and income taxes. Direct government revenues from tourism include a 5 percent government tax on all hotel rooms and a $15 per person departure tax. Indirect revenues probably are about 5 percent to 10 percent of tourism expenditures.

The following table illustrates the estimated revenues of the government from these sources for both a good tourist year and a poor year. As shown, the government received an estimated $10.5 million in revenues from visitors in 1985 from these sources. In contrast, 1987 revenues from visitors on these taxes decreased by almost $3 million. About two-thirds of this decrease resulted from fewer tourists staying at hotels and beach hotels.

Table 6. ESTIMATED GOVERNMENT REVENUES FROM VISITORS THROUGH HOTEL AND DEPARTURE TAXES FOR 1985 AND 1987

Year	Total Visitors	Total Hotel/ Gst Hse Visitors	Avg Nts/ Gst 1/	Avg Cost/ Room 2/	Est. Hotel Tax (000)3/	Depar-ture Tax (000)4/	In-Direct Rev (000)5/
1985	149,650	110,260	8	$60	$2,700	$2,250	$5,250
1987	121,800	77,000	8	$55	$1,700	$1,800	$4,250

Notes: 1/ Estimate; based on Office du Tourisme statistics.

2/ Weighted average of hotel, beach hotel, and guest house room charges. According to industry sources, room charges have not increased in past few years. Difference

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results from fewer hotel guests while guest house guests remained steady.

3/ 5% of room charges.

4/ $15 per person.

5/ Based on $500 per person per trip expenditures and a revenue of 7 percent of these total expenditures.

Source: Office National du Tourisme et des Publique Relations, Haiti and consultant.

Tourism Generated Employment

The tourist industry generates various forms of employment. A major source of employment lies with the hotels. The Caribbean Tourism Research and Development Centre (CTRDC) estimates that approximately 92 persons are employed for every 100 rooms, or almost one person per room. In addition, other direct and indirect employment may be attributed to the tourist industry, such as taxi drivers, restaurant, casino, souvenir shop, and other public and private sector service business employees.

The major Caribbean tourist-developed countries achieve employment ratios of over 4:1 of indirect and direct tourist employment to accommodation employment. The estimate of the number employed for other less tourist developed countries is 3:1 (CTRDC, 1986).

In 1983, the total number of rooms (hotels, beach hotels, and guest houses) in Haiti was estimated by the CTRDC at about 3,600. The Office National du Tourisme and the Haiti Hotel Association did not have any figures for total accommodations. Using the CTRDC estimates for accommodation employment and indirect and direct employment, among the Caribbean countries it is estimated that the Haitian tourist industry provided an estimated 14,400 jobs during the peak tourist period.

Today, employment related to the tourist industry is significantly less. The closing of numerous hotels has decreased the number of rooms by at least 650. In addition, most hotels are operating with reduced staffs of approximately half to two-thirds of their peak employment. Further, the drop in the tourist industry has reduced demand for ancillary services and, therefore, the direct and indirect tourist industry ratio would be considerably less than 3:1.

III. STATE OF TOURISM IN THE LES ARCADINS REGION

Tourist Activity Between 1980 - 1987

Unfortunately, specific data on tourist visits to the

region are non-existent. However, through interviews with hotel owners and operators and an analysis of government tourist data, inferences can be made about tourist activity in the region between 1980 and 1987. This time frame includes both peak and valley tourist periods for Haiti and the region.

Information gathered by the Office du Tourisme et des Relations Publique about tourist destinations to beach hotels portrays a remarkable climb in tourist numbers between the late 1970's and the mid-1980's. The bulk of these tourists likely went to the beach hotels in the Les Arcadins region. Of the almost 800 beach hotel rooms in Haiti, over 80 percent are in the Les Arcadins region.

Table 7 depicts the increase in tourists to the beach hotels. These numbers do not include visits by Haitian residents. In 1976 about 9,000 tourists had beach hotels as their primary destinations. At this time about 250 beach hotel rooms were available in Haiti. Based on these numbers, the calculated average annual occupancy rate was about 30 percent for these hotels. By 1981, annual tourists to beach hotels had doubled to almost 16,500. Additions to the hotels at this time included the 350-room Club Mediterranean, a high volume generator of tourists. The calculated average annual occupancy rate for all beach hotels, however, remained about 30 percent because of the substantial increase in hotel rooms.

Beach hotel tourism climbed to 24,000 annually by 1985 which brought the calculated average annual occupancy rate up to about 50 percent for the beach hotel industry. Club Mediterranean most likely generated about 50 percent of these tourists. From these numbers, it is clear that Haiti and this region had achieved recognition as a Caribbean resort destination.

Unfortunately, the bottom fell out of the tourist industry in 1986. Due to the uprisings and ouster of Duvalier, annual tourists to beach hotels numbered just over 5,000 according to Office of Tourism statistics, or one-fifth that of the previous year.

The next year, however, started out relatively well. Club Mediterranean was operating and European tourists were still making their way to some beach hotels. This optimism was squelched by the civil disturbances of the summer of 1987 and the violent turmoil during the fall elections. These events have all but eliminated foreign tourists in Haiti.

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Table 7. **NUMBER OF VISITORS TO BEACH HOTELS IN HAITI AND CALCULATED AVERAGE ANNUAL OCCUPANCY RATE, 1976, 1981, 1985 - 1987, 1/**

Year	Visitors at Beach Hotels	Average Num of Tourists/ Room 2/	Average Num of Nights/ Visitor	Average Occupied Room Nights	Avail Beach Rooms	Avail Room Nights	Annual Occup Rate
1987	8,200	1.5	9.2	50,140	785	286,500	17.5%
1986	5,250	1.5	9.0	31,500	785	286,500	11.0%
1985	24,000	1.5	8.8	140,800	785	286,500	49.1%
1984	20,200	1.5	8.6	115,800	755	275,600	42.0%
1981	16,450	1.5	7.5	82,300	735	275,600	30.0%
1976	8,650	1.5	5.0	28,800	250	91,200	31.5%

1/ 1981-1983 data are not available from Office of Tourism because record tracking was being transferred to computer system.

2/ Consultant estimate.

Source: Office National du Tourisme et des Relations Publiques, Haiti.

These government figures are substantiated by the beach hotels in the region. During the peak tourist years, which all resorts refer to as 1980 to 1985, each resort reportedly operated at 50% to 65% average annual occupancy. (This is higher than shown for the early 1980's in Table 7 because some resorts were just beginning operation in the early 1980's.) Peak season for these resorts was December to February when occupancy rates would hover near 100%. March and April remained strong at rates around 75%. Low seasons were early summer and fall. Late summer usually was a strong season with most hotels achieving about 50% occupancy levels.

At these levels of occupancy, the beach hotels in the Les Arcadins region catered to between 90 percent and 95 percent of all tourists with beach hotels as their primary destinations in Haiti. This likely is not too off-the-mark as few beach hotel rooms existed in other parts of Haiti. Club Mediterranean would have garnered the greatest number of guests and likely accounted for almost two-thirds of the visitors to the region.

Since 1986, few hotels report seeing foreign visitors. Club Mediterranean remained open until late summer 1987 and therefore generated some foreign tourists. Most other hotels, however, have found little support from abroad over the past three years.

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Table 8. **OVERALL NUMBER OF VISITORS AND OCCUPANCY RATES FOR LES ARCADINS REGION BEACH HOTELS DURING PEAK TOURIST YEAR 1985**

Hotel	Peak Avg Annual Occup Rate1/	Occupied Room Nights	Avg Room Night/ Tourist	Average Tourists per Room	Total Num of Visitors
Ibo Beach	45-50%	12,800-14,200	8.5	1.5	2,250- 2,500
Kyoná Beach	50-55%	3,600- 4,000	8.5	1.5	650- 700
Kaliko Beach	50-55%	7,300- 8,000	8.5	1.5	1,300- 1,400
Ouanaga Bay	40-45% 2/	5,900- 6,600	8.5	1.5	1,000- 1,150
Xaragua	40-45% 2/	7,000- 7,900	8.5	1.5	1,200- 1,400
Club Med	60-65%	76,600-82,850	8.5	1.5	13,400-14,600
Jolly Beach	60-65%	4,400- 4,700	8.5	1.5	800- 850
Moulin Sur Mer	30-35%	3,300- 3,800	8.5	1.5	600- 700
Totals					21,200-23,300

1/ Based on operator's estimate.
2/ Consultant estimate.

Sources: Office National du Tourisme et Relations des Publiques, Haiti; Association Hoteliere et Touristique d'Haiti; and, personal interviews.

Regional Beach Hotels (See Section 4, Appendix I. in the Resource Document.)

Characteristics of Beach Hotels

The full-service hotels are the most significant employers within the regional tourist industry. Each hotel is designed as a resort which caters to most of the needs of the tourists and where each tourist spends the majority of his time and money. These resorts provide lodging, restaurants, bars, entertainment, and recreational amenities such as tennis courts, snorkeling and windsurfing equipment, horseback riding, and excursion boats.

Table 9 lists the eight hotels with 626 rooms that operate in the Les Arcadins region, although the Xuragua is closed and the Club Mediterranean has temporarily suspended operations. The largest of the region's hotels is the chain-operated, 350-room Club Mediterranean. All other hotels are local owner-operated businesses and are much more modest in scale from 20 to 78 rooms.

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Table 9. CHARACTERISTICS OF BEACH HOTELS IN THE LES ARCADINS REGION, 1987

Hotel	Year Built	Number of Rooms	Winter Rates Single	Room (MAP) 1/ Double
Ibo Beach	Late-1950's	78	65.00	65.00
Kyoná Beach	1965	20	69.00	93.00
Kaliko Beach	Early-1970's	40	83.00	117.00
Ouanaga Bay	mid-1970's	40	N/A	N/A
Xuragua	1979	48	Closed	Closed
Club Med.	1980	350		115.00 2/
Jolly Beach	1982	20	68.00	88.00
Moulin Sur Mer	1985	30	58.00	90.00
Totals		626		

Notes: 1/ Modified American Plan of two meals per day.
2/ Package cost of $1,100 includes airfare. Estimated room cost is $115 per day per person with American Plan.

Source: Association Hoteliere et Touristique d'Haiti and personal interviews.

Employment

Total direct employment at hotels during the peak tourist years amounted to over 560 full-time workers (460 local Haitians), or slightly less than one person per hotel room. Most Haitians employed lived in the villages nearest the resorts and a few traveled from Port-au-Prince or St. Marc. Club Mediterranean was the largest resort employer in the region with a total of 250 employees; 150 of which were Haitians.

Today less than half that amount would be considered full-time employees. The actual number of people employed by hotels may be close to 300 but many of these are employed in a swing shift fashion where they work two weeks of every month. Many hotels are using this practice in order to spread the wages to as many employees as possible. However, in comparable terms, the level of full-time employment has fallen below 200 employees.

Wages received by hotel employees contribute substantial cash to the local economy. The average wage per employee at beach hotels ranges from $100 to $200 per month. Most hotels pay between $100 and $150 per month. This is from $30 to $80 more than the minimum wage in Haiti. An employee's take-home pay, however, is higher than the paid wages as each employee receives a portion of the 10% service charge added to all expenses at the resort. Each worker is given a proportionate amount of the service charge depending on their degree of contact

with the guests. Waiters receive the greatest proportion, while cleaners and grounds keepers the lowest proportion. In total, this service charge adds from 10 percent to 50 percent of an employees wages. It could even add up to 100% of a waiter's wages.

The annual inflow of dollars into the local economy during the peak tourist years through wages was about $700,000. Today, the annual inflow through wages is about $300,000, or 40% of the peak amount.

Incidental employment is more difficult to assess. Spin-off employment is generated by the presence of large numbers of tourists. Examples of this spin-off employment include Haitian fishermen who transport guests of the beach hotels to Les Arcadins; the 25 to 50 villagers who sell crafts and shells every week at the resorts; and, the Haitian bands and voodoo shows that perform at the resorts. Using CTRDC's factor of three times the hotel employment as direct and indirect tourist industry employment, incidental employment associated with the local hotel industry during peak years would have amounted to almost 1,700 persons. This employment would have affected locals from Port-au-Prince to St, Marc.

In total, it is estimated that the hotel industry provided some 2,200 Haitians with employment during the peak years and injected at least $2 million into the local economy in wages.

Revenues

Government revenues were generated from the hotel room tax and the departure tax. As shown in Table 10 below, in the peak tourist year for the beach hotels, the government would have received an estimated $1.8 million dollars in revenue from the beach hotels. This is over half the estimated revenue of all government revenues from these taxes generated by tourists to Haiti.

Based on estimated annual incomes for beach hotels and the average number of guests staying at hotels during the peak years, the estimated weekly expenditure per guest at beach hotels during 1980 to 1985 was between $800 and $1,200. These figures exclude expenditures on gifts, diving equipment, boat rides, and other recreational activities. The average daily expenditure per tourist for these items was relatively low and estimated between $25 to $50 per day, or $200 to $350 per week.

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Table 10. ESTIMATED GOVERNMENT REVENUES FROM BEACH HOTELS DURING PEAK TOURIST YEAR 1985

Total Visitors to Region's Beach Hotels 1/	21,200-23,300
Departure Tax per Tourist	$15
Departure Tax Revenues	$320,000-$349,500
Occupied Room Nights 1/	120,900-132,000
Average Price per Room 2/	$100
Government Tax Revenue at 5%	$605,000-$650,000
Indirect Government Revenues	
Using $500 per stay Expenditures	$750,000-$800,000
Using $1,000 per stay Expenditures 3/	$1,500,000-$1,600,000
Estimated Total Government Revenues	$1,675,000-$1,800,000 ($2,425,000-$2,600,000)

Notes:
1/ From Table 8.
2/ Weighted average.
3/ Based per visitor expenditure as detailed below.

In total, each tourist was estimated to be spending between $1,000 and $1,400 during their stay, or $115 to $165 per day. These figures are comparable to those of tourists at the more tourist-developed nations of the Caribbean.

For the peak tourist year of 1985, this expenditure at beach hotels in the Les Arcadins region injected the Haitian economy with an estimated $24 million to $34 million, which included wages and salary payments and fish and seafood purchases. This is about one-third to one-half the CTRDC estimate of visitor expenditure for all of Haiti in 1985.

Tourist Contribution to the Fishing Industry

The tourist industry has always depended heavily on the fishing industry because fish and seafood are in demand by resort guests. In order to meet these demands, the resorts purchase fish and seafood from either the local villages or from the major fishing ports of Port-au-Prince and St. Marc. The place of purchase differs per hotel and depends on its proximity to a fishing village.

In general, the village of Luly supplies the lobster and lambi to the hotels in its vicinity, Kyoná Beach, Kaliko Beach, Jolly Beach, and Ouanaga Bay. Fish is supplied to these hotels mostly from St. Marc. The Ibo Beach purchases fish and lobster from the village of Seminote while lambi is purchased from Port-au-Prince. Moulin Sur Mer, the most distant hotel from Port-au-

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Prince, interestingly enough purchases all its fish and seafood from Port-au-Prince.

Annual revenues to the fishing industry generated from purchases of fish and seafood during the peak tourist years is estimated to range from $500,000 to over $750,000. Today, annual revenues are about half.

The price paid per pound of fish ranged in 1988 from $1.30 to $2.20 with the majority of hotels paying in the $1.30 to $1.60 range. Lobster was priced from $2.20 to $3.50 per pound with the average around $2.50 per pound. Lambi was priced from $2.00 to $2.50 per pound.

The study's estimate of the demand for fish and seafood during the peak tourist years was based on the current quantities being purchased by the hotels and the current number of meals served. The ratios calculated were applied to estimates of the number of meals served during the peak tourist years in order to establish a demand for fish at that time. These figures are rough estimates and they are given only to provide a benchmark of the potential revenues which could be generated by the tourist economy to the local fishing industry.

The weekly quantities of fish and seafood demanded by each local hotel, except Club Mediterranean, during the peak tourist years is estimated to be between 300 and 400 pounds of fish, 250 to 350 pounds of lobster, and 200 to 275 pounds of lambi. These quantities would serve from 400 to 600 meals at each hotel. Today the hotels are purchasing from 150 to 200 pounds of fish, 100 to 125 pounds of lobster and about 50 to 100 pounds of lambi for an average of around 200 meals per week.

SCUBA Diving and Snorkeling: History and Promise

Diving facilities were introduced to Haiti in the early 1970's. Business was not entirely successful in the early days, but by the 1980's, when a dive shop moved to Kaliko Beach, diving had become an attraction for a number of visitors to the area. Other diving guides were located in Petit Gonâve and Cap Haitien, but these businesses did not offer any services.

Most divers enjoy their experiences in Haiti and give the area a positive critique. A write-up in the July, 1983 issue of Undercurrents gave a favorable report of the diving in Haiti, although the reporter found the area lacking in large tropical fish. This report was a quick and unscientific assessment of the resources of the area. The article commented that

> "the stationary life was alive, abundant, and healthy, the many tropicals were varied, the shallow depths provided great bottom time for photographers.... This

is aquarium diving, and the list of what I observed in my week is quite a list....Overall, I would say the diving I experienced was, perhaps, diving for connoisseurs..."

In the past, Les Arcadins divers were almost exclusively from visitors. The major emphasis of the business was to market the dive site to U.S. divers. During the peak tourist years, an average of two groups of ten to twelve divers per month would come to Les Arcadins. About 200 divers per year would visit Kaliko Beach Hotel through package tours on an average of one week stays. A percentage of divers used the dive shop at Kaliko while staying at other resorts. This amounted to about 20% of the overall operation of the shop. As of August 1988, the last dive package group to visit Kaliko Beach was in February 1986. An estimated 20 to 25 percent of all those staying at the region's resorts visited the dive shop.

During its heyday, the dive shop was capable of generating over $150,000 in revenues annually. Divers would generally pay about $35 per day and stay an average of seven days. Additional revenue would be generated from sales, snorkel and other equipment rentals, and boat excursions. The Les Arcadins took up about two days of diving activity. During the course of a week's stay, divers also traveled to La Gonâve and Amani, on the coast, for wall dives, and a look at the so-called "world's largest sponge."

Today the Kaliko Dive Center is equipped to fully furnish ten divers with an extra supply of 40 tanks. Facilities at the shop include a compressor, repairs, sales, a zodiac launch capable of carrying four divers or six snorkelers, and three dive instructors and a new boat which can handle up to eight divers or ten to twelve snorkelers. Current operations handle about 20 to 25 local divers and 30 snorkelers per month with most destinations to Les Arcadins. Each local diver generally makes the day-trip to the Kaliko Beach from Port-au-Prince. Few divers have been arriving from outside of Haiti. SCUBA instructions amount to about five persons per month.

IV. REBUILDING HAITIAN TOURISM

Rebuilding tourism in Haiti will require a rebuilding of the Haitian image abroad and stronger government interest in strengthening this major element of its economy.

New marketing elements that will sell Haiti and promote the country both to resident Haitians and to foreign markets are necessary. At present, plans for potential development of such marketing elements include the creation of an marine park at Les Arcadins and the revitalization of Cap Haitien. The marine park could provide a new destination for small draft cruiseships and

increased tourism to local hotels.

Studies are planned for Cap Haitien to determine what infrastructure is needed to attract cruise ship lines and re-establish Haiti's presence in the Caribbean. Public relations efforts also are being explored which will highlight the 500 year aniversary of Columbus's landing at Cap Haitien and the discovery of the Santa Maria.

All of these elements require government support and outside funding. Financial support for tourism would provide the government with a lucrative return on its investment. New tax revenues and jobs would be immediate impacts; tourist expenditure would provide much needed foreign capital; and value will be added to the economy as each dollar spent in Haiti is turned over numerous times for goods and services.

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V. PARK ESTABLISHMENT ISSUES

Legal Status of Les Arcadins

Les Arcadins islands, although not yet designated by the government as a park protected area, have been singled out by a Presidential Decree on November 11, 1983. It was stated that since the public domain includes islands and since Les Arcadins islands had tourist value and represented an ideal area or zone for the development of tourism, the Les Arcadins islands were being transferred from the public domain to the private domain of the State. L'Administration Generale des Contributions was authorized to survey the islands so that they could be further utilized.

The Decree of 1983 is still in effect. Haitian legislation does not have a clear and simple definition of "domaine privé de L'Etat" (private domain of the State). However, it is, by opposition to the definition of public domain, any part of state properties capable of being transferred to a private entity. (Ewald, 1988)

Park Management Options

Government of Haiti (GOH)

The recent political events, in Haiti, made government participation in the marine park project difficult during the field work. In fact, until recently, discussions with the GOH were restricted by U.S. government policy. However, once the Les Arcadins Marine Park Action Plan is adopted by the Haiti Hotel Association, it will be important for the Association to take the plan to the appropriate government agencies to obtain their views and endorsement of the project. It will then be up to the private sector and the GOH agencies to transmit the proposal to the President of Haiti, at the most opportune time, to request that it be designated a park by Executive Order. World Wildlife Fund will be available to work with the Haiti Hotel Association, during this time, if the Association requests them to do so.

There are essentially two branches of the GOH immediately relevant to the marine park, representing the two major objectives of the park; tourism and marine resource protection. The first is the Office National du Tourisme and the second is the Service de la Pêche/Ressources Naturelles, in the Ministre d'Agriculture. The former Office National du Tourisme originally sponsored the idea of the marine park at Les Arcadins in 1986, and the current Office National du Tourisme has been kept informed of the marine park field work by the Hotel Association.

Marine resource protection falls within the purvue of the Direction de Peche des Ressources Naturelles, Service de Peche et pisciculture (Fisheries Office of the Natural Resources Department). The Fisheries Office has recently agreed to serve as counsellor to the marine park on fisheries related issues. However, because of internal political problems, the GOH administration and management of the park was not considered as a viable option, at the present time.

Non-Governmental Organization (NGO)

An informal survey of potential NGOs was undertaken in the Fall of 1988 and February of 1989 to identify a private organization or group that might be suitable to manage a marine park. In the immediate area of Luly, only two NGOs are currently operating. One is "Mission Possible" and the other is a small group which runs a community clinic south of Luly. The former is apparently already over-extended and failing, the latter health-oriented and too small. Neither would be appropriate. Other NGO's surveyed included ISPAN (Institut pour la Sauvegarde de la Patrimonie Nationale), FAN (Federation Des Amis De La Nature), a conservationist organization, the Haitian Audubon Society, Agouée Dive Club, and the Haiti Hotel Association.

Currently, as in the past, ISPAN has been primarily involved in the restoration of La Citadelle and Sans Soucie in the north near Cap Haitien. Most of the funds and expertise have come from UNESCO and USAID. At one time ISPAN was engaged in the production of school texts on Haitian history. ISPAN does not appear to have the organization to manage a marine park but may have the background and contacts to work with a park educational program. FAN is a group of conservationists who have just begun to organize. Although they lack administrative and management experience, their role as a private citizen's organization, should be encouraged. The Haitian Audubon Society appears to have the same drawbacks as FAN. The Dive Club, although very supportive of establishing a park at Les Arcadins, does not have the practical experience as a group to manage the park. Their collective advice, individual interest, and expertise, however, should be utilized.

The Haiti Hotel Association, local sponsors of the Les Arcadins project, have also been very supportive of the project. The Association, however, is in a much better position to serve as manager and administrator of the park, since it has an office with staff and a permanency in Haiti which most other NGOs do not have. It also has a long standing, working relationship with the government's Office National du Tourisme and is thus in a position to coordinate park development with the new government's present efforts on behalf of tourism. Although the Association does not have the time nor the means to become a full marine park manager, it is a good choice to act as overall administrator; to

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receive and disburse funds and take the steps needed to establish the park. With the promise of funding from the park budget to pay for increased overhead costs, the Association has indicated its willingness to accept fiscal responsibility for the project.

Another important NGO, the Haitian Association of Voluntary Agencies (HAVA) is an umbrella organization uniting all the NGOs, foreign and Haitian, currently operating in Haiti. In addition to functioning as a clearing house for information affecting NGOs, it also represents this sector to the government, coordinates development activities by its member organizations throughout the country, engages in fund-raising, and also operates a number of small, self-help community projects through specialized committees composed of representatives from its member organizations. HAVA is a well-organized and efficient agency with considerable experience. Its officers are seasoned and knowledgeable participants in the Haitian development sector. It is recommended that HAVA be asked to serve as one of the official counsellors to park management.

Potential Funding Agencies

United States Agency for International Development (USAID)

There are three current Haiti projects, funded by the USAID Mission, that share common objectives and issues with a marine park project in Haiti. First, the Agricultural and Rural Development Office of USAID has funded a Hillside Farming Project (Project Officer: Cat McIntyre), to provide a multidimensional approach specifically targeting poor peasant farmers on eroding hillsides in the Les Cayes area. This project area includes the newly established Pic Macaya National Park. The Pic Macaya component is being managed by the University of Florida (Paul Paryski) and a Haitian government secretariat, situated in the Ministry of Agriculture. This project's role in the designation, delineation, and maintenance of the Pic Macaya park provides valuable insight into ways in which the Les Arcadins park project fits into the funding objectives of USAID, that is, to help solve local social, biological and institutional problems. It also sets some precedences in connection with working with the Haitian Ministry of Agriculture and could provide a basis for a future marine park relationship with the GOH.

The USAID Office of Private Enterprise Development, funds PROMINEX (Project Officer: Cris Juillard), which serves the private business community in the same way that HAVA serves the NGO sector. That is, PROMINEX is a clearing house for information, coordination, and lobbying both to the GOH and to foreign investors to stimulate economic growth. The establishment of a marine park at Les Arcadins would enhance the efforts of PROMINEX and could be considered by USAID in that context. Furthermore, once the marine park is established and

operating, PROMINEX might be the place to start with a promotional campaign to publicize the marine park, and attact the foreign tourist industry.

Third, and of the most immediate interest, the Office of Human Resources hosts the Special Development Activities Project (SDA) (Project Officers: Patrick McDuffie and Jean-Claude Lucas). SDA provides material grants to self-help community projects. These grants provide up to $20,000 in material assistance to approximately 30 communities each year. The communities provide labor and transportation costs, SDA provides the materials. No money is disbursed directly to the communities. Although most SDA projects involve school building construction, irrigation canals construction, rural infrastructure initiatives, it is currently funding two fishing projects and is eager to initiate others. These funds could be very important in the strengthening of the Luly Fisheries Cooperative to benefit the park's working relationship with the the fishermen of Luly. USAID's SDA office has already expressed an interest in working with Luly in relationship to the establishment of Les Arcadins Marine Park.

Food and Agricultural Organization (FAO) and the United Nations Development Program (UNDP)

FAO and UNDP are also charged with funding programs which benefit the social, biological, economic and institutional framework of local areas, in collaboration with national governments. Currently, FAO is supplying a marine fisheries expert and a fresh water fisheries expert to the Service de la Pêche and the Ministere de L'Agriculture des Ressources Naturelles (The Fisheries Department in the Ministry of Agriculture) in Haiti. Recently, it has been working with fishermen all over the country, particularly in the Dame Marie/Anse d'Hainault area at the far end of the southern peninsula.

The FAO is planning to install FADs (Fish Attracting Device) in the waters off Luly in the near future with a fund which provides support for short-term technical assistance. The FAO might be willing to collaborate with park administration to provide additional on-site technical assistance to the Luly Cooperative, as part of a fisheries program for Luly.

One of UNDP's major funding objectives is the protection of the environment. Under its mandate, UNDP can fund personnel to work with governments, provide training and some equipment, and subcontract to NGOs. The UNDP mission, in Haiti, has expressed an interest in the marine park at Les Arcadins, from the standpoint of the development of tourism and the protection of biological diversity.

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In 1987, the UNDP funded a film about Haiti's fishing sector and marine resources, photographed by two Peruvian marine biologists. It apparently presents a picture that is contradictory to the essentially negative film by the Cousteau Society, and would be a valuable asset to any educational or promotional efforts on behalf of Les Arcadins.

Other Funding Agencies

In addition to USAID's SDA program, several other governments (French, Dutch and Belgian) have SDA-like community project funds. These agencies usually work with HAVA sponsored projects.

Park Establishment of the Park Rules

Existing Marine Resource Regulations

It is recommended that for the first two years, existing regulations for Haiti's territorial waters and continental shelf be used at Les Arcadins Marine Park. These regulations have already been published in The Moniteur, and appear in the Official Journal de la Republic of Haiti. They include general provisions for fishing, the exercise of the right to fish and specifications for fishing devices.

The Articles of the Constitution which have the most applicabilty to the park are listed below.

Article 29. With the exception of sardines and sharks, any small fish caught by mesh of less than 16 millimeters shall be thrown back.

Article 30. The mesh of "hoop-nets" shall be at least 16 mm.

Article 32. Spear guns and harpoon fishing are strictly prohibited.

Article 33. It shall also be prohibited to transport spear guns and harpoons in boats used for fishing or gathering seafood.

Article 40. Fishing nets shall have 16 mm. mesh when stretched. Beach seine fishing nets shall have the following meshes:

Bottom of the seine fishing net, 16 mm. Mesh gauge diameter, 96 mm.
Middle of the seine fishing (net), 217 mm. Mesh gauge diameter, 17.2 mm.
Tail of the seine fishing 48 mm. (net). Mesh gauge diameter, 25.4 mm.

Article 42. Nets shall be 300 meters long at the most.

Article 95. Nobody shall be authorized:

(1) to dump in the sea or in watercourses any material likely to affect their ecology; (2) throw drugs to bait in order to inebriate or destroy fish; (3) use dynamite or other similar products in order to catch fish.

Article 97. It shall be strictly prohibited: a) to catch, sell or export tritons (Claronia variegata); b) to catch turtles and sea-tortoises from May through October (Laying season); c) to collect eggs of turtles or of any species in territorial waters, particularly those of sea-tortoises and turtles; d) to catch turtles and sea-turtles on the beach; e) to gather sea crabs between December 1st and May 31st; f) to hunt pinnipeds (seals, sea-lions), or cetaceans (whales, dolphins, and porpoises) in territorial waters without special authorization from the State Secretariat of Agriculture, Natural Resources and Rural Development; g) to cut the American mangroves used as shelter by different aquatic species (particularly oysters).

Article 100. Exploitation of coral of any type shall be prohibited. This shall also apply to sea fans and limestone from the seabed.

Article 101. The catching and exploitation of seafood shall be prohibited within 50 meters from protected sites designated as national parks.

Article 102. The boundaries of sites chosen as national parks shall be indicated by phosphorescent signal buoys.

Article 111. Crayfish (lobster) fishing shall be closed from April 1st to September 30th every year in order to protect the species.

Article 112. The sale of egg carrying Caribbean spiny lobsters shall be prohibited at any time. It also shall be prohibited to engage in the commercialization of crayfish which are moulting or whose eggs have been purposely removed.

Article 113. The following shall also be prohibited: 1) the sale of black belly (rotten) crayfish on local or external markets or for export; 2) any capture, sale, export of crayfish of less than 15 grams or 5 ounces; 3) the export or local sale of chopped up crayfish (lobster) flesh. Only those crayfish tails weighing at least 5 ounces may be sold.

Article 116. The length of a crustacean shall be measured from the top of its eye to its posterior or the end of its tail.

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Future Regulations

There may be a need to enact special regulations for the park, at some future date. These regulations would have to be proposed to the GOH, by the Advisory Committee, for inclusion in the existing regulations.

Enforcement

The legal authority for enforcement of all national regulations rests with the Haitian government. However, as in most marine area enforcement throughout the world, an effective enforcement presence is lacking. The best chance of regulating the use of the marine waters of Les Arcadins is by educating and assisting the users; fishermen and SCUBA, snorkelers alike, to the reasons for the regulations. Park rangers can be selected from among the fishing community, trained and equipped with a small boat to survey and monitor Les Arcadins waters. Dive club volunteers could also be trained to help in the educational process.

Public Awareness and Environmental Education

The lasting protection of the marine resources at Les Arcadins and elsewhere in Haiti, depends on an informed public and local involvement, not on the enforcement of park regulations. This can best be achieved through a public awareness and environmental education program. Les Arcadins will be the first marine park to be established in Haiti. As such, the concept of a marine park, its purpose and potential value to the community is not common knowledge. In addition, except for fishermen and others who live near the sea, knowledge about underwater ecosystems such as coral reefs and seagrass beds is minimal.

The idea of a marine park must be introduced with thought, care, and a genuine concern for the community. Otherwise the investment of funds for the marine park could be viewed, by some, as a case of misplaced priorities, especially when there are so many other immediate social needs. Many people living near the proposed site are poor and depend on the marine resources for their subsistence. Any move to restrict their use of the area must take into consideration the possible impacts on the community and provide viable alternatives.

To a great extent, communicating ideas about the park and gaining public support will be the mission of the public awareness and environmental education program. Not everything outlined below is possible within the first two years. Priorities will have to be set by the advisory committee and the Executive Director.

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Audience

There are several important audiences which must be reached, requiring a variety of approaches and the use of different media. First there is the local fishing community which will be directly affected by the park. Their support is essential. They must be informed and involved in the decision-making process and in the formation of management policies. It is critical to the long-term success of the park that the local fishermen see tangible benefits from the establishment of a protected area for themselves and for their community.

The hotel and other land owners, along the coast, are influential people whose businesses could directly benefit from increased tourism at Les Arcadins. Many of these people and their guests will want to use the park for recreation. As the potential of the park is realized, they will probably begin to improve the tourism infrastructure along the coast adjacent to Les Arcadins, thus leading to increased economic development. As development occurs, their cooperation will also be needed to ensure that land development does not pollute the marine environment. Their assistance in promoting the park and in observing park regulations is also needed.

Visitors to the park will include international tourists such as SCUBA divers and snorkelers and national visitors (although this group may not be significant at first). They will need to learn about the available facilities and the regulations once they arrive, entrance or diving fees, and other existing leisure options.

Although government officials may not play an active role in the management of the park, at the beginning, their cooperation and assistance is desirable. They will need to be kept informed of developments at the park and involved in an advisory manner, especially the Office du Tourisme and the Service de la Peche. The general public will need to receive basic information such as why the park was established, what benefits are expected, and why the park is important to Haiti. Over time, this is an audience that, if properly informed and motivated, could support broader conservation programs for Haiti.

The Action Plan Public Awareness and Environmental Education Program

The proposed educational program is divided into three broad areas of operation: (1) national, international (2) community outreach and development, and (3) interpretation. The first area is designed to create public awareness of Les Arcadins at the national and international levels. Community outreach and development should sponsor activities aimed at the local

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community, involving them in park management, and ensuring that the community benefits from park establishment. The interpretive program is designed for the benefit of on-site visitors. Each of these program areas is considered, in the Action Plan, as a step towards a successful marine park, and described, in greater detail in steps 10 though 18, with a continuation of programs in years 3 through 5.

VI. STEPS TOWARDS PARK ESTABLISHMENT/YEARS ONE AND TWO

Approach

In the interests of accommodating both tourist-related park activities and fisheries related activities, it will be necessary to allocate responsibilities to park management and the Luly Cooperative during the organizational and operational stages of the first two years. Any activity that has to do with improving the economic well-being of Luly fishermen and their community would be a project of the cooperative, whereas an activity associated with the marine park, per se, administration, monitoring, advancing tourism, and so on, would be the responsibility of the marine park director. This approach could have advantages in obtaining funding from a variety of sources.

Treating marine park activities and Luly cooperative activities separately does not, however, mean that they have separate agendas. Each entity should be encouraged to understand the objectives of the other, and, through the advisory committee, be ready to compromise and make trade-offs. For example, the marine park should actively seek funding for the development of alternative fishing technology and improvements, and even maintain a fund for this purpose, while the cooperative, for its part, would ensure that proper fishing techniques and restrictions were being respected by its members. Likewise, the marine park should encourage the local hotels to buy fish only from the cooperative, not from the speculators, with the cooperative only harvesting acceptable sizes and species. Exchanges of this sort will ensure the success of the project.

The Les Arcadins Action Plan provides a vehicle for contractual relationships between the cooperative, representing the village, and park management. Specific mechanisms to deal with failure to respect obligations will have to be worked out following designation of the park.

Organizational Stage

PHASE I.

The first three months of park organization, or PHASE I, will be critical to the successful implementation of the marine park. It is essential that the Hotel Association take the initiative to organize the Advisory Committee, seek legal status and adopt the timeline and budget as soon as possible, following adoption of the Draft Action Plan.

STEP 1 Convene a Les Arcadins Marine Park Advisory Committee.

To provide a forum for solving conflicts in the use of Les Arcadins (i.e. fisheries vs. tourism) and to give the park a chance to benefit from various points of view, it is recommended that a five person advisory committee, each with one vote, be organized and chaired by the Haiti Hotel Association. The Advisory Committee would act as administrator for the park and be served by an Executive Director who would manage the park on a daily basis.

Recommended members are as follows:

Haiti Hotel Association

One of the major objectives of the park is tourism development. The local Haitian sponsor of marine park development, the Haiti Hotel Association, has been and continues to be an instrumental force behind efforts to secure a marine park for its country. The Association has offered to act as overall park administrator and treasurer of the park. It is proposed that the Hotel Association act as chairperson of the advisory committee for the first two years of park operation. It would be responsible for convening meetings of the Committee and its advisors, securing the funding, hiring the Executive Director and receiving and disbursing funds.

Representation from the Luly Fishing Cooperative

The existence of the Luly Fishing Cooperative is an enormous advantage to park management. Priority should be given to not only use the Cooperative as the sole means of liaison with the community, but to help it to incorporate new members and consolidate its own community authority and power. In this way, the marine park management will avoid becoming embroiled in social factions within Luly itself and will force Luly to take a socially united stand within the context of the project (and hopefully outside of it as well), and finally be able to avoid the machinations and demands that will inevitably come from local power brokers and speculators.

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True participation of Luly will rest on a series of real and concrete exchanges and benefits between the Cooperative and the marine park. To facilitate this, Luly should be given actual authority within the framework of park management. Too often the fundamentals of responsible social collaboration are left behind through lack of patience with knowledgeable local people and an unwillingness to take class differences into account.

The President of the cooperative would serve as a voting member on the Advisory Committee.

The Dive Club, Agouée

Agouée has a wide ranging membership, brought together through a mutual love of underwater exploration in the marine environment. It is recommended that they have a voting member on the Advisory Committee to represent snorkeling and SCUBA diving recreational interests.

Private Environmental Organization

Attempts to survey environmental non-governmental organizations were largely unsuccessful due primarily to lack of time and the difficulties of locating key people interested and responsible for these organizations. It has been suggested, however, that the Federation au Nature (FAN) would be the most likely candidate for this post on the Advisory Committee. Once the committee is constituted, perhaps the Hotel Association, using the questionnaire in the Resource Document, could survey groups once more and then make a decision as to which organization should represent the private environmental sector.

Representative of Community Development

The organization representing the point of view of community development must also be selected carefully. The Community Outreach and Development Program, outlined in the Environmental Education section, will need an experienced advocate on the Committee to lend its expertise and to guide the program through the first two critical years. HAVA has indicated a willingness to serve in an advisory capacity to the Committee and should be called on at the earliest opportunity.

STEP 2 Adopt the timeline and budget for the park.

A two year timeline and budget for park management and administration which carries forth the objectives of the marine park and ensures its long term success, will have to be considered and approved by the Advisory Committee. The Action Plan's proposed timeline and budget, submitted here, lists the recommended steps leading to the establishment of the park, and indicates their timing and costs.

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FIG. 8 TIMELINE
LES ARCADINS MARINE PARK
STEPS TO PARK ESTABLISHMENT

		YEAR ONE					YEAR TWO		
		1	3	6	9	12	15	18	21	24
ORGANIZATIONAL STAGE										
Phase I										
STEP 1	Convene the Advisory Committee.									
STEP 2	Adopt the timeline and budget.									
STEP 3	Obtain the marine park specialist.									
STEP 4	Adopt park objectives and park boundaries.									
STEP 5	Secure legal status.									
STEP 6	Arrange for and fund temporary office support/hire secretary									
Phase II										
STEP 7	Hire Executive Director (E.D.).									
STEP 8	Acquire or lease Visitor Center building.									
STEP 9	Establish reference library.									

	YEAR ONE					YEAR TWO		
	1	3	6	9	12	15	18	21	24

Phase III

STEP 10 Design the interpretive program and modifications to the visitors center building.

STEP 11 Purchase park equipment.

STEP 12 Prepare promotional materials brochure, slide show posters.

STEP 13 Begin renovation of visitors center.

STEP 14 Initiate fisheries program for Luly.

- Contact fishing cooperative in Luly
- Establish the fish reserve
- Evaluate fish marketing problems
- Expand and upgrade local fisheries
- Offer training course on record keeping
- Provide technical advice on acquiring fisheries gear
- Hire park rangers

O P E R A T I O N A L S T A G E

Phase IV

STEP 15 Initiate interpretive program.

- Construct trails
- Recrui' guides
- Contract/produce educational aids:
  - conservation booklets
  - video
- Install interpretive exhibits
- Sell guides for park income

	YEAR ONE					YEAR TWO		
	1	3	6	9	12	15	18	21	24
STEP 16 Development of the National, International Program.									
- Hold slide presentations									
- Distribute posters/brochures									
- Contact Office of Tourism and make promotional arrangements									
- Contact airlines, special press									
- Arrange for video at airport/hotels									
- Contact news media									
- Hold open house for media/ special guests									
- Plan special activities									
STEP 17 Initiate park management training.									
- Design/arrange SECOAST attachment for E.D.									
- Conduct SECOAST attachment									
- Design/arrange mobile seminar									
- Conduct mobile seminar									
- Design and conduct guide training program									
- Design/arrange Hol Chan attachment for E.D.									
- Conduct Hol Chan attachment									

	YEAR ONE						YEAR TWO		
	1	3	6	9	12	15	18	21	24
STEP 18 Establish a community outreach and development program.									
- Assist cooperative to improve fishing yields and equipment									
- Evaluate fish marketing problems in Luly									
- Assist cooperative with Literacy Program									
- Explore fishing and sailing tours with cooperative									
- Recruit fishermen for monitoring fish reserve									
- Contact/visit schools									
- Organize school visits to the park									

YEARS 3 -5 Initiate Research Program.

Continue Community Outreach and Development Program.

- Conduct a census of fishermen and boats
- Prepare a stock assessment survey
- Assess the wholesale market
- Provide incentives and other ways of including Haitian students
- E.D. participates in other regional training as appropriate

Continue Interpretive Program.

- Produce park guide booklet

FIG. 9 BUDGET
LES ARCADINS MARINE PARK

ITEM	YEARS 1	2	Total	3-5
MANAGEMENT AND ADMINISTRATION				
Salaries				
Executive Director	20,000	20,000	40,000	60,000
Park Rangers (2)	3,000	3,000	6,000	9,000
Secretarial Support	4,000	4,000	8,000	12,000
Salary subtotals	27,000	27,000	54,000	81,000
Transportation				
Land Transportation Allowance (gasoline, insurance, repairs)	2,500	2,500	5,000	3,000
Fishing Boat Rental for ED	3,000	0	3,000	0
Support for Boat Transportation	2,000	2,000	4,000	6,000
Transportation subtotals	7,500	4,500	12,000	9,000
Overhead Expenses				
Operation Allowance for Advisory Committee Members	500	500	1,000	1,500
Support Services/Kaliko Dive Center (includes temp. park office)	1,200	1,200	2,400	3,600
E.D. interviewing expenses	1,500	0	1,500	0
Support Services/Haiti Hotel Ass.	3,600	3,600	7,200	3,000
Lease on Vis. Cntr.	12	12	24	36
Legal fees to draw up lease with Kailco for use of building	500	0	500	0
Postage	500	500	1,000	1,500
Xerox	250	250	500	750
Telephone	1,000	1,000	2,000	3,000
Miscellaneous supplies	500	500	1,000	1,500
Maintenance Fund	0	1,000	1,000	4,500
Overhead subtotals	9,562	8,562	18,124	19,386

ITEM	YEARS 1	2	Total	3-5
Technical Assistance				
Marine pk. specialist consultancy for Advisory Com & ED	8,000	8,000	16,000	0
Technical Assistance subtotals	8,000	8,000	16,000	0
PUBLIC AWARENESS AND ENVIRONMENTAL EDUCATION				
Community Outreach				
Open House for media/special guest	0	500	500	0
Community visits to park	0	1,000	1,000	3,000
Community Outreach subtotals	0	1,500	1,500	3,000
Interpretation				
Design phase for Interpretive program and Visitor Center	7,000	0	7,000	0
Construction of trails, facilities at Lighthouse Island	0	8,500	8,500	0
Install Vis. Cntr. interp. exhibits	0	5,000	5,000	5,000
Contract/Produce educational aids				
Slide program (2 sets)	1,000	0	1,000	250
Brochure/10,000 copies	4,500	0	4,500	0
Poster/5,000 copies	8,500	0	8,500	0
Three cons. bks./3,000 copies each	2,000	2,000	4,000	0
Fifteen minute Video/50 copies	3,000	9,000	12,000	0
Park guide booklet	0	0	0	8,000
Purchase guides for resale	0	0	0	2,000
Establish library	500	500	1,000	500
Interpretation subtotals	26,500	25,000	51,500	15,750

ITEM	YEARS 1	2	Total	3-5
Training				
Design/arrange E.D.'s SECOAST attachment	1,000	0	1,000	0
Conduct SECOAST attachment	3,500	0	3,500	0
Design/arrange mobile seminar	2,500	0	2,500	0
Conduct mobile seminar	0	15,000	15,000	0
Design guide training prg.	0	1,000	1,000	0
Conduct guide training prg.	0	1,500	1,500	0
Design record keeping course for fishermen	0	500	500	0
Conduct record keeping course for fishermen	0	1,500	1,500	0
Design/arrange E.D.'s Hol Chan attachment	0	1,000	1,000	0
Conduct Hol Chan attachment	0	3,500	3,500	0
E.D.'s other regional training	0	0	0	5,500
Training subtotals	7,000	24,000	31,000	5,000
CAPITAL INVESTMENTS				
Renovation of Ad. Cntr./Vis. Cntr.	7,500	7,500	15,000	0
Park Boat	6,000	0	6,000	0
Outboard Motor and back-up motor	4,000	0	4,000	0
Boat Equipment (two-way radio, etc.)	2,000	0	2,000	0
Marker Buoys for fish reserve	2,000	0	2,000	0
Mooring Buoys for pleasure boat anchoring	2,000	1,000	3,000	0
Office Equipment	5,000	0	5,000	0
Office Furniture	3,000	0	3,000	0
Capital Investments subtotals	31,500	8,500	40,000	0
TOTALS	117,062	107,062	224,124	133,136

Total for 5 years = U.S. $357,260.00
Average operational costs per year, starting with third year = $44,378.

Because the marine park represents a new initiative on the development scene, in Haiti, it will be important at the outset, to avoid common failures of past projects and slowly work towards the successful establishment of the marine park. For example, it will be useful to devise a series of institutional steps, with funding, which follow an evolutionary path. As each step is achieved, the next is embarked upon. Recipients of funds would have to earn a small "pot" of money and strictly account for it.

STEP 3 Arrange for a marine park specialist consultancy.

Although the Action Plan and the Executive Director, once hired, will be useful guides to the Advisory Committee, there will be times, during the first two years, when expertise will be required to answer both organizational and operational questions. Experience and knowledge, gained during the establishment of other marine parks and protected areas, could be usefully applied to Les Arcadins. It is proposed that the park budget provide funds for a specialist to work with the Advisory Committee on an as needed basis, during the two years. This individual would be responsible for either advising the Committee directly, or putting the Advisory Committee in touch with the appropriate persons or groups for further information. Three or four field trips to Haiti will probably be necessary.

STEP 4 Adopt park objectives and park boundaries.

The three major objectives for Les Arcadins Marine Park; protect biological diversity, advance tourism, and improve local fisheries, are closely related to one another and cannot be separated. To enhance tourism and improve local fisheries production, it is necessary to protect the marine resource at Les Arcadins. To protect the biological diversity of Les Arcadins, local fishermen must be assisted and a park must be established to generate funds for protection of the environment.

To successfully meet the objectives it will be necessary to designate a marine area large enough to protect biological diversity and yet small enough to be administered effectively. These objectives can be met, in the opinion of the project team, by including the three islands and the surrounding waters out to the 20 m contour (Fig. 3). This area would incorporate representative biotopes (i.e. reef crest habitats, deep and shallow coral patch reefs, seagrass beds) of the Les Arcadins region and incorporate, within the park, most of the ecological system.

Preliminary discussions with the fishermen indicate that they understand the purpose of the park and are willing to work with park management to advance their own interests. Fishing would be allowed within the boundaries of the park and regulated by the existing fisheries regulations. A fish reserve would be

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set aside, inside the boundaries of the park, where no fishing would be permitted, thus creating a fish breeding, nursery area. Two options for the location of the fish reserve are discussed in the fisheries program, STEP 14. These recommendations will have to be discussed with the fishermen, once the Advisory Committee is convened and the Director has been hired.

STEP 5 Secure legal status.

The first and most important step in the path to park establishment will be to secure legal status for Les Arcadins Marine Park. This will entail having the islands and their surrounding waters set aside by Presidential decree as a Park. Clear legal establishment is mandatory if the marine park is to protect the biological diversity for the long term, and thereby attract tourists to Haiti.

STEP 6 Arrange for and fund temporary office support/Hire part-time secretary.

During the first six months, arrangements will have to be made, by the Advisory Committee, to hire a bookkeeper to set up the accounting system for the park, to provide all the necessary supplies and office equipment to begin park organization and operation and to hire a part-time secretary. The budget allocates funds for temporary office support at the Hotel Association headquarters and the Kaliko Dive Center office. Once the visitors center has been revovated, the park office can be located there, at the site.

PHASE II.

PHASE II begins the park administrative effort to establish an onsite presence at the site. These steps will mostly likely take place between the third month and the ninth month of park organization.

STEP 7 Hire the Executive Director.

The Executive Director to the Advisory Committee should be hired by the Hotel Association as a full-time director to serve the Committee and act as a manager, on a daily basis, for the park. Once in place, and after receiving training, he or she should be able to assume most of the responsibility for park administration and management. Due to the special nature of the post, the following qualifications are suggested, as a guide for candidates interested in the job.

<u>Qualifications</u>

Skill and knowledge necessary to be able to work

effectively with the Luly Cooperative leadership and with funding agencies, to develop the fish reserve program and the community outreach and development program.

Knowledge and experience in the marine environment; i.e. educational background in tropical marine ecology; SCUBA diver preferred.

Working knowledge of Creole.

Hands-on experience in renovation and construction of buildings desirable.

Ability to work harmoniously with a wide variety of people.

Experience with boats, motors, desirable.

Appreciation of the importance of environmental education with some experience in interpretative programs desirable.

STEP 8 Make final arrangements to acquire or lease the Visitor Center.

The owners of the Kaliko Beach Hotel have agreed to provide a building near the entrance to the hotel to serve as the administrative headquarters and the point of orientation for the visitor. As the Visitor Center is developed, it will be important to remember that the center only introduces the visitor to the resource and prepares him to enjoy the resource itself. It should not duplicate the resource.

Legal steps will need to be taken to clarify the terms under which the building becomes a visitors center. It is, of course, preferable if the building becomes the permanent property of the park, since major renovations will be needed to transform the building into a usable visitor center.

STEP 9 Establish a reference library.

A small reference library, on topics such as coral reef ecology and environmental conservation, established at the Visitor Center, could be used by the occasional visitor who wants more detailed information and by local residents, with an interest in the subject of marine life and the environment.

PHASE III.

PHASE III should begin towards the end of the first year. These steps, during months nine through twelve, will initiate activities which will hopefully continue and improve as the marine park becomes better established.

STEP 10 Concurrently design modifications to the Visitor Center building and the overall interpretive program.

The modification of the building and the design and construction of the interpretive exhibits should be accomplished in relationship to one another. When completed, (this may take 5 years), the Visitor Center should contain a three-dimensional display of Les Arcadins, Luly, and the surrounding area and highlight other sites in the region which might be of interest to the visitor. Two major themes could be developed through exhibits. The first would focus on the biological diversity of Les Arcadins, especially the fascinating sponge life and feature the important role that coral reefs play in marine and coastal ecosystems. Threats to coral reefs and what is being done to protect them could also be highlighted. The second major theme could look at local peoples' relationship to the marine environment. Equipment used by the fishermen would be on display and its use explained. The exhibit could take the visitor through a typical fishing expedition and end with an illustration of park rules and activities. Exhibit text should be written in French, Creole, and English.

Because maintenance of equipment is difficult and a continuous electrical supply cannot be relied on at Kaliko, exhibits at the visitors center should be selected for low maintenance and minimum reliance on electrical power. Dioramas using natural lighting should be used wherever possible. At the time that the building's roof is replaced, construction which allows maximum natural lighting should be employed. Complex exhibits with moving parts, audio devices, or electronics are not recommended. Exhibit photographs and other materials, sensitive to humidity, should be laminated or set in airtight cabinets.

An environmental education specialist may have to be consulted, through a subcontract, for this task.

STEP 11 Purchase park equipment.

Park management will need to patrol the area, by boat, as often as possible, in order to conduct formal and informal educational activities, survey the use of the area by recreational visitors and fishermen, and periodically monitor the fish reserve. These activities will require a boat, large enough to make the four mile trip to and from the coast, and fast enough to manuever easily among the islands. The proposed budget

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provides for a boat, an outboard motor with a back-up motor and funds for boat maintenance and gas. Marker buoys for the fish reserve, mooring buoys for pleasure boat anchoring, office equipment and furniture, miscellaneous supplies, all need to be purchased by the end of the first year, to carry out the objectives of the park.

STEP 12 Preparation of promotional materials.

A one-page, fold-out brochure introducing Les Arcadins Marine Park, describing services and activities and the reasons for the park's establishment, should be designed, printed and available for use, during the first year. It should include a small map and accompanying chart of the area and list a telephone number for further information. (This could be distributed free at the center and at other locations in Haiti.)

During this same period, a four-color poster depicting the beauty and diversity of underwater life at Les Arcadins would also be produced. The poster could be used to promote the park by distributing it free to local hotels, other tourist facilities and government offices. It could also be sold at the Visitor Center to help generate needed income.

Photographs and slides of the land and waters of Les Arcadins, taken by the project team during the field work, are already available, for use by park management. A slide program about the park could be perfected, during this step, using the available slides from the project team and from members of the Dive Club. The Executive Director could use the slide program to give special presentations about the park to selected audiences, in Haiti, to help gain public support for the park and for environmental conservation. On some occasions, a fee could be charged to benefit park programs.

STEP 13 Begin renovation of the Visitor Center.

Once an agreement has been signed between the park administration and the owners of the proposed visitors center building, renovations, including a new roof, new plumbing for bathrooms and interior carpentry and painting will be necessary. With the necessary renovations, the Executive Director can set up a park office, establish the library and begin the interpretive program.

STEP 14 Initiate a fisheries program for Luly.

The community of reef fishes at Les Arcadins Islands and Recif Arcadins has relatively high species diversity and abundance compared to other reef systems in the Caribbean. Fish community structure is strongly influenced by algal grazers, such as damselfishes and parrotfishes, and by benthic invertebrate

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feeders, such as wrasses. Top reef predators, such as large groupers, snappers and barracuda were rare.

Species diversity increased with reef surface area and was positively correlated with the number of species present. Coral/sponge bioherms presented the lowest amount of species, but had the highest number of species per unit area. Mean abundance of fish individuals ranged from 1.8 ind m^2 at deep patch reefs and 24.8 ind m^2 at coral/sponge bioherms.

The present status of the local fisheries appears to be in a precarious condition, with a relatively low production of fish per unit area of reef and/or seagrass in the shelf (9.5 kg/ha) compared to other estimates in the Caribbean. Also, a large proportion of the fisheries yield is met by species of small size and low commercial value. Most of the fishing effort is concentrated on shallow, demersal species. Neritic pelagic species represent an important component of fish trap yields. Offshore pelagic and deep water bottom fisheries are presently unexploited due to very limited economic and technological development.

The full-time fishermen of Luly are aware of the decline of the marine resource base due to siltation from eroding land areas, urban pollution from Port-au-Prince, and commercial collection of coral. They are also aware that, they are "cutting their own throats" when they consistently take juvenile fish and undersize lobster. They would like to fish the largely unexploited deep-water fish (below 150 ft) but cannot reach them with their primitive fishing gear and methods. While those that are not full-time fishermen in Luly cannot be said to have the same knowledge of the problem, these part-time fishermen are also aware of the decreasing amount and size of fish and the long-term disadvantages of the taking of juveniles.

To preserve and enhance fish diversity, the following park strategies are recommended as part of a local fisheries program.

1. Establish a fish reserve, in conjunction with the Luly cooperative.

This would be an area where no fishing is practiced, to increase the spawning biomass of commercially important and rare species which are affected by severe fishing pressure on the reefs. The reservoir zone should encompass all the physiographic zones characteristic of Les Arcadins reefs, i.e., a reef crest/*A. palmata* zone, shallow patch reefs, deep patch reefs, and the coral/sponge bioherm habitat, including the deep seagrass zone.

The idea of a fish reserve at Les Arcadins was discussed with the fishermen during the field work. The concept of a

reserve as a nursery and breeding ground for fish and other marine fauna which would, in the long term, increase the overall fish population, was immediately grasped and understood. However, park management should be aware of several issues which will make this management technique difficult to achieve.

First, the reserve will place a limitation on the Luly fishing territory which will add to the problem of already diminishing fish catches. This might endanger the economic survival of the 35% of the fishing population who are marginal. Les Arcadins lies within reach of boats which have no sails and is an important area for trap (*nas*) placement. Trap fishermen are usually those that have no other viable economic alternatives to fishing. Not only would making Les Arcadins a reserve directly affect these fishermen, other fishermen, even those with higher incomes, will not patrol and enforce the reserve because of their ethos of not preventing another from making a living. Alternative sources of income or larger yields from fishing will have to be found, if the fish reserve is to succeed. Finally, closing off an area to fishermen but allowing activities which would appear to favor the Haitian elite and foreigners, at the expense of the fishermen, may also engender resentment and hostility.

Two locations for a fish reserve are proposed for further discussion with Luly. Alternative I would set aside all the physiographic zones surrounding the entire island of Ti Teal (Fig. 4). This is the preferred alternative because it represents a reserve with a complete ecological system and an excellent chance of good results within a short period of time. This area is also easily recognizable by all users of the waters at Les Arcadins and could probably be monitored and regulated effectively. Alternative II, a quadrangle on the eastern end of Lighthouse Island, from the reef crest down to a depth of 20 m, proportional to the length dimension of the island (squared), would also be appropriate because the main habitats, mentioned previously, would also be well represented (Fig. 5). This is a smaller area and might be more acceptable to the fishing community. Periodic surveys to test the effectiveness of the fish reserve in terms of increased species diversity and abundance of commercially important and rare fish species will be needed at whichever site is selected.

2. Evaluate the actual fish marketing problems of Luly fishermen and provide alternatives that would offer a better economic compensation for their fishing effort.

3. Provide means to enable Haitian fishermen to buy fishing gear from other places in the Caribbean.

4. Offer a basic training course for Haitians on how to keep

records of the fundamental fisheries statistics for Luly. Initially, records of total daily catches and associated fishing effort data should be obtained. Species specific information could be progressively acquired.

5. Expand and upgrade local fisheries. There are two practical possibilities for expansion of fisheries for Haitian fishermen: (i) deep-sea hook and line reel fishing, (ii) fish attraction devices.

The shelf edge or break beyond the region of Les Arcadins is relatively wide with depths between 50 and 200 fathoms (100 - 400 m) (Fig. 3). The depth distribution of commercially important deep-water fish species, such as the silk snapper (Lutjanus vivanus), voraz snapper (Pristipomoides macropthalmus), blackfin snapper (Lutjanus buccanella), and misty grouper (Epinephelus mystacinus) is known to be between 40 and 175 fathoms in the U.S. Virgin Islands (Brownell and Rainey, 1971). From personal interviews with Haitian fishermen it was clear that silk snapper and blackfin snapper are present in the shelf break off Les Arcadins where they have been occasionally caught. Access to shelf break waters is possible with some of the best Haitian fishing boats, but essential fishing gear is lacking. More detailed information about the optimal fishing depth for each of these four fishes and methods of deep-water fishing are found in the Section 2, Appendix III.

A good alternative to the lack of a motorized fishing fleet is a Fish Attracting Device (FAD). The FAD can be anchored off the shelf break in about 400-600 m depth where pelagic fishes are accessible. In concept, the FAD acts as a surface, or subsurface primary substrate where a food web eventually develops to the top predators level. Aggregations of small fish (generally jacks, Decpaterus spp. and juvenile Caranx spp.) serve as forage fish for larger predators, such as barracuda, jacks, mackerel, wahoo, tunas, dolphin fish, sharks, and billfishes. The FAO, in Haiti, has begun working with the Luly Cooperative to place FAD's offshore of Luly.

Operational Stage

PHASE IV.

PHASE IV begins the operations phase of the park. By this time, the Executive Director has been in place for at least six months and the work of developing the public awareness and environmental education program and training programs can go forward. All the steps in PHASE IV should commence during the beginning of the second year and eventually become integrated into permanent park operations programs.

STEP 15 Initiate the interpretive program.

The park interpretive program should: (1) interpret the marine, land, and cultural resources for the visitor, (2) gain the visitor's cooperation in following park regulations and protecting marine resources, and (3) ensure visitor safety. Interpretive information about the park would be offered at the Visitor Center and the Kaliko Dive Center, located on the water.

A variety of educational aids will be required, for use by the interpretive program and for park promotion, including a video for installation at the airport and at local hotels, a coloring book for use in the schools, and several conservation booklets for distribution in the local community. In addition, a small number of commercial publications should be printed and offered for sale at the Visitor Center, to earn needed income for the park. All publications, produced by the center, should be available in French, Creole, and English. Section 6 of the Resource Document summarizes education aids to be used in the Interpretive Program (Appendix IV).

The interpretive program will need to recruit individuals to act as guides to carry out the park program. Private, local, certified SCUBA divers, members of the Dive Club, fishermen and other local people interested in the flora and fauna of Les Arcadins can be trained in interpretive techniques, park management objectives, coral reef ecology, identification of coral reef species, coral reef conservation, tide pool and salt pond ecology, and the history and culture of the area. These guides would accompany the visitor and provide on-site interpretation. Several tours could be developed for Lighthouse Island, including a tide pool walk, a walking tour noting the birds of the salt pond, the history of Lighthouse Island, and an underwater "tour" featuring the coral and sponges of Les Arcadins. Within this interpretive corp, several languages such as English and French, should be spoken.

Eventually, the park could perhaps attract a concession for a glass bottom boat. This would make the reefs accessible to non-swimmers and others who prefer a boat ride to snorkeling or diving. A coral reef interpreter, from the Visitor Center, would accompany visitors during the cruise. (The training of the interpretors, the installation of interpretive exhibits and the development of interpretive themes, stories, and trails on Lighthouse Island will probably need to be done by a specialist as part of a subcontract.)

STEP 16 Develop the national, international education program.

The geographic focus, at the national educational level, should be the capital city of Port-au-Prince. Its principle message should emphasize Les Arcadins as an important Haitian

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treasure. It should stress the potential benefits that the park will bring to Haiti and publicize Les Arcadins as a good example of wise use of natural resources and sustainable development. The most appropriate media for the general program will be radio, press coverage, television, posters, and slide programs. Radio and press coverage can be achieved through interviews and an open house during the park's official opening. Actual footage of the site will be necessary for television. This can be accomplished by utilizing short takes from a video that will have to be produced. Periodic special activities, at the park, will help keep Les Arcadins in the news. Posters can be distributed throughout the city and displayed in shops. Copies of the posters can also be given to government officials working in tourism, fisheries, and other appropriate offices. Slide programs can be used by the Executive Director and the Advisory Committee for special presentations to businessmen, government officials, civic clubs, and conservation organizations.

Park management will need to work closely with the Office du Tourisme to ensure that the marine park is included in international promotion campaigns. The Director should also work closely with the hotel managers and dive centers to develop publicity and tour packages featuring Les Arcadins Marine Park. A brochure providing basic information can be distributed at Haitian hotels and mailed to travel agencies in other countries. Diving specialty magazines such as Skin Diver should receive brochures, a poster, and be invited to visit the park. Major airlines, serving Haiti, should also be informed about Les Arcadins. Arrangements to display the park poster, distribute brochures and offer a video at the Port-au-Prince international airport should be made.

STEP 17 Initiate park management training.

Because national parks, protected areas, and resource management are not commonly understood concepts in Haiti, the training of staff, guides, advisory members, and community leaders must be a key element of the Action Plan. A customized mobile seminar should be designed to permit the Executive Director and advisory board members to visit other marine parks in the Caribbean region. These visits should offer opportunities to see first-hand, a variety of management and development approaches for marine protected areas and the daily requirements of park management. Once back in Haiti, the shared experiences of the trip will give the group a frame of reference from which to make park management decisions.

At least two, but preferably three different sites are recommended for the mobile seminar. Possible sites include the Hol Chan Marine Reserve and Half Moon Cay in Belize; several sites in the Cayman Islands; Bonaire, Curacao, and Saba Underwater Parks in the Netherlands Antilles. Some of these

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sites are managed by government whereas others are managed by NGOs. This seminar should take place during the secong year of park operation.

About six months after the mobile seminar has taken place, a short-term attachment for the Executive Director should be arranged at an actively managed marine protected area such as the Hol Chan Marine Reserve in Belize. The 4-6 week attachment would provide training in all aspects of the day-to-day operation of a marine reserve. This attachment would prepare park management to handle the routine management responsibilities of Les Arcadins Marine Park. See the Resource Document, Section 6, Appendix III - Hol Chan Marine Reserve, for more information about the Hol Chan Reserve.

Since the Executive Director will also be responsible for conducting the community outreach and development program for Les Arcadins, it would be useful for him to visit a site where such a program is being conducted. A short-term attachment with the USAID/WWF Southeast Coast Project in St. Lucia, would offer practical experience in community outreach. This training should occur soon after the Director is hired. Appendix II in Section 6 of the Resource Document demonstrates how well it matches the resource use issues associated with Les Arcadins. This program will have to be designed and coordinated through a subcontract.

STEP 18 Establish a Community Outreach and Development Program.

Local support for the park will depend on the extent to which the program reaches the needs of Luly. Early discussions with members of the community indicate that they can accept the idea of the park and understand its usefulness but they want to have a role in developing management strategies. An education program for local fishermen that only provides information about the importance of the park and need for protection, will be of dubious value since it would have little impact on the immediate issue of poverty which drives resource over-exploitation. For example, a school program in Luly that focuses only on the need to conserve marine resources will have little, if any, impact on the overfishing at Les Arcadins. Such a program will have almost no meaning for the local fisherman.

The Executive Director should keep local community members informed of park activities and seek local advice as appropriate, and involve key members of the community in park monitoring. Local fishermen are much more likely to understand and believe in the value of the park and fish reserve if they are involved in gathering the data. Periodic monitoring could also serve as a small source of income for some of the fishermen.

The residents of Luly have expressed an urgent need to have

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a literacy program for adults. While such a program is not within the marine park's scope, working with the community to start such a program would demonstrate a genuine concern for the needs of the community. There are several things that the Director could offer to do without taking away from his other duties. He could assist the local fishermen by contacting private organizations through HAVA, for technical and financial support for a literacy program, give assistance in proposal writing, and serve on a local committee. If classroom space is not available in Luly, the Visitor Center could be used after hours. Several advanced students might be able to help by composing park publications in Creole, or assisting in other activities where reading and writing Creole are needed.

The community has also expressed a basic need for equipment such as boat motors, fishing materials, and refrigerators. These are all items that would help to improve the catch and increase their control over marketing the fish. Again, such activities are outside a traditional marine park program, but by taking an interest and assisting the fishermen in acquiring the equipment and necessary training for its use, the Director could win the fishermen's support for the park as well as reduce fishing pressure. Park management should work closely with the Luly Cooperative to help the cooperative contact agencies such as UNDP/FAO for technical and financial assistance.

The Executive Director will also be responsible for developing local programs with the fishermen to ensure that they will receive some direct benefits from the park. This could include working with the cooperative to sell fish directly to the local hotels, setting up fishermen operated traditional sail boat rides and fishing tours, training some of the fishermen to be park guides, and establishing a monitoring program as mentioned above.

Because working with Luly's fishermen is the first priority of the park's outreach and development program, only limited activities with the public schools are anticipated for the first few years. There is one State primary school in Luly, two small, private primary schools, and one community-run primary school as yet not functioning due to lack of funds for teachers' salaries. The nearby roadside community of Williamson has a USAID-funded community school, which is attended by some of the Luly children. Eventually activities could include visits to primary and secondary schools to help publicize the park and explain why it was established, provide reading materials to local schools on a variety of environmental topics (these materials are particularly important since the schools have almost no resource materials), and visits to the park by students. After the first two years the park's educational program with schools can be expanded. See the Resource Document, Section 6, Appendix I - La Planada Nature Reserve for an example of what kind of program could be developed

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at Les Arcadins.

VII. RECOMMENDED ACTIONS FOR YEARS THREE, FOUR AND FIVE.

Initiation of the Research Program

Due to their distance from the coast and, therefore, their presumably pollution-free environment, Les Arcadins offers a unique opportunity to study the underlying causes of present algal proliferation in Caribbean waters, in the absence of human-induced effects. The results of these studies could be of great importance to the rest of the Caribbean. This same argument can also be made offered for using Les Arcadins as a test center for the study of the causes of recent, Caribbean-wide coral bleaching (loss of symbiotic zooxanthellae) (Goenaga, 1987; Williams et al. 1987). These studies have a very high priority and should be carried out as soon as a research program can be developed for the Les Arcadins Marine Park.

Continuation of the Community Outreach Program

Park management should continue to help the community of Luly by helping the fisheries cooperative to perform the following tasks:

1. Conduct a census of both fishermen and boats in order to determine the exact numbers and details of the relationships among fishermen and their factors of production. (Without this information it will be difficult to judge the exact numbers of fishermen using Les Arcadins, the possible collective strength of the cooperative, and the degree to which fishermen are in "control" of the distribution system outside the immediate area).

2. Conduct a census detailing the numbers, and kinds, of encumbered relations between fishermen and fish-buyers to reveal the ability of fishermen to act as independent agents.

3. Prepare a more complete, and extended (at least a year long), stock assessment survey, including not only numbers, sizes and species of fish being harvested, but also beach and market prices and any systematic relation these may have to overall production figures. This would more precisely gauge the economic situation of the area fishermen. The Luly Cooperative has already demonstrated an interest and a willingness to participate in such an assessment and could provide selected individuals to receive training and actually carry out the survey.

Note: Ideally, the surveys listed above

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should be extended to include the fishermen from neighboring areas who are currently fishing in Les Arcadins waters. These men would also be directly affected by the establishment of a marine park, and the Luly Cooperative would require them to be members in order to fish in the Les Arcadins/Luly territory.

4. Assess the wholesale export market, especially the *pwason wouj* exchange circuit centered in Port-au-Prince, and reports of foreign fishing. Further information is necessary in order to block further environmentally destructive commercial collection of coral and shells in the Les Arcadins area. There is also a reliable report that foreign companies, especially American ones out of Miami, are beginning to exploit Haitian waters on an industrial scale. If fishermen are assisted in acquiring the equipment and methods necessary to exploit so far untouched fishing grounds, this would put them in direct competition with such foreign companies.

5. Provide incentives and mechanisms for selected Haitian students to participate in fisheries and marine sciences programs available in some universities of the Caribbean region, and or other places in the U. S. A. and Europe. This approach represent the seeding of future professors, scientists and administrators of Haitian marine resources. At the same time, this action brings, in the short term, confidence and support of the local community to the long term management plan. Likewise, training opportunities in mechanics of outboard motors, refrigeration systems and general boat handling and marine technical services should be offered to Haitians, as to provide support services to the modest technological progress of the fisheries and community living standard.

<u>Continuation of the Interpretive and Training program</u>

1. Produce a park guide booklet for sale by park management.

2. Support attendance by the Executive Director to short-term training opportunities in the Caribbean region.

To increase the Director's ability to manage more complex management concerns, he/she should attend short workshops on specific marine reserve management topics as opportunities arise within the Caribbean region. For example, in March 1989, a workshop on marine and coastal protected areas was held in Dominica. It trained participants in project development, proposal writing, and fund raising.

VIII. CONCLUSION

In Haiti, limited coastal access and the absence of large scale development along the coast, have thus far combined to protect most of the country's coastal and marine habitats from the damaging effects of commercial and industrial pollution so evident in other parts of the Caribbean. That is not to say, however, that Haiti does not have other environmental problems in the coastal zone. Population pressures and the lack of arable land have forced peasant farmers onto the steep slopes near the sea, causing nearshore siltation of coral reefs and seagrass beds from damaging agricultural practices. To compound this problem, poverty and overpopulation are causing artisanal fishermen to fish nearshore waters without benefit of modern training and equipment, technical assistance and marketing infrastructure, resulting in the serious depletion of fish stocks and the disruption of the marine ecological system.

Although Haiti's vast coastal and marine resources are largely unexplored, a few scientific studies and observations point to a marine ecological system of high biological diversity. The establishment of a marine park at Les Arcadins where a park authority could actually work with the fishermen to to manage the marine resource, and, at the same time, create a special public awareness among visitors and Haitians alike, of the importance of protecting the marine environment, would be an excellent addition to present efforts to preserve biological diversity in this part of the Greater Antilles.

The social, economic and ecological benefits of maintaining and increasing renewable fisheries resources, derived from the park plan could be substantial to the nearby residents. Lessons learned from the park fisheries program at Luly, could be usefully applied to other fishing communities, in Haiti, and throughout the Caribbean, wherever artisanal fishing communities have similar economic and environmental circumstances.

The economic benefits from tourism, to the hotels of the region and indirectly to the government of Haiti, could also be substantial as Les Arcadins Marine Park becomes better known as a major diving center and marine park in the Caribbean. In the past, the tourist sector of the Les Arcadins region contributed significantly to the Haitian economy, bringing employment and income to the people of the region and revenues to the government. New marketing elements, such as the creation of a marine park, could help to rebuild Haiti's image abroad and bring foreign tourists back to the region.

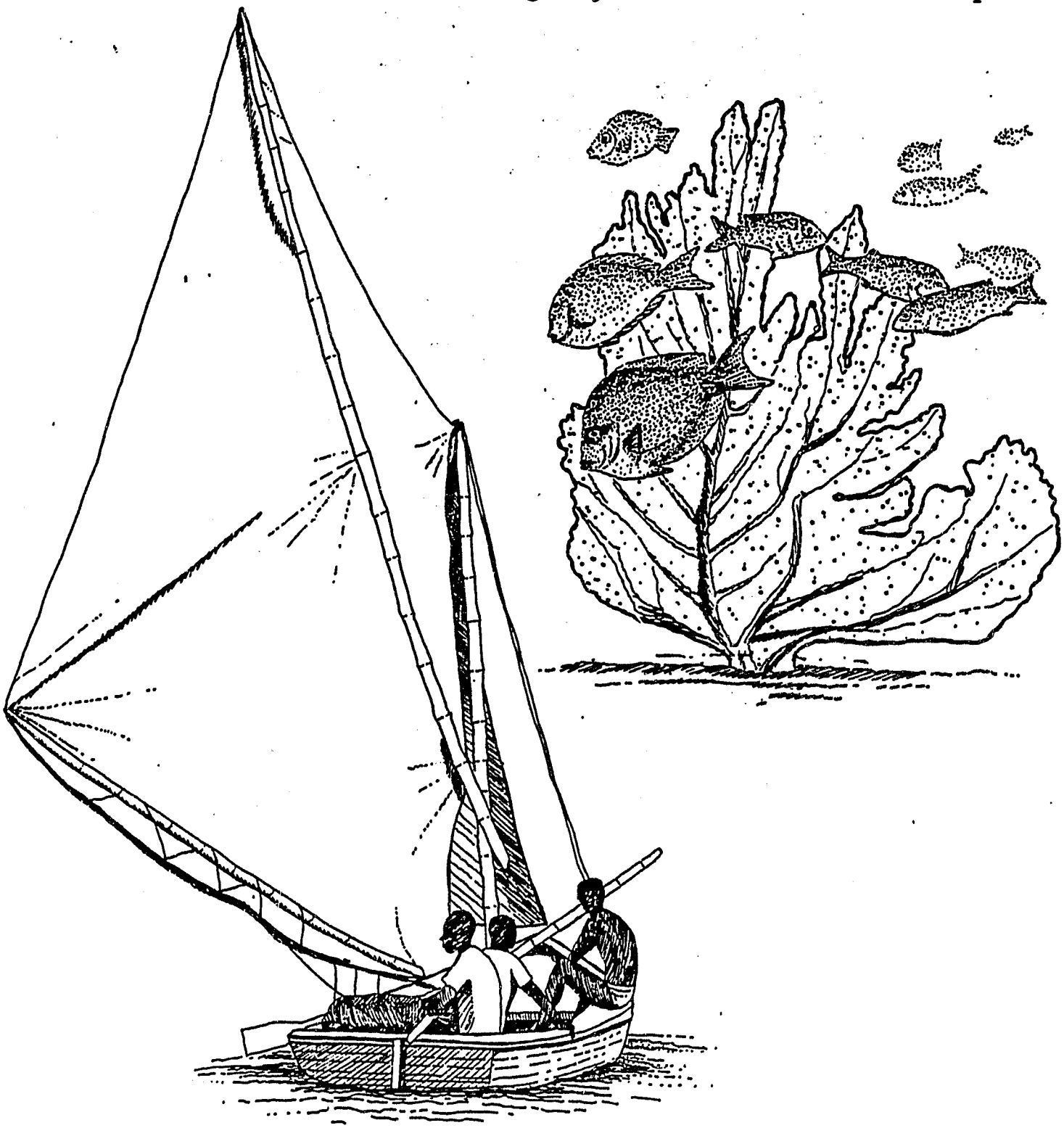
The eighteen steps towards park establishment, outlined in the Draft Action Plan, were carefully researched and thoughtfully prepared. With sufficent funding, they represent a workable plan for establishment of Haiti's first marine park at Les Arcadins.

Resource Document

LES ARCADINS NATIONAL MARINE PARK

Haiti

U.S. Agency for International Development



World Wildlife Fund

Wilcox Associates

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HAITI

PROPOSED
LES ARCADINS NATIONAL MARINE PARK
RESOURCE DOCUMENT

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and the USAID Mission to Haiti

MAY, 1989

USAID Grant Number
LAC-0605-G-SS-7041-00

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LES ARCADINS NATIONAL MARINE PARK
RESOURCE DOCUMENT

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LES ARCADINS NATIONAL MARINE PARK
RESOURCE DOCUMENT

I. BENTHIC SURVEY

Field stations were selected, by the biologic team, to obtain information on the major epibenthic components, their spatial distribution and relative abundance. The location of each station is found in Appendix I. Station number and location, type of survey and date for data collection are given. Photointerpretation of reef habitats and station location are depicted in Figure 1. Aerial photographs on which these photointerpretations are based on found in the Action Plan. Reef habitat photointerpretation is preliminary and will need to be refined with more detailed ground truthing.

A tabulation, by station, of corals, hydrocorals, and octocorals, identified in the field descriptions, can be found in Appendix II. Sponges commonly found at each station are listed in Appendix III. A phylogenetic list of observed organisms alphabetically arranged within taxa, is found in Appendix IV. A preliminary systematic species list of sponges (Porifera: Demospongea and Calcarea) collected within the region of Les Arcadins, Haiti, between June 15-29, 1988 is found in Appendix V.

All sponges were collected between .5 m to 36.4 m of depth at Les Arcadins islands (Lighthouse Island, Ile de Sud, and Ti Teal), at the Recif Arcadins, and at the shelf edge. This list includes only those species that were readily discernable in the field, based largely on external morphological features and ecological criteria. This list will not to be considered final until: 1) scleroanalysis is completed; 2) specimens become deposited and adequately registered in a National Museum of Natural History; 3) an additional 14 sponge specimens, different from those listed, become classified and 4) new species are described. Photographic examples of underwater life at Les Arcadins (Figures 7 through 18) are found, following the field station summaries.

A. Approach

Objectives:

(1) To assess the coral reef communities surrounding Les Arcadins (and other related sites (i.e., shelf edge and Recif Arcadins).

(2) To conduct an assessment of coral reef benthos:
a) characterize the major epibenthic components of Les

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Arcadins (coral, sponges, other predominant benthos and fish).
b) describe their overall spatial distribution within and among sites.
c) quantify their relative abundance at selected sites surrounding the three islands.

(3) evaluate the functional aspects and health status of the coral reefs around Les Arcadins.

(4) To generate recommendations based on 1 - 3), concerning the designation of Les Arcadins as a Marine Park and or Reserve.

B. Methods

(1) Aerial Photography

A series of aerial photographs were taken of the reefs and of the adjacent reef systems. These were used to help select study sites by interpreting discernible habitats from the photographs. Aerial photographs were utilized in the field, to confirm study site locations and to graphically describe the benthic habitats.

(2) Qualitative and Quantitative Transects

Qualitative transects were made by laying a line, marked every 5 m, from the shallowest to the deepest reef (i.e., perpendicular to depth contours) and making qualitative and semi-quantitative observations every 10 m. Depth was recorded every 5 m to generate schematic profiles. To minimize possible variations due to orientation during the survey of the islands, some of the transects always included the eastern reefs of the three islands.

Swim transects involved qualitative and quantitative observations across a depth gradient (without laying a line). General observations were made during spot dives of short duration (up to 15 min.). In these, divers swam randomly within habitats, noting major topographic features, depth, most abundant species and common species.

Although the main emphasis of the survey was descriptive, quantitative transects, collecting limited quantitative data, were used in an effort to derive knowledge about the relative abundance of the most notable benthic organisms. Quantitative line transects (four transects at each of the four main study sites) were made by laying 10 m of a metric tape in top of a haphazardly selected hard substrate, mainly reef outcrops (used here interchangeably with "patch reefs"), and noting the linear cover and position along the tape, of every epibenthic component

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(Loya, 1976). This method does not detect benthic organisms that live in crevices and underestimates the coverage abundance of standing or erect forms with low basal cover. This method was specifically designed to look at the relative abundance of organisms that live in the exposed surfaces of substrates. Cryptic and endolithic species (i.e., those species that live within skeletons of other organisms or within the reef framework) were not surveyed in this study, due to the limited nature of this first effort to survey the area.

(3) Photographic Transects

Photographic transects were carried out during this study, at selected sites, to establish baseline information in relative abundance of identifiable taxa. Comparison of these transects, in the future, at the same sites, along the delineated areas, will reveal major changes, if any, of the relative abundance of the epibenthic flora and fauna.

Sites for photographic transects were located on the eastern reefs, at similar depths, for all three islands. The transects were "permanently" marked with a polypropylene line, 10 m. long, tied to the reef framework. Overlapping photographs, each covering approximately 1 m^2, were taken along the line. Landmarks were noted and the area adjacent to the transects were mapped in case lines were lost.

C. Field Descriptions

STATION 1

LIGHTHOUSE ISLAND (longitude: 72°38'27"; latitude: 18° 48'04") (south of Station 2) - June 15, 1988- Figures 1 and 2.

reef flat

Sparse, short bladed *Thalassia* over coral rubble. Depth 0.3-0.4 m. *Dictyota dentata*, *Codium* sp., fleshy blue green algae, *Valonia ventricosa*, *Galaxaura fastigiata* (?), *Padina* sp. and *Halimeda opuntia*, *Turbinaria turbinata* common among *Thalassia* with *Laurencia* sp. in the shallower waters. Rubble covered by thick, fleshy algae assemblage. *Cliona aprica* over dead *A. palmata*. Common corals: *Siderastrea radians* (3 cm diameter), *Porites porites*, *Porites branneri* (?), *Porites astreoides*. Depressions with large heads of *Diploria strigosa*, *Siderastrea radians* and *Gorgonia ventalina*. *Echinometra lucunter* common to abundant (10-20/m^2 in shallowest waters up to 30/m^2 in slightly deeper waters) beneath rubble. *Tripneustes esculentus* common (1-5/m^2). *Lytechinus variegatus* common. Frequent depressions of reef flat (1.2-1.5 m deep). *Porites* biotope Typical *Porites* biotope with interspersed *Halimeda*.

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Corals and hydrocorals (*Montastrea annularis*, *Diploria labyrinthiformis*, *Agaricia agaricites*, *Millepora complanata*) and encrusting gorgonians (i.e., *Erythropodium caribaeorum*) common within holes of the biotope. Zoanthids uncommon.

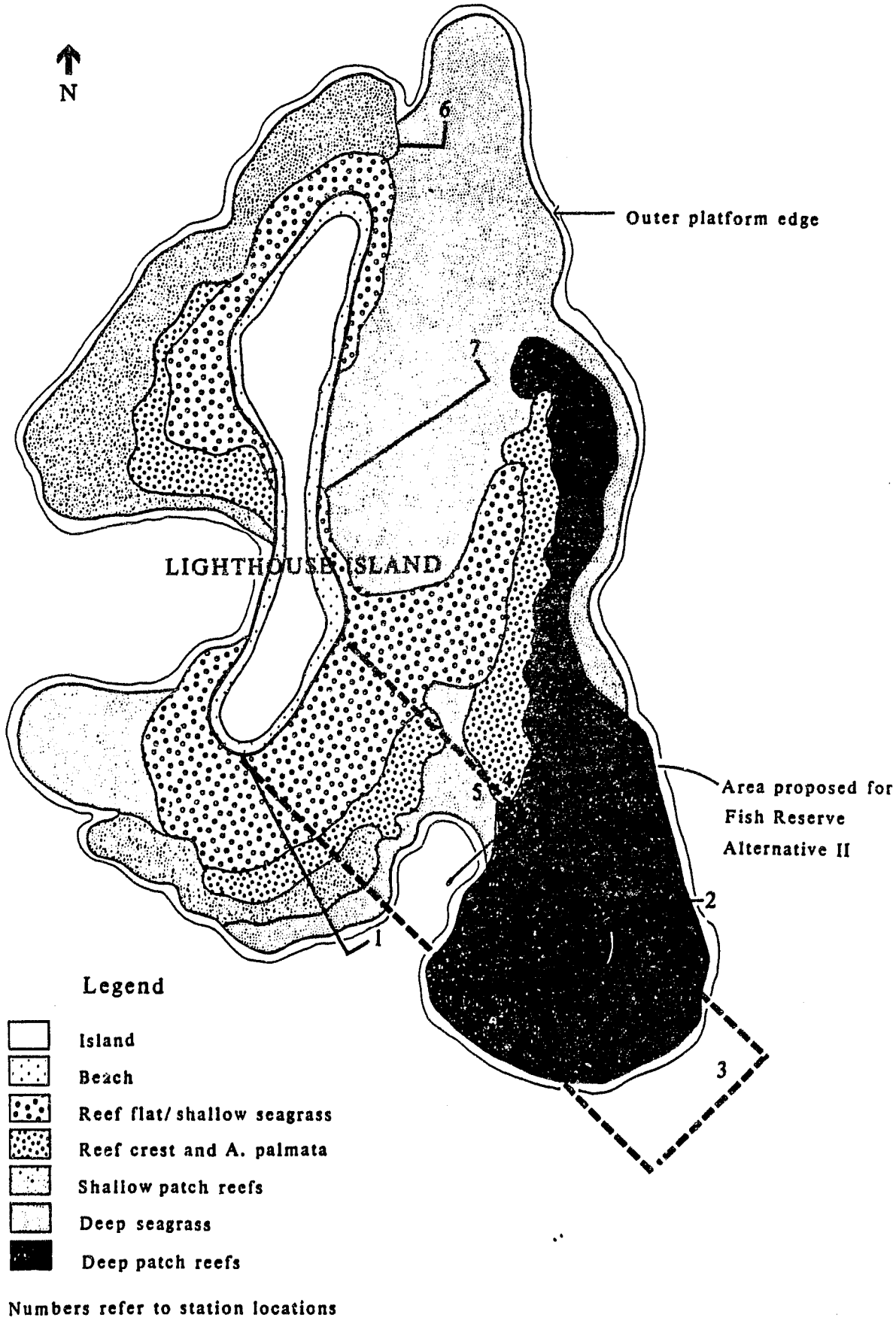

Figure 1. Aerial Photointerpretation of Lighthouse Island

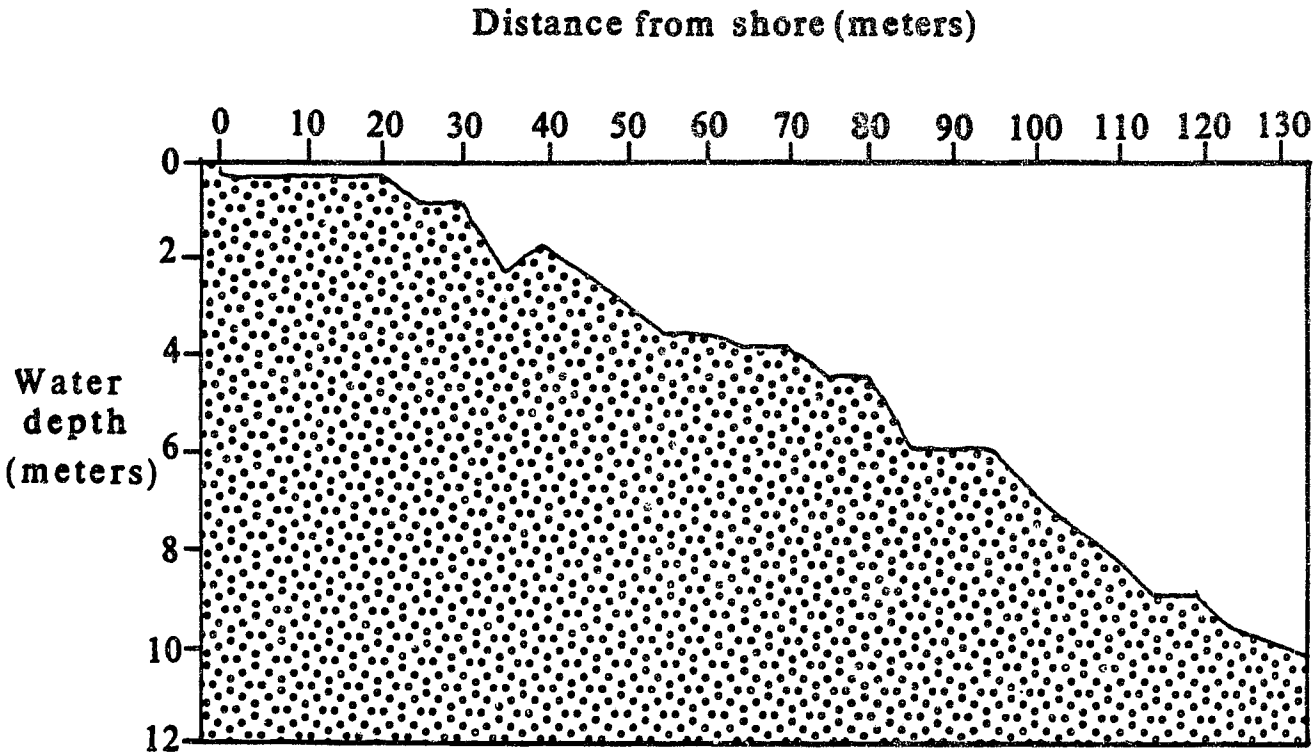

Figure 2. Reef Profile of Lighthouse Island

reef crest

Abundant but discontinuous stands of Millepora complanata. M. complanata dead (standing) and covered with algae turf or crustose red algae in parts of the crest. Brown algae (e.g., Turbinaria turbinata, Dictyota sp., Galaxaura sp., Padina sp., Dyctiosphaeria cavernosa) common among rubble. Sand patches protected from waves with Penicillus capitatus and Liagora sp. Cliona aprica common in dead A. palmata. A. palmata frequently overgrown with Padina sp. Common corals among M. complanata: Isophyllia sinuosa (f. sinuosa), I. sinuosa (f. multiflora) P. astreoides and Favia fragum. Anthosigmella varians (f. varians) common. Isolated Aplysina common over Diploria strigosa. Erythropodium caribaeorum common. Large (>2 m), multilobed heads of Diploria strigosa and M. annularis, sometimes with their tops dead, common in slightly deeper waters. Gorgonians rare, except for occasional Eunicea sp. D. antillarum in aggregations.

Acropora palmata zone

Typical, although discontinuous, A. palmata zone. Well developed A. palmata stands with 100 % cover. A. palmata colonies frequently with lumps whose calices are significantly larger and with thicker walls than the rest of the colony. Montastrea cavernosa and M. annularis common. H. incrassata, Turbinaria turbinata, L. variegata and Padina sp. common. T. turbinata, Sargassum sp. and Padina sp. common among coral heads in depressions. Gorgonians rare except in the deeper portions where Eunicea sp. G. ventalina, Plexaura homomalla, Pseudopterogorgia americana. Aplysina abundant and C. aprica dominant. Palythoa common on coral substrate. D. antillarum common. Shallow substrates with M. complanata. Palythoa caribea, E. lucunter and T. esculentus common. Discosoma sanctithomae common under ledges. A. palmata resembling A. prolifera at their tips. Dead, unbroken shells of young Strombus gigas common.

shallow reef patch zone

M. annularis: structural component of patch reefs. Gorgonians abundant (G. ventalina and P. americana) although low in diversity. Common sponges: Agelas schmidti, A. clathrodes, Ectyoplasia ferox, Iotrochota birotulata (without Parazoanthus swiftii), Spinosella vaginalis and Homaxinella rudis. Common corals: Madracis mirabilis, Stephanocoenia michelinii, Eusmilia fastigiata, Agaricia agaricites, Manicina areolata (f. areolata), Diploria labyrinthiformis, Manicina areolata (f. mayori), Dendrogyra cylindrus, Siderastrea siderea, M. annularis, M. cavernosa. M. complanata, M. alcicornis common; M. squarrosa rare. G. ventalina frequently aggregated and oriented in a single plane.

9/x

Thalassia bed with abundant gorgonians (P. homomalla, Gorgonia flabellum and three species of Eunicea). The bed adjoins outcrops and also extends windward of them to deeper waters. Common sponges: Xestospongia tierneyi, erect H. rudis, Aplysina fistularis, Pandaros acanthifolium, Mycale laxissima and massive Tethya crypta. Average size and abundance of patches decrease in deeper waters. Syringodium filiforme (manatee grass) shares substrate with T. testudinum. Common algae among deeper Thalassia turions: R. fenix, Penicillus sp., U. flavellum. Dominant algae among rubble: Dictyosphaeria cavernosa. Irregular urchins common in deeper waters (10.3 m). Occasional gorgonian: P. acerosa. Dominant mollusc: Pinna carnea (semi infaunal bivalve).

STATION 2

LIGHTHOUSE ISLAND (longitude: 72°38'27"; latitude: 18° 48'04")-Off eastern shore-qualitative observations on outcrops and associated Thalassia-June 16, 1988- Figures 1 and 2.

deep patch reefs (outcrops)

Outcrops (from 1-3 m in relief and less than 1 to tens of meters in diameter) among Thalassia beds in waters about 6 m deep. Sediment generally calcareous (largely Halimeda blades), coarse and well oxygenated. Overhangs with abundant cryptic biota (tunicates, S. rosaceus, sponges, hydroids, bryozoans). 100 % biotic cover on outcrops. Biota commonly associated with deeper water (A. lamarcki, Nemaster sp., H. goreaui) present. M. complanata and M. decactis common on flat top of outcrops. Tops of outcrops frequently covered with brown algae. Low gorgonian diversity. Dominant gorgonians on tops and sides of outcrops: B. asbestinum (7-40 cm high). G. ventalina rare. Other gorgonians: E. caribaeorum, P. acerosa, H. homomalla. Dominant algae on outcrop sides: L. variegata. Common brown algae: D. dentata, Dilophus sp., Dictyota sp. Common green algae on sides of outcrops: A. fragilissima, Caulerpa sp., C. racemosa, H. goreaui, Halimeda sp., D. cavernosa, Anadiomenes stellata. New sponge species (O. Haplosclerida) dominates semicryptic habitats on base of outcrops. Other sponges, such as E. formosus, S. plicifera, N. digitalis, N. nolitangere, A. varians (f. incrustans), A. varians (f. varians), C. nucula, unidentified cryptic sponge, E. ferox, A. fistularis (up to .3 m high), C. fallax, C. eschrichti, I. birotulata, M. unguifera, A. clathrodes and A. schmidti also common on outcrops. New sponge genus in vertical outcrop depressions. G. neptunii common on substrate near base of outcrops. Common corals: M. annularis, A. agaricites, P. astreoides, P. porites, M. cavernosa, I. sinuosa (f. sinuosa), E. fastigiata, A. lamarcki, A. fragilis, A. tenuifolia, L. cucullata, S. siderea, M. ferox, P. astreoides, M. mirabilis, I. sinuosa (f. multiflora), C. natans, M. meandrites, A. cervicornis (not very common), T. aurea. Less common invertebrates: E.

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viridis (on top of outcrops), E. tribuloides (on sides of outcrops), Heteractis sp., D. antillarum (with white spines), Linckia guildingii, C. gigantea, B. annulata, T. williamsi, Strombus gigas, encrusting unidentified ascidean. Echinometra spp. apparently feeding on M. annularis.

shallow seagrass bed

Turions sparsely distributed. Green algae (R. fenix, H. monile) interspersed among turions. Sediment: broken, dead fragments of H. monile. Common sponges: H. rudis (1-5/10m^2), I. strobilina, T. crypta (.3 m in diameter and on the sandy substrate of bed), N. digitalis (up to 1 m high and up to .3 m wide), Agelas (schmidti), A. varians (f. varians), A. varians (f. incrustans), M. laxissima (up to .6 m high), X. alloclada, P. acanthifolium, A. fistularis (up to .6 m high), N. nolitangere (young). Ophiothrix sp. commonly within N. digitalis. Other invertebrates: S. costatus, P. carnea, P. porites, P. acerosa, Sabella sp.

STATION 3

LIGHTHOUSE ISLAND (longitude: 72°38'27"; latitude: 18° 48'04")-Off of eastern shore-deep-qualitative observations-June 16, 1988-Figures 1 and 2.

deep seagrass bed

Depth: 12-14 m. Deep Thalassia bed with sparse algae. Outcrops common and less than 1.5 m in diameter. Sediment consists of fragments of H. monile. Common algae: Avrainvillea (green), Rhipocephalus sp., V. ventricosa, C. mexicana, Penicillus sp., H. monile (dominant). Dead leaves of Coccoloba sp. on bottom. Common sponges: isolated G. neptunii, S. aurea, V. arbis, V. gigantea, I. strobilina, M. laxissima, 7 C. fallax, E. ferox, C. nucula (on sides of corals). Hippospongia sp. present. Common corals: M. annularis (structural component of many outcrops), S. radians, S. siderea, P. astreoides, M. mirabilis, E. fastigiata, A. agaricites. Other invertebrates: L. scabra, C. gigantea, S. seticornis, P. argus, P. guttatus, Periclemenes sp., T. esculentus, L. danae, unidentified serpulids and sabellids.

STATION 4

LIGHTHOUSE ISLAND (longitude: 72°38'27"; latitude: 18° 48'04")-Leeward of previous station (off of the eastern shore)-very shallow-qualitative observations-June 17, 1988-Figures 3, 4, and 5.

reef flat (.3-1.2 m deep)

93x

Dead A. palmata in growth position. Encrusting A. palmata common. Some overturned colonies of this species. Common sponges: Agelas sp., C. aprica. Common corals: P. porites, D. stokesi, M. mirabilis, F. fragum (patchy), I. sinuosa (f. sinuosa). A. agaricites, M. annularis (some colonies in very shallow water with no apparent effects from solar radiation) and A. crevicornis rare. Hydrocorals: M. complanata. Common brown algae: T. turbinata, L. variegata, Padina sp., D. linearis, Dictyota sp., Sargassum sp. Common green algae: C. racemosa, H. opuntia, Halimeda sp., V. aegraegopila. Unidentified cyanophyte, filamentous chlorophyte and fleshy, red algae. Encrusting red algae. Common gorgonians: E. caribaeorum and B. asbestinum, G. ventalina, H. homomalla. Zoanthus solanderi common. T. esculentus abundant (5-10/m^2) on cement bags and consolidated substrate. D. antillarum in crevices. E. lucunter common. Other invertebrates: L. danae, Heteractis sp., Z. sociatus, P. caribaea, C. gigantea, Molgula (?) sp.

STATION 5

Shallow (4-5 m) seagrass bed.

Aggregations of Clypeaster sp. (>2/m^2). T. esculentus (dead and alive), L. variegatus, H. mexicana. Common gorgonians: G. flabellum, P. acerosa, Eunicea sp., E. caribaeorum. Dominant sponge: T. crypta. Common sponges: E. formosus, I. strobilina, A. varians (f. varians), A. varians (f. incrustans), C. aprica. Common corals: M. annularis (many with dead or pale tops), M. areolata (young and adults) among Thalassia blades. A. agaricites, D. labyrinthiformis, A. tenuifolia, P. porites. Encrusting Millepora and M. complanata. Some outcrops built by A. agaricites. Common algae: Peysonellia sp. (common in cracks and crevices on sides of outcrops). Beroe sp. (about 1 cm in diameter) abundant (>100/m^3), although patchy, in the water column.

STATION 6

LIGHTHOUSE ISLAND (longitude: 72°38'27"; latitude: 18° 48'04")-Off of the northeast shore-qualitative swim transect-June 17, 1988-Figures 1 and 2.

shallow seagrass bed

Depth: 1-5 m. Thalassia bed. Turions 3-5 cm apart. Sediment of fine, calcareous sand. Strong northerly current (1130). Common corals: M. areolata (juveniles) and P. porites. Large individuals and young individuals of L. variegatus (3-5/m^2 near shore). L. variegatus frequently forming mounds of about 20 individuals. E. tribuloides sparse. T. esculentus common (1/m^2). O. reticulatus common. A. muricatum on H. homomalla. Pinna sp. common. H. monile common. S. gigas (juvenile) common.

Common sponge: A. viridis. Gorgonians rare. Syringodium filiforme sparse among Thalassia in shallow water. Thalassia leaves significantly longer near outcrops.

Interesting feature at depth of 6 m (shows in aerial photograph as marked line parallel to shore). Field observations reveal that the "line" represents an increase in density of Thalassia leaves within the bed. Leaves are also larger than at either side of the "line". No substrate discontinuities, in terms of inclination, depth nor sedimentology are apparent.

shallow patch reefs

Depth: 2-4 m. Coral-gorgonian-sponge assemblage among sparse Thalassia. Common sponges: A. varians and C. nucula, E. formosus, A. dispar, C. aprica (commonly with Parazoanthus), A. schmidti, T. morchella, I. campana, X. tierneyi, I. strobilina, A. compressa, M. unguifera, T. crypta (young individuals). Frequent bioerosion of corals by C. aprica. Common corals: M. annularis, S. siderea, I. sinuosa (f.multiflora), D. stokesi (up to 30 cm in diameter), A. agaricites, E. fastigiata, P. porites, A. tenuifolia, F. fragum, M. decactis, M. lamarckiana, S. michelinii (in very shallow water). Dominant gorgonian: H. homomalla. Other gorgonians: H. homomalla, G. ventalina, Pseudoplexaura sp., Eunicea sp., B. asbestinum, P. americana, P. acerosa, Pterogorgia sp. and E. caribaeorum. Other invertebrates: Astraea sp., O. reticulatus, purple Zoanthus, P. crucifer, B. annulata, D. antillarum, S. hispidus. Typical reef crest (with predominant M. complanata) in water less than .1 m deep. Abundant Linuche sp. (Scyphozoa) (>1/m^3) about 2 cm in diameter.

STATION 7

LIGHTHOUSE ISLAND (longitude: 72°38'27"; latitude: 18° 48'04")-Off of the north shore of northern bay- swim transect-June 17, 1988-Figures 1 and 2.

shallow seagrass bed

Thalassia bed with sparse gorgonians (mainly Pterogorgia sp.) and with large (3 m in diameter) outcrops towards the east. Tubes of unidentified, long (.3 m) polychaete common. Common corals: M. annularis (up to 1 m high; major structural component and sometimes bleached or pale on its top), P. astreoides, A. tenuifolia, P. porites, A. lamarcki, I. sinuosa (f. sinuosa), I. sinuosa (f. multiflora), D. labyrinthiformis, F. fragum, D. strigosa. Other invertebrates: C. gigantea, Heteractis sp., Rhodactis sanctithomae, Hermodice carunculata, D. antillarum, E. tribuloides, T. esculentus (1-3/m^2). Outcrops decrease in abundance and size towards shallower water.

95x

STATIONS 8 AND 9

TI TEAL ISLAND (NORTH ISLAND) (longitude: 72°38'14"; latitude: 18°48'13")-Northwest of Ti Teal -qualitative observations-June 18, 1988-Figures 3 and 4.

STATION 8

deep seagrass bed

Depth: 13 m. Thalassia bed adjoining patch coral reefs. Seagrass turions with silted appearance. Algae in bed: Rhipocephalus sp. and Halimeda spp. Common corals: M. cavernosa (colonies up to 2 m in relief and height), S. siderea, P. astreoides, A. agaricites, S. michelinii, D. stokesi. Sponges: I. birotulata common and in dense aggregations.

STATION 9

deep patch reefs

Depth: 6-15 m. Rocky outcrops of high relief. Scenery dominated by Aplysina spp. and medium sized colonies of M. annularis interspersed with calcareous Halimeda sand. Common sponges: A. lacunosa, A. archeri, C. nucula, C. aprica (large stands and with no Parazoanthus sp.), A. varians. Common corals: M. annularis, P. astreoides, A. agaricites, A. lamarcki, P. porites, S. siderea, S. michelinii, I. sinuosa (f. multiflora), C. natans, M. cavernosa, E. fastigiata, M. mirabilis, A. cervicornis, M. mirabilis (abundant), M. decactis, M. meandrites, A. fragilis, L. cucullata, D. labyrinthiformis, M. alcicornis, M. complanata, S. rosaceus (growing over M. complanata). Gorgonians few (B. asbestinum and G. ventalina mainly). Other common invertebrates: Nemaster sp., Zoanthus sp. (purple), R. florida, C. gigantea, D. antillarum, Heteractis sp., E. tribuloides, Astichopus sp.(?). Stichopathes sp. (whip black coral) present.

STATION 10

TI TEAL (longitude: 72°38'14"; latitude: 18°48'13")-off the eastern shore of Ti Teal(North Island) qualitative transect-June 20, 1988-Figures 3 and 4.

reef flat

Depth less than .3 m. Algae bed (Dictyota sp. predominant) with isolated colonies of S. radians and P. astreoides over flat, rocky slabs. E. lucunter common under ledges formed by slabs. Other invertebrates: H. carunculata, T. chrispata, C. gigantea, D. antillarum, T. esculentus, L. guildingii (with 6 arms). Depth

increases slightly seaward and then decreases to form the reef crest.

leeward reef crest

Dead, standing A. palmata among M. complanata stands. Predominant algae: L. variegata, T. turbinata, Dictyota sp. (common on top of dead A. palmata). B. asbestinum common.

windward reef crest

M. complanata common to abundant. Z. sociatus abundant but patchy and sometimes together with E. caribaeorum. Dominant algae: Dilophus sp., Dictyota sp., C. racemosa. Dominant sponge: C. aprica (growing over dead A. palmata). Common corals: A. agaricites, P. astreoides, D. stokesi. M. alcicornis common. Erect B. asbestinum common.

A. palmata zon

A. palmata and M. complanata common but not abundant. Some broken and overturned colonies of A. palmata (does not appear to be storm damage). Dominant sponges: C. nucula and C. aprica. B. asbestinum common.

shallow patch reef zone

Depth 3 m. Irregular topography with patches that rise to the surface and with M. complanata on their tops. Outcrops surrounded by Dictyota sp. prairies. Thalassia sparse. Dominant sponge: A. varians. Common corals: P. porites, P. astreoides, F. fragum, A. agaricites, A. tenuifolia. M. alcicornis common. Common gorgonians: P. flexuosa and G. ventalina. Other invertebrates: L. danae, C. gigantea, R. florida and E. lucunter (abundant).

Depth 4-8 m. Erect gorgonians (B. asbestinum, Eunicea sp. and G. ventalina) more common on outcrops. I. sinuosa (f. sinuosa) common and unattached in sediment. M. annularis common to abundant.

Thalassia-brown algae mat assemblage. Sediment consists of loose coral rubble. Common algae among Thalassia: H. monile and H. incrassata. Common gorgonians on bed: P. flexuosa, G. ventalina. Common sponges: A. varians and T. crypta. Juveniles of S. gigas and adults of S. costatus abundant.

deep patch reefs

Depth 8-13 m. Outcrops larger (>3 m in relief) and with M. annularis as principal structural component. M. complanata common on tops of outcrops. Algae: Lobophora-Dictyota-Padina

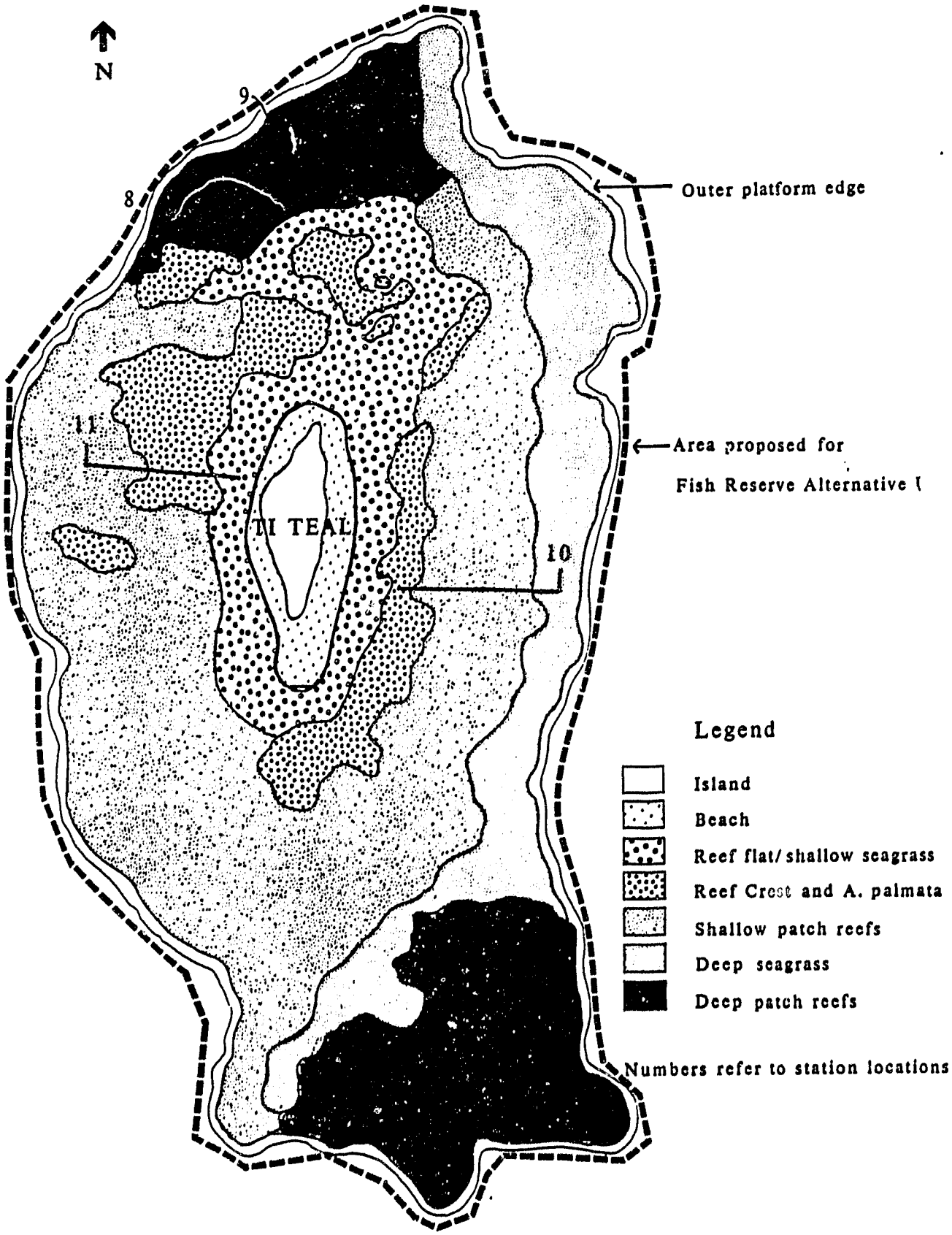

Figure 3. Aerial Photointerpretation of Ti Teal

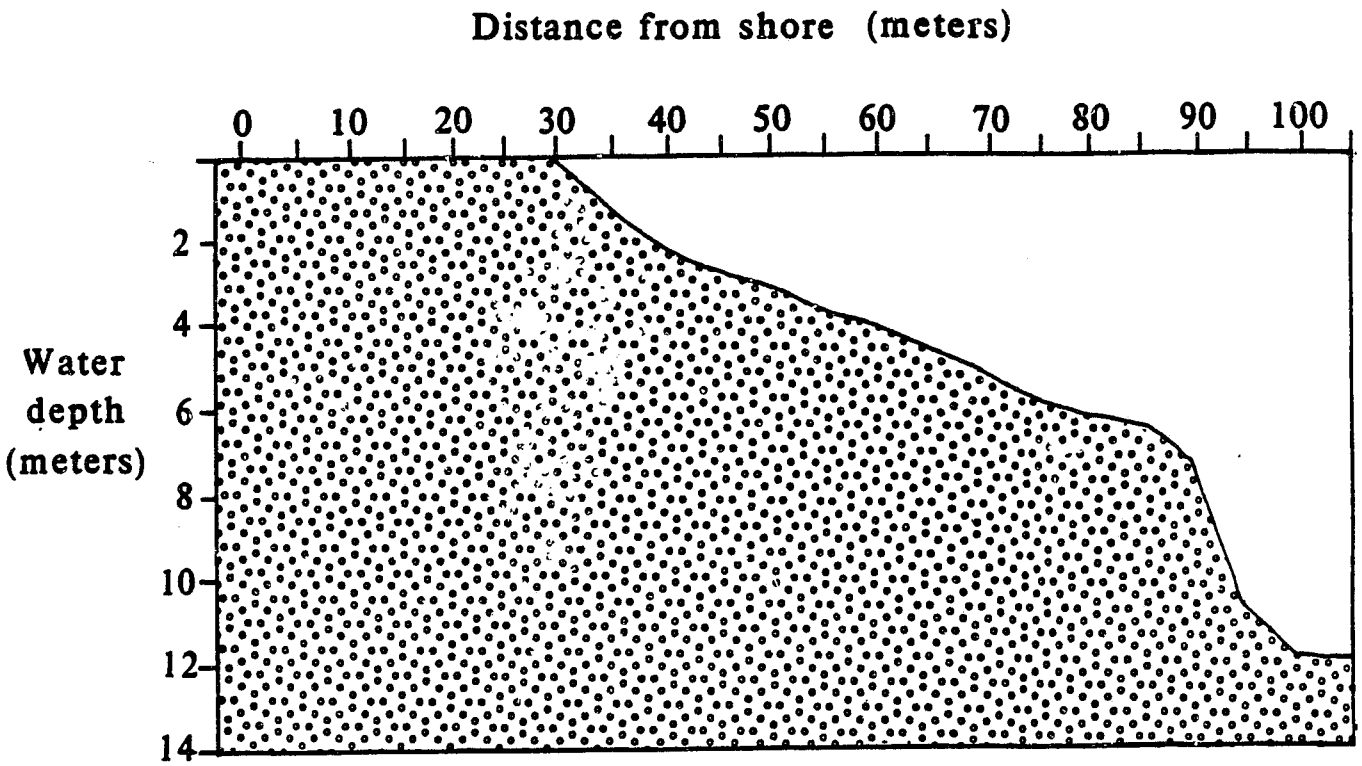

Figure 4. Reef Profile of Ti Teal

assemblage. H. opuntia common on top of outcrops. Common sponges: A. varians, Agelas sp., A. schmidti, S. plicifera, N. digitalis, C. aprica, P. halichondroides, S. vaginalis, N. nolitangere, E. formosus, A. clathrodes, A. compressa, A. archeri. Common corals: M. lamarckiana, A. agaricites, P. astreoides, M. annularis (heads > 1 m in diameter), L. cucullata, A. fragilis, M. decactis, D. labyrinthiformis, A. tenuifolia, P. porites, E. fastigiata, D. cylindrus. Other invertebrates: B. annulata, C. alata, B. asbestinum, D. antillarum, E. tribuloides.

Deep seagrass bed

Depth 6-13 M. Thalassia with sparse Syringodium and small outcrops. Common algae: R. phoenix, H. monile, P. capitatus, Penicillus sp. Unusual individuals of Caulerpa sp. Common sponges on small outcrops: G. neptunii, I. birotulata, T. crypta, U. funicularis, A. schmidti, S. plicifera, A. archeri (>1 m high), S. vaginalis (1 m high), X. muta and one unidentified species. Common corals: A. tenuifolia, S. siderea, P. porites, M. cavernosa, P. astreoides, S. michelinii, C. natans, M. mirabilis. Other invertebrates: L. scabra, S. seticornis, P. guttatus, unidentified Strombus with unusual dorsal projection of the shell.

STATION 11

TI TEAL (longitude: 72°38'14"; latitude: 18°48'13")-West of Ti Teal-swim transect from reef crest windward with qualitative observations-June 22, 1988-Figures 3 and 4.

reef flat

Irregular, consolidated substrate (.3-.4 m deep) with very high densities of Echinometra lucunter (about 100 individuals/m^2). Common algae: Dictyota sp. and Halimeda sp. Small (less than 5 cm in diameter) colonies of Siderastrea radians, Favia fragum and Porites astreoides. Dictyota sp. less common and E. viridis less abundant (about 10/m^2) in slightly deeper water (.5-.6 m). Tripneustes ventricosus common (1-8/m^2). T. testudinum occurs very sparsely and in lumps. Small colonies of P. astreoides abundant.

reef crest

Predominance of M. complanata in waters less than .3 m. Occassional colonies of Acropora prolifera, P. porites and D. strigosa and flattened boulders of Siderastrea radians (about 1 m in diameter and 15 cm tall) in deeper pockets.

Acropora palmata zone

Poorly developed, discontinuous stands of A. palmata at depths of about 1.5 m. Common corals: A. agaricites, A. tenuifolia, S. siderea, P. porites, F. fragum (patchy), P. astreoides, A. cervicornis, A. prolifera, M. annularis. S. siderea sometimes forming marked band with high abundance at depths of about 3 m. Stephanocoenia michelinii common and exposed at this depth. Common hydrocorals: M. complanata, M. alcicornis. Common gorgonians: B. asbestinum, G. ventalina, Pseudoplexaura sp., Erythropodium caribaeorum. Palythoa common. Common sponges: C. nucula and C. aprica. More dense Thalassia with large, multilobate, abundant colonies of M. annularis in deeper water (2.1 m). Some of these colonies with clear signs of recent loss of zooxanthellae (paleness). Thalassia increases with depth.

reef patch zone

Depth: 2.1-9.0 m. Much denser Thalassia with outcrops varying in size. Outcrops apparently with lesser algal cover than on eastern side of island. M. annularis predominant. M. cavernosa, Isophyllia sinuosa (f. multiflora), Dendrogyra cylindrus, Dichocoenia stokesi, M. areolata (f. areolata), M. areolata (f. mayori) and D. labyrinthiformis common. Thalassia and Lobophora variegata predominant among boulders. B. asbestinum very abundant (>40 individuals/m^2) in some patches. Pseudopterogorgia americana and H. homomalla common to rare. Isolated Aplysina and A. varians common to rare. Occassional, very large (>1.5 m high) individuals of Xestospongia muta with invertebrates (Astrophyton muricatum) common in cloaca. Icillogorgia schramii common on sides of patches.

STATION 12

ILE DE SUD (SOUTH ISLAND) (longitude: 72°38'29"; latitude: 18°47'20")-East of Ile de Sud-qualitative transect from reef crest windward-June 23, 1988-Figures 5 and 6.

reef flat

Depth .4 m. Seagrass bed immediately below supralittoral sandy beach. Thalassia over fine sand. Small colonies of S. radians and P. porites. T. esculentus rare to common (less than 1/m^2) and E. lucunter abundant (about 4/m^2). Slightly seaward Thalassia is sparse and Dictyota sp. becomes predominant over highly irregular, low relief (10-20 cm relief) bottom. E. lucunter more abundant (>10m^2). Large heads of D. strigosa (.75 m diameter) near leeward reef crest.

leeward reef crest

Depth .4 m. Dead, standing A. palmata with fleshy algae on top and algal turf on sides. Scleractinians (P. astreoides, A.

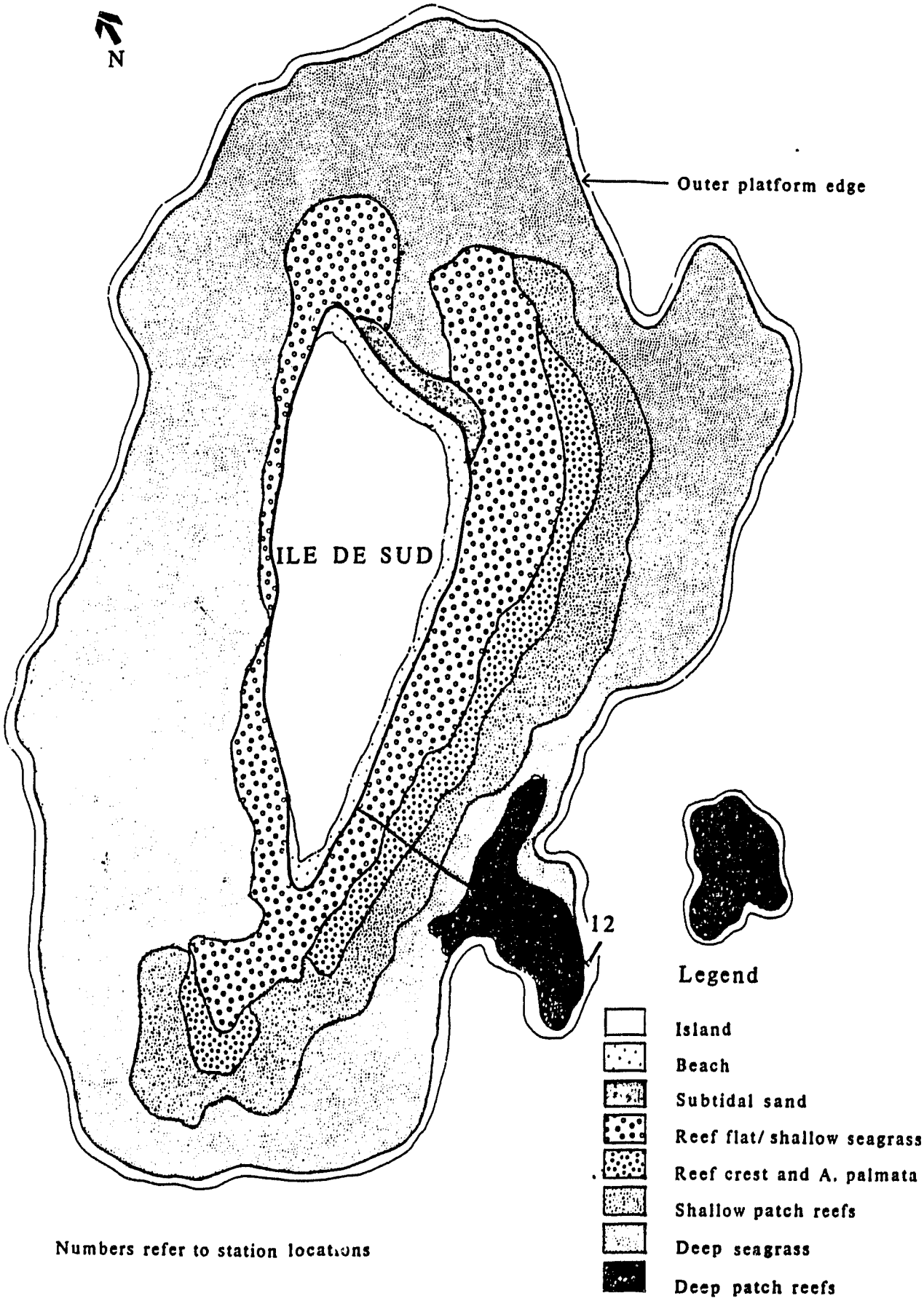

Figure 5. Aerial Photointerpretation of Ile de Sud

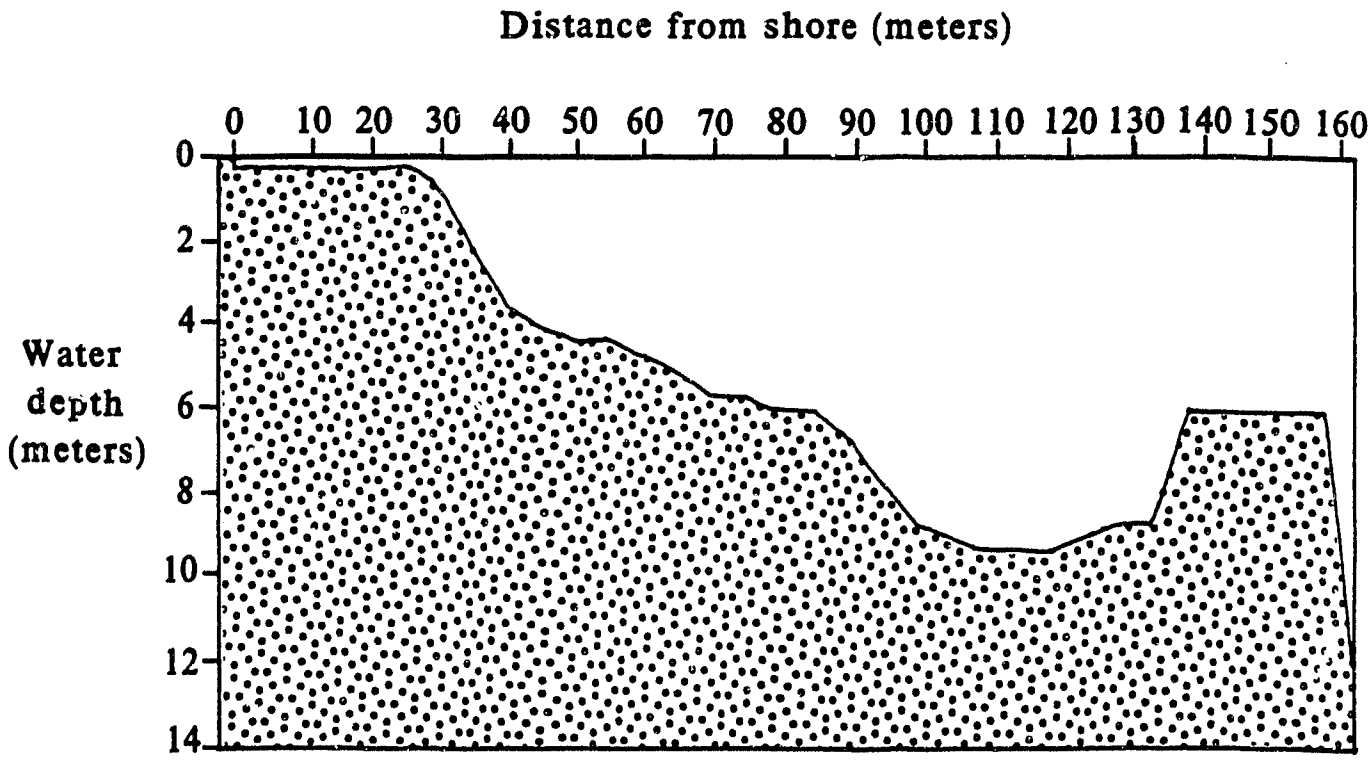

Figure 6. Reef Profile of Ile de Sud

agaricites and F. fragum) common on sides of A. palmata. P. caribaea common. Z. sociatus beneath dead A. palmata.

windward reef crest

Depth .3 m. M. complanata common but crest discontinuous.

A. palmata zone

Depth 1 m. Poorly developed and with many dead colonies overgrown by green and brown algae.

patch reef zone

Depth 2.4-5.7 m. Large outcrops consisting mainly of colonies of M. annularis (> 3 m diameter and 2 m high) among very sparse Thalassia. Heads decrease in size with depth. Dictyota sp. abundant on outcrops and, in deeper patch reef zone covering more than 80 % of their surfaces with Lobophora sp. Upper surfaces of outcrops with M. complanata and M. alcicornis but the latter more abundant to the periphery. Sponges uncommon except for Ircinia spp., A. clathrodes, A. varians and Aplysina spp. Common corals: P. astreoides, A. agaricites, M. annularis, S. siderea, L. cucullata, A. cervicornis, D. labyrinthiformis. Common gorgonians: H. homomalla, G. ventalina, Pseudoplexaura sp. and erect B. asbestinum.

deep seagrass bed

Depth 5.7-6.6 m. Thalassia bed with isolated sponge bioherms (mainly Ircinia sp.). Large outcrops (>4 m in diameter and in relief) at depths of 6.6 m.

deep patch reef zone

Depth 6-13.3 m. Continuous hard substrate with irregular topography. Abundant invertebrate and fish life. Seaward wall of outcrops drops vertically to 13.3 m and is visually dominated by large colonies of I. schrammi. Large, platy colonies of A. agaricites and P. astreoides common on wall. Other corals: M. mirabilis (cryptic in caves, M. annularis, L. cucullata and A. lamarcki. Agelas spp. common. Halimeda goreauii (?) common on overhangs. Stichopathes sp. and Nemaster sp. common on wall. Seaward of wall an extensive Thalassia bed extends to deeper depths.

STATION 13

Recifs ARCADINS (the adjacent fishing banks) (longitude 18°47'30"; latitude 72°36'00")-Qualitative observations-June 28, 1988- Figure 2.

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deep seagrass bed

Depth 14.5 m. Thalassia bed with S. filiforme. Common algae: H. incrassata and Rhipocephalus phoenix, Udotea sp., Avrainviella sp., Lobophora variegata. Sponge outcrops (.5 m in diameter) common on bed. Common sponges: I. strobilina (bell-shaped), N. nolitangere, S. plicifera (1 m high), A. fistularis, Spongia (under I. strobilina), S. vesparium (with lobster hosts), C. vasculum. Other invertebrates: D. antillarum, Holothuria thomasii, Stichopathes sp. and unidentified branched antipatharians.

Depth 18-21 m. (S. filiforme not seen). Dominant algae L. variegata. Sponges: X. muta, Spongia sp., C. eschrichti. T. esculentus common (eating L. variegata).

Reef patchs between 10 and 20 m in diameter, about 3 m high and dominated by sponges. Shallowest depth of outcrops 4.8 m. Common sponges: D. anchorata, Agelas spp., N. digitalis, V. gigantea, I. campana, V. fistularis, I. strobilina, I. birotulata, E. formosus, S. vaginalis, E. ferox, N. erecta, M. laevis, A. crassa, T. juniperina, A. lacunosa, C. delitrix, C. vasculum, N. nolitangere, N. amorpha, A. archeri, A. cauliformis, Inflatella sp., P. acanthifolium, G. neptunii, M. laxissima, P. halichondroides. Common corals: S. siderea, P. astreoides, E. fastigiata, M. decactis, A. agaricites, A. tenuifolia, M. areolata (f. mayori), M. cavernosa, M. annularis (some individuals >2 m high), S. siderea, P. porites, L. cucullata, A. agaricites, M. lamarckiana, S. michelinii (all with unidentified serpulids), C. natans, A. tenuifolia, F. fragum, M. decactis, D. stokesi, M. mirabilis, S. bournonii, D. labyrinthiformis, S. lacera, M. areolata (f. areolata), A. cervicornis, M. angulosa (one specimen about .8 m in diameter). Many corals being covered by fleshy algae (mainly by Dictyota sp., C. mexicana and Dictyosphaeria sp. Individuals of M. annularis and S. michelinii bleached on their tops. Gorgonians abundant but patchy. Common gorgonians: P. homomalla, G. ventalina, P. acerosa, B. asbestinum, I. schramii. Other invertebrates: Nemaster sp., mysids.

Outcrops adjoined by seagrass bed with T. testudinum and S. filiforme. Common algae on bed: Udotea sp., Avrainviella sp., Halimeda spp., Rhipocephalus sp., Lobophora sp.

STATION 14

SHELF EDGE (longitude 72°41'50"; latitude 18°48'00")-West-northwest of Les Arcadins-15 min. spot dive-June 26, 1988 (Figure 3 Action Plan)

Depth 33 m. Slope of shelf edge 10 to 20 degrees. Bottom sandy (sediment consisting mainly of Halimeda sp.) with high

105x

algal cover (Lobophora sp.). Isolated, small outcrops with coral and sponges. Common sponges: D. etherea and D. morchella, Petrosia sp. (cryptic, lining cave ceiling), X. muta and C. aprica. Common corals: M. cavernosa, S. michelinii, S. siderea, A. lamarcki, M. annularis (platy), M. cavernosa (colonies of high vertical relief). Algal cover diminishes down the slope in a band-like fashion after which another band of unconsolidated sediment starts. Another "band" of algae (?) was discerned visually from 33 m at about 50 m depth. It is not clear whether it was related to a change in slope.

SITES ADJOINING ISLANDS

15 min. spot dive between Ile de Sud and Lighthouse Island-June 27, 1988

Depth: 16 m. Dominant vegetation: T. testudinum, Penicillum spp., Avrainvillea spp., V. ventricosa, Udotea sp. Sediment consisting of Halimeda fragments. Reef related sponges loose on Thalassia bed (e.g., Agelas sp., E. ferox, S. aurea). Sponges on substrate: A. compressa, I. proteus, X. muta, O. hemorraghes. Other invertebrates associated with sponges: C. gigantea, unidentified hydrozoan, juvenile S. gigas, O. reticulatus, T. esculentus, E. tribuloides, S. costatus. Dominant sponge within Thalassia bed was an orange, unidentified species.

15 min. spot dive between Lighthouse Island and Ti Teal. June 27, 1988.

Depth 13 m. Dominant vegetation: T. testudinum and S. filiforme. Associated algae: P. capitatus, Avrainvillea sp. Common sponges: M. unguifera, A. compressa, P. acanthifolium, X. muta. Small coral bioherms consisting of Madracis sp., S. radians, A. agaricites. Other invertebrates: H. mexicana.

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Fig. 7

The green echinoid Lytechinus variegatus was found to be particularly abundant in shallow turtle grass (Thalassia testudinum) beds.

Fig. 8

The asteroid Oreaster reticulatus. Juvenile individuals were frequently seen within shallow turtle grass.

Vicente, 1988

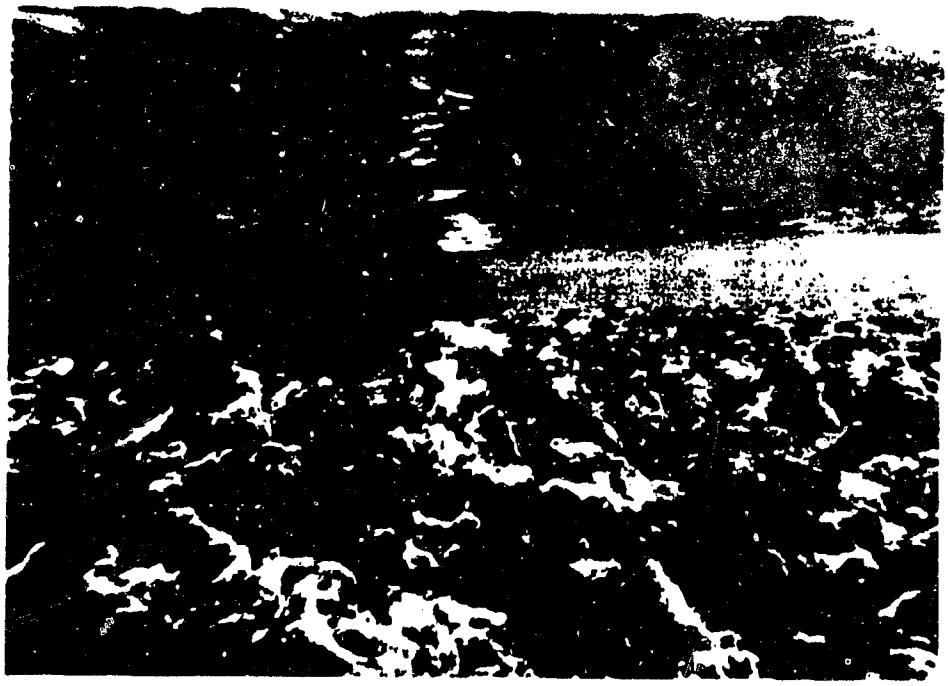

Fig. 9 Panoramic view of reef crest on the east coast of Lighthouse Island. Dead colonies of Acropora palmata are standing, suggesting that the area has been influenced little by the impact of storms.

Goenaga, 1988

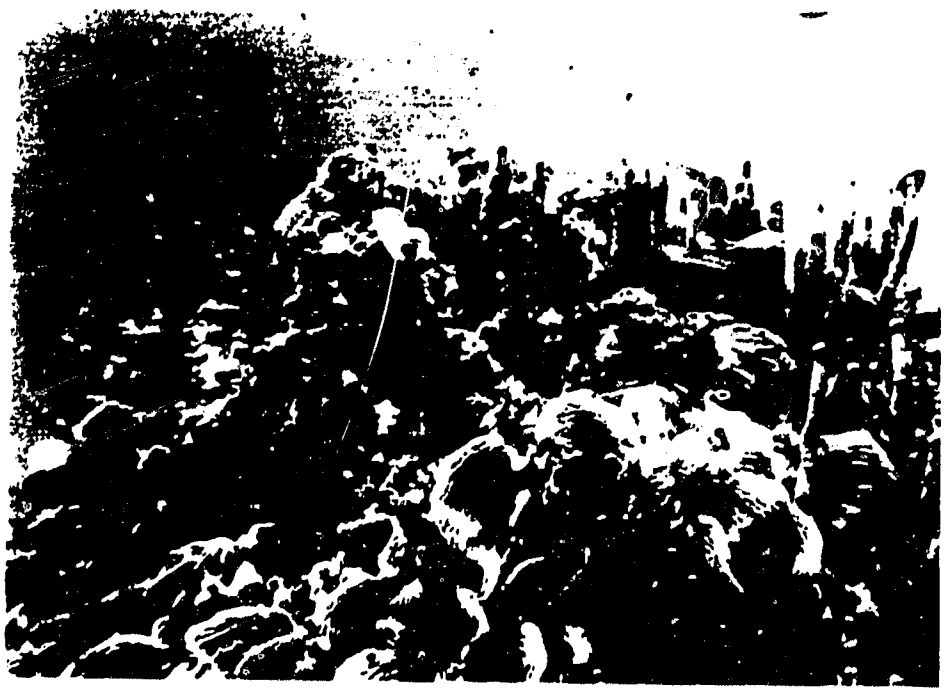

Fig. 10 Top of a shallow submerged outcrop showing typical species associated with this habitat, such as the corals Agaricia agaricites (bottom) and Millepora sp. (see arrows), the octocoral Briareum asbestinum (all the finger-like projections), and fish, blue chromis, wrasses, and damselfish.

Goenaga, 1988

Fig. 11 The soft coral Iciligorgia, although usually found in deeper water or in semicryptic conditions elsewhere in the Caribbean, is common in the shallow waters of Los Arcadins.

Goenaga, 1988

Fig. 12 The basket star Astrophyton muricatum was frequently observed attached to gorgonians such as Plexaura sp.

Goenaga, 1988

Fig. 13
The axinellid sponge Ectyoplasia ferox.

Fig. 14
The chicken leg sponge Xestospongia tierneyi, was commonly found within the seagrass beds at all three islands.

Vicente, 1988

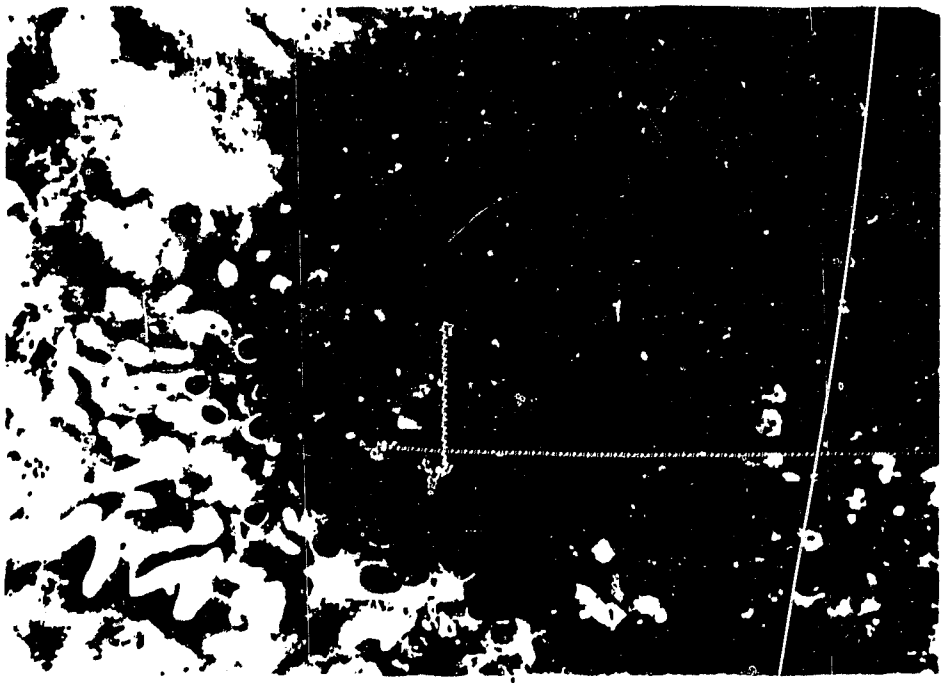

Fig. 15 The blue sponge (Callyspongia fallax), in the center , is a haploscerid, which sometimes becomes fluorescent. The coral to which the sponge is attached is the finger coral Porites porites. (f. typica).

Vicente, 1988

Fig. 16 The left arrow points to a tube of the verongid demosponge Aplysina lacunosa. The right arrow points to a tube of Agelas sp. This species, although common in deep Caribbean reef habitats has has not been described yet. It was found in shallow water (5) at Les Arcadins. Juvenile fish were frequently observed to take refuge inside the cloacal cavities of tubular sponges in the region.

Vicente, 1988

Fig. 17

Fig. 18

Two specimens of Niphates digitalis. This species is very common on seagrass beds as well as in reef habitats at all depths below 1m in Les Arcadins. Invertebrates (e.g. polychaetes) and fish (pomacanthids) feed or utilize the sponge as refuge (e.g.crabs Stenorynchus seticornis and Dromidia antillensis). Gigantism in N. digitalis is unusual at shallow depths within the Caribbean.

Vicente, 1988

APPENDIX I. LEGEND FOR STATIONS

# STA	STATION DESCRIPTION
1	Lighthouse Island-East-June 15, 1988 -from the reef flat (close to shore) to about 140 m offshore
2	Lighthouse Island-East-June 16, 1988 -on offshore coral outcrops that are separated from Station 1 by deeper area
3	Lighthouse Island-East (deep)-June 16, 1988 -deep *Thalassia* bed with small coral algal assemblages
4	Lighthouse Island-East (1 m deep)-June 17, 1988 -reef crest in the vicinity of dumped cement sacs leeward of Sta. 2
5	Lighthouse Island-East (4 m deep)-June 17, 1988 -*Thalassia* bed directly south of Sta. 4
6	Lighthouse Island-West Northwest-(.1-6 m deep)-June 17, 1988 -*Thalassia* bed and shallow coral outcrops W-NW of island
7	Lighthouse Island-North (1-5 m deep)-June 17, 1988 -*Thalassia* bed with coral outcrops in the eastern portion of northern bay
8	Ti Teal-Northwest (13 m deep)-June 18, 1988 -deep *Thalassia* bed
9	Ti Teal-Northwest (6-15 m deep)-June 18, 1988 -deep coral outcrops
10	Ti Teal-East (.3-13 m deep)-June 20, 1988 -from reef flat to deep seagrass bed
11	Ti Teal-West (.3-9 m deep)-June 22, 1988 -from reef flat to deep seagrass bed
12	Ile de Sud-East (.3-13 m deep)-June 23, 1988 -from reef flat to deep patch reefs
13	Recifs Arcadins (fishing banks)(4.8-21 m deep)-June 28,1988 -deep seagrass bed (*T. testudinum* and *S. filiforme*) with coral outcrops
14	Shelf edge-west-northwest of Les Arcadins-(33 m deep)-June 26, 1988 -shelf edge sloping 10-20°

113r

APPENDIX II.

CORALS (*SCLERACTINIA*, *GORGONACEA* AND *HYDROCORALLIA*) OBSERVED AT EACH SITE

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
SCLERACTINIA														
ASTROCOENIIDAE														
S.michelinii	x	x				x	x	x	x	x	x	x	x	x
M.decactis						x			x	x	x		x	
M.mirabilis	x	x	x	x					x	x	x	x	x	
ACROPORIDAE														
A.palmata	x			x						x	x	x		
A.cervicornis		x		x					x		x	x	x	
A.prolifera											x			
AGARICIDAE														
A.agaricites	x	x	x	x		x	x	x	x	x	x	x	x	
A.tenuifolia		x			x	x	x		x	x	x		x	
A.lamarcki		x					x		x	x	x		x	x
A.fragilis		x							x	x				
L.cucullata		x								x		x	x	
SIDERASTREIDAE														
S.siderea	x	x	x		x	x	x	x	x	x	x	x	x	x
S.radians	x									x	x	x		
PORITIDAE														
P.porites	x	x		x		x	x		x	x	x	x	x	
P.branneri	x													
P.astreoides	x	x	x	x		x	x	x	x	x	x	x	x	
FAVIIDAE														
F.fragum	x			x		x	x			x	x	x	x	
D.strigosa	x					x	x				x	x		
D.labyrinthyformes	x				x		x		x	x	x	x	x	
M.areolata(f.areo)	x	x					x				x		x	
M.areolata(f.mayo)	x										x		x	
C.natans		x							x	x	x		x	
M.cavernosa	x	x	x			x		x	x	x	x		x	x
M.annularis	x	x	x	x	x	x	x		x	x	x	x	x	x
S.bournonii		x											x	
MEANDRINIIDAE														
M.meandrites		x				x			x					
D.stokesi				x		x		x		x	x		x	
D.cylindricus	x									x	x			
MUSSIDAE														
M.angulosa													x	

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	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Scolymia sp.													x	
I.sinuosa(f.sinu)	x	x		x			x			x				
I.sinuosa(f.mult)	x	x				x	x		x		x			
M.lamarckiana						x	x				x		x	
M.ferox		x												
CARYOPHYLLIDAE														
E.fastigiata	x	x	x			x			x	x			x	
T.aurea		x												
GORGONACEA														
E.caribbaeorum	x	x		x		x				x	x			
G.ventalina	x	x		x		x			x	x	x	x	x	
G.flabellum						x								
Eunicea sp.	x					x								
P.homomalla	x	x		x		x	x				x	x	x	
P.americana	x					x					x			
P.acerosa		x				x	x						x	
B.asbestinum		x		x		x	x		x	x	x	x	x	
Pseudoplexaura sp.						x	x			x	x	x		
Pterogorgia sp.							x							
I.schramii											x	x	x	
unid. gorgonian														x
HYDROCORALLIA														
M.complanata	x	x		x			x			x	x	x		
M.alcicornis		x		x		x	x			x	x	x		
S.rosaceus		x							x					

115x

APPENDIX III. SPONGES COMMON AT EACH STATION

SPECIES	STATION													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Anthosigmella varians f. var.	x	x			x				x					
Anthosigmella varians f. inc.		x			x	x			x	x	x	x		
Cliona aprica	x			x	x	x			x	x				x
Cliona delithrix													x	
Aplysina sp.	x								x		x			
Aplysina fistularis	x	x							x			x		
Aplysina lacunosa									x			x	x	
Aplysina archeri									x	x			x	
Aplysina cauliformis													x	
Verongula ardis			x											
Verongula gigantea			x										x	
Agelas schmidtii	x	x				x				x				
Agelas clathrodes	x	x								x		x	x	
Agelas dispar						x						x	x	
Agelas sp.				x	x					x				
Ectoplasya ferox	x	x	x										x	
iotrochota birotulata	x	x						x		x			x	
Spinosella vaginalis	x									x			x	
Amphimedon viridis						x								
Amphimedon compressa						x				x				
Cribrochalina vasculum													x	
Spinosella plicifera		x								x			x	
Callyspongia fallax		x	x											
Callyspongia eschrichti		x											x	
Homaxinella rudis	x	x												
Xestospongia tierneyi	x					x								
Xestospongia muta										x	x		x	x
Pandaros acanthifolium	x	x											x	
Mycale laxissima	x	x	x										x	
Mycale laevis													x	
Tethya crypta	x	x			x	x				x				
Erylus formosus		x			x	x				x			x	
Niphates digitalis		x											x	
Niphates erecta													x	
Niphates amorpha													x	
Neofibularia nolitangere		x								x			x	
Desmapsamma anchorata													x	
Chondrilla nucula		x	x			x			x	x	x			
Monanchora unguifera		x				x								
Geodia neptuni		x	x							x			x	
Ircinia strobilina		x	x		x	x						x	x	

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APPENDIX III. (CONTINUED)

SPECIES	STATION													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Ircinia campana						x						x	x	
Cyunachira alloclada		x												
Smenospongia aurea			x											
(*Hippospongia* sp.)			x											
Spheciospongia vesparium													x	
Spongia sp.													x	
Teichaxinella morchella						x								x
Ulosa funicularis										x				
Ailochroia crassa													x	
Thalysias juniperina													x	
inflatella sp.													x	
Plakortis halichondroides														
Dysidea etheria														x
Petrosia sp.														x

117x

APPENDIX IV. PHYLOGENETIC LIST OF OBSERVED ORGANISMS (SPECIES ARE ARRANGED ALPHABETICALLY WITHIN TAXA)

Gymnosperma (seagrasses)

Syrirgodium filiforme
Thalassia testudinum

Algae
Green algae

Codium sp.
Halimeda sp.
Halimeda opuntia
Halimeda incrassata
Penicillus capitatus
Valonia ventricosa

Brown algae

Avrainviella sp.
Dictyota sp.
Dictyota dentata
Lobophora variegata
Padina sp.
Sargassum sp.
Turbinaria turbinata

Red algae

Galaxaura fastigiata
Laurencia sp.

Porifera (sponges)

Agelas clathrodes
Agelas compressa
Agelas schmidti
Anthosigmella varians incrustans
Anthosigmella varians varians
Callyspongia fallax
Chondrilla nucula
Cliona aprica
Ectyoplasia ferox
Erylus formosus
Homaxinella rudis
Iotrochota birotulata
I. proteus
Ircinia strobilina
Neofibularia nolitangere
Niphates digitalis
O. hemorraghes
Pandaros acanthifolium
Spinosella vaginalis
Verongula gigantea
Xestospongia muta

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Hydrocorallia (fire coral or hydrocorals)

Millepora alcicornis
Millepora complanata
Millepora squarrosa
Stylaster rosaceus

Scleractinia (stony corals)

Acropora palmata
Acropora cervicornis
Acropora prolifera
Agaricia agaricites
Agaricia fragilis
Agaricia lamarcki
Agaricia tenuifolia
Colpophyllia natans
Dendrogyra cylindrus
Dichocoenia stokesi
Diploria strigosa
Diploria labyrinthiformis
Eusmilia fastigiata
Favia fragum
Isophyllia sinuosa (f. *sinuosa*)
Isophyllia sinuosa (f. *multiflora*)
Leptoseris cucullata
Madracis mirabilis
Madracis decactis
Manicina areolata (f. *areolata*)
Manicina areolata (f. *mayori*)
Meandrina meandrites
Montastrea annularis
Montastrea cavernosa
Mussa angulosa
Mycetophyllia ferox
Mycetophyllia lamarckiana
Porites porites
Porites branneri
Porites astreoides
Scolymia sp.
Siderastrea radians
Siderastrea siderea
Solenastrea bournoni
Stephanocoenia michelimi
Tubastrea aurea

Gorgonacea (soft corals)

Briaerum asbestinum
Erythropodium caribaeorum
Eunicea sp.
Gorgonia flabellum
Gorgonia ventalina
Icilliogorgia schramii
Plexaura homomalla

119x

Pseudoplexaura sp.
Pseudopterogorgia americana
Pseudopterogorgia acerosa
Pterogorgia sp.

Actiniaria (anemones)

Bartholomea annulata
Condylactis gigantea
Heteractis sp.
Rhodactis sanctithomae

Zoanthidea (colonial anemones)

Palythoa caribaea
Zoanthus sociatus

Corallimorpharia (coral-like anemones)

Rhodactis sanctithomae

Antipatharia (black corals)

Stichopathes sp.

Echinoidea (sea urchins)

Diadema antillarum
Echinometra lucunter
Echinometra viridis
Eucidaris tribuloides
Lytechinus variegatus
Tripneustes esculentus

Crinoidea (sea lillies)

Nemaster sp.

Holothuroidea (sea cucumbers)

Holothuria thomasii

Polychaeta (segmented worms)

Hermodice carunculata

Mollusca (snails)

Strombus gigas
Strombus pugilis
Strombus costatus

Crustacea

Panulirus argus
Panulirus guttatus

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APPENDIX V. PRELIMINARY SYSTEMATIC SPECIES LIST OF SPONGES COLLECTED AT LES ARCADINS

	A
1	Phylum Porifera Grant 1836
2	Class Demospongea Sollas 1885
3	Subclass Ceractinomorpha Levi 1953
4	Order Dictyoceratida Minchin 1900
5	Family Spongiidae Grav 1867
6	Spongia tubulifera Lamarck 1814
7	Spongia sp. Linne 1759
8	Family Thorectidae Berquist 1978
9	Hyrtios proteus D&M 1864
10	Ircinia felix D&M 1864
11	Ircinia strobilina Lamarck 1816
12	Ircinia campana Lamarck 1816
13	Oligoceros hemorrhages de Laubenfels 1936
14	Smenospongia aurea Hyatt 1875
15	Family Dysideidae Gray 1867
16	Dysidea etheria de Laubenfels 1936
17	Order Dendroceratida Minchin 1900
18	Family Aplysillidae Vosmaer 1883
19	Aplysilla glacilis Merejkowsky 1878
20	Order Verongida Berquist 1978
21	Family Aplysinidae Carter 1875
22	Aplysina fistularis D&M 1864
23	Aplysina fistularis f. insularis D&M 1864
24	Aplysina fulva Pallas 1776
25	Aplysina archeri Higgin 1875
26	Aplysina lacunosa Pallas 1776
27	Aplysina cauliformis Carter 1882
28	Verongula rigida Esper 1794
29	Verongula gigantea Hyatt 1875
30	Verongula ardis de Laubenfels 1950
31	Family Aplysinellidae Berquist 1980
32	Pwseudoceratina crassa Hyatt 1875
33	Order Haplosclerida Topsent 1928
34	Family Haliclonidae de Laubenfels 1932
35	Haliclona hogarthi Hechtel 1965
36	Haliclona molitba de Laubenfels 1949
37	Family Niphatidae van Soest 1980
38	Amphimedon compressa D&M 1864
39	Amphimedon viridis D&M 1864
40	Niphates erecta D&M 1864
41	Niphates digitalis Lamarck 1814
42	Cribrochalina vasculum Lamarck 1814
43	Family Callyspongidae de Laubenfels 1936
44	Callyspongia fallax D&M 1864
45	Spinosella vaginalis Lamarck 1814
46	Spinosella plicifera Lamarck 1814

APPENDIX V. (CONTINUED)

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A

47 Callyspongia eschrichti D&M 1864
48 Family Petrosiidae van Soest 1980
49 Xestospongia muta Schmidt 1870
50 Xestospongia tierneyi de Laubenfels 1953
51 Petrosia pellasarca de Laubenfles 1934
52 Petrosia sp.
53 Family Oceanapiidae van Soest 1980
54 Pellina nodosa George & Wilson 1919
55 Pellina carbonaria Lamarck 1814
56 Order Poecilosclerida Topsent 1928
57 Family Mycalidae Lundbeck 1905
58 Mycale laevis Carter 1882
59 Mycale laxissima D&M 1864
60 Mycale sp.
61 Family Esperiopsidae
62 Desmapsamma anchorata Carter 1882
63 Iotrochota birotulata Higgin 1877
64 Monanchora unguifera de Laubenfels 1953
65 Family Clathriidae Hentschel 1923
66 Pandaros acanthifolium
67 Neofibularia nolitangere D&M 1864
68 Family Microcionidae Carter 1875
69 Thalysias juniperina D&M 1864
70 Order Halichondrida Vosmaer 1885
71 Ulosa funicularis Rutzler 1981
72 Sublcass Tetractinomorpha Levi 1953
73 Order Axinellida Levi 1955
74 Family Axinellidae Carter 1875
75 Ptilocaulis walpersii D&M 1364
76 Teichaxinella morchella Wiedermayer 1977
77 Pseudaxinella lunaecharta Ridley & Dendy 1886
78 Family Raspailiidae Hentschel 1923
79 Ectyoplasia ferox D&M 1864
80 Family Agelasidae Verrill 1907
81 Agelas dispar D&M 1864
82 Agelas schmidt Wilson 1902
83 Agelas conifera Schmidt 1870
84 Agelas sceptrum Lamarck 1815
85 Agelas clathrodes Schmidt 1870
86 Order Hadromerida Topsent 1894
87 Family Clionidae Gray sensu de Laubenfels 1936
88 Cliona aprica f. profunda Pang 1973
89 Cliona aprica f. aprica Pang 1973
90 Cliona delitrix Pang 1973
91 Family Spirastrellidae Ridley & Dendy 1886
92 Anthosigmella varians f. varians D&M 1864
93 Anthosigmella varians f. incrustans D&M 1864

APPENDIX V. (CONTINUED)

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A

94 Spheciospongia vesparium Lamarck 1814
95 Family Tethydae Gray 1867
96 Tethya crypta de Laubenfels 1949
97 Family Chondrosiidae Schulze 1877
98 Chondrilla nucula
99 Order Choristida Sollas 1880
100 Family Geodiidae Gray 1867
101 Geodia (papyracea)
102 Geodia neptuni Sollas 1886
103 Erylus formosus Sollas 1886
104 Family Craniellidae de Laubenfels 1936
105 Cynachira alloclada Uliczka 1929
106 Cynachira sp.
107 Subclass Homoscleromorpha Levi 1953
108 Plakortis halichondroides Wilson 1902
109 Class Calcarea
110 Order Clathrinida
111 Family Clathrinidae Minchin 1898
112 Clathrina coriacea Montagu 1814

123x

II. THE FISHERIES SURVEY

A. Approach

In order to define the principal physiographic areas of the reef at each site, a transect running perpendicular to the shoreline was set down from the reef crest to a depth of approximately 20 m. General observations of the physical and biological structure of the reef were recorded, including depth, predominant coral assemblages and structural formations. From this initial observation the main habitats in the reef were identified and qualitatively described in terms of its physical dimensions and biological characteristics. The principal habitats studied were: (1) the reef crest/ *Acropora palmata* zone, (3) shallow patch reefs, (4) deep patch reefs, and (5) coral/sponge bioherms. Qualitative descriptions of predominant fish assemblages were performed in order to relate species with particular types of habitats within the reef. A complete list of diurnal, non-cryptic species of fish was prepared for each habitat, at each site, from random swim surveys of 30 minutes. This list was supplemented by additional records of species in quantitative surveys.

B. Methods

Fish diversity was addressed using information on total number of species and the relative abundance of each species in the sample. The Shannon-Wiener index (H') was used as a measurement of diversity since it is relatively independent of sample size (Bowman *et al*, 1970) and its proportionality approach reflects community structure (McErlean *et al*, 1973; Kimmel, 1978). The Shannon-Weiner index is obtained as:

$$H' = \sum_{i=1}^{n} Pi \, Log_e \, Pi$$

where Pi is the proportion of the number of individuals of the ith species to the total number of individuals (^{n}) in the population (sample).

Species and individuals were visually recorded underwater, using SCUBA gear along 10 m transects, including all individuals within one meter of each side of the transect line. In relatively small and/or high vertical relief structures, such as those common in coral/sponge bioherms and shallow patch reefs, the approach was to count the total number of species and individuals and circumference of the reef as an approximation of the reef surface area. Fish abundance was obtained by dividing the number of individuals by the total surface area of the reef surveyed and is reported as individuals per m^2. This makes intercomparisons between different habitats and sites possible.

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Ichthyofaunal similarities in species composition were obtained using the similarity index derived by Sorenson (1948), where:

$$S = 2C / (A+B),$$

C is the number of species in common, A is the total number of species at site (or habitat) A, and B is the total number of species at site (or habitat) B. Similarity in terms of the relative abundance of fish species at the different habitats and sites was determined by cluster analysis, using the Czekanowsky coefficient (Bray and Curtis, 1957; Stoner, 1986). The lowest values of relative abundance for each species in paired comparisons were added to obtain a similarity value for each sample pair. Similarity between the principal clusters was obtained by the average linkage procedure, whereby the average of all samples in both clusters was considered.

The principal fisheries related information pursued in this study was the species specific catch per unit effort for the main species and traditional fishing methods in practice by fishermen from the Luly fishing village. Fisheries data was obtained upon visits to the fish market at Luly. Only the data from one such visit (July 1, 1988) has been analyzed and included in this report.

Interviews with fishermen provided information on the relative effort applied to each particular fisheries. Fishermen at Luly do not weigh their catch nor sell it themselves. The catch of the day is placed on a string and handed to the *madam sara*, who cleans the fish and makes the sale. The *madam sara* allowed us for purposes of this survey, to measure the fish but not to weigh it. All weights reported are estimates obtained by hand-weighing the fish. The following data was collected:

(1) Total number of boats and fishermen at Luly.
(2) Soak time of fish traps.
(3) Most abundant species (target species) captured by each method.
(4) Size distribution (weight) of the most abundant species in the catch.
(5) Number of fishing trips/ boat/week.

C. Results and Discussion

Taxonomic Distribution and Abundance at the Main Reef Habitats

A total of 126 diurnal, non-criptic fish species were visually recorded from Les Arcadins Islands, Recif Arcadins (also known as Arcadins fishing bank), and from a single observation

125x

at the shelf-edge. A complete listing of these species is included as Appendix I. An additional 109 species are reported from haitian fishermen landings (FAO, 1961). Following is a characterization of the dominant assemblages of fishes present at the main reef habitats.

Reef crest/Acropora palmata zone (depth: 0-2 m):

Only qualitative observations were performed at this reef zone due to the shallow nature of the habitat. The most common fish species present were the bluehead wrasse, Thalassoma bifasciatum, yellowtail and sargent mayor damselfishes, Microspathodon chrysurus and Abudefduf sexatilis, surgeonfishes, Acanthurus bahianus and A.coeruleus, parrotfishes, Scarus iserti, S. vetula, Sparisoma radians and S. rubripinne and the hamlets, Hypoplectruspuella, Hindigo, and H. nigricans. Altogether, 45 species were recorded at this zone in the three islands.

Shallow Patch Reefs (depth: 2-10 m)

These are mostly mound (nearly cylindrical) shaped coral bioherms with ledges and crevices on the sides and a fairly uniform top. Between the discontinuous reef formations the substrate was covered by the seagrass, T. testudinum. A total of 22 patch reefs were surveyed, ranging in surface area from 6.7 - 53.2 m^2 (mean: 22.3 m^2). Vertical relief ranged from 0.9 - 3.5m. A total of 76 species were recorded at shallow patch reefs.

Table 1 shows the average numerical abundance and relative composition of dominant fish species at shallow patch reefs. The mean numerical abundance ranged between 2.89 ind m-2 (_ 1.4 s.d.) at North Is. and 4.0 ind m-2 (_ 0.6 s.d.) at the Recif Arcadins. Wrasses (Labridae) and damselfishes (Pomacentridae) dominated at the top of the reefs. The bluehead wrasse, T. bifasciatum, was present in all observations from the Arcadins islands and the submerged reef (Recif Arcadins) with mean abundance ranging from 0.4 ind m^{-2} to 1.0 ind m^{-2}. The combined abundance of wrasses at all sites was 1.1 ind m^{-2} (_ 0.2 s.d.). Yellow and bicolor damselfishes, Stegastes planifrons and S. partitus, and the blue chromis, Chromis cyanea, were highly abundant at all sites, particularily on the top of the reefs. The combined abundance of damselfishes was 1.3 ind m^{-2} (_ 0.2 s.d.). Ledges were mostly inhabited by squirrelfishes, Holocentrus rufus(0.2 ind m^{-2}) and Neoniphon marianus (0.1 ind m^{-2}). The sharpnose puffer, Canthigaster rostrata and the royal gramma, Gramma loreto were generally present beneath the reef ledges and crevices but in low abundance. At the base of the reef, parrotfishes (Scaridae) dominated in numerical abundance. The combined abundance of parrotfishes was 0.4 ind m^{-2} (_ 0.2 s.d.). The striped and stoplight parrotfishes, Scarus iserti,

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TABLE 1. NUMERICAL ABUNDANCE AND RELATIVE COMPOSITION OF DOMINANT FISH SPECIES AT SHALLOW PATCH REEFS.

SITES	LIGHTHOUSE IS.		SOUTH IS.		NORTH IS.		RECIF ARCADINS		MEAN ABUNDANCE	
SPECIES	(IND/M2)	%	(IND/M2)	%	(IND/M2)	%	(IND/M2)	%	(IND/M2)	%
T. bifasciatum	1.01	27.2	0.54	14.9	0.97	33.6	0.4	9.9	.73	21.3
S. partitus	0.52	14.0	0.55	15.2	0.63	21.8	0.67	16.5	.59	17.3
C. cyanea	0.17	4.6	0.39	10.8	0.14	4.8	0.82	20.2	.38	11.1
S. planifrons	0.44	11.9	0.34	9.4	0.23	8.0	0.17	4.2	.30	8.6
H. garnoti	0.21	5.7	0.33	9.1	0.24	8.3	0.3	7.4	.27	7.9
S. iserti	0.18	4.9	0.35	9.7	0.08	2.8	0.25	6.2	.22	6.3
H. rufus	0.09	2.4	0.12	3.3	0.1	3.5	0.38	9.4	.17	5.0
G. loreto	0.11	3.0	0.35	9.7	0.01	.3	0.03	.7	.13	3.6
N. marianus	0.14	3.8	0.22	6.1	0.09	3.1	0.03	.7	.12	3.5
S. aurofrenatum	0.02	.5	0.13	3.6	0	.0	0.28	6.9	.11	3.1
S. viride	0.1	2.7	0.14	3.9	0.1	3.5	0.07	1.7	.10	3.0
O. chrysurus	0.02	.5	0.01	.3	0.03	1.0	0.28	6.9	.09	2.5
C. parrae	0	.0	0	.0	0	.0	0.3	7.4	.08	2.2
H. puella	0.04	1.1	0.09	2.5	0.08	2.8	0.05	1.2	.07	1.9
C. rostrata	0.08	2.2	0.05	1.4	0.05	1.7	0.02	.5	.05	1.5
M. chrysurus	0.04	1.1	0.01	.3	0.14	4.8	0	.0	.05	1.4
TOTAL ABUNDANCE (IND/M2)	3.17		3.62		2.89		4.05		3.43	

and Sparisoma viride were present at all sites. There was substantial activity of fishes in the water column. Large aggregations of reef silversides, Allanetta harringtonensis, juvenile bar-jacks, Carangoides ruber, and associated predators, such as little tuna, Euthynnus alletteratus, and houndfish, Tylosurus crocodilus were commonly present.

The combined abundance of predominantly herbivorous fish species, such as parrotfishes and damselfishes (Bakus, 1967; Randall, 1967), represented approximately 40 % of the numerical fish abundance at shallow patch reefs. Carnivorous types, such as wrasses, squirrelfishes and hamlets (Randall, 1967), represented approximately 40 % of the total fish numerical abundance. Zooplanktivorous species, such as the blue chromis and the creole fish (Clepticus parrae) were also represented (13%) at shallow patch reefs.

Deep Patch Reefs (depth: 10-20 m)

These are platform shaped coral bioherms surrounded by the seagrass T. testudinum, comparable in horizontal dimension with some of the larger shallow patch reefs at the islands (10-15 m^2), but of less than 1 meter in vertical relief. Deep reefs studied were located west off South Is., east off Lighthouse Is. and at the base of the reef slope west off Recif Arcadins. The total number of fish species recorded from deep patch reefs was 63.

Table 2 shows the mean numerical abundance and relative composition of dominant fishes at deep patch reefs. Mean numerical abundance for the three sites studied was 1.76 ind m^{-2} (_ 0.2 s.d.). Damselfishes were the most abundant taxonomic group with 1.2 ind m^{-2}. Parrotfishes and wrasses followed in numerical abundance with 0.7 ind m^{-2} and 0.3 ind m^{-2}, respectively. The most abundant species were the striped parrotfish, Scarusy iserti (0.5 ind m^{-2}), the blue chromis, C. cyanea (0.5 ind m^{-2}), and the bicolor damselfish, Stegastes partitus (0.4 ind m^{-2}). Also common, but in lower abundance, were the yellowhead wrasse, Halichoeres garnoti, longspine squirrelfish, Neoniphon marianus, and latin grunt, Haemulon steindachneri. A few large, commercially important fishes, such as mutton snapper, Lutjanus analis, yellowtail snapper Ocyurus chrysurus, and pelagic species, Scomberomorus regalis, Carangoides crysos, and Sphyraena barracuda were observed at the deep patch reefs of Recif Arcadins.

Herbivorous fishes represented approximately 40 % of the total individuals at deep patch reefs. As in shallow reefs, parrotfishes and damselfishes were the principal herbivorous groups. Turtlegrass (Thalassia testudinum) and associated epiphytic algal complexes as well as macroalgae growing in the reefs seem to be important sources of plant material at deep patch reefs. The diet of parrotfish species present in deep

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TABLE 2. NUMERICAL ABUNDANCE AND RELATIVE COMPOSITION OF DOMINANT FISH SPECIES AT DEEP PATCH REEFS.

SITES	LIGHTHOUSE IS.		SOUTH IS.		RECIF ARCADINS		MEAN ABUNDANCE	
SPECIES	(IND/M2)	%	(IND/M2)	%	(IND/M2)	%	(IND/M2)	%
S. iserti	0.62	17.2	0.47	16.0	0.41	12.2	.50	15.2
C. cyanea	0.6	16.6	0.38	13.0	0.45	13.4	.48	14.4
S. partitus	0.48	13.3	0.47	16.0	0.27	8.0	.41	12.3
H. garnoti	0.4	11.1	0.22	7.5	0.38	11.3	.33	10.1
S. planifrons	0.3	8.3	0.35	11.9	0.3	8.9	.32	9.6
N. marianus	0.32	8.9	0.22	7.5	0.14	4.2	.23	6.9
H. rufus	0.05	1.4	0.07	2.4	0.43	12.8	.18	5.6
S. aurofrenatum	0.12	3.3	0.15	5.1	0.2	6.0	.16	4.7
H. puella	0.32	8.9	0.08	2.7	0.05	1.5	.15	4.5
H. flavolineatum	0.1	2.8	0.07	2.4	0.27	8.0	.15	4.4
H. steindachneri	0	.0	0.18	6.1	0.2	6.0	.13	3.8
P. cruentatum	0.1	2.8	0.12	4.1	0.15	4.5	.12	3.7
G. loreto	0.18	5.0	0.02	.7	0.08	2.4	.09	2.8
S. viride	0.02	.6	0.13	4.4	0.03	.9	.06	1.8
TOTAL ABUNDANCE (IND/M2)	1.71		1.46		2.12		1.76	

reefs at Les Arcadins has been shown to consist mostly of algae and to a lesser extent by seagrass (Randall, 1967). Juveniles of striped parrotfish (the most abundant fish at deep reefs) have been observed to feed upon epiphytic algae growing on Thalassia blades (Munro, 1983).

Seagrass is also a source of food and habitat for many benthic invertebrates which are the main food of carnivorous fishes present at the deep reefs of Les Arcadins, such as wrasses (T. bifasciatum, H. garnoti) and grunts (H. flavolineatum, H. steindachneri) (Randall, 1983).

Coral/ Sponge Bioherms (depth: 12-23 m)

These are small, low relief bioherms dispersed in the deep seagrass bed surrounding Les Arcadins Islands. The typical structure was characterized by a live coral colony-sponge combination, but in some cases the whole bioherm consisted of a relatively large sponge attached to a dead coral or other supporting structure. The vertical relief of these bioherms ranged from 0.3-0.9 meters, with an average surface area of 2.1 m^2 (_1.3 s.d.). A total of 15 coral/sponge bioherms were surveyed.

The mean numerical abundance and relative composition of dominant fishes at sponge/coral bioherms is presented in Table 3.

Mean numerical abundance for the three sites studied was 24.8 ind m^{-2} (_ 14.5 s.d.). Mostly juvenile aggregations of the yellowhead wrasse, Halichoeres garnoti (11.5 ind m^{-2}), and bicolor damselfish, Stegastes partitus (5.9 ind m^{-2}) dominated in abundance. Striped parrotfish, Scarus iserti (2.7 ind m^{-2}), adult groupers, Epinephelus guttatus (1.0 ind m^{-2}) and Petrometopon cruentatum (0.6 ind m^{-2}), and the sharpnose puffer, Canthigaster rostrata (1.0 ind m^{-2}) complemented the typical fish assemblage present at these coral/sponge bioherms. Occassionally, large aggregations of juvenile blue chromis, Chromis cyanea, were observed. A relatively large variety of fish species were either only or mostly sighted at these habitats. These included the tobacco fish, Serranus tabacarius, lantern bass, Serranus baldwini, yellowspotted stingray, Urolophus jamaicensis, spotted moray, Gymnothorax moringa and red hind, Epinephelus guttatus.

Predominantely carnivorous fishes were the dominant trophic types at coral/sponge bioherms (55 %). Ichthyofaunal Similarity Between Sites and Habitats

Table 4 presents similarity values in the composition of species between sites for each mayor habitat surveyed. Among habitats, ichthyofaunal similarity ranged between 67 % at deep patch reefs and 57 % at coral/sponge bioherms. For the reef

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TABLE 3. NUMERICAL ABUNDANCE AND RELATIVE COMPOSITION OF DOMINANT FISH SPECIES AT CORAL/SPONGE BIOHERMS.

SITES	LIGHTHOUSE IS.		SOUTH IS.		NORTH IS.		MEAN ABUNDANCE	
SPECIES	(IND/M2)	%	(IND/M2)	%	(IND/M2)	%	(IND/M2)	%
H.garnoti	8.08	46.17	21.98	51.84	4.41	30.60	11.49	46.4
S. partitus	5.05	28.86	10.32	24.34	2.34	16.24	5.90	23.8
S. iserti	1.22	6.97	4.99	11.77	1.84	12.77	2.68	10.8
C. rostrata	1.6	9.14	1.02	2.41	0.37	2.57	1.00	4.0
H. puella	0.54	3.09	0.92	2.17	0.38	2.64	.61	2.5
E. guttatus	0.45	2.57	0.7	1.65	0.13	.90	.43	1.7
P. cruentatum	0.4	2.29	1.32	3.11	0.1	.69	.61	2.4
C. cyanea	0.16	.91	0	.00	4.84	33.59	1.67	6.7
G. moringa	0	.00	0.48	1.13	0	.00	.16	.6
H. rufus	0	.00	0.67	1.58	0	.00	.22	.9
TOTAL ABUNDANCE (IND/M2)	17.5		42.4		14.41		24.77	

TABLE 4. ICHTHYOFAUNAL SIMILARITY BETWEEN SITES FOR EACH MAJOR HABITAT SURVEYED.

SITE LEGEND : A= LIGHTHOUSE IS.
B= SOUTH IS.
C= NORTH IS.
D= RECIF ARCADINS

HABITATS	SITES	# SPECIES IN COMMON	% SIMILARITY
REEF CREST/PALMATA ZONE	AB	22	68
	AC	18	59
	BC	21	72
SHALLOW PATCH REEFS	AB	32	79
	AC	25	72
	BC	23	67
	AD	30	73
	BD	27	72
	CD	22	63
DEEP PATCH REEFS	AB	23	85
	AD	22	83
	BD	26	85
CORAL/SPONGE BIOHERMS	AB	9	53
	AC	18	75
	BC	10	48

note : With the exception of the reef crest/palmata zone data all other similarity values were calculated from the quantitative survey's species lists.

crest/Acropora palmata zone, the mean species similarity was 66%, highest similarity was between South and North islands (72%) and lowest between Lighthouse and North islands (59%). Lighthouse island presented the highest amount of species (34) at this reef zone. Shallow patch reefs averaged a similarity of 73% between sites, the number of species ranged between 44 at Lighthouse and 32 at North Island. Mean species similarity between sites at deep patch reefs was 84% (range 83-85 %), South Island presented the highest amount of species with 31. For coral/sponge bioherms, similarity averaged 59% between sites, highest similarity resulted between Lighthouse and North Islands (75%) and lowest between South and North Islands (48%).

In terms of the relative abundance of species, higher similarity resulted among habitats (e.g. shallow patch reefs, 56%; deep patch reefs, 52%; and coral/sponge bioherms, 63%). Shallow and deep patch reefs showed the highest similarity between habitats (48%), while the lowest similarity resulted between shallow patch reefs and coral/sponge bioherms (34%). A relatively low similarity was also found between deep patch reefs and coral/sponge bioherms (37 %), Fig. 19. The data set used in the clustering analysis is shown in Appendix II.

Some of the main ichthyofaunal differences between shallow and deep patch reefs was in the relative abundance of wrasses (Labridae). The bluehead wrasse (T. bifasciatum) was the most abundant species at shallow patch reefs (mean =19%) but was rare at the deep patch reefs (<1%). Conversely, yellowhead wrasse (H. garnoti) was relatively more abundant at deep than at shallow patch reefs. The cummulative composition of wrasses at shallow patch reefs was 26% compared to 9.2% at deep patch reefs. Another marked variation in the species assemblages between shallow and deep patch reefs was the higher composition of yellow and bicolor damselfishes (Stegastes planifrons and S. partitus) at shallow patch reefs (23%) compared to deep patch reefs (16%). The relative abundance of blue chromis (C. cyanea) was consistently higher at deep (11.8%) than at shallow patch reefs (8.6%). Striped parrotfish (S.iserti) also showed a higher relative abundance at deep patch reefs (12.4%) compared to shallow patch reefs (5.2%).

Coral/sponge bioherms differed substantially from both shallow and deep patch reefs in terms of the relative abundance of fish species. The cummulative composition of only three species, yellowhead wrasse (H. garnoti), bicolor damselfish (S. partitus) and striped parrotfish (S. iserti) accounted for 68% (mean of three sites) of the total individuals at coral/sponge bioherms. The mean abundance of H. garnoti and S. partitus at coral/sponge bioherms was several fold higher here than at any other habitat studied. Individuals of H. garnoti, S. partitus and S. iserti were present mostly in aggregations of juvenile

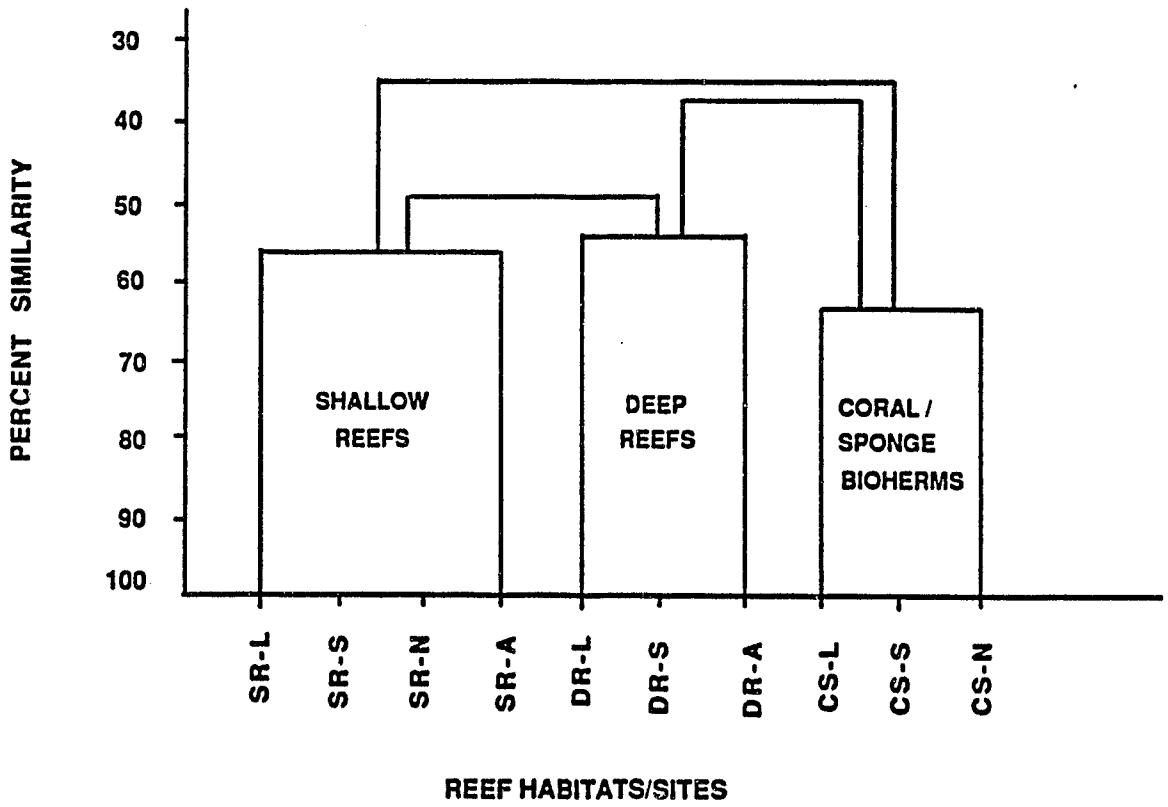
FIGURE 19. CLUSTERING OF SIMILARITY IN FISH RELATIVE ABUNDANCE BETWEEN REEF HABITATS.

LEGEND : HABITATS

SR = SHALLOW REEFS
DR = DEEP REEFS
CS = CORAL/SPONGE BIOHERMS

SITES

L = LIGHTHOUSE IS.
S = SOUTH IS.
A = RECIF ARCADINS
N = NORTH IS.



stages at coral/sponge bioherms, suggesting an apparently important role as a nursery habitat.

Species Diversity Patterns

A summary of the diversity index values for the sites and habitats studied is presented in Table 5. Species diversity was significantly higher (within 95% confidence limits) at shallow (mean =2.39) and deep patch reefs (mean =2.56) than at coral/sponge bioherms (mean =1.66). The mean coefficient of variation among habitats was 8.9%. A composite of diversity values plotted versus reef surface area is shown in Figure 20. The distribution appears to have a curvilinear pattern, with low diversity values associated with the smaller reefs (< 5 m^2) and higher diversity associated with the larger reefs. It is evident that substantial variability resulted from the wide scatter of diversity values within narrow size ranges. Figure 21 shows a composite of diversity values plotted versus depth at the base of the reefs surveyed. In general, the scatter of points suggests a three lobed distribution of the diversity values, which seem to represent the three main habitats studied. High diversity resulted both at shallow and deep reefs, but low diversity was mostly associated with deep habitats. The cluster of low diversity values at high depth correspond to the depth distribution of coral/sponge bioherms (depth >12 m). There was not any significant relationship of species diversity with reef area or depth for any given habitat studied. The number of species accounted for 72% of the variability in diversity index values.

Table 6 shows that coral/sponge bioherms have a significantly higher (within 95 % confidence limits) number of species per unit area (mean = 6.0 species m^{-2}) than either shallow (mean = 1.3 species m^{-2}) or deep patch reefs (mean = 1.0 species m^{-2}). The relatively lower diversity values at coral/sponge bioherms do not result due to the lack of species, but rather by low equitability in the relative abundance of species. In fact, there is both higher packing of species (species/m^2) and individuals (individuals/m^2) at coral/sponge bioherms. Juvenile fish aggregations typically represented a large proportion of the total fishes at coral/sponge bioherms. The occurrence of these aggregations may be related to the relatively isolated nature of these habitats, suggesting lower predatory pressure than at the coral reef. Another possibility is that more food is available for juvenile fish at the bioherms. It was common to see dense aggregations of mysid shrimps at this habitat, which potentially increases food availability for carnivorous fish. Production by the extensive seagrass bed surrounding coral/sponge bioherms is most likely influencing the relatively high fish production of this particular habitat. Two of the most important commercial species in the local fisheries, the red hind (Epinephelus

TABLE 5. SUMMARY OF SPECIES DIVERSITY INDEX (H') VALUES CALCULATED FOR THE VARIOUS SITES AND HABITATS.

SHALLOW PATCH REEFS	MEAN H'	ST DEV	n
LIGHTHOUSE IS	2.41	0.29	6
SOUTH IS	2.38	0.2	5
NORTH IS	2.2	0.21	4
MEAN	2.39	0.15	
DEEP PATCH REEFS			
LIGHTHOUSE IS	2.53	0	2
SOUTH IS	2.43	0.3	3
RECIF ARCADINS	2.73	0.1	3
MEAN	2.56	0.16	
CORAL/SPONGE BIOHERMS			
LIGHTHOUSE IS	1.66	0.24	4
SOUTH IS	1.44	0.2	5
NORTH IS	1.92	0.38	5
MEAN	1.66	0.24	

FIGURE 20. COMPOSITE OF DIVERSITY INDEX VALUES (H') PLOTTED VS. REEF SURFACE AREA.

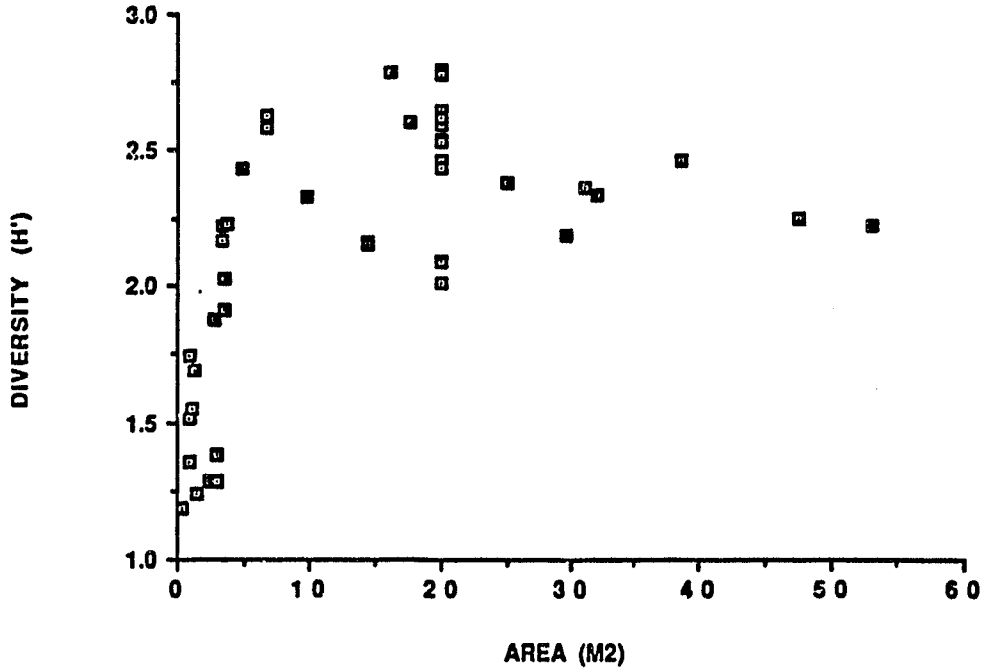


FIGURE 21. COMPOSITE OF DIVERSITY INDEX (H') VALUES PLOTTED VS. DEPTH.

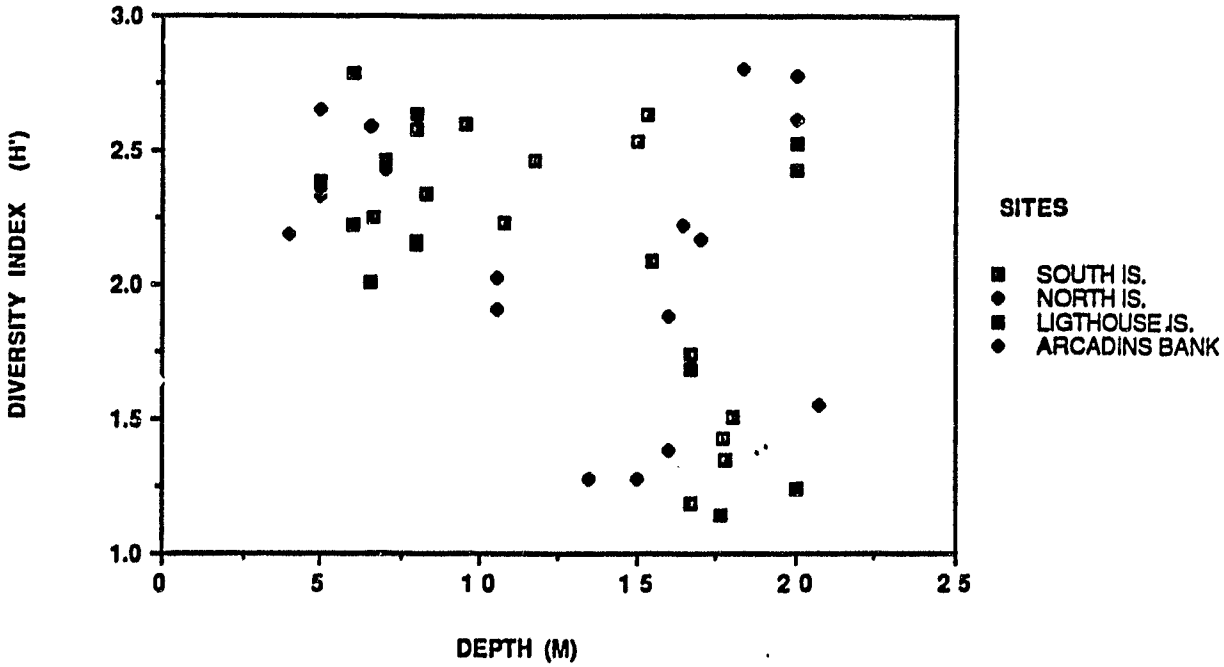


TABLE 6. DISTRIBUTION OF SPECIES PER UNIT AREA AT THE VARIOUS SITES AND HABITATS

SHALLOW PATCH REEFS	MEAN # SPECIES/M2	ST DEV	n	(95 % C. I.)
LIGHTHOUSE IS	1.06	.80	5	
SOUTH IS	1.26	.80	7	
NORTH IS	1.80	2.03	4	
RECIF ARCADINS	1.20	.15	3	
MEAN	1.33	1.05	19	(1.11-1.55)
DEEP PATCH REEFS				
LIGHTHOUSE IS	0.8	0.03	2	
SOUTH IS	1.1	0.17	3	
RECIF ARCADINS	1.07	0.12	3	
MEAN	1.02	.16	8	(.89-1.15)
CORAL/SPONGE BIOHERMS				
LIGHTHOUSE IS	3.03	2.4	4	
SOUTH IS	10.28	5.48	5	
NORTH IS	3.32	0.21	6	
MEAN	5.95	4.46	15	(3.39-8.51)

guttatus) and graysby (Petrometopon cruentatum), were higher at coral/sponge bioherms than at any other habitat. Granted its potentially important nursery function and as natural habitat for commercially valuable and other rare species, coral/sponge bioherms represent critical habitats within the shelf region of Gonave Bay.

The abundance of reef fish species and individuals at Les Arcadins Islands and Recif Arcadins compares favorably with some of the best developed reef systems in Puerto Rico and the Virgin Islands. Risk (1972) obtained abundances of 5.5 species and 9.0 individuals per square meter of reef in the Virgin Islands. Kimmel (1985) counted a total of 5094 individuals and 89 species in 8 transects of 300 m^2 each, for a mean abundance of 2.1 individuals per square meter at the shelf-edge reef six miles off La Parguera, Puerto Rico. Among 11 different reef sites surveyed around the island of Puerto Rico (García et al, 1984) only the Fajardo (northeast) and Guayanilla (southwest) sites the abundance of both fish species and individuals exceeded 2.0 per m^2. The shelf-edge reefs at Fajardo, La Parguera and Guayanilla are probably among the best developed and pristine in the insular shelf of Puerto Rico (Goenaga, personal communication). In nearshore areas of Puerto Rico which have been heavily impacted by dredging activities and/or land erosion, such as in Ponce Bay, Mayaguez Bay, Aguadilla Bay and Carolina the abundance of fish individuals and species is rarely above 0.5 per m^2 (García et al, 1984). On the north coast of Puerto Rico, where high waves predominate during the winter, such as in Arecibo and Dorado, the abundance of fishes does not exceed 0.3 individuals per m^2 (García et al, 1984).

Some factors that seem to be influencing high fish diversity and abundance at Les Arcadins Islands and Recif Arcadins are 1) the variety of physiographic zones, or habitats, present in the reefs, 2) the extensive seagrass bed surrounding the reefs, and 3) their proximity to the shelf edge.

Estimate of the Luly Fisheries Yields

A quantitative survey of fish landings by Luly fishermen was performed during July 1, 1988. A fleet of thirty four (34) boats had gone out fishing that day. Of these, 25 were sailboats and nine were row boats of the canoe type. Most of the sailboats had three fishermen, while only one or two fishermen went out in canoes. Out of the 15 boats sampled, eight (8) had lifted fish traps which had been set the previous day, and seven (7) were bottom fishing with hook and line. All of the boats sampled were sailboats. The total catch from these 15 boats was hand weighted and visually estimated at 87 Kg, of which 48 Kg corresponded to the hook and line fishing effort. It was visually estimated that approximately 50 kg of fish had been

landed in addition to the catch from the 15 boats sampled, for a total fish catch of 137 Kg during that day.

Luly fishermen estimate that they land approximately 2268 kg (~5000 pounds) of fish per week (Gardella, this volume), fishing 4 days per week, for an average catch of 567 kg/day. This estimate seems too high relative to our observations of July 1, 1988. Using 137 kg of fish yield per day as the mean daily catch (from our observations of July 1, 1988) and assuming a total effort of 200 fishing days (approx. 4 da/week), the annual yield must be in the order of 2.7×10^4 kg/yr. Taking the 20 m contour surrounding Les Arcadins Islands and the Arcadins Reef as the demersal fisheries zone, it is estimated that the total extension of the fishing grounds for Luly fishermen is approximately 28.4 km^2 (2,843 ha). The 20 m contour is within the depth limit of seagrass growth around the reefs and drops sharply into deeper water within the insular shelf. Dividing the estimated annual catch (7×10^4 kg) by the 2,843 ha of shelf surrounding Les Arcadins Islands and the Recif Arcadins, an annual yield of 9.5 kg/ha results as our best crude estimate for the Luly fisheries. This figure is within the range of values for other estimates of Caribbean coral reef fisheries (Table 7). It must be noted, however, that this estimated yield for the Luly fisheries (9.5 kg/ha) encompases only highly productive areas within the shelf, such as the extensive seagrass beds and the coral reefs. Dividing that yield by the total area of the shelf would result in a considerably lower value if yields from other fishing ports are not considered. Since data from other Haitian fisheries are not presently available, our present estimate can be considered only as a crude approximation of, perhaps, one of the most productive regions within Gonave Bay. The present estimate is likely to be biased by unaccounted yields from other fishermen landing catches from the Les Arcadins shelf region in ports other than Luly.

The estimated annual fisheries yield of the Les Arcadins region (9.5 kg/ha) represents a relatively low fish production for a coral reef/seagrass ecosystem. The highest estimated yield reported for the Caribbean is from an artificial reef in the U. S. Virgin Islands (17,400 kg/ha; Randall, 1963). Estimates from natural (coral) reefs in the Caribbean range between 1,500 and 2,000 kg/ha/yr (Bardach, 1959; Randall, 1963; Fast and Pagan-Font, 1973). The underlying reasons for this low fish production at the Les Arcadins region deserve a more comprehensive examination than what is possible within the scope of this project. The insular shelf within Gonave Bay is very limited in extension and exploitation of the fishery resources at Les Arcadins seems to be proceeding at a very intensive rate without any management organization.
In the particular case of the Luly fisheries, the lack of technological development has led toward a highly concentrated fishing effort on shallow reef areas. At present, there is a

TABLE 7. REVIEW OF CARIBBEAN SHELF FISHERIES YIELDS, BASED ON GREATEST REPORTED ANNUAL CATCHES (FROM MUNRO,1983).

SHELF	SHELF AREA (X 1000 ha)	LARGEST ANNUAL CATCH (X 1000 T)	YIELD (Kg/ha/yr)
JAMAICA	342	6.6	17.2
COLOMBIA	3875	60.8	15.7
MARTINIQUE	127	4.8	15.5
ST. LUCIA	55	1.7	15.5
ST. KITS BANK	77	1	13
GUADELOUPE AND DOMINICA	211	4.8	11.4
BARBADOS	34	4	10.6
CUBA	10287	72.5	7
BERMUDA	171	1	5.8
ST. VINCENT & GRENADINE	360	2.4	4.8
HISPANIOLA	2640	11.1	4.2
PUERTO RICO & U. S. V. I.	1183	4.9	3.6
BELIZE	694	2	2.9
ANTIGUA	336	0.8	2.4
COSTA RICA	377	0.8	2.1
NICARAGUA	5353	7.9	1.5
HONDURAS	6937	4.4	0.6
TURKS & CAICOS	760	0.7	0.9

very high fishing effort with small mesh fish traps and gillnets in shallow reef areas, and the bulk of the fisheries yield is met by small sized fish. Pelagic neritic and offshore fisheries alternatives are curtailed by lack of motors and more advanced technical gear, such as echosounders, electric reels, large freezers, marketing facilities, etc.

Species Composition and Catch Per Unit Effort (CPUE)

Fish traps:

Table 8 shows the weight distribution of different fish species in fish trap collections. The bar jack, *Carangoides ruber*, was the main species in fish traps with a CPUE of 0.14 kg/trap/da (Table 8). Luly fishermen use a floating trap to capture neritic pelagic species of which the bar jack appears to be the most important. Figure 22 illustrates the size-frequency distribution of the bar jack at the Luly fisheries during July 1, 1988. The combined CPUE in fish traps was 0.69 kg/trap/da. Parrotfishes accounted for the highest yield as a family group (35 %). Although we do not have size-frequency distribution data for other dominant species in fish trap collections, it is evident from Table 8 that most of the species are of very low commercial value (e.g. parrotfishes, squirelfishes). Also, the presence of several small species (e.g. *Neoniphon marianus*, *Scarus isert*) in the collections is indicative that a very small mesh is presently used in the trap fisheries. There were no lobsters landed by fishermen in Luly at the time of our observations.

Hook and Line:

Table 9 shows the weight distribution of species captured with hook and line. The most important species was the red hind, *Epinephelus guttatus*, with a CPUE of o.41 kg/fishing hr. The combined CPUE for this fishing method was 0.88 kg/fishing hr. The size-frequency distribution recorded for red hind during July 1, 1988 at Luly is shown in Fig 23. A study by Garcia-Moliner (1986) suggests that reproductive maturity of the red hind is attained at a size of approximately 16 cm. One third (32 %) of the individuals (red hind) collected in the Luly fisheries during July,1988 were below 16 cm. Model size of red hind at Luly was of 20 cm and maximum size was 22 cm.

TABLE 8. CATCH PER UNIT EFFORT FOR FISH SPECIES COLLECTED USING FISH TRAPS.

BOATS	NB-1	NB-2	NB-3	NB-4	NB-5	NB-6	NB-7		
# TRAPS (DAY SOAK)	20	7	10	5	5	8	1		
SPECIES	KILOGRAMS PER BOAT (JULY 1, 1988)							TOTAL KGMS.	CPUE (KG/TRAP/DAY)
Carangoides ruber			0.9	1.8			5.4	8.1	0.14
Epinephelus guttatus			1.1			2.2		3.3	0.06
Scarus vetula		1.5		0.3	0.5	0.8		3.1	0.06
Sparisoma viride		1.2		0.5	0.4	1		3.1	0.06
Neoniphon marianus			0.5		0.3	2		2.8	0.05
Pseudopeneus maculatus	1.8		1.2					3	0.05
Holocentrus rufus					0.2	2.7		2.9	0.05
Scarus coeruleus				2.7				2.7	0.05
Scarus iserti	0.9		0.2	1	0.3			2.4	0.04
Haemulon plumieri	0.9			1.3				2.2	0.04
Epinephelus striatus	2.2							2.2	0.04
Sparisoma chrysopterum		0.9			0.3	0.2		1.4	0.03
Haemulon flavolineatum	0.9							0.9	0.02
Lactophrys triqueter					0.3			0.3	0.01
							TOTALS	38.4	0.69

TABLE 9. CATCH PER UNIT EFFORT FOR SPECIES CAPTURED USING HOOK AND LINE.

BOATS	LB-1	LB-2	LB-3	LB-4	LB-5	LB-6	LB-7	LB-8		
HOURS FISHING	8	8	4	8	8	8	8	3		
TOTAL HRS. = 55										
SPECIES	KILOGRAMS PER BOAT (July 1, 1988)								TOTAL KGMS.	CPUE (KGMS/HR)
Epinephelus guttatus	4.5	1.8	0.9	9	2.7	1.8	1.8		22.5	0.41
Sphyraena barracuda								4.5	4.5	0.08
Malacanthus plumieri	1.8	1.4		0.9					4.1	0.07
Petrometopon cruentatum	0.5			2.7			0.9		4.1	0.07
Scomberomorus regalis		2.7							2.7	0.05
Haemulon plumieri			0.9				1.4		2.3	0.04
Gymnothorax moringa					1.4	0.9			2.3	0.04
Ocyurus chrysurus						1.8			1.8	0.03
Neoniphon marianus					0.9	0.5			1.4	0.03
Holocentrus rufus					0.5	0.5			1	0.02
Calamus pennatula							0.9		0.9	0.02
Epinephelus striatus				0.5					0.5	0.01
Lutjanus synagris				0.5					0.5	0.01
									48.6	0.88

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FIGURE 22. SIZE-FREQUENCY DISTRIBUTION OF THE BAR JACK, *CARANGOIDES RUBER*, IN THE FISHERIES OF LULLY.

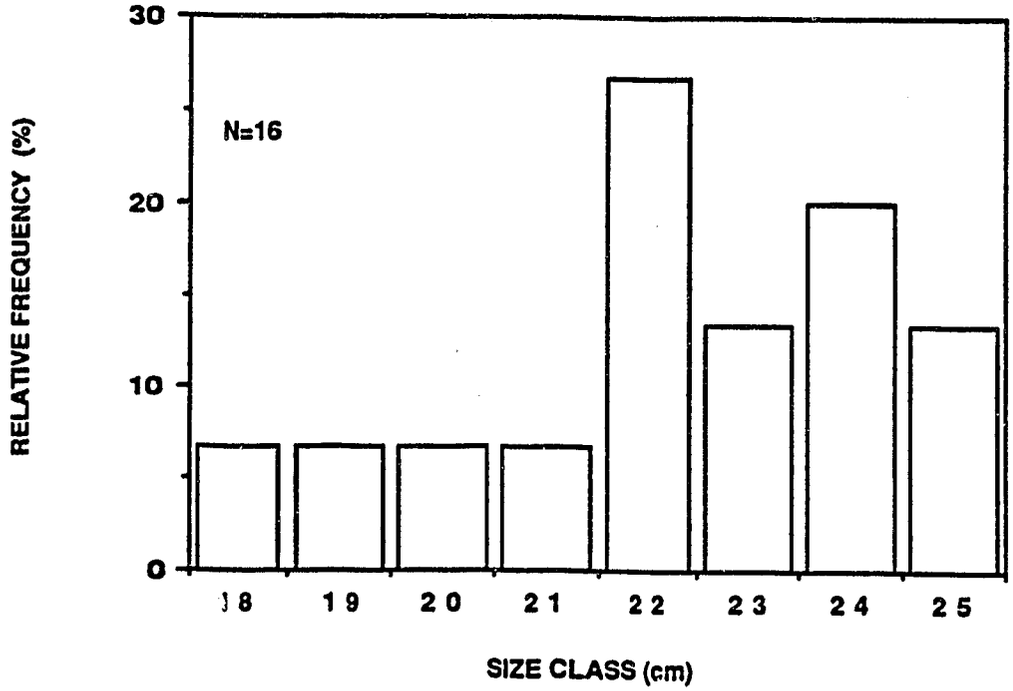
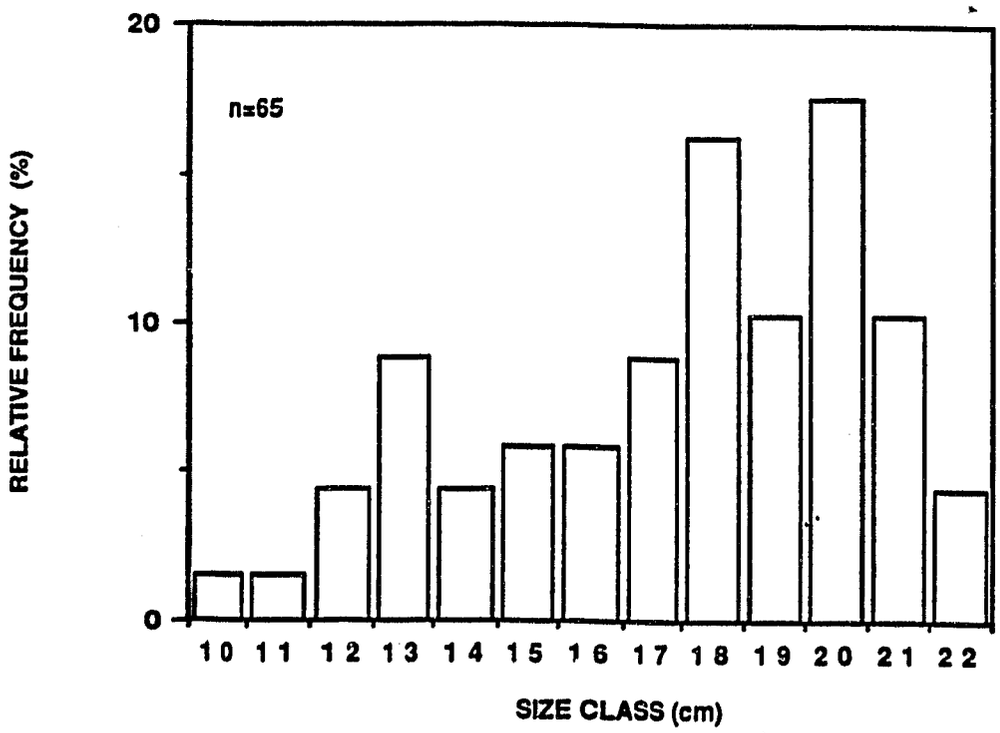


FIGURE 23. SIZE-FREQUENCY DISTRIBUTION OF THE RED HIND, *EPINEPHELUS GUTTATUS*, IN THE FISHERIES OF LULLY.



APPENDIX I. LIST OF FIELD IDENTIFIED FISH SPECIES FROM THE LES ARCADIN ISLANDS, RECIF ARCADINS, AND THE SHELF EDGE WEST OF LES ARCADINS ISLANDS

HABITAT LEGEND:

A = REEF CREST/PALMATA ZONE
B = SHALLOW PATCH REEFS
C = DEEP PATCH REEFS
D = CORAL/SPONGE BIOHERMS
E = SHELF EDGE

SPECIES	COMMON NAME	TYPICAL HABITAT
Urolophus jamaicensis	Yellowspotted Stingray	D
Synodus intermedius	Sand Diver	A,B
Ophichthus gomesi	Shrimp Eel	B
Myrichthys oculatus	Goldspotted Snake Eel	B
Gymnothorax moringa	Spotted Moray	D
Gymnothorax funebris	Green Moray	C
Enchelycore nigricans	Viper Moray	C
Echidna catenata	Chain Moray	B
Strongylura timucu	Timucu	A,B
Tylosuru crocodilus	Houndfish	A,B
Hemiramphus brasiliensis	Ballyhoo	A,B
Aulostomus maculatus	Trumpetfish	A,B,C
Holocentrus ascensionis	Longjaw Squirrelfish	B,C
Holocentrus rufus	Squirrelfish	B,C
Neoniphon marianus	Longspine Squirrelfish	B,C
Adioryx vexillarius	Dusky Squirrelfish	C
Myripristis jacobus	Blackbar Soldierfish	B,C
Atherinomorus stipes	Hardhead Silverside	B,C
Sphyraena barracuda	Great Barracuda	C
Epinephelus striatus	Nassau Grouper	C
Epinephelus guttatus	Red Hind	D
Cephalopholis fulva	Coney	C
Petrometopon cruentatum	Graysby	C,D
Mycteroperca venenosa	Yellowfin Grouper	C
Hypoplectrus puella	Barred Hamlet	B,C,D
Hypoplectrus unicolor	Butter Hamlet	A,B
Hypoplectrus indigo	Indigo Hamlet	A,B,C
Hypoplectrus nigricans	Black Hamlet	A,B
Hypoplectrus guttavarius	Yellowbellied Hamlet	A,B,C
Serranus tigrinus	Harlequin Bass	D
Serranus tabacarius	Tobacco Fish	D
Serranus baldwini	Lantern Bass	D
Gramma loreto	Fairy Basslet	B,C
Gramma melacara	Blackcap Basslet	E
Rypticus saponaceus	Soapfish	A,B

APPENDIX I. (CONTINUED)

SPECIES	COMMON NAME	TYPICAL HABITAT
Priacanthus cruentatus	Glasseye	B,C
Priacanthus arenatus	Bigeye	B,C
Malacanthus plumieri	Sand Tilefish	B,C
Amblycirrhitos pinnos	Redspotted Hawkfish	C
Decapterus macarellus	Mackerel Scad	B,C
Caranx ruber	Bar Jack	B,C
Caranx bartholomaei	Yellow Jack	B,C
Euthynnus alleteratus	Little Tuna	B
Scomberomorus regalis	Cero	C
Lutjanus apodus	Schoolmaster	A,B
Lutjanus jocu	Dog Snapper	B,C
Lutjanus analis	Mutton Snapper	C
Lutjanus synagris	Lane Snapper	B,C
Ocyurus chrysurus	Yellowtail Snapper	B,C
Haemulon chrysargyreum	Smallmouth Grunt	B
Haemulon plumieri	White Grunt	B,C
Haemulon sciurus	Bluestripped Grunt	B,C
Haemulon flavolineatum	French Grunt	A,B,C
Calamus calamus	Saucereye Porgy	C
Calamus pennatula	Pluma	C
Odontoscion dentex	Reef Croaker	C
Equetus lanceolatus	Jackknife Fish	A,B
Mulloidichthys martinicus	Yellow Goatfish	B,C
Pseudopeneus maculatus	Spotted Goatfish	B,C
Gerres cinereus	Yellofin Mojarra	B
Kyphosus sectatrix	Bermuda Chub	B,C
Bothus Iunatus	Peacock Flounder	A,B
Dactylopterus volitans	Flying Gurnard	B,C,E
Opistognathus aurifrons	Yellowhead Jawfish	B,C
Chaetodon capistratus	Foureye Butterflyfish	A,B,C
Chaetodon striatus	Banded Butterflyfish	B,C
Prognathodes aculeatus	Longnose Butterflyfish	E
Pomacanthus arcuatus	Gray Angelfish	C
Pomacanthus paru	French Angelfish	C
Holacanthus tricolor	Rock Beauty	C
Holacanthus ciliaris	Queen Angelfish	C
Centropyge argi	Cherubfish	E
Stegastes planifrons	Yellow Damselfish	A,B
Stegastes variabilis	Cocoa Damselfish	A,B
Stegastes leucosticus	Beau Gregory	A,B
Stegastes fuscus	Dusky Damselfish	A,B
Stegastes partitus	Bicolor Damselfish	B,C
Microspathodon chrysurus	Yellowtail Damselfish	A,B
Abufdefduf sexatilis	Sargeant Major	A,B
Chromis multilineata	Yellow-Edge Chromis	B
Chromis insolatus	Sunshine Damselfish	E
Chromis cyanea	Blue Chromis	C,D
Bodianus rufus	Spanish Hogfish	C

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APPENDIX I. (CONTINUED)

SPECIES	COMMON NAME	TYPICAL HABITAT
Halichoeres bivittatus	Slippery Dick	B
Halichoeres radiatus	Pudding Wife	B
Halichoeres garnoti	Yellowhead Wrasse	C,D
Halichoeres maculipinna	Clown Wrasse	B,C
Halichoeres pictus	Painted Wrasse	B,C
Halichoeres poeyi	Black-Ear Wrasse	B
Thalassoma bifasciatum	Bluehead	A,B
Clepticus parrae	Creole Wrasse	C
Sparisoma rubripinne	Yellowtail Parrotfish	A,B
Sparisoma chrysopterum	Redtail Parrotfish	A,B
Sparisoma viride	Stoplight Parrotfish	B,C
Sparisoma aurofrenatum	Redband Parrotfish	A,B,C
Sparisoma radians	Bucktooth Parrotfish	B,C
Scarus vetula	Queen Parrotfish	B,C
Scarus croicensis	Stripped Parrotfish	B,C,D
Scarus taeniopterus	Princess Parrotfish	B,C
Scarus coeruleus	Blue Parrotfish	C
Ophioblennius atlanticus	Redlip Blenny	B,C
Labrisomus filamentosus	Quillfin Blenny	C
Malacoctenus triangulatus	Saddled Blenny	B,C
Carapus bermudensis	Pearlfish	C
Gnatholepis thompsoni	Goldspot Goby	B,C
Gobiosoma evelynae	Sharknose Goby	D
Coryphopterus personatus	Masked Goby	D
Monacanthus tuckeri	Slender Filefish	B
Lactophrys triqueter	Smooth Trunkfish	B,C
Lactophrys bicaudalis	Spotted Trunkfish	C
Acanthostracion quadricornis	Scrawled Cowfish	C
Sphaeroides spengleri	Bandtail Puffer	B
Canthigaster rostrata	Sharpnose Puffer	B,C,D
Diodon histrix	Porcupinefish	B
Diodon holocanthus	Spiny Puffer	B
Labrisomus nuchipinnis	Hairy Blenny	B,C
Gnatholepis thompsoni	Goldspot Goby	B,C
Coryphopterus glaucofraenum	Bridled Goby	C
Gobiosoma evelynae	Sharknose Goby	C,D
Acanthurus coeruleus	Blue Tang	B,C
Acanthurus bahianus	Surgeonfish	A,B
Acanthurus chirurgus	Doctorfish	A,B
Balistes vetula	Queen Triggerfish	C
Cantherhines pullus	Tail-Light Filefish	B,C

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APPENDIX II. SIMILARITY MATRIX OF FISH RELATIVE ABUNDANCE BETWEEN SITES AND HABITATS

HABITATS:

SPR = SHALLOW PATCH REEFS
DPR = DEEP PATCH REEFS
CSB = CORAL/SPONGE BIOHERM

SITES:

L = LIGHTHOUSE IS.
S = SOUTH IS.
N = NORTH IS.
A = RECIF ARCADINS

SIMILARITY VALUES

	SPR-L	SPR-S	SPR-N	SPR-A	DPR-L	DPR-S	DPR-A	CSB-L	CSB-S	CSB-N
SPR-L	X									
SPR-S	0.63	X								
SPR-N	0.73	0.55	X							
SPR-A	0.49	0.5	0.47	X						
DPR-L	0.37	0.59	0.33	0.44	X					
DPR-S	0.56	0.6	0.44	0.49	0.52	X				
DPR-A	0.45	0.53	0.39	0.51	0.46	0.59	X			
CSB-L	0.28	0.29	0.3	0.26	0.36	0.28	0.26	X		
CSB-S	0.29	0.32	0.32	0.27	0.37	0.34	0.32	0.8	X	
CSB-N	0.4	0.49	0.37	0.5	0.53	0.45	0.41	0.48	0.51	X

MEAN RELATIVE ABUNDANCE OF SPECIES AT EACH SITE AND HABITAT

HABITAT/SITE SPECIES	SPR-L	SPR-S	SPR-N	SPR-A	DPR-L	DPR-S	DPR-A	CSB-L	CSB-S	CSB-N
T. bifasciatum	0.27	0.13	0.29	0.08	0.02	0.03	0.02	0	0	0.1
S. planifrons	0.19	0.8	0.07	0.03	0.01	0.09	0.07	0	0	0
S. partitus	0.14	0.13	0.19	0.13	0.12	0.12	0.06	0.27	0.23	0.12
H. garnoti	0.06	0.08	0.07	0.06	0.1	0.06	0.09	0.43	0.5	0.23
C. cyanea	0.04	0.09	0.04	0.17	0.14	0.1	0.1	0.01	0	0.25
N. marianus	0.04	0.05	0.03	0.02	0.08	0.06	0.04	0	0	0.01
S. iserti	0.05	0.08	0.02	0.05	0.15	0.12	0.1	0.06	0.11	0.1
S. viride	0.03	0.04	0.03	0.01	0	0.04	0.01	0	0	0
H. rufus	0.02	0.03	0.03	0.08	0	0.02	0.1	0	0.02	0
C. rostrata	0.02	0.01	0.01	0.01	0.04	0.01	0.01	0.08	0.02	0.02
G. loreto	0.01	0.08	0.01	0.01	0.04	0	0.02	0	0	0
M. chrysurus	0.01	0.01	0.04	0.01	0	0	0	0	0	0
O. chrysurus	0.01	0.01	0.01	0.06	0	0	0.01	0	0	0
S. aurofrenatum	0.01	0.01	0.01	0.01	0.06	0	0.04	0.05	0	0
H. puella	0	0	0	0	0.08	0.02	0.01	0.03	0.02	0.02
H. steinachneri	0	0	0	0	0	0.05	0.05	0	0	0
P. cruentum	0	0	0	0	0	0	0.04	0.02	0.03	0.01
H. flavolineatum	0	0	0	0	0	0	0.06	0	0	0
E. guttatus	0	0	0	0	0	0		0.02	0.02	0.01

APPENDIX III. DEEP WATER FISHING

A typical fishing technique for large pelagic fishes consists of expensive heavy duty rods and reels, but more feasible alternatives for Haitian fishermen are available. The nylon hand trolling gurdy rigged with 80 lb. test monofilament line is adequate for most pelagics excluding very large billfish and sharks. This system is adaptable for small boats and can be also used for bottom fishing in waters at the shelf break and beyond.

SPECIES COMMONLY CAUGHT IN THE VIRGIN ISLANDS OFFSHORE
TAKEN FROM TABLE A-I (DAMMAN, 1969)

Blue Marlin

Size:	Average 250 pounds; two most recent world records (814, 845 pounds) caught in the Virgin Islands Waters.
Habitat:	Blue water; caught at edge of 100 fathom shelf.
Season:	Year-round; best time: July-October.
Method:	Trolling with outriggers from charter boat.
Bait:	Mullet or other suitable fish weighing from 1/4 to 10 pounds.
Tackle:	80# - 130#

White Marlin

Size:	Average 45 pounds.
Habitat:	Blue water; at edge of 100 fathom shelf.
Season:	Year-round; best time: spring and fall.
Method:	Trolling with outriggers from charter boat.
Bait:	Small mullet or ballyhoo.
Tackle:	30# - 50#

Sailfish

Size:	Average 45 pounds.
Habitat:	Blue water; caught inshore and sometimes at edge of 100 fathom shelf.
Season:	Occasional fish year round; best time: January-February.
Method:	Usually by trolling with outriggers from charer boat; sometimes by casting from small boat.
Bait:	Ballyhoo, strips, artificial lures.
Tackle:	20# - 30#

Dolphin

Size:	Average 15 pounds.
Habitat:	Blue water; caught at edge of 100 fathom shelf and sometimes inshore.
Season:	Fall to spring; best time: spring.
Method:	Trolling.
Bait:	Ballyhoo, feather.

Tackle: 20# - 30#

Blackfin tuna

Size: Average 10 pounds.
Habitat: Edge of 100 fathom shelf and inshore.
Season: Year-round; best time: January-March.
Method: Trolling.
Bait: Yellow feather.
Tackle: 20#

Wahoo

Size: Average 45 pounds; five current world records (to 124 pounds) caught in Virgin Islands waters.
Habitat: Blue-water; caught at edge of 100 fathom shelf.
Season: Year-round; best time: September-May.
Method: Trolling form charter boat, with or without outriggers.
Bait: Ballyhoo, mullet.
Tackle: 30# - 50#

Allison Tuna

Size: To 150 pounds; average 40 pounds. Pending world record (76 pounds; 12# tackle) caught in Virgin Islands waters.
Habitat: Blue water; caught at edge of fathom shelf and sometimes inshore.
Season: Year-round; best time: spring and fall.
Method: Trolling from charter boat, with or without outriggers.
Bait: Ballyhoo, mullet, yellow feather.
Tackle: 50#

Cobia

Size: Average 40 pounds, world record (52 3/4 pounds, 12# tackle) caught in Virgin Islands waters.
Habitat: Inshore.
Season: Winter-Spring; best time: January-February.
Method: Trolling.
Bait: Ballyhoo.
Tackle: 30# - 50#

Bonito

Size: Average 10 pounds.
Habitat: Edge of 100 fathom shelf and inshore.
Season: Year-round; best time: spring.
Method: Trolling.
Bait: Ballyhoo, yellow feather.
Tackle: 20#

Barracuda

Size: Average 10 pounds.
Habitat: Inshore and at edge of 100 fathom shelf.
Season: Year-round.
Method: Trolling or spinning.
Bait: Ballyhoo, feather.
Tackle: 20#

Tarpon

Size: 15 to 50 pounds.
Habitat: Inshore.
Season: Year-round; best time: spring.
Method: Casting, spinning, trolling.
Bait: Plug, spoon, sprat.
Tackle: 20# - 30#

Bonefish

Size: Average 5 pounds.
Habitat: Flats.
Season: Year-round; best time: spring.
Method: Spinning.
Bait: Crab, spoon, pink jig.
Tackle: 10#

Mackerel

Size: Average 3 pounds.
Habitat: Inshore.
Season: Year-round.
Method: Trolling, casting, spinning.
Bait: Strips, feathers.
Tackle: 12#

Amberjacks and other jacks

Size: Average 10 pounds (amberjack).
Habitat: Inshore.
Season: Year-round.
Method: Trolling, casting, spinning.
Bait: Ballyhoo, sprat, spoon, feather.
Tackle: 10# - 30#

Equipment List

from Atlantic & Gulf Fishing Supply Co. (1981 Manual)

Deep-water bottom fishing gear (per boat):	Amount
Econo Manual Reels "stainles steel"	1 or 2
Mustad O'Shaughnessy hooks #5	buy per 100's
Felco C-7 wire cutter	1 or 2
Cannonball weights 3 lb. & 5 lb.	2 or 3 of each
Three way swivels 5/0	buy per gross
Berley-McMahon "nickel plated" swivels 8/0	buy per box
Ande Monofilament line 150 lb. test tube	(1 or 2) 9lb.
Seastrand stainless steel single strand wire 140 lb. test (size .026)	buy coils p/dz
Galvanized wire (the one used to make fish traps)	buy per pound
Detecto heavy duty scale (30 lb. dial capacity)	1
Basic Ecosounder powered by a 12 V battery	1
Ritchie Compass (Cat No. B-15 A)	1

Offshore pelagic fishing gear (per boat):	
Nylon Hand Trolling Gurdy (with accessories)	1 or 2
Ande Monofilament line 80 lb. test	(1) 9 lb. tube
Ande Monofilament line 300 lb. test	(1) 2 lb. tube
Stainless steel gaf 8' long 4" hook	1
Stainless steel gaf 4" long 4" hook	1
Seastrand stainless steel single strand wire 240 lb. test (size .035)	buy coils p/dz.
Mustad O'Shaughnessy "big game fish" hooks 9/0 & 10/0	buy per 100's
300 lb. test snap swivels	buy per box
Type C wire cutter and crimping tool	2 or 3
Sevenstrand "brass" leader sleaves (A-6, A-14)	buy per pkg.
Ritchie Compass (Cat No. B-15 A)	1

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III. SOCIO-CULTURAL FIELD INVESTIGATION

A. Context

The fieldwork for this research was carried out over a period of six weeks. Initial inquiries regarding Luly itself and possible contact persons began in the Fall of 1987, culminating in May 1988 with the anthropologist's introduction to a core group of full-time fishermen who became key informants.

B. Methods

Fieldwork consisted of participant observation, comprising many extended, in-depth discussions with several groups and individuals in a variety of social settings. Topics of discussion were organized through an interview schedule, but relative depth of inquiry and inclusion or exclusion of specific topics varied according to the identity and number of informants present and the social setting; on the beach among fish-buyers, in the public "square" in the center of the village, in the cooperative meeting house, and in several private residential settings. Key topics were cross-checked by soliciting the participation of different groups and individuals, both in the presence of the original informants, and apart from them. Differences of opinion, various versions of particular incidents, reluctance to discuss certain topics in the presence of specific individuals, were all carefully noted and analyzed according to subject matter, social position and degree of involvement of the relevant informants.

Observations, made by outsiders having regular contact with the people of Luly, were also solicited and assessed according to their own social positions and the nature of their relationships with Luly. Fieldwork was facilitated by previous anthropological research in three other Haitian fishing villages. This prior familiarity with the commercial distribution of fish, artisanal fishing equipment and methods, and certain key social variables present in the Haitian fishing sector, eliminated the necessity for preliminary exploration of generalized social characteristics.

Factors of production, fishing territories and commercial distribution and the relationship of fishermen to boat owners are discussed, in detail, in Appendices I, II and III.

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APPENDIX I. FACTORS OF PRODUCTION

TRADITIONAL ARTISANAL GEAR AND FISHING METHODS

The single most important item, of course, is the fishing boat. *Kanot* are wood, flat-bottomed boats, ranging in length from about 10 feet to 16 feet in length. *Kanot* are equipped minimally with oars and a pole for shallower waters, and secondly by sails. The *kanot*, oars, poles, and masts and sails are made locally with locally available materials. *Kanot* range in price from about $450 U.S.for the smallest, to about $1,000 U.S.for the largest ones. The smallest, most rudimentary sails start at about $50, and go up in size and price to about $150. There are about 100 *kanot* in Luly itself, and about 300 along the entire coast from Cabaret to Montrouis. Of the 100 *kanot* in Luly, about 20 are without sails and powered only by rowing. There are no motor-driven *kanot* in Luly or the surrounding area used by fishermen.

In Luly, there are seven *bos kanot* (boat-makers) and five *galfa* (boat repairmen who do caulking and related small repairs). There are three *bos vwal*, or sail-makers.

The four basic complexes of fishing gear and associated fishing methods require access to a boat. These are: nets, lines, traps and diving.

(1) Nets. There are four basic kinds of nets and two kinds of seine nets.

a. *file tremay*, trammel or drag net. Characterized by three nap (weaves) using #9-#6 (5mm) and #36-#40 (16mm) cord size. Length and width depends on individual's investment. Most common catches: lobster, crab, conch, snapper, goatfish, parrotfish, shark. There are six *file tremay* in Luly, with two others in construction.

b. *file senp* or "simple" net. Only one weave using nylon monofilament and string; size depends on investment. Most common catches: lobster and all size fish, especially grunt and jacks.

c. *file sifas* or surface net. Primarily used May through September for the jack migration, but also used for bonito, tuna, spearfish and swordfish.

d. *file epevye* or round sweepnet. Primarily used along the shore for anchovies and héringlets. Although these are present in the Luly area, they are not found in Luly itself due to the absence of these fish.

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e. *sèn* and *sèn timay* are both seine nets differentiated by mesh size, and are used for ladyfish, thread herring, sardines, pilchards and goatfish. There are no *sèn* in Luly, but they are found in the area and are also brought in from St. Marc and Cayes.

There are fifteen bos file in Luly and the going manufacture rate is $5/lb of net. While there are only together a dozen file tremay, file senp and file sifas in Luly, this is a relatively large number. More typically, any one fishing community in other parts of Haiti is not likely to have more than 2 or 3 nets of any kind.

(2) Lines. There are five basic line methods: *flotan* (floating with buoys), *ala deriv* (bottom to surface, weighted), *bank* (motionless), *ala trèn* (trawling), and *ala palang* (single line with series of pendant lines. The nylon lines and hooks are imported and are cheap enough to be accessible to most fisherman. They are used to catch all fish and are baited with either fresh bait or artificial lures.

(3) Fish traps. The bamboo-strip fish traps, or *nas*, fall into four categories, and can be either floated or weighted:

a. *gwo nas* with mesh openings of 2-3 inches. These are checked every 10 to 15 days.

b. *nas ven* with mesh openings of about 1-1 1/2 inches. These are checked every 8 days.

c. *nas razwa* with 1 inch openings, checked every 3 days.

d. *nas coundol* with 1/2 inch openings, checked every day.

The average life of a *nas* is 5 to 6 months if they are not lost. The walls of the nas are imported, already woven, from Léogane and are stitched together by five local, part-time *bos*. They cost from a couple of dollars to up to $10. On the average, most fishermen own about five *nas* each at any one time. All kinds of fish are caught in *nas*: snappers, goatfish, grunts, squirrel fish, parrotfish, conly, and graysby.

Nas are the single most important fishing method/gear. In absolute numbers present in the area, in their accessibility to virtually all fishermen and, finally, in terms of the amount of fish caught.

(4) Diving. There are two kinds of diving, free diving with mask, fins and spear gun, and diving with a boat-mounted compressor and 60 feet of tubing. In Luly there are about 30 fishermen who free-dive, though not consistently. The cost of the spear-gun (approximately $70) and the relatively greater degree

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of skill necessary to dive, make spear fishing the province of the younger, somewhat better-off fishermen.

There are two boat-mounted compressors in Luly, both owned by spekilatè. There are currently four young men who dive regularly with compressors, but it should be noted that in Luly alone four men are dead and five men permanently disabled due to compressor-diving accidents.

Both kinds of diving are done primarily for lobster and conch as well as any large fish. Compressor diving is also done for the collection of coral, aquarium fish and shells for export. The fishermen in Luly estimate approximately 20,000 pounds of fish, on average, coming out of Luly each month. They estimate about half of that coming from *nas* alone. The remaining amount varies in proportion between nets and lines, but normally with a larger proportion coming from nets. The yields from diving are more difficult to ascertain as these comprise the better quality fish and are primarily sold to the spekilatè. In general then, the basic factors of production for fishing in Luly, apart from boats, are the *nas* and, by virtue of their almost universal accessibility, lines. The more efficient, and relatively more lucrative, net fishing is confined to a smaller segment of the fishing population, which is characterized by the *gwo pechè,* the full-time, professional, well-equipped fishermen receiving the major portion of their income from fishing activities. This is the same segment of the fishing population who are also *mèt kanot*, owners of their own boats.

There are, in Luly alone, 100 *kanot* and 312 full-time fishermen. In the entire area, from Cabaret to Montrouis there are 1100 fishermen and about 320 *kanot*. That is, there is an approximate ratio of one boat per three full-time fishermen. Since access to a boat is the first condition necessary to fish in Luly, the relationship between boat-owning fishermen and others is crucial.

APPENDIX II. FISHING TERRITORIES AND COMMERCIAL DISTRIBUTION

A. Fishing Territory

The fishing community with Luly as its main market center, stretches from Cabaret (Boucassin) in the southeast to Montrouis in the northwest, a coastline of approximately 23 miles. The area these fishermen habitually exploit forms a triangle, with its base along the coast and extending to its apex at the fishing banks just off the east coast of La Gonave, a distance of about 12 miles from the mainland. Les Arcadins are situated in the middle of this territory. This area includes both reefs, grass beds and deep channels, in addition to the fishing banks. (cf. biologists' description). The western edge of this area is also exploited by the fishermen of La Gonave. Once a year, in September-October, the Luly fishermen traditionally move to the west coast of La Gonave for a period of 3-4 weeks. Together with La Gonave fishermen, they fish intensively in the mornings and clean, salt, and dry their fish in the afternoons. At the end of this period they bring their total preserved catches back to Luly to sell.

Haitian fishermen are territorial in the sense that they habitually exploit particular marine areas. The above delineated area is the traditional territory of the Luly area fishermen, shared in part by La Gonave fishermen. Unlike fishermen in other parts of the world, however, Haitian fishermen do not jealously guard their territories and there are no rigid social conventions regarding territoriality. However, when threats to their territories are perceived, Haitian fishermen can and do act to repel outsiders. Though not occurring in the Luly area, two recent incidents in Haiti indicate the nature of fishermen's territoriality. In the Dame Marie area (at the far end of the southern peninsula), a fisherman from Les Cayes installed himself and persisted in taking certain fish of a certain size that Dame Marie fishermen did not exploit. When he persisted, despite warnings from the Dame Marie fishermen, his house was burned down and his gear destroyed. In another incident, occurring in the last year, Luly fishermen were repelled from a fishing area off the southern coast of the northwest peninsula by the local fishermen. The Luly fishermen report that they were forced out because their superior techniques and knowledge were allowing them to capture larger quantities of fish than the local fishermen.

In recent years, the fishermen from the St. Marc area have been fishing much more in the Luly area waters. The St. Marc waters have been greatly affected by siltation and overexploitation and, in addition, their market has dried up because of the recent dumping of imported toxic waste in the Gonaves area. The Luly area fishermen have not moved to repel these outsiders, nor the ones from La Gonave, largely because

they recognize the economic necessity that brings these fishermen to their waters. They say they cannot "*anpeche yo viv,*" they cannot prevent those fishermen from making a living. This is an important ethos not only among these fishermen, but among Haitian peasants in general. It signals the recognition and the respect due any individual trying to make a living, even in circumstances difficult for all.

B. Commercial Distribution of Fish

Individuals who are not fishermen also play an important role in the Luly fishing industry. These are the various kinds of fish-buyers and those pursuing livelihoods related to fish buying. The commercial distribution of fish is the single most important aspect of the fishing industry, apart from fishing per se, not just in Luly but in all fishing areas in Haiti.

Commercial fish distribution follows two separate circuits of exchange in the Haitian economy. Each of these circuits has two basic classes of fish, one comprising the better quality fish, the other the poorer qualities. The former is usually classed as *pwason wouj* or *pwason woz* ("red" or "pink" fish) and includes not only lobster, crab, conch, and shrimp but also various demersal species such as grouper and snapper. The latter, less valuable fish are called *pwason blan* ("white" fish). There is also a third category, called *pwason nwa* ("black" fish), which is not normally sold because the flesh is "blackish," i.e. unattractive, and requires special preparation. The exact cut-off point between *pwason wouj* and *pwason blan* is variable, depending on the size and quality of the fish, rather than on certain species. *Pwason wouj* receives the highest prices and is destined for the luxury market; tourist hotels, Port-au-Prince restaurants and retail shops and the export market. *Pwason blan,* on the other hand, is distributed through the internal marketing system and consumed by the general Haitian population. *Pwason nwa* is usually destined for fishermen's families and the poorest local people. One study shows that though *pwason wouj* is only about 33% of the total catch in Haiti, it provides more than 60% of total cash income for Haitian fishermen (CORERE 1979).

Pwason blan is bought directly from incoming fishermen on the beach by *marchann* and *madanm sara*. The *marchann* are local market women, who rarely buy more than 10-15 lbs of fish in a single day. They clean and gut the fish right on the beach and then return to their home territories. If the fish is not sold immediately that evening, it is either put on ice, or lightly salted for sale in the local market the next morning. The madam sara buy the *pwason blan* in larger quantities and usually transport it (on public transportation) to Port-au-Prince where they sell it in the large urban markets. These fish are either kept on ice or lightly salted. In contrast to more remote fishing areas, it is feasible, here, to keep the majority of

pwason blan on ice because Luly is close enough to Port-au-Prince and other regional markets, and ice (at $13/300 lbs) is readily available through the public transportation system traveling on Route Nationale #1.

In contrast to *pwason wouj, pwason blan* readily responds to fluctuating market prices. Prices appear to respond to supply, as demand is steady and apparently never saturated. Negotiations between fishermen and *marchann* and *madam sara* is in itself interesting. *Pwason blan* is sold by the kod or string of fish and the panyè or basket. The nominal price per pound is steady year-round at 4 gourdes/lb for "regular" fish and 5 gourdes/lb for the better *pwason blan* (1 gourde = $.20). What is actually negotiated is the number of pounds of fish on a kod or in a panyè -- the fishermen claiming a greater number of pounds than the *marchann* or *madam sara*. Although there are scales on the beach, these are rarely used to weigh *pwason blan*. At the time of fieldwork, kod and panyè were being consistently calculated at less than their actual poundage. This would appear to indicate that market prices were low, but only further systematic fieldwork can show whether or not this under-weighing fluctuated with the supply or rather represents a systematic advantage of the *marchann* and *madam sara* over the fishermen. Several of the madam sara own boats which they let out to Luly fishermen for 50% of the catch. No *marchann* own boats, but several of them have *nas* in the hands of the fishermen, for which they receive exclusive rights to the catch at slightly lower prices than those prevailing.

The *pwason wouj* distribution system is completely different. It is handled almost exclusively by the *spekilatè*. There are two classes of *spekilatè* in Luly. The first consists of six individuals resident in Luly itself or in the immediate area. Through their *badjougan* or beach buying agents, these six men buy most of the *pwason wouj* that comes in. Much of this *pwason wouj* is acquired through existing relations of debt-clientage or through ownership of boats by virtue of the exclusive rights to the catch that the *spekilatè* acquire in return. The market advantage of these *spekilatè* is further enhanced by the fact that they each have regular buyers. These include most of the local beach hotels, several of the tourist hotels in Port-au-Prince, several of the more upscale retail outlets in Port-au-Prince, and several of the wholesale export companies in Port-au-Prince. Furthermore, these *spekilatè* have the means to preserve and transport the *pwason wouj* quickly which is crucial to the value of the fish. A second, less significant, class of *spekilatè* in Luly are those who are based in Port-au-Prince and simply employ a Luly *badjougan* to buy the fish for them on a straight percentage basis. Apparently, these *spekilatè* are large export wholesalers themselves. They are also involved in contracting out the collection of coral,

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aquarium fish and shells for export through the local *spekilatè* who own the compressor boats.

The highest prices for *pwason wouj* are for mature lobster, followed by shrimp (rarely available in Luly), crab, conch and fish. If an unencumbered fisherman sells lobster to a *spekilatè*, he will get approximately $2.20/lb. The price an encumbered fisherman receives is a closely guarded secret, but is obviously below $2.20. If a visitor to Luly buys a lobster directly from a fisherman, the prevailing price is about $3/lb. But it is unusual for a visitor to not be waylaid by a *spekilatè* before he can get to a fisherman, and the visitor will end up paying $3 and up for a lobster, without any benefit to the fisherman. The *spekilatè* buys from many fishermen and can provide a fairly consistent supply to the hotels and retail outlets. The hotels and retail outlets need to have a steady supply that they can rely on to satisfy their own clientele. Because *pwason wouj* loses value quickly if it is not fresh, the independent fishermen must be able to sell their *pwason wouj* catch immediately. If the *spekilatè* are the only buyers on the beach, the fishermen has little choice. Individual fishermen with a good catch often go independently to the beach hotels or directly to individuals to try to sell their catch, but they cannot provide a consistent supply nor can they sell at the same price as the *spekilatè* who is buying, at an advantage, from encumbered fishermen. Social class differences also play a part in enhancing the *spekilatè's* advantage. Most fishermen feel awkward walking into a tourist hotel to try to sell fish or lobster. In most of the hotels the fishermen would not even get past the door.

Luly fishermen are aware of the advantages that *spekilatè* wield, but are faced with few alternatives to change the system. Currently, the fishermen of Luly have erected a sign on the main road, advertising Luly as "*La cité de la pêche*," to attract individual buyers and bypass the *spekilatè*. Although this has attracted a few more buyers to Luly, it has done little to change the overall situation.

Finally, that the fishermen of Luly are clearly controlled by their market is further indicated by the fact that their major fishing days are geared to coincide with the days that the buyers come to Luly, both for *pwason wouj* and *pwason blan*. Tuesdays, Thursdays and Saturdays are full market days in Luly, chosen to serve the increased consumption of fish on Fridays and Sundays, and those are the days that virtually every fisherman goes out.

APPENDIX III. RELATIONSHIP OF FISHERMEN TO BOAT OWNERSHIP

A. Boat Owners

Each boat is manned by a crew of from two to four men, called *matlo*, or mates. Although these crews tend to be stable in their composition, there are no social rules maintaining these relationships permanently. Young men start out as *matlo* for their fathers, but may change crews as they wish. Often crew members are of the same extended family but, again, this varies. The economic relationship entailed in crew composition is visible in how the catches are apportioned.

Just before landing, a small portion of the catch is allotted to each crew member for his personal consumption, including the *mèt kanot* (if he is on board), and set aside. The rest of the catch is then sold as soon as the boat comes ashore to either a *marchann, madanm sara* or a *spekilatè* agent. The cash proceeds from the sale of the catch are divided into one portion for each crew member, including the *mèt kanot*, and an extra portion for the *mèt kanot* in his capacity as boat-owner.

This general rule-of-thumb for catch apportionment has certain variations dependent on the gear used. For example, when nets are being used, from 40 to 50% of the catch goes to the mèt file (net-owner), the rest then being portioned out to the crew, always with a double portion for the *mèt kanot* if he is among the crew and not the mèt file. Often a boat is taken out that does not belong to any of the crew, but does belong to a fisherman, to service the crew's respective *nas*. Each fisherman collects his own catch from his own *nas*, but then a few fish are taken from each catch and given to the boat-owner.

B. Fishing with *Spekilatè, Madanm Sara and Marchann* Boat Ownership

The rules of catch apportionment are quite different when the owners of the gear or boat are not fishermen. Not only *spekilatè,* but also *madanm sara* and *marchann* own boats, *nas*, and in areas outside of Luly, nets as well. These non-fishermen/fishermen relations fall into two general categories. In the first category, a *spekilatè* or a madanm sara owns a boat. The fishermen who use the boat automatically turn over one full half of the catch to the owner, even if the catch consists of only a couple of pounds of fish. In the second kind of relationship, usually only involving *nas*, the fisherman is provided with several *nas* by a *madanm sara* or a *marchann*. The catch he collects must be sold exclusively to the provider of the *nas*, often at less than market prices. In Luly, there are 15 boats which are owned by non-fishermen, i.e. owned by *spekilatè* or madanm sara, and among those 15, 4 are owned by one single *spekilatè*. There are three *spekilatè* who also provide *nas*, but

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it is primarily the *madanm sara* and *marchann* who provide *nas*, and their number varies.

Considering that there are 100 boats in Luly, and 15 are owned by non-fishermen, then there are only 85 boats independently owned. Subtract from these the approximately 20 boats that have no sails and are therefore seriously curtailed in their fishing territory, there remains approximately 65 boats operated by relatively independent *mèt kanot* and their crew, or about 195 individuals who, judging from appearances, are free agents receiving direct benefits from their catches. However, as we shall see in the section devoted to the commercial distribution system, even these apparently independent fishermen are subject to economic constraints.

IV. TOURISM STUDY

A. Approach

The Tourism Study analyzed overall tourism in Haiti and the regional tourist industry in the Les Arcadins region. The basis of the analysis was published information from the Haiti Office du Tourisme et des Relations Publique, interviews with tourist industry associations and local hotel operators. The purpose of the study was to assess the socio-economic benefits of a marine park at Les Arcadins for the regional hotels, the local people and the government of Haiti. The goal was to: 1) identify the "tourist" segment of the visitors to Haiti; 2) identify changes which have taken place in tourism in Haiti and the Les Arcadins region from 1970-1987, the reasons for these changes; and 3) estimate the socio-economic relationship between tourism and the Haitian economy both at the country and regional levels.

B. Methods

The study briefly reviewed the history of tourism, assessed the current state of tourism and provided an outlook for the future. A significant element of this methodology was to isolate from government data actual "tourists" visiting Haiti, as current government tourist numbers also include business people, returning Haitian nationals or Diaspora Haitians, missionaries, and other non-vacationing visitors. The analysis of the tourist industry in the Les Arcadins region provided area specific information on beach hotel characteristics along the coast, and the relationship between the tourist industry and the local economy.

APPENDIX I. REGIONAL HOTELS

Ibo Beach. This is both the oldest resort in the region and the closest, about 35 kilometers, from Port-au-Prince. Located on an island, this 78-room hotel features a 120-seat, open-air restaurant, a 40-slip marina, an outdoor bar, a 3-level swimming pool with an outdoor bar and grill, tennis and basketball courts, mini-golf, and a large, well-groomed beach area. The accommodations are A-frame bungalows. Currently, 12 of the structures are inoperational. The hotel was in substantial disrepair when purchased by a Swiss businessman. Renovations have taken place on many of the bungalows and the main building. The emphasis of the current marketing program is toward Canada, Switzerland, and Germany. The owner is claiming he can achieve 65% occupancy in the winter of 1988.

Kyoná Beach. Opening in 1965, the Kyoná is one of the two smallest resorts with only twenty rooms. The accommodations are duplex thatched roof huts with moderate sized rooms. The resort is situated on a grand, curving, sand beach with large tropical trees throughout the property. While one of the most picturesque of the region's resorts, the Kyoná lacks amenities with only an outdoor restaurant and bar. Presently, the resort continues to attract large local crowds on the weekends.

Kaliko Beach. Located about a kilometer north of Kyoná, this resort is designed as a small, thatched-roof hut village with a total of 40 rooms. Most of the huts are duplexes with a couple of single room huts. The hotel used to operate under the name Kaloa Beach until it was refurbished in 1982. The resort features a 100-seat restaurant with an adjoining bar overlooking the beach, a swimming pool, the only dive shop in Haiti, a tennis court, gift shop, and a modest, well-maintained beach dotted with palm trees. A second restaurant use to operate and serve dinners but this was closed a few years ago. This restaurant is now used for seminars and conferences.

The accommodation section of the resort has been neglected for the past couple of years and the lack of maintenance shows. The restaurant, dive shop, and beach are the best kept areas of the resort and the mainstay of the operation. The quaint surroundings and pleasant appearance of the grounds maintains appeal for the resort but further neglect could damage its attraction in the future.

Ouanaga Bay. This 40-room hotel is located only a few kilometers north of Kalico Beach. It is sited on a small strip of land between National Route 1 and the La Gonave Bay. The resort is of modest appeal with very little land around the resort. The two-level hotel fronts the beach and overlooks the bay. The beach is a small strip of land running the length of the hotel and has few trees. Amenities include an open-air,

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indoor, 50-seat restaurant and an outdoor bar on a pier jutting into the bay. The buildings appear ill-maintained and in need of serious repair.

Xaragua. This hotel was foreclosed a couple of years ago and stands empty and locked in the village of Deluge. It is the farthest from Port-au-Prince lying a few kilometers north of Club Mediterranean. The concrete 4-story building contains 48-rooms.

Club Mediterranean. The largest of the region's resorts with 350-rooms, it is also the only resort with a world renown name. It is located near the village of Montrouis about 90 kilometers from Port-au-Prince. Of all the resorts, Club Med presents the most "private club" appearance. The resort is the most lavish in the region and offers the greatest package of amenities which include three restaurants, a three-part swimming pool, lighted tennis courts, golf driving range, pool basketball, nightclub, windsurfing, and a kilometer long beach full of palm trees. The complex is entirely self-contained and the only resort showing a manicured entrance from National Route 1 to the resort. While the resort has been closed since late summer 1987, the property has been meticulously maintained.

Tourists to the hotel came via tour packages and would stay for one or two weeks. Tourist originating points included the U.S., Canada, Europe, and South America.

Jolly Beach. Situated on a promenade overlooking La Gonave Bay and the island of La Gonave, this 20-room hotel offers pleasant, well-maintained surroundings for its guests. The hotel opened in 1982 and offers an open-air, 100-seat restaurant and bar, a swimming pool, tennis court, horseback riding, windsurfing, and a small beach. A grand staircase descends from the restaurant and hotel through a garden to a small, yet well-maintained, beach. Each room has a porch or balcony looking out over the bay. The rooms and buildings show few signs of neglect. (Closed in early 1989)

Moulin Sur Mer. This 30-room resort near Club Mediterranean is the newest and most unique of the beach resorts. Built by a renowned Haitian architect, its focal point is a reconstructed 18th-century sugar plantation home. Originally built as a residence for the architect in the early-1980's, it was later converted into a restaurant and administrative building. The accommodations area of the resort opened in 1985 on property fronting La Gonave Bay. The resort includes miniature golf, a 50-seat, open-air restaurant, a swimming pool, tennis courts, and a small beach.

Unfortunately, the hotel never achieved a substantial occupancy rate because the worst years for regional tourism followed its opening. If problems in the tourist industry persist for another six months, the hotel faces the prospect of having to shut down.

V. INSTITUTIONAL ANALYSIS

A. Approach

The objectives of the institutional analysis were to 1) determine the legal status of Les Arcadins, 2) provide all necessary steps for park establishment, 3) propose an institutional arrangement for park administration and management which could succeed in the context of the Haitian institutional environment and 4) provide long term planning recommendations for future action. The original approach, designed to consider several alternatives for park administration and management, including institutional arrangements with the GOH had to be modified, however, due to the political situation. Much of the institutional research therefore, had to be performed without benefit of government input and thus only the non-governmental institutional arrangement has been proposed.

B. Methods

To find answers relating the the fundamental questions of who will administer the park and manage the funds, a variety of private sector groups and organizations were interviewed. Criteria for selecting a lead agency or organization included; the motivation and ability to protect and manage an important natural area, the degree of stability and infrastructure, in place, to handle management responsibilities and park funds and the probability of immediate results. Appendix I contains a sample questionnaire which was distributed to known NGO's in Haiti.

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APPENDIX I. INSTITUTIONAL ANALYSIS QUESTIONNAIRE

January, 1989

INSTITUTIONAL ANALYSIS QUESTIONNAIRE
LES ARCADINS MARINE PARK PROJECT
HAITI

In September 1987 the U.S. Agency for International Development awarded a grant to World Wildlife Fund, a private international conservation organization, to study the biological importance of Les Arcadins and develop a plan for establishing a marine park at Les Arcadins. The purpose of this questionnaire is to identify organizations (and individuals) in Haiti who can either act as a primary management agency for the park or can assist in its development.

World Wildlife Fund, in cooperation with Wilcox Associates, a private consulting firm, and the Haiti Hotel Association has conducted several studies of the Les Arcadins area. Les Arcadins is located in Port-au-Prince Bay near the Kalico Beach Hotel and the village of Luly.

Our recent biological study indicates that Les Arcadins is a coral reef site of high biological diversity. The economic, tourism, and cultural studies suggest that with proper management and the start of community development programs, Les Arcadins could become an important tourist site for SCUBA divers and snorkelers while improving the economic condition of local fishermen. For this to occur the park will need a manager, an office, funding, equipment, and the assistance of Haitian organizations.

This questionnaire will help us to identify potential organizations that can provide technical, financial, and administrative assistance for the establishment and management of the marine park.

1. What is the name of your organization? _____
_____

2. What is your organization's primary mission? _____
_____
_____
_____

List two of your most successful projects. _____
_____

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3. In what year was your organization established? _____

4. Is your organization legally recognized in Haiti?
   Yes _____
   No _____, Please explain _____

5. How many people work for your organization?
   Paid _____
   Volunteer _____

6. Does your organization have members?
   Yes _____
   No _____

7. If yes, how many people are members? _____

8. Does your organization have experiene or knowledge in the following areas? Please place an "X" next to all that apply.

_____ Snorkeling and SCUBA diving activities
_____ Tourism Development
_____ Marine Fisheries
_____ Scientific Marine Research
_____ Working with Rural Communities
_____ Working with Fishing Communities
_____ Environmental Monitoring of Marine Areas
_____ Park Administration and Management
_____ Budget Preparation and Accounting
_____ Personnel Management
_____ Project Management
_____ Fund raising
_____ Development of educational Materials
_____ Public Relations
_____ Other, please specify:

_____
_____

Please underline any of the above which your organization would be interested in exploring.

9. What technical specialist are employed by or are members of your organization?

_____
_____
_____
_____

10. What is the source(s) of your operating funds?_____
_____
_____

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11. What is the size of your annual operating budget? _____

12. How do you track income and expenditures in your organization?

_____
_____
_____
_____

13. Are your books audited each year?
Yes _____
No _____

14. What other organizations do you suggest we speak with?
Name of Agency or Organization: _____
_____
What does this organization do? _____
_____

14. Name/Organization: _____

15. Contact Person: _____
Mailing Address: _____
_____
_____
_____

16. Telephone Number: _____

Thank you for helping with this survey.

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VI. ENVIRONMENTAL EDUCATION

A. Approach

Objectives:

(1) To design a preliminary environmental education program for Les Arcadins Marine Park that informs the public about the key issues and provides a means for citizen participation.

(2) To determine the need, important audiences and most effective media for an environmental education and public awareness program concerning Les Arcadins and other marine resources.

(3) To identify existing educational materials which could easily be adapted for use in Haiti.

B. Methods

To accomplish the above objectives the following activities were conducted.

(1) A review of environmental education, interpretation, and training programs for marine reserves in the wider Caribbean and other regions relevant to Les Arcadins was completed. Because of their similarities in environmental and socio-economic factors to Les Arcadins, the review focused on the Southeast Coast Project in St. Lucia, the Hol Chan Marine Reserve in Belize, and La Planada Nature Reserve in Colombia. (Appendices I, II and III)

(2) A review of the biologic, socio-cultural, tourism, and institutional surveys, which were completed as part of the Les Arcadins project, was completed. The surveys pull together existing knowledge as well as add important new information about Les Arcadins and the surrounding community. The information in the surveys was used extensively in designing the environmental education program for Les Arcadins.

(3) A review of existing environmental education publications and audio/visuals being used in the wider Caribbean was completed. Regional materials as well as country specific publications from St. Lucia, Dominica, Guadeloupe, Dominican Republic, and Belize were analyzed for effectiveness, appropriateness, and adaptability to Haiti. (Appendix IX)

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APPENDIX I. LA PLANADA NATURE RESERVE

The La Planada Nature Reserve in Southwest Colombia has become one of the best examples in Latin America of a wildland protection project linking conservation and development. A key element in the success of this model project has been the design and implementation of an education program which has helped to insure the sound management of the lands surrounding the reserve and has secured community respect and support for La Planada.

Situated on a forest, high plateau, this small, 1700 hectare reserve harbors a significant number of endemic plant and animal species and several rare and endangered animals such as the Spectacled bear and jaguar. WWF has assisted the Foundation for Higher Learning (FES) to purchase land, develop the operational plan, and implement management activities. The operation plan stressed the need to extend management activities into the surrounding communities in order to inhibit inappropriate land use that could reduce the small reserve to an island of greenery surrounded by degraded landscapes. Such geographic isolation would severely reduce the conservation value of the reserve.

Consequently, FES and the Ministry of Education designed a unique education project, the "Escuela Nueva Program," which addresses the special needs of this rural population and promotes a strong environmental ethic among those involved. The program features activities in health, community development, appropriate land use, and environmental conservation. Many of the recipients of this program are the indigenous Kwaiker Indians and a major orientation of the education activities involving them is "cultural recuperation" and community organization.

Using the interpretive /education center at La Planada, reserve staff have trained 31 school teachers from 22 rural schools that are within the "influence zone" of the reserve. In addition, the program has supported physical improvements to over 20 rural schools and has provided desperately needed teaching materials. Teachers trained at La Planada are given technical backstopping when they return to their schools.

In addition to teacher training, the reserve has developed a mobile conservation education unit that visits schools and community groups. The education center at the reserve has developed several interpretive displays and written materials for visitors. There are also several nature trails with corresponding pamphlets that discuss forest ecology and man's relationship to this environment.

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APPENDIX II. THE SOUTHEAST COAST PROJECT, ST. LUCIA

The southeast coast of the West Indian Island of St. Lucia reflects the economic development and conservation needs typical of the Eastern Caribbean. It encompasses all major ecosystems characteristic of small, insular environments in the Caribbean, including reefs, seagrass beds, mangroves, dry forests, beaches and cliffs, and supports artisanal fisheries, tourism, charcoal production, recreation, sand mining, and agriculture.

The southeast coast project began in 1986 as part of the World Wildlife Fund/U.S. AID Wildlands and Human Needs Program. Based on the results of a 1981 study carried out by the Eastern Caribbean Natural Areas Management Program (ECNAMP) and the Government of St. Lucia, the project aims at promoting sustainable development through the integration of research, development and training activities with the active participation of local resource users. Specific project activities focus on improved management of artisanal fisheries, mangrove and fuelwood management, sea moss and sea egg cultivation, and management of the Maria Islands Nature Reserve.

Sustained use management of the fishery and mangroves are important to peoples' livelihood on the southeast coast. However, because of insufficient numbers of trained natural resources personnel and inadequate mechanisms for community participation, little progress had been made towards reducing over fishing and cutting of mangroves for charcoal production. At the same time, development activities have led to increased pollution of the marine environment and the drainage of mangrove swamps, thus further decreasing the productivity of these already stressed environments.

The southeast coast project addresses these problems by working directly with the resource users. Local fishermen and charcoal producers are being organized into cooperatives and are receiving training in ecology, resource management, and management of cooperatives so that they can more effectively manage the resources they depend upon. They are also participating in the baseline studies which are providing the information necessary to better manage their resources.

The project develops alternatives such as establishing tree plantations for future charcoal production, developing techniques for successful sea moss cultivation, and establishing farming sites so that cooperative members are less dependent on charcoal for their subsistence. Tourism is being promoted through the Maria Island Nature Reserve and Museum (originally funded by WWF). Six tour guides, trained by the southeast coast project, lead field trips to the Maria Islands.

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Eventually, the fishermen and charcoal producers will have direct responsibility for the management of their natural resources. They will thus have a bigger stake in making sure that the southeast coast's natural resources are well managed. If this approach is effective, fewer natural resource managers at the government level will be needed. This would be a significant contribution to natural resource management since lack of trained personnel is such a widespread problem.

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APPENDIX III. HOL CHAN MARINE RESERVE, BELIZE

The rectangular shaped, five square kilometer Hol Chan Marine Reserve encompasses mangrove swamps, shallow water ecosystems, a well developed section of barrier reef, and a kilometer or so of deeper water beyond the reef. Located off of Ambergris Cay near the popular tourist town of San Pedro, the reserve's creation has become a major drawing card for visitors to the country.

At this time the Belize Department of Fisheries is not financially able to support the one-year old project but it is expected that the Park should begin generating at least some of its own revenue by the second or third year of operation. The reserve will begin charging admission in 1989. At present, funding for the reserve comes from the U.S. Agency for International Development and World Wildlife Fund.

Considerable progress has been made in one year. All reserve staff have been hired and most of them have received some training. The reserve boundaries have been marked and are being regularly patrolled. Major items of equipment have been purchased, including a patrol boat and motor, an administrative and education center has been opened, educational publications, about the reserve, have been produced and resource management activities have been initiated.

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APPENDIX IV. SUMMARY OF EDUCATIONAL AIDS FOR PUBLIC AWARENESS AND ENVIRONMENTAL EDUCATION PROGRAM

Park Brochure

Objective: inform the general public and potential visitors about the park's existence, purpose, services, and location.
Description: a simple four color, three section brochure in English and French.
Preparation: Subcontract
Estimated Cost: $4,500.00
Dissemination: Haiti hotels and businesses, airport arrivals area, selected travel agencies catering to SCUBA divers, and the visitor center.

Les Arcadins Poster

Objective: inform the general public and potential visitors about the park's existence, location, and how to obtain further information. Produce small income for reserve through sale of poster.
Description: a four color poster depicting a general underwater scene of coral reefs with the name of the park, a short conservation message, and invitation to visit the reserve. Text would be in Creole.
Preparation: Subcontract. WWF has access to color separations for coral reef poster.
Estimated Cost: $8,500.00
Dissemination: same as for brochure but only for display purposes, poster would be available for sale at reserve visitor center. Poster would also be displayed in schools, other public buildings, and businesses.

Les Arcadins Video

Objective: highlight Les Arcadins Marine Park at key visitor arrival centers such as the international airport and hotels in Port-au-Prince. Provide takes for television news coverage.
Description: a 15 min. color video in English and French with underwater shots of Les Arcadins.
Preparation: Subcontract. Underwater video footage of Les Arcadins already exist. Arrangements would have to be made to use material.
Estimated Cost: $12,000.00
Dissemination: airport arrival area, local hotels, short spots for television.

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Three Conservation booklets

Objective: inform resource users and school children about sustainable development and important local species and ecosystems. Booklets would serve as enrichment reading material for schools and literacy program.
Description: a coloring booklet on coral reefs, a booklet about conch, and a booklet about spiny lobsters. All three booklets would be in Creole.
Preparation: Subcontract. Editions of each booklet have already been produced by WWF. Text would have to be adapted to Haiti and translated into Creole.
Estimated Cost: $4,000.00
Dissemination: Local schools and fishery cooperative.

Les Arcadins Slide Program

Objective: Publicize and gain support for Les Arcadins Marine Park and the concept of sustainable development.
Description: a program with 80 slides and a written text in English, French, and Creole.
Preparation: Subcontract. Slides of Les Arcadins are available and can be used for this program. Sufficient technical information also exist.
Estimated Cost: $1,000.00
Dissemination: program will be presented by the Executive Director to civic groups, business people, and government officials.

Marine Life of Les Arcadins Booklet

Objective: provide more detailed information about the ecology, species, and history of Les Arcadins Marine Park. Raise revenue for Les Arcadins.
Description: a 50-60 page booklet in English and French with a four-color cover and line-drawing illustrations.
Preparation: Subcontract. Much of the technical information concerning the marine life is already available. Work is needed on the terrestrial components and history of the park.
Estimated Cost: $8,000.00
Dissemination: for sale at visitor center and book shops in Port-au-Prince.

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