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Protecting Biological Diversity: *Jamaica Case Study*

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Jamaica Case Study

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This Working Paper is one of a number of case studies prepared for CDIE's assessment of USAID Protecting Biological Diversity programs. As an interim report, it provides the data from which the assessment synthesis is drawn. Working Papers are not formally published and distributed, but interested readers can obtain a copy from the DISC.

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FOREWORD

USAID has helped Jamaica start a new chapter in its natural history. With support from the USAID Protected Areas Resources Conservation (PARC) project, Jamaica has established a national park system approach to conserving its biological resources where before there were only a few regulations and no areas officially set aside for wildlife protection. A pilot marine park and terrestrial park are now in operation and plans for a national parks and protected areas system are emerging from studies and assessments of the island's natural resources.

Responsibilities that come with setting up a park system to protect biological diversity are daunting. Qualified people must be recruited and trained to patrol and enforce park boundaries, to protect and inform visitors, to monitor and manage wildlife and their habitats. Money must be raised and budgets provided for basic park operations, up-keep and improvement.

Jamaica is well positioned to mobilize the human and financial resources to operate its new parks and protected areas system. Above all Jamaica has a cadre of concerned and qualified people, inside and outside government willing to shoulder a share of the burden. The government has a healthy outlook toward engaging non-governmental organizations in planning and managing conservation programs. While public resources are limited, there is considerable scope for leveraging private sector resources through regulatory measures and incentive policies. The tourism sector has a particularly large vested interest in promoting and projecting a "clean and green island" image for Jamaica and generates significant revenues, a share of which could be tapped through entrance fees or "green taxes" for biodiversity conservation programs. The fisheries, timber, potable water and hydro-power sectors all have a strong interest in preservation of marine and terrestrial habitats.

The drafters of this report applaud Jamaican's for their progress to date in conservation of the island's threatened biological diversity. This report is prepared in the spirit of helping sustain the momentum propelling Jamaica toward environmentally sustainable development and improved quality of life. In this small way we hope we can repay all those who helped in compiling the information for this evaluation of Jamaica's biodiversity conservation program. Of course, the authors of this report assume full responsibility for its content and conclusions.

GLOSSARY

CDC	Conservation Data Center
CIDA	Canadian International Development Agency
DEMO	Development of Environmental Organizations
EFJ	Environment Fund of Jamaica
GIS	Geographic Information System
GOJ	Government of Jamaica
GPS	Global Position System
IDB	Inter-American Development Bank
JDF	Jamaica Defense Force
JCDT	Jamaica Conservation and Development Trust
LAC	Local Advisory Committee
NEST	National Environmental Societies Trust
NPTF	National Parks Trust Fund
NRCA	Natural Resource Conservation Authority
ODA	Overseas Development Agency (United Kingdom)
PARC	Protected Areas Resource Conservation Project
PIOJ	Planning Institute of Jamaica
PMU	Park Management Unit of the PIOJ
RADA	Rural Agriculture Development Authority
REA	Rapid Ecological Assessment
TNC	The Nature Conservancy
USAID	United States Agency for International Development
UWI	University of the West Indies

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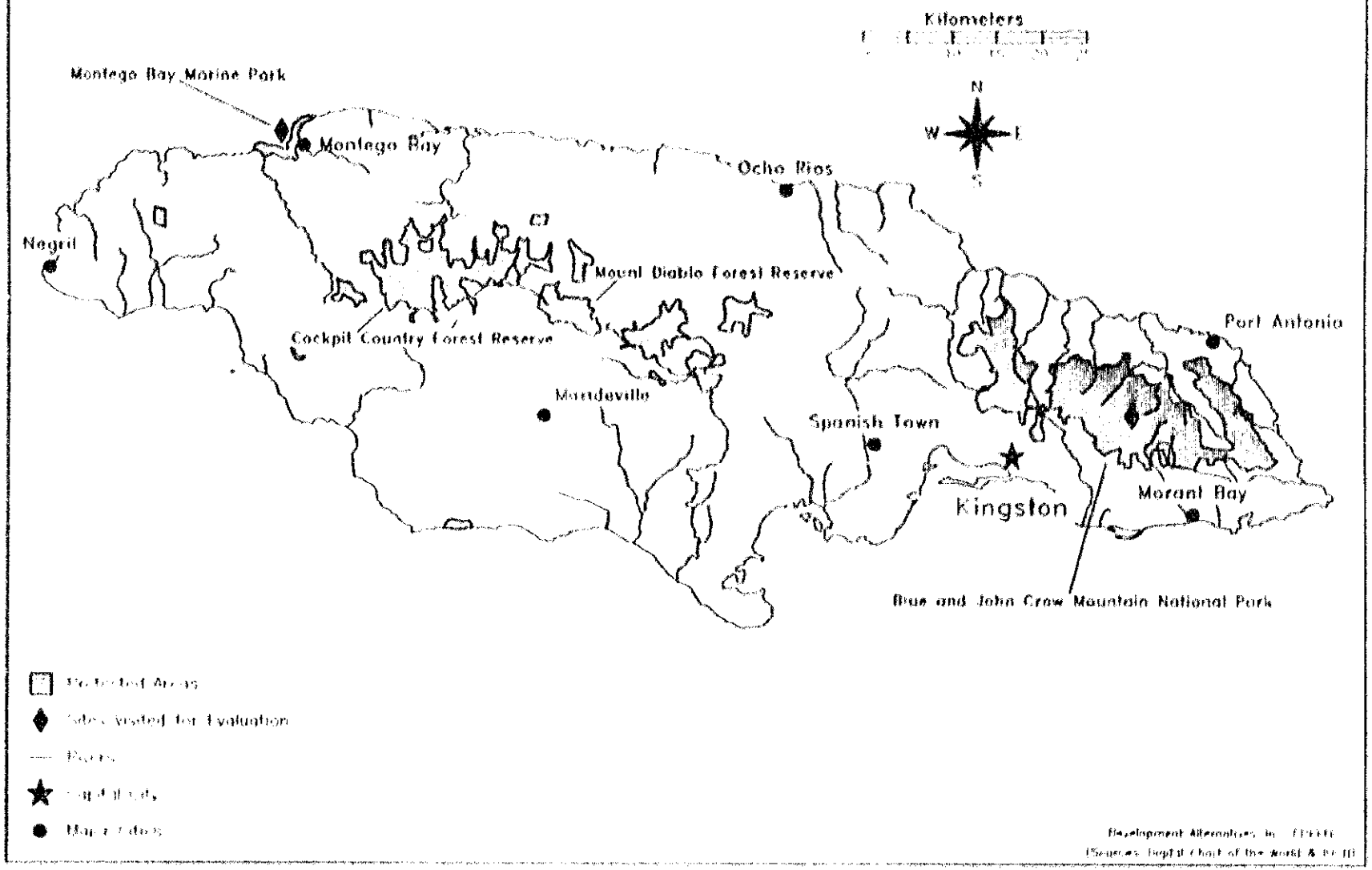
Protected Areas in Jamaica



Development Alternatives, Inc. (DAI)
(Sources: Digital Chart of the World & DAI)

1. INTRODUCTION

For an island nation, Jamaica possesses a range of terrestrial and marine habitats that give the country both ecological and economic significance. Its 7,000 foot mountain peaks are the highest in the Caribbean basin and, along with coastal piedmont zones, serve as homes for hundreds of endemic birds, insects and plants. From its near shore and offshore marine habitats have emerged a spectrum of sea life, including endangered sea turtles, manatees, corals and crocodiles.

Since Christopher Columbus landed on the island's north coast in 1494, Jamaica's landscape has undergone transformations that today place much of its biological diversity at risk. Changes over the last thirty years have been particularly damaging to the country's natural biological resources. To supply export markets and earn foreign exchange, commercial agriculture and bauxite mining have changed much of the country's landscape and destroyed wildlife habitats. Near shore marine life has been severely strained by the run-off of soil and agricultural chemicals as a result of these activities. More recently, expansion of urban and tourism centers along Jamaica's coasts continue to degrade marine ecosystems with over fishing and pollution.

This report examines USAID's Protected Areas Resources Conservation (PARC) project and the approach it has taken to arrest and reverse further degradation of Jamaica's remaining natural forest and marine habitats. The purpose of PARC was to set up a national park system, create two pilot parks, provide a source of continued funding for park management and foster NGO participation in operating the new national parks system as a means of extending government reach and of increasing local involvement in the conservation of biological resources.

The Jamaica case study of park system development and management -- as an approach to biodiversity conservation -- is part of a worldwide examination of such programs. Other country field assessments on forest habitat protection include Sri Lanka, Thailand, Nepal, Madagascar, and Costa Rica.

The report summarizes findings from an evaluation of Jamaica's program. Section 2 of this report discusses problems threatening biological diversity in Jamaica and USAID's solution. This section also describes the data collection methods used in the evaluation. Section 3 describes the evaluation findings on program implementation, impact, effectiveness, sustainability, and replicability of biodiversity conservation activities in Jamaica. Section 4 summarizes the major lessons learned, and Section 5 summarizes outstanding issues and challenges ahead.

2. BACKGROUND

The Problem

Jamaica has strayed from the path of environmentally sustainable development (GOJ 1987). This finding, from the USAID funded Country Environmental Profile of Jamaica in 1987, is most clearly evidenced in the steady degradation of the island nation's biological resources. Terrestrial wildlife and their habitats have given way to expanding commercial farming and logging, to mining and urban growth. The island's coastal marine ecosystems are under increasing stress from the impact of over fishing and growing concentrations of solid and liquid wastes.

Cumulative debt, a byproduct of unproductive overspending during previous administrations, denies the current Jamaican government adequate financial resources to address its major environmental problems, let alone other pressing social needs like the education, housing and health of its growing population. The need to produce for export has led to the unwise use of chemicals on crops -- coffee, sugar and bananas -- and on shortcuts in cleaning up and avoiding river and ocean pollution from mining. Even the hotel and resort industry which depends on the country's white coral sand and blue water beaches as a tourist draw has not been disciplined in its waste management.

With heavy foreign and domestic debt and pressing social needs, the Government of Jamaica by 1990 has had little left with which to address its emerging environmental problems. Yet deteriorating environmental conditions, unless promptly halted and reversed threaten to further erode capacity of the country's 2.5 million population to achieve and sustain positive rates of economic growth.

Assuming Jamaica was totally forested prior to Spanish settlement, centuries of agriculture, logging and mining activities have reduced the original forest cover by approximately 70 percent (USAID, 1987). These activities continue to deplete forest cover at a rate of between one to three percent per year (Eyre, 1987). Moreover, selective logging continues to lessen the diversity of tree species within remaining forest habitats. In short, Jamaica continues to experience a depletion of its forest resources and with them habitats for much of its terrestrial wildlife.

Today over thirty species of rare plants found in Jamaica, some endemic to the country are threatened with extinction. Several species of vertebrates and invertebrates are also threatened or endangered. As an example, the Jamaican iguana, once believed to be extinct was recently rediscovered on the island and

the giant swallowtail butterfly, the second largest in the world is found only in Jamaica.

Jamaica's near and off shore marine environments were once the major focus of international scientific inquiry. Research pioneered by T.F. Goreau in the 1950's and 60's, and followed by other scientists, established Jamaica's coral reefs as standards by which researchers described and directed study in other tropical marine environments worldwide. However, within a single human generation these same reefs are drastically different in structure and species composition. Long term research has identified human-induced pressures as being largely responsible for the changes observed (Hughes, 1994; Goreau, 1992). Once abundant, marine fishes and shellfish have been over-exploited as food for an increasing human population. Marine mammals and reptiles, such as manatees, sea turtles and crocodiles, were once common along Jamaican shores but are now listed as threatened or endangered.

Institutionally, Jamaica has not been well-equipped to address threats to its biological resources. Until, 1993, Jamaica has had no official parks and protected areas system for plant and wildlife conservation. The only tools at hand was some wildlife protection legislation and some forest reserve lands that predated the country's independence from British colonial rule in the 1960's. Jamaica also has not had a single public agency responsible for biodiversity conservation. Instead, a number of government agencies -- forestry, agriculture, fisheries, mining -- shared often conflicting responsibilities for wildlife protection with little coordination among them.

The challenge is not just one of protecting remaining forests and marine areas as habitats for endangered species. The sustainable economic development is also threatened by any further destruction of habitats that serve as watersheds for the supply of potable water for drinking and water for crop irrigation. The capacity of the island's few reservoirs and irrigation systems has already been reduced by siltation from soil run-off where forest cover has been removed for farming.

Jamaica's small size has raised the question in some circles about whether there is room for both wildlife and human life on the island. Recent environmental problems have brought home the lesson that Jamaica's human population is as dependent on the island's wildlife and wildlife habitats for survival as these biological resources are dependent on responsible human behavior for their future existence. At issue is how peaceful, compatible and interdependent co-existence of man and nature can be achieved in Jamaica in a period of economic austerity and persistent social problems.

The USAID Assistance Approach

USAID was among first foreign donors to help Jamaica address the environmental impacts of its economic development. Serious attention to developing an environmental agenda for the country began in 1987 when USAID financed a Country Environmental Profile carried out by the Jamaican government and with support by independent consultants. The profile revealed that existing policies, laws and institutions -- some of which dated long before independence from the British in 1962 -- were not adequate conserving Jamaica's wildlife and their habitats from degradation. Wildlife and forest reserves were demarcated on maps and legislation regulating hunting and trading of endangered species was on the books, but enforcement was weak, encroachment a growing problem and extinction an increasingly likely outcome.

In direct response to the findings of the Profile, USAID worked with the Government of Jamaica to design and implement a three year $1.95 million Protected Areas Resources Conservation (PARC) project aimed at:

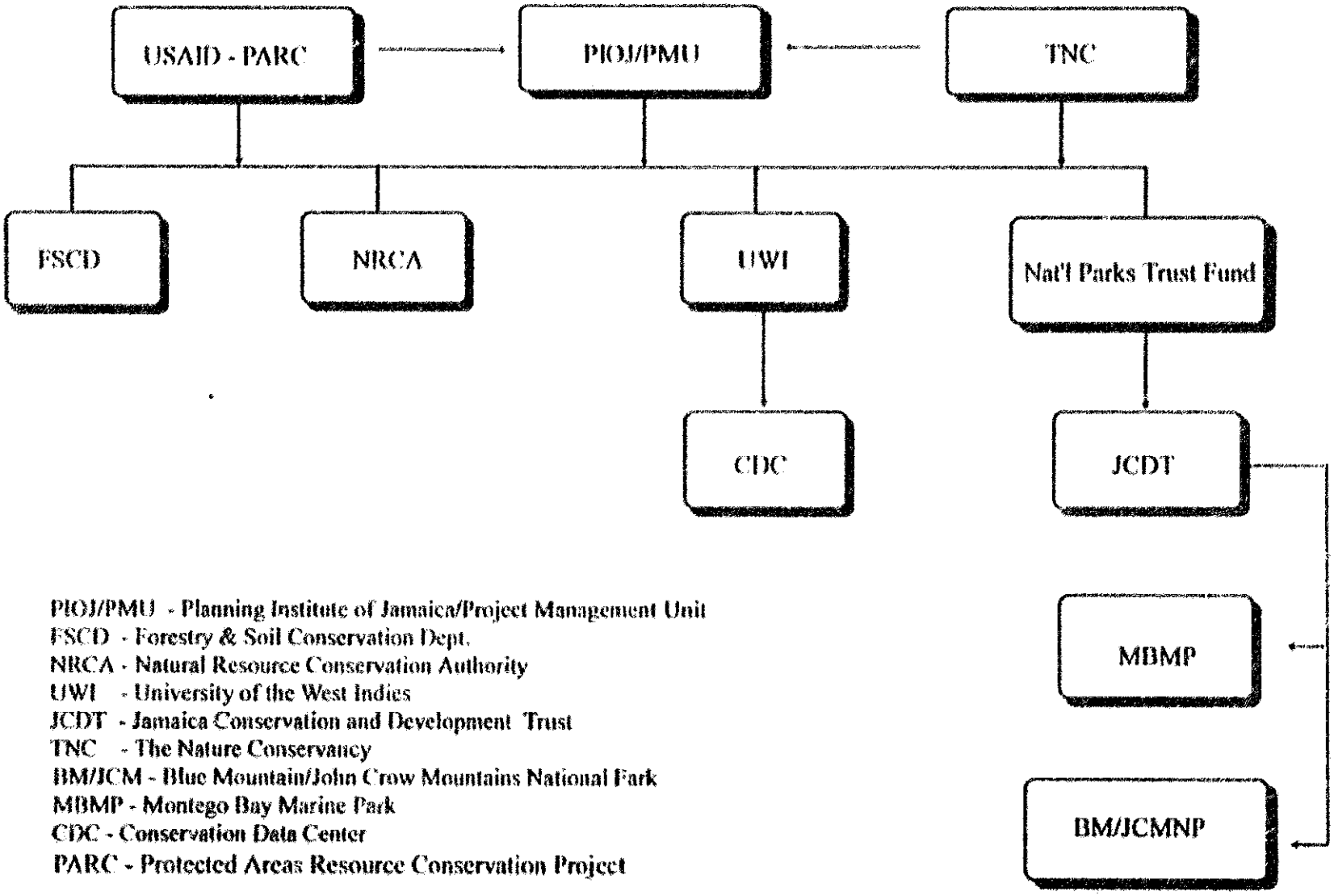
- providing the legal, institutional and financial foundations for a national park system;
- demarcating and operating two pilot parks -- one marine park and one terrestrial park -- as part of the new national system.

USAID support was directed first at approving and strengthening of a new Natural Resources Conservation Act that mandated government's role in managing all forest, fisheries, wildlife and other natural resources and empowered it to involve local groups and communities in the stewardship of those resources. The act also provided for the management of these resources to be integrated together within a single new Natural Resources Conservation Authority (NRCA) which was elevated from a ministerial department to autonomous government agency status.

Part of the NRCA is the Parks and Protected Areas Division, responsible for overseeing areas set aside and designated as national parks for conservation and recreation purposes. At the outset, and until NRCA has the budget and staff positions approved, the Parks and Protected Areas Division has been housed within the Special Project Management Unit (SPMU) of the Planning Institute of Jamaica (PIOJ) where it received direct funding from PARC for staff salaries and operating expenses. Figure 1 shows the flow of technical and financial support under the PARC project.

To provide for the long-run financial solvency of the new park system, USAID negotiated with The Nature Conservancy (TNC),

Figure 1: Jamaica Biodiversity Conservation Program
Flow of Technical and Financial Support



PIOJ/PMU - Planning Institute of Jamaica/Project Management Unit
FSCD - Forestry & Soil Conservation Dept.
NRCA - Natural Resource Conservation Authority
UWI - University of the West Indies
JCDT - Jamaica Conservation and Development Trust
TNC - The Nature Conservancy
BM/JCM - Blue Mountain/John Crow Mountains National Park
MBMP - Montego Bay Marine Park
CDC - Conservation Data Center
PARC - Protected Areas Resource Conservation Project

a U.S. environmental NGO, and the Government of Jamaica, to have approximately $400,000 in US dollar debt converted to a local currency Jamaican dollar endowment held by a national environmental NGO t. Jamaica Conservation and Development Trust (JCDT). With earnings from the endowment, JCDT would continue to pay park system staff salaries and operating expenses until the NRCA or local groups were capable of doing so. At the same time, JCDT could use interest from the seed capital to conduct additional fund raising campaigns, run environmental awareness programs, and support other environmental initiatives.

To help meet the information needs of the new park system and to tap into a segment of the country's scientific community, PARC funded the creation of a Conservation Data Center (CDC) at the University of the West Indies (UWI) in Kingston. Responsible for inventorying all of the island's plant and animal life, the CDC was also expected to track and monitor changes in ecological conditions and wildlife over time.

A final component of the PARC project was the creation of two pilot parks, the Montego Bay Marine Park (MBMP) and the Blue and John Crow Mountain National Park (BJCMNP). PARC sought to build government capacity for operating the parks and linkages to involve local groups in the process. (See Appendix B: "Profile of the Montego Bay Marine Park" and Appendix C: "Profile of Blue and John Crow Mountain National Park). BJCMNP is the site of a previous forest reserve and benefits from earlier demarcation, some road and trail development and buildings for park ranger housing and offices. Some lands within the park boundaries continue in private hands and have yet to be acquired by the government. While subject to use restrictions, until purchased -- which is unlikely given current public revenue shortage -- some of these lands are still logged or farmed by their owners as are lands immediately adjacent to the park area. Cultivation of Blue Mountain coffee, which commands a premium on international markets, is one of the main uses to which these lands are converted.

USAID implemented PARC through a cooperative agreement with TNC, which itself raised matching funds for park start-up, staff training and ecological monitoring activities. TNC al o brought to Jamaica skills in conservation data collection and management including techniques like "rapid ecological assessments" and in environmental education and communications to help build public awareness and local support for the fledgling park system and wildlife conservation movement.

USAID extended the termination date of PARC to August 1993 to allow time for the start up of a second phase of PARC as one of four components of a new 4 -year $17.5 million Development of Environmental Management Organizations (DEMO) project aimed at further building capacity of local Jamaican NGOs. The PARC II

component under DEMO was counted against a USAID contribution to the World Bank's Global Environmental Facility (GEF) and for continuing support to the NRCA's Parks and Protected Areas System a central approach to biodiversity conservation.

Data Collection and Analysis Methods

CDIE employed a variety of primary and secondary sources of data and information to construct the chain of events linking PARC activities with observed program impacts and to identify lessons from program implementation (See Appendix A: "Evaluation Methodology"). Central to the analysis are the changes in practices and in bio-physical and socio-economic conditions that can be attributed to four strategies -- e.g., institution building, technology introduction, education and awareness, and policy reform -- employed by the USAID project.

In preparation for the field work, CDIE collected and analyzed secondary information available in Washington, D.C. and in the host country from a range of sources including project designs and evaluations, technical reports and special studies. Evaluation staff also met with US-based resource persons familiar with Jamaica and its biodiversity conservation program.

In Jamaica, the assessment team reviewed USAID project document files and reports prepared by government agencies, non-government organizations, international institutions, and private consultants. Critical to this report was an independent evaluation of the PARC project conducted early in 1992 about nine months before scheduled project completion (IRF, 1992). That evaluation examined the extent to which the project was delivering proposed outputs. This report builds on the 1992 evaluation by presenting evidence and analysis of what impact -- institutional, biological, social and economic -- PARC project outputs have had on biodiversity conservation in Jamaica. Evaluation team members visited project sites at both Montego Bay Marine Park and Blue and John Crow Mountain National Park for direct examination of these "pilot" parks and their ecological conditions.

The CDIE field team conducted extensive key informant interviews to obtain data, ideas, insights, interpretation of events and actions, suggestions for unresolved issues, etc., from a range of project beneficiary participants and knowledgeable people. Questions were based on an interview guide developed prior to site visits. Respondents included government officials and technicians and representatives of international agencies, local NGOs and universities (See Appendix E).

3. EVALUATION FINDINGS: PROGRAM IMPLEMENTATION

This evaluation examines the following strategies as determinants of biodiversity conservation program performance and impact:

Institution building -- strengthening capacity of local and national public agencies and non-governmental organizations responsible for conducting biodiversity conservation programs;

Technological change -- introducing new practices and techniques for wildlife and habitat management;

Education and awareness -- increasing local and national understanding of the value of biodiversity conservation;

Policy reform -- enhancing economic and other incentives for the conservation of biological diversity.

This section examines the changes in Jamaica's biodiversity conservation program from implementation of these strategies under the USAID PARC project.

Institution Building

In Jamaica, USAID has helped build public and private institutional capacity for biodiversity conservation in two ways:

- Preparing the legal, administrative and financial foundations for a national park system;
- Initiating the operation of two pilot national parks -- one marine and one terrestrial.

USAID has helped the GOJ define a new "modus operandi" for conservation of the country's biological resources using a national parks system approach. Pending still, however, is approval of a national plan for institutionalizing and operating the protected areas system on the principles pioneered with PARC's assistance.

Under the PARC project USAID has worked with the GOJ to create the country's first system of national parks and to institutionalize that system under a newly created Natural Resources Conservation Authority (NRCA). Earlier, USAID supported the preparation of a National Environmental Profile which highlighted the breadth of the country's biological resources and underscored the need for

a national effort to assure their sound management and conservation (Ministry of Agriculture 1987). Findings and recommendations of the Profile led to draft legislation creating the NRCA from a small division level government agency.

Among its environmental protection responsibilities, the NRCA has a broad legal mandate to address a range of pressures that have caused destruction and degradation of Jamaica's biological resources. Jamaica's Natural Resources Conservation Act, approved on 29 April 1991, assigns responsibility to the NRCA for the natural -- including biological -- resources planning, management and monitoring. For the conservation of biological resources, the Act provides for the creation of a national parks and protected system.

The new Act introduces to biodiversity conservation a degree of flexibility in park management and operations. For example, the Act provides for control and operation of national parks by local groups and NGOs where appropriate. The Act also promotes NGO participation in funding park operations. Because of its recent reorganization, still growing staff and limited budget, the NRCA is currently being supported by a spectrum of environmental NGO's acting to extend the "reach" of government programs at the local level. PARC has been instrumental in the process of engaging NGOs in park management through its support to the Jamaica Conservation Development Trust (JCDT), a national environmental NGO, which at the time of the evaluation had direct responsibility for operating newly created parks under the Act.

In addition the Act provides a means for coordinating activities -- forestry, mining, agriculture, fisheries, hunting, waste disposal -- within protected areas where previously responsible public agencies operated independently of each other. Better integration of these activities under the NRCA is evidenced by participation of the heads of these agencies as well as others such as tourism, industry on the managing boards of the newly created Montego Bay Marine Park and Blue and John Crow Mountain Parks. PARC helped formalize this participation by supporting formation of ad hoc interagency advisory committees for each of the parks.

Thus far the major successes scored by the NRCA have been official gazetting and formation of the country's first two "pilot" national parks: Montego Bay Marine Park (MBMP)and Blue and John Crow Mountains National Park (BJCMNP). Still to emerge, however, is a permanent home for the national park system which at the time of the evaluation was based in Project Management Unit (PMU) of the PIOJ Special Projects Division.

Also, a national park system plan, drafted during PARC implementation, was still under NRCA review during this evaluation with possible public vetting to take place toward the end of 1994. The draft plan has left unresolved the question of whether the park service should be transferred to a still nascent and institu-

tionally inexperienced Protected Areas Division within the NRCA or to a proposed but yet to be formed National Parks Institute. Delaying the resolution of this question are concerns over funding which is very limited within the NRCA budget and over reducing park management load on NRCA leadership that is also responsible for all other natural resource management needs of the island.

Devolving authority for the park system as a whole to a national non-governmental parks institute and for specific park operations to local environmental organizations are also to contentious issues yet to be address by the GOJ. Delays in resolving these issues are already manifesting themselves in eroding local support and park staff morale around existing parks and skepticism of local groups in other areas of the country over the willingness of the Kingston based NRCA to include them in efforts at biodiversity conservation.

PARC funded the creation of Jamaica's first two national parks and provided initial resources to demarcate, equip and operate them. Local acceptance of and support for the parks is high but limited funds for recurrent and capital costs of park operations limits effectiveness of ranger and administrative staff to provide supervision and educational services to visitors.

Interest in developing national parks was first sparked in the 1930's when Hardware Gap and Clydesdale Forest Reserves were demarcated. Facilities for overnight accommodation and trail systems attracted public use. The principle of protection of natural areas was also addressed in various acts, including the Forest Act (1942) the Wildlife Protection Act (1945), Beach Control Act (1956), and the Watershed Protection Act (1963). Since their passage, the GOJ has set aside more than 288,450 acres of forest reserve and proposed marine parks at Montego Bay and Ocho Rios. Despite this effort, until 1993 no comprehensive national parks legislation had been introduced.

The National Physical Plan (1970-1990) calls for "an integrated regional system of a wide range of parks, recreational and conservation areas reflecting Jamaica's social needs and natural environment." Acting on this provision, the GOJ established a Provisional National Parks Committee under the Forest Department in 1970. It aimed to identify and initiate activity in other areas suitable for national parks development. This committee evolved into the National Parks Branch of NRCD, but until PARC nothing really happened.

Until PARC, conservation of biological resources in Jamaica took the form of loosely administered protected areas, forest reserves and wildlife sanctuaries. Economic and population growth, coupled with often unenforced regulation, led to increased en-

croachment into these areas. PARC provided the funds for designation, staffing and equipment for two pilot parks. The evaluators visited each of the parks and inspected the current status of boundaries, facilities and equipment.

Montego Bay Marine Park (MBMP)

The Marine Park is located directly offshore from the city of Montego Bay and runs the entire coast line of the urban area (Figure 2; see also Appendix B). The beaches and nearshore coral reefs are probably the most frequented tourist destination in the country.

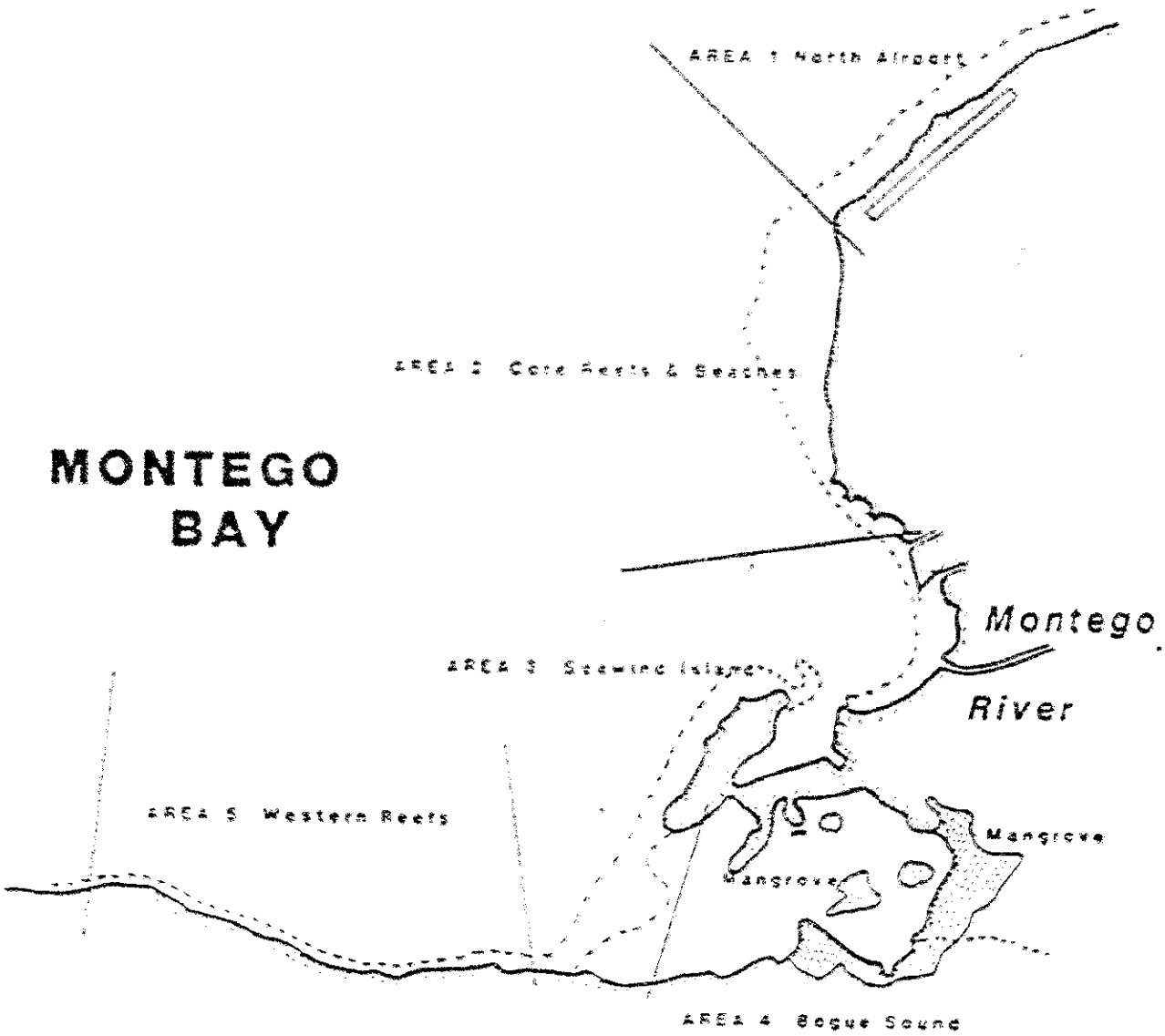
The community of Montego Bay has called the nearshore area a "park" since 1974, but prior to PARC made no arrangements for its operation and management as such. PARC helped establish MBMP from three standpoints: 1) installation of marker buoys to designate park boundaries and mooring buoys to reduce anchor damage to coral from dive and fishing boats; 2) establishment of a park headquarters, temporarily housed on one of the public beaches adjacent to the local offices of the national tourism association; and 3) promotion of the park and its resources through outreach, such as billboard advertizing -- contributed by local businesses; training courses for local fisherman to become tour-guides; and the formation of a local advisory committee on which fishermen, resort and dive shop operators and other concerned Montegonians were represented.

The evaluation found that the no-fishing zones within MBMP were adequately marked, but boundary buoys have not remained in place, resulting in the outer boundary of the park not clearly delineated. The buoys purchased were designed for fresh water use; the hardware associated with them failed quickly, due to electrolysis and corrosion. Although no-fishing and beach bathing zones have been well marked, other use areas have not yet been clearly defined (i.e. Jet Ski, N. Wake Zones).

The Marine Park headquarters and staff dormitories were inadequate for the needs of the park. The headquarters are two small octagonal buildings located directly on Cornwall beach. Office space was inadequate given the number of park staff employed. Desks and chairs were cramped, and the layout of the offices was not conducive to visitors wishing to learn more about the Marine Park. Although an adjacent open air hut contained billboards displaying information, there was no official visitor or interpretive center established at the headquarters.

Through PARC, MBMP hired a staff member to spearhead a community outreach and information campaign, aimed at increasing

Figure 2: Montego Bay Marine Park (Park Boundaries and Zones)



awareness of the park and the environmental challenges facing Montego Bay. The individual serving in the position developed a strong relationship with the local press, which enabled MBMP to quickly develop a high profile in the community. Based on interviews and review of the press files, the evaluators found the early stages of this campaign to be highly effective. Published newspaper articles and a newsletter are informative, allowing Montegonians to become increasingly aware of the park's boundaries, environmental features and threats. The evaluation team noted one large billboard and several small signs along roads in the Bay area advertising the Marine Park and noting boundaries nearby.

Montego Bay citizens formed local committees to promote the idea of a national marine park in the early 1970's following findings from a study conducted at that time that the Bay's ecology was already at risk. Official designation of MBMP fostered greater local participation and activity. Recorded minutes of Local Advisory Committee (LAC) meetings indicate that the group appeared active through 1992, but stopped convening by that year's end shortly after MBMP management control shifted to Kingston. No meetings have been held since that time.

MBMP rangers, scientists, administrative and volunteer staff have been active in outreach programs. Staff have been involved in various clean-up and education initiatives of beaches and ravines in the bay area, although several of the initiatives have not been recurrent. However, a retraining program for local spear fishermen to gain skills as tour guides was underway during the evaluation, and generated positive responses from both participants and staff.

PARC also provided funds for two patrol boats, an air compressor, dive gear, radio communications and office equipment and some office equipment. The evaluation team found some equipment (patrol boats and motors) to be in need of repair or improperly located (e.g., air compressor in a location with poor ventilation and now cooling water), reflecting selection of equipment too sophisticated for project needs and inadequate technical assistance on their use and maintenance.

Blue and John Crow Mountains National Park

Jamaica's first official terrestrial park is located within a one-hour drive of the capital city, Kingston (Figure 3; see also Appendix C). Formerly designated as a forest reserve, the park boundaries enclose native forest, secondary forest and some lands that are logged or farmed by individuals still holding title or squatting.

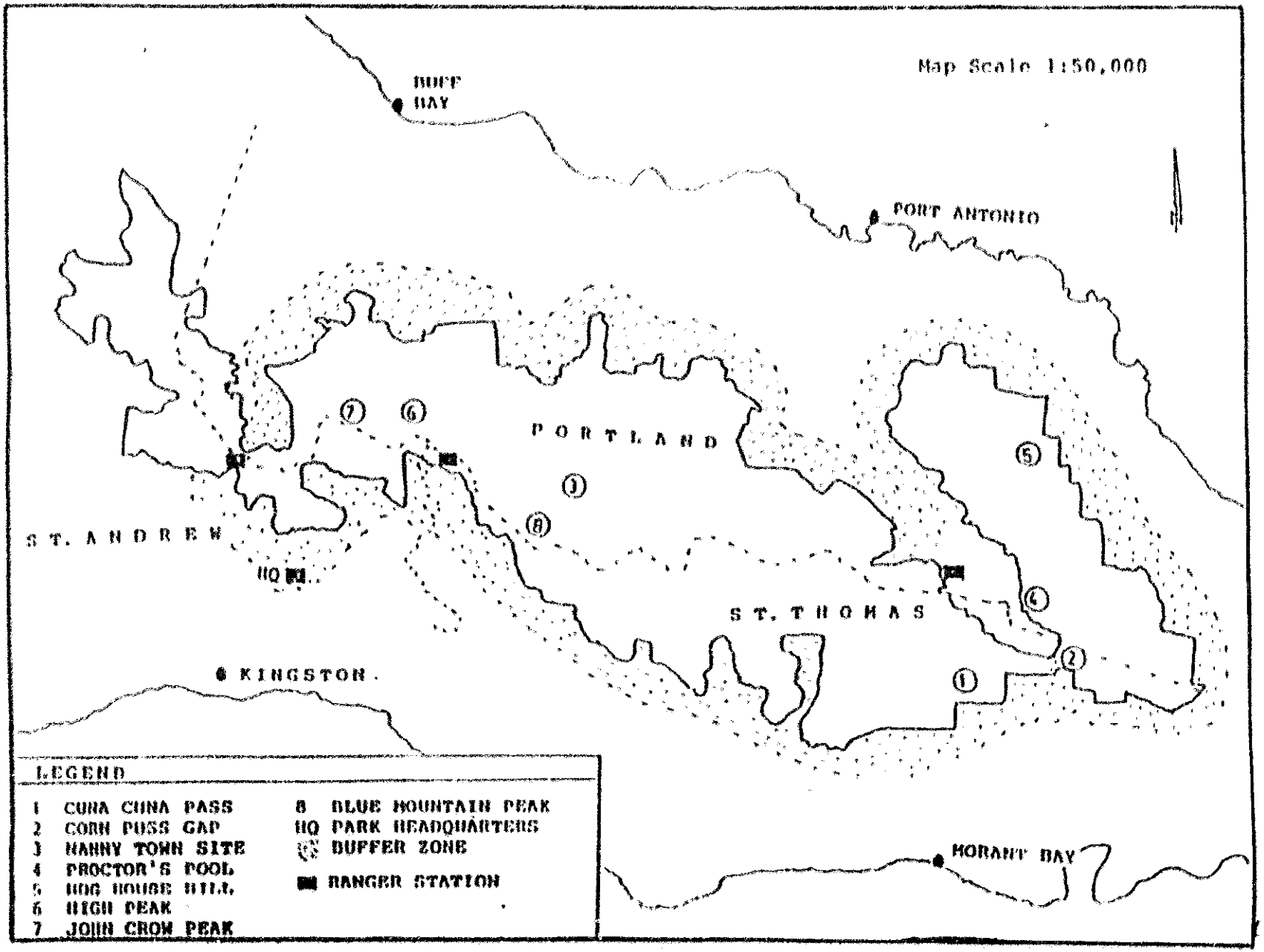


Figure 3: Blue and John Crow Mountains National Park
(Special Conservation Zones and Sites)

PARC provided funds to complete a study of management alternatives for BJCMNP using local and international assistance, develop a management plan based on study results, establish new park boundaries, hire a superintendent and staff, and develop a staff training program. PARC also provided funds for two 4 wheel drive vehicles, trail motorcycles and two-way radio equipment for ranger communications.

The evaluation found no evidence of a formal study specifically aimed toward management alternatives for the park. Previous reports, such as TNC's island-wide REA and Jamaica's 1987 Environmental profile offered recommendations for protected areas to be investigated in greater detail. The island-wide REA eventually led to the more specific REA developed and finalized for the BJCMNP in October, 1994. The JCDT with TNC help has drafted a BJCMNP management plan which at the time of the evaluation had yet to be reviewed and approved by the NRCA, PIOJ and other members of an inter-agency group convened for the task.

The evaluation team observed no coordinated training program for park staff. Although training goals for the national park system staff are set up in the JCDT work plans, the evaluation team found the content and organization of the training activities to vary widely. In 1991, some JCDT and parks division staff travelled to the United States for a park management course. Since that time, however, no formal training courses have been offered to national park system field staff under the PARC project. Two JCDT staff are currently pursuing academic programs in administrative areas. The 1993 Third Trimester Work Plan states that training has been provided to 21 staff of the national park system Protection Program and 16 staff of the Environmental Education Program. During interviews, several of the rangers from both parks expressed the desire to gain more experience and training, particularly in the areas of biological science and monitoring. The TNC has conducted short course on a range of conservation topics during PARC implementation but there are no explicit plans for continuing these efforts.

The NRCA parks division rangers began operating the park in 1992, with 6 rangers organized into three patrol zones. Each zone is equipped with two motorcycles. Personal inspection by the evaluation team found that living quarters at the ranger stations were spartan with no electricity or indoor running water. Rangers must bring all food and cooking fuel with them up a foot trail.

Both 4WD vehicles acquired for the park are used for management staff and therefore not consistently available for rangers patrolling or use. Because of the rugged terrain, equipment breakdown can be frequent. Down-time of the motorcycles has been extended given availability of parts. Rangers also report a lack of gear such as tents, sleeping bags, compasses, or rescue equip-

ment. This means that certain park areas get little and infrequent patrol.

PARC financed the purchase of communication base stations, accompanied by numerous mobile units. The radio system's usefulness is limited by the park's size and broken mountainous terrain. A repeater system is planned for at least one of the higher peaks, to improve communication between stations. Problems also exist with the current arrangement of sharing frequencies with police. A separate frequency was to be assigned the park but had not been arranged at the time of the evaluation.

The evaluation observed the road and trail access to the park to be adequate; the highway provides a good scope for developing visitor facilities at several entry locations. A public trail system is relatively well marked but heavily weathered and eroded in spots. Warning signs, distance markers and a few nature interpretation signs have been set up. A few signs remain from the period when the park was managed as a forest reserve.

The adequacy of facilities varies. A small picnic area at Portland Gap, a ranger station and out-buildings demonstrate to the public that the park is monitored and patrolled. Currently, the park staff is working with a local, private tour company to provide several overnight facilities for visitors at Portland Gap. A few forest service buildings remain that could be repaired and upgraded to provide additional covered lodging. Some small lodges have also sprung up around the edges of the park area for use by people taking day trips to the top of the peaks.

PARC helped capitalize an endowment fund, the revenues from which are managed by a national not-for-profit environmental NGO. The current commitment of most fund revenues to pilot park operations limits its support for other critical biodiversity conservation activities.

Under a debt-for-nature swap, USAID provided US$ 200,000 of PARC funds and the Puerto Rico Conservation Trust contributed US$ 100,000 for the Nature Conservancy (TNC) to purchase US$ 437,965.20 -- at about 70 percent of its value of $300,000 -- in Jamaican debt owed US and Canadian banks. TNC arranged the transfer of the debt to the JCDT which used the money to set up a National Parks Trust Fund (NPTF). On "Earth Day", April 22, 1992, the GOJ through the Bank of Jamaica converted the debt to "local registered stock" at prevailing exchange rates establishing a Jamaican $12.3 million fund on which the government makes interest payments in local currency. JCDT's staff manages the fund and budgets its interest earnings, with oversight from a 14-member Board of Directors, for conservation activities.

By helping create the NPTF, PARC has also contributed to institutionalizing financial mechanism for attracting additional capital assets to fund conservation efforts in Jamaica. Since Fund establishment, JCDT has obtained donations and capital subscriptions from several environmental foundations, foreign governments and Jamaican business firms to increase the Fund assets to nearly $US 1.2 million at the time of the evaluation.

Originally, USAID envisioned the earnings from the debt-for-nature-swap endowment to be used to finance a range of local NGO environmental initiatives. In practice, one national NGO, JCDT, has used most endowment earnings to pay operating expenses -- staff salaries, maintenance, repairs, logistics -- of the two pilot parks. JCDT continues to receive additional direct USAID payments under the second phase of PARC to pay for a share of other -- education, community development, fund raising, and administrative -- conservation activities. At the time of the evaluation, JCDT was conducting, with support from the second phase of PARC, a fund-raising campaign to capitalize the NPTF endowment to a level where it could generate revenues sufficient to replace USAID support when its funding terminates.

In addition to paying the costs of park operations, the NPTF and JCDT are a vehicle for NGO, private sector and government cooperation in biodiversity conservation. The JCDT Board of Directors includes among its membership, participants from Jamaica's professional consulting, development finance, manufacturing industry, recreational tourism and higher education communities.

The Fund still does not generate sufficient income to meet all necessary park operating costs and still allow JCDT conduct its other environmental activities. As a result, rangers have gone without salary increases and basic equipment -- sufficient camping gear or motorcycles -- to conduct their patrols. Also there are few funds budgeted for construction of new trails, nature interpretation centers or staff housing.

The evaluation notes that JCDT has also participated in arranging, under the Enterprise for the Americas Initiative a second debt-for-nature swap that involves the payment of a 3 percent interest on the remaining portions of US$ 54 million in PL 480 Food for Peace debt to the US government until the year 2010 when GOJ payments will be finished. The total potential capital accumulation of over $US 9.8 million will form a fund administered by the Environmental Foundation of Jamaica to support NGO environmental activities in Jamaica, including biodiversity protection. The significance of this additional debt-for-nature swap is still unknown. It opens the door to financing a range of environmental activities without the need to divert funds from meeting park operating expenses.

PARC funded the creation and initial operations of a Conservation Data Center (CDC) to inventory Jamaica's biological resources, monitor ecological conditions, and manage information. The CDC faces challenges in generating effective demand for its services and mobilizing funding from sources other than USAID to cover operating costs.

USAID assisted the GOJ in creating, equipping and staffing a Conservation Data Center (CDC) to provide technical assistance to the pilot parks in the form of scientific information, resource mapping, and monitoring. PARC arranged for location of the Conservation Data Center at the University of the West Indies (UWI) which makes space available for offices within the Department of Botany but provides no financial support to cover Center staff salaries or operating costs.

The CDC's structure and methods are modeled directly from The Nature Conservancy's (TNC) Conservation Data Centers, located in all 50 US States. Conservation data centers use a combination of electronic and manual filing systems to record data on "elements" of biological diversity (i.e. species of plants or animals, rare or unique features or biological communities). The approach used to locate and record data on elements is the basis for rapid ecological assessments. (See Box 1).

The CDC was very active in the early stages of PARC and accomplished several initial objectives. Within the first year, staff reportedly logged 1000 records for element occurrences in both National Parks and other locations throughout Jamaica, more than any other Center that TNC instituted system-wide. To date, the CDC has element occurrence data on terrestrial plants, vertebrates and 2 invertebrates, and marine hard and soft corals. CDC transferred plant data from herbaria at UWI and the Institute of Jamaica to electronic form in the biological conservation database, and developed a library of books and scientific articles relevant to Jamaica's natural heritage. Staff assisted the MBMP with the marine REA and other field monitoring activities.

Since 1993 staffing has fallen by one-half and can only provide limited support to the national parks. CDC cannot consistently produce maps for the parks or provide field assistance due to equipment, staff and fiscal limitations. While the CDC has provided service to private interests, income from this sector has been small. At the time of the evaluation the CDC still relied almost exclusively on USAID to fund its operations.

Centralized information to serve conservation management and monitoring functions within the park system has been acknowledged as essential since the early stages of PARC. The conservation database for Jamaica has been an important first step. CDC has yet

Box 1: Rapid Ecological Assessments (REA)

The Nature Conservancy (TNC) promotes "rapid ecological assessments" (REAs) as information tools for biodiversity conservation program management. An REA is a flexible process used to obtain biological and ecological information for conservation and resource management decision-making. REAs integrate a hierarchy of methods to produce maps of natural communities and descriptions of flora and fauna. The synthesis of information is the basis for development of monitoring programs and strategic resource conservation planning and management.

In Jamaica TNC introduced REA's for use in national park management plan development, and identifying areas of needed scientific research and monitoring. Assisted by USAID funds, TNC conducted REAs for both the Montego Bay Marine Park (MBMP) and the Blue and John Crow Mountains National Park (BJCMNP).

Surveys were followed by literature research, image analyses from aerial photography, and data analyses. The focus of the MBMP REA was characterization and assessment of the bottom communities (including coral reefs and sea grass beds) and mangrove communities within the park. In the BJCMNP, the REA covered a much larger geographical area, and built upon available information in the form of maps, photographs, written documents, and undocumented knowledge of scientific specialists and local people. Additional information such as satellite images, photographs and field surveys were then added to the information base.

The two REAs in Jamaica have provided important initial information for conservation planning. However, the products generated to date are only useful if they are consistently updated, integrated into management planning, and spawn effective monitoring programs for national park management.

Sources: Sullivan and Chiappone, 1994; Muchoney et al., 1994.

to benefit from and share data and expertise with an array of other organizations in the country. Potential partners and contributors to a conservation data network might include:

- The existing Conservation Database currently housed within the CDC;
- Separate databases and technical assistance from researchers (local and international) through UWI;
- Biological databases and technical expertise from the Institute of Jamaica;
- Specific monitoring databases generated by the NRCA or its affiliates;

- Specific monitoring databases generated by the MBMP science officer;
- Specific monitoring databases generated by the BJCMNP science officer;
- Databases generated by the Goss Bird Club or other private NGOs;
- Geographical and remote sensing data by the RPPU, UWI, or other sources.

Through the PARC and, more recently, DEMO projects USAID has fostered involvement of national and local NGOs in environmental clean-up and management initiatives that contribute to conservation of Jamaica's biological diversity.

Under the NRCA Act, NGOs are given a critical role in executing and assisting with enforcement of those provisions related to local environmental conditions. Local groups throughout the country are uniting to form a network of Environmental Protection Associations (EPAs) that provide outreach capacity for the NRCA in just about every region of the country.

While NRCA sets guidelines and standards for protected area implementation, the day to day role of operational manager is allocated to a partner (usually an NGO). In practice, the system for setting standards and allocating management authority to a designated 'operator' is new and evolving. To date, the PARC experience with JCDT is by far the most advanced model. JCDT is the only organization thus far to have received formally delegated authority. Moreover, JCDT and the PMU continue to provide NRCA with guidance as it attempts to put into place systems for monitoring and enforcing park regulations, generating and managing local funds and recruiting and training park rangers and administrative staff.

PARC, with TNC, has assisted JCDT in sharing park operation and management responsibilities with the NRCA. This NRCA/JCDT model is constrained financially, however; and is not yet solvent or sustainable. The National Parks Trust Fund established by PARC allows JCDT to finance the rangers, but PARC still supports salaries for MBMP and BJCMNP managers and administrators. Environmental and conservation NGOs in other regions of the country with potential parks or protected areas show interest in assuming park management roles but appear to be taking a more independent course toward developing operating plans and alternative funding. These initiatives are quite tentative but provide a good indication that the PARC NRCA/NGO model, with local modifications, is spreading if not yet sustainable.

Several local NGOs, for example, are moving toward direct management of protected areas or reserves in other regions. In the PARC project sites, the Hollywell Conservation Trust and the Montego Marine Park Trust have organized to assume some responsibilities now held by JCDT. These local NGOs seek to keep conservation actions more local and hopefully less costly through broader grassroots participation. The evaluation team visited two non-PARC protected area sites: Negril, The Coral Reef Protection Society and Port Antonio, The Portland Environmental Protection Association, which emphasize conservation education of local communities. These and others, such as environmental groups in the Black River and Trelawny areas, are beginning to undertake studies, implement small projects, and seek financial assistance in readying themselves for an enlarged conservation area management roles. While it is difficult to determine to the degree to which this groundswell of NGO involvement in biodiversity and park protection can be attributed to USAID support. It is clear, however, that the institutions created and strengthened by PARC play a critical biodiversity conservation role within the new national parks and protected areas system.

The evaluation notes, as a point of concern, that local environmental NGOs view "Kingston" (NRCA/JCDT) as reluctant to share its authority for park operations. They view Kingston's demands for comprehensive management plans as requisites to delegation of park operations to be a tactic for delaying NGO participation in park operations. In turn, they see JCDT as NPTF steward and NRCA partner, to be overtaxed in its ability to respond to and protect their interests as NGOs, if not to be on the look out for its own interests first and theirs last. To build more harmony into NGO and GOJ conservation efforts, the new USAID DEMO project is supporting a National Environmental Societies Trust (NEST) as a central clearinghouse, training and networking hub for the growing array of regional environmental NGOs.

PARC has promoted local advisory committees (LACs) as vehicles for introducing local participation in pilot park planning and management. LAC engagement in park operations has been uneven and sporadic, however.

For each of the pilot parks, PARC helped create or engage local advisory committees (LACs) to establish links between Kingston based rangers and staff and neighboring local communities whose members would be affected by new practices and regulations. The idea was to make management aware and responsive to community needs and concerns with respect to the parks. As such they were composed of a wide and sometimes conflicting range of stakeholders. Moreover, LACs were to serve as a means of communicating with and educating the local community about local conservation issues.

To address BJCMNP's geographic and economic diversity, PARC supported formation of three advisory groups from which to forge and expand partnerships between local interests and park management. The LAC in Montego Bay was established in 1989 as the PARC project was in its formative stages. The LAC initially reflected the interests of Montego Bay's water sport and hospitality industries and their longstanding desire to see the MBMP become a reality. During the PARC start-up the committee met regularly to discuss key park issues such as staff recruitment, research, monitoring, training, outreach, and insuring a lasting legal and financial basis for the park. The meetings provided a forum in which local commercial and conservation concerns were aired and transmitted to park and to the Kingston-based project management.

Some LAC members interviewed for this evaluation indicated that their committee's advisory role had little effect on Kingston-based park management decisions. Other members, particularly most fishermen expressed disenchantment with LAC participation and tended to view the committee as an elitist organization. To insure more direct control and to channel local financing capacity, some interests represented on the LAC initiated the Montego Bay Marine Park Trust, to raise revenues and fund park operations. At present, local frustration over not being heard and not having a substantive role to play threatens to undermine the foundations of LAC's as vehicles for engaging local groups in park management and protection.

The marine park management appears to have been more effective in involving locals when outreach programs were more narrowly targeted to a specific sub-group: dive operators support use and help place and maintain mooring buoys, spear fishermen are responding to the combination of rigorous patrolling with a skills training course for alternative livelihood activities; community groups inhabiting the inland valleys are being rallied around focussed conservation education and community action programs.

In BJCMNP the LAC's are composed of existing farmer organization and community groups, large coffee estate owners, guest house owners, and others such as tour operators. The disparity of social and economic backgrounds is not quite so great among members. But many of the same organizational problems exist, suggesting the importance of having a clear mandate, direction and authority are critical to substantive local involvement in park planning and operations.

The experience to date is mixed. The issue revolves around the extent to which LAC advice is acted on by park management. The JCDT park management staff recognizes that LACs seem to function best when they have a current issue around which to concentrate efforts. Without a pressing and unifying issue, the LACs cease meeting as was the case with two of the four PARC initiated LACs.

Technological Change

PARC has introduced "rapid ecological assessment" techniques to identify threatened areas in need of priority attention within the country's new national parks system. However, with the exception of a scientific fish monitoring program conducted for the past year within MBMP, neither of the new national pilot parks has prepared scientific monitoring plans for approval and implementation.

Using "rapid ecological assessment" techniques developed in its other programs (see Box 1), the TNC has helped park staff define the resource base, identify areas where land-use change is most likely to occur and where biological diversity is threatened. TNC completed its final report of the BJCMNP REA in October 1994, and recently presented the findings through a presentation held by the CDC.

Capacity exists within the Jamaican conservation community and its US and foreign affiliates to support research upon which effective monitoring programs can be based. The CDC could become a vehicle for mobilizing and directing conservation research and monitoring within the park system. At present CDC's biodiversity research and monitoring activities are poorly linked with Jamaica's scientific community and concerned NGO and government agencies.

Only MBMP has a scientific officer on staff, but currently, the officer has been assigned an increasing administrative and educational/outreach workload due to the resignation of the park manager. The officer cannot use rangers for field assistance because of their need to patrol park boundaries. To compensate, the officer has had to rely on volunteers to serve as field assistants, or dive alone (a dangerous risk when employing SCUBA). Reliance on volunteers can contribute to inconsistency in field sampling, both in scheduled frequency of monitoring and quality of data collected. Consequently, only one monitoring program (a standardized fish census) is consistently in place within MBMP. The fish monitoring program began on June 24, 1992, but data for this study have not been analyzed, reported or peer-reviewed. Preliminary review by the scientific officer indicate that the monitoring data do **not** support the general observations and claims of local fishermen and sports operators (i.e. no-fishing zones have resulted in obvious increases in the number and sizes of fishes under park protection).

Because bethic (or bottom dwelling) communities are the foundation of the park's resources, active and consistent monitoring is essential to guide park management decisions. Methods for systematic measurement of benthic communities -- a task specifically identified under the PARC project -- have been well established since the late 1970's and but were not implemented upon gazetting of the park.

The 1992 REA conducted in MBMP by TNC and the CDC sampled several benthic communities, providing useful species-level census, percent cover trends, and community characterizations. The survey established six sites for reef monitoring and 4 for assessing mangrove conditions. Locations of the study sites were recorded using global positioning system (GPS) coordinates, mooring buoy locations or triangulations. However, at the reef sites, these surveys did not mark or record **exact** physical locations where study plots can be revisited to detect change with high statistical confidence or power. Consequently, the REA's effectiveness as a long-term change detection tool as implemented is limited. Techniques for systematic benthic surveys are currently being tested by the scientific officer with assistance from NRCA. To date only pilot study plots have been established to test a quadrate photographic method, and proofs are currently being evaluated.

In the BJCMNP, there is no monitoring program to assess rates of deforestation or encroachment within park boundaries. A science officer is not assigned to develop and prioritize monitoring activities. The REA conducted within the BJCMNP was finalized by TNC and presented to the National Park program through the CDC in October, 1994. Data generated from this effort has provided a wealth of useful information (predominantly plant species and communities), recommendations for research and monitoring, and a basis for change detection studies. However, without a science officer on staff with an active plan, it will be a challenge for park management to constructively benefit from the information. Park management is considering the formation of a scientific technical advisory committee to oversee research and monitoring needs within the park; however, CDC has not yet form the committee and scientific monitoring is currently not supporting park management decisions.

Neither the CDC nor the National Park system has made active use of geographic information system (GIS) technology to inventory natural resources and to track changes in forest cover, urban growth, marine water pollution and other factors influencing park conditions. Moreover, with exception of the BJCMNP REA, there are no baseline maps describing general vegetation types, physical features, land use, hydrology, roads, streams and population distribution. From these data, maps of proposed biological corridors, critical areas for management and management zones can be developed. The CDIE evaluation team finds the recommendations on development of programs to inventory and monitor biodiversity the PARC June 1992 evaluation report to be valid. Appendix D contains additional recommendations for indicators to monitor park conditions.

PARC helped introduce improved marine resource management measures including zoning MBMP for fishing, recreation and marine life replenishment.

MBMP encompasses multiple uses that include a commercial sea port, water sports and recreation and artisanal fishing. Parts of the park are more fragile than others and parts, like fish breeding grounds and reef habitats, are particularly critical to maintaining ecological balance. In addition to demarcation, park managers introduced zoning as a means of regulating usage that was compatible with survival of park marine systems.

MBMP rangers have been effective in enforcing no-fishing zones from water and land-based patrols. Citations have been issued and illegal spear fishing equipment has been confiscated from those violating sanctuary areas. However, rangers currently are limited in their options for water-based patrol, given the current repair status of one of the patrol boats.

Specific use zones have not been broadly established in BMJCM as in the marine park; however, the evaluation team found boundaries to be well marked in high use areas. Little statistical information has been compiled on arrests and warnings of boundary violations issued by the park guards. The process of bringing legal action against violators is time consuming and done more to set an example. Currently, enforcement arrangements within the park are with local police, and arrest procedures are inefficient. Park rangers have to observe a violation and contact local police for assistance before pursuing with an arrest. This leaves ample time for violators to leave an area prior to arrest or citation.

PARC has introduced boat mooring buoys at MBMP to help park management, visitors and fishermen reduce damage to coral reef habitats. At BJCMNP PARC promoted a few sporadic efforts at alternative farming and soil conservation to improved buffer zone conditions that might affect park wildlife.

In 1990, mooring buoys were placed along the fore reef so that boats could tie to the buoys instead of setting anchor, thereby avoiding risk of physical damage to coral. MBMP started with 30 mooring buoys placed around the fore reef section of the park. In 1991 that number had decreased to 7, presumably due to buoys having been cut away from their mooring by local fisherman protesting placement. Today, about 17 mooring buoys lie along the main fore reef of the park.

The buoys require periodic maintenance, due to the wear and chaffing of lines, so it is expected that not all mooring sites originally designated will have markers in place. Furthermore, the buoys assist park management in controlling the frequency of

visitation to specific sites; buoy rotation can serve as an important management tool in conserving and restoring heavily used areas.

Awareness and Education

PARC's pilot efforts in MBMP and BJCMNP have raised awareness among most of the surrounding population that conservation of biodiversity has cultural and economic importance (e.g., greater employment and income through providing visitor services.

PARC did not have a specific awareness raising component or objective, but linked awareness, outreach and local participation with pilot park operations. For instance, park rangers, although largely engaged in patrolling and enforcement, have a visitor and local community educational role as well. The team observed the rapport between rangers and the local population in several instances and noted that they included imparting conservation messages as part of their daily work routine.

The project, especially in Montego Bay, supported outreach and public relations activities. At the time of the evaluation, PARC continued to fund a MBMP community outreach officer and an approximately $60,000 budget to carry out a conservation awareness activities to make local populations more knowledgeable about marine ecology, more concerned about the threats to marine life, and more motivated to adopt environmentally friendly practices with regard to waste disposal, recreational activities and removal of endangered sea life. Particularly in the first years of project implementation, MBMP was able to harness the local press to run a regular column and provide frequent news coverage to park related concerns. Based on an assessment of the PARC press clippings, the frequency of reporting has declined in recent years, apparently due to the departure of project staff.

MBMP staff also produced a descriptive program brochure which has expanded into an information packet. The packet includes a simplified discussion of the relevant legislation under the NRCA Act which bears on the marine park and its use. Although park staff have prepared several interpretative signboards, the provisional park headquarters has no space to accommodate their display. Public education programs through schools and community groups residing in the watersheds affecting Montego Bay had encouraged local populations to clean up garbage and litter, but these practices remained isolated. This outreach activity continues with the aim of permanently changing how the poorer residential communities deal with trash and sanitation.

In BJCMNP park, awareness activities were not organized under a formal program until late in the PARC project's first phase.

Since then, JCDT staff have conducted a conservation education campaign to build environmental awareness of and advocacy for wildlife preservation. As an example, the Jamaican swallowtail butterfly has been selected as the symbol of a Caribbean-wide conservation education campaign.

The swallowtail butterfly conservation education campaign contributed to the overall awareness and commitment to conservation aims in the Blue Mountains. One its most visible manifestations was the implantation of roadside signs (considered attractive) promoting the country's essential conservation message, "It is ours. Take care of it." The billboards, which include the logos of commercial contributors were fully subscribed with minimal solicitation. The following year, commercial subscribers renewed their contributions to the campaign spontaneously and voluntarily to retain their logos on the billboards. This continuing private support without demonstrates that a linkage between business and conservation has been established.

The billboard campaign was but one of over twenty actions aimed at increasing awareness and conservation value of the park ranging from sermons and school programs to music videos, the issuance of a conservation postage stamp, and legislative review. In all 8,500 butterfly fact sheets (explaining conservation legislation) were distributed, 30,000 school children were addressed, 2,000 bumper stickers distributed, a newsletter started and circulated. Over J$257,000 was raised through local sponsors.

The campaign was apparently effective. Pre and post campaign surveys involving over 2,000 respondents indicate greater awareness -- a drop from almost 30 to under 5 percent reporting not having heard of the park -- and greater understanding of the park's benefits -- for example, an increase from 11 to 27 percent among those expressing soil and water conservation as a reason that the park is important for people.

The pilot parks are serving as useful teaching tools for both park staff and rangers and for members of neighboring communities seeking employment as nature guides.

A number of educational methods and techniques can be applied by the GOJ toward achieving environmental education and awareness objectives. JCDT and the park service already engage local community groups in interactive park-based education programs. JCDT supports outreach projects to local schools. The objective of the education program within the National Park system is to provide information about the parks and their contribution to habitat and biodiversity protection.

This service might also be provided by the people who work in the parks...the rangers themselves....as well as trail guides and tour guides specially trained for the task. Resort operators and dive shops in Montego Bay and some trail guides around Blue and John Crow Mountain Park already conduct much of the environmental education of tourists in the national parks. The limited number of park rangers has meant that park guards spend most of their time controlling tourists and do not have the time to give nature interpretation tours to visitors.

Park guards currently have only limited substantive technical training in the area of natural resource management, either of which would encourage greater interaction with park visitors. To supplement ranger staff, Montego Bay draws on a corps of local volunteers to provide educational services. At the time of the evaluation, the Montego Bay Marine Park staff were conducting a three month nature tour guide training course for spear fishermen that included a spectrum of skills from wildlife identification to first aid and CPR. (See Box 2).

Box 2: Montego Bay Guide Training Course for Spear Fishermen

Montego Bay Marine Park is addressing the problem of public education by training and organizing local spear fishermen to be tour guides either on their own or as resort employees. The park conducted the tour guide course for Montego Bay spear fishermen between September and November 1994. Training has involved teaching anchoring techniques to avoid coral damage, skin diving, life guarding, and CPR.

The evaluation team interviewed two of the individuals participating in the current program, and found them to be largely motivated at the marketing prospects associated with the retraining. The fisherman also stated that their motivation for program participation was philosophically driven, so that their children might learn and benefit from resources within the park. However, because of the newness of the program, its success as a replacement of spear fishing as a source of income for participants has not yet been determined.

The evaluation team observed that environmental knowledge of private tour guides varies widely. While it appears that many of these private guides are motivated and well trained (language and attitude/behavior) to deal with tourists, others have little formal training in the natural sciences. The apparent trend toward use of freelance guides by tour operators, while economically rational, may not provide freelancers with the opportunity or the motivation to pursue further training. NGOs have produced and published trail guides and trail maps for use by visitors to Blue and John Crow Mountains National Park.

As a complement to nature interpretation by park rangers, PARC has supported initiatives to provide educational interpretation along park trails. The evaluation team observed that the frequency and c[illegible]nt of the trail signs is limited, however.

Policy Reform

PARC's most important contribution to policy reform has been the creation of national park system to address biodiversity conservation.

A national park system now has a legal foundation in Jamaica, thanks in great measure to USAID support throughout PARC implementation. The first conservation legislation approved under the Act was for the formation of the Montego Bay and Blue and John Crow national parks. (At the time of the evaluation this was also the only approved legislation under the Act.)

The Act offers a framework for formulating and implementing a spectrum of measures supporting biodiversity conservation in the future. The most critical, which are now under public review are national industrial, land use and forestry plans which would strengthen measures for controlling major sources of pollution affecting marine parks and causes of encroachment still plaguing terrestrial parks. While these policies and plans have yet to become codified in law, early successes of the Act in creation of two pilot parks have developed a momentum and sense of "can do" that merits sustained endorsement and support from USAID, other donors and NGOs.

PARC endorsement and support for NGO funding and operation of newly created national parks has helped the GOJ evolve a broader policy of popular participation in stewardship of the country's environmental agenda and natural heritage.

The PARC project called for the GOJ to involve local community participation in protected areas funding and operation. This has required reform in national resource management policy to transition protected forest and marine areas from government agencies -- forestry and fisheries -- to be overseen by the NRCA but operated by local environmental trusts.

The USAID has worked through PARC to obtain GOJ approval for concessionaires to conduct lodging, food and crafts sales operations within the parks. Currently a small contract with one buffer zone local NGO provides for cottage and trail maintenance within the park. Another group provides trail guides accredited to provide services to visitors hiking in the park. One issue is how to assure that local communities will participate and not get pushed aside by larger tourist hotel and resort enterprises.

4. EVALUATION FINDINGS: PROGRAM IMPACT

Impact on Practices

The evaluation looked for evidence that PAFC has changed practices and behavior of resource users (tourists, fisherman, Montego Bay watershed industries and residents, farmers in the park peripheries) in ways that improve conservation of biological resources contained within the Montego Bay Marine Park and Blue and John Crow Mountain National Park. The evaluation team examined practices both within and outside the parks that influence the quality of their eco-systems.

Inside the parks, the evaluation looked at: A) conduct of recreational users -- divers and dive shop and boat operators at MBMP and hikers and tour guides in BJCMNP; b) encroachment into the parks for illegal hunting or fishing, logging or shell collecting; and c) conduct of legal resource extraction -- mining, logging and farming on lands now within the park boundaries although sometimes not yet owned by the government. **Outside the parks**, the evaluation examined the effects of liquid and solid waste pollution from agriculture, industry, urban growth and recreational facilities.

Boundary demarcation and ranger patrolling have had a mixed impact on the behavior of recreational visitors to the parks. Awareness of park ecosystems is greater among visitors but cultural factors have affected how well this has led to more responsible actions.

The evaluation team was struck by the enthusiasm among tourism sector representatives for developing ecotourism operations based on the parks as attractions. This was expressed in several ways.

Dive shop, resort and beach concession operators were willing to provide land on which to locate a park headquarters and visitor interpretation center in Montego Bay. Resorts were installing more efficient septic tank facilities to handle waste water effluent returned to the marine park bay area. Several had offered to employ spear fishermen as guides once the graduated from a training course being conducted by the marine park at the time of the evaluation. Several NGO's sought to launch public awareness and education programs based on the park and at least two had already produced and were circulating guidebooks and wildlife identification publications. Two local companies had sprung up since park demarcation to offer trail maintenance and trail guide services.

All of these groups were driven by the investment, income and employment opportunities they say from the parks as attractions for

future tourist clients. Some also sought environmental grants to continue their operations. The extent of interest and the ease with which these firms individuals were entering the ecotourism market demonstrate the capacity and resources available in the private sector for promoting responsible biodiversity stewardship on the basis of economic self-interest. Equally promising were the informal and formal associations of resort operators, dive shop operators and trail guide enterprises that were emerging to promote their involvement in park management and use decisions.

Nevertheless, some park visitors continue to abuse park resources and to put themselves at risk because there is a lack of information on park regulations and a shortage of ranger staff to enforce proper behavior. Despite signs to encourage visitors to protect Jamaica's cultural heritage, evidence of graffiti and vandalism can be seen on the buildings and trails of Blue and John Crow Mountain National Park. Eroded hillsides reveal places where hikers have ignored signs cautioning to stay on trails.

Periodically, hikers are lost and must be rescued by rangers because they fail to follow trails. While the evaluation team was in Jamaica during a national holiday, five park visitors were lost in BJCMNP for approximately 24 hours, as a result of ignoring marked trails. Park rangers report that the attitude of many visitors is: "This is my park and I will do what I want." This is most apparent where it is evident that tourists have strayed from the main pathway, a process that is injurious to the natural communities adjacent to the trails, and potentially dangerous to visitors.

Available data suggest mixed but overall effectiveness of park demarcation and protection measures in reducing encroachment by fishermen, farmers and loggers.

The evaluation was unable to determine whether increases in the number of citations for illegal activities filed are leading to reductions in illegal natural resource use behavior by local populations. Rangers within the BJCMNP claim that encroachment by farming into park boundaries has been reduced. One former forest ranger disagreed and argued that buffer zone people respected the area more when it was under their stewardship. In the Blue Mountains, the evaluation team observed rangers awareness of new encroachments, and were directed by management to visit the farmers involved.

Rangers are unarmed and while in official "military looking" uniforms still feel uneasy about citing park abusers. Most encroachers, the vast majority of which engage in logging, are generally warned and have any equipment and cut timber confiscated. The process of bringing legal action against them is time consuming and done more to set an example. Rangers must request local police

to arrest violators after they witness an infraction which leaves ample time for violators to escape the scene before citation. When arrests are made, rangers must prepare reports and appear in court to testify as witnesses.

In the Montego Bay Marine Park, fishermen have become clearly aware of the Park boundaries and enforcement. Citations have been issued by park rangers enforcing no-fishing zones, and equipment has been confiscated after arrests or citations. The highest fine to date has been approximately $200.00, and over 12 sets of confiscated spear guns and related equipment were counted by the evaluation team at park headquarters. However, fishermen continue to encroach, shifting from day to night spear fishing, where yields can increase by ten-fold due to reduced activity of resting fish, and the easy prey of fish stunned by underwater dive lights).

Where fishing is allowed in and around MBMP, fishermen have yet to adopt practices, other than use of mooring buoys to, achieve more sustainable fish harvests.

Various fishing techniques are used in Montego Bay, such as trap fishing (usually employed by older men), seining and spear fishing (usually by young men). During interviews, the evaluation team found that fishermen are not well organized as a group, and opinions varied as to the impacts of their trade on fisheries.

Trap fishermen interviewed identified spearing as the biggest over-exploiter of the resource, whereas spear fisherman interviewed identified small-sized mesh traps, night spearing and shallow water seining as the most destructive practices. Trap fishermen appear to be aware of the increased mesh sizes used in Discovery Bay to reduce the harvest of fish before they reach breeding size. They also have some knowledge of fisheries management techniques proposed or practices elsewhere in Jamaica. (See Box 3). However, the evaluation team could find no evidence that any of these practices were adopted or even promoted in the MBMP area.

Park creation and demarcation has had only a limited effect on reducing practices of polluters outside the parks that currently threaten their terrestrial and marine ecosystems.

Perhaps the greatest problem in Montego Bay comes not from sea-based fishermen but from poor land use practices, urban, agricultural and industrial effluent and failure to enforce or comply with environmental regulations. During the course of the evaluation, interviewers reported campaigns they had participated in to halt destruction of fish breeding ground and remaining mangrove trees by developer seeking to construct buildings, dredge channels and otherwise modify the habitat. While successful so far

Box 3: The Jamaica North Coast Fisheries Improvement Project

In 1989, the Canadian International Development Agency (CIDA) provided funds for development of an innovative fisheries program in Discovery Bay, Jamaica. The program's objective was defined to "improve fish stocks and fish catches in the vicinity of Discovery Bay and ultimately elsewhere in Jamaica".

The program's main components defined the status of the fishery in Discovery Bay, identified problems and established a basis for solutions. The program also helped establish a local fisherman's cooperative to minimize expenses of fuel and equipment, engage in community development and education, and experiment with commercial algal farming as an alternative to fishing.

In defining existing conditions of the fishery, researchers combined applied sociology with fisheries ecology. Researchers invested time to know and learn from the local fisherman, and consequently established trust in conducting research.

Data on size classes and species composition of fish stocks were collected directly from commercial catches, and catch per unit effort (CPU) was determined from the data. Researchers conducted fish censuses throughout Discovery Bay, using a method that has since been adopted by the Montego Bay Marine Park in its fish monitoring program. Also, new measurement technology, involving ear otoliths of selected species, improved the researchers' capability for age estimates of catch.

Program findings influenced the design and successful implementation of a mesh exchange program in all but one of 47 active fisherman in Discovery Bay. The program offered a two-for-one materials exchange, to replace traps using 4.1 cm diameter mesh with mesh of 5.5 cm. The larger mesh size allows smaller fish to go free, thereby increasing the potential number of larger fish to reach adulthood and reproductive maturity. Through the trust established between fishermen and researchers during the study period, local fisherman chose to increase the mesh size of their traps, so that they might improve the CPU of their harvests.

Significant differences in fish sizes were reported between 4.1 and 5.5 cm mesh traps, and point to fish stocks having more larger sized fish after the mesh exchange program. Although an initial reduction in CPU was observed and remains variable, the length of fishes at first capture has increased by approximately 10 mm since the program began. Many external variables likely contribute to the differences observed; however, the program has generated enough interest to be replicated in other communities in Jamaica. Local fisherman in Montego Bay are aware of the larger mesh sizes, but few trap fishermen currently participate.

Source: Sandeman and Woodley, 1994.

at stopping development damaging to Bay marine life, local conservation groups expressed apprehension that they will not be able to sustain the vigilance and influence needed to avoid future recurrence of these attempts.

As the largest tourism center in Jamaica, Montego Bay is lined with hotels and related support services. Some light industry is found in the Bay area, with heavier industry being considered for future development. The human population of Montego Bay places heavy burden on its existing infrastructure, and problems such as solid and liquid waste management have mounted over the past thirty years. Of consequence to MBMP is mismanagement of liquid waste, particularly untreated agricultural and sewage effluent rich in nutrients. Obviously, the park's creation and management within boundaries cannot directly address such waste management issues. Education and outreach throughout Montego Bay, as well as effective regulation of polluters, appears the most effective strategy for slowing and ultimately reversing degradation of the park's resources.

In BCOMNP, habitat damage from the occasional spread of wild fires from field burning and use of agricultural chemicals appear to be the biggest problems. Increase in agricultural practices largely coincide with two factors: product price increases (i.e. bananas and coffee) and adjacent infrastructure for product transport. In the Blue Mountains, an increase in market demand for coffee over the past few seasons has increased the acreage converted to coffee production and encroachment into park boundaries has occurred. In the Rio Grande Valley, which separates the Blue and John Crow Mountains, banana production has also increased recently, but is closely tied with the existing road network, and has not encroached into the park. However, buffer zone lands in the valley are presently being converted from forested cover to banana production, and burning is a common practice in land preparation. Agricultural pesticide use within buffer areas is likely to have non-target effects on native species within the park, (i.e. butterflies) especially as farming encroaches further within park boundaries.

Biophysical Impact

Coral reef and forest habitat degradation continue to be a problem within the new national park areas.

Montego Bay Marine Park

Presently most communities within MBMP appear stressed. Observations indicating a stressed condition include:

the most common form of sewage disposal in the Montego Bay area, and this technology offers no treatment of waste, but relies upon natural breakdown of waste material as it passes through limestone substrate. Because tropical marine systems have been historically low in nutrient concentrations, the continued addition of nutrients is resulting in the biological change of nearshore communities. Research within the last tens years, suggests that observed domination of coral reefs by algal cover is largely tied to increases in nearshore nutrient concentrations (Bell, 1992; Lapointe, *et al.*, 1993).

One public sewage treatment plant exists in the Montego Bay area. It has been designed to handle 750 gpd of effluent; however, estimates as high as 5 million gpd have been made, with much of the waste water actually by-passing treatment. Large volumes of solid organic waste material have also been observed in the plant.

2. <u>Solid waste, storm water runoff and land development</u>: The MBMP staff has initiated solid waste cleanup campaigns, in an attempt to centralize collection locations. However, the central storm water canal in Montego Bay is a large repository for solid waste and debris. Heavy rains wash stagnant, polluted water from this canal system directly into the Bay.

Since 1989, the population of land squatters in the hills around Montego Bay, has increased by approximately 40,000. This has resulting in an increased deforestation of higher elevations surrounding the Bay. Land development, either directly adjacent to Park boundaries, or within the watershed, increases the percentage of surface storm water and sediment loading into the rearshore waters or rivers feeding directly into Montego Bay. Greater sediment loading to nearshore waters adds to chronic stresses on corals, which have to physically slough sediment from their surfaces to restore exposure to sunlight and feeding.

The elimination of coastal vegetation, such as mangroves, directly adjacent to park boundaries minimizes pollution filtration functions as well nursery habitat for marine invertebrates and fishes.

3. <u>Hotels, resorts and industry</u>: Some hotels in the Bay area are beginning to change their product usage to environmental friendly ones (such as phosphate free detergents) or practices (i.e. requesting patrons to reuse towels rather then have them removed daily for laundering). However, team members found the consistency of these programs to vary widely among area hotels.

Blue/John Crow Mountains National Park

The fragmentation or elimination of habitat is the most serious threat to conservation of biological diversity (Norton, 1986). To a large degree, the steep slopes and rugged terrain associated with BJCMNP provide a physical refuge for habitat protection.

Although illegal tree cutting in BJCMNP appears to have slowed since park designation, encroachment into the park by logging, mining and farming practices has not been eliminated or contained within buffer zones. The evaluation team found no evidence to substantiate increased citations for illegal encroachment into the park. Rangers reported using mild threats of sanction to give violators a grace period in which to modify their behavior. Encroachment for agricultural use is impractical on extremely steeps slopes, and crops, such as bananas, require adjacent roads for product transport.

The presence of invasive, fast-growing exotic plants, such as wild coffee, or opportunistic feral animals pose a significant threat to conservation of biodiversity. (See Box 4). In Jamaica, the introduction of the mongoose is potentially serious threat to endemic vertebrates, such as the Jamaica Boa, and bird eggs and chicks. Wild coffee (i.e. Pittosporum spp.) has already been documented as an invasive problem in the Blue Mountains, out-competing native plants for space within forests. There is currently no eradication program or action plan employed by the park system.

Rangers currently enforce a no hunting regulation within the park, particularly for wild boar, a non-native species. In other countries, including island communities, wild pigs have negatively impacted native plants and animal populations. No research has been conducted to establish whether the boar has been naturalized, or poses a threat to native plants or animals in Jamaica.

With the exception of birds, the BJCMNP does not harbor a great diversity of vertebrate species. However, invertebrates, and especially insects are much more abundant and diverse. For example, Jamaica has 120 species of butterflies. Only a portion of these species reside within the park, however, they along with other insects are important prey for birds. Reduction of insect populations through the non-target consequences of pesticides, would likely have immediate effects on insect populations, and subsequent effects on bird abundance and distribution within park boundaries.

Box 4: Exotic Species: Potential Threats to Biodiversity

The growth and competitive characteristics of certain species introduced to new environments (known as exotic species) create potential problems for native plants and animals, and ultimately the conservation of biological diversity. Exotics have been especially problematic for island communities worldwide, where endemic species have often lost competitive strategies to mainland counterparts over ecological time. From the 1500s to early 1900s, animal introduction to islands was a common practice among seafarers and pirates, as a source of food to and from destinations. During his voyage of the H.M.S. *Beagle* in 1836, Charles Darwin noted the effects of non-native species introductions on local flora and fauna of St. Helena island (south central Atlantic):

> "The fact that goats and hogs had destroyed all the young trees as they sprang up, and that in the course of time the old ones, which were safe from their attacks, perished from age, seems clearly made out. Goats were introduced in the year 1502; eighty-six years afterward, in the time of Cavendish, it is known that they were exceedingly numerous. More than a century afterwards, in 1731, when the evil was complete and irretrievable, an order was issued that all stray animals should be destroyed. It is very interesting thus to find, that the arrival of animals at St. Helena in 1501, did not change the whole aspect of the island, until a period of two hundred and twenty years had elapsed: for the goats were introduced in 1502, and in 1724 it is said 'the old trees had mostly fallen.' There can be little doubt that this great change in the vegetation affected not only the land shells, causing eight species to become extinct, but likewise a multitude of insects."

Today, introduced rats, goats, pigs, cattle and various pack animals have had drastic effects on abundance and distribution of native species, including extinction. For example, in the Galápagos Islands, Ecuador, feral pigs uproot the nests of giant tortoises and several bird species and eat their young and eggs. In Hawaii, The mongoose, originally introduced to control rats in sugar cane fields, has decimated ground-nesting bird populations.

Many exotic plants were originally introduced as ornamentals or for agricultural purposes. Exotic plants often quickly colonize sites disturbed by human activity, and can take advantage of disturbances caused by natural events, such as hurricanes and forest fires, to dominate over native species for space. As examples, three species of shrubs and trees have been successful invaders of [illegible]th Florida, including the Everglades. Brazilian pepper, (*Schinus terebinthifolius*), the paper or cajeput tree, (*Melaleuca* spp.), and the Australian pine, (*Casuarina* spp.) grow and reproduce rapidly, are resistant to fire, and easily pollinated by insects.

Some governments, such as in the Galápagos Islands, have implemented eradication or management programs to eliminate harmful exotic species, or to keep their populations low to minimize impacts on native species. However, once established, eradication of some exotic species has proved difficult, especially among plants.

Sources: Darwin 1839; Thornton 1973; Johnson and Olmstead 1982

Socio-Economic Impact

The parks have already proven to be a big hit among both domestic and international visitors. Pilot park managers have taken initial steps to increase recreational, educational and related benefits to park users by: preparing plans for nature appreciation programs, improving measures to assure safety of park users and budgeting funds to upgrade and maintain hiking trails, camping and lodging facilities.

Jamaicans, particularly those engaged in the recreational tourism sector, have been quick to capitalize on the newly formed pilot parks. The team has found numerous references to the parks in tourism literature distributed in Jamaica and the U.S. The parks are featured in excursions offered to guests by resorts and hotels. Jamaican residents flock to the mountains and beaches of the parks during week-ends and holidays.

The evaluation also detected certain simple steps that could be taken to increase the use and safety of the parks. Most of these are low-cost measures to implement; a few will require more significant investments to put in place and operate.

In BJCMNP visitor needs are already being met by a published trail guide with nature interpretive information. Locations where the guide can be purchased are limited, however, and its cost -- about $US 7.00 is high for some Jamaican visitors, especially school-age children. A simple map of main trails that could be handed out to all visitors would be a useful addition as would additional trail signs with clearer indications of walking distance between main points in the park. A nature interpretation facility with further instructions on how visitors should conduct themselves in the park could help reduce trail cutting that causes hillside erosion and getting lost which consumes ranger time in conducting search and rescue operations.

MBMP is in even greater need of warning signs against power boat use and literature on the fragile nature of coral reef sea life. Another need is for frequent water quality monitoring to alert swimmers to period when bacterial or sea life counts are at levels that can cause skin rashes, infections and discomfort. Several, MBMP visitors have reported skin irritations from swimming in park areas, a problem that can eventually lead to disenchantment with Jamaica as a tourism destination and a drop in revenues. MBMP also lacks a nature interpretation facility, or even a permanent headquarters facility from which park operations can be managed and which could become a tourist attraction from which to generate operating income.

Spear, trap and net fishermen have been those most adversely effected, in the short run, from creation of Montego Bay National Park. Restoration of their livelihood from fishing depends on the park's effectiveness at halting further pollution and regulating coastal land development that continue to destroy fish breeding and feeding areas, and on introducing sound fisheries management.

The most immediate and direct socio-economic impact of a marine park in Montego Bay has been negative by making a livelihood more difficult for spear and trap fishermen who harvest fish from the area. This impact has not been so great, however, because fish catches have been declining over the years due both to increased fishing activity and to greater damage to fishing breeding and feeding grounds from land-based pollution. Still some fishermen report that adjustment has cost them income.

The park has tried to compensate for this loss of livelihood in two ways. The most direct has been its efforts at training some fishermen as tour guides. MBMP staff were conducting such a training course for 10 spear fishermen at the time of the evaluation. The course, which covered marine life, first aid and CPR, and boat handling techniques, basic business finance and communications skills, was designed to make spear fishermen marketable among local resorts and diver operations. Indirectly, the park may have contributed to the restoration of fish populations and size of fish catch by providing a refuge for breeding and feeding. Anecdotal comments by fishermen and dive shop operators alike suggest that fish populations are up.

PARC has helped identify opportunities for new employment and income from providing services to tourists and park visitors to offset losses from restrictions against fishing, hunting, logging and farming within the parks.

The evaluation identified several costs and benefits associated with formation of the Blue and John Crow Mountain National Park. The most tangible costs have been the cessation of all logging, farming and hunting activity within the park. This cost may not be very high, however, since most of the park area is very mountainous and steep terrain not suitable for farming and difficult for logging and hunting. Some owners of lands within the park boundaries have been affected by restrictions that limit the sale of these lands only to the government, which at present has no resources to purchase them in the foreseeable future.

At the same time, several owners of land contiguous to the park have already begun to build lodging facilities for expected increases in visitors. Others to benefit are local groups that have formed trail guide and trail maintenance enterprises. The

location of the park in watersheds that supply irrigation water to coffee and sugar plantation and to the cities of Kingston, Port Morant and Port Antonio ensures that significant additional indirect benefits will derive from conservation of the parks as natural wildlife habitats.

More nature tourism investors are operating facilities around the protected areas. More employees of nature tourism operations and local community members are working as guides or as food and lodging service assistants. The evaluation team spoke with tour guides and resort operators at the park sites. All agreed that Jamaica's park system has been a big draw for the tourism industry. Tour operators and tour guides regularly take groups of tourists to where they can go for a walk in the rain forest or dive on the coral reefs. Resort operators, restaurants and craft shops have sprung up around the edges of national parks.

There is some evidence that creation of the parks is beginning to have an impact on the Jamaican tourism sector. A few jobs have been created during renovation of facilities within BJCMNP, and the resort owners and diver operators report that MBMP has definitely been a "tourist draw" for them. Still, there is ample scope for capitalizing on the parks as "ecotourism" destinations and as attractions for capturing more tourist dollars that can be used for park maintenance and operation.

At the very least the parks hold a key to increasing the share of Jamaica's tourist dollar -- in the form of salaries, services and goods (food, crafts, etc.) -- that reaches local communities. The evaluation estimates that Jamaica's share of the tourism dollar today is small, ranging between 10 and 20 percent or about $US 250 from a typical one-week $2,000 tour package. (See Box 5). This is due in part to limited linkages between the tourism sector and the rest of the national economy which lead to importing some conveniences -- food, drink etc. -- that can be supplied by the local economy.

A positive impact on local communities can come from jobs created by added tourist flows if local communities and groups can gain access to contracts for park maintenance and improvements and for operating food and crafts concessions. At the time of the evaluation, BJCMNP rangers and managers had worked out arrangements with one group, Top of Jamaica, to clean cabins and repair trails and with another, Rio Grande Trail Guides, accompany visitors to park attractions. MBMP, with its tour guide course for spear fishermen, was beginning to develop such linkages as well.

Box 5: How Eco-tourism Dollars are Distributed

A look at how the costs of a typical eco-tourism package are distributed gives an idea of how much impact on local communities -- in the form of salaries and services -- can be expected from the draw of the park system. A typical one-week package originating and ending in the continental United States breaks down as follows:

Item	Amount	%
Air transportation	$ 600	30
US tour commissions/fees	$ 400	20
Local tour commissions/fees	$ 200	10
Meals and lodging	$ 600	30
labor	$ 200	10
other	$ 400	20
Local services (transport, guides)	$ 100	5
Taxes (10% of local costs)	$ 100	5
Total	$ 2,000	100

5. EVALUATION FINDINGS: PROGRAM PERFORMANCE

Program Efficiency

PARC has not yet matured to a point where benefits demonstrate the project to be a cost-effective way to protect and restore Jamaica's terrestrial and marine biological resources.

PARC has laid the institutional and financial foundations for a national park system as a vehicle for conserving the country's biological resources. However, because so many destructive forces come from outside park boundaries, creation of a park system, demarcation of park boundaries, funding park staff and operations are insufficient conditions to assure the conservation of the biological resources they contain. This is particularly true for MBMP where PARC has helped highlight damage due to land based pollution and coastal urban/industrial development. PARC has neither the resources nor a mandate beyond its activist public awareness agenda to deal with these threats to biological diversity at MBMP. At BJCMNP threats also exist from buffer zone activities and from the "invasion" of certain exotic species that are out-competing plants and animals indigenous to the area. PARC has not directed resources to any ecological monitoring or natural regeneration work that would address this long-run threat to park integrity.

Since the parks are defined as inherently worthwhile, reducing management costs rather than valuing park resources and ancilary economic benefits is the principle issue. The willingness to pay of tourists and other park users has not been tested yet although it is certainly part of the long term strategy. The long term institutional plan calls for NRCA lease fees to fund its monitoring operation and for these lease fees to be justified by the value of lease to the park operator through the opportunities it generates for capturing local revenues.

Jamaica's first two parks do not yet have any system for generating a return on PARC project investments from the collection of visitor and user fees. The NRCA is reviewing entrance fees and fees for concession operators as arrangements for generating park revenues and reducing park operating costs but has yet to initiative them. JCDT has just begun to develop visitor services and infrastructure in Blue and John Crow Mountain Park as an incentive to attract more visitors and provide a basis for charging entrance fees. Similar measures are contained in the MBMP plan but JCDT has made no investments yet.

Where the potential for user fees to cover park operating costs is low, other funding mechanisms would be needed. The USAID debt swap has planted the seed of a sustainable source of conservation finance through the NPTF. If this fund can be adequately capitalized through additional large contributions and perhaps through a 'green' tax, then the efficiency of the new system will seem more favorable. Over time management costs can be expected to decline as new practices become the norm and self-regulation corrects most threats. The team witnessed this process taking place in Montego Bay, where a few restaurant owners had stopped serving lobster out of season one year. This lead to 50% stopping within a short time and informed observers postulating that the practice will be complete within a year. Voluntary adherence is definitely less costly than controlling restaurateurs and fishermen. At a general level, the simplified organizational hierarchy, the reduced role of government bureaucracy, and the involvement of local groups in management certainly constitute a promising point of departure toward an efficient approach to conserving the country's natural heritage.

Program Effectiveness

Small providers of local nature tourism services around the new pilot parks are the major beneficiaries to date from PARC investments.

The benefits from Jamaica's booming tourist trade have been captured, some would argue, by large resorts and hotel owners. A large percentage of international tourists to Jamaica either purchase all-inclusive packages in their country of origin, or have their lodging and meal arrangements made through major hotels and resorts. Scope for small local providers of goods and services have been limited.

Creation of the pilot parks appears to be opening up opportunities for more small participants in the tourism sector. Local communities and groups around the parks are attempting to capitalize on the natural advantages they have in catering to nature tourists -- intimate knowledge of the region and its resources, direct relationship with, or use of, resources, or a stronger cultural identity -- but are hampered by lack of capital, limited accounting or management skills, and inexperience with marketing and promotion activities.

The NRCA has yet to submit a proposal to increase local community and individual involvement in nature tourism operations. USAID has assisted small business owners and operators involved in tourism promotion through its private sector program. However, beyond creation of the parks themselves, the evaluation did not find that the PARC project has linked conservation efforts well

with small scale nature tourism development. Small operating grants, such as start-up funding for Top of Jamaica trail guide and tourist service and a marine tour guide training course for spear fishermen are examples of good starts in this direction.

The Local Advisory Committees are too frequently dominated by local elites to fully insure that local interests are evenly represented.

The LACs serve a useful role as vehicles for public oversight of park management. The PARC project paper refers to the creation of local management committees but during implementation the name was modified to reflect the actual role assigned to the diverse bodies. as local bodies. they reflect the specific socio-cultural and ecological characteristics of the areas they encompass. The MBMP LAC was created to serve the interests of water sport facility, hotel and related business owners whose aim was to rejuvenate the longstanding vision of a park in the area. From the beginning it failed to accommodate the concerns of the region's various fishermen. The project's final evaluation notes in Montego Bay that , "there were problems with unilateral declarations of intent which were contrary ... technical consensus" (IRF 1993).

Despite efforts to redress this imbalance, the issue persists. A leading spokesperson for the area's pot fisherman, who was introduced to the CDIE team as a key LAC member, actually claimed not to be on the committee but only to attend the meetings so, "I'll know what's going on." Because of this lack of balance, the LAC had not meet for the approximately two years prior to the CDIE evaluation.

Program Sustainability

Management structures put in place under PARC are not sustainable as currently institutionalized within the GOJ bureaucracy and NGO community.

PARC can be credited for getting a national park system "on the books" legislatively and creating the legal framework for setting aside national terrestrial and marine areas for the protection of their biological diversity. The evaluation finds cause for concern, however, in the lack of an institutional "home" within the government system for the two pilot parks and in the limited budget and staff of the NRCA's Parks and Protected Areas Division.

At the time of the evaluation, the two pilot national parks were operating under the direction of the Special Projects Division of the Planning Institute of Jamaica's (PIOJ) Projects Management Unit (PMU). The national park system plan prepared under PARC has

yet to be approved. In one draft version of the plan called for direction and management of the parks to pass to a proposed "National Parks Institute". Recent concern over the creation of "another bureaucracy" however, has left this proposal up for review. With no park budget or staff, the NRCA's Parks and Protected Areas Division has not participated in park operations beyond addressing issues such as land use policy, visitor fee and concession arrangements and additional park demarcation.

The country's overall biodiversity conservation program also remains heavily dependent on foreign donors for both further development and operating costs. Given its newness this should not be surprising. Still there is yet no clear plan or strategy to move it toward greater financial independence. The national parks have yet to draw on tourism revenues to cover any share of its operating revenues and improve financial solvency. At present the national parks depend heavily on revenues generated from its environmental trust for their development and operation. Neither park taps into revenues from visitors because there is no system for collecting entrance fees or a "tax" on services (lodging) used by those that visit the parks.

The JCDT and GOJ face continual challenges to their working relationships in operation and funding of a national park system. JCDT was established under the Foundations Law of Jamaica in 1989 and operates under various funding and cooperative agreements signed by USAID, JCDT and the Government of Jamaica. The JCDT may have control of financial resources but it has not authority to the complex land-use problems within and around the pilot park areas. Moreover, the two pilot national parks continue to operate without an approved national park system plan to provide direction and to coordinate among the different public agencies -- forestry, mining, agriculture -- that retain some jurisdiction over operations within or near them.

One bright spot in Jamaica's national park system development is a recent arrangement with the U.S. Forest Service to exchange visits and information on managing habitats shared by wildlife that make their homes in both countries. (See Box 6). Such networking arrangements are possible for Jamaica now that it has a national park system up and running.

Box 6: Sustainability Through International Networking
The US-Jamaica Sister Forests Partnership

PARC paved the way for the US Department of Agriculture through the Western North Carolina and Tennessee Cherokee National Forests to arrange a sister forests partnership with the NRCA, PIOJ, and the Forest and Soil Conservation Department. The US and Jamaica formalized the partnership agreement in May, 1994 to conserve biological diversity and promote sustainable development by improving long term management of the Blue and John Crow Mountain a National Park. USAID funds and manages the program's annual budget of under $50,000.

The US-Jamaica sister forests partnership is one of several such arrangements that USAID has helped put in place with developing countries around the world. In the case of Jamaica the arrangement arises from the recognition that through a common biological resource, migratory birds, wildlife habitats in both areas are directly linked. The partnership will support long term sustainability of BJCMNP by helping park management across a wide range of technical areas including: inventory, research and monitoring; watershed management and soil conservation; ecotourism, recreation, and interpretation initiatives; environmental education and community participation;

The arrangement also includes provision for support to NGOs involved in the park's management. Already park staff from Jamaica have undertaken observational study tours in Nantahala National Forest where they were exposed firsthand to US approaches to trail, timber, and recreational management. Future plans call for the new BJCMNP manager and one representative of the parks division of NRCA to attend an NGO sponsored "Watchable Wildlife" conference in the US and follow this visit with a study tour of the recreational management systems in the southeastern US forests. Despite being new and requiring further nurturing, the sister forests partnership provides evidence that the GOJ's biodiversity conservation program is making some progress toward sustainability.

Long-run financial solvency of the Jamaican Environmental Trust Fund is uncertain given the present structure of its asset portfolio and absence of a strategy for furthering its capitalization.

The first phase of PARC concluded without formulating a strategy for moving the Fund toward financial sustainability. A plan was nearing completion, however, at the time of the evaluation. While financial sustainability is a difficult term to define let alone a condition to achieve, basic objectives and guidelines can help improve prospects for financial solvency.

The evaluation was troubled, for example, that the staffing of a position for capital fund raising had run into difficulties because of constraints on how USAID money could and could not be used for such purposes. While a fund-raising arrangement between

USAID and JCDT was emerging under the second phase of PARC, an asset growth strategy had not.

Fund reliance of government debt is also a matter of concern because of the precariousness of the country's public finances. The rate of interest earned on government debt is set by the Finance Ministry and according to some financial analysts generally falls below annual inflation rates. Over time, this would lead to a decline in real annual Fund earnings and revenues for park operations. JCDT has already tried to compensate for limited Fund earnings by limited the growth of staff, deferring park ranger and Trust staff salary increases and minimizing investments in park upgrading and maintenance. These actions, however, only delay hard financial decisions and pose an undue burden on the key people needed to operate the parks.

As presently demarcated and managed neither of the two pilot parks provides for long-term viability of their marine or terrestrial biological resources.

Efforts are underway to expand and consolidate BJCMNP with more land acquisition and provision of biological corridors, but the invasion of exotic species, and continued encroachment into park lands threatens viability of some plant and animal species.

Given the physical size of the park, current management has little alternative but to focus on areas most frequented by tourists. In 1992 an estimated 50,000 people visited BJCMNP. As tourism increases, so will threats to the biological communities, especially near heavily used areas. Integrating biological monitoring programs into daily park management will be essential in conserving park resources. The benefits of monitoring are more than scientific; they aid management in determining the best application of limited resources. At present, the evaluation team found monitoring and its integration into management to be a lessor priority compared to regulatory and outreach initiatives.

Around MBMP pollution and disruptive land use practices are affecting nearshore water quality, resulting in stark changes of nearshore marine communities. Solutions to such problems lie outside of the parks' physical boundaries. Founders of the marine park and MBMP staff have been well aware of the external problems which affect environmental quality within the park, and have made attempts to address them through outreach and education. However, the biological survival of Montego Bay and other marine parks in Jamaica will largely depend on a concerted national effort to reverse land based pollution of marine habitats by urban, industrial, mining and agricultural activity. Until such national programs are implemented, or local initiatives reach levels to change practices around Montego Bay, the quality of MBMP will remain largely at the mercy of surrounding environs.

Program Replicability

Several conditions unique to the two pilot park's raise questions about how applicable the PARC conservation approach will be elsewhere in Jamaica.

The two pilot parks offer useful lessons in helping Jamaica move up the biodiversity learning curve. Each has a unique set of problems and challenges around which skill and experience at parks and protected areas management can be built. Some of this experience will be useful when decisions are reached to incorporate other protected areas into the national parks system. At the same time, these two pilot parks have unique features that limit the replicability of the approached to biodiversity conservation promoted by PARC.

Blue and John Crow Mountain Park has lands and a topography not suitable for uses other than wildlife habitats, watersheds or tourist attractions. The park is largely steeply sloping areas with dense tropical vegetation. Some logging and farming have taken place in lands now incorporated within the park but further expansion of these areas is limited by physical barriers. In other parts of the country where park lands could be used for purposes other than wildlife habitats, the PARC model may encounter resistance in neighboring communities seeking access to the same lands for logging, farming and other means of livelihood.

Montego Bay Marine Park has a rich array of resorts and hotels at its doorstep all with a vested interest in seeing that the park does not fail. Missing only is local leadership with vision to tap the support of this sector to address the land-based threats to the park's viability. There is no shortage of resources for park restoration and protection in Montego Bay.

Good roads and proximity to major population centers make the two pilot parks attractive tourism destinations that can bring in significant sources of operating revenues from entrance fees with the potential to function as the "cash cows" for the country's national park system. No other protected areas have visitor rates approaching those of the Montego Bay Marine and Blue and John Crow Mountain Parks. Still, there area other marine areas and some more remote terrestrial areas that are also becoming major tourist draws. The future challenge is finding mechanisms for raising revenues locally to manage these areas on a sustainable basis.

Expansion and consolidation of the land based national park system are limited by tenure issues and lack of funding to purchase title to private lands.

Successful land tenure reform is unlikely to occur where funding for land acquisition is a problem. In the absence of

willingness by private owners to sell or release lands for incorporation within the park, a share-ownership arrangement among owners of natural park lands may be one potential vehicle for building protected areas in other locations.

Future flows of foreign donor and international NGO funds into Jamaica and to other countries are not likely to reach the levels enjoyed in the last decade, unless major donors, or mechanisms such as the Global Environmental Fund, can mobilize the financial resources. Demands on existing environmental trust funds for addressing other environmental problems facing Jamaica will also compete with those for expanding biodiversity conservation efforts.

Perhaps the most positive feature of the Jamaican program is the resilience of local private groups to mobilize people and resources to address environmental problems they perceive. Given the limited financial and administrative reach of the Jamaican government in the near future, USAID could do well to foster, directly and through US environmental groups with which it works, local private initiatives around the island to address critical environmental problems that affect both the Jamaican population and the biological resources with which it coexists.

6. LESSONS LEARNED

Protected areas programs work best when they have clear goals or visions (e.g., park creation, education, tourism, habitat restoration) to build and sustain support for conservation of biological diversity.

Jamaica's early success with the formation of a national park system resulted from having a clear goal: demarcating and operating two pilot park habitats for endangered wildlife. The evaluation detected that local environmentalist groups, like occupying armies, have been hard pressed to sustain momentum and interest now that parks have been formed and the more mundane tasks of daily park operations -- staffing, maintenance, visitor supervision, wildlife monitoring -- confronts them. In some respects, their interests have turned to "concurring" other protected areas in the name of biodiversity conservation and away from consolidating gains so far to assure sustainability of the newly created parks.

It is apparent from interviews that a vision and leadership are needed for the parks to sustain interest and support. In the case of the marine park that vision could be one of restoring degraded coral reef habitats through aggressive measures at land-based pollution control while extolling these efforts among tourists to generate increased visitor fees for park operation and restoration. Such visions can serve as rallying cries for both domestic and international supporters and create "friends of the parks" constituencies that will further enhance awareness and change practices that lead to park degradation without the government needing to resort to draconian regulatory measures that often alienate rather than rally support for conservation.

USAID must be prepared to make a long-term commitment to countries where it supports biodiversity conservation programs that call for creation and management of park systems.

USAID through PARC set about an ambitious agenda and accomplished most of it during the three years of project implementation. With a park system plan still to be approved and an environmental endowment still short of resources to continue program operations, the mission found it necessary to launch a second PARC phase to consolidate progress and sustain momentum. PARC, perhaps, should have been designed for implementation over the longer period needed to create the legal, institutional and financial basis for a park system but also to train and equip staff to assume full operation of a park system. The "pilot" nature of

the first two parks attests to the fact that the first phase of PARC was only long enough to set up and test a system.

In Jamaica USAID can still play a critical role in arbitrating among various interest groups as they work to resolve issues over further expansion of the national park system and consolidation of current park operations. USAID can also buy time needed for reaching a consensus over where new directions in biodiversity conservation are most needed. Finally, USAID can help still stumbling new organizations such as the CDC gain a credible place in the process of biodiversity conservation and to build an effective demand for their services. All these needs suggest that USAID should be examine first if it is prepared to continue its involvement and commit the staff resources over a sufficient period of time and at a sufficient level to achieve lasting results.

Measures to address external threats from pollution, etc. must accompany demarcation and operation of parks for sustainable conservation of terrestrial and marine ecosystems.

Demarcation and management of MBMP clearly indicates that national park creation alone is not enough to assure conservation of the wildlife and the habitats they are designed to protect. USAID most also focus on addressing the land-based problems such as pollution and coastal land development that destroy near shore habitats and degrade fragile marine ecosystems.

To do so requires going outside the framework of a park system to engage other sectors -- urban, industrial, commercial, mining, agricultural -- in the process of conservation. Parks and protected are can serve as places to launch campaigns for environmental clean-up and changes in their ecosystems can serve as indicators of progress in pollution control. But solid leadership willing and capable of engaging all contributors to park degradation is critical to effective use of parks and protected areas for sustainable conservation of biological resources.

APPENDIX A

EVALUATION PROCEDURES

CDIE assessments of environmental programs are aimed at answering two central questions: "Has USAID made a difference?" and, if so "How well did it do it?" The central hypothesis of the environmental assessments is that USAID, through the right mix of program strategies, can impact on local conditions and practices to produce favorable long-lasting changes in the bio-physical environment and on the socio-economic welfare of cooperating countries. This Appendix describes the process used to test this hypothesis in USAID programs aimed at protecting biological diversity.

Impact - How much?

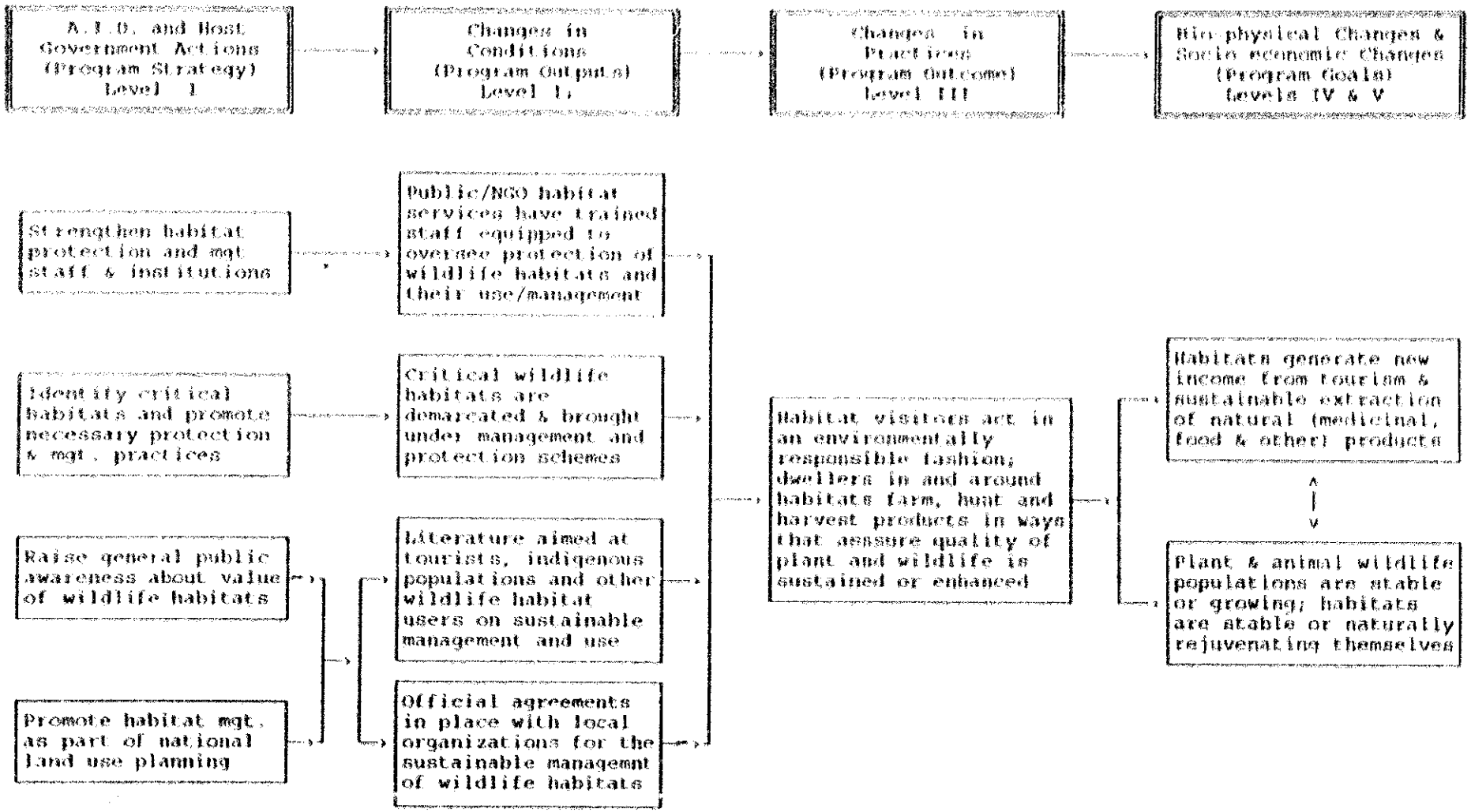
The assessment seeks to establish plausible associations between USAID program strategies or activities and the benefits to the human population which result from improved environmental quality and better natural resource management. In answering the first question, "Did USAID make a difference?", the assessment has attempted to document what happened or can be expected to happen from USAID assistance. The evaluation examines the relationships between environmental impact and USAID program investments using a five-level analytical framework (See Figure A-1.)

In the assessment framework, **Level I** describes the **"program strategies"** that USAID and the host government employed to conserve biological diversity through forest and marine habitat protection programs. These strategies include: strengthen habitat protection and management staff and institutions, identify critical habitats and promote necessary protection and management practices, raise general public awareness about value of wildlife habitats, and promote habitat management as part of a national land use planning.

The information is collected and organized in terms of four, cross-cutting strategies employed by USAID: 1) strengthening institutional capacity; 2) introducing technological change 3) fostering environmental education and awareness; and 4) adopting environmentally sound economic, regulatory, and tenure policies. The operating hypothesis is that by successfully carrying out development programs that create enabling conditions in these areas or .by successfully recognizing and building on pre-existing conditions, meaningful progress toward the conservation of biological diversity will be made.

Figure A-1: Framework for Assessing USAID Bio-Diverisity Protection Programs

(Focus of Forest and Marine Wildlife Habitats)



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At **Level II, "program outputs"** are the conditions that have resulted from implementing these strategies. Examples include: public agencies or NGOs services have trained staff equipped to oversee protection of wildlife habitats and their use/management,critical wildlife habitats are demarcated and brought under management and protection schemes, literature is published and disseminated to tourists, indigenous populations and other wildlife habitat users on sustainable management, or official agreements are in place with local organizations for the sustainable management of wildlife habitats.

The **Level III "program outcomes"** resulting from changes in Level II conditions are the adoption of practices and technologies by target groups. Such changes in practice include: habitat visitors conduct themselves in an environmentally responsible fashion, dwellers in and around habitats farm, hunt, and harvest products in ways that assure quality of plant and wildlife is sustained or enhanced.

Level IV and V "program goals" constitute the biophysical and socio-economic changes expected to result from the adoption of Level III program outcomes or practices. Level IV and Level V goals can be viewed as mutually supportive; each contributes to the sustainability of the other (and in many respects each flowing from the other.)

For the purposes of the evaluation, **Level IV "bio-physical goals"** are the specific environmental objectives of the program being assessed. Level IV indicators measure environmental conditions and biophysical changes that contribute to producing the strategic objective. Such changes would include: plant and animal wildlife populations are stable or growing, or habitats are stable or naturally rejuvenating themselves.

Level V "socio-economic goals" represent the development goals and are generally associated with sustainable increases in income, profits, remunerative employment, overall well-being, or production. While access to income data is difficult, the continued involvement of beneficiaries in the program can be used as a "vote with their feet" proxy indicators of improved farm incomes and profits, at least at the time of the evaluation.

Performance Scales: How well?

In answering the second question, "How well?", CDIE's primary concern is the **efficiency, effectiveness, sustainability** and **replicability** of the program.

Where data exist, the evaluation measures program **efficiency** by using monetary estimates of the flow of benefits to calculate an economic rate of return for those USAID and host government program

investments to which benefits can reasonably be attributed. Because benefits occur into the extended future, their value must be annualized and adjusted to net out all costs and expressed as a discounted net present value to compare with project investment.

To assess program **effectiveness**, the evaluation examines how well USAID sponsored techniques or services are reaching intended target groups and whether there is equity or bias in access and participation by these groups. Examples of effectiveness indicators include the make-up of participating groups according to resource endowments and social status (e.g., farm size, gender)

The examination of **sustainability** is important at all program levels (See Figure A-1). Evidence of sustainability includes the continuation of activities, regulations, or institutions beyond the termination of USAID technical and financial assistance either on their own "internal" momentum or with host government or other donor assistance. At the conditions level II indicators include how long NGO's have continued to operate independently of outside support or how successful local NGOs have been in obtaining outside funding support for their operations. At the practices Level II indicators include the economic viability of new enterprises introduced to dwellers around the perimeters of protected areas and the financial soundness of park management and protection programs. At the bio-physical Level IV indicators include evidence that native plant and animal populations are stable and growing, invader species of exotics are under control and that feeding and breeding grounds are remaining in or returning to their natural state.

To determine the **replicability** the evaluation examines whether conditions and practices, promoted by the program, have spontaneously spread beyond the target areas. This spread may occur among participants by "word of mouth" or other means without further outside support, or "induced" by public, private or donor agencies which have picked up on a USAID supported concept. Replicability indicators include the number of similar activities supported by local or international agencies outside the program target area and population; number of participants outside the target area that have adopted in sum or in part USAID sponsored practices.

Data collection procedures

CDIE employs a variety of primary and secondary sources of data to: construct the chain of events linking program activities and to impacts; examine major evaluation issues; and identify lessons learned.

In preparation for the field work CDIE collected and analyzed relevant secondary data and information that are available in Washington or in host countries from a range of sources including

project documents, technical reports, and special studies (available with the Agency's Development Information System).

CDIE's fieldwork methods combine an examination of changed and changing conditions at the national policy, planning and institutional levels with a more in-depth evaluation of one case where a site-specific protected area program has been operating with USAID support. Data collection methods included key informant, focus group and informal interviews, direct observation and analysis of secondary sources

Evaluation data collected in the field will form the basis for a country case study synthesizing lessons learned from USAID programs in fostering conservation of biological diversity through protection and management of protected forest and marine habitats. The case study experience will in turn contribute a global assessment of USAID biological diversity.

In addition to a review of program and project documentation (see bibliography of all documents cited in this assessment), data collection includes field visits to document implementation efforts. These include non-statistical evaluation of the biophysical state of habitats under improved management practices and a comparison of conditions in areas that have not experienced USAID supported interventions.

Following each field site visit, participating team members gather to discuss their findings. A structured checklist is applied to these discussions to ensure team consensus on key points related to program performance. In addition, the team develops a roster of key technical, institutional, social and economic indicators for evaluating program impact at each site. The team members use this roster to strengthen their consensus on the assessment of field site. The consensus building checklist and the key indicators lists are attached in the following pages.

APPENDIX B

PROFILE: JAMAICAN CORAL REEFS & MONTEGO BAY MARINE PARK

[Note: The contents of this appendix were taken largely from the following sources: The Nature Conservancy-Rapid Ecological Assessment of the Montego Bay Marine Park, Jamaica, Technical Report, January 1994 Draft. Hughes, T.P. 1994. Catastrophes, phase shifts, and large-scale degradation of a Caribbean coral reef. *Science* (265) 1547-1551. Montego Bay Marine Park Draft Management Plan, December, 1992. UNEP/IUCN 1988. Coral reefs of the world. Volume 1: Atlantic and eastern Pacific. UNEP Regional Seas Directories and Bibliographies. IUCN, Gland, Switzerland and Cambridge, U.K./UNEP, Nairobi, Kenya. Editing and additional citations were incorporated.]

Background

Jamaica (17 N, 77 W) is the third largest island in the Caribbean, measuring 235 km long and 80 km wide. The major axis of the island is oriented east-southeast to west-southwest (see map in Introduction chapter). Jamaica lies in the belt of northeasterly trade winds which produce a semi-continental climate in the elevated central interior regions (e.g. Blue Mountains). On the northwest coast, surface winds blow from a northeasterly direction. Coastal surface water temperature varies from 24 C in January to 28 C in July. Two wet seasons occur during October and May, while the dry seasons occur during February and March.

The marine environments of the Caribbean region are united by the Caribbean Sea. Dispersal and recruitment patterns for larvae and propagules result in uniform and wide distribution of flora and fauna in the tropical western Atlantic. Jamaican marine fauna have been historically richer compared to Floridian waters.

The tidal regime in Jamaica is irregular and ranges between 20-36 cm. There is a well-defined westward current on both the north and south coasts; this current is more pronounced during the trade wind season from April to December.

Geologically, the island of Jamaica is a low dome built upon a core of upper Cretaceous rocks overlain by a sedimentary mantle ranging in age from eocence to present. Jamaica can be divided into two main blocks; an eastern block (including the Blue Mountains) and a central/western block containing faulted and eroded plateau of Tertiary limestones. More than 2/3 of Jamaica is covered by limestone.

Coastal formations on the north shore are hermatypic (reef building) limestone of Miocene to Pliestocene age, while the south coast of Jamaica consists of older limestone and recent alluvial deposits that fan out from the central highlands. The offshore shelf on the north coast is very narrow; the 30 m contour usually lies less than 500 m from shore. The south coast, between Kingston and Savanna-la-Mar, is characterized by a broad, insular shelf up to 20 km wide, and extensive alluvial plains between limestone hills, drained by many rivers. Two large and important shallow banks lie off the south coast: the Pedro Bank to the south-west and Morant Cays to the south-east. These small isolated islands are poorly known biologically, but are important fishing and bird breeding areas, with impressive and healthy reef development.

Coral Reefs

Coral reef ecosystems of Jamaica are specialized environments which chemically convert dissolved calcium carbonate by living organisms into insoluble calcareous material (Goreau and Goreau, 1973). In other words, corals and certain species of algae lay down skeletons which contribute to the physical formations known as reefs. Though animals, coral polyps live in symbiotic association with small single-celled plants known as zooxanthellae. The importance of the symbiosis lies in the tight chemical cycling between plant and animal in response to nutrient deficiency, particularly nitrogen, in tropical waters. The importance of this symbiosis is also clearly reflected in the morphology of many corals, a number of which are plantlike in their growth forms, maximizing their surface area and orientation toward light (Porter, 1976).

Along the north coast, spectacular coral formations have developed on top of a bottom topograpny largely created by a descending series of Pleistocene land surfaces, cliffs and terraces formed during past "ice ages" when sea level was lower than it is today. Reefs fringe most of the north Jamaican coast along a narrow (<1 to 2 km) belt and occur sporadically on the south coast on a much broader shelf (< 20 km).

Jamaica lies at the center of coral diversity in the Atlantic Ocean. Over 60 species of reef-building corals occur, four of which are historically spatial dominants: branching elkhorn and staghorn corals, *Acropora palmata* and *A. cervicornis*, form two distinctive zones on the shallow fore reef; massive or platelike star coral, *Montastrea annularis*, which is the most important framework coral; and encrusting or foliose *Agaricia agaricites*. Sea-grass beds and mangroves are often closely associated with reef areas and provide significant nurseries for commercially important reef fisheries.

Jamaican reefs have been extensively studied and represent a unique type of reef system in the tropical western Atlantic. Coral

reef community structure along the north coast of Jamaica has been well documented, particularly in Discovery Bay, 60 km to the east of Montego Bay. Reefs throughout the north coast consist of historically well-defined biotic zonation patterns reflected in a distinct species composition controlled by many parameters, such as depth, wave energy, light attenuation. Moving from shore, a general model of reef zonation for much of the Jamaican north coast contains the following characteristics (Fig. B-1):

* a back reef lagoon, often containing isolated coral patches and seagrass beds;

* reef crest and rubble zone, historically colonized by large elkhorn coral, clubfinger coral and fire corals;

* spur and groove formations--large seaward-extending coral features, separated by sand channels;

* staghorn coral zone--compared to shallower depths, a lower wave energy environment allowing development of more fragile coral morphologies, such as staghorn coral (*A. cervicornis*). The fast growth rate of this species has resulted in dominant stands where conditions have been favorable;

* deeper reef slope and deep fore reef--often characterized by large sponges, and massive and plate-like coral formations.

However, within the last 40 years, human activity appears to have affected historically documented zonation patterns (Hughes 1994; Goreau 1992). Recent research has identified drastic reduction in percent cover by live coral over a 30 yr period (Fig. B-2). A combination of several factors are considered responsible for the changes in zonation observed in Jamaica's coral reefs (Hughes, 1994). The change identified is a shift in dominance from reef building corals as the primary space occupiers to reefs dominated by macro algae (Fig. B-3). Factors attributed to this change include overfishing, recent damage by hurricanes in 1980 and 1988, severe reduction in population of an algae grazer by a Caribbean-wide disease (the sea urchin, *Diadema antillarum*), and pollution of nearshore waters.

Jamaican reefs are heavily overfished. The reef fish community has been altered and the relative abundance of certain predators, herbivores and other other grazers has been changed (Munro 1983; Lessios 1982).

Since the 1960's construction and engineering work along the north coasts has generated high temporary sediment loads, a condition physically stressful to corals. Infrastructure for sewage treatment is inadequate for the general population, and many large

hotels discharge relatively untreated effluent directly into nearshore waters.

Tropical marine surface waters are typically clear, unproductive and low in nutrients. Research documenting increases in nutrients to coral reefs from domestically derived sewage and measurement of rapid growth responses by algae on the reefs is considered by some researchers to be the dominant factor (Bell 1992; Lapointe 1993, personal communication; T.J. Goreau, personal communication). Recovery of reefs to historically high percent coverage by corals is likely to be directly linked with a reduction in nutrient inputs to Jamaica's nearshore environment.

The ecology of coral reefs have adapted to periodic physical disturbances such as hurricanes. Today, however, questions arise as to the resiliency of these tropical systems if weakend by anthopogenic factors, such as pollution and overfishing. Hurricane Allen devasted the north coast of Jamaica in 1980. The impact of this storm was most severe on the NE portion of the island, although mechanical damage extended all along the coast (Woodley, et al. 1981). The immediate effects of Allen on reef communities was significant; a 95% reduction in staghorn coral populations on the fore reef was documented (Knowlton et al. 1981).

Montego Bay Marine Park

Montego Bay is one of Jamaica's leading tourist centers, receiving over 500,000 visitors annually, and accounting for one-third of the revenue earned each year from tourism in the country. The city is served by an international airport, a major seaport, and a number of major resort developments.

In 1986, the Minister of Tourism formed the Marine Park Action Committee to act as a catalyst for the development of the marine parks in Jamaica. The committee initiated the preparation of the project proposal for the development of the Montego Bay National Park, Jamaica. This study was incorporated along with the suggestion for the establishment of protected areas articulated in the Country Environmental Profile. A proposal was made to the Government of Jamaica and the Untied States Agency for International Development (USAID) for the establishment of a Jamaica National Parks system, which took the form of the Protected Areas Resource Conservation (PARC) project in August of 1989. The Montego Bay Marine Park is a component of the PARC project.

Montego Bay Marine Park (MBMP) encompasses an area offshore from the city of Montego Bay extending from 9 km from the Donald Sangster International Airport to point east of the Great River. The park extends from the shoreline at mean high tide (MHT) to the 100 m depth contour (See Map on page 12). The main communities and features found within the park include coral reefs, mangroves, sea

grass beds and beaches. Three main coral reefs are found in the park; the airport-hotel strip, the Seawind reef, located in the central park; and the Reading or Chalet reef in the southern section of the Park. Approximately 83 ha of mangrove border and form four islands in the Bogue Island lagoon, including the Bogue Island Fish Sanctuary. Extensive sea grass beds are also found with Bogue Island Lagoon, along its south-east border and in patches, off shore immediately south of the Sangster International Airport.

The MBMP represents the first marine park established in Jamaica with the essential components of adequate funding, effective management, legislation, community involvement, support and Government commitment. MBMP's marine resources comprise the sea and the sea floor, as well as the plants and animals living within the boundaries.

MBMP has traditionally been used by fisherman, water-sports operators, hoteliers, and settlements living along the shoreline of the Bay. Several events in the coastal zone likely had the largest impact on marine communities in Montego Bay:

* development of the Freeport and Seward resort area by dredging and filling of mangrove forests and islands;

* change in drainage patterns and nutrient loading of coastal rivers and estuaries with a growing human population and inadequate infrastructure;

* bulkheading of coastlines, loss of coastal vegetation, and the change in quality of storm water runoff;

* natural episodes, such as hurricane Allen in 1980, hurricane Gilbert in 1987, and the Diadema sea urchin die-off in 1983-84.

Because of these varying factors, the environmental and public health problems that now exist in Montego Bay present an enormous challenge requiring the best information and ideas in science and public policy for ecological restoration efforts. Specific management actions will require the cooperation of the Montego Bay Marine Park, the government of Jamaica (GOJ) and non-governmental organizations (NGOs). The restoration actions will require an active participation of scientists and resource managers within Jamaica to formulate realistic goals and priorities of action.

MBMP Resources

The Montego Bay ecosystem comprises marine and estuarine communities tied to upland watersheds through rivers and freshwater wetlands. Virtually the entire coastline of the Bay has been

altered by development or dredging. Natural terrestrial or freshwater wetlands are greatly reduced and relatively rare.

Coral Reefs: Reef communities in MBMP can be described as a fringing reef system with local variations in the width of the back reef lagoon (comprised of many hard and soft bottom communty types), and the presence or absence of reef crest zones. About 39% of the park is less than 5 m deep, and is a continuation of a shallow shelf extending from shore. At the edge of the shelf, the first cliff drops to a fore-reef terrace which slopes seaward from 5 to 15m depth. Another steep escarpment then drops to a muddy slope at 30 m depth, and the remaining [illegible] lies in water depths inaccessible to divers.

Most reefs consist of a framework of elkhorn coral (*Acropora palmata*) or club finger coral (*Porites porites*) depending on the width of the shallow shelf areas inshore from the spur and groove formations. Reef crest areas in the northern portion of the park are built on an underlying *A. palmata* framework, although this species has since suffered marked reductions in abundance. A well developed reef crest to the west of the airport contains surprising numbers of large *A. palmata* colonies, although most reef crests along the northern area of the park have become rubble-dominated communities with high coverage by algae.

Offshore of Seawind Island are narrow bands of club finger coral-dominated reef crests approximately 100 m from shore. These shallower areas tend to have larger populations of club finger coral than elkhorn coral. However, today most reef crests are dominated by fleshy algae (>50%) and coral rubble.

Further offshore from reef crests are well-developed spur and groove systems along much of the MBMP. Through qualitative observations in the northern, central and western region of the park, coral cover has been largely taken over by algae. Historically, these reefs were characterized as having greater than 80% coral coverage, principally by staghorn coral (*Acropora cervicornis*), star coral (*Montastrea annularis*), and lettuce coral (*Agaricia agaricites*).

Today, it is evident that many of the reefs exhibit the following characteristics:

* coral coverage has been greatly reduced from historical observations (e.g. 80-95% during the 1960's and 70's to less than 15% based upon recent sampling (TNC, REA of MBMP)), and replaced by marine algae as primary space occupiers;

* with the exception of fast growing corals, such as *Porites* sp., recruits of young corals appear rare, especially from large, massive reef-building species;

* large reef sponges are uncommon, while boring and encrusting sponges are locally abundant in reef rubble areas;

* most reef features have been reduced to dead rubble, which has become dominated by three gnerea of flehy brown algae (*Lobophora, Dictyota, Caulerpa*).

Hurricane Allen caused significant reductions of elkhorn coral (*A. palmata*) on shallower reef crest communities. Prior to 1980, the fore reef terrace was dominated by thick stands of staghorn coral (*A. cervicornis*). On one study site north of Montego Bay airport, prehurricane staghorn coral populations covered over 75% of the bottom, but were reduced to approximately 20% cover by 1982. Similar results for reef communities were documented along the entire north coast. The initial impact of the storm was manifested in mechanical damage to coral colonies. It is also likely that reef crests within the MBMP suffered severe mechanical damage during hurricane Gilbert in 1988.

Back reefs and lagoons: Nearshore marine benthic communities can be defined as areas inshore of spur and groove formations and reef crests, often less than 200 m from shore. This habitat is considered to be part of the larger back reef lagoon. Nearshore communities throughout MBMP dsiplay extensive variability, but are generally characterized by a simple invertebrate fauna (sponges and some corals), and a rich and diverse assemblage of macro algae and seagrass.

Seagrass Communities: Seagrass communities play a vital role in marine ecosystem function; they provide refuge and a foraging base for a host of fishes and bethic invertebrates. In addition, Seagrasses serve an important link between nearshore fringing mangrove communities and offshore hardbottom and reef habitats.

Seagrass communities, principally of the species known as turtle grass (*Thalassia testudinum*), vary in size and coverage throughout the MBMP. In the northern area of the park, these communities are close to shore and are small in size (< 5 ha). To the west of the airport, seagrass communities occur in patches, especially near the core beaches; however, in the western region of MBMP, they are abundant, although much of this section of the park has been historically subjected to dredge and fill activities.

Mangrove Communities: Mangrove communities within MBMP include large forests associated with the deltas or mouths of rivers and treams, smaller finging stands along the coastline, mangrove islands offshore, and dwarf mangrove areas to the north adjacent to coastal wetlands.

Substantial coastal mangrove forest and scattered islands hisotrically existed where the Montego Freeport and Seawind resort

now stand. These mangroves undoubtedly served as an important nursery for marine invertebrates (e.g. crab and shrimp) and fishes. Stands of mangroves along the coast also filtered terrestrial run-off from storms and floods, limiting sediment and nutrient transport to the reefs, especially at Reading and Utility Hall. The filtering function of mangroves provides a critical service to the overall health of offshore reefs.

Mangrove forests of MBMP can be further divided into community types based on dominant species composition and peat accumulation. From the water moving inland these types are usually red mangrove, black mangrove, and mixed white mangrove and buttonwood types. These three forest types make up the riverine, fringing, dwarf and island overwash mangrove communities located in the Park.

The areas dominated by red mangroves include mangrove islands within Bogue Sound. These islands are described as red mangrove overwash forests, where high tides and storm surges cover the entire island. Two islands have land-locked or mangrove-lined saline ponds, which represent important feeding areas for wading birds. The ponds support unusual assemblages of clams, burrowing worms and starfish.

Along the mainland, red mangroves make up the seaward extent of the mangrove forest Extensive areas of red mangroves have been cut and filled to create the soccer stadium (Whimbley Field) and dumps. Encroachments along Montego Bay's coastline have been numerous, and have drastically reduced the area of mangrove forests, as well accelrating the flow of sediment and pollutants into nearshore waters.

The areas dominated by black mangroves are characterized by less water movement and some freshwater influx. Black mangroves line the small creeks and inlets of the mangrove forests, and are typically found inland from red mangroves.

Mixed white mangroves and buttonwood areas grow in dry saline soils that flood seasonally. These areas have suffered the greatest pressure from wood gatherers and are only found along the landward extent of the magrove forest in Bogue Sound.

Threats to MBMP

One of the most important factors leading to decline of the environmental quality of Montego Bay has been the removal of large sections of fringing mangrove forests. It is likely that severe storms and heavy rains transport excess sediment and pollutants from nearshore to the outer reef because of the absence of forests to retain this material.

Sedimentation is another cause for concern in the park. In addition to increased sedimentation from coastal erosion and storms which have subsequently flushed many cleared mangrove areas, deforestation or changes in land use patterns in the coastal uplands surrounding the city of Montego Bay has likely resulted in increased sedimentation in nearshore marine communities. In addition, dredge and fill operations in the Freeport area have resulted in increased sedimentation and turbidity on outer reefs.

The removal of coastal vegetation, coupled with increases in coastline development and population have resulted in increased pollution loads to the nearshore environment. Pollution from sewage is rich in nutrients

Park Management and Operations

During the evaluation of MBMP, the team was struck by the enthusiasm and level of commitment displayed by the current park staff, rangers and volunteers. However, their commitment was seconded by a level of frustration with the current facilities, equipment and fiscal and oversight status of the operation from Kingston.

The team made several observations regarding selection and use of equipment. The outboard power for the patrol boats appears excessive for the application intended. Several respondents interviewed during the evaluation expressed concern that patrol boats were frequently observed operating at excessive speeds with no evidence of regulatory pursuit. The boats are 21 ft. fiberglass cabin cruisers outfitted with 250 hp V-8 outboard engines. These are very large engines which contain sophisticated technology and can rarely be serviced *in situ*. Staff were not trained in the operation and maintenance of the boats or engines, and there are no authorized repair facilities in Montego Bay with parts in stock.

While the boat length chosen is sufficient for rough water encountered during patrols, smaller, less complicated outboard engines would have been more efficient and much easier to service and repair. Since purchased, both boats were sunk, the apparent result of operator error. At the time of the evaluation, only one of the two boats was operational, and is not conveniently located near the headquarters. Rather, mooring space has to be rented from a marina, requiring staff to travel over land for access. During the team's visit to the mooring slip, the boat appeared clean and operational; however, the switching and throttle console was in need of repair. The boat in dry dock requires major engine and lower unit repair before it can resume patrol.

The air compressor purchased for the MBMP was not designed for SCUBA shop operation in a marine environment, but for fire departments with controlled environmental conditions. This

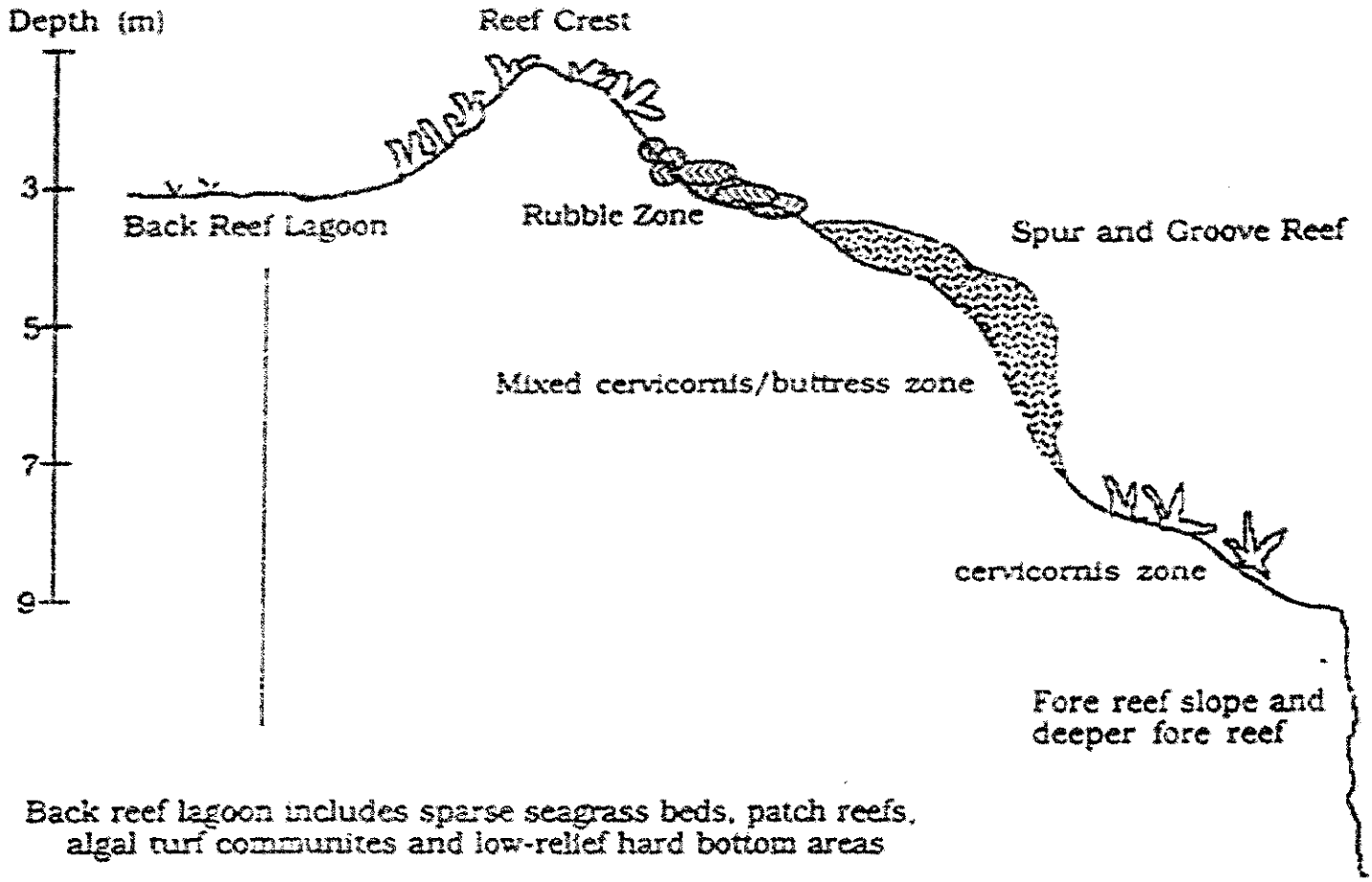
particular compressor's operation is largely dependent upon microprocessors, which are sensitive to corrosion within a humid atmosphere. No staff at MBMP were specifically trained to operate the compressor, and it has malfunctioned previously. There are no authorized repair facilities in Montego Bay with parts in stock, and MBMP has had to rely upon service from Kingston or from the dive officer of the Discovery Bay Marine Laboratory. The compressor has recently been repaired, and was operational at the time of the evaluation. The evaluation team observed burning of vegetation and debris at Cornwall Beach in a vicinity adjacent to the compressor's air intake-a potentially dangerous practice for the quality of compressed air available to the park staff.

The buoys purchased for marking the boundaries of MBMP have also had technical problems. The buoys were designed for fresh water use, and the mooring hardware attached to the floats failed quickly, due to electrolysis and corrosion. The bouys were often adrift from their set location. Consequently, most of the bouys were in storage during the evaluation.

PARC funds also provided rangers with hand held radio communications equipment. The evaluation team found all of these to be operational, and communications appeared to be adequate for park needs.

Figure B-1

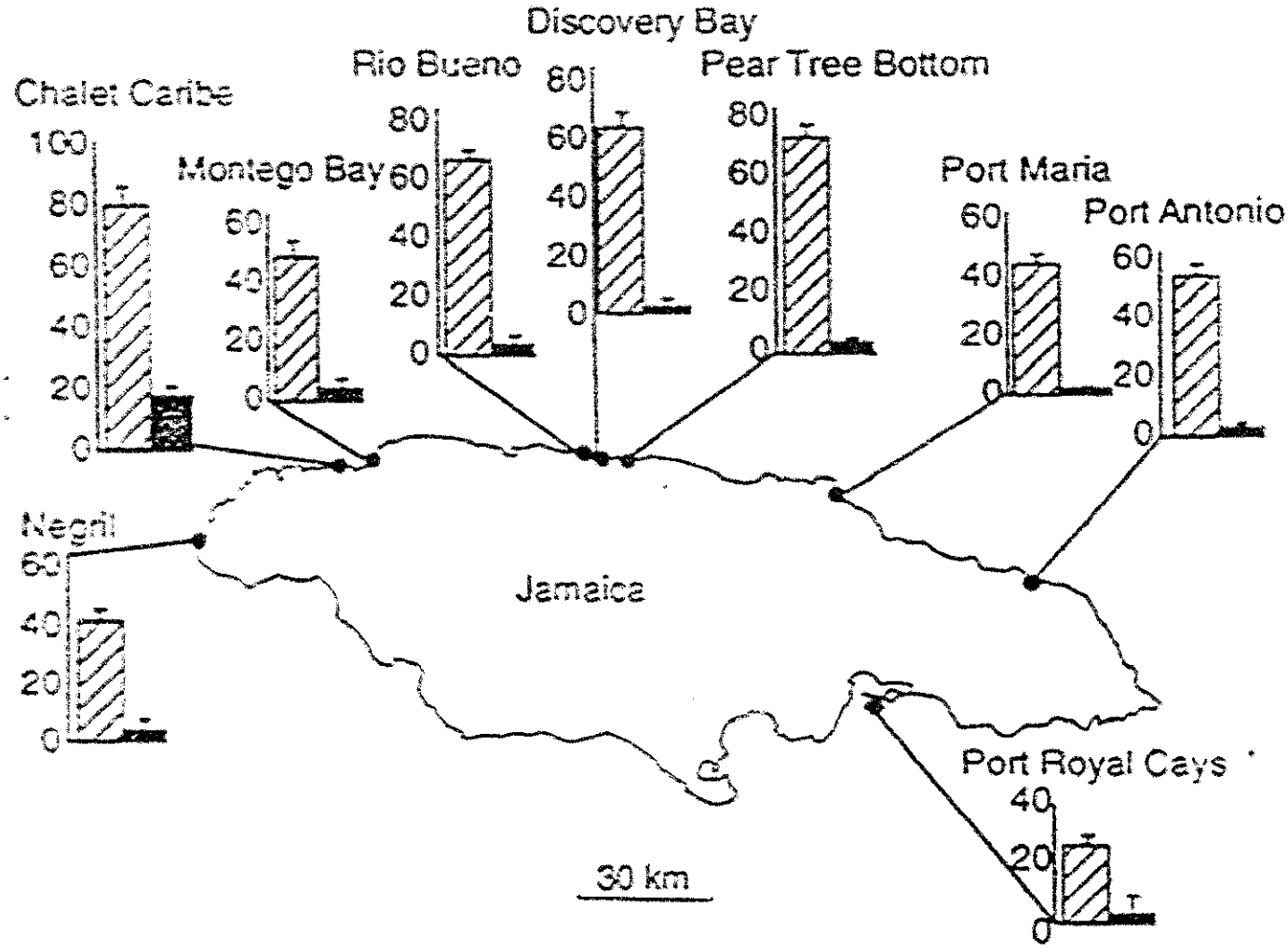
JAMAICAN SHALLOW WATER REEF ZONATION



Back reef lagoon includes sparse seagrass beds, patch reefs, algal turf communites and low-relief hard bottom areas

(The Nature Conservancy, 1994)

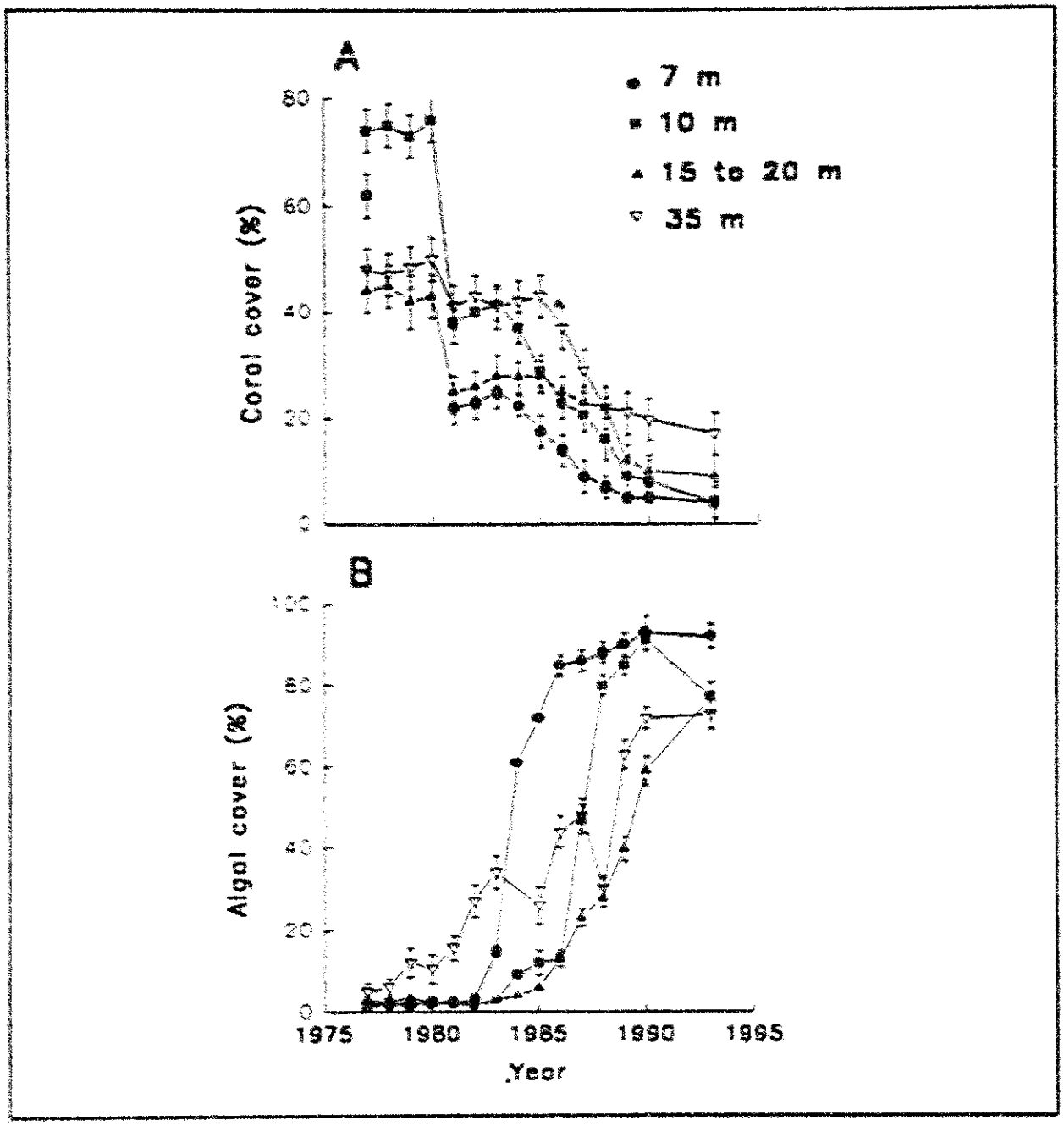
Figure B-2



Large-scale changes in community structure at fore-reef sites along >300 km of the Jamaican coastline, surveyed in the late 1970s (1977, hatched bars) and the early 1990s (1993, solid bars).

(Hughes, 1994)

Figure B-3



Degradation of Jamaican coral reefs over the past two decades. Small-scale changes in (A) coral cover and in (B) macroalgal cover over time at four depths near Discovery Bay

(Hughes, 1994)

APPENDIX C

PROFILE: BLUE AND JOHN CROW MOUNTAINS NATIONAL PARK

[Material in this section is drawn from the USAID 1989 Country Environmental Profile, the BJCMNP Management Plan and the draft Rapid Ecological Assessment of the park.]

February 28, 1993 marked the official opening of the Blue and John Crow Mountains National Park (BJCMNP). It is the first terrestrial National Park established in Jamaica. Comprising 78,212 ha (193,262 acres) it incorporates an area of Crown Land previously administered as a Forest Reserve. Together, the Blue and John Crow Mountains compose an area of tremendous economic and ecological value to Jamaica and one of the island's few remaining stands of pristine and unspoiled forest. The lands incorporated in this National Park are described in greater detail in the Blue and John Crow Mountains National Park Management Plan 1993.

Jamaica is divided into thirteen Parishes. The BJCMNP falls into the easternmost three parishes: Portland, St. Thomas and St. Andrew. (See Map on page 14). The park contains two contiguous but strikingly different mountain ranges: the Grand Ridge of the Blue Mountains extending roughly from east to west; and, at the easternmost end of the Blue Mountains, the massif of the John Crow Mountains, extending from south-east to north-west.

The Grand Ridge forms the backbone of the Blue Mountain range. It extends 16 km and includes the highest land in Jamaica, much of it over 1800 m. Among the major peaks are Blue Mountain Peak, comprised of Middle Peak (2256 m) and East Peak (2246 m); Sugar Loaf (2150 m); High Peak (2082 m); Mossman's Peak (2028 m) and Sir Johns Peak (1927 m). Lesser peaks radiate from these and give way to slopes sometimes in excess of 70 degrees and frequently over 50 degrees. To the west of the Grand Ridge are lower ranges. Between Kingston and the Grand Ridge are the Port Royal Mountains. Only the north of this range is within the Park, including Mount Horeb and Catherine's Peak.

The John Crow Mountains rise gently from the eastern littoral to a maximum height of 1140 m, and end abruptly along a steep escarpment to the west. The Rio Grande River Valley separates the John Crow Mountains from the Blue Mountains, except at its head where the ranges converge at Corn Puss Gap (640 m). This also marks the boundary of the Parishes of Portland and St. Thomas.

Unlike the sharp peaks of the Blue Mountains, the summit of the John Crow Mountains is a slightly tilted plateau, which forms an unusual landscape of sinkholes and outcrops devoid of prominent features. These differences are result of contrasting geology and geomorphology.

While the Blue Mountains exhibit both igneous and marine influences with volcanic, metamorphic and sedimentary rocks in evidence, the John Crow mountains comprise white limestone overlying shale and marine sandstone. Such differences are re-emphasized in the differing soils between the two mountain areas; vegetation is more a function of rainfall and altitude.

Climate and Soils

Jamaica's tropical marine climate is modified by north or northeast trade winds and land-sea breezes with rainfall and temperature patterns varying locally according to physical aspect and altitude.

Average temperatures on the coastline are 27 degrees Celsius although this drops to 13 degrees on the Blue Mountain peak. Over the entire island rainfall averages about 200 cm. per year, but such averages are deceptive as rainfall, like temperature, varies widely with location and altitude. For example, the "Blue Mountains and northeast coast lying in the path of the tradewinds receive over 330 cm., while Kingston, in the lee of the range, receives less than 127 cm annually."

Rainfall is the single most important climatic factor affecting the area's ecology. The vast majority of precipitation in the Park falls as rain but the regular mists affect the vegetation by influenring humidity and therefore evapo-transpiration. The ensuing tropical vegetation and haze combine to give the rise to the name "Blue" mountains.

While the number of rainy days within the park is usually high, the heaviest precipitation tends to occur in May and October. July to November is officially defined as "Hurricane Season" and throughout this period the island is under constant threat of "being hit." Between 1886 and 1967, 19 hurricanes and tropical storms directly struck Jamaica while 98 had their centers within 150 miles of the island. The 1988 storm devastated commercial pine plantations owned by the government parastatal FIDCO, thus making their incorporation into the new park less problematical.

The most powerful storm in living memory was the September 1988 passage of Hurricane Gilbert that inflicted widespread devastation along the length of Jamaica resulting in the loss of 45 lives and in excess of US$ 100 million in property damage. Gilbert wiped out 55% of the island's forest plantations an area comprising some 5,436

hectares, many of which were within or near the current park boundaries.

The soils of the western Blue Mountains are derived from shales and comprise mostly yellow-brown or pale brown loams while those to the east and north of the range are derived from older volcanics and are generally deeper and comprise brown or reddish-brown loams or clays. In the John Crow Mountains, the bedrock limestone is often at or just below the surface; soils are shallow and stony. Deeper soils, usually a sticky clay are found mainly in hollows and on ridge tops. The massif's eastern slopes soils are characterized by "a mixture of poorly drained deeper yellow-brown clays under a thin humic layer and better drained shallow yellow-brown loams and clays."

The soils of the central area of the eastern slopes are a mixture of well-drained deeper red to Yellowish-red clays under a deep loam and well-drained shallow brown to red-brown loams and clays with bedrock at or near the surface.

The steep south-east slopes are composed of a mixture of poorly drained olive to yellow-brown clays and better drained shallow brown to dark yellow-brown loams and clays. The soils of the steep western escarpment are well-drained, shallow yellow-brown and olive-yellow loams, with gravelly layers. The geography, geology, soils and climate of the Blue Mountains and John Crow National Park all influence its flora and fauna.

Vegetation

More than 500 species of flowering plant have been collected from the Blue and Port Royal Mountains. About 40% of the higher plants are endemic, and many are considered rare and endangered. (REA 1992) The native forests of the John Crow Mountains support a high proportion of flowering plant species with a limited geographical range. They are the principal refuge for the 47 flowering plant species endemic to Portland, which has the highest level of endemism of all Jamaican Parishes. The lower reaches of this mountain range support the only remaining lower montane forest in Jamaica.

Most plants owe their origins in Jamaica either to wind or bird seed dispersal. Subsequent to their establishment, radial evolution has brought high degrees of endemism not only at the species level (e.g. nine out of ten palm species) but in the creation of seven new genera of flowering plants. Between 1972 and 1982 44 new plant species were recorded, a remarkable fact on a small island that has over the centuries been the home of generations of botanists.

To place the conservation value of the park in context, it is important to note that forests occupy over 660,000 acres or 24.3% of Jamaica's total land mass and comprise a great diversity of

species with over 2,800 flowering plants and 5,500 ferns (CEP, 1987) having been recorded. In absolute terms, nearly one third of the country's remaining forest is found within the park, a figure certainly closer to one half when the park's buffer zones are included. The Environmental Profile (1988) classifies Jamaica's natural forests into four basic types. Although there is great variety within forest types, the BJCMNP offers excellent coverage of two of the four major forest ecosystems.

Forest classification is based on elevation, bio-temperature and annual rainfall (Asprey and Robbins, 1952). The four systems are:

a: Dry Limestone Forest (Tropical Very Dry Zone) 0-1,250 feet in elevation. This life zone dominates the southern limestone hills such as the Hellshire and Portland Ridge, Morant Point, Don Figuero and Santa Cruz mountain near Negril. Limited distribution within the park and buffer zone (with more in the latter). Vegetation comprises mainly Cedar, *Cedrela odorata*; Santa Maria, *Calophyllum calaba*; Breadnut, *Brosimum alicastrum*; Cotton and Birch.

b: Wet Limestone Forest (Tropical Moist Life Zone) 0-1,250 feet in elevation. This life zone is well represented in the Cockpit country, as well as at Mount Diablo and in the Dolphin Head Mountain area. Corridors to the surrounding coastal areas would include transition from montane to wet forests. Dominant species include Broadleaf, *Terminalia latifolia*, and Santa Maria, *Calophyllum brasiliense*.

c: Lower Montane Moist Forest (Premontane) Between 1,250 and 4,000 feet on the northern slopes of the Blue and John Crow mountains. Well captured by the existing park boundaries. Dominated by species such as *Psidium montana*, *Symphonia globulifera* and *Ficus suffocans* this life zone supports trees that may tower up to 150 feet in height and which form a layered or stratified canopy. Other common species: Santa Maria, Slugwood and Cedar.

d: Higher Montane Moist Forest (Premontane Wet Forest) This life zone is restricted to elevations in excess of 4,000 feet and comprises comparatively small (<50 feet), profusely branched species such as *Podcarpus urbanii*, *Cyrilla racemiflora* and the endemic *Juniperus barbadensis*. Poor soils, low temperatures and high winds make this a harsh environment and only the most hardy species can survive. Such conditions can be found on the exposed upper slopes of the Blue Mountain. Unique environment essentially completely contained in the park.

Best Available Copy

Since Asprey and Robbins' work Marsh forests, Mangroves and Herbaceous swamps have been added to his forest classification. These are found in the buffer areas and downslope near the coasts.

Specific information on the floristic composition of the Blue and John Crow Mountains National Park is provided in the park's Management Plan.

Fauna

Jamaica's small size, island make-up and isolation from a continental landmass means that it possess a comparatively poor fauna in terms of numbers of species. However these same characteristics also mean that a large proportion of its wildlife are endemic. Groups which have high ratios of endemic to total species include birds (27:256 breeding species); bats (4:23); Lizards (20:24); and amphibians (15:19).

The National Park presents a wide variety of habitats and the majority of Jamaica's indigenous land birds, including all its endemics, are to be found within its boundaries. The Park is especially important in so much as it represents the largest contiguous tract of forest left on the island and includes a broad range of life zones and thus varied habitats for both resident and migratory species.

The rain forests of Blue and Port Royal mountains are a stronghold for several endemic bird species. The nectivorous hummingbirds are represented chiefly by the Red-billed Streamertail, which is common. Vervain Hummingbirds occur chiefly at forest margins and at large gaps in the forest.

The lower montane rain forests are the principal habitat for the rare Jamaican Blackbird, which although found in low numbers in the John Crow Mountains and Cockpit Country (another region of Jamaica under consideration for park designation), probably has its greatest population in the primary forests of the Blue Mountains, especially those of the northern slopes.

Other fairly common endemic birds in montane forests include the Crested Quail Dove, White-eyed Thrush, Jamaican Becard, Jamaican Tody, Jamaican Woodpecker and Blue Mountain Vireo.

The lower montane forests of the John Crow Mountains support some of the greatest diversity of land birds to be found in Jamaica. In addition to those species found in the high elevations of the Blue Mountains the John Crow Mountains support major populations of larger, more mobile frugivores and omnivores. Some of these are endemic to Jamaica, and include the Yellow-billed Parrot, the rarer Black-billed Parrot and Jamaican Crow. The endemic Jamaica Owl is also found here as well. Most importantly, the John Crow Mountains

are the center of the range and principal habitat of the Black-billed Streamertail.

The Blue and John Crow Mountains are also a refuge for more than 40 species of north American migrants and serve as a vital link in the annual passage of these birds.

Similarly, the Park is home to a number of endemic mammals, reptiles, amphibians and insects including the signature Giant Swallowtail Butterfly (*Papilo homerus*).

Threats

Over the past hundred years habitat destruction, particularly in coastal and forested areas, uncontrolled exploitation and predation by introduced species have taken their toll on Jamaica's fauna and flora. At least eight vertebrate species have become extinct in the last 150 years, and many more species of animal and plant are endangered, threatened or rare. Prior to colonization by the Spanish after 1492, it is likely that all of Jamaica was forested. Assuming this to be the case the clearing of land for farming and settlement have reduced the island's original forest cover by approximately 70%. Of the island's 33 watersheds, nineteen are very badly eroded and loosing top soil at the rate of about 10-40 tons per acres per year. Nearly one-third of the remaining forest (217,471 acres-CEP, 1987) remain in the east of the island, much of it protected within the Blue and John Crow Mountains National Park.

The threats facing the fauna and flora of Jamaica can be summarized as:

a: <u>Forest clearing for agriculture</u>. This is particularly the case on the Southern slopes of the Blue Mountains. During the past two decades agriculture has continued to be a mainstay of the Jamaican economy employing between 20-35% of the work force. In 1987 there were an estimated 178,000 single holder farmers in Jamaica and these individuals occupied more than 99% of the farms and two-thirds the acreage. In the Blue Mountain area Jamaican coffee has become the dominant cash crop where the correct climatic conditions prevail.

Some of the environmental problems and management challenges associated with agriculture include:

- cash crop farming on steep hillsides without the use of soil conservation measures;

- lack of management in clear felling and extracting timber such as the clearing of hillsides for coffee plantations;

- the construction of agricultural feeder roads without adherence to standards and specifications;

- clear cutting rather than selective felling of timber;

- the abuse of pesticides and other agrochemicals.

b: Urban Development. The expansion of Kingston and larger towns into their hinterlands in an apparently uncontrollable way and the absence of machinery to ensure the enforcement of conditions and regulations are serious local problems. A bi-product of this pernicious urban invasion is evidenced in the ubiquitous graffiti and defacement of park signs, trees and buildings.

c: Industry. Extractive industry, particularly bauxite mining, destroys the terrestrial features of the area and the Alumina production process generates a highly caustic mud which when not properly disposed off can threaten groundwater supplies. Sugar and coffee processing also produce potentially damaging waste products particularly when disposed of in the local rivers and marine environments.

d: Hunting and Pet Trade. Sport hunting for pigeons is a familiar pastime amongst certain groups of Jamaicans. While such sport is governed by an open and closed season and by bag limits, these and other regulations are poorly enforced. In addition parrots (Black and Yellow-billed) are popular as pets. Despite being protected by law these endemic psittacines remain threatened by trade for local and overseas markets.

Management, Regulation and Enforcement

The Blue and John Crow Mountains National Park Project is a pilot project currently managed by the National Resources Conservation Authority and executed by he Planning Institute of Jamaica through the Protected Areas Resources Conservation (PARC) Project. Funding for the Blue and John Crow Mountains National Park Project came jointly from the Government of Jamaica and the United States Agency for International Development. The project covers the present Blue Mountains Forest Reserve which is over 193,000 acres of forested area and involves the parishes of St. Andrew, St. Thomas, Portland and St. Mary.

Two main objectives guiding the development of the park were are: (i) management of the area's natural resources for long-term sustainable use, and (ii) provision of opportunities for income generation by park management and local communities through the promotion of the park's natural, cultural and recreational attractions.

A guiding principle measuring the park's success is that "in order for it to be successful in its efforts to preserve valuable forest land and wildlife, it must be accepted by and receive support from the local community."

Accomplishing this will require the coordination of a range of institutional and organizational actors:

Even with PARC, the physical protection and establishment of reserves and protected areas in Jamaica is a comparatively recent phenomena, and the administration of areas set aside is handled by several different agencies each having their own mandate and bias.

While the principal responsibility for the management of Jamaica's wildlife resource rests with the Natural Resources Conservation Authority, there are a plethora of other agencies and organizations having an active interest in wildlife management and the protection of BJCMNP. These include but are not limited to:

Government: Planning Institute of Jamaica; The Forest and Soils Conservation Department; Fisheries Department; Veterinary Division; Phytosanitary Division; Plant Protection Division; Hope Zoo; Royal Botanic Gardens; Rural Physical Planning Unit; Institute of Jamaica and the Trade Board.

Quasi-Government: The National Heritage Trust; Petroleum Corporation of Jamaica; Jamaica Attractions Development Company; Urban Development Corporation; Forest Industries Development Company and The Coffee Industry Development Company.

Non-Governments (NGO's: The Natural History Society of Jamaica; Jamaica Junior Naturalists; Gosse Bird Club; Jamaica Society of Scientists and Technologists; Jamaica Geographical Society; Jamaica Geological Society; University of the West Indies; Hope Zoo Trust; Hollywell; Entity.

Recently, a number of other bodies have been established - Portland Environmental Protection Association (PEPA), St. Thomas Environmental Protection Association (STEPA), Jamaica Environmental Trust, which have bearing on the management of the park.

APPENDIX D

INDICATORS FOR MONITORING PARK MANAGEMENT IMPACT

Marine -- Montego Bay Marine Park (MBMP)

- **Water quality** -- This is essential! Based on recent studies of nutrients in tropical marine waters, threshold nutrient concentrations have been identified above which damaging effects upon coral reefs (i.e. overgrowth by marine algae) can be expected. The threshold concentrations are useful indicies to guage the status of dissolved inorganic nitrogen (DIN), and soluble reactive phosphorus (SRP). Standards should be established at approximately 1.0 micromolar DIN and 0.1 micromolar SRP for monitoring and goals for achievement in water quality improvement programs.

  References for more information on this subject are: Bell, P.R.F. 1992. Eutrophication and coral reefs-some examples in the Great Barrier Reef lagoon. *Water Research*, 26: 553-568. D'Elia, C.F. K.L. Webb and J.W. Porter. 1981. Nitrate-rich groundwater inputs to Discovery Bay, Jamaica: A significant source of N to local coral reefs? *Bull. Mar. Sci.* 31:903-910. Lapointe, B.E. and J.D. O'Connell. 1989. Nutrient-enhanced growth of Cladophora prolifera in Harrington Sound, Bermuda: Eutrophication of a confined, phosphorus limited marine ecosystem. *Estuarine, Coastal and Shelf Science* 28:347-360. Lapointe, B.E., W.R. Matzie and M.W. Clark. 1993. Phosphorus inputs and eutrophication on the Florida Reef Tract. In: *Global Aspects of Coral Reefs: Health, Hazards and History*, University of Miami.

- **Coral Reef Benthic Surveys** (very important)-- Aside from monitoring nutrient concentrations, changes in coral reefs will be observed primarly in the percent cover, abundance, distribution and species composition of marine invertebrates and algae attached to the reef. Proven methods for measuring the status of benthic invertebrates have been well established since the late 1970's. New monitoring technology is currently being tested on corals reefs within the Florida Keys, and will be shared with interested parties through at least one U.S. University (J.W. Porter, personal communication).

- **Fish Monitoring (very important)**-- Number, size and species composition of fishes within the MBMP. The MBMP is currently active in a fish monitoring program, using a standarized method for fish census. Monitoring should continue within

MBMP inside and outside the replenishment zones, as well as study sites adjacent to park boundaries.

- **Share of "Green" hotels, resorts and dive shops** (very useful)-- Data from newly emerging eco-tourism monitoring groups that are issuing "green" certifications to tourist facitilities meeting standards of: energy efficiency, solid waste recycling, waste water treatment, employee training.

- **Status of Municipal Waste Water Systems (important)** -- Data from records regarding treatment capacity vs treatment volume and effluent quality.

- **Sales/Installation of waste water equipment (useful)**-- From industry and user surveys

- **Solid waste composition, use and recycling** (useful)-- Paper vs. plastic; deposit/return bottles, etc. from surveys.

<u>Terrestrial -- Blue and John Crow Mountain Park</u>

- **Status of endangered, threatened, or rare species/biological communities** (essential)-- Number and status of 'keystone' or indicator species and habitat condition.

- **Changes in forest cover** using remote sensing tools (very important)-- (e.g. total area; agricultural and forest cover; new and old growth mix).

- **Status of invasive exotic species (essential)**-- Extent of exotic plant invasion or population estimates of feral animals not native to the area and their relative rates of domination over native species.

- **Rates of agro-chemical use** (important)-- Use of chemical fertilizer and pesticides on crops in buffer zones bordering the park

- **River flow rates in specific watersheds** (very important)-- e.g., # of days/yr of observed dry or flood stage; water clarity; max/min flow coefficients.

APPENDIX E

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BIBLIOGRAPHY

Bell, P.R.F. 1992. "Eutrophication and coral reefs-some examples in the Great Barrier Reef lagoon." Water Research, 26: 553-568.

Berkes, F. 1987. "The common property resource problem and the fisheries of Barbados and Jamaica." Environ. Manag. Vol 11, No. 2, pp 225-235.

Berkes, F. and A.B. Shaw. 1986. "Ecologically sustainable development: a Caribbean fisheries case study." Can. Journ. of Devel. Studies. 175-196.

Björk, S. 1991. "Development and degradation, redevelopment and preservation of Jamaican wetlands." Ambio. Vol. 20, No. 7: 276-283.

Chambers N. 1993. "Analysis of a Conservation Corridor and Buffer Zone for the Blue and John Crow Mountains National Park and the Port Antonio Marine Park." Master's Thesis, University of Idaho.

Darwin, C. 1839. "The voyage of the Beagle." Leonard Engel, Ed. The Natural History Library, Doubleday & Company, 1962.

Eyre, L.A. 1987. "Jamaica: Test case for tropical deforestation?" Ambio. Vol 16, No. 6, 338-342.

Ford, Loren B. Undated. Background Assessment: Analysis of needs for conservation of biological diversity and tropical forests. USAID/Kingston. Publication No. ABN-018 8031.

Goreau, T.F. 1959. "The ecology of Jamaican coral reefs. I. Species composition and zonation." Ecology 40:67-90.

Goreau, T.J. and R.L. Hayes. 1994. "Coral bleaching and ocean hot spots." Ambio Vol. 23, No. 3, 176-180.

Goreau, T.J. 1992. "Bleaching and reef community change in Jamaica: 1951-1991." Amer. Zool., 32:683-695.

Government of Jamaica, 1991. The Natural Resources Conservation Authority Act. 22 Sections.

Grossman, D.H., S. Iremonger, and D.M. Muchoney. 1992. Jamaica: A Rapid Ecological Assessment. The Nature Conservancy, Arlington, VA.

Hughes, T.P. 1994. "Catastrophes, phase shifts, and large-scale degradation of a Caribbean coral reef." Science. 265: 1547-1551.

Island Resources Foundation (IRF) 1992. Evaluation Report of Protected Areas Resources Conservation Project (PARC) Jamaica. St. Thomas, U.S. Virgin Islands.

IUCN 1992. Protected areas of the world: a review of national systems. Volume 4: Nearctic and Neotropical. IUCN: Gland, Switzerland and Cambridge, UK.

Jamaica Conservation and Development Trust (JCDT) 1994. A Plan for a system of protected areas in Jamaica. Revised Draft, 13 May 1994.

Jamaica Ministry of Agriculture, Natural Resources Conservation Division, and Ralph M. Field Associates, Inc. 1987. Jamaica Country Environmental Profile. 361 pp.

JCDT, 1992. Montego Bay Marine Park Management Plan. Draft Work Book, 7 December 1992.

Knowlton N., J.C. Lang, C.M. Rooney and P. Clifford. 1981. "When hurricanes kill corals: evidence for delayed mortality in Jamaican staghorns." Nature 294: 251-252.

Kumar, K. 1993. "An overview of rapid rural appraisal methods in development settings." In: K. Kumar Ed. Rapid Appraisal Methods. The World Bank: Washington, D.C.

Lapointe, B.E., W.R. Matzie and M.W. Clark. 1993. "Phosphorus inputs and eutrophication on the Florida Reef Tract." In: Global Aspects of Coral Reefs: Health, Hazards and History. Univ. of Miami.

Lessios H.A., D.R. Robertson and J.D. Cubit, 1984. "Spread of Diadema mass mortality through the Caribbean." Science. (226) 335-337.

Loope, L. L. and V.L. Dunevitz, 1981. "Impact of fire exclusion and invasion of *Schinus terebinthefolius* on limestone rockland pine forests of southeastern Florida." Report T-645. National Park Service, South Florida Research Center. 29 pp.

Muchoney, D.M., S. Iremonger, and R. Wright. 1994. A rapid ecological assessment of the Blue and John Crow Mountains National Park, Jamaica. The Nature Conservancy, Arlington, Virginia.

Munro, J.L. 1983., Ed. "Caribbean Coral Reef Fishery Resources." ICLARM Studies and Reviews.

Negril Coral Reef Preservation Society, 1994. K. Thacker, Ed. Protecting Jamaica's Coral Reef Ecosystems, Phase II: Water Quality Issues Final Report. September 1994.

Negril Coral Reef Preservation Society, and Reef Relief, 1992. Protecting Jamaica's Coral Reefs. Final report of the Negril Reef Mooring Workshop and Installation Project. February, 1992. 49 pp. plus appendicies; 4 plates.

Norton, B.G., 1986, Ed. The Preservation of Species. (Under the auspices of the Center for Philosophy and Public Policy, University og Maryland.) Princeton University Press, Princeton, NJ.

NRCD and Field, R.M. Assoc. 1987. Jamaica Country Environmental Profile. Natural Resources Conservation Division on behalf of International Institute for Environment and Development.

Porter, J.W. 1976. "Autotrophy, heterotrophy and resource-partitioning in caribbean reef-building corals." Amer. Natur. Vol. 110: 731-742.

Sandeman, I.M. and J.D. Woodley. 1994. Jamaica north coast fisheries improvement project. C.I.D.A. Final Report No. 504/13778.

Sullivan, K.M. and M. Chiappone. Undated. "Conservation science and rapid ecological assessment of coral reef ecosystems: A tale of two Caribbean marine protected areas." The Nature Conservancy, Florida and Caribbean Marine Conservation Science Center, Coral Gables, FL.

Sullivan, K.M., et al., 1994. Rapid ecological assessment of the Montego Bay Marine Park Jamaica: Evaluation of Marine Parks as Marine Fisheries Reserves. The Nature Conservancy, Coral Gables, Florida.

Thornton, I. 1973. Darwin's Islands. A natural history of the Galápagos. The Natural History Press: Garden City, New York.

UNEP/IUCN 1988. Coral reefs of the world. Volume 1: Atlantic and eastern Pacific. IUCN: Gland, Switzerland and Cambridge, U.K./UNEP: Nairobi, Kenya.

USAID 1993. Jamaica: Project Authorization Amendment for Protected Areas Resurces Conservation II. Component Amendment to the Development of Environmental Management Organizations (DEMO) project.

USAID 1990. "Project Grant Agreement between the Government of Jamaica and the United States of America for the Protected Areas Resurces Conservation Project." Number 532-0148.

USAID 1989. Jamaica: Project Paper for Protected Areas Resurces Conservation. USAID: Washington, D.C.

USAID 1989. "Project Grant Agreement between the Government of Jamaica and the United States of America for the Protected Areas Resurces Conservation Project."

USAID/Jamaica 1994. Jamaica Action Plan FY 1995/96. Kingston.

Walling, L.J. and D. Lee, 1990. "Montego Bay Marine Park: An Integrated Approach." Unpublished Report of the Protected Areas Resource Conservation Project presented to the Fourth Annual National Conference on Science and Technology. Oct. 30-Nov. 1, 1990

Woodley, J.D., et al., 1981. "Hurricane Allen's impact on Jamaican coral reefs." Science 214: 749-755.

World Bank, 1993. "Jamaica: Economic Issues for Environmental Management." Report No. 11239-JM.