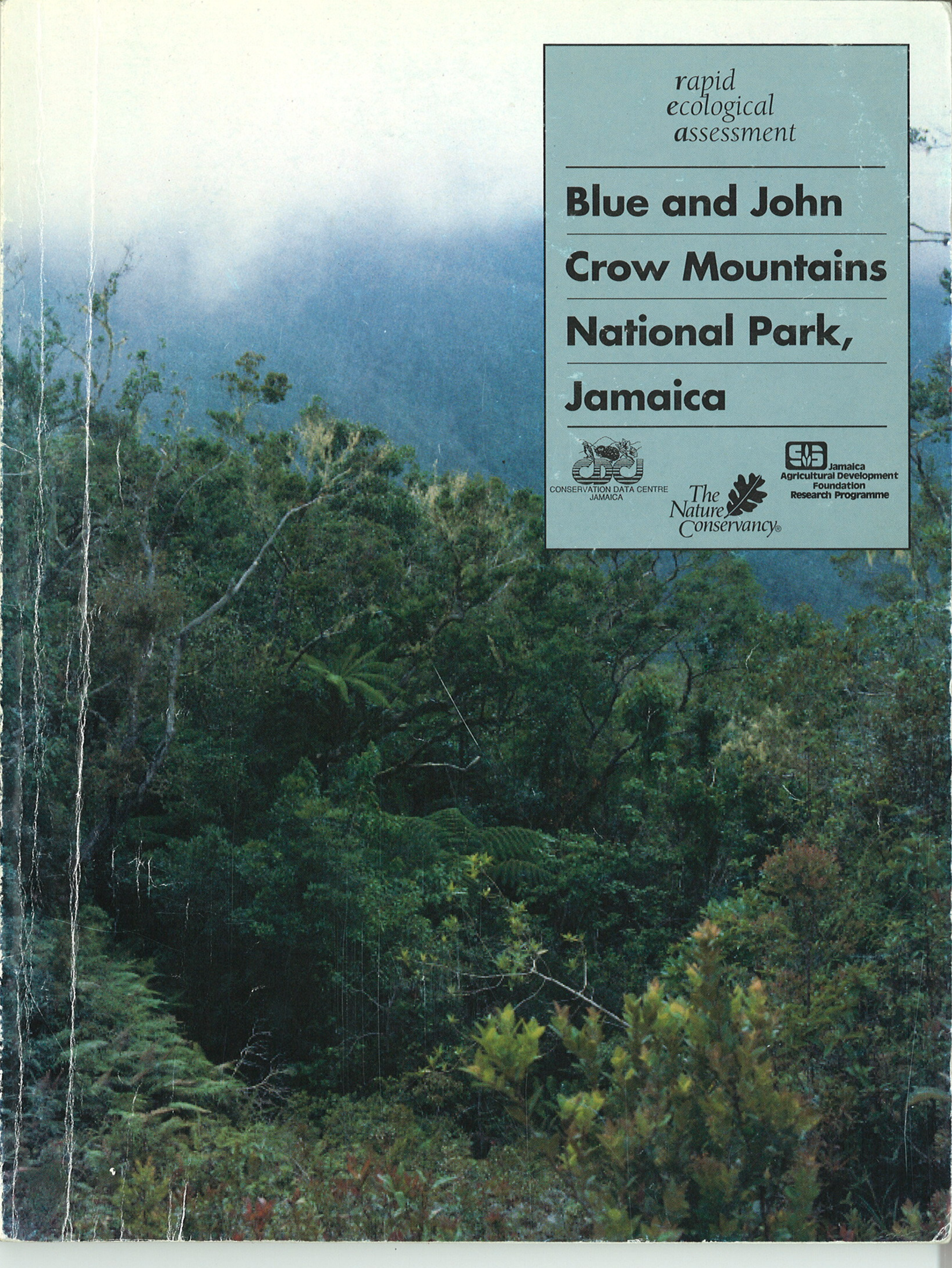
rapid ecological assessment

Blue and John Crow Mountains National Park, Jamaica



CONSERVATION DATA CENTRE JAMAICA

The Nature Conservancy®

Jamaica Agricultural Development Foundation Research Programme

rapid ecological assessment

Blue and John Crow Mountains National Park

JAMAICA

Douglas M. Muchoney
Susan Iremonger
Robb Wright

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A Study by The Nature Conservancy and the Conservation Data Centre–Jamaica with financial support from the Jamaica Agricultural Development Foundation, the North-South Center, the Moriah Fund and the MacArthur Foundation.

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A Rapid Ecological Assessment of the Blue and John Crow Mountains National Park, Jamaica

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Cover photograph by Susan Iremonger depicts upper montane rain forest in the Blue Mountains.

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SUMMARY

The Blue and John Crow Mountains National Park was established in 1990 by the Government of Jamaica. The Crown Lands which were designated Forest Reserve in that area were re-designated for stricter protection through the establishment of the park. The total area is 79,666 ha and includes the Blue and John Crow mountain ranges, which are the watersheds for the Kingston Metropolitan Area, the town of Port Antonio and many other smaller towns, villages and farmland. The highest point is at 2256 m in the Blue Mountains, which are mainly composed of a complex shale rock. The John Crow Mountains are composed of limestone and rise to 1140 m. Much of the park area is covered in native montane forest, but there are also timber and coffee plantations, as well as some mixed subsistence agriculture within its boundaries. In recent years these activities have increased and pose a threat to the native forest ecosystems.

A Rapid Ecological Assessment (REA) was carried out during 1992 in the national park. REA is a process developed by The Nature Conservancy (TNC) and its partner organizations for cost-effective acquisition, analysis and management of conservation information. This information may then be used to aid management plans and to pinpoint areas that need very active vigilance or further investigation. This REA was carried out in conjunction with the Conservation Data Centre–Jamaica (CDC–J) of the University of the West Indies, the staff of the Forest Department of the Ministry of Agriculture and with other collaborators. Training was provided by TNC for Forest Rangers and for the staff of the CDC–J in map and aerial photograph interpretation, field survey techniques, and species identification and preservation procedures.

The procedures used in this REA for natural community recording and mapping were as follows:

(a) the literature and all prior research and documentation available on the area were studied, and the gaps in the available information identified;
(b) SPOT satellite imagery and large scale colour aerial photographs were acquired and studied;
(c) field forms were designed specifically for this REA to facilitate data collection and subsequent analysis, which were compatible with the format used in the Biological Conservation Data System installed in the CDC–J ;
(d) six weeks of field surveys were designed and carried out, covering the less known areas of the park;
(e) aerial surveys augmented the information from the field;
(f) descriptions and characterizations were written for all the different vegetation types in the park;
(g) aerial photographs, satellite imagery, soils maps, geology maps and topography maps were interpreted and the land cover types mapped onto a printout of the satellite image;
(h) polygons drawn on the image were digitised into a Geographic Information System (GIS);
(i) maps were drawn; and
(j) a final report was written which included recommendations for management.

The field surveys were the main information-gathering phase of the project, and the time when field teams were trained in REA methodology. During six weeks nine different survey sites were visited. In the Blue Mountains these were Spanish River, Vinegar Hill, Cuna Cuna Pass, Lookout Hill, House Hill and Nanny Town. In the John Crow Mountains the sites visited were Ecclesdown, Hog House Hill and Millbank. In the subsequent analysis of 27 detailed field survey records the following 36 vegetation categories were found to be present in the park: 11 natural forest types, six modified forest or woodland types, one natural and nine modified scrub types, one natural and four modified herbaceous communities, three natural and one modified sparsely vegetated community type.

During the study 540 plant specimens were collected. Of all the forest communities sampled the modified one was the least diverse and has the lowest ratio of endemic to non-endemic plants. The communities of the highest reaches of the John Crow Mountains had the highest ratios, where over half of the species were endemic. A population of a plant thought to be extinct was found, and a first Jamaican record was made for another species.

Animals were not studied in depth in this REA. In one area the birds were surveyed and 15 of Jamaica's 25 endemic birds were observed. Notes were made on other animals, and the endemic giant swallowtail butterfly and the Jamaican coney were observed in some places. Evidence of coney activity was particularly noticeable in the upper reaches of the John Crow Mountains, and the butterfly was most apparent in the lower reaches of the Blue Mountains.

One of the principal aims of the REA was to increase the information base in Jamaica on the park area, and provide an informational basis for the park management plan. The data gathered during the fieldwork were entered and stored in the data system in the CDC–J. All satellite images and digital vector files were entered into the GIS system in the Rural and Physical Planning Unit of the Ministry of Agriculture. A zoning scheme for management was drawn up in collaboration with the park management body, and a number of recommendations for future work were made. These are as follows:

1. **Management zones.** These should be clearly defined and known to all the park staff. A division into two main categories was suggested, (a) General access zones and (b) Limited access zones. An additional Buffer zone would be outside of the park boundary, and needs to be defined. Large areas of the park have in the past been used as timber plantations and coffee farms. These areas will need to be clearly defined both in terms of their geographic cover and in terms of management activities, and recommendations for these are made in this report.
2. **Management infrastructure.** Because of the size of the park and the inaccessibility of some areas and to ensure maximum staff effectiveness it was recommended to provide adequate ranger station facilities, transportation and vehicle running costs. An efficient firefighting system should be put into effect as soon as possible. The success of the park depends to a great extent on the support of the local people. Wherever possible staff should be recruited from the local communities for guide jobs and for working on demonstration projects for the Buffer zone.
3. **Monitoring activities.** Long term monitoring of natural and plantation forest cover may be carried out using satellite imagery. Periodic visits by experts in botany and zoology will be necessary to monitor the populations of rare and endemic species, which give the park much of its international importance. The spread of troublesome exotic plants should be monitored by the Forest Rangers and programs put into place which reduce their impact on the natural systems. The monitoring system, in order to be effective, must have the authority to change management practices if they are found to be inadequate or inappropriate.
4. **Future scientific research.** The park holds a wealth of information for scientific research. Very little is known about the endemic species, their physiology, environmental requirements, population dynamics, reproductive systems and chemical properties. Projects to investigate these subjects should be permitted and encouraged by the park management. Research already carried out on productivity of forest plantations and the most suitable farming methods for coffee on the steep mountain slopes should be augmented by designing projects to investigate sustainability and soil conservation policies and practices.

This REA built upon the information available in the form of maps, photographs, written documents, undocumented knowledge of scientific specialists and local people. Additional information was gathered during the project in the form of satellite images, photographs and field surveys. This report, along with the aforementioned products, will help the conservation planning and management of the park into the next century.

LIST OF ACRONYMS

BCD	Biological and Conservation Data System
BJCMNP	Blue and John Crow Mountains National Park
CAST	College of Arts, Science and Technology
CDC-J	Conservation Data Centre–Jamaica
CIDA	Canadian International Development Agency
CIR	Colour Infrared
DBH	Diameter at Breast Height
EOR	Element Occurrence Record
GIS	Geographic Information System
GOJ	Government of Jamaica
GPS	Global Positioning System
HRV	Haute Resolution Visible
IHS	Intensity, Hue and Saturation
JADF	Jamaica Agricultural Development Foundation
JDF	Jamaica Defence Force
JCDT	Jamaica Conservation and Development Trust
MABR	Managed Area Basic Record
NRCA	Natural Resources Conservation Authority
PARC	Protected Areas Resources Conservation Project
PIOJ	Planning Institute of Jamaica
REA	Rapid Ecological Assessment
RPPU	Rural and Physical Planning Unit, Ministry of Agriculture
SAR	Synthetic Aperture Radar
SBR	Site Basic Record
SPOT	Satellite Probatoire pour l'Observation de la Terre
TIN	Triangulated Irregular Network
TM	Landsat Thematic Mapper
TNC	The Nature Conservancy
USAID	U.S. Agency for International Development
UWI	University of the West Indies

1.0 INTRODUCTION

Jamaica is located in the Greater Antilles and is the third largest island in the Caribbean with a total land area of 10,938 km^2 (4411 mi^2, Figure 1). Reefs, beaches and an extensive coastal plain surround a plateau and backbone of peaks across the island. More than half of the island lies higher than 300 m above sea level (Government of Jamaica, 1987), the highest point being Middle Peak in the Blue Mountains at 2257 m.

Jamaica emerged as an island 10 to 15 million years ago and has never been connected to any other land mass. This has resulted in the development of a unique flora and fauna, with a high percentage of endemic species. Of the approximately 3000 flowering plant species known to occur on the island, almost 28% are endemic. Based on these figures, Jamaica ranks fifth among islands of the world in terms of number of endemic plant species*. Of the approximately 100 breeding bird species in Jamaica, there are 25 endemic species, which is more than any other West Indian island including Cuba and Hispaniola. Jamaica possesses great biological diversity due to its genetic isolation, size, range of elevation and diversity of habitats.

The rich natural heritage is threatened by development and exploitation of natural resources. The importance of these resources is based on biological and environmental values, as well as nature-based tourism, a primary source of revenue for Jamaica. Despite the threat to the biological richness of Jamaica, there has been no national park system in

* According to Davis *et al.*, 1986 who excluded Australia, New Zealand, Borneo and New Guinea. The first four islands are Madagascar, Cuba, New Caledonia and Hispaniola.

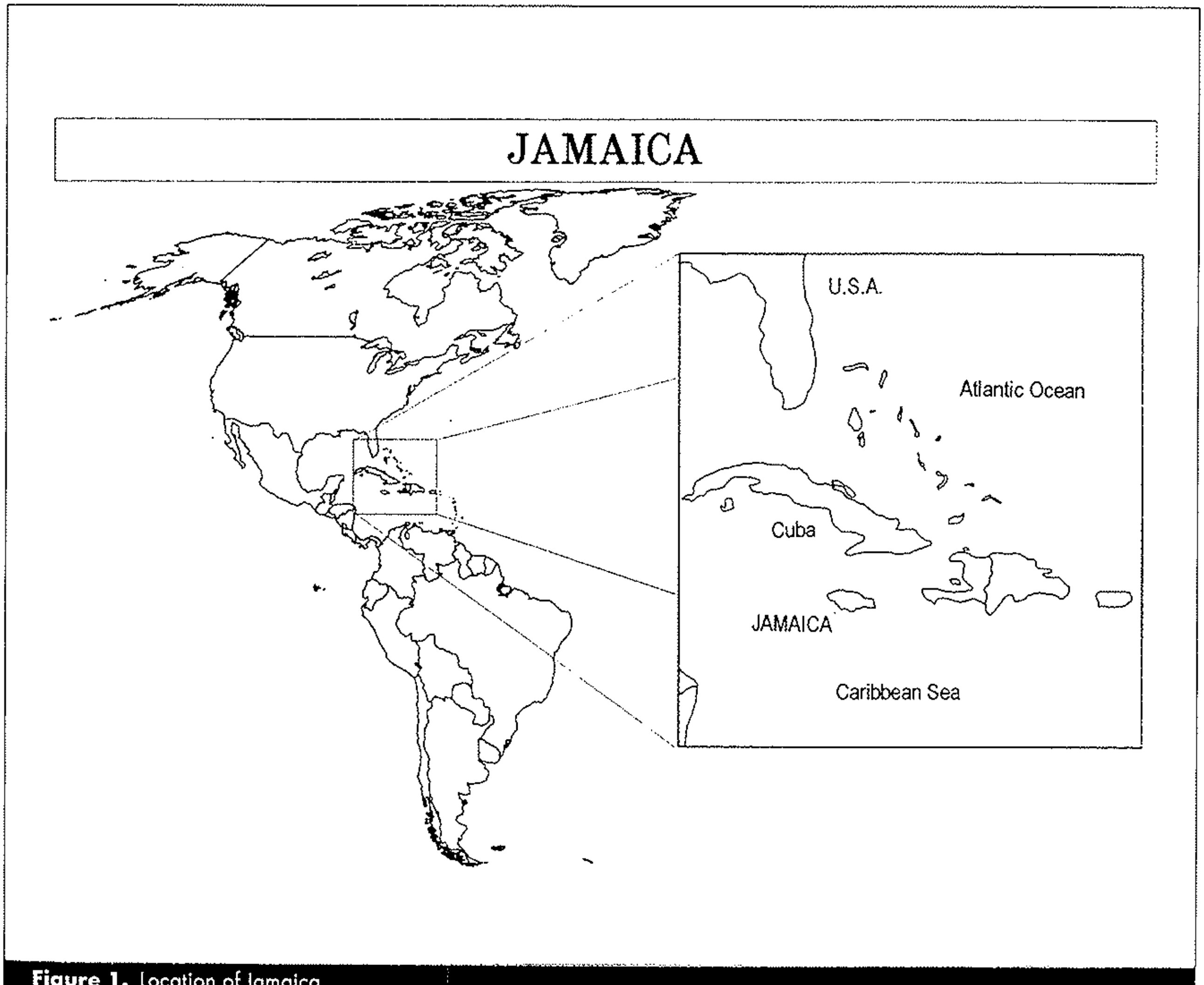

Figure 1. Location of Jamaica.

place, and only recently have conservation objectives been integrated into the national planning process.

1.1 Project Background

In 1990 the Government of Jamaica (GOJ) and the United States Agency for International Development (USAID) embarked on an effort to protect the biological diversity of Jamaica through the Protected Areas Resources Conservation (PARC) Project. The goal of this project was to lay the foundation for a Jamaican national parks and protected areas system. This goal included developing a national parks system plan and the establishing and managing two pilot parks, the Montego Bay Marine Park and the Blue and John Crow Mountains National Park (BJCMNP). In developing successful models for the inventory, design and management of the pilot parks, the aim was to provide valuable experience for a national parks and protected areas system for the entire country.

1.2 Rapid Ecological Assessment

Rapid Ecological Assessment (REA) is a set of methods developed by TNC and partner organizations for the cost-effective acquisition, analysis and management of biological and conservation information. REA has been developed in response to the need for rapid information collection and analysis in areas that are either biologically not well known, or are exceptionally diverse at a habitat or species level.

The REA process consists of a series of increasingly detailed analyses, with each step further defining those sites of high conservation interest. This process is carried out through the sequential analysis of satellite images, aerial photographs, and existing thematic maps to delineate priority areas and potential threats and to efficiently stratify and direct further field investigations.

The analytical products from appropriate imagery (aerial photography, videography and satellite imagery), are combined with existing information to direct cost-effective biological and ecological data acquisition through stratified field sampling. The spatially referenced information is optimally managed through GIS technology for ease of analysis and generation of map products (Koeln *et al.*, 1991).

Analysis of up-to-date imagery enables the development of an accurate characterization of the biological, physical and human components of the landscape. The integration of airborne and satellite imagery analysis with additional thematic maps and tabular data significantly improves the accuracy of the image data classification (Saterwhite *et al.*, 1984; Wheeler and Ridd, 1985). Field sampling stratified from the classification provides an efficient inventory approach that supports further analysis, monitoring and planning needs (Franklin, 1987).

Components of these REA methods have proven to be effective in classifying diverse landscapes throughout the western hemisphere. The Nature Conservancy has used REA to characterize the biological components of a barrier islands ecosystem in Virginia (Muchoney *et al.*, 1991) and has applied REA to support conservation planning and inventory in South Carolina, Georgia, North Carolina, Brazil and Venezuela. REA work is currently being undertaken in Belize, Costa Rica, Guatemala, Honduras, Panamá, and the Dominican Republic.

Within the Caribbean Basin, ecological studies based on multisensor approaches using accompanying field surveys have been undertaken in Puerto Rico (Sader *et al.*, 1985). These approaches have also been used in Costa Rica (Joyce and Sader, 1985). The Virgin Islands Resource Cooperative uses aerial photography and map data to assess marine habitats and communities (Beets *et al.*, 1986). Florida river flood plains have been monitored using Landsat data and aerial photo analysis with extensive field surveys (USGS, 1983).

1.3 Overview of The Nature Conservancy's Role in Rapid Ecological Assessments in Jamaica

The Nature Conservancy (TNC) is a private nonprofit organization dedicated to the protection of biodiversity. One of TNC's objectives is the systematic acquisition and management of biological and conservation information. TNC provided technical assistance to the PARC project in the areas of institutional development, protected area design and management, scientific information management and trust fund development. Although not included in the original PARC project design, TNC initiated an islandwide Rapid Ecological Assessment (REA) for Jamaica in collaboration with several local and international institutions (Grossman *et al.*, 1992). This REA was designed to assist with the protected areas planning activities sponsored under the PARC project through the provision of reliable and up-to-date natural resource information in the form of maps, digital databases and reports for the whole country. The islandwide REA was completed through computer-assisted analysis of multispectral Landsat Thematic Mapper (TM) imagery, with substantial field verification, and the products have been available to aid the planning process since 1992.

REAs have been designed to complement the information generation, analysis, and dissemination activities carried out by the conservation departments of many local and national governments in the western hemisphere. There are currently 200 installations of the Biological and Conservation Data System (BCD) at 85 U.S. National Heritage Programs and Conservation Data Centres in other countries and 115 cooperating data centres such as TNC Field Offices and U.S. federal agency installations. The installations are in all 50 U.S. states, five Canadian provinces and 13 Latin American and Caribbean countries.

The primary method of information management within the TNC network is the BCD system. BCD is a microcomputer-based data management system that facilitates the collection, distribution and exchange of information pertinent to the preservation of biological diversity. Major classes of data in the BCD include information on species and community types and their occurrences in the landscape, sites, land ownership parcels, managed and protected areas and information sources. The system represents TNC's seventh generation of biodiversity data management software and is the standard tool for managing and exchanging biodiversity inventory data in the network of U.S. National Heritage programs and Conservation Data Centres.

As part of the PARC project, a Conservation Data Centre was established for Jamaica (CDC–J) at the University of the West Indies (UWI) in collaboration with the Planning Institute of Jamaica (PIOJ), the Jamaica Conservation and Development Trust (JCDT), and TNC. The CDC–J compiles, analyzes and disseminates relevant conservation information on the biological diversity of Jamaica. For the PARC project the CDC–J provides an ideal environment for synthesizing information generated by REAs and incorporating this information into the park planning process.

The progress of the PARC project and the questions about the management of the two pilot parks (BJCMNP and Montego Bay) prompted TNC to plan REAs in each of the new parks. These were carried out by separate teams of scientists, and the present report documents the REA in the BJCMNP.

1.4 Project Objectives

The primary goal of the BJCMNP REA was to complete a detailed, mapped inventory of the important ecological information needed to assist conservation planning and management activities in and around the national park. This information included data on natural and modified ecological communities, rare and endemic species, and landscape and topographic information. Field surveys were conducted to acquire data for characterization of ecological community types and to provide some biological inventories.

Research teams were established to carry out necessary training and fieldwork, and to examine the management and monitoring issues concerning the national park. Special forms were designed for the fieldwork, which enabled the subsequent data analysis and data entry into the BCD in the CDC–J.

Primary objectives of this project included natural community classification and inventory work, enhancement of the conservation information system in the CDC–J, development of baseline data for monitoring activities in the park and the training of park rangers and CDC–J staff in REA methodologies. These objectives are explained below.

(a) Natural community classification and inventory
A principal objective of the REA was to draw up a detailed classification and inventory of the park and adjacent areas to assist with the design and management of the park and its buffer zone. This work included recording vegetation in the field, making cursory inventories of flora and fauna, and using aerial photographs and satellite images to map the extent of the different vegetation types. The information generated was to feed into the BJCMNP management plan, in particular indicating the areas of highest sensitivity and areas where ecotourism and sustainable agriculture/forestry activities could take place without damaging the integrity of the natural systems that the park was set up to conserve.

(b) Enhancement of the conservation information system in the CDC–J
The project was designed to enhance the information management system for park planning and conservation activities being developed at CDC–J. This conservation information consists of the manual files, maps, textual and spatial databases. This system will be able to support change detection analyses to track ecosystem dynamics as well as the sustainability of development activities in the park and buffer zones.

(c) Development of baseline data for monitoring in the park
The community classification and mapping products are intended to provide baseline data to meet planning, design, management and research needs. These baseline maps and supporting data will serve to guide decisions, document resource depletion and other development activities that affect the conservation values of these areas, and to help monitor the effectiveness of conservation activities.

(d) Training in REA methodologies
The project was designed for extensive training of in-country personnel in ecological field survey techniques, species identification and specimen preservation procedures, map reading skills, aerial photograph interpretation. The training component was included to instruct both managers and information users, as well as researchers in REA and information management methods. The training program included both laboratory and field exercises.

1.5 Project Reports and Products

The maps, digital databases and reports that were developed during the project were intended to assist in the management of the BJCMNP and to provide information for the institutions involved in conservation in Jamaica. These products are all lodged with the relevant institutions of the GOJ. Land cover maps were produced and special elements of biological diversity characterized and inventoried to set the framework for long-term management and monitoring. A set of forty-three 35 mm slides was produced and distributed, which can be used in future educational and informational projects. The slides depicted survey sites and plot locations in the Blue and John Crow Mountains, map overlays of soils, geology and topography and remote sensing imagery. The present report documents the process and results of the REA including the characterization and mapping of the natural communities and modified vegetation types of the BJCMNP and the immediately surrounding area.

1.6 Institutional Support and Cooperation

Funding for this project was provided by the Jamaica Agricultural Development Foundation (JADF), with additional support provided by the Moriah Fund Inc., the John D. and Catherine T. MacArthur Foundation and the North-South Center of the University of Miami. In addition to the involvement of TNC, the REA was made possible by the close collaboration of various Jamaican institutions. The two most active institutional participants were the CDC–J and the Rural and Physical Planning Unit (RPPU) of the Jamaican Ministry of Agriculture. Digital databases for topography and soils from the RPPU were used in the ecological analysis of the park area. Spatial information generated by the project is managed and maintained at CDC–J and at RPPU. Biological and ecological information derived from fieldwork has been integrated with this spatial data at CDC–J, which closely interacts with the PARC project planning team. Other institutions that were actively involved were the Forest Department of the Ministry of Agriculture, which provided Forest Rangers to participate in the fieldwork, and a number of other institutions listed below, given their role in the park planning process: the PARC Project Management Unit of the Planning Institute of Jamaica (PIOJ), the Natural Resources Conservation Authority (NRCA) of the Ministry of Development, Planning and Production, the JCDT and the Botany Department of UWI. In addition, botanists and vegetation ecologists from Cambridge, Dublin and North Wales Universities took part in certain aspects of the project.

2.0 TECHNICAL BACKGROUND AND REVIEW

2.1 The Blue and John Crow Mountains

(from Bellingham and Iremonger's contributions to Kerr *et al.*, in prep.)

The BJCMNP is located at the eastern end of Jamaica between 17°57' and 18°12' north latitude and 76°16' and 76°49' west longitude (Figure 2). The REA determined the planimetric area of the park to be 48,284 ha (119,310 ac). The total surface area of the park, which takes into account the topographical variation (based on a terrain model developed for the REA) is 79,666 ha (196,775 ac). The perimeter of the park boundary measured 289 km. The two ranges of the Blue Mountains and the John Crow Mountains are conterminous but their geology, physiognomy, soils and vegetation are vastly different.

The Blue Mountains rise steeply within 5 km of the coast and are characterized by steep-sided valleys and deeply-gorged rivers. The Grand Ridge forms the backbone of the range. It extends for 16 km and includes the highest land in Jamaica, much of it over 1800 m. Among the major peaks are Blue Mountain Peak, composed of Middle Peak (2256 m; the highest point in Jamaica) and East Peak (2246 m); Sugar Loaf Peak (c. 2150 m); High Peak (2082 m); Mossman's Peak (2028 m) and Sir John Peak (1927 m). Lesser peaks and ridges radiate from these and give way to slopes sometimes in excess of 70° and frequently more than 50°.

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 the range is within the park, including Mount Horeb (c. 1490 m) and Catherine's Peak (1539 m) above Newcastle. The Mount Telegraph range extends in a north-westerly direction from Hardwar Gap.

The Blue Mountains and the outlying Port Royal and Mount Telegraph ranges have a complex geology reflecting a varied history of sedimentation, volcanism, plutonism and metamorphic activity. The Blue Mountain Inlier is dominated by Cretaceous volcanic and igneous rocks, with minor sedimentary (limestone) and metamorphic units. The Port Royal and Mount Telegraph ranges consist of sedimentary and volcanic rocks formed in a Paleocene graben.

The soils of the Blue Mountains are derived from the metamorphic and igneous rocks that constitute the range, with the exception of the limestone outcrops. The soils derived from the igneous and metamorphic rocks are generally highly porous and subject to heavy leaching, resulting in low nutrient content (especially of nitrogen and phosphorus) and low pH. Decomposition of organic matter is slow in forest soils, especially at higher altitudes. The soils found on steep slopes are highly susceptible to erosion.

The John Crow Mountains rise gently from the east to a maximum height of 1140 m and end abruptly along a steep escarpment to the west. The Rio Grande Valley separates the John Crow Mountains from the Blue Mountains. The sedimentary rocks of this valley are a sequence of marine sandstones and shales, overlain by limestones deposited in a downfaulted belt which formed in the Paleocene (65–56 million years BP). The ranges converge at Corn Puss Gap (640 m) at the boundary of the Parishes of Portland and St Thomas.

The massif of the John Crow Mountains is of entirely different origin from the volcanic-dominated Blue Mountains. It is composed of hard, massive, white limestone formed during the late Eocene (about 40–35 million years BP). Unlike the sharp peaks of the Blue Mountains, the summit of the John Crow Mountains is a slightly tilted plateau, an unusual landscape of sinkholes and outcrops devoid of prominent features. The limestone has eroded to form a rugged landscape with a pattern of steep rocky knolls and deep closed depressions.

The bedrock limestone of the John Crow Mountains is often at or just below the surface. Soils are shallow and stony. Deeper soil, usually a sticky clay, is found in hollows and on ridge tops. There is a thin litter layer above a humus-enriched stratum. The soil types of the John Crow Mountains are all derived either from limestone or from calcareous shales on the western escarpment.

2.2 Review of Biological Inventories

The earliest botanical collections made in Jamaica were those of Sir Hans Sloane, who published an account of the flora of Jamaica in 1696. Many significant collections were subsequently made in the 18th and 19th centuries. In 1814 Lunan described some of Jamaica's indigenous plants. This was followed by Macfadyen's flora of Jamaica (1837), which was improved upon by Fawcett and Rendle who published a number of volumes of the flora of Jamaica between 1910 and 1936. This publication remains incomplete. However, a resurgence of taxonomic expertise in Jamaica culminated in the publication by Adams of Flowering Plants of Jamaica in 1972. Subsequent additions to the flowering plant flora were published by Proctor in 1982. Proctor also published Ferns of Jamaica in 1985.

Large collections of plants now reside in Kingston, Jamaica, at the herbaria of the Institute of Jamaica and the University of the West Indies. Many of the most recent additions to the UWI herbarium were collected in the Blue and John Crow Mountains by Tanner, Healey and Bellingham (University of Cambridge), Iremonger (UWI) and Kelly (University of Dublin).

The most recent advances with regard to biological inventories in Jamaica have been made with the establishment of the CDC–J in 1991. The CDC–J houses a national-level version of the BCD system (see Section 1.3). This system is used in conjunction with manual files and computerized and hard-copy maps, and contains data on all flowering plant species in Jamaica, corals and all terrestrial and freshwater vertebrate animals. It is being populated with site data on protected areas and contains extensive information on reference materials. These digital files are interactive so that with a fully operational data base, all organisms in a particular protected area, or all the protected areas which support a particular species, can be listed.

An important feature of the BCD is the record of the endangerment rank of each taxon. Each taxon is assigned both a Global and a National rank denoted by the prefixes "G" and "N". The ranks range from 1 to 5, denoting extremely rare to common and abundant. For example, a species which is common in Mexico and Cuba but very rare in Jamaica would be assigned the rank of "G5N1" in the Jamaican database. This would indicate that it is not under any threat on a global scale, but is very rare on a national scale. Other attributes are also noted in the ranking system. "H" indicates that the organism has been recorded historically, but not in the last 20 years. "E" denotes that the organism was introduced (is not native). "R" indicates that the organism has been reported, but without persuasive documentation which would provide a basis for either accepting or rejecting the report. "X" means that the organism is apparently extinct. Thus, a taxon with a national rank of "NER" would mean that there is an unconvincing report of an exotic species. In addition to the "G" rank, "T" ranks are used for global infraspecific taxa.

Information gathered in the course of this study was recorded so as to facilitate entry into the BCD system. The BCD was in turn used to provide the necessary information on conservation ranks for the species documented. A recent study indicated that there are more than 600 species of flowering plants in the BJCMNP, 275 species and 14 varieties of which are endemic to Jamaica and 87 of which are locally endemic to the parishes of Portland, St Andrew, St Thomas and St Mary (Iremonger, 1993, in press). The data presented here augment the information available on the park area.

2.3 Review of Vegetation Classification Studies

Sir Hans Sloane wrote the first account of the natural history of Jamaica in the early 1700s (Sloane, 1696; 1707; 1725). A Danish naturalist, Ørsted, produced a diagram of the topographic distribution of the different vegetation types in Jamaica in 1857. Some descriptions of Jamaica's natural history followed (*e.g.*, Thomas, 1891), but the first comprehensive categorization of all Jamaican plant communities was that of Asprey and Robbins (1953). Their system largely followed that of Beard (1944; 1955) for the vegetation of the Caribbean. A new vegetation classification for the island was developed during the first (islandwide) REA in Jamaica (Grossman *et al.*, 1992). The report from that REA outlines the classifications of Beard (1944 and 1955) and of Asprey and Robbins (1953).

Vegetation studies which have most influenced the classification of communities within the park presented here are the evocative descriptions of the montane forests of the Blue Mountains by Shreve (1914) and studies which have taken place in the last 20 years in both the Blue and in the John Crow Mountains. In the Blue Mountains, Shreve observed differences between the forests dictated by topography, and distinguished forests of ridges, windward and leeward slopes and windward and leeward gullies. Shreve (1914) was also the first to report a high altitude grassland in the Blue Mountains near High Peak.

Grubb and Tanner (1976) distinguished eight forest types for the Blue and Port Royal mountain ranges and two for the John Crow range. Permanent plots were established in the forests by this team (Tanner, 1977), providing the baseline data for a number of ecological studies (*e.g.*, Healey, 1990 and Tanner, 1980a, 1980b, 1986). Bellingham (1993) accomplished extensive collection work along the ridges and also down the little-explored northern slopes. Iremonger (1992) added to the description of the forests found above 1850 m. Lower montane forests in the Blue Mountains have not been well described. Accounts of lower montane forest given by Asprey and Robbins (1953) were based on observations re-

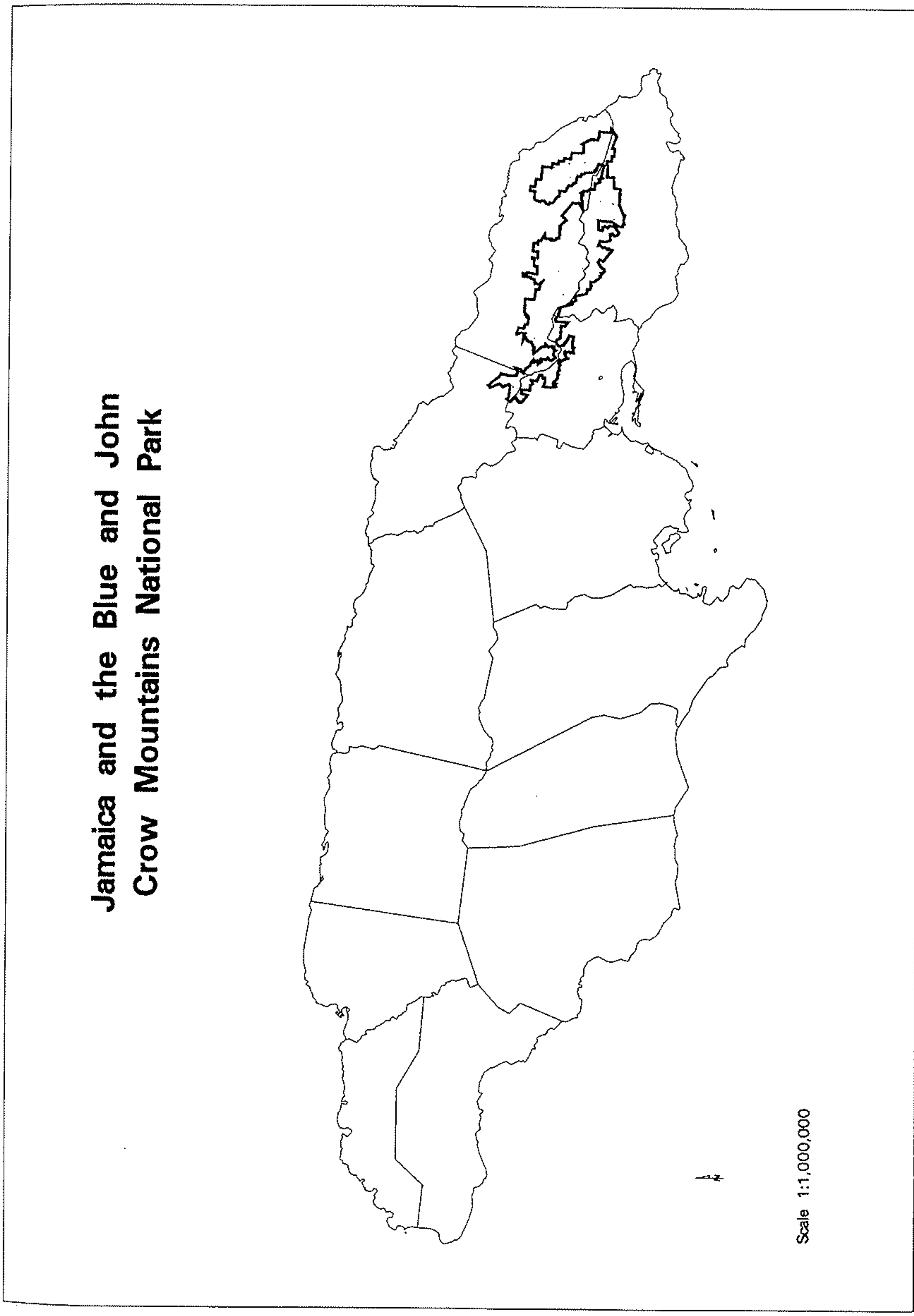

Figure 2. Location on Jamaican parishes and the Blue and John Crow Mountains National Park.

corded in the Cuna Cuna Pass area and on the lower slopes of the John Crow Mountains. The lower montane forests in the John Crow mountains were described in more detail by Kelly (1986) and Kelly *et al.* (1988), who established permanent plots and obtained good baseline data. The upper montane forests of this range have only been described cursorily by Asprey and Robbins (1953) and by Grubb and Tanner (1976).

The present study includes new biological and geographical information for the natural communities within the park derived from fieldwork, aerial surveys and the analysis of environmental data. In particular, species-level data were gathered to help the assessment of the conservation value of each vegetation type.

2.4 Review of Resource Inventories Based on Imagery and Spatial Information Systems in Jamaica

Natural resources inventory and other applications based on aerial photography have been used successfully in Jamaica. The RPPU (1988) used both black and white and colour-infrared (CIR) aerial photography from 1979/80 and 1985/86 to perform comparative land use surveys. These surveys quantified land use changes for agricultural, forestry and watershed protection planning purposes. Kohout *et al.* (1979) used colour and CIR photography and thermal imagery to detect submarine springs in the coastal waters of Jamaica. Huddleston (1979) applied remote sensing analysis to develop a sampling approach for agricultural and resource assessment. Dual polarization synthetic aperture radar (SAR) imagery has also been used for vegetation type mapping in Jamaica (Keifer and Wessman, 1985).

In 1982, RPPU initiated a program to develop a national spatial resource database, the Jamaica Geographic Information System or JAMGIS. The original system was modeled after the Comprehensive Resource Inventory and Analysis System (CRIES) from Michigan State University. The current configuration of JAMGIS includes ARC/INFO, a vector geographic information system (GIS) and ERDAS, a raster GIS and image processing system. This sophisticated spatial data processing centre enables RPPU to input and export data in most formats and to perform complex overlay analyses.

3.0 ANALYTICAL METHODS

3.1 Development of Community Classification

The classification defined during this study was based largely upon the previous islandwide classification presented by Grossman *et al.* (1992). The community classification presented in 1992 followed the outline of major plant formations accepted by UNESCO (Mueller-Dombois and Ellenberg, 1974). According to this system, the structure and spacing of the vegetation is of primary importance. The categories of major formations are listed below.

I. Closed forests
II. Woodlands
III. Scrubs
IV. Herbaceous communities
V. Deserts and other sparsely vegetated formations
IV. Aquatic plant formations (except marine)

Within these major formations, the communities were differentiated firstly according to whether they were wetlands or not, and then by using physiognomic as well as floristic criteria, which are influenced by environmental characteristics such as microclimate, topography and edaphic factors (aside from severe waterlogging) associated with the site. Grossman *et al.* (1992) drew heavily upon all the previous work on natural community description and classification in Jamaica described in section 2.3.

In the BJCMNP REA it was important to describe more fully the communities within the park area. Due to lack of published information there were a number of communities within the park which had not been described in the classification produced for the islandwide REA. The fieldwork undertaken for the BJCMNP REA from February to June of 1992 (see section 3.4) provided the missing information, so that the system presented here for the park is more complete than any prior classification. A combination of the information in the literature (outlined in sections 2.2 and 2.3) with the information gathered in the field surveys resulted in the classification presented in this report.

3.2 Spatial Data Development

The primary remote sensing data for the REA were Landsat Thematic Mapper data, SPOT (Satellite Probatoire pour l'Observation de la Terre) Panchromatic (PAN) data and colour aerial photography. Collateral thematic cartographic data were also obtained for the analysis from the GIS at RPPU or developed at the TNC Remote Sensing Lab. These data sets included digital terrain, geology, hydrology, transportation, infrastructure and soils, and are described below.

Table 1. Landsat Thematic Mapper sensor/platform parameters.

Satellite:	Landsat 4
Orbit:	Sun-synchronous
Orbit inclination angle:	98.22°
Altitude:	705 km (438 miles)
Swath:	185 km
Standard Scene:	170 km × 185 km
Sensor:	Thematic Mapper
Spatial Resolution:	30 m
Spectral Resolution (below):	

BAND	WAVELENGTH (μm)	DESCRIPTION
1	.45–.52	Visible Blue
2	.52–.60	Visible Green
3	.63–.69	Visible Red
4	.76–.90	Near-Infrared
5	1.55–1.75	Mid-Infrared
6	10.40–12.50	Thermal Infrared
7	2.08–2.35	Mid-Infrared

a) Landsat Thematic Mapper
Landsat TM data from 22 November 1988 were acquired for eastern Jamaica covering the BJCMNP (Landsat WRS Path/Row 11/047 and 11/048). These data were originally obtained for use in the islandwide REA. The TM sensor acquires data relative to seven portions of the electromagnetic spectrum; the sensor and platform parameters are listed in Table 1. These data were radiometrically corrected, rectified and registered to the prevailing Lambert Conical Orthomorphic map projection using the Jamaica Metre Grid with a 18° North Standard Parallel and the Clarke 1866 spheroid. The root mean square error (RMSE) of the transformation was less than one pixel (28.5 m). A natural colour photographic image was produced by writing the image data to film.

(b) SPOT-HRV Panchromatic Data
SPOT-HRV (Haute Resolution Visible) panchromatic data were obtained from SPOT Image Corporation for 21 July 1991 (WRS K=635, J=314, Scene ID 26353149107211539372P). The time of acquisition for the scene centre was 15:39:37 GMT. The SPOT-PAN data have a spatial resolution of 10 m and record reflected electromagnetic energy

in the wavelength range of 0.51 to 0.73 µm. These data were radiometrically corrected, rectified and registered to the prevailing Lambert Conical Orthomorphic map projection using the Jamaica Metre Grid with a 18° North Standard Parallel and the Clarke 1866 spheroid. The root mean square error of the transformation was approximately 1.5 pixels (15 m). A black and white photographic image (orthoimage) was produced by writing the image data to film at 1:50,000-scale with metre grid lines for alignment with the 1:50,000-scale metric topographic map series of the Jamaica Survey Department. Cirrus Technology Incorporated donated the film writing service.

(c) Aerial Photography

Colour aerial photography was contracted through Mr. Jack Tyndale-Biscoe. The scale of this stereo photography was nominally 1:22,500. The film for this photography was donated by Aerial Systems, Eastman Kodak Company through Steve Mango. Film development was donated by Mr. Harry Stiller of HAS Imaging Inc. of Dayton, Ohio USA.

Stereo colour aerial photography was also obtained from the Canadian International Development Agency (CIDA). This photography was at a nominal scale of 1:18,500. The flight lines for both sets of photography are delineated in Figure 3.

(d) Digital Terrain Data

Digital terrain data were acquired from the RPPU. These were digitized and attributed contour lines taken from the 1:50,000 English unit map series in ARC/INFO format. The digital terrain data were used to generate slope, aspect and elevation classes for use in describing and classifying the communities. The vector contour files were merged and a triangulated irregular network (TIN) generated using ARC/INFO TIN software.

From the TIN structure, slope, aspect and elevation classes were generated. Slope classes represented 8 classes in slope degree units:

1. 00.00–00.57°
2. 00.57–01.23°
3. 01.23–02.66°
4. 02.66–05.71°
5. 05.71–12.13°
6. 12.13–24.89°
7. 24.89–45.00°
8. 45.00–90.00°

Aspect classes correspond to 9 directional degree units:

1. 337.5–022.5°
2. 022.5–067.5°
3. 067.5–112.5°
4. 112.5–157.5°
5. 157.5–202.5°
6. 202.5–247.5°
7. 247.5–292.5°
8. 292.5–337.5°
9. Flat or no relief

Elevation classes were originally 100 ft contours. These data were converted to metric units and interpolated to 250 m contours. The three topographic map layers were also converted to a raster image format so that they could be used in conjunction with the raster image data.

The derived slope angle, elevation and aspect topographic data were used to improve the stratification for field sampling and to enhance the natural community classification in the park and surrounding area.

(e) Soils

The RPPU provided digital raster files of the 1:250,000-scale Jamaica Soils Series for use in the REA in raster format. The soils data were also converted to vector GIS format.

(f) Geology

The existing 1:250,000-scale geology map (Jamaica Geological Survey, 1984) was digitized and coded by TNC in ARC/INFO GIS format. The geology data were also converted to raster format for use in the analysis.

(g) Hydrography

Hydrography is defined as linear and polygonal water and drainage features. This thematic map (Figure 4) was derived by digitizing the Jamaica 1:50,000-scale Metric Topographic Map Series as modified through manual interpretation of the SPOT data and aerial photography. Watershed boundaries were developed through the analysis of drainage patterns with respect to topography. The watershed boundaries were also digitized into GIS format. Twelve watersheds were identified, all of which have their headwaters within the park (Figure 5).

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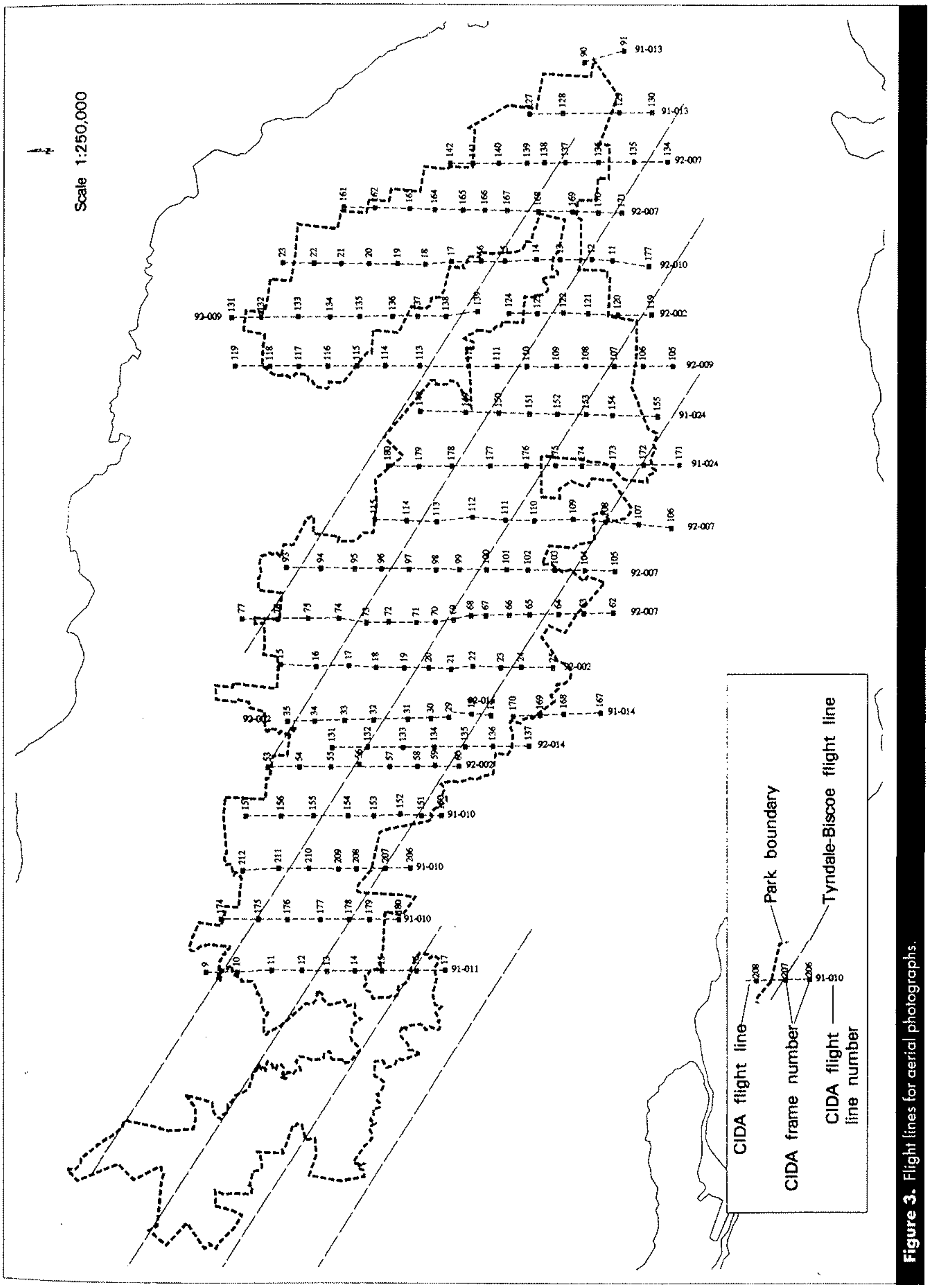

Figure 3. Flight lines for aerial photographs.

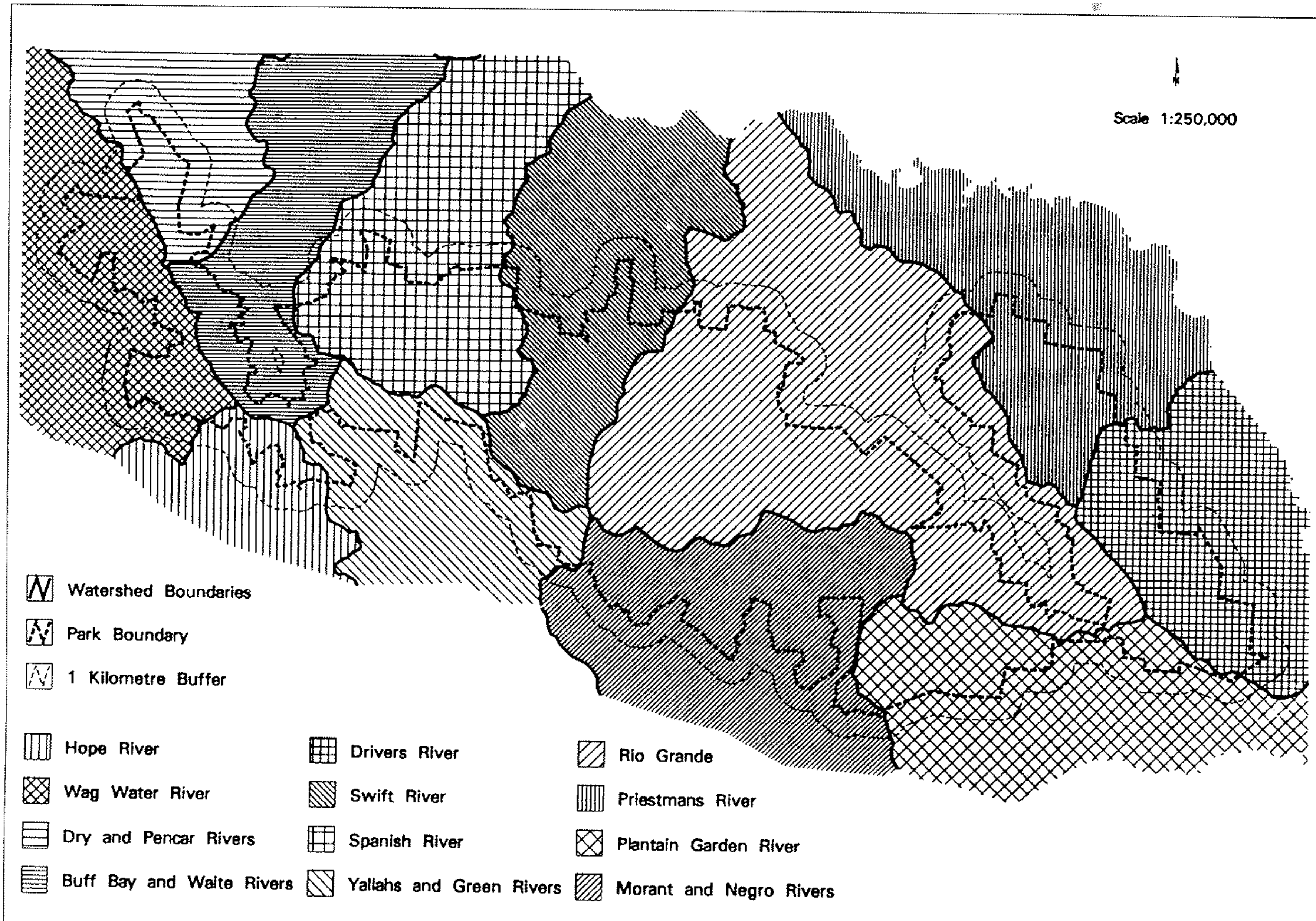

Figure 5. Watersheds in the Blue and John Crow Mountains National Park.

Buff Bay and Waite Rivers | Yallahs and Green Rivers | Morant and Negro Rivers

Figure 5. Watersheds in the Blue and John Crow Mountains National Park.

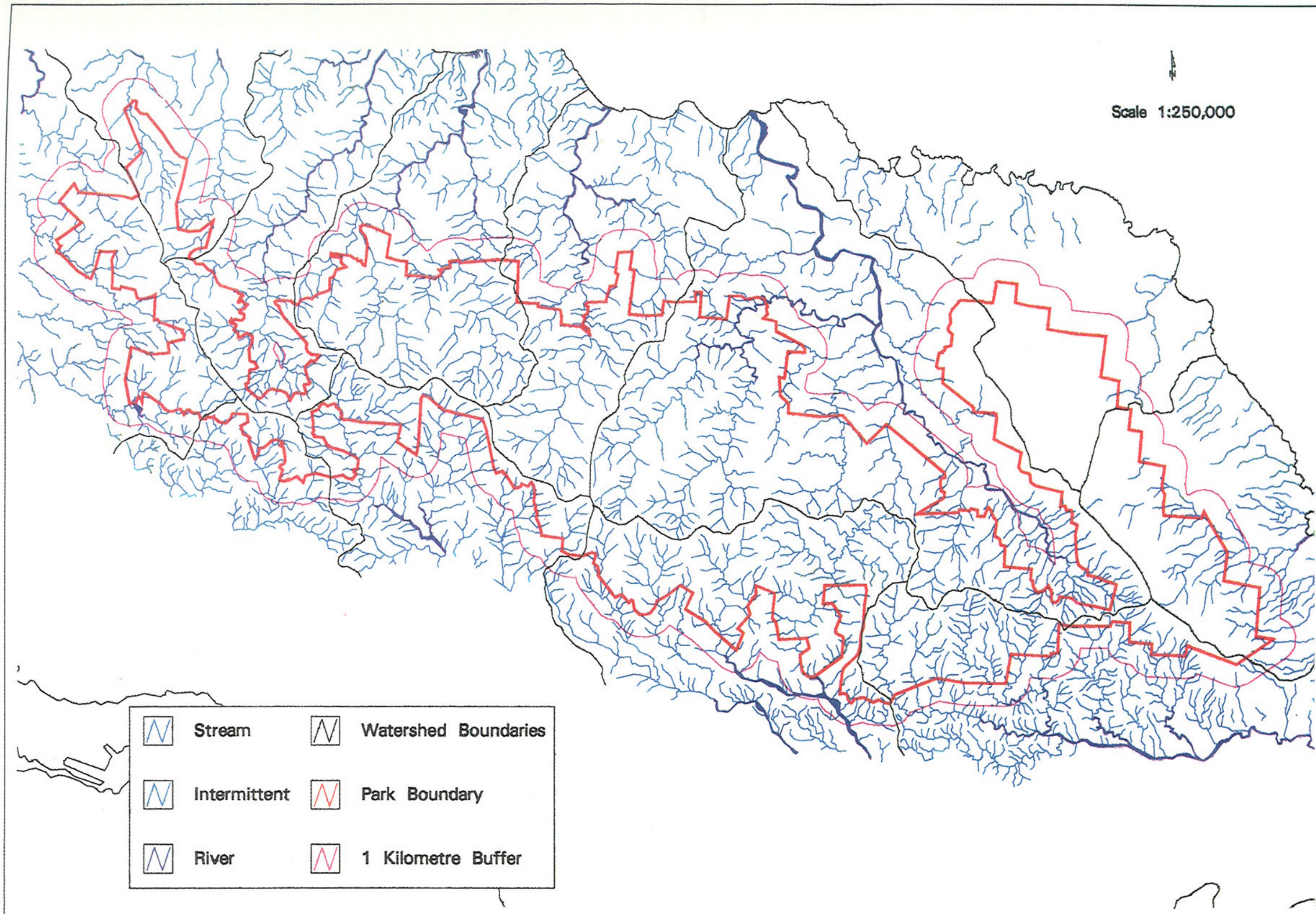

Figure 4. Hydrography of the Blue and John Crow Mountains National Park.

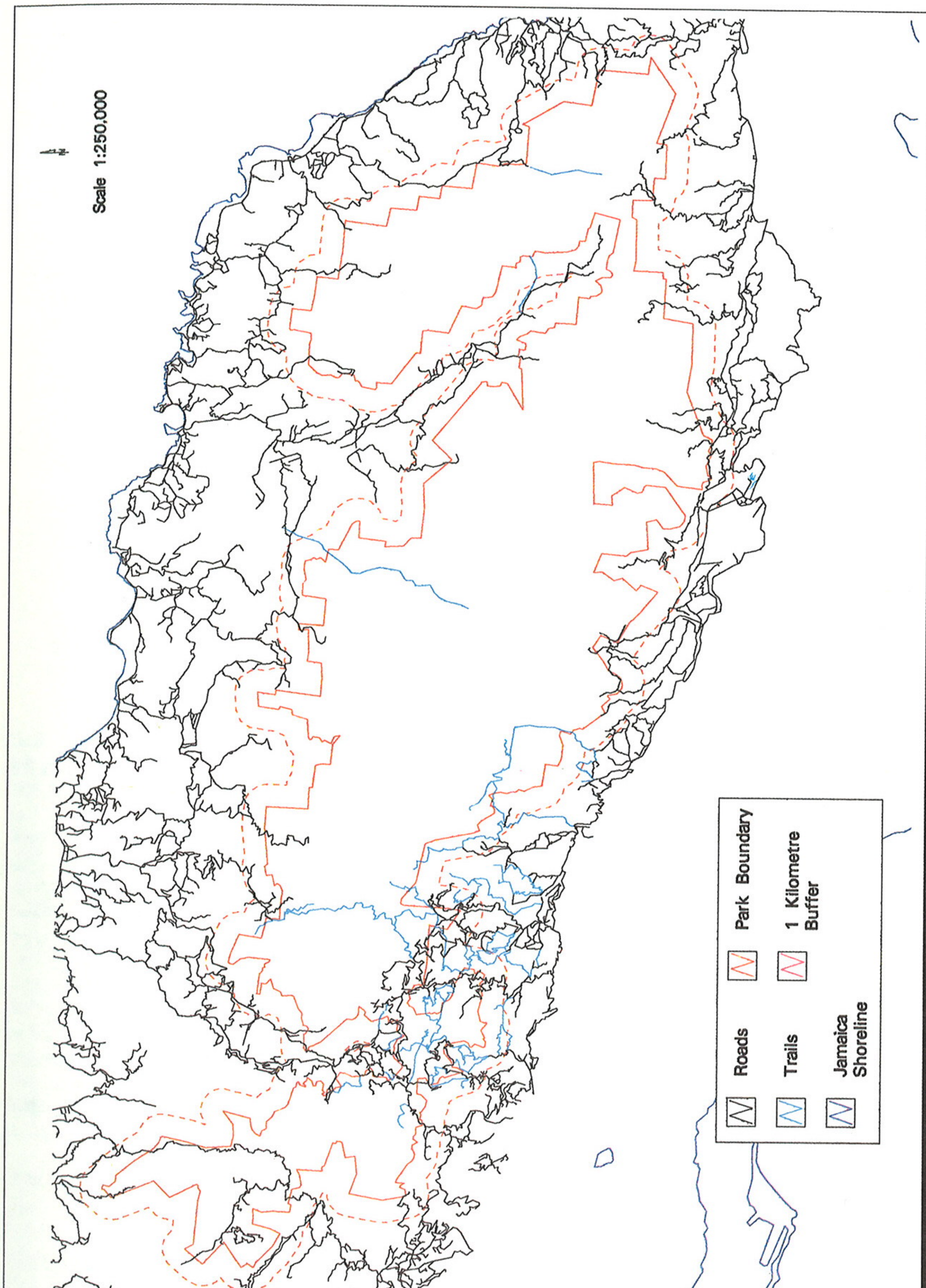

Figure 6. Roads and trails of the Blue and John Crow Mountains National Park.

(h) Infrastructure
Infrastructure comprises transportation, political and park boundaries, and other features of cultural or management significance (Figures 6 and 7). These map figures were derived from the Jamaica 1:50,000-scale Metric Topographic Map Series and other existing infrastructure maps.

(i) Digital Topographic Map Series
The Jamaica Metric Topographic Map Series for eastern Jamaica were digitally scanned and edge-matched to create a digital mosaic. This mosaic was used to aid the image base map for overlay and analysis.

(j) Park Boundary
The boundary of the BJCMNP was declared to be that of the older Forest Reserve within the Crown Lands. This was digitized and used in the analyses.

(k) Park Boundary Buffer Areas
The park boundary was buffered to one and two km for use in the natural and modified community mapping and in the development of the hydrography maps. The planimetric area of the park plus the one-km buffer was 72,884 ha. The surface area of the park plus the one-km buffer area was 119,725 ha.

3.3 Image Processing and Sampling Stratification

The digital analyses were performed using ERDAS GIS and image processing software, ARC/INFO GIS software, MIPS (Mapping and Image Processing System) GIS and image processing software and SAS (Statistical Analysis Software) on Sun and PC workstations. Initial stratification for fieldwork was attempted using a computer classification of the imagery along with the digital and hard-copy soils and geology maps. Additional geographical data were used to improve the stratification for field sampling to ensure that the complete range of natural and anthropogenic communities were being identified and sampled efficiently. This process aided the ecological classification and helped to meet the information requirements for park design and management.

3.4 Field Sampling and Verification

Fieldwork was designed to collect current information on the biological diversity and natural communities, particularly those about which there was little information. These data were also used to verify the accuracy of the natural and modified community classification maps. The field research was carried out by teams of local scientists, project collaborators, students and field assistants. D.L. Kelly provided floristic expertise for the work in the John Crow Mountains, as did S. Iremonger in the Blue Mountains. M. Jones acted as the lead for the zoological work.

Data were collected to describe the biological, ecological, and environmental characteristics of the natural communities. Systematic data collection on standard forms ensured accuracy and facilitated the data synthesis and analysis processes. The use of standard field forms and methods made data compatible for entry into the BCD. It will also contribute to future change detection and monitoring activities because it provides a record of exact locations and methodologies. Information on rare and endangered species, particularly endemics, and on the conservation value of each community type was emphasized during the fieldwork so that appropriate information would be available for park zoning and management.

The Blue and John Crow Mountains were sampled in two sets of field surveys, one in each mountain range. The sampling objective was to cover as broad a geographical range as possible, taking into account that some places in these mountains have been intensively studied and other areas are very inaccessible. Access was made to the John Crow Mountains by truck through Ecclesdown, Sherwood Forest and Millbank, and to the Blue Mountains though Shirley Castle, Claverty Cottage and Mount Felix. Access was made to Nanny Town by helicopter and by foot from Coopers Hill.

Within each of these areas survey sites were determined based on analysis of the TM, soils, geology and elevation data. Three survey sites were defined in the John Crow Mountains, while six survey sites were determined for the Blue Mountains. Using the field forms designed for this REA (Appendix I), the natural communities in these areas were recorded. In some areas only the dominant plant families, the structure of the vegetation and locational information were recorded. This type of record was called an "observation point". In other areas, a detailed 20 m × 20 m quantitative plot was recorded in addition to the information for the observation point. In each plot the diameter at breast height (DBH) and species of all trees with DBH greater than 10 cm were recorded. The herbaceous, climbing and epiphytic vegetation was also inventoried in nested 5 m × 5 m plots.

During the 18-month project period, a number of reconnaissance overflights were made by helicopter and light plane of the area during which

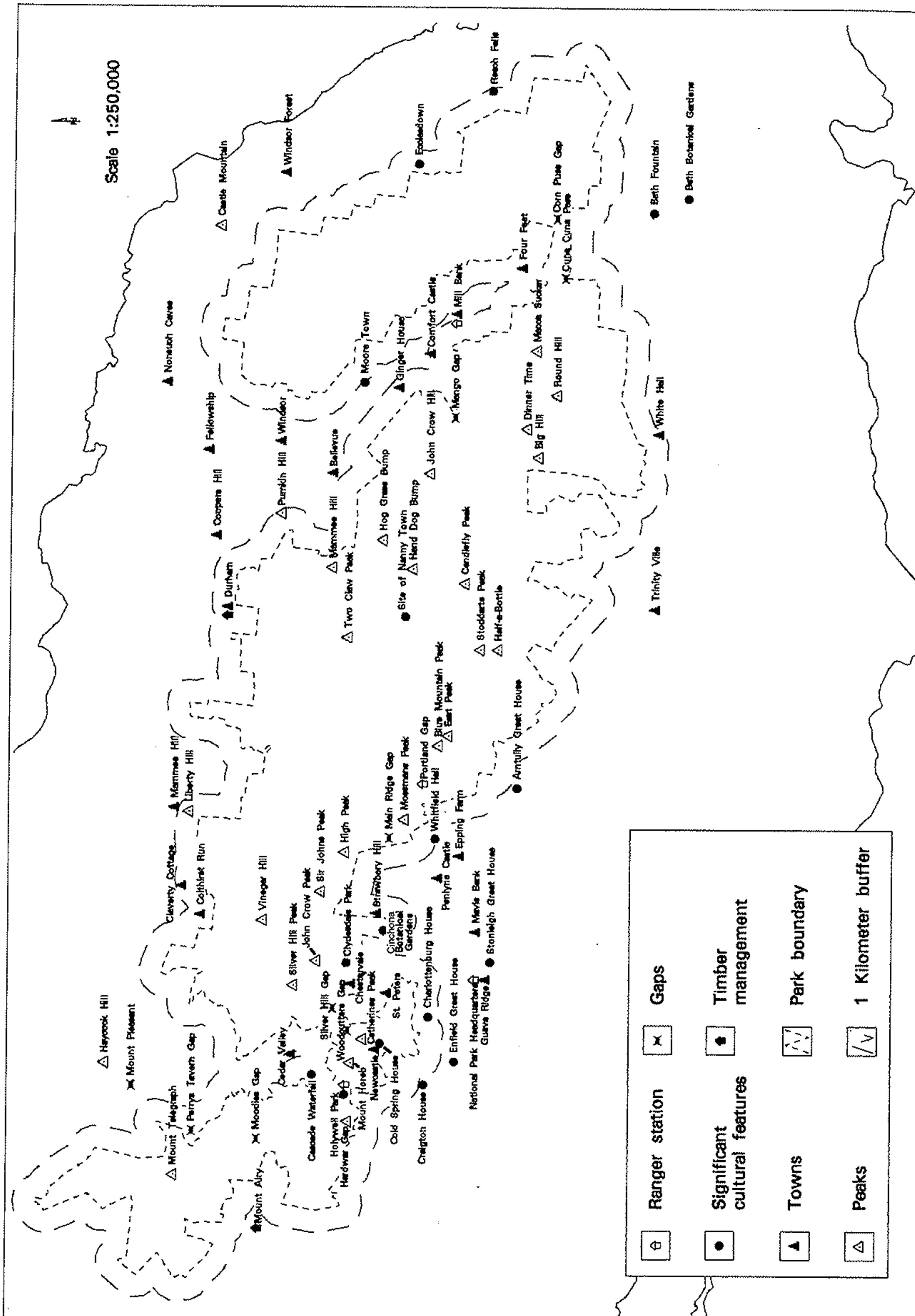

Figure 7. Cultural and management features of the Blue and John Crow Mountains National Park.

Figure 7. Cultural and management features of the Blue and John Crow Mountains National Park.

points were logged using a Global Positioning System (GPS) and the vegetation type corresponding to each location was recorded. In addition to aiding the photointerpretation effort, this enabled an accuracy assessment to be carried out.

3.5 Aerial Photo Interpretation

Aerial photography was acquired to provide high-resolution, current spatial information [see section 3.2(c)]. This is the preferred substrate for ecological inventory, mapping, monitoring and research. Detailed photointerpretation was carried out by TNC. The most important advantages of aerial photography are that it allows for stereoscopic, or 3-d viewing, and that it has a very high spatial resolution. Photointerpretation incorporates human analyst interpretation of colour, texture, shape and context. Community type boundaries and other information were drawn and labelled on mylar overlays. In order to edge-match and rectify the individual photo overlays, it was necessary to produce a base map.

The SPOT-PAN orthoimage was used as a base map for delineating land cover polygons identified during stereo photointerpretation. The use of this 10 m resolution, rectified and geo-coded orthoimage permitted accurate boundary and community definition and obviated costly manual transfer of photointerpreted information to a map base. The SPOT-PAN data were also merged with the TM data using an Intensity, Hue and Saturation (IHS) algorithm. The IHS merge combines the spatial resolution of the SPOT-PAN with the spectral resolution of the TM. Printouts were made of the merged data at the approximate scale of the photos and used as base maps for delineating photointerpreted polygons. Results of the photointerpretation were digitized into ARC/INFO GIS format.

3.6 Accuracy Assessment

Field surveys and reconnaissance flights were undertaken to assess the accuracy of the land cover map and to evaluate potentially significant natural areas. The aerial overflights were also designed to augment field inventory information, especially in areas where field sampling was difficult due to access problems.

4.0 RESULTS

4.1 Natural Community Classification

The classification of Jamaican vegetation types which was presented by Grossman *et al.* (1992) for the previous islandwide REA was revised during this study. Full descriptions of communities found within the boundaries of the park are given in Appendix II. The descriptions of the community types recorded during the fieldwork include many details of structure and species composition that have not been previously published. These are included in Appendix II. The names of authors who have previously described community types are included after the community names in the classification. Modified communities are marked with an asterisk. The names of communities in Jamaica which are not found in the park are listed in this appendix also, in the interests of retaining the hierarchical structure of the classification. The names of all the communities in the park are presented in Table 2.

During the REA fieldwork a total of 12 observation point records were made in the John Crow Mountains and plots (both 400 m^2 and 25 m^2) were recorded at nine of these. In the Blue Mountains, a total of 15 observation point records were made and plots were recorded at 11 of these (see Appendix III). In the analysis and subsequent community categorization process, the numbers of observation points (OP) and quantitative plots recorded in each community types were:

Lower montane rain forest over limestone: 4 OPs, 2 plots.
Lower montane rain forest over shale, transitional var.: 3 OPs, 3 plots.
Lower montane rain forest over shale, typical var.: 6 OPs, 6 plots.
Modified lower montane rain forest: 2 OPs.
Upper montane rain forest over limestone, typical var.: 1 OP, 1 plot.
Upper montane rain forest over limestone, edaphic var.: 1 OP, 1 plot.
Upper montane rain forest over shale, typical assoc., typ. var.: 2 OPs, 1 plot.

Table 2. Plant communities in the Blue and John Crow Mountains National Park. Modified and secondary communities are marked with an asterisk.

Forests and Woodlands
Lower montane rain forest over limestone
Lower montane rain forest over shale†, typical variant
Lower montane rain forest over shale, gully variant
Lower montane rain forest over shale, transitional variant
*Modified lower montane rain forest
Upper montane rain forest over shale, typical association, typical variant
Upper montane rain forest over shale, typical association, *Selaginella* variant
Upper montane rain forest over shale, Mor Ridge forest type
Upper montane rain forest over shale, high altitude scrub forest type
Upper montane rain forest over limestone, typical variant
Upper montane rain forest over limestone, edaphic variant
Upper montane rain forest over limestone, Blue Mountains variant
* Modified upper montane rain forest
* Pine plantations
* Broadleaved timber plantations
* Biomass plantations
* Coconut palm plantations

Scrubs (Shrublands or thickets)
Upper montane thicket complex over limestone
* Modified submontane and montane scrub
* Bamboo variant
* *Hedychium* variant
* *Polygonum chinense* variant
* *Rubus* variant
* Tree fern brake
* Mixed subsistence agriculture with dwellings
* Commercial shrub plantations
* Coffee plantation

Herbaceous Communites
Montane summit savanna
* Fern-dominated sward
* Anthropogenic graminoid-dominated sward
* Sugar cane field
* Banana plantation

Sparsely Vegetated Formations
Cliffs and landslides, seed plants and ferns predominant
Cliffs and landslides, lichens and bryophytes predominant
Rock rubble
* Rocky wall vegetation

†"Shale" is used here as by Asprey & Robbins (1953): Geologically, two major series are included: the Carbonaceous shales of the Lower Eocene (black shales, coarse conglomerates, limestone and sandstone) and the Cretaceous shales. These latter are red and purple shales, tuffs, breccias and conglomerates interbedded with fossiliferous limestone of the Upper Cretaceous. These rocks produce a complex of local soil types that is included under the term "shale".

Upper montane rain forest over shale, typical assoc., *Sel.* var.: 2 OPs, 2 plots.
Upper montane thicket complex over limestone: 5 OPs, 3 plots.
Anthropogenic graminoid-dominated sward: 1 OP.

4.2 Mapping the Results of the Community Classification

It was possible to map most of the communities accurately. Those which were not mappable included particularly those which covered very small patches or for some other reason were not distinguishable in the aerial photographs or the satellite imagery. The communities which were mapped were the following (modified communitied marked with an asterisk):

1. Lower montane rain forest over limestone
2. Lower montane rain forest over shale
3. Lower montane rain forest-transitional variant
4.* Modified lower montane rain forest
5. Upper montane rain forest over shale, typical variant
6. Upper montane rain forest over shale, *Selaginella* variant
7. High altitude scrub forest over shale
8. Upper montane rain forest over limestone
9. Upper montane rain forest over limestone, Blue Mountains variant
10.* Modified upper montane rain forest
11.* Pine plantation
12.* Broadleaved timber plantation
13.* Coconut palm plantation
14. Upper montane thicket complex over limestone
15.* Modified submontane and montane scrub
16.* Bamboo-dominated scrub
17.* *Rubus*-dominated scrub
18.* Mixed agriculture
19.* Coffee plantation
20. Montane summit savanna
21.* Fern-dominated sward
22.* Anthropogenic graminoid-dominated sward
23.* Sugar cane field
24.* Banana plantation
25. Cliffs and landslides

Other land cover types which were not included in the community classification but which were inserted on the map were:

26. Bare sand and soil
27. Urban
28. Industrial
29. Roadside residential
30. Water

The map of natural and modified communities for the BJCMNP is shown in Figure 8. The areas calculated for each land cover type in the BJCMNP and their summary statistics from the digital GIS files are presented in Figure 9.

4.3 Flora

During the fieldwork plant species which could not be identified in the field were collected for future identification. In the John Crow Mountains approximately 540 plant specimens were collected, while approximately 460 specimens were collected in the Blue Mountains. C.D. Adams of the British Museum later identified 278 of these combined specimens. The remainder were identified in Jamaica by D. Kelly, S. Iremonger and P. Lewis. Voucher specimens were lodged in the UWI herbarium. Many of the plants encountered were sampled several times. The total number of plants with confirmed identification were 276 flowering plants, 37 pteridophytes, one bryophyte and one lichen. Because of the nature of an REA, there was an emphasis on tree species, and other plants were generally less rigorously recorded. The lists of species are presented by community type in Appendix IV.

The number of plant species recorded in each community type ranged from 23 to 101 (Table 3). Because more intensive sampling was carried out in some communities, the number of species recorded does not necessarily reflect the diversity of the community. There are, however, certain significant details worth noting. The modified community was the least diverse of all forest communities sampled. It had the lowest ratio of endemic to non-endemic plants (3:20). The communities of the highest reaches of the John Crow Mountains had the highest ratios at 20:36 (Upper montane rain forest over limestone, typical variant) and 46:85 (Upper montane thicket complex over limestone). The highest species diversity was recorded in the Lower montane rain forest over shale, typical variant, and in Upper montane thicket complex over limestone, probably because the sampling intensity was greatest in these areas. Only cursory descriptions of these community types exist in the literature (Asprey and Robbins, 1953; Grubb and Tanner, 1976; Shreve, 1914). The Lower montane

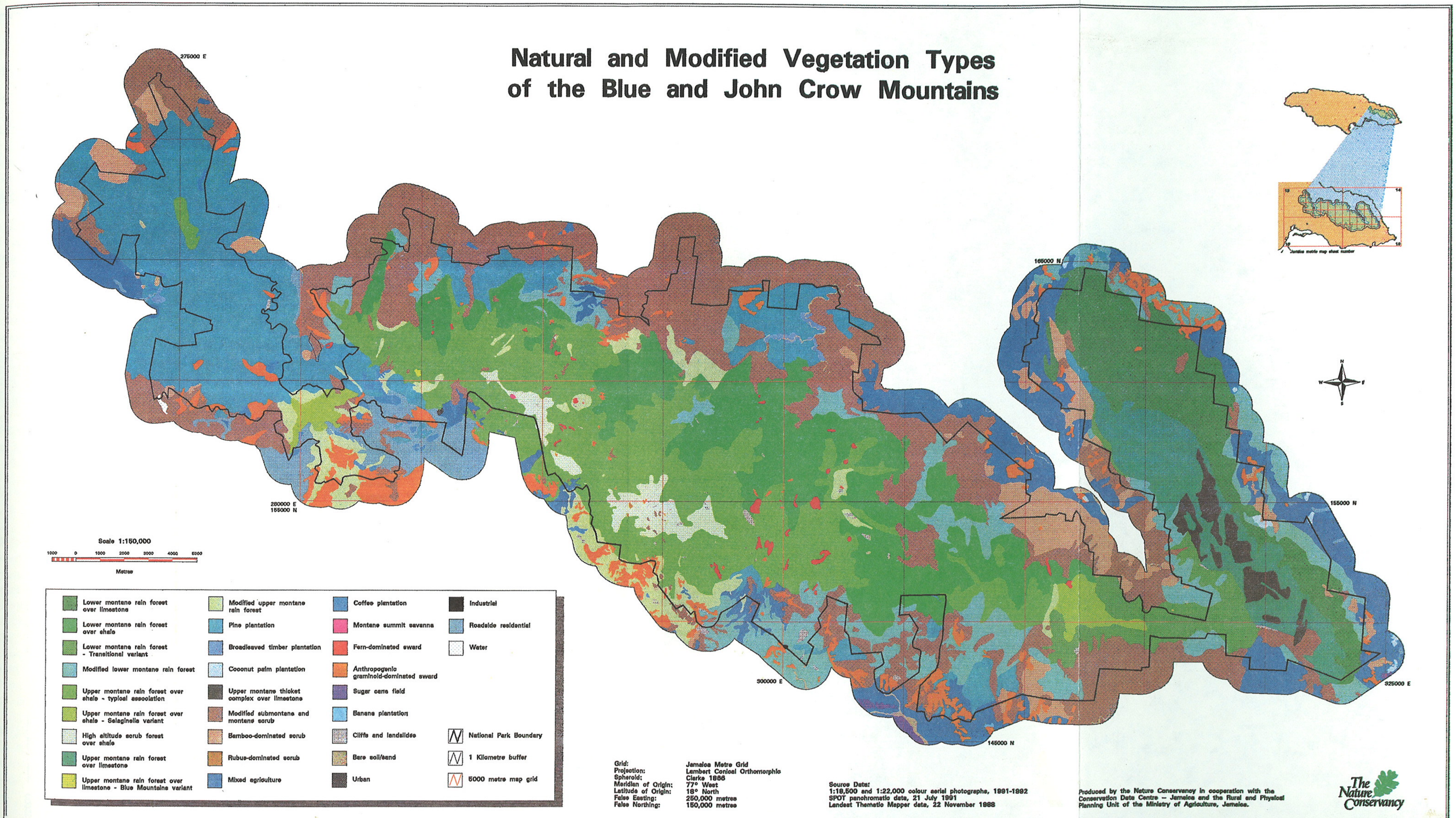

Figure 8. Natural and modified communities of Blue and John Crow Mountains National Park.

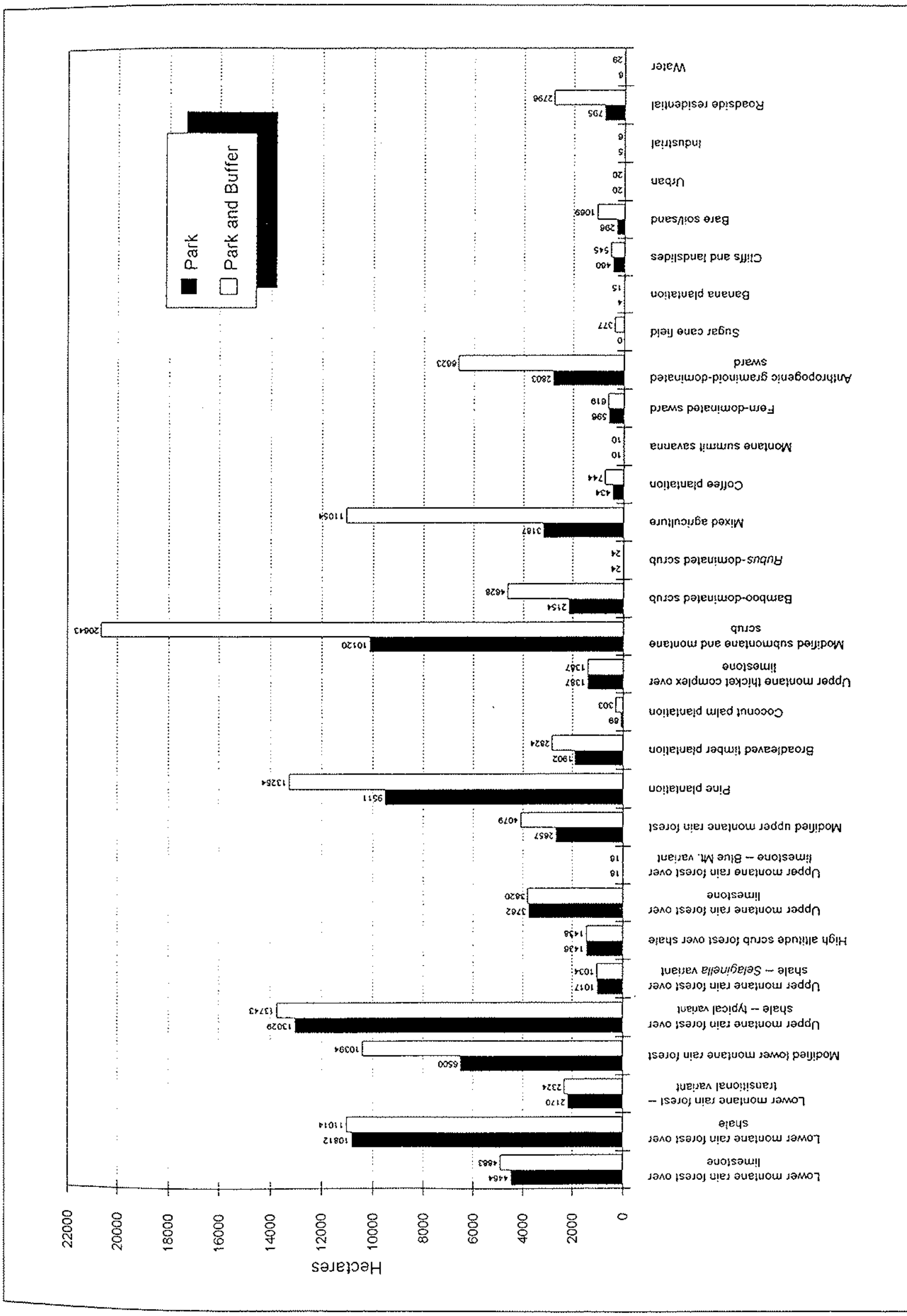

Figure 9. Surface area of each land cover type in the Blue and John Crow Mountains National Park.

rain forest over shale demonstrated a low endemism rate in comparison to all other communities except the modified community. This is because it is not as isolated as the other types. Communities of the more coastal and accessible areas of Jamaica do not support as many endemics as do the more isolated mountainous communities (Adams, 1972, 1990; Kelly, 1988). The topographic isolation of these areas gives rise to genetic radiation.

In terms of the conservation status of the plants found, the Upper montane thicket complex over limestone delivered the highest number of rare endemics (with global ranks of G1 or G2). The next highest was Upper montane rain forest over limestone, typical variant. These communities both cover the upper reaches of the John Crow Mountains, which are relatively inaccessible. The hostility of the terrain provides the endemic species with a certain level of natural protection. The rediscovery of a very rare (and quite unusual-looking) plant, *Wercklea flavovirens*, in the Lower montane rain forest over shale, transitional variant, near Millbank, was particularly gratifying. The only known other population has disappeared, which has led scientists to fear that the species might be extinct. *Myrcia calcicola* had not been collected since the pre-1972 collection by Proctor (Adams, 1972; Proctor, 1982). It was found in both the Upper montane rain forest over limestone community types, so the national and global ranks were changed to G1N1. *Hernandia catalpifolia* was found in the three unmodified Lower montane rain forest classes. This tree is not particularly rare although it is endemic, but it has been given the conservation rank of G2N2 because of its significance as the only known species on which the caterpillars of the giant swallowtail butterfly (*Papilio homerus*) feed.

Of the non-endemics which had high N-ranks (N1, N2, NH, NR) there are a few worthy of indi-

Table 3. An analysis of the flowering plant taxa recorded during the REA fieldwork. Some of the plants were not identified to species level and are not included in the numbers analysed for conservation rank or for endemism. Taxa which are probably endemic are included as endemic.

	Taxa identified to species or genus level	Taxa identified only to family level	Number of endemics	Number of endemics with ranks of G1, G2, GH	Number of non-endemics with ranks of N1, N2, NH or N?
Lower montane rain forest over limestone	71	4	27	9	4
Lower montane rain forest over shale, transitional variant	71	5	24	11	0
Lower montane rain forest over shale, typical variant	101	1	20	7	4
Modified lower montane rain forest over shale	23	2	3	1	1
Upper montane rain forest over limestone, typical variant	36	0	20	12	0
Upper montane rain forest over limestone, edaphic variant	33	0	10	8	0
Upper montane rain forest over shale, typical association, typical variant	41	0	15	5	1
Upper montane rain forest over shale, typical association, *Selaginella* variant	51	0	20	6	0
Upper montane thicket complex over limestone	85	1	46	19	2
Unlocalized species	12	0	6	4	0
Total of all areas visited during the fieldwork	276	Not applicable	111	49	11

vidual mention. *Oxandra laurifolia* was found in Lower montane rain forest over shale, typical variant. The species is very rare in Jamaica, although it is also found in other Greater Antillean islands and in Guadeloupe. *Savia sessiliflora*, which has been recorded in other Greater Antillean islands and in the Virgin Islands, had not been found in Jamaica since the original collection by Swartz in the 19th century. The national rank for this plant may now be changed to N1. *Hirtella triandra*, a plant heretofore only recorded in the Lesser Antilles, was found in Lower montane rain forest over shale, typical variant. *Trichilia pallida*, a tree of fairly wide distribution in Central America, Mexico, and other Antillean islands, was recorded for the first time in Jamaica in this study. It was found in the disjunct community types of Upper montane thicket complex over limestone and Lower montane rain forest over shale, typical variant, in some abundance, which indicates that it may have a wider distribution. *Symphysia racemosa*, the only ericaceous climber in Jamaica, is very rare in Jamaica, and was found in the Upper montane thicket complex over limestone. Its distribution outside of Jamaica includes other Antillean islands as well as possibly northern South America.

4.4 Fauna

An avifauna survey was performed at the Cuna Cuna Pass survey site by M. Jones of CDC–J and R. Chipley of TNC between 10 and 23 May 1992. During the period of the field survey, which was mostly botanical in nature, *ad hoc* observations were made, when and where possible, of the avifauna of the area. Specific surveys were conducted to assess the avifauna on 21–22 May. These surveys were conducted along three trails leading from Cuna Cuna Pass: Trail 1 to Millbank, Trail 2 to Hayfield and Trail 3 to Glenmoy.

On each trail points were marked with permanent flagging at 100 m intervals. At each point all birds seen and identified, as well as all calls and songs identifiable, were recorded over a 10 minute period. At the beginning of each trail, the compass bearing was determined and at each point the aspect was recorded. Fifteen survey points were determined based on accessibility. The survey was conducted mornings and afternoons although inclement weather hampered observations at several points. The following endemic species were sighted:

Amazona collaria (Yellow-billed Parrot)
Columba caribea (Ring-tailed Pigeon)
Dendroica pharetra (Arrow-headed Warbler)
Euneornis campestris (Orangequit)
Euphonia jamaica (Jamaican Euphonia)
Geotrygon versicolor (Crested Quail-dove)
Hyetornis pluvialis (Chestnut-bellied Cuckoo)
Melanerpes radiolatus (Jamaican Woodpecker)
Myiarchus barbirostris (Sad Flycatcher)
Nesopsar nigerrimus (Jamaican Blackbird)
Todus todus (Jamaican Tody)
Trochilus polytmus (Streamertail)
Turdus jamaicensis (White-eyed Thrush)
Vireo modestus (Jamaican Vireo)
Vireo osburni (Blue Mountain Vireo)

An indication of the avifauna diversity of the survey area is that 15 of the 25 endemic Jamaican birds were observed. Faunal records were also made during the fieldwork. Two animals of interest to conservationists in Jamaica, the Jamaican coney (*Geocampromys brownei*) and the giant swallowtail butterfly (*Papilio homerus*) were recorded in Upper montane rain forest over limestone (the coney), and in Lower montane rain forest over shale, both typical and transitional variants (the butterfly). The information on both faunal and floral species presented in this report was entered into the BCD. Locations are recorded on maps and the original field forms archived at CDC–J.

Several additional faunal observations were made during the course of the field inventories. *Papilio homerus* was sighted in Lower montane rain forest over shale, at 500 m, in a clearing at Macuna Level about two hours hike from Nanny Town. The tree *Hernandia catalpifolia* was observed downslope, about 45 minutes away. This area may support a viable population of this animal which has not yet been studied. Further surveying is required.

Geocampromys brownei was recorded in Upper montane rain forest over limestone, at approximately 600 m elevation. There were many coney holes and droppings in the area. Further study of this obviously thriving population is urged. *Amazona collaria* was sighted in fair abundance in Lower montane rain forest over shale, transitional variant at approximately 600 m.

4.5 Information Management

A major objective of this project was to ensure data will be available to and used by conservation and resource scientists and managers. To that end, information generated by the REA has been housed in and may be distributed by local institutions.

All digital geographic information resides in the computer facilities of RPPU and is available to researchers and resource conservation and development planners. The rectified satellite images are on file at RPPU and the Remote Sensing Lab at TNC. The raw Landsat TM data and resulting classifications are archived at RPPU. The purpose of archiving is to ensure that original, uncorrupted data can be provided to those who need them.

Field data from this REA which concerned natural communities, species of conservation concern (threatened and/or economically important) and managed areas has been integrated into the Element Occurrence Records (EOR), Site Basic Records (SBR) and Managed Area Basic Records (MABR) in the BCD system at the CDC–J.

4.6 Training

The field teams included representatives of the planning team, as well as trainees, students and field assistants. Staff from the CDC–J, UWI, NRCA, JCDT and the Forest Department involved in field reconnaissance and inventory work in the park and the transfer of this information into the conservation database were trained during the course of this project. Formal training was co-hosted with CDC–J and RPPU at RPPU on 2–6 March 1992. This specialized training was given to RPPU and CDC–J staff in image processing, spatial information management, field methods, and generation of map products.

A presentation workshop about REA was held at UWI on 2 June 1992. Participants included representatives of TNC, CDC–J, JADF, Forest Department, JCDT, CAST, UWI, USAID and the Geological Survey Department. The meeting was organized by TNC, CDC–J and RPPU.

5.0 DISCUSSION AND CONCLUSIONS

5.1 Applications of REA Products for Park Management and Monitoring

This project provided accurate mapping and assessment of the ecological communities of the BJCMNP, as well as potential threats to their existence. The REA activities and results will have four major effects on park management and monitoring. Firstly, the vegetation community data may be used to delineate the extent and conservation value of each community type, which will provide a sound basis for the park management zonation. Secondly, the exact whereabouts of quite a number of rare species are now known (including new locations for the very important *Papilio homerus* and the very rare *Wercklea flavovirens*), so that focused monitoring activities can be organized. Thirdly, the digital data sets and the aerial photographs used for this study will provide baseline data for periodic change detection activities, which should form a significant part of any monitoring program. Finally, a substantial amount of training was given to the Jamaican staff of the CDC–J, to many of the Forest Rangers, and to the herbarium staff of the UWI. These individuals now form a human resource base for conservation activities in Jamaica, not only in the BJCMNP.

5.2 Conservation Considerations within the Park

An analysis of the vegetation data recorded during this REA provided certain information which helped evaluate the different areas of the park for conservation. There were three elements in this evaluation: (a) the nature of the different community types; (b) the geographic extent and number of occurrences of each community type; and (c) the impact that visits by people have had or will have under different management practices. For example, a community can cover one relatively large area in the park, it can cover several small areas that are geographically separated, or it can cover one small area. It may support a high number of endemic (or otherwise important) species, or it may only have one or none. The community may only occur in a location which would be dangerous for tourist activity, or tourist activity may already be intense and destroying the community. These are only a few examples of a great number of possible scenarios that must be taken into consideration. The rest of this section outlines the main considerations which have come to light during the REA as issues for management practices and policies.

The High altitude scrub forests are under threat because of their small extent and the amount of visitor activity in the Blue Mountain Middle Peak area. Fortunately, this community type is not limited just to this peak but has also been recorded on Mossman's Peak. However, the number of endemics known to occur on Middle Peak may not all also occur on Mossman's Peak. Of 48 species of flowering plant recorded in permanently-marked plots in the Middle Peak area (Iremonger, 1992), 18 were endemic (ratio of 18:30, more than half). A number of these are not found in any other forest type. Thus the importance of protecting the Middle Peak area becomes apparent, and a survey of Mossman's Peak would be useful.

The Mor Ridge forest has been recorded from the eastern slopes of John Crow Peak. Tanner set up permanent monitoring plots in this forest type, which will provide a good baseline for further work. This community type is notable because of its unique species combination, which includes the rare *Lyonia octandra* (which the hemiparasitic mistletoes seem to favor) and *Ilex obcordata*. Particularly notable is its unusual humic soil, which supports a number of plants which are only found as epiphytes elsewhere in the forests. Other patches of Mor Ridge forest occur elsewhere in the Blue Mountains, but they have not been officially documented (Bellingham, pers. comm.). Further survey work is needed in the area to pinpoint these.

The Blue Mountains variant of Upper montane rain forest over limestone occurs on John Crow Peak. At least two endemic plant species are limited to this community type due to its geographical isolation from other limestone areas. These are *Salvia jamaicensis* and *Zanthoxylum hartii*, and there are a number of *Pileas* and *Peperomias* which need further investigation.

The Montane summit savanna dominated by *Danthonia domingensis* (which also grows at high altitudes in Hispaniola) documented by Shreve (1914) to be confined to a small area on the north side of High Peak is still in existence. This is the only piece of high altitude grassland in Jamaica, and it is thought that it may be a relict community from the last Ice Age, when the tree-line in the Blue Mountains may have been about 1000 m lower than it is now. However, this may not be so since the factors controlling its presence until the present time are obscure, and also the absence of the community from higher peaks in the mountains adds to the puzzle. Currently the access to this grassland for visitors is very difficult because of the dense thickets which block the old trail. The grassland, although valuable from a conservation point of view, would not be a stimulating attraction for any ecotourists and therefore the trail should remain closed except if there is a reason for scientific investigation in the area.

The Upper montane forests over shale are relatively undisturbed on the very steep and inaccessible northern slopes of the Blue Mountains. However, on the ridges and on the southern slopes they have been largely removed (particularly for coffee farming) or degraded, causing a rate of soil erosion which is among the highest in the world. The remaining forests are under extreme threat. Encroachment takes place daily at an alarming rate. The threat is not only from direct removal or degrading of forest by human activity; an additional and perhaps more insidious threat to these forests is the alarming spread of a number of exotic plant species which displace the naturally occurring species and even prevent them from regenerating. This problem should be addressed immediately. Tom Goodland, a scientist from the University of North Wales, has been studying the effects of one such exotic species, the Australian *Pittosporum undulatum* (mock orange). Other troublesome species are *Hedychium gardnerianum* (ginger lily), *Polygonum chinense* (red bush) and *Melinis minutiflora* (molasses grass).

The Mount Horeb region in the Port Royal Mountains supports a particular sub-type of Upper montane rain forest over shale (the *Selaginella* variant). This was thought to be confined to this area in Jamaica, but the REA fieldwork found a very similar community on Lookout Hill in the Cuna Cuna pass area, and also in the Vinegar Hill area. However, the conservation value of Mount Horeb lies not only in its particular community type, but also in its proximity to the Kingston Metropolitan Area. It is an island of nature in an otherwise highly degraded location and provides habitat for forest fauna which would otherwise be absent from the south-western part of the park. Its conservation also provides Jamaica with an intact montane rain forest within reach of the capital city and is an ideal spot for nature education and ecotourism.

The Lower montane forests over shale in the Blue Mountains, despite having been cleared to a great extent for pine plantations, still cover large areas, and support many endemic species and some very large trees. Because of the vast clearing that has taken place, we do not recommend here that logging activities be permitted to continue in the natural forest, and encourage the planting of native broadleaf timber species in the places which have already been cleared. The occurrence of *Papilio homerus* near Nanny Town should be surveyed. This endangered species is currently the subject of a study in the Lower montane forests over shale, transitional variant which occurs around the Rio Grande valley. These transitional forests should be the subject of a special protection effort, particularly on the western slopes of the John Crow range near Four Feet.

Our knowledge of the forests of the John Crow range, even after the extensive fieldwork during the REA and the previous work of Kelly *et al.* (1988), remains limited geographically. This is due mainly to the extremely difficult terrain of jagged limestone karst. However, our work has shown the value of both the Upper montane rain forest over limestone and the Upper montane thicket complex. Apart from some disturbance by local hunters, these areas are not visited by people. Ecotourism would be the only other activity which could take place in these areas, and we recommend that it be discouraged or strictly confined to a particular well-maintained trail in this area of the park because of the dangerous terrain and the high number of rare endemic plants.

The remaining intact Lower montane forests of the John Crow range are not extensive, due to encroachment for farming palms and bananas and selective cutting or high-grading of timber. However, the potential for development of one or two locations for ecotourism is high and is recommended with rigorous monitoring. The sustainability of timber extraction from the area should be studied, because although the forests support large trees useful for lumber, they are widely spaced and their populations would take some time to recover from felling activities. No further roads should be built into the area and those that are already established should only be used for timber extracting activities (rather than further felling activities). After the sustainability study, felling should be carried out in accordance with the recommendations.

5.3 Management, Monitoring and Research Recommendations for the Blue and John Crow Mountains National Park and Surrounding Area

(a) Management zones

The natural community data discussed above have implications for zoning within the park. There are a number of highly localized communities which are unique in that they support a high percentage of endemic species, which in some cases are actually limited in their entire global extent to that community type in Jamaica. In the Blue Mountains, communities which need particular attention in a zoning plan are the High altitude scrub forest, the Mor Ridge forest, the Blue Mountains variant of Upper montane rain forest over limestone, and the Montane summit savanna. Using the information from the REA work, a zoning plan was designed in collaboration with Robert Kerr (Table 4, Figure 10).

There are two main categories of zones proposed for the park: general access zones and limited access zones (see also Figures 6 and 7). Visitors and people who live and work in the vicinity of the park would be welcome to use any of the general access areas. For management purposes these should be divided into five categories (see Table 4). Buffer zones (which need further work to be more precisely delimited geographically; Figure 10 shows a regular band 1 km wide, but this might not be the ideal shape) would be those areas surrounding much of the park where conservation-compatible use would be encouraged. For farmers this would mean practicing recommended planting, harvesting and animal husbandry activities. Growing crops or raising animals which pose a threat to the natural ecosystems in the park would not be permitted in the buffer zones. In the interests of preventing the soils of the watershed being washed into the sea the cultivation of steep slopes would likewise be prohibited, in line with accepted recommendations (GOJ, 1987). The sustained yield management zones are those areas within the park which are currently used for pine cultivation or cultivation of other tree crops such as the legume biomass producers *Leucaena leucocephala* and *Calliandra* sp. These would continue to be managed for production, closely monitored for sustainability. The trails would be divided into those on which a guide would not necessarily be needed and those on which a guide is strongly recommended. The free passage roads and trails are those which are not necessarily open to the public in general but which the people who have traditionally used (and in some cases maintained) them may continue to use them as needed. The limited access zones would be divided into two major categories (see Table 4). The nature restoration zones are those areas which have been more or less severely degraded, and which will need rigorous monitoring and some restoration activities (such as planting native forest tree species) so that they can revert to native forest. The special conservation zones are those areas which for reasons outlined above need special attention, mostly in terms of ensuring that they are not subjected to visitor activity except under very strict supervision. Scientists may need to visit these areas, and archaeologists or other history researchers may need to visit the site of Nanny Town.

(b) Management infrastructure

A complete report on the current and recommended management infrastructure is beyond the scope of the REA report. A management plan for

Table 4. Management zones for the Blue and John Crow Mountains National Park.

General Access Zones	Limited Access Zones
1. Buffer zones	1. Nature restoration zones
2. Sustained yield management zones	a. Mt Telegraph
3. Visitor trails-unguided	b. Holywell
a. Blue Mountain Peak trail	c. Clydesdale
b. Hollywell trails	d. Sportsman's Hall, Mabess River valley
c. Cuna Cuna Pass trail	e. Queensbury Ridge, Arntully
d. Vinegar Hill trail	f. Moore Town
e. Blue hole recreation area	g. South of Macungo Hill
4. Visitor trails-guided	2. Special conservation zones
a. Millbank to John Crow Mts	a. Hog House Hill research sites
b. Ecclesdown to John Crow Mts	b. Cuna Cuna Pass and Corn Puss Gap
c. Nanny Town	c. Nanny Town
d. Moore Town	d. High Peak
e. Cinchona to Portland Gap	e. John Crow Peak (Blue Mts) and research sites
f. Portland Gap to Mossman's Peak	f. Blue Mountain Peak research sites
g. Mossman's Peak to Port Antonio	
5. Free passage roads/trails	

the park is currently under preparation and the reader is referred to this when it is produced (Kerr *et al.*, in prep.). However, some observations may be made on the basis of the REA experience. The Forest Rangers who worked on this project were conscientious and dedicated, but the park is a very big area for such a small staff to effectively patrol and caretake. Staff effectiveness may be maximized by providing adequate station facilities, transportation and vehicle running costs. While augmenting the staff and its mobility is costly, it may prove much costlier in the long run to have an inadequate system for the patrolling and maintenance of the park and its infrastructure, because the threats to the system are severe in many parts.

One of these threats is fire. Particularly during the dry season fires burn on many of the hillsides. Molasses (or Wynne) grass is a very combustible non-native species which has spread over much of the southern slopes of the Blue Mountains in the last 70 years or so. It spreads particularly into abandoned fields and cutover hillsides, some of which are included within the nature restoration zones. Since the fires destroy the seedling and sapling trees and shrubs which colonize the grasslands, these will not revert to natural forest unless they are prevented from burning. The park management can help this situation by ensuring that there is an efficient firefighting system (piped water, emergency staff with transportation) which can access these areas with speed.

In the Blue Mountains coffee is farmed on many slopes which are too steep, and soil runoff is very quick. The coffee crops should be kept to slopes preferably <30° but certainly <45°. The ground in between the coffee bushes should be kept with a grass cover to prevent excessive erosion. Intercropping is encouraged. The wealth of global information on coffee farming should be drawn upon so that the coffee farms in the Blue Mountains (many of which will be inside the park buffer zone) become a truly sustainable productive enterprise.

There is an important resource of knowledgeable people in a number of villages around the park. These are people who have lived in the area sometimes for generations, and information about the forests and uses of wild plants has been passed down. These people should be consulted about and included in plans for activities in and around the park, such as about agricultural practices and maintenance of trails and signs, and they should also be employed whenever possible as guides for tourists. The support of the local people for the park is very important to its success. If the sustained yield zones are to be successful they will need planning and staffing, and much of the staff can be recruited from the local communities. A special outreach program by the Rangers and other park staff would be beneficial.

(c) Monitoring activities

These activities may be of two types, long-term and short-term. The purpose of a monitoring system is to ensure that the management practices designed to protect the natural systems in the park are working, both in terms of the quality of the natural communities and the success of operations in the sustained yield and nature restoration zones. A monitoring system, to be successful, must have the authority to change management practices if they are found not to work.

Over the long term satellite images can be used to measure the success of the national park (maintenance of extent of the natural systems, extending of the natural systems in the nature restoration zones and also state of commercial forestry operations in the sustained yield zones). The RPPU has the facilities to carry out this work, which could be supported by additional GIS manipulation in the CDC–J.

Periodic visits by experts in botany and zoology will yield information on the populations of rare and endangered species, including the endemics. Because these species add to the international importance of the park it is of the utmost importance that the park management system foster their protection and health. Every effort should be made to ensure the continuity of the unique genetic resource that these species harbour.

The park staff should monitor the populations of the troublesome exotic plants through regular site visits during which photographic records of the extent of these populations is recorded and compared to the previous visit. The object of these activities would be to lessen the cover of the exotics or at least to keep them in check. The experience of park staff dealing with exotics in other countries should be drawn upon. The "U.S. Forest Service Sister Forest Program" would provide an ideal vehicle for this type of information exchange. If a decision is made to make a concerted effort to reduce their extent in the park, volunteer programs could be put into place in which community groups could participate. This would reduce the cost to the park system as well as involve Jamaicans directly in the success of their national park.

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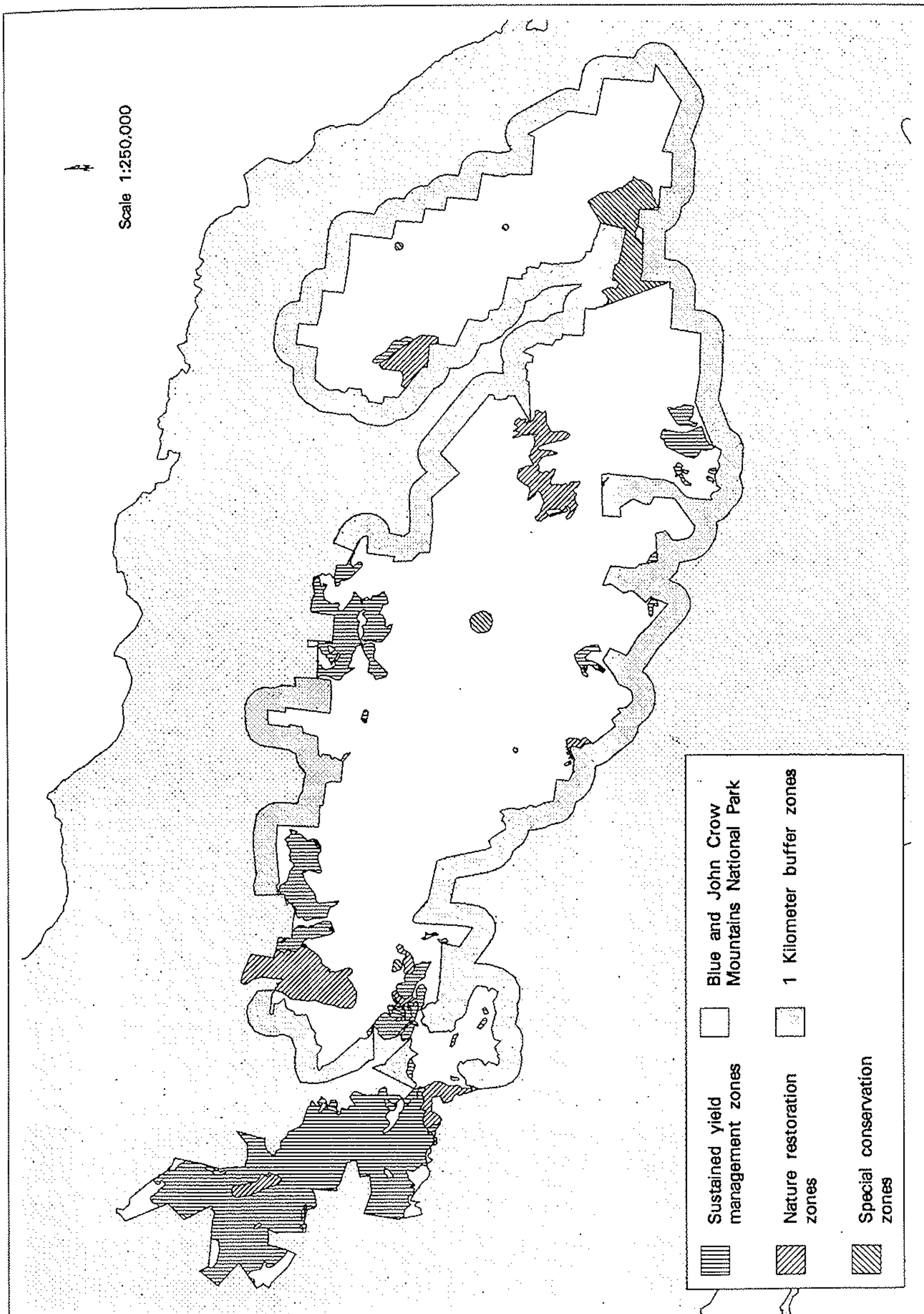

Figure 10. Management zoning scheme for the Blue and John Crow Mountains National Park.

(d) Future scientific research

The BJCMNP holds a wealth of information for scientific research. Very little is known about the endemic species, their physiology, environmental requirements, population dynamics, reproductive systems and chemical properties. Projects to investigate these subjects should be permitted and encouraged by the park management. In particular the staff of the University of the West Indies should be involved in the research projects, during which graduate students could gain experience and qualifications.

Although information about the natural communities has been recorded, there is still much to learn about the ecosystems and how they function. In particular, studies which focus on animal–plant interactions should be conducted. Plant species pollination and dispersal mechanisms have often been found to be highly evolved, with one endemic plant species relying on one endemic animal species for its reproductive success. This works both ways, because some animals have evolved to be dependent on a particular plant for food or structural support of nests.

In addition to the native fauna and flora, the exotic species should be studied for most effective control measures. Some methods may be more labour-intensive while others may require the controlled use of toxic compounds. In a national park the use of toxic chemicals should be kept to a minimum because of the damage they can do to non-target organisms. The more we know about the life history and ecology of an organism the more alternatives we will be able to design to control its population growth.

Research into lumber and biomass production as well as agroforestry and other intercropping systems should be conducted to streamline the methods used in the sustainable yield and buffer zones of the park. The use of native tree species should be thoroughly researched and encouraged, and a nursery with these species should be equipped to provide saplings for planting. Demonstration projects for agroforestry and organic farming methods should be put into place as soon as possible, and the local farmers involved. It is important to have a successful demonstration in progress so that farmers using traditional methods can see that the alternatives are more productive, particularly in the long term.

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DATA REFERENCES

1. Landsat TM
   Scene WRS: 11/047
   Date of Acquisition: 22 November 1988
   Scene WRS-2: 11/048:
   Date of Acquisition: 22 November 1988

2. SPOT-PAN
   Scene KJ: K=635, J=314
   Date of Acquisition: 21 July 1991
   Scene ID: 26353149107211539372P
   Time of acquisition (scene center): 15:39:37 GMT

3. Digital Terrain Data
   Source Data: Jamaica Topographic Map Series, Jamaica Survey Department; from Rural and Physical Planning Unit, Ministry of Agriculture, Jamaica
   Scale: 1:50,000; 100 ft. contours

4. Soils
   Source Data: Jamaica Soils Series; from Rural and Physical Planning Unit, Ministry of Agriculture, Jamaica
   Scale: 1:250,000

5. Geology
   Source Data: Jamaica Geological Survey, 1984
   Scale: 1:250,000

6. Aerial Photography
   Source: CIDA
   Nominal Scale: 1:18,500

   Source: J. Tyndale-Biscoe
   Nominal Scale: 1:22,500

APPENDIX I FIELD FORMS

JAMAICA - PROPOSED PROTECTED AREAS

FIELD FORM #1 FOR PROPOSED PROTECTED AREA (SITE) DESCRIPTION

Identifiers/Location

Proposed protected area (Site) name: ______________________ Proposed protected area (Site) number: ________________

Surveyor: ________________ Date: ___________ Parish: ________________ 1:50,000 map number: __________

Lambert projection: ___________________ Latitude & Longitude: __________________ Elevation range: __________

Ownership: ________________________________ Management: ________________________________

Physiographic province: ________________________________ Watershed: ____________________________

Name of principal contact(s): ____

Site location map:

[Append map of area and\or draw diagram indicating numbered survey sites which will correspond to the survey site forms.]

JAMAICA - PROPOSED PROTECTED AREAS

FIELD FORM #2 FOR SURVEY SITE INVENTORY

[Cover page for Survey Site Obs Points]
[also for use alone if no Obs Points are recorded]

Identifiers/Location

Proposed protected area (Site) name: ______________________ Proposed protected area (Site) number: ________________

Survey site name: ____________________ Survey site number: ______________ Surveyor: ___________________

Date: ____________ 1:50,000 map number: ______________________ Elevation range: _______________________

Imagery (if used) Type: ____

If aerial photo: roll #: ________ flight line #: _________ frame #: _________ date: ________ 10,10 location: ________

Directions for locating Survey Site: ____

____

____

Ownership: ____________________________ Management: ____

Name of principal contact(s): ____

Level of information gathered: Number of Observation Points with species lists:_____ without species lists: _______

If Field form #3 was completed for any Obs. Pts., give Obs. Pt. # and number of Form #3s completed at that Obs. Pt. __________

____

Miscellaneous comments/observations: ____

____

Survey site [with observation points]:

[Draw a topographic diagram of the survey site line with observation points and plots (if applicable) marked in.]

Site Obs Points]
ts are recorded]

OBSERVATION POINT DATA [continuation of field form #2, Page 1 of a set of 3 pages for Obs Point data]

Proposed protected area (Site) name: ______________________ Proposed protected area (Site) number: __________

Survey site name: ______________________ Survey site number: ______________________

Observation point number: __________ Observation point photograph: Y __ N __ Lat. & Long. ______________________

Lambert Projection: ______________ Elevation: ________ Aspect: (N,NE,E,SE,S,SW,W,NW or degrees of North)________

Date: ______________________ Number of Field form #3 plots: ______________________

Community name:______________________________________ Size of patch:______________________

Depth of Information gathered	Topography	Slope (degrees)	Ecological System	Physiognomic class
___ general information (field form #2)	___ summit	___ flat, 0 - 4	___ estuarine	___ multiple canopy forest
___ general species list (field form #2 list)	___ step in slope	___ gentle, 4 - 5	___ lacustrine	___ single canopy forest
___ plot or transect (field form #3)	___ slope	___ moderate, 6 - 14	___ riverine	___ woodland
	___ plateau	___ somewhat steep, 15 - 26	___ palustrine	___ scrub
	___ cliff	___ steep, 27 - 45	___ terrestrial	___ tree savanna
	___ valley	___ very steep, 45 - 69	___ subterranean	___ shrub savanna
	___ plain	___ abrupt, 70 - 100		___ grassland
	___ other	___ overhanging, >100		___ fernland
				___ mixed herbaceous
				___ sparsely vegetated
				___ non-vascular
				___ non-vegetated
				___ other

SOIL

Bedrock: igneous ____ sedimentary ____ metamorphic ____ Soil type: ______________________

Colour: light brown __ dark brown __ black __ red __ orange__ yellow__ ochre__ other________ Depth of litter layer:________

Texture		Structure	Drainage
_____ clay	_____ clay loam	_____ blocklike	_____ waterlogged
_____ silt	_____ sandy clay loam	_____ platelike	_____ very poor
_____ sand	_____ silty loam	_____ crumb	_____ poor
_____ loam	_____ other	_____ single-grained	_____ moderate
_____ sandy loam		_____ massive	_____ well drained

GENERAL DESCRIPTION:

DIAGRAM OF OBSERVATION POINT:
(include any particular directions, and positions of detailed plots)

OBSERVATION POINT DATA [continuation of field form #2, Page 2 of a set of 3 pages for Obs Point data]

CONSERVATION (fill out the options below to indicate the conservation potential or condition of the community (the EO) under study).

EO quality: (ie, how representative is this occurrence? Consider the size of the patch and the vitality and vigour of the plants)
A - Excellent B - Good C - Marginal D - Poor

EO condition: (ie, is the community pristine or degraded? Is there a potential for the community to recover from disturbances?)
A - Excellent B - Good C - Marginal D - Poor

EO viability: (ie, what are the long term prospects for continued existence of this occurrence at the indicated level of quality?)
A - Excellent B - Good C - Marginal D - Poor

EO defensibility: (ie, can this occurrence be protected form extrinsic human factors?)
A - Excellent B - Good C - Marginal D - Poor

EO rank: (conservation potential/importance of this community occurence, summary of all criteria above): A B C D

Evidence of disturbance (cut or burned stumps, trails, etc): ____________________

____

Principal threats: ____________________

Rare species: ____________________

____

STRUCTURAL PROFILE

Leaf type: broadleaf____ needleleaf____ mixed____

Successional stage: early ____ middle ____ late ____ Leaf loss periodicity: evergreen ____ deciduous ____ mixed ____

Stratum	Height (m)	Cover of layer	Dominant species/families--Cover of Dominants
Tree layers			
Emergent			
Canopy			
Subcanopy			
Shrub layers			
1			
2			
3			
Herb layers			
Graminoid			
Forb			
Mixed			
Others			
Bryophytes			
Lianas			
Epiphytes			

Unvegetated surface: bare soil _____ stones & gravel _____ leaf litter _____ bedrock _____ sand_____ woody debris _____ water_____

Cover: 7=95-100%; 6=75-95%; 5=50-75%; 4=25-50%; 3=5-25%; 2=1-5%, 1=0-1%

OBSERVATION POINT DATA [continuation of field form #2, Page 3 of a set of 3 pages for Obs Point data]
GENERAL SPECIES LIST (list animals and plants on separate pages)
Survey site name: ______________________ Observation Point number: ________ Date: ____________

Species	Cover-Abundance	Comments

JAMAICA - PROPOSED PROTECTED AREAS

FIELD FORM #3 FOR OBSERVATION POINT DETAILED PLOT DATA [Page 1 of 2 pages]

Identifiers/Location

Proposed protected area (Site) name: ____________________ Proposed protected area (Site) number: ____________

Survey site name: ______________________________ Survey site number: ____________________

Observation point number: _____ Plot number: _____ Surveyor: ________________ Date: ____________

Photos of plot: yes___ no___ Community name: ________________________________

Directions to plot: ____

____

Plot size and shape: ______________________________________ Permanent or temporary: P ___ T ___

RELEVE/TRANSECT DATA

Cover: 7=95-100%; 6=75-95%; 5=50-75%; 4=25-50%; 3=5-25%; 2=1-5%, 1=0-1%
Sociability: 5=large mats covering whole plot; 4=large patches; 3=small patches, large tussocks; 2=small groups, small tussocks; 1=solid
Unvegetated surface: bare soil_____ stones & gravel_____ leaf litter_____ bedrock_____ sand_____ woody debris_____ water_____

Species	Specimen #	Photo #	DBH (cm)	Height (m)	Cover abundance & Sociability	Comments
						IF USING LAYERS FOR THE SURVEY: 1 = >8m 2 = 2-8m 3 = 0.5-2m 4 = <0.5m 5 = Epiphyte 6 = Climber

[Field form # 3, Page 2 of 2 pages]

Survey site name: ______________________________ Obs. Pt. no.: __________ Plot no.: ___________ Date: ____________________

Species	Specimen #	Photo #	DBH (cm)	Height (m)	Cover abundance & Sociability	Comments
Species found outside of plot						

CONSERVATION DATA CENTRE - JAMAICA
SPECIAL ANIMAL SURVEY FORM

Element Name:________________________ Element Code: ________________________

Name of Zoologist:________________________ Date:____________ Time:____________

Weather Observations:________________________

State:________________________ District: ________________________

Name of Site: ________________________

Repeat visit: (yes) _______ (no) _______ Date: ____________

____

B I O L O G Y

____

Was the element found? (yes) _______ (no) _______ If the element is not present, explain why:

____

____

Type of Observation: Visual:__________ Tracks:__________ Song:__________ Excrement, Pellets:__________

Number observed:__________ Estimated number:__________ Type of estimation:________________________

____

Age and sex of the individuals:________________________

Populational tendency in accordance with the previous visit: More__________ Equal__________ Less__________

The element resides year round at the site:__________ It is found only during the reproductive period: __________

It is only found during the non-reproductive period:__________ The element is in the site temporarily:__________

Evidence of reproduction at the site:________________________

____

____

General notes about the behavior of the element:________________________

____

____

Suggestions for the next visit:________________________

____

____

____

____

SPECIAL ANIMAL SURVEY FORM cont'd. Element name:________________ EO code:__________

H A B I T A T

Description of habitat:____

____

____

____

Extention of the habitat in the immediate area (approximate area): ______________________

Proportion of habitat in the immediate area occupied by the element: ______________________

Associate natural community/ Vegetative community:______________________

____

Caracteristics of associated species:______________________

____

____

____

C O N S E R V A T I O N

Is the site owned? Yes, No Does the owner know about the existence of the element? Yes, No

Will this site sustain the species for several years? ______________________

____

____

Evidence of disturbance of the population and the habitat:______________________

____

____

Threats to the Element:______________________

____

____

What size must the area be for the species to survive here? ______________________

____

____

Research needs:______________________

____

____

SPECIAL ANIMAL SURVEY FORM cont'd. **Element Name:**________________________ **EO code:**_______

The site should be monitored for this species regularly (i.e., annually)? Explain:________________________________

COLLECTION OF SPECIMENS

If a specimen(s) was collected, explain how:____

Where was it deposited?____

Collection number:________________________________ Reference used in the identification:__________________

Comments:____

CONSERVATION DATA CENTRE - JAMAICA
SPECIAL PLANT SURVEY FORM

Proposed protected area (Site) name: ____________________ Site #: ____ Survey site name: ______________

Observation point #: ____ Element (species) name: ______________ Element code: ______________

Common name(s): ______________________________ Source code: F______________

Element Ocurrence code: ______________ 1:50,000 map #: ______________ Elevation range: __________

Surveyor: ______________ Date: ________ Community name: ______________________

Life form (habit): Tree ___ Shrub ___ Climber ___ Herb ___ Epiphyte ___ Photograph: Y N

If specimens were collected indicate collector, collection # and herbarium: ______________________

____

Other particulars: ____

____

____

Phenology	Approx. # of individuals	Approx. poulation area	Age structure	Vigour
___ In leaf	___ 1 - 10	___ 1m²	___% Seedlings	___ Very feeble
___ In bud	___ 11 - 50	___ 1 - 5m²	___% Juvenile	___ Feeble
___ In flower	___ 51 - 100	___ 5 - 10m²	___% Mature	___ Normal
___ Immature fruit	___ 101 - 1000	___ 10 - 100m²	___% Senescent	___ Vigorous
___ Mature fruit	___ 1001 - 10,000	___ 100m² - ha.		
___ Dormant	___ > 10,000	___ > 1 ha.		
		________ estimated area		

EO-Data (description of element as it occurs in this place) ______________________

____

____

____

Directions to area: ____

____

____

____

____

HABITAT

Aspect	Slope	Light	Topographic position	Moisture
___ N ___ NE	___ Flat	___ Open	___ Crest	___ Inundated
___ E ___ NW	___ 0° - 10°	___ Filtered	___ Upper slope	___ Saturated
___ S ___ SE	___ 10° - 35°	___ Shaded	___ Lower slope	___ Moist
___ W ___ SW	___ > 35°		___ Bottom	___ Dry
	___ vertical			

SPECIAL PLANT SURVEY FORM PAGE 2 **Element name:**________________ **EO code:**________

General description of area: ________________________________

____

____

Natural community: ________________________________

____

Dominant species and % cover: ________________________________

____

Associated native species: ________________________________

____

____

Associated exotic or weedy species: ________________________________

____

____

Threats: ________________________________

____

Protection and/or management recommendations:________________________________

____

____

SUMMARY

EO quality: (ie, how representative is this occurrence? Consider the size and productivity of the population and the vitality and vigour of the individuals) A - Excellent B - Good C - Marginal D - Poor

EO condition: (ie, is the habitat supporting the EO pristine or degraded? Is there a potential for the habitat to recover from disturbances?)
A - Excellent B - Good C - Marginal D - Poor

EO viability: (ie, what are the long term prospects for continued existence of this occurrence at the indicated level of quality?)
A - Excellent B - Good C - Marginal D - Poor

EO defensibility: (ie, can this occurrence be protected form extrinsic human factors?)
A - Excellent B - Good C - Marginal D - Poor

EO rank: (ie, a summary of all factors listed above) A B C D

Comments: ________________________________

____

____

____

APPENDIX II NATURAL AND MODIFIED COMMUNITY DESCRIPTIONS

The following text describes the communities within the BJCMNP within the framework of the vegetation classification of the whole country of Jamaica (Iremonger, in prep.). Community types present in Jamaica only outside of the BJCMNP are therefore named but not described. A framework of this type was first presented by Grossman *et al.* (1992). The current classification differs slightly from that of Grossman according to new information gathered during the REA process. The full classification with descriptions of all community types for Jamaica will be published at a later date. The names of authors who have described the community types are included after the community names. Modified (not natural) communities are marked with an asterisk after the community number. For a synoptic list of the community types in the BJCMNP please see section 4.1.

I. CLOSED FORESTS

Communities formed by (generally scapose) trees at least 5 m tall with crowns interlocking. In lowland tropical conditions the lower limit may be 8 or 10 m, in montane conditions, 1.5 m (Richards, 1952).

Ia. Non-wetland forests

Forest communities in which soil waterlogging is not the primary environmental factor influencing the structure and composition of the community.

Ia1. Lowland rain forest

Not known from the BJCMNP

Ia2. Lower montane rain forest (Beard, 1944; Grubb and Tanner, 1976; Richards, 1952)

Two tree strata, canopy between 12 and 33 m, and a lower story 3–16 m. Leaves are predominantly simple, notophyll or mesophyll, drip tips frequent or occasional, cauliflorous species rare. Thick-stemmed woody climbers are rare but other climbers often frequent, and vascular epiphytes are abundant.

Ia2.1. Lower montane rain forest over limestone (Kelly, 1986; Kelly *et al.*, 1988)

Canopy 26–28 m, understory 10–13 m and a tree fern-dominated third stratum at 2–7 m. Climbers (many aroids), epiphytes and ground herbs are abundant. In plots recorded for this study, tree density (trunks > 10 cm DBH only) ranged from 925 to 1350 trees per ha, with maximum DBH 69 cm. Diagnostic species combination: *Calophyllum calaba, Calyptronoma occidentalis, Drypetes alba, Heliconia caribaea, Cyathea grevilleana. Pilea* spp. are abundant in the herb layer. In areas where the soil drainage is impeded and the soil texture clayey, *Symphonia globulifera* and *Roystonea* cf. *altissima* were found, and the herb layer was made up of sedges and *Selaginella* sp. In gully areas the tree fern *Cyathea grevilleana* was very abundant. The faunal records indicated that *Amazona agilis* and *Geotrygon versicolor* were present.

Soil colour yellowish brown, light brown or reddish dark brown, texture from clay through sandy clay loam to organic loam, leaf litter layer 0–3 cm, drainage from very poor to well drained, stucture crumb or (on clay soils) massive, in one area soil depth c. 17.5 cm, pH 6.4 towards surface; 7.3 lower down.

Ia2.2. Lower montane rain forest over shale* (Grubb and Tanner, 1976; Shreve, 1914)

* "Shale" is used here as by Asprey & Robbins (1953): Geologically, two major series are included: the Carbonaceous shales of the Lower Eocene (black shales, coarse conglomerates, limestone and sandstone) and the Cretaceous shales. These latter are red and purple shales, tuffs, breccias and conglomerates interbedded with fossiliferous limestone of the Upper Cretaceous. These rocks produce a complex of local soil types that is included under the term "shale".

Canopy between 12 and 33 m, understory present. Lauraceae and Myrtaceae are frequent, and in some areas tree ferns are abundant.

Ia2.2.1. Typical variant (Grubb and Tanner, 1976)

Canopy height 15–33m and fairly dense, some trees with buttresses. Most frequent tree species are *Pouteria multiflora, Dendropanax arboreus, Guarea glabra, Brosimum alicastrum, Calophyllum calaba* and a number of Lauraceae including *Ocotea leucoxylon* and *Beilschmiedia pendula*. Subcanopy trees of in the families Lauraceae and Myrtaceae are frequent. *Piper* spp. and *Psychotria* spp. occur in the shrub layer, and there are patches of the large herb *Heliconia caribaea*. A lower layer between 0.5 and 1 m is often represented by juvenile trees; however, there is usually little or no herb layer. Climbing Araceae and vascular epiphytes are abundant.

The soils investigated were generally organic loams with crumb structure, dark brown colour and a litter layer of 2–5 cm. The presence of stones was variable, but most soils were well to moderately well drained.

Ia2.2.2. Gully variant (Bellingham, 1993)

This forest type has been recorded higher in the Blue Mountains (to about 2000 m) than other lower montane forest types, because it is more sheltered. It displays such lower montane forest characteristics as notophyll and mesophyll leaf size preponderance, some trunk buttressing, presence of a thick-stemmed woody climber, yet it is smaller in stature and has fewer species the other variants of this forest type (Types Ia2.2.1 and Ia2.2.3).

Canopy height is 12–18 m, with five species, *Guarea glabra, Maytenus jamaicensis, Gordonia haematoxylon, Solanum punctulatum* and *Turpinia occidentalis* contributing significantly to the forest structure. There is an understory in which smaller trees such as *Mecranium purpurascens, Psychotria corymbosa* and *Cestrum hirtum* are well represented, and tree ferns are very frequent, particularly *Cyathea pubescens*. This layer includes *Boehmeria caudata*, which is absent from the other forest types in the area (see Type Ia3.1. Upper montane rain forest over shale). The shrub layer includes *Besleria lutea, Piper arboreum, Piper fadyenii, Acalypha virgata* and *Tournefortia glabra*, and the thick-stemmed woody climber *Marcgravia brownei* is present. The gullies of the windward (north-facing) gullies differ from those in the leeward (south-facing) gullies most noticeably in the abundance of pendent bryophytes and filmy ferns, as well as a more hygrophilous ground flora.

Soils have a discontinuous litter layer overlying a dark brown clay-loam with poor crumb structure to a depth of 10 cm, gradually becoming lighter in colour with depth, pH 4.5–5, loss on ignition c. 36%. This covers a yellow brown clay, pH 4.5–6, which reaches depths of 70 cm to 1 m or more.

Ia2.2.3. Transitional variant

This forest type combines the characteristics of Ia2.1 and Ia2.2. It is found in areas of mudstone and conglomerate near to limestone, such as the geologically transitional Cuna

Cuna Pass area and the western slopes of the John Crow Mountains that lead down to the Millbank area. Much of this forest type has been badly hurricane-damaged. Fieldwork revealed that the canopy height generally ranged from 18–27 m, but in the hurricane-damaged areas was as short as 7 m. Tree density (trunks > DBH 10 cm only) ranged from 725–1200 per ha, and 475 per ha in the hurricane-damaged area recorded. Maximum DBH was 97 cm. The subcanopy was recorded between 8–14 m (in the hurricane-damaged area, 5–6 m), shrub layers between 1 and 3 m, and a herb layer 0.5–1 m. This latter was mainly composed of juvenile trees and ferns. Bryophytes were present on tree bases, climbers were abundant and lush and epiphytes were frequent.

The most frequent large tree species were *Matayba apetala, Calophyllum calaba, Pouteria multiflora, Clethra occidentalis.* Species which have affinities to limestone substrata are *Psychotria dolphiniana, Hirtella multiflora* and *Tetrapterys citrifolia.* These are mixed with species which occur over volcanics in the Blue Mountains, *e.g., Brunfelsia jamaicensis, Clethra occidentalis, Sapium harrisii. Pithecellobium arboreum* was recorded from here and from Type Ia2.2.1, and was absent from Type Ia2.1. Some species common to both the limestone forests of the John Crow Mountains and to the Blue Mountains which occur in these forests are *Calophyllum calaba, Guarea glabra* and *Calyptronoma occidentalis.* A population of the very rare *Wercklea flavovirens* was discovered in this forest type, the last known population having disappeared from its only previously known location (in Type Ia2.1). A list of birds seen during a bird survey for this community type is in section 4.4.

Ia2.3.* Modified lower montane rain forest

The forest, when disturbed either by human activity or by hurricane, tends to have a different tree species composition and to support a profusion of climbing plants. These climbers cover the tops of the trees, uniting adjacent individuals and forming a web of stems which droop to the ground. *Cecropia peltata* becomes abundant. In more damaged or cleared areas, a savanna-type vegetation occurs, in which *Bambusa vulgaris* is often dominant.

Gullies in the Blue Mountains tend to be less disturbed than slopes or ridges at a similar altitude. However in many gullies tall trees are no longer found, and tall weedy shrubs and small trees (e.g., *Piper* spp. and *Goldfussia colorata*) replace the original structured species composition.

The forest has been selectively cut for timber in some areas, leading to a less diverse flora and a structurally diminished form of the forest. Old Forestry Department plantations occur, *Hibiscus elatus* or *Cedrela odorata* being the chief species used. Other cultivated species are *Musa* spp. (Banana) and *Cocos nucifera* (Coconut).

Ia3. Upper montane rain forest (Grubb and Tanner, 1976; Grubb *et al.*, 1963; Richards, 1952)

Tree strata one or two, 1.5–18 m tall, with microphyll leaves dominant. Trunk buttresses and cauliflorous species usually absent, compound leaves on trees, drip tips and climbers usually few or none, and vascular epiphytes frequent.

Ia3.1. Upper montane rain forest over shale (adapted from Grubb and Tanner, 1976; Shreve, 1914)

Canopy height ranges from about 5–13 m, and trees characteristically lean over in sloping areas or in places with deep peat soil (see Mor Ridge forest, Type Ia3.1.2). The dominant leaf sizes are microphyll and notophyll. Constant tree species are *Alchornea latifolia*, *Clethra occidentalis*, *Clusia havetioides*, *Cyrilla racemiflora*, *Ilex macfadyenii* and *Podocarpus urbanii*, although *A. latifolia* and *C. occidentalis* are absent at high altitudes (Type Ia3.1.3). In most areas there is a well developed but discontinuous shrub layer of 2–3 m tall, composed chiefly of *Psychotria corymbosa* and *Palicourea alpina*. The herb layer is generally well developed, the most common taxa being ferns, orchids and the graminoids *Rhynchospora polyphylla, R. jamaicensis* and *Zeugytes americana. Chusquea abietifolia* forms occasional dense thickets, and the cushion moss *Leucobryum giganteum* is locally abundant (in Type Ia3.1.2). Thick woody climbers are absent, and in general climbers and scramblers are few in number. Woody hemiparasites such as *Dendropemon parvifolius*, *Dendrophthora opuntioides*, *Phoradendron flavens* and *Eubrachion ambiguum* are probably frequent, but not readily visible.

With the exception of the soils in the Mor ridge forest type (Ia3.1.2), soils have a discontinuous layer of litter and a brown to dark brown clay loam A horizon extending to 10–30 cm, pH 3.5–4.6. This overlies a yellowish clay B horizon, ph 4.5–6. On slopes stones and rocks are common throughout the soil. In the Mor ridge forests the soil is very different, having a continuous litter layer 1–2 cm thick, and a deep (20–50 cm) organic (LOI c. 96%) horizon composed of acid mor humus, pH 2.8–3.5, overlying a yellowish clay B horizon.

Ia3.1.1. Typical association (Grubb and Tanner, 1976; Shreve, 1914)

This includes the forest types Mull Ridge, Wet Slope and Very Wet Ridge described by Grubb and Tanner, and the Windward and Leeward slopes and most of the Ridge type described by Shreve. It is recognizable from the general description given above for Ia3.1. Characteristics which distinguish it from Type Ia3.1.2 are the different soil types (see Type Ia3.1, above) the higher, more closed canopy (8–13 m), fewer epiphytes, the presence of the tree species *Hedyosmum arborescens* and *Calyptranthes rigida*, and the tree ferns *Cyathea pubescens*, *C. furfuracea* and *C. woodwardioides*.

Ia3.1.1.1. Typical variant of the Typical association (Grubb and Tanner, 1976)

This excludes the Very Wet Ridge forests described by Grubb and Tanner from the Mt. Horeb region, which are treated as a separate variant here. *Selaginella denudata* does not cover the forest floor as it does in those forests. A very well-developed forest area had *Matayba apetala*, *Haenianthus incrassatus* and *Turpinia occidentalis* in the canopy (22–25 m), *Sapium harrisii* in the subcanopy (16–18 m), and two shrub layers (3 m and 1.5 m), mainly Rubiaceae. Greatest DBH was 35.5 cm, tallest tree height was 25 m, and there were 1275 stems > 10 cm DBH per ha. In another area that had been hurricane damaged, the canopy was much lower (8–10 m), trees were sparse, resprouting *Clethra occidentalis* and *Cyrilla racemiflora* being the most common. The shrub layer was dense at 2 m, being composed of juvenile trees in addition to shrub species.

Ia3.1.1.2. *Selaginella* variant of the typical association (Grubb and Tanner, 1976).

Described by Grubb and Tanner (1976) under the name Very Wet Ridge Forest. Differentiated from the above variant in the abundance of *Selaginella* spp. on the forest floor, the greater abundance of epiphytic bryophytes. In one plot, the tallest tree was 20 m, largest DBH 31 cm and the density of trunks was 875 per ha. In a hurricane-damaged area, trunk density was 1325 per ha. and an old *Cyrilla racemiflora* reached 103.5 cm DBH.

Ia3.1.2. Mor Ridge forest type (Grubb and Tanner, 1976).

Infrequent and distinguished from Type Ia3.1.1 by the soil (see description in Type Ia.3.1 above), the rather open canopy 5–7 m tall with most of the trees leaning in all directions, the presence of the tree ferns *Blechnum underwoodianum* and *Cyathea gracilis*, as well as *Leucobryum giganteum* cushions on the ground and the composition of the field layer, in which are found an abundance of bromeliads and other plants which only grow epiphytically in the Typical association (Ia3.1.1).

Ia3.1.3. High altitude scrub forest (adapted from Asprey and Robbins, 1953; Grubb and Tanner, 1976; Iremonger, 1992; Shreve, 1914)

The aspect of this type is dominated by the stunted and gnarled morphology of the trees. Canopy height ranges from 1.5–6 m, and the pendent moss *Phyllogonium fulgens* is abundant. Floristically the forest is distinct from Types Ia3.1.1 and Ia3.1.2 in that some of the species of the lower altitude forests are absent and other species which are confined to these high altitudes are missing in the lower forests. *Clethra occidentalis* is replaced by *Clethra alexandri*. *Alchornea latifolia* is absent, and *Eugenia alpina*, *Ilex obcordata* and *Myrsine coriacea* are abundant. The high altitude shrubs *Odontocline laciniata* and *Lobelia martagon* and the tree fern *Cyathea harrisii* are present.

Ia3.2. Upper montane rain forest over limestone (Grubb and Tanner, 1976).

Canopy 2–11 m, the tree trunks generally < 15 cm DBH, and may be gnarled and tangled, giving the vegetation more of a thicket-like appearance. In isolated areas there are local endemics.

Ia3.2.1. Typical variant

Canopy 8–11 m, trees upright, no buttresses or prop roots. Few trees with DBH > 15 cm. Notophylls and mesophylls dominate the leaf size spectrum. Field layer may be dominated almost exclusively by *Diplazium costale*, 10–15 cm. Climbers are generally occasional-frequent, and epiphytes occasional-abundant. Many species of the lower forest type (Type Ia2.1) are present (*e.g., Calyptronoma occidentalis, Cordia elliptica, Ardisia brittonii*), but the species *Solanum acropterum* has not been recorded in other montane forest types. In the plot recorded for this REA, the largest DBH was 29.5 cm, the tallest tree was 13.5 m and the density of trees > 10 cm DBH was 2000 per ha. Myrtaceae and Rubiaceae were abundant, and *Psychotria clusioides, Clusia* sp. and *Thrinax* sp. were present. Evidence of *Geocampromys brownei* was abundant. The soil was a light brown clay loam with crumb structure and a litter layer of 1–3 cm.

Ia3.2.2. Edaphic variant

Dispersed among the Typical variant in patches influenced by impeded drainage. Similar in tree species composition to the above, but distinguished by its more open appearance (550 trunks >10 cm DBH per ha), the presence of *Symphonia globulifera* (largest tree in plot at 14 m and 30 cm DBH) and other species which favour soils with impeded drainage, and the much greater cover of the herb layer. This can be composed of *Scleria cubensis, Dicranopteris pectinata* and *Odontosoria jenmanii*. Soil in the plot was dark brown clay loam with poor drainage, massive structure and mottling. Litter 0–2 cm.

Ia3.2.3. Blue Mountains variant (Grubb and Tanner, 1976)

Found on limestone outcrops in the Blue Mountains, best known example is on SE side of John Crow Peak, where isolation has given rise to the local endemics *Zanthoxylum hartii* and *Salvia jamaicensis*. The canopy is relatively open, 2–6 m, and *Chusquea abietifolia* locally dominates the herb layer. The soils are different from other Blue Mountains forest soils in their shallowness, lack of humus enrichment and higher pH.

Ia3.3.* Modified upper montane rain forest

The most notable feature of these altered forests is perhaps their vulnerability to invasion by certain aggressive introduced species. These plants threaten the forests not only by occupying the niche of native species, but by their domination of the entire vegetation type. These plants form dense cover and prevent native species from regenerating. The most significant and widespread of these are *Pittosporum undulatum*, *Hedychium gardnerianum* and *Polygonum chinense*. In some areas the forest vegetation has completely disappeared, and in its place is a monospecific scrubland, described below (Type IIIa5.*). Where forest was cleared for agriculture and then abandoned, grasslands dominated by the alien species *Melinis minutiflora* occur (described below, Type IVa3.*).

In areas that are still forest, weedy species such as *Cecropia peltata* and *Bocconia frutescens* occur. These are indicators of disturbance. Some areas support old broadleaf plantations such as *Hibiscus elatus*, which have matured to form a framework for native forest shrubs, climbers and herbs.

Ia4. Evergreen seasonal forest
Not known from the BJCMNP

Ia4.1. Mesic forest over limestone
Not known from the BJCMNP

Ia4.2.* Modified mesic forest over limestone
Not known from the BJCMNP

Ia5. Dry semi-evergreen forest
Not known from the BJCMNP

Ia5.1. Dry semi-evergreen forest over limestone
Not known from the BJCMNP

Ia5.2.* Modified dry semi-evergreen forest over limestone
Not known from the BJCMNP

Ia6.* Commercial forest plantations
Composed of tree crops with a definite canopy.

Ia6.1.* Pine plantations
Frequent in the Blue Mountains and in the centre of Jamaica, and consist more or less exclusively of *Pinus caribaea*, although other species of pine were also planted. There is no understory, and the presence of the shrub and field layers depends upon the prevailing forestry practices.

Ia6.2.* Broadleaved timber plantations
Eucalyptus spp., *Hibiscus elatus*, *Cedrela odorata* and *Swietenia mahagoni* occur in old plantations. Plantations generally now either lie idle and are reverting to secondary forest, or have been under-planted with coffee, as in the Blue Mountains.

Ia6.3.* Biomass plantations
Experimental plantations of *Leucaena leucocephala* and *Calliandra portoricensis*. No field layer.

Ib. Wetland forests
Not known from the BJCMNP

Ib1. Swamp forest
Not known from the BJCMNP

Ib1.1. Swamp forest
Not known from the BJCMNP

Ib1.2. Riparian forest
Not known from the BJCMNP

Ib1.3.* Modified swamp forest
Not known from the BJCMNP

Ib2. Mangrove forest
Not known from the BJCMNP

Ib2.1. Mangrove forest
Not known from the BJCMNP

Ib2.2.* Modified mangrove forest
Not known from the BJCMNP

II. WOODLANDS (Open stands of trees)
Formed by (generally scapose) trees at least 5m tall, with most crowns not in contact but covering at least 30% of the surface; grass cover sometimes present. Height criteria as for CLOSED FORESTS.

IIa. Non-wetland woodlands
Woodland communities in which soil waterlogging is not the primary environmental factor influencing the structure and composition of the community.

IIa1. Strand woodland
Not known from the BJCMNP

IIa2.* Modified strand woodland
Not known from the BJCMNP

IIa3.* Plantation woodlands
Tree crops where the individuals are widely spaced.

IIa3.1.* Citrus grove
Not known from the BJCMNP

IIa3.2.* Coconut palm plantation
Dominated by *Cocos nucifera*, usually with a field layer of grasses.

IIb. Wetland woodlands
Not known from the BJCMNP

IIb.1.* Palm woodland
Not known from the BJCMNP

III. SCRUBS (Shrublands or thickets).
Mainly composed of caespitose woody phanerophytes 0.5–5m tall, but to 10m in tropical areas. In shrublands most of the crowns are not in contact, but in thickets they are.

IIIa. Non-wetland scrubs.
Scrubs in which a soil waterlogging is not the overriding environmental factor in the ecosystem.

IIIa1. Dry semi-evergreen thicket over limestone
Not known from the BJCMNP

IIIa2. Thorn scrubs
Not known from the BJCMNP

IIIa2.1. Partly deciduous thorn thicket
Not known from the BJCMNP

IIIa2.2. Cactus thorn scrub
Not known from the BJCMNP

IIIa3. Mesic seasonal scrub over limestone.
Not known from the BJCMNP

IIIa4. Upper montane thicket complex over limestone
Thickets developed in montane areas where the soil is impoverished, resulting in some stunting of phanerophytes. Occurs in areas of high rainfall at > 1000 m in the John Crow Mountains. Canopy 2–10 m. May be dominated by *Clusia havetioides*, which forms a dense tangle of trunks and branches over the terrain of vertically fissured and crevassed limestone. In some areas limestone "castles" (Asprey and Robbins, 1953), or blocks, rise vertically to heights of 5 m or more. Other woody species are *Picramnia antidesma*, *Columnea hirsuta*, *Conostegia icosandra*, *Viburnum alpinum*, *Schefflera sciadophyllum*, *Wallenia venosa* and the climber *Schradera involucrata*. Among the few herbs are *Lobelia grandiflora*, *Pilea grandiflora* and *Psychotria discolor*. *Gesneria pumila* is frequent on the vertical rock faces, which support cliff vegetation. This cliff vegetation is mixed in with the shrubs to form the characterisitic vegetation complex of this limestone.

Soils are very sparse, in parts being represented only by pockets of debris in the limestone. They range from dark brown clay loam with massive structure and poor drainage to dark brown organic clay loam with crumb structure and moderate drainage.

IIIa5.* Modified hill and montane scrub
Phanerophyte height generally 1–4 m, density very variable, field layer with graminoids. This impoverished vegetation is recognizable through the many weedy introduced species which generally dominate. Common woody species are *Moghania strobilifera*, *Guazuma ulmifolia*, *Lantana* spp., *Conostegia* spp., *Datura suaveolens*, *Piper* spp., *Dunalia arborescens*, *Solanum torvum*, *Senecio discolor* and *Baccharis scoparia*. In most areas clumps of bamboo (*Bambusa vulgaris*) occur. At medium to high altitudes, *Rubus* spp. form impenetrable thorny tangles in areas which have been burned, and *Hedychium gardnerianum* and *Polygonum chinense* can form monospecific stands. In areas where there is a clear preponderance of one species, a subcategory of this scrub type may be distinguished.

IIIa5.1.* Bamboo variant
Scrub vegetation as in IIIa5.* with a clear dominance of *Bambusa vulgaris*.

IIIa5.2.* *Hedychium* variant
Scrub vegetation as in IIIa5.* with a clear dominance of *Hedychium* sp., usually *H. gardnerianum*.

IIIa5.3.* *Polygonum chinense* variant
Scrub vegetation as in IIIa5.* with a clear dominance of *Polygonum chinense*.

IIIa5.4.* *Rubus* variant
Scrub vegetation as in IIIa5.* with a clear dominance of one or more of *Rubus ellipticus, R. alpinus, R. jamaicensis* and *R. racemosus*.

IIIa5.5.* Tree fern brake (Asprey and Robbins, 1953; Ørsted, 1857)
Thicket community dominated by *Cyathea* spp., including *C. arborea*. It is found at altitudes up to c. 1000 m and is probably the result of clearance of lower montane forest. It occurs in small stands and, contrary to Asprey and Robbins (1953), it is relatively widespread.

IIIa6.* Mixed subsistence agriculture with dwellings (Grossman *et al.*, 1992)
Commonly has the physiognomy of a scrub formation, and is therefore included here. Often encompasses areas dominated by herbs and scattered trees, and blends with Modified submontane and montane scrub (Type IIIa5.*). Common non-farm trees are *Spathodea campanulata* and *Cecropia peltata*. Among the more common agricultural trees are *Mangifera indica*, *Artocarpus altilis*, *A. heterophyllus*, *Citrus* spp., *Manilkara* spp., *Chrysophyllum cainito*, *Syzigium* spp., *Persea americana*, *Coffea arabica, Theobroma cacao*, *Bixa orellana* and *Blighia sapida*. Shrubs and herbs include *Capsicum* spp., *Dioscorea* spp., *Allium* spp. and *Thymus vulgaris*.

IIIa7.* Commercial shrub plantations
Plantation agriculture where shrubs are the dominant life form.

IIIa7.1.* Coffee plantations
Plantation scrubland where *Coffea arabica* (Arabian coffee) and *C. canephora* (Robusta coffee) are dominant. Banana plants are often interspersed, and a herb layer may be present or absent.

IIIa7.2.* Pawpaw plantations
Not known from the BJCMNP

IIIb. Wetland scrubs.
Not known from the BJCMNP

IIIb1. Mangrove scrub
Not known from the BJCMNP

IIIb2.* Modified wetland scrub
Not known from the BJCMNP

IV. HERBACEOUS FORMATIONS
Grasses, graminoid and other herbaceous plants predominate in the cover, but woody plants may be sparingly present (*i.e.*, < 30% cover).

IVa. Non-wetland herbaceous communities.
Herbaceous communities in which soil waterlogging is not the primary environmental factor governing the structure and composition of the community.

IVa1. Montane summit savanna (Asprey and Robbins, 1953; Shreve, 1914)
Grassland dominated by caespitose high altitude grass *Danthonia domingensis*, which forms an almost monospecific stand at to about 1 m. Confined to the N side of High Peak in the Blue Mountains.

IVa2.* Fern-dominated sward
Generally dominated by *Pteridium aqiulinum*, *Dicranopteris* spp., *Gleichenia* spp. or *Nephrolepis* spp.(particularly the recently naturalized *N. multiflora*, of which the earliest collection was apparently 1948). Is perpetuated by burning.

IVa3.* Anthropogenic graminoid-dominated sward (Grossman *et al.*, 1992)
Sward dominated by *Panicum maximum*, with *Mangifera indica*, *Samanea saman*, *Delonix regia* and/or *Solanum torvum* occasional, creating a parkland appearance. *Melinis minutiflora*-dominated hillsides in the east of Jamaica, with the occasional shrub and clump of bamboo (*Bambusa vulgaris*). This broad category of modified grassland also covers pastures, which are used for grazing cattle, goats and other animals, and are generally dominated by such pan-tropical grasses as *Cynodon dactylon*, *Chloris petraea*, *Setaria barbata*, *Digitaria ciliaris* and *Andropogon glomeratus*. Trees of secondary formations are often present, such as *Samanea saman*, *Cocos nucifera*, *Delonix regia*, *Casuarina equisetifolia* and *Mangifera indica*.

IVa4.* Commercial non-wetland herbaceous crops
Herb crops grown on a commercial scale, the most widespread being sugar cane and banana.

IVa4.1.* Sugar cane field
Croplands dominated exclusively by *Saccharum officinarum*.

IVa4.2.* Banana plantation
Plantation croplands of *Musa* spp., which are technically herbs.

IVb. Herbaceous wetlands.
Herbaceous communities in which soil waterlogging is an overriding environmental factor in the community.

IVb1. Freshwater herbaceous wetlands.
Herbaceous wetlands affected by freshwater.

IVb1.1. Freshwater mudflat
Not known from the BJCMNP

IVb1.2. Sedge savanna
Not known from the BJCMNP

IVb1.3. Riparian swale (Proctor 1986b)
Non-woody thickets along river margins, generally 1–3m high.

IVb1.3.1. Graminoid-dominated riparian swale.
Diagnostic species *Phragmites australis* may form pure stands, or it may be partly or fully replaced by other tall graminoids such as *Typha angustifolia*, *Cladium jamaicense*, *Cyperus giganteus*, *Scirpus validus*, *S. olneyi* and *Fuirena umbellata*. The introduced *Alpinia allughas* forms monospecific stands in some places, and *Thalis geniculata* is locally dominant. *Sagittaria lancifolia* is locally frequent, and twiners are abundant.

IVb1.3.2. Fern-dominated riparian swale.
Not known from the BJCMNP

IVb1.4.* Rice padi
Not known from the BJCMNP

IVb2. Brackish-water herbaceous wetlands.
Not known from the BJCMNP

IVb2.1. Estuarine mud flat
Not known from the BJCMNP

IVb2.2. Herbaceous salt marsh
Not known from the BJCMNP

V. SPARSELY VEGETATED FORMATIONS

Bare mineral soil determines the aspect more or less constantly. Plants are scattered or absent.

Va. Limestone pavement vegetation

Not known from the BJCMNP

Vb. Pioneer beach vegetation

Not known from the BJCMNP

Vc. Cliffs and landslides

Rocks and large stones are the substratum in these communities. Where soil accumulates, vegetation becomes denser and tends towards the adjacent community type.

Vc1. Seed plants and ferns predominant

Perennial higher plants dominate, rooted in fissures of rocks. The species composition depends upon the location of the area, *e.g.*, near the sea *Coccoloba uvifera*, *Conocarpus erectus* and/or *Plumeria obtusa* may occur; in the Cockpit Country *Gesneria acaulis* may be the dominant plant; at higher altitudes over shale, bromeliads and *Pilea microphylla* form a particular type. In areas with more human influence, this vegetation tends to modified herbaceous communities (Type IVa3.*).

Vc2. Lichens and bryophytes predominant

On the shale rocks at higher altitudes, lichens frequently form a community on bare rocks. Fruticose genera are *Cladonia* and *Usnea* and the foliose *Sticta* and crustose species are also present.

Vd. Rock rubble and walls

Generally fern-dominated sparsely vegetated formations.

Vd1. Rock rubble

Most often seen where rubble remains from road construction activities. Dominant fern is *Pteris longifolia* and other common plants are *Wedelia* spp., *Spilanthes urens*, *Portulaca oleracea* and *Cynanchum* spp.

Vd2. Rocky wall vegetation

Polypodium spp. may dominate along with *Bryophyllum pinnatum*, and orchids are locally frequent on older walls. In places with older decorative gardens, *Ficus pumila* may dominate.

VI. AQUATIC FORMATIONS (freshwater)

Composed of rooted and/or floating plants that endure or need water covering the soil constantly or at most times of the year. The following subdivisions often occur intermixed. Rooted emergent vegetation such as reed beds are included under IV, HERBACEOUS FORMATIONS. *The BJCMNP has not been surveyed for aquatic communities: one or all of the following may occur.*

VIa. Free-floating nonrooted fresh water communities (Mueller-Dombois and Ellenberg, 1974; Proctor, 1986b)

Mat-forming plants such as *Eichornia crassipes* dominate, others are *Nymphaea ampla* and *Nymphoides indica* or the smaller *Pistia stratiotes* and/or *Lemna* spp.

VIb. Rooted floating-leaf communities (Mueller-Dombois and Ellenberg, 1974; Proctor, 1986b)

Composed chiefly of aquatic plants that are rooted, and have floating leaves, e.g., *Potamogeton fluitans*.

VIc. Rooted underwater communities (Mueller-Dombois and Ellenberg, 1974; Proctor, 1986b)

Comprised of aquatic plants that are structurally supported by water, e.g., communities with *Ludwigia repens*.

VId. Non-rooted underwater communities (Mueller-Dombois and Ellenberg, 1974; Proctor, 1986b)

Characterized by such plants as *Utricularia foliosa*, *Cabomba piauhiensis* and *Ceratophyllum demersum*.

APPENDIX III SURVEY SITES, NUMBER OF OBSERVATION POINTS AND PLOTS, STAFFING

John Crow Mountains Survey Sites.

1. Ecclesdown: 6–13 March 1992
   Observation Points: 8
   Plots: 5 (each one represents both a tree and a herb plot)
   Team: D. Kelly, S. Iremonger, W. Parchment, M. Jones, J. Littau, D. Muchoney, D. Grossman, P. Lewis, Rh. Kerr, T. Goodland, M. Alison, Giuliana, P. Bedasse, G. Green, C. Bogle, K. Wint.
2. Hog House Hill (Sherwood forest): 15 March 1992
   Observation Points: 1
   Plots: 1
   Team: D. Kelly, S. Iremonger, M. Jones, J. Littau, W. Parchment, P. Lewis.
3. Millbank: 17–18 March 1992
   Observation Points: 3
   Plots: 2
   Team: D. Kelly, S. Iremonger, J. Littau, W. Parchment, P. Lewis, E. Folkes.

Blue Mountains Survey Sites.

1. Spanish River: 5 May 1992
   Observation Points: 1
   Plots: 1
   Team: S. Iremonger, D. Muchoney, M. Jones, P. Lewis, D. Reid, A. Singh, Miller, K. Bussoo, C. Bogle, K. Wint.
2. Vinegar Hill: 6–8 May 1992
   Observation Points: 2
   Plots: 2
   Team: S. Iremonger, D. Muchoney, M. Jones, D. Reid, A. Singh, P. Lewis, Miller, Karl Bussoo, C. Bogle, K. Wint.
3. Cuna Cuna Pass: 19 May 1992
   Observation Points: 1
   Plots: 1
   Team: S. Iremonger, P. Lewis, M. Jones, R. Chipley, N. Stewart, M. Smith, E. Walcott, K. Wint, C. Bogle, Dul.
4. Lookout Hill: 20 May 1992
   Observation Points: 2
   Plots: 1
   Team: Iremonger, P. Lewis, M. Jones, R. Chipley, N. Stewart, M. Smith, E. Walcott, K. Wint, C. Bogle, Dul.
5. House Hill: 21 May 1992
   Observation Points: 1
   Plots: 1
   Team: S. Iremonger, P. Lewis, M. Smith, E. Walcott, K. Wint, Dul.
6. Nanny Town: 1–5 June 1992
   Observation Points: 8
   Plots: 5
   Team: S. Iremonger, P. Lewis, M. Jones, Lewis, M. Myrie, K. Wint, C. Bogle, G. West, W. West.

APPENDIX IV PLANT SPECIES LISTS FOR 10 COMMUNITY TYPES, WITH CONSERVATION RANK

Plant species recorded in each community type listed by family. Lower plants are listed after each list of flowering plants. Nomenclature follows Adams (1972), Proctor (1982, 1985) and Howard (1979–89). The Nature Conservancy's Global and National conservation rank status of each species is also shown for the flowering plants, as is whether the plant is endemic to Jamaica. The ranks operate on a scale of 1 to 5, 1 denoting very rare and 5 indicating that the taxon is common. "H" indicates that the species has not been found recently and is possibly extinct, and "R" indicates that a species has been recorded for that nation, but without persuasive documentation which would provide a basis for either accepting or rejecting the report. Records which still need to have the identifications confirmed have the specimen numbers in brackets. Numbers in the thousands are those of D.L. Kelly, numbers in the hundreds are those of S. Iremonger.

Family	Species Name	G Rank	N Rank	Endemism
Lower montane rain forest over limestone				
Apocynaceae	*Plumeria* sp. (no specimen)			
Apocynaceae	*Tabernaemontana rendlei*	G1G2	N1N2	Endemic
Aquifoliaceae	*Ilex jamaicana*	G1	N1	Endemic
Aquifoliaceae	*Ilex* sp. (9723)			
Araceae	*Anthurium cordatum*	G5	N4	
Araceae	*Anthurium grandifolium*	G5	N5	
Araceae	*Philodendron schottii*	G2	N2	Endemic
Araceae	*Syngonium auritum*	G5	N5	
Araliaceae	*Dendropanax arboreus*	G5	N5	
Araliaceae	*Dendropanax blakeanus*	G2	N2	Endemic
Arecaceae	*Calyptronoma occidentalis*	G3	N3	Endemic
Arecaceae	*Thrinax multiflora*	G5	N5	
Arecaceae	*Thrinax parviflora*	G4	N4	Endemic
Asteraceae	cf. *Mikania* (9746)			
Burmanniaceae	*Burmannia* sp.			
Celastraceae	*Maytenus jamaicensis*	G5?	N4	
Clethraceae	*Clethra occidentalis*	G5	N4	
Clusiaceae	*Calophyllum calaba* (= *C. antillanum*)	G5	N5	
Clusiaceae	*Clusia* sp. (no specimen)			
Clusiaceae	*Symphonia globulifera*	G5	N4	
Combretaceae	cf. *Terminalia* sp. (9731, 9751)			
Convolvulaceae	*Ipomoea ternata*	G3	N3	Endemic
Cunoniaceae	*Weinmannia pinnata*	G5	N4	
Cyperaceae	*Scleria mucronata* (= *S. cubensis*)	G?	N4	
Cyrillaceae	*Cyrilla racemiflora*	G5	N5	
Elaeocarpaceae	*Sloanea jamaicensis*	G4	N4	Endemic
Euphorbiaceae	*Alchornea latifolia*	G5	N5	
Euphorbiaceae	*Ateramnus ellipticus*	G4	N4	Endemic
Euphorbiaceae	*Hyeronima jamaicensis*	G2	N2	Endemic
Euphorbiaceae	*Phyllanthus cladanthus*	G2	N2	Endemic
Euphorbiaceae	*Sapium jamaicense*	G5	N4	
Euphorbiaceae	*Savia sessiliflora*	G?	NHNR (new rank: N1)	
Flacourtiaceae	*Casearia arborea*	G5	N3	
Flacourtiaceae	*Casearia sylvestris*	G5	N4N5	

Family	Species Name	G Rank	N Rank	Endemism
Flacourtiaceae	*Homalium racemosum*	G5	N4	
Gentianaceae	*Leiphaimos aphylla*	G?	N2	
Gesneriaceae	*Gesneria pumila*	G3	N3	Endemic
Gesneriaceae	*Rytidophyllum grande* var. grande	G3	N3	Endemic
Hernandiaceae	*Hernandia catalpifolia*	G2	N2	Endemic
Lauraceae	*Ocotea leucoxylon*	G5	N4	
Marcgraviaceae	*Marcgravia brownei*	G4	N4	?Endemic
Melastomataceae	*Adelobotrys adscendens*	G?	N2	
Melastomataceae	*Clidemia plumosa*	G4G5	N4	
Melastomataceae	*Conostegia icosandra*	G5	N4	
Melastomataceae	*Meriania* sp. (no specimen)			
Melastomataceae	*Miconia rubens*	G3	N3	Endemic
Meliaceae	*Guarea glabra*	G5	N5	
Moraceae	*Trophis racemosa*	G5	N4	
Myrsinaceae	(9743)			
Myrtaceae	(9733)			
Myrtaceae	*Eugenia* sp. (9749)			
Orchidaceae	*Brassia* sp. (no specimen)			
Orchidaceae	*Stelis* sp. (no specimen)			
Orchidaceae	*Vanilla wrightii*	G4?	N2	
Passifloraceae	*Passiflora oblongata*	G3	N3	Endemic
Piperaceae	*Peperomia hernandiifolia*	G?	N3	
Piperaceae	*Piper hispidum*	G5	N4	
Polygalaceae	*Securidaca brownei*	G3	N3	Endemic
Polygonaceae	*Coccoloba* sp. (9711)			
Rhamnaceae	*Rhamnus sphaerospermus*	G5	N4	
Rubiaceae	cf. *Portlandia* (9737)			
Rubiaceae	*Guettarda argentea*	G4?	N4	
Rubiaceae	*Guettarda elliptica*	G5	N5	
Rubiaceae	*Hamelia* sp. (no specimen)			
Rubiaceae	*Macrocnemum jamaicense*	G3	N3	Endemic
Rubiaceae	*Palicourea wilesii*	G3	N3	Endemic
Rubiaceae	*Psychotria clusioides*	G2	N2	Endemic
Rubiaceae	*Psychotria uliginosa*	G5	N4	
Rubiaceae	*Rondeletia portlandensis*	G1	N1	Endemic
Sapotaceae	*Sideroxylon montanum* (= *Bumelia montana*)	G4	N4	Endemic
Smilacaceae	*Smilax domingensis*	G5	N5	
Theaceae	*Gordonia haematoxylon* (= *Laplacea haematoxylon*)	G3	N3	Endemic
Theaceae	*Ternstroemia rostrata*	G3	N3	Endemic
Urticaceae	*Gyrotaenia microcarpa*	G3	N3	Endemic
Urticaceae	*Pilea diffusa* (= *P. lamiifilia var. puberula*)	G3T3	N3	Endemic
Pteridophyte	*Cyathea grevilleana*			
Pteridophyte	*Cyathea parvula*			
Pteridophyte	*Danaea* sp. (no specimen)			
Pteridophyte	*Nephrolepis* sp. (no specimen)			
Pteridophyte	*Oleandra articulata*			

Family	Species Name	G Rank	N Rank	Endemism
Pteridophyte	*Selaginella denudata*			
Pteridophyte	*Trichomanes crispum*			
Pteridophyte	*Trichomanes scandens*			
Lower montane rain forest over shale, transitional variant				
Acanthaceae	*Blechum killipii*	G2	N2	Endemic
Araceae	*Philodendron lacerum*	G5	N5	
Araceae	*Syngonium auritum*	G5	N5	
Araliaceae	*Dendropanax arboreus*	G5	N5	
Arecaceae	*Calyptronoma occidentalis*	G3	N3	Endemic
Asteraceae	*Salmea scandens*	G5	N5	
Canellaceae	*Cinnamodendron corticosum*	G1	N1	Endemic
Cecropiaceae	*Cecropia peltata*	G5	N5	
Celastraceae	cf. *Maytenus* sp. (10232)			
Celastraceae	*Maytenus jamaicensis*	G5?	N4	
Chloranthaceae	*Hedyosmum arborescens*	G5	N4	
Chrysobalanaceae	*Hirtella multiflora*	G2	N2	Endemic
Clethraceae	*Clethra occidentalis*	G5	N4	
Clusiaceae	*Calophyllum calaba*	G5	N5	
Clusiaceae	*Symphonia globulifera*	G5	N4	
Cyperaceae	*Rhynchospora polyphylla*	G5	N5	
Cyrillaceae	*Cyrilla racemiflora*	G5	N5	
Euphorbiaceae	*Acalypha virgata* var. *virgata*	G3T3	N3	
Euphorbiaceae	*Alchornea latifolia*	G5	N5	
Euphorbiaceae	*Drypetes alba*	G?	N3N4	
Euphorbiaceae	*Drypetes lateriflora*	G4	N4	
Euphorbiaceae	*Sapium harrisii*	G3	N3	Endemic
Euphorbiaceae	*Sapium jamaicense*	G5	N4	
Fabaceae	*Pithecellobium arboreum*	G5	N4	
Flacourtiaceae	*Homalium racemosum*	G5	N4	
Flacourtiaceae	*Lunania polydactyla*	G2	N2	Endemic
Gesneriaceae	*Besleria lutea*	G5	N4	
Heliconiaceae	*Heliconia caribaea*	G?	N3	
Hernandiaceae	*Hernandia catalpifolia*	G2	N2	Endemic
Lauraceae	*Ocotea leucoxylon*	G?	N4	
Lauraceae	cf. *Ocotea patens* (197) (= *Nectandra patens*)	G?	N4	
Lauraceae	cf. *Ocotea robertsoniae* (198)	G2	N2	Endemic
Lauraceae	*Cinnamomum montanum*	G?	N4	
Malpighiaceae	*Tetrapteris citrifolia*	G?	N3	
Malvaceae	*Malvaviscus arboreus*	G5	N5	
Malvaceae	*Wercklea flavovirens*	G1	N1	Endemic
Melastomataceae	*Conostegia procera*	G3	N3	Endemic
Melastomataceae	*Meriania leucantha*	G3	N3	?Endemic
Melastomataceae	*Ossaea asperifolia*	G4?	N4	
Meliaceae	*Guarea glabra*	G5	N5	
Menispermaceae	*Cissampelos pareira*	G5	N5	
Myrsinaceae	*Ardisia brittonii*	G1	N1	Endemic
Myrsinaceae	*Myrsine acrantha*	G4G5	N3	

Family	Species Name	G Rank	N Rank	Endemism
Myrsinaceae	*Wallenia subverticillata*	G5	N3	
Myrsinaceae	*Wallenia sylvestris*	G1G2	N1N2	Endemic
Myrsinaceae	*Wallenia venosa*	G3	N3	Endemic
Myrtaceae	cf. *Calyptranthes* (10235, 10242)			
Myrtaceae	*Eugenia axillaris*	G5	N5	
Myrtaceae	*Psidium montanum*	G4	N4	Endemic
Myrtaceae	*Syzygium jambos*	G?	NE4	
Orchidaceae	*Stelis* sp. (no specimen)			
Passifloraceae	*Passiflora* sp. (no specimen)			
Phytolaccaceae	*Trichostigma octandrum*	G5	N5	
Piperaceae	*Piper discolor*	G3	N3	Endemic
Piperaceae	*Piper murrayanum*	G4	N4	?Endemic
Poaceae	*Lasiacis maculata* (= *L. sorghoidea* var. sorghiodea)	G5T5	N5	
Rubiaceae	*Cephaelis elata*	G5	N5	
Rubiaceae	*Faramea occidentalis*	G5	N4	
Rubiaceae	*Palicourea domingensis*	G5	N4	
Rubiaceae	*Psychotria danceri* (= *P. dura*)	G3	N3	Endemic
Rubiaceae	*Psychotria dolphiniana*	G2	N2	Endemic
Rubiaceae	*Psychotria uliginosa*	G5	N4	
Rubiaceae	*Rondeletia hirsuta*	G2	N2	Endemic
Rutaceae	cf. *Zanthoxylum* sp. (no specimen)			
Sapindaceae	*Matayba apetala*	G5	N5	
Sapindaceae	*Paullinia* sp. (no specimen)			
Sapotaceae	*Pouteria multiflora*	G5	N5	
Smilacaceae	*Smilax domingensis*	G5	N5	
Solanaceae	*Brunfelsia jamaicensis*	G3	N3	Endemic
Staphyleaceae	*Turpinia occidentalis*	G5	N5	
Theaceae	*Cleyera theaeoides*	G5	N4	
Theaceae	*Gordonia haematoxylon*	G3	N3	Endemic
Verbenaceae	*Citharexylum caudatum*	G5	N4	
Viscaceae	*Dendrophthora opuntioides*	G3	N3	Endemic
Vitaceae	*Cissus microcarpa*	G5	N5	
Zingiberaceae	*Renealmia sylvestris*	G3	N3	Endemic
Pteridophyte	*Blechnum plumieri*			
Pteridophyte	*Cyathea grevilleana*			
Pteridophyte	*Cyathea* sp. (no specimen)			
Pteridophyte	*Odontosoria fumarioides*			
Pteridophyte	*Olfersia cervina*			
Pteridophyte	*Polybotrya osmundacea*			
Pteridophyte	*Selaginella* sp. (no specimen)			
Pteridophyte	*Thelypteris deltoidea*			
Lower montane rain forest over shale, typical variant				
Amaranthaceae	*Chamissoa altissima*	G5	N5	
Amaranthaceae	*Iresine celosia*	G5	N5	
Annonaceae	*Oxandra laurifolia*	G?	N1	
Apocynaceae	*Forsteronia floribunda*	G4	N4	

Family	Species Name	G Rank	N Rank	Endemism
Araceae	*Philodendron scandens* ssp. *isertianum*	G5T5	N4	
Araceae	*Philodendron scandens*	G5	N4	
Araceae	*Philodendron schottii*	G2	N2	Endemic
Araceae	*Syngonium auritum*	G5	N5	
Araliaceae	*Dendropanax arboreus*	G5	N5	
Arecaceae	*Calyptronoma occidentalis*	G3	N3	Endemic
Begoniaceae	*Begonia glabra*	G5	N5	
Bignoniaceae	*Schlegelia parasitica*	G4	N3	
Boraginaceae	*Cordia elliptica*	G2	N2	Endemic
Boraginaceae	*Cordia laevigata*	G5	N4	
Boraginaceae	*Tournefortia bicolor*	G5	N4	
Bromeliaceae	*Hohenbergia* sp. (no specimen)			
Campanulaceae	*Lobelia innominata*	G3	N3	Endemic
Caricaceae	*Carica jamaicensis*	G2	N2	Endemic
Caricaceae	*Carica papaya*	G?	NE5	
Cecropiaceae	*Cecropia peltata*	G5	N5	
Chrysobalanaceae	*Hirtella triandra*	G5	N1	
Clusiaceae	*Calophyllum calaba*	G5	N5	
Combretaceae	*Terminalia latifolia*	G4	N4	Endemic
Elaeocarpaceae	*Sloanea jamaicensis*	G4	N4	Endemic
Euphorbiaceae	*Drypetes lateriflora*	G4	N4	
Euphorbiaceae	*Phyllanthus angustifolius*	G4	N4	
Euphorbiaceae	*Sapium jamaicense*	G5	N4	
Fabaceae	*Andira inermis*	G5	N5	
Fabaceae	*Desmodium axillare* var. *stoloniferum*	G5T4	N3	
Fabaceae	*Pithecellobium arboreum*	G5	N4	
Flacourtiaceae	*Casearia sylvestris*	G5	N4N5	
Flacourtiaceae	*Homalium racemosum*	G5	N4	
Flacourtiaceae	*Laetia thamnia*	G5	N5	
Heliconiaceae	*Heliconia caribaea*	G?	N3	
Hernandiaceae	*Hernandia catalpifolia*	G2	N2	Endemic
Lauraceae	*Beilschmiedia pendula*	G5	N4	
Lauraceae	*Cinnamomum montanum*	G?	N4	
Lauraceae	*Licaria triandra*	G4	N4	
Lauraceae	*Ocotea globosa* (= *Nectandra antillana*)	G?	N5	
Lauraceae	*Ocotea leucoxylon*	G5	N4	
Melastomataceae	*Clidemia plumosa*	G4G5	N4	
Melastomataceae	*Meriania leucantha*	G3	N3	Endemic
Melastomataceae	*Miconia cf. prasina*	G5	N4	
Melastomataceae	*Miconia laevigata*	G?	N5	
Melastomataceae	*Miconia triplinervis*	G?	N4	
Melastomataceae	*Mouriri myrtilloides*	G5	N2	
Meliaceae	*Cedrela odorata*	G4	NE?4	
Meliaceae	*Guarea glabra*	G5	N5	
Meliaceae	*Guarea jamaicense*	G1	N1	Endemic
Meliaceae	*Trichilia havanensis*	G5	N3N4	
Meliaceae	*Trichilia pallida*	G5	N1 (new country record)	

Family	Species Name	G Rank	N Rank	Endemism
Moraceae	*Brosimum alicastrum*	G5	N4	
Moraceae	*Ficus maxima*	G5	N4	
Moraceae	*Ficus trigonata*	G5	N5	
Moraceae	*Trophis racemosa*	G5	N4	
Myrsinaceae	*Ardisia solanacea*	G?	NE4	
Myrsinaceae	*Wallenia fawcettii*	G1G2	N1N2	Endemic
Myrsinaceae	*Wallenia subverticillata*	G5	N3	
Myrtaceae	(305)			
Myrtaceae	*Calyptranthes chytraculia*	G5	N5	
Myrtaceae	*Calyptranthes pallens*	G4	N4	
Myrtaceae	*Eugenia marchiana*	G2	N2	Endemic
Myrtaceae	*Eugenia* sp. (no specimen)			
Myrtaceae	*Eugenia virgultosa* var. virgultosa	G3T3	N3	Endemic
Myrtaceae	*Pimenta dioica*	G5	N4	
Myrtaceae	*Psidium montanum*	G4	N4	Endemic
Ochnaceae	*Ouratea laurifolia*	G4	N4	
Orchidaceae	*Brassia caudata*	G3	N3	
Orchidaceae	*Stelis* sp. (no specimen)			
Passifloraceae	*Passiflora* sp. (no specimen)			
Piperaceae	*Peperomia acuminata*	G?	N3N4	
Piperaceae	*Peperomia amplexicaulis*	G4	N4	
Piperaceae	*Peperomia stellata*	G3	N3	Endemic
Piperaceae	*Piper arboreum* var. arboreum	G4?	N4	
Piperaceae	*Piper hispidum*	G5	N4	
Piperaceae	*Piper jamaicense forma magnifolium* (no number on specimen)			
Piperaceae	*Pothomorphe* sp. (no specimen)			
Poaceae	*Lasiacis maculata*	G5	N5	
Poaceae	*Pharus glaber*	G?	N4	
Poaceae	*Pharus latifolius*	G?	N3	
Polygonaceae	*Coccoloba diversifolia*	G5	N4	
Polygonaceae	*Coccoloba longifolia*	G3	N3	Endemic
Rhamnaceae	*Zizyphus chloroxylon*	G3	N3	Endemic
Rosaceae	*Prunus myrtifolia*	G4	N4	
Rubiaceae	*Faramea occidentalis*	G5	N4	
Rubiaceae	*Psychotria brachiata*	G?	N4	
Rubiaceae	*Psychotria marginata*	G?	N4	
Rubiaceae	*Psychotria sloanei*	G3	N3	Endemic
Rubiaceae	*Psychotria tenuifolia*	G?	N4	
Rutaceae	*Zanthoxylum culantrillo*	G?	N4	
Sapindaceae	*Exothea paniculata*	G5	N3	
Sapindaceae	*Matayba apetala*	G5	N5	
Sapindaceae	*Paullinia jamaicensis*	G5	N4	
Sapotaceae	*Chrysophyllum oliviforme*	G5	N4	
Sapotaceae	*Manilkara sideroxylon*	G4	N4	
Sapotaceae	*Pouteria multiflora*	G5	N5	
Smilacaceae	*Smilax domingensis*	G5	N5	
Solanaceae	*Brunfelsia jamaicensis*	G3	N3	Endemic
Staphyleaceae	*Turpinia occidentalis*	G5	N5	
Ulmaceae	*Trema floridanum*	G5	N3	
Urticaceae	*Gyrotaenia microcarpa*	G3	N3	Endemic

Family	Species Name	G Rank	N Rank	Endemism
Vitaceae	*Cissus sicyoides* (= *C. verticillata*)	G5	N5	
Pteridophyte	*Adiantum pyramidale*			
Pteridophyte	*Asplenium dissectum*			
Pteridophyte	*Blechnum occidentale*			
Pteridophyte	*Polybotrya osmundacea*			
Pteridophyte	*Polytaenium feei*			
Pteridophyte	*Tectaria incisa*			
Modified lower montane rain forest over shale				
Amaranthaceae	*Iresine diffusa*	G5	N5	
Begoniaceae	*Begonia glabra*	G5	N5	
Cecropiaceae	*Cecropia peltata*	G5	N5	
Clusiaceae	*Calophyllum calaba*	G5	N5	
Convolvulaceae	*Merremia* cf. *umbellata* (412)	G?	N5	
Dioscoreaceae	*Dioscorea polygonoides*	G?	N5	
Fabaceae	*Pithecellobium arboreum*	G5	N4	
	cf. *Flacourtiaceae* (413)			
Heliconiaceae	*Heliconia caribaea*	G?	N3	
Icacinaceae	*Mappia racemosa*	G?	N3	
Lauraceae	*Ocotea leucoxylon*	G5	N4	
Moraceae	*Artocarpus altilis*	G5	NE4	
Moraceae	*Trophis racemosa*	G5	N4	
Myrtaceae	(no specimen)			
Nyctaginaceae	*Pisonia subcordata*	G?	N1	
Piperaceae	*Piper discolor*	G3	N3	
Piperaceae	*Piper murrayanum*	G4	N4	?Endemic
Poaceae	*Bambusa vulgaris*	G5	NE5	
Poaceae	*Oplismenus hirtellus*	G5	N4	
Poaceae	*Pharus glaber*	G?	N4	
Rubiaceae	*Macrocnemum jamaicense*	G3	N3	Endemic
Rutaceae	*Zanthoxylum* sp.			
Staphyleaceae	*Turpinia occidentalis*	G5	N5	
Ulmaceae	*Trema floridanum*	G5	N3	
Urticaceae	*Pilea* cf. *andersonii* (may be new species) (417)	G1	N1	Endemic
Upper montane rain forest over limestone, typical variant				
Apocynaceae	*Plumeria obtusa*	G?	N4	
Apocynaceae	*Tabernaemontana rendlei*	G1G2	N1N2	Endemic
Araceae	*Anthurium cordifolium*	G5	N4	
Araliaceae	*Dendropanax blakeanus*	G2	N2	Endemic
Arecaceae	*Thrinax* sp. (no specimen)			
Celastraceae	*Maytenus* sp. nr. *clarendonensis* (9776)			
Chrysobalanaceae	*Hirtella* cf. *multiflora* (9753)	G2	N2	Endemic
Clusiaceae	*Calophyllum calaba*	G5	N5	
Clusiaceae	*Clusia portlandiana*	G2	N2	Endemic
Clusiaceae	*Garcinia decussata*	G2	N2	Endemic

Family	Species Name	G Rank	N Rank	Endemism
Cyrillaceae	*Cyrilla racemiflora*	G5	N5	
Elaeocarpaceae	*Sloanea jamaicensis*	G4	N4	Endemic
Euphorbiaceae	*Croton lucidus*	G?	N4	
Euphorbiaceae	*Phyllanthus cladanthus*	G2	N2	Endemic
Flacourtiaceae	*Samyda glabrata*	G2	N2	Endemic
Gesneriaceae	*Gesneria pumila*	G3	N3	Endemic
Gesneriaceae	*Rytidophyllum grande* var. grande	G3	N3	Endemic
Lacistemataceae	*Lacistema aggregatum*	G?	N4	
Malpighiaceae	*Byrsonima crassifolia* (= *Byrsonima coriacea*)	G?	N4	
Myrtaceae	*Pimenta jamaicensis*	G2	N2	Endemic
Myrtaceae	*Myrcia calcicola*	GH (new rank: G1 N1)	NH	Endemic
Myrtaceae	*Psidium albescens*	G2	N2	Endemic
Orchidaceae	*Lepanthes* cf. *multiflora*	G2	N2	Endemic
Passifloraceae	*Passiflora oblongata*	G3	N3	Endemic
Polygonaceae	*Coccoloba swartzii*	G5	N5	
Polygonaceae	*Coccoloba* sp. (9788)			
Rubiaceae	*Coccocypselum herbaceum*	G5	N5	
Rubiaceae	*Macrocnemum jamaicense*	G3	N3	Endemic
Rubiaceae	*Psychotria clusioides*	G2	N2	Endemic
Rubiaceae	*Psychotria uliginosa*	G5	N4	
Rubiaceae	*Rondeletia racemosa*	G3	N3	Endemic
Rubiaceae	*Schradera involucrata*	G4	N4	Endemic
Rutaceae	*Amyris elemifera*	G5?	N5	
Rutaceae	*Zanthoxylum spinosum*	G5	N3	
Smilacaceae	*Smilax balbisiana*	G5	N5	
Theaceae	*Gordonia haematoxylon*	G3	N3	Endemic
Pteridophyte	*Camptodium pedatum*			
Pteridophyte	*Cyathea* sp. (no specimen)			
Pteridophyte	*Thelypteris deltoidea*			
Pteridophyte	*Trichomanes osmundoides*			
Upper montane rain forest over limestone, edaphic variant				
Aquifoliaceae	*Ilex jamaicana*	G1	N1	Endemic
Araceae	*Anthurium* sp. (no specimen)			
Araliaceae	*Schefflera sciadophyllum*	G3	N3	Endemic
Arecaceae	*Thrinax* sp. (no specimen)			
Bromeliaceae	*Hohenbergia* sp. (no specimen)			
Bromeliaceae	*Vriesea ringens*	G?	N4	
Chrysobalanaceae	*Hirtella multiflora*	G2	N2	Endemic
Clusiaceae	*Calophyllum calaba*	G5	N5	
Clusiaceae	*Clusia portlandiana*	G2	N2	Endemic
Clusiaceae	*Garcinia decussata*	G2	N2	Endemic
Clusiaceae	*Symphonia globulifera*	G5	N4	
Combretaceae	cf. *Terminalia* sp. (9731, 9751)			
Cyperaceae	*Rhynchospora uniflora*	G?	N4	
Cyperaceae	*Scleria cubensis*	G?	N4	

Family	Species Name	G Rank	N Rank	Endemism
Cyrillaceae	*Cyrilla racemiflora*	G5	N5	
Erythroxylaceae	*Erythroxylum areolatum*	G?	N5	
Euphorbiaceae	*Croton laurinus*	G2	N2	Endemic
Malpighiaceae	*Byrsonima crassifolia*	G?	N4	
Melastomataceae	*Conostegia balbisiana*	G4	N4	Endemic
Melastomataceae	*Miconia prasina*	G?	N4	
Myrsinaceae	*Myrsine coriacea*	G5	N4	
Myrsinaceae	*Wallenia laurifolia*	G4G5	N3	
Myrtaceae	*Calyptranthes wilsonii*	G2	N2	Endemic
Myrtaceae	*Calyptranthes zuzygium*	G4	N4	
Myrtaceae	*Eugenia axillaris*	G5	N5	
Myrtaceae	*Myrcia calcicola*	GH	NH	Endemic
Ochnaceae	*Ouratea* cf. *laurifolia* (9968)	G4	N4	
Polygonaceae	*Coccoloba* sp. (9955)			
Rubiaceae	*Guettarda argentea*	G4?	N4	
Sapindaceae	*Matayba apetala*	G5	N5	
Simaroubaceae	*Simarouba glauca*	G?	N4N5	
Theaceae	*Ternstroemia* cf. *howardiana* (9975)	G1	N1	Endemic
Pteridophyte	*Cyathea* sp. (no specimen)			
Pteridophyte	*Dicranopteris pectinata*			
Pteridophyte	*Odontosoria jenmanii*			
Pteridophyte	*Selaginella denudata*			
Pteridophyte	*Selaginella* sp. (no specimen)			
Pteridophyte	*Trichomanes holopterum*			
Upper montane rain forest over shale, typical association typical variant				
Araceae	*Philodendron* sp. (no specimen)			
Araliaceae	*Dendropanax arboreus*	G5	N5	
Asteraceae	*Mikania jamaicensis*	G1	N1	Endemic
Boraginaceae	*Tournefortia* sp. *aff. astrotricha* (357)			
Caprifoliaceae	*Viburnum alpinum*	G3	N3	Endemic
Chloranthaceae	*Hedyosmum nutans*	G4?	N3	
Clethraceae	*Clethra occidentalis*	G5	N4	
Clusiaceae	*Clusia havetioides* var. *havetioides*	G3T2	N2	Endemic
Clusiaceae	*Clusia* sp. (no specimen)			
Convolvulaceae	*Ipomoea ternata*	G3	N3	Endemic
Euphorbiaceae	*Chaetocarpus globosus*	G4?	N4	
Euphorbiaceae	*Sapium harrisii*	G3	N3	Endemic
Flacourtiaceae	*Casearia sylvestris*	G5	N4N5	
Gentianaceae	*Lisianthius* sp. (no specimen)			
Lauraceae	*Cinnamomum montanum*	G?	N4	
Lauraceae	*Ocotea patens*	G?	N4	
Lauraceae	*Ocotea* sp. (50)			
Melastomataceae	*Blakea trinervia*	G4	N4	Endemic
Melastomataceae	*Miconia tetrandra*	G?	N4	
Myrsinaceae	*Wallenia fawcettii*	G1G2	N1N2	Endemic
Myrsinaceae	*Wallenia subverticillata*	G5	N3	
Myrtaceae	*Wallenia laurifolia*	G4G5	N3	

Family	Species Name	G Rank	N Rank	Endemism
Myrtaceae	*Eugenia virgultosa* var. *virgultosa*	G3T3	N3	Endemic
Oleaceae	*Haenianthus incrassatus*	G3	N3	Endemic
Orchidaceae	*Erythrodes* sp. (63)			
Orchidaceae	*Psilochilus macrophyllus*	G5	N2	
Piperaceae	*Piper* sp. (no specimen)			
Polygonaceae	*Coccoloba swartzii*	G?	N5	
Polygonaceae	*Coccoloba zebra*	G2	N2	Endemic
Rubiaceae	*Cephaelis elata*	G5	N5	
Rubiaceae	*Faramea occidentalis*	G5	N4	
Rubiaceae	*Psychotria brachiata*	G?	N4	
Rubiaceae	*Psychotria uliginosa*	G5	N4	
Rubiaceae	*Schradera involucrata*	G4	N4	Endemic
Sapindaceae	*Matayba apetala*	G5	N5	
Sapotaceae	*Sideroxylon montanum*	G4	N4	Endemic
Smilacaceae	*Smilax domingensis*	G5	N5	
Solanaceae	*Brunfelsia jamaicensis*	G3	N3	Endemic
Staphyleaceae	*Turpinia occidentalis*	G5	N5	
Symplocaceae	*Symplocos octopetala*	G2	N2	Endemic
Theaceae	*Gordonia haematoxylon*	G3	N3	Endemic
Pteridophyte	*Cyathea* sp. (no specimen)			
Pteridophyte	*Polypodium* sp. (no specimen)			
Upper montane rain forest over shale, typical association, *Selaginella* variant				
Aquifoliaceae	*Ilex harrisii*	G2	N2	Endemic
Araceae	*Anthurium grandifolium*	G?	N5	
Araliaceae	*Dendropanax arboreus*	G5	N5	
Araliaceae	*Schefflera sciadophyllum*	G3	N3	Endemic
Asclepiadaceae	*Gonolobus stapelioides*	G1	N1	Endemic
Asteraceae	*Mikania* sp. (no specimen)			
Asteraceae	*Odontocline fadyenii* (= *Senecio fadyenii*)	G3	N3	Endemic
Asteraceae	*Urbananthus critoniformis* (= *Eupatorium critoniforme*)	G2	N2	Endemic
Balanophoraceae	*Scybalium jamaicense*	G?	N4	
Chloranthaceae	*Hedyosmum arborescens*	G?	N4	
Clethraceae	*Clethra occidentalis*	G5	N4	
Clusiaceae	*Clusia* sp. (no specimen)			
Convolvulaceae	*Ipomoea ternata*	G3	N3	Endemic
Cyrillaceae	*Cyrilla racemiflora*	G5	N5	
Euphorbiaceae	*Alchornea latifolia*	G?	N5	
Euphorbiaceae	*Chaetocarpus globosus*	G4?	N4	
Euphorbiaceae	*Drypetes lateriflora*	G4	N4	
Euphorbiaceae	*Sapium harrisii*	G3	N3	Endemic
Flacourtiaceae	*Casearia sylvestris*	G5	N4N5	
Gesneriaceae	*Columnea hirsuta*	G4	N4	Endemic
Lauraceae	*Beilschmiedia pendula*	G5	N4	
Lauraceae	*Ocotea patens*	G?	N4	
Lauraceae	*Persea alpigena*	G3	N3	Endemic

Family	Species Name	G Rank	N Rank	Endemism
Melastomataceae	*Clidemia plumosa*	G4G5	N4	
Melastomataceae	*Mecranium amygdalinum*	G5	N4	
Melastomataceae	*Meriania leucantha*	G3	N3	Endemic
Melastomataceae	*Miconia dodecandra*	G?	N5	
Melastomataceae	*Miconia laevigata*	G?	N5	
Melastomataceae	*Miconia prasina*	G?	N4	
Melastomataceae	*Miconia tetrandra*	G?	N4	
Meliaceae	*Guarea glabra*	G5	N5	
Moraceae	*Ficus maxima*	G?	N4	
Myrsinaceae	*Myrsine acrantha*	G4G5	N3	
Myrsinaceae	*Wallenia sylvestris*	G1G2	N1N2	Endemic
Myrtaceae	*Calyptranthes* sp.			
Myrtaceae	*Psidium montanum*	G4	N4	Endemic
Oleaceae	*Haenianthus incrassatus*	G3	N3	Endemic
Orchidaceae	*Erythrodes cf. plantaginea* (173)	G?	N4	
Orchidaceae	*Stelis* sp. (no specimen)			
Piperaceae	*Piper discolor*	G3	N3	Endemic
Poaceae	*Chusquea abietifolia*	G5	N4	
Rubiaceae	*Cephaelis elata*	G5	N5	
Rubiaceae	*Manettia lygistum*	G3	N3	Endemic
Rubiaceae	*Palicourea alpina*	G?	N4	
Rubiaceae	*Psychotria corymbosa*	G3	N3	Endemic
Rubiaceae	*Psychotria dolphiniana*	G2	N2	Endemic
Rubiaceae	*Schradera involucrata*	G4	N4	Endemic
Sapindaceae	*Matayba apetala*	G5	N5	
Symplocaceae	*Symplocos octopetala*	G2	N2	Endemic
Theaceae	*Gordonia haematoxylon*	G3	N3	Endemic
Pteridophyte	*Cyathea aspera*			
Pteridophyte	*Cyathea parvula*			
Pteridophyte	*Cyathea* sp. (no specimen)			
Pteridophyte	*Gleichenia/Dicranopteris* sp. (no specimen)			
Pteridophyte	*Hypolepis* sp. (no specimen)			
Pteridophyte	*Olfersia cervina*			
Pteridophyte	*Polybotrya osmundacea*			
Pteridophyte	*Selaginella* sp. (no specimen)			
Pteridophyte	*Trichomanes rigidum*			
Bryophyte	*Phyllogonium fulgens*			
Upper montane thicket complex over limestone				
Aquifoliaceae	*Ilex macfadyenii*	G?	N4	
Araceae	*Anthurium cordifolium*	G5	N5	
Araceae	*Syngonium auritum*	G5	N5	
Araliaceae	*Dendropanax arboreus*	G5	N5	
Araliaceae	*Dendropanax blakeanus*	G2	N2	Endemic
Araliaceae	*Schefflera sciadophyllum*	G3	N3	Endemic
Arecaceae	*Calyptronoma occidentalis*	G3	N3	Endemic
Asclepiadaceae	*Gonolobus jamaicensis*	G1	N1	Endemic

Family	Species Name	G Rank	N Rank	Endemism
Asclepiadaceae	*Metastelma harrisii* (= *Cynanchum harrisii*)	G3	N3	Endemic
Asteraceae	*Clibadium terebinthinaceum*	G?	N4	
Asteraceae	*Critonia parviflora* (= *Eupatorium parviflorum*)	G3	N3	Endemic
Asteraceae	*Mikania maxonii*	G1	N1	Endemic
Asteraceae	*Urbananthus critoniformis*	G2	N2	Endemic
Begoniaceae	*Begonia acutifolia*	G4	N4	
Begoniaceae	*Begonia glabra*	G5	N5	
Bignoniaceae	*Schlegelia axillaris*	G?	N1	
Boraginaceae	*Tournefortia glabra*	G?	N5	
Campanulaceae	*Lobelia alticaulis*	G1	N1	Endemic
Campanulaceae	*Lobelia grandifolia*	G2	N2	Endemic
Caprifoliaceae	*Viburnum alpinum*	G3	N3	Endemic
Caprifoliaceae	*Viburnum villosum*	G5	N4	
Celastraceae	*Maytenus jamaicensis*	G5?	N4	
Chloranthaceae	*Hedyosmum arborescens*	G?	N4	
Clethraceae	*Clethra occidentalis*	G5	N4	
Clusiaceae	*Clusia havetioides*	G3	N3	Endemic
Clusiaceae	*Clusia portlandiana*	G2	N2	Endemic
Clusiaceae	*Garcinia decussata*	G2	N2	Endemic
Cunoniaceae	*Weinmannia pinnata*	G5	N4	
Cyrillaceae	*Cyrilla racemiflora*	G5	N5	
Ericaceae	*Symphysia racemosa*	G?	N1	
Euphorbiaceae	*Chaetocarpus globosus*	G4?	N4	
Gentianaceae	*Lisianthius exsertus*	G3	N3	Endemic
Gesneriaceae	*Alloplectus pubescens*	G1	N1	Endemic
Gesneriaceae	*Besleria lutea*	G5	N4	
Gesneriaceae	*Columnea fawcettii*	G3	N3	Endemic
Gesneriaceae	*Columnea hirsuta*	G4	N4	Endemic
Gesneriaceae	*Gesneria acaulis*	G4	N4	Endemic
Gesneriaceae	*Gesneria calycina*	G1	N1	Endemic
Gesneriaceae	*Gesneria onychocalyx*	G1	N1	Endemic
Gesneriaceae	*Gesneria pumila*	G3	N3	Endemic
Gesneriaceae	*Rytidophyllum* sp. (no specimen)			
Lauraceae	*Ocotea leucoxylon*	G?	N4	
Malvaceae	*Malvaviscus arboreus*	G?	N5	
Melastomataceae	*Blakea trinervia*	G4	N4	Endemic
Melastomataceae	*Conostegia balbisiana*	G4	N4	Endemic
Melastomataceae	*Miconia* nr. *quadrangularis* (9837)			
Melastomataceae	*Miconia* sp. (no specimen)			
Meliaceae	*Trichilia pallida*	G5	N1	
Myricaceae	*Myrica cerifera*	G5	N4	
Myrsinaceae	*Ardisia tiniifolia*	G3	N3	Endemic
Myrsinaceae	*Wallenia sylvestris*	G5	N3	
Myrtaceae	*Eugenia kellyana*	G1	N1	Endemic
Myrtaceae	*Eugenia* sp. (9912)			
Myrtaceae	*Eugenia virgultosa* var. *virgultosa*	G3T3	N3	Endemic
Oleaceae	*Haenianthus incrassatus*	G3	N3	Endemic
Orchidaceae	*Epidendrum nocturnum*	G?	N4	

Family	Species Name	G Rank	N Rank	Endemism
Orchidaceae	*Epidendrum* sp. (no specimen)			
Orchidaceae	*Erythrodes plantaginea*	G?	N4	
Orchidaceae	*Lepanthes obtusa*	G3	N3	Endemic
Orchidaceae	*Lepanthes* sp. (no specimen)			
Orchidaceae	*Malaxis umbelliflora*	G?	N3	
Orchidaceae	*Stelis trigoniflora*	G4	N4	
Passifloraceae	*Passiflora oblongata*	G3	N3	Endemic
Piperaceae	*Peperomia fawcettii*	G3	N3	Endemic
Piperaceae	*Peperomia hernandiifolia*	G?	N3	
Piperaceae	*Piper arboreum var. stamineum*	G3?T3	N3	
Poaceae	*Zeugites americana*	G4?	N4	
Polygonaceae	*Coccoloba swartzii*	G5	N5	
Rubiaceae	cf. *Guettarda* sp. (9950)			
Rubiaceae	*Manettia lygistum*	G3	N3	Endemic
Rubiaceae	*Psychotria clusioides*	G2	N2	Endemic
Rubiaceae	*Psychotria discolor*	G2	N2	Endemic
Rubiaceae	*Rondeletia portlandensis*	G1	N1	Endemic
Rubiaceae	*Rondeletia subsessiliflora*	G1	N1	Endemic
Rubiaceae	*Schradera involucrata*	G4	N4	Endemic
Solanaceae	*Cestrum hirtum*	G4?	N4	
Solanaceae	*Solanum stellatum*	G3	N3	Endemic
Symplocaceae	*Symplocos* cf. *tubulifera* (9927)	G1	N1	Endemic
Urticaceae	*Boehmeria jamaicensis*	G3	N3	Endemic
Urticaceae	*Gyrotaenia microcarpa*	G3	N3	Endemic
Urticaceae	*Pilea ciliata*	G2G3	N2N3	Endemic
Urticaceae	*Pilea nigrescens*	G3	N3	Endemic
Urticaceae	*Pilea rufa*	G2	N2	Endemic
Verbenaceae	*Aegiphila* sp. nr. *swartziana* (9804)			
Zingiberaceae	*Renealmia sylvestris*	G3	N3	Endemic
Pteridophyte	*Camptodium pedatum*			
Pteridophyte	*Cyathea grevilleana*			
Pteridophyte	*Cyathea parvula*			
Pteridophyte	*Cyathea* sp. (no specimen)			
Pteridophyte	*Cyathea tussacii*			
Pteridophyte	*Diplazium fadyenii*			
Pteridophyte	*Elaphoglossum crinetum*			
Pteridophyte	*Grammitis hartii*			
Pteridophyte	*Grammitis serrulata*			
Pteridophyte	*Grammitis suspensa*			
Pteridophyte	*Grammitis trifurcata*			
Pteridophyte	*Hymenophyllum hirsutum*			
Pteridophyte	*Hymenophyllum polyanthos*			
Pteridophyte	*Hypolepis nigrescens*			
Pteridophyte	*Nephrolepis pectinata*			
Pteridophyte	*Olfersia cervina*			
Pteridophyte	*Polypodium loriceum*			
Pteridophyte	*Polypodium repens*			
Pteridophyte	*Selaginella* sp. (no specimen)			
Pteridophyte	*Thelypteris opulenta*			

Family	Species Name	G Rank	N Rank	Endemism
Lichen	*Coenogonium* (Lichen)			
Unlocalized species				
Convolvulaceae	*Ipomoea ternata*	G3	N3	Endemic
Euphorbiaceae	*Croton lucidus*	G?	N4	
Euphorbiaceae	*Phyllanthus eximus*	G1	N1	Endemic
Gesneriaceae	*Alloplectus pubescens*	G1	N1	Endemic
Lauraceae	*Ocotea exaltata*	G2	N2	Endemic
Lauraceae	*Persea alpigena*	G3	N3	Endemic
Myrsinaceae	*Wallenia laurifolia*	G4G5	N3	
Myrtaceae	*Eugenia marchiana*	G2	N2	Endemic
Orchidaceae	*Malaxis umbelliflora*	G?	N3	
Piperaceae	*Piper arboreum*	G4	N4	
Podocarpaceae	*Podocarpus* sp. (juv.)			
Ranunculaceae	*Clematis dioica*	G5	N4	
Pteridophyte	*Cyathea arborea*			
Pteridophyte	*Cyathea gracilis*			
Pteridophyte	*Cyathea tussacii*			
Pteridophyte	*Olfersia cervina*			

About The Nature Conservancy

The mission of The Nature Conservancy is to preserve plants, animals and natural communities that represent the diversity of life on Earth by protecting the lands and waters they need to survive. The Conservancy acts internationally by assisting countries in building the capacity and commitment to conserve their biological diversity and the natural systems necessary to sustain life.

For more than 40 years, the Conservancy, a nonprofit membership organization headquartered in Arlington, Virginia, USA has worked with local conservationists both in the United States and internationally to identify and protect critical habitat. To date the Conservancy and its members, who now number more than 750,000, have been responsible for the protection of more than 6.5 million acres in the United States and Canada. Internationally, the Conservancy has a well-developed program in Latin America and the Caribbean and during the last several years has begun focusing on conservation challenges in the Pacific. Through the "Parks in Peril" program, which has targeted 200 of the Western hemisphere's most important and most imperiled natural areas, more than 35 million acres are being protected.

The Conservancy is well-known for its expertise in land acquisition for conservation purposes; in the United States, the organization owns more than 1,300 preserves, the largest private system of nature sanctuaries in the world. The Conservancy also developed the Natural Heritage methodology, which has grown into a hemisphere-wide network of computerized biodiversity inventories known as Conservation Data Centers. The Conservancy has also developed widely adopted techniques of managing land for conservation purposes. Each of these strategies plays an important role in the Conservancy's goal of preserving biodiversity by protecting whole ecosystems with both people and nature in mind.

Internationally, the Conservancy recognizes that local organizations have the best insight into local conservation issues. It therefore works to support partners ensuring that they have the resources and skills to make decisions that will guarantee a rich natural legacy for the future. Its closest partners generally are private land-conservation organizations which, like the Conservancy, have a clear mission of protecting areas of high biological importance but it also collaborates closely with government institutions and other international organizations.

In Latin America and the Caribbean, the Conservancy's partners number more than 40 organizations in 22 countries. The Conservancy focuses on institutional development, protected areas management, long-term conservation financing and the application of science and information technologies for conservation decision-making.

For more information about The Nature Conservancy and its work in Latin America and the Caribbean, call (703) 841-4860 or write The Nature Conservancy, Latin America/Caribbean Program, 1815 North Lynn Street, Arlington, Virginia 22209.

America Verde

Publications for preservation — a series of *The Nature Conservancy* to enhance the capacity to preserve the biological diversity of Latin America and the Caribbean.

The Nature Conservancy®

A Rapid Ecological Assessment of the Blue and John Crow Mountains National Park, Jamaica

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