

Jamaica's National Ecological Gap Assessment Report



May 2009

**A component of the Protected Areas System Master Plan of
Jamaica**

TABLE OF CONTENTS

List of Illustrations	ii
Preface	iv
Acknowledgements	v
Executive Summary	vi
List of Acronyms	xi
Introduction	1
Jamaica's Path Towards Protected Areas	3
Conservation Targets	7
Target Viability and Threats	10
Conservation Goals	12
Identification of Gaps	17
Closing Jamaica's Protected Area Gaps	21
Recommendations	27
Glossary	32
References	34
Maps	37
Appendices	
1. Contributors to National Ecological Gap Assessment	57
2. Marine Conservation Targets Represented Within Existing Protected Areas	60
3. Freshwater Goal Conservation Targets Represented Within Existing Protected Areas	61
4. Terrestrial Conservation Targets Represented Within Existing Protected Areas	62
5. Results of Protected Area Classification Workshop	64
6. Protected Areas Prioritization Workshop Results	67
7. National Biodiversity Research Agenda	74

ILLUSTRATIONS

TABLES

Table 1: Existing Protected Area Categories in Jamaica	5
Table 2: Marine, Freshwater and Terrestrial Conservation Targets	8
Table 3: Major Threats to Marine, Freshwater and Terrestrial Biodiversity in Jamaica	10
Table 4: Conservation Goals for Marine Targets	13
Table 5: Conservation Goals for Freshwater Targets	14
Table 6: Conservation Goals for Coarse-filter Terrestrial Targets	15
Table 7: Conservation Goals for Fine-filter Terrestrial Targets	16
Table 8: Overview of Proposed Add-ons to Existing Protected Areas	23
Table 9: Overview of Proposed Protected Areas	24
Table 10: Consolidated Protected Area Classification System	28

BOXES

Box 1: Recommended Priority Areas	29
Box 2: Potential Conservation Mechanisms	30

MAPS

Map 1.0: Recommended System of Protected Areas	ix
Map 1.1: Legally Declared Protected Areas in Jamaica	38
Map 1.2: Current Protected Area Network	39
Map 2.0: Distribution of Marine Targets	40
Map 3.0: Distribution of Freshwater Targets	41
Map 4.0: Distribution of Terrestrial Coarse- and Fine-filter Targets	42
Map 5.0: Distribution of Freshwater and Coarse-filter Terrestrial Targets	43
Map 6.0: Distribution of Freshwater and Fine-filter Terrestrial Targets	44
Map 7.0: Distribution of Freshwater and Marine Targets	45
Map 8.0: Cost Surface Model for Terrestrial Biodiversity	46
Map 8.1: Cost Surface Model for Freshwater Biodiversity	47
Map 8.2: Cost Surface Model for Marine Biodiversity	48
Map 9.0: Integrated Cost Surface	49
Map 10.0: Recommended Marine Conservation Portfolio with Goals Met	50
Map 11.0: Recommended Terrestrial Areas Portfolio with Goals Met	51

Map 12.0: Recommended Freshwater Portfolio with Goals Met	52
Map 13.0: Proposed National Protected Areas Portfolio – Priority Ranking: Biodiversity	53
Map 14.0: Proposed National Protected Areas Portfolio – Priority Ranking: Threat	54
Map 15.0: Proposed National Protected Areas Portfolio – Priority Ranking: Feasibility	55

PREFACE

The Convention on Biological Diversity (CBD) at its seventh Conference of Parties in 2004, adopted a set of goals and objectives on protected areas, called the “Programme of Work on Protected Areas” (PoWPA). The PoWPA is divided into three phases which span from 2004 to 2012. The first phase of activities requires that all parties (including Jamaica) complete a **Protected Areas System Master Plan** (PASMP). Preparing a Master Plan requires undertaking an ecological gap analysis to assess where the nation’s current protected areas systems fall short of protecting all biodiversity; assessing the management effectiveness of existing protected areas; planning to build the capacity of Protected Area managers at local and system level; and assessing the financial gap and planning for long-term financial sustainability. The National Ecological Gap Assessment Report (NEGAR) is the ecological component of the PASMP as required by the CBD guidelines.

The Protected Areas Committee (PAC) is leading the development of the PASMP. The committee consists of heads of the government entities with legal responsibility for protected areas declaration and/or management. Formation of the PAC was necessitated due to the number of entities making decisions independent of, but impacting, each other.

Members are:

- CEO and Conservator of Forests, Forestry Department (Chair)
- CEO, National Environment and Planning Agency (NEPA);
- Senior Director, Environmental Management Division, Office of the Prime Minister;
- Executive Director, Jamaica National Heritage Trust (JNHT);
- Chair of Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) Scientific Authority of Jamaica; and
- Director, Fisheries Division.

The mandate of the PAC is to prepare the Master Plan in accordance with CBD guidelines and national needs, as the road map towards an effectively managed and sustainably financed, representative protected area system. A Secretariat is provided to the PAC by The Nature Conservancy (Jamaica) and NEPA.

In 2004 when the PoWPA was adopted Jamaica already had aspects of the plan completed through an Environmental Foundation of Jamaica project: legal, heritage and culture, and public awareness. Subsequently completed components are, Management Effectiveness Assessment and Capacity Development Planning. Ongoing work includes the sustainable finance analysis and planning; institutional mechanisms; and the National Ecological Gap Assessment, the subject of this report.

The PAC will have a Master Plan drafted from the components developed, and will, through public consultations, define and publicise the system plan, leading to its formal adoption as a National Plan.

The Ecological Working Group (EWG) was given the task by the PAC to prepare the NEGAR. The EWG is a multi-stakeholder grouping (governmental and non-governmental). Members of the EWG are listed in Appendix 1.

It should also be noted that the PAC is the entity responsible for the PASMP and all of its components, including the NEGAR, and as such any comments or queries should be directed to the PAC Chair, Miss Marilyn Headley, CEO and Conservator of Forests, Forestry Department.

ACKNOWLEDGEMENTS

We are grateful to the numerous individuals and institutions that contributed to making this report possible. In particular, we would like to thank BlueMaris Ventures, Dr Matthew McPherson and Mrs. Maya Gorrez-de Jongh, the consultants who wrote the first drafts and facilitated stakeholder workshops. The Nature Conservancy contributed in a number of ways, providing their guidance, technical and other support throughout this project. We would also like to acknowledge the technical assistance of Ms. Shawn Margles, Dr. Steve Schill and Mr. Owen Evelyn who diligently provided the maps as well as ongoing technical and logistical support for GIS-related products. We would also especially like to acknowledge the time and effort of the Jamaican experts and stakeholders who participated in the consultations carried out to review the results of this work (see Appendix 1)—their critical thinking, provided over a period of ten months, was instrumental in shaping the results of the final integrated protected areas system portfolio.

EXECUTIVE SUMMARY

As a party to the Convention on Biological Diversity (CBD), Jamaica is committed to developing an ecologically-representative network of protected areas designed to conserve at least ten per cent of the nation's remaining naturally-occurring terrestrial, aquatic and marine flora and fauna. The consensus is that this target is inadequate to protect Jamaica's biodiversity because of the high levels of endemism. To achieve Jamaica's goal, the National Ecological Gap Assessment Report was commissioned by Jamaica's Protected Areas Committee to fulfil two basic objectives:

- 1) Identify where the existing protected areas fall short in adequately protecting a representative sample of all marine, terrestrial and freshwater biodiversity in the country, that is, identifying the ecological gaps.
- 2) Based on the identified gaps in representative protected areas, provide recommendations for bridging the gaps and implementing conservation of these areas.

Jamaica's current protected areas cover approximately 18% of the country's land area as well as 15% of its archipelagic waters. Beginning with the Harbours Act of 1874 and the Morant and Pedro Cays Act of 1907, conservation efforts evolved through a number of legislative acts applied in a largely *ad hoc* fashion and, as a result, protected areas now fall into 19 different named categories under the jurisdiction of four government agencies within 3 ministries. Jamaica is currently addressing the need to reform the present protected areas complexity to ensure that the country's resources are supported by viable and well-functioning biological processes. This will enable a robust system—aligned with international paradigms—to be put in place. Although the nature of the impending reform is under discussion among relevant agencies, this document provides parameters for consideration based on consultations with key stakeholders.

The **integrated ecological gap assessment** described in this report builds on the Jamaica Ecoregional Plan (JERP). The latter provided separate gap assessments for marine, terrestrial and freshwater ecosystems that were used to make recommendations to adequately conserve critical biodiversity within each one of these habitats. Expert and stakeholder consultations in conjunction with technical analyses using existing research data and other available information were used to develop the Plan. The work required a series of chronological analyses that commenced with identifying **conservation targets**—that is, specific biological features that are representative of Jamaica's biodiversity and, consequently, the focus of long-term conservation efforts. Conservation targets were selected using criteria such as endemism, threat levels, ecological representativeness and vulnerability. The marine plan identified 13 conservation targets, the terrestrial plan, 55; and the freshwater plan, 22. Threat analyses and cost surface modelling were then used to determine where these targets occurred, how many of them remained and in what condition. Based on these analyses, a specific (or adaptive) conservation goal for each target was established by local experts to ensure that the number, size or extent of each target conserved is sufficient to maintain long-term ecological functionality. However, the marine, freshwater and terrestrial assessments also use higher percentage conservation goals for particular targets when needed, based on unique considerations related to Jamaica's island geography and application of the precautionary principle¹.

¹ Rio Declaration definition of "precautionary approach" also known as the precautionary principle: Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation.

The **recommendations** presented in the Jamaica Ecoregional Plan provide networks for marine, terrestrial and freshwater ecosystems that collectively achieve the CBD ten per cent minimum threshold for the conservation of all biodiversity targets.

Meanwhile, an independent management effectiveness assessment (Hayman 2007) evaluated performance at the site and national levels taking into account existing protected areas that encompass terrestrial, marine and freshwater ecosystems. Finally, overlay analyses using the JERP conservation recommendations and the independent management effectiveness assessment were then conducted to determine the extent to which Jamaica's current protected areas provide adequate management and protection of the conservation targets.

Shortfalls in present protected areas in which conservation targets were lacking in representation (representative gaps), insufficient to maintain ecological functionality (ecological gaps) or were not adequately managed (management gaps) were then identified as specific conservation and ecological gaps. Taking these gaps into consideration, the recommendations were then optimized by redesigning the protected areas in a way that efficiently addresses the critical gaps while meeting specific conservation goals. This optimized conservation network was then used as the basis of the national level gap analysis through which the National Ecological Gap Assessment Report (NEGAR) was generated.

GAPS IDENTIFIED

The national level gap analysis was conducted using overlay and spatial assessments to determine critical representation, ecological and management gaps concurrent throughout Jamaica's marine, terrestrial and freshwater ecosystems. Based on these results, an integrated protected area portfolio was developed that includes a complementary suite of areas from each habitat realm, these then act in conjunction with one another to render a functional, mutually reinforcing network of protected areas designed to maintain the island's critical ecosystems. The proposed national protected area portfolio underwent a review process by critical stakeholders for finalization for the NEGAR.

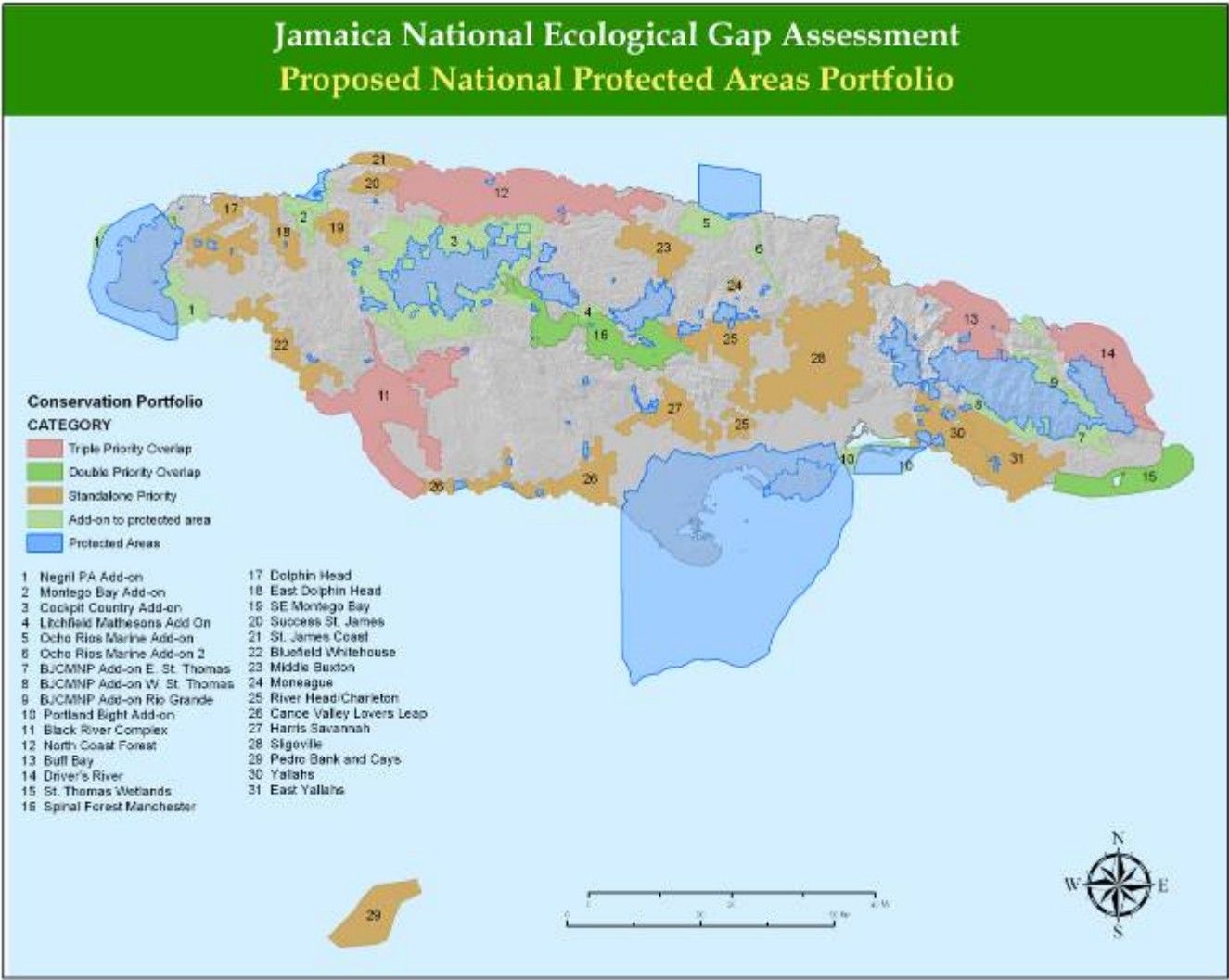
The overall gap analysis revealed that the representation of critical marine conservation targets in the eastern coast of Jamaica is ecologically insufficient for functionality within existing protected areas. Of particular concern is the complete absence of offshore banks in any designated protected area, and the highly selective representation of cays. Moreover, the current protected area legislation is not designed to accommodate seascape-scale connectivity, functions and processes that are necessary to maintain overall marine biodiversity health.

Terrestrial Gaps were the most difficult to analyse and the most serious based on the fact that, for plants, very limited data is available at present; while faunal targets are more comprehensively covered. As a result, only threatened plant assemblages and vegetation types were selected as floral targets. Of particular concern is the under-representation of four targets that fall below the ten per cent threshold: Wet and Very Wet Forest on Alluvium, Mesic Forest on Shale and *Osteopilus marianae* (frog species). Also 44 of the 55 terrestrial targets fail to meet the adaptive goals that were established, suggesting that most of the terrestrial targets may be highly vulnerable to existing threats and lack of connectivity.

Freshwater gaps are large rivers, wetlands, ponds and lakes as well as freshwater caves that occur in the eastern part of the island and high-altitude streams in the western part that have no representation in any of Jamaica's protected areas. John (2006) states "...the island's rivers, wetlands and ponds are yet to be regarded as whole systems. This accounts for the fact that no protected areas in Jamaica cover complete river systems from headwaters to the coast. The main ecological gap in the design of Jamaica's protected areas is that of connectivity." Longitudinal (or linear) and lateral connectivity are critical for the sustainable health of freshwater systems.

With regard to the management of Jamaica's current protected areas, it was reported that major gaps exist relating to a lack of focus on conservation actions that directly impact biodiversity such as threat abatement and enforcement. These gaps are fuelled by overall inadequate investment of monetary and human resources in conservation. At the policy level, the complications of multiple-agency management combined with the lack of a harmonised system of classification to guide the management of protected areas are contributing to inefficiencies and shortcomings in overall performance.

As a result, the map on page ix, illustrates the recommended conservation portfolio of protected areas for Jamaica that meets biological conservation goals as well as the country's commitment to protect at least ten per cent of its biodiversity.



Map 1.0: Recommended System of Protected Areas

The proposed protected areas network (including existing and proposed sites) specifically addresses gaps in critical biodiversity as well as ecological functions; it also exemplifies a “ridges-to-reefs” conservation approach that is critical to an island biological system. To consolidate this network as Jamaica’s protected areas system, a suite of recommendations are made (pages 39-43). An abridged and prioritised list of these recommendations is given below.

RECOMMENDATIONS

I. Recommended Strategies for Jamaica’s Protected Areas System

- 1) Implement the proposed protected area portfolio to fill critical ecological gaps as well as meet CBD goals in a phased manner starting with the highest priority areas where feasibility is high and the probability of success is equally high.
 - A detailed national implementation plan should be drafted.
- 2) Harmonise Jamaica’s protected area management categories, cross referencing with the International Union for the Conservation of Nature (IUCN) categories where applicable, and standardise their application at the national scale.

II. Recommended Strategies for Enabling Jamaica’s Protected Areas Policy

- 1) Revise the current Protected Areas Policy based on clear agreements regarding ministerial and government departmental roles, responsibilities and authorities with regard to the coordination, management, monitoring and enforcement of Jamaica’s protected areas system.
- 2) Revise relevant legislation to incorporate the protected areas portfolio and protected areas system.
- 3) Mainstream protected areas into decision-making processes at all levels of governance including Parish Councils, and national development projects and proposals.

III. Recommended Strategies for Protected Areas Conservation Capacity

- 1) Implement sustainable finance mechanisms to support core aspects of protected areas policy.
- 2) Strengthen and improve the capacity of relevant government environmental agencies to regulate, monitor and report on the ecological and socio-economic condition of protected areas.
- 3) Strengthen the Environmental Impact Assessment process implementation particularly in relation to developments within, surrounding and otherwise impacting on protected areas, with special attention given to mitigation actions and monitoring of sites.
- 4) Develop technical capacity-building measures for protected area managers to enable field-related staff to carry out key conservation actions

IV. Recommended Key Research Areas

Research is a critical underpinning of the NEGAR. A research agenda is proposed (on page 43), but here are the main areas under which urgent research is needed:

- 1) Marine, terrestrial and freshwater ecosystem connectivity in protected areas
- 2) Status of critical resource stocks in protected areas
- 3) Economic and monetary value of ecological services of ecosystems

ACRONYMS

BJCMNP	Blue and John Crow Mountain National Park
CBD	Convention on Biological Diversity
CCAM	Caribbean Coastal Area Management
CITES	Convention on the International Trade in Endangered Species of Wild Fauna and Flora
CSAP	Comprehensive Sustainability Assessment Tool
EDU	Ecological Drainage Units
EWG	Ecological Working Group
GIS	Geographic Information System
IUCN	International Union for the Conservation of Nature
JERP	Jamaica Ecoregional Plan
MSU	Marine Stratification Unit
NBSAP	National Biodiversity Strategy and Action Plan
NEGAR	National Ecological Gap Assessment Report
NEPA	National Environment and Planning Agency
NGO	Non-governmental Organisation
NRCA	Natural Resources Conservation Authority
OPM	Office of the Prime Minister
PAC	Protected Areas Committee
PASMP	Protected Areas System Master Plan
PoWPA	Programme of Work on Protected Areas (Convention on Biological Diversity)
RAPPAM	Rapid Assessment and Prioritization of Protected Areas Management

INTRODUCTION

Jamaica is an important contributor to biodiversity of the Caribbean Basin which is ranked fifth out of “the eight hottest hotspots” on Conservation International’s list of “Biodiversity Hotspots”, that is, the Caribbean has the fifth highest concentration of endemic species on earth (Myers et al. 2000). However, the Caribbean also ranks no. 5 for “Hottest Hotspots with Extreme Conservation Needs”, in fact, Mittermeier (2005) comments “in many of these countries (i.e., the Caribbean), the existing protected area network is ineffective and poorly managed”, and Rodrigues (2003) cites the Caribbean as one of the “four main regions ... high-lighted as urgent priorities for the establishment of new protected areas”. Additionally, Jamaica is no. 6 on the IUCN Red List for mammals at risk of extinction because of threats to endemic bats and the hutia (Schipper et al., 2008).

As a party to the Convention on Biological Diversity (CBD), Jamaica is committed to developing an ecologically-representative network of protected areas designed to conserve at least ten per cent of the nation’s remaining naturally-occurring ecosystems. The local consensus is that this target is inadequate to protect Jamaica’s biodiversity because of the high levels of endemism. In consideration of the geography of islands where ecosystems are more vulnerable to environmental change, the ecoregional planning in Jamaica applied the precautionary approach² and set higher percentage conservation goals.

In the process of generating the comprehensive protected areas system, a national ecological gap assessment was first conducted to evaluate the extent to which the current protected areas in Jamaica are effective in conserving a representative and functional portion of the country’s biodiversity. The primary objectives of the national ecological gap assessment are the following:

- 1) Identify specific areas representing critical marine, terrestrial and freshwater biological diversity that are not presently under any form of protection under Jamaica’s current protected areas.
- 2) Provide recommendations relevant to an appropriate protected areas system design that address these priority conservation area gaps.

To meet these objectives, selection was made of targets considered necessary for conservation, and these were located and mapped. In the course of developing ecoregional plans for Jamaica, comparison was then made by cross-referencing marine, terrestrial and freshwater areas of high conservation value against existing protected areas. Thus it was possible to identify specific areas and targets that fall outside of the nation’s current protected areas. These conservation gaps were then analysed in conjunction with one another to achieve a holistic view in order to address conservation through a mutually-reinforcing network. The National Ecological Gap Assessment Report (NEGAR) therefore provides the results of a comprehensive gap analysis as well as recommendations to enhance the country’s long-term sustainability, and ensure Jamaica meets its commitment to the CBD.

The primary source of information for the NEGAR is the Jamaica Ecoregional Plan (JERP).³ **Ecoregional Planning** is a means of systematic planning by selecting and designing networks of sites that will conserve the diversity of species, communities, and ecological systems in each region (Groves et al. 2000).

The JERP results, provided in June–August 2006, (with terrestrial results revised in February 2008) outline the necessary conservation areas and strategies. This first iteration of the JERP was the culmination of a three-year effort involving the collection, analysis and synthesis of available biological

² Rio Declaration definition of “precautionary approach”: Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation.

³ Documents are available at www.forestry.gov.jm

and socio-economic data relevant to biodiversity conservation on the island and its waters. The JERP was led by The Nature Conservancy (Jamaica) and supported by a multidisciplinary group of local and international scientists, technicians and conservation practitioners.

Also taken into consideration was management of existing protected areas, as identified in the January 2007 *National Report on Management Effectiveness Assessment and Capacity Development Plan for Jamaica's System of Protected Areas* (Hayman 2007). This assessment was designed to identify the strengths and weaknesses of the current protected areas with a view to producing a prioritized set of strategic actions to improve management.

Other key sources of information for the NEGAR included: the Policy for the National System of Protected Areas (1997), management plans for the Blue and John Crow Mountains National Park and Portland Bight Protected Area; national plans including A Plan for a System of Protected Areas in Jamaica (1992), the National Forest Management and Conservation Plan (2000), and the National Strategy and Action Plan on Biological Diversity in Jamaica (2003); and documents related to legislation such as the draft Fisheries Act (2006), the Protected Areas System Plan Legal Framework Final Report (2004) and the Categorization of Protected Areas in Jamaica report (Yugorsky and Sutton, 2004).

Several workshops and meetings were held to ensure that key stakeholders had opportunities to contribute to the development of the NEGAR. See Appendix 1 for the dates of the workshops/meetings and the lists of participants.

These studies are available for public review through the Jamaica Forestry Department: www.forestry.gov.jm

JAMAICA'S PATH TOWARDS PROTECTED AREAS

Jamaica's awareness of natural resources matched the worldwide pattern of exploitation followed by attempted control or management—beginning with the Harbours Act in 1874 which prohibited pollution of certain marine waters and the Morant and Pedro Cays Act of 1907—in an attempt to limit exploitation of species (fishes, birds, turtles). Among subsequent acts referring to natural resources were the: Forest Act (1937), Mining Act (1947), Wild Life Protection Act (1945), and the Beach Control Act (1956). In similar fashion these acts were geared to management of natural resources for exploitation.

By the 1960s the world was becoming aware of the depletion of resources and degradation of natural sites, so too in Jamaica other legislation was promulgated that reflected these growing concerns, for example, the Watershed Protection Act (1963) and the Fishing Industry Act (1975).

The local stimulus towards biodiversity conservation and natural resource management was provided by the Stockholm Conference on the Environment in 1972, which resulted in the establishment of the Natural Resources Conservation Department in 1975. "In 1977 Jamaica joined the Convention on International Trade of Endangered Species (CITES) initiating its entrance into the international arena of environmental conservation.... [It] marked the first serious commitment to conserve Jamaica's natural resources to the global community" (Brown & Edwards 2005). Despite this, that Convention was not ratified until 20 years later; followed three years later by the passing of The Endangered Species (Protection, Conservation and Regulation of Trade) Act 2000.

In 1988 that the word 'biodiversity' appeared in a publication for the first time and signalled a new approach that engendered awareness of the need for protection of the natural environment. In Jamaica, the Natural Resources Conservation Department was upgraded in 1991 to the Natural Resources Conservation Authority (NRCA), specifically "to take such steps as are necessary for the effective management of the physical environment of Jamaica so as to ensure the conservation, protection, and proper use of its natural resources" (SOE 1995). This was followed in 1996 by a new Forest Act that required "the protection, conservation and production of forest resources."

Subsequent to Cabinet's approval of Jamaica's Policy for the National System of Protected Areas in 1997, the NRCA was incorporated into the National Environment and Planning Agency (NEPA), which is an amalgamated institution, composed of the NRCA, the Town Planning Department and the Land Development and Utilization Commission. NEPA now functions under the Development Division of the Office of the Prime Minister.

Over the past century in Jamaica, different types of protected areas were established independently and declared under various acts aiming to capture unique biological attributes, not necessarily in conjunction with one another as a complementary network or national system. As a result, there are 19 different categories of "protected areas" under the jurisdiction of four government agencies. Currently, the Forestry Department of the Ministry of Agriculture and NEPA are the two organisations responsible for the majority of protected areas (Table 1).

Today, management of protected areas operates through a combination of state efforts and co-management agreements with non-governmental organisations (NGOs) that began in the early 1990s when "the Protected Areas Resource Conservation (PARC I) project was initiated through United States Agency for International Development (USAID) to "... integrate conservation of biological diversity with sustainable economic development" (Brown & Edwards 2005).

The existing protected areas cover nearly 2000 km² (just over 18%) of Jamaica's lands as well as approximately 1800 km² of marine area or approximately 15% of the country's archipelagic waters (see Map 1.0 for primary areas).

Jamaica's protected areas encompass a variety of biologically important features such as ecosystems, communities, habitat types, as well as plant and animal species. However, despite capturing many of Jamaica's significant biological features, the extent to which the current complexity captures critical processes necessary to maintain them over the long term is limited. In this regard, through its commitment to the CBD, Jamaica is currently addressing the need to make the present protected areas cohesive in order to ensure the country's resources and biodiversity are supported by viable and well-functioning biological processes. The resultant system can then be harmonised with international protected area management standards.

The suggested portfolio of protected areas proposed here should become an important part of government planning as is set out in Vision 2030 Jamaica, National Development Plan, which promises to be "a quantitative planning tool [that] supports the integration of economic, environmental and social elements of the society; and provides scenarios of future long-term outcomes ...". It also addresses the missing elements of conservation in Jamaica as set out in the State of the Environment report (1995) where the sentiments expressed about conservation in Jamaica are as follows: "The legislative framework in Jamaica does not comprehensively protect ecosystem diversity, species diversity or genetic diversity. A new framework is needed that recognises the components of biodiversity ...".

In the meantime, the nature of the protected areas reform remains in discussion led by the PAC in collaboration with other key government agencies. This document provides guidance based on widespread consultation with key stakeholders regarding recommendations for reform.

Table 1: Existing Protected Areas Categories in Jamaica

CATEGORY	RESPONSIBLE AGENCY	LAW	EXAMPLES
National Park	NEPA (NRCA): Office of the Prime Minister - Environmental Management Division	NRCA Act, 1996	Blue and John Crow Mountains National Park
Marine Park	NEPA (NRCA): Office of the Prime Minister - Environmental Management Division	NRCA Act, 1996	Montego Bay Marine Park; Ocho Rios Marine Park
Protected Area	NEPA (NRCA): Office of the Prime Minister - Environmental Management Division	NRCA Act, 1996	Portland Bight Protected Area, Coral Spring-Mountain Spring Palisadoes-Port Royal
Environmental Protection Area	NEPA (NRCA): Office of the Prime Minister - Environmental Management Division	NRCA Act, 1996	Negril Environmental Protection Area
Game Sanctuary	NEPA (NRCA): Office of the Prime Minister - Environmental Management Division	Wild Life Protection Act, 1945	Includes all crown lands (e.g. Forest Reserves)
Game Reserve	NEPA (NRCA): Office of the Prime Minister - Environmental Management Division	Wild Life Protection Act, 1945	Various, includes public and private areas declared under the Act e.g. West Harbour, Amity Hall, Canoe Valley etc.
Tree Preservation Order	NEPA (Town and Country Planning Authority): Office of the Prime Minister - Environmental Management Division and Local Government Department, through Parish Councils	Town Planning Act, 1958	San San/Blue Lagoon Negril Royal Palm Reserve Fern Gully Bush Cay
Conservation Area	NEPA (Town and Country Planning Authority, parish councils): Office of the Prime Minister - Environmental Management Division	Town Planning Act, 1958	Specified areas in gazetted Development Orders
Protected Watershed	NEPA (NRCA): Office of the Prime Minister - Environmental Management Division	Watershed Protection Act, 1963	Whole island
Marine Protected Area	NEPA (Beach Control Authority): Ministry of Land and Environment	Beach Control Act, 1956	Ocho Rios, Port Royal
Ramsar site	NEPA (NRCA): Office of the Prime Minister - Environmental Management Division		Black River Lower Moras
Foreshore	NEPA (Beach Control Authority): Office of the Prime	Local Improvements Act, 1977	One mile from coast around

CATEGORY	RESPONSIBLE AGENCY	LAW	EXAMPLES
	Minister - Environmental Management Division		island
Forest Reserve	Forestry Department: Ministry of Agriculture	Forestry Act (1996) and Forest Regulations	Various
Protected Area	Forestry Department: Ministry of Agriculture	Forestry Act (1996) and Forest Regulations	
Fish Sanctuary	Fisheries Division: Ministry of Agriculture	Fishing Industry Act 1976	Bogue Islands, Montego Bay
Morant and Pedro Cays	Fisheries Division: Ministry of Agriculture	Morant and Pedro Cays Act, 1907	Morant and Pedro Cays
Protected National Monument	Jamaica National Heritage Trust: Ministry of Information, Culture, Youth and Sports	Jamaica National Heritage Trust Act, 1985	Some examples include: Clarendon; Mason River, God's Well Portland: Nanny Town St. Ann: Harmony Hill –caves and arawak carvings; Chestfield caves; Dunn's River Falls, Fern Gully St. Catherine: Mountain River Cave; White Marl arawak midden St. Elizabeth: Black River Spa, Bamboo Avenue, YS Falls St. Thomas: Judgement Cliff Trelawny: Windsor Caves; Glistening Water
Protected National Heritage	Jamaica National Heritage Trust: Ministry of Information, Culture, Youth and Sports	Jamaica National Heritage Trust Act, 1985	Various, examples including natural and built heritage include Marshall's Pen
Public Parks and Gardens	Superintendent of Gardens: Ministry of Agriculture		Fern Gully, Bamboo Avenue

Source: Modified from Yugorsky and Sutton 2004.

CONSERVATION TARGETS

Conservation targets are the specific biological features that serve as the focus of conservation planning and management efforts. These targets are chosen as representative elements of an ecologically defined region (ecoregion) or a nation's biological diversity deemed important to conserve over the long term. Conservation targets can be defined as coarse-filter targets or fine-filter targets. **Coarse-filter targets** include broad characteristic examples of ecological communities and ecosystems. **Fine-filter targets** encompass rare and endangered or wide-ranging species and ecosystem assemblages not adequately represented at the scale of coarse-filter targets (Groves 2003). These different types of targets are an important starting point for conservation as they represent key elements of biological diversity that are critical to maintaining significant ecological functions on which both man and nature depend. As such, conservation targets are the foundation upon which conservation actions are developed.

The marine, freshwater and terrestrial ecoregional plans for Jamaica all identified a combination of coarse- and fine-filter targets to include critical biological diversity in developing the national protected areas system. Fine-filter targets for which little or no data existed for credible analysis were addressed as nested targets within coarse-scale target surrogates. To illustrate, all marine turtle species were nested under the turtle nesting beaches target in order to focus on protecting a particularly vulnerable stage of their lifecycle. Similarly, Queen Conch (*Strombus gigas*) is included in the soft bottom communities and seagrass beds targets to encompass the major habitats critical to juvenile and adult life stages. Endemic freshwater crabs and other aquatic species were subsumed under the appropriate stream targets while terrestrial flora is nested in the appropriate forest ecosystem targets.

Table 2 provides a summary of Jamaica's marine, freshwater and terrestrial conservation targets resulting from the respective ecoregional planning efforts. Maps 2.0, 3.0 and 4.0 illustrate the distribution of these targets across Jamaica's land- and seascape. These conservation targets were derived from a combination of ecological expert inputs, published literature, existing maps and other credible documentation. They were chosen using specific criteria that include parameters such as endemism, level of threat impacting the target, ecological representativeness and vulnerability.

The geographical distribution of targets is influenced by a combination of topographical, geophysical and environmental processes that have shaped Jamaica's biological diversity. The eastern portion of the island is mountainous and dominated by older igneous and metamorphic rock and shale. This is where the highest point on the island occurs—at Middle Peak of the Blue Mountain range—reaching 2,256 m above sea level. In contrast, the central and western portions of the island are comprised of younger limestone forming lower-lying hills and plateaus. These topographical features give rise to fast-flowing but short-reach rivers originating from the highlands in the east, and longer rivers in the west that drain through sinkholes, floodplains and wetlands.

Significant complementarities exist among the targets from the three ecosystem assessments. The concentration of species-level terrestrial targets occurs along the same clusters of coarse-scale terrestrial ecosystem and freshwater targets (Maps 5.0 and 6.0). Of particular interest are the watershed areas on the eastern side of the island in proximity to the Blue Mountains (e.g., Buff Bay/Pencar River, Rio Grande, Swift River, Spanish River and Morant River watershed management units) and the Black River watershed on the south-western side of the island where target overlap is dense, reflective of the co-dependence between terrestrial and freshwater ecosystems and species.

Table 2: Marine, Freshwater and Terrestrial Conservation Targets

Marine Conservation Targets	Freshwater Conservation Targets	Terrestrial Conservation Targets
Sandy shores Rocky shores Mangroves Estuarine areas Seagrass beds Corals and Coral Reefs Soft bottom communities Cays Offshore banks Seabird nesting and roosting areas Overwintering shorebird areas Turtle nesting beaches Manatees	High-Altitude Headwater Streams Medium-Sized Streams (karstic and non-karstic) Large Low-Altitude Streams Coastal Springs and Streams Small high-altitude headwater streams non-karstic Karstic Aquatic Systems: Karstic Streams Karstic Aquatic Systems: Springs Springs Karstic Aquatic Systems: Freshwater Caves Freshwater caves (non-karstic) Freshwater wetlands Lakes and Ponds: Blue Mountain Endemic fish Endemic turtle	Dry Forest (on alluvium, limestone and shale) Very Dry Forest (on alluvium, limestone and shale) Mesic Forest (on alluvium, limestone and shale) Wet Forest on Alluvium (on alluvium, limestone, serpentine and shale) Very Wet Forest (on alluvium, limestone and shale) Montane Cloud Forest Montane Summit Savanna Non-mangrove Wetlands Mangroves Endemic Bat Species Black-billed Parrots Black-throated Blue Warbler Caves with Bats Caves with Guano Threatened Frogs Jamaican Hutia Giant Swallowtail Butterfly West Indian Whistling Duck Ring-tailed Pigeon Plain Pigeon Limpkin Ruddy Quail Dove Yellow-billed Parrot Yellow Boa Iguanas Northern Waterthrush Threatened Plants

The corresponding impacts of the physical and hydrogeological features of terrestrial and freshwater targets on the environment are reflected in the distribution of marine biodiversity between northern and southern Jamaica (Map 7.0). The presence of mangrove patches along the entire coast of the island suggests terrestrial and freshwater influences on the marine environment. However, differences in the degree of freshwater impact can be found between north and south. The southern coast of Jamaica is an alluvial floodplain lined with a number of rivers that flow into a gradually sloping wide marine shelf (up to 24 km). These conditions tend to promote the mixing of fresh and salt water resulting in increased turbidity, productivity and few patchy reef formations. In contrast, the narrower marine shelf (1 km) of the northern coast of the island, which drops off steeply into a 7 km trough, is almost continuously lined with fringing reefs reflecting less influence from freshwater as a probable result of less inundation by rivers and streams or increased water circulation induced by the drop-off.

The implication of such dynamics is that developing a portfolio network of protected areas should adequately capture the effects of ecological differentiation resulting from various physical characteristics that influence the occurrence of biodiversity within Jamaica's land- and seascape.

TARGET VIABILITY AND THREATS

The viability of conservation targets refers to the overall status or condition of the targets that indicates the likelihood of their long-term survival (at least 50 years). Assessing target viability, therefore, enables the understanding of

- a. the potential for the target to persist over the long term; and
- b. how much of each target is necessary to ensure its functionality and survival.

In this regard, target viability analysis is important in establishing specific conservation goals, and this impacts the spatial design of the resultant protected areas network. The analysis utilises the most important ecological factors that affect longevity as parameters for assessing viability. Problems arise in the absence or scarcity of detailed information regarding the target's biology and ecology, and as a result surrogate assessments in the form of two complementary processes: expert analysis and **cost surface modelling** were used to infer target viability.

EXPERT ANALYSIS

The term “**threat**” refers to the combination of stresses or negative impacts that directly or indirectly affect the viability of targets, and the human activities that are the sources of these stresses (Groves et al. 2000). Several expert workshops were conducted to generate lists of threats or stresses to terrestrial, freshwater and marine biodiversity. Table 3 identifies the major threats in all three ecosystem types.

Table 3: Major threats to marine, freshwater and terrestrial biodiversity in Jamaica

Marine Threats	Freshwater Threats	Terrestrial Threats
Coastal development	Nutrient Loading (agriculture and agro-processing)	Mining
Land run-off	Invasive species (Australian redclaw, and other exotic aquaculture and aquarium species)	Invasive species
Overfishing	Deforestation and removal of riparian vegetation	Unsustainable use of resources e.g. deforestation
Solid waste pollution	Unsustainable harvesting of freshwater biodiversity	Poor land use planning

COST SURFACE MODELLING

Cost surface modelling maps the impact of human activities on an area, commonly described as the human footprint. Described in more technical terms, the cost surface involves the use of spatial data to quantify the intensity of human activities acting on biodiversity. This provides a surrogate means of assessing habitat condition and vulnerability of targets (Dudley and Parish 2006; McPherson et al. 2008). The cost concept is based on the idea that in areas where the impact of human activities is severe, the cost of conservation will be higher than in areas with lower levels of impact.

The cost surface used the most recent GIS-based data coverage from government agencies, NGOs and other sources that show the country-wide distribution of the activities that represent the primary threats to Jamaican biodiversity. The experts-derived threats list was one of the major considerations in generating cost surfaces to account for the different ways that human activities impact biodiversity.

From the individual cost surface models (Maps 8.0–8.2), a composite cost surface model (Map 9) that combines cost values for all three realms was generated to provide an overall view of human impacts in

the region. Densely-populated areas with a high level of human activity generally display the highest cost for conservation action.. The rural, more isolated and lightly populated areas have lower associated costs..

In the ecoregional planning process the cost surface maps were incorporated into protected area analysis using computer programmes that are designed to identify an optimized combination of areas that meet conservation goals most efficiently.

CONSERVATION GOALS

There are three major factors that are necessary in designing a functional system of protected areas:

- 1) Representativeness of biological elements to ensure that all critical elements are included in the network;
- 2) Functionality of the biological elements to ensure that they are of sufficient occurrence in terms of number, size or extent to be viable; and
- 3) Management capacity of the protected areas network to ensure effective conservation of the biological elements.

While the biological representation factor was already addressed in the selection of targets, functionality is addressed by establishing goals for each target. Conservation goals are established primarily to determine how much of each target is required and where it is most critically in need of protection in order to maintain key ecological functions.

The Convention on Biological Diversity stipulates that at least ten per cent of the current occurrence of biodiversity should be protected to preserve ecological functionality. Goals are articulated as a percentage of either the total historical occurrence or the current extent of the targets that will be set aside for conservation purposes. However, because Jamaica is an island, there is a natural limit to the range of biodiversity distribution, and ecosystems are more vulnerable as well as sensitive to environmental change, the ecoregional planning process therefore applied the precautionary principle and set higher percentage conservation goals.

Due to limited information on the original extent of biological elements in Jamaica, as well as the long history of human use that makes it impractical to apply historical information, conservation goals were defined in terms of the current occurrences of targets. Based on current targets, higher value or **adaptive goals** were set for those that are known to have been substantially reduced. These conservation goals for marine, terrestrial and freshwater targets then provided the framework for developing the conservation area portfolios. Tables 4 to 7 show the conservation goals that were set.

Table 4: Conservation Goals for Marine Targets

Marine Conservation Targets	% Goals
Coarse-Filter Targets	
Sandy shores	20%
Rocky shores	20%
Mangroves	50%
Estuarine areas	20%
Seagrass beds	30%
Corals and Coral reef	10–30%*
Soft bottom communities	20%
Cays	30%
Offshore banks	10%
Fine-Filter Targets	
Seabird nesting and roosting areas	50%
Overwintering shorebird areas	30%
Turtle nesting beaches	50%
Manatees	50%

* A 10% goal was assigned to Pedro Bank coral and coral reef target due to its very large size relative to the other stratified reef targets and the conservation feasibility of managing such an extensive area.

Table 5: Conservation Goals for Freshwater Targets

Freshwater Conservation Targets	Total	% Goals*
<u>Coarse-Filter Targets</u>		
Streams	0–100 Km	50%
Streams	100–500 Km	25%
Streams	500–1000 Km	15%
Streams	> 1000 Km	10%
Lake/Ponds	845 ha	25%
Eastern Wetlands	221 ha	50%
Western Wetlands	12,894 ha	25%
Eastern Springs	109	10%
Western Springs	417	10%
Eastern Caves	9	50%
Western Caves	214	10%
<u>Fine-filter (species-based) Targets</u>		
<i>Cubanichthys pengellyi</i>	N/A	50%
<i>Gambusia melapleura</i>	N/A	50%
<i>Gambusia wrayi</i>	N/A	30%
<i>Limia melanogaster</i>	N/A	25%
<i>Pseudemys terrapin</i>	N/A	25%

*Goals determined using target abundance such that rare abundance = 50% goal, uncommon abundance = 25% goal, common = 15% goal and very common = 10% goal.

Table 6: Conservation Goals for Coarse-filter Terrestrial Targets

Terrestrial Coarse Filter Targets	Goals
Forest Dry alluvium	90%
Forest Dry limestone	80%
Forest Dry shale	90%
Forest Mesic alluvium	90%
Forest Mesic limestone	40%
Forest Mesic shale	80%
Forest Very Dry alluvium	90%
Forest Very Dry limestone	80%
Forest Very Dry shale	90%
Forest Very Wet alluvium	90%
Forest Very Wet limestone	90%
Forest Very Wet shale	90%
Forest Wet alluvium	90%
Forest Wet limestone	40%
Forest Wet serpentine	90%
Forest Wet shale	80%
Mangroves	90%
Montane Cloud Forest	90%
Montane Summit Savanna	90%
Threatened Plants	100%
Wetlands	90%

Table 7: Conservation Goals for Fine-filter Terrestrial Targets

Terrestrial Fine Filter Targets	Goals
Bats: <i>Phyllonycteris aphylla</i>	100%
Black-billed Parrot	90%
Black-throated Blue Warbler	75%
Caves: bats	95%
Caves: guano	50%
Frog Species: <i>Eleutherodactylus alticola</i>	100%
Frog Species: <i>Eleutherodactylus andrewsi</i>	75%
Frog Species: <i>Eleutherodactylus cavernicola</i>	100%
Frog Species: <i>Eleutherodactylus cundalli</i>	50%
Frog Species: <i>Eleutherodactylus fuscus</i>	75%
Frog Species: <i>Eleutherodactylus grabhami</i>	75%
Frog Species: <i>Eleutherodactylus griphus</i>	100%
Frog Species: <i>Eleutherodactylus jamaicensis</i>	75%
Frog Species: <i>Eleutherodactylus junori</i>	100%
Frog Species: <i>Eleutherodactylus luteolus</i>	50%
Frog Species: <i>Eleutherodactylus nubicola</i>	100%
Frog Species: <i>Eleutherodactylus orcutti</i>	100%
Frog Species: <i>Eleutherodactylus pentasyringos</i>	75%
Frog Species: <i>Eleutherodactylus sisypodemus</i>	100%
Frog Species: <i>Osteopilus brunneus</i>	75%
Frog Species: <i>Osteopilus crucialis</i>	75%
Frog Species: <i>Osteopilus marianae</i>	75%
Frog Species: <i>Osteopilus wilderi</i>	50%
Hutia: <i>Geocapromys brownii</i>	90%
Iguana: <i>Cyclura collei</i>	100%
Limpkin: <i>Aramus sp.</i>	100%
Northern Waterthrush: <i>Seiurus noveboracensis</i>	100%
Plain Pigeon: <i>Patagioenas inornata</i>	100%
Ring-tailed Pigeon: <i>Patagioenas caribaea</i>	100%
Ruddy Quail Dove: <i>Geotrygon Montana</i>	75%
Swallowtail: <i>Papilio homerus</i>	100%
Threatened Plants	100%
West Indian Whistling Duck: <i>Dendrocygna arborea</i>	90%
Yellow-billed Parrot: <i>Amazona collaria</i>	90%
Yellow boa: <i>Epicrates subflavus</i>	75%

IDENTIFICATION OF GAPS

In compliance with the Convention on Biological Diversity (CBD), protected area gaps were analysed according to the three prescribed types:

- 1) **Representation Gaps** – *How much of critical biodiversity is protected?* Representation gaps are species, ecosystems or habitats that are not included within present protected areas, or they do not occur in sufficient quantities to ensure long-term viability.
- 2) **Ecological Gaps** – *Is that which is protected ecologically healthy?* Ecological gaps refer to biodiversity representation within protected areas that are of insufficient quality to ensure their functionality and, therefore, their long-term survival.
- 3) **Management Gaps** – *Is that which is protected under effective management?* Management gaps refer to ineffective management regimes governing protected areas that perpetuate their vulnerability to further degradation.

The following section summarizes the representation, ecological and management gaps described in the marine, terrestrial and freshwater ecoregional plans, but management gaps in the current protected areas were not addressed within the Jamaica Ecoregional Plan (JERP).

It should be noted also that there was very limited, current islandwide data on any of the three realms, including current identification and distribution of plants, and the associations within ecosystems.

A. REPRESENTATION GAPS

Marine Gaps

To facilitate the overall ecoregional analysis for Jamaica, the country was stratified into four Marine Stratification Units (MSUs)—Northern, Southern, Eastern and Pedro Bank. To identify gaps, the distribution of targets was overlaid with Jamaica's present protected areas that encompass marine targets (Map 10.0).

The Northern and Southern MSUs have the best representation of targets each with 92% of target occurrences found within existing Marine/National Parks and Protected Areas and Game Reserves.⁴ Although Seabird Nesting and Roosting areas in the Northern MSU are not represented in any protected areas, they are represented in the Southern MSU. The Eastern and Pedro Bank MSUs, however, present a different scenario with only 69% (or 9 of 13) target representation in the former and no representation at all in the latter.

Freshwater Gaps

Analysis of freshwater system targets and National Park, Forest Reserve, Game Reserve and Fish Sanctuary protected area designations revealed that 71% (or 12 of 17) of the targets are protected within the current protected areas system while 29% occurred outside of any protected area designation (Appendix 4). Of particular significance is the Blue and John Crow Mountains National Park (BJCMNP) that protects 61.8% of headwater streams critical to maintaining lower altitude freshwater targets. Also of importance are the Negril Environmental Protection Area and the Lower Morass Game Reserve that harbour 29% and 37% of freshwater wetlands respectively. Of concern are the four freshwater targets occurring within the Eastern part of the island, that are completely unrepresented in the current protected areas system. Another target of concern is the Western high-altitude streams that are critical to Jamaica's

⁴ Game reserves were included in the marine and freshwater analyses.

western watershed area; also not protected under the current system.

Terrestrial Gaps

Floral fine-filter targets were limited to threatened plant assemblages. The data is inadequate and disjointed for most groups of plants, such as cycads, orchids, palms, ferns, and bromeliads. Of specific concern therefore is the fact that floral targets were mapped exclusively on the basis of vegetation types. However, faunal targets dealt with species and groups.

To identify representation gaps in the terrestrial realm, the distribution of terrestrial targets were cross-referenced with Natural Resources Conservation Authority (NRCA) declared Protected Areas, as well as Forest Reserves and Fish Sanctuaries. Game Reserves were eliminated from the analysis because this classification does not mandate specific protection for biodiversity targets.⁵ Many coarse- and fine-filter target occurrences meet the ten per cent CBD conservation goal with the exception of the Very Wet Forest on Alluvium target (0%); the Wet Forest on Alluvium target (8.3%), the Mesic Forest on Shale target (1.8%) and the fine-filter target frog species *Osteopilus marianae* (8.3%) (See Appendix 3). However, the **adaptive** goals are Jamaica's benchmark for success, and only 12 of 55 targets, or 22% meet the goals set.

B. ECOLOGICAL GAPS

Marine Gaps

The majority of the targets within the Northern and Southern MSUs that falls into existing protected areas are of sufficient replication and condition to maintain functionality of critical marine ecosystems and processes as well as meet or exceed the CBD protection goal. However, significant gaps are found in the Eastern MSU targets of which only two targets (Turtle nesting beaches and Sandy shores) meet the ten per cent protection goal within current protected areas and the other two represented targets (Corals and Coral Reefs, and Overwintering Shorebird Areas) have five per cent or less under protection. Apart from the Portland Bight Protected Area that is relatively large in size and encompasses a range of ecosystem and species-based targets and functions, the current protected areas system of Jamaica is not designed to accommodate seascape-scale connectivity, functions and processes critical to the overall health of marine environments. In this regard, the ecological and functional significance of Offshore Banks is in all likelihood being underestimated, as well as the importance of the Eastern occurrences of cays and Manatees that are not necessarily interchangeable with their counterparts in the North and South. For Jamaica's protected areas to be resilient in the long term, these gaps will need to be addressed through appropriate design of the protected area portfolio.

Freshwater Gaps

Of the 12 freshwater conservation targets under protection in existing protected areas, only six meet the ten per cent CBD conservation goal while the other six targets are insufficiently protected and are within a range of 0.5% to 7.3%. While the majority of Eastern headwaters are protected, a majority of downstream systems are not protected giving reason for concern over the long term. In the western part of the island, there appears to be more protection built around protecting water flow from the watershed, however, the high-altitude headwater streams themselves are not protected, and this also provides a reason for concern.

Terrestrial Gaps

⁵ As above

In many cases terrestrial ecological systems failed to meet their goal (12 of 55 targets, or 22%), or only small, isolated patches are protected, this therefore implies an inability to maintain functionality, lack of connectivity, and susceptibility to degradation. Importantly, little assessment has been made in Jamaica of the faunal targets identified by experts, yet these include, for example, ecological communities and species that serve to link habitat types or terrestrial and freshwater systems, and which represent ecological processes. Similarly, evaluations of spatial relationships of forest ecosystems are still required to ensure that migration processes are maintained, such as the seasonal movement of columbids (including game birds) between breeding habitats and coastal areas used during the non-breeding season.

Caves should be evaluated within the context of their terrestrial habitat matrix to determine the ecosystem services of the cave dwellers, such as bats.

C. MANAGEMENT GAPS

Identifying gaps or weaknesses in the management of Jamaica's protected areas required a three-fold assessment involving Management Objectives to determine if appropriate objectives are being used to design protected areas, Governance Models that evaluate whether the day-to-day management scheme used is appropriate to the objectives for which protected areas were designed as well as Management Effectiveness and Performance that determines how well the protected areas are meeting their objectives.

Management Objectives

Currently, Jamaica has over 19 protected area categories designed for a variety of management objectives that are enabled through different policies and administered by four government agencies within three ministries. Categories of "areas for protection" are not well defined in all cases and further complication arises due to inadequate linkages across the various agencies and ministries. These hinder effective management.

Governance Models

In Jamaica there are four management models in use, and these are recognised by the International Union for the Conservation of Nature (IUCN):

- 1) Government Management – protected areas are managed solely by national or local government authorities, e.g., forest reserves.
- 2) Co-Management or Collaborative Management – protected areas are managed in a participatory manner and in some cases management is relinquished to a non-governmental entity such as a community or non-governmental organization, e.g., National Park/forest reserve
- 3) Community Conserved Areas – voluntary conservation of community lands by indigenous or traditional communities, e.g., Maroon lands.
- 4) Private Protected Areas – protected areas that are managed by private individuals, companies or trusts, e.g., forest reserves and forest management areas.

Management Effectiveness and Performance

The effectiveness and performance of protected areas were evaluated at the system level by considering enabling environment processes, through the application of the World Wildlife Fund's rapid appraisal tool, Rapid Assessment and Prioritization of Protected Areas Management (RAPPAM) in 2006. To a limited degree site level assessments were done within the RAPPAM; but mainly focused on capacity needs identification.

The report outlining the abovementioned assessment, National Report on Management Effectiveness Assessment and Capacity Development Plan for Jamaica's System of Protected Areas (Hayman 2007), showed that:

“Management of protected areas has been mixed. Weak areas include ecological outputs, research and monitoring.... Critical management issues surround zoning and boundary demarcation in protected areas, surrounding land use, critical site level law enforcement, infrastructure, staff numbers and employment conditions, community outreach and conflict resolution.”

However the strengths at the site level were found to be community outreach and the implementation of participatory processes to involve stakeholder communities in planning and management.

Resource gaps are primarily financial in nature with protected areas having inadequate funding to support day-to-day operations as well as critical conservation functions such as threat abatement, ecosystem restoration, monitoring and research.

In addition, human resources are also a gap both in terms of technical skills and capacity as well as maintaining staff due to inadequate employment conditions among other human resource issues. Limited resources were also found to lead to a high level of multi-tasking where staff had to carry out the work of different positions. These gaps, acting together, have a limiting impact on the overall performance of protected areas to effectively conserve biodiversity.

System Level Effectiveness

System level effectiveness primarily involves policy-based factors that provide an enabling environment for protected areas to achieve the conservation goals and objectives for which they are designed. The most significant gaps were found in the following factors:

- 1) Insufficient funding for protected areas
- 2) Insufficient law enforcement
- 3) Need for a wider array of conservation mechanisms (i.e., conservation incentives for private landowners)
- 4) Unsustainable land use in some areas
- 5) Need for a comprehensive inventory of biodiversity

CLOSING JAMAICA'S PROTECTED AREA GAPS

The analyses described within this document identified gaps that need to be met in order to conserve biodiversity—species, communities and ecosystems—not only to meet Convention on Biological Diversity (CBD) commitments, but also to preserve ecosystem services that are critical to survival of the human population. In order to do this the comprehensive protected areas portfolio needs to be designed in a manner that meets conservation goals as well as addresses conservation gaps. This will require action on three fronts:

- developing a viable and resilient conservation area portfolio,
- enhancing an enabling protected area policy framework, and
- developing conservation capacity on-the-ground.

To draft a comprehensive portfolio for Jamaica, overlay analysis of the marine, terrestrial and freshwater realms (Maps 10.0, 11.0 and 12.0) was conducted to determine spatial overlaps and connectivity between them. They were then merged to show specific areas of convergence and those that are equally important as individual or stand-alone areas (Maps 13.0–15.0). The integrated analysis provided the basis for the proposed recommended system of protected areas, also called recommended conservation portfolio for Jamaica (Map 1.0).

Building on the inter-connections and inter-dependencies of ecological systems that enable them to function, the integrated portfolio is a network of protected areas that complement one another. This addresses the primary objective of the portfolio which is to identify the critical biological and ecological gaps of the current protected areas.

As an essential conduit between terrestrial and marine environments, freshwater systems are particularly important for maintaining the ecological health of all three. The complete portfolio therefore seeks to preserve the integrity of freshwater systems, including species, caves and riparian areas. Indeed, freshwater systems represent one of the most important factors to influence the country's economic future—they are the source of the island's water—and therefore, this portfolio is of utmost importance for conservation and financial consideration.

It can be seen from the targets listed in the analyses that this more comprehensive approach revealed that a number of biodiversity elements and ecological processes are not included in the present protected areas, thus the network in place is very limited. Building on the integrated portfolio, the final complementary network of protected areas was developed through further refinement using expert knowledge to ensure that critical gaps were addressed, conservation goals met, (Map 16, Tables 8-9), and a ridges-to-reef configuration achieved.

The portfolio map demonstrates the complementarity of the proposed conservation areas with existing protected areas. The addition of Martha Brae and Falmouth areas provides a connecting corridor from the upper mountains of Cockpit Country to the Northern Coast that, if effectively conserved, can ensure the functionality of ecosystems from freshwater headwaters to the marine environment. In the South, the same can be observed with the conservation of the upper reaches and marine drainage areas of the Black River. Equally important is the Rio Grande area abutting the Blue Mountains inland, as well as Anchovy, Long Bay and Manchioneal on the coast.

Recognising that the recommended additions to protected areas were fairly extensive and that resources would likely continue to be limited into the medium to long term, the ecological working group (EWG) conducted a prioritization exercise. Stakeholders were invited to join the EWG in the prioritization

exercise which had as its aim; to provide guidance to any entity or individual regarding the most important places to receive early actions and emphasis. The group agreed to use relative biodiversity importance (level of biodiversity present, rareness, endemism, ecosystem services), threat level and feasibility (including land ownership, ease of establishment and management of protected area status) as means to prioritize the sites; with biodiversity relevance being the most important ranking. The approximately 30 stakeholders, considered all 31 of the recommended sites and the resulting rankings were mapped (see Executive Summary). See Appendix 6 for the tables showing the results of the prioritization exercise.

Table 8: Overview of Proposed Add-ons to Existing Protected Areas

Area ID and Location Name	Description
Area 1 Negril Protected Area Add-on	Proposed add-on to Negril protected area. This area is of particular importance to fulfilling 44.4% of the conservation goal for lakes and ponds in the western ecological draining unit of Jamaica which harbours a West Indian whistling duck population (<i>Dendrocygna arborea</i>) that fulfills 20% of the conservation goal for this target.
Area 2 Montego Bay Marine Park Add-on	Proposed add-on to Montego Bay marine park. This area is a priority northern estuarine area that contributes 59.8% to the overall conservation goal. Its proximity to the Montego Bay protected area complements the capture of estuarine targets in Northern Jamaica.
Area 3 Cockpit Country Forest Reserve Add-on	Proposed add-on to Cockpit Country forest reserve. This area would extend the boundary of Cockpit Country to include critical bird areas and freshwater habitats. The area harbours 49% (27 of 55) of all terrestrial targets including seven forest types and a wide range of species-level targets. Of particular significance are its significant contributions to the conservation goals of key species as follows: 41.7% black-billed parrot, 22.7% limpkin, 30.1% ruddy quail dove, 21.4% yellow-billed parrot, 30.1% swallowtail butterfly as well as contributions ranging between 17% and 38% for various frog species. The area is equally important for freshwater systems encompassing between 24% and 28% conservation goals contributions for headwater, low-altitude and non-karstic streams, 52.4% for karstic streams and over 100% contribution for freshwater caves.
Area 4 Litchfield Matheson's Run Add-on	Proposed add-on to adjacent Forest Reserve. This area is a relatively small parcel of land that contributes 47.6% towards meeting the karstic freshwater cave conservation goal.
Area 5 Ocho Rios Protected Area Add-on	Proposed add-on to Ocho Rios protected area. This area is a relatively small patch that fulfills small percentages of the conservation goals for mesic alluvium forest (0.9%), mesic limestone forest (5.4%), mesic shale forest (1.1%) and caves (3.1%). Due to the low occurrence of these targets available for conservation, these contributions, in aggregate with those elsewhere, become necessary to achieve the overall goals for these targets. This area also harbours freshwater targets such as karstic streams (20%), coastal spring and streams (21.4%) and karstic springs (21.4%). However, the contributions made from this area for these targets are more efficiently met elsewhere and, therefore, are not a high priority for meeting freshwater conservation goals.
Area 6 Ocho Rios Protected Area Add-on 2	Proposed add-on to Ocho Rios protected area. This area covers the length of the Rio Nuevo from its headwaters to its drainage area in the Ocho Rios protected area. The area is significant for its 23% contribution towards fulfilling the conservation goal for large low-altitude streams target as well as its ecological functionality in maintaining the overall environmental quality of the Ocho Rios area.
BJCMNP Add-ons: Area 7 E St. Thomas Area 8 W. St. Thomas Area 9 Rio Grande	Proposed add-ons to Blue and John Crow Mountains National Park. The proposed add-ons to the Blue and John Crow Mountains National Park part are divided into three parts. The proposed area located to the south of BJCMNP (area 7) contributes a small but nevertheless essential percentage of occurrences necessary to meet overall conservation goals for wet alluvium forest (0.6%), wet shale forest (4.5%), hutia (<i>Geocapromys brownii</i>) (2.4%) and a frog species (<i>Eleutherodactylus jamaicensis</i>) (4.2%). Area 8 proposed for addition in the west of BJCMNP is critical as it contains the only large tranche of wet serpentine forest in the country, which contributes 70.8% towards the overall conservation goal. Moreover, it contains the only remaining population of a frog species (<i>Eleutherodactylus orcutti</i>) making the only contribution (28.6%) towards meeting the goal for this target.
BJCMNP Add-ons Areas 7–9	To the north, Area 9 contains the headwaters and length of the Rio Grande. This area is important as it displays significant occurrences of a variety of freshwater habitat targets that make a critical contribution towards meeting conservation goals. These targets are high altitude headwater streams (11.6%), medium-sized streams (38.8%) and large low altitude streams (78.5%). This area also makes a 20% contribution towards meeting the conservation goal for <i>P. terrapen</i> and a 6.6% contribution that is necessary to meet the overall wet alluvium forest goal.
Area 10 Portland Bight Protected Area Add-on	Proposed add-on to Portland Bight protected area. This coastal area lies to the east of the Portland Bight protected area. For the southern coast of Jamaica it contributes 46.2% towards the goal for soft bottom communities, 10.5% of manatee sightings, and 33.8% towards the rocky shore target.

Table 9: Overview of Proposed Protected Areas

Area ID and Location Name	Description
Area 11 Black River Complex	This area, referred to here as the Black River complex, is primarily a riverine ecosystem that is designed to encompass the river itself, supporting terrestrial habitats as well as coastal and marine habitats. Significant terrestrial contributions include dry limestone forest (2.9%), mesic alluvium forest (14.9%) and wet alluvium forest (3.3%) that, in conjunction with other areas, are necessary to meet the overall conservation goals for these targets. The riverine system contributes over 65% towards meeting the conservation goal for wetlands, 234% for freshwater wetlands, 98.6% for lakes and ponds in the Western-Central EDU and contributes over 15% for mangroves that have low occurrences in Jamaica. The area makes equally important contributions to meeting goals for the following fish species targets, 50% <i>Cubanichthys pengellyi</i> , 100% <i>Gambusia melalepura</i> and 116.7% <i>Limia melanogaster</i> . The area also makes significant contributions towards the goals for the West Indian whistling duck (23.5%) and Northern Waterthrush (38.3%) targets. The coastal portion of Black River harbours critical marine habitats including the largest rocky shore area (103.7%), and sandy shore area (101.5%) in Southern Jamaica as well as coastal mangroves (29.7%). The coastal area is of particular importance due to the significant occurrences of critical habitats for various species specific to Southern Jamaica including karstic freshwater caves (33.3%), very dry alluvium forest (14.9%), seagrass areas (39%), overwintering shorebird areas (81.2%), turtle nesting beaches (27.2%) and seabird nesting and roosting areas (141%). It is also an area in which 21.1% of manatee sightings have occurred in the south of the island.
Area 12 North Coast Forest	This area adjoins the northern portion of Cockpit Country and extends to the coast. The contributions of the area to meeting terrestrial goals are 15.7% dry alluvium forest, 30.0% dry limestone forest, 0.9% mesic alluvium forest, 2.7% mesic limestone forest, 32% guano caves, 4.2% <i>Eleutherodactylus jamaicensis</i> (frog species) and 22.7% limpkin. The contributions of the area to meeting freshwater goals are 29.7% large low-altitude streams, 81.1% karstic streams, 74.9% coastal springs and streams, 80% of <i>Pseudemys terrapen</i> (turtle) occurrences, 45.3% of karstic springs, 28.6% of karstic freshwater caves and 26.3% of lakes and ponds in the Western draining unit of Jamaica. For the Northern coast of the country, the area contributes the following to meeting conservation goals, 40.5% sandy shore target, 85.5% mangroves, 111% estuarine areas, 62.5% seagrass beds, 46.1% coral and coral reef targets, 66.3% overwintering shorebird areas, 18.2% turtle nesting beaches, 36.7% of soft bottom communities and 28.6% of manatee sighting in northern Jamaica.
Area 13 Buff Bay	This area adjoins the Blue and John Crow Mountains protected area to the north and the Rio Grande to the west. This area is significant for terrestrial conservation as it is the only large expanse of very wet alluvium forest left, contributing 111% towards the conservation goal for this target. Other contributions include 8.7% very wet shale forest, 11.1% wet alluvium forest, 7.9% wet limestone forest, 2.9% wet shale forest and 3.1% bat caves without which the total goals cannot be met. This area's contributions towards meeting freshwater goals are 60.1% of medium-sized streams, 94.3% of coastal springs and streams, 20% of <i>P. terrapin</i> population and 36.4% of springs. The coastal and marine portion of the area contributes the following towards meeting marine conservation goals for Northern Jamaica, 80.6% sandy shore, 12.2% for coral and coral reefs, and 51.7% for turtle nesting beaches.
Area 14 Driver's River	This area adjoins Blue and John Crow Mountains protected area to the northeast and harbours large aggregates of important terrestrial, freshwater and marine conservation targets that are critical to meeting conservation goals. For terrestrial goals, this area contributes the following, 17.5% very wet limestone forest, 3.7% wet alluvium forest, 13.4% wet limestone forest, 8% guano caves, 4.2% <i>Eleutherodactylus jamaicensis</i> (frog species) and 28.6% <i>Eleutherodactylus pentasyringos</i> (frog species). The area's contribution to freshwater goals are mainly 33.1% medium-sized streams, 87% coastal springs and streams, 54.4% springs and 120% freshwater caves. For marine goals, the area contributes the following for North and Eastern Jamaica, 204.6% rocky shore, 80.6% of Northern rocky shore, 31.7% sandy shore, 28.9% seagrass beds, 25.8% coral and coral reef, 19.6% turtle nesting beaches, 118.5% seabird nesting and roosting areas as well as 116.1% of Northern seabird nesting and roosting areas, and 57.1% of Northern Jamaica manatee sightings.
Area 15 St. Thomas Wetlands	This coastal area is in the Eastern most tip of Jamaica and represents an area important to meeting mangrove goals as part of terrestrial and marine priorities. This area contains the largest expanse of mangroves that meet 186.5% of mangrove conservation goals for Eastern Jamaica. Moreover, it also harbours large intact tranches of the following targets that contribute significantly to meeting their conservation goals for Eastern Jamaica, sandy shore (191.2%), estuarine areas (440.5%), seagrass beds (292.6%), overwintering shorebird areas (247.5%), turtle nesting beaches (71.1%), soft bottom communities (500%) and manatee sightings (60%).
Area 16 Spinal Forest	This large area extends to the East of Cockpit Country through the spine of Jamaica and is important for both terrestrial and freshwater conservation. In addition to forest targets, this area contains comparatively large populations of frog species that are likely associated with specific freshwater habitats. Of particular significance to meeting terrestrial conservation goals are the occurrence of the following targets, 6.2% mesic alluvium forest, 2.7% mesic limestone forest, 12.6% mesic shale forest,

Area ID and Location Name	Description
	0.9% wet alluvium forest, 3.1% wet shale forest, 1.6% hutia (<i>geocapromys brownii</i>) and the following frog species, 12.9% <i>Eleutherodactylus garbhami</i> , 66.6% <i>Eleutherodactylus junori</i> , 8.9% <i>Osteopilus crucialis</i> and 22.2% of <i>Osteopilus marianae</i> which is under-represented in the protected areas system. To freshwater conservation goals, this area contributes the following, 209.5% and the only large expanse of small high altitude headwater non-karstic streams, 103.2% medium-sized non-karstic streams, 20% of <i>G. wrayi</i> (fish species), 114.3% karstic springs and 66.7% freshwater caves.
Area 17 Dolphin Head	This area is East of the Negril protected area and is important for terrestrial conservation. This area makes important contributions towards meeting forest habitat goals as well as species based goals. The main habitat contributions of this area are 13.4% wet alluvium forest, 4.7% wet shale forest, 3.2% mesic shale forest and 0.4% mesic alluvium forest and 8% guano caves. Species based contributions are 7% black-throated blue warbler and various frog species, namely 23.3% <i>Eleutherodactylus cundalli</i> , 66.7% <i>Eleutherodactylus fuscus</i> , 8.6% <i>Eleutherodactylus grabhami</i> , and 4.2% <i>Eleutherodactylus jamaicensis</i> .
Area 18 East Dolphin Head	This area is East of Area 2 and west of Montego Bay. While this area comparatively does not contain many targets, the few occurrences do contribute to completing conservation goals as follows, 1.8% mesic limestone forest, 9.8% wet alluvium forest, 1.6% hutia (<i>Geocapromys brownii</i>), 4.2% <i>Eleutherodactylus jamaicensis</i> (frog species) and 8.9% <i>Osteopilus crucialis</i> (frog species).
Area 19 SE Montego Bay	This area is inland and South of the Montego Bay area. Similar to Area 3, it contains few targets but does, in conjunction with other areas, help complete conservation goals for the following, mesic alluvium forest (2.2%), mesic limestone forest (2.8%), wet alluvium forest (2.8%), and wet shale forest (0.2%).
Area 20 Success St. James	This area is important for terrestrial ecosystem conservation without which conservation goals for specific targets cannot be met. This area contributes the following towards meeting conservation goals, 4.9% dry limestone forest, 2.8% mesic shale forest, 14.4% very dry alluvium forest, 10.3% very dry limestone forest and 8% guano caves. Although this area also contains significant freshwater targets such as coastal springs and streams and karstic streams, the goals for these targets are better met elsewhere and so it is not a high priority for freshwater conservation.
Area 21 St. James Coast	This is a coastal area east of Montego Bay. This area contributes the following to conservation goals for targets in Northern Jamaica, 39.9% sandy shore, 30% seagrass beds, 25.3% coral and coral reef, and 24.5% turtle nesting beaches.
Area 22 Bluefield Whitehouse	This coastal area is located to the West of the Black River complex and is important for meeting specific terrestrial goals as follows, 11.8% dry alluvium forest, 5% mesic alluvium forest, 4.9% mesic limestone forest, 5% wet alluvium forest, 1.8% wetlands, 9.3% <i>Eleutherodactylus cundalli</i> (frog species), 9.5% <i>Eleutherodactylus luteolus</i> (frog species), and 8.9% <i>Osteopilus crucialis</i> (frog species).
Area 23 Middle Buxton	This area in north central Jamaica contains six terrestrial targets but significantly contributes to meeting the conservation goal of only one target, mesic limestone forest (3.6%).
Area 24 Moneague	This area is a very small but important patch of land East of Rio Nuevo that contributes to completing conservation goals for karstic freshwater caves (9.5%) and 23.2% of lakes and ponds within the Western-Central ecological drainage unit.
Area 25 Tetford Mountain/Tydxton Park = large Bannister/Resource = small	This area along the spine of central Jamaica harbours 11 targets of which six are at the species level. This area contributes the following to meeting terrestrial habitat conservation goals, 4.8% dry limestone forest, 10.8% mesic alluvium forest, 11.5% mesic limestone forest, 8.3% wet alluvium forest, and 0.3% wet shale. This area is more significant due to the high contribution to species conservation goals as follows, 31.7% hutia (<i>Geocapromys brownii</i>), 50% bats (<i>Phyllonycteris aphylla</i>), 18.6% frog species (<i>Eleutherodactylus cundalli</i>), and 33.3% for another frog species (<i>Osteopilus marianae</i>).
Area 26 Canoe Valley/ Lovers Leap	This coastal forest area extends East of the Black River complex and is important for meeting forest habitat goals. More specifically, this area contributes the following towards conservation goals, 4.2% dry alluvium forest, 9.1% dry limestone forest, 21.4% dry shale forest, 16.4% very dry alluvium forest, and 13.4% very dry limestone forest. Although this area has not been identified specifically as a priority for freshwater conservation, it is important to note that it is the only area in which a fish species (<i>Gambusia melapleura</i>) is found to occur and meets 100% of its conservation goal. It is also an area of the highest occurrence and, therefore, contribution of another fish species (<i>Limia melanogaster</i>) that meets 33.4% of the overall goal. Other contributions to freshwater goals include 49% karstic streams, and 20% of <i>Gambusia wrayi</i> (fish species).
Area 27 Breadnut Bottom	This inland area is North of the Portland Bight protected area. Although the area contains low level occurrences of targets, they are necessary to complete their respective conservation goals. The

Area ID and Location Name	Description
	contribution of this area to goals is as follows, 9.8% dry limestone forest, 7.9% dry shale forest, 3.9% mesic alluvium forest, 1.5% mesic shale forest, and 42.2% very wet alluvium forest.
Area 28 Sligoville – Robin's Bay	This area is a large expanse of forest that extends from South-Central Jamaica to the Northern coast just west of the Blue and John Crow Mountains. This area is significant mostly for its relatively large patches of different forest types. The contribution of this area to conservation goals is as follows, 42% mesic shale forest, 17.2% mesic alluvium forest, 15.8% dry limestone forest, 12.9% mesic limestone forest and 9% wet shale forest. The area also contributes 7.8% towards the hutia (<i>Geocapromys brownii</i>) target goal, 3.5% towards the black-throated blue warbler target goal and 7.2% towards the Ruddy quail dove target goal. This area also makes some contributions to freshwater targets such as medium-sized streams (73.2%), karstic streams (87.1%) as well as medium-sized non-karstic streams (65.4%), although these goals are met elsewhere in freshwater priority areas.
Area 29 Pedro Bank and Cays	This area is referred to as Pedro Bank and Cays. The primary targets of concern are mostly marine although the cays itself are terrestrial and serve as important bird areas. The offshore bank contributes 16.7% towards meeting the conservation goal for this target while the cays contribute 333.3% towards the overall goal. As critical habitat for bird and turtle species, this area contributes the following towards conservation goals, 191.1% Pedro Bank seabird nesting and roosting areas, 200% Pedro Bank turtle nesting areas and 333.3% Pedro Bank overwintering shorebird areas. This area also contributes 125.7% for Pedro Bank coral and coral reefs as well as 110.6% for Pedro Bank seagrass beds.
Area 30 Yallahs	This area is to the West of Yallahs River and is important primarily for completing forest target conservation goals. Its outstanding features include relatively high contribution to the conservation goals of the following targets, dry shale forest (50.8%), mesic shale forest (16.3%) and bat caves (21.1%). Other contributions that are necessary for completing conservation goals include 2.6% dry alluvium forest, 2.5% dry limestone forest, 2.9% mesic alluvium forest, 3.1% very dry limestone forest, 3.3% very dry shale forest, and 0.8% wet shale forest. Although not a freshwater priority area due to high levels of degradation, this area contributes the following towards meeting conservation goals, 65.6% high altitude headwaters streams, 58.8% medium-sized streams and 54.5% streams.
Area 31 East Yallahs	This area is to the East of Yallahs River and, similar to Area 13, is important for completing forest conservation goals. The contributions of this area towards meeting goals are the following, 11.3% mesic alluvium forest, 9.9% mesic shale forest, 5.2% mesic limestone forest, 5.2% dry alluvium forest, 3.1% dry limestone forest, 2.6% wet shale forest, 0.7% wet alluvium forest, 0.7% dry shale forest, and 7% towards the Black-throated blue warbler goal. This area is not a freshwater priority primarily due to high levels of degradation, however, the following targets occur within the area, medium-sized streams (71.7%), springs (27.3%), and the fish species <i>Limia melanogaster</i> (33.3%), and <i>Cubanichthys pengellyi</i> (25%).

RECOMMENDATIONS

Following the various analyses and the resultant proposed comprehensive protected area portfolio for Jamaica, below are recommendations for addressing Jamaica's ecological gaps from the portfolio, in terms of suggestions for building a system and the commensurate capacity, and amending policy.

I. Recommended Strategies for Jamaica's Protected Areas System

- 1) Implement the proposed protected area portfolio to fill critical ecological gaps as well as meet Convention on Biological Diversity (CBD) goals in a phased manner starting with the highest priority areas where feasibility is high and the probability of success is equally high.
 - i) It is recommended that a detailed national implementation plan be drafted. This would outline the process for establishing and operationalising each of the proposed protected areas into a functional protected area.
- 2) Characterise each protected area in terms of biological, socio-economic, and cultural values, elucidate and prioritize the conservation actions required and identify the types of activities that may be permitted.
- 3) Harmonise Jamaica's protected area management categories, cross referencing with the International Union for the Conservation of Nature (IUCN) categories where applicable, and standardise their application at the national scale (see Table 10 for suggested alignment of IUCN and Jamaican nomenclature).
- 4) Develop and maintain a protected areas system database.
- 5) Site specific recommendations for highest biodiversity priority areas:
 - i) Black River – Establish a protected area and thereby improve the protection status of Black River from a Game Reserve and Ramsar Site to be able to capture terrestrial, freshwater and marine ecosystems critical to the overall health and functionality of the river as well as its riparian and estuarine areas.
 - ii) Portland Bight & Negril – Their respective management objectives should include special management attention to mitigate freshwater-specific threats and other potential upstream issues as well as integrated management of marine, terrestrial and freshwater targets.
 - iii) Cockpit Country & Blue and John Crow Mountains – Adopt management measures for freshwater systems in addition to species which could include such actions as regulations for maintenance of river buffer zones, and other terrestrial ecological system-based conservation strategies that support and maintain the watershed (Box 1 is a product of the May 20, 2008 workshop, after which a priority workshop was held).

Table 10: Consolidated Protected Area Classification System

International (IUCN) Management Categories	Subsumed Jamaica Protected Area Categories
Category I Strict Nature Reserve/Wilderness Area IA Strict Nature Reserve	1. Forest Reserve (strict conservation)
IB Wilderness Area	--
Category II National Park	1. National Park (recreational focus) 2. Marine Park (limited use) 3. Forest Reserve (recreational focus)
Category III Natural Monument	1. Tree Preservation Area 2. Protected National Monument 3. Protected National Heritage 4. Protected Cultural and Historical Assets (proposed)
Category IV Habitat/Species Management Area	1. Tree Preservation Area 2. Protected National Monument 3. Protected National Heritage 4. Protected Cultural and Historical Assets (proposed) 5. Forest Reserve (restoration) 6. Protected Area 7. Fish Sanctuary
Category V Protected Landscape or Seascape	1. Forest Management Area (proposed)
Category VI Managed Resource Protected Area	1. National Park (traditional/sustainable use of resources) 2. Marine Park/Marine Protected Area (fishing use) 3. Environmental Protection Area (only for Negril) 4. Morant and Pedro Cays 5. Forest Management Area (proposed)

Box 1**RECOMMENDED PRIORITY AREAS**

The following recommendations are intended to serve only as a guide for prioritizing areas within the integrated portfolio based on purely biological features described in Map 13.0. These recommendations represent areas of high target occurrence and high contribution towards meeting conservation goals as primary considerations for optimizing conservation investments. They are not in any particular order and do not consider other, non-biological factors that are equally important to conservation feasibility and efficiency.

Black River Complex – This area is of great importance as it not only harbours a wide range of targets that are critical to marine, terrestrial and freshwater ecosystems, the targets are also highly concentrated in the area providing a unique opportunity to capture representativeness in relatively large amounts or occurrences. Because it is a priority for all three realms, this area also represents the potential to conserve not just the targets themselves but the supporting habitats they need to complete vulnerable and critical stages of their lifecycle. Moreover, there is no other area that provides the opportunity to conserve relatively large quantities of targets such as wetlands and mangroves that are naturally scarce in Jamaica.

Cockpit Country Add-on/Spinal Forest – This highly diverse and relatively intact area is an important complement to Cockpit Country. With a wide range of species and habitat occurrences, the area is important for species connectivity (particularly birds) as well as freshwater connectivity from headwaters to coast. In terms of meeting conservation goals, the target occurrences are significant contributions to completion of goals, specifically for wide ranging targets.

Rio Grande (BJCMNP add-on) – In addition to being a repository of freshwater targets, the Rio Grande is an important functional linkage between the Blue and John Crow Mountains and the North-eastern coast of Jamaica. Equally important, however, is that the Rio Grande is the only major river system in Eastern Jamaica which makes it a high priority and unique opportunity for conservation.

Driver's River – This area is particularly significant to conserving important targets for marine, terrestrial and freshwater ecosystems that are under-represented elsewhere. It is also an important complement to both the Blue and John Crow Mountains and Rio Grande.

St. Thomas Wetlands – Similar to Area 14, this area harbours concentrated occurrences of under-represented marine targets, bird habitat and critical nesting areas that make it specifically imperative for the longevity of species targets but also of economically important marine resources.

North Coast Forest – This area is a triple priority area that presents an opportunity to implement a “ridges-to-reef” conservation approach aimed at addressing connectivity gaps from the headwaters of Cockpit Country to the Northern coast of Jamaica.

Pedro Bank and Cays – Pedro Bank not only harbours unique marine and terrestrial features that are under-represented but it is also an important area for marine resources.

II. Recommended Strategies for Enabling Jamaica's Protected Areas Policy

- 1) Revise the current Protected Areas Policy based on clear agreements regarding ministerial and government departmental roles, responsibilities and authorities with regard to the coordination, management, monitoring and enforcement of Jamaica's protected areas system.
- 2) Revise relevant legislation to incorporate the protected areas portfolio and protected areas system.
- 3) Mainstream protected areas into decision-making processes at all levels of governance including Parish Councils, and national development projects and proposals.
- 4) Develop additional legal mechanisms to promote and facilitate conservation on private lands (see Box 2 on Potential Conservation Mechanisms).
- 5) Standardise monitoring, evaluation, and reporting protocols across the Protected Areas System to enable comparative analyses and adaptive management at the site and national scales.
- 6) Determine and implement sustainable finance mechanisms to support core aspects of protected areas policy.
- 7) Facilitate and develop partnerships to further advance implementation of the National Ecological Gap Assessment Report (NEGAR) and other aspects of the Protected Areas System Master Plan (PASMP).

Box 2**POTENTIAL CONSERVATION MECHANISMS**

Described below are conservation mechanisms that could be used in Jamaica to implement its protected areas system. The appropriateness of these mechanisms is largely dependent on the tenure status of the area for conservation consideration. It is likely that a combination of these mechanisms is necessary to achieve Jamaica's conservation goals.

Public Lands – As a traditional mechanism, the government can place any areas that are government owned under conservation status through legal acts and edicts. Public lands protected areas are customarily managed by government departments although private entities or non-governmental organisations (NGOs) may also assume administration of protected areas through co-management agreements.

Conservation Easements – This mechanism involves the voluntary agreement by private landowners to surrender or limit user rights on their land to achieve specific conservation goals. Landowners may either sell or donate their land and corresponding user rights to a government or NGO-managing party for conservation purposes. In other cases, the easement may allow continued management by the landowner but with specific limitations on how designated lands are to be used, if at all. The key to the success of this conservation tool is that easements are legally binding, long term (i.e., in perpetuity) and transferable with changing ownership. In this regard, government support is necessary to enable the legal precedence for easements to be recognised by law.

Private Lands Conservation – Similar to conservation easements, landowners agree to achieve specific conservation goals by limiting uses or preventing development on ecologically valuable and sensitive parts of their land. In some examples, management of the land remains under the landowner and lands are developed albeit for low-impact uses such as tourism. However, these agreements may not necessarily be legally binding and are heavily reliant on the goodwill of landowners to engage in conservation over the long term. In this regard, this conservation tool may be limited unless it is made legally binding.

Conservation Set-Asides – As a condition for any kind of development, high conservation value areas such as those in the integrated portfolio can be left intact to achieve specific conservation goals. Set-asides can be found in the logging industry, for example, where environmentally sensitive or ecologically important areas are exempt from any timber activities. This tool is effective in conjunction with economic or other incentives or product certification schemes that reward developers for their conservation efforts.

Integrated Conservation and Economic Development – Ecological conservation can be integrated into development plans as specific conditions for industry. Ecotourism, for example, requires operations to be environmentally and socially sustainable. The same is true with timber certification schemes that mandate sustainability of timber resources as well as minimal environmental impacts as a condition for certification. In this regard, government support and promotion of such industry conditions can forward conservation efforts.

Conservation Incentives – Providing incentives for conservation is often a strong tool for achieving conservation goals. Government actions can include tax incentives, compensatory mechanisms and other economic-based incentives for private landowners, developers and private sector businesses to proactively participate in conservation efforts. Provision of conservation incentives is supported by market information from some industries such as tourism and timber that show a growing demand for products produced in an environmentally responsible manner.

III. Recommended Strategies for Protected Areas Conservation Capacity

- 1) Strengthen and improve the capacity of relevant government environmental agencies to regulate, monitor and report on the ecological and socio-economic condition of protected areas.
- 2) Strengthen the Environmental Impact Assessment process particularly in relation to developments within, surrounding and otherwise impacting on protected areas and other ecologically sensitive areas, with special attention given to mitigation actions and monitoring of sites
- 3) Develop technical capacity-building measures for protected area managers to enable field-related staff to carry out key conservation actions such as ecosystem to species level monitoring, basic research, ecosystem restoration and maintenance, as well as species-related strategies such as population rehabilitation.
- 4) Establish mechanisms for capacity-building such as a Conservation Mentorship programme and ongoing community-based conservation to supplement training and workshops for the transfer of knowledge and building of skills.
- 5) Build technical and management capacity within protected areas through a pooled expert base.

IV. Recommended Key Research Areas

As research is critical for the support of the recommendations made above, a detailed research agenda is recommended in Appendix 7. Institutions and individuals interested in pursuing biodiversity research would be encouraged to use this list as a guide to national priority research areas.

- 1) **Marine, freshwater and terrestrial ecosystem connectivity in protected areas** – In order to effectively conserve “ridge-to-reef” protected areas, it is critical to comprehend how ecological connectivity can be incorporated into conservation strategies such as zoning and restoration.
- 2) **Status of critical resource stocks in protected areas** – This includes improving the knowledge base on critical resource populations such as fish and shellfish, birds, and plants such as palms and withes (“wiss”) that are targeted for national and international consumer markets and the role of protected area management strategies in the long-term sustainability of these resources.
- 3) **Ecological needs of biodiversity resources** – In addition to direct measures of population, harvested resources can also be better conserved by understanding key events in their lifecycle that may make them more vulnerable. These include pollination/fertilization, breeding/spawning seasons, formation of spawning aggregations, dispersal, population numbers, and seasonal migrations.
- 4) **Economic and monetary value of ecological services provided by ecosystems** – Methodologies for assigning economic or monetary values for ecosystem services are becoming more necessary particularly when faced with economically motivated threats. Methods for determining the value of ecosystem services are becoming more available and should be incorporated into protected area technical programmes.
- 5) **Research on plant families** – Few fine-filter targets for flora were identified therefore, further studies need to be undertaken. Additionally local knowledge and unpublished information should be incorporated into the research.
- 6) **Restoration strategies for critical habitats** – Given the large extent to which many ecosystems have been degraded, restoration strategies should be devised for critical habitats incorporating cost benefit and ecological considerations
- 7) **Red List** – Compile a Red List of Jamaica's species using IUCN categories.

GLOSSARY

Biodiversity or Biological Diversity: the variety and variability of biological organisms – genes, species, communities and ecosystems.

Coarse-Filter target – See **Targets –Coarse-filter**

Conservation Targets: specific biological features that are representative of Jamaica’s biodiversity

Conservation Gaps: See **Gaps – Conservation**

Cost Surface Modelling: maps the impact of human activities on an area, commonly described as the human footprint. Described in more technical terms, the cost surface involves the use of spatial data to quantify the intensity of human activities acting on biodiversity

Ecology: the study of the interactions of organisms with their environment and with each other.

Ecological Drainage Units: are groups of watersheds that share a common zoogeographic history, physiography and climate. EDUs contain aquatic systems with similar patterns of drainage density, gradient, hydrologic characteristics, and connectivity.

Ecological Gaps: See **Gaps - Ecological**

Ecoregion (Ecological Region): an ecologically and geographically defined area. Ecoregions cover relatively large areas of land or water, and contain characteristic, geographically distinct assemblages of natural communities and species. The biodiversity of flora, fauna and ecosystems that characterise an ecoregion tends to be distinct from that of other ecoregions.

Ecoregional Planning: a methodology that is a systematic, science-based approach to conservation, analysing current levels of biodiversity in major terrestrial, freshwater, coastal and marine environments.

Fine-Filter Targets – See **Targets – Fine-filter**

Focal Species: small number of species whose distributions and abundances are well known; used in conservation planning; and assumed to reflect the distribution and abundance of the regional biota.

Gaps - Conservation - specific areas and targets that fall outside of the nation’s current protected areas (page 2)

- Ecological - biodiversity representation within protected areas that are of insufficient quality to ensure their functionality and, therefore, their long-term survival

- Management - ineffective management regimes governing protected areas that perpetuate their vulnerability to further degradation

- Representation - species, ecosystems or habitats that are not included within present protected areas, or do not occur in sufficient quantities to ensure long-term viability

Gap Analysis: Gap analysis is a scientific method for identifying the degree to which native animal species and natural communities and habitats are represented in our existing mix of conservation lands and waters, also called protected areas. Those species and communities not adequately represented in the existing protected areas constitute conservation “gaps.”

Goals - Conservation – value of the current occurrences of targets defined in terms of percentage (page 14)

- Adaptive – higher value conservation goal for each target established by local experts to ensure that the number, size or extent of each target conserved is sufficient to maintain long-term ecological functionality (page vi; 14)

- Integrated protected area portfolio - a complementary suite of areas from each habitat realm which act in conjunction with one another to render a functional, mutually reinforcing network of protected areas designed to maintain the island’s critical ecosystems (page vii)

Integrated Ecological Gap Assessment: Ecological gap assessments done in the 3 realms – terrestrial, marine and freshwater – are integrated into one assessment.

Management Gaps: See **Gaps – Management**

Overlay Analysis: Technique of deriving new information from two or more layers of data covering the same area.

Precautionary principle: Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation. (Rio Declaration)

Representation Gaps: See **Gaps – Representation**

Targets:

- course filter – include broad characteristic examples of ecological communities and ecosystems.
- fine filter – encompass rare and endangered or wide-ranging species and ecosystem assemblages not adequately represented at the scale of coarse-filter targets.

Terrestrial Gaps: Those species, communities and habitats not adequately represented in the existing terrestrial protected areas.

Threat: the combination of stresses or negative impacts that directly or indirectly affect the viability of targets, and the human activities that are sources of these stresses.

REFERENCES

Brown, Charlie, and Scott Edwards. 2004. 'Situation Analysis of Jamaica's Protected Areas System Plan'. Washington DC: Center for Park Management.

Dudley, N., and J. Parish. 2006. *Closing the Gap. Creating Ecologically Representative Protected Area Systems: A Guide to Conducting the Gap Assessments of Protected Area Systems for the Convention on Biological Diversity*. Montreal: Secretariat of the Convention on Biological Diversity, Technical Series no. 24: vi + 108 pages.

Groves, C., L. Valutis, D. Vosick, B. Neely, K. Wheaton, J. Touval and B. Runnels. 2000. *Designing a Geography of Hope: A Practitioner's Handbook for Ecoregional Conservation Planning*. Arlington, VA: The Nature Conservancy. Available online: www.conserveonline.org

Groves, C. R., and contributors. 2003. *Drafting a Conservation Blueprint: a Practitioner's Guide to Regional Planning for Biodiversity*. Washington, DC: Island Press.

Hayman, A. 2007. 'National Report on Management Effectiveness Assessment and Capacity Development Plan for Jamaica's System of Protected Areas'. Submitted to Capacity Development Working Group, Kingston, Jamaica. January 2007. 110 pp.

John, Kimberly. 2006. 'Jamaica Ecoregional Planning Project: Jamaica Freshwater Assessment. Draft Report'. Kingston, Jamaica: The Nature Conservancy Jamaica Programme.

McPherson, Matthew, S. Schill, G. Raber, K. John, N. Zenny, A. Sutton, K. Thurlow. 2008. 'GIS-Based Modeling of Environmental Risk Surfaces for Conservation Planning in Jamaica'. *Journal of Conservation Planning*, 4:60–89.

Mittermeier, Russell A., et al. 2005. *Hotspots Revisited: Earth's Biologically Richest and Most Endangered Terrestrial Ecoregions*. University of Chicago Press for Conservation International.

Myers, Norman, et al. 2000. 'Biodiversity Hotspots for Conservation Priorities'. *Nature* 403:853–58.

Rodrigues, A.S.L., et al. 2003. 'Global Gap Analysis: Towards a Representative Network of Protected Areas'. In *Advances in Applied Biodiversity Science*. Washington DC: Conservation International.

Schipper, Jan, et al. 2008. 'The Status of the World's Land and Marine Mammals: Diversity, Threat, and Knowledge'. *Science*, vol. 322, no. 5899 (October 10):225–30.

Yugorsky, Patrick, and A. Sutton. 2004. 'Jamaica's Protected Area System Plan Biodiversity Report. Working Paper 1: Categorization of Protected Areas in Jamaica. First Draft'. Prepared for the National Environment and Planning Agency, and National Environmental Societies Trust. November 3.

Additional works

The following documents were reviewed for and are relevant to the gap assessment process

Caribbean Coastal Area Management Foundation. 1999. 'Caribbean Coastal Area Management Foundation (CCAM) Management Plan for the "Portland Bight Protected Area" 1999–2004'. CCAM Publication No. 1. Presented to the Natural Resources Conservation Authority. Kingston, Jamaica. May.

Draft Fisheries Act, July 2006.

International Union for the Conservation of Nature. 2002. 'The IUCN Protected Area Management Categories'. Information Sheet No. 3. Cardiff University and IUCN. Access online: www.cardiff.ac.uk/cplan/sacl

Jamaica Conservation and Development Trust. 2005. 'Blue and John Crow Mountains Management Plan: 2005–2010'. Kingston, Jamaica. December.

———. 1992. 'A Plan for a System of Protected Areas in Jamaica'. Presented to the Natural Resources Conservation Authority. Kingston, Jamaica. 60 pp.

Forestry Department. 2000. 'National Forest Management and Conservation Plan'. Kingston, Jamaica: Forestry Department.

Government of Jamaica. 1997. 'Policy for the National System of Protected Areas: A White Paper'. Government of Jamaica. November. 43 pp.

Jamaica Vision 2025: A Framework for Sustainable National Development.

John, K., A. Sutton and N. Zenny. 2006. 'Jamaica Ecoregional Plan Summary: Essential areas and strategies for conserving Jamaica's biodiversity'. Kingston, Jamaica: The Nature Conservancy Jamaica Programme. August.

John, Kimberly. 2006. 'Jamaica Ecoregional Plan: Technical Summary of the Freshwater Analysis. Essential areas and strategies for conserving Jamaica's freshwater biodiversity'. Kingston, Jamaica: The Nature Conservancy Jamaica Programme. June.

McCalla, Winston. 2004. 'Protected Areas System Plan, Legal Framework: Final Report'. Unpublished technical report.

Morant and Pedro Cays Act, 1907 found at: www.moj.gov.jm

National Environment and Planning Agency. 2003. 'National Strategy and Action Plan on Biological Diversity in Jamaica'. Kingston, Jamaica: National Environment and Planning Agency (MLE/NEPA).

Negril Area Environmental Protection Trust. 2005. 'Negril & Green Island Area Environmental Protection Plan, 1995'. Natural Resources Conservation Authority, August. 117 pp.

Sutton, Ann, and Daniel Dorfman. 2007. 'Jamaica: A Terrestrial Eco-regional Assessment . Final Draft'. Kingston, Jamaica: The Nature Conservancy, March. 67 pp.

Sutton, Ann. 2007. 'Jamaica Terrestrial Gap Assessment. Draft Final Report'. Kingston, Jamaica: The Nature Conservancy Jamaica Country Programme. January 15, 2007. 57 pp.

Venema, Siebren. 2004. 'Fishery Policy Document. Fifth Draft'. Food and Agriculture Organization. July 20, 2004.

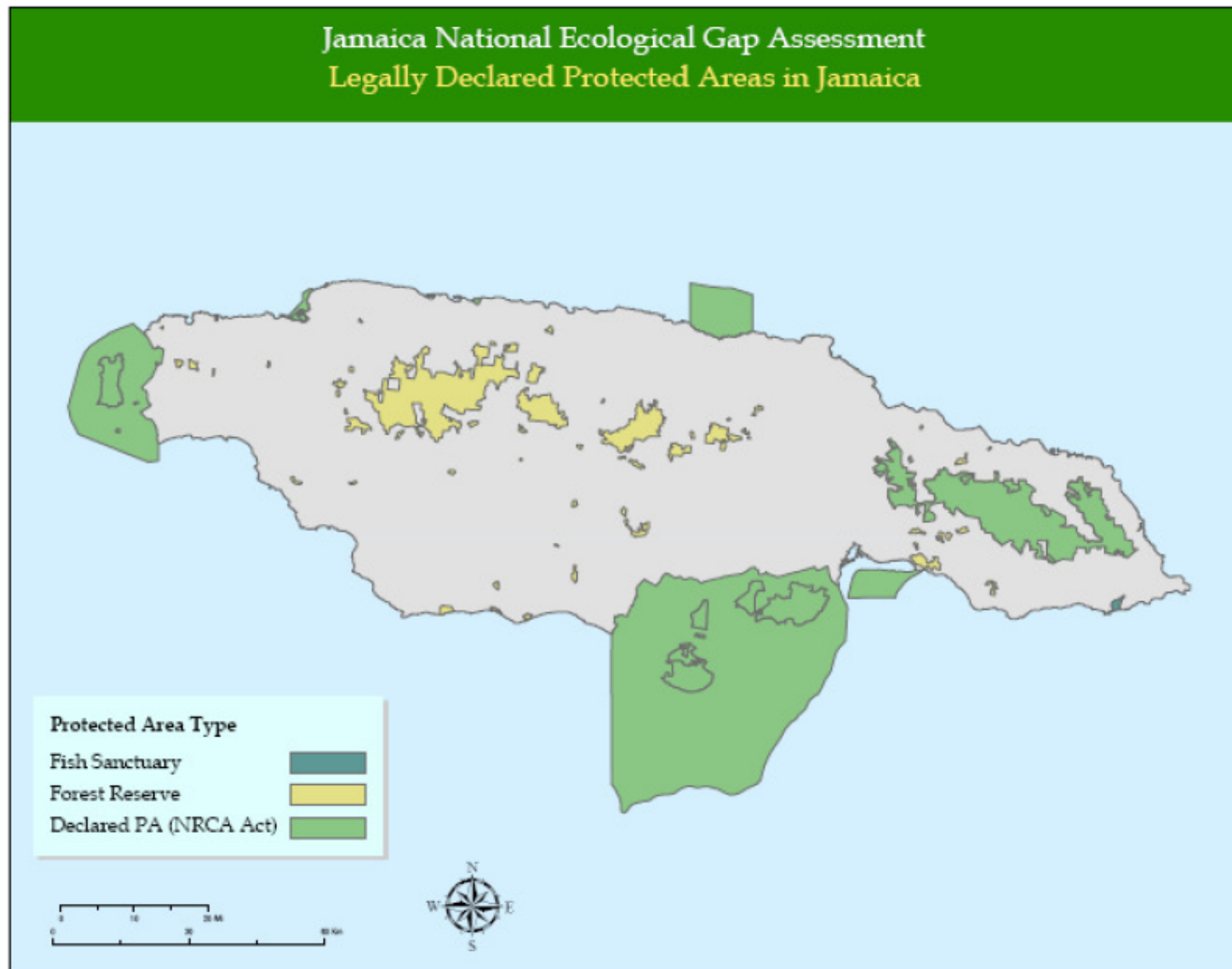
Wilson, Scott. 2002. 'Jamaican South Coast Sustainable Development Programme. Final Report'. November.

Zenny, N. 2006. 'Jamaica Ecoregional Planning (JERP), Marine Analysis Report. Draft'. Kingston, Jamaica: The Nature Conservancy Jamaica Country Programme. July. 55 pp.

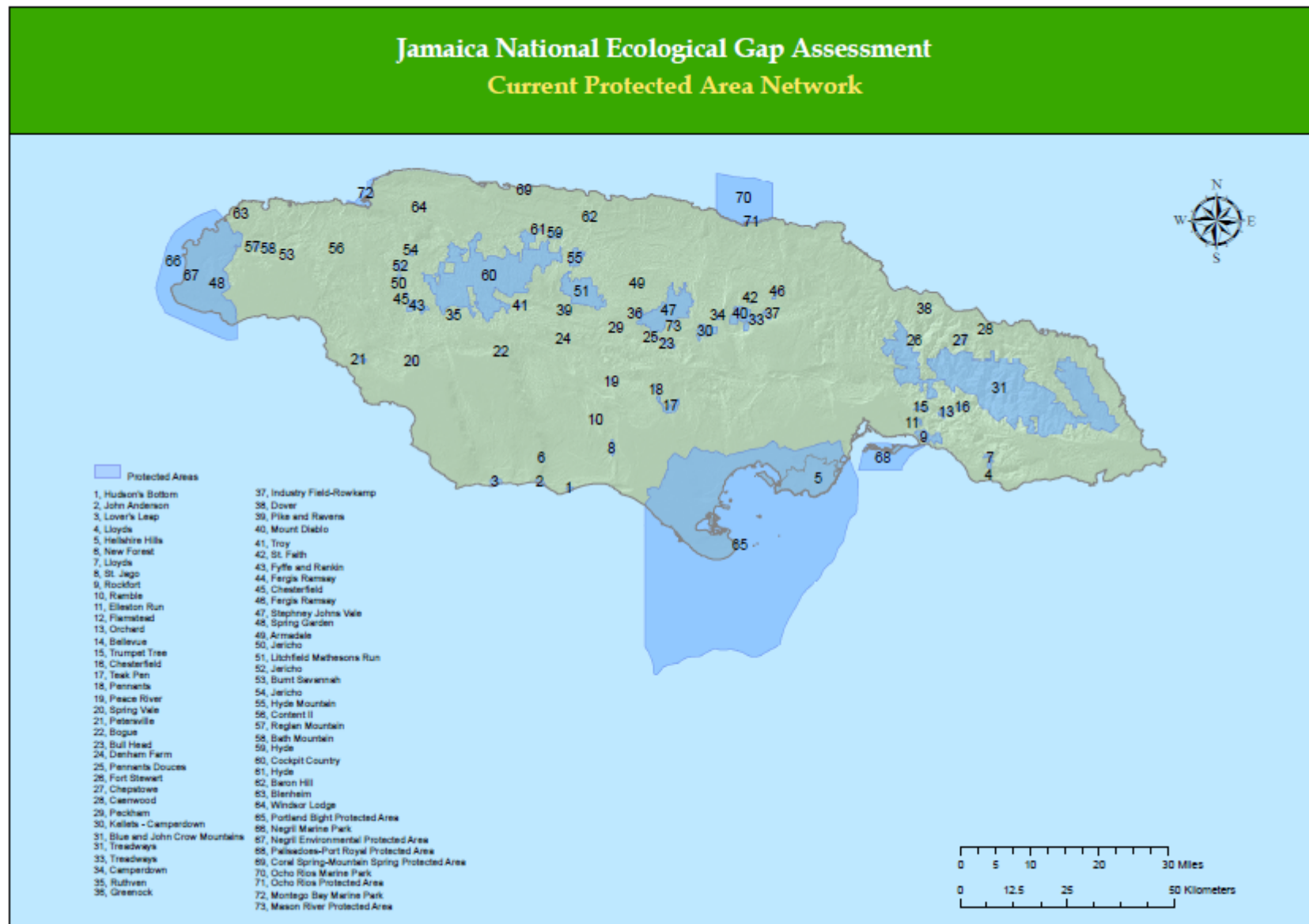
http://www.cabinet.gov.jm/current_initiatives/creation_national_vision_jamaica

http://www.cabinet.gov.jm/current_initiatives/comprehensive_sustainability_assessment_tool_csap (last modified 09/10/2008).

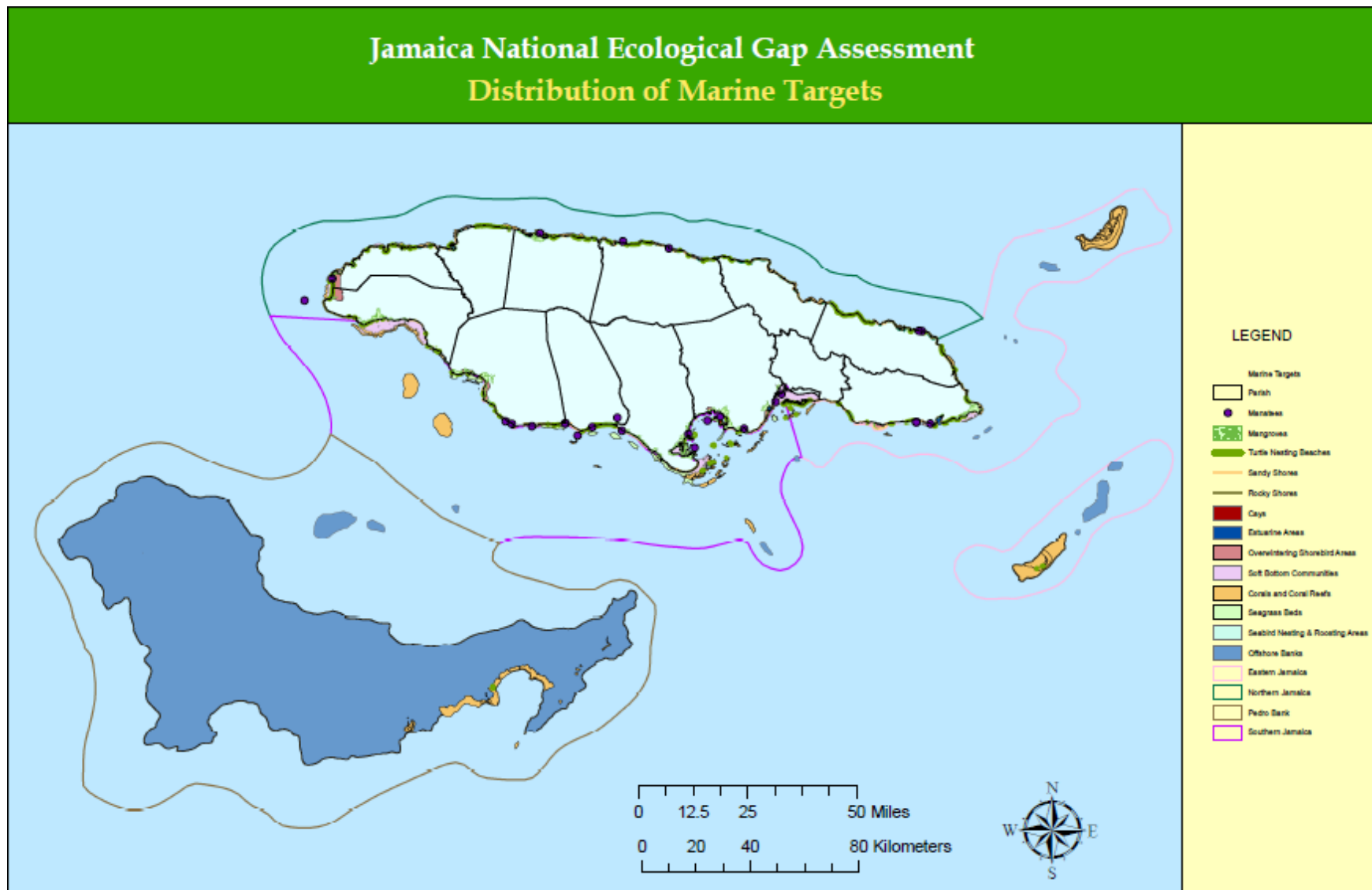
MAPS



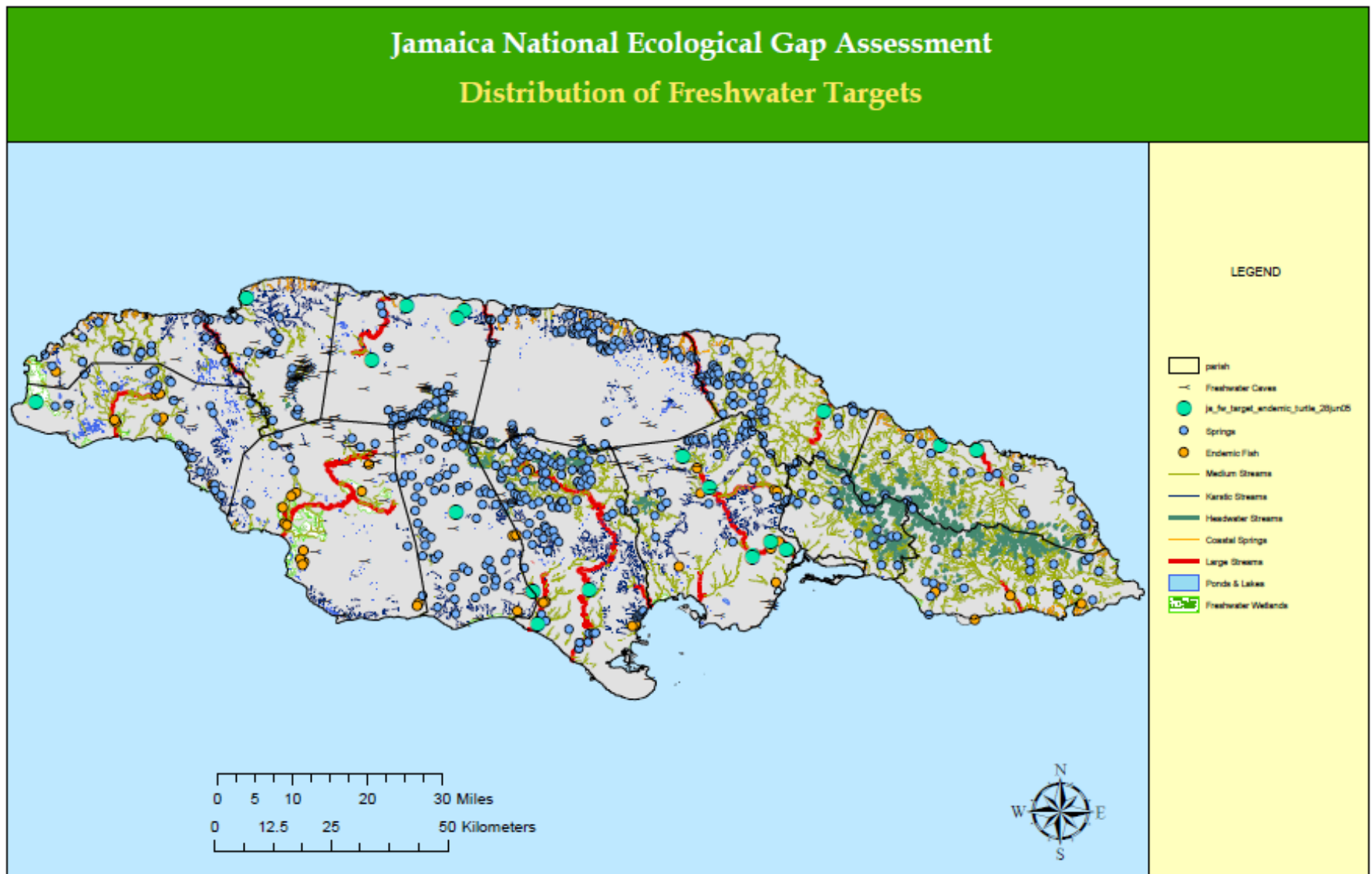
Map 1.1: Legally Declared Protected Areas in Jamaica



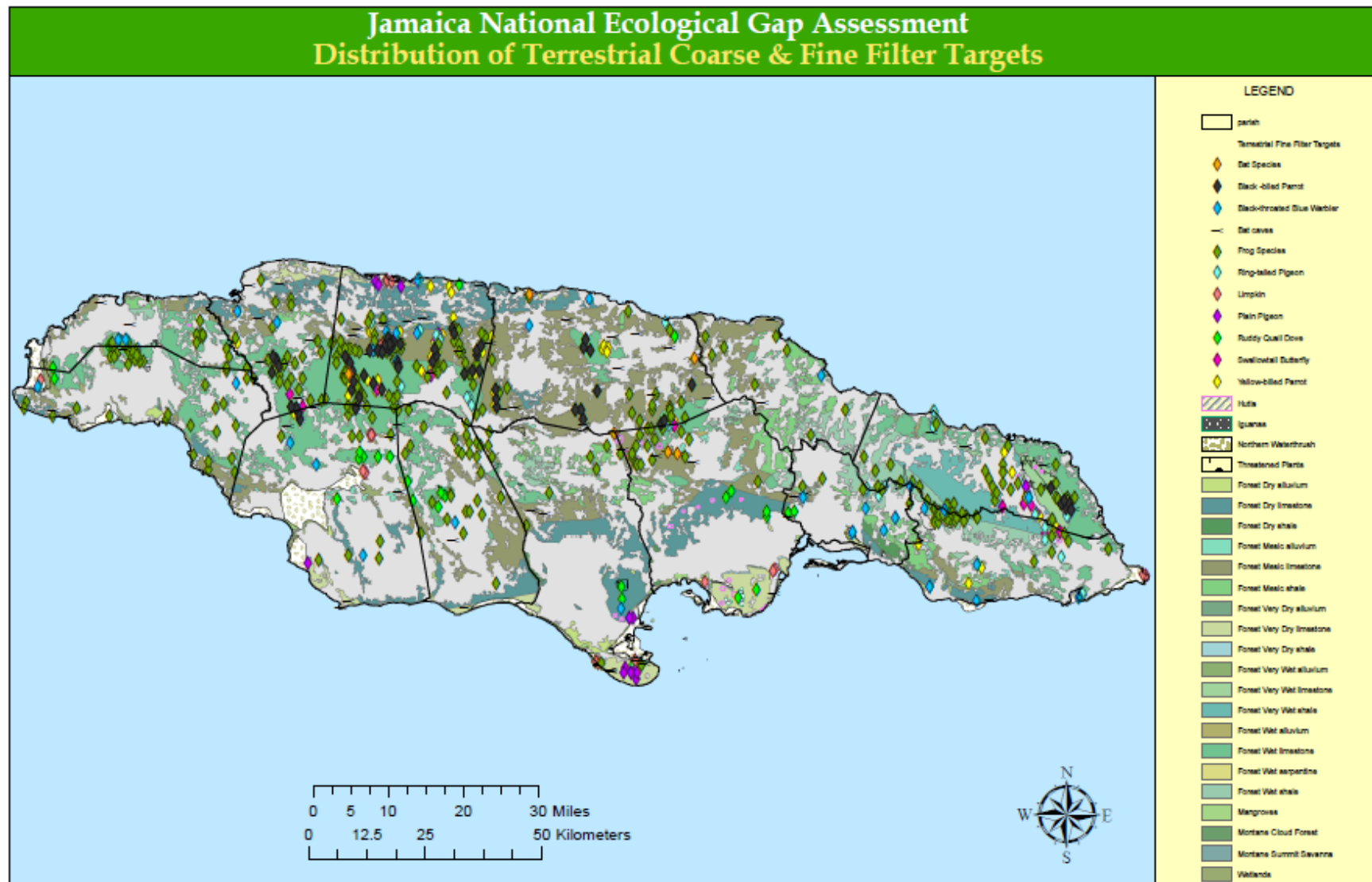
Map 1.2: Current Protected Area Network



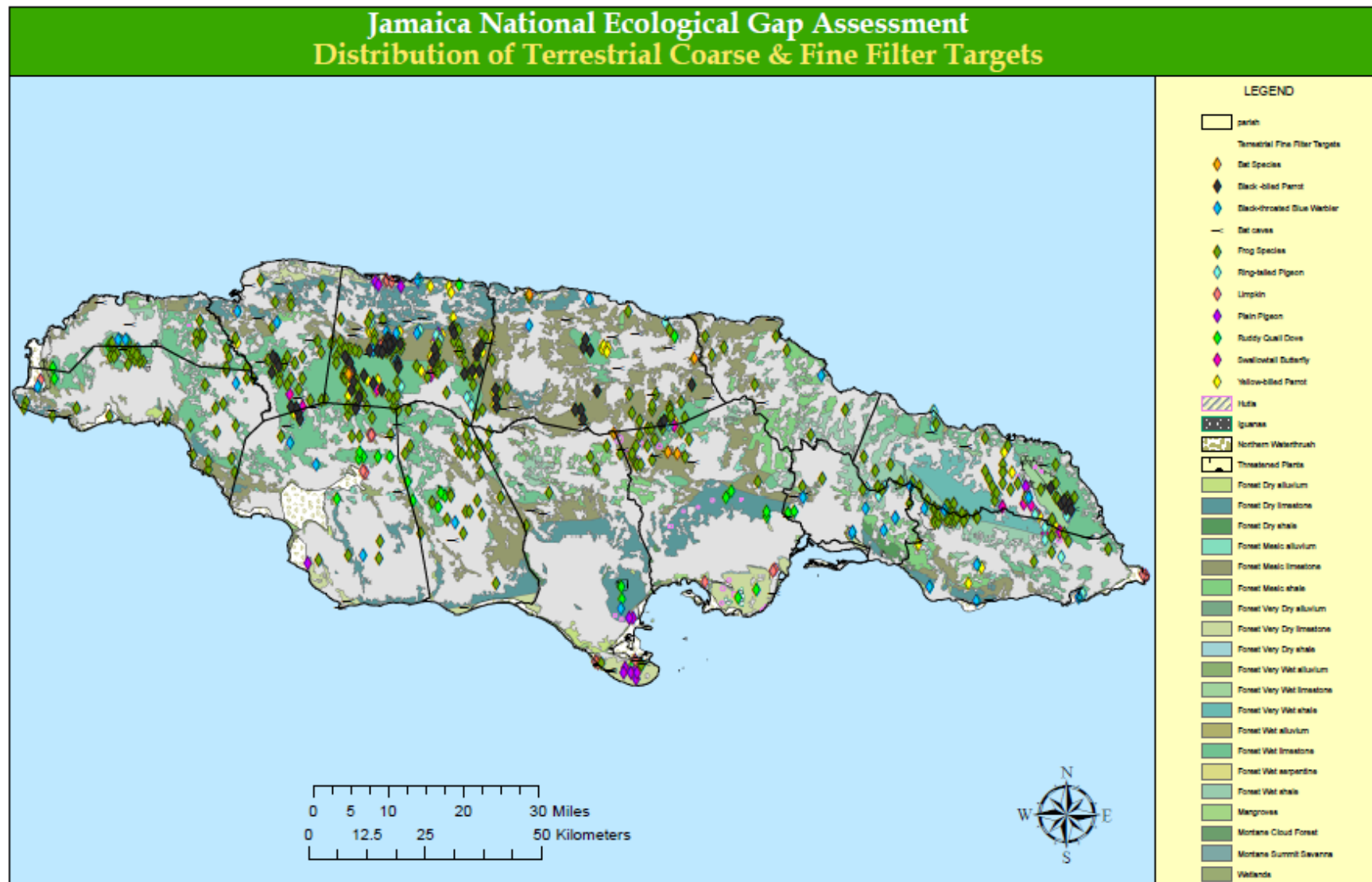
Map 2.0: Distribution of Marine Targets



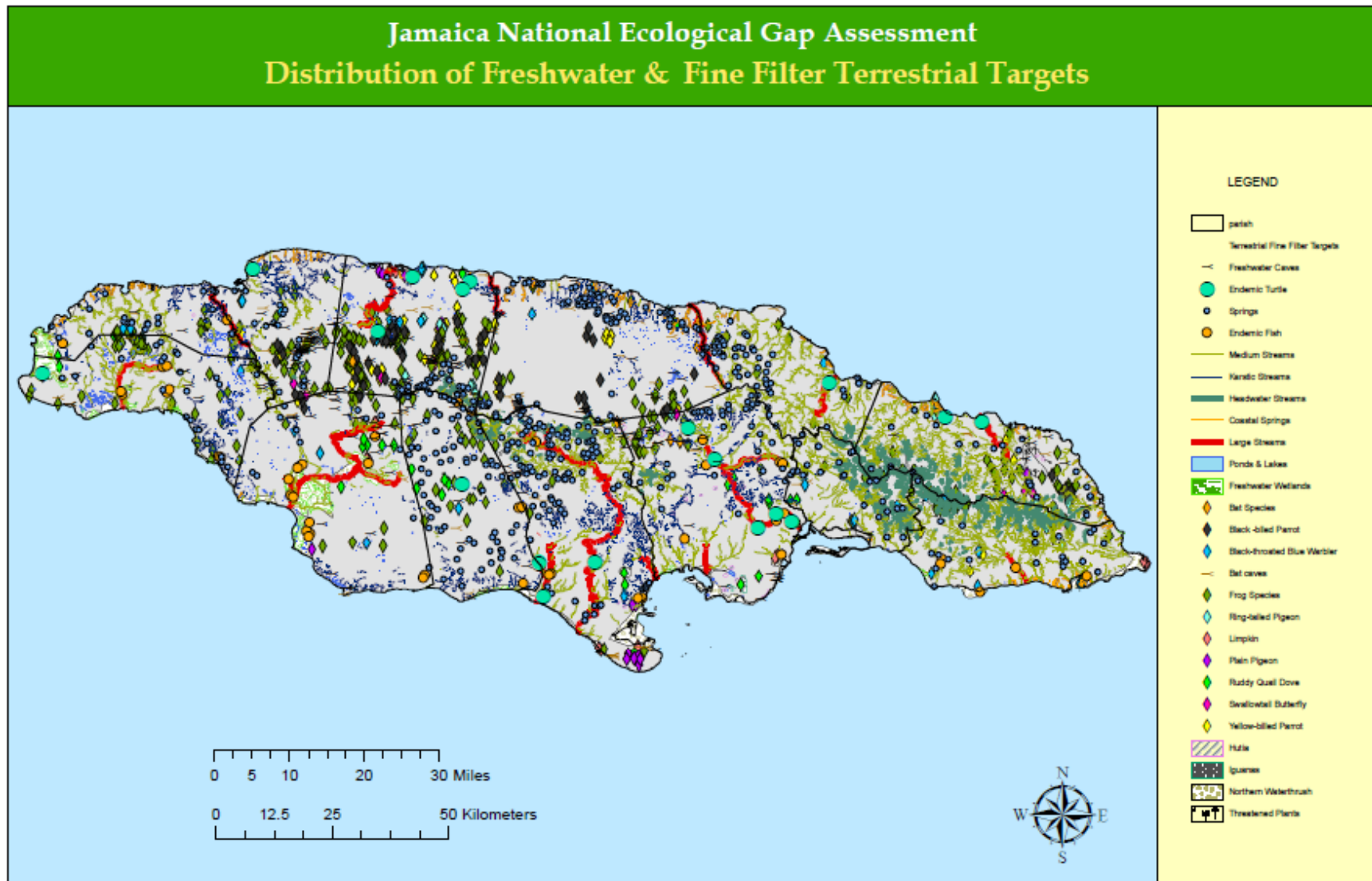
Map 3.0: Distribution of Freshwater Targets



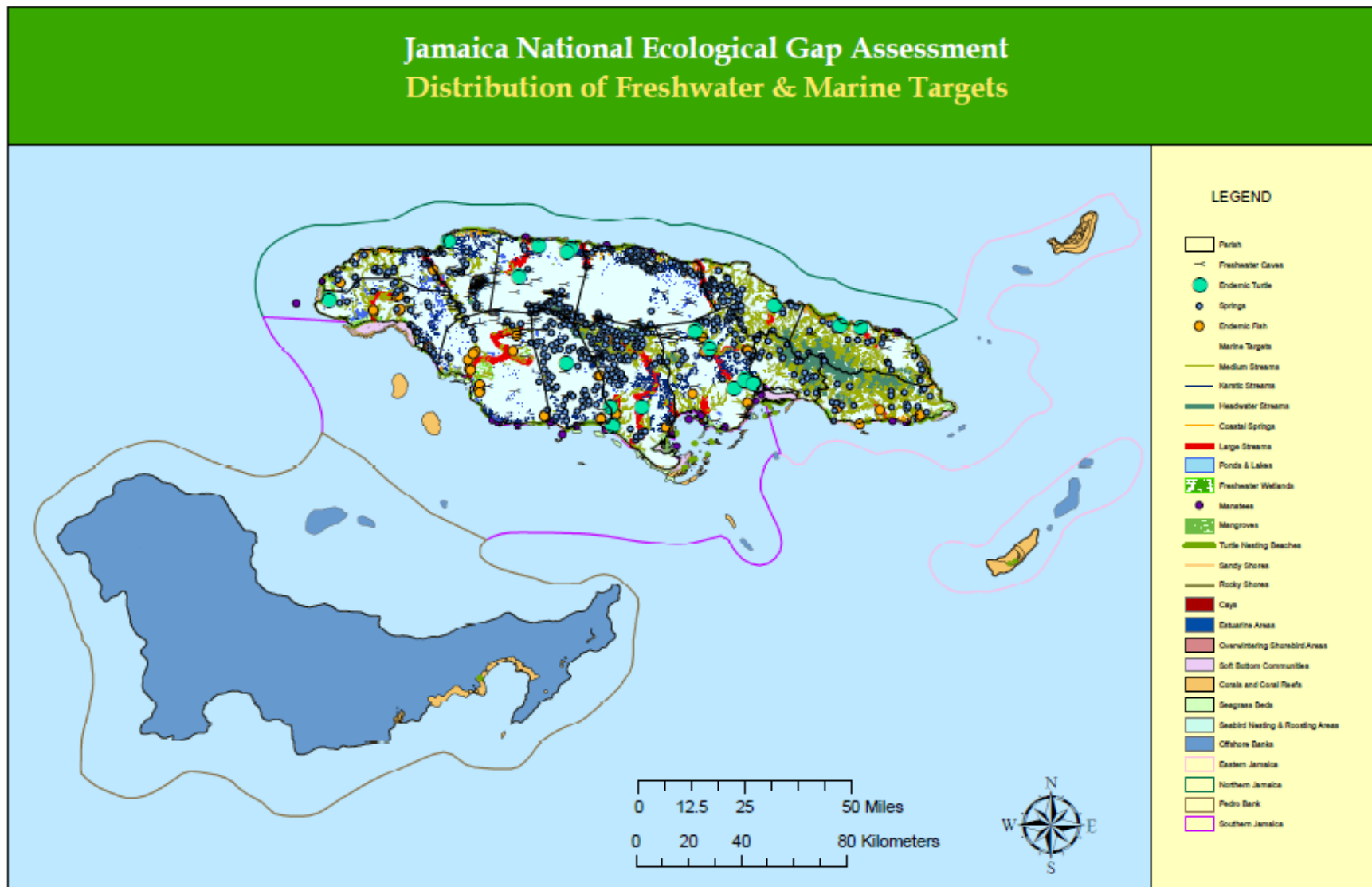
Map 4.0: Distribution of Terrestrial Coarse- and Fine-filter Targets



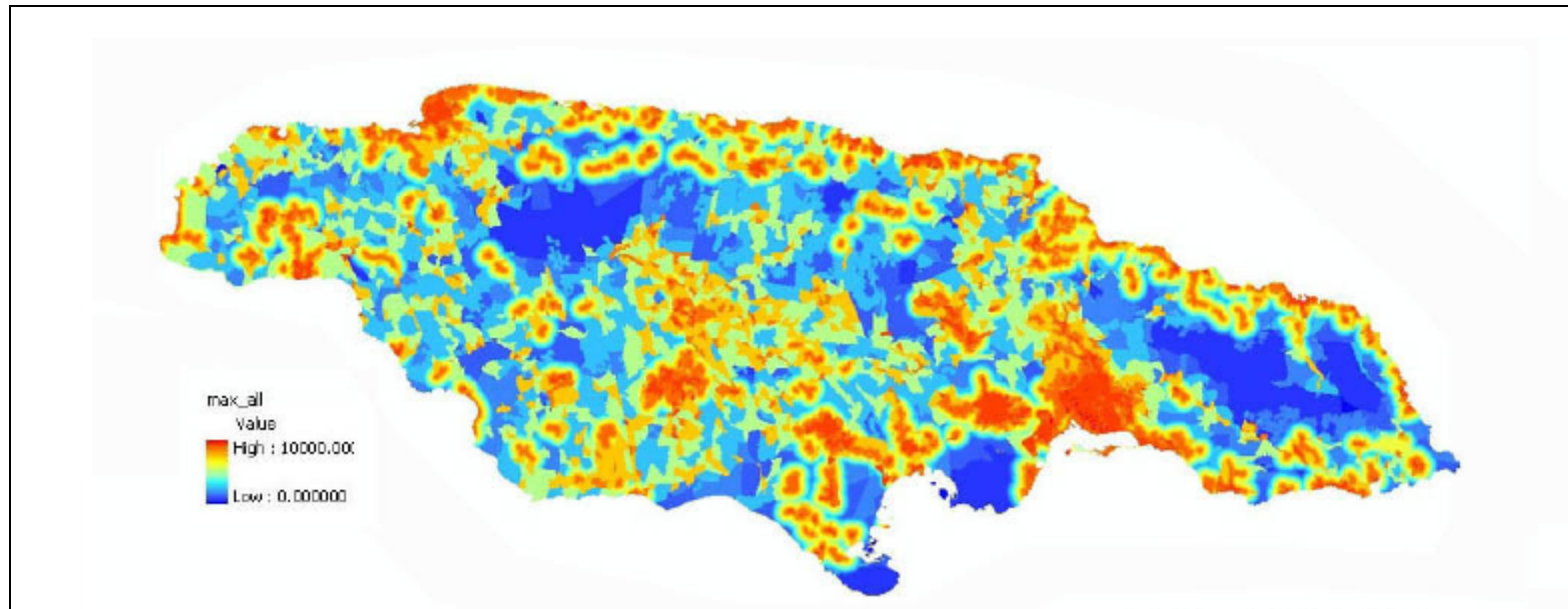
Map 5.0: Distribution of Freshwater and Coarse-filter Terrestrial Targets



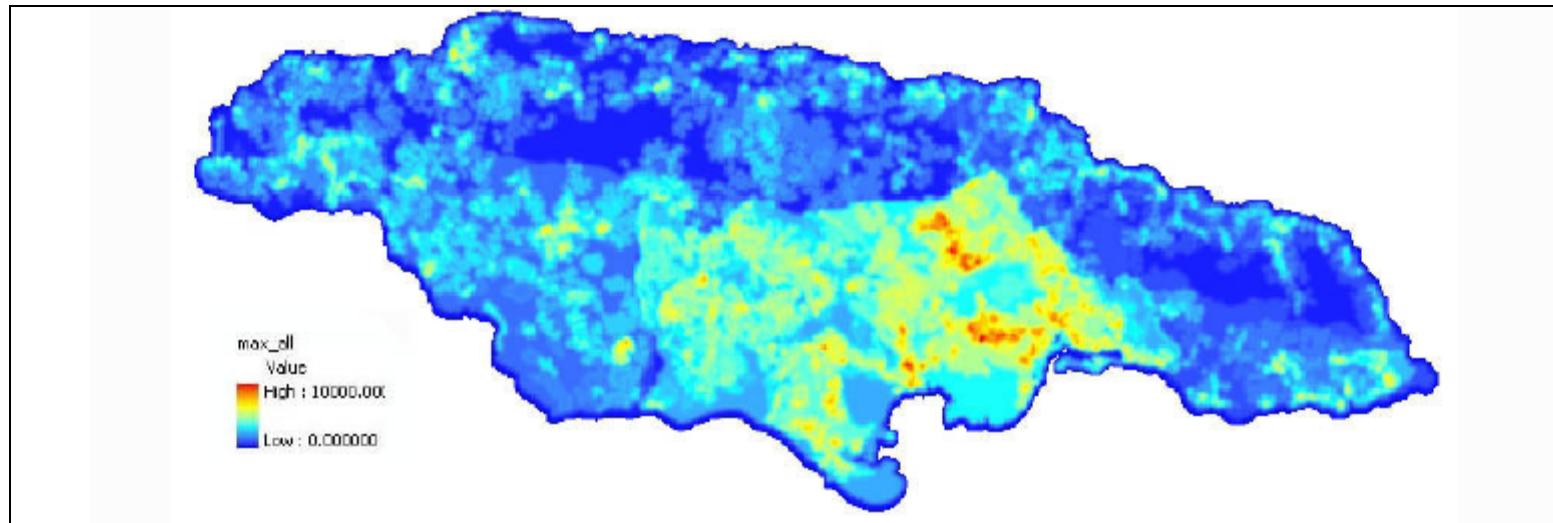
Map 6.0: Distribution of Freshwater and Fine-filter Terrestrial Targets



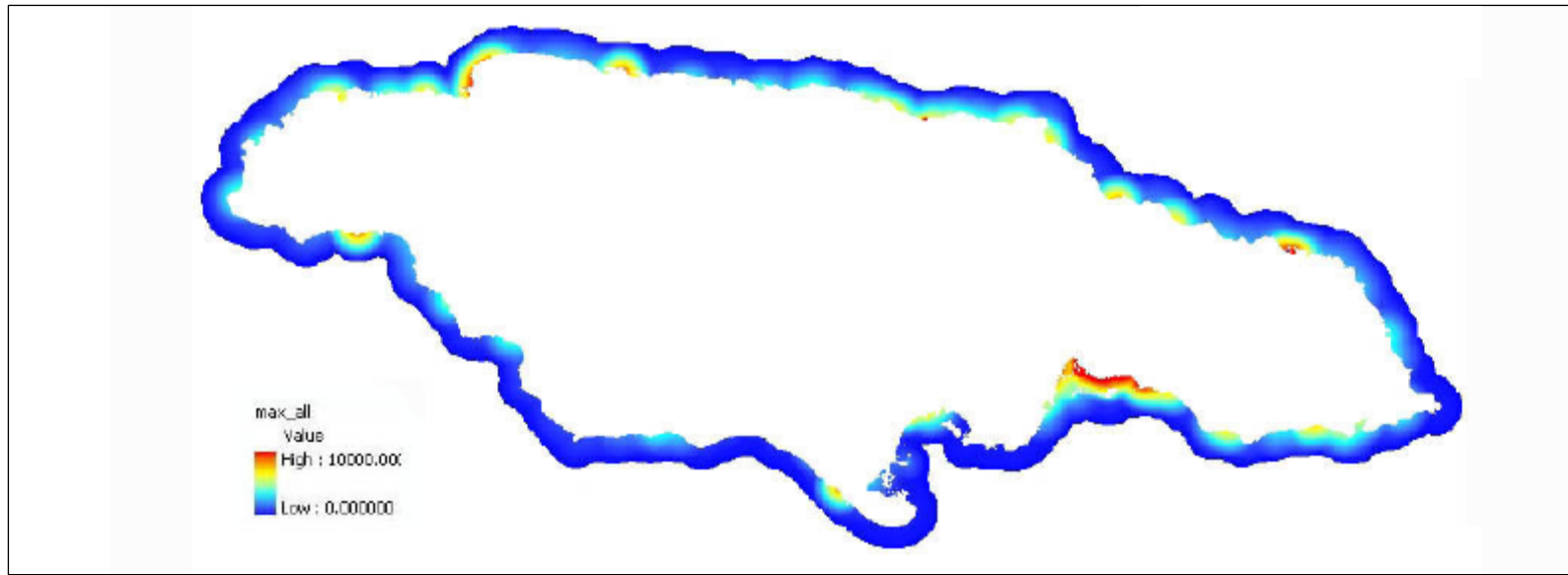
Map 7.0: Distribution of Freshwater and Marine Targets



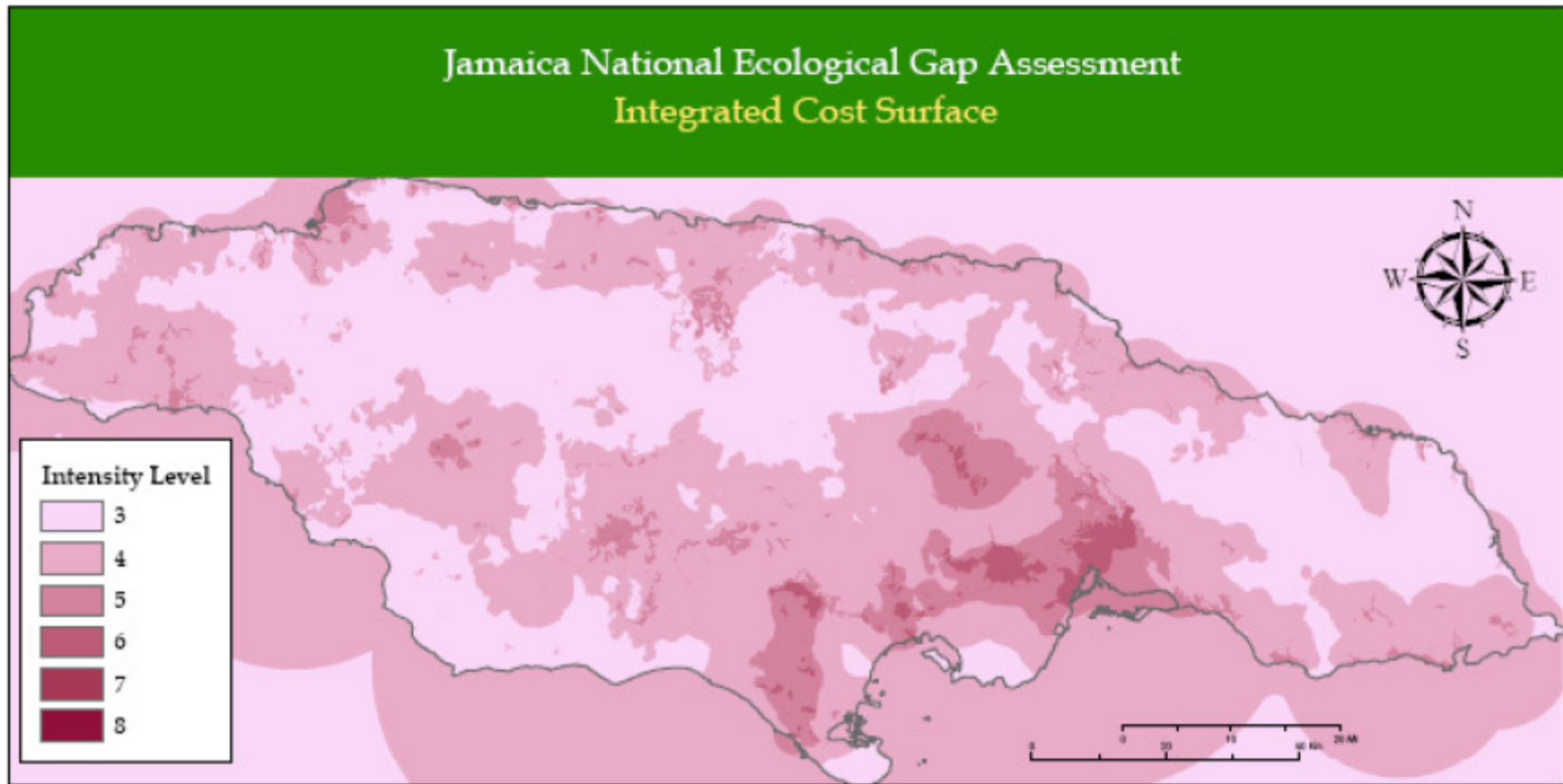
Map 8.0: Cost Surface Model for Terrestrial Biodiversity (Source: *McPherson et. al.* 2008)



Map 8.1: Cost Surface Model for Freshwater Biodiversity (Source: *McPherson et. al.* 2008)

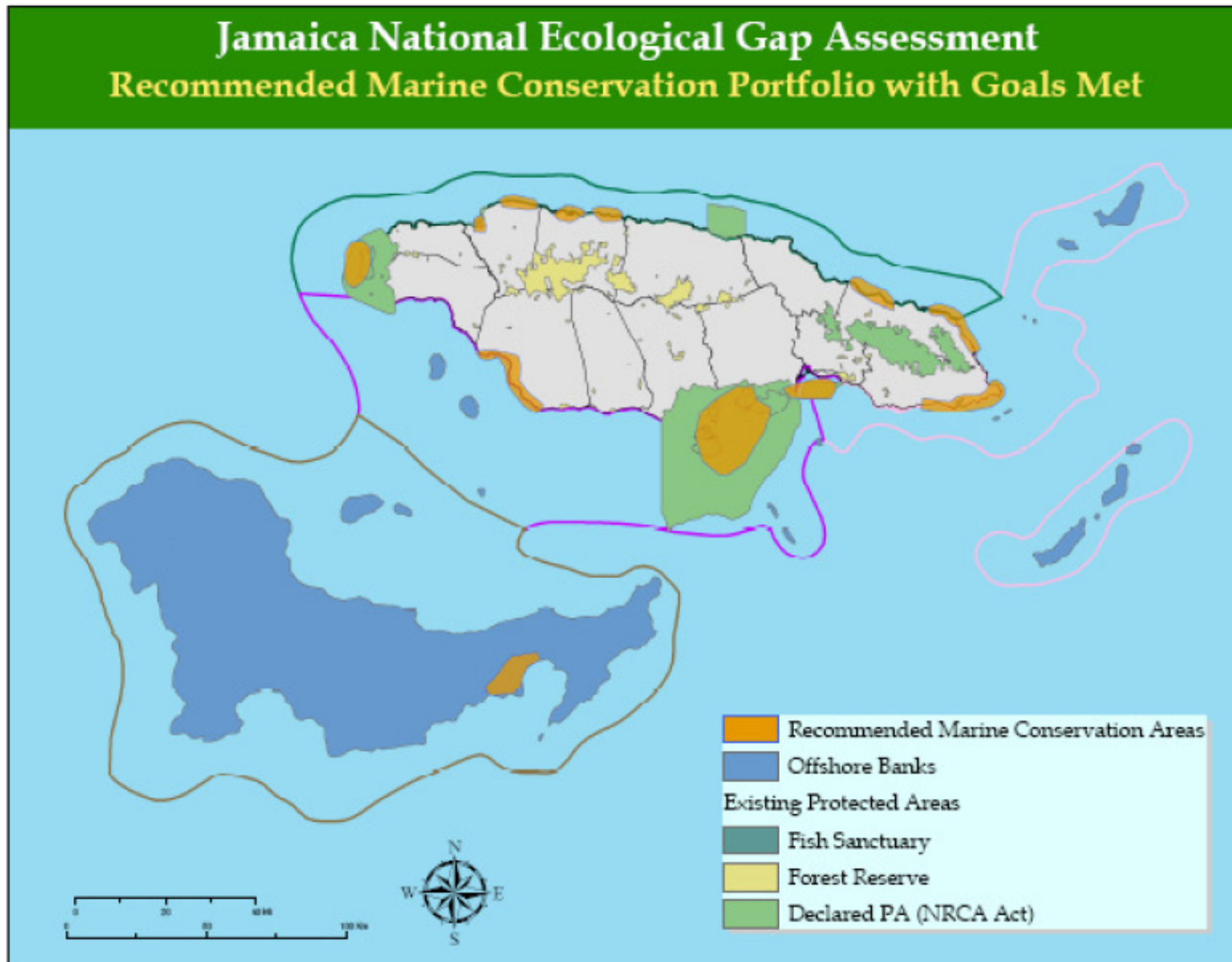


Map 8.2: Cost Surface Model for Marine Biodiversity (Source: *McPherson et. al.* 2008)

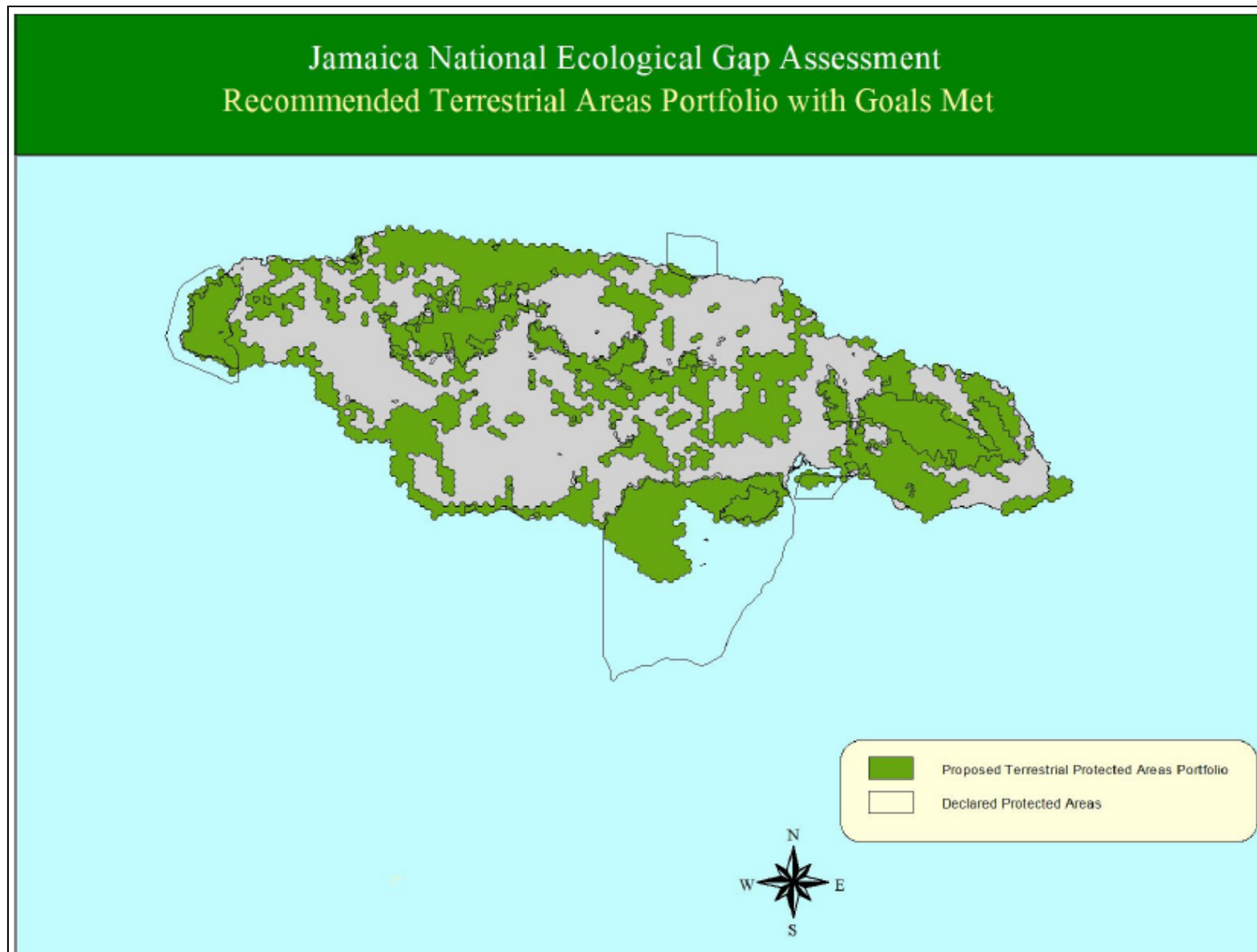


Map 9.0: Integrated Cost Surface

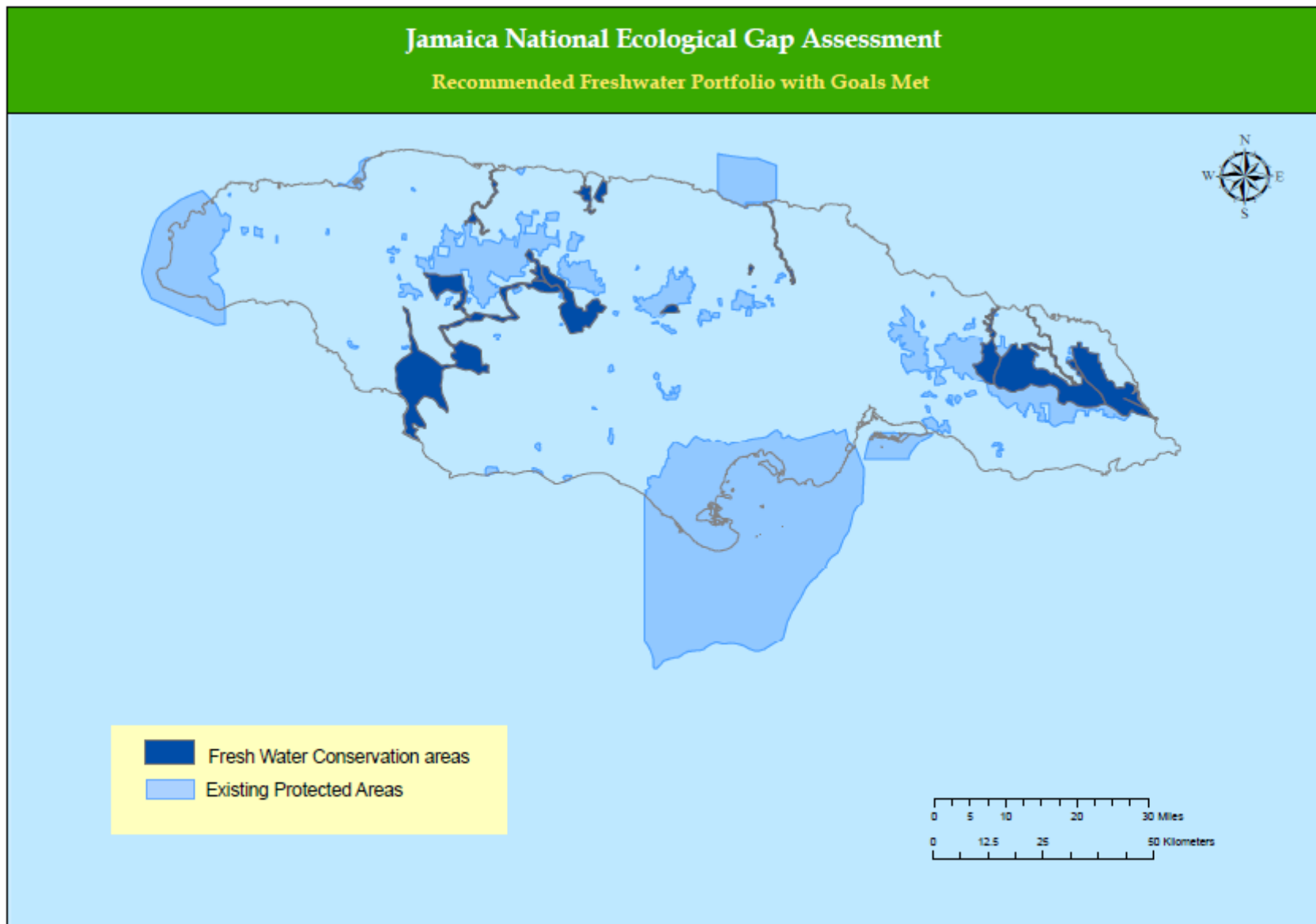
This map combines the scores from the terrestrial, freshwater and marine cost surfaces. The color distribution ranges from light red, indicative to low cost areas, to dark red indicative of areas of heavy human impact.



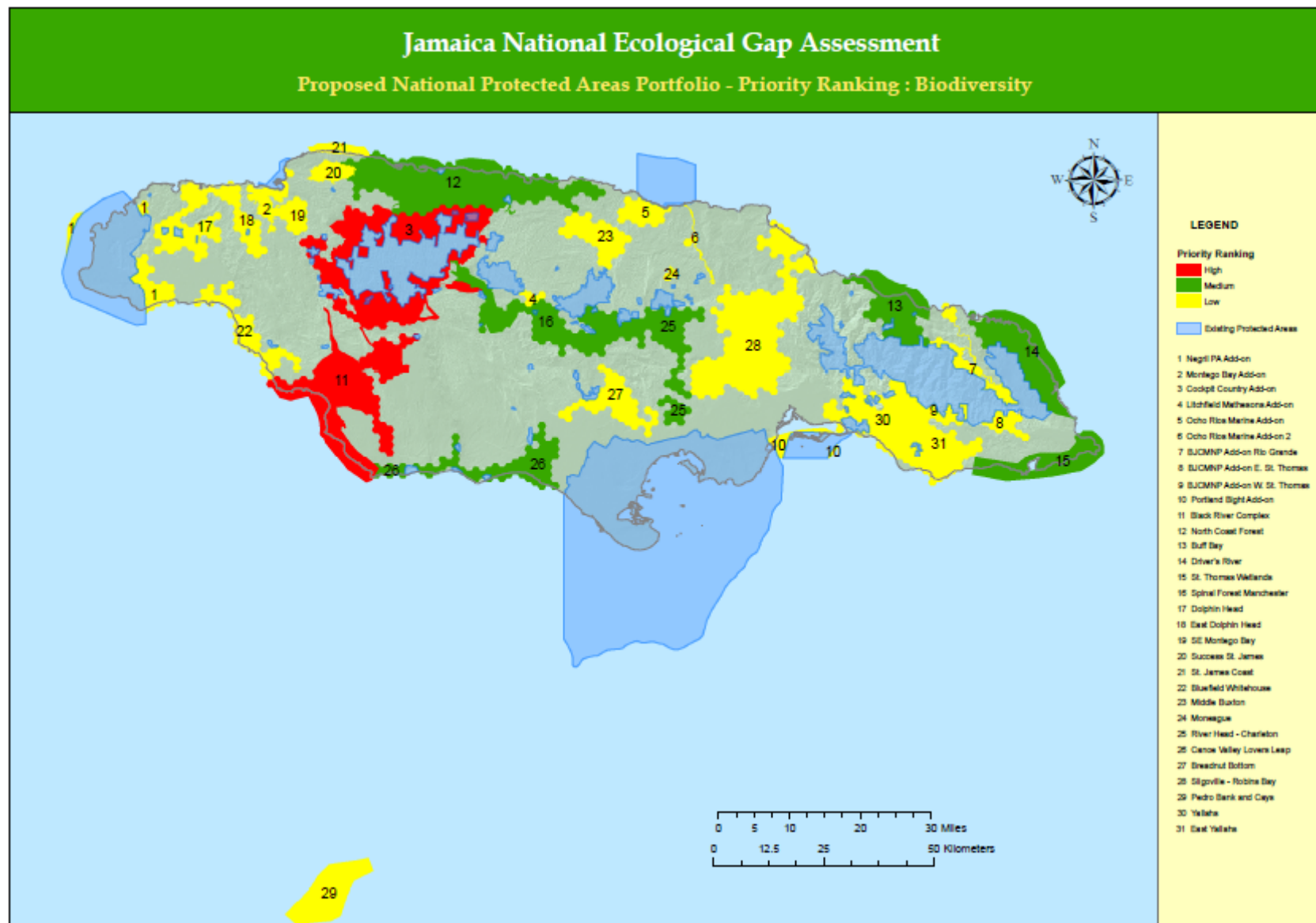
Map 10.0: Recommended Marine Conservation Portfolio with Goals Met



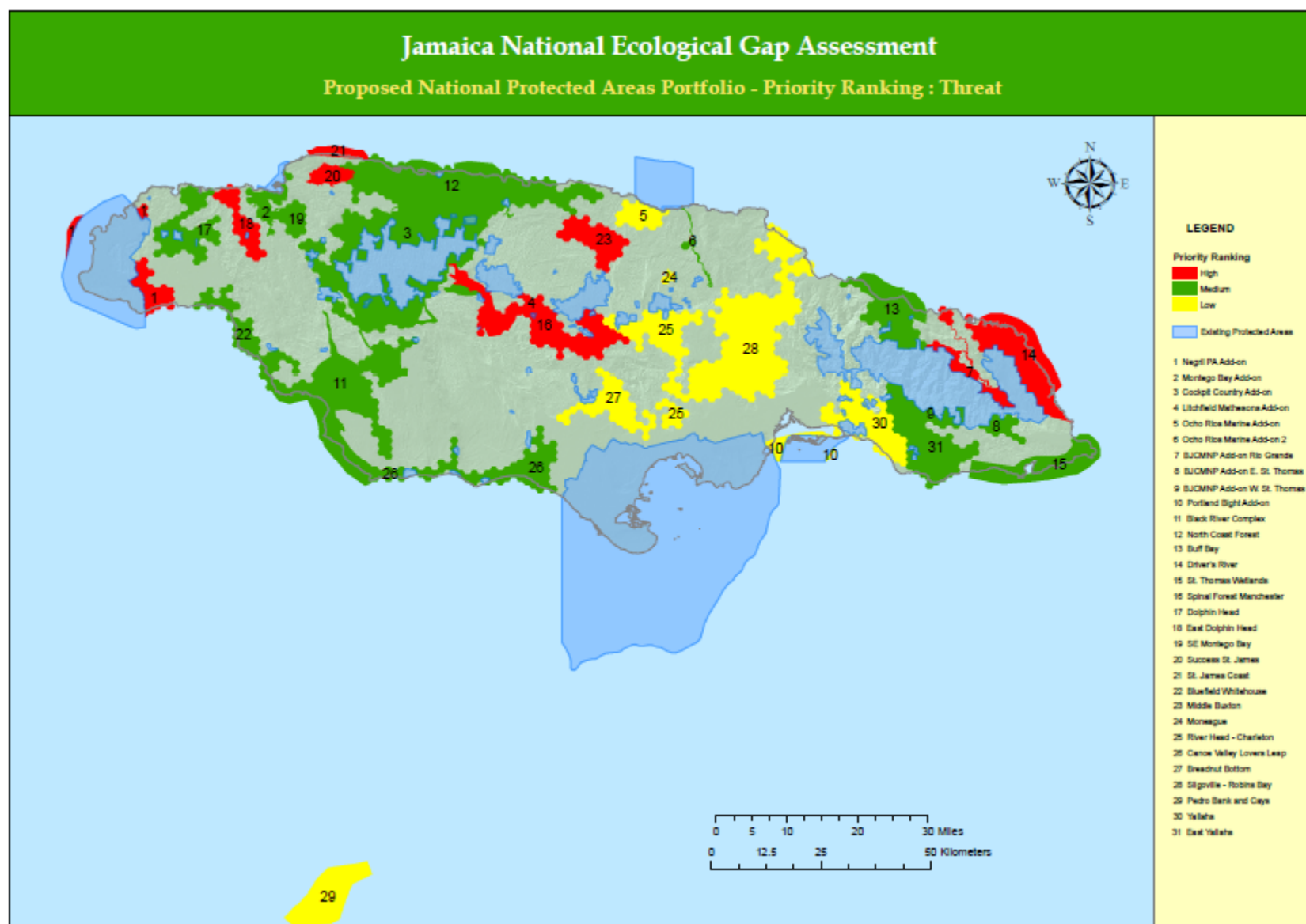
Map 11.0: Recommended Terrestrial Areas Portfolio with Goals Met



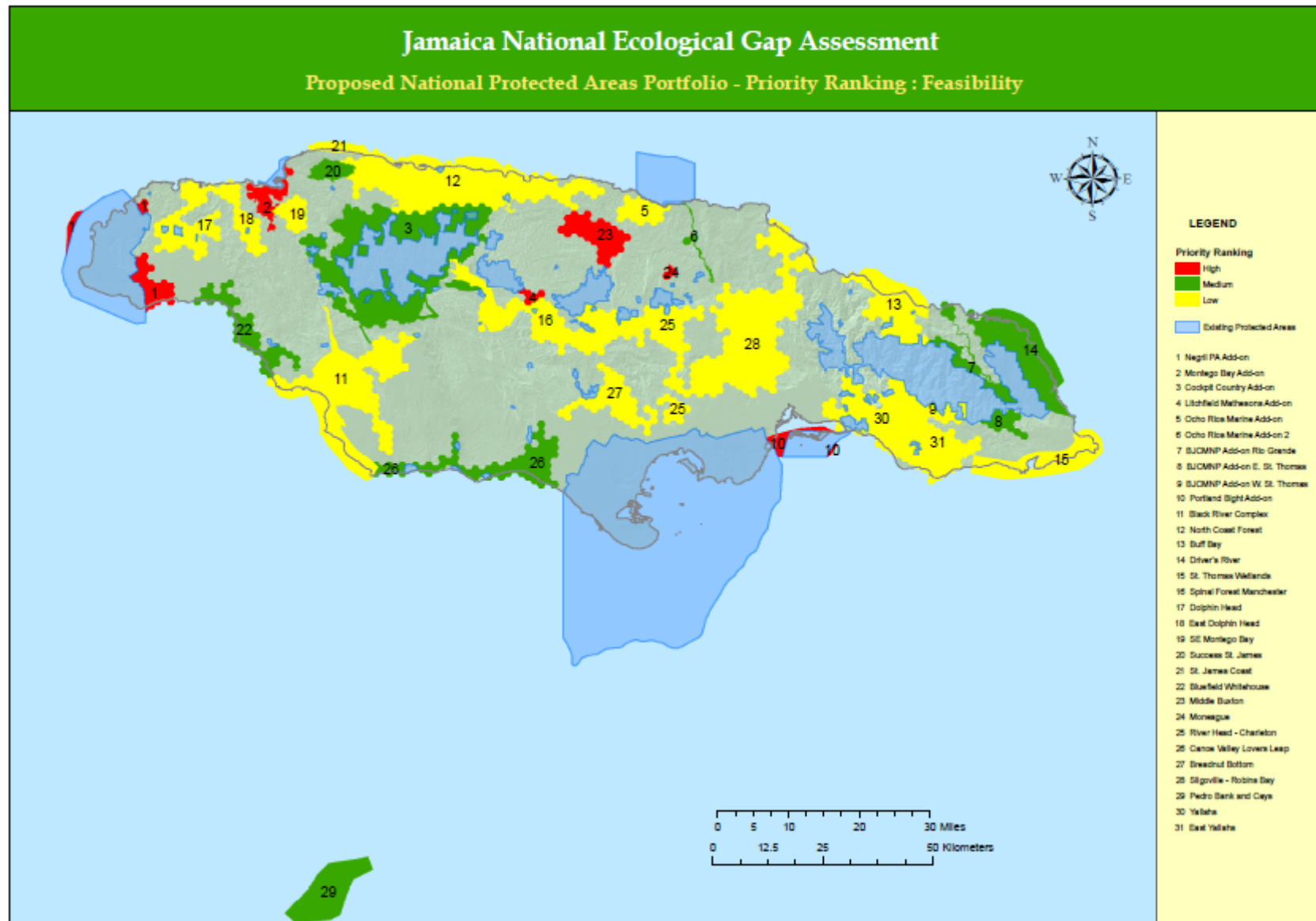
Map 12.0: Recommended Freshwater Portfolio with Goals Met



Map 13.0: Proposed National Protected Areas Portfolio – Priority Ranking: Biodiversity



Map 14.0: Proposed National Protected Areas Portfolio – Priority Ranking: Threat



Map 15.0: Proposed National Protected Areas Portfolio – Priority Ranking: Feasibility

APPENDICES

APPENDIX 1

CONTRIBUTORS TO NATIONAL ECOLOGICAL GAP ASSESSMENT

Contributors include the Ecological Working Group members and other persons and institutions, over a number of meetings, and four public consultations.

Ecological Working Group Members

Tracy Commock, EWG Co-Chair, *Institute of Jamaica*
 Dayne Buddo, PhD., EWG Co-Chair, *Urban Development Corporation*
 Andrea Donaldson, *National Environment and Planning Agency*
 Owen Evelyn, *Forestry Department*
 Catherine Levy, *Institute of Jamaica - Natural History Division* and *BirdLife Intl.*
 Mike Schwartz, *Windsor Research Centre*
 Marlon Beale and Shauna-Lee Chai, *Jamaica Conservation and Development Trust*
 Jerome Smith, *Environmental Management Division, Office of the Prime Minister*
 Donna Blake, Judith Blake, Kimberly John, and Sacha-Renee Todd, *The Nature Conservancy*

Subject area experts

Susan Koenig, PhD., *Windsor Research Centre*
 Andreas Oberli, *National Arboretum Foundation*

Contributors

Department of Life Sciences, *University of the West Indies*
 Fisheries Division, *Ministry of Agriculture*

Attendees at Consultations and Workshops

Joy Alexander, National Environment and Planning Agency
 Shakira Azan, National Environment and Planning Agency
 Leonie Barnaby, Environmental Management Division, Office of the Prime Minister
 Marlon Beale, Jamaica Conservation and Development Trust
 Donna Blake, The Nature Conservancy
 Judith Blake, The Nature Conservancy
 Melecia Brown, Southern Trelawny Environmental Agency
 Dayne Buddo, Urban Development Corporation
 Keron Campbell, Institute of Jamaica
 Tracy Commock, Institute of Jamaica
 Marcia Creary, University of the West Indies (UWI)
 Laleta Davis-Mattis, Jamaica National Heritage Trust
 Hugh Dixon, Southern Trelawny Environmental Agency
 Andrea Donaldson, National Environment and Planning Agency (NEPA)
 Thera Edwards, Independent (terrestrial) consultant
 Tracey Edwards, Portland Environment Protection Association
 Peter Espeut, Caribbean Coastal Area Management Foundation
 Owen Evelyn, Forestry Department
 Elaine Fisher, Chairperson, CITES Scientific Authority of Jamaica
 John Fletcher, Birdlife Jamaica
 Jose Galindo (Sustainable finance consultant), Mentefactura, Ecuador
 Eric Garraway, PhD., University of the West Indies (UWI)
 Carla Gordon, National Environment and Planning Agency
 Royan Gayle, Urban Development Corporation
 Maya Gorrez-de Jong, BlueMaris Consulting
 Ellie Grennan Hirtshew
 Aurélien Guingand, Caribbean Coastal Area Management Foundation
 D. Brandon Hay, Caribbean Coastal Area Management (CCAM) Foundation
 Marilyn Headley, Forestry Dept.
 Paula Hurlock, Dolphin Head Trust
 Kimberly John, The Nature Conservancy
 Susan Koenig, PhD., Windsor Research Centre
 Wendy Lee, Northern Jamaica Conservation Association
 Gerard Lee, St. Elizabeth Parish Council
 Catherine Levy, Institute of Jamaica / Birdlife International
 Patrick Lewis, University of the West Indies (UWI)
 Trevion Manning, Hanover Parish Council
 Andrea McKenzie, Local Government Division, Ministry of Local Government
 Andrine McLaren, Kingston and St. Andrew Council
 Matthew McPherson, PhD., BlueMaris Consulting
 Llewelyn Meggs, The Nature Conservancy
 Malden Miller, United States Agency for International Development
 Terry Montaque, St. James Parish Council
 Avian Morgan-Johnson, Water Resources Authority
 Ricardo Morris, Ministry of Agriculture and Fisheries
 Elizabeth Morrison – Institute of Jamaica
 Stacey Moses, National Environment and Planning Agency
 Richard Murray, Ministry of Finance
 Andreas Oberli, National Arboretum Foundation

Rainee Oliphant, Forest Conservation Fund
Susan Otuokon, Jamaica Conservation and Development Trust
Shanti Persaud, Jamaica Bauxite Institute
George Proctor, PhD., Institute of Jamaica
Oral Rainford, Ministry of Energy Mining and Telecommunications
Ranya Reid, National Environment and Planning Agency
Orlando Robinson, Nature Preservation Foundation
Sean Rowe, Manchester Parish Council
Joan Sampson, St. Ann Parish Council
Michael Schwartz, Windsor Research Centre
Jerome Smith, Environmental Management Division, Office of the Prime Minister
Thredroy Smith, Portland Parish Council
Junior Squire, Ministry of Agriculture and Fisheries
Keisha Spencer, Negril Environmental Area Trust
Ann Sutton, PhD., Independent consultant
Sophia Terrelonge, University of the West Indies, Mona
Sacha-Renee Todd, The Nature Conservancy
Danae Vacciana, Urban Development Corporation
Peter Vogel, PhD., University of the West Indies, Mona
Terry Williams, The Nature Conservancy
Michael Witter, PhD., University of the West Indies, Mona
Ronald Young, Prof., University of the West Indies, Mona
Nathalie Zenny, The Nature Conservancy

APPENDIX 2

MARINE CONSERVATION TARGETS REPRESENTED WITHIN EXISTING PROTECTED AREAS

Percentage of Marine Conservation Targets Represented within Existing Protected Areas in Jamaica

Conservation Target	Northern MSU			Southern MSU			Eastern MSU			Pedro Bank and Cays MSU		
	% in MPA	% in Fish Sanctuary	% in Game Reserve	% in MPA	% in Fish Sanctuary	% in Game Reserve	% in MPA	% in Fish Sanctuary	% in Game Reserve	% in MPA	% in Fish Sanctuary	% in Game Reserve
Sandy shores	20	NA	1	35	NA	10	18	2	10	NA	NA	NA
Rocky shores	25	NA	3	34	NA	6	0	0	1	NA	NA	NA
Mangroves	24	NA	12	63	NA	12	0	2	88	NA	NA	NA
Estuarine areas	53	NA	79	81	NA	0	0	72	0	NA	NA	NA
Seagrass beds	35	NA	4	47	NA	0	0	8	0	0	NA	0
Corals and Coral reef	20	NA	0	62	NA	0	4	0	0	0	NA	0
Soft bottom communities	60	NA	15	27	NA	0	1	0	1	NA	NA	NA
Cays	39	NA	35	100	NA	0	0	0	0	0	NA	0
Offshore banks	NA	NA	NA	0	NA	0	0	0	0	0	NA	0
Seabird nesting and roosting areas	0	NA	0	29	NA	57	0	0	0	0	NA	0
Overwintering shorebird areas	75	NA	1	71	NA	19	1	1	65	0	NA	0
Turtle nesting beaches	20	NA	1	52	NA	27	32	0	12	0	NA	0
Manatees	14	NA	0	21	NA	0	0	0	0	NA	NA	NA

Note: **Bold** numbers/shaded area denote conservation targets of specific concern that are unrepresented or under-represented throughout their distribution.

APPENDIX 3

FRESHWATER CONSERVATION TARGETS REPRESENTED WITHIN EXISTING PROTECTED AREAS

Percentage of Freshwater Conservation Targets Represented within Existing Protected Areas in Jamaica.

Freshwater Target	% of Target Protected	% of Target Protected	Goals Met
Eastern high-altitude headwater streams	61.8%	> 20%	Protection Exceeds CBD Goal
Western freshwater wetlands	66%	10 – 20%	Protection Meets CBD Goal
Western ponds and lakes	18.7%	0 – 10%	Some Protection Below CBD
Eastern medium-sized streams	13.8%	0%	No Protection
Western large rivers	10.9%		
Western medium-sized streams	10.5%		
Eastern springs	7.3%		
Western coastal springs	6.3%		
Western springs	6.2%		
Western freshwater caves	5.6%		
Western karstic streams	4.4%		
Eastern coastal springs	0.5%		
Eastern large rivers	0%		
Eastern wetlands	0%		
Eastern ponds and lakes	0%		
Western high-altitude streams	0%		
Eastern freshwater caves	0%		

CBD 10% Protection Goal Benchmark

APPENDIX 4

TERRESTRIAL CONSERVATION TARGETS REPRESENTED WITHIN EXISTING PROTECTED AREAS

Percentage of Coarse-Filter Terrestrial Conservation Targets Represented within Existing Protected Areas in Jamaica Compared to Conservation Goals

Target Name	Adaptive Goal	Amount Total (number or hectares)	Amount Goal (number or hectares)	Extent of Target Under Protection (number or hectares)	% Protected
Forest Dry alluvium	90%	4398.8	3958.9	2218.6	50.4%
Forest Dry limestone	80%	74311.7	59449.4	9628.9	13.0%
Forest Dry shale	90%	3701.0	3330.9	635.5	17.2%
Forest Mesic alluvium	90%	6564.8	5908.3	784.8	12.0%
Forest Mesic limestone	40%	137415.5	54966.2	18393.8	13.4%
Forest Mesic shale	80%	31408.2	25126.5	573.2	1.8%
Forest Very Dry alluvium	90%	1076.5	968.9	523.1	48.6%
Forest Very Dry limestone	80%	22117.0	17693.6	13418.5	60.7%
Forest Very Dry shale	90%	597.0	537.3	452.7	75.8%
Forest Very Wet alluvium	90%	8.5	7.6	0.0	0.0%
Forest Very Wet limestone	90%	7143.2	6428.8	5594.4	78.3%
Forest Very Wet shale	90%	18188.2	16369.4	14879.8	81.8%
Forest Wet alluvium	90%	4862.1	4375.9	401.6	8.3%
Forest Wet limestone	40%	136849.9	54739.9	34943.8	25.5%
Forest Wet serpentine	90%	171.7	154.6	56.5	32.9%
Forest Wet shale	80%	35830.0	28664.0	14843.5	41.4%
Montane Cloud Forest	90%	875.8	788.2	875.8	100.0%
Montane Summit Savanna	90%	2.2	2.0	2.2	100.0%
Northern Waterthrush: <i>Seiurus noveboracensis</i>	100%	29625.8	29625.8	32836.9	110.8%
Threatened Plants	100%	12240.9	12240.9	12785.8	104.5%
West Indian Whistling Duck: <i>Dendrocygna arborea</i>	90%	15571.0	14013.9	15441.8	99.2%
Wetlands	90%	13279.5	11951.6	11150.2	84.0%
Yellow boa: <i>Epicrates subflavus</i>	75%	12178.5	9133.9	11399.0	93.6%

NOTE **Bold** numbers/shaded area denote terrestrial conservation targets that are under-represented.

Percentage of Select Threatened Fine-filter Terrestrial Conservation Targets Represented within Existing Protected Areas in Jamaica

Target Name	Adaptive Goal	Amount Total	Amount Goal	Extent of Target Under Protection	% protected
Bats: <i>Phyllonycteris aphylla</i>	100%	6.0	6.0	1.0	16.7%
Black-billed Parrot: <i>Amazona agillis</i>	90%	64.0	57.6	33.0	51.6%
Black-throated Blue Warbler: <i>Dendroica caerulescens</i>	75%	38.0	28.5	9.0	23.7%
Caves: bats	95%	34.0	32.3	17.0	50.0%
Caves: guano	50%	25.0	12.5	3.0	12.0%
Frog Species					
<i>Eleutherodactylus alticola</i>	100%	4.0	4.0	4.0	100.0%
<i>Eleutherodactylus andrewsi</i>	75%	7.0	5.3	7.0	100.0%
<i>Eleutherodactylus cavernicola</i>	100%	2.0	2.0	2.0	100.0%
<i>Eleutherodactylus cundalli</i>	50%	43.0	21.5	7.0	16.3%
<i>Eleutherodactylus fuscus</i>	75%	8.0	6.0	2.0	25.0%
<i>Eleutherodactylus grabhami</i>	75%	31.0	23.3	10.0	32.3%
<i>Eleutherodactylus griphus</i>	100%	3.0	3.0	2.0	66.7%
<i>Eleutherodactylus jamaicensis</i>	75%	32.0	24.0	11.0	34.4%
<i>Eleutherodactylus junori</i>	100%	3.0	3.0	1.0	33.3%
<i>Eleutherodactylus luteolus</i>	50%	21.0	10.5	8.0	38.1%
<i>Eleutherodactylus nubicola</i>	100%	10.0	10.0	10.0	100.0%
<i>Eleutherodactylus orcutti</i>	100%	7.0	7.0	4.0	57.1%
<i>Eleutherodactylus pentasyringos</i>	75%	14.0	10.5	4.0	28.6%
<i>Eleutherodactylus sisypodemus</i>	100%	3.0	3.0	3.0	100.0%
<i>Osteopilus brunneus</i>	75%	72.0	54.0	15.0	20.8%
<i>Osteopilus crucialis</i>	75%	15.0	11.3	3.0	20.0%
<i>Osteopilus marianae</i>	75%	12.0	9.0	1.0	8.3%
<i>Osteopilus wilderi</i>	50%	39.0	19.5	6.0	15.4%
Limpkin: <i>Aramus sp.</i>	100%	22.0	22.0	12.0	54.5%
Plain Pigeon: <i>Columba inornata</i>	100%	22.0	22.0	14.0	63.6%
Ring-tailed Pigeon: <i>Columba caribaea</i>	100%	44.0	44.0	19.0	43.2%
Ruddy Quail Dove: <i>Geotrygon montana</i>	75%	93.0	69.8	43.0	46.2%
Swallowtail: <i>Pterourus homerus</i>	100%	.0	.0	6.0	37.5%
Yellow-billed Parrot: <i>Amazona collaria</i>	90%	57.0	51.3	21.0	36.8%

NOTE: **Bold** numbers/shaded area denote terrestrial conservation targets that are under-represented.

APPENDIX 5

RESULTS OF PROTECTED AREA CLASSIFICATION WORKSHOP

The primary objective of the focus groups was:

To generate recommendations for revising Jamaica's national protected area categories, inclusive of adding new categories, by harmonising the country's existing protected area categories with international classifications represented by the International Union for the Conservation of Nature (IUCN) Protected Area Management Categories.

To achieve this objective, two separate focus groups—one comprised of government stakeholders and another comprised of non-governmental organisations (NGO) representatives—were convened. Each group was facilitated through a process of re-classifying Jamaica's existing protected area categories into the six IUCN protected area management categories. Where possible, consensus on the fit or equivalence of national categories with those of IUCN was obtained. Where consensus was not possible, differing points of view were recorded for consideration at a later stage. Each focus group was conducted using the same facilitation method and was confined to two hours.

Some parameters that set the framework for discussion included the use of information derived from the 2004 report entitled 'Categorization of Protected Areas in Jamaica' and the assumption that the current national protected area designations would be evaluated for placement into IUCN categories based on the original objectives for which they were designed and not the existing status of the parks. It was also taken into consideration that some national designations such as the National Park and Forest Reserve classifications contain areas that are managed under different IUCN protected area management categories. In addition, the physical and management dimensions of the IUCN category definitions were interpreted based on appropriateness for Jamaica as an island system.

Below is a summary of the outcomes of the discussions from the government and NGO focus groups.

- 1) **Use of "Protected Areas"** – There was consensus in both groups that the term "Protected Areas" was used as a generic term to refer to all areas that are under some form of protection regardless of the enabling mechanism. Under the current system, both groups did not classify the term "Protected Areas" under any IUCN management category but instead assigned it to denote overarching classification under which all protected area categories occur.
- 2) **Use of "Conservation Areas"** – There was agreement in both groups that Conservation Areas were not, in fact, spatially explicit areas but rather a type of designation used for zoning within planned development activities. Conservation areas occur within a larger area of development and where activities are required to be implemented in a manner that preserves natural features. In this regard, a conservation area can take the form of any of the classified protected area categories and, therefore, was not classified under the IUCN nomenclature.
- 3) **Consolidation in Category I Strict Nature Reserve (IA) and Wilderness Area (IB)** – Both sets of stakeholders did not place any national protected area category under the wilderness classification (IB) based on the assumption that only a very minimal extent of Jamaica's forest would meet the condition requirements for this category. Moreover, given the expanse of human activities on an island ecosystem, remaining wilderness areas would be difficult to maintain as such. It was agreed however, that some Forest Reserves do function as protected areas maintained in as natural a state as possible while allowing for low impact activities such as monitoring, research and other scientific uses. These Forest Reserves would fall under IUCN Category IA and, presumably, represent areas of the least human disturbance in Jamaica.

- 4) **Consolidation in Category II National Park** – Despite the vague definition for the National Park designation in Jamaica, both sets of stakeholders concurred that this category should be subsumed under IUCN Category II. Also included in Category II is the Marine Park designation, with particular reference to the Negril area, and some Forest Reserves. All three national designations were placed under Category II to reflect the dual management focus on preserving unique natural features in these areas, while allowing the public to benefit through highly limited use or access associated with low-impact recreational activities.
- 5) **Consolidation in Category III National Monument** – In general, there was extensive discussion regarding Jamaica's monument classifications as they often include man-made infrastructures of cultural significance in addition to unique natural features that are of equal significance to the country's heritage. Recommendations for treatment of heritage and monument designations within biologically oriented protected areas are made separately. However, for the purpose of the focus group exercise, the current definitions which include both natural and man-made elements were considered. The government stakeholders classified the Tree Preservation Order, Protected National Monument, Protected National Heritage and the proposed Protected Cultural and Historical Assets designations under IUCN Category III in capturing biological and anthropological features that are of specific cultural importance. The NGO group included only the Protected National Monument classification with a stipulation that only natural elements provided for under this designation should be considered under Category III.
- 6) **Consolidation in Category IV Habitat/Species Management Area** – In addition to Category III, the government stakeholder group also placed the Tree Preservation Area, Protected National Monument, Protected National Heritage and the proposed Protected Cultural and Historical Assets designations under Category IV citing the fact that these protected areas can often harbour specific species or habitat types. The group also included some Forest Reserves, particularly those with restoration objectives, Marine Protected Areas and Fish Sanctuaries. The group used the Game Sanctuary designation interchangeably with the Game Reserve classification which was also placed in Category IV. The NGO group, meanwhile, included only Forest Reserve, Fish Sanctuary and the Morant and Pedro Cay designations under Category IV as sites whose management is oriented towards specific habitat types or species.
- 7) **Consolidation in Category V Protected Landscape or Seascape** – The NGO group subsumed the Environmental Protection Area and proposed Forest Management Area designations in Category V that encompasses large-scale areas with allowable human uses compatible with the environment. The government stakeholder group did not classify any protected area types under this category.
- 8) **Consolidation in Category VI Managed Resource Protected Area** – This IUCN Category included the Environmental Protected Area (or Environmental Protection Area) classification used for only one site in Negril, Morant and Pedro Cays and a proposed Forest Management Area designation, all of which are designed and managed specifically for sustainable use of resources. The National Park and Marine Park designations recurred in Category VI as some of these types of parks in Jamaica allow and are managed for traditional or subsistence use of resources. It was noted that the NGO discussion group used the Marine Protected Area classification interchangeably with the Marine Park term and, hence, was subsumed under this category as well.
- 9) **Other Designations** – It was agreed in both stakeholder groups that the Watershed Protection, Foreshore, Ramsar Site and Public Parks and Gardens were not protected area designations per se and so should not be classified under any of the IUCN categories.
- 10) **Unclassified Protected Area Designations** – While the government stakeholder group was able to classify all of Jamaica's protected area types into IUCN categories, the NGO stakeholder group identified several types as unclassifiable.

- The Tree Preservation Order (referred also as Tree Preservation Area) was not classified because it could not be agreed whether such a site would constitute a functional protected area on its own. Moreover, the order for tree preservation is reversible and, therefore, does not offer any long-term or permanent guarantee for protection.
- The Game Sanctuary (also Game Reserve) designation was also not classified. It was discussed that all Forest Reserves in Jamaica are, in fact, Game Sanctuaries under the Wildlife Protection Act. In this regard, the Forest Reserve designation which has been classified into IUCN categories, by default would include game management objectives. However, not all Game Sanctuaries are Forest Reserves and as a result, some would require special management which the group felt was not defined in any of the IUCN Categories.
- The Protected National Monument designation, while included under Category III, was also set aside as a potential exclusion with the argument that areas under this classification include culturally significant sites that are not of value to the conservation of biodiversity. The same was discussed for the Protected National Heritage designation.
- Some members of the group identified the Conservation Area term as a designation that does not lend itself to any of the IUCN categories.
- Some members of the group consider Public Parks and Gardens as a protected area designation that does not fit into any IUCN categories primarily because such areas can be comprised of ornamental, non-native and introduced fauna that do not contribute to biodiversity conservation.

The outcomes of the government and NGO stakeholder focus groups show that there is functional compatibility between Jamaica's national protected area classifications and the internationally accepted IUCN protected area management categories.

The process generated useful discussion on Jamaica's current protected areas system framework as well as recommendations for how they might be consolidated into the IUCN categories for future use in the classification and management of Jamaica's network of protected areas. Some important considerations for moving this consolidation process forward include a critical assessment of the definitions and management objectives of national protected area designations that will serve as the basis for further harmonisation with IUCN adapted categories and, in the future, enable their reclassification into the new system. In some cases, it was recognised that revisions to some definitions may be necessary for the categories to be appropriate for Jamaica. Other factors to consider are the associated policies that enable and legitimise the protected areas system. While the recommended protected area categories may provide guidelines for classification and management, review and adaptation of the protected areas policy framework is critically important to allow the new system to exist and function. In the interim, the consolidated protected areas system will be reviewed and critiqued by a broader group of stakeholders as part of a continuing effort to socialise the system and eventually gain approval for its implementation.

APPENDIX 6

PROTECTED AREA PRIORITIZATION WORKSHOP RESULTS

NEGAR Protected Area Site Prioritisation Workshop – 22nd July 2008 - held at The Nature Conservancy Jamaica office

The prioritisation workshop was chaired by Mr Dayne Buddo, Co-chair of the EWG. The workshop purpose was to provide to the PAC a list of the recommended sites for adding to the protected areas system that shows where emphasis should be placed first. That is, prioritising the sites for actions to be taken. Approximately 20 stakeholders were present representing NGOs and government entities at national and local level and also knowledgeable individuals and experts in biodiversity related matters. Handouts and the basis of discussion were 2 tables and their associated maps: 1. Table of relative threat levels and (2) relative biodiversity indices (RBI) of the 31 areas identified as gaps in the protected area network; and maps of the integrated threat analysis and RBI per site.

At a workshop held at Urban Development Corporation in May 2008 there was an ‘informal’ prioritisation exercise done, applying a prioritisation tool developed by the consultants BlueMaris Ventures. Whilst trying to apply the tool as it was presented, it became apparent that the results favoured those sites recommended by persons who were able to state most convincingly the reasons for their site to be prioritised, and most persons felt that this method to prioritise was much too subjective to be defended in any fora, hence the need for another workshop based on analysis of data.

Based on the last workshop in May 2008, the presence of biodiversity was deemed to be the highest means of ranking a site. Hence the development of the RBI for Jamaica’s recommended protected area sites to be added to the system. There was also great interest in the matter of threats and using this to guide actions, hence this was the next layer of additional information generated by Miss Kimberly John and Mr Owen Evelyn to assist in analysing the sites. They jointly presented the tables and maps for discussion.

Feasibility as a ranking means was discussed at the meeting and the participants felt very strongly that any ranking of sites must include feasibility. At the workshop a ranking system was developed and approved for use, applied to the 31 sites under consideration and integrated into the tables.

The Excel tables were formulated to rank based on biodiversity, feasibility and threat status of all 31 sites. The group agreed that biodiversity was the highest priority concern for them and that of the 3 rankings, the biodiversity ranking took pre-eminence.

Following are the tables showing the results of the prioritisation exercise.

Final Integrated Feasibility Rankings

				Threat Level*					Biodiversity Level**		Feasibility			
1	Negril PA Add-on	Add-on to protected area	7,863.0	3	5	3.8	292,130.0	37.2	1.05	0.15	0			
24	Former Area 31 - Moneague ???	Standalone Priority	621.5	4	5	4.0	27,860.0	44.8	0.12	0.00	0			
2	Montego Bay Add-on	Add-on to protected area	4,960.7	3	7	3.8	207,818.0	41.9	0.41	0.04	3			3
4	Forest Reserve Add-on	Add-on to protected area	1,189.4	3	4	3.1	40,628.0	34.2	0.05	0.00	1	1	1	3
10	Portland Bight Add-on	Add-on to protected area	2,871.1	3	6	4.4	141,465.0	49.3	0.22	0.01	1	1	1	3
23	Former Area 7 - Middle Buxton	Standalone Priority	9,606.4	3	5	3.1	331,173.0	34.5	0.28	0.05	1	1	1	3
7	Rio Grande	Add-on to protected area	6,165.9	3	5	3.3	229,340.0	37.2	1.13	0.13	1	2	1	4
8	East St. Thomas	Add-on to protected area	3,338.0	3	5	3.6	132,262.0	39.6	0.31	0.02	1	2	1	4
3	Cockpit Country Add-on	Add-on to protected area	48,321.5	3	6	3.5	1,848,490.0	38.3	6.68	5.35	2	2	1	5
6	Ocho Rios Marine Add-on 2	Add-on to protected area	1,352.1	3	5	3.5	51,729.0	38.3	0.36	0.01	1	2	2	5
20	Success St. James	Standalone Priority	3,619.4	3	5	3.1	125,782.0	34.8	0.23	0.01	1	2	2	5
22	Bluefield Whitehouse	Standalone Priority	11,649.6	3	6	3.7	473,136.0	40.6	1.18	0.25	2	2	1	5
26	Canoe Valley Lovers Leap	Standalone Priority	17,369.8	3	5	3.5	661,983.0	38.1	2.49	0.77	1	2	2	5
29	Pedro Bank and Cays	Standalone Priority	14,731.7	N/A	N/A	N/A	N/A	N/A	0.43	0.11	2	2	1	5
14	Driver's River	Triple Priority Overlap	21,234.8	3	7	3.3	767,837.0	36.2	3.17	1.22	2	2	2	6
13	Area 11	Triple Priority Overlap	17,198.6	3	6	3.5	669,255.0	38.9	3.86	3.06	2	3	2	7
17	Dolphin Head	Standalone Priority	12,731.9	3	7	3.7	517,049.0	40.6	1.79	0.41	2	2	3	7
25	Former Area 16 - River Head	Standalone Priority	17,287.0	3	6	4.3	819,488.0	47.4	2.46	0.77	2	2	3	7
28	Sligoville/Islington	Standalone Priority	48,066.6	3	6	4.1	2,210,790.0	46.0	2.21	1.94	2	3	2	7
30	Yallahs	Standalone Priority	14,982.0	3	7	4.1	678,421.0	45.3	2.18	0.60	2	2	3	7
15	St. Thomas Wetlands	Double Priority Overlap	15,983.3	3	6	4.0	693,723.0	43.4	2.55	0.74	3	3	2	8
5	Ocho Rios Marine Add-on	Add-on to protected area	5,430.7	3	6	4.1	245,038.0	45.1	0.29	0.03	3	3	3	9
9	West St. Thomas	Add-on to protected area	5,053.5	3	4	3.5	195,015.0	38.6	1.59	0.15	3	3	3	9
11	Black River Complex	Triple Priority Overlap	39,823.5	3	5	3.5	1,540,940.0	38.7	6.51	4.59	3	3	3	9
12	North Coast Forest	Triple Priority Overlap	48,558.4	3	6	3.7	1,956,230.0	40.3	2.56	0.80	3	3	3	9
16	Spinal Forest Manchester	Double Priority Overlap	23,893.4	3	5	3.3	871,077.0	36.5	3.14	1.30	3	3	3	9
18	East Dolphin Head	Standalone Priority	6,958.1	3	5	3.1	240,643.0	34.6	0.75	0.09	3	3	3	9
19	Area 25 - Montpelier/Roehampton	Standalone Priority	4,158.9	3	5	3.5	160,986.0	38.7	0.15	0.01	3	3	3	9
21	St. James Coastal	Standalone Priority	3,351.3	3	5	3.6	48,748.0	14.5	0.23	0.01	3	3	3	9
27	Harris Savannah	Standalone Priority	11,565.6	4	6	4.1	521,374.0	45.1	0.41	0.09	3	3	3	9
31	East Yallahs	Standalone Priority	18,174.4	3	6	3.6	734,026.0	40.4	1.36	0.45	3	3	3	9
ID	NAME	CATEGORY	Area (ha)	MIN	MAX	MEAN	SUM	SUM/area	RBI(T1)	RBN(T1)	Protection*	Cost	Rehab/Restore	SUM
Mean values:						3.6		39.4		1.6	0.8			6

Note:

*Threat Level: This value is based on the integrated cost surface which is a GIS-based representation of the cumulative levels of human activities that threaten terrestrial, freshwater and marine biodiversity. The cost surface values are based on a relative intensity and geographical influence of elements such as agriculture, dams, urbanization, tourism zones and hotels, roads, industry, and population density. The threat levels for each conservation area were determined by calculating the zonal statistics for each area based on the cost raster in ArcGIS. Outputs of this calculation include the minimum and maximum cost values across the conservation area, the mean and sum were also determined. The sum cost was then divided by the area to generate an area-weighted threat intensity values across each conservation area.

In this case the mean cost value is 3.6 and the mean area-weighted value is 39.3.

**Biodiversity Level: This value is based on the Relative Biodiversity Index (RBI) which quantifies the area-weighted relative contribution of each conservation area compared to the total distribution of each conservation target. The RBI is a calculation of the proportion of the length, area and number of occurrences of each conservation target present in the conservation area. Higher RBI sum scores (> 1) imply that there is a greater abundance or extent of the targets than is expected for the conservation area size, in comparison to the rest of the landscape. The RBN (T1) is the normalized RBI value average based on the sum of total number of targets found across the landscape (i.e. total landscape).

As such an:

RBI = 1 Complement of targets is proportional to the area of the conservation unit

RBI > 1 Complement of targets is overrepresented in the conservation unit

RBI < 1 Complement of targets is underrepresented in the conservation unit

In this case the total landscape area (land and sea) is 5,493,676 ha. The average RBI(T1) is 1.61 and the average RBN(T1) is 0.75

Relative Threat Levels and Biodiversity Indices of Areas Identified as Gaps in the Protected Area Network: Final Priorities

				Threats		Biodiversity		Feasibility	
ID	NAME	CATEGORY	Area (ha)	SUM/area	Threat Rank	RBI(T1)	Biodiversity Rank		Feasibility Rank
14	Driver's River	Triple Priority Overlap	21,234.8	36.2	1.0	3.17	2.00	6	2
16	Spinal Forest Manchester	Double Priority Overlap	23,893.4	36.5	1.0	3.14	2.00	9	3
1	Negril PA Add-on	Add-on to protected area	7,863.0	37.2	1.0	1.05	1.00	0	1
4	Forest Reserve Add-on	Add-on to protected area	1,189.4	34.2	1.0	0.05	1.00	3	1
23	Former Area 7 - Middle Buxton	Standalone Priority	9,606.4	34.5	1.0	0.28	1.00	3	1
7	Rio Grande	Add-on to protected area	6,165.9	37.2	1.0	1.13	1.00	4	2
20	Success St. James	Standalone Priority	3,619.4	34.8	1.0	0.23	1.00	5	2
18	East Dolphin Head	Standalone Priority	6,958.1	34.6	1.0	0.75	1.00	9	3
21	St. James Coastal	Standalone Priority	3,351.3	14.5	1.0	0.23	1.00	9	3
3	Cockpit Country Add-on	Add-on to protected area	48,321.5	38.3	2.0	6.68	3.00	5	2
11	Black River Complex	Triple Priority Overlap	39,823.5	38.7	2.0	6.51	3.00	9	3
26	Canoe Valley Lovers Leap	Standalone Priority	17,369.8	38.1	2.0	2.49	2.00	5	2
13	Area 11	Triple Priority Overlap	17,198.6	38.9	2.0	3.86	2.00	7	3
15	St. Thomas Wetlands	Double Priority Overlap	15,983.3	43.4	2.0	2.55	2.00	8	3
12	North Coast Forest	Triple Priority Overlap	48,558.4	40.3	2.0	2.56	2.00	9	3
2	Montego Bay Add-on	Add-on to protected area	4,960.7	41.9	2.0	0.41	1.00	3	1
8	East St. Thomas	Add-on to protected area	3,338.0	39.6	2.0	0.31	1.00	4	2
6	Ocho Rios Marine Add-on 2	Add-on to protected area	1,352.1	38.3	2.0	0.36	1.00	5	2
22	Bluefield Whitehouse	Standalone Priority	11,649.6	40.6	2.0	1.18	1.00	5	2
17	Dolphin Head	Standalone Priority	12,731.9	40.6	2.0	1.79	1.00	7	3
9	West St. Thomas	Add-on to protected area	5,053.5	38.6	2.0	1.59	1.00	9	3
19	Area 25 - Montpelier/Roehampton	Standalone Priority	4,158.9	38.7	2.0	0.15	1.00	9	3
31	East Yallahs	Standalone Priority	18,174.4	40.4	2.0	1.36	1.00	9	3
25	Former Area 16 - River Head	Standalone Priority	17,287.0	47.4	3.0	2.46	2.00	7	3
24	Former Area 31 - Moneague ???	Standalone Priority	621.5	44.8	3.0	0.12	1.00	0	1
10	Portland Bight Add-on	Add-on to protected area	2,871.1	49.3	3.0	0.22	1.00	3	1
28	Sligoville/Islington	Standalone Priority	48,066.6	46.0	3.0	2.21	1.00	7	3
30	Yallahs	Standalone Priority	14,982.0	45.3	3.0	2.18	1.00	7	3
5	Ocho Rios Marine Add-on	Add-on to protected area	5,430.7	45.1	3.0	0.29	1.00	9	3
27	Harris Savannah	Standalone Priority	11,565.6	45.1	3.0	0.41	1.00	9	3
29	Pedro Bank and Cays	Standalone Priority	14,731.7	N/A		0.43	1.00	5	2
				39.4	1.6		6		

Relative Threat Levels and Biodiversity Indices of Areas Identified as Gaps in the Protected Area Network: Feasibility First

Unique_ID	NAME	CATEGORY	Threat Rank	Biodiversity Rank	Feasibility Rank
1	Negril PA Add-on	Add-on to protected area	1.0	1.00	1
4	Forest Reserve Litchfield	Add-on to protected area	1.0	1.00	1
23	Former Area 7 - Middle Buxton	Standalone Priority	1.0	1.00	1
2	Montego Bay Add-on	Add-on to protected area	2.0	1.00	1
24	Former Area 31 - Moneague ???	Standalone Priority	3.0	1.00	1
10	Portland Bight Add-on	Add-on to protected area	3.0	1.00	1
3	Cockpit Country Add-on	Add-on to protected area	2.0	3.00	2
14	Driver's River	Triple Priority Overlap	1.0	2.00	2
26	Canoe Valley Lovers Leap	Standalone Priority	2.0	2.00	2
7	Rio Grande	Add-on to protected area	1.0	1.00	2
20	Success St. James	Standalone Priority	1.0	1.00	2
8	East St. Thomas	Add-on to protected area	2.0	1.00	2
6	Ocho Rios Marine Add-on 2	Add-on to protected area	2.0	1.00	2
22	Bluefield Whitehouse	Standalone Priority	2.0	1.00	2
29	Pedro Bank and Cays	Standalone Priority		1.00	2
11	Black River Complex	Triple Priority Overlap	2.0	3.00	3
16	Spinal Forest Manchester	Double Priority Overlap	1.0	2.00	3
13	Area 11	Triple Priority Overlap	2.0	2.00	3
15	St. Thomas Wetlands	Double Priority Overlap	2.0	2.00	3
12	North Coast Forest	Triple Priority Overlap	2.0	2.00	3
25	Former Area 16 - River Head	Standalone Priority	3.0	2.00	3
18	East Dolphin Head	Standalone Priority	1.0	1.00	3
21	St. James Coastal	Standalone Priority	1.0	1.00	3
17	Dolphin Head	Standalone Priority	2.0	1.00	3
9	West St. Thomas	Add-on to protected area	2.0	1.00	3
19	Area 25 - Montpelier/Roehampton	Standalone Priority	2.0	1.00	3
31	East Yallahs	Standalone Priority	2.0	1.00	3
28	Sligoville/Islington	Standalone Priority	3.0	1.00	3
30	Yallahs	Standalone Priority	3.0	1.00	3
5	Ocho Rios Marine Add-on	Add-on to protected area	3.0	1.00	3
27	Harris Savannah	Standalone Priority	3.0	1.00	3

Relative Threat Levels and Biodiversity Indices of Areas Identified as Gaps in the Protected Area Network: Biodiversity First

Unique_ID	NAME	CATEGORY	Threat Rank	Biodiversity Rank	Feasibility Rank
3	Cockpit Country Add-on	Add-on to protected area	2.0	3.00	2
11	Black River Complex	Triple Priority Overlap	2.0	3.00	3
14	Driver's River	Triple Priority Overlap	1.0	2.00	2
16	Spinal Forest Manchester	Double Priority Overlap	1.0	2.00	3
26	Canoe Valley Lovers Leap	Standalone Priority	2.0	2.00	2
13	Area 11	Triple Priority Overlap	2.0	2.00	3
15	St. Thomas Wetlands	Double Priority Overlap	2.0	2.00	3
12	North Coast Forest	Triple Priority Overlap	2.0	2.00	3
25	Former Area 16 - River Head	Standalone Priority	3.0	2.00	3
1	Negril PA Add-on	Add-on to protected area	1.0	1.00	1
4	Forest Reserve Litchfield	Add-on to protected area	1.0	1.00	1
23	Former Area 7 - Middle Buxton	Standalone Priority	1.0	1.00	1
7	Rio Grande	Add-on to protected area	1.0	1.00	2
20	Success St. James	Standalone Priority	1.0	1.00	2
18	East Dolphin Head	Standalone Priority	1.0	1.00	3
21	St. James Coastal	Standalone Priority	1.0	1.00	3
2	Montego Bay Add-on	Add-on to protected area	2.0	1.00	1
8	East St. Thomas	Add-on to protected area	2.0	1.00	2
6	Ocho Rios Marine Add-on 2	Add-on to protected area	2.0	1.00	2
22	Bluefield Whitehouse	Standalone Priority	2.0	1.00	2
17	Dolphin Head	Standalone Priority	2.0	1.00	3
9	West St. Thomas	Add-on to protected area	2.0	1.00	3
19	Area 25 - Montpelier/Roehampton	Standalone Priority	2.0	1.00	3
31	East Yallahs	Standalone Priority	2.0	1.00	3
24	Former Area 31 - Moneague ???	Standalone Priority	3.0	1.00	1
10	Portland Bight Add-on	Add-on to protected area	3.0	1.00	1
28	Sligoville/Islington	Standalone Priority	3.0	1.00	3
30	Yallahs	Standalone Priority	3.0	1.00	3
5	Ocho Rios Marine Add-on	Add-on to protected area	3.0	1.00	3
27	Harris Savannah	Standalone Priority	3.0	1.00	3
29	Pedro Bank and Cays	Standalone Priority		1.00	2

Relative Threat Levels and Biodiversity Indices of Areas Identified as Gaps in the Protected Area Network: Threat First

Unique_ID	NAME	CATEGORY	Threat Rank	Biodiversity Rank	Feasibility Rank
14	Driver's River	Triple Priority Overlap	1.0	2.00	2
16	Spinal Forest Manchester	Double Priority Overlap	1.0	2.00	3
1	Negril PA Add-on	Add-on to protected area	1.0	1.00	1
4	Forest Reserve Litchfield	Add-on to protected area	1.0	1.00	1
23	Former Area 7 - Middle Buxton	Standalone Priority	1.0	1.00	1
7	Rio Grande	Add-on to protected area	1.0	1.00	2
20	Success St. James	Standalone Priority	1.0	1.00	2
18	East Dolphin Head	Standalone Priority	1.0	1.00	3
21	St. James Coastal	Standalone Priority	1.0	1.00	3
3	Cockpit Country Add-on	Add-on to protected area	2.0	3.00	2
11	Black River Complex	Triple Priority Overlap	2.0	3.00	3
26	Canoe Valley Lovers Leap	Standalone Priority	2.0	2.00	2
13	Area 11	Triple Priority Overlap	2.0	2.00	3
15	St. Thomas Wetlands	Double Priority Overlap	2.0	2.00	3
12	North Coast Forest	Triple Priority Overlap	2.0	2.00	3
2	Montego Bay Add-on	Add-on to protected area	2.0	1.00	1
8	East St. Thomas	Add-on to protected area	2.0	1.00	2
6	Ocho Rios Marine Add-on 2	Add-on to protected area	2.0	1.00	2
22	Bluefield Whitehouse	Standalone Priority	2.0	1.00	2
17	Dolphin Head	Standalone Priority	2.0	1.00	3
9	West St. Thomas	Add-on to protected area	2.0	1.00	3
19	Area 25 - Montpelier/Roehampton	Standalone Priority	2.0	1.00	3
31	East Yallahs	Standalone Priority	2.0	1.00	3
25	Former Area 16 - River Head	Standalone Priority	3.0	2.00	3
24	Former Area 31 - Moneague ???	Standalone Priority	3.0	1.00	1
10	Portland Bight Add-on	Add-on to protected area	3.0	1.00	1
28	Sligoville/Islington	Standalone Priority	3.0	1.00	3
30	Yallahs	Standalone Priority	3.0	1.00	3
5	Ocho Rios Marine Add-on	Add-on to protected area	3.0	1.00	3
27	Harris Savannah	Standalone Priority	3.0	1.00	3
29	Pedro Bank and Cays	Standalone Priority		1.00	2

APPENDIX 7

NATIONAL BIODIVERSITY RESEARCH AGENDA

This research agenda is derived from the priorities of the National Strategy and Action Plan on Biological Diversity in Jamaica (NBSAP) and the Jamaica Ecoregional Assessment (JERP).

Jamaica's NBSAP was prepared in July 2003 and is being implemented in order to fulfill the nation's obligation as a Party, under Article 6 of the Convention on Biological Diversity. NBSAP research priorities were identified by a "Biodiversity Research Needs" survey which was developed and implemented by the Biodiversity Branch of the National Environment and Planning Agency. The stakeholders surveyed included government agencies having responsibility for the management of some aspects of biodiversity, non-governmental organizations and academic institutions.

The JERP research priorities were also determined through a consultative process including workshops, and questionnaires between 2003 and 2006. The JERP, led by TNC, is a systematic priority-setting exercise which aimed to identify the places and strategies essential for conserving Jamaica's biodiversity. Knowledge gaps in Jamaica's ecosystems, the human activities that impact them and the required conservation strategies were compiled as freshwater, marine, terrestrial and cross-cutting research topics. This JERP framework was preserved in the following table with research activities identified in the NBSAP included in the relevant sections.

Research strategy: In collaboration with the University of the West Indies, and other academic institutions design an applied National Biodiversity Research framework which will underpin and inform Jamaica's biodiversity conservation and management strategies and address important conservation gaps (species, communities, important ecological phenomena)

FRESHWATER RESEARCH	• Biology, distribution and status of Jamaica's endemic and migratory freshwater species, estuarine and riparian communities. • Population dynamics, sustainability and management requirements for economically and nutritionally important freshwater fish and shellfish (mullet- <i>Agnostomus monticola</i> and <i>Joturus pichardi</i>, and the shrimp <i>Macrobrachium</i> spp. and <i>Atya</i> spp.). • Status and distribution of invasive species that harm freshwater systems. • Compilation of a freshwater database of existing ecological and geographical data on freshwater biological systems in Jamaica. • Contribution of ecological products and services provided by freshwater ecosystems to Jamaica's society and economy particularly in priority freshwater conservation areas. • The diversification of fishing practices and commercial rearing of native species towards reducing fishing pressure at important inland fishery sites (e.g. Black River, Rio Grande).
MARINE RESEARCH	• Status of rare, endangered and keystone coastal and pelagic species such as manatees, cetaceans, sharks, turtles, crocodiles • Historic (and current) fish and conch spawning aggregations • Marine micro and meiofauna • Essential breeding, nesting and feeding areas (especially for keystone, rare and endangered species) • Establish a well-documented historic baseline for conservation targets (species, habitats & ecosystems) • Develop a national digital bathymetry dataset. • Effects of ballast water on marine ecology. • To determine the negative and positive human impacts of urbanization on the coastal and marine ecosystem. • To establish and implement a rehabilitation programme for Jamaica's coral reef. • Identify areas for establishing artificial reefs and new marine protected areas including land surveys.
TERRESTRIAL RESEARCH	• Groundtruth southern St. Thomas (and other focal areas) vegetation target status to verify conservation importance. • Develop and test restoration techniques for high priority targets and invasive species control, e.g. Bamboo • Develop project to produce revised terrestrial classification and mapping of vegetation classes • Conduct population status and habitat assessment of the following: ○ Jamaican Boa in northern Jamaica. ○ American crocodile ○ Native orchids (including a germplasm/seed bank) ○ Lignum vitae • Research the commercial propagation of native plant species. • Inventory of endangered and endemic plant species and their habitats.
CROSS-CUTTING RESEARCH PRIORITIES	• Research ecological processes (e.g. migration) and connectivity as a basis for refining and revising protected area boundaries • Further develop and refine the JERP Cost Surface model for use as an applied management (and predictive) tool as well as a research and learning tool for tertiary-level and Integrated Coastal Management training. • Investigate the effects of invasive species in protected areas. [e.g. Green-lipped Mussel- <i>Perna viridis</i>; Mock Orange- <i>Pittosporum</i> spp.; Shiny Cowbird- <i>Molothrus bonariensis</i>; Red-claw crayfish- <i>Cherax quadricarinatus</i>; Wild ginger lily- <i>Hedyechium coronarium</i>; Red bush- <i>Polygonium chinense</i>; White-tailed deer- <i>Odocoileus virginianus</i>, Small Indian mongoose- <i>Herpestes javanicus</i> (<i>auropunctatus</i>)] and to prepare for implementation an Alien Invasive Species Plan. • Investigate stress factors affecting critical endangered species (CES). • Identify socio-economic and other issues preventing sustainable fishing practices in marine and inland fishery sites. • Complete inventory of all endangered and endemic biological resources and their habitats.