Jamaica Protected Area Gap Assessment: Freshwater

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Draft, June 13, 2006

INTRODUCTION

Jamaica's Ecoregional Plan aims to identify the conservation areas and strategies necessary for conserving the country's biodiversity. Before updating the conservation area network, existing protected areas were examined against the standards set by the Convention on Biological Diversity (CBD) and other goals. This evaluation of protected area coverage and effectiveness in biodiversity conservation is called a Protected Area Gap Assessment.

Jamaica, as a signatory to the CBD, has committed to protect at least 10% of its terrestrial, freshwater and marine biodiversity in *ecologically representative* protected areas. There have also been recommendations for protection of as much as 30% (IUCN??). This document explains the process and results of the first Gap Assessment for Jamaica's freshwater biodiversity. Furthermore, recommendations are offered for filling the gaps in the protected area network through improved management of existing protected areas and the expansion of the protected area network.

AIM:

The gap assessment was conducted to determine the effectiveness of the current protected area network in the conservation of freshwater biodiversity and thus to identify and recommend freshwater priorities for protection in a revised conservation area network.

DATA SETS:

Protected Areas

Spatial data on the type and location of Jamaica's protected areas were obtained from National Environment and Planning Agency. The GIS layers were first edited to remove protected areas that contained no freshwater biodiversity. The layers were modified to remove areas of overlap which would have resulted in double and in many cases triple counting of the biodiversity in PAs. Because there was considerable spatial overlap among the different protected areas (e.g., most of Blue and John Crow Mountains National Park is also a Forest Reserve), it was necessary to rank the protected areas so that in areas of overlap there would be a primary protected area category followed by a secondary and tertiary if necessary(Table 1). Even then there was still overlap between the Negril Protected Area and Negril Great Morass Protected Area, both of which are declared under the NRCA Act. Consequently the larger of the two, Negril Protected Area was used for the final protected area network shapefile.

Table 1: Jamaica's protected areas

Description	Total Area (Ha)	Number	Management status	*Rank
National and Marine Parks declared under the NRCA Act	316,656	9	Managed by NEPA through NGO delegations. Effectiveness unknown.	1
Forest Reserves declared under Forest Act 1996	99,881.27	166	Managed by the Forestry Department**	2
Game reserves declared under the Wild Life Protection Act	18,959 (provisional)	20	Managed by NEPA (off limits for hunting, wardens present to enforce no-hunting)	3
Fish sanctuary declared under Fishing Industry Act		2	Managed by Fisheries Division	4
Proposed Protected Areas*** (as determined in the 1990 Protected Area System plan)		8		5

* Gap assessment rank- There is considerable overlap between Pas. The ranking system assigns one PA category to areas of overlap.

** Forest Reserves are also designated Game Reserves

***These proposed protected areas are those that are mapped and available from the Protected Areas Branch of the National Environment and Planning Agency. There are several others proposed PAs across the island but these have not been mapped and geo-referenced.

Freshwater Biodiversity

The distribution and status of Jamaica's freshwater biodiversity are yet to be assessed and mapped on an island-wide basis. Therefore, the island's freshwater ecosystems (called targets in ecoregional planning) were used as the basis of the gap assessment. 17 ecologically significant freshwater systems were used to represent Jamaica's total freshwater biodiversity. In order ensure to the representative-ness and ecological significance of these systems, they were developed based on climatic, topographical, hydrological and biogeographical, hydrogeological patterns across Jamaica (John 2005). In many cases, these patterns have produced distinct faunal community distributions across the island, (Hunte 197?)

Table 2: Jamaica's freshwater ecosystems (after John 2005)

Freshwater ecosystem targets	Unstratified freshwater ecosystems	Coarse-scale freshwater ecosystems
Blue mountain High altitude, headwater streams	**High altitude headwater streams**	**Rivers & Streams**
Western Small high altitude headwater streams: non karstic		
Blue mountain Medium-sized streams	**Medium sized streams**	
Western Medium-sized streams: non karstic		
Blue Mountain Large low-altitude streams	**Large low altitude streams**	

Freshwater ecosystem targets	Unstratified freshwater ecosystems	Coarse-scale freshwater ecosystems
Western Large low-altitude streams		
Western Karstic aquatic systems: Karstic streams	**Karstic streams**	
Blue Mountain Coastal springs and streams	**Coastal Springs**	
Western Coastal springs and streams		
Blue Mountain Springs	**Springs**	**Springs**
Western Karstic aquatic systems: Springs		
Blue mountain Freshwater caves	**Freshwater Caves**	**Freshwater caves**
Western Karstic aquatic systems: Freshwater caves		
Blue Mountain Freshwater wetlands	**Freshwater wetlands**	**Freshwater wetlands**
Western Freshwater wetlands		
Blue Mountain Lakes and ponds	**Ponds and lakes**	**Ponds and lakes**
Western Lakes and ponds		

METHODS:

Protected Area Attributes
Three aspects of the Protected Area Network were analysed:

1) **Representation**: indicates whether the target is represented and replicated sufficiently in the PA network. This is measured by the amount and percentage of each target's distribution within each protected area.
2) **Ecological Integrity**: indicates whether the represented targets are in adequate ecological condition and whether factors such as connectivity particularly for freshwater systems are incorporated in the network.
3) **Management**: indicates whether the represented targets are protected in reality by the appropriate management systems.

Protection Benchmarks
The current protected area network was measured against the "10%" target commitment of the Jamaican Government. This target was based on the concept of terrestrial protected areas which does not apply to linear freshwater ecosystems such as rivers and streams and even subterranean systems. However, the freshwater benchmarks will be refined in the future as the conservation requirements of freshwater ecosystems are understood.

A more qualitative standard used in the analysis was "connectivity" which is an important attribute of freshwater ecosystems absolutely critical for their ecological integrity. For this, protected areas with significant freshwater biodiversity were individually evaluated according to how well longitudinal and horizontal connections were preserved in their design.

Freshwater Ecosystem Distribution in PAs
GIS software, specifically SPOT (Spatial Optimisation Tool, TNC 2001), was used to calculate the distribution of freshwater ecosystems in the protected area network. The protected areas shapefile prepared as described above was selected as *planning units* in the SPOT extension in ArcView 3.3. Freshwater ecosystem shapefiles were then extracted (i.e. overlaid and intersected with) the protected area planning units. The amount of each target contained in each protected area was then calculated from the resulting distribution database.

RESULTS:

Representation (Table 4)

10 of 17 freshwater systems are adequately represented in Jamaica's protected area network. This implies that 59% of the island's biodiversity is protected and 41% unprotected. Freshwater ecosystems in the west of the island were relatively well-represented in a network comprising a national park, forest and game reserves. In the east, there were serious gaps. Apart from Blue and John Crow Mountains National Park (BJCMNP) which includes a large proportion of high altitude streams, freshwater systems, such as low altitude streams and wetlands are excluded in the east.

Major Gaps in Blue Mountains

- Blue Mountain large streams
- Blue Mountain lakes and ponds
- Blue Mountain freshwater wetlands
- Blue Mountain coastal streams

Major Gaps in Western limestone complex:

- Western springs
- Western karstic streams
- Western coastal springs

Protection opportunities:
Table 3 outlines significant opportunities for freshwater biodiversity conservation that lie within the existing protected area network. It is expected that any modifications to Jamaica's Protected Area Network would use these protected areas as nuclei.

Table 3: Protected areas containing significant freshwater biodiversity

Category	Representation
National and Marine Parks	1) BJCMNP- A high altitude national park that protects most of the headwater streams (62%) and much of the medium sized low altitude streams (14%) in eastern Jamaica.

Category	Representation
	2) Portland Bight Marine Protected Area- a terrestrial and marine protected area that includes 11% of large streams, 11% ponds and lakes, 7% medium sized streams, freshwater caves and springs in western Jamaica 3) Negril Protected Area- a terrestrial and marine protected area that includes 29% of freshwater wetlands, ponds and lakes (7%) and coastal springs(5%) in western Jamaica
Forest Reserves	1) Rockfort Forest Reserve- This includes 1 of 9 freshwater caves in Blue Mountains 2) Deeside/Peru Mountain Forest Reserves- protect 13 freshwater caves in the Western Limestone Complex
Game reserves	1) The Great Morass Game Reserve, Parottee- includes 5% of Western freshwater wetlands and is < 200m away from Jamaica's largest natural freshwater lake. 2) Upper Morass Black River Game Reserve- includes 11% of Western freshwater wetlands. 3) The Lower Morass Game Reserve- includes 6% of western large streams and 37% of western freshwater wetlands.
Fish sanctuary	1) Bowden Fish Sanctuary- includes only 2% of Blue Mountain Freshwater Wetlands but is surrounded on its landward edge by a small but significant freshwater wetland which is rare in eastern Jamaica.
Proposed Protected Areas**	Although the list of Proposed Protected Areas is incomplete, two proposed areas are outstanding: 1) Wider Black River Wetlands and Coastal Area- includes 11% of Western ponds and lakes. 2) Port Antonio Marine Protected Area- includes 3 of 9 eastern freshwater caves and 6% of Eastern Coastal streams. Is also adjacent to main stem of Rio Grande, a major eastern river.

Ecological Gaps

Freshwater ecosystems are maintained by a specific combination of five ecological factors:

1) Hydrologic Regime
2) Water physico-chemistry regime
3) Physical habitat conditions
4) Connectivity
5) Biological Composition and Interactions

The PAs mentioned above were not specifically designed to preserve these ecological factors and the integrity of freshwater ecosystems. Furthermore, 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.

Category	Protected Area	Ecological Gaps
National and Marine Parks	4) BJCMNP-	A connection with low altitude streams and coastal areas is required in at least one watershed.
	5) Portland Bight Marine Protected Area	A connection with upstream areas along Rio Minho is required to ensure longitudinal connectivity
	6) Negril Protected Area	Encompasses an entire watershed.
Forest Reserves	1) Rockfort Forest Reserve-	Connections are unclear
	2) Deeside/Peru Mountain Forest Reserves-	Connections with downstream Martha Brae and Black River are required to ensure longitudinal connectivity. NB. Black River connectivity and hydrological regime may be compromised by the Magotty Dam.
Game reserves	1) The Great Morass Game Reserve, Parottee-	Excludes major freshwater ecosystem (Wallywash pond) <200m from the PA.
	2) Upper Morass Black River Game Reserve-	Connections with upstream and downstream Black River are required to ensure longitudinal connectivity.
	3) The Lower Morass Game Reserve-	Connections with upstream Black River and/or YS River are required to ensure longitudinal connectivity.
Fish sanctuary	1) Bowden Fish Sanctuary-	Connections with inland wetlands and streams are required to ensure lateral and longitudinal connectivity.
Proposed Protected Areas	1) Wider Black River Wetlands and Coastal Area-	Connections with upstream Black River and/or YS River are required to ensure longitudinal connectivity
	2) Port Antonio Marine Protected Area-	

Management gaps

This assessment does not include an in-depth analysis of protected management gaps. Evaluating the management effectiveness of Jamaica's protected area system should ideally be a collaborative and participatory process. According to IUCN this evaluation should include the following representatives with varying degrees of involvement: local managers, senior agency managers, different tiers within government agencies, local communities, indigenous groups, NGO's, donors, international convention staff, and private sector bodies involved in PA management (Hocking *et al*. 2000).

Table 4: Framework for assessing management effectiveness of protected areas and protected area systems (World Commission on Protected Areas)

Elements of evaluation	Context	Planning	Input	Process	Output	Outcome
Explanation	*Where are we now?* Assessment of importance, threats and policy environment	*Where do we want to be?* Assessment of protected area design and planning	*What do we need?* Assessment of resources needed to carry out management	*How do we go about it?* Assessment of the way in which management is conducted	*What were the results?* Assessment of the implementation of management programmes and actions; delivery of products and services	*What did we achieve?* Assessment of the outcomes and the extent to which they achieved objectives
Criteria that are assessed	Significance Threats Vulnerability National context	Protected area legislation and policy Protected area system design Reserve design Management planning	Resourcing of agency Resourcing of site Partners	Suitability of management processes	Results of management actions Services and products	Impacts: effects of management in relation to objectives
Focus of evaluation	Status	Appropriateness	Resources	Efficiency and appropriateness	Effectiveness	Effectiveness and appropriateness

Nevertheless, given that protected areas in Jamaica were not designed to sustain the ecological integrity of freshwater systems, a more fundamental gap assessment may be appropriate. Such a preliminary assessment of management gaps in Jamaica may ask simple questions, such as "Is there a management plan for the protected area?", "Does the plan provide for the management and abatement of threats to freshwater systems within the protected area?", "Are freshwater systems being monitored for their ecological integrity?"

SUMMARISED FINDINGS AND RECOMMENDATIONS

The results of this gap analysis indicate that Jamaica's protected area network will not protect the island's freshwater biodiversity without upgrading the network design and management systems. This is because the protected area network

was not designed with freshwater ecosystem functionality in mind although the integrity of freshwater ecosystems and security of freshwater supplies are so intimately linked. However, this can be corrected because a few protected areas already offer some incidental protection (such as BJCMNP, Portland Bight and Negril Protected Area). These protected areas will form the building blocks of a more representative protected area network.

The main findings of the gap assessment are:

1) **Most FW habitats under or unrepresented in Jamaica's protected area network.**
2) **The current PA network fragments freshwater systems and does not preserve the longitudinal and lateral connectivity of freshwater ecosystems.**
3) **Management effectiveness of existing Protected Area Network with respect to freshwater systems is uncertain but is likely to be a major gap.**

Recommendations:

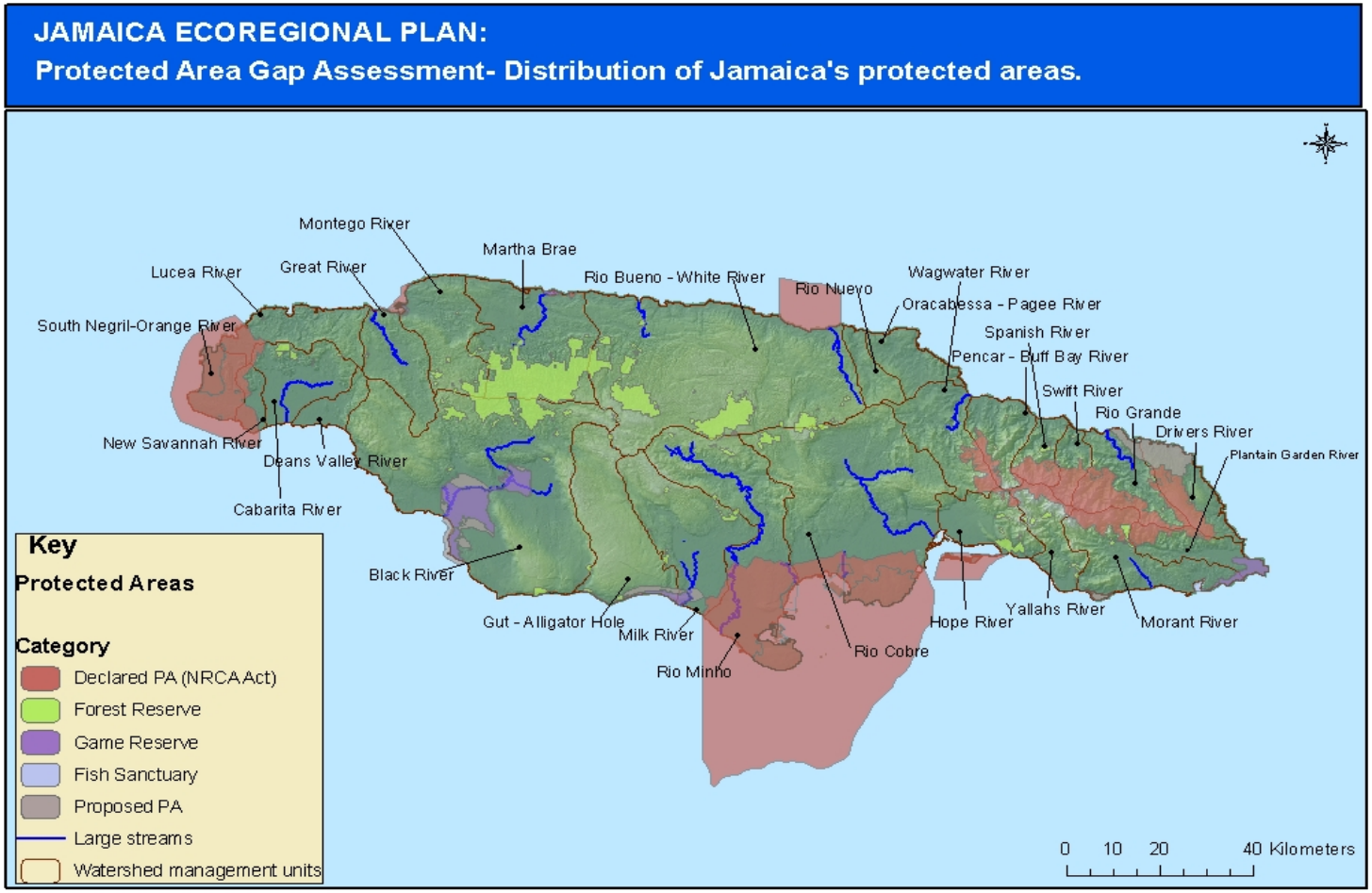
Table 5: Recommendations for addressing gaps in Jamaica's protected area system with respect to Freshwater systems

Recommendations	Conservation Actions
1) Include un-protected freshwater systems in Protected Area Network across at least 10% of their distribution	Explore existing and future mechanisms for protecting entire river corridors (as protected areas or under watershed protection act, development orders, private land conservation)
2) Redesign established Protected Areas using a watershed approach to restore lateral and longitudinal connectivity in freshwater ecosystems (See figure 3 below).	Incorporate lower Rio Grande/ Drivers River into wider Blue and John Crow Mountains Protected Area.
	Protect from Cockpit Country north into downstream Martha Brae watershed and/or south into Black River watershed.
3) Assess and improve the management effectiveness of protected areas with respect to freshwater ecosystems.	Train water resource management and protected area practitioners in freshwater conservation methods (planning, implementation and monitoring).

Table 6: Details of freshwater target distributions across protected area types.

	Target name	Declared PA (NRCA Act)	Fish Sanctuary	Forest Reserve	Game Reserve	Proposed PA	All Present PAs	All Present and Proposed PAs
Blue Mountains	High altitude, headwater streams	61.82	0.00	2.55	0.00	0.00	**64.37**	**64.37**
	Medium-sized streams	13.77	0.02	1.45	0.60	1.01	**15.84**	**16.85**
	Large low-altitude streams	0.00	0.00	0.48	0.00	0.00	**0.48**	**0.48**
	Coastal springs and streams	0.54	0.00	0.45	1.72	5.54	**2.70**	**8.25**
	Freshwater wetlands	0.00	1.67	0.00	0.00	0.00	**1.67**	**1.67**
	Lakes and ponds	0.00		0.00	0.00	0.00	**0.00**	**0.00**
	Springs	7.34	0.00	2.75	0.00	0.92	**10.09**	**11.01**
	Freshwater caves	0.00	0.00	11.11	0.00	33.33	**11.11**	**44.44**
	Small high altitude headwater streams: non karstic	0.00	0.00	59.48	0.00	0.00	**59.48**	**59.48**
	Large low-altitude streams	10.95	0.00	1.43	9.64	2.53	**22.02**	**24.54**
	Karstic aquatic systems: Freshwater caves	5.61	0.00	10.28	0.00	0.93	**15.89**	**16.82**
	Karstic aquatic systems: Springs	6.00	0.00	0.72	0.24	0.48	**6.95**	**7.43**
	Karstic aquatic systems: Karstic streams	4.38	0.00	1.40	0.30	0.73	**6.08**	**6.81**
	Coastal springs and streams	5.08	0.00	0.00	0.08	0.00	**5.16**	**5.16**
	Lakes and ponds	17.76	0.00	0.00	1.50	11.22	**19.26**	**30.48**
	Freshwater wetlands	31.16	0.00	0.04	55.66	2.56	**86.86**	**89.41**
Western limestone	Medium-sized streams: non karstic	9.74	0.00	0.23	3.34	1.17	**13.31**	**14.48**
	C. pengellyi	12.50	0.00	0.00	0.00	37.50	**12.50**	**50.00**
	G. melapleura	0.00	0.00	0.00	0.00	50.00	**0.00**	**50.00**
	G. wrayi	13.33	0.00	0.00	0.00	0.00	**13.33**	**13.33**
	L. melanogaster	4.35	0.00	0.00	13.04	17.39	**17.39**	**34.78**
	P. terrapen	11.11	0.00	0.00	11.11	0.00	**22.22**	**22.22**

Figure 1: Overlay of Jamaica's Protected area and major freshwater systems



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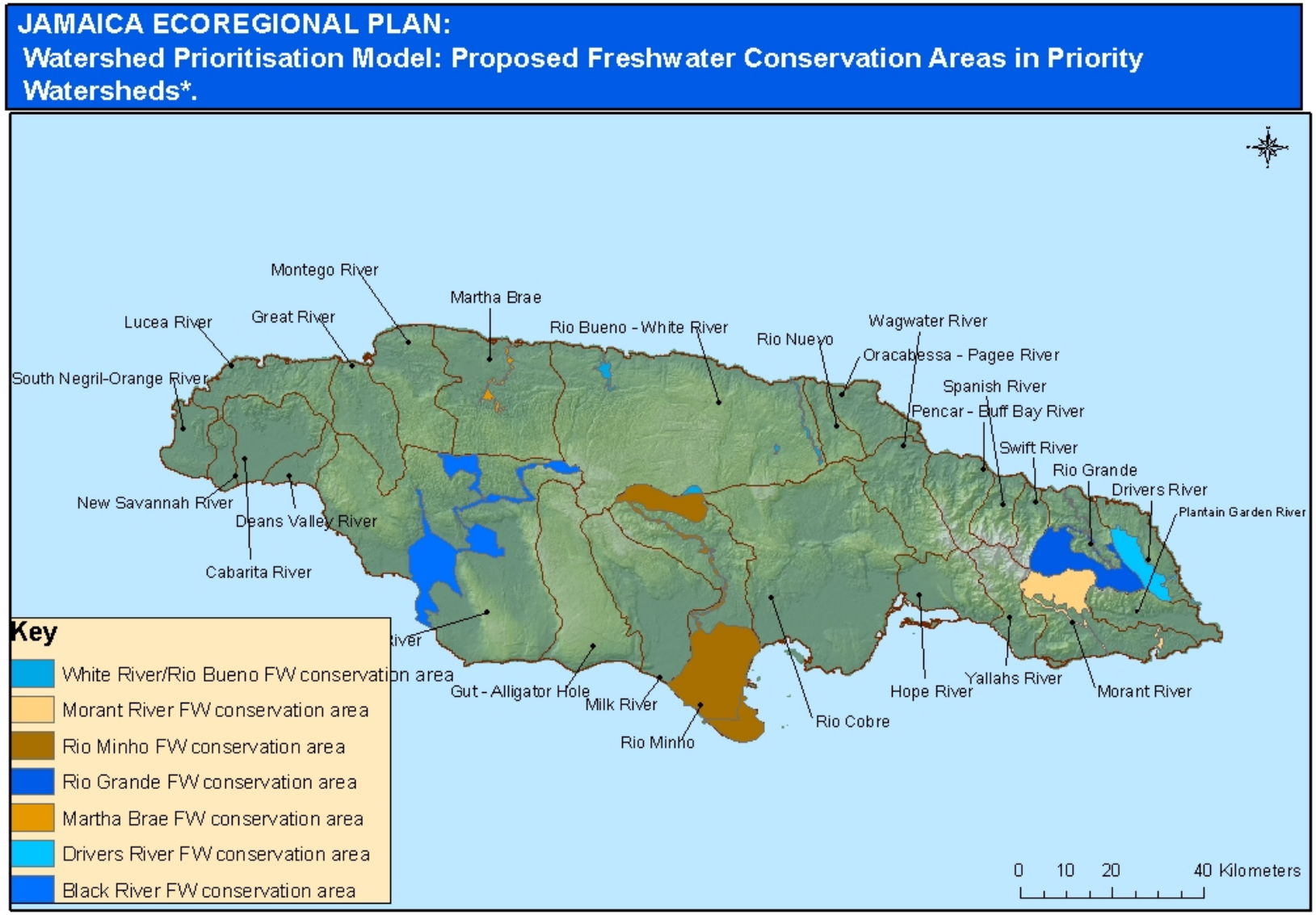
Data Sources: TNC, Forestry Department, Water Resources Authority and National Environment & Planning Agency

Figure 2: Proposed freshwater conservation areas



* Watersheds were prioritised according to their biological richness, ecological integrity and the existence of protected areas (conservation opportunities) in the watershed.

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Data Sources: TNC, Forestry Department, Water Resources Authority and National Environment & Planning Agency

Acknowledgements

Reference List

Hocking, M., Stolton, S. and Dudley, N. (2000) Evaluating Effectiveness: A Framework for Assessing the management of Protected Areas. IUCN, Gland, Switzerland and Cambridge, UK. X + 121pp

Hunte 1978

John 2005