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Rethinking Biodiversity Conservation Effectiveness and Evaluation in the National Protected Areas Systems of Tropical Islands: The Case of Jamaica and the Dominican Republic

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RETHINKING
BIODIVERSITY CONSERVATION EFFECTIVENESS AND EVALUATION
IN THE
NATIONAL PROTECTED AREAS SYSTEMS OF TROPICAL ISLANDS:
THE CASE OF JAMAICA AND THE DOMINICAN REPUBLIC

by

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ABSTRACT

Island conservation theory and practice with regard to conservation of tropical terrestrial biodiversity in protected areas systems has yet to be adequately addressed in conservation literature. This knowledge gap is identified as a key contributor to the adoption of scientific principles for *in situ* biodiversity conservation, and "universal" conservation and protected area management paradigms that are unsuitable for island contexts and geographical scale. The underlying assumption is that "universal" concepts of biodiversity conservation, protected areas management, and evaluation of their effectiveness are transferable to the ecological and socio-economic contexts of tropical islands. The expected outcome of this knowledge transfer is that protected areas managers on tropical islands should be able to effectively conserve biodiversity. The risk of evaluation recommendations proposing unrealistic biodiversity conservation outcomes for protected areas management on tropical islands points to the question of how to assess conservation effectiveness in the tropical island geographic scale and context.

Keeping these considerations in mind, a "two-case" case study was designed to provide a new perspective on the concept of effective biodiversity conservation and its evaluation with respect to tropical islands. The first goal was to provide empirical and theoretical knowledge of the critical components of effective terrestrial biodiversity conservation in national protected areas systems and the second goal was to abstract this knowledge into an island-specific framework for effective biodiversity conservation that can be used to assess the conservation outcomes of protected areas management. The conservation effectiveness framework is a representation of the critical components of effective biodiversity conservation and their relationships. Its development was not

dependent on understanding every characteristic and causal process behind a national protected areas system. Rather, the focus was on the system components whose presence or absence dramatically affected conservation effectiveness.

Four major categories of criteria (i.e. goals/objectives, biophysical outcomes, management institutions and governance) representing effective biodiversity conservation were identified from biogeographical and ecological theories, conservation paradigms for biodiversity, the management paradigms for protected areas and documented protected area experiences related to *in situ* biodiversity conservation in tropical oceanic islands. Taking a contextual, holistic view of the social phenomenon, biodiversity conservation in protected areas systems, a theoretical framework for biodiversity conservation effectiveness in the terrestrial protected areas system of a tropical island was constructed from the identified criteria. Specific propositions of the framework are that the achievement of conservation outcomes is dependent on:

- Critical relationships between concepts of biodiversity conservation, conservation goals and objectives, the associated management institutions and governance of a protected areas system.
- Ecological and socio-economic contexts representative of tropical islands.
- Critical linkages between conservation effectiveness at the system and site levels of protected areas management.

The case study, located in Jamaica and the Dominican Republic, was used to a) validate and revise the theoretically-derived framework for achievement of biodiversity conservation in protected areas system on tropical islands and b) explain how the framework's criteria and indicators can be used to assess conservation effectiveness.

Jamaica presented a smaller fragmented landscape with concentrations of terrestrial biodiversity; a knowledge base inclusive of conservation biology yet under-exposed to the science of protected areas management; adoption of 'universal' concepts of biodiversity, protected area, conservation networks and management effectiveness; and a complex protected areas management structure due to overlapping jurisdictions. The Dominican Republic presented a much larger fragmented landscape with concentrations of terrestrial biodiversity; a knowledge base under-exposed to both conservation biology and the science of protected areas management; adoption of 'universal' concepts of biodiversity, protected area, the World Conservation Union (IUCN) system of protected areas categories and conservation networks; and a centralized protected areas management structure. The study sites in Jamaica included the Blue and John Crow Mountains National Park, Portland Bight Protected Area and Mason River Protected Area with sizes ranging from 495.2 km^2 to 0.49 km^2. The study sites in the Dominican Republic included the Sierra Bahoruco National Park and Laguna Cabral Wildlife Refuge with sizes ranging from 1,126 km^2 to 65 km^2.

The case study methodology, data collection and analysis of this research were oriented towards a qualitative approach. The methodology included a participatory aspect where the inputs of protected area and conservation experts as well as representatives from protected area communities were sought. The research methods for each of the two islands included a review and content analysis of island literatures, biophysical data and information extraction, a Delphi process, community workshops and interviews. Methodological triangulation was used to isolate the critical components of effective

biodiversity conservation in the contexts of the case study locations and to reconstruct a concept of effective biodiversity conservation for tropical islands. Data analysis allowed for causal explanations of conservation outcomes and suggestions for improvement in the management of national protected area systems.

The research findings for both Jamaica and the Dominican Republic indicate that the transferability of 'universal' concepts on *in situ* biodiversity conservation to tropical islands is dependent on the ecological and socio-economic contexts of the islands. The contemporary design of a protected areas system based on ecological representation in conservation networks is not facilitated by the small, highly fragmented landscapes such as that mapped for Jamaica, with restricted distribution ranges for several island species. Traditional conservation values and practices have focused conservation planning on select species and forest ecosystems in both study locations rather than on as wide a range of biodiversity as is practically possible. Conceptual challenges with and a narrow local knowledge base for biodiversity conservation are masked by the assumptions of a 'universal' perspective for *in situ* biodiversity conservation. Consequently, there have been difficulties with application of the IUCN categories in the Dominican Republic and limited identification of conservation outcomes in both study locations. Successful biodiversity conservation is limited to increasing population numbers for the Jamaican Iguana and maintaining the variety of types of forest in both study locations.

The island-sensitive framework that has been developed through this research presents another perspective on biodiversity conservation by:

- Highlighting the critical biogeographical and ecological features, for protected areas design and conservation outcomes that would perpetuate tropical island

biodiversity

- Pointing out the need for more attention to the socio-economic aspects of biodiversity protection and use in the planning and evaluation of biodiversity conservation
- Establishing the importance of harmonizing management of a PAS at national level with management of individual protected sites

The final framework for biodiversity conservation effectiveness in the terrestrial protected areas system of a tropical island is island-sensitive with respect to its biogeographical criteria. However, a claim of island-specificity could not be made for the other criteria which have universal applicability.

Recommendations for *in situ* biodiversity conservation on tropical islands in general, and in particular to Jamaica and the Dominican Republic, are directed to the academic community, conservation educators, protected area managers and policy makers, and international environment and development agencies. Major points include the development and testing of the evaluation framework by conservation scientists over a wider variety of ecological and socio-economic contexts on tropical islands, building the capacity for educating and training protected areas and conservation scientists and practitioners, implementing a policy of periodically evaluating biodiversity conservation outcomes, coordination of conservation planning, enforcement and financing at both the system and site levels of protected areas management, and encouraging the application of island-sensitive evaluation criteria in internationally funded conservation evaluations.

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CONTENTS Page

CONTENTS Page

CONTENTS Page

LIST OF TABLES

LIST OF TABLES

LIST OF TABLES

LIST OF TABLES

LIST OF FIGURES

1. INTRODUCTION

The terrestrial biodiversity of tropical islands, in spite of their high global conservation value, has been under-represented in academic discourse on protected areas systems. Traditionally, academic literature has been biased towards conservation of tropical continental biodiversity such as tropical Africa, South and Central America (e.g. Terborgh et al. 2002, Brandon et al. 1998, Kramer and van Schaik 1997). When an island perspective is taken towards protection of tropical terrestrial biodiversity, it is usually with respect to i) "habitat islands" or ii) the biogeographical distinctiveness of islands. For over three decades, the former viewpoint has been widely discussed in both academic and conservation practitioner circles (Kingsland 2002, Shafer 1990, Simberloff and Abele 1976, Diamond 1976). The conservation of a habitat type, isolated as a result of surrounding anthropogenic habitat or habitat degradation by humans, is still promoted today as an essential feature of protected areas system design. The latter perspective, the focus of this research, has within the last ten years been put into the international conservation spotlight primarily by Conservation International's Biodiversity "Hotspots" Programme and the United Nations Convention on Biological Diversity. Greater recognition is now given to the disproportionate contribution of tropical islands worldwide to global diversity of plant and animal species in terms of their high numbers of endemic (i.e. geographically unique) species relative to island size.

The inadequacy of academic literature in addressing terrestrial biodiversity conservation in the protected areas systems of tropical islands is problematic because it has to some extent facilitated the adoption of scientific principles for *in situ* biodiversity conservation, and "universal" conservation and protected area management paradigms, that are unsuitable for island contexts and geographical scale. More specifically of concern are the ecological and socio-economic contexts, and the conservation effectiveness of management across a national system of protected areas and within individual areas. Consequently, apart from endemism, other distinct biogeographic features that characterize tropical island biodiversity and are important to protected areas system design (e.g. high vulnerability to invasive species, taxonomic and niche disharmony) have been under-valued or overlooked by academics and conservation practitioners. Furthermore, there is a high risk that conservation planning and implementation across a protected areas system and within protected sites will fail to achieve desired conservation outcomes. This failure is anticipated because of limited understanding and knowledge of the conservation challenges facing protected area managers. Management effectiveness evaluations have been an instrumental strategy in accumulating knowledge relevant to conservation practice in protected areas (Hockings et al. 2006). However, underlying their evaluation criteria is the assumption that "universal" concepts of protected areas management are transferable to island contexts.

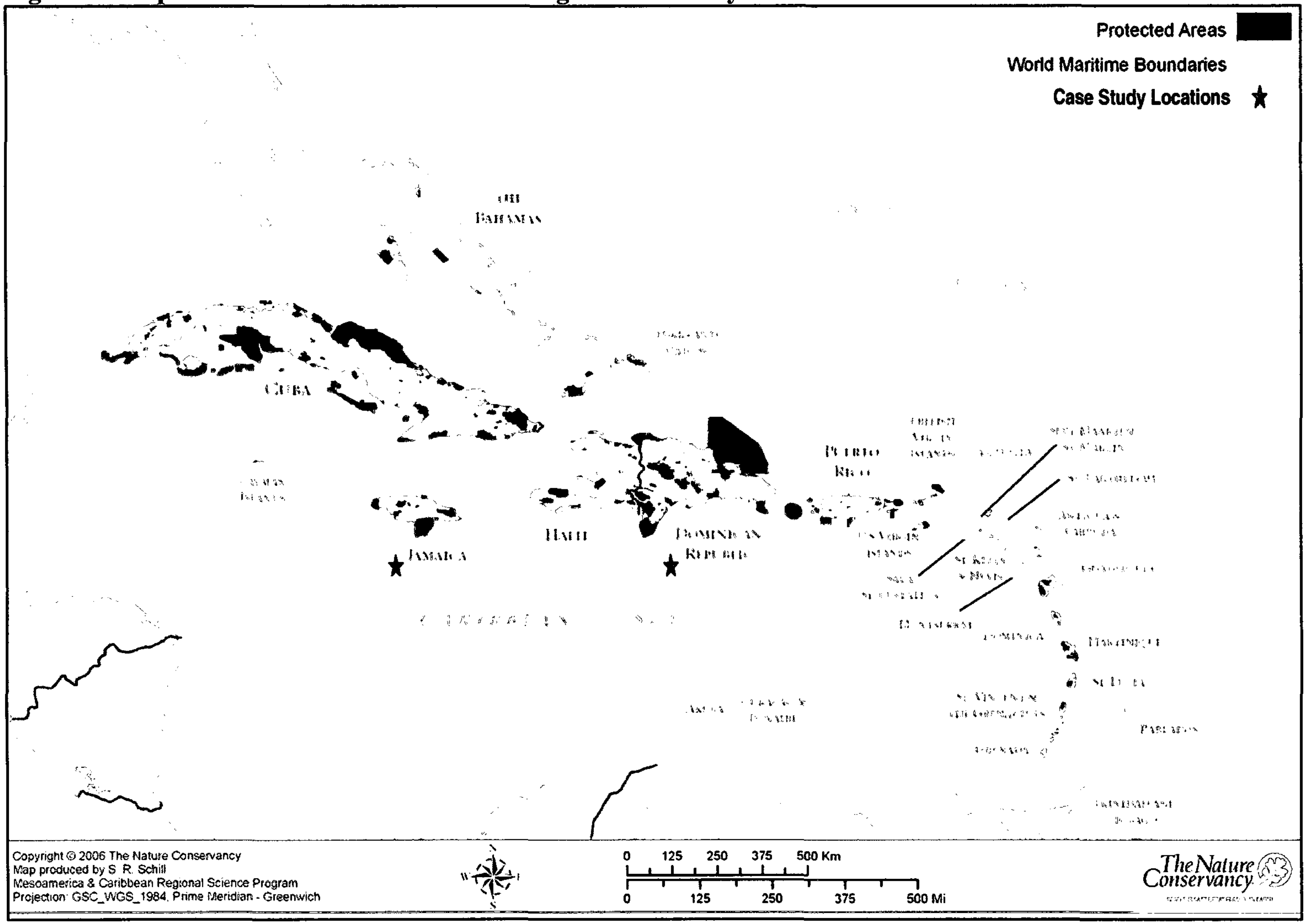
Should it be assumed, in the case of tropical islands, that if their geographic context and scale preclude certain components of 'universal' conservation thinking then they are unable to effectively conserve their biodiversity? On the contrary, an opportunity exists for an analysis of what constitutes effective biodiversity conservation looking beyond conventional frames of reference. Recognizing this opportunity, this dissertation contributes a new perspective on effective biodiversity conservation in tropical islands grounded in contextual knowledge and a consciousness of scale. A better understanding of the role of biodiversity conservation theory and conservation practices in protected areas systems is essential in order to avoid the risk of proposing unrealistic conservation outcomes and adoption of inappropriate biodiversity conservation actions. The complex, multi-faceted nature of biodiversity conservation will not allow for a comprehensive study of the subject within the logistic constraints of a graduate degree. Therefore, my thesis question is, "In the tropical island geographic scale and context, how can conservation effectiveness in protected areas systems be assessed with respect to the critical components of effective biodiversity conservation?". The question is addressed with reference to a case study of national protected areas systems in two oceanic island states in the Caribbean, namely Jamaica and the Dominican Republic.

Over time through past academic and professional research experiences in Jamaican protected areas, I have come to appreciate that insights into or solutions for conservation problems require a holistic approach that takes a "bird's eye" view of issues and integrates multiple disciplines and concepts. Consequently, this dissertation embraces plurality of concepts and integration of experiential knowledge, natural and social sciences. It is hoped that the findings of this research will augment current efforts by colleagues in the Caribbean to improve protected areas management and effectively conserve island biodiversity.

1.1 An Overview of Protected Areas Systems and Biodiversity Conservation in the Caribbean

The Caribbean archipelago comprises over 21 island states extending from the Gulf of Mexico to above the northern South American countries of Suriname and the Guianas (Figure 1). With the exception of few continental islands that are close to the

Figure 1. Map of the Caribbean islands showing the case study locations



Note. Adapted from The Nature Conservancy 2006

South American coast, the majority of the Caribbean region is composed of tropical oceanic islands. Although the estimated total land area of the Caribbean islands is roughly 23 million hectares, approximately a third the size of Mexico (UNEP 1996), this insular region has been recognized as a biodiversity 'hotspot' by Conservation International. These islands, in spite of their small land area, are considered significant contributors to global biodiversity especially with regard to the high levels of endemic species and the range of widely differing ecosystems (The National Conservancy 2007). Hedges (2001) estimates that there are 10,000 plant species from the Caribbean region with roughly a third being endemic.

The largest biodiversity of Caribbean islands resides in the four largest islands of Cuba, Hispaniola, Jamaica and Puerto Rico, in order of decreasing land area. Collectively known as the Greater Antilles, these islands exhibit ecosystem heterogeneity due to the variety of coastal and inland topographical features. The Greater Antilles have the greater deposits of limestone rock which are a major geological component of the Caribbean islands with volcanic rock types occurring to a lesser extent except on the smallest islands (Kelly et al. 1998). A typical feature of Caribbean islands is their mountainous regions with the majority of dry and rainforests occurring in the Greater Antilles. The isolation of these islands from continents and mainlands by the Caribbean Sea and the Gulf of Mexico has resulted in unique island ecologies indicative of long-term biogeographic patterns and processes (Woods and Sergile 2001, Whittaker 1998). Biogeographers believe that over evolutionary time, vertebrates especially have adapted to the insularity, geomorphological features, hydrological and climatic cycles of islands to produce biota that is atypical of adjacent mainlands (Royle 2001, McNab 2001). Wing (2001) points out that native Antillean land animals common to or in abundance on the islands include rice rats, capromyid rodents, certain species of pigeons, iguanid lizards and land crabs. There is a tendency for the largest herbivorous and carnivorous niches to be filled by specific groups of reptiles and rodents.

In considering the history of protected areas systems in the Caribbean, the first legally designated land areas for protection of some social value tended to be forest reserves, noted from as far back as the eighteenth century in Trinidad (EU/IUCN 1999). The major impetus for these forest reserves, established under colonial rule, was to stop rapid deforestation of the islands as their populations grew. The inherited legacy of forest reserves met with the modern concept of protected areas in the twentieth century - the American model of a national park. The general trend in the development of protected areas systems in the Caribbean has been the establishment of national and marine parks. Nevertheless, a challenge that still exists on some islands today is the creation of legal instruments that enable the establishment of national parks and their effective management. Other types or categories of protected areas have gradually been established to protect not only watersheds and timber production, but also protect social values associated with public recreation and wildlife.

The adoption of biodiversity conservation as a goal for any protected area was uncommon until the 1990s which marked the beginning of a dramatic increase in the number and extent of Caribbean protected areas (Rosabal 2004). Some authors note that this momentum coincided with the greater involvement of the islands in international environmental treaties. Focusing on international conventions of relevance to terrestrial biodiversity, a few Caribbean islands participate in UNESCO's Man and the Biosphere programme which among its range of protected areas objectives included on-site conservation of representative ecosystems and biodiversity. Other Caribbean islands have ratified the World Heritage Convention. However, the majority of the current protected areas seem to have been declared on the islands after each one had signed the U.N. Convention on Biological Diversity (CBD). The institutional arrangements for protected areas in the Caribbean are dominated by *ad hoc* establishment and guided by social and political influences. Usually government or a designated government partner has authority for protected areas declaration, policies, and creation of legislation. In keeping with global patterns of protected areas management, various types of protected areas are being organized into national systems. Governance has gradually been extended to non-government organizations and community-based organizations with responsibility for on-site management. However, the place of biodiversity conservation in these national systems of protected areas is ambiguous and is a major concern of this thesis.

1.2 Research Goal and Objectives

My exploratory study has two goals with respect to the geographic scale and context of tropical oceanic islands:

1) To provide empirical and theoretical knowledge of the critical components of effective terrestrial biodiversity conservation in national protected areas systems, and

2) To abstract this knowledge into an island-specific framework for effective biodiversity conservation that can be used to assess the conservation outcomes of protected areas management.

By targeting 'tropical oceanic islands' as a group I have implied that there are common shared features among these islands and I identify these features below. Firstly, a tropical island is geographically positioned on a political map between the Tropics of Cancer and Capricorn. Secondly, the biogeographic features of oceanic islands account for most of the unique biodiversity of tropical islands and so I have prioritized oceanic islands for the development of my framework. Hereafter, 'tropical islands' will be used in lieu of 'tropical oceanic islands' meaning oceanic islands located in the tropical region of the world bearing the biogeographic features unique to islands and possessing a national level of governance for protected areas management.

From a biogeographic perspective, a terrestrial focus provides a stronger thesis in terms of a wider knowledge base and easier identification of criteria for assessing species distributions and protected area design. Spatial patterns of distribution for endemic and co-adapted species on tropical islands are more clearly associated with land area and different land environments than with the marine environments surrounding islands. Marine centres of endemism or biodiversity tend to occur in warm tropical oceans as a result of latitudinal gradients in temperature rather than as a result of a specific island feature. Furthermore, the interconnectivity of marine environments and the higher mobility of marine species require a different perspective for the design and evaluation of marine protected areas. My intention is not to minimize the importance of evaluating marine protected areas and critiquing their assessment tools, but such research would best be pursued in a separate study.

Another distinguishing feature of evaluations is that they not only determine if goals are achieved but establish causal relationships between management capacity and outcomes (Kleiman et al. 2000, Clark and Dawson 1999). With this in mind, the specific objectives of the study with reference to the terrestrial biodiversity of tropical oceanic islands include:

1. To explore perceptions and definitions of biodiversity conservation influencing the setting of conservation goals, objectives and outcomes.

2. To review the intended objectives and outcomes of *in situ* biodiversity conservation and to use these outcomes as benchmarks of conservation effectiveness.

3. To identify the critical i) outcomes, ii) management institution and governance contexts, and iii) linkages between the system and site levels of protected areas planning for effective conservation of island biodiversity.

4. To develop a framework for the effective biodiversity conservation that also guides its evaluation based on explicit linkages between the critical outcomes, and critical management institutions and governance arrangements.

5. To engage the participation of biodiversity and protected area 'experts', and local community stakeholders in the identification of critical components and subsequent development of framework criteria and indicators.

6. To field-test the framework criteria and indicators with particular reference to i) island-specific biophysical outcomes and ii) critical management institutions and governance arrangements in different island contexts.

1.3 Layout of the Dissertation

The remainder of this dissertation builds the argument for rethinking the concept of biodiversity conservation effectiveness in the national protected areas systems of tropical islands. The biodiversity conservation problem on tropical islands is explored in a literature review on biodiversity conservation and conservation assessment in Chapter 2, with reference to:

- conservation paradigms
- protected area management paradigms
- scientific principles for protected areas system design
- approaches to the assessment of biodiversity conservation

This section ends with the presentation of a theoretically-derived framework for biodiversity conservation effectiveness in the terrestrial protected areas system of a tropical island.

Chapter 3 presents the case study methodology and the literature-based and participatory methods. The rationale for the selection of the case study locations is also presented in this chapter. In Chapters 4 and 5, the contributions of four research datasets, the methodological triangulation from which the critical conservation components are identified and subsequent revisions to the theoretically-derived framework are presented for each case study location. The revisions are based on incorporation of the critical components of biodiversity conservation into the conservation effectiveness framework.

Chapter 6 describes field-testing of the framework criteria in the national protected areas systems of Jamaica and the Dominican Republic through evaluation interviews designed around the framework criteria. The interview findings are then presented and discussed with the intention of showing which revised criteria and indicators are realistic and which ones should be used conditionally or eliminated from the final conservation effectiveness framework. The interview findings are comparatively analysed and the decision made to collate the two sets of criteria into a single framework. Chapter 7 provides an overall summary of the major research findings and the conclusions.

CHAPTER 2. LITERATURE REVIEW

Biodiversity, the shortened form of the term 'biological diversity', is generally accepted as the naturally occurring variety among and within living organisms and ecological systems (Pullin 2002, Noss and Cooperrider 1994, Wilson 1992). Especially in the protected area context, it is the variety of wild plants and animals, and their associated ecosystems that are the primary interest. There is actually no formal scientific consensus on the definition of biodiversity. The ambiguity of the word in protected area management is revealed in interpretations such as the variety of life, or emphasis on species diversity or broader definitions encompassing variety and variability of species, ecosystems and their associated ecological interactions and processes (Ricotta 2005, Terborgh 1999, Redford and Richter 1999, Kramer et al. 1997, Takacs 1996, Noss and Cooperrider 1994). The responses to the ambiguity of the word vary according to the influences of biological taxonomy, evolutionary biology and ecology, and the conservation priority of biodiversity within protected areas.

In order to develop an understanding of the complex, multifaceted nature of biodiversity and how its conceptual issues affect conservation and assessment of biodiversity conservation, I will:

1) Synthesize the key discussion points on the biodiversity concept from the aforementioned sciences.

2) Explore how biodiversity has been perceived and prioritized in the conservation programmes of protected areas

3) Review the major developments in the evaluation of biodiversity conservation in protected areas systems, with particular reference to islands

2.1 Biodiversity: The Species Concept

Commenting on the taxonomic perspective, Perrings (1995) noted that of the multiple levels at which it is possible to discuss biodiversity, genetic and species diversity have historically dominated the literature. Known as the theory and practice of classifying organisms (Ereshefsky 2005), taxonomy has generated and used classification schemes to organize the vast diversity of the Earth's biota. Of particular interest is the Linnaean hierarchy which was first accepted in the late 18th century and pioneered the human categorization of living organisms into taxa. The members of each taxon category within the plant or animal kingdom share some similar morphological features. The occurrence of more than one species taxon in a genus or more than one genus in a family indicates diversity of organisms within each category and morphological similarities across each category. Sanderson and Redford (1997, p. 117) pointed to an evolution in the species concept of biodiversity resulting in a focus on the number of species:

> In 1988 E. O. Wilson edited the book *Biodiversity*... At this point an interesting shift developed in the ways in which the term biodiversity was used. ... Wilson and others began to use the term biodiversity as almost synonymous with species richness.

Evolutionary biologists on the other hand moved beyond species numbers to the evolutionary lineages of species. Evolutionary biology, popularized by Charles Darwin and other 19th century biologists, rejected the solely empiricist argument that the common characteristic of the species category was one or more observable and shared similarities. Founded on population genetics and evolutionary theory, the membership criteria for the species category were shifted to shared biological lineages and a species taxon was regarded as a unit of evolution (Ereshefsky 2005, Wiley 1981). The driving forces behind these lineages are historic geographic and genetic isolations, and natural selection of genes. By the 20th century, evolutionary biology had encouraged additional schools of thought on how to perceive and characterize the diversity of biological life in terms of the species category. Four species concepts will be outlined here, namely Ernst Mayr's 1970 Biological Species, Ecological Species, Evolutionary Species and Phylogenetic Species. The significance of mentioning these various species concepts is that each one prioritizes for conservation a different biological unit with its spatial and temporal scales.

The Biological Species Concept which has dominated biodiversity conservation literature, is associated with the idea of "successfully interbreeding organisms". The mechanism for creation of unique gene pools is reproductive isolation of natural populations (e.g. different breeding seasons). Natural populations exclude interbreeding via domestication, cultivation or captivity by humans. The main purpose of reproductive isolation is protection of a genotype that enhances an organism's adaptability to a niche (i.e. a specific set of abiotic and biotic resources). According to the Biological Species Concept, reproductive isolation is initiated by geographic isolation of a population of organisms from the parent population of the species. Geographic isolation is usually caused by a long-term natural barrier, e.g. change in a river's course after repeated flooding. It is the distinctiveness of genotypes that determines the Linnaean species diversity or a diagnostic set of character traits for different species.

Wilson (1992), while a strong supporter of the Biological Species Concept, acknowledges that it is not applicable to asexual and self-fertilizing animals (e.g. some protozoans, snails, insects) as interbreeding is a feature of sexual reproduction. However, he also points out that the great majority of species are sexual and have closed-gene pools. The concept is further compounded by some plant species (e.g. a minority of oak species) that produce fertile interbreeding hybrids which create partially closed gene pools. However, Wilson (1992) does not feel that these exceptions discredit the biological species concept of biodiversity. Of particular relevance to my research are his observations that the biological species concept works "maximally so in well-demarcated communities on islands and isolated habitat patches" and, in reference to hybridizing plant species that form partially-closed gene pools, "Tropical species appear to exchange genes less extensively than those in temperate zones...maintenance of a shorter pattern of species diversity." The last point is accompanied by a word of caution to the paucity of genetic studies on hybridization and species formation in tropical plants.

Objections to this closed gene pools notion and to speciation via reproductive isolating mechanisms resulted in the Ecological Species and Evolutionary Species Concepts. Both of these alternative concepts are also genealogically based but differ by supporting species taxa with asexual organisms, by not requiring a hierarchical pattern in the processes that determine genotype inheritance. For the Ecological Species Concept, the process is natural selection where over successive generations an inheritable trait becomes prominent in response to changing ecological factors that require a new environmental adaptation (Ereshefsky, 2005). The two criteria for a species in this case are that organisms 1) be a part of a single evolutionary lineage and 2) occupy a similar niche or adaptive zone. The Evolutionary Species Concept while arguing that a species is a single lineage of ancestral and descendent populations, goes on to recognize that development of different lineages may involve different types of processes. A more specialized derivative of the Evolutionary Species Concept is the Phylogenetic Species Concept, where organisms in a lineage must have a common ancestor and the relationships and character traits between ancestral and descendant populations are of importance.

The conservation of distinct species taxa is greatly influenced by 1) the co-occurrence of fertile interbreeding organisms and 2) continued expanses of suitable habitat – habitat which is compatible with a species' adaptability to its environment. Genetic exchange and environmental adaptability must be maintained over successive generations of a species' populations. So biological species conservation requires a sense of generational time and this time differs among species. With the Ecological Species concept, conservation would be directed towards distinct historic lineages of organisms that share an ecological niche. The space-time region becomes more complex as one also has to look within a species' range at the micro-level of the niche while keeping in mind that factors influencing natural selection of the niche may occur at a topographic scale. Then there is the difficulty of tracing lineages along an evolutionary time scale when fossil evidence is lacking for several species leading to incomplete lineages. The gaps in paleontological knowledge have been compensated for by the development in DNA technology which enables the mapping of genotypes. However, the technology is expensive and DNA studies tend to be oriented towards research and funding agendas that do not necessarily meet biodiversity conservation needs. Nevertheless, with DNA sequencing revealing hidden phylogenetic separations that were undetected by conservative morphology, interest has grown in conserving genetic diversity for existing species survival and for determining future biodiversity (Bowen, 1999).

While the Phylogenetic Species Concept is not universally embraced, its value in highlighting the protection of single evolutionary lineages in biodiversity conservation on islands is recognized. Erwin (1981) makes the important note that phylogenetically related species undergoing adaptive radiation of their lineages on continents and islands do so within the context of occupied habitat. He makes a direct link between successful evolution and contiguous habitat that facilitates natural adaptation of species as their lineage rises to dominance. The implication is that human disruption and destruction of the natural environment (habitat space) are disruptions and destructions of evolutionary processes. His statement "Centres of Endemism and relict occurrences of organisms, are the last remaining footholds of past radiations" is reiterated in the biogeographical literature for islands (e.g. Whittaker 2007). Tropical islands of Caribbean, Pacific and Indonesian regions are renowned for the adaptive radiations of their plant and especially animal species, and for having higher densities of endemic species than continents (Whittaker 2007, Lomolino 1998). Therefore the high scientific value of conservation of tropical island species can be argued under the criteria of taxonomic and phylogenetic distinctiveness.

The concept of biodiversity did not remain in the species realm but expanded to incorporate not only genetic differences between organisms and evolutionary processes, but also types of ecosystems and their various ecological processes. For some ecologists, this stance was a counteraction to taxonomic definitions of biodiversity (Sanderson and Redford 1997).

2.2 Biodiversity: The Ecosytem Concept

A typical definition for the third level of biodiversity oriented towards ecological function is provided by Noss and Cooperrider (1994, p. 5):

> Biodiversity is the variety of life and its processes. It includes the variety of living organisms, the genetic difference among them, the communities and ecosystems in which they occur and the ecological and evolutionary processes that keep them functioning, yet ever changing and adapting.

Ecological field studies confirm that each species has evolved or acclimatized in tandem with multiple species and their physical environment to form numerous complex patterns and processes of living systems known as ecosystems (Hansson 1997). Ecosystems also exhibit spatial and temporal variation according to the distribution and state of their component species and physical conditions leading to the identification of biotic variety at larger scales than a species' niche or habitat (Golley 1993). Recognition of increasingly complex levels of biological organisms and larger geographic scales across genes, species and ecosystems led to their acceptance as a three-tiered hierarchy of biodiversity. Although an undercurrent of the species concepts outlined above is the dependency of species survival on species compatibility with their habitat, these concepts do not provide a basis for understanding the place and function of a species in its natural environment. Such understanding has come from the ecological concept of the ecosystem.

The ecosystem concept, as presented by British ecologist Alfred G. Tansley in 1935,, resulted from an effort to integrate the highly debated ecological concepts of how biotic communities are organized, developed and maintained. Golley (1993), in his historical review of the ecosystem concept, pointed out its value in creating a more inclusive perception of the natural environment. More specifically, the concept reduced the prevalence of vegetation community studies by increasing the number of studies that included 1) animals in the assemblage of species in an area, 2) the geological-chemical environment, and 3) the biotic-abiotic interactions. This recognition of an interrelated natural system was gradually influenced by system science which goes beyond a reductionist focus on individual components of a system to a holistic emphasis on the whole system resulting from the interrelationships between components.

Pluralization of the ecosystem concept has left contemporary biodiversity conservation with yet another conceptual dilemma. The common application of traditional ecology to protected areas management involves modeling an ecosystem as a 'closed' system that develops towards a steady or stable state and is maintained by dynamic equilibrium forces (Wallington et al. 2005, Fiedler et al. 1997). However, modern science promotes understanding of an open, complex system that undergoes changing states because of non-equilibrium forces. The contention is over how to systematically characterize biotic communities, the nature of ecosystem development, and how to factor in disturbances in ecosystem development and conservation.

The equilibrium model is typical of discussions concerning ecosystems of oceanic islands or lakes or habitat patches. Their geographic and/or ecological isolation from the surrounding matrix and scientific assumptions of environmental homogeneity, few climatic fluctuations, and rarity of extreme events are analogous to 'closed' or self-contained systems (Cronk 1997, Robinson 1981, Holling 1973). The species components of island ecosystems are prioritized in this ecosystem model. The focus is the natural progression towards a nearly constant or equilibrium number of species on an island as a result of counteracting processes such as birth and mortality, colonization and extinction. Equilibrium underlies the botanical concept of succession where vegetation communities undergo stepwise development towards a fixed state known as a climax community. Natural events such as hurricanes and volcanoes are regarded as random disturbances in the equilibrium model and seen as external to the normal functions of an ecosystem. Human disturbances e.g. harvesting and pollution, although also considered external, are of rapidly increasing frequency and intensity. The aftermath is rising species extinctions and ecosystems that are permanently altered so that they move to new states of existence. In other words, equilibrium is not regained and the ecosystem becomes unstable or fragile.

MacArthur and Wilson (1967) provided a quantitative basis for faunal species equilibrium on islands through their diversity-equilibrium theory and species-area model. They proposed that minimal fluctuation in species numbers occurs when equilibrium on is obtained between rates of immigration from adjacent mainlands and rates of species extinction on islands. A stable ecosystem is indicated by established species numbers and consistent population sizes over extended periods of time, and return to these equilibrium levels of species richness after temporary natural and human disturbances. A pattern observed by MacArthur and Wilson on Neotropical mainlands and islands, and some Pacific and Indonesian islands, was that greater isolation from neighbouring mainlands contributed to 1) lower species richness for birds due to lower immigration rates and 2) higher rates of bird species extinction. It was also found that the higher rates of bird extinction occurred on the smaller islands. The apparent appeal of the equilibrium model of an ecosystem is the sense of certainty it provides in explaining how an ecosystem develops to an endpoint and the ability to predict species extinctions (Wallington et al. 2005, Wu and Loucks 1995).

Biodiversity came into the spotlight of the global conservation movement in the 1980s amidst calls from biologists for action to deal with the contemporary crisis of mass species extinction (Wilson 1988, Erhlich 1988). Endangered and rare species, and protection of their habitats were the priority of early biodiversity conservation since extinction was inevitable without restoration or rehabilitation of their habitat (Pullin 2002, Noss et al. 1995). However, in spite of these efforts, a limited autecological knowledge base that was ignorant of ecosystem dynamics manifested itself in accelerating habitat loss and habitat fragmentation (Knapp 2003). The equilibrium ecosystem model failed to account for 1) patterns of species composition and their interactions, and 2) the effects of biophysical features such as habitat heterogeneity and historical land use activities. Furthermore it was criticized and challenged on assumptions of linear, static ecological community development (Wallington et al. 2005, Margules and Pressey 2000, Wu and Loucks 1995, Robinson 1981).

The limitations of equilibrium theory have contributed to low or no priority for ecosystem diversity in the development of at least two prominent global approaches to protected areas conservation planning. The hotspots and important areas approaches (See section on Conservation Paradigms) reflect a biogeographical bias towards species composition and assume static climax communities which have set species ranges and thresholds for ecosystem resilience (Whittaker et al. 2005). High global value is attached to the occurrence of many endemic taxa on islands amidst a species-poor biota which contrasts markedly with continental areas that have low levels of endemism and high species numbers (Sadler1999, Spellerberg and Sawyer 1999, Lomolino 1998, Cronk 1997). These approaches also emphasize threats to total species richness and to habitat.

While sharing the bias towards patterns of vegetation types and species distributions, the ecological representation approach goes further. It delineates plant and animal associations into biological zones or ecoregions at a coarse regional scale (Whittaker et al. 2005). Each ecoregion is treated as a biological unit within which ecological dynamics are maintained. However, the scale of ecoregions, while convenient for global conservation planning, is problematic for national conservation planning on islands. A single ecoregion may encompass several island nations, each with significant variation in its internal ecosystems as a result of unique species and differently structured governance and institutional environments for the management of national protected areas systems (Table 1). The growing tendency to recognize internal ecosystem division and dynamics on islands has been attributed to renewed attention to and support for non-equilibrium ecology (Wallington et al. 2005, Fiedler et al. 1997).

Table 1. Examples of Global 200 Ecoregions that include Several Tropical Islands

Ecoregion	Island Regions
Greater Antillean Moist Forest	Haiti, Cuba, Dominican Republic, Jamaica, Puerto Rico
New Guinea Montane Forests	Papua New Guinea, Indonesia
Seychelles and Mascarene Island Forests	Mauritius, Seychelles, Comoros, Reunion, Rodrigues

Note: From Olson and Dinerstein 1998

The non-equilibrium model builds on the equilibrium concepts of disturbance, stability, resilience and thresholds but in a different context. The ecosystem is accustomed to both chance and periodic disturbances and multiple species-environmental interactions at various spatial and temporal scales and inclusive of external influences

(Wallington et al. 2005, Wu and Louck 1995, Holling 1973). The emphasis is on maintenance of ecological functions through relationships between different species and within species (e.g. food webs, co-adaptations) and between species and their environment (e.g. lengthening rainy seasons that cause new flowering periods for plants). Some of these functions include regulation of population density, maintenance of habitat structure, nutrient cycling and a resilience to disturbance (Sinclair and Byrom 2006). A novelty of the non-equilibrium model is to include humans as part of an ecosystem. Deviating from classical ecology, human disturbance, especially historical landuse is now seen as an important part of ecosystem change because of its impact on ecological, evolutionary and environmental processes (Wallington et al. 2005).

An underlying assumption about the openness of a non–equilibrium ecosystem is that it has no long-term stability due to continually changing environmental conditions that induce multiple states over time (Wallington et al. 2005, Gunderson et al. 2002, Holling 1973). Rather, an ecosystem's components and processes will change minimally or dramatically depending on the nature of the disturbance and the ecosystem's capacity to respond. A new state of existence is maintained until the next disturbance surpasses the 'stability' threshold and causes a dramatic shift or flip into another state. A contribution of the non-equilibrium model to biodiversity conservation is that it has directed attention to the importance of ecological resilience as a buffer to human disturbance that may eventually cause irreversible damage to an ecosystem. Ecological resilience is an ecosystem's ability to absorb change and maintain its ecological functions in a different (system) state (Gunderson et al. 2002, Holling 1973). An additional benefit of ecological resilience pointed out in Gunderson et al. (2002) is that it also buffers the failed conservation actions of natural resource managers and provides managers with an opportunity to learn from their past decisions and choose appropriate actions in the future.

While it is generally agreed that the non-equilibrium ecosystem model provides a more realistic understanding of complex, non-linear ecosystem behaviour, its wide adoption as a basis for conservation planning has been hindered by insufficient empirical testing and knowledge gaps (Wallington et al. 2005). Its acceptance of some level of unpredictability in ecosystem responses (especially to human disturbances) and some uncertainty in the proposed outcomes of conservation actions is a new challenge to classical ecology and natural resources management. This is not necessarily problematic for protected areas decision-makers provided that there are criteria that guide management decisions and that a sense of probability of success can be established. It is not surprising that finding examples of the practical application of this model for conservation of tropical island biodiversity proved difficult. Alternatively, drawing on a synthesis of temporal and spatial implications for biodiversity conservation by Wallington et al. (2005), I have highlighted what I see as implications of special significance to protected areas system design and conservation strategy for tropical islands (Table 2). The more general implications concerning values for biodiversity, historical background and landscape context for protected area establishment, design and management are considered in the following sections with reference to protected areas on tropical islands.

Table 2. Implications of the Non-Equilibrium Ecosystem Model for Biodiversity Conservation on Tropical Islands

General Implications for Biodiversity Conservation (Wallington et al. 2005 paraphrased)	Conservation Implications of Special Significance to Tropical Islands
Prevailing disturbance regimes must be recognized and incorporated into conservation strategies.	Tropical storms, volcanic events, and invasive species need to be reflected in conservation management strategies (Drake 2002).
Due to inter-relationships between species, species conservation must be conducted with consideration to how it impacts the wider ecosystem.	Of particular concern are 1) unusually high occurrences of co-adapted species and co-evolved interactions (Spellerberg and Sawyer 1999, Cronk 1997), 2) island keystone species removal which results in large changes in communities despite their low biomass (Drake 2002).
The importance of socio-ecological history and especially spatial position at the landscape level must be incorporated into rare species conservation.	The small size of tropical islands means relatively narrow species ranges compared with continental biota (Cronk 1997).

2.3 Protected Areas Management and Biodiversity Conservation: The Paradigms

In order to introduce the concept of a protected area, reference will first be made to the 1994 definition of the term by IUCN as well as the definition provided by the Convention on Biological Diversity (CBD). Then the IUCN's organization of traditional and contemporary experiences of protected areas management into two paradigms of protected areas management is presented. The discussion includes a review of the priority given to biodiversity conservation in protected areas management, in light of three prevailing conservation paradigms which are referred to for the sake of discussion as protectionism, neoliberalism and sustainable use.

An appreciation of the plethora of protected area categories can be gained from the diversity of names reported by IUCN and the UN 2003 List of Protected Areas. There are international categories established through international environmental organizations or conventions (e.g. World Heritage Site), nationally and locally designated names (e.g. national parks and game reserves), names of cultural and religious significance (e.g. sacred gardens). The goals and conservation targets of these protected areas vary from biological, to cultural to geological, and the same protected area name may convey a different purpose depending on geographic location. The IUCN captures this diversity in its 1994 definition:

> "Area of land/or sea especially dedicated to the protection and maintenance of biological diversity, and of natural and associated cultural resources, and managed through legal or other effective means" (IUCN 1994).

The definition provided by the CBD in Article 2 is more general and highlights the need for clear boundaries for any area designated protected status: "Geographically defined area which is designated or regulated and managed to achieve specific conservation objectives". Common to both these definitions is the expectation that biodiversity will be a conservation objective, although whether it is given first, second or no priority is dependent on the relevant management authority. These definitions also imply that a management authority in support of biodiversity conservation already exists. Hints of some of the associated management responsibilities such as protected area establishment, designation of category, and regulation of human activity are provided by the words "dedicated", "legal", "designated" and "regulated". At this point, the recent revision of the IUCN definition in 2008 is acknowledged (Dudley 2008). However, since the protected areas systems reviewed in this study would have been established prior to 2008, precedence is given to the 1994 definition.

The place of biodiversity conservation in protected areas management and the influence of the management environment become more apparent when the two protected areas management paradigms are considered (Table 3). There is strong suggestion of a shift in the management objectives from the traditional management paradigm to the contemporary management paradigm. The traditional objectives seem more conducive to higher priority for wildlife and biodiversity conservation. The contemporary objectives indicate a merging of wildlife and biodiversity conservation with human development objectives. Notably, the level of priority given to biodiversity conservation seems less clear for the contemporary objectives.

In reality, the decisions on what natural patterns and processes to maintain, what the threats to diversity are, and how to minimize the identified threats have proven perplexing for conservation planners and managers. In a review of twenty-one international approaches to biodiversity conservation, Redford et al. (2003) pointed out that although biodiversity is a common conservation target, it was often undefined and the goals for its conservation were generally unclear. A major contributor to fuzzy goal-setting is the value judgements that have to be made for what species and ecosystems to protect. Redford et al. (2003) and Sanderson and Redford (1997) noted that there is confusion surrounding the concept of biodiversity which, coupled with various scientific and socio-economic values and motives, has facilitated different political interpretations of conservation. Notwithstanding, patterns in the multiple constructs of biodiversity conservation have led to three conservation paradigms which for the sake of discussion are referred to as protectionism, neoliberalism and sustainable use.

The conservation paradigms (Table 4) present different perspectives on the relationship between humans and biodiversity conservation problems, particularly human

Table 3. The Shift in Paradigms for Protected Areas Management

Topic	As it was: protected areas were ...	As it is becoming: protected areas are ...
Objectives	▪ Set aside for conservation ▪ Established mainly for spectacular wildlife and scenic protection ▪ Valued as wilderness ▪ Managed mainly for visitors and tourists ▪ About protection	▪ Run also with social and economic objectives ▪ Often set up for scientific, economic and cultural reasons ▪ Managed with local people more in mind ▪ Valued for the cultural importance of so-called "wilderness" ▪ Also about restoration and rehabilitation
Governance	▪ Run by central government	▪ Run by many partners and an array of stakeholders
Local People	▪ Planned and managed against people ▪ Managed without regard to local opinions	▪ Run with, for, and in some cases by local people ▪ Managed to meet the needs of local people
Wider context	▪ Developed separately ▪ Managed as 'islands'	▪ Planned as part of national, regional and international systems ▪ Developed as 'networks' (strictly protected areas buffered and linked by green corridors)
Perceptions	▪ Viewed primarily as a national asset ▪ Viewed only as a national concern	▪ Viewed primarily as a community asset ▪ Viewed also as an international concern
Management techniques	▪ Managed reactively within a short timescale ▪ Managed in a technocratic way	▪ Managed adaptively in a long-term perspective ▪ Managed with political considerations
Finance	▪ Paid for by taxpayer	▪ Paid for from many sources
Management skills	▪ Managed by scientists and natural resource experts ▪ 'Expert' led	▪ Managed by multi-skilled individuals ▪ Drawing on local knowledge

Note. From Thomas and Middleton 2003

Table 4. Conservation Paradigms Influencing the Conservation of Biodiversity

Socio-Ecological Problem	Approach	Basic Principles/ Concepts	Influencing Values		Conservation Targets/ Strategies
			Scientific	Social	
Human threats to the survival of wild species and biological systems especially those leading to species extinction	Protectionism or classical approach	• All living things have an intrinsic right to life • Humans have a moral obligation to act as stewards of the Earth • Restricted human access to protected biodiversity	• Ecology and conservation biology • Management sciences (concept of centralized authority)	• Mainly ethics • To a lesser extent utility (e.g. amenities & commodities)	• Endangered species • Rare species • Umbrella species • Species guilds • Hot spots • Source and sink populations • Genetic stock • Indicator species • Keystone species • Ecosystems • Landscape corridors and connectivity • Coarse filter-fine filter strategy
Human depletion of biological resources, thus reducing the survival capacity of biota and human welfare.	Sustainable use or populist approach	• Maintenance of biota and their natural interactions and functions • Use of resources at rates within their capacity for renewal • Sustenance of inter-generational economic welfare	• Ecology and conservation biology • Management sciences (devolution of authority) • Concept of local/ community participation • Ecological economics	• Utility and ethics focused • Also encompasses future utility and evolutionary options	
Retardation or loss of economic growth.	Economic development or neoliberalism	• Nature exists for human benefit • Ensuring continual economic welfare • Technological innovations and increased man-made capital as compensation for natural resource loss	• Natural resources management • Neoclassical economics • Environmental economics	• Primarily utility • Also option	

Note: From Brown 2002, Wilshusen 2002, Tisdell 1999, Gowdy 1997, Kramer and van Schaik 1997, Robinson 1993.

threats and their solutions. Most importantly, these paradigms help determine conservation priorities and strategies along with scientific rhetoric, values and social factors. Despite the conceptual differences between species diversity and ecosystem diversity, as conservation targets or cornerstones of conservation strategies, any of these paradigms may apply to species and/or ecosystems. Pausing a moment to reflect on the management objectives of the traditional and contemporary management paradigms, it is evident that the traditional management paradigm has incorporated the protectionist form of conservation while the contemporary paradigm has incorporated sustainable use.

The presumably shifting attitude towards biodiversity conservation, as indicated by the contemporary management paradigm, is set in the wider context of changing leadership and delegation of authority, additional stakeholders and participants in management, promoting integration of protected areas into national, regional and international conservation planning, expanding values from just a national level to community and international levels, embracing of adaptive management, new sources of funding and an expanded knowledge base that includes local knowledge as well as technocratic and scientific skills. Outlined below are different models and approaches to protected areas management. First is a circular logic model used in the development of IUCN's framework for assessing protected areas management, followed by an approach based on complex systems theory and then adaptive management based on the experiences with protected areas management in Australia.

The logic model used by Hockings et al. (2000) was based on Context, Planning, Inputs, Process (implementation), Outputs and Outcomes, and provides a continuous sequence for how different stages of the conservation process feed into each other.

Traditional protected areas management tended to be aligned with linear decision-making where expected outcomes were perceived as a result of having certain inputs and strategies in place. The challenge in contemporary protected areas management is to accept uncertainty as a normal feature in the management process and to embrace adaptive management.

Worboys (2005), an Australian and greatly influenced by the Australian experience with protected areas management, defines management as an overall process of achieving organizational goals by undertaking management functions of planning, organizing, leading and controlling. Worboys et al. (2005) sees protected areas management from an adaptive management perspective: a repetitive cycle of review and revision of the management process. In other words, learning through experience and so there is no one fixed way of management to be implemented. Adaptive management requires flexibility where one learns through experience and when an unexpected or unwanted result is achieved, the management process is modified to achieve the desired goal. It recognizes uncertainty and responds to changing circumstances.

The underlying systems theory used in conceptualizing a national protected areas system in the IUCN publication by Davey (1998) indicates the dynamism of the conservation process from a holistic point of view (Table 5). Complex systems theory also promotes an approach that establishes connections within and between ecosystems and social systems. These systems' structure, organization and processes operate at different scales. They are said to be adaptive when they can change in ways that promote their survival in an ever-changing environment. Davey (1998, p.13) names five essential characteristics of a protected areas system:

1) Representativeness - the full range of biodiversity is covered by a network of individual protected sites,
2) Adequacy – sufficiency of protected area design including habitat/area needs, connectivity of sites, natural system linkages and boundaries, existing degradation and external threats, resource use and sustainability,
3) Coherence and complementarity – each new site should contribute positively to the protected areas system
4) Consistency – in application of management objectives, policies and applications so actions flow from plans, and
5) Cost effectiveness, efficiency and equity – efficiently weighing the costs and benefits and the distribution of benefits in a protected areas system.

Recognizing that the driving forces behind major threats to conservation often are external to protected areas, Davey (1998) recommends that consideration be given to the linkages between protected areas management and its external environment.

Table 5. Key Features of General Systems Theory (the Systems Approach)

Holism:- a system can be understood as a resultant whole of inter-related parts or subsystems and not as the sum of the individual components.
Emergent properties appear at the level of the system as distinct features or behaviours and are absent from individual system components.
Systems are hierarchical.
Alteration to one part of a system affects the other parts.
The objectives of sub-systems or system parts should fit with the overall goal of the whole system.
Organizational systems contain hard and soft properties. Hard properties can be measured objectively while soft properties are a matter of values or taste.

Note: Adapted from Lucey 1997

These concepts of protected areas management all point to the necessity of inputs for planning where planning is a process of deciding how to get to where we want to be. Also important is a process of orienting human and other resources in order to achieve goals. The overall goal of contemporary protected areas is a representative sampling of the world's biodiversity. The associated outcomes include 1) retention of essential ecosystem services, 2) retention of ecosystem processes and life support systems, and 3) opportunities for recreation. Once the inputs have been acquired planning can proceed at different levels, namely the strategic, tactical and operational levels (Worboys et al. 2005). These three levels, in my opinion, can be treated as if they are synonymous with the protected areas system, individual site management and specific work plans.

Work or action planning is specific to an activity or action within an individual protected area. Management planning addresses a range of social and ecological issues and activities for a protected area but not with the detail of the work plan. System planning considers the contribution of each individual protected area and the linkages between the protected areas in the system that enable the achievement of overall goals e.g. ecological representation. There is a hierarchy to these levels of planning. Management at the system level occurs at a broad national scale which is inter-related to the smaller scale management of individual protected sites. Interactions at the system level may affect interactions at the site level and visa versa. Biodiversity conservation is a direct outcome of site management operations, but is also affected by the other components of the hierarchy. Biophysical and socio-economic factors affect or influence the environment in which the protected area system functions as well as the two levels of management. Not all the biophysical and socio-economic factors may be independent of each other, but some may interact. External factors may directly influence management at both the national system and site levels.

At the system and individual site levels, management organizational structure determines the arrangement and the distribution of authorities and responsibilities. Organizational structure is particularly important as it determines the power relations behind the planning and implementation stages of protected areas management. Planners or small groups of experts may initiate and dominate planning and implementation to the near exclusion of other staff levels or stakeholders. This manner of management is called 'top-down' management. An alternative and contrasting approach is 'bottom-up' management which includes extensive stakeholder and multiple levels of staff involvement, not only informing but participating in decisions. These approaches form part of the hierarchical, 'vertical' linkages within different stages of management. These issues of organizational structure, distributions of authority and decision-making powers are further addressed in the literature on protected areas institutions and on governance (e.g. Lu et al. 2005, Furze et al. 1996).

The literature with reference to developing countries indicates two prominent institutions that directly influence management operations in the protected areas systems of tropical islands. The first is noted in James (1999) as a dependency on foreign funding resources by developing countries. The second is in Danielsen et al. (2000) as the adoption of scientific, data-based conservation strategies (e.g. IUCN system of protected areas categories, conservation networks and biodiversity monitoring as required by Article 7b of the Convention on Biological Diversity [UNEP 1992]).

The operations of management organizations are another important aspect of implementation that was identified from the literature on protected areas institutions, and common to both system and site levels of management. Key management operations include a) sourcing and organization of financial, human and technical resources; and b) the utilization of these resources in designating management authority, garnering stakeholder participation, income generation and building scientific knowledge base and staff expertise. Worboys (2005) places high priority on leadership by singling it out as one of the critical functions of protected areas management. His particular concern is with the executive and senior levels of staff e.g. the executive director and managers. Content knowledge and operational experience coupled with motivational skills to influence staff behaviour are presented as requirements for successful leadership of a protected areas organization. With adequate planning, organization and leadership it is expected that staff will meet their responsibilities to ensure planned activities occur with the desired outcomes.

For the purpose of this dissertation, protected areas governance is defined as the legal and social arrangements of management organizations, their authority, and decision-making processes through which protected areas stakeholders influence conservation outcomes. Of particular interest is the governance type 'collaborative management' (co-management) which is a feature of contemporary protected areas management, in contrast to the more traditional form of governance by government. Rather than provide a single definition for co-management, reference is made to the plurality of the definition of the concept in Carlsson & Berkes (2005). The authors outline four types of co-management and propose a fifth, namely co-management as:

1) An exchange system of information goods and services between the State and a community of resource users.
2) Joint organization through the formation of formal arena for cooperation (e.g. joint bodies or cooperative units) by autonomous entities.

3) A State-nested system where the State is the holder of all the legal rights to a natural resource and delegates management authority to approved non-government stakeholders.
4) A community-nested system where resource users exercise all legal rights associated with an area and its resources but the State can put restrictions on management of the area.
5) A network of several independent State authorities interacting with a number of non-government entities to solve the problems of resource management.

Outcomes may be seen as measures of how a conservation problem may be resolved. They are the end result of fulfilling chosen goals for protected areas management. The outcomes that result from the performance of a management organization are not necessarily consistent. They may vary with the effectiveness and efficiency of the organization in addressing conservation needs or problems, or in addition to intended outcomes, unintended outcomes may arise. Identification of areas for improved management is one benefit of monitoring organizational effectiveness and efficiency. Such information facilitates control of organizational performance by indicating where adjustments in plans, organization and leadership need to be made.

What signals the effectiveness of protected areas in alleviating biodiversity conservation problems on tropical islands? Although urgent attention has been and continues to be given to the protected areas of the Tropics, the interest has been skewed towards controlling deforestation and the establishment of national parks. A starting point to exploring this question is provided in the historical background to protected areas systems below. Cognisant of the extensive existing literature on the management effectiveness of individual protected area, my primary focus is on the effectiveness of systems of protected areas in achieving biodiversity conservation.

2.4 History of Protected Areas and Biodiversity Conservation

From as early as the eighteenth century, protected areas as defined by the World Conservation Union - IUCN, existed in the Caribbean, Pacific and Indonesia as forest reserves, game and wildlife sanctuaries and protected watersheds (European Union/ IUCN 1999, Solahuddin et al. 1998). These protected areas were established either through traditional systems that legislated community-based control or through colonial powers that legislated central government control and restricted human access (European Union/ IUCN 1999, Solahuddin et al. 1998, Johnson 1988). Recreational, silvicultural and watershed benefits derived from biological resources have been the historical generators of conservation interest, while the religious practices of some islands provided motivation for the designation of sacred grounds.

The importation of forest reserve policies from Europe later followed by the spread of the American model of a national park were instrumental in determining the types of protected areas that exist on tropical islands today. European colonists such as the British in the Caribbean and the Dutch in Java made the establishment of forest reserves a priority (Hooper 1886). The justification for reserve establishment in tropical regions was acceptance of the principle that forests play an important role in regulating climate. The forest conservation goals were maintenance of water supply for the public, mitigating against flood rains and erosion of denuded hillsides. On Java as well as in the

Caribbean, peasant farmers were regarded as a threat to commercial timber trade (Peluso 1993, Hooper 1886). Consequently, there was restricted human access to forest reserves.

In the United States of America (U.S.A.), national parks became a favoured alternative to game and forest reserves which offered inconsistent levels of species protection as a result of political and human population pressure for timber harvest, grazing and mining (Prato and Fagre 2005 , Noss and Cooperrider 1994). The U.S.A. introduced the world's first national park, Yellowstone, in 1872 in Wyoming. The legacy of Yellowstone model of a national park includes:

- A shift from natural resource values based on utilitarian extraction to an appreciation of natural beauty and geological wonders based on intrinsic values. In other words a non-consumptive or non-extractive use of the natural environment that embraced earning a profit from nature recreation and protecting nature (Prato and Fagre 2005).
- The inclusion of the general public as a stakeholder in protected area management. Other types of protected areas such as games reserves and forest reserves catered to elite sport hunters and commercial timber interests, respectively. National Parks provided wider access to countryside for recreational pleasure.
- "The problematic heritage of the concept of wilderness" (Adam 2004, p. 79), where wilderness is defined as wild rural areas with no visible human presence. This perception has been to the detriment of any historical interaction between indigenous people / rural communities and the land.
- A shift from favouring human access to and consumptive use of protected areas to the displacement of rural and indigenous communities from national parks.

The U.S. national park model epitomizes the protectionist philosophy which identifies consumptive human use of biological resources and systems as a direct threat to the protection of biodiversity and ecological integrity (Wilshusen 2002, Kramer and van Schaik 1997). Therefore the prevention of local people from establishing communities and resource use patterns in protected areas is seen as eliminating competition between biodiversity conservation and socio-economic development (Brown 2002). Protected area managers are expected to uphold this principle by only allowing recreational, research and educational pursuits and enforcing the spatial boundaries of protected areas. It is presumed that there is a central (usually state or government) authority that has the political will to establish a system of protected areas. The central authority would control or decide how decision-making power was delegated for conservation and protected areas management. This would include responsibility for relevant policies and regulations for both biodiversity protection and the operation of protected areas.

The concept of a national park received a lukewarm reception in Europe where the first national park was not established until 1909 in Sweden (Adam 2004). The United Kingdom in particular has a long established tradition of protected areas as 'cultural' spaces for recreation, education, scientific endeavour and spiritual upliftment. Furze et al. (1996) defined these as habitats, even the most naturally-appearing ones, that have been created mainly by human influence. Protected areas and reserves are expected to contribute to human well-being and allow some human access and interaction with the land (Bishop et al.1995). Europeans and North Americans exhibited a dichotomy in their thinking on the idea of protected area categories.

The early European conservation approaches are oriented towards neoliberalism or the economic development stance. This paradigm is anthropocentric and strongly supports access to and utilization of biodiversity for livelihoods and general human welfare (Brown 2002). It is based in neoclassical economic theory which regards biodiversity components as commodities in a free market system (Gowdy 1997). Whenever species, genetic resources and ecosystem functions provide beneficial goods and services that are profitable or unattainable through technology or other man-made systems, a high market value is attached. In such cases what often occurs is a 'tragedy of the commons' where there is a lack of protection for biodiversity because of the strong appeal for short-term economic gain to individuals utilizing open-access resources (Gjertsen and Barrett 2004, Hambler 2004, Swanson 1995). Conservation of biodiversity, from an economic perspective, therefore requires incentives for socio-economic benefit as well as compensation for socio-economic loss (Brown 2002). Environmental economics (extended to ecological economics) has attempted to address the major deficiencies of neoclassical economics by developing economic-valuation techniques that incorporate option, existence and bequest values of biodiversity (Furze et al. 1996). These techniques are based on how much society is willing to pay for non-consumptive use of biodiversity such as appreciation of scenic landscapes, educational experiences and sources of spiritual upliftment (Kramer and Sharma 1997, Gowdy 1997, Furze et al. 1996).

One of the common contentions between neo-liberalism and protectionism is the allocation and distribution of property rights that accompany the establishment of a protected area. Criticisms about the relocation of local communities from 'open access' public lands by government for the establishment of protected areas are not unfounded as disruption of social structure and traditional cultural values often occur (Wilshusen 2002, Peluso 1993). In tropical developing countries, growing population pressure on protected biological resources is the usual justification for exclusion of or restricted resource use for local communities (Naughton-Treves 2005, Jenkins et al. 2004). However, an important factor to keep in mind is that population pressure on protected areas is not limited to local scales but operates through national and global market demands for biodiversity and socio-economic externalities such as air and water pollution (Ferraro and Kramer 1997).

Over the decades, the IUCN sought to address the confusion in protected areas terminology by developing a system of categories for protected areas that acts as a global framework for management objectives (Dudley 2008, Bishop et al. 2004). The 1994 IUCN system of categories for protected areas along with revisions recently made in 2008 are provided in Table 6. As biodiversity conservation became a priority for protected areas on tropical islands in the latter part of the 20th century, the World Conservation Union (IUCN) categories for protected areas were adopted. However, Rosabal (2004) in a comparison of protected areas coverage for 39 small island states worldwide indicated that from 1993 to 2003 there was a shift from the adoption of wildlife sanctuaries, national parks, scientific, wildlife and nature reserves to more national parks, and the introduction of habitat/species management areas and managed resource protected areas. In other words, there was a global trend among islands to develop protected areas systems that were accommodating greater human intervention.

Table 6. The IUCN 1994 and 2008 Protected Area Management Categories and their Management Objectives

Category	1994 Primary Objective(s)	2008 Primary Objective(s)
Ia. Strict Nature Reserve	Primarily for scientific research and/or environmental monitoring.	To conserve regionally, nationally or globally outstanding ecosystems, species (occurrences or aggregations) and/or geodiversity features: Formed mostly or entirely by non-human forces and highly vulnerable to human impact.
Ib. Wilderness Area	Mainly for wilderness protection or maintaining the natural condition of an area.	To protect the long-term ecological integrity and bequest value of natural areas that are undisturbed by significant human activity, free of modern infrastructure and where natural forces and processes predominate.
II. National Park	Preservation of species and genetic diversity, maintenance of environmental services, and for tourism and recreation.	To protect natural biodiversity along with its underlying ecological structure and supporting environmental processes, and to promote education and recreation.
III. Natural Monument changed to Natural Monument or Feature	Preservation of species and genetic diversity, protection of specific natural cultural features, and for tourism and recreation.	To protect specific outstanding natural features and their associated biodiversity and habitats.
IV. Habitat/Species Management Area	Preservation of species and genetic diversity, maintenance of environmental services, (includes maintenance of habitats and meeting specific species needs.	To maintain, conserve and restore species and habitats.
V. Protected Landscape/ Seascape	Protection of specific cultural and natural features and their attributes (where interaction of people and nature over time has produced areas of distinct character).	To protect and sustain important landscapes/seascapes and the associated nature conservation and other values created by interactions with humans through traditional management practices.
VI. Managed Resource Protected Area changed to Protected Area with Sustainable Use of Natural Resources	Preservation of species and genetic diversity, maintenance of environmental services, sustainable use of resources from natural ecosystems.	To protect natural ecosystems and use natural resources sustainably, when conservation and sustainable use can be mutually beneficial.

Note: From IUCN 1994 and Dudley 2008

The 2003 UN List of Protected Areas provided summary statistics for 953 Caribbean and 321 Pacific protected areas classified according to the IUCN categories (Table 7). The nearly 40% uncategorized sites in the Caribbean and Pacific regions suggests that protected areas systems of insular regions include other types of protected areas along with those in the IUCN categories or simply that the designation of the IUCN categories is incomplete. The management objectives of the non-IUCN protected areas may or may not coincide with those of the IUCN categories.

Table 7. Summary Statistics for Caribbean and Pacific Protected Areas Using Data from the 2003 UN List of Protected Areas

Island Region	**Dominant Category** By % of total number	By area (km^2)
Caribbean	36.5% Uncategorized 26.6% Habitat/Species Management Area	39% National Park 29.1% Managed Resource Protected Area
Pacific	42.4% Uncategorized 21.2% Habitat/Species Management Area	52.6% Managed Resource Protected Area 27% National Park

Note: From Chape et al. 2003

Of all the IUCN categories, Category II (National Parks) has been popularized in conservation literature as the most important for biodiversity conservation. The appeal of the national park lies in its characteristically large size which conservation theory says has the greatest likelihood of encompassing ecosystem processes as well as species-specific habitat needs within its boundaries. A design feature of the island protected areas systems is establishment of several small and few large sites. Insular regions tend to focus on select species and their habitats within the smaller sites. Furthermore, the previously mentioned dichotomy of protected areas philosophies is echoed here with respect to the larger sites, reflecting the European and American influences. The Caribbean seems focused on minimal exploitation compatible with non-consumptive values (national parks) and the Pacific seems focused on sustainable use being integrated with biodiversity conservation (managed resource protected areas).

The effect of economic theories on protected areas management is apparent in the growing acceptance of the sustainable use paradigm which promotes the integration of biodiversity conservation with socio-economic development (van Schaik and Kramer 1997). It advocates a "win-win" outcome for both the protectors and consumers of biodiversity (Naughton-Treves et al. 2005). The focus is on biodiversity that has both direct and indirect value to people and whose functions maintain ecosystem integrity and evolutionary potential (Tisdell 1999, Gowdy 1997). The motivation for biodiversity conservation is the prolongation of the capacity of ecosystems to support generations of humans, a capacity that depends on natural resource use that does not irreversibly diminish biodiversity (Kangas 1997, Robinson 1993). The desired resource exploitation is unattainable through the conventional market system and so sustainable use has encouraged the development of less consumptive markets and new resource systems that reward benefits and compensate for protection of biodiversity (Table 8). Concurrently, there is strong international advocacy for state authorities to garner conservation support by involving local communities, private enterprises and international stakeholders in the decision-making and management of protected areas (Gjertsen and Barrett 2004, Brown 2002, Miranda and LaPalme 1997). A comparison of protected area objectives across 39 islands worldwide, between 1993 and 2003 (Rosabal 2004), indicated a marked increase over a ten-year period in objectives addressing sustainable biodiversity use.

Table 8. Types of Payments for Biodiversity Protection

Type Of Payment	Selected Examples
Purchase of high-value habitat	Private land acquisition
Payment for access to species or habitat	Bioprospecting rights, research permits
Payment for biodiversity conserving management	Conservation easements, conservation land lease, conservation concession
Tradable rights under cap-and-trade regulations	Tradable wetland mitigation credits, tradable biodiversity credits
Support biodiversity-conserving business	Biodiversity-friendly businesses and products

Note: From Jenkins et al. 2004

Experiences with biodiversity conservation in Caribbean, Pacific and Indonesian islands indicate that property rights, land use and land tenure issues were major reasons for failed protected areas or weak natural resources management (European Union/ IUCN 1999, Solahuddin 1998, Barker and Miller 1995). European Union/ IUCN (1999) relates an interesting account of how attempts to develop classical protected areas systems in many Pacific islands failed in the 1970s and 1980s. The protectionists displayed a lack of recognition for traditional systems of protected areas and natural resource management. Additionally, a great misconception was that a central authority was responsible for land use issues. On the contrary, the majority of land was communally owned through national constitutions which meant that government control was excluded and communities had property rights to land. It was not until the 1990s that it became accepted that effective biodiversity conservation on islands with strong cultural traditions depended on the involvement of local communities. On the Pacific islands where the classical approach worked, Hamnett (1990) alludes to the marginalization of traditional culture by colonial influences.

The scientific reviews that I located on biodiversity conservation in the protected areas of Caribbean islands are *Biodiversity and Conservation in the Caribbean: Profiles* *of Selected Islands* (Johnson 1988) and *Protected Areas of the World: A Review of National Systems Vol. 4: Neartic and Neotropical* (IUCN 1992). Nine islands, including Jamaica, were common to both publications. IUCN (1992) addressed fifteen other islands, including the Dominican Republic, while Johnson (1988) only addressed two other islands. IUCN (1992) provided a descriptive account of national protected areas systems (NPAS) while Johnson (1988) presented information relevant to NPAS as part of an account on each island's biodiversity conservation. In light of the slight difference in focus between each review, particular attention was paid to general similarities and differences in the reviewers' presentations.

Both publications described protected areas and their management with reference to biophysical features, policy and legislative environments (local and international), conservation programmes and activities, and system administration and management structure. A sense of context for Caribbean biodiversity conservation was derived from common features of the ecological and socio-economic environments:

- Considerable ecosystem heterogeneity, especially in the Greater Antilles
- High occurrence of endemic and restricted range species
- Biophysical features of global importance based on international recognition of specific sites (e.g. Ramsar sites, Important Bird Areas, World Heritage sites)
- Cultural and social biases in values towards Caribbean forests and wetlands as important natural resources e.g. watershed and catchment areas and as sources of timber, medicinal plants.
- Land use competition and tenure conflicts primarily between agricultural, tourism and environmental conservation interests

- High variability amongst islands in policy and legislative structures for the establishment of protected areas and biodiversity conservation.

In addition to identifying the major biophysical and socio-economic factors influencing biodiversity conservation, both reviews commented on the connections between these factors. The comments were generally limited to issues concerning protected area coverage, land and species resource use, legal protection, enforcement, and conservation planning.

Protected area issues were tackled at the site level in Johnson (1988) where the emphasis was on different types of proposed and designated protected areas, and supporting legislation. On the other hand, the IUCN (1992) publication reflected a later shift in protected area priorities to representation of the full range of wild ecosystems and species in established protected sites. Protected sites were presented as units of the protected area system but it was not clear how system and site levels of management inform each other. In fact, a recurring and critical management issue for tropical islands that I have identified not only from these two reviews but also from other scientific literature is the inadequate organization of national protected areas systems and insufficient coordination of management in protected sites.

2.5 Systems of Protected Areas for Effective Biodiversity Conservation

In spite of their various protected area categories, a global gap analysis report by Rodrigues et al. (2004) flagged many of the tropical African, Asian, Caribbean and Pacific islands as urgent priorities for the establishment of new protected areas for vertebrate diversity. Several mammals, birds, turtles/tortoises and amphibians were not included or adequately conserved within existing protected area systems. In Table 9, I summarize what the conservation literature indicates are major elements for protected areas management when effective biodiversity conservation is one of the goals. Contemporary management of protected areas systems has called for a shift in the establishment of protected areas as 'islands', where little attention is paid to ecological interactions and processes across the boundaries of a protected area, to the consideration of the surrounding environment. System management of protected areas for biodiversity conservation also requires expansion of traditional conservation policies from their focus on mainly species conservation to also include ecosystem and landscape conservation.

Table 9. Summary of Major Elements of Effective Biodiversity Conservation in National Protected Areas Systems

Protected Areas System Design	Implementation Of Strategies	Conservation Outcomes
OPTIONS: **Strategy:** Conservation Networks **Intended Objective:** Sites large and contiguous enough (i.e. not fragmented) to allow population persistence for different taxa. **Strategy:** IUCN categories **Intended Objective:** Prioritization of biodiversity conservation across PAS	• Coarse filter- fine filter focus (conservation at both ecosystem and species scales) • Strengthening of management capacity e.g. participatory management • Monitoring of management activities • Periodic evaluations of management effectiveness	• Achievement of ecological objectives e.g. decline in species extinctions, ecological representation, preservation of natural population dispersal, species interactions, and relationships between biodiversity and ecosystem functioning • Achievement of socio-economic objectives e.g. protection of social/cultural values, benefits/incentives for local communities from biodiversity conservation • Efficient use of financial, human and technical resources

Note: From Dudley and Parrish 2006, Kingsland 2002, Terborgh et al. 2002, Margules and Pressey 2000, Spellerberg and Sawyer 1999, Noss and Cooperrider 1994, Diamond 1976, Simberloff and Abele 1976

Conservation targeting ecosystems instead of single- or multi-species conservation is now accepted practice for achieving more efficient and cost-effective biodiversity conservation (Poiani 2000, Noss 1996, Franklin 1993, Rojas 1992).

However, experiences with ecosystem conservation have shown that while several species are also protected there is a risk of overlooking the specific needs of restricted range and specialist-habitat species (Noss et al. 1995, Wilcove et al.1992). Consequently, a combined species-ecosystem approach to conservation is now considered optimal for achieving effective biodiversity conservation (Kerr 1997, MacKinnon 1997, Noss 1996). Some of the more pressing implications for protected areas managers include value judgements about which ecosystems and species are acceptable or valuable and the monitoring of multi-state ecosystems in order to detect and work with or manage change (Wallington et al. 2005). Furthermore, management decisions should be made with reference to knowledge of land use and disturbance legacies, and the wider landscape context beyond the boundaries of each protected area.

Two conservation strategies, in particular, that have supported this policy shift are 1) creating networks of protected areas and 2) adopting the World Conservation Union (IUCN) system of categories for protected areas. The desired outcomes expected from implementation of these strategies are respectively:

- The sampling of the full variety of ecosystems, species and genes (i.e. ecological representation) in comprehensive, effectively managed national protected areas networks.
- Reduced biodiversity loss.

However, implementation of these strategies and their associated outcomes raises issues of compatibility between traditional management of protected areas systems in tropical islands in order to realize ecological representation in national protected areas networks or a system of categories focused on biodiversity conservation.

A common vision for 'a desired status for biodiversity' in protected area systems has been embraced by the international community through the United Nations Convention on Biological Diversity (CBD). Ecological representation in comprehensive, effectively managed national protected areas networks is a stated target for both the CBD Protected Areas Programme of Work and the more recent CBD Programme of Work on Island Biodiversity (UNEP 2006). Recalling Margules and Pressey's (2000) definition of ecological representation (sampling of the full variety of ecosystems, species and genes for the long-term survival of biodiversity), it is important to recognize that ecological representation is achievable only through a system of protected areas and not by any single protected area. Therefore a number of geographic scales, biodiversity targets and their threats have to be considered in order to achieve representation.

The CBD Programme of Work target assumes that protected areas are organized into networks. The network strategy is a response to the historical *ad hoc* establishment of various types of protected areas and inadequate protected areas designs guided by principles of island biogeography as stated in Shafer (1990). It represents a shift to large spatial scales and connectivity for species, ecosystems and landscapes. In establishing the scientific basis for protected areas networks, Soulé and Terborgh (1999) argue that effective biodiversity conservation requires large-scale planning and implementation. They refer to empirical evidence that maintenance of ecological structures, regulation and resilience are hampered by protected areas being: 1) too small to support crucial processes e.g. predation, and 2) too isolated to support population gene flows and species migratory patterns. The network is actually a number of core areas, each surrounded by a buffer zone for human activity, linked by ecological corridors (Soulé and Terborgh

1999). In accordance with Levin's metapopulation theory and landscape ecology, this system design is expected to facilitate natural colonization and immigration for species distributed among naturally disjunct habitats (Pullin 2002, Hess and Fischer 2001, Spellerberg and Sawyer 1999).

It is noteworthy that Soulé and Terborgh (1999) caution against the inappropriate application of the network strategy. They highlight the need for sensitivity towards social and biological contexts and note that on islands where large carnivorous predators have never existed or are extinct, connectivity may be less of an issue. Considering that Caribbean islands as well as other islands generally have tourism and agriculture-based economies that decrease natural resources (Whittaker 1998), there is high potential for conflict between broad land-use planning and implementation of large-scale protected areas policies.

2.6 Assessment of Biodiversity Conservation

Management assessments of protected areas for tropical biodiversity conservation have been the subject of much academic debate and global conservation concern (Hockings et al. 2006, Pomeroy 2005, Brandon 2002, Brown 2002). They are said to be important tools in assessing conservation effectiveness (Hockings et al. 2006). Evaluation theorists usually present formal or professional evaluation as the systematic determination of the quality or value of something in order to inform or improve a decision-making process or entity (Davidson 2005, Clarke and Dawson 1999, Patton 1990). The evaluation of protected areas management for biodiversity conservation falls into the category of program evaluation. This type of evaluation responds to the needs of the program administrators and managers, and establishes causal relationships between management activities and outcomes. The Hockings (2000) review revealed a wide variety of approaches to program evaluation based on evaluation purposes, program stages being evaluated, evaluation methodologies and methods (Table 10).

Table 10. Approaches to Programme Evaluation Identified from Hockings (2000)

EVALUATION COMPONENT	**SPECTRUM OF APPROACHES**
1. Evaluation Purpose	Improvement .... Accountability/Effectiveness (Formative) (Summative)
2. Programme Stage	Process .... Outcome
3. Methodology: **i) role of evaluator** **ii) sampling, data collection, analysis**	 Independent .... Participatory Quantitative .... Qualitative
4. Methods /models	Goal-oriented, process-outcome study, needs-based, management component analysis, action research, goal free

N.B. Only extreme ends of the spectrum are shown for components 1 – 3.
Note: Table categories from Davidson (2005), Bamberger (2000), Hockings (2000), Dawson (1999), Patton (1990).

By incorporating values, social and cultural, as well as ecological contexts into descriptive analyses, evaluations can potentially inform management strategies, inputs and actions (Kleiman et al. 2000, Clark and Dawson 1999). Many of the existing evaluation schemes are based on the IUCN World Commission on Protected Areas framework for assessing protected areas management (See Table 11, Leverington et al. 2008, Ervin 2003(a), Ervin 2003(b), Ervin 2003(c), Hockings 2003). If we take a quick look at this framework, we see that the evaluation criteria are based on the planning, implementation and outcome stages of protected areas management (Hockings et al. 2006). The creators of this framework say that an evaluation that assesses the outcomes of PA management is the **best indicator** of management effectiveness (Hockings et al. 2006). Hockings et al. (2006) define outcomes as the reflection of whether or not long-

Table 11. **IUCN-WCPA Framework for assessing management effectiveness of protected areas and protected area systems**

	Design		Appropriateness/ Adequacy		Delivery	
Elements of management cycle	**Context**	**Planning**	**Inputs**	**Process**	**Outputs**	**Outcomes**
Focus of evaluation	Assessment of importance, threats and policy environment	Assessment of protected area design and planning	Assessment of resources needed to carry out management	Assessment of the way in which management is conducted	Assessment of the implementation of management programmes and actions; delivery of products and services	Assessment of the outcomes and the extent to which they achieved objectives
Criteria that are assessed	Significance/values Threats Vulnerability Stakeholders National context	Protected area legislation and policy Protected area system design Protected area design Management planning	Resources available to the agency Resources available to the protected area	Suitability of management processes and the extent to which established or accepted processes are being implemented	Results of management actions Services and products	Impacts: effects of management in relation to objectives

Note: From Hockings et al. 2000

term objectives are met. Criteria are defined as either environmental conditions or aspects of management selected for assessment, and their associated indicators are measures that reflect any change in the criteria (Hockings et al. 2004). The criteria for this framework are very general in nature, but especially for the outcome section. My major concern is with the outcome criteria and associated indicators and the quality of the information that is generated from them.

The universal applicability of the IUCN management effectiveness framework for evaluating biodiversity conservation in protected areas has not been widely critiqued. To its credit, this management effectiveness framework allows customized assessment tools to be developed for different protected areas systems or sites. The framework's evaluation criteria and indicators surround the planning and implementation stages of overall protected areas management. The underlying logic model used by Hockings et al. (2000), based on Context, Planning, Inputs, Process (implementation), Outputs and Outcomes, can be applied to the conservation process, thus showing how the different stages relate to each other. The strength of the framework lies in its capacity to facilitate the development of methodologies that i) prioritize biological conservation targets and resource allocation, ii) identify under-resourced and vulnerable protected areas, iii) identify weaknesses and strengths in protected areas governance and institutions, iv) identify major pressures and threats to biodiversity, and v) comparatively assess sites distributed throughout a system or assess single sites (Gilligan et al. 2005, Hockings et al. 2004, Ervin 2003, Hockings 2000).

A recent report on tools used in management effectiveness evaluations reveals that among the tropical islands assessed, the Rapid Assessment and Prioritization of

Protected Areas Management (RAPPAM) and the Parks in Peril Scorecard were prominent in terms of both frequency in islands and frequency of assessments (Leverington et al. 2008). In order to understand the major issues influencing the assessment of protected area effectiveness for biodiversity conservation or conservation outcomes on islands, the following methodologies will be briefly explored:

- The Nature Conservancy (TNC) Parks in Peril Scorecard
- TNC - Measures of Conservation Success
- the WWF International - Rapid Assessment and Prioritization of Protected Areas Management (RAPPAM)

The Measures of Conservation Success assessment tool has been included because it is specific to conservation effectiveness and directly addresses the status of biodiversity targets.

The Parks in Peril the (PiP) Scorecard was developed to primarily inform TNC and its collaborators on the progress being made by the PiP program, located in Latin America and the Caribbean. In order to be eligible for the PiP evaluation, protected sites had to meet key PiP program standards of institutional management capacity and financial sustainability (Hockings 2000). The emphasis on national park management excludes other categories of protected areas from this evaluation. Overall, the PiP scorecard has no applicability to protected areas on islands outside of the PiP program.

Parrish (2003), in reference to the Pacific Islands, indicated that the Measures of Conservation Success (MOCS) could be an alternate assessment tool for islands. The essence of MOCS is integration of quantitative and qualitative data to categorically rate the status of biodiversity targets and then use an overall rating of biodiversity status as a measure of conservation effectiveness. While MOCS achieves direct linking of the conservation process with biodiversity conservation outcomes, the approach is ecologically biased and does not address socio-economic aspects of biodiversity conservation.

RAPPAM is based on an adaptation of the WCPA Framework and not surprisingly, its results reflected conservation priorities, and the relationships between overall management planning, practice and inputs, but not a conclusive picture of management outcomes. Each management component in the WCPA Framework is assessed using criteria which are actually selected attributes of protected area management, and associated indicators. An attribute is either an environmental condition or an aspect of management selected for assessment, and an indicator is a measure that reflects any change in an attribute (Hockings et al. 2004). All the elements of the WCPA Framework can be utilized to provide a comprehensive overall evaluation, or one or more elements may be combined in conducting a formative or summative evaluation. However, explicit goals or objectives do not guarantee the detection of desired outcomes or adequately articulated evaluations.

The Fraser Island methodology, which was based on desired outcomes stated in the Greater Sandy Bay Region's Management Plan, has both outcome evaluation and monitoring aspects. With respect to the outcome evaluation aspect, it was recognized that the effort required to cover the 55 subject areas in the plan far exceeded available human resources. Consequently, only one or two performance indicators were used to assess the accomplishment of objectives for biodiversity conservation and other subject areas. With such a restriction on the number of indicators, it was inevitable that only a sample of the desired outcomes for biodiversity conservation would be detected in the evaluation. Careful thought would have been required to choose indicators that would reflect the conservation impacts as best as possible.

The Finnish case study exemplifies a theoretical criticism that objectives-based evaluation inadequately addresses multiple and competing objectives in a management program (Hockings et al. 2000). The quantitative analysis of the RAPPAM was intended to complement a qualitative methodology called Management Effectiveness Evaluation (MEE) that was also used to assess the Finnish protected area system (Gilligan et al. 2005). The evaluation report indicates that the objectives set for protected areas are influenced by national conservation programs (external to the national protected areas system) and Finland's involvement in the European Union programme, Natura 2000. While the Finnish RAPPAM generally showed that protected area objectives were addressing biodiversity protection and management policies and plans were consistent with objectives, the link to the responsible national and external institutions was not made. Actual and potential conflicts between national and international objectives and between biodiversity conservation and other protected area objectives were not identified. It was the MEE questionnaire that provided insight into conservation objectives for the national protected area system and Natura 2000, and how the two sets of objectives were incorporated into management plans.

2.7 Criteria for Evaluating *in situ* Biodiversity Conservation

The tendency with conservation assessment tools based on the WCPA Framework is to focus on management institutions and organizational structure, financing and protected area design in the selection of evaluation criteria. Protected area system design, reserve design, legislation and policy, and plans for systems and sites are the criteria listed for evaluating the planning aspects of protected areas management in the WCPA Framework (Hockings et al. 2000). In two independent studies, Naughton-Treves et al. (2005) and Bruner et al. (2001) signaled that deforestation extent, land use issues and institutional factors are important criteria in evaluating the effectiveness of tropical biodiversity conservation. Criteria addressing management inputs and processes as exemplified by the WCPA Framework (e.g. agency or site resourcing, suitability of management processes) are more a feature of process evaluations than outcome evaluations. However, where evaluations have addressed both management outcomes and processes for island protected areas, biodiversity conservation was only one of several outcomes. The management criteria were so general that it was difficult to pinpoint how inputs into protected areas management help realize intended biodiversity conservation goals.

However, I have identified from biogeographical elements peculiar to insular environments (Table 12), criteria for evaluating conservation effectiveness. An island biogeographic element has been missing from existing evaluation schemes that are designed to assist managers and policy-makers in improving conservation programmes and addressing management outcomes and their impact on biodiversity. The socio-economic elements, on the other hand, are typical of tropical developing countries and no element specific to tropical island contexts has been identified. Consequently, the priority has been given to the biogeographic and ecological features in the discussion below.

Table 12. Distinguishing Biogeographical Features of Islands

• Restricted range species (more endemic species per unit area and more limited or local geographic distributions than on continents)
• Taxonomic disharmony (fewer faunal species in higher taxonomic groups relative to continental fauna)
• Niche disharmony (tendency for greater occupation of species niches relative to niche occupation on continents)
• Higher vulnerability to risk from exploitation and introduced species
• Higher vulnerability to natural disasters
• Fragile natural systems

Note: From Royle 2001, Spellerberg and Sawyer 1999, Whittaker 1998, Cronk 1997

The occurrence of many endemic taxa amidst relatively low species richness provides a striking contrast to continental areas where low levels of endemism occur amidst high species richness (Sadler 1999, Spellerberg and Sawyer 1999). In terms of criteria for biophysical outcomes of tropical biodiversity conservation, the focus has largely been on maintaining relatively high levels of species endemism, rarity and controlling threats. Rarity can mean i) low density occurrence of a species, or ii) distribution according to a small geographic range (Whittaker et al. 2005).

Recently, an assessment of three different types of avian hotspots for species endemism, threat level and overall species richness (Orme et al. 2005), revealed that species endemism may be a reasonable indicator of threatened and overall bird species richness. The assessment was based on measurement of the extent of spatial overlap (i.e. congruence) between global hotspots for birds. However, the authors point out that generality for this pattern has not been established and it needs to be tested for different taxa. In the meantime, the implication is that conservation priorities established by using multiple criteria will probably achieve the most comprehensive coverage of biodiversity. The three species richness indices utilized by Orme et al. (2005), based on endemism, overall species richness and threatened species are thus acceptable as criteria for species diversity and as indicators of how well threats and disturbances are being managed.

Congruence can also be adopted as a criterion for the distribution of biodiversity by measuring the spatial overlap between the distribution ranges of endemic species from different taxa. It is generally accepted that some groups of species ('umbrella' species) occupy areas large enough to include the distribution range of other species, thus serving as indicators of species rich habitats or ecosystems (Hambler 2004, Pullin 2002, Spellerberg and Sawyer 1999, Simberloff 1998). Similarly, the area of spatial overlap between the distribution ranges of endemic species may be indicative of a habitat or ecosystem important to the conservation of endemicity.

Another addition of island-specific biological criteria such as endemic co-adapted species has the potential to include a surrogate measurement of genetic diversity and evolutionary and ecological processes. Using the African island of St. Helena as an example, Cronk (1997) notes that the interactions (e.g. pollination) between co-adapted endemic flora and fauna on islands are products of niche-separated adaptive radiation. Marten (2001) states:

> "The consequence of co-adaptation is a group of plants, animals and microorganisms from which the community assembly process can form viable ecosystems".

In other words, co-adapted species are essential to the self-organizing processes of biological communities (e.g. natural selection) in the production and survival of ecosystems. In my opinion, if island protected area systems can successfully protect unique co-evolutionary processes through protection of co-adapted species, they are also protecting the genes favoured by natural selection.

The protected areas evaluation literature mentioned above is inconclusive about the significance of protected area size and spatial orientation. Unique co-evolutions and co-adaptations of island flora and fauna (Cronk 1997), have provided opportunities for selection of protected areas on the basis of congruence in their distribution ranges. Protected area design for islands may be better assessed by the level of congruence between selected species indices, how well the total range of island ecosystems is represented and complemented within a protected areas system (Margules and Pressey 2000). In the event of a severe threat or disturbance, repeated examples of disjunct species populations distributed across more than one protected area would probably increase the chances of species survival. This population redundancy is not one of the usual criteria but is worth exploration as a buffer for island fragility.

Another significant feature of tropical oceanic islands is that their small size means relatively narrow species ranges compared to continental biota, with several co-evolved endemic species occurring in the same habitat (Sadler 1999, Cronk 1997). Not only do threats arising from human exploitation need to be curtailed but high island vulnerability to introductions of invasive species makes invasive species a priority issue for island biodiversity conservation.

Davidson (2005) and Hockings et al. (2000) make it clear that the actual data collection in program evaluation is based on identified sources of evidence or indicators for each criterion. A single criterion may have many dimensions, sometimes referred to as sub-criteria. The authors point out that it is usually impractical to try and measure all the sub-criteria, so one approach is to prioritize them and determine indicators for those of highest priority. These indicators may be quantitative or qualitative and are usually derived from multiple sources of information. As far as possible, indicators should clearly relate to the criteria being measured, vary over space and prolonged time, and be simple to measure, interpret, and collect relevant data (Hockings et al. 2004). One of the lessons learned from previous developments of evaluation schemes for protected areas management is that the applicability of general evaluation criteria and indicators to different protected areas systems should not be assumed. Pomeroy (2005) and Hockings (2003) indicate that evaluation systems that have been proposed but not yet field-tested were limited in their utility as field data was necessary to analyze their adequacy and appropriateness. The adequacy and appropriateness of criteria and their indicators are dependent on i) the natural, cultural and socio-economic contexts of the protected area system and ii) the availability of data.

2.8 Presentation of a Theoretically-Derived Framework for Biodiversity Conservation Effectiveness in the Terrestrial Protected Areas System of a Tropical Island

In light of assertions that the most valuable test of management effectiveness is one that assesses the impact or outcome of conservation effort on biodiversity (Hockings et al. 2000), I have conceptualized a theoretically-derived framework for effective biodiversity conservation, useful for an evaluation of conservation outcomes in protected areas systems on tropical islands (Table 13). The purpose of this framework is to

Table 13. Theoretically-Derived Framework for Biodiversity Conservation Effectiveness in the Terrestrial Protected Areas System of a Tropical Island

	Biodiversity Biophysical Features		**Socio-Economic**	
	PA System	**PA Site**	**PA System**	**PA Site**
Goals/ Objectives	• System plan goals & objectives	• Management plan goals & objectives	• System plan goals & objectives	• Management plan goals & objectives
Biophysical Outcomes	• Biological representation • Congruence of species indices • Ecosystem complementarity • Population redundancy • System threats • Disturbances • Land cover	• Species indices: endemism, richness, co-adaptation, threat status • Level of deforestation • Control of invasive species • Population pressure	• Proposed biological targets for direct & indirect consumption • Proposed biological targets for non-consumptive use	• Actual biological targets for direct & indirect consumption • Actual biological targets for non-consumptive use
Management Institutions	• Number & types of associated organizations • Training for PA managers & staff • Occurrence of biodiversity surveys	• Choice of conservation strategy • Staff numbers • Collaborators for scientific surveys	• Funding sources/partners • Expected stakeholder participation • Designation of management authority	• Salaries • Actual stakeholder participation • Income generation
Governance	• System planning • Networking with various environmental sectors • Presence of NPAS policy • Implementation of PA laws	• Site planning • Community awareness • Presence of park rangers • PA demarcation	• National land use policies • Payments for biodiversity protection • Plans for externalities	• Land tenure and use arrangements • Types of natural resource use regimes • Local/community incentives

Explanatory notes: Choice of conservation strategy refers to whether the focus is coarse filter-fine filter, species or ecosystems. PA means protected areas, NPAS means national protected areas system.

represent the concept of effective terrestrial biodiversity conservation in a national protected areas system based on biogeographical and ecological theories, and social science concepts. Specific propositions of the framework are that the achievement of conservation outcomes is dependent on:

1) Critical relationships between concepts of biodiversity conservation, conservation goals and objectives, the associated management institutions and governance of a protected areas system.
2) Ecological and socio-economic contexts representative of tropical islands.
3) Critical linkages between conservation effectiveness at the system and site levels of protected areas management.

The conceptual framework facilitates both the conservation paradigms of protectionism and sustainable use. It is likely that a national protected areas system will encompass a range of protected sites that reflect both these conservation paradigms. These paradigms are instrumental in influencing the goal and objective-setting aspect of conservation planning. The framework assumes that a national protected areas system has biodiversity conservation as one of its goals. Biodiversity is evidently a pluralistic concept encompassing the variety of phylogenetic and biological species, and equilibrium and non-equilibrium ecosystems. These values usually determine conservation priorities and goals which direct the processes leading to conservation outcomes. The lack of consensus on the ways to regulate human impact on biodiversity and on desired outcomes for biodiversity conservation, and the observed goal-setting difficulties signal the importance of having a definition of biodiversity conservation to work with. After considering the plurality of both biodiversity and conservation concepts and the common theme of minimizing human threats, I propose the following definition:

> Biodiversity conservation is the prevention of loss and degradation of populations, species and ecosystems by minimizing anthropogenic threats to ecological interactions and evolutionary processes, in order to maintain the natural variety among and within living organisms.

In light of the discussions in Section 2, effective biodiversity conservation should have two goals, namely that of maintaining natural patterns and processes of biodiversity and minimizing human threats to biodiversity. Effective biodiversity conservation must protect populations, species and ecosystems without subversion of biodiversity value to economic development. In other words, conservation must not be equated with human use although socio-economic benefits may be expected and the value of biodiversity must not be determined primarily by economic criteria. Consequently, the first major set of criteria identified for my theoretical framework is that of Goals/Objectives as stated in biodiversity conservation and socio-economic (natural resource use) plans. In keeping with the systems approach to management, conservation effectiveness occurs when the goals and objectives of individual protected sites fit with the overall goals and objectives of the system.

System and site levels are considered concurrently in the framework to allow identification of any linkages between national and local scales of protected areas planning. A factor which has probably contributed to poorly coordinated protected areas systems and seems overlooked in the literature, is the lack of explicit linkage between system and site levels in the planning of protected areas systems. The World Conservation Union (IUCN) in its guidelines on national system planning for protected areas (Davey 1998) states that system planning is about "… defining the relationships between a) different units and categories of protected areas and b) protected areas and other relevant categories of land". Saterson et al. (2004) note the need to improve links between site-specific conservation activities and regional and global monitoring of biodiversity. No mention is made of the link between national and local scales of protected areas planning, presenting the challenge of establishing the relationship between the system and site levels of protected areas systems. Two advantages of considering a system-site relationship in the evaluation of *in situ* biodiversity conservation are:

1) insight into how the objectives of a protected areas system are achieved through site operations and governance, and reflected in site outcomes for biodiversity conservation.
2) minimizing the risk at the system level of implementing financial and legal institutions, and governance structures that unwittingly compromise site operations or are impractical.

Evaluations of protected areas systems would have added value if they contributed to knowledge of how system and site level scales of management connect in order to conserve biodiversity.

In effective conservation planning, it is expected that not only goals and objectives, but also associated conservation outcomes will be identified. When the proposed goals of effective biodiversity conservation are considered, determining actual conservation outcomes can be broadly seen as assessment of the biophysical features of a protected areas system. The Biophysical Outcomes criteria address the island biogeographic features of significance to tropical islands (i.e. species indices: endemism, species richness, co-adaptation, threat status and control of invasive species). These criteria also cover conservation network targets and major threats to biodiversity. Furthermore, direct links between the outcomes at the system and site levels can be established by exploring for example how levels of species endemism, richness, co-adaptation within sites contribute to biological representation or if proposed resource use targets for the system are realized in the sites. A protected area can be regarded as effective if the indicators for the criteria show an overall achievement of conservation goals and objectives for biodiversity patterns and processes, and reduction or minimizing of human threats to biodiversity.

Actual conservation outcomes are dependent on the implementation stage of protected areas management. Protected areas literature has shown that, in general, implementation of conservation actions is usually a product of governance and management operations for a protected areas system. Governance usually sets the boundaries of legal power and authority for managers, and guides the interactions between management staff and other stakeholders. Management experiences provide feedback on what policy and legislative structures and processes facilitate or hinder biodiversity conservation. The framework categories Governance and Management Institutions comprise major criteria for management resources, stakeholders and conservation actions underlying governance structure and management institutions. These criteria represent the driving forces and critical resources for generating conservation outcomes.

Having abstracted the concept of effective biodiversity conservation into the framework, the framework can be used to guide both biodiversity conservation planning protected areas management. One of the expected strengths of this framework is that it is designed to assess different types of protected areas ranging from strict nature reserves to multiuse resource areas. Accordingly, it addresses both the ecological and socio-economic aspects of biodiversity conservation.

3. RESEARCH METHODOLOGY AND METHODS

The purpose of this "two-case" case study was to 1) validate and revise a theoretically-derived framework for achievement of biodiversity conservation in protected areas system on tropical islands and 2) explain how the framework's criteria and indicators can be used to assess conservation effectiveness. An understanding of biodiversity conservation in the protected areas systems of Jamaica and the Dominican Republic was expected to enable construction of the framework from an informed perspective. One of the lessons learned from previous developments of evaluation schemes for protected areas management is that the applicability of general evaluation criteria and indicators should not be assumed but field-tested to overcome any limitations in their utility (Pomeroy 2005, Hockings 2003). Another consideration was the heavy reliance on experimental designs and quantitative measurement of outcomes in past effectiveness evaluations which were often supported by numerical indicators and statistics on achievements. Classified as summative evaluations, they were limited in their ability to establish critical contextual and causal factors behind the realization of intended and unintended outcomes (Patton 2002, Clarke and Dawson 1999). Based on the spectrum of evaluation approaches mentioned by several authors (Davidson 2005, Patton 2002, Hockings 2000, Clarke and Dawson 1999), a qualitative approach was taken towards this research design. Consequently, a holistic, contextual understanding of a complex and current social phenomenon, *in situ* biodiversity conservation, was facilitated by the research methodology.

This chapter describes the case study methodology and its associated data collection methods and techniques. Details on their rationale, information needed, research sample, data collection, benefits and limitations, analysis and synthesis of data are provided. Both quantitative and qualitative data were used, as together they provide a richer, complementary data set for the research purpose. An interpretative stance was taken towards data analysis to allow for causal explanations of conservation outcomes and suggestions for improvement in the management of national protected area systems.

3.1 Selection of Case Study Locations

In 2003, over 700 protected areas matching IUCN categories were reported for small island developing states worldwide and at least half of these were located in the Caribbean (Rosabal 2004). These statistics indicate that the Caribbean region has one of the highest levels of activity for the establishment of protected areas systems. The constraints of time and funding for this study did not allow comprehensive sampling of the protected areas systems of the insular Caribbean. Consequently, the criteria described below were used to decide on the study locations.

Study locations were chosen from the Greater Antilles, where according to both theory and field studies, the larger and more topographically diverse islands should support a wider variety of ecosystems and species than the Lesser Antilles. It is evident from literature on Caribbean biodiversity that the four Greater Antillean islands of Cuba, Hispaniola – comprising Haiti and Dominican Republic, Jamaica and Puerto Rico do indeed harbour the larger proportion of terrestrial Caribbean biodiversity (IUCN 1992, Johnson 1998). For instance, the wet limestone forests of the Caribbean and certain endemic taxa such as the Todidae family of birds are restricted to the Greater Antilles (Raffaele et al. 1998, Kelly 1988). Preferred study locations should support my argument that tropical islands contribute disproportionately to global biodiversity by having protected sites that have been designated global importance through international conventions. Furthermore, accessibility of ecological, socio-economic and technical information on protected areas management in selected islands was important to the success of this research project. In light of these determining factors, the following criteria were used in the final choice of case study locations:

- The presence of a protected area system with active management of protected areas and supporting legislation.
- Occurrence of a wide variety of Caribbean ecosystems and high levels of species endemism.
- The presence of protected wildlife and ecological services of national, regional or global importance
- Documentation through past biogeographical studies and ecological and socio-economic surveys.
- Access to protected areas and resource persons involved in protected areas management

All five Greater Antillean countries have a national protected areas system (NPAS). However, country profiles by IUCN (1992) for the NPAS of Haiti and Puerto Rico indicate that they have both suffered considerable losses of wild biodiversity due to severe deforestation. Additionally, there are more gaps in information on species occurrence and range in Haiti and Puerto Rico compared to the other three countries. While Haiti is reported as still being biologically significant, the remaining vegetation is said to be similar to that of neighbouring Dominican Republic (IUCN 1992). It was also difficult to assess the international importance of Haiti and Puerto Rico. The United Nations Environment Programme (UNEP) - World Conservation Monitoring Centre (WCMC) website (www.unep-wcmc.org/wdpa) highlights their minimal participation in international conventions. Haiti, to date, has one site declared under the World Heritage Convention (WHC). Although the United States has ratified to the WHC and the Ramsar Convention on Puerto Rico's behalf, as of early October 2006, no sites had been declared.

Eliminating Haiti and Puerto Rico from the list of possible locations left Cuba, the Dominican Republic and Jamaica. Cuba was considered a significant option because it has been reported as the most biodiverse country of the West Indies (IUCN 1992). It also has an extensive protected areas system with over 70 different sites including Ramsar, World Heritage, and Man and the Biosphere sites (UNEP-WCMC website 2006). Through my professional experience as coordinator of Jamaica's Clearing-House Mechanism (national biodiversity information network in support of the Convention on Biological Diversity) and good international relations between Jamaica and Cuba, I have visited two Cuban protected areas and established contact with protected area professionals in government. Two major concerns were i) my professional contacts were limited in terms of non-government organizations (NGOs) and community-based organizations involved in protected areas management and ii) the ability to adequately assess the Cuban protected areas system within the timeframe of a Ph.D. degree. Cuba is more than twice the size of the Dominican Republic and ten times the size of Jamaica.

The Dominican Republic with its relatively high levels of biodiversity and representation of Haitian vegetation provides an alternative to Cuba. More opportunities for information access exist through prior contact with NGO members of Grupo Ecologista Tinglar and Grupo Jaragua at Society for the Conservation and Study of Caribbean Birds (SCSCB) meetings. Both these NGOs are involved in management activities of protected areas in south-western Dominican Republic, where the highest level of biodiversity occurs. A few members of the two NGOs are employed in the government agency responsible for protected areas. Furthermore, the presence of The Nature Conservancy (TNC) offices in both the Dominican Republic and Jamaica provides another comparable information source. A more direct link with the aforementioned Dominicano government agency was established with one of its employees who attended the Waterloo-Laurier Graduate Programme in Geography while doing his Master of Environmental Studies degree. Note that the Spanish adjective Dominicano is used in this text to differentiate the Dominican Republic from the Caribbean island of Dominica.

There is a strong advantage in selecting Jamaica as a study location based on past academic studies and the professional experience of this researcher. As a Master of Philosophy Degree student at the University of the West Indies, my research was based in the Blue and John Crow Mountains National Park. I later worked as an ornithologist with the NGO that manages the park, the Jamaica Conservation Development Trust. When I later began working for the national Clearing-House Mechanism located at the Institute of Jamaica (IOJ), a government organization, national protected area issues fell within my portfolio. The IOJ also manages a small protected area where I have conducted ecological research. Prior to the start of this research project previous contact had already been made with policy-makers, government authorities and government and NGO managers for protected areas in Jamaica.

Finally, it was decided that the study locations would be Jamaica and the Dominican Republic. In order to minimize biases towards a single protected area category, selected protected area sites within each island include national parks, a wildlife refuge and uncategorized protected areas. A range of protected area sizes was chosen to see if size was really an important factor for achieving effective biodiversity conservation (Table 14). Site selection was also based on the existence of different management priorities, regimes and levels of human impact in order to facilitate field-testing of how applicable the framework is for different socio-economic contexts.

The study sites in Table 14 not only include national parks and large protected areas but also smaller protected areas which help complete ecological representation of island biodiversity. In the Caribbean, opportunities for national park establishment are limited, especially on the smaller islands, because of strong traditions of agriculture, silviculture and rural habitation on forested hillsides (Chalmers 2002). Given the high value for forest resource use and ecological services, it is important to also assess how well small protected areas are protecting ecological, scientific and recreational values.

3.2 Methodology

The case study approach was selected to guide the design, data collection and analysis of my research. The features of this approach as characterized by (Babbie 2004, Yin 2003, Patton 2002) are summarized below and followed by a description of its application to my research. According to the literature, research questions According to the literature,

Table 14. Summary of Study Sites and their Biodiversity Conservation Features

FEATURE	JAMAICA (JM)			DOMINICAN REPUBLIC	
Island Area (km^2)	10,990			48,442	
Study Sites	Blue & John Crow Mountains National Park	Portland Bight Protected Area	Mason River Protected Area	Sierra Bahoruco National Park (NP)	Laguna Cabral Wildlife Refuge
Site Area (km^2)	495.2	519.8	0.49	1,126	65
% of Island Area	4.5	4.7	0.004	2.3	0.13
National & Global Importance	Only national (land) park; rain forest; protects IUCN Red List species	Only remnant intact dry forest in JM; protects IUCN Red List species; has a Ramsar site	Rare scrub savanna; rare species; national heritage site	Greatest diversity of ecosystems out of 17 NPs; rain and dry forests; protects IUCN Red List species	Largest body of natural fresh water; woodland; proposed Ramsar site

Note: From Caribbean Coastal Management Foundation 1999, Jamaica Conservation Development Trust 2005, Secretaría de Estado de Medio Ambiente y Recursos Naturales Republica Dominica: www.ceiba.gov.do/2004/areas_naturales/esp/areas_proteccion/areas_prot_esp.html , Weck, S. G. 1970.

research questions description or explanation of a real-life situation, event or behaviour for their answers are likely candidates for the case study approach. The distinguishing feature of this approach is that it encompasses empirical investigation that considers both historical and contemporary events. The coupling of theory with logical enquiry as a guide to data collection is one of the foundation principles. This means that the researcher posits theoretical propositions and then tests their validity during the research process. Only a subset of the total number of factors contributing to a complex phenomenon is usually addressed by any single data collection method. Consequently, more than one method is utilized in order to create multiple sources of data and conduct methodological triangulation.

The case study has been identified as a useful means of tackling complex causal links in real-life interactions in evaluation research. Furthermore, it offers the following potential contributions of relevance to programme evaluations:

- Linking programme implementation with programme effects.
- Description of an intervention and the real-life context in which it occurred.
- Illustration of certain topics descriptively
- Exploration of a situation even if there is no set outcome.

An important limitation is that if a single case is used in the research, there is little basis for generalizing results to other cases not included in the research. However, conclusions have greater validity if they are derived from independent analyses of two rather than just one case study and generalizations are better supported if similar conclusions arise from different case study contexts. On the practical side, case studies are time-consuming and can generate vast amounts of data that may be a challenge to organize and collate. Nevertheless, the benefits of this methodology are expected to outweigh its limitations.

Sutherland (2005) argues that existing scientific knowledge and the experiential knowledge of conservationists have not been adequately utilized and documented in order to define effective approaches in conservation. I agree with this view and in order to ensure that the final conservation effectiveness framework was both theoretically and empirically sound, the selected research methods involved review and analysis of scientific conservation data and information for each island, and a local participatory component in the development of the conservation effectiveness framework. The research methods for each of the two case study locations included a review and content analysis of island literatures, biophysical data and information extraction, a Delphi process involving biodiversity and protected area 'experts', community workshops and interviews.

The targeted biodiversity and protected area 'experts' included conservation scientists, protected area policy-makers and planners, managers and staff. On the other hand, the targeted community stakeholders included leaders of community-based organizations not involved in protected area management, private and state-employed farmers, private and state-employed foresters, and school teachers. An incentive for local participation in the research process was the sense of ownership of the framework that could be claimed through involvement in its construction. The policy-makers, planners and managers are the most likely to utilize the results from an evaluation based on the proposed framework.

After review and acceptance by the Wilfrid Laurier University (WLU) Research Ethics Board, the research was conducted according to the WLU Research Ethics Policy between December 2006 and early August 2008. An average of six calendar weeks per trip was made to Jamaica and an average of two calendar weeks and two days per trip was made to the Dominican Republic. Tropical Storm Dean delayed field activities whilst in Jamaica, in August 2007. One scheduled field trip to the Dominican Republic was cancelled in late October/early November 2007 due to Tropical Storm Noel. Up to December 2007, funding for field data collection was provided from a Social Sciences Humanities Research Council (SSHRC) grant awarded to my supervisor, Dr. Scott Slocombe, and from this researcher's personal funds. Some greatly appreciated in-kind logistic support was also received in Jamaica and in the Dominican Republic for interpreter services, distribution of workshop invitations and Delphi questionnaires. Thereafter, the aforementioned funding sources were complemented by grant funds for field research in Jamaica received from the Environmental Foundation of Jamaica in December 2007 and funds from a TransCanada Pipelines Graduate Award received in May 2008.

The methods and corresponding data collection were conducted in two phases. During the first phase of data collection, three field trips were made to Jamaica and two field trips were made to the Dominican Republic. The first phase involved simultaneous literature review and analysis, biophysical data and information extraction, Delphi process and the community workshops for both islands. The selection of methods was guided by the data and information requirements for meeting the research objectives (Table 15). My study objectives are restated below:

1. To explore perceptions and definitions of biodiversity conservation influencing the setting of conservation goals, objectives and outcomes.
2. To review the intended objectives and outcomes of *in situ* biodiversity conservation and to use these outcomes as benchmarks of conservation effectiveness.
3. To identify the critical i) outcomes, ii) management institution and governance contexts, and iii) linkages between the system and site levels of protected areas planning for effective conservation of island biodiversity.
4. To develop a framework that guides evaluation of the effectiveness of biodiversity conservation based on explicit linkages between the critical outcomes, and critical management institution and governance arrangements.
5. To engage the participation of biodiversity and protected area 'experts', and local community stakeholders in the identification of critical components and subsequent development of framework criteria and indicators.

6. To field-test the framework criteria and indicators with particular reference to i) island-specific biophysical outcomes and ii) critical institutional and governance arrangements in different island contexts.

Table 15. Expected Contributions of Research Methods to Development of Evaluation Criteria

	CATEGORIES OF CRITERIA IN CONSERVATION EFFECTIVENESS FRAMEWORK			
RESEARCH METHOD	**Goals/ Objectives**	**Biophysical Outcomes**	**Management Institutions**	**Governance**
Literature Review & Analysis for Island Cases	Intended goals, objectives, outcomes for *in situ* biodiversity conservation	NPAS design and ecological history and context	History and context of NPAS planning and implementation	NPAS history and context
Extraction of Biophysical Data/ Info	Comparison of biophysical goals and objectives for protected areas system with actual biophysical features of sites	Assessable i) biogeographical/ ecological features, ii) targets and iii) uses of biological resources		Comparison of planned biological targets with actual biological targets
Delphi process	Expert opinion on critical goals, objectives, outcomes for *in situ* biodiversity conservation	Expert opinion on i) all theoretical criteria, ii) other criteria	Expert opinion on i) all theoretical criteria, ii) other criteria	Expert opinion on i) all theoretical criteria, ii) other criteria
Community Workshop	Community opinion on appropriate goals and objectives for protected areas systems	Community opinion on biodiversity, associated values, threats to and uses of biodiversity	Community opinion on i) criteria: PA stakeholder actor role, income generation ii) other criteria	Community opinion on i) theoretical criteria at the site level, ii) other criteria
Evaluation Criteria & Indicator Interviews	Status of intended goals and outcomes for NPAS and study sites	Field-testing of validated criteria on biodiversity status, natural resource use and threats	Field-testing of validated criteria on conservation strategies, stakeholders and activities	Field-testing of validated criteria on policy, plans, legislation, regulations, conservation incentives

N.B. NPAS = national protected areas system PA = protected area

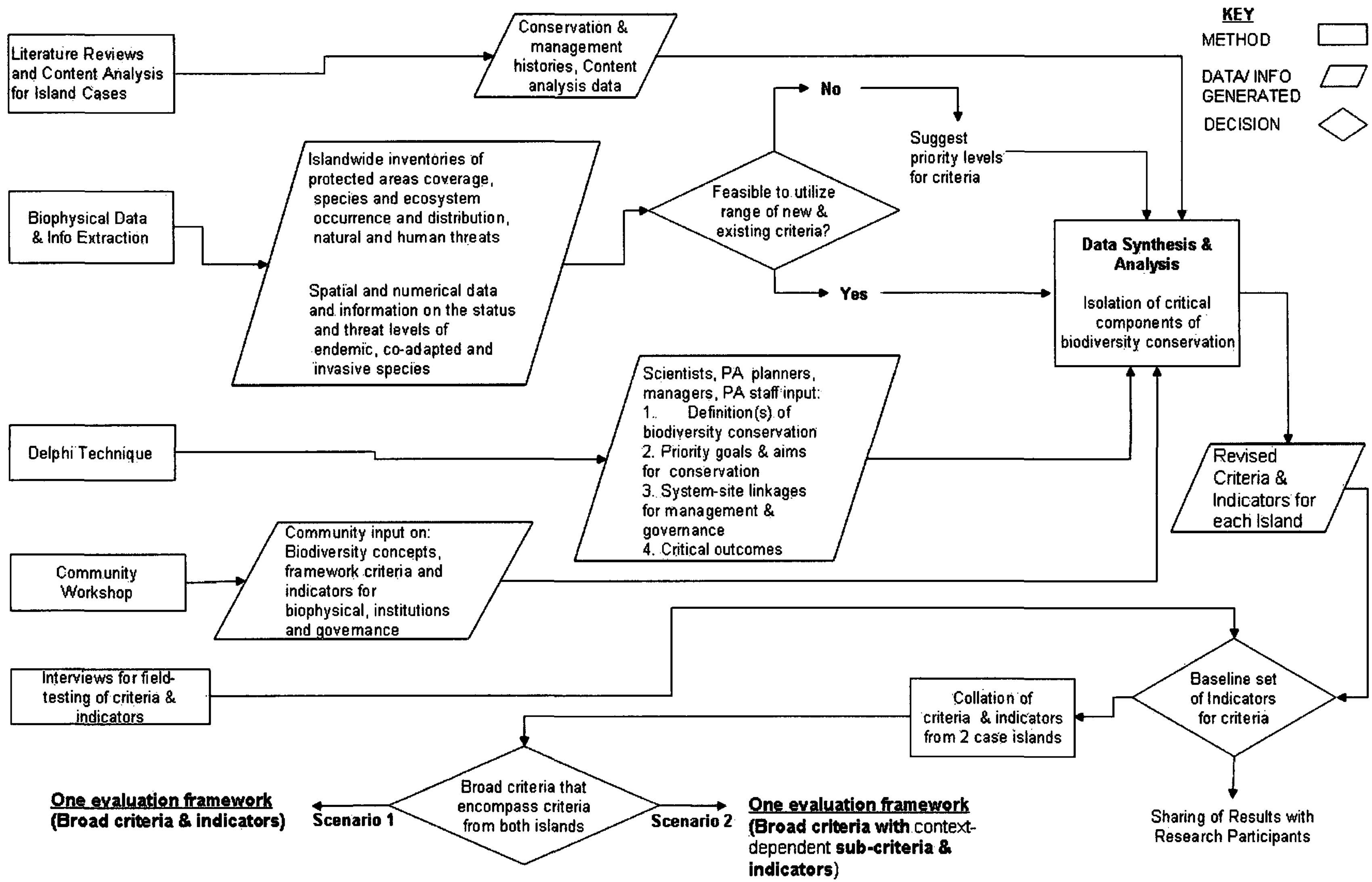
The first phase culminated in the synthesis and analysis of data and information from these multiple methods (Figure 2).

The collected data for were organized each case study location according to the first three study objectives under the broad captions "Biodiversity Conservation: A Perspective", "Biodiversity Conservation Goals and Objectives for National Protected Areas System", and "Biodiversity Conservation Outcomes for National Protected Areas System", "Implementation for National Protected Areas System: Management Institutions and Governance". Nested within each of these broad captions are sub-headings corresponding to the four methods of the first research phase. This organization of data was chosen to facilitate methodological triangulation of the research data in order to isolate the critical components of effective biodiversity conservation. In this study, triangulation is considered the collective analysis of multiple datasets generated from multiple methods in order to confirm, disconfirm or elaborate on the propositions of the conservation effectiveness framework as discussed in Section 2.8.

Support of perceptions, goals and objectives of biodiversity conservation, identification of framework criteria for conservation outcomes, management institution and governance issues and system-site linkages by three or more datasets was considered an indicator of strong corroboration. If none of the datasets addressed the biodiversity conservation criteria then the criteria was called indeterminate and did not warrant inclusion in the framework. However, where theoretical criteria were not corroborated by the research data, justification was provided for the inclusion of the theoretical criteria in the conservation effectiveness framework.

The second research phase was field-testing the utility of the Jamaican and

FIGURE 2. FLOWCHART SHOWING THE CASE STUDY RESEARCH PROCESS



Dominicano criteria and indicators through semi-structured interviews (Figure 2). This research period required one final field trip for each case study location. Note that no attempt was made to evaluate the protected areas system of either island. This stance was taken because of the way I envision the final framework being used to assess conservation effectiveness. That is, the framework criteria and indicators are used to develop evaluation interview protocols for the NPAS management organization(s) and management agencies for individual sites. Consequently, a key agency responsible for system management was selected on each island for interviews along with a partner organization responsible for management of study site protected areas. The usefulness of the criteria and indicators were interpretatively analyzed by this researcher in terms of whether or not the answers reflected the desired linkages and contexts outlined in the framework propositions. The interview results were used to further revise the conservation effectiveness framework and create a baseline set of criteria and indicators for each island. The two baseline datasets were collated and the decision made on whether or not there should be one conservation effectiveness framework with broad criteria and indicators or one conservation effectiveness framework with broad criteria divided into context-dependent sub-criteria and indicators.

This dissertation including the final conservation effectiveness framework will be put on CDs and deposited in the libraries of participating organizations on each island. However, in the interim at different points of the research process, there was informal sharing of the research findings with research participants. A summary of the full dissertation findings is in draft stages for distribution in late 2009.

3.3 Literature Review and Analysis for Island Cases

The primary role of literature in case studies is corroboration and augmentation of evidence from other sources (Babbie 2004, Yin 2003, Patton 2002). For my research purpose, I searched for positive and negative evidence for my framework propositions. The literature search included Jamaican and Dominicano academic books and journals, and technical documents which I have classified as policy documents, management plans and miscellaneous technical documents (i.e. reports, newsletters, conference proceedings and correspondence). The academic and technical literature allowed exploration of the conceptual or theoretical knowledge base with the documented perspectives and practices of island conservationists. National conservation and PA policies were critiqued for consistencies between national positions and directions for biodiversity conservation and the plans to be implemented in a national system of PAs and in the PAs selected as study sites. Ultimately, only the documents that offered insights on the influences of conservation paradigms, management capacities for PA systems, implementation experiences and framework propositions were utilized. Where original sources or copies of information are not available for collection, information was recorded into a computer database or by hand. The texts, maps and images selected for review were sourced from university libraries, the libraries and websites of national government organizations and partner NGOs involved in PA management & on-line databases (Table 16).

The desired insights were sought using two approaches towards the contents of texts:

1) Review of ecological, conservation and protected areas management history in order to understand cultural perceptions & decisions concerning biodiversity conservation and protected areas management.

2) Content analysis to determine the presence of concepts and criteria behind my theoretical conservation effectiveness framework and to infer meaning from such content. Qualitative content analysis, as discussed in (Macnamara 2006, Krippendorf 2004, Fish et al. 2002), is the systematic analysis of the manifest and latent content of a body of communicated material by using a different eye from the author or user to infer meaning.

Table 16. Sources of Literature for Review and Content Analysis

Island (location)	Source	
	Organization	On-line Resources
Jamaica (Capital city of Kingston)	University of the West Indies Mona Campus (Main & Science Libraries, Sir Arthur Lewis Institute for Social & Economic Sciences) www.uwimona.org.jm Natural Environment & Planning Agency www.nepa.gov.jm the Documentation Centre Forestry Department www.forestry.gov.jm Institute of Jamaica www.instituteofjamaica.gov.jm Science Library Planning Institute of Jamaica www.pioj.gov.jm The Nature Conservancy - Jamaica Program www.nature.org/wherewework/caribbean/jamaica Jamaica Conservation and Development Trust www.greenjamaica.org Library	Databases: Scholars Portal Web of Science Google Scholar Networks: Jamaica Clearing-House Mechanism www.jamaicachm.org.jm Birds Caribbean listserv

Island (location)	Source	
	Organization	On-line Resources
Dominican Republic (Capital city of Santo Domingo)	Universidad Autonoma de Santo Domingo www.uasd.edu.do Main Library Subsecretaria de Areas de Protegidas y Biodiversidad www.medioambiente.gov.do Library Grupo Ecologista Tinglar www.geocities.com/tinglar The Nature Conservancy – Dominican Republic Program www.nature.org/wherewework/caribbean/dominicanrepublic Grupo Jaragua www.grupojaragua.org.do Sociedad de Hispaniola www.geocities.com/sociedad_ornitologica_hispaniola	Scholars Portal Web of Science Google Scholar Birds Caribbean listserv

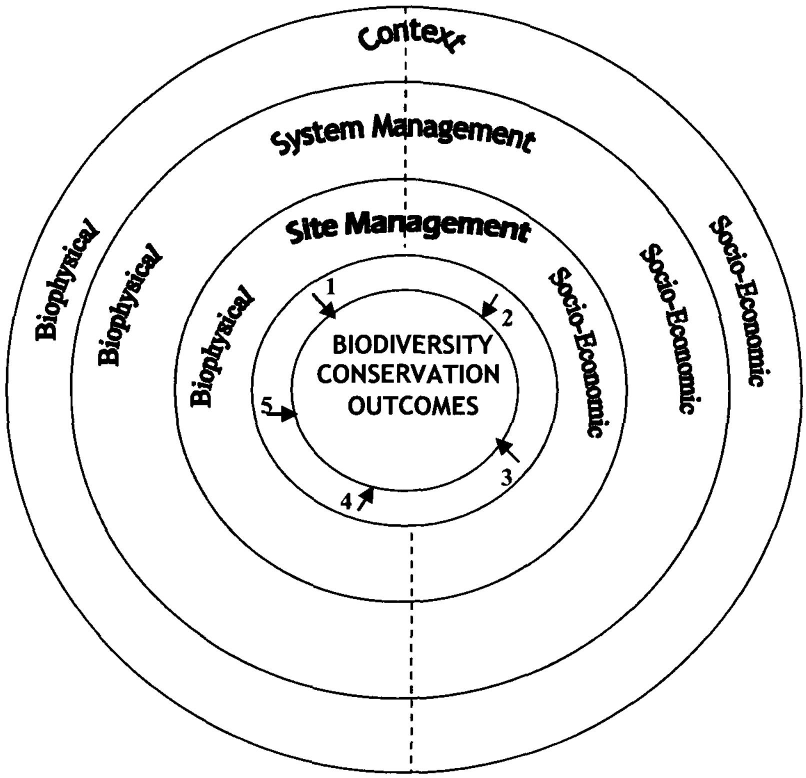
Text has both manifest content, which is the obvious message or view of the author for a particular audience, and latent content, which is the hidden view revealed by content analysis to a reader whose interpretation of the text is based on a predetermined concept. The specifications of the content analysis framework provided by Krippendorf (2004) were conducive to the qualitative stance of this research and formed the basis of my content analysis (Table 17).

Table 17. Conceptual Components of the Content Analysis Framework
According to Krippendorf (2004)

A body of text, which is the data that a content analyst has available to begin analytical effort
A research question that the analyst seeks to answer by examining the body of text
A context of the analyst's choice within which to make sense of the body of text
An analytical construct that operationalizes what the analyst knows about the context
Inferences that are intended to answer the research question, which constitute the basic accomplishment of the content analysis
Validating evidence, which is the ultimate justification of the content analysis

The texts whose contents were analyzed were those that had biodiversity conservation and PA management as a key focus, either for the entire document or for specific chapters or sections. Considering the relatively recent arrival of biodiversity conservation in history of protected areas in the Caribbean, it was anticipated that the issues relating to the theoretically-derived framework might not be explicitly discussed in selected texts. Keeping my research question and study objectives 1 - 3 in mind, creating a context for content analysis meant formulating guidelines as to how the texts should relate to my research question.

In seeking to remain focused on the biophysical and socio-economic aspects of PA management and conservation within their ecological and socio-economic contexts, and how the system and site levels of management informed each other, I adopted a general systems theory perspective to biodiversity conservation in PA system (Figure 3). I see a hierarchical relationship between the system and the individual sites comprising it and their respective management at national and local scales. Biophysical and socio-economic factors act on a NPAS and create the external context in which the system exists. They also occur within the system and affect its operations. In Figure 3, the dotted line indicates that these factors may interact with each other and do not necessarily act independently.



KEY: 1 Concept of biodiversity conservation 2 Conservation goals 3 Objectives
3 Management institutions 5 Governance

Figure 3. Systems Perspective for Biodiversity Conservation in a Protected Areas System

My analytical construct was a coding system that utilized the above systems perspective to build a relationship between text and my theoretical conservation effectiveness framework. The underlying concepts and the criteria in the theoretical framework were organized into a list of categories of issues or topics (Table 18). The category list was used to consistently identify the presence of the framework concepts and criteria and to draw inferences about them form the text being analyzed. These inferences are abductive, meaning that they are not made directly from the written contents but are new proposals about the content as a result of the coding system. The adbuctive inferences require validation by the results of the other research methods.

Table 18. Coding Categories Used in the Content Analysis

Category Name	Category Description
Characterizing biodiversity	Total numbers or variety of species, &/or genes, &/or ecosystems, &/or biogeographic units or patterns
Concept of biodiversity conservation (BioC)	Definition of BioC; values associated with biodiversity; biodiversity targets; BioC paradigms of protectionism, neo-liberalism & sustainable use
Outcomes for *in situ* BioC	W.r.t BioC in protected area systems and sites: Intentional and unintentional outcomes; intentional and unintentional goals; benefits to social and ecological systems
BioC priority	biological representation; endemism, rarity; biodiversity threat status (vulnerable, threatened, endangered); landscape function
BioC challenges and problems	Natural and man-made threats e.g invasive species, natural resource exploitation (non-consumptive & consumptive), non-biological resource use e.g. mining, ecosystem conversion or degradation, pollution; and pressures e.g. dependency on protected area biodiversity for livelihood or contribution to national economy
BioC opportunities	Research collaborations; livelihood for communities; equitable sharing of conservation benefits
Coordinated planning for *in situ* BioC	Cross-referencing of related policies, strategies and plans; recognition of incoherent/ conflicting policies, strategies and plans
Planning and management outputs	Policies; legislation; system plans; management plans; site declarations; zoning and other regulations; other
Mechanisms & instruments for implementing plans	Decision-making procedures; stakeholder involvement or empowerment processes; market incentives e.g. carbon payments
Administration for *in situ* BioC	Responsible organization(s) for protected area system; responsible organization(s) for individual

	sites; enforcement responsibilities; management styles; management authorities; accountability procedures
Site design & establishment for protected areas	PA categories; boundary demarcation; congruence between PA boundaries and ecological boundaries; number of actively managed sites; PAs numbers and coverage/size
BioC research, monitoring & assessments in PAs	Inventories & surveys; monitoring programmes; evaluations/ assessments of protected areas systems and sites
Human resources dedicated to *in situ* BioC	Level of staffing in responsible organization(s); formal educational programmes on protected areas management; staff training; capacity-building
Financial resources for *in situ* BioC	Debt-for-nature swaps; trust funds; economic investment; capacity-building
Technical resources for *in situ* BioC	Equipment; scientific expertise; training/ educational opportunities for protected area professionals; capacity-building
Changes in management institutions	Increase, decrease or emergence in: planning mechanisms and instruments, administration, site design and establishment and resources
Changes in management outcomes	Increase, decrease or emergence in intended and unintended outcomes
External influences	Policy environment; political will; political stability; economic position; international relations; neighbour and stakeholder relationships; weather patterns

The document title, the recording unit (i.e. if it is a whole text, chapter or paragraph for analysis), the coding categories, notes on the specific sections that were coded and the inferences were manually recorded in a Microsoft Access relational database. For each island, data collation and analysis were conducted within each document and across documents. More specifically, the inferences in each document were explored for relationships between the issues covered by the coding categories and for any meanings that emerge from the text that were not detected by coding. Electronic cross-referencing of the same category across the total sample of documents for each island enabled efficient detection of major themes, arguments and assumptions.

3.4 Biophysical Data and Information Extraction

The biophysical data and information extraction a) gives insight into how biodiversity is characterized with reference to the ecological biophysical criteria, and b) provides evidence of measurable conservation objectives and outcomes. The biophysical criteria address protected areas system design, the occurrence and distribution of species and ecosystems, and their major threats. Their applicability to the island context is dependent on their recognition and prioritization in the planning and implementation of conservation strategies, and the availability of supporting scientific data and information . The literature review and analysis would have indicated recognition and priority. However, there is the possibility, especially for the island-specific biophysical criteria, that there may be inadequate data to support their assessment. In such instances it would not be feasible to use these criteria in the conservation effectiveness framework and priority would be given to criteria for which indicators could be generated.

Certain key data and information requirements were identified at both the system and study site levels of protected areas in order to determine applicability and conservation significance of the island-specific biophysical criteria. The first is islandwide inventories of protected areas coverage, species and ecosystem occurrence and distribution, natural and human threats to biodiversity. Second, is the data and information from monitoring programmes on the status and threat levels of endemic, co-adapted and invasive species within each island-country. The secondary numerical and spatial data and information of interest were not generated with my research purpose in mind and often had to be extracted from documentation, then collated or summarized to meet my data collection needs. Data and information sources were relevant documents and databases included in the literature review and analysis, as well as additional texts, maps and images. The biophysical profile in Table 19 was used to guide the collection and collation of data and information. Comments were also made on the quality of the data and information. One of the challenges with this method was that much of the data was fragmented in different organizations and in different formats which made its collection and collation very labour intensive.

Table 19. Template for Island Biodiversity Profile

ISLAND NAME:					
ISLAND AREA:					
MAJOR LANDFORMS:					
CLIMATIC VARIATION:					
MAJOR ECOSYSTEM #1:					
	Endemic	Rare	Endangered	Invasive	Co-adapted
# Plant Species: Taxonomic Plant Groups: # Animal Species: Taxonomic Animal Groups:	- -	- -	-	-	-
MAJOR ECOSYSTEM #2:					
	Endemic	Rare	Endangered	Invasive	Co-adapted
# Plant Species: Taxonomic Plant Groups: # Animal Species: Taxonomic Animal Groups:					
OTHER ECOSYSTEMS:					
MAJOR BIODIVERSITY CONSERVATION TARGETS & STRATEGIES:					
MAP SHOWING PROTECTED AREA COVERAGE OF ISLAND ECOSYSTEMS:					
MAJOR USES OF BIOLOGICAL RESOURCES	Descriptions: Quantitative estimates:				

Of particular interest are existing gap analyses, distribution maps and geo-referenced data for endemic tree, bird and mammal species. Gap analyses determine which species and ecosystems have been included or omitted from protected area systems and if biodiversity targets for the five study sites have been achieved. Gap analysis is a technique, based on spatial data, for identifying vegetation types and species that fall outside an existing protected areas system (Langhammer et al. 2007, Dudley and Parrish 2006). Endemic trees were selected because of the importance of tree cover to forest ecosystems, endemism and endangerment of island birds. Caribbean mammals, a highly endangered group, provide an example of niche disharmony in tropical islands (Whittaker et al. 2005, Rodriguez 2004, Spellerberg and Sawyer 1999). Areas of congruence (i.e. spatial overlap) will be indicated on the land cover maps and particular note will be paid to the frequency of occurrence and extent of such areas.

3.5 Delphi Process for the Case Study

Historical application of the Delphi technique for group communication indicates that the primary goal is to get consensus on opinions of selected 'experts' in determining the accuracy of forecasts and predictions (Landeta 2006, Linstone and Turoff 2002). Since its origins in the early 1950s, the use of the Delphi technique has expanded beyond quantitative research to its current use in qualitative research as a means of clarifying, prioritizing or identifying complex social problems and solutions (Landeta 2006, Smith et al. 2003). A series of questionnaires (at least two) are the usual data collecting instruments. These are interspersed with controlled feedback both to and from the 'experts'. The norm is that the first round of questions is open-ended, avoiding the categorization of responses (e.g. multiple choice answers) (Mullen 2003, Powell 2002). The expected benefit is freely expressed views with minimal researcher bias. This bias is more likely to occur with the restriction on group expression imposed by closed-ended questionnaires. The answers to each of the round one questions are processed for major themes. However, successive rounds actually take the form of increasingly closed-ended questionnaires, where the collated results from previous rounds are presented for ranking or categorization. In these rounds the responses are based on consideration of the collective views of the expert group. Their distribution ends when consensus is achieved, or the content of the responses shows little variation, or the designated number of rounds is reached (Mullen 2003, Powell 2002). The final stages of the Delphi technique are the analysis of data and the provision of feedback on the analysis to the 'experts'.

With its structured use of questionnaires, the Delphi technique may at first glance resemble a modified survey method. However, the Delphi technique has key principles and characteristics that distinguish it from a standard survey method (Table 20).

The Delphi technique has appealed to researchers and surveyors in the natural and social sciences, education and health sciences. It has been observed in the literature that application of the Delphi technique may be determined by one of three broad intentions (Franklin and Hart 2007, Stewart 2001, Woudenberg 1991):

1) A forum for establishing facts (through opinion consensus) – i.e. 'classical' Delphi
2) A forum for generating ideas – 'Policy' Delphi
3) A forum for collaborative decision-making – 'Decision' Delphi

The group of 'experts', sometimes referred to as Delphi participants, may be a full census or a sample of one or more social groups. The Delphi participants in a single study may range in number from ten to hundreds. Different modes of communication have been utilized including posted and computer-mediated questionnaires, interviews and email. Consequently, several Delphi methods and approaches have emerged over the years which vary according to purpose, the targeted social group, number of Delphi participants and the mode of communication. Although there is no single Delphi method, all methods are expected to share the key characteristics (Table 20).

Table 20. Key Principles and Characteristics of the Delphi Technique

PRINCIPLES	COMPONENTS OF THE DELPHI TECHNIQUE	CHARACTERISTICS (Characteristics in italics, followed by brief explanation)
• Group communication more accurate or more valid than separate individual opinion	• Data collection process	• *Iteration*: Reliance on at least two successive consultations with the same expert group
• Structured communication strengthens data-generating process in comparison to unstructured communication	• Communication between 'experts'	• *Anonymity*: 'Experts' are anonymous to each other whilst interacting with each other through their responses to 2nd and successive rounds
	• Communication between researcher and participants	*Controlled feedback:* • All direct feedback from the expert group is sent solely to the researcher or group coordinator. • Researcher provides feedback of collated results to the expert group
• Objectively analyzed and presented empirical data increases confidence in the data?	• Analysis	• *Summary statistics of group response*: Collated data is often presented as averages, standard deviations, median values to allow meaningful comparisons of data.

Note: From Mullen 2003, Powell 2002, Turoff and Linstone 2002

A derivative of the classical Delphi, namely the Policy Delphi proposed by Murray Turoff in the 1970s, is of particular relevance to this study (Table 21). Mitroff and Turoff (2002) establish Hegelian or Dialectic Philosophy as the underlying philosophy for the Policy Delphi. The general idea is that systems or issues under study are perceived as the products of opposing or conflicting factors or elements. In order for information generated from a Policy Delphi to have validity, the data and its interpretation should reflect the widest range of pros and cons to truly reflect the construct of the whole system or issue. Two key assumptions are that contradictory positions are inherent features of the system or issue and important matters will emerge in the data through strong divisions in opinions or feelings. Like the Policy Delphi, my interest in expert opinions is not oriented towards achieving consensus. On the contrary, with regard to the complex dialectic subject of *in situ* biodiversity conservation, my Delphi objectives include capturing:

1) A diversity of scientific and practitioner viewpoints,
2) The collective priority placed on the biophysical, institutional and governance issues, and
3) The expert opinions of a spatially dispersed social group within the time constraints of this study.

Two benefits credited to the Policy Delphi and of interest to my research are its capacity to reveal changes in events as related to the topic of study and to tackle complex issues as well as issues of undetermined or no historical context (Franklin and Hart 2007).

Table 21. Outline of the Policy Delphi

OBJECTIVES	KEY PROCEDURES	COMMON PRACTICES
1) To elicit from Delphi participants all the differing options and perspectives surrounding a policy or policy-related issue 2) To estimate the impact and consequences of particular options 3) To examine and estimate the acceptability of options	1) Formulation of the issues 2) Exposing the available policy options 3) Determining initial positions on issues 4) Exploring and obtaining the reasons for disagreement 5) Evaluate underlying reasons 6) Re-evaluating options	1) Utilization of 3 – 4 rounds 2) Utilization of informed people representative of many sides of an issue 3) "Deals largely with statements, arguments, comments and discussion" 4) Rating scales used to evaluate the ideas expressed by the participants

Note: From Turoff 2002

However, should there be any observations of dissension in the Delphi responses arise, then Turoff (2002) argue that the best possible information cannot be achieved without investing extra effort to clearly establish the basis of the observed dissension. A second limitation highlighted by Turoff (2002) was the lack of control by a researcher in preventing consensus as a legitimate outcome of the Delphi process. Turoff (2002) states:

> "While it is consistent with the objective of a Policy Delphi to choose a respondent group such that a consensus is unlikely to occur, it can never be guaranteed that it will not be a result."

Another noteworthy point is that while the findings resulting from a Policy Delphi may facilitate more informed decision-making; unlike the Decision Delphi, decisions about the issue under study are not required from researcher or participants. The analysis of Policy Delphi data usually points out patterns of polarity or non-polarity or skewedness in the responses to questions and, if relevant, how these patterns relate to the Delphi participants. Other benefits and limitations of the Policy Delphi exist but they are not unique and are addressed below with specific reference to the Delphi process for this study.

With respect to Jamaica and the Dominican Republic, a Policy Delphi process was developed to systematically focus the existing scientific and experiential knowledge of biodiversity and protected area 'experts' into the identification of critical components of effective *in situ* biodiversity conservation and into the subsequent development of conservation effectiveness framework criteria and indicators. An expert group of conservation scientists, protected area policy-makers and planners, protected area managers and staff was systematically established in each island. The general basis for the expertise of group members was their past and current experiences in the scientific study of *in situ* biodiversity and in the planning and management of protected areas. The eligibility of the expert group in each island was based on meeting at least one of the following criteria: 1) scientifically published on freshwater or coastal or terrestrial biodiversity located in protected areas or on bio-physical or social aspects of protected areas management, 2) is (or has been) a manager of an active protected area, including heads of non-government and community-based organizations that are designated co-managers of protected sites by state authorities, 3) is (or has been) responsible for the development or implementation of protected area policy and legislation, 4) is (or has been) responsible for the development or implementation of a protected areas system plan, 5) is a protected area education officer and 6) is a protected area ranger. Consequently, six categories of protected areas expert were identified namely, conservation scientist, manager, policy-maker, planner, education officer and ranger.

The term expert has been used generally to mean a primary knowledge holder of 1) local concepts of a protected areas system and of biodiversity and its conservation outcomes, and 2) the challenges of and opportunities for implementing (i.e. organizing and coordinating) a protected areas system. On the other hand a 'non-expert' or lay person may have a useful opinion to offer on the two aforementioned points but it has been assumed that there would be less depth and limited scope to such an opinion that has not been informed by scientific or experiential knowledge. Mitroff and Turoff (2002) acknowledge that a likely misconception of past Policy Delphi processes is emphasis on expert opinion at the expense of non-expert contributions that could add alternative viewpoints for the researcher's consideration. One potential bias recognized in the use of 'experts' for this study is that they may have a different perception of community-related issues (e.g. community awareness, land tenure and use, natural resource use, and local community incentives) than residential communities within or adjacent to protected area boundaries. The independent collection of community opinions through workshops compensates for this possible Delphi limitation.

Email was the chosen mode of communication as it allowed for efficient long-distance contact with invitees to the Delphi process and subsequent repeated contact between the researcher and each expert. Repeated contact with the expert group was mandatory considering the iterative nature of the Delphi technique. In addition to the quick exchange of correspondence, the invitation to participate, questionnaires and feedback can be emailed simultaneously to all members of the expert group without revealing the identity of group members. From the researcher's perspective, email contact was also the most economical mode of communication. Provided that members of the expert group were already using email, no additional monetary costs would be incurred if they chose to participate in this study. Exploration of the level of Internet access and email use in each study island revealed that the majority of protected areas management and policy organizations and research institutions had email connectivity with many employees having individual email accounts. Where some 'experts' did not have email accounts, an effort was made to deliver hard copies of the Delphi questionnaires and have the completed questionnaires collected.

A form invitation was prepared for email distribution to each potential member of the expert group. English and Spanish versions of the invitation were prepared for Jamaica and the Dominican Republic respectively (Appendices A and B). They were sent simultaneously and anonymously to Delphi invitees using the Blank Carbon Copy (i.e. Bcc) feature of the email service. The invitation introduced me as the researcher, my supervisor and the research purpose. Written consent, emailed to the researcher, was requested as a confirmation of voluntary participation. The Delphi process was briefly outlined along with the obligations of both participants and the researcher.

A desired feature of the proposed conservation effectiveness framework is its accommodation of different constructs of biodiversity conservation and approaches to implementing a protected areas system. Consequently, a major aim of the Delphi process was to facilitate freedom of expression in responses to Delphi questionnaires without pressure from the status quo to withhold differing or even conflicting points of view. The anonymity of 'experts' to each other was instrumental in encouraging free expression. Getting information from Delphi participants required an investment in building a relationship with participants and adequate motivation on the part of the researcher to increase the chances of having successive rounds. The design for the first questionnaire, hereafter referred to as Delphi Questionnaire 1, was the other critical factor in creating the desired communication environment.

Insights gained from the general literature review on *in situ* biodiversity conservation in tropical islands and the theoretical framework provided a basis for the development of the first questionnaire. The objectives of Delphi Questionnaire 1 were to explore:

1) Concepts of biodiversity conservation including underlying values for biodiversity and approaches to conservation
2) Prioritizing of biodiversity conservation goals and objectives as a basis for identifying critical outcomes
3) Sensitivity to the distinction and critical linkages between system and site levels of protected areas management
4) Perspectives on how protected areas management institutions and governance at the system level affect biodiversity conservation, and finally to harness
5) Scientific and practitioner inputs into revisions of the theoretical conservation effectiveness framework.

**EVALUATING BIODIVERSITY CONSERVATION
IN THE PROTECTED AREAS OF TROPICAL ISLANDS:
THE CASE OF THE CARIBBEAN**

Delphi Questions Round 1

Thank you for agreeing to participate in the above titled study. As an expert on protected areas management and biodiversity conservation, you are being asked to respond to <u>each</u> of the following questions. Your answers will contribute towards the development of a framework for evaluating the achievement of planning objectives and biodiversity outcomes *in situ* biodiversity conservation on tropical islands.

Detailed answers that address social as well as ecological issues are welcome. Please complete the questionnaire before **February 14, 2007** and return your responses to davi2804@wlu.ca

1. How would you define biodiversity conservation?
2. What biodiversity conservation goals and objectives do you think are priorities for an effective national protected areas system?
3. What institutional issues at the protected areas system level do you think have the greatest influence on biodiversity conservation in protected sites?
4. What governance issues at the protected areas system level do you think have the greatest
   influence on biodiversity conservation in protected sites?
5. Please consider the following evaluation criteria for assessing biophysical outcomes and associated inputs and actions for protected areas management and governance. Each criterion was identified from conservation literature and is defined as an environmental condition or aspect of management for assessment. Add others that you think should be there. Kindly use an asterisk (*) to indicate criteria you think are of greatest importance. The other criteria will be considered those of less importance. Please provide brief explanatory notes for your choices.
   N.B. PA = protected area.

Delphi Question #5, (continued): Evaluation Criteria in Theoretical Framework

Biophysical Features	Management Institutions	Governance
• Biological representation (full range of native biodiversity) • Congruence (or overlap) of species distribution ranges for endemics • Ecosystem complementarity (no. of unrepresented ecosystems that a new site adds) • Population redundancy (different sites protecting different populations for same species) • System threats • Disturbances • Species indices: endemism, co-adaptation, richness, threat status • Level of deforestation • Control of invasive species • Land cover • Population pressure • Biological targets for direct & indirect consumption • Biological targets for non-consumptive use	• Conservation strategy (species and/or ecosystem focus) • Designation of management authority • Training for PA managers & staff • Staff • Salaries • Biodiversity surveys & research • Partners/ collaborators for scientific surveys & research • Stakeholder/ actor participation • Funding sources/ partners • Income generation	• Networking with various environmental sectors • PA policy • Implementation of PA laws • System planning • Community awareness • Park ranger patrols • PA demarcation • Site planning • National land use policies • Payments for biodiversity protection • Plans for external influences on the protected areas system • Land tenure and use arrangements • Types of natural resource use regimes • Local/ community incentives

After major themes in the Round 1 responses were identified, they were emailed to Delphi participants for ranking in Round 2.The second round actually took the form of a survey where the summarized results from the first round were presented for ranking or categorization by the expert group. The final design of the Round 2 questionnaire was dependent on the Round 1 feedback. The distribution of Delphi questionnaires ended with Round 2.

Implementation of the Delphi process as outlined above resulted in two different experiences for Jamaica and the Dominican Republic. The Delphi process was applicable to the Jamaican case but required modification to a standard survey process for the

Dominicano case. The invitees to the Jamaican Delphi process included 51 persons located islandwide and covering all six categories of 'experts' (Table 22). Emailed consent to participate in the Delphi process was received from 18 persons and these persons were emailed the Delphi Round 1 questions. A 56% response rate was observed for Round 1 with 10 participants returning completed questionnaires. Scrutiny of the Delphi Round 1 responses revealed close similarity among some participants' statements as well as some unique statements. After the removal of duplicate statements or the merging of very similar statements, and some minimal editing for clarity, the statements for each Round 1 question were collated for ranking in Round 2. Each of the10 Delphi participants then received the Round 2 questions (Appendix C). Participants were then asked to rank their level of agreement or disagreement with each statement using the following five-point Likert scale:

1	2	3	4	5
Strongly disagree	Disagree	Neutral	Agree	Strongly agree

The 2nd round of questions saw a 90% return rate (Table 23).

Table 22. Summary Statistics for Jamaican Delphi Process

CATEGORY OF EXPERT	# INVITEES	# CONSENTEES	# VOLUNTARY PARTICIPANTS
1.SCIENTIST	21	6	4 (Associated with University of the West Indies and The Nature Conservancy)
2. PLANNER	13	5	2 (Both persons associated with the national park)
3. MANAGER	6	2	2 (From two of three study sites)
4. POLICY-MAKER	5	3	1 (from environment ministry)
5. EDUCATION OFFICER	3	1	0
6. RANGER	3	1	1 (From the national park)
TOTAL	51	18	10

Table 23. Response Rate throughout the Jamaican Delphi Process

ROUND	QUESTIONNAIRE SENT	QUESTIONNAIRE RECEIVED	RESPONSE RATE
1	18	10	56%
2	10	9	90%

Charts were used to simultaneously present the collated statements and associated ratings generated in the Delphi Rounds for a definition of biodiversity conservation, biodiversity conservation goals, biodiversity conservation objectives, management institutional and governance issues. The individual ranks for Round 1 statements were converted to a group rating for each statement (i.e. mean and standard deviation) to allow comparison of responses across the group as well as across the range of statements. A mean rating is the average of the nine numerical ranks given to each statement in Round 2. The standard deviation, located on either side of the mean, indicates the spread of the numbers along the Likert scale. A small standard deviation means that most persons indicated the same level of agreement or disagreement, moving towards group consensus. A large standard deviation means that there was relatively high variation in the levels of agreement or disagreement, indicating no group consensus. The standard deviation was calculated using the following formula:

$$s = \sqrt{\left[\frac{\Sigma (x - X)^2}{(n - 1)}\right]}$$

where x is a rank, X is the mean rank
sample size (n) = 9

Particular attention was paid to which Delphi Round 1 statements elicited strong agreement or strong disagreement in order to detect any opposing or conflicting group opinions. All statements that had a mean rating of 4.5 or more were regarded as critical framework criteria identified by Delphi participants. Statements that had a mean rating of 4.0 – 4.49 with small standard deviations were regarded as very important issues.

Two cultural factors beyond my control required modification to the Delphi invitation process. First of all, the DR protected area system is managed through such a centralized system that at a meeting with the Vice-Minister for the Subsecretaría de Áreas Protegidas y Biodiversidad, I was advised to liaise with his Technical Assistant in inviting persons to participate in the Delphi process. The reasons provided for this approach were 1) the first concern before participants consent would be if the Vice-Minister had approved my project and 2) an introduction and a request for commitment through the Subsecretaría would decrease some of the invitees' inevitable hesitation to communicate with me, a foreign researcher. So, my Delphi invitation was emailed to government staff and protected area managers by the Technical Assistant (and copied to me) with a few introductory sentences indicating that the Vice-Minister was aware of my project and soliciting support.

Secondly, the lower availability and access to personal email services amongst the invitees in the Dominican Republic required a mixed approach to distributing invitations. The Subsecretaria forwarded my invitation to 12 email addresses, some personal and others were organizational addresses. Additionally, I emailed the Delphi invitation to 8 other persons including relevant TNC – Dominican Republic staff. A low response rate to the email invitation (consent to participate from 3 persons, 2 questionnaires returned - not all questions were completed) was received. Some persons had access to cyber cafés but I do not believe this kind of email access is appropriate for a Delphi process, considering the limitations that would be imposed on access and response to my follow-up emails. These communication challenges resulted in the Delphi process being replaced by a survey using the questions developed for Round 1 of the Delphi Process. I resorted to personal communication and distribution of the questionnaire at a training workshop [not related to my research] organized by the Subsecretaria and a guest presentation at a Subsecretaria meeting. I was able to distribute the questionnaire to an additional 35 persons via these fora, bringing the total number of distributed questionnaires to 55. A total of 24 persons submitted questionnaire answers, including the 2 who had emailed their Delphi Round 1 questionnaire (Table 24). The survey results presented in Chapter 5 are based on responses from 24 'experts' to the Delphi Round 1 questions, a return rate of 44%.

Table 24. Summary Statistics for Dominicano Survey Respondents

CATEGORY OF EXPERT	# RESPONDENTS
1.SCIENTIST	2
2. PLANNER	8
3. MANAGER	1
4. POLICY-MAKER	3
5. EDUCATION OFFICER	3
6. RANGER	4
Did not indicate their category	3
TOTAL	**24**

3.6 Community Workshops

Community was defined for my research purpose as the group of residents and organizations located within and immediately outside the protected area boundaries. Their input into the conservation effectiveness framework was considered valuable because their attitudes and values are major influences on the effectiveness of administration and governance of a protected areas system (e.g. cooperation with enforcement measures and their level of natural resource use), and the resultant outcomes. Each workshop was designed to get answers to the following four questions, but also facilitated discussion of other related topics considered useful for the research:

1) What is biodiversity?
2) What biodiversity should be protected and why?
3) What issues need to be considered in establishing protected areas and a system for managing them and enforcing the related laws?
4) What would you have to see or experience to be satisfied with how a protected area is managed?

Questions 1 and 2 explored the level of awareness for *in situ* biodiversity conservation as reflected by community concepts of biodiversity and what were acceptable reasons for its conservation. Questions 3 and 4 elicited community input into the identification of framework criteria and indicators for the biophysical, institutions and governance categories of the framework.

Workshop participants for each island were recruited primarily from leaders of community-based organizations not involved in protected area management, private and state-employed farmers, private and state-employed foresters, and school teachers, in addition to other persons interested in attending the workshops. With the assistance of the government or non-government organizations in Table 25 and community groups, written invitations (Appendix D) were circulated to individuals, schools and community centres that were adjacent to or fall within the protected areas. The targeted number of workshop participants was between 20 and 25 persons. The selected workshop venues were suggested by the collaborating organizations and tended to be central and accessible to the communities of interest.

Table 25. Workshop Locations and Attendance

Protected Area	Collaborating Organizations or Groups	Number of Workshops (Total = 10)	Workshop Venues (Number of Participants)
Jamaican:			
Mason River Protected Area	Institute of Jamaica	1	McNie Secondary School (16)
Cockpit Country Forest Reserve	Forestry Department	1	Siloah All Age School (estimate of over 100)
Portland Bight Protected Area	Caribbean Coastal Area Management Foundation	1	Caribbean Coastal Area Management Foundation (10)
Blue & John Crow Mountains National Park	Jamaica Conservation and Development Trust & Bowden Pen Farmers' Association	2	Holywell Learning Centre (~8) a Mason River night club (~10)
Dominican Republic:			
Laguna Cabral Wildlife Reserve	Grupo Ecologista Tinglar	4	Cabral (11), El Peñon (5), La Lista (10), Cristobal (6)
Sierra de Bahoruco National Park	Grupo Ecologista Tinglar, Grupo Jaragua	1	Puerto Escondido Community Centre (17)

One of two exceptions to the recruitment process was an invitation from the Forestry Department in Jamaica. I was invited to make a presentation on my research at a meeting for communities adjacent to the Cockpit Country Forest Reserve or who had a tradition of natural resource use in the area. I included my workshop questions as part of an interactive presentation in order to utilize this opportunity for collecting additional data. I asked the Forestry Department officers about the attendees and learned that they included the groups of persons that fit my recruitment criteria. The second deviation was the Cabral Workshop in the Dominican Republic. Having indicated the persons targeted for the workshop, some of the participants turned out to be the park rangers for Laguna Cabral. I have included their input because with the exception of the head ranger the other rangers were relatively new, only being in the job for almost four months. All of them lived in, or in the vicinity of, Cabral and their knowledge level was not comparable to that of seasoned conservationists.

The workshop format was an interactive presentation on biodiversity conservation and protected areas systems as part of a brief introduction of my research project. This was intermingled with discussions arising from participant questions and four questions posed by the researcher. Where feasible, a multimedia projector was used to deliver a Power Point presentation specific to each island context. Alternatively, 3 ft (0.91 m) by 4 ft (1.22 m) colour posters in English and Spanish were produced for the workshops, summarizing the main points of the presentation. An interpreter was utilized for each of the Dominican Republic workshops to facilitate Spanish to English and English to Spanish communication. Other presentation aids were colour maps showing the protected areas of Jamaica and the Dominican Republic, and letter-size black-and-white copies of the posters as give-a-ways. Participants were encouraged to brainstorm, that is, to share as many ideas as possible and to discuss these ideas as part of a learning experience for both the workshop facilitator and participants. Participants not only provided verbal contributions but in some cases responded to the invitation to write their ideas on flip chart paper or cartridge paper. Other participants preferred that the researcher wrote their ideas on the paper which they would then read and confirm. Where participants consented, the workshop was tape recorded.

Most of the workshops followed the format outlined above except for the Sierra de Bahoruco National Park Workshop. Representatives from both the management and collaborating organizations were emphatic that my research topic was new to community "ears" and they anticipated a low attendance and the need to make the subject matter as easily understood as possible. In response to these concerns I took a different approach to the presentation aspect of the workshop. I did some research into biodiversity of the National Park, referring to the forms of biodiversity addressed in my presentation (i.e. endemic, native, migratory and invasive). I then wrote examples of these in Spanish on strips of paper and put them in an envelop. After introduction of myself and the interpreter for the workshop, I posed the first question. There were very few persons who were acquainted with the term biodiversity. I then proceeded with an exercise where each person pulled a piece of paper from the envelop. I modified Question 2 and asked each person to say if they thought that specific example of biodiversity should be protected and to provide their reasons. This approach also elicited discussion from participants. Unlike the brainstorming technique used in the other workshops, this construction of participant knowledge enabled me to assess first hand the knowledge level of the workshop participants with respect to biodiversity conservation. I then introduced the conservation and protected areas aspect of my presentation building on the responses of the participants, leading up to Questions 3 and 4.

Data and information most useful to my case study were transcribed from workshop discussion and flip chart notes, respectively. They were analyzed for level of awareness for *in situ* biodiversity conservation, biophysical and socio-economic contextual background of land and biological resource use in communities, and identification of evaluation criteria and indicators.

3.7 Methodological Triangulation

Four datasets corresponding to the four methods described above were generated during the first phase of the research process. The data and information available for triangulation included:

- Ecological, conservation and protected areas management history and content analysis data
- Descriptions of 1) islandwide inventories of protected areas coverage, species and ecosystem occurrence and distribution, natural and human threats to biodiversity and 2) data and information from monitoring programmes on the status and threat levels of endemic, co-adapted and invasive species
- Expert input on conservation goals and objectives (system level only), biophysical, management and governance criteria at both system and site levels
- Expert rating of conservation goals and objectives (system level only), biophysical, management and governance criteria at both system and site levels
- Community input on biophysical, management and governance criteria
- Community rating of biophysical, management and governance criteria

Each dataset represents a different level of knowledge. The literature review and content analysis provided factual, historical and contextual background on the planning and implementation aspects of *in situ* biodiversity conservation. Additionally, it also had a subjective component where the literature helped to establish the conceptual basis for biodiversity conservation on the case islands. The biophysical data and information extraction complemented the literature review by providing a synopsis of the scientific and technical knowledge base for the planning aspect of *in situ* biodiversity conservation. The emphasis was on the planning stage of the management cycle as this is where conservation objectives and their associated outcomes are identified. Implementation issues were better covered by the Delphi process and community workshop methods. The results of the Delphi process and the alternative survey method represent the collective opinion of conservation and protected area experts (i.e. managers, policy-makers, planners and scientists) on the concept of biodiversity conservation, and the practices and outcomes of greatest importance to effective biodiversity conservation. Note, only the expert data with Delphi ratings of 4.5 – 5.0 which signified top priorities and critical issues were utilized for methodological triangulation.The community workshop data reflects the collective voice of non-management stakeholders in biodiversity conservation with different opinions and priorities as natural resource users and those affected by management decisions.

I realized during the data collection process that study objectives #1-3 and the theoretically-derived conservation effectiveness framework had biased my identification of critical components to structural elements, that is, 'the what' of biodiversity conservation but had not established 'the how' of moving from conservation objectives to outcomes. I needed a more explicit focus on what cause-effect relationships between the components of conservation programme were critical in producing desired outcomes. I found that I also needed to articulate a general sequence of how the goals and objectives, and the implementation environment comprising institutional and governance arrangements relate to each other in order to produce critical outcomes.

After deliberating over ways in which to move beyond just a structural view to also include an operational perspective of realizing conservation outcomes, I decided to include the following rationale in the methodological triangulation. A conceptual basis for biodiversity conservation is the starting point for the formulation of conservation goals and objectives. During the planning stage of protected areas systems management, intended outcomes would be identified for each objective. The next step is implementing the necessary institutional arrangements and governance that would produce the derived outcomes. The governance and institutional arrangements of a protected areas system are intended as indicated by the linking arrows. The actual outcomes on-the-ground as well as the implementation experiences provide feedback for the planning stage. The outcomes, both intended and unintended, provide indications of whether or not the implementation structure and processes are appropriate for achieving the intended outcomes. The process of realizing conservation is a non-linear one occurring at both system and site levels of protected areas management.

The confirmations, disconfirmations and elaborations from the multiple datasets are presented under the broad captions "Biodiversity Conservation: A Perspective", "Biodiversity Conservation Goals and Objectives for National Protected Areas System", and "Biodiversity Conservation Outcomes for National Protected Areas System", "Implementation for National Protected Areas System: Management Institutions and Governance", and with reference to the process links between these aspects of conservation. Methodological triangulation marked the end of the first phase of data collection. The triangulated datasets led to the re-construction of a programme of biodiversity conservation in the case island contexts. This re-construction facilitated isolation of the critical components of effective biodiversity conservation.

3.8 Data Analysis and Revision of Theoretical Framework

A comparative analysis was made of theoretical and field data and indicators as part of the process of isolating the critical components of effective biodiversity on tropical islands. Particular attention was paid to the framework propositions:

1) Critical relationships between concepts of biodiversity conservation, conservation goals and objectives, the associated management institutions and governance of a protected areas system.
2) Ecological and socio-economic contexts representative of tropical islands.
3) Critical linkages between conservation effectiveness at the system and site levels of protected areas management.

The implications of the individual critical components for revising the framework criteria for each island are then discussed. Revision of the framework criteria and indicators for each island occurred with the organisation of the critical components under the framework categories and a list of associated indicators for each criterion. The revised criteria are used to develop an interview protocol as described in section 3.9 below.

3.9 Interview Questions and Protocol

Rather than assume that methodological triangulation successfully isolated the critical components on which the revised criteria and indicators are based, the utility of criteria and indicators for an outcome evaluation of a protected areas system needed to be tested in a real-life setting. Recalling that the purpose of these criteria and indicators is to assess whether or not intended conservation outcomes have been achieved and to indicate what stages of protected areas management and driving forces need adaptive actions and responses for improved outcomes, what questions can be designed to collect the relevant information? The semi-structured interview was the research method selected for collecting evaluative information because of the flexibility it offered in allowing the interviewer to guide the conversation along issues critical to outcome achievement, probe for further information if necessary as well as allowing the interviewee to provide their own perspectives and in their own words (Patton 2002, Clarke and Dawson 1999).

Using the revised criteria and indicators, an interview protocol was developed which outlined the critical issues according to the conservation effectiveness framework categories (Appendix E). Over the research period, it became apparent that depending on what portfolio a person had with regard to protected areas management they were better at answering some questions than others. For example persons responsible for scientific research and monitoring were not necessarily versed in enforcement issues. In order to make efficient use of the interview protocol, it was not used in its entirety with any one individual but relevant sections selected for interviews based on the interviewee's management responsibilities. There were a few instances when a question posed by the interviewer was referred to another person who the interviewee felt could best answer the question. These other persons were able to provide the required information. Interviewees included PA system planners and site managers, environmental policy-makers, education officers, enforcement officers, and research staff (Table 26).

Interviews were conducted face-to-face with the assistance of an interpreter in the Dominican Republic. They were conducted by this researcher mostly at the workplace of interviewees or at a location of their preference where it was thought that they would be most comfortable. A total of 17 interviews were held across the two islands. Where the interviewee consented, the interview was tape recorded. Notes were made on what each interview had to offer in terms of the desired evaluative information and the notes documented as MS Word text along with the interviewee's name, employment position and address. Interview duration varied and tended to last between 45 minutes to 1 ½ hours.

Table 26. Summary Statistics for Jamaican and Dominicanos Interviewees

CATEGORY OF 'INTERVIEWEE'	# RESPONDENTS	
	JAMAICA	DOMINICAN REPUBLIC
1.CONSERVATION OFFICER/ RESEARCHER	1	2
2. PLANNER	2	2
3. POLICY-MAKER	2	1
4. EDUCATION OFFICER	1	0
5. ENFORCEMENT OFFICER	0	2
6. SITE MANAGER	2	2
TOTAL	**8**	**9**

The interview data helped fine-tune the list of indicators. If interview questions repeatedly elicit responses that did not directly or indirectly relate to achievement of outcomes or system coordination, then the associated indicators were considered inappropriate and were excluded from the final list of indicators. When more than one interviewee provided a similar response to a question that related to the framework propositions for conservation outcomes then the responses were considered corroborative and the indicators accepted. The intention is to provide a baseline set of indicators for the evaluation, with evaluators having the option of developing their own indicators. Consequently, no attempt was made to provide a comprehensive list of indicators for each criterion but just a recommended list of indicators that have proved useful and appropriate through field-testing.

3.10 Collation of Criteria and Indicators from Jamaica and the Dominican Republic

The final stage of the research process included collating the validated criteria and indicators for Jamaica and the Dominican Republic into a conservation effectiveness framework. As indicated in Figure 2, after the baseline list of indicators was collated for both island frameworks a decision was made about grouping the criteria from each of these frameworks under broad criteria. Broad categorization of criteria in a single conservation effectiveness framework was explored using similarities in the framework criteria and indicators for both islands (Scenario 1). Where significant differences between the two sets of framework criteria and indicators (Scenario 2) occurred then sub-criteria organized under broader criteria was explored.

3.11 Presentation of Data for the Jamaican and the Dominican Republic Cases

Research data and discussion are presented in the next three chapters on the Jamaican and Dominicano case studies. Each case study starts with an overview of the national protected areas system. Then the contributions of the four datasets to an understanding of island perceptions of effective biodiversity conservation and in testing the framework propositions are described separately for each method. Then the datasets are triangulated to give a perspective grounded in empirical evidence. The descriptions are made with reference to the broad headings of "Biodiversity Conservation: A Perspective", "Biodiversity Conservation Goals and Objectives for National Protected Areas System", and "Biodiversity Conservation Outcomes for National Protected Areas System", "Implementation for national Protected Areas System: Management Institutions and Governance". The general trends are highlighted for the total data collected, followed by findings specific to each method. The findings from the aforementioned methods are then synthesized in order to isolate the critical components of biodiversity conservation.

The critical components are presented as revised criteria and indicators for the conservation effectiveness framework. The interview findings are presented and discussed with the intention of showing which revised criteria and indicators are realistic and which ones should be used conditionally or eliminated from the final conservation effectiveness framework.

4. THE JAMAICAN NATIONAL PROTECTED AREAS SYSTEM

Located in the Greater Antilles, Jamaica is the third largest island of the Caribbean with a land area of about 11,400 km^2. The island topography is diverse with several hill and mountain ranges interspersed by plains and networks of river systems. The highest point of the island is the Blue Mountain Peak at an elevation of 2,255 m. The rainiest side of the island is the eastern end which can receive more than 300 inches of rainfall in a year. This is in contrast to the south coast known for its dry coastal habitats. The western end of the island harbours a distinct karst limestone formation and associated karst freshwater caves. Jamaican conservationists have identified five centres of natural biodiversity of which three are mountainous and hilly regions and the fourth is a wetland (Statistical Institute of Jamaica [STATIN] and the National Environment and Planning Agency [NEPA] 2001). The known animal groups include land mammals including bats, land birds, reptiles, amphibians, ants, butterflies, fireflies, freshwater fish, jumping spiders, square back crabs and land snails (STATIN and NEPA 2001). All these groups record a number of endemic species ranging in proportion of endemic species from about 10% to 100%.

Planning for a protected areas system has been recognized as an important management activity as far back as 1992 when the first system plan was drafted by the Jamaica Conservation and Development Trust (a NGO). However, the document (Jamaica Conservation and Development Trust 1992) was never formally endorsed by the Jamaican government. It was not until 2004 that the second attempt to develop a system plan was made. The current project to develop the plan is called the Protected Areas System Master Plan Project (PASMP). A significant feature of this effort is that the

Jamaican government has decided to unify three protected areas jurisdictions into one national protected areas system. The Forestry Department, the National Environment and Planning Agency (NEPA) and the Jamaica National Heritage Trust (JNHT), each with protected areas responsibilities, were established independently of each other and have historically resided in different government ministries. The challenge has been how to harmonize the different goals and protected areas management styles in the absence of a formalized central protected areas authority. There is a national Protected Areas Committee which has been overseeing the development of the Protected Areas System Master Plan (PASMP) but it operates more as a network of mainly government stakeholders. The PASMP is in the final stages of development and its completion is expected for late 2010.

Forest reserves are the oldest category of protected area in Jamaica, with the number totalling about 96. They have been directly managed by the Forestry Department with the exception of one reserve that has been managed by a NGO. NEPA on the other hand has invested in co-management agreements with NGOs in order to compensate for limited human or financial resources available to actively manage various categories of protected areas. These two organizations administer protected areas with biodiversity conservation goals. The NEPA protected sites are administered under three different pieces of legislation and include the island's only national park, marine parks, game reserves, and other sites generally called "Protected Areas". The generic "Protected Areas" category is used as Jamaica has not adopted any formal system of nomenclature for its protected areas and there is uncertainty over how to classify these areas. Based on a listing from NEPA dated September 14, 2003, there are about 26 terrestrial protected areas although this is not an absolute number as a few protected areas have been declared under different legislation and have been assigned to more than one of the aforementioned categories.

In the National Biodiversity Strategy and Action Plan for Jamaica (NRCA 2003a), Article 8 of the Convention on Biological Diversity is cited as the reason for embracing a protected areas system as a key strategy for national biodiversity conservation. Article 8 encourages the establishment of a protected area system and component sites. The first strategic direction listed speaks directly to biodiversity conservation: "Expand the system of protected areas to ensure that it encompasses the country's diversity of natural resources, landscapes and seascapes." At first glance, this strategic direction seems to echo the concept of ecological representation. However, a notable distinction is the denotation of human-natural environment interactions in the words natural resources, land- and sea-scapes which goes beyond a strict focus on the diversity of genes, species and ecosystems.

Has Jamaica's protected areas system, with land coverage of over 30%, effectively conserved its terrestrial biodiversity? One of the Jamaican case findings was that the first management effectiveness assessment for Jamaica's protected areas system conducted in December 2006, based on RAPPAM, revealed little about the biodiversity conservation outcomes of the system (Capacity Development Working Group 2007). Biodiversity conservation effectiveness was not adequately addressed. The Jamaican case findings presented in this chapter present positive and negative evidence for biodiversity conservation effectiveness and the need for an outcome-oriented framework to guide its evaluation.

4.1 Biodiversity Conservation: A Jamaican Perspective

Literature Review and Content Analysis

Jamaican perceptions of biodiversity conservation were explored in order to see how this influenced conservation goals and objectives, and the intended outcomes. Not surprisingly, there was no consensus on a definition of the term amongst the experts, the different community groups or the literature. What stood out from the total range of perceptions, however, was the dominance of the species concept of biodiversity and the high priority given to endemic species. There was a general tendency to equate biological variety with the different species of plants and animals and to a lesser extent also with different ecosystems. In explaining the concept of conservation, three words kept resurfacing among the expert responses and in the literature - protection, preservation and maintenance. These words were either used synonymously or to indicate types of approaches to conservation. Protection was often used in a way that was implicit of human threat although that threat was not explicitly identified in definitions of biodiversity conservation.

The four academic publications referred to in this section offered the most substantial information on biodiversity conservation in Jamaica's protected area system (Chalmers 2002, Goodbody and Smith 2002, Miller 1999, Smith 1995). Noteworthy, is the paucity of academic publications that specifically address biodiversity conservation in the management of Jamaican protected areas. There were academic publications that made passing mention of biodiversity conservation under the subject of sustainable development and others that addressed the conservation of single species or specific ecosystems. However, management-related issues for conservation in protected areas systems were either outside the scope of these papers or dealt with in the context of an individual site which excluded system-site relations. Where relevant, papers addressing single species and ecosystem conservation were reserved for the biophysical data and information extraction. It was easier to locate technical literature on the Jamaican protected area system (Jamaica Conservation and Development Trust 2005, Forestry Department 2001a, Forestry Department 2001b, Government of Jamaica 1997, Jamaica Conservation and Development Trust 1995, Jamaica Conservation and Development Trust 1992, Natural Resources Conservation Authority 1991, Jamaica National Heritage Trust 1985).

In both the academic and technical documents, biodiversity is often not explicitly defined. Such instances of implicit definitions led to characterization of biodiversity as inferred from the context of the document. The book chapters by Chalmers (2002) and Goodbody and Smith (2002) make no definitive statement on biodiversity conservation. Instead, an appreciation is expressed for various natural environments and endangered animals and threatened plants and the need for their protection. The authors' comments on the terrestrial environment are biased toward species and environments of forest conservation or recreational interests, in particular birds, mammals, orchids, bromeliads, montane and mangrove forests. With other academic texts such as Smith (1995) the meaning of biodiversity conservation is assumed, leaving readers to form their own conclusions on what exactly is being conserved. Miller (1999) does mention "... the diversity of flora and fauna and the various aquatic and terrestrial habitats of the island (p. 52)." However, in defining a protected area he states "... an area of land or water that is managed for the protection and maintenance of its ecological systems, biodiversity and/or specific natural, cultural or aesthetic resources (p. 52)." By distinguishing ecosystems from biodiversity, he suggests that biodiversity is synonymous with species diversity. He also emphasizes the high level of plant and animal endemicity, naming snails, terrestrial grapsid crabs, amphibians, reptiles and land birds. No taxonomic groups are specified for endemic plants. Goodbody and Smith (2002), Miller (1999) and Smith (1995) support the integration of sustainable development with biodiversity conservation, a sentiment strongly reflected in the technical literature.

A national system plan, and its supporting project report, policies and a national conservation strategy were selected for review because they directly influence the development of a national protected areas system. The species and endemicity themes were as pronounced in the technical literature as in their academic counterpart. Ecosystems and the relationship of species with their physical environment while sometimes mentioned are not prominent. An additional focus offered by technical literature is genetic diversity as a scientific or a commercial resource.

Neither the first Plan for a System of Protected Areas (Jamaica Conservation and Development Trust [JCDT] 1992) nor the Protected Areas Resources Conservation (PARC) Project that produced the plan clearly presented a biodiversity concept. The PARC Project report (U.S. Agency for International Development 1989) took an encompassing approach to biodiversity. It depicted biodiversity with examples of habitats/natural environment/life zones, species diversity and genetic diversity. JCDT (1992), however, used the term biodiversity in three different contexts with a different meaning in each instance. More specifically, in one section biodiversity seemed limited to species. When stating the objective for IUCN category I (Scientific Reserve), species, land areas and genetic resources were highlighted. Later in the document a biodiversity index was introduced for selection of protected areas sites based on habitat diversity, species diversity and variety (according to least area). The 1992 Plan for a System of Protected Areas was never formally adopted or implemented but instead formed the basis for the drafting of the 1997 Policy for a National System of Protected Areas.

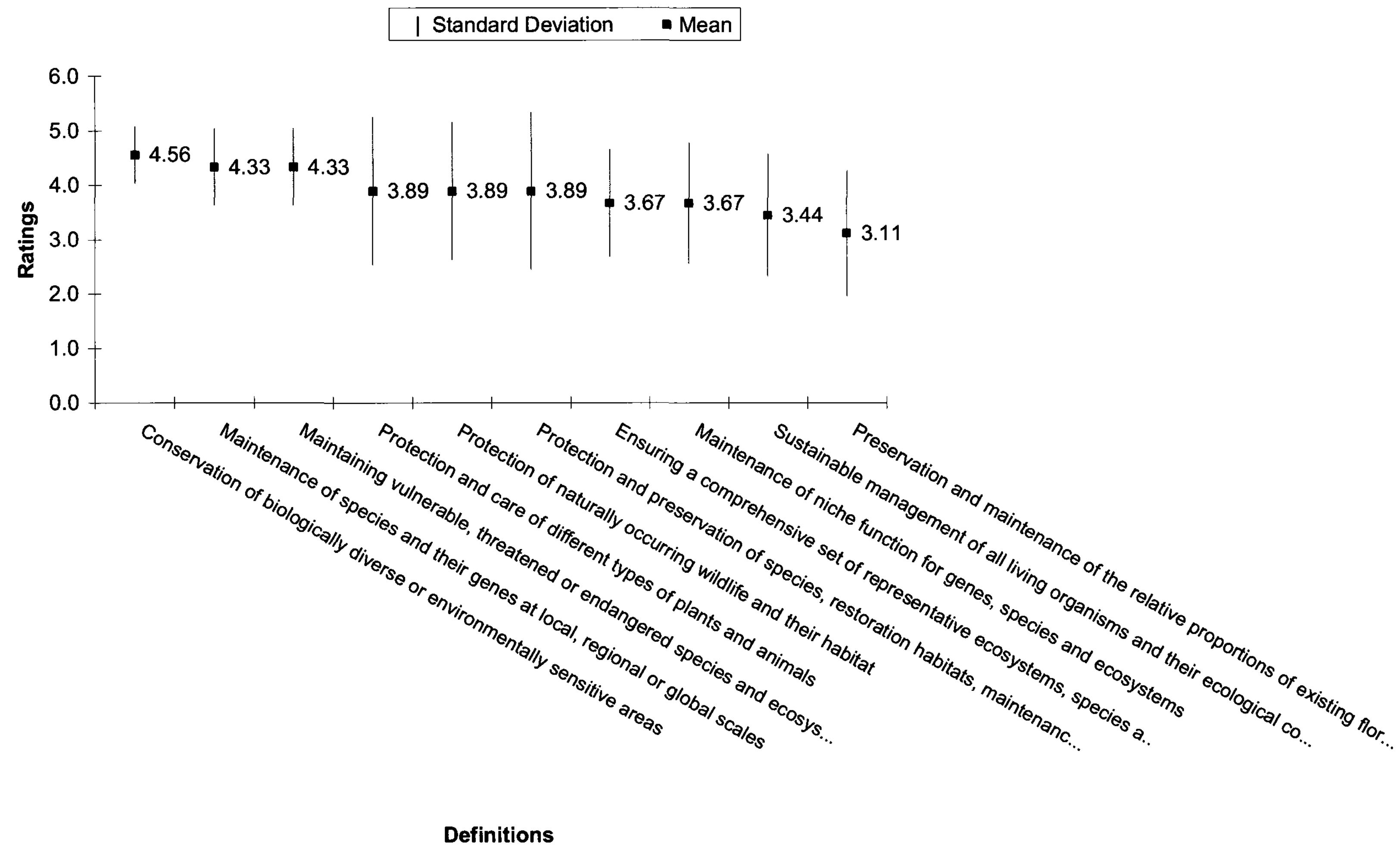
Different definitions are used in the National Land Policy (Government of Jamaica [GOJ] 1996), the Policy for the National System of Protected Areas (Government of Jamaica [GOJ] 1997) and in the National Strategy and Action Plan on Biological Diversity (Natural Resources Conservation Authority [NRCA] 2003a). There is some overlap between "diversity of flora and fauna, and land and water habitats (GOJ 1996, p. 67)", "rich array of living organisms (GOJ 1997, p.7)" and "variety of all plants, animals, and micro-organisms (NRCA 2003a, p. x)" respectively used in the definitions of biodiversity. However, the Land Policy (Section 7.4) concentrates on species, habitats and ecosystems. The System Policy's Goal 2 (i.e. Environmental Conservation) goes further to include genetic diversity, biotic and abiotic relationships. This wider perception of biodiversity is also reflected in the national strategy on biodiversity except for the minimal mention of ecological relationships.

Having established the thinking on *in situ* biodiversity conservation at the system level, available delegation instruments for the three study sites were perused for acknowledgment of biodiversity conservation as a management responsibility. The delegation instruments are legally-binding documents issued by government authorities for protected areas management, to organizations with whom they have agreed to share management responsibilities. The delegation instrument for the Blue and John Crow

Mountains National Park (NRCA 2002) and two different delegation instruments for the Portland Bight Protected Area (NRCA 2004 and NRCA 2003b) were issued under the NRCA Act of 1991 by the National Environment and Planning Agency. Two delegation instruments exist for Portland Bight Protected Area (PBPA) because an NGO (The Caribbean Coastal Area Management Foundation) and a government agency (The Urban Development Corporation) manage different lands within this protected area. The ten-year instrument for the Blue and John Crow Mountains National Park (BJCMNP) and the five-year instrument for PBPA-UDC are current. However, the five-year instrument for PBPA-CCAM expired July 17, 2008 and was not renewed. The Mason River Protected Area (MRPA) does not have a delegation instrument but is in the process of finalizing a co-management agreement with the Jamaica National Heritage Trust, the land title holders of the MRPA, and with NEPA. The fourth version of a draft co-management agreement for MRPA (NRCA 2006) provided to this researcher will be referred to in lieu of a delegation instrument.

In all four documents the term biodiversity conservation is absent. Instead, the generic term 'conservation' is used in the delegation instruments in the section on Obligations and Functions. Conservation is noted as a necessary component of management and operational plans and as an outcome for management of the natural environment. The only stated social obligation concerning conservation promotes public education on the value of conserving ecosystems and natural/heritage resources and its sustainable use in Jamaica. The co-management agreement is quite vague in its sole mention of conservation, where it is requested that any related conservation measures implemented in the area should be included in a written biannual report.

FIGURE 4. DELPHI RATINGS FOR DEFINITION OF BIODIVERSITY CONSERVATION



Expert Input

There was no consensus on a definition of biodiversity conservation amongst the experts (Figure 4). What stood out from the total range of perceptions, however, was the dominance of the species concept of biodiversity. Species was a part of, or the, answer given in nine out of ten Delphi Round 1 responses. There was a general tendency to equate biological variety with the different species of plants and animals and to a lesser extent also with different ecosystems. Protection and maintenance were the most commonly used action words in the definitions. "Protection" implied the presence of a threat but the threat was not explicitly identified in definitions of biodiversity conservation. "Maintenance" on the other hand suggested no loss to a constant species, genetic, and ecosystem composition and function. However in Delphi Round 2, the definition with the highest Delphi rating, signalling high group acceptance, was the very general "Conservation of biologically diverse or environmentally sensitive areas".

Community Input

In general, the community representatives that attended the four workshops had no clear definition of biodiversity conservation. Most persons either said nothing or shook their heads when asked to share their understanding of biodiversity conservation. A few individuals from the Mason River Protected Area and the Millbank – Blue & John Crow Mountains National Park workshops gave responses. They said they had a sense that it involved the protection of wildlife or reasoned that since "bio-" meant living things and "diversity" meant many things then the term concerned many types of life. In dialogue about the meaning of the word, it became apparent that a higher value was placed on different species of economic value and those that are endemic. Views on the ecosystem level of biodiversity for protection were restricted to ecosystems that have utilitarian values e.g. mangroves for coastal zone protection, forests for watershed protection, fuel wood.

4.2 Biodiversity Conservation Goals and Objectives for Jamaica

Literature Review and Content Analysis

What has been noticeable in the local academic literature and less so in the technical literature is the inconsistent perception of biodiversity conservation as a programme with set goals, objectives and outcomes, and an associated strategy or process. In publications that focused on the whole protected areas systems (e.g. Smith 1995; Miller 1999) biodiversity conservation was mentioned as one of the system goals but these articles did not elaborate on biodiversity conservation itself. I approached the academic literature from another angle in order to discover any publications that would indicate academic viewpoints on conservation goals and objectives. I resorted to reviewing articles that associated Caribbean ecosystems and taxonomic groups with the role of protected areas in their conservation. This approach directed me to Eyre (1998), and Kueny and Day (1998) who highlighted the importance of protected areas in the protection of tropical rainforests and in the range of karst (i.e. limestone) landscapes respectively.

The globally significant and rich biodiversity, and the high endemism of the Eastern Caribbean rainforests are features also typical of the rainforests of Jamaica and Dominican Republic. Eyre in his comments on conservation of tropical rainforest ecosystems notes that protected areas, whether they be national parks or forest reserves or biosphere reserves have been instrumental in fighting rainforest deforestation. His accounts of forest conservation in selected islands indicate that tropical rainforest conservation has been a goal for Caribbean protected areas systems. Kueny and Day (1998) included Jamaica and other Greater Antilles islands in their review of the protected status of karst landscapes as these islands have the greatest extent of karst in the Caribbean. They point out that biological value of karst landscapes is among the criteria for their protection, primarily because of the floral diversity of their limestone forests with high levels of endemism. When faunal diversity which also exhibits high endemism is added, the overall species diversity is less impressive in the author's opinion. The authors indicate the existence of legislation in Jamaica for the protection of six karst areas through forest reserves including the world renowned Cockpit Country, and the BJCMNP.

In order to identify the nationally-oriented goals and objectives for biodiversity conservation, I referred to a range of planning documents and supporting legislation (Jamaica Conservation and Development Trust [JCDT] 2005, Forestry Department 2001a, Forestry Department 2001b, Government of Jamaica 1997, JCDT 1995, JCDT 1992, Natural Resources Conservation Authority 1991, Jamaica National Heritage Trust [JNHT] 1985). The 1992 plan for a national protected areas system did not provide clear goals or promote a programme for biodiversity conservation in protected areas systems. However, this observation is made against the backdrop of the supporting legislation at the time, namely the 1985 JNHT Act and the 1991 National Resources Conservation Authority (NRCA) Act. The JNHT Act (Appendix F) authorizes the Trust to assign

'Protected National Heritage' status to any place and species of animal or plant. In addition to this vague directive, mention of responsive action to disrepair or maintenance of protected national heritage is devoid of any biological focus and is more suited to physical non-living structures or monuments. The NRCA Act (Appendix G), in Section 5, authorizes the designation of national parks or protected areas by the NRCA. It also emphasizes the maintenance of societal values and well-being. The 1992 System Plan echoed the minimal attention paid to biodiversity conservation in relevant national legislation.

By the time the Policy for a National Protected Areas System came on board in 1997, the 1996 Forest Act (Appendix H) and the 1996 National Land Policy were facilitating wider, more comprehensive conservation planning. The Forest Act supports forest reserve or forest management area goals that protect intrinsic as well as utilitarian values for forest, and endemic floral and fauna. The National Land Policy highlights the importance of a national system of protected areas and its role in conserving biological diversity. In the 1997 System Policy, Goal 2 places biodiversity conservation under the umbrella of

conserving Jamaica's natural heritage along with scenic landscapes and cultural resources. It provides details on biodiversity conservation in a sub-goal which reads:

> " Preserve major representative stocks or areas of all of Jamaica's biological resources, including populations of indigenous animal and plant species, natural communities and ecosystems."

Section 9.2 (Actions Towards Protecting Significant Biological Diversity) presents a single action statement that for the purpose of this research is acceptable as a conservation objective of the policy. The objective which is about protected areas systems design is " to protect and sustainably manage centers of significant biological diversity." There is no elaboration on the word 'significant' leaving this objective open to ambiguity.

In situ biodiversity conservation while not an overtly stated goal in the 2001 Forest Policy (Appendix H), has been incorporated into this policy through its goals and priorities for conservation and protection of forests. Conservation of native endemic flora and fauna in remaining forests, especially closed broadleaf forest, and conservation of coastal diversity, are desired outcomes for the goals of forest land and mangrove conservation. Formal support for the national protected areas systems from forestry sector is indicated but from the perspective that the system's purpose is natural resources conservation. Aligned with this policy is a 2001 National Forest Management and Conservation Plan (NFMCP) in which forest biodiversity conservation is a stated goal (Appendix H). The sole objective in the plan associated with biodiversity conservation is surprisingly general considering the forest policy's priorities. The conservation targets are not limited to just endemic species but included non-endemic native flora and fauna as well. Furthermore, objectives related to ecosystem conservation, namely protection of closed broadleaf forest and mangrove forest are associated with the goals for protecting forest resources and restoring tree cover. On closer inspection, it is apparent that ecosystem conservation objectives have been separated from biodiversity conservation objectives confirming a species and habitat focus for biodiversity.

Scientific assessments of Jamaica's biodiversity by international and non-government conservation organisations such as The Nature Conservancy have augmented the range of goals and objectives proposed for *in situ* biodiversity conservation. The

Jamaica Ecoregional Planning (JERP) Programme co-ordinated by The Nature Conservancy-Jamaica Office (TNC-JM) scientifically assesses the biodiversity of Jamaica's terrestrial, freshwater and marine environments and supports the management of the national protected areas systems and individually protected sites. JERP promotes protected areas as ecologically functional landscapes and as a platform for managing and rehabilitating ecosystems. An important feature of the JERP is that it directs attention to freshwater biodiversity conservation which the wider conservation literature openly admits has been neglected, until recently, by conservationists worldwide.

Through partnership with the Jamaican government, JERP data and information is currently being used as baseline data for the National Ecological Gap Analysis Report (NEGAR) which will assist the development of the Protected Area System Master Plan according to CBD guidelines and national needs. TNC-JM anticipates that national planning for biodiversity conservation will be in reference to the CBD's programme of work for Island Biodiversity. This programme of work encompasses the three levels of biodiversity: ecosystems, species and genes. It also embraces ecological representation in national protected areas networks. Furthermore, it assumes application of scientific knowledge based on the non-equilibrium ecosystem concepts of resilience, ecological and physical connectivity in conserving viable species populations. Consequently, the design promoted for a protected areas system is a conservation network where ecologically connected protected areas achieve ecological representation in regions of conservation concern.

At the time of writing this section of the dissertation, I was informed by TNC-JM that the final reports for the national gap analysis and ecoregional planning project were not yet publicly available. Also, the draft report for terrestrial ecoregions was not as yet completed. In light of this information constraint the following observations on the JERP goals are from the first draft report on freshwater ecoregions (John 2006). Freshwater conservation targets identified through the JERP include 17 freshwater ecosystems, four endemic fish species and one endemic turtle species. At first, two conservation areas were modelled with different goal scenarios applied to the targets. One model had as its goal a target size of 10% for ecosystem length or area, or 10% of total species numbers for inclusion within the protected areas system while the other model set its target size at 20%. However, the lesson learned was that these quantitative targets contributed to a lack of connectivity between upstream and downstream parts of rivers in the design of a protected areas system. An alternative was sought in a third goal scenario referred to as an adaptive goal scheme where conservation targets were quantified at a minimum of 10% of their extent and the target size adapted according to conservation priority (Table 27). In this scenario, higher priority and thus higher quantitative goals were assigned to under-represented, less abundant and more localized biodiversity targets in comparison to better represented, abundant or widespread biodiversity. The classification of ecosystem and species targets according to their abundance and their corresponding quantitative goals are presented below.

Table 27. Abundance classes for adaptive goals for freshwater targets

System	Total (length/area/#)	Abundance	Goal (%)
Streams	0-100km	Rare	50
Streams	100-500km	Uncommon	25
Streams	500-1000km	Common	15
Streams	>1000km	Abundant	10
Lake/ponds	845 ha	Uncommon	25
Eastern Wetlands	221ha	Rare	50
Western Wetlands	12894ha	Uncommon	25
Eastern springs	109	Abundant	10
Western springs	417	Abundant	10
Eastern caves	9	Rare	50
Western caves	214	Abundant	10
Endemic Fish Species	2 - 23	Uncommon to Rare	25 - 50
Endemic Turtle	18	Uncommon	25

Note: Taken from John 2006

A question that came to mind was what influence, if any, do these goals and objectives have on planning at the site level. An answer was precluded for the Mason River Protected Area due to the absence of a written management plan. Of the other two study sites, the 2005-2010 Management Plan for the Blue and John Crow Mountains National Park was the only plan to clearly identify the role of the park or protected area in contributing to the overall biodiversity of the island. It states as its over-arching goal "To protect the remaining core area of natural (closed broadleaf) forest for its biological diversity and the maintenance of ecosystem services including water supply and recreational services (JCDT 2005, p. xii)." The dual status of national park and forest reserve are acknowledged early in the plan and there is clear intention to integrate national park and forest reserve goals and objectives through collaborative management. The Blue and John Crow Mountain National Park conservation goal shares the same priority as a forest policy, namely protection of closed broadleaf forest. The plan also confidently speculates that this park is currently perhaps the most significant contributor to the implementation of the protected areas system goals, referring to the one-third of the island's remaining natural habitats that are found within the park. There is no claim to representation of all the natural habitats and their associated species that occur within the park. Instead, justifications for top prioritization of select ecosystems, ecological communities and species are provided. The eight BJCMNP conservation targets (* for endemic species) are:

Montane forest on shale
Montane forest on limestone
Epiphytic communities
Headwater ecosystems
Montane forest birds*
Jamaican Coney*
Yellow Snake*
Giant Swallowtail Butterfly*

The very general goal of ecosystem and species conservation for PBPA does not have dry limestone forest biodiversity as one of its conservation targets although this protected area includes limestone forest habitat critical to the survival if the Jamaican Iguana. Instead, the draft 2008-2013 management plan emphasizes the establishment of forest conservation areas that would include dry limestone forest and the monitoring human activities within the forest conservation areas. The Jamaican Coney and the Jamaican Boa are also not included in the PBPA conservation targets list although Portland Bight is a major habitat for these two endemic and threatened species. The conservation targets relevant to terrestrial biodiversity and categorized under "Natural Resources and Habitats" and "Threatened and Important Species" are:

Wetlands
Caves
Jamaican Iguana*
American Crocodile
West Indian Manatee
Avifauna (including the West Indian Whistling Duck and several endemics)

An example of how site level planning can inform system level planning emerged from the data. There are two system-level goals, namely riparian habitats conservation and conservation of restricted range species that lack corresponding system-level objectives and have only site-level objectives. The BJCMNP objectives, while in support of the system-level goals, are applicable only to the national park and not across the entire protected areas system. Without the corresponding system-level objectives as a guide for site conservation, riparian habitats are likely to be continually overlooked by other protected areas managers that have not as yet recognized their value. Both the PBPA and the MRPA have riparian or pond habitats but these have not been a target of past conservation activities or plans.

The BJCMNP objective that promotes non-threatening research highlights the absence of scientific encroachment in the corresponding system-level objective. This is most significant for scientific research in any protected area considering a concern in the BJCMNP's Management Plan about previous intense harvesting of study species and the creation of vegetation gaps as a research activity. Revising the system-level objective to read "Reduction of urban, agricultural and scientific encroachment" would favour better prevention of biodiversity loss across the entire protected area system.

Biophysical Data and Information Extraction

A total of eight conservation objectives for protected areas systems management and four objectives for national park management have been collated in column 1 of Table 28. This table presents some key data and information needed, in my opinion, for

Table 28. Sampling of Biophysical Data and Information in Support of Conservation Objectives

Biodiversity Conservation Objectives	Biophysical Data & Information	Sources of Data and Information
System Level		
1. To protect and sustainably manage centres of significant biological diversity. (From Policy for National System of Protected Areas)	Distribution Map of JERP terrestrial vegetation targets (shows islandwide distribution and overlaps in occurrence for 18 vegetation classes and endemic plant sites); Distribution Map of JERP terrestrial fauna targets (shows islandwide distribution and overlaps in occurrence for endemic Giant Swallowtail Butterfly and *Amazona* Parrots, W.I. Whistling Duck, Bat species, Corey, Iguana, Frog, Yellow boa); Distribution Map of JERP terrestrial freshwater targets (shows islandwide distribution and overlaps in occurrence for springs, streams, ponds and lakes, wetlands and caves, endemic turtle, endemic fish); Distribution Map of Important Bird Areas for Jamaica; National Land Cover/Land Use Maps (1988 and 1998); Geo-referenced localities for endemic tress	Draft Jamaica Ecoregional Plan (JERP), TNC-JM; Birdlife International Online Database; Biophysical inventory database of Forestry Department; Natural History Division, Institute of Jamaica Endemic Trees Project
2. Habitat for native flora and fauna is maintained by increasing the extent of forest reserves and other protected areas together with effective patrolling and protection of these areas. (From Forest Management and Conservation Plan)	Ecological information on: endemic caddisflies, grapsid crabs, migratory freshwater shrimp, endemic fish, the endemic pond turtle, birds, butterflies, insects; flowering plants, ferns, mosses; Number and spatial extent of forest reserves, and other protected areas	Citations for journal publications in Draft JERP Report; Citations for journal publications and field studies in UNEP-WCMC species online database; Institute of Jamaica's taxonomic and ecological surveys and inventories; UWI theses on terrestrial and freshwater species; Biophysical inventory database of Forestry Department; NEPA protected areas inventory

Biodiversity Conservation Objectives	Biophysical Data & Information	Sources of Data and Information
System Level		
3. To design a network of conservation areas that will conserve the diversity of species, communities and ecosystems in Jamaica. (From JERP)	Data and information on how native or migratory species use ecological corridors connect with and utilize different habitants in the natural landscape was not found	
4. At least 10% of each of the island ecological regions effectively conserved. (From CBD Programme of Work) 5. Areas of particular importance to island biodiversity are protected through comprehensive, effectively managed and ecologically representative national and regional protected area networks. (From CBD Programme of Work)	Table of percent representation of freshwater targets in Jamaica's Protected Areas, using IUCN 10% Benchmark as indicator of representation; Biogeographic distribution for select taxa; Overlay map of Jamaica's protected areas and freshwater targets. Summary List of protected areas by Designating Act, Surface Area, and Number of Sites; Spatial land cover and land use geo-referenced dataset; Gap analysis component of JERP	Draft JERP Report; Biophysical inventory database of Forestry Department; Woods and Sergile (2001); Whittaker and Fernández – Palacios (2007)
6. Populations of island species of selected taxonomic groups restored, maintained, or their decline substantially reduced. (From CBD Programme of Work) 7. Status of threatened island species significantly improved. (From CBD Programme of Work)	Breeding biology studies for *Amazona* Parrots, Giant Swallowtail Butterfly, Jamaican Iguana (all endemic species); Bird survey data; Monitoring date for harvesting/collection of species for trade through CITES; Monitoring of species threat status through IUCN Red Data Lists; List of species threats	UWI graduate degree theses – fieldwork in protected areas; Birdlife Jamaica publication and database; Windsor Research Centre; IUCN Red Data list online database; CITES trade database
8. Genetic diversity of crops, livestock, and other valuable island species conserved, and associated indigenous and local knowledge maintained. (From CBD Programme of Work)	Phylogeography study of the Rock Iguanas (Cyclura); Phylogenetic and phylogeographic analyses of anolid lizards	Malone et al. (2000); Whittaker and Fernández-Palacios (2007), p. 234.

Biodiversity Conservation Objectives	Biophysical Data & Information	Sources of Data and Information
Site Level - BJCMNP		
1. To protect threatened biodiversity by focusing on arresting further movement of the conservation targets towards endangerment and extinction (according to the IUCN Red List).	Breeding biology studies for *Amazona* Parrots, Giant Swallowtail Butterfly, Jamaican Iguana (all endemic species); Bird survey data; Monitoring date for harvesting/collection of species for trade through CITES; Monitoring of species threat status through IUCN Red Data Lists; List of species threats	UWI graduate degree theses - fieldwork in protected areas; Birdlife Jamaica publication and database; Windsor Research Centre; IUCN Red Data list online database; CITES trade database
2. Rehabilitation of at least 200 acres of degraded area within the priority areas for management interventions, as identified in the zoning scheme.	Land Cover; and Zonation maps; Botanical history of park; Plant and animal species inventory; 1992 Rapid Ecological Assessment; NFMCP	BJCMNP Management Plan which in divided citations for published results of plan and animal surveys and studies; NFMCP
3. Creation and maintenance of a 50m (25m on each side) riparian buffer along headwater streams.	Inventory of headwater streams; Map of headwaters and surrounding land cover	JERP draft report, TNC-JM; Water Resources Authority; BJCMNP Management Plan
4. To promote research that will guide park management but will not threaten the resources of the park.	Research permit applications noting biological specimens or materials for collection from national park	National Environment and Planning Agency research database

protected areas policy makers, planners, and managers to address their stated conservation objectives. It is intended to be a sampling of and not a comprehensive listing of data/information and their sources applicable to the biodiversity conservation objectives. The emphasis is on composite data and information which is already in a more user-friendly format for the target audience than baseline data and information. To avoid extremely long lists of literature references in the 'Sources' column, I used several secondary sources of information accompanied by a note on the primary sources that they cite.

I located useful biophysical data and information in support of all the objectives except for system objective # 3. A general trend was the existence of multiple datasets that could be associated with objectives, independently generated by different sources and in different formats. A benefit was that the various datasets and information for each objective tended to complement each other by filling in each other's gaps or representing a different perspective on the same subject matter. This is a result of inventories, studies, and assessments conducted and databases created for different purposes, not all directed to biodiversity conservation and protected areas concerns, and at different times. For data and information produced at widely separated times, some ground truthing may be required to overcome limitations such as undetected changes in land cover or species distributions.

Both baseline and applied levels of data and information are represented in Table 29. Basic biological and ecological studies and surveys have primarily contributed to the

Table 29. Jamaica Community Workshop Responses For Biodiversity Conservation Goals

Question	Mason River Protected Area	Portland Bight Protected Area	Cockpit Country Forest Reserve	Blue & John Crow Mtns. National Park (Millbank)	Blue & John Crow Mtns. National Park (Woodford)
Biodiversity for protection	• Different types of plants and animals • Valuable plant and animal species • Plants and animals found in different environments • Plants and animals and the ecosystems they are a part of	• Flora and fauna restricted to Hellshire [a region within this PA that is relatively high in biodiversity] • Mangrove ecosystem • Forests	• Species • Birds • Wild pigs • Wild goats	• Endemic species especially the Giant Swallowtail Butterfly and birds • Freshwater and riparian habitats • Medicinal plants	• Birds and their habitats • Forests • Fish
Reasons for protection	• Plants for medicinal purposes e.g. Aloe vera, Spirit Weed, Jack in the Box, Red Head, Spirit Weed • Continued species existence (crocodile, alligator, butterflies, vultures) • Prevention of soil erosion, deforestation • Beautification (esp. last 2 species: Pine tree, cedar, mahoghany, blue mahoe) • Medicinal purposes • Reproductive health purposes • Beautification	• Endemic species and other species found only in certain areas are part of cultural heritage • Mangroves protect the coastal zone. Cutting them down leads to coastal erosion • Forests are part of the rainfall cycle. Tend to be cut down for fuelwood and yam sticks.	• Birds were said to be less visible over recent times. [Note: In the Cockpit Country and elsewhere that wild pigs occur, they are hunted by residents for their meat. Wild goats are not mentioned in literature for subsistence hunting or spoken about in other areas where wild pig hunting occurs, so it was interesting that they	• Species of commercial and economic value particularly for butterfly farming and ecotourism. • Maintenance of cultural medicinal practices. • Maintenance of freshwater supply.	• Aesthetic value e.g. pleasure of bird songs • Recreational activities e.g. hiking along trails (both local people and foreign tourists), renting of cabins, social events hosted at Holywell Recreational Park within the National Park, other ecotourism activities • Reduction of deforestation • Creation of a fish tank as a public attraction at Holywell Recreational Park

Question	**Mason River Protected Area**	**Portland Bight Protected Area**	**Cockpit Country Forest Reserve**	**Blue & John Crow Mtns. National Park (Millbank)**	**Blue & John Crow Mtns. National Park (Woodford)**
Reasons for protection (cont.)	• Tourist interests e.g. ferns at Fern Gully • Preventing the extinction of endemic plants and animals • Protecting their habitats • In one group, value of biodiversity not defined; reasons not given		were identified as a species of interest.		

understanding of occurrence, distribution and abundance of species and ecosystems. Important biophysical data including surface area and boundaries of protected areas and topographical features (e.g. river networks, hills and valleys, vegetation cover, land use) are included in inventories and databases of the Forestry Department, the NEPA and the Water Resources Authority. Furthering that knowledge are biogeographical publications of which Woods and Sergile (2001) is the most comprehensive for Caribbean islands, although strongly biased towards selected animal taxa. The biogeographical information on Jamaica is for the most part incomplete. The challenge for protected areas management is to collate and channel existing data and information towards illumination of conservation problems.

A number of international conservation organizations and information networks such as the United Nations Environment Programme – World Conservation Monitoring Centre (UNEP-WCMC) partnership, IUCN and Birdlife International have taken on the challenge. Their online databases pull on scientific publications of local and overseas researchers and provide a standardized, scientific and internationally accepted way of accessing species taxonomy; species and habitat distribution and status; threat level criteria and ranking and threats to species and ecosystems; ecosystem distribution along with information references where available. Other general tendencies in the biophysical data and information is the greater level of detailed information for animals compared to plants with a greater knowledge base for vertebrates than invertebrates. Another limitation obvious in UNEP-WCMC online database that provides ecosystems classification and maps at global and regional scale is that these scales hide the heterogeneity of island landscapes. The most useful ecosystem maps were those produced on a national scale such as the land cover/land use maps of the Forestry Department, TNC-JM. Data and information on genetic diversity was the least and most difficult to find.

I will now briefly comment on the conservation objectives and the utility of the supporting data and information. Due to the availability and application of GIS technology in the named local organizations, concentrations of terrestrial (including freshwater) biodiversity can be revealed by overlaying the various map layers and geo-referenced points. The IBA list (BirdLife International 2008) which considers multiple bird occurrences across Jamaica compensates for the narrow focus on parrots and the W.I. Whistling Duck by JERP. System objectives # 1,2,5,6,7, and 8 all call for value judgments or decisions on the extent of biodiversity to be made. It is improbable that management resources exist to conserve all native flora and fauna. Terms such as 'significant', 'areas of particular importance', 'selected taxonomic groups' and the criteria for 'threatened island species and other valuable island species, need specification. As an example, the BJCMNP objective # 1 (JCDT 2005, p.75) qualifies 'threatened biodiversity' by referring to the IUCN Red List which provides a range of criteria for threat status starting at vulnerable and increasing in threat level to the conditions critically endangered and extinct. There is a need to clarify what ecoregions will be targeted for conservation of ecological representation. Is it the ecoregions as defined by TNC or the land classifications as determined by the Forestry Department? While there are overlaps, these two classification schemes are not the same. In fact the BJCMNP Management Plan acknowledges this and indicates that it uses the Forestry Department's scheme since much of the national park is a forest reserve. Overall the national park's objectives supports the national protected areas system objectives but lack an explicit focus on genetic diversity and its conservations. More site-specific data and information on historical species composition and ecology is required for area rehabilitation and creation and maintenance of a riparian buffer in the national park.

Expert Input

The goal statements generated by the Delphi group were a mix of statements on human activity both related and unrelated to protected areas management and on maintenance of biodiversity (Figure 5). The two goals that were given the highest priority with a rating of 4.67 were public awareness and understanding of protected areas and biodiversity conservation, and reduction of threats. High priority is also given to up-to-date assessments of species and ecosystem status with a focus on endemic species and their habitats. The subsequent statements suggest a lack of clarity on goals specific to biodiversity conservation and those specific to wider protected areas management. There seems to be considerable agreement on closing of information gaps concerning threats and vulnerabilities, and sound and current ecological data. Threat reduction and goals about management activities hold higher priority with the Delphi group. Of particular interest to the Delphi group was the direct tackling of the threatened or vulnerable state of biodiversity through rehabilitation of degraded or destroyed areas, conservation strategies for threatened animal species and protection of reproductively active populations.

The Delphi statements on conservation objectives of priority follow the pattern of mixed focii, but are more specific about threat reduction (Figure 6). Another distinction is that the conservation of community/ecosystem diversity is prioritized before conservation

FIGURE 5. DELPHI RATINGS FOR GOALS OF BIODIVERSITY CONSERVATION

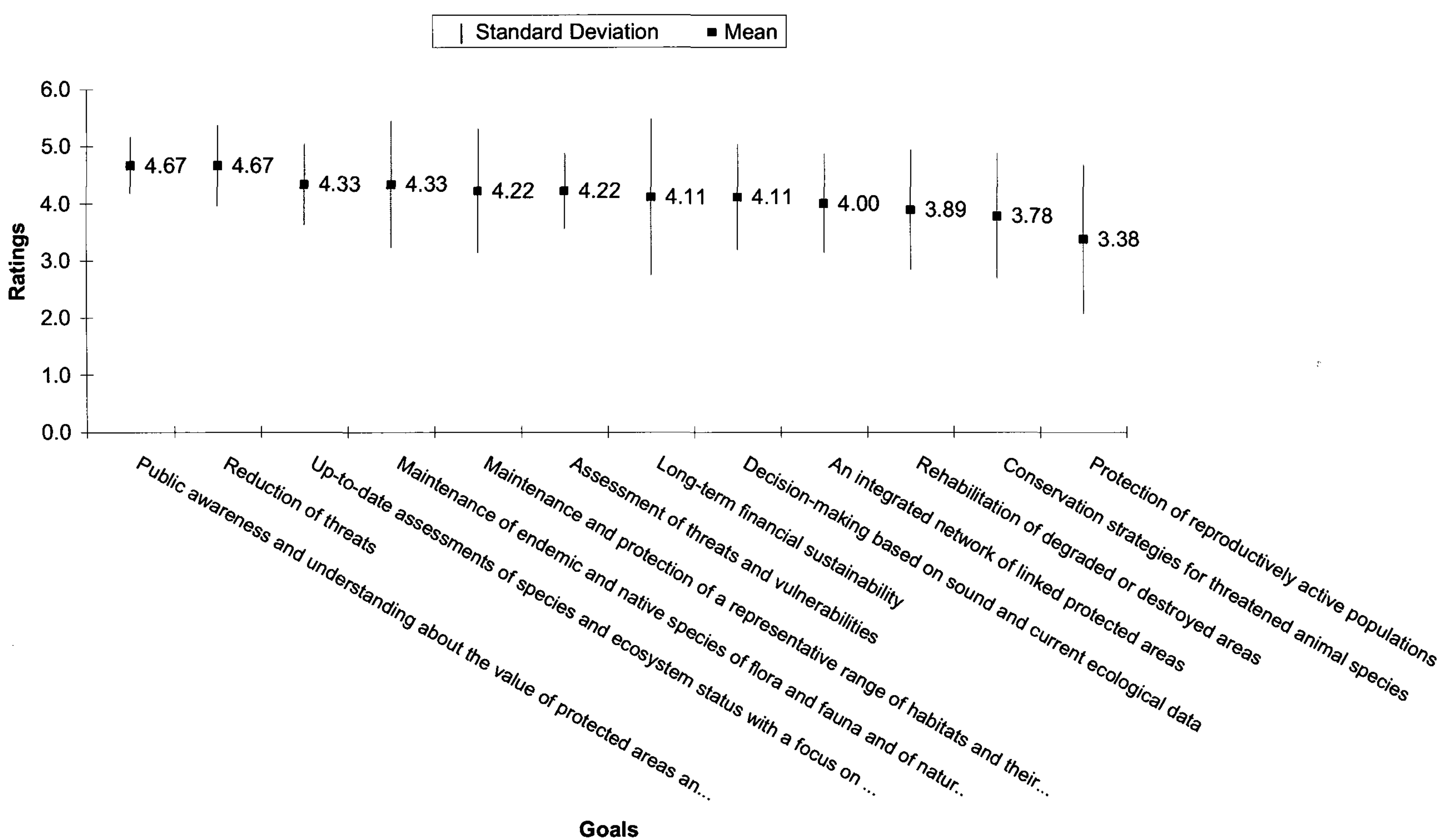
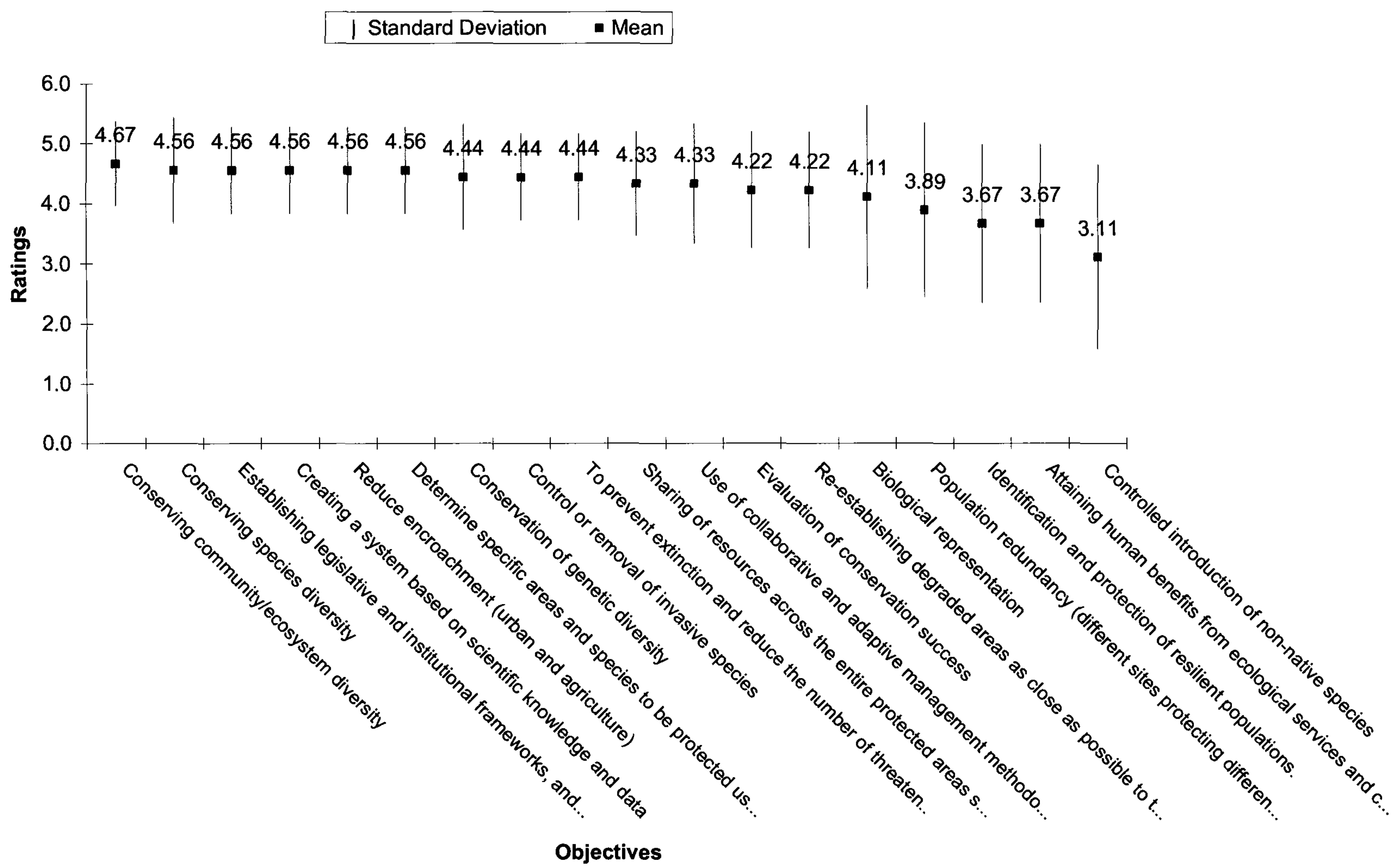


FIGURE 6. DELPHI RATINGS FOR OBJECTIVES OF BIODIVERSITY CONSERVATION



of species. The high priority placed on creating a protected areas system based on scientific knowledge and data and the low priority placed on protection of populations within a species is maintained in the ratings. The agreed on objectives particular to threat reduction were to reduce encroachment (urban and agriculture), to determine specific areas to be protected and mark protected areas with defined boundaries, to prevent extinction and reduce the number of threatened species, re-establishing degraded areas as closely as possible to their original state or re-planting these areas with native species, and controlled introduction of non-native species. The descent in the Delphi ratings for these statements, starting at 4.56, indicate that reducing urban development and agriculture at and within protected areas boundaries is essential and of greater priority than the control of or removal of invasive species. Controlling the introduction of non-native species into the protected areas system was considered important but not a critical issue.

Community Input

In identifying what biodiversity should be protected, the more specific responses that moved beyond just species or plants and animals tended to be focused on restricted range, especially endemic species, and species of utilitarian value (Table 29). These values are associated with species of medicinal, cultural, economic and aesthetic use. Ecosystems only came into the picture because of the ecological services that they provide, most notably mangroves and forests. Clear biodiversity conservation goals and objectives were not articulated by community groups, rather conservation goals were strongly implied in the priority attached to biodiversity identified for conservation and in the rationale for such priority.

4.3 Biodiversity Conservation Outcomes for Jamaica

Two sets of conservation outcomes were collected. Intended outcomes were obtained from the aforementioned policy and conservation plans, experts and community groups. They indicate the end results that are expected by conservation planners, implementers of and participants in protected areas management and biodiversity conservation when biodiversity conservation objectives are fulfilled. The second category is actual outcomes which indicate what has really been achieved at an island landscape level. Note is made of how the conservation objectives that were achieved on-the-ground compare with those that were intended.

At the time of writing this dissertation I was informed that the final reports for the national ecoregional planning and gap analysis (NEGAR) project were not as yet publicly available. In light of this information constraint, actual outcomes for the JERP freshwater targets are discussed below in the Biophysical Data and Information Extraction section with reference to the first draft report on freshwater ecoregions (John 2006). The draft report for terrestrial ecoregions is not as yet completed.

Literature Review and Content Analysis

Two desired outcomes for biodiversity conservation in a protected areas system are prominent in the reviewed academic literature. One outcome is the reduction of deforestation and the other is outdoor recreational opportunities and ecotourism-related livelihoods. Eyre (1998) and Kueny and Day (1998) indicate that maintenance of, 1) forest cover, and 2) the habitats of endemic and endangered species, are a major achievement of a protected area system. The apparent expectation is that designation of 'protected' status will be accompanied by active and enforced regulation of human activity in order to reduce negative impacts on forested areas. Consequently, reduced deforestation is an assumed outcome of increased protected areas coverage. The second outcome is usually mentioned with reference to proposed national parks or to the existing national park. It is no coincidence that Goodbody and Smith (2002) and Smith (1995) who promote recreation and ecotourism are also supporters of the sustainable use conservation paradigm.

However, Goodbody and Smith (2002) find the definition of ecotourism in the 1993 Report of the Third Caribbean Conference on Ecotourism inadequate (p. 396). The definition (Goodbody and Smith 2002, p. 395) reads:

> "… the interaction between a visitor and the natural or cultural environment, which results in a learning experience while maintaining respect for the environment and culture and providing benefits for the local economy."

Their major criticism is that it does not emphasize the need for conservation. The learning experience should result in visitor education on conserving valuable natural resources. The important point is made that "Regardless of the financial success of a tourism operation, it is not truly successful unless the resource is actually being protected" (Goodbody and Smith 2002, p. 408). The solution in Goodbody and Smith's opinion is to objectively determine the impact of ecotourism on the quality of natural resources through monitoring programmes.

The authors further point out that there should be much broader distribution of resulting benefits so that ecotourism in protected areas generates revenue for their operations as well as supports community entrepreneurship. Other reviewed policy and planning documents generally lacked statements on intended or desired conservation outcomes. The 1992 System Plan, while offering no intended biodiversity conservation outcomes, does state, "A number of criteria may be used to indicate success for a system of protected areas" (JCDT 1992, p.12). Of the criteria listed, the ones relevant to biodiversity conservation are:

1) Recovery of threatened areas and species, and
2) Increased wildlife populations.

These system criteria imply desired outcomes of decreased threats to areas and species of conservation value. The NFMCP lists threats and disturbances to forests which covers most of the threats identified in other system-level technical documents:

- Degradation of water supply or quality
- Degradation or loss of soil
- Loss of biological diversity
- Non-sustainable harvesting (over-cutting) of timber or fuel wood
- Illegal removal of timber or fuel wood
- Legal cultivation on unsuitable sites
- Illegal cultivation
- Damage resulting from illegal or excessive grazing by livestock
- Fire
- Despoiling of recreational or scenic values
- Other non-forest uses of land [e.g. mining]

Note: From Forestry Department 2001a, p.61

It was expected that the National Biodiversity Strategy and Action Plan would have named system outcomes. However, it stopped short at outputs. These outputs actually are associated with biodiversity conservation projects. The Action Plan did not refer to any stated conservation objectives but considered high priority management issues identified in the Strategy and proposed projects to deal with these issues. The titles for biodiversity conservation projects relevant to terrestrial protected areas are:

- Rehabilitation of Degraded Forests
- Regulation of Collection and Harvesting of Wild Fauna and Flora
- Reduction of Pollutants in Freshwater and Marine Environments
- Implementation/preparation of recovery strategies for critically endangered species

In summary, the twenty-five related outputs can be generally grouped as surveys and monitoring or research programmes, policy and programmes for recovery, and rehabilitation and regulated use of forests and species, public education and outreach tools.

In searching for intended outcomes a report on the first management effectiveness assessment for Jamaica's protected areas system was also reviewed (Capacity Development Working Group 2007). This assessment which occurred in December 2006 was in the form of a RAPPAM workshop held over a two-day period. This workshop was one of several activities for the current development of a Protected Areas System Master Plan. Dr. Jamison Ervin, author of the World Wildlife Fund's publication on RAPPAM, facilitated the workshop with the assistance of TNC staff. It is instructive that one of the comments in the report on the RAPPAM process is that it did not elicit details on conservation outcomes (Capacity Development Working Group, 2007, p. 32). Based on the workshop process and the participant contributions described in the report, what was accomplished was a system-wide analysis of overall planning, inputs, processes and outputs using site information for some of the marine and terrestrial protected areas.

There was no linkage of the management components to the specific outcomes they were expected to achieve. In spite of the difficulty in finding clearly stated outcomes, the comment about the RAPPAM process is valuable because it points to recognition and acknowledgment of outcome identification as an important gap in the planning process.

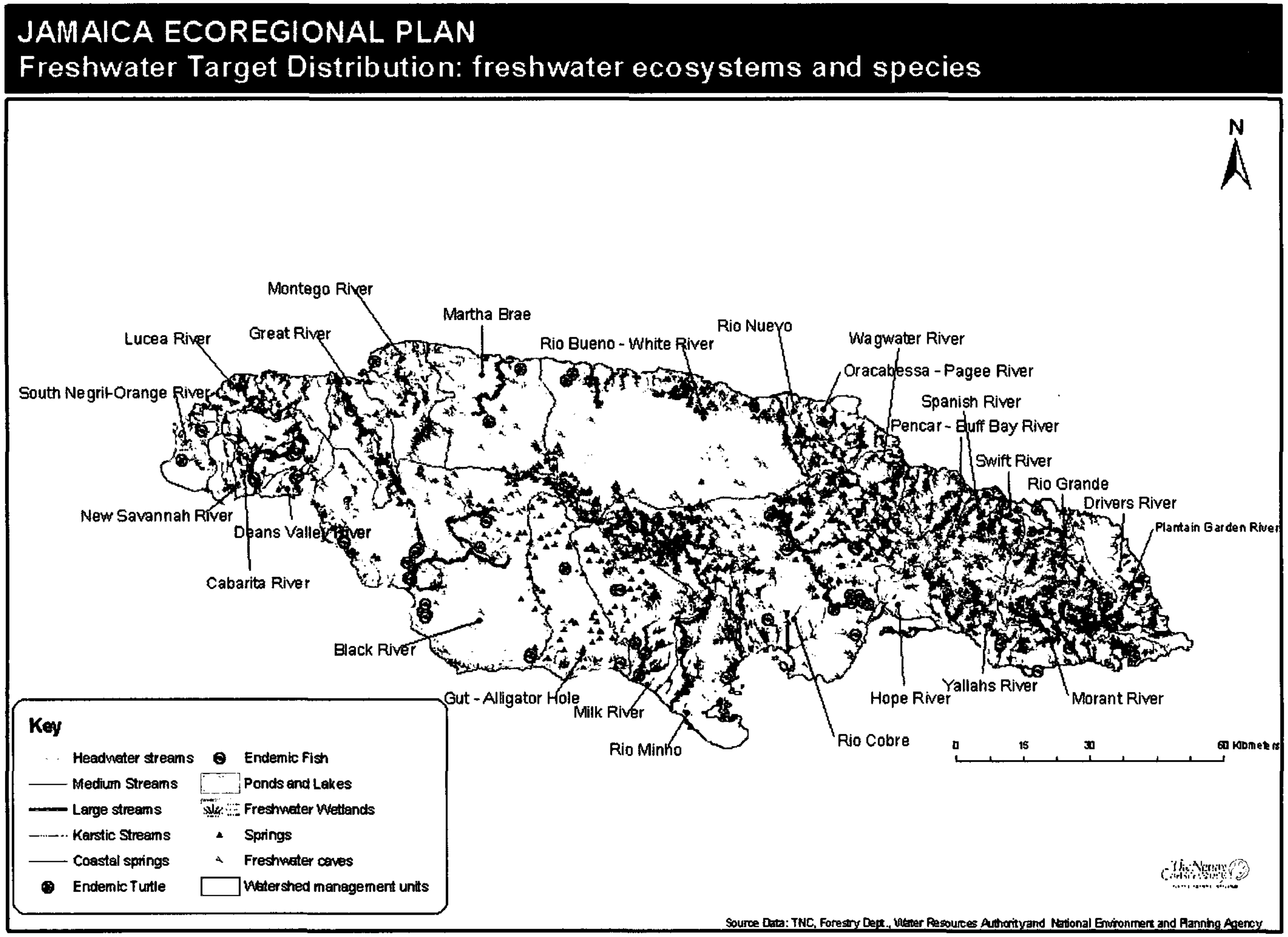
The Nature Conservancy-Jamaica Office (TNC-JM) has tried to bridge this gap by adopting the CBD's benchmark of at least 10% representation of conservation targets in protected areas. At the global level the intended outcome is the significant reduction of the current rate of biodiversity loss. Trying to quantify outcomes with arbitrary numbers has not simplified the issue of setting outcomes but instead has raised a few questions. In a technical note on the draft methodology and work plan for Jamaica's protected areas gap analysis, one of the issues mentioned is how does a minimum 10% relate to current and historical extent of ecosystems, habitats and species (Weary 2005). Another question was what are the best approaches when no high quality remnants of an ecosystem still exist? The lack of easy answers to the questions in Weary (2005) is exemplified by TNC's experience with applying the 10% minimum benchmark to its freshwater targets and is related in the section below.

Biophysical Data and Information Extraction

Exploration of the data and information sources in Table 30 enabled identification of actual conservation outcomes for the JERP freshwater and NFMCP's conservation targets. There is also evidence that the CBD's species conservation objectives have been met for the Jamaican Iguana. Keeping a national scale of protected areas management in mind, an islandwide perspective was taken towards the distribution of Jamaican biodiversity conservation targets and protected areas with biodiversity conservation goals. The distribution and protected areas coverage for freshwater and forest ecosystem targets is the starting point for my discussion which later extends to species conservation targets. Using the available data and information, I show 1) that centres of endemic and endangered biodiversity are included in the current protected area system, 2) habitat status for different forest ecosystems in terms of changing land cover, 3) that protected areas coverage is not a reliable indicator for the habitat status and population numbers. The conservation of water body ecosystems (i.e. streams/rivers, ponds, lakes, springs) will be discussed with reference to the JERP map for freshwater targets for two reasons. The JERP map (Figure 7) presents a clearer islandwide picture of surface water ecosystems than the 1998 Land cover/Land Use Map (Figure 8), where surface waters are obscured by other map features. Additionally, freshwater ecosystems are featured, namely freshwater caves and springs, which are absent from the 1998 Land cover/Land Use Map.

A highly noticeable landscape feature on the JERP map is the hydrologic networks of northern, western, southern and eastern Jamaica. The densest and larger network spans eastern Jamaica with many of the source points (springs) and their direct outflows (headwater streams) occurring in the Blue and John Crow Mountains National Park. However, much of the low-altitude extent of this hydrologic network falls outside the national park. The springs and some of the headwaters for the southern hydrologic network arise in the central hills of the island. There are few large rivers such as the Rio Minho (Jamaica's longest river) and many small rivers in this network. Many springs and headwaters feeding the southern region fall outside the PBPA and the northern protected

Figure 7.

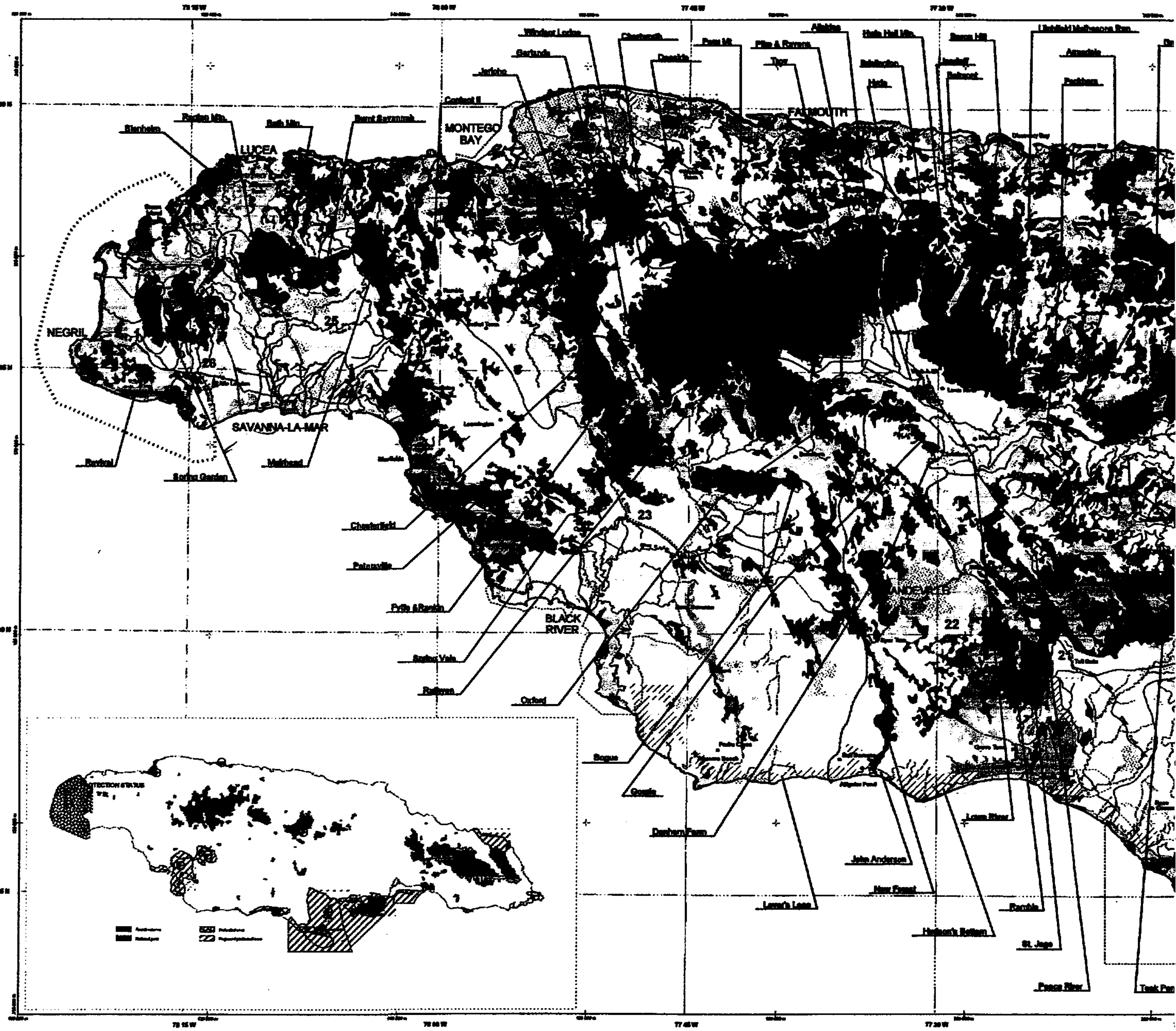


Note: From John 2006

Figure 8. 1998 Land Use/ Cover Map

1 : 250 000 Metric edition

JAMA



LEGEND

Base map features

- Roads - First class
- Roads - Second class
- Roads - Unclassified
- Rivers - Perennial
- Rivers - Seasonal
- Town or village (Name) — Montego Bay
- Watershed boundary (Number) — 25
- Forest reserve
- National park
- Protected area
- Proposed protected area
- Bird sanctuary
- Coast

Forest land use / cover (> 75 %)

- Closed broadleaved forest
- Disturbed broadleaved forest
- Bamboo
- Tall Open dry forest
- Short Open dry forest
- Swamp forest
- Mangrove forest

Mixed land use / cover (First class > 50 % second class > 25%)

- Fields or Disturbed Broadleaved Forest and Pine plantation
- Disturbed Broadleaved Forest and Fields
- Bamboo and Disturbed Broadleaved Forest
- Bamboo and Fields
- Fields and Disturbed Broadleaved Forest
- Bauxite extraction and Disturbed Broadleaved Forest

Non-forest land use / cover

- Plantations: tree crops, shrub crops, sugar cane, bananas
- Fields: herbaceous crops, fallow, cultivated grass/vegetables
- Herbaceous wetland
- Water bodies
- Bare rock
- Bauxite extraction
- Buildings and other infrastructure

Watershed Management Unit

Number and name

1 South Negril-Orange River
2 Lucea River
3 Great River
4 Montego River
5 Martha Brae River
6 Rio Bueno-White River
7 Rio Nuevo
8 Oracabessa-Pages River
9 Wag Water River
10 Pencar- Buff Bay River
11 Spanish River
12 Swift River
13 Rio Grande
14 Drivers River
15 Plantain Garden River
16 Morant River
17 Yallahs River
18 Hope River
19 Rio Cobre
20 Rio Minho
21 Milk River
22 Gut Alligator Hole
23 Black River
24 Deans Valley River
25 Cabarita River
26 New Savanna River

1998 LAND

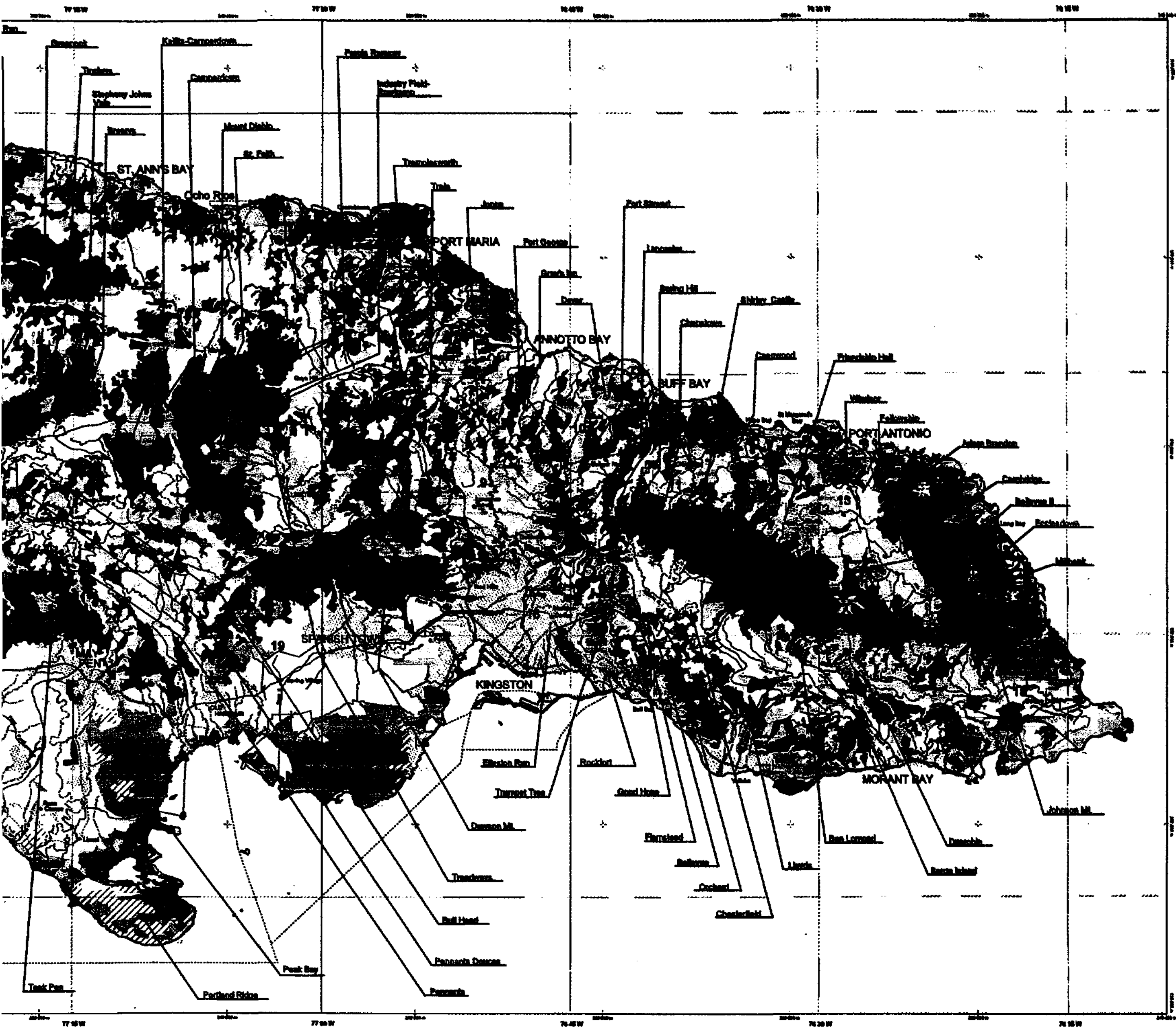
FO

5 000 0

Note: From Forestry Department 2001

JAMAICA

Preliminary Edition



LAND USE / COVER MAP

FORESTRY DEPARTMENT

JAMAICA

1 : 250 000 scale

0 5 000 10 000 15 000 20 000 25 000 meters

Prepared by the
Trees for Tomorrow Project - Phase II
(ref 504/15608)
Government of Jamaica
Forestry Department
173, Constant Spring Rd.
Kingston 8

MINISTRY OF
AGRICULTURE

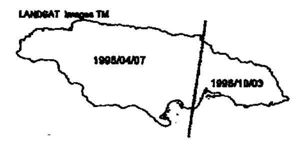
Map series derived from
Survey Department base maps digitised as follows :

- Protected areas status, rivers and watershed boundaries (1 : 50 000) supplied by Natural Resources Conservation Authority-Coastal Atlas

- Roads (1 : 250 000) supplied by Spatial Innovision Ltd.

INTERPRETATION SOURCE

LANDSAT Images TM



PROJECTION PARAMETERS

Projection : Lambert Conical Orthomorphic
Spheroid : Clarke 1866
Datum : Fort Charles Flagstaff
Standard parallel : 18 ° N
Central meridian : 77 ° W
Origin latitude : 18 ° N
False easting : 250 000 m
False northing : 150 000 m

This map is not an authority on legal boundaries.

Date : February 1999

area boundary virtually dissects the larger rivers. While much of the Black River network is within the declared game reserve and Ramsar site, the uppermost extents of the river lack protected area coverage. In western Jamaica most of that region's hydrologic network lies outside the various protected areas.

Of the 17 freshwater ecosystem targets distributed island-wide across eastern and western drainage units, only 6 (35%) were represented in Jamaica's protected areas declared under the NRCA Act. Other types of declared protected areas were not considered in the TNC-JM gap analysis. The ecosystems that had more than 10% of their extent protected included eastern high-altitude headwater streams, freshwater wetlands, medium-sized streams, some large rivers, ponds and lakes (Table 30). Under-represented ecosystems included springs, freshwater caves, karstic streams, high altitude headwater streams, some large rivers, some freshwater wetlands, ponds and lakes.

Table 30. Representation of JERP Freshwater Targets in Protected Areas

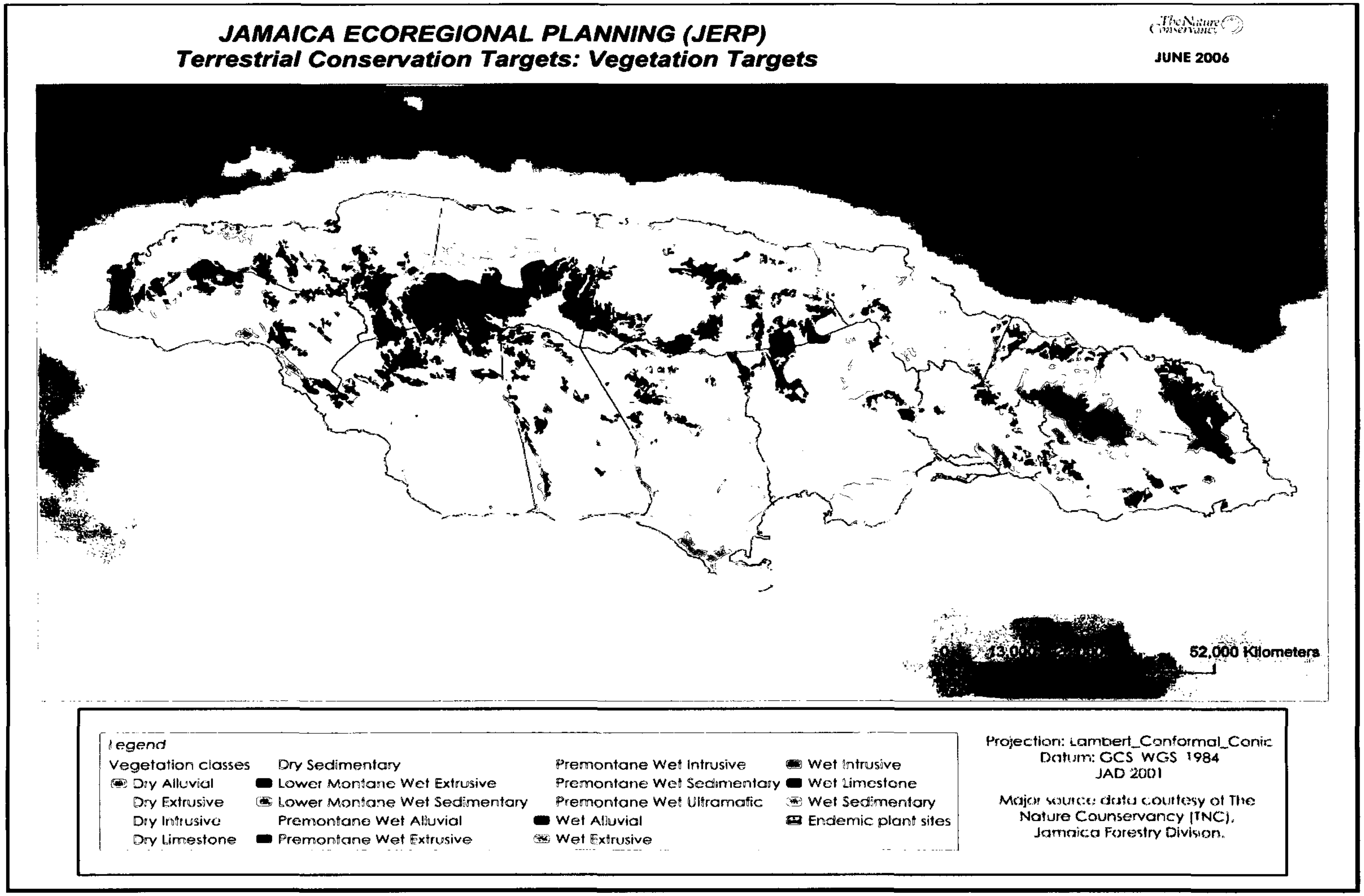
Distribution of Targets	**Protected Area Coverage**	
	Less than 10 %	**Over 10%**
Islandwide	Springs, coastal springs, freshwater caves	Medium-sized streams
Eastern Jamaica (eastern drainage basin)	Large rivers, freshwater wetlands, ponds and lakes, freshwater caves	High-altitude headwater streams * (62%)
Southern,Western and Northern Jamaica ('western' drainage basin)	Karstic streams, high-altitude headwater streams, freshwater caves	Freshwater wetlands* (31%), large rivers, ponds and lakes

Note: From John 2006

The stated intention of the Forest Management and Conservation Plan (FMCP) is protection of native flora and fauna by maintenance of forest habitat, that is, no net loss of natural forest cover. The Forest Management and Conservation Plan (FMCP) objective also highlights the need to increase the extent of forest reserves. The JERP approach to ecosystem conservation utilizes a different classification scheme from the FMCP for its vegetation targets. These targets are predominantly various forest ecosystems. The JERP maps for these targets are at the time of writing under revision and the revised maps are unavailable for this thesis. However, my review of an earlier draft vegetation map revealed spatial correspondence between the two forest classifications (Figure 9). Since the FMCP is an approved planning document currently in use, reference will be made only to the forest classifications in this plan. The desired outcome is protection of the full range of biodiversity (ecological representation) through a network of conservation areas. While declaration of protected areas is not directly addressed in the JERP conservation objective, the draft JERP report indicates that additional protected areas will be necessary to achieve ecological representation.

Turning our attention to the mapped landscape for Jamaica (Figure 8), an obvious feature is that the two largest continuous expanses of natural forest are closed broadleaf forest located at opposite ends of the island. Most of these two broadleaf forests are enclosed in the north-westerly Cockpit Country Forest Reserve and in the eastern Blue and John Crow Mountains National Park. Small, completely isolated patches of closed broadleaf forest separate the largest forest reserve and the national park amidst a highly fragmented land cover of disturbed broadleaved forest, fields, plantations and mixtures of the aforementioned or mixtures with bamboo and bauxite mines. Protected area coverage exists as forest reserves for much but not all of the isolated closed broadleaf forest as well as for some of the mixed vegetation and disturbed broadleaf forest. Tall open dry forest,

Figure 9.



Note: From John et al. 2006

one of the naturally occurring forest types, is the most extensive forest of southern Jamaica. However, it is segmented by mainly cultivated fields into four south-central patches and several strips along the southern and north-western coastline. Occurring adjacent to and sometimes apart from tall open dry forest is short open dry forest. Prior to the declaration of the Portland Bight Protected Area (PBPA) in 1999, only two of the four major patches of tall open dry forest and very little short open dry forest were protected in forest reserves. With the NRCA declaration of PBPA, the other tall open dry forest patches were covered and protected area coverage was also extended to more short open dry forest, mangrove and swamp forests. The largest stretch of mangrove forest also is found along the south-central coastline and within the PBPA. Otherwise mangrove forest occurs occasionally around the south coast and even less on the north coast which has more buildings and infrastructure. Swamp forests are small and few, usually forming part of the inland border to mangrove forests. Two of three substantial areas of herbaceous wetland have protected area status. The largest is the Black River Morass ecosystem (a Ramsar site) in the south-west and the second largest occurs at the western tip in the Negril Environmental Protection Area. The third wetland at the eastern tip is currently unprotected. These herbaceous wetlands are classified as freshwater wetlands by the JERP programme (Figure 7).

Species diversity is the next consideration in pinpointing the distribution of islandwide conservation targets and their protected areas coverage. More attention has been given to faunal targets than to floral targets. Multiple faunal species covering different taxonomic groups have been targeted by JERP and Important Bird Areas (IBA) projects (Table 31). The Giant Swallowtail Butterfly, the Yellow Boa, Jamaican Iguana, various species of frogs, Amazona parrots, West Indian Whistling Duck, many IBA species, various species of bats and the Hutia distributions appear habitat-specific. The points of occurrence for the butterfly, bird, many frog and bat species coincide with the closed broadleaf forests, especially that of the Blue and John Crow Mountain National Park (BJCMNP) and the Cockpit Country Forest Reserve. Tall open dry forest, especially dry limestone forest, supports a different ecological community comprising the Indian Coney or Hutia, the Jamaican Iguana and the Yellow Boa. The West Indian Whistling Duck is typical of herbaceous and mangrove wetlands. Not all species in the target groups are habitat specialists as some bats, frogs and birds (both endemic and non-endemic) also occur in disturbed forests and cultivated fields. These ecosystems may or may not fall within protected areas boundaries. Of a total of fifteen IBA's, thirteen are located across broadleaved forests, dry forests, herbaceous and mangrove wetlands which provide habitat for native and migratory land and shorebirds (BirdLife International 2008). As outlined in the Caribbean IBA Report, the population numbers for fifty-three species of globally threatened, restricted range, and congregatory shorebirds and waterbirds were used to determine the IBA's. Protected area coverage exists for ten of the thirteen IBAs spanning forty-four percent of the total IBA land. A striking distinction shared by the various endemic fauna is their concentration within forest ecosystems, with the larger sized of these forest ecosystems already within the protected areas system.

Table 31. Representation of National Conservation Targets in the Largest Jamaican Protected Areas

Conservation Targets	Cockpit Country Reserve	Blue and John Crow Mtns. National Park	Portland Bight Protected Area	Outside of declared Protected Areas
Closed Broadleaf Forest	√	√		√
Distributed Broadleaf Forest	√	√		√
Bamboo Forest		√		√
Tall Open Dry Forest			√	√
Short Open Dry Forest			√	√
Swamp Forest		√	√	√
Mangrove Forest			√	√
Streams	√	√	√	√
Lake/ponds				√
Wetlands			√	√
Springs		√		√
Caves	√	rare	√	√
Giant Swallowtail Butterfly	√	√		
Bat species	√	√	√	√
Black-billed Parrot	√	√		
Yellow-billed Parrot	√	√		√
Frog species	√	√	Rare	√
Coney (Hutia) distribution	√	√	√	√
Iguana distribution			√	
West Indian Whistling Duck distribution			√	√
Yellow Boa distribution	√	√	√	√
Important Bird Areas	√	√	√	√
Endemic fishes			√	√
Endemic turtle			√	√
Endemic Trees	√	√	√	√

Finding comparable islandwide distribution maps and date for specific plant species or groups was a challenge. Returning to the draft JERP vegetation map (Figure 6), there was evidently an attempt to map the endemic plant sites of Jamaica. However, the absence of mapped sites for closed broadleaved and dry forest locations (e.g. Cockpit Country and Portland Bight/Hellshire Hills) points to incomplete inventorying and /or mapping of endemic plant sites. Personal communication from the lead botanist and the consultant botanist on the endemic trees of Jamaica project at the Institute of Jamaica (IOJ) indicated the following distribution patterns from preliminary data. The majority of the 310-320 endemic tree species that have been recorded occur in central Jamaica in broadleaf forests. Surveying and inventorying is ongoing with more of the Institute of Jamaica field effort in disturbed broadleaf forest than in closed broadleaf forest. Other records for endemic tree species occurrence are collated from the Natural History Museum specimens of the Institute of Jamaica and previous dendrology studies (Parker 2003). While endemic tree species have been recorded from the different forest types, their relative distribution across closed and disturbed broadleaved forests, and tall and short open dry forests are yet to be determined. Herbaceous wetlands and the tropical scrub savanna of Mason River Protected Area are other areas harbouring multiple species of endemic trees. Not all the known species' localities have been geo-referenced as yet. The project, for its purposes, has mapped tree species distribution according to the administrative parishes of the island. Consequently, little comment can be offered on the distribution of endemic trees across the range of protected areas. However, the lead botanist has indicated coverage for some endemic trees in the national park, some forest reserves and wetland protected areas. There are also areas with endemic tree species that are excluded by the current protected areas system.

Expert Input

Question 5 on the Delphi questionnaire asked Delphi participants to consider the theoretically-derived evaluation criteria for assessing biophysical outcomes, associated inputs and actions and to indicate:

1) What other criteria should be added
2) Which ones they thought were of greatest importance
3) Reasons for their choices

The responses are presented in Figure 10. For ease of interpretation I have extracted the ratings for the biophysical outcomes in Table 32 below. No new criteria were added to the outcomes but what is interesting is the unanimous exclusion of the biological targets for direct and indirect consumption, and the biological targets for non-consumptive use. Overall there was general agreement for all the outcomes except for population redundancy and disturbances which scored less than 4.0. The strongest group agreement is indicated in the 4.67 rating for biological representation. Group ratings of 4.44 for species indices for endemism, richness, co-adaptation and threat status, and 4.44 for control of invasive species showed strong agreement for these criteria as well. The request for explanatory notes was met by one participant whose point was that the complexity of island ecosystems was under-studied, so biological representation would enable research on ecosystem dynamics and then able the continuation of benefits to humans.

FIGURE 10. DELPHI RATINGS FOR THEORETICAL FRAMEWORK CRITERIA

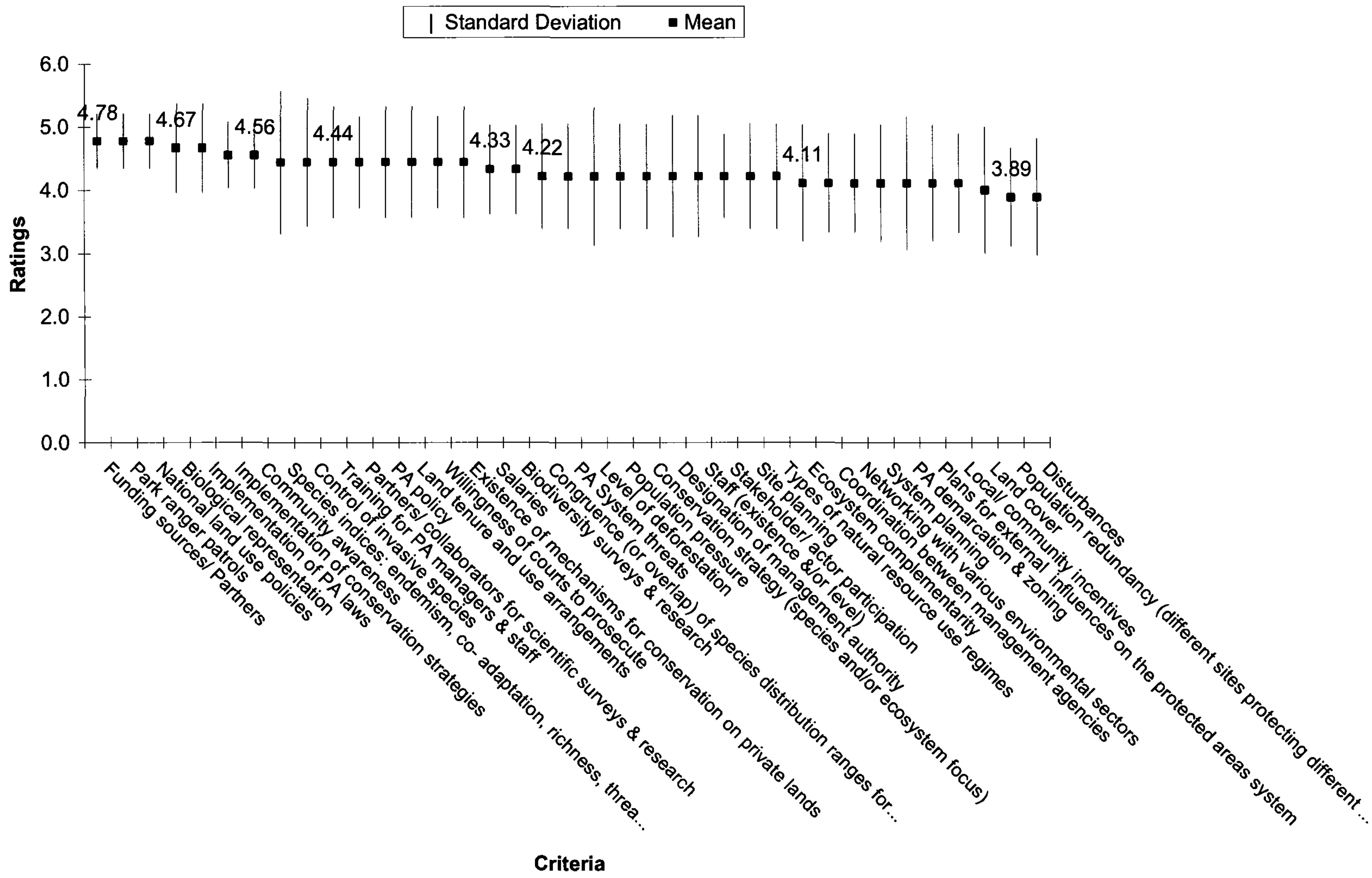


Table 32. Delphi Ratings for Theoretically-Derived Biophysical Outcomes

Criteria	**Delphi Rating**
• Biological representation	4.67
• Species indices: endemism, co-adaptation, richness, threa…	4.44
• Control of invasive species	4.44
• Congruence (or overlap) of species distribution ranges for…	4.22
• Protected Areas System threats	4.22
• Level of deforestation	4.22
• Conservation strategy (species and/or ecosystem focus)	4.22
• Ecosystem complementarity	4.11
• Land cover	4.00
• Population redundancy (different sites protecting different…)	3.89
• Disturbances	3.89

Community Input on Biodiversity Conservation Outcomes

The community workshop question "What would you have to see or experience to be satisfied with how a protected area is managed?" was designed to elicit community ideas on what should happen to species and ecosystems including humans when protected areas management practice effective conservation. The responses ranged widely, covering only a few biodiversity conservation outcomes (which are bulleted and in bold in Table 33) and many implementation actions. Three different suggestions for conservation outcomes came from the Mason River Protected Area, Cockpit Country Forest Reserve, and the Blue and John Crow Mountains National Park (Millbank) communities. Increased and improved conditions for plants and animals and reduction of environmental pollution pointed to some pre-determined 'health' or beneficial state for the natural environment which has changed as a result of human threat. On the other hand, the livelihood opportunity in organic farming was specific to human benefit and did not consider the effect of conservation activities on species and ecosystems. However, in

Table 33. Jamaica Community Workshop Responses for Biodiversity Conservation Outcomes

Mason River Protected Area	Portland Bight Protected Area	Cockpit Country Forest Reserve	Blue & John Crow Mtns. National Park (Millbank)	Blue & John Crow Mtns. National Park (Woodford)
• Proper fencing • Edges (vegetation) properly bushed • Proper signs • Provision of educational tours • Community outreach programmes • Visible law enforcement • Taking drastic action without fear or favour on anyone who breaches the law • Infrastructure for the PA should be established and maintained • **Site tours that show increased/ improved conditions for plants and animals** • Display of laws • Prosecution of law breakers • Rangers living near the site in order to effectively monitor PA.	• A mechanism for PA offences to be promptly reported by citizens • Adequate management structure at government level so they can effectively implement regulations.	• More or better management of water resources. • Reduction of pollution to the environment caused by garbage disposal and the use of agricultural pesticides.	• Help in developing livelihood opportunity of organic farming • Facility to dispose of and sort garbage instead of fines for littering • Posters on penalties for poisoning the rivers, for capturing birds and the coney, and for other restrictions • Collection of pesticide containers • More visibility of and communication from park management • Education programmes on the purpose of a national park	• More community involvement • More education and outreach programmes • Greater impact from education and outreach programmes

Millbank community's point about posters on penalties for river poisoning, for capturing birds and the coney, it is implied that a reduction in both environmental and river pollution, and illegal collection and harvesting of species are desired conservation outcomes.

4.4 Implementation of Management Institutions and Governance in Jamaica

Literature Review and Content Analysis

Smith (1995) and Miller (1999) provide rare insight into the protected areas management experiences. I say rare because few Jamaican academics or practitioners directly involved in Jamaican protected areas management write about their management experiences. With reference to the then pilot BJCMNP and the Montego Bay Marine Park, Smith (1995) states that one of the valuable lessons learned was that the shortage of human resources was as limiting a factor as financial resources. He pointed to persons with zoology degrees from University of the West Indies (UWI) as current park managers and noted that persons with natural science degrees often ended up in jobs that underutilized their qualifications because of the narrow environmental job market. Another important issue mentioned by Smith was the limited legal support from NRCA which at the time of his article did not have an in-house lawyer. He implies that law enforcement lacked real 'teeth', as this involved confiscation of illegally collected material, e.g. logs, and few prosecutions. There was also the issue of NRCA having no enforcement powers over forest reserves declared under the Forestry Act and governed under Forest Regulations. This is an important point as the NFMCP shows that some forest reserves lie within some of the NRCA-declared protected areas.

Miller (1999) elaborated on the plans for financing of the National Protected Areas Systems. The primary national sources of funding were to be annual Government of Jamaica budgeting allocations and the Jamaican National Park Trust Fund which was initiated through a 'Debt for Nature Swap' with the United States Government. The idea was for the Jamaican government to provide 'in kind' contributions for projects, annual contributions to the NRCA's Wildlife and Protected Areas Branch and an annual contribution of J$5 million to the Trust Fund. In-kind contributions were made in 1998 but since then there have been consistently reduced contributions to the NRCA Wildlife and Protected Areas Branch and to the Trust Fund with no contributions being made in some years. Miller stresses that financial sustainability for the National Protected Areas Systems is dubious. The major source of financial sustainability for the two parks was supposed to be the Trust Fund which was expected to cover much of but not all the operational costs. However, without the government contributions to cut expenses the original intention of managing the Trust Fund mainly as endowment with expenses paid through investment incomes and the principal untouched did not materialize. Instead, disbursements to cover salaries and other costs in the two parks between 1993 and 1997 strained the fund's viability (Miller 1999). To date, the Trust Fund is still in need of new income and long-term financing (Capacity Development Working Group 2007).

Miller outlined how lack of financial sustainability at the system level would affect management and difficulties with finances at the site level. He mentions two unrealistic expectations of consistent local donor support, and some economic relief through the introduction of park user fees. Unrealistic because of lack of awareness among interested NGOs and community-based groups of the Trust Fund's demise, and of how the various protected areas would attract different levels of interest and support and not all of them would be eligible for user fees. Furthermore, challenges with the sustainability of NGOs and community-based groups indicated that Jamaica was not prepared to manage its growing National Protected Areas Systems.

The NRCA Board of NEPA and the Forestry Department both have legislative powers to declare protected areas for biodiversity conservation, but these powers are unequal and uncoordinated. The NRCA Board of NEPA can declare protected areas under three pieces of legislation creating national parks, protected areas, game reserves or sanctuaries (NRCA Act 1991). The Forestry Department can declare forest reserves, forest protected areas and forest management areas (Forestry Department 2001). Some of the NRCA protected areas eg. BJCMNP and PBPA contain forest reserves but no mechanism exists as to how the two jurisdictions should relate to each other. In fact the NRCA Act in Section 5(1) states that it is after NRCA consultation with the Jamaica National Heritage Trust that protected areas may be declared by the Government of Jamaica's environment minister. Consultation with the Forestry Department is not mentioned.

NRCA is now a part of NEPA as a result of a merger with the Town Planning Department and the Land Development and Utilization Commission. At present, NEPA has a Legal and Enforcement Division. The Division has provided the capacity to draft wildlife conservation and protected areas regulations, and institute proceedings for the handling of violations (McCalla 2004). Key legislative instruments under NEPA's jurisdiction that directly govern *in situ* biodiversity conservation include:

- Natural Resources Conservation (Blue and John Crow Mountains National

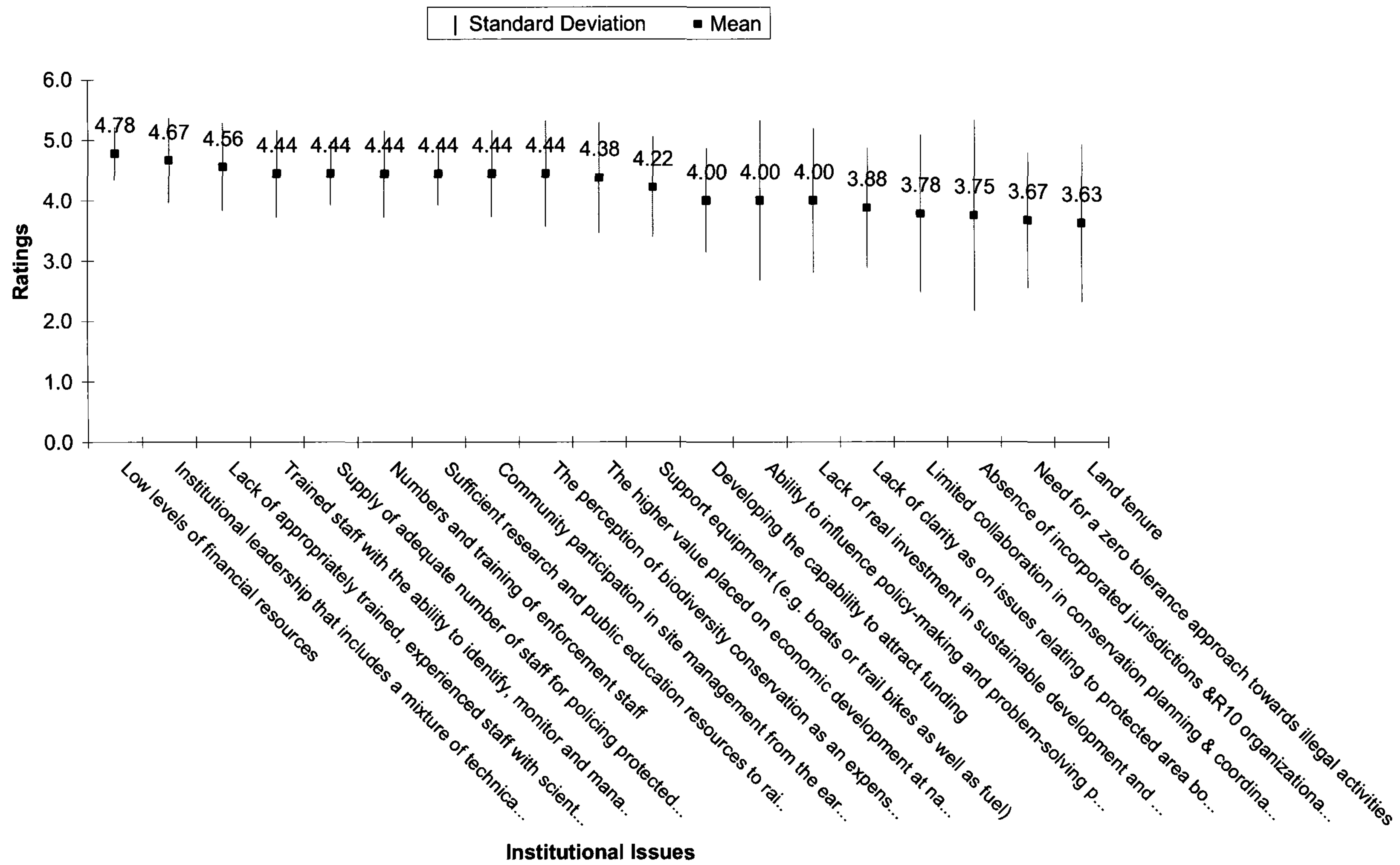
Park) (Declaration) Order (1993) and the Natural Resources National Parks Regulations.

- Natural Resources (Blue and John Crow Mountains National Park (User Fees) Regulations (2003)
- Wild Life Protection Act (1945)
- Endangered Species Act (2001)
- Natural Resources (Prescribed Areas) (Prohibition of Categories of Enterprise, Construction Development) Order (1996)
- Portland Bight Protected Area Regulations (in draft stages)

Expert Input on Institutional Issues

Question 3 of the Delphi Round 1 asked what institutional issues at the protected areas system level do you think have the greatest influence on biodiversity conservation in protected sites (Figure 11). Low levels of financial resources were seen as the institutional issue of greatest influence (4.78) on biodiversity conservation in sites (Table 34). However, the five next highest rated statements all are associated with human resources for leadership (4.67) and the numbers and capabilities of management and enforcement staff. Community participation in site management was a fairly well received idea (4.44) indicating that while the focus was on a technocratic, expert-oriented approach to protected areas management the institutional culture was willing to entertain the addition of community stakeholders to the management process.

FIGURE 11. DELPHI RATINGS FOR INSTITUTIONAL ISSUES



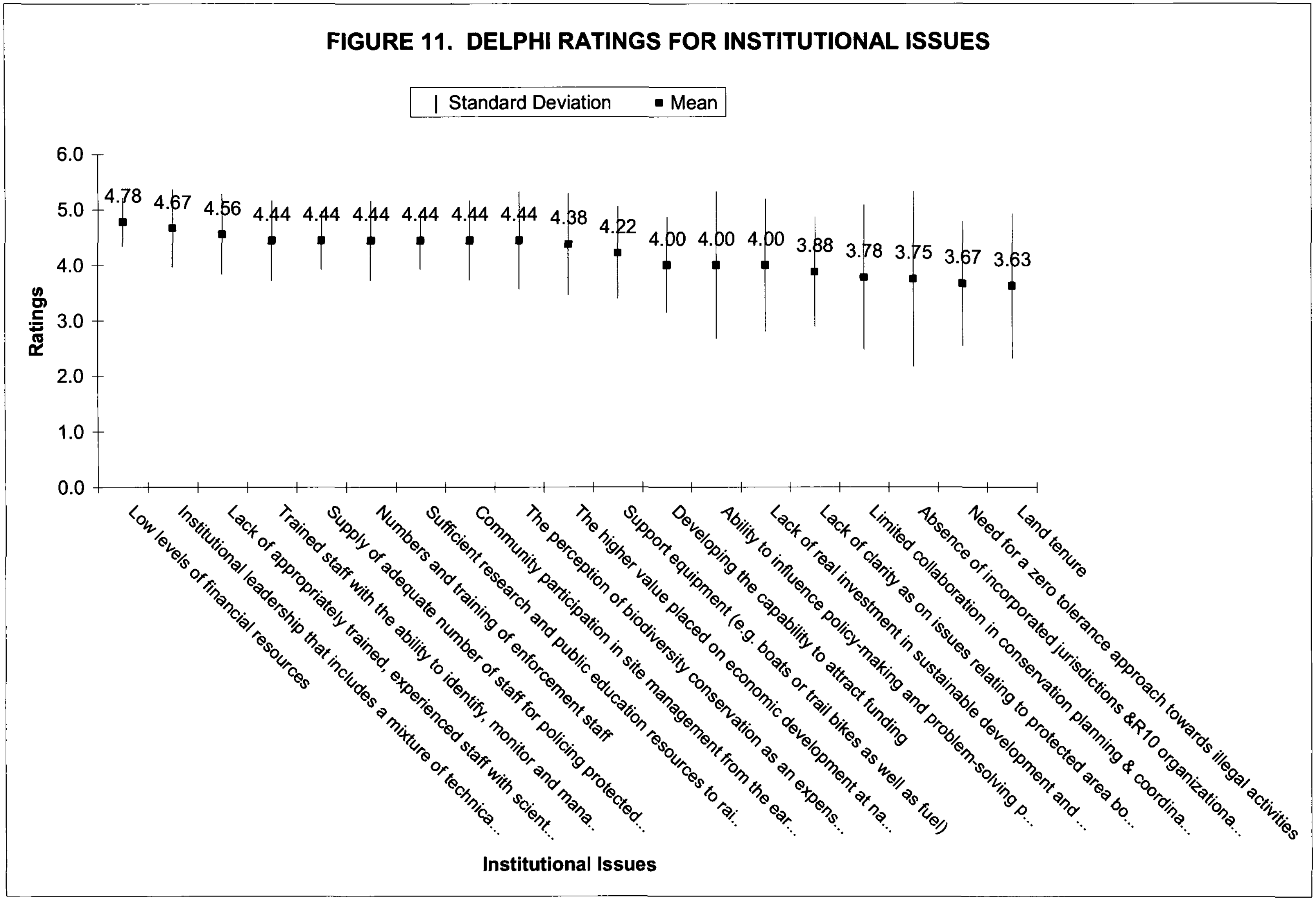


FIGURE 11. DELPHI RATINGS FOR INSTITUTIONAL ISSUES
| Standard Deviation
Mean
6.0
5.0
4.0
3.0
2.0
1.0
0.0
Ratings
4.78
4.67
4.56
4.44
4.44
4.44
4.44
4.44
4.44
4.38
4.22
4.00
4.00
4.00
3.88
3.78
3.75
3.67
3.63
Low levels of financial resources
Institutional leadership that includes a mixture of technica...
Lack of appropriately trained, experienced staff with scient...
Trained staff with the ability to identify, monitor and mana...
Supply of adequate number of staff for policing protected...
Numbers and training of enforcement staff
Sufficient research and public education resources to rai...
Community participation in site management from the ear...
The perception of biodiversity conservation as an expens...
The higher value placed on economic development at na...
Support equipment (e.g. boats or trail bikes as well as fuel)
Developing the capability to attract funding
Ability to influence policy-making and problem-solving p...
Lack of real investment in sustainable development and ...
Lack of clarity as on issues relating to protected area bo...
Limited collaboration in conservation planning & coordina...
Absence of incorporated jurisdictions &R10 organizationa...
Need for a zero tolerance approach towards illegal activities
Land tenure
Institutional Issues

Table 34. Delphi Ratings for Theoretically-Derived Management Institutions Criteria

Criteria	Delphi Rating
• Funding sources/partners	4.78
• **Implementation of conservation strategies**	**4.56**
• Training for protected areas managers and staff	4.44
• Salaries	4.33
• Biodiversity surveys and research	4.33
• Staff (existence and/or level)	4.22
• Stakeholder/actor participation	4.22

However, the statement on developing the capability to attract funding did not have as strong an agreement by the group, which at first seems contradictory. A possible explanation was provided by one Delphi participant who indicated that the protected areas site he was affiliated with had developed successful relationships with funding agencies to attract funding on their own. While the capability to attract funding at the system level was still important, he went on to point out that alternatives were being pursued by site managers. The fact that the theoretical criteria of income generation at the system level was excluded by the Delphi group as an important site influence strongly suggests that the government agencies responsible for protected areas have not been financially supportive of site level conservation. Two national perceptions of biodiversity conservation that were generally supported by the expert group also provide possible reasons for the lack of financial support. The perceptions are biodiversity conservation is an expense and less valuable than economic development. In keeping with these sentiments one of the statements generated during the Delphi process was "lack of real investment in sustainable development". However, the expert group did not see this as affecting system and site level institutional relationships.

Less importance was placed on planning issues such as influencing policy-making and problem-solving, collaborative conservation planning and harmonized jurisdictions which were rated from 4.00 to 3.63. The low prioritization of planning issues would certainly have facilitated the multi-year delay in adopting a national system plan for protected areas and lack of coordination between agencies responsible for protected areas management. In one of the alternative interviews to the Delphi an expert stressed that coordination between the different agencies involved in protected areas management was critical.

The zero tolerance approach towards illegal activities received the second lowest rating of 3.67, leaving one to wonder what level of enforcement is envisioned by the expert group. Land tenure received the lowest rating of 3.63. This issue was pursued with three experts who opted not to participate in the Delphi process but were comfortable with an informal interview. Based on the three conversations that were held and which included comments on land issues, several points were made clear. The lands declared under the NRCA Act were either government-owned or Crown lands. Squatter settlements were sometimes a problem but not to the extent that it was thought detrimental to conservation efforts. The Forestry department pointed out that matters of land tenure were the responsibility of the Commissioner of Lands, whose jurisdiction is external to the Forestry Department. The Forestry Department is more involved in surveying the boundaries for its forest lands estate in order to update its records on the extent of forest lands under its management. The site manager was adamant that biodiversity conservation and natural resource management were separate missions from land management. Biodiversity conservation was concerned with what was on the land and not the parcels of land and their tenure or ownership.

The pattern of the Delphi ratings for the theoretically derived criteria remained consistent with the generated Delphi statements on management institutions. Funding sources/partners was given the highest rating, staff training and capacity received strong agreement from the group, as well as stakeholder/actor participation. A new addition was "implementation of conservation strategies" which received the second highest rating signifying is great importance on conservation at the site level.

Community Input on Institutional Issues

The common thread across the five sets of community responses was that there was a desire for community groups to be involved in protected areas management (Table 35). Each group had further individual contributions on necessary management issues for a protected areas system. The Portland Bight Protected Area and the Cockpit Country Forest Reserve groups specified that the involvement could beat planning stages of management. The Portland Bight protected areas group named public tree-planting with specific targets in mind as a way of integrating community into on-the-ground activities. The Mason River Group repeatedly emphasized the need for greater public awareness and education on the value of protected areas systems, the benefits of asserting its protection. They also felt that environmental laws should be promoted through various educational media.

Table 35. Jamaica Community Workshop Responses for Management Institutions and Governance

Mason River Protected Area	Portland Bight Protected Area	Cockpit Country Forest Reserve	Blue & John Crow Mtns. National Park (Millbank)	Blue & John Crow Mtns. National Park (Woodford)
• Greater public awareness in the area slated for protection so that people do not destroy or harm protected species • Importance of the protected area e.g. protecting the habitats of species, preserving watersheds, developing eco-tourism • Promotion of environmental laws through different media e.g. billboard, radio, brochures • Educating citizens close to the designated PA on the reasons for protection • Educating these citizens on the benefits to be obtained in assisting in the protection and management the area • Train community persons to assist in the protection and management of the area • Land ownership • Factors conflicting with the PA establishment e.g. plants and animals in the area, deforestation, settlement, population growth	• Adequate funding • Deal with deforestation through public tree-planting with set targets (i.e. # trees planted p.a.) • A PA authority with the power to stand up to housing developments in environmental areas • Strong leadership in order to gain public support • Information sharing between researchers and PA management • Restoration of degraded areas • Controlled extraction • Getting government to hear community voice and taking it seriously at public meetings concerning development plans	• Observed declines in water resources, namely river flows and rainfall, linked to deforestation • Pollution to the environment caused by garbage disposal and the use of agricultural pesticides Inclusion of indigenous people, i.e. the Maroons, in the planning of protected areas.	• Co-management agreements for community groups and national park management • More and long-term resourcing (especially financial) for the national park • Literacy level thought to be a major factor influencing participation in park management • Maintenance of the area's heritage and cultural practices through information distribution on natural and other aspects of heritage	• More signage along trails • Consultation with Woodford Community Action Group by Jamaica Conservation & Development representatives • Planning for job creation

Expert Input on Governance Issues

The statements on governance issues collected in Round 1 of the Delphi process provide insights on the role of local people, the nature of governance and the management approach (Figure 12). High priority is placed on educating local communities around the protected areas and having their support for management's conservation actions. However, there is less agreement among the experts that the public should participate in conservation itself. In addition to identifying local communities as non-managerial stakeholders, the private sector was also recognized but apparently not expected to engage in conservation and so that issue received the lowest rating of 3.33. It is curious that the perception that there is no obvious, immediate benefit to stakeholders also received one of the lowest ratings (3.44) as providing a sense of benefit to local people would enhance efforts at public outreach and education. One possible explanation that comes out of the responses is a centralized, top-down approach to governance indicated by the low agreement that having a large number of diverse stakeholders is of greatest importance. The stronger agreement on the need for system management to be cognisant of site needs, the need for a dedicated authority for system management and the role of government in delegating management and having the capacity for management. The statements on financial support are vague and little has been said about the sources or administration of these finances. A noteworthy statement receiving one of the higher ratings is the lack of agreed measures/indicators for success at biodiversity conservation, indicating an awareness and valuing of evaluation as part of the management process.

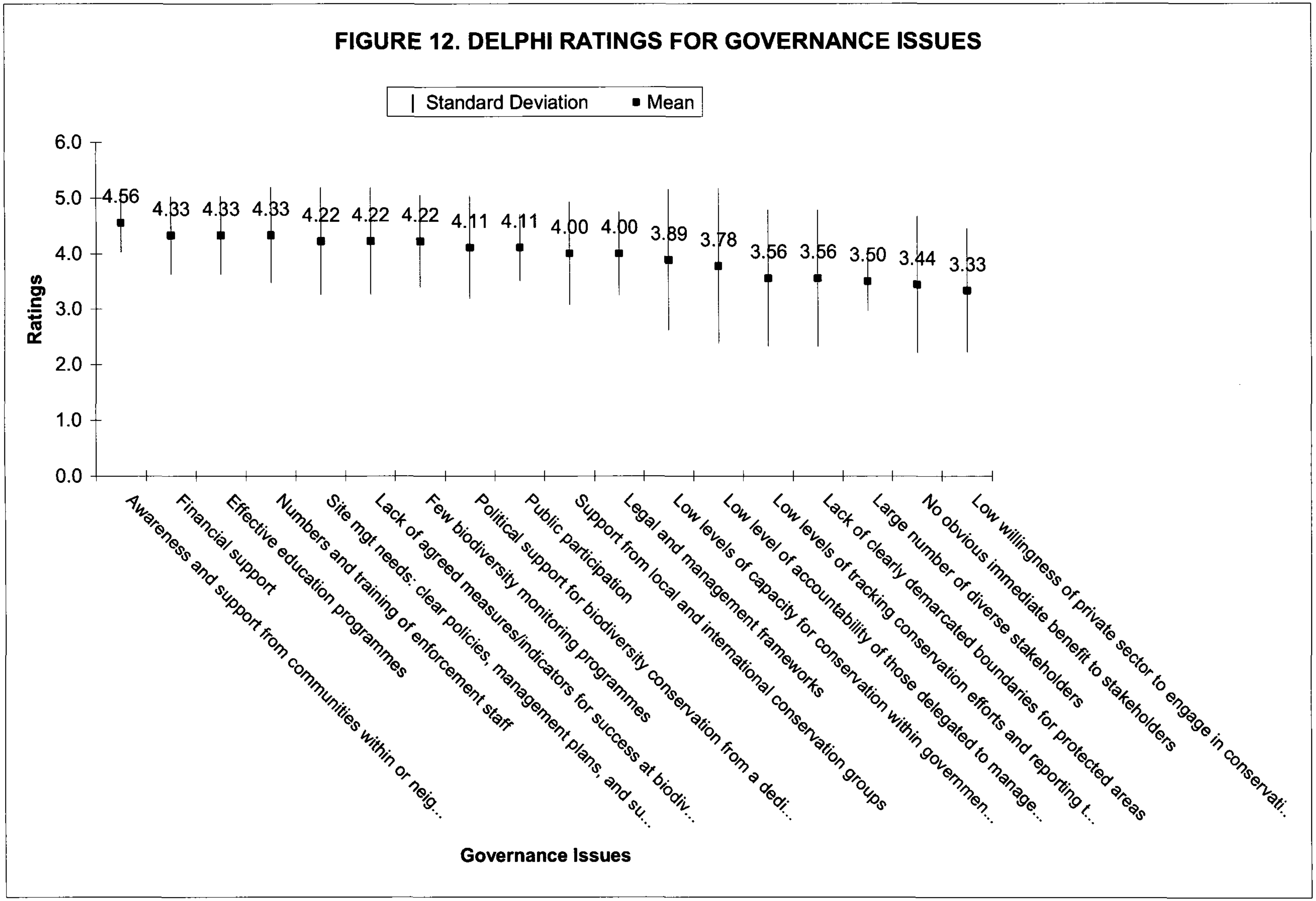


FIGURE 12. DELPHI RATINGS FOR GOVERNANCE ISSUES
Standard Deviation
Mean
Ratings
6.0
5.0
4.0
3.0
2.0
1.0
0.0
4.56
4.33
4.33
4.33
4.22
4.22
4.22
4.11
4.11
4.00
4.00
3.89
3.78
3.56
3.56
3.50
3.44
3.33
Awareness and support from communities within or neig...
Financial support
Effective education programmes
Numbers and training of enforcement staff
Site mgt needs: clear policies, management plans, and su...
Lack of agreed measures/indicators for success at biodiv...
Few biodiversity monitoring programmes
Political support for biodiversity conservation from a dedi...
Public participation
Support from local and international conservation groups
Legal and management frameworks
Low levels of capacity for conservation within governmen...
Low level of accountability of those delegated to manage...
Low levels of tracking conservation efforts and reporting t...
Lack of clearly demarcated boundaries for protected areas
Large number of diverse stakeholders
No obvious immediate benefit to stakeholders
Low willingness of private sector to engage in conservati...
Governance Issues

Question 4 of the Delphi Round 1 questionnaire asked participants what governance issues at the protected areas system level they thought had the greatest influence on biodiversity conservation in protected sites (Table 36). Awareness and support from communities within or neighbouring protected areas was the issue that had the highest rating of 4.56 in Round 2. Financial support, effective education programmes, and numbers and training of enforcement staff all received the second highest rating of at 4.33.

Park ranger patrols and national land use policies had the highest Delphi ratings of 4.78 amongst the theoretically-derived governance criteria. It is interesting that land use policies scored this highly when land cover was not considered a very important outcome for conservation. Whereas it is not surprising that implementation of protected areas laws and community awareness received fairly high ratings of 4.67 and 4.56 respectively, several of the system-oriented management activities such as system planning, coordination among management agencies, networking with various environmental organizations and protected areas demarcation and zoning received the lowest scores of 4.11. Again the criterion that was thrown out by the group, namely payments for biodiversity protection was another socio-economic issue.

Note that in both instances of rating governance issues, community awareness and protected areas enforcement were rated highly although not with the same priority. Nevertheless this trend serves to confirm enforcement and community awareness as very important governance issues in the eyes of the experts.

Table 36. Delphi Ratings for Theoretically-Derived Governance Criteria

Criteria	Delphi Rating
• Park ranger patrols	4.78
• National land use policies	4.78
• Implementation of protected areas laws	4.67
• Community awareness	4.56
• Protected areas policy	4.44
• Land tenure and use arrangements	4.44
• **Willingness of courts to prosecute**	**4.44**
• **Existence of mechanisms for conservation on private lands**	**4.44**
• Population pressure	4.22
• Designation of management authority	4.22
• Site planning	4.22
• Types of natural resource use regimes	4.22
• **Coordination between management agencies**	**4.11**
• Networking with various environmental sectors	4.11
• System planning	4.11
• Protected areas demarcation and zoning	4.11
• Plans for external influences on the protected areas system	4.11
• Local/community incentives	4.11

Community Input on Governance

The key point shared by the community groups was that protected areas management should have a participatory approach. The BJCMNP suggested co-management agreements as a way of formulizing community participation thereby sharing some of the decision-making power with community groups.

4.5 Methodological Triangulation of Biodiversity Conservation: A Jamaican Perspective

The problem of minimizing biodiversity loss and decline has been seen and approached from two different angles in Jamaica. On one hand is a sustainable development view of biodiversity conservation as conservation of species and ecosystems useful to humans and of natural heritage. Natural heritage seems limited to endemic species, species of value to folk medicine, and land areas of historical importance eg. Maroon lands. The focus is on compatibility between maintenance or protection of genetic, species, ecosystem diversity and utilization of natural resources for human welfare. The national policies and plans on protected areas and forest reserves seem strongly in favour of biodiversity conservation as an aspect of sustainable development, a position also upheld by some academics.

On the other hand, is the more protectionist view which, while recognizing the utilitarian value of wildlife and its variation, places the emphasis on protection of the intrinsic values of the natural landscape and of ecosystems.

Other academics and the expert group were oriented towards prevention of threats to, and maintenance and preservation of species composition and ecosystem state. Ecosystem conservation seems oriented toward species' needs and not with respect to wider ecological patterns and processes. What was common to both concepts was the prominence of the species concept and the high priority placed on endemic plants and animals. Genetic diversity is included as a conservation target in both concepts but other than putting it in the context of a natural resource or affiliating it with species conservation very little insight has been offered on gene conservation by the datasets.

4.6 Methodological triangulation of Biodiversity Conservation Goals and Objectives for Jamaica

The biodiversity conservation goals and objectives proposed by academic literature, experts and community groups, and the intended goals stated in system-level conservation plans or programmes are collated in Table 37. They reflect a strong influence of the protectionist conservation paradigm on goal and objective setting in spite of the tendency of academic and technical literature here to subsume biodiversity conservation under sustainable development. The list of goals and objectives appears to form two groups, biological and social. The predominant biological goals and objectives follow the themes of ecosystem diversity conservation and species diversity conservation. The literature, expert and community groups all contributed to varying extents to the biological goals.

However, the expert and community groups were the greater contributors of social goals (i.e. public awareness, reduction of threats and protection of ecological services important to communities).

Note that the goals have been organized as nested goals in Table 37 to show the relationship between goal setting for *in situ* biodiversity conservation at global and national scales. The system goals are those in national conservation plans and reports, and provided by the expert and community groups. These goals fall within the CBD's broad ecosystem and species diversity conservation goals. The only CBD conservation goal that is not clearly reflected in conservation planning in Jamaica is conservation of genetic diversity. However, this was named as an important objective by the experts. The CBD goals tend to be very broad and general in the wording, allowing for the national goals and objectives to be more specific about which island ecosystems, habitats, species and genetic diversity should be conserved. With the global conservation value for island biodiversity being endemic species, the planned and active protection of endemic species

Table 37. Range of Proposed Biodiversity Conservation Goals and Objectives for Jamaica's Protected Areas System

System Conservation Goals [Associated Site Goals in brackets]	System Conservation Objectives [Associated Site Objectives in brackets]	Data Source for Goals & Objectives				
		Acd. Lit.	Tech. Lit.	Expert Group	Comm. Groups	Biophysical Data /Info
•Promote the conservation of the island's ecosystems, habitats, biomes.	•At least 10% of each of the island ecological regions effectively conserved. •Areas of particular importance to island biodiversity … comprehensive, effectively managed and ecologically representative national … networks. • Conserving community/ecosystem diversity		CBD Island Biodiv. POW	√		√
•Preserve major representative stocks or areas of all Jamaica's biological resources	• To protect and sustainably manage centres of significant biological diversity.		National PAS policy			√
•Forest biodiversity conservation [To maintain & enhance the remaining area of closed broadleaf forest & component species … in the BJCMNP]	•Habitat for native flora and fauna ... by increasing the extent of … protected areas together with effective patrolling and protection of these areas. [Rehabilitation of at least 200 acres … of degraded area within the priority areas for management interventions, as identified ...]	√	NFMCP BJCMNP Mgt.Plan			√
•Forest conservation	Objectives not identified				√	√
•Rainforest biodiversity conservation	Objectives not identified	√				√
•Limestone forest biodiversity conservation	Objectives not identified	√				√
• Freshwater biodiversity conservation	• To design a network of freshwater conservation areas that will conserve the diversity of species, communities and ecosystems in Jamaica. •		JERP		√	

System Conservation Goals [Associated Site Goals in brackets]	System Conservation Objectives [Associated Site Objectives in brackets]	Data Source for Goals & Objectives				
		Acd. Lit.	**Tech. Lit.**	**Expert Group**	**Comm. Groups**	**Biophysical Data /Info**
•Riparian habitats conservation	[Creation and maintenance of a … riparian buffer along headwater streams.]		JERP BJCMNP Mgt.Plan		√	Mostly hydrologic, no forest data.
* Promote conservation of island's species diversity	* Populations of island species of selected taxonomic groups restored, maintained, or their decline substantially reduced. * Status of threatened island species significantly improved.		CBD Island Biodiv. POW			Jamaican Iguana
*Different plants and animals	* Conserving species diversity			√	√	Limited
*Restricted range plants and animals *Endemic species*	[To protect threatened biodiversity by focusing on arresting further movement of the conservation targets towards endangerment and extinction.]	√	NFMCP BJCMNP Mgt. Plan		√	Conserv-ation targets
*Medicinal plants	Objectives not identified by communities				√	Limited
*Birds and their habitats	Objectives not identified by communities				√	√
*Fish	Objectives not identified by communities		JERP		√	Limited
* Promote conservation of genetic biodiversity	* Genetic diversity of crops, livestock, and other valuable island species conserved, and associated indigenous and local knowledge maintained.		CBD Island Biodiv. POW			Rock iguanas & anolid lizards

FIGURE 11. DELPHI RATINGS FOR INSTITUTIONAL ISSUES

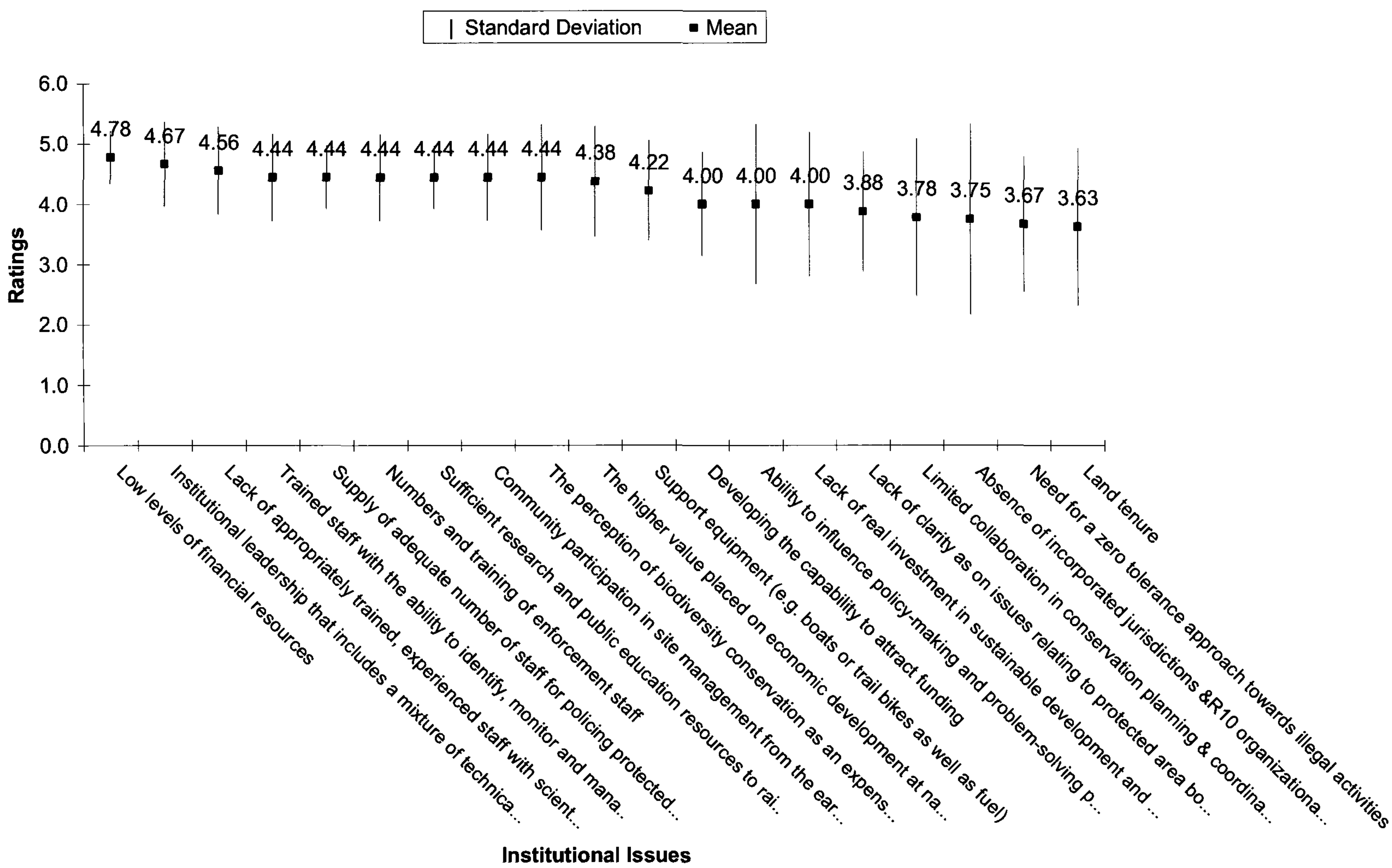


FIGURE 11. DELPHI RATINGS FOR INSTITUTIONAL ISSUES

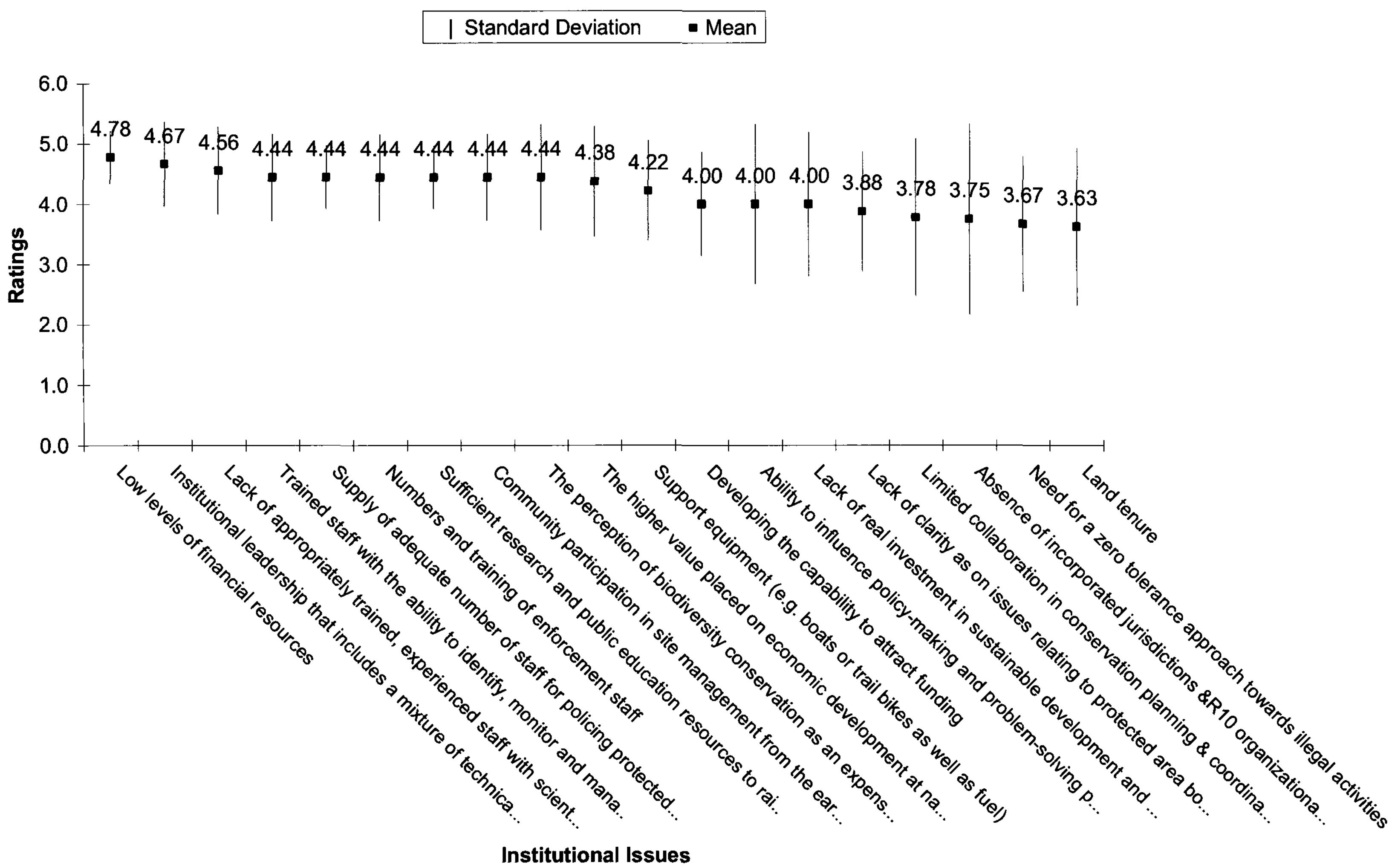
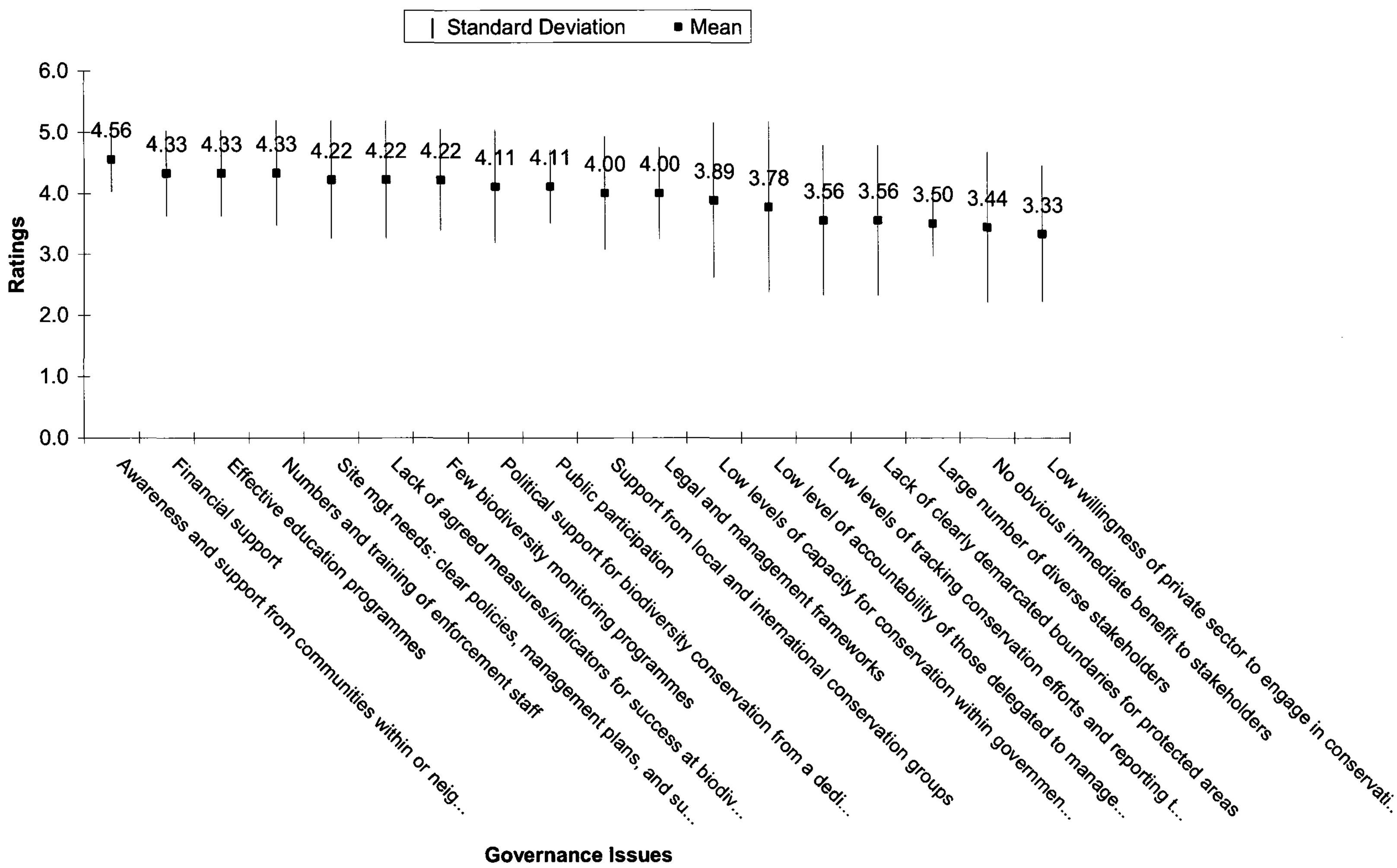


Table 35. Jamaica Community Workshop Responses for Management Institutions and Governance

Mason River Protected Area	Portland Bight Protected Area	Cockpit Country Forest Reserve	Blue & John Crow Mtns. National Park (Millbank)	Blue & John Crow Mtns. National Park (Woodford)
• Greater public awareness in the area slated for protection so that people do not destroy or harm protected species • Importance of the protected area e.g. protecting the habitats of species, preserving watersheds, developing eco-tourism • Promotion of environmental laws through different media e.g. billboard, radio, brochures • Educating citizens close to the designated PA on the reasons for protection • Educating these citizens on the benefits to be obtained in assisting in the protection and management the area • Train community persons to assist in the protection and management of the area • Land ownership • Factors conflicting with the PA establishment e.g. plants and animals in the area, deforestation, settlement, population growth	• Adequate funding • Deal with deforestation through public tree-planting with set targets (i.e. # trees planted p.a.) • A PA authority with the power to stand up to housing developments in environmental areas • Strong leadership in order to gain public support • Information sharing between researchers and PA management • Restoration of degraded areas • Controlled extraction • Getting government to hear community voice and taking it seriously at public meetings concerning development plans	• Observed declines in water resources, namely river flows and rainfall, linked to deforestation • Pollution to the environment caused by garbage disposal and the use of agricultural pesticides Inclusion of indigenous people, i.e. the Maroons, in the planning of protected areas.	• Co-management agreements for community groups and national park management • More and long-term resourcing (especially financial) for the national park • Literacy level thought to be a major factor influencing participation in park management • Maintenance of the area's heritage and cultural practices through information distribution on natural and other aspects of heritage	• More signage along trails • Consultation with Woodford Community Action Group by Jamaica Conservation & Development representatives • Planning for job creation

FIGURE 12. DELPHI RATINGS FOR GOVERNANCE ISSUES



System Conservation Goals [Associated Site Goals in brackets]	System Conservation Objectives [Associated Site Objectives in brackets]	Data Source for Goals & Objectives				
		Acd. Lit.	**Tech. Lit.**	**Expert Group**	**Comm. Groups**	**Biophysical Data /Info**
•Riparian habitats conservation	[Creation and maintenance of a … riparian buffer along headwater streams.]		JERP BJCMNP Mgt.Plan		√	Mostly hydrologic, no forest data.
* Promote conservation of island's species diversity	* Populations of island species of selected taxonomic groups restored, maintained, or their decline substantially reduced. * Status of threatened island species significantly improved.		CBD Island Biodiv. POW			Jamaican Iguana
*Different plants and animals	* Conserving species diversity			√	√	Limited
*Restricted range plants and animals ****Endemic species***	[To protect threatened biodiversity by focusing on arresting further movement of the conservation targets towards endangerment and extinction.]	√	NFMCP BJCMNP Mgt. Plan		√	Conservation targets
*Medicinal plants	Objectives not identified by communities				√	Limited
*Birds and their habitats	Objectives not identified by communities				√	√
*Fish	Objectives not identified by communities		JERP		√	Limited
* Promote conservation of genetic biodiversity	* Genetic diversity of crops, livestock, and other valuable island species conserved, and associated indigenous and local knowledge maintained.		CBD Island Biodiv. POW			Rock iguanas & anolid lizards

System Conservation Goals [Associated Site Goals in brackets]	**System Conservation Objectives** [Associated Site Objectives in brackets]	**Data Source for Goals & Objectives**				
		Acd. Lit.	**Tech. Lit.**	**Expert Group**	**Comm. Groups**	**Biophysical Data /Info**
*Public awareness of understanding of protected areas biodiversity conservation	Objectives not identified by experts			√		
*Reduction of threats.	* Reduction of urban and agricultural encroachment [To promote research that will guide park management but will not threaten the resources of the park] [To protect threatened biodiversity by focusing on … the conservation targets … extinction.]		NFMCP BJCMNP Mgt. Plan	√	√	Types of threats
Protection of ecological services	Protection of species of medicinal, cultural and economic value.				√	

System Conservation Goals [Associated Site Goals in brackets]	**System Conservation Objectives** [Associated Site Objectives in brackets]	**Data Source for Goals & Objectives**				
		Acd. Lit.	**Tech. Lit.**	**Expert Group**	**Comm. Groups**	**Biophysical Data /Info**
*Public awareness of understanding of protected areas biodiversity conservation	Objectives not identified by experts			√		
*Reduction of threats.	* Reduction of urban and agricultural encroachment [To promote research that will guide park management but will not threaten the resources of the park] [To protect threatened biodiversity by focusing on … the conservation targets … extinction.]		NFMCP BJCMNP Mgt. Plan	√	√	Types of threats
Protection of ecological services	Protection of species of medicinal, cultural and economic value.				√	

in not only all three study sites, but also islandwide, contributes to Caribbean and global monitoring of endemic island biodiversity. The CBD objectives on the other hand tend to be more specific, providing quantitative or qualitative parameters which guide the planning of conservation objectives.

Two shortfalls in the national objective setting are the absence of objectives for identified goals and the lack of direction in terms of desired results, particularly with the expert and community groups. Goals, particularly species goals that have no associated objectives tend to lack assessable quantitative or qualitative parameters for the production of conservation outcomes, also making outcome assessment difficult. Apparent gaps in the protected areas system planning process are the lack of specific objectives and supporting biophysical data and information for public education and awareness and threat reduction. Most of the other objectives have various levels of supporting biophysical data and information available with the exception of designing networks of conservation areas, species identified for conservation by experts and communities, threat reduction and protection of ecological services.

The variation across goals for ecosystem diversity and species diversity and across their sources points to the importance of wide stakeholder involvement in conservation planning in order to ensure the inclusion of interests. Although approximately half of the ecosystem goals are forest-related, the rainforest (a type of closed broadleaf forest) seems to be held in higher esteem than limestone forest or any other forest type as a conservation target. In general, the protected areas stakeholders share very high priority for conservation of restricted range species, especially endemic plants and animals. The literature and the Delphi ratings display a bias towards threat reduction objectives for species diversity conservation with reduction of deforestation a major emphasis. The coupling of the endemic priority and the threat reduction focii is reflected in the conservation species targets for JERP and the Blue and John Crow Mountains National Park, and for the bird species considered in the IBA report which comprise many endemic and endangered species. Overall, the range of goals and objectives are in tandem except for two that tackle protected areas design. The concept of conservation networks introduced by the CBD and embraced in JERP contrasts with 'centres of significant biological diversity' in the protected areas systems policy. It is possible to incorporate both these approaches into the protected areas system considering the benefit of networks to aquatic ecosystems and the highly fragmented landscape that has to support restricted range species. In other words I see both these approaches co-existing within the same protected areas system.

Snapshots into the possible linkages between system and site planning were provided by the conservation goals and objectives of the three study sites. The assumed hierarchical relationship between these two levels was inconsistent across the study sites. The BJCMNP has clearly aligned itself with the National Forest Conservation goal and many of the national conservation targets that fall within its boundaries are included as targets for its biodiversity conservation programme. The Portland Bight Protected Area (PBPA) although in support of forest conservation has not clearly incorporated national forest goals and objectives in its management plan, especially with regard to its highly degraded and localized dry limestone forests. In addition to lacking a biodiversity conservation programme, national mammal targets (i.e. endemic and non-endemic bat and Hutia species), frog species and the endemic Yellow Boa were omitted from the list of conservation targets for Portland Bight. At the other extreme is the MRPA which although actively managed, lacks a management plan and so is subject to changing conservation priorities and targets dependent on field researchers' interests. Keeping in mind that most forest reserves are devoid of on-site management and have no set site-level objectives, it is probable that the goal setting for sites is either done within the context of national biodiversity conservation goals and objectives (i.e. hierarchically) or independently of system-level goals.

Table 37 shows that protected areas system goals and objectives cannot all be accomplished by any single site. Some sites will be more important than others for fulfilling specific conservation objectives depending on their corresponding site-level objectives and conservation targets. The question is what conservation priorities and targets each site should have in order to collectively cover an island's biodiversity. Assuming knowledge of an island's biodiversity distribution, the advantages of a hierarchical protected areas system are that it allows for:

1) multiple scale identification of gaps in goal and objective setting for comprehensive coverage of biodiversity and conservation actions within the protected areas systems,

2) more efficient prioritization of conservation targets across protected sites, and

3) harmonized setting of goals and objectives at global, national and site levels.

One disadvantage is that this relationship suggests that if planning does not occur within a hierarchy it will not positively contribute to system level conservation. The MRPA indicates this is not so, as in spite of a lack of stated goals and objectives, management has protected unique species and the native insectivorous plant and communities not found in other protected sites.

With regard to the aforementioned island-specific features of biodiversity, consideration of the conservation targets indicates a strong bias toward endemic species particularly animals, sensitivity to endemic and endangered localized species and ecosystems. Omitted from the planning documents for the protected areas system are objectives addressing disturbance regimes including invasive species, conservation of ecologically important species such as keystone species, co-adapted species and the relative taxonomic distributions and ecological niches of biodiversity. Specific invasive species are noted and planned for in the BJCMNP and MRPA but this group is not presented in the system level as a top conservation priority. An immediate red flag rises about the national commitment to the monitoring and control of invasive species across the protected areas system. There is a national invasive species working group that has its secretariat at NEPA but there is little evidence to show recognition of invasive species as a system level concern for protected areas management.

4.7 Methodological Triangulation of Biodiversity Conservation Outcomes for Jamaica

The biodiversity conservation outcomes desired by academics, experts and community groups, and the intended outcomes stated in system-level conservation plans or programmes are collated in Table 38. The five biophysical and three social outcomes correspond with conservation objectives for the Jamaican protected area system. No conservation outcomes were identified for system-level conservation goals that had no associated objectives. In Section 4, the contribution of conservation outcomes in the study sites to the overall biodiversity conservation outcomes of the protected area system was shown. Here the focus is on the system-level outcomes and these outcomes primarily concern the status of ecosystem and species diversity. Amidst the variation in expected and intended outcomes, two findings emerge. First, plant species or other plant taxonomic groups are not reflected in the actual outcomes. Second, the policy and planning documents (i.e. technical literature) apparently do not include the social outcomes concerning livelihood opportunities in their sections on biodiversity conservation.

The technical literature revealed inconsistent generation of intended conservation outcomes for stated system-level goals and objectives (Table 38). The most decisively stated outcomes in planning documents were the NFMCP's intention of preserving remaining forests intact (Forestry Department 2001, p. 65) and the JERP desire for self-sustaining freshwater ecosystems and long-term survival of freshwater species targets in Jamaica's protected areas (John 2006, p. 15). The use of the words 'preserving' and 'intact' strongly hint at a stable ecosystem concept. However, such a concept denies the interference of identified threats and disturbances to effective forest biodiversity conservation. A more advanced concept of an ecosystem underlies the freshwater outcome, incorporating ecological integrity. The draft JERP report (p. 19) prioritized conservation targets that have ecological integrity, that is, the "... key ecological attributes remain intact and function within their natural range of variation." The rationale provided for this emphasis was that ecological integrity is usually accompanied by ecological resilience which increased the likelihood of conservation targets surviving disturbances such as fires, hurricanes and invasive species. However, determination of

Table 38. Range of Biodiversity Conservation Outcomes for Jamaica's Protected Areas System

Corresponding Conservation Objectives	Conservation Outcomes (Intended in *italics*; Actual in regular font)	Data Collection Source for Outcomes				Biophysical Data /Info
		Acd. Lit.	Tech. Lit.	Expert	Comm.	
•At least 10% of each of the island ecological regions effectively conserved. •Areas of particular importance to island biodiversity … comprehensive, effectively managed and ecologically representative national … networks.	Up to year 2000: •Highest protected area coverage (71 ± 3%) for closed broadleaf forest and mangrove forest. •Just over 50% of swamp forest and just under 50% of open dry forests included in NPAS. •Least protected areas coverage for disturbed broadleaf and bamboo forests (10%). •High protected area coverage for high-altitude headwater streams in BJCMNP but low coverage for rest of island. •In excess of 10% minimum benchmark coverage for medium-sized streams, 'Western' freshwater wetlands, 'Western' large rivers 31%, ponds and lakes. •Poor coverage for inland and coastal springs, freshwater caves, karstic streams, eastern ponds and lakes.		NFMCP JERP	√		√
• Conserving community/ecosystem diversity.	•Biological representation			√		√

Corresponding Conservation Objectives	Conservation Outcomes (Intended in *italics*; Actual in regular font)	Data Collection Source for Outcomes				Biophysical Data /Info
		Acd. Lit.	Tech. Lit.	Expert	Comm.	
• Conserving community/ecosystem diversity.	*Biological representation*		√	√		√
• Areas of particular importance to island biodiversity… comprehensive, effectively managed and ecologically representative national … networks.	Indeterminate					
• To protect and sustainably manage centres of significant biological diversity.	3 largest land protected areas include centres of endemic and endangered species.		NFCMP JERP IBA Report			√
• Habitat for native flora and fauna ... by increasing the extent of … protected areas together with effective patrolling and protection of these areas.	*Reduction in deforestation* *Preserving the remaining forest intact*	√	NFCMP			√
	Net loss in 6 out of 7 forest classes that provide critical habitat for several endemic and endangered species. Net gain in bamboo forest which is less important as habitat to conservation targets.		NFCMP			√
• To design a network of conservation areas that will conserve the freshwater diversity of species, communities and ecosystems in Jamaica.	• *Self-sustaining freshwater ecosystems and long-term survival of species targets.* • Fragmentation of hydrologic networks.		JERP			√
• Reduction of urban and agricultural encroachment	Indeterminate					
• Protection of species of medicinal, cultural and economic value.	Indeterminate					

the ecological integrity of freshwater targets proved unsuccessful for JERP due to insufficient islandwide data on the status of freshwater ecosystems and species. Both aforementioned outcomes are assessed using quantitative indicators based on spatial extent and distribution of the different types of forest, ponds and lakes, the length of streams and the numbers of species. No indicators are provided for the characteristic species composition and ecological interactions of various terrestrial and freshwater ecosystems, presumably because of insufficient scientific data and information. Assessments of conservation outcomes are therefore limited to quantification of their size and distribution with adequate indicators yet to be set for the composition and abundance of species and ecosystems.

Mixed success for Jamaica's protected area system is reflected in a comparison of intended and actual outcomes notwithstanding the obvious biases against plant diversity and livelihood opportunities. As a starting point, consider the intended outcome of biological (or ecological) representation. In spite of some protected area coverage well in excess of the CBD's 10% benchmark or adaptive goal thresholds, not all the targeted land and freshwater ecosystems have been included within the protected area system. While understanding that limited financial and human resources preclude widescale conservation targeting, no provision has been made for non-endemic rare species or migratory species. An unintended benefit of the three land centres of endemic and endangered species is that their large size is likely to include several non-endemic rare as well as migratory species based on species-area model where species numbers increase with land area. Protected areas coverage based on quantitative benchmarks did not account for the gap of ecological connectivity in protected area design, a point highlighted in the draft JERP Report. The implication is that biological representation for freshwater ecosystems is incomplete due to exclusion of habitats for especially low-altitude aquatic plants and restricted range animals. The unintended fragmentation of hydrologic networks indicates the need for more active use of freshwater ecology in the design of a protected area system.

The secondary data for forest cover change according to forest class confirm that deforestation is indeed a reality for Jamaican protected area managers (Appendix H). However, the data presented in NFMCP is not specific to protected areas because forest cover change has been calculated for the entire island. The significant point as far as *in situ* biodiversity conservation is concerned is that overall deforestation rates, e.g. 0.24 loss in total forest cover over a ten-year period, obscure the deforestation reality of the various forest classes. Net loss or gain calculations in forest cover are more useful if they are applied to classification levels for vegetation or by extension animal communities as these classifications truly reflect changes in biodiversity. Another value of such biostatistics is if, as in the case of the increasing bamboo cover, there is a potential for changing spatial distribution to accompany changing forest sizes. How much of this bamboo expansion is occurring in declared protected areas? At the expense of what other forest classes has this growth in bamboo occurred? While the figures do not answer these questions they flag the importance of how the forces of deforestation can change the spatial orientation of the island's landscape, including the protected forests and the fauna it supports.

The combined processes of forest reduction and various degrees of isolation resulting in forest fragments are evident in the very fragmented Jamaican landscape.

While the conventional wisdom of island biogeographic theory seems accepted in the instance of freshwater habitats, the need for large and connected forests across the protected area system has not been articulated by Jamaican protected area stakeholders. The effects of habitat fragmentation on Jamaican biodiversity have not surfaced in this research as a subject of high priority for protected area managers. A likely deterrent is the multiple land uses responsible for habitat fragmentation that protected area managers feel are beyond the scope of their influence. The resultant protected area design has been several reserves of variable sizes encompassing several highly endangered species including the extinction-prone Jamaican endemic Iguana. The successful re-introduction of the species into fragmented dry limestone forests and the recovery of this iguana population is testament to the limitations of the species-area model in predicting local extinctions, at least with species-specific management.

It is impossible to say if there has been any decline or improvement in the plant and animal diversity of Jamaica protected areas because of no pre-protected areas coverage baseline against which to make a comparison. The Jamaican Iguana is an exception, however, it must be understood that it is not the only species that has its population numbers monitored within protected areas. Birds are a popular taxonomic group that have been surveyed or monitored periodically in many of the NRCA-declared protected areas and a number of forest reserves. The challenge has been identifying what elements of protected area management accounts for changes in species numbers or population abundance. Changes in species diversity may arise from natural disturbances to biota, natural processes that change the physical environment or compounded effects of natural and human influences. If protected areas are managed from a protectionist perspective as is the case of the BJCMNP and MRPA, then monitoring of human use of biodiversity and human impact on the protected area along with species monitoring, may compensate for lack of biodiversity baseline. Potentially, relationships between the regulation of human access to biodiversity and the impact on biodiversity can be established by such monitoring. The level of human use would serve as a proxy for the effectiveness of regulating human access to biodiversity. These relationships are also of value to protected area management under the sustainable use paradigm as monitoring of biodiversity status against human use of biodiversity would potentially provide evidence of conservation prescriptions that are beneficial or detrimental to the natural environment and humans.

Ironically, a marked gap in the intended and actual conservation outcomes generated for Jamaica is the absence of a reduction in human threat level and the extent of natural resource use. The absence of these outcomes in the literature, the unanimous exclusion of associated criteria in my theoretical conservation effectiveness framework by the experts, in community opinion and the limited biophysical data strongly suggests neglect of utilitarian social outcomes in protected area system management. Social outcomes have been optimistically viewed in light of mutually beneficial returns from environmentally friendly livelihoods such as ecotourism and organic farming. However, the very localized incidences of ecotourism (e.g. bicycle tours in BJCMNP) and the need for an informed account of how livelihood opportunities linked to biodiversity conservation are utilized by communities, weakens any argument in their favour. Nevertheless, a worthwhile indicator for livelihood opportunities is the number of persons that find alternative employment or supplementary income in protected areas.

4.8 Methodological Triangulation of Implementation of Governance and Management Institutions in Jamaica

The key governance and institutional resources issues identified in this research is presented in Table 39. The governance issues cover on one hand the relationships between various stakeholders in protected areas management and on the other hand the relationship between people and the land. The lack of inter-agency coordination with respect to biodiversity conservation, lack of financial sustainability and the overlapping jurisdictions that affect conservation actions in protected areas including enforcement as well as limited community involvement in and support for biodiversity conservation have evidently deterred smooth implementation of conservation activities and efficient use of management resources. The data strongly suggest that interagency coordination, harmonized protected areas jurisdictions and community involvement in and support of biodiversity conservation are important criteria for effective biodiversity conservation. The research data sources concurred on the high significance of financial sustainability and community involvement in particular.

Biodiversity conservation in Jamaica seems shaped by three ideas about the natural environment:

- Public awareness and education about biodiversity and protected areas are crucial for creating pro-conservation attitudes
- Biodiversity conservation should at least directly involve communities in at least the conservation planning stage of protected areas management and in benefit sharing Controlling exploiters of natural resources on state-owned or Crown lands will reduce urban and agricultural threats to biodiversity

Table 39. Range of Key Institutional and Governance Issues for Jamaica's Protected Areas System

Governance & Management Institutions Issues	Data Source for Goals & Objectives			
	Acd. Lit.	Tech. Lit.	Expert Group	Comm. Groups
Governance				
Financial sustainability	√	√	√	
Community involvement in conservation planning	√	√		√
Inter-agency coordination of biodiversity conservation	√	√		
Conservation legislation and regulations		√		
National land use policies			√	
Natural resource regimes		√		
Enforcement			√	
Compliance		√		
Public awareness and support			√	
Delegation of biodiversity conservation responsibility		√		
Management Institutions				
Organizational sustainability	√	√		
Financial support	√	√		
Public awareness and education programmes		√	√	√
Implementation of protected areas laws		√	√	
Dedicated lead authority for protected areas management			√	
Skilled staff with scientific background			√	
Co-management agreements		√		

The emphasis in the governance of the protected areas system is to legally define acceptable and unacceptable natural resource uses depending on the category of protected area. However, enforcement of conservation regulations by relevant authorities and compliance with the regulations by people are other dimensions that are apparently unrecognized. The changes in the composition and extent of biodiversity are not accounted for in the concentration on types of natural resource use. What is further required data on the number or quantitative extent of species, genes or ecosystems is added to or lost from protected areas. The theoretical criteria on proposed and actual biological targets for consumption were an attempt at incorporating this dimension into the theoretical conservation effectiveness framework – a perspective clearly not shared by protected area stakeholders.

Conservation legislation and regulations, and financial sustainability directly address the institutional resources of enforcement staff and their scope of authority, the hiring and responsibilities of other staff for a protected areas system and the implementation of conservation strategies. Amidst the variety of institutional issues elicited by the research, the theme of building a knowledge base stood out. An understanding of protected area categories, public education and awareness programmes points to building the knowledge base for communities while biological surveying and research, and scientifically skilled staff, focus on the technical capacity of management staff. It is hard to discern from the data in Table 39 which of these institutional issues could serve as valid criteria in the conservation effectiveness framework. Consequently, these issues are further explored in the evaluation interviews.

4.9 Revision to the Theoretically-Derived Framework for Biodiversity Conservation Effectiveness in the Terrestrial Protected Areas System of Jamaica

The two aspects of the theoretical conservation effectiveness framework discussed below in light of the methodological triangulation for Jamaica are the structure and the criteria of the framework. The dual concepts of biodiversity conservation (i.e. protectionism and sustainable use) endorse the integration of both ecological and social dimensions of biodiversity conservation into any evaluation of *in situ* conservation effectiveness. Such integration is reflected in the "Biophysical" and "Socio-economic" columns of criteria. In retrospect, the "Biodiversity" caption in the theoretical conservation effectiveness framework only adequately describes a subset of the criteria under that caption and does not account for plans, surveys and research. The term "Biophysical" seems more appropriate and substitutes in the revised conservation effectiveness framework.

The goal-outcome orientation of the conservation effectiveness framework is critical considering the outcome gaps in the planning process. During the research process "Biophysical features" was the caption under which conservation outcomes were represented in the framework in order to keep the focus on the biophysical features of the natural environment and avoid the tendency with other assessments to elicit outcomes for the management process and not specifically for conservation. However, an "Outcome" caption that explicitly establishes the direct link between goals/objectives and outcomes is desirable for the conservation effectiveness framework and the framework was modified accordingly.

The Jamaica case of *in situ* biodiversity conservation made significant contributions to the development of the framework criteria. It identified centres of endemic and endangered biodiversity, and introduced freshwater ecosystem conservation as specific system goals along with the corresponding site goals. It also confirmed the theoretical emphasis on ecological representation, forest ecosystem and endemic species conservation. The social goals of public education and support have been brought to the forefront of conservation planning and they complement the reduction of human encroachment (i.e. urban development and agriculture). The most significant criteria emerging in the management institutions and governance categories are conservation training, delegation of conservation (not just management) responsibilities and coordinated enforcement.

Based on the research findings, a clear establishment of vertical linkages between the management of a protected areas system and the individual sites is evidently essential to effective biodiversity conservation. Before conservation outcomes at the system level can be achieved, the site goals and objectives must be aligned with system goals and objectives so that site contributions to system plans are clearly understood. Then it is more likely that intended outcomes at both levels will be realized. The site level outcomes collectively, as opposed to the summing of their individual contributions, build ecological representation, networks and strengthen species recovery islandwide. In order to achieve conservation outcomes, site managers must work within the boundaries of the 'top-down' institutional and governance relationships with system managers. On the other hand, system managers must account for the appropriateness and adequacy of human resourcing (especially management and enforcement staff), delegation of management authority and financial sustainability. When individual sites do not attain desired outcomes, the protected areas system may be compromised at the least or fail to conserve biodiversity at the worst. Therefore an advantage of the theoretical conservation effectiveness framework is the recognition of vertical linkages in a protected areas system through the alignment of criteria for protected sites with the system criteria.

Comments were received from Jamaican experts on ambiguity in the meanings of the captions "Management Institutions" and "Governance" in the conservation effectiveness framework. One suggestion was that Management Organizations may be more appropriate if the primary concern was about human, financial and technical resources. Another view was that there were overlaps between institutional and governance issues. Additionally, there was evidence of such ambiguities influencing the Delphi responses on management issues and governance questions judging from the same responses to both questions by one participant.

The nomenclature issues outlined above pointed to the benefit of referring to a classification for the terms used in the conservation effectiveness framework. A classification for common conservation actions is provided by Version 1.0 of the IUCN-CMP (Conservation Measures Partnership) Unified Classification of Conservation Actions (IUCN-Conservation Measures Partnership 2006). This classification scheme was applicable to my framework because the term "action" is taken to be synonymous with activity, response and strategy of conservation practitioners which broadly describes some of the conservation effectiveness framework criteria. Using the definitions of IUCN-CMP Actions, I was able to match their terminology to the relevant criteria in my revised conservation effectiveness framework. The revised conservation effectiveness framework for Jamaica is presented in Table 40 indicating the IUCN-CMP Actions, the criteria that were validated from the research data and theoretical criteria that are still critical in my opinion even if uncorroborated by the research data.

Table 40. Revised Framework for Biodiversity Conservation Effectiveness in the Terrestrial Protected Areas System of Jamaica

	Biophysical		Socio-Economic	
	PA System	**PA Site**	**PA System**	**PA Site**
Goals/ Objectives	• PAS plan with biodiversity conservation goals & objectives • Conserving centres of endemic and endangered biodiversity • Network of freshwater conservation areas	• Management plans with biodiversity conservation goals & objectives • Forest conservation targets • Freshwater conservation targets • Threatened endemic and co-adapted plant and animal conservation targets	• PAS plan with socio-economic goals & objectives • Reduction of human encroachment	• Management plans with socio-economic goals & objectives • Greater public awareness • Greater public support
Outcomes	• Representation of ***all*** major forest classes and fresh-water ecosystems • No loss of forest cover • No loss of freshwater bodies • Recovery of threatened biodiversity	• Reduction in deforestation • Prevention of water pollution • Self-sustaining breeding populations of endemic & co-adapted species • Control of invasive species	• Types of land use • Proposed limits to natural resource use	• Types of natural resource use regimes • Actual extent of natural resource use
Management Institutions	• Human resources • Implementation of conservation strategy	• Conservation training • Scientific research collaborations	• Livelihood opportunities	• Income generation from livelihood opportunities
Governance	• Delegation of conservation responsibilities • Community involvement in conservation	• Biodiversity conservation programme planning • Community participation in conservation actions	• Financial sustainability • Coordinated enforcement • National land use policies	• Financial support • Patrol effort • Natural resource use regulations

4.10 Field-testing Results for Framework Criteria and Indicators for Jamaica

The utility of both theoretically-derived and field-derived criteria for guiding an evaluation interview was tested, either through an evaluation interview or with reference to existing maps, land cover statistics or scientific papers. These two approaches were taken in investigating criteria utility because some criteria (e.g. conserving centres of endemic and endangered biodiversity, reduction of threats and recovery of threatened species) would generate interview responses that needed to be confirmed by supporting data and information. On the other hand, the experiential knowledge of interviewees provided a more comprehensive understanding of institutional and governance issues and removed potential researcher's bias or misinterpretation of documented institutional or governance issues. The National Environment and Planning Agency (NEPA) was the system level management agency selected for the interviews that utilized system level criteria as presented in the interview protocol (Appendix E). Interviews that were based on questions using site level criteria were conducted with representatives from the management agencies for the Blue and John Crow Mountains National Park and the Mason River Protected Area.

NEPA has been the government agency that has had responsibility for coordinating the development of the Protected Areas System Master Plan (PASMP). However, system planning has not been incorporated into the routine operations of the responsible branch. Instead, a project approach has been adopted where NGO, consultancy and other government partners have been responsible for implementing various aspects of the project whose outputs will be different components of the plan. A major incentive for the project approach was that this facilitated funding from the Environmental Foundation of Jamaica and The Nature Conservancy. The Nature Conservancy is responsible for the development of the ecological component of the plan through a multi-agency Ecological Working Group.

Interestingly, when the concept of ecological representation was raised with three individuals at NEPA there was acknowledgement and awareness of the concept, but the responses also indicated that it had not been incorporated into *in situ* conservation planning. It was rather difficult to assess the status of ecological representation in the protected areas system from these interviews. Interviews with the management authority for the national park revealed that there was awareness of the ecological representation idea but it had not formed the basis of their biodiversity programme. This lack of focus on ecological representation was also evident for the study sites. The conservation emphasis of the Blue and John Crow Mountains National Park (BJCMNP) on broadleaf forest broadly addresses natural forest but there are no plans specific to the different types of forest included in that category. Nor are there any conservation plans for rare ecosystems in the park such as the grassland ecosystem. Ecological representation has not been part of the planning discussions for the Mason River Protected Area. Traditionally, botanical conservation has dominated the biodiversity conservation efforts of this protected area. Consequently, there are gaps in the faunal inventory and research of the area.

There has been no formal monitoring of natural resource use in the Jamaican protected areas. There is some anecdotal reporting of cultural uses of medicinal plants and records are maintained of visitor use of the Holywell Recreational Park within the BJCMNP. Apart from these, it is reported offences, e.g. clearing of forest, that indicate how biodiversity is being used. However, it was made clear that the protected area is under-staffed, especially with respect to enforcement officers, and so records of offences would not be a reliable indicator of biodiversity conservation. On the subject of enforcement it was pointed out that there were several conservation laws that regulated bird shooting, harvesting of conch, logging and illegal harvesting of protected species. The problem was the lack of personnel to adequately enforce laws and the variable support from the judiciary in making prosecutions.

The issue of data and information sharing from scientific research in protected areas was explored. NEPA recently re-organized its organizational structure to form an Ecosystems Branch that has monitoring and assessment of biodiversity across the protected areas system as a priority. However, the greater part of this monitoring has occurred in coastal areas. There were recognized information gaps for some protected areas and the Cockpit Country was named as one example. However, a formal scientific monitoring programme needs to be established for the entire system. With regards to research external to NEPA, both local and foreign researchers are required to apply for a research permit. One of the conditions of the permit is that the results of the research be deposited with NEPA. It was said that so far most researchers cooperate with the request. The co-managing NGO and government agencies have been particularly active in implementing research projects and collaborating with overseas conservation organizations. However, it seems as if the information once deposited with NEPA is not translated into on-the-ground actions to improve biodiversity conservation.

Although financial sustainability is considered an issue of high priority by system managers, there is no national conservation budget. Costs are shared through division of labour across relevant branches within NEPA. The co-management agreement is also considered one of the ways in sharing management resources. The protected areas system is reliant on multiple sources of funding.

Keeping in mind the factors discussed above that reveal the desirable or undesirable changes in or quality of the criteria for effective biodiversity conservation, the criteria and associated indicators listed in Table 41 are proposed for the conservation effectiveness framework. Note that these are only recommended indicators and are not intended to be a list of possible indicators. Users of the conservation effectiveness framework are expected to select indicators that are relevant to their protected areas system context.

Table 41. Revised Framework Criteria and Associated Indicators for Jamaica

Criteria	**Indicators**
National biodiversity conservation goals & objectives	Presence or absence Relevance to biodiversity conservation
Conservation plan goals & objectives	Presence or absence Relevance to biodiversity conservation
Ecological representation	Presence or absence in conservation planning
Natural resource use	Type and quantity of resource
Stakeholder/ actor participation	Types (NGO, government, private) Jurisdictions w.r.t. protected areas
Financial sustainability	Number and types of funders Timeline of funding source
Financial support	Existence of conservation budget
Biodiversity conservation expertise	Source: local/foreign Field of expertise
Biological and socio-economic surveys	Scientific research permit system Distribution of research activities across protected area system
Implementation of laws	Number of prosecutions for conservation offences in protected areas Resultant penalties for prosecutions
Legal enforcement (number of enforcement officer; enforcement laws)	Number of rangers per unit area of each site Regulations for known offences

5. THE DOMINICANO NATIONAL PROTECTED AREAS SYSTEM

The Dominican Republic occupies the eastern end of the two-country island of Hispaniola. The Dominican Republic is approximately 60% the size of the entire island with a land area of about 48,442 km^2. The wide climatic and topographic variation has resulted in a diversity of montane, coastal and aquatic ecosystems. Ranging from 40 m below sea level to over 3,000 m above sea level, rainfall varies from 450 mm per annum in the drier locations to 2,500 mm per annum in the wetter locations (SEMARENA 2007). Hispaniola includes several mountain and valley ranges with the political border between Haiti and the Dominican Republic sharing the major ranges of Cordillera Central, Sierra de Neiba and the Sierra de Bahoruco (Secretaría de Estado de Agricultura 1990). These ranges change names as the country border is crossed. The highest point of the island is Pico Duarte at an elevation of 3,175 m located in the largest mountain range of the Cordillera Central (Pons 2004). Many of the island's freshwater lakes and lagoons lie within the Dominican Republic with the western region having the hypersaline Lago Enriquillo and the largest freshwater lake Laguna de Ríncon (also called Laguna Cabral). Several river systems are distributed across the landscape of the Dominican Republic.

The Dominican Republic has unique limestone formations and associated karst freshwater caves in its northern, eastern and southern regions (Kueny and Day 1998). The south-western region of the island has been identified as the most biodiverse region of the country. The known animal groups include land mammals including sloths and bats, land birds, reptiles, amphibians, ants, butterflies, freshwater fish, land snails and aquatic insects. The land fauna show high levels of endemism ranging from about 10% to 100%

across taxonomic classes, and several species are on the IUCN's Red List of endangered species.

The national protected areas system of the Dominican Republic is particularly important for Hispaniola considering the pressures of environmental devastation, higher poverty and political instability faced by the Haitian protected areas system (Grupo Jaragua 1994). In other words, the conservation of much of Hispaniola's biodiversity is dependent on effective *in situ* biodiversity conservation in the national protected areas system of the Dominican Republic. For example, although only 13% of Hispaniola's karstic formations are protected, the vast majority of this area is in the protected areas of the Dominican Republic with the Haitian protected areas covering only 0.2 % (Kueny and Day 1998).

The earliest types of protected areas in the Dominican Republic were forest reserves legally established in 1920 through Executive Order 586. Their purpose was the conservation of forests and water resources such as rivers and springs primarily for human benefit. Although in subsequent years there was no systematic management of biodiversity and natural resources, scientific interest and interest in conserving natural environments and landscapes, areas for recreation and timber led to the first national park, National Park Armando Bermúdez in 1928. A landmark in the development of the national system of protected areas occurred in 1974 with the passing of the Law 67-74. This law institutionalized the system through its National Office of Parks and made provisions for national parks, forest reserves, natural reserves, recreational and cultural areas.

Twenty years later in 1994, on the initiative of a local NGO called Grupo Jaragua, *A Strategy for Biodiversity Conservation in the Dominican Republic* was developed. However this strategy was not adopted by the government. It was not until 2000 through the General Law for the Natural Environment and Natural Resources (La Ley General de Medio Ambiente y Recursos Naturales No. 64-00) that laws specific to environmental conservation, restoration and protection, particularly for sustainable use, materialized. An output of Law No. 64-00 was the creation of the Ministry of Natural Environment and Natural Resources which has administrative powers for environmental laws and regulations relevant to biodiversity conservation and seeks to eliminate threats to sustainable development. Then in 2004 another national law, the Protected Areas Sectoral Law (Ley Sectorial de Areas Protegidas No. 202-04) was passed that elaborated on No. 64-00 but also addressed the strengthening of the National System of Protected Areas for biodiversity and landscapes.

Both Laws 64-00 and 202-04 indicate the adoption of the IUCN management categories as the units of the protected areas system. A national policy for a system of protected areas came much later in 2007. This policy provides a historical background to the national protected areas system which reveals that the IUCN categorization has proven problematic for a few reasons, including inconsistent application of the IUCN categories within Articles 13 and 14 of Law 202-04. By then 86 marine and terrestrial protected areas had been declared (Table 42) covering roughly 24% of the land area. An evaluation of biodiversity conservation for the entire system has not as yet been done.

Table 42. Protected Area Categories in the System of Protected Areas for the Dominican Republic.

Category of Protected Area		Number of Sites
Scientific Reserve		6
Marine Mammal Sanctuary		2
National Park		17
Submarine National Park		2
Natural Monument	Natural Monument	17
	Wildlife Refuge	2
Management Areas of Habitats/Species – Wildlife Refuge		13
Forest Reserves		15
Panoramic View		9
Recreational Area		3
TOTAL		86

5.1 Biodiversity Conservation: A Dominicano Perspective

Literature Review and Content Analysis

Searching for local academic literature on *in situ* biodiversity conservation in the Dominican Republic was very challenging and the small number of useful publications identified certainly did not reflect the considerable search effort. A likely reason is that the Caribbean books that address environmental and natural resources management in the Caribbean tend to be published in English by the University of the West Indies and present cases mainly for English-speaking islands. Scientific journals provided a handful of scientific papers on *in situ* biodiversity conservation in the Dominican Republic, mostly oriented towards socio-economic issues in selected national parks or in reference to avian conservation. This researcher's initial journal searches were biased towards

English-speaking publications because of limited Spanish skills. However having recognized this bias, during the research process online journal and Internet browser searches were conducted using key Spanish words, "Republica Dominica" and "biodiversidad" or "áreas protegidas" to locate Spanish scientific papers about *in situ* biodiversity conservation in the Dominican Republic. The search results were mainly online technical documents dealing with various aspects of biodiversity, biodiversity conservation, or protected areas management.

In a paper on avian conservation planning in the Dominican Republic, Latta (2000) briefly commented on the country's biodiversity in terms of wildlife, species and habitats. In acknowledging the Grupo Jaragua-coordinated development of a strategy for conservation of biodiversity, he establishes conservation as the protection of species and their habitats. The paper then turns to its primary focus on avian protection. Other scientific papers were concerned with conservation and community development or boundary and open access issues with reference to case studies for specific protected sites. These papers provided no definition or concept of biodiversity or biodiversity conservation which implied a common definition for biodiversity conservation.

A visit to the Universidad Autonoma de Santo Domingo library and to the library of the Sub-Ministry for Protected Areas and Biodiversity yielded little academic insight into the concept of biodiversity conservation in the Dominican Republic. Halffter (1998), written in Spanish, included the Dominican Republic in a discussion of biodiversity research studies in Latin America. Specific reference was also made to Cuba and Mexico. In this researcher's opinion the book clearly presented biodiversity conservation for the Dominican Republic in the broader context of sustainable development. In fact this orientation was consistently echoed in the technical literature. As a check to my inference I referred to a review of this book by Garí (2000). The reviewer indicates that biodiversity is characterized as species, plant and animal, and ecosystems. Conservation of these levels of biodiversity has both ecological as well as social dimensions resulting in Garí's comment that the compiled research papers for the Dominican Republic suggest a plural approach to biodiversity conservation.

Biodiversity tends to be defined, either explicitly or implicitly in the Dominicano planning and legislative documents. Common to the 1994 - 2003 Biodiversity Strategy (Grupo Jaragua 1994), Law 64-00 (El Congreso Nacional 2000) and the 2000 Natural Resources Management Strategy for South-Western Dominican Republic (SEMARENA 2000) is the definition of biodiversity as the variety of life forms differentiated at three levels – genes, species and ecosystems. Law 202-04 (El Congreso Nacional 2004) does not define biodiversity but seems to assume the definition provided in Law 64-00. Both the 2007 policy for a protected areas system (SEMARENA 2007) and the biodiversity strategy consider biodiversity at multiple scales including ecological communities and processes. Similarly, the Dominican Republic Ecoregional Planning Assessment has selected conservation targets based on a concept of biodiversity that encompasses genetic variation in a species, species populations, ecological communities, systems and processes. Sometimes biodiversity is referred to as an extension of natural resources but in other documents by the SEMARENA it is treated as separate and apart from a natural resource. This observation has also been made within the 2007 policy. Two global influences on the formulation of 2007 Policy seem responsible for its characterizations of biodiversity. An alignment with the Convention on Biological Diversity (CBD) highlights multiple biological levels and geographic scales while the sustainable use paradigm encompasses utilitarian values in the notion of a resource.

The 2007 policy points out that in the early stages of protected area establishment the emphasis was on protected areas that correspond to IUCN protected areas categories I – IV. These categories are in favour of strict protection of biodiversity from human impact. However the government, especially since 1990, has undergone a shift in its perception of biological conservation to measures that not only protect biodiversity but facilitate their human use. Consequently, Law 64-00, Law 202-04 and the 2000 Natural Resources Management Strategy for the Southwestern Dominican Republic firmly promote conservation as a mechanism for sustainable development. According to the Biodiversity Vision for up to 2025, as presented in Law 202-04, the desire is to have sustainable use of the various components of biodiversity (genes, species, and ecosystems) as a contribution to national development. Conservation is explained in Law 202-04 as the maintenance of natural ecosystems or the recovery of ecosystems in order to support preservation, recreational and production activities. The manifestation of this conservation policy shift is the increase in protected areas that are compatible with IUCN categories V and VI, and the creation of a biosphere reserve for south-western Dominican Republic. These categories are in accordance with the policy shift towards community participation in protected areas management.

Whether a protected site is government or NGO managed, the precedence for biodiversity conservation is set by Laws 64-00 and 202-04. The site-specific commitments of protected area managers to biodiversity conservation were explored in order to trace the consistency of the biodiversity concept at the site management level. It was found that contracts of employment exist for government-employed administrators of protected areas (e.g. Sierra de Bahoruco National Park). However, there was inconsistent issuing of delegation and co-management instruments to NGOs. There were no such instruments for Grupo Ecologista Tinglar's management of Laguna Cabral Wildlife Reserve. Grupo Jaragua National Park indicated that it had an old management agreement which was unavailable for my perusal. Exploration of the management agreements for all terrestrial protected areas was beyond the scope of this study. The above selected sites suggest a limited communication of the biodiversity concept from the central authority of the Vice-Ministry for Protected Areas and Biodiversity to protected areas managers. The apparent assumption of the Vice-Ministry is that managers of protected areas share a common concept of biodiversity and its conservation as stated by law. As the survey results clearly show, this is an unfounded assumption.

Expert Input

The twenty-two survey definitions of biodiversity conservation rendered no overall consensus or dominant definition (Appendix I). 50% of the survey respondents did not answer the question but addressed factors relating to biodiversity conservation or were irrelevant. The remaining statements mainly perceived conservation as the protection or preservation of plant and animal species and ecosystems. A few included ecological processes. An omission was the protection of the genetic level of biodiversity. Two definitions included the relationship between humans and biodiversity and that biodiversity conservation was natural resource use. Biodiversity conservation was rarely seen as having a benefit for both humans and wildlife. The primary beneficiary of biodiversity conservation was wild or natural environment.

Community Input

Most of the community workshop participants were not familiar with the term biodiversity conservation and those who were familiar did not have a clear understanding. Some individuals said they thought the term had to do with nature and the types of plants and animals.

5.2 Biodiversity Conservation Goals and Objectives for the Dominican Republic

Literature Review and Content Analysis

My search for academic literature on *in situ* biodiversity conservation in the Dominican Republic produced scientific papers published by researchers based in overseas institutions, with a focus mainly on avian diversity. Not only was there a paucity of writing on the country's *in situ* conservation goals for Dominicano biodiversity but literature references and my enquiries to protected area managers and a science lecturer at Universidad Autonoma de Santo Domingo reflected a scarcity of local academic research or publications on the subject. Eyre (1998) and Kueny and Day (1998) were the journal articles that highlighted the important role of protected areas in protecting tropical rainforests and karst landscapes. Eyre noted global significance, rich biodiversity and high endemism as characteristics of rainforests in the Eastern Caribbean. These features are also shared by the rainforests of the Dominican Republic. Eyre in his comments on conservation of tropical rainforests points out that protected areas, whether they be national parks or forest reserves or biosphere reserves have been instrumental in fighting rainforest deforestation. His accounts of forest conservation in selected islands indicate that tropical rainforest conservation has been a goal for Caribbean protected areas systems.

Kueny and Day (1998) indicate that less emphasis may be placed on biodiversity conservation in karst landscapes of the Dominican Republic than on protection of the intrinsic value of the karst formation or on cave systems of anthropological importance. The biodiversity of karst landscapes is not discussed in the journal paper but biodiversity conservation is mentioned as one of a range of reasons for protecting karst landscapes. The statistics presented in the paper imply that conservation of a significant portion of the Caribbean's karst biodiversity is dependent on protected karst landscapes in Hispaniola. Noteworthy is the fact that at the time of the paper's publication, five out of the six protected areas covering less than 7% of the Caribbean's protected karst area occurred in the Dominican Republic. It is also noted that there is significant Dominicano legislation protecting karst areas.

A published case study is outlined below because its implications are relevant to national parks that conserve biodiversity, protect watersheds and water resources, and facilitate ecotourism. In the case study of park-community relationships for the Armando Bermudez National Park in the Cordillera Central mountains and the gateway park community of La Cienage de Manabao, two key conservation benefits - one ecological and the other economic - were identified (Schelhas et al. 2002). A reliable source of good water which contributed to good human health in La Ciénaga was seen as an outcome of prohibiting forest extractive activities within park boundaries. The park restrictions have been reportedly successful in limiting human penetration into primary forests, enabling growth of secondary forest on former agricultural land and maintenance of riparian forest within park boundaries. Accompanying this favourable aspect of conservation is the conflict of park restrictions with the cultural practices of collecting dead and downed wood, and the hunting of feral pigs. Based on interviews with community residents it was obvious that biodiversity conservation involved a cost in terms of reduced sources of subsistence.

The economic benefit was opportunities for augmenting scarce cash income through eco-tour guiding, selling of food or services and rental of mules. Importantly, Schelhas et al. (2002) note the unlikelihood of eco-tourism being an alternative livelihood to agriculture and financially supporting the community. Limitations of eco-tourism identified in the study included infrequent or seasonal tourist trips, earning potential of any tourist group, foreign or local, is size dependent with the foreign tourists tending to come in small groups and so spending less than is desired by locals. It was apparent from the case study findings that conservation that integrated human use of biodiversity also introduced human trash and facilitated erosion of trails when there was heavy use of the trails.

In the absence of a formal plan for a national system of protected areas, nationally-oriented goals and objectives for biodiversity conservation were found in Laws 64-00 and 202-04, the 1994 – 2003 Biodiversity Conservation Strategy for the Dominican Republic, the 2007 policy for a system of protected areas and a project proposal for the establishment and management of a biosphere reserve in the south-west.

The biodiversity strategy's goal is facilitating use of biological resources in a way that does not threaten biodiversity. Developed by an NGO at a time when legislative and policy background to biodiversity conservation was needed, this goal has not been included in current policy and laws. The 2007 policy states that the government position on an effective national system of protected areas is as a means for conservation of biodiversity of national and global importance particularly for diverse and extraordinary ecosystems. Biodiversity conservation in turn is expected to form the basis for sustainable development and secures the future viability of the nation. Law 202-04 in comparison with Law 64-00 better addresses *in situ* biodiversity conservation as a protected areas system goal. In Law 64-00, strengthening the national system of protected areas for biodiversity and landscape protection is a stated objective. However, this law's primary focus is on establishing and outlining the structure and function of protected areas management authorities, and promoting public participation in protected areas management, and control and regulatory support for protected areas. Law 202-04 is specifically concerned with biodiversity conservation as well as resultant ecological services and economic benefits. Article 1 of this law provides the over-arching goal "... to ensure conservation and preservation of representative samples of the different ecosystems and of natural heritage ..." (El Congreso Nacional 2004, p.1). Article 7 (El Congreso Nacional 2004, p.7) lists conservation objectives of biological, cultural and social relevance. The conservation objectives that relate to biodiversity are as follows:

1. Hold representative samples of natural ecosystems
2. Conserve biodiversity and genetic resources
3. Maintain ecological processes and enhance environmental services

4. Protect endemic wildlife and endangered species
5. Protect underground systems including water, ecosystems and Aboriginal sites.

Apart from the repetition of the conservation goal in the first objective, the objectives are very general and provide little guidance on expected conservation outcomes. They do however target genetic, species, ecosystem and ecological process levels of biodiversity on land and in freshwater as well as ecological services. High priority is placed on endemic and endangered species. Non-endemic or other native species seem only considered in the context of underground ecosystems. The other objectives of the national protected areas system are predominantly in the interest of human welfare: protection of watersheds and water resources; maintaining archaeological sites, monuments and colonial relics architectural; provision of opportunities for scientific research and monitoring environmental; promoting the maintenance of specific cultural attributes and the traditional knowledge of local populations; contributing to the environmental education of the population; provision of opportunities for recreation and tourism which serve as a natural basis for a tourist industry based on the principles of sustainable development; providing environmental services to current and future generations; provision of revenue-generating opportunities that are environmentally and ecologically sound.

Comprehensive scientific assessments of the Dominican Republic's biodiversity have been conducted by SEMARENA and by The Nature Conservancy – Dominican Republic Office (TNC – DR). Secretaría de Estado de Agricultura (1990) indicates that protected areas play a role in 1) providing habitat for species and 2) safeguarding some species from human impact. The Dominican Republic Ecoregional Planning Programme (DERP) – a TNC initiative – scientifically assessed the biodiversity of terrestrial, freshwater and marine environments. The results of the assessments are expected to fill information gaps hindering conservation planning and policy-making, and management of protected areas. The stated goals of the terrestrial and freshwater components of DERP point to the prioritization of conservation areas; ecological functionality as a feature of a national protected areas system; strategies for handling and use of biodiversity; and inter-agency coordination and collaboration for implementation of these strategies.

The terrestrial coarse filter, ecosystem-level conservation targets were derived from an overlay of natural vegetation classes of a recent land cover map with forty-four geoclimatic regions. The resultant conservation targets were over three hundred (300) vegetation formations currently distributed across the forty-four (44) geoclimatic regions (Keel 2006). The vegetation formations in each geoclimatic region were collectively treated as one conservation target so that forty-four (44) ecosystem targets were generated. The spatial extent of each ecosystem target was modelled for conservation goals of 10%, 20% and 30% of the vegetation extents derived from the geoclimatic regions. It was recognized in the DERP assessment that many plants and animals were included within the coarse filter targets. Nevertheless, it was felt there was a need for fine filter conservation targets that focused on rare or threatened species. Fine filter targets were selected by the representatives from the National Botanical Garden, Universidad Autonóma de Santo Domingo, and a consultant with the Moscoso Puello Foundation comprising thirty-seven (37) plant species and two hundred and six (206) animal species.

A goal of conserving 100% of these species was set for rare or threatened species with less than twenty known points of occurrence in the Dominican Republic.

Ecological aquatic systems (EAS) which are spatial units for the conservation of endemic, rare and common species are the selected freshwater coarse filter targets. The ecosystems of interest in EAS are springs, various-sized rivers, lakes, estuaries, and coastal lagoons. Individual species or groups of species form the fine filter targets, particularly fish and macro-invertebrate species that are endemic, threatened or declining in population. At the time of data collection for my field research, the quantitative goals for freshwater conservation targets were still being determined. In a draft updated report entitled "Caribbean Ecoregional Assessment: Dominican Republic" (Keel 2006), the uncertainty in establishing freshwater conservation goals is acknowledged and attributed to the enormous gaps in information on freshwater ecosystems and species. Additionally, it is noted that there is a general lack of natural history studies and studies on evolutionary and ecological processes that are critical to understanding biodiversity.

Law 202-04 appears to be guiding the conservation priorities and planning of some of the protected sites. The two study sites are said to be managed for representation of natural ecosystems. The draft 2005 management plan for the National Park of Sierra de Barohuco (SEMARENA 2005) states seven conservation objectives of which three directly address conserving unique karst formations typical of Hispaniolan mountains, pine and relict forest vegetation, and representative samples of optimum habitat for native and especially endemic birds as well as migratory species (Table 43). Emphasis is placed on the protection of endemic and threatened species. The importance of environmental

Table 43. Sampling of Biophysical Data and Information in Support of Dominicano Conservation Objectives

Biodiversity Conservation Objectives	Biophysical Data & Information	Sources of Data and Information
System Level		
1. Hold representative samples of natural ecosystems	TNC-DR distribution map of terrestrial conservation targets (shows islandwide distribution and overlaps in occurrence for 46 vegetation classes, plant and animal species); TNC-DR list of terrestrial conservation targets (including islandwide distribution in occurrence for endemic and other native insects and birds, mammals, amphibians and reptiles); TNC-DR distribution maps of rivers and other freshwater targets (shows islandwide distribution and overlaps in occurrence for springs, streams, lakes, wetlands and coastal lagoons); Distribution Map of Important Bird Areas for Dominican Republic; National Land Cover/Land Use Maps (1988 and 1998); Maps* of Geomorphologic Regions – OAS 1967, Ecological Zones 1965 – 67, Land Use and Cover 1996.	Draft Dominican Republic Ecoregional Assessment (DERP), TNC-JM; Birdlife International Online Database; *Atlas of Natural Resources of the Dominican Republic 1st Edition 2004.
2. Conserve biodiversity and genetic resources	Types of use of the land and human impact on natural resources. No biophysical data and information found on genetic resources.	2000 Natural Resources Management Strategy for South-western Dominican Republic

Biodiversity Conservation Objectives	Biophysical Data & Information	Sources of Data and Information
System Level		
3. Maintain ecological processes and enhance environmental services	Map of productive zones of surface waters*	*Atlas of Natural Resources of the Dominican Republic 1st Ed. 2004; SEMARENA protected areas inventory
4. Protect endemic wildlife and endangered species	Lists of reptilian, amphibian and bird species of Hispaniola; Scientific papers on ecology and conservation of threatened forests and on avifauna.	Project reports of the Ornithological Society of Hispaniola (SOH); Citations for journal publications in Draft Ecoregional Assessment Report; Citations for journal publications and field studies, and names of field researchers in *Biodiversity of the Dominican Republic*, also in UNEP-WCMC species online database; IUCN Red Data list online database;
5. Protect underground systems including water, ecosystems and Aboriginal sites	Geomorphologic Regions – OAS 1967*; Mosaic of images Landsat TM NASA 1987 – 1993*	*Atlas of Natural Resources of the Dominican Republic 1st Ed. 2004

Biodiversity Conservation Objectives	**Biophysical Data & Information**	**Sources of Data and Information**
Site Level – Sierra de Bahoruco		
1. Conserve unique karst formations typical of Hispaniolan mountains	Management plan for Sierra de Bahoruco; Journal paper on protected karst areas (Kueny and Day 1998)	
2. Protect pine and relict forest vegetation of Western Bahoruco that harbour an old and very threatened flora	Anthropogenic change in subtropical dry forest (Roth 1999) Land Cover; and Zonation maps; Inventory and studies by National Botanical Gardens;	*Journal of Biogeography* 1986 Management Plan provided citations for published results of plantand animal surveys and studies; SEMARENA
3. Ensure representative samples of optimum habitat for native and migratory species of birds especially endemic species	Project report on ecology and threatened avifauna of Hispaniola; Bird survey data; Journal paper:Winter bird communities along 4 habitats in an elevation gradient on Hispaniola; other papers on specific species or groups.	Ornithological Society of Hispaniola project *Condor*; other journals including the Journal of Caribbean Ornithology; Field guide to the birds of Hispaniola
4. Preserve ecosystems inhabited by endemic mammals	Short Guide to the Bats of the Northern Lesser Antilles; Monitoring of species threat status through IUCN Red Data Lists	IUCN Red Data list online database;
5. Preserve habitat for the herpetofauna both endemic and other native species	Journal papers on the status of *Cyclura* Iguanas Complete species list of reptiles and amphibians of Hispaniola	e.g. *Journal of Zoo & Wildlife Medicine*
6. To facilitate appreciation and public use of representative samples of the ecosystems in Sierra de Bahoruco	2000 Natural Resources Management Strategy for South-Western Dominican Republic	SEMARENA
7. Ensure continuity of the scarce surface waters of the Western Bahoruco, as well as the ground water resources.	TNC-DR distribution maps of rivers and other freshwater targets	

services is reflected in an objective that promotes public use and value of the park's ecosystems and in another objective that aims to guarantee continual surface and ground water resources. Although ground water resources form part of underground systems, no other underground ecosystems (e.g. caves) are recognized. Obvious gaps in the list of objectives are with reference to genetic resources and ecological processes.

A management plan had not been drafted for LCWR during the field research period of my study. However, through personal communication with GET members it was apparent that major conservation objectives were to protect the habitats of the LCWR, a designated Important Bird Area, and promote ecotourism based on birdwatching as a social benefit. In general, while there is recognition of specific plant and other animal groups as important to biodiversity conservation, they have not as yet been incorporated into the planning for the lagoon.

In addition to the individual conservation objectives for protected sites aligning themselves with national conservation law, there is also a seeming orientation of objectives towards the regional Jaragua-Bahoruco-Enriquillo Biosphere Reserve. The biosphere reserve seeks to protect major ecosystems located mainly in core zones, and to reduce the human impact on these ecosystems but at the same time facilitate sustainable use activities outside the core zones. The creation of the Jaragua-Bahoruco-Enriquillo Biosphere Reserve is a clear indication of the commitment of the Dominicano government to the merging of conservation and development goals.

Biophysical Data and Information Extraction

A total of five conservation objectives for protected areas systems management and seven objectives for national park management for Sierra de Bahoruco have been collated in column 1 of Table 43. This table presents some key data and information needed, in my opinion, for protected areas policy makers, planners, and managers to address their stated conservation objectives. It is intended to be a sampling of and not a comprehensive listing of data/information and their sources applicable to the biodiversity conservation objectives. The emphasis is on composite data and information which is already in a more user-friendly format for the target audience than baseline data and information. To avoid extremely long lists of literature references in the 'Sources' column, I used several secondary sources of information accompanied by a note on the primary sources that they cite.

I located useful biophysical data and information in support of most of the objectives except for system objective #2 (genetic resources) and site objective # 7 (ground waters). What was noticeable is that of the data and information reviewed or brought to my attention in this research, the local universities did not have any projects of their own. Faculty members, however, sometimes were utilized as resource persons on projects implemented thought SEMARENA. Overall there is a general lack of local scholarly writing on biodiversity conservation and protected areas. Journal publications on these topics are often the work of overseas universities or conservation institutions. A visit to the office of the Ornithological Society of Hispaniola (HOS) revealed that as an NGO they were effective in attracting overseas funding for biodiversity research projects.

However, the field data were usually sent to overseas organizations for analysis because of a lack of confidence in local expertise to handle the datasets. I asked if the projects selected by HOS were aligned with national biodiversity conservation needs. The response indicated that while this may occur in some instances, the dominant factor was the conservation interest of HOS which extended to beyond just birds and included the natural history of Hispaniola.

Both baseline and applied levels of data and information are represented in Table 43 with an apparent need for greater baseline studies. Basic biological and ecological studies and surveys have primarily contributed to the understanding of occurrence, distribution and abundance of species and ecosystems. Important biophysical data including surface area and boundaries of protected areas and topographical features (e.g. river networks, hills and valleys, vegetation cover, land use) are included in inventories and databases of SEMARENA and TNC-DR. An interesting knowledge gap seemed to be publications on the biogeography of Hispaniola. Woods and Sergile (2001) selectively discussed some aspects of Haitian biogeography but little to nothing was said about the Dominican Republic.

The online databases of the United Nations Environment Programme – World Conservation Monitoring Centre (UNEP-WCMC) partnership, IUCN and Birdlife International provide a standardized, scientific and internationally accepted way of accessing species taxonomy; species and habitat distribution and status; threat level criteria and ranking and threats to species and ecosystems; and ecosystem distribution, along with information references where available. Other general tendencies in the biophysical data and information are the greater level of detailed information for animals compared to plants, with a greater knowledge base for vertebrates than invertebrates. Another limitation obvious in the UNEP-WCMC online database that provides ecosystems classification and maps at global and regional scale is that these scales hide the heterogeneity of island landscapes. The most useful ecosystem maps were those produced on a national scale such as the land cover/land use maps of the Forestry Department, TNC-JM. Data and information on genetic diversity was the least and most difficult to find.

In briefly commenting on the conservation objectives and the utility of the supporting data and information a first observation is the seemingly greater data and information availability for system level objectives 1 and 4, and site level objective 3. Various datasets and information exist and were easier to find for the system objective on conserving representative samples of natural ecosystems, avifauna, endemic and endangered species. Generally, the other objectives have fewer datasets with which they can be associated. The objectives concerning resource use and ecological services seem to have few datasets that will allow a comprehensive or detailed assessment of human exploitation of and impact on biodiversity in protected areas. The distribution and occurrence of islandwide biodiversity for select ecosystems and taxa can be updated through GIS technology utilized at SEMARENA and TNC-DR. Concentrations of terrestrial (including freshwater) biodiversity can be revealed by using GIS to overlay distribution maps for various species and ecosystems. The IBA Programme is an asset to protected areas management with 11 protected areas being designated IBAs and contributing to the IBA list for the Dominican Republic.

Overall the national park objectives contribute to the national protected areas system objectives but lack an explicit focus on genetic diversity and its conservation, protection of ecological processes, and underground ecosystems. Most of the site-specific objectives and associated data and information are oriented toward ecosystem representation and habitat protection. The 2007 policy for the national system of protected areas, in the section on Management Categories, states that technical assessments of natural/cultural resources and socio-economic characteristics have materialized for only 18 (21%) of the 86 protected areas in the system. The policy makes the important point that lack of biological and socio-economic information has hampered objective determination of what IUCN categories are applicable to a protected site.

Expert Input

The majority of the sixty-three statements generated by the survey did not differentiate between goals and objectives (Appendix I). Consequently, the statements are all treated as goals. They include a mix of proposed intentions for wildlife and human conservation targets as well as desired institutional and governance capacities. In fact the latter predominate indicating that most of the experts have not separated biodiversity conservation goals from wider management-related goals in their minds. Of the seven statements that I consider most relevant as conservation goals, only plant species are addressed through "Reforestation with native and endemic species." Animals, various ecosystems, and the genetic levels of biodiversity are not reflected in these statements. The focus is definitely on reducing human threats, whether these threats are in the form of deforestation, pesticide/herbicide pollution, sources of fires, or hunting and collection of species. The following themes emerged from the statements:

- Control of human threats
- Enforcement and enforcement staff
- Financing
- Community involvement
- Scientific research and inventory
- Education and public outreach
- Management plans
- Policy and legislation
- Logistic support
- Role of the state

The most dominant theme in terms of number of statements was education and public outreach.

Community Input

A discussion of the variety of living organisms, their significance and reasons for their protection produced very general conservation goals across all five community groups. All of the communities indicated that conservation efforts should target plant and animal species. In particular, endemic, endangered species useful to humans, and aesthetically appealing species should be given priority. There was no acknowledgement of genetic diversity conservation and only the Cristobal community hinted at the presence of systems and relationships as a part of biodiversity. However, a farmer from Sierra de Bahoruco made a specific reference to the inter-relations between a species of cactus and honey bees. That particular cactus apparently enabled the bees to provide a more tasty, higher quality honey which was sold at higher market value by farmers. Although the conservation of habitat for species survival was mentioned at the Cristobal workshop, none of the community groups seemed to appreciate the variety of ecosystems in south-western Dominican Republic as a component of variety. Consequently, not even one type of ecosystem e.g. forest or mangrove, was named as important to biodiversity conservation.

5.3 Biodiversity Conservation Outcomes for the Dominican Republic

The scarcity of biodiversity conservation outcomes in both academic and technical literature on the *in situ* conservation in the Dominican Republic was profound. Consequently, intended outcomes were obtained mainly from expert and community groups. They indicate the end results that are expected by implementers of, and participants in, protected areas management such as conservation planners and site managers and staff, as well as affected community groups. The actual outcomes which indicate what has really been achieved at an island landscape level are obtained mainly from technical literature and expert and community opinion. Note is made of how the conservation objectives that were achieved on-the-ground compare with those that were intended.

Literature Review and Content Analysis

Two desired outcomes for biodiversity conservation in a protected areas system are prominent in the reviewed academic literature. One outcome is the reduction of deforestation and the other is outdoor recreational opportunities and ecotourism-related livelihoods. Eyre (1998) and Kueny and Day (1998) indicate that maintenance of 1) forest cover, and 2) the habitats of endemic and endangered species, are a major achievement of a protected area system. The apparent expectation is that designation of 'protected' status will be accompanied by active and enforced regulation of human activity in order to reduce negative impacts on forested areas. Consequently, reduced deforestation is an assumed outcome of increased protected areas coverage. The second outcome is usually mentioned with reference to proposed national parks or to the existing national park.

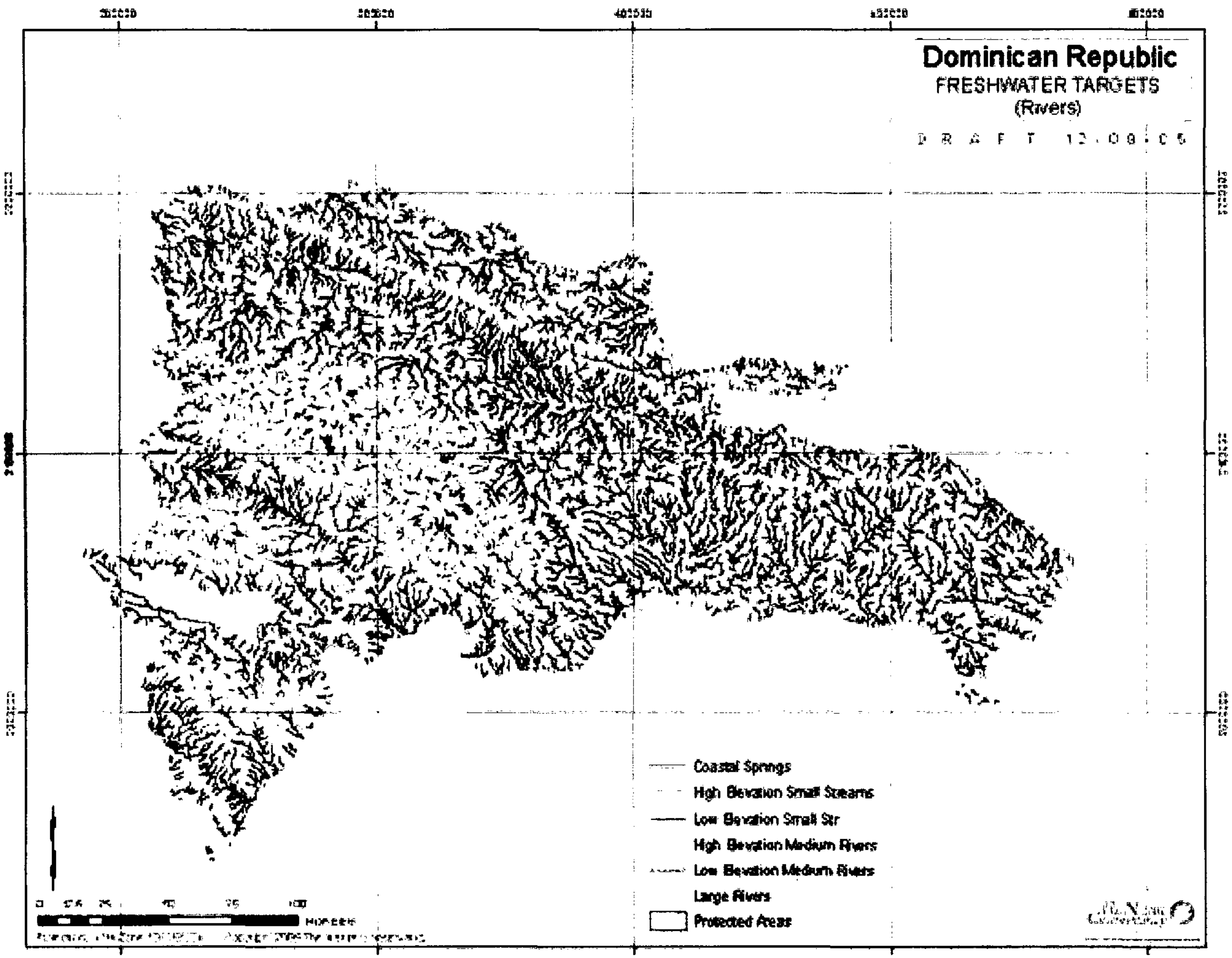
Schelhas et al. (2002) through a case study based on Armando Bermudez National Park explored benefits and constraints as a result of the relationships between local community and park development. They support the school of thought that sees strict protection as delivering benefits to only the natural ecosystems whereas conservation that is integrated with development benefits both the natural environment and humans. The social benefits recognized by community residents are protection of watersheds and the provision of high quality water in amounts to support dependent communities and ecotourism opportunities affiliated with hiking to the Pico Duarte Peak and along trails. The 2007 protected areas policy names major constraints in the protected area system especially the common problem of the increasing advance of agriculture into protected area borders, burning of vegetation, illegal shooting and fishing, and extraction of sand.

Biophysical Data and Information Extraction

The information provided by TNC-DR during my fieldwork for the freshwater component seemed to be in preliminary stages, focused on the distribution of various ecosystem conservation targets and of levels of human activity. Using the available map data for freshwater ecosystem conservation targets I make inferences about their protected areas coverage. No map data was provided for freshwater species conservation targets. The terrestrial component of the DERP report has more detailed data and information that allows for landscape-level discussion. Consequently, the distribution, the status and protected areas coverage of land-specific conservation targets are dominant in this section on actual terrestrial conservation outcomes. The conservation of freshwater ecosystems (i.e. streams/rivers, estuaries, lakes, wetlands, coastal springs, coastal lagoons) will be discussed with reference to the DERP map for freshwater targets (Figure 13). In spite of the system level conservation objective to conserve underground systems, freshwater caves are absent from this data.

Also noticeable is that the entire island is permeated by a dense hydrologic network which covers both low and high altitudes. The periphery of the Dominican Republic is interspersed with numerous coastal springs some of which fall within the protected areas system. A total of six large rivers are distributed along the cardinal regions of the country, with sections of four of these rivers falling within protected areas. The high elevation small and medium rivers occupy the western and south-western Dominican Republic. From the map, most of these high altitude hydrologic systems are covered by the protected areas of the Cordillera Central, Sierras de Neiba and de Bahoruco, and Jaragua National Park.

Figure 13. Dominican Republic Ecoregional Plan (DERP): Freshwater Targets (Rivers)

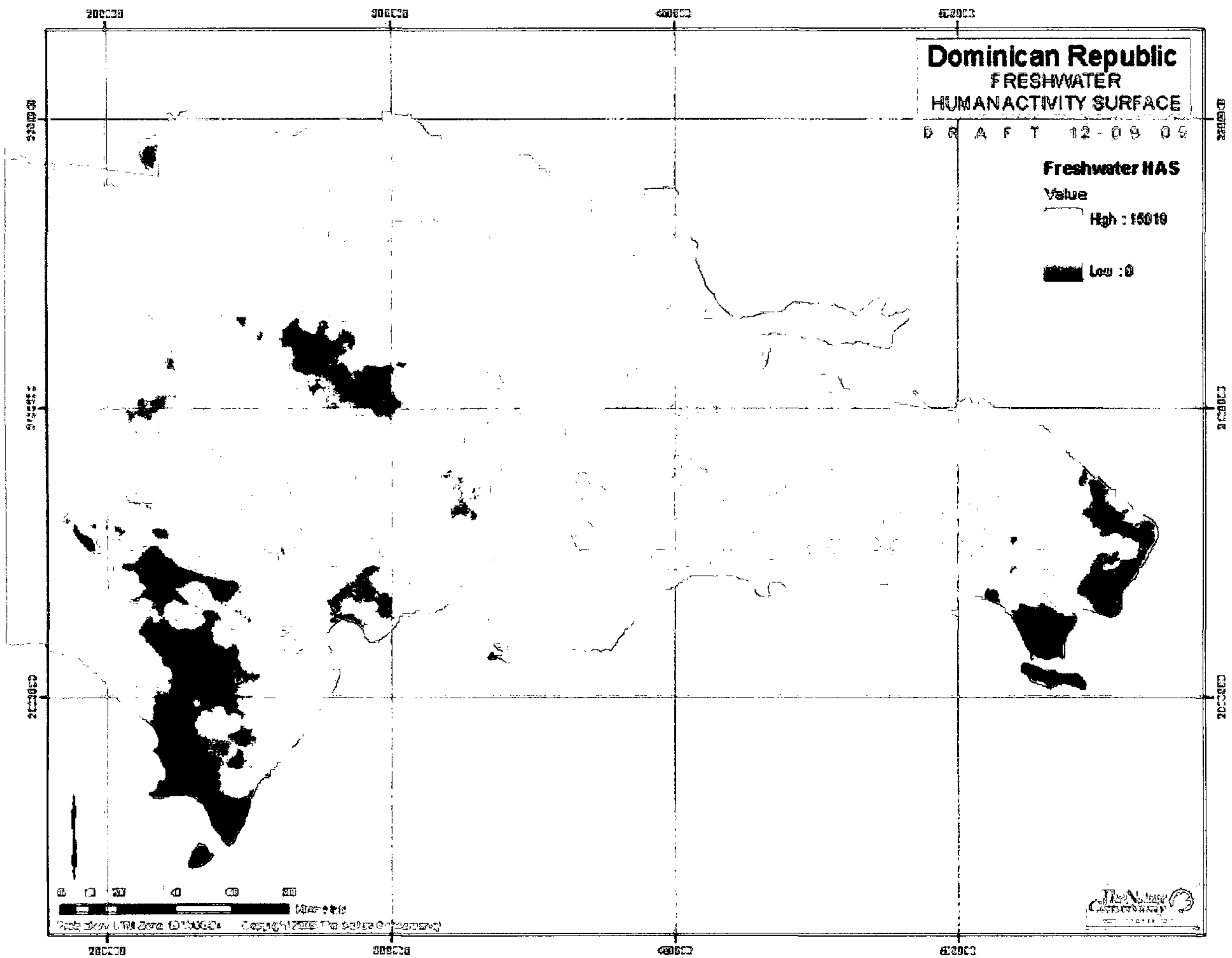


Note: From The Nature Conservancy 2005

In contrast, much of the country's low-altitude hydrologic network falls outside the protected areas system. Furthermore, the low-altitude rivers particularly those covering the north-central, central and south-central sections of the country coincide with areas of the highest human activity affecting freshwaters (Figure 14). Most of the other freshwater bodies are included in the protected areas system. A minimal number of estuaries and lowland wetlands are unprotected. The south-western end of the country stands out with the only 2 substantial lakes of the Dominican Republic as well as examples of each of the different freshwater conservation targets. The southwest has also distinguished itself in terms of the number of protected areas and the spatial extent of these areas.

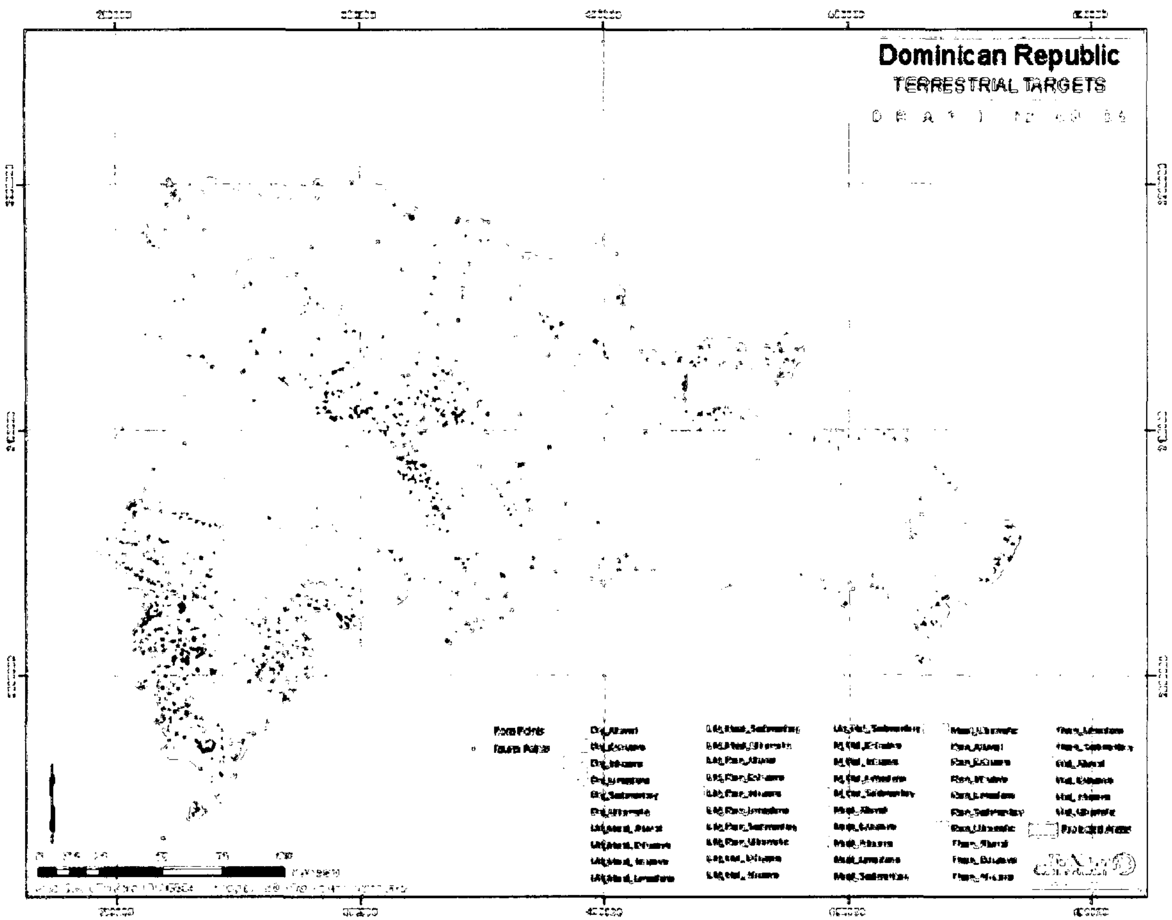
Turning our attention to the land-based conservation targets for the Dominican Republic, Figure 15 presents an overlay of natural land cover with the occurrences of rare and threatened species. This map overlay allows an interpretation of the relative distribution of ecosystem and species conservation targets that must be considered in achieving representation of biodiversity. Land cover is presented as 46 vegetation classes which correspond with the ecosystem targets. The coloured points on the map indicate multiple localities for 37 species of flowering plants and 206 animal species which include 19 amphibian species, 30 bird species, 19 mammal species, 45 butterfly species, 31 mollusk species, and 51 species and 11 subspecies/varieties of reptiles (Keel 2006). According to the ecoregional terrestrial assessment report (Keel 2006), only 14 of the ecosystem targets are currently in the protected areas system (Table 44). Open coniferous forest and rainforest are the better represented of the ecosystems with 86% and 71% coverage respectively. Very low protected areas coverage has been

Figure 14. Dominican Republic Ecoregional Plan (DERP): Freshwater Human Activity Surface



Note: From The Nature Conservancy 2005

Figure 15. Dominican Republic Ecoregional Plan (DERP): Terrestrial Targets



Note: From The Nature Conservancy 2005

achieved for remnant Matorral Latifoliado [Broadleaf scrub] (9%) and Dry Forest (16%).

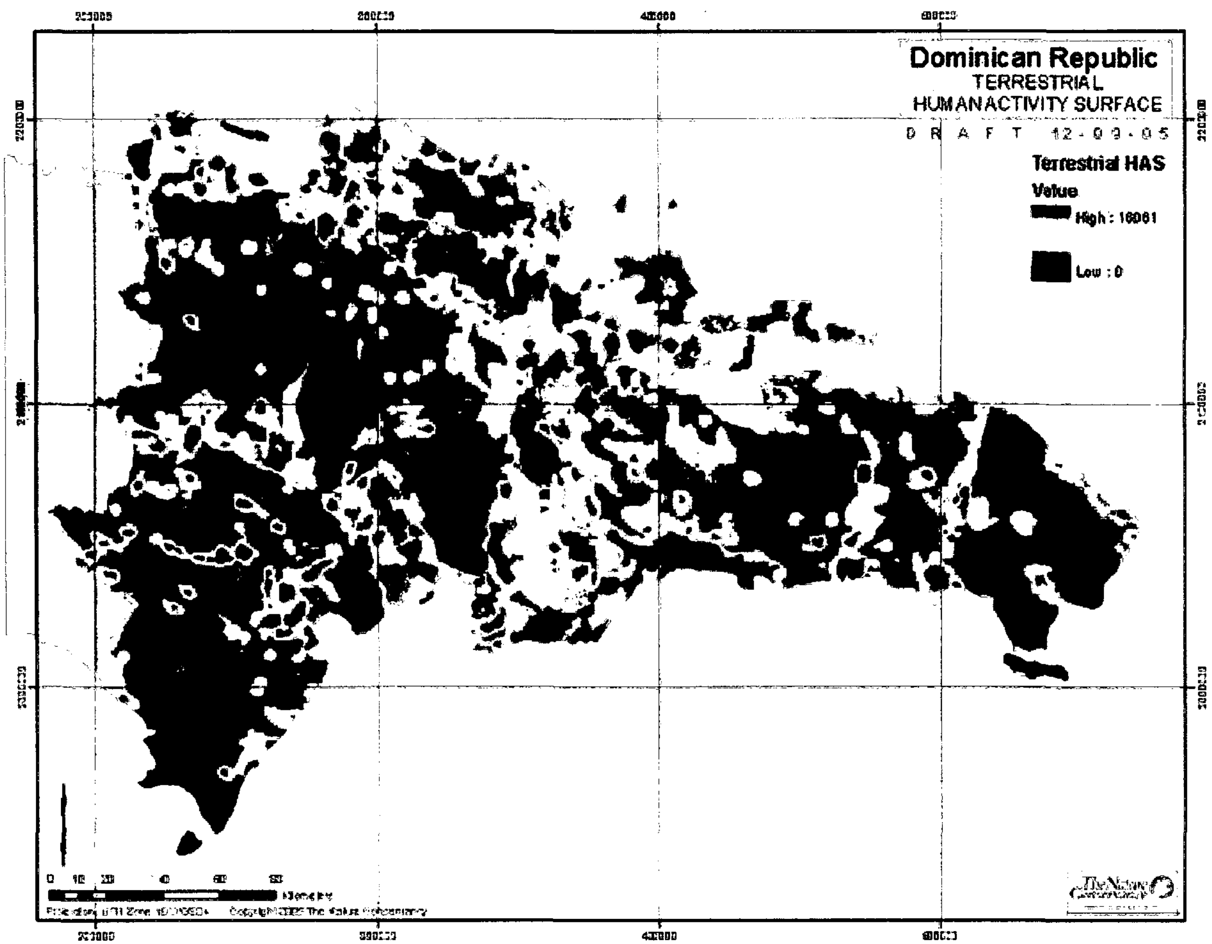
Table 44. Current Vegetation Classes in the Dominicano Protected Areas System

Vegetation Class	Total areas in DR (ha)	Areas included in the protected area system	% of vegetation class in the protected area system
Bosque Conifera Abierto	33148.68	28552.87	86.14
Bosque Conifera Denso	253915.72	157623.39	62.08
Bosque Latifoliado Humedo	483113.33	97018.33	20.08
Bosque Latifoliado Nublado	210650.91	71752.75	34.06
Bosque Latifoliado Semi Humedo	196407.79	43254.66	22.02
Bosque Seco	437647.72	70660.01	16.15
Bosque de Humedales de Agua Dulce (drago)	5584.99	3983.10	71.32
Eneal	92.34	60.01	64.99
Encasa Vegetacion	49204.62	13376.18	27.18
Mangles	28616.69	18880.99	65.98
Matorral Latifoliado	185460.54	16919.87	9.12
Matorral Seco	561562.41	75310.08	13.41
Sabana de Humedales Salobres	8195.64	2860.84	34.91
Sabana de Humedales de Agua Dulce	1274.14	134.66	10.57

Note: From Keel 2006

The largest continuous expanses of forest are located on the western end of the island occurring primarily within the Armando Bermudez, José del Carmen Ramirez and Sierra de Bahoruco National Parks. The forest expanses of at least four different ecosystems include limestone moist and rain forests, and to a lesser extent dry forests. Habitat fragmentation is apparently typical of the Dominicano landscape even for the larger protected areas. Outside of the protected areas the degree of habitat fragmentation of natural vegetation is so extreme that it takes on a speckled appearance. The highest levels of habitat fragmentation are likely to occur in the northern and central parts of the Dominican Republic where human activity is greatest (Figure 16). Sierra de Bahoruco and Valle Nuevo National Parks seem to harbour more animal species conservation targets than other protected areas.

Figure 16. Dominican Republic Ecoregional Plan (DERP): Terrestrial Human Activity Surface



Note: From The Nature Conservancy 2005

The 2000 Natural Resources Management Strategy for the South-western Dominican Republic refers to the South-west as a centre of endemism, comprising a hypersaline lake, the largest freshwater body, mangrove wetlands and three main forest categories, namely dry forests, evergreen broadleaf forests and pine forests. The south-west not only harbours the largest expanse of primary forests in the country but in the Sierra de Bahoruco has the best representation of pine forests for the country and a large portion of the dry forest, most of which is closed forest. A peculiarity is the vegetation of an exposed southern slope on Sierra de Neiba which is poorly developed due to excessive exposure to the sun, poor soil cover and the steepness of the slope. Shifting agriculture is a major landscape feature, occupying over about 25% of the surface area on Sierra de Bahoruco and about 40% on the Sierra de Neiba. The 2000 Strategy notes the minimal presence of monocultures and credits the removal of dry forest on both sierras to shifting agriculture which involves tree felling and burning, as well as livestock breeding. The problem is said to become more pronounced as one approaches the Haitian border where the activities of the Dominicano farmers are augmented by the employment of Haitian farmers. The southern end of the region shows the impact of such land use in its degraded secondary forests.

In a gap analysis for the Dominican Republic, the TNC-DR assessment found that of the 37 proposed plant species targets and 206 faunal species targets 11 plant species and 21 animal species are not included in the present protected area system. Nevertheless, a considerably larger proportion of plant conservation targets than animal targets are outside of the protected areas system and need greater conservation attention. A limitation of both the conservation targets map and the species listing, is that although endemic species are included in the rare and threatened conservation targets they are not explicitly marked to allow an appreciation of how well endemic species are being protected. La Placa in the Sierra de Bahoruco provides important habitat for the vulnerable Hispaniolan Parrot (*Amazona ventralis*), the Endangered Bay-breasted Cuckoo (*Hyetornis rufigularis*) and a population of Critically Endangered Solenodon (*Solenodon poradoxus*) (Brocca 2007). These species are IUCN Red Listed indicating threat levels of conservation concern. The 2000 Natural Resources Management Strategy for the South-western Dominican Republic states that current inventorying of species numbers is inadequate especially since species new to science are still be reported and collected from the south-west. Newly reported species include endemic as well as other native species.

Expert Input

Question 5 on the survey questionnaire asked participants to consider the theoretically-derived evaluation criteria for assessing biophysical outcomes, associated inputs and outcomes and to indicate:

4) What other criteria should be added

5) Which ones they thought were of greatest importance

6) Reasons for their choices

The responses are presented in Appendix I. For ease of interpretation I have extracted the frequencies for the biophysical outcomes in Table 45 below.

Table 45. Selection Frequency for Theoretically-Derived Conservation Outcomes

Criteria	Frequency (%)
System threats	68
Level of deforestation	64
Conservation strategy	45
Control of invasive species	45
Congruence	45
Biological representation	45
Population pressure	41
Species indices: endemism, richness, co-adaptation	36
Ecosystem complementarity	32
Disturbances	23
Biological targets for direct and indirect consumption	14
Biological targets for non-consumptive use	9
Population redundacy	9
Land cover	4

No new criteria were added. The outcomes that were selected as most important, namely system threats and levels of deforestation, indicated that threat reduction is an important indicator of effective biodiversity conservation. The control of invasive species, another outcome concerning threat reduction, was considered to be of lesser importance. In spite of the strong planning orientation towards biological representation, this placed only moderately high in the survey results. Criteria considered to be of least importance were those concerning targeted consumption of biological resources, population redundancy for species with disjunct populations and land cover. These findings suggest a lack of recognition of setting limits for resource use as a critical part of sustainable resource use within protected areas. In light of the high frequency given to the deforestation it is curious that land cover scored so poorly.

Community Input

Notably answers to the workshop question on what would have to be seen or experienced to satisfy on protected area management were dominated by comments on the administrative and institutional aspects of management. Of the five communities, two addressed conservation outcomes for human targets only. Missing from all workshop responses were conservation outcomes for ecosystem, plant and animal conservation targets. The greater interest was in community benefits from conservation. The most specific reference, after struggling with the question, came from the El Penon workshop. They saw direct benefits coming to the community from ecotourism and sustainable development projects. However, their understanding of ecotourism was incorrect, as they felt it involved attracting large numbers of people to the protected area and accommodating these people in hotels.

5.4 Implementation of Management Institutions and Governance in the Dominican Republic

Literature Review and Content Analysis

My searches for scholarly or experiential publications on *in situ* biodiversity conservation by academics or conservation practitioners in the Dominican Republic were unsuccessful. However, key institutional and governance factors contributing to effective biodiversity conservation were identified in Law 202- 04, the 1994 Strategy on Biodiversity Conservation and the 2007 Policy for a National System of Protected Areas. Dialogue with SEMARENA officers and protected areas managers indicated that Law 202-04 is utilized as a framework for biodiversity conservation. A comparison of the background to biodiversity conservation in the 1994 Strategy and 2007 Policy allowed a pre- and post-Law 202-04 analysis of biodiversity conservation. Based on this analysis, successful implementation of Law 202-04 seems mainly associated with:

- correct application of the IUCN system of protected areas categories
- prioritization of biological criteria in determining protected areas categories
- overcoming financial obstacles
- minimizing conflict between legal facilitation of both biodiversity conservation and use

The discussion below elaborates on how each of these issues affects the fulfillment of conservation goals and objectives for the protected areas system.

One of the observations of the conservation strategy is that protected areas have traditionally been established in an *ad hoc* manner. The eventual adoption of the IUCN management categories is obviously an attempt to declare and manage protected areas in a systematic manner. However, the 2007 policy reveals that in Law 202-04 some of the definitions for the 86 protected areas are inaccurate because of confusion in the legislation about: a) definitions of categories, b) definitions of protected areas boundaries, and c) differentiation between terrestrial and marine areas. Articles 13 and 14 of Law 202-04 present two non-corresponding classifications of protected areas using the IUCN management categories. Article 13 lists six IUCN categories with sub-categories that include traditional protected areas such as national parks, forest reserves and recreational areas. Article 14 defines the management objectives for five categories, excluding the IUCN category "Natural Monuments" and introducing a category called Specially Protected Areas which seems to be a substitute for the ICUN category "Species/Habitat

Management Area". This situation sets the stage for "fuzzy" conservation goal-setting. So it comes as no surprise that the 2007 policy highlights the lack of clearly documented management objectives for many of the protected areas.

A significant limiting factor in the appropriate application of the IUCN categories is the minimal technical research supporting assignment of the categories. The government's position is that decisions on management category for an area should correspond to its intrinsic features, capacities and potential uses as determined by relevant biological and socio-economic studies. The 2007 policy points out only 21% of the total number of protected areas have had such studies done. While the importance of biological and socio-economic studies is stressed, in the policy there is no hint of biological criteria influencing the design of a protected areas system. The urging of the 1994 conservation strategy to select representative samples of ecosystems and assign categories based on biogeographical factors seems to have been ignored. The implication of limited data for representative sampling of ecosystems is inevitable difficulty in determining how most individual protected sites contribute to the coverage of the forty four ecosystem targets in the protected areas system. Furthermore, an apparent gap in the biological information for protected areas planning is that which deals with ecological connectivity between protected areas. Although Ecological Corridors is one of the sub-categories of the protected areas system no such category has been declared and it is likely that the lack of information on ecological connectivity is an influencing factor.

Conservation planning would benefit not only from greater utilization of biological information but from the integration of such with socio-economic information. Then, most likely, there would be no more repeated instances of the same area being declared by two different sectors for non-compatible use, such as agriculture and national park or mining and national park (Grupo Jaragua 1995). In addition to the planning stages, Article 20 of Law 202-04 which requires accounting for both conservation and the use of areas for tourism development and ecotourism, indicates the potential use of integrated information for operational monitoring of protected areas. Apart from the Biodiversity Conservation Strategy suggesting assessment of forest cover as a priority indicator for the degree of threat to or protection of biodiversity and calling for long-term and more in-depth inventorying, monitoring and assessments of biodiversity, little else is documented about either biological or socio-economic indicators for monitoring biodiversity conservation.

The financing of the protected areas system is especially important since it determines the level of human and technical resources. Law 202-04, Article 29 makes provision for a multi-pronged financing mechanism including government funds, donations, debt-for-nature swaps, in-kind payment by environmental services, and funds generated by protected areas. The government seems to have changed its reliance on international funding for specific projects or programs for a limited time to national budgeting for conservation. The 1994 biodiversity conservation strategy explains that overseas funders such as World Wildlife Fund, European Union, McArthur and Ford Foundations have been instrumental in providing funding opportunities. However, projects have limited time frames that do not ensure financial sustainability for the protected areas system. The 2007 policy focuses on national budgeting for conservation as a means of achieving financial sustainability. This strategy, however, has not been aided by the approximately 90% allotment of the national budget to salaries only. The returns from ecotourism and tourism developments in the protected areas, although legislated to support system development, have not mitigated the high overhead cost of having skilled officers and technicians, park rangers, and providing adequate infrastructure (SEMARENA 2007). Only thirty-four of the eight-six protected areas are staffed with various levels of staffing in terms of quality and numbers.

Inevitably, there will be conflicts between illegal users of protected areas and conservation practitioners. However, legalized use of protected areas that is not in harmony with their conservation programmes can also seriously threaten effective biodiversity conservation. The specific reference to tourism in Law 202-04, Article 20 suggests that this is expected to be a major resource use for protected areas. However, both legal and illegal subsistence use of biodiversity in protected areas have been significant challenges. An example of legal use of biodiversity is the adjustment of the boundary for Sierra de Bahoruco to apparently facilitate the "Dry Forest Capitalization Areas" zoning. Effective enforcement of regulations concerning natural resource use is of grave concern in light of increasing slash and burn farming in the Sierra de Barohuco National Park, and the lack of supervision observed for wood collection and tree cutting in the Dry Forest Capitalization zone (see Brocca 2007). The 2007 policy for protected areas systems indicates that defence of protected borders are hampered by:

- inadequate number of park rangers and ranger stations per km^2
- insufficient logistical support such as the number of portable radios.
- low salary for park rangers.

Additionally, the influx of Haitian loggers into Sierra de Bahoruco has not relieved the minimal patrolling problem. Recalling the protected areas system objectives of ecosystem representation, protection of endemic and threatened wildlife and maintenance of ecological services the setting of protected areas' boundaries and their defence requires a major investment of human, technical and financial resources for effective conservation.

Development interests and activities won over conservation actions when rather than using the distribution and occurrence of the threatened species as references for setting park boundaries, the Puerto Escondido-Aguacate highway was used to delimit the park. The result was the removal of La Placa from within the park's border and its designation along with other lands north of the highway as "Dry Forest Capitalization Areas" zone. This means that authorization is given to cut dry trees for sale for posts, rods, etc. In creating access roads for trucks however, the loggers go further and cut live trees. An NGO, the Hispaniolan Ornithological Society, recommended a stop to the harvesting of dry wood and have been in consultation about revision to the boundary of Sierra de Bahoruco National Park. Their hope is that La Placa will be again included in the park and that negative impacts on the IUCN Red Listed bird and mammal species will be alleviated (Brocca 2007).

Expert Input into Institutional Issues

Some senior officers at SEMARENA and management personnel affiliated with the study sites opted for interviews over participation in the survey. Their interview responses discussed below provided insight on the institutional orientation and structure of the protected areas system, and on boundary and funding issues relevant to protected areas management.

The difference in management style of the current government agency (Subsecretaria de Areas Protegidas y Biodiversidad), compared to past agencies, is its holistic approach to protected areas management. Not only were ecological aspects considered but socio-economic considerations are now factored into the planning processes. Many of the socio-economic aspects are focused on how local communities can participate in management and benefit from the protected areas. In addition to the declaration of protected areas on government lands, protected areas may be declared by government on privately-owned lands at the request of the land owner. The history of protected areas establishment has evolved from unilateral decrees of dictator presidents such as Rafael Trujillo who ruled from 1930-1961 and Balaguer from 1966-1978 and 1986-1990, to a single central government office for protected areas and biodiversity management that works in collaboration with other central government agencies, municipal government and NGO managers of protected areas.

One of the newer policies of the government is to use scientific knowledge in the demarcation of protected areas boundaries. Formerly, the tendency was for boundaries to be set on non-scientific or political interests which did not require any assessment of the biodiversity of the area. Having acquired some scientific expertise within government, the quality of the expertise has sometimes proven questionable, e.g. based on experience with generating protected area boundaries as described in Law 202-64. One of the points for Jaragua National Park was incorrectly entered in their GIS resulting in a boundary point located in Venezuela. Assistance was provided by TNC-DR in remedying the faux pas. With regards to civil society, it is thought that protected areas boundaries need to be made more visible so that the spatial limits to activities are clear.

The Protected Areas and Biodiversity Vice-Ministry claim success with two initiatives: (a) improved economic income of local communities, and (b) part of the taxes or visitor fees collected from tourists must be invested in protected areas and local communities. The key to these alleged successes is a formal collaborative agreement between the Ministry of Tourism and SEMARENA for the development of ecotourism in the national protected areas system. In discussion, it was pointed out that local communities such as those in Salta del Limon in Samana and Twenty-seven (27) Charcos and Rio Damajagua in Puerto Plata were accessing the ecotourism market. Community residents provided accommodation, transportation and tour services to tourists. According to the environment ministry, whole families have been able to substitute their agricultural livelihoods with ecotourism and as a result there have been fewer negative agricultural activities. No specific agricultural activity was identified although it seemed that there was less clearing of land. A social repercussion is the migration of other rural residents into or close by the protected areas offering ecotourism opportunities.

The involvement of the tourism ministry in protected areas management has also increased the struggle to protect the intrinsic values associated with biodiversity while facilitating contributions to human welfare. Different persons who fall into this research's category of "protected areas expert" acknowledged that there is a controversial relationship between the environmental and tourism ministries particularly over the changing of protected areas boundaries in the biodiverse south-west region in order to accommodate tourism development. These changes to boundaries often reduce the area of a protected site. The boundary issues coupled with increasing human presence in protected areas threaten the sustainability of the protected areas system. Resolution of this dilemma seems confounded by the Ministry of Tourism's participation in the co-management of the protected areas system.

Co-management as described to me by officers in the protected areas and Biodiversity Vice-Ministry is a collective agreement between management-related and community stakeholders to participate in the responsibilities and decisions of protected areas management. Co-management councils are established for protected areas (thirteen protected areas had co-management up to 2007) and these councils may comprise central and municipal governments, environmental NGOs, community-based organizations or any institution that may make a relevant contribution to the management of a protected area. Further discussion revealed the rationale behind the deliberate omission of a definition for co-management in Laws 64-00 and the 2007 policy as well as Law 202-04's position where the form of co-management is left to the discretion of the administering authority. Upon enquiry, it was also discovered that co-management was not defined either in management plans. With the variation in stakeholders and local contexts across the protected areas system, it was decided not to have a single model for co-management or a strict definition in guidelines for the preparation of a management plan. In this author's opinion this leaves co-management wide open to a variety of interpretations and makes it exceedingly difficult to monitor in a standardized way.

Conversation with a protected areas manager highlighted some flaws in the co-management process as implemented in the protected areas system of the Dominican Republic. Whereas managing NGO's are involved in the joint preparation of a management plan for a protected area, operational plans were prepared annually by the Protected Areas and Biodiversity Vice-Ministry. Problems with the co-management arrangements include vertical decision-making or a top-down approach by the government, leaving NGO's with little authority in decision-making. An example that was provided was the hiring and firing of rangers by SEMARENA without consultation with the co-managing NGO. The NGO felt that the loss of the rangers was a disadvantage because training had been invested in these rangers and new rangers would have to be trained before they could function effectively in the reserve. Another challenge was the inconsistent production of an operational plan by the Vice-Ministry. Even after discussions about the plan had started in 2005, up to 2007 the plan was yet to be approved and forwarded to the NGO. The NGO was uncertain of the status of the plan.

In spite of the government's intention to practise co-management, what seems to have evolved is better described as participatory management centered around the government administrative authority. In fact the 2007 Policy refers to co-management as public participation in the management of protected areas. While in the interview it was boldly stated that there was no hierarchy in the relationship of the co-management stakeholders, the government is evidently reluctant to relinquish its decision-making power to NGO co-managers. The desired outcomes of co-management stated in the 2007 policy include increased support and participation of civil society in the conservation of cultural and natural heritage. There is no indication that such support has been achieved and that ecotourism providers are conscious of how their efforts contribute to biodiversity conservation. What has been noted are ongoing social conflicts around the use of and access to natural resources in protected areas. Another desired outcome is the reduction in government subsidies allocated to management of the protected areas system. Through the availability of more resources via co-management councils, more efficient management including better utilization of funds was expected. The government does collect a tourism tax from visitors to protected areas offering eco-tours, but it was not clear what portion was invested in management costs. In the protected areas, the general thinking was that the tax was not re-invested into protected areas management but used otherwise by the government.

Financing, community involvement, legislation and logistic support were themes that re-appeared more appropriately in response to the survey question on institutional issues influencing conservation in protected sites (Table 46). The dominant themes based on seven statements each were organizational role and resource capacity (i.e. human, financial and technical). Another theme not previously mentioned and of significance to this research is the prioritization of and planning for biodiversity conservation, upon which all other steps of the management process in support of conservation are dependent.

Table 46. Selection Frequency for Theoretically-Derived Management Institutions Criteria

Criteria	Frequency (%)
Salaries	77
Staff	68
Stakeholder/actor participation	64
Training for protected areas managers and staff	59
Biodiversity surveys and research	54
Income generation	50
Funding sources/partners	50
Partners/collaborators for scientific surveys and research	45
Plans for external influences on the protected areas	18

Note: % = No. responses x 100/Total no. of respondees

Interestingly, the frequency of selection for the theoretically-derived institutional criteria placed greater importance on management resources in terms of salaries and on human resource – namely staff. Technical capacity indicated by the criterion "training for protected areas managers and staff' again was considered an important influence for effective biodiversity conservation. Surprisingly with the high frequency for salaries, considerably less concern was shown for "funding sources/partners." Of least concern were external influences on protected areas.

Community Input on Institutional Issues

Four out of the five communities contributed ideas on the criteria for inclusion in the conservation effectiveness framework concerning institutional and governance issues. There was no emergent theme for institutional issues. The three suggestions were more funding, more conservation education and public outreach, and the need for capacity to respond to forest fires quickly and prevent their spread. However, one community (LCWP – El Peñon) apparently had not given much thought to management issues and their role in protected areas management, or perhaps were hesitant to be critical of the government. Apart from pointing to the need for more funding of protected areas operations they struggled to give suggestions on other institutional and governance concerns. Rephrasing and clarification of the third workshop question did not result in any further participation. This lack of response at the El Peñon workshop is an important observation as it clearly indicates that some communities may not have the initial capacity to participate in protected areas management. Creating opportunities for community involvement in protected areas management is no indicator of how well those opportunities will be utilized or their outcomes.

Expert Input into Governance Issues

The forty-seven statements concerning governance issues revealed a top-down, centralized governance structure organized around the state (Appendix I). None of the emergent themes were particularly dominant:

- Political interests and values
- Protected areas and biodiversity laws
- Creation of community incentives and benefits
- Administrative arrangements
- Conservation budgeting
- Political support
- Logistic support
- Enforcement of laws

A few of these themes are closely correlated. For instance political interests and values will determine the level of political support given to *in situ* biodiversity conservation. The creation of protected areas and biodiversity laws must precede their enforcement. Conservation budgeting inevitably influences the level of legislative support.

When the theoretically-derived criteria are considered (Table 47), it is the criteria that are at the site-scale that seem to be given higher priority than criteria assessing issues dependent on state authority. Park ranger patrols, community incentives and community awareness require on-site presence and active park administration. Community incentives are also prioritized here as in the generated survey statements. On the other hand, matters that fall directly under the state's jurisdiction were of lower frequency. More specifically these criteria include cross-agency networking, designation of management authority, land tenure and use arrangements and types of natural resource use regimes.

Table 47. Selection Frequency for Theoretically-Derived Governance Criteria

Criteria	Frequency (%)
Park ranger patrols	68
Local community incentives	68
Community awareness	64
National land use policies	59
Protected areas demarcation	59
Payments for biodiversity protection	54
Implementation of protected areas laws	50
Protected areas policy	41
Networking with various environmental sectors	41
Designation of management authority	41
Land tenure and use arrangements	32
Types of natural resource use legends	27

Community Input on Governance Issues

Better enforcement was considered of greatest importance for effective biodiversity conservation by three communities while the other one felt that creating agricultural incentives for sustainable use and economic benefit was the key issue. Noteworthy is the variation across the communities with regards to the improvement of enforcement. The Cabral group thought that better laws were needed to facilitate better enforcement. This opinion contrasted with the Puerto Escondido group who felt the laws were adequate, they just needed enforcing. An uncommon suggestion offered by one person in the Cristobal group was that enforcement responsibilities could be shared across neighbouring communities. The suggestion was not well-received by other group members who did not appreciate the point that human impacts by one community could affect another and so environmental patrolling could not be distinctly divided between communities. There was also a difference of opinion on what form economic incentives should take. The Puerto Escondido group thought ecotourism would be a better option. Ecotourism as a favourable option was voiced by the El Peñon group in response to the question about outcomes (what would have to be seen or experienced to qualify as satisfactory management). Governance issues rather than conservation outcomes formed the majority of the responses. Better law enforcement was again mentioned by the Puerto Escondido group with the emphasis this time on less government corruption. Better enforcement was a concern for question four in the Cabral and Cristobal communities.

5.5 Methodological Triangulation for Biodiversity Conservation: A Dominicano Perspective

The concept of biodiversity is not well understood or seems unfamiliar to several experts and to communities in general. In accordance with responsibilities under the Convention on Biological Diversity and in response to the influence of the sustainable use paradigm, the concept has been adopted for conservation planning and legislation in the Dominican Republic. The pluralist nature of biodiversity conservation is evident in the co-existence of protectionist and sustainable use approaches to conservation. The policy shift from a protectionist to a sustainable use approach claimed by the government seems to have happened in theory, but seems unrecognized by the expert group and community stakeholders. All stakeholders have a common focus on the species and ecosystem levels of biodiversity. Genetic diversity has been neglected in the majority of discourse on biodiversity. Ecological processes also seem to be under appreciated overall.

5.6 Methodological Triangulation for Biodiversity Conservation Goals and Objectives for the Dominican Republic

The broadness of some goal statements and the general lack of associated objectives reflect the challenge of setting clear protected areas system goals and objectives. Usually the objectives indicate the specific conservation targets, assessable actions and timelines for biodiversity conservation. Nevertheless, influences of the protectionist conservation paradigm seem to have oriented conservation planning mainly towards biological goals, with an overall interest in ecosystem conservation. The few social goals tend to be limited to the use of biodiversity in a way that does not threaten biological resources for humans. In considering the data sources of ecosystem goals and objectives, the opinions of the academics, 'experts' and communities do not seem to be represented in the objectives of Law 202-04. Rather, objective statements such as "representative samples of natural ecosystems", "conserve biodiversity and genetic resources" and "maintain ecological processes…" echo the CBD's conservation goal and objectives for ecosystems. On the other hand, the conservation of endemic wildlife and threatened species was a commonly shared objective amongst stakeholders except for the community groups.

In organizing the protected area system and CBD goals as a nested hierarchy (Table 48), it is apparent that the system-level goals and objectives fall within the CBD's species and ecosystem goals and objectives. Notably, the CBD goal of promoting conservation of genetic biodiversity has no associated system-level goal or objectives. The CBD's conservation objectives are better defined than the system-level objectives and this limitation of the system-level objectives is likely a manifestation of limited available data and information for conservation planning. There seems to be relatively more information on the variety of natural ecosystems, the numbers of endemic and endangered species than there is on ecological processes, environmental services and freshwater biodiversity. Table 48 also highlights that there is little or no corroboration between the data sources as to which ecosystems, habitats and species should be conserved. Consequently, for the purpose of this thesis, no priorities could be identified from the variety of goals and objectives collated.

With regards to the two protected area study sites, Sierra de Bahoruco National Park and the Laguna Cabral Wildlife Reserve, available information on the national park allows for only tenuous observations to be made on the linkages between protected area system and site levels of conservation planning. The conservation objectives for the national park as previously stated in Table 48 consistently address ecosystems and habitats with no explicitly stated species conservation objectives. With regards to species conservation, there is a focus on endemic and native birds, mammals and herpetofauna. The conservation objectives for the national park to not address threatened animals. Clearly, it is assumed that intact ecosystems and habitats guarantee sustained species populations. The system conservation objectives that these site objectives seemed aligned with are protection of representative samples of natural ecosystems and habitats, comprising protection of endemic species and threatened plants.

Additionally, two conservation objectives specific to biodiversity use and ecosystem services are stated which are in accordance with the 1994 conservation strategy's goal of using biological resources in a sustainable manner.

Table 48. Range of Proposed Biodiversity Conservation Goals & Objectives for the Dominicano Protected Areas System

System Conservation Goals [Associated Site Goals in brackets]	System Conservation Objectives [Associated Site Objectives in brackets]	Data Source for Goals & Objectives				
		Acd. Lit.	Tech. Lit.	Expert Group	Comm. Groups	Biophysical Data /Info
•Promote the conservation of the island's ecosystems, habitats, biomes.	•At least 10% of each of the island ecological regions effectively conserved. •Areas of particular importance to island biodiversity … comprehensive, effectively managed and ecologically representative national … networks. • Conserving community/ecosystem diversity [Protect pine and relict forest vegetation of Western Bahoruco that harbour an old and very threatened flora]		CBD Island Biodiv. POW	√		√
•Tropical rainforest conservation conservation	Objectives not identified	√				√
•Limestone forest conservation	Objectives not identified [Conserve unique karst formations typical of Hispaniolan mountains]	√				√
• Ensuring conservation and preservation of representative samples of the different ecosystems and of natural heritage	• Hold representative samples of natural ecosystems • Conserve biodiversity and genetic resources • Maintain ecological processes and enhance environmental services • Protect underground systems including water, ecosystems and Aboriginal sites.		Law 202-04			

System Conservation Goals [Associated Site Goals in brackets]	System Conservation Objectives [Associated Site Objectives in brackets]	Data Source for Goals & Objectives				
		Acd. Lit.	**Tech. Lit.**	**Expert Group**	**Comm. Groups**	**Biophysical Data /Info**
* Promote conservation of island's species diversity	• Populations of island species of selected taxonomic groups restored, maintained, or their decline substantially reduced. • Status of threatened island species significantly improved.		CBD Island Biodiv. POW			
	• Protect endemic wildlife and endangered species	✓	Law 202-04	✓		✓
	• [Ensure representative samples of optimum habitat for native and migratory species of birds especially endemic species]		✓			✓
	• [Preserve ecosystems inhabited by endemic mammals]		✓			✓
	• [Preserve habitat for the herpetofauna both endemic and other native species]		✓			✓

5.7 Methodological Triangulation of Biodiversity Conservation Outcomes for the Dominican Republic

The biodiversity conservation outcomes at the system level identified by the academic, expert and community stakeholder groups are collated in Table 49. There was weak corroboration across the stakeholder groups for the sole biophysical and sole socio-economic outcomes, namely a reduction in deforestation, and ecotourism and recreational benefits. It is apparent that there is no unified vision of biodiversity conservation outcomes for the Dominicano protected areas system. Considering the strong orientation towards the CBD's ecosystem goals and objectives, noteworthy absentees in the planning process are outcomes specific to biological representation, and to species and ecosystem conservation. One may argue that reduced deforestation may be said to indirectly correspond to the first four conservation objectives in Table 49. Maintaining representative samples of forest ecosystems, conserving terrestrial biodiversity, maintaining watershed processes and enhancing water production, and protecting endemic wildlife probably would result in reduced deforestation. However, the objectives are so broad or vague that reduced deforestation is only one of several potential outcomes. Similarly, if environmental services were specified it would be easier to determine how well ecotourism and recreational benefits correspond as an outcome. Consequently, there are no proposed indicators for the two conservation outcomes.

Table 49. Range of Biodiversity Conservation Outcomes for the Dominican Republic Protected Areas System

Corresponding Conservation Objectives	Conservation Outcomes (Intended in *italics*; Actual in regular font)	Data Collection Source for Outcomes				Biophysical Data /Info
		Acd. Lit.	Tech. Lit.	Expert	Comm.	
• Hold representative samples of natural ecosystems	•*Biological representation*		√	√		√
• Conserve biodiversity and genetic resources	•*Reduction in deforestation*	√		√		Limited
• Maintain ecological processes and enhance environmental services	•*Ecotourism and recreational benefits*	√			√	√
• Protect endemic wildlife and endangered species	•*Maintenance of habitats of endemic and endangered species* •High representation of conifer and freshwater swamps	√				√
• Protect underground systems including water, ecosystems	• Indeterminate					Limited
	• [Protected Area] System threats			√		

In the absence of nationally set indicators for conservation outcomes, the actual conservation outcomes of the protected area system will be discussed with reference to the ten per cent minimum protected area coverage set by the CBD. Assuming that the CBD target for protected areas coverage has been adopted by the Dominicano government, then a desired outcome is ten per cent coverage of each of the ecosystem targets. However, of the forty-six ecosystem targets set by the Dominicano government, less than twenty-five per cent are currently in the protected areas system. On closer inspection of the eleven protected ecosystems, it is significant that the proportion of vegetation for most of these targets is above ten per cent. Open Coniferous Forest and Freshwater Swamp Forest are the two ecosystems that stand out with coverage of eighty six per cent and seventy one per cent respectively. The high coverage for Open Coniferous Forest has an implication for species conservation, particularly for endemic and endangered wildlife. Generally, endemic and endangered plants and animals tend to be concentrated in closed broadleaf and rainforests. The coverage for these ecosystems is minimal, ranging from twenty to thirty-four per cent in contrast to the eighty-six per cent for Open Coniferous Forest. It is a fair conclusion that the primary habitat of endemic and endangered species is being overlooked and greater inclusion of such habitat in the protected areas system would augment species conservation efforts.

In spite of the stark habitat fragmentation across the country, this major threat to biodiversity conservation seems to be unrecognized by protected area stakeholders. There was no mention of it in the local academic and technical literature, nor was it identified in the survey responses or community workshops. Habitat fragmentation can curtail a protected areas system designed for large areas. Nevertheless, the areas designated as

IUCN category II (National Park) seem to have successfully enclosed the remnant forest expanses. There is evidently manipulation of the protected areas system design counter to the best interests of biodiversity conservation. In other words, changes in park boundaries facilitate commercial use of species and ecosystems at the expense of species of higher conservation value. The problem with the Dry Forest Capitalization Project presents such a scenario where the level of harvesting of firewood for local economic benefit does not seem to support the argument for sustainable use. Unfortunately, no available data on change in forest cover was found. So although a shared concern among protected area stakeholders was deforestation rate, the lack of quantitative data precluded a discussion of the matter.

Vaguely, species conservation is approached from the view that by protecting habitat then inevitably species will be protected. As an outcome, this does not require direct monitoring of species populations. This approach is probably the result of very limited data on specific species. At the site level, e.g. Sierra de Bahuroco National Park, endangered species on the IUCN Red List have been identified. The entire protected areas system would benefit both ecologically and socially from countrywide identification of species for conservation focus. For species that occur in multiple locations the monitoring of different populations would help establish alerts to the risks of endangerment and indicators of species resilience. It was noted that freshwater species diversity was not addressed by the protected areas system goals. Yet, the majority coverage of freshwater swamp forest in the system has highlighted the importance of establishing protected areas in spite of limited conservation planning. In so doing, the opportunity for protection of freshwater swamp forest and the associated species was created and their loss inadvertently minimized.

5.8 Methodological Triangulation of Implementation of Governance and Management Institutions in the Dominican Republic

Table 50 presents the key governance and institutional issues influencing in situ biodiversity conservation in the Dominican Republic. Based on corroboration by the academic expert and community stakeholder groups, a critical governance issue is law enforcement. The field data suggest that enforcement is perceived as the patrolling of protected areas in order to report breaches and prevent removal of destruction of the natural environment. Enforcement within protected areas re-emerged throughout the dataset as an essential for effective biodiversity conservation, independent of the various governance structures or protected area management objectives. Lack of adequate enforcement stands out as a direct contributor to declining biodiversity, especially in forested areas.

Table 50. Range of Key Institutional and Governance Issues for the Protected Areas System of the Dominican Republic

Governance & Management Institutions Issues	Data Source for Governance & Institutional Issues		
	Tech. Lit.	Expert Group	Comm. Groups
Governance			
Enforcement of conservation laws	√	√	√
Financial sustainability	√		√
Role of civil society	√		
Conflicting land use-conservation interests	√		
Governance (e.g. dictatorship, participatory)		√	
Management Institutions			
Financial support for site operations	√		
Capacity to respond to natural resource use pressures	√		
Conservation planning	√	√	√
Implementation of protected areas laws	√	√	
Limited technical expertise and research		√	

Governance structure, while seemingly not as significant as law enforcement, was instrumental in setting the stage for the other key governance issues in Table 50. Financial sustainability seems highly dependent on both long-term local and external financial support. It is well known that American-based organizations such as the World Wildlife Fund and McArthur and Ford Foundations favour democratic governments and so would not have been funding options for the Dominican Republic when it was under dictatorship. With respect to the role of civil society in protected areas management, it was not until a more participatory approach was taken towards protected areas governance that co-management and community incentives were facilitated. Yet, top-down centralized decision-making power continues to restrict management operations at protected sites. The type of governance also affects the relationship between land-use and conservation. If cross-sectoral planning is not incorporated into the governance structure, the Dominicano experience shows that land use conflicts may arise. On the other hand, involvement of other government sectors (e.g. Ministry of Tourism) in protected area governance may be problematic where sectors have conflicting land-use interests and conservation is not given high priority.

The three stakeholder groups consulted for data collection pointed to financial support for site operations as a critical institutional issue for effective biodiversity conservation. When the other key institutional issues are also considered, it is apparent that the need to increase management resource capacity is the overall challenge. The understaffing of the protected areas, the relatively low salaries and poor logistic support are as a result of inadequate funds for site operations. Consequently, protected areas boundaries are only partially patrolled or not at all, and natural resource use in protected areas is minimally monitored. The limited availability of local technical expertise is likely due to the inability to afford highly skilled technicians, but also due to the lack of education and training facilities and opportunities within the Dominican Republic.

Local academic knowledge has not at all kept pace with the policy and planning demands for knowledge or biodiversity conservation at both system and site levels. More specifically, there is a need for more information on human use of biodiversity, genetic diversity and its resources, and species occurrences. Considering that the 'experts' who participated in the survey are usually included in the development of conservation policy and plans, it is evident from the survey results that the local knowledge base for conservation planning is weak. Were it not for the presence of international NGO, TNC, and foreign researchers and collaborative arrangements, much of the existing scientific or other technical information would not be available. If the Dominicano government seriously intends to incorporate civil society into biodiversity conservation through co-management, they must provide communities within and near to protected areas with information and exposure to biodiversity-related issues. This does not seem to be the case for the workshop communities as they were unable to dialogue in a meaningful way until I provided background information on the concept of biodiversity conservation. However, notwithstanding educational levels and extent of community interests in environmental affairs, the workshop results indicated that some communities would be able to articulate conservation goals once they were exposed to and informed on conservation issues.

The difficulties of adopting global models of protected areas management, particularly the IUCN system of categories and the sustainable use of biodiversity stance, are highlighted by the key governance and institutional issues. These models assume that the paradigm shift as presented by Thomas and Middleton (2003) has occurred in the protected areas management of the island (see p. 28). The management approach in the Dominican Republic may be in paradigmatic transition as suggested by the attempts at a holistic orientation to management, the greater involvement of civil society in management through co-management councils, and the sourcing of system-level funds from multiple sources. However, the traditionally centralized governance structure, the absence of a network concept in the protected areas system design, lack of a single vision for biodiversity conservation, and minimal contribution from local technical expertise show up the incompatibilities of the newer paradigm with the social, political and economic contexts of the Dominican Republic.

5.9 Revision to the Theoretically-Derived Framework for Biodiversity Conservation Effectiveness in the Terrestrial Protected Areas System of the Dominican Republic

The triangulated data for the Dominican Republic substantiate the development of an outcome conservation effectiveness framework that reflects protectionist and sustainable use conservation paradigms (Table 51). Regardless of international treaties for biodiversity conservation and the participation of tropical island states, biodiversity conservation is not universally understood. The goal-outcome orientation of this research revealed the inadequacies in the establishment of conservation objectives and outcomes. There is evidently the need to prioritize coherently between conservation objectives and outcomes in protected areas system planning, and to then be guided by these priorities in the allocation of institutional and governance resources. The inter-relationship between the biological and socio-economic aspects of protected areas management needs to be holistically considered in a conservation effectiveness framework. One cannot truly assess the status of biodiversity unless one incorporates the impacts of natural resource use on the diversity of ecosystems, species and their genes.

In turning our attention to the theoretical evaluation criteria, let us first consider the criteria for goals and objectives. As yet, the Dominican Republic has no protected areas system plan. The critical issue is that there exist nationally stated goals and objectives for biodiversity conservation associated with the protected areas system. Furthermore, although only conservation goals and objectives for Sierra de Bahoruco and their links to system goals and objectives were addressed, the linkage between these two levels is important for protected sites. Consequently, the criteria should be revised to reflect biodiversity conservation as well as natural resource use goals at the system and site levels, with associated indicators being the presence or absence of the goals and objectives. The minimal corroboration between datasets for goals and objectives only yielded "conservation of endemic wildlife and endangered species" as the critical system objective.

Table 51. Revised Framework for Biodiversity Conservation Effectiveness in Terrestrial Protected Areas System of the Dominican Republic

	Biodiversity		Socio-Economic	
	PA System	**PA Site**	**PA System**	**PA Site**
Goals/ Objectives	• National biodiversity conservation goals & objectives	• Management plan goals & objectives	• National natural resource use goals & objectives	• Management plan goals & objectives
Biophysical Outcomes	• Representation • System threats	• Species indices: endemism, richness, co-adaptation, threat status • Extent/rate of deforestation	• Natural resource use trends	• Natural resource use for each site
Management Institutions	• Funding sources/ partners • Biodiversity conservation expertise	• Financial support • Biological and socio-economic surveys	• Expected stakeholder/ actor participation • Knowledge base	• Actual stakeholder/ actor participation • Income generation
Governance	• Networking with various environmental sectors • Presence of NPAS policy • Implementation of PA laws	• Community outreach & education programmes • Enforcement • PA demarcation	• National land use policies • Payments for biodiversity protection	• Types of natural resource use regimes • Local/community incentives

The Dominicano datasets contributed very little to the identification of outcome criteria for the conservation effectiveness framework. Representation, system threats, endemism and extent of deforestation emerged from the data as outcome criteria and coincided with theoretical criteria. However, of these criteria only extent of deforestation seemed critical. A socio-economic outcome that also seemed critical was that of income generation through ecotourism and recreational benefits from protected area biodiversity.

In spite of the strong push for natural resources use in protected areas there was no attempt to have targets for direct and indirect exploitation of biodiversity. Nvertheless. The Dominicano dataset pointed to the critical need for criteria that monitor natural resource use at both the system and site levels.

Management institution criteria in the theoretical framework that were confirmed as critical by the triangulated research data included occurrence of biodiversity surveys, expected stakeholder participation and actual stakeholder participation, and externalities. In retrospect, a better terminology for the surveys is "biological and socio-economic surveys" which encompasses both natural and social survey options. The execution of scientific surveys to build baseline data and inventory species, ecosystems, and natural resources requires scientific expertise that is available to all the protected sites, albeit local or foreign. Having on-staff expertise would be an advantage in terms of availability of and especially accessibility to expertise for surveys. Consequently, a new criterion offered by the research data is "biodiversity conservation expertise" with levels of availability and accessibility as indicators.

Based on the few study sites included in this research, a complete understanding of the linkages between the management of the protected areas system and the individual sites was not possible. Nevertheless, the centralized governance structure in place for the protected areas system makes the protected sites dependent on the government for staffing, preparation of their management plan and funding for daily operations.

5.10 Field-Testing Results for the Framework Criteria and Indicators for the Dominican Republic

The critical evaluation criteria and indicators identified by methodological triangulation and used to revise the theoretical framework are expected to form the basis of an outcome evaluation for biodiversity conservation in protected areas systems. However, not all the criteria have associated indicators as yet. So in addition to field testing the usefulness of the evaluation criteria in the revised framework, the questions in the interview protocol were also used to identify other indicators. The interview discussions covered not only the critical criteria but offered further insight into the Dominicano experience. A better indication of the protected areas management style, the planning process and what were the perceived conservation successes were gleaned from the interviews. Existing documentation that clarified or provided answers to interview questions was also consulted.

The key points of the interview discussions which revolved around the critical evaluation criteria and indicators are presented here and used for fine-tuning the evaluation criteria and indicators. The theoretical conservation effectiveness framework assumed that a protected areas system plan would exist with national conservation goals and objectives. However in the case of the Dominican Republic no such plan existed and the reality was that national conservation goals and objectives were formed independently of a system plan. The framework for actually establishing goals and objectives came from the sectoral law for biodiversity conservation, that is Law 202-04, and the policy for the system of protected areas. The Dominicano Government is currently in the process of developing a biodiversity conservation strategy. During this process they will be referring to the 1994 biodiversity conservation strategy. Protected areas managers indicated that they tended to deal with conservation issues as they arise. This signifies reactive rather than pro-active management of protected areas and conservation planning. Additionally, experiential knowledge is used as the basis for conservation planning instead of a scientific foundation.

If we consider the criteria of biological representation, few people seem to understand this concept. The rating of the concept in the survey results was fairly low and contrasted with the government's intention to make biological representation a legally binding outcome of the protect areas system by writing it into Law 202-04. The other criteria such as congruence, complementarity, population redundancy and disturbances were not endorsed by the field results with the exception of system threats. The major system threat identified here was that of corruption interfering with proper application of the laws for the protected areas systems.

While endemic species were not directly addressed in the interview protocol, during the course of the interview discussions it was apparent that protected areas experts were quite aware of the importance of conserving endemic species. Less consideration was given to species richness and species co-adaptation did not even come up in discussion. Deforestation was one of the theoretical criteria that was strongly endorsed by the field data. Although invasive species was not a well recognized criterion, I think it is one of the theoretically-derived criteria that should be included in the Dominicano framework because of their capacity to devastate the natural environment of tropical islands.

A look at the socio-economic outcomes directs our attention to natural resource use. To date, there is no compilation of a natural resource use listing for the protected areas system. However there is some field monitoring of natural resource use by the government as well as by managing NGOs of protected sites. Examples of natural resource use include fishing, sand extraction, and harvesting of mangrove wood for charcoal. There is clearly a need to periodically monitor natural resource use and consequently, two of the critical criteria contributed by the Dominican Republic are natural resource use at sites and the trends across the protected areas system. There is a desire to provide alternatives for natural resource use especially where these alternatives can generate an income for local communities in and around protected areas. Ecotourism is seen as major income generator for local communities. However, implementing ecotourism so that local communities directly benefit from it has proven challenging. The government has focused more on its collection of a tourist tax than ensuring that local communities have adequate infrastructure to capitalize on the presence of tourists.

Not surprisingly, conservation financing was one of the critical criteria that directly affected the human resources, the logistic support for several activities such as ranger patrols, and biodiversity surveys, and the daily management operations across the protected areas system. One of the current priorities for the Vice-Ministry is the financial sustainability of the protected areas system meaning that the protected areas would have enough long-term funding to maintain their operations. The development of a financial plan is considered instrumental for the achievement of financial sustainability. There are protected areas that are said to be able to support themselves. However, the government needs to be in a position to support the other protected areas. Steps have already been taken in this direction where prior to about 2004 taxes collected from the protected areas system went to Central Government but now the income generated as of 2005 goes to the Ministry of Environment. I was also provided with a copy of the Environment Ministry's budget for 2007 showing that there was a budget allocation for protected areas and biodiversity.

A critical human resource for effective biodiversity conservation is biodiversity conservation expertise. The Vice-Ministry actually has on staff biologists specializing in the fields of ornithology, herpetology, mammalogy, botany and general ecology. Most of these persons are equipped for animal conservation resulting in less support for plant conservation. The staff members operate as a team for their monitoring and inventorying programmes which are outlined in annual work plans. However, due to the large size of the protected areas system the numbers of staff are inadequate for comprehensive surveying of the system. In order to compensate for the gaps in expertise, collaborations with other groups and organizations such as the National Botanical Garden are the norm.

Staff biologists said that the surveys they conduct are usually reflective of their various specialist fields and do not include or have minimal socio-economic data. As a result of the limited resources that staff have to work with, the surveys are conducted at specific sites and not across the entire protected areas system. Consequently, there is a reliance on data and information from collaborating organisations including non-governmental organisations (NGOs) that have responsibility for managing some of the sites. Logistic support for biological and socio-economic surveys was identified as one of the major limiting factors. Some NGOs had resources or were able to acquire resources to conduct the surveys and the Vice-Ministry seemed to think that their monitoring programme was an important part of their function. Collaborative research projects such as the ecotourism monitoring project in Armando Bermudez National Park with the German Technical Cooperation (GTZ/DD) have provided baseline socio-economic data through before and after impact assessments of visitor trails and camp grounds. Monitoring has continued after the project life and data is recorded in a SPSS database. In response to a question on whether there were priority research areas that researchers were informed of so that studies could address information gaps it was pointed out that there was no specific direction for the research done in the protected areas.

The interviews were truly valuable in providing a better understanding of law enforcement for biodiversity conservation. The Vice Ministry has a Protection and Surveillance Unit which carries out regular monitoring and patrolling in 34 of 86 protected areas has statistics and documented reports for these areas. Compliance with Laws 64-00 and 202-04, and existing regulations for hunting seasons, and authorized commercial activities, and in support of CITES is sought from all citizens. Common breaches of the laws and regulations include the setting of forest fires in order to clear land for agriculture, deforestation for charcoal production, and the collection of green parrots, iguanas and turtle eggs. The rangers are authorized to carry guns sourced from the army but they can only use these guns defensively, that is, to shoot in the air as a strong warning and not shoot law-breakers. They have powers of arrest and the existence of environmental justice departments in many provinces allows for the prosecution of perpetrators. However, if evidence of the offence is not provided in 34 hours then the offender may be freed. Regulations exist for the application of penalties which include fines or imprisonment.

There is a relationship between the two Vice Ministries of Forestry and of Protected Areas and Biodiversity (SAPB). The SAPB enforcement officers are trained to work along with forest wardens in dealing with forest fires, land clearing, agriculture and establishment of illegal infrastructure. However, the interviewee did not know how many protected areas included forestry substations. The implication of this information is that enforcement in the protected areas system is being conducted by officers belonging to two different jurisdications, only partially informed about their overlapping authorities which creates the potential for organizational conflict. Additional enforcement support is provided by Environmental Police who are members of the navy or army and have authority to enforce not only laws relevant to protected areas but the full range of environmental laws for the country. In some instances the Environmental Police officers have been assigned for a period (e.g. one month) to a protected site to strengthen the enforcement activities being implemented by managers and site enforcement officers.

Keeping in mind the factors discussed above that reveal the desirable or undesirable changes in or quality of the criteria for effective biodiversity conservation, the criteria and associated indicators listed in Table 52 below are proposed for the conservation effectiveness framework. Note that these are only recommended indicators and are not intended to be a list of possible indicators. Users of the conservation effectiveness framework are expected to select indicators that are relevant to their protected areas system context.

Table 52. Revised Framework Criteria and Associated Indicators for the Dominican Republic

Criteria	Indicators
National biodiversity conservation goals & objectives	Presence or absence Relevance to biodiversity conservation
National natural resource use goals & objectives	Presence or absence Relevance to biodiversity conservation
Management plan goals & objectives	Presence or absence Relevance to biodiversity conservation
Biological representation	Forest and freshwater types of ecosystems and species
Deforestation	Area
Natural resource use	Type and quantity of resource
Stakeholder/ actor participation	Types (NGO, government, private) Jurisdictions w.r.t. protected areas Inter-agency collaborations, networking or conflicts
Financial sustainability	Number and types of funders Timeline of funding source
Financial support	Existence of conservation budget
Biodiversity conservation expertise	Source: local/foreign Field of expertise
Biological and socio-economic surveys	Frequency Distribution across protected area system
Implementation of laws	Number of prosecutions for conservation offences in protected areas Resultant penalties for prosecutions
Legal enforcement (number of enforcement officer; enforcement laws)	Number of rangers per unit area of each site Regulations for known offences

6. EFFECTIVE BIODIVERSITY CONSERVATION IN NATIONAL PROTECTED AREAS SYSTEMS OF TROPICAL ISLANDS

It is evident from the data presented that biodiversity conservation is an accepted goal for the national protected areas systems of both Jamaica and the Dominican Republic. This section presents a) the final conservation effectiveness framework, b) an analysis of the concept of effective biodiversity conservation for a tropical island, and c) justification for the final framework criteria. The Jamaican and Dominicano criteria are collated into a single framework and consideration given to how field-derived criteria compare with theoretically-derived criteria, and the level of generality in the criteria. The major conclusions are provided followed by limitations of the study and major recommendations.

For easy recollection, the *in situ* biodiversity conservation and evaluation argument of this thesis is re-stated below:

> Biodiversity conservation outcomes on tropical island states are greatly influenced by specific biogeographic features of islands and the ecological and socio-economic contexts of the protected areas system. They are not pre-determined by the adoption of 'universal' conservation and protected area management paradigms. Consequently, outcome evaluations of biodiversity conservation effectiveness for tropical islands that fail to incorporate island-sensitive features will make inappropriate outcome evaluations resulting in unrealistic recommendations to protected areas system managers.

Having presented the case study data, the major research findings are summarized in Table 53. Comments on the research findings that did not specify JM or DR are to be understood as applicable to both study locations.

Table 53. Summary of the Major Research Findings

Paradigms & Concepts	General Findings	Major Case Study Findings (JM = Jamaica, DR = Dominican Republic)
Conservation Targets	Biodiversity includes: • ecosystems • species • genes	For JM, DR biodiversity includes: • ecosystems a priority but biased towards forests • species - dominant priority • genes - rare consideration Fair level of unfamiliarity with biodiversity concept in DR.
Definition of Protected Area	• IUCN: an area managed legally or otherwise for conservation of biodiversity or natural/cultural resources. • CBD: geographically defined area with specific conservation objectives.	Both definitions utilized.
Definition of a Protected Areas System	IUCN: Organization of and inter-relations between protected areas and their external environment to achieve: 1} representativeness 2) adequacy 3) coherence and complementarity 4) consistency 5) cost effectiveness	• Explicit definition rarely stated. • Management authorities and organizational structures exist. • Need for their coordination is recognized. • Of the five essential characteristics of a protected area system, only representativeness, and adequacy (in terms of threats), are addressed.
Biodiversity Conservation Paradigm	Protectionism and sustainable use more prominent than neoliberalism. General shift in emphasis from protectionism to sustainable use.	Both protectionism and sustainable use co-exist in a national protected areas system.
Protected Area Management Paradigms	• Traditional (more biologically oriented, central authority, protected areas as 'islands'), and • Contemporary (more socially oriented, shared authority, conservation networks).	Traditional approach more common with some shifting towards contemporary (e.g. inclusion of local communities in management conservation networks)
Biodiversity Conservation Strategies and their Outcomes	• IUCN system of categories for protected areas with emphasis on national parks. Expected outcome: reduced biodiversity loss • Networks of protected areas. Expected outcome: representation of island biodiversity.	• Variety of protected area categories, including some IUCN categories such as a national park. • IUCN system of categories: formally adopted in DR; being considered in JM. • Acceptance of a protected areas system designed on ecologically representative networks. • General outcomes: System

		design shows centres of biodiversity across a fragmented landscape; some reduction in loss of or threat to specific species; network concept related to JM freshwaters; several challenges to achieving overall biodiversity conservation.
Assessment of Biodiversity Conservation	IUCN-WCPA management effectiveness framework for protected areas. Facilitates development of tools that assess the planning and implementation stages of biodiversity conservation.	Application in JM of RAPPAM tool, derived from IUCN framework. Resultant insights on planning inputs, processes and outputs for selected sites. No insight on conservation outcomes or system to site level coordination.
Evaluation Criteria for *in situ* Biodiversity Conservation	• Focus for conservation targets mainly on restricted- range species especially endemics, species richness and control of threats. Other ecological criteria include design of a protected areas system and its sites. • Under-utilization of other criteria based on unique biogeography of islands (e.g. high vulnerability to invasive species, taxonomic and niche disharmony). • Common socio-economic criteria based on protected areas legislation and policy, plans and land use issues.	• Critical criteria include co-adapted species as well species endemism, representation of forest and freshwater ecosystems, control of their threats and protected areas design integrating both centres of biodiversity and conservation networks. • No island-specific socio-economic criteria. Similar to 'universal'. New critical criteria include conservation expertise, coordinated enforcement, public awareness and support, natural resource use trends. Greater priority placed on criteria for conservation expertise, conservation programme planning.
Critical Relationships for Achievement of Biodiversity Conservation Outcomes	• General challenge is the setting of clear and explicit conservation objectives.	• In addition to better setting of clear and explicit conservation objectives, resultant conservation outcomes with assessable attributes need to be clearly identified. • Coordination of stakeholder participation in conservation within a top-down, hierarchical governance structure is essential. This applies to both a pluralistic (JM) or centralized (DR) governance style.

The collated criteria from the Jamaican and Dominicano case study are presented in Table 54, comprising theoretically-derived criteria and field-derived criteria. A collation of the Jamaican and Dominicano evaluation categories and criteria enables a direct analysis of their contextual similarities and variations with respect to this thesis. The collated framework indicates the potential for variation in the criteria for the four aspects of biodiversity conservation (extreme left column) across tropical islands. In spite of this research being limited to only two case study island states, the similarities and dissimilarities of their criteria and indicators highlight how contextual differences in the protected areas systems of tropical islands can vary conservation outcomes even when the concept of conservation is similar. The framework facilitates three options of conservation paradigms: protectionism, sustainable use or a combination of the two within a national protected areas system. The "Biodiversity" and "Socio-economic" categories of criteria introduced in the theoretical conservation effectiveness framework are particularly relevant in assessing conservation outcomes under the respective paradigms.

As a necessary precursor to and determinant of conservation outcomes, conservation goals and objectives are critical planning components of biodiversity conservation. One of the factors affecting the setting of conservation goals and objectives is the design of the protected areas based on the IUCN management categories and /or conservation networks of many large areas. Whichever design is chosen, the research findings indicate the importance of protected area management stakeholders at both system and site levels sharing common conservation goals and objectives. The Jamaican and Dominicano cases provided two different scenarios of conservation goals and

Table 54. Framework showing Collated Criteria from Jamaica & the Dominican Republic

	Biophysical or Biodiversity		Socio-Economic	
	PA System	**PA Site**	**PA System**	**PA Site**
Goals/ Objectives	• PAS plan with biodiversity conservation goals & objectives • National biodiversity conservation goals & objectives • Conserving centres of endemic and endangered biodiversity • Network of freshwater conservation areas	• Management plans with biodiversity conservation goals & objectives • Management plan goals & objectives • Forest conservation targets • Freshwater conservation targets • Endemic, co-adapted and threatened plant and animal conservation targets	• PAS plan with socio-economic goals & objectives • National natural resource use goals & objective • Reduction of human encroachment	• Management plans with socio-economic goals & objectives • Management plan goals & objectives • Greater public awareness • Greater public support
Biophysical Outcomes	• Representation of ***all*** major forest classes and freshwater ecosystems • Representation • No loss of forest cover • No loss of freshwater bodies • Recovery of threatened biodiversity • System threats	• Reduction in deforestation • Extent/rate of deforestation • Prevention of water pollution • Self-sustaining breeding populations of endemic & co-adapted species • Species indices: endemism, richness, co-adaptation, threat status • Control of invasive species	• Types of land use • Proposed limits to natural resource use • Natural resource use trends	• Types of natural resource use regimes • Actual extent of natural resource use • Natural resource use for each site
Institutional & Civil Society Development or Management Institutions	• Human resources • Biodiversity conservation expertise • Implementation of conservation strategy • Funding sources/ Partners	• Conservation training • Scientific research collaborations • Biological and socio-economic surveys • Control of invasive species	• Livelihood alternatives • Expected stakeholder/ actor participation • Knowledge base	• Income generation from livelihood opportunities • Income generation • Actual stakeholder/ actor participation
Governance	• Delegation of conservation responsibilities • Community involve-ment in conservation • Networking with various environmental sectors • NPAS policy • Implementation of PA laws	• Biodiversity conservation programme planning • Community participation in conservation actions • Community outreach & education programmes • Enforcement • PA demarcation	• Financial sustainability • Coordinated enforcement • National land use policies • National land use policies • Payments for biodiversity protection	• Conservation finance • Patrol effort • Natural resource use regulations • Types of natural resource use regimes • Local/community incentives

KEY: Contributions to the criteria from: ☐ Theoretical review only ☐ Jamaica only ☐ Dominican Republic only ☐ Theoretical review, Jamaica &/or Dominican Republic objectives in the protected area systems built on forest reserves, IUCN categories, and in Jamaica, general protected areas. In Jamaica, there is the intention to align existing protected areas with the IUCN categories but indecision on how to categorize for all but national parks has slowed the full adoption of the IUCN management categories. The Dominicano conservation law has incorporated the IUCN management categories but their adoption proved to be problematic in terms of interpretation of the management objectives and fitting historical protected areas into these categories. Reflecting on the place of biodiversity conservation in these two national protected area systems, criticisms of the IUCN management categories by Boitani et al. (2008) are indeed fair. The criticisms point to the IUCN management categories being so broad that they do not explicitly address biodiversity, and lack of clarity about the role of each protected area in protecting biodiversity and about conservation targets.

Several implications for effective biodiversity conservation arise from the research findings on categories as well as from the aforementioned criticisms. It seems impractical to limit categories of protected areas in national protected area systems to just IUCN categories. A system of categories needs to acknowledge and incorporate a more comprehensive range of management objectives. Each protected area category, for biological protection should have clearly stated biodiversity conservation objectives. Each protected site within a protected area category should have clearly stated conservation goals and objectives for the associated category. Then, the place of biodiversity conservation within a national protected areas system would become explicitly established.

Conservation networks are still relatively new to the planning of protected area systems in Jamaica and the Dominican Republic. In Jamaica, there are relatively few large protected areas and many more small protected areas. The proportion of large protected areas is greater for the Dominican Republic, presumably because of the larger land area overall. Competition over land use for agriculture, tourism and urban development, as well as the resultant high levels of habitat fragmentation preclude the establishment of large or many conservation networks in Jamaica and restrict their number and extent in the Dominican Republic. Considering that tropical islands typically have no wide-ranging large or migratory mammals and much wildlife of conservation interest is restricted to centres of forest biodiversity, conservation networks are a better strategy for aquatic biodiversity. Goals and objectives specific to forest and aquatic ecosystems are critical in order to protect endemic species and ecosystems, and to close the planning gap on aquatic biodiversity.

Notably, neither IUCN management categories nor conservation networks guarantee that the state of island biogeographic features will be factored into the conservation of tropical island biodiversity. While the protection of island endemism is already included in the goal and objective setting of the case-study island states, other biogeographic features are yet to be recognized. Protection of centres of endemic and endangered biodiversity encompasses not only species uniqueness but also restricted range species distributions, highly vulnerable and threatened species. However, the marked lack of focus on genetic diversity favours the inclusion of co-adapted species as conservation targets. Co-adapted species conservation, based on conservation theory, could be used as a proxy for the protection of the phylogenetic uniqueness of tropical islands. However, use of this criterion in a conservation effectiveness framework would require an expanded knowledge base of conservation expertise in conservation genetics.

The weakest aspect of conservation planning in this researcher's opinion is that of social goal and objective setting. Two social issues that emerged as critical in this study are natural resource use within the protected area system and public education and awareness. Especially where certain categories of protected area facilitate natural resource use, it is important to have acceptable limits to resource extraction and to monitor and account for its impacts on biodiversity. Related criteria in the framework allow for identification of human benefits from and human threats to biodiversity. Achieving greater compliance with conservation, law enforcement is a pre-requisite for reduced human threats. Nevertheless, this is dependent on a higher valuing of biodiversity and better understanding of its conservation. Public education and awareness become critical goals, not just for the sake of an informed society, but ultimately for changed social attitudes towards natural resource use that reduce human encroachment on biodiversity. Of additional importance is the increased capacity that local communities would have to actively participate in the conservation planning and implementation of a national protected area system.

Concentrating on the outcome category of criteria, it is a primary concern that this is the category that encompasses the least number of theoretically-derived criteria. Congruence of species distribution ranges would be an important outcome for the goal of conserving centres of biodiversity. This criterion directly relates to the biogeographical feature of tropical islands where species tend to have restricted range distributions. Congruent ranges would also help identify priority areas for monitoring of natural resource use and invasive species. For these reasons the criteria for congruence will be added to the final conservation effectiveness framework. Complementarity and population redundancy will not be added to the final framework as the respective criteria of representation and self-sustaining breeding populations incorporate these criteria.

While individual "experts" recognized the debilitating impact of invasive species on individual protected sites, this biological disturbance was not endorsed by field data as an evaluation criterion for a protected areas system. In fact, disturbances were in general overlooked as outcome criteria worth monitoring. Especially with respect to the impact of natural disturbances on a protected area, there is the need to ascertain if the levels are low (which is preferred) or high and require restoration of habitat. The high vulnerability of islands to these disturbances warrants the inclusion of this criterion in an island-specific framework. The monitoring of human disturbance in terms of planned exploitation or consumption of natural resources was also under-appreciated as a protected area management activity. With the struggle between protectionist and sustainable use management approaches within the protected areas of both Jamaica and the Dominican Republic, recognition of biological targets for natural resource use and ensuring that use does not subvert conservation efforts are critical. The field data indicated that the original terminology for the criterion of proposed biological targets was difficult to articulate. Consequently, in the final framework the terms have been replaced by "Natural resource use trends" and "Actual extent of natural resource use".

Recalling the purpose of institutional and governance criteria in the framework as identification of the critical issues needed to realize outcomes, two main points arise. The theoretically-derived and field-derived criteria for the institutional and governance categories greatly overlap. The apparently critical issues in the achievement of goals to produce outcomes can be summarized as technical knowledge and expertise, financing, and the role of the various management stakeholders with different emphases for Jamaica and the Dominican Republic. The field data contributed new criteria namely biodiversity conservation expertise, knowledge base for conservation, implementation of conservation strategy, delegation of conservation responsibilities and biodiversity conservation programme planning. Where conservation literature tends to highlight inadequacies in biodiversity surveying and monitoring, it was the field research that signalled the crux of the matter as insufficient biodiversity conservation expertise. Another contrast between the theoretically-derived and field-derived criteria is also a result of academic interests currently focusing on community participation in management. However, this research has prioritized the management processes of planning and implementation and clear roles for the various stakeholders in these processes.

At the beginning of the research it was not clear what external influences to protected areas management were critical for conservation on tropical islands. What are evidently crucial external factors for tropical islands are the conservation knowledge base and the availability of local biodiversity expertise. In fact, in enquiring about the oldest most well established universities in Jamaica and the Dominican Republic, the University of the West Indies (UWI) – Mona Campus and Universidad Autonoma de Santo Domingo respectively, it was noted that neither had a protected areas course at the undergraduate or graduate level.

UWI – Mona has a well established tradition of teaching marine ecology over its approximately 60 year history, with conservation topics tending to be incorporated into marine ecology courses. Terrestrial ecology and the conservation of terrestrial ecosystems as an undergraduate course were introduced in 1990. Prior to that year, these subjects were included in undergraduate botanical and forestry-related courses. Protected areas are now included in these courses as a topic. So the cultivation of local expertise in the field of terrestrial ecology and more recently conservation biology is relatively new for Jamaica. I raise these points to show that there are genuine challenges in the local capacity to manage protected areas and conserve biodiversity, based on the most recent scientific knowledge. With a greater scientific knowledge base there is likely to be more appreciation of biodiversity conservation as an interdisciplinary process, of uncertainty in protected areas design, and greater adaptive management, where conservation strategies are periodically reviewed with subsequent guidelines for improved protected areas management.

The criteria in the final conservation effectiveness framework included those that highlighted the biogeographic features of islands, captured the ecological and resource use aspects of institutional and civil development, and governance critical for effective biodiversity (Table 55). As far as possible the relevant IUCN-CMP Classification of Conservation Action terminology was applied. In a few instances, criteria were similar or the same for both Jamaica and the Dominican Republic (e.g. income generation, national land use policies) and these were retained in the final framework. The terminology for other criteria facilitated possible contextual variations that could occur across different tropical islands. Conservation literature has demonstrated that the choice of conservation paradigm may change over time, as with the current trend from protectionism towards sustainable use. A distinct advantage of the generic nature of the final framework is that

Table 55. Framework for Biodiversity Conservation Effectiveness in the Terrestrial Protected Areas System of a Tropical Island

	Ecological Criteria		Socio-Economic Criteria	
	PA System	**PA Site**	**PA System**	**PA Site**
Conservation Goals/ Objectives	• National *in situ* biodiversity conservation goals & objectives • Conserving centres of endemic and endangered biodiversity • Network of freshwater conservation areas	• Biodiversity conservation goals & objectives for all sites • Forest conservation targets • Freshwater conservation targets • Endemic, co-adapted & threatened plant and animal conservation targets	• National natural *in situ* resource use goals & objectives • Greater public education and awareness	• Natural resource use goals & objectives for all sites • Greater public support
Conservation Outcomes	• Representation of ***all*** major forest classes and fresh-water ecosystems • No loss of forest cover • No loss of freshwater bodies • Recovery of threatened biodiversity • Reduction in no. of invasive species • System threats	• Reduction in deforestation • Prevention of water pollution • Self-sustaining breeding populations of endemic & co-adapted species • Control of invasive species	• Natural resource use trends • Proposed limits to natural resource use	• Natural resource use for each site • Actual extent of natural resource use
Institutional & Civil Society Develop-ment	• Biodiversity conservation expertise • Implementation of conservation strategy • Funding sources/ Partners	• Conservation training • Biological and socio-economic surveys • Conservation budget	• Income generation • Expected stakeholder/ actor participation • Conservation knowledge base	• Livelihood opportunities • Actual stakeholder/ actor participation
Governance	• Delegation of conservation responsibilities • Community involvement in conservation • Networking with various environmental sectors • Implementation of PA laws	• Biodiversity conservation programme planning • Community participation in conservation actions • PA demarcation	• Financial sustainability • Coordinated enforcement • National land use policies • Payments for biodiversity protection	• Conservation finance • Patrol effort • Natural resource use regulations • Local/community incentives

of still being applicable to a protected areas system in the event that its conservation paradigm eventually changes.

As highlighted earlier, there has been a tendency in protected areas management literature to overlook explicit linkages between the system and site levels of management. The biodiversity conservation effectiveness framework proposes that effective biodiversity conservation depends on critical linkages between the system and site levels of protected areas management. The case study findings provide an empirical basis for such linkages in a top-down, hierarchical governance structure. By considering this governance structure for two scenarios, namely the autonomous government management authorities of the Jamaican case and the centralized government authority of the Dominican Republic, critical links affecting conservation outcomes were identified. The official delegation of biodiversity conservation responsibilities by protected areas system managers in delegation instruments to site managers emerged as an essential means of committing biodiversity conservation as a management goal. Once such a commitment is established, the results point toward conservation planning that involves a two-way flow of information between the system and site managers for identification of gaps in the setting of conservation objectives and the assessment of outcomes.

A key obstacle to the conservation of the unique ecological features and protection of endangered species and ecosystems is the lack of bi-directional scientific exchange at system and site levels. Strengthening the scientific knowledge base and including local community knowledge of biodiversity would also help orient conservation planning towards the unique biogeographical features of tropical islands.

Another operational issue that was found to exhibit a clear vertical link is the financing of protected area conservation activities. In the case of both Jamaica and the Dominican Republic it was the system-to-sites flow of funds that was critical in maintaining staff. In particular, the case study showed that top-down financial support for enforcement officers hired by protected areas is a critical link. The Government of Jamaica through its different agencies pays salaries to game and forest wardens and park rangers. In the Dominican Republic the protected areas and biodiversity conservation authority paid protected area enforcement officers. Although doubts have been expressed in the literature about the impact of inadequate enforcement officers on natural resource use monitoring and regulation, they play a critical role in encouraging compliance with conservation regulations. The Dominican Republic case also indicated that national conservation budgeting, although not adequate to sustain all site activities, alleviated some of the operational cost of staffing. Furthermore, a sites-to-system flow of funds may occur through the collection of ecotourism taxes for visits to protected sites.

6.1 Limitations of the Research

Contemporary *in situ* biodiversity conservation promotes a management style for protected areas that incorporates transboundary ecological, institutional and governance issues. This approach was not a focus for this study. The researcher in considering the hierarchical, government-centred governance structure for national protected areas systems management on Caribbean islands felt that the greater need was to improve aspects of management directly controlled or influenced by in-country stakeholders. The expectation is that this focus will allow more flexibility in adapting management to greater facilitate effective biodiversity conservation.

The small number of case study locations that could be addressed in the scope of this graduate study affects the general application of the findings to other Caribbean and by extension tropical islands. Management infrastructure for protected areas systems in terms of conservation planning, stakeholder participation, governance and conservation expertise can be viewed as more developed (Jamaica) to less developed (Dominican Republic) along a spectrum of management levels for a protected areas system. The findings of this research would be relevant to island contexts that fall along this spectrum.

Specific limitations were identified for the review of Dominicano literature, the Jamaican Delphi and Dominicano survey processes, and the community workshops. The language barrier, that is locating documents and translating from Spanish literature to English, was partially overcome by consulting with a protected area scientist and managers about publications familiar to them, searching on-line databases in both English and Spanish and utilizing a part-time Dominicano interpreter. Nevertheless, it is likely that academic literature was more difficult to locate for the Dominican Republic not only because of limited research on their *in situ* biodiversity conservation, but also because of publications on the subject in Spanish journals that were not accessed. Language was also an issue for the community workshops as three workshops had the same interpreter and the other two each had a different interpreter due to the unavailability of any of the three persons for all workshops. The implication is that the variable quality of spoken language interpretation across the workshops would have affected the quality of workshop data collected according to the competence of the interpreter.

Due to the voluntary nature of the Delphi process and community workshops the small sample of expert and community participants was accepted. The participants represent only a small sample of the total expert and community residents pool and so their contributions to the research data are not definitive but indicative of the opinions held by these two stakeholder groups. The technological constraint of accessing individual email accounts, especially in rural areas, and the legitimizing of communication between the researcher and potential Delphi participants by the government agency clearly indicated that the Delphi process was not applicable to the Dominican Republic case. The alternate survey approach was based on selective rather than random distribution of the questionnaire among the expert group in order to successfully collect data. Consequently, a direct comparison of the Jamaican Delphi results and the Dominicano survey results was not possible due to the different data collection methods.

6.2 Conclusions

The assumption underlying previous applications of conservation effectiveness frameworks on tropical islands is that biodiversity conservation has been constructed according to a 'universal' perspective. This study indicates that for tropical islands this assumption masks significant differences in conservation values, management context and scale. Consequently, protected areas design, institutional management capacity, management approaches and social goals of tropical islands are yet to be adequately represented in the conceptual foundations of existing conservation effectiveness frameworks.

Contemporary thinking characterizes effective biodiversity conservation in a protected areas system as protection and maintenance of a sampling of the full range of genes, species and ecosystems for a geographic location. The magnitude of such a programme flags the necessity of applying practical limits to the interpretation of 'full range'. The Jamaican and Dominicano research findings strongly suggest that these limits be based on accessible, scientific data and information for species and ecosystems on tropical islands. In both study locations, genetic diversity has been marginalized in the plans for biodiversity conservation, presumably because of greater data collection and financial challenges involved in its direct monitoring. It is therefore reasonable to place higher priority on species and ecosystem diversity in discussing effective biodiversity conservation in the case study ecological context. Even so, successful biodiversity conservation has been restricted to increased population numbers (e.g. Jamaican Iguana) and maintaining the variety of types of forest for both study locations. Biodiversity distribution data and information reviewed in this study, indicate that existing scientific records for birds, mammals and endemic trees have been under-utilized in conservation planning. Inevitably, the limited variety of species and ecosystems considered in conservation planning will hamper the achievement of effective biodiversity conservation.

Recalling Table 3, tropical islands are more aligned with the traditional management paradigm for protected areas than the contemporary with the exception of finances where overseas or non-government funding is often sought. A change in progress is the increasing involvement of local people although their decision-making power is considerably limited. Existing assessments have generated much information and discourse on the conservation of tropical biodiversity and the effectiveness of protected areas in alleviating conservation problems. What they have not done is to highlight the particular and growing conceptual and pragmatic challenges facing tropical islands worldwide as they seek to effectively conserve biodiversity in national systems of protected areas.

Biodiversity conservation is a pluralistic concept that demands changes in human-natural environment relationships by:

1) Challenging dominant anthropocentric values that have traditionally favoured conservation of species useful to humans
2) Requiring expanded or new environmental conservation actions based on biodiversity conservation goals and outcomes
3) Requiring that the knowledge base for wild species conservation expand to include ecosystem dynamics

4) Requiring that reductionist scientific approaches be replaced with integrated or non-linear, holistic scientific approaches.

What this thesis has shown is how the differences in geographic scale, conservation values, ecological and socio-economic factors between the "universal" and island concepts and practices of conservation have resulted in different protected areas design, institutional management capacity, appropriate management approaches and social goals.

Effective biodiversity conservation has been perceived as an outcome of conserving large land areas for biodiversity at the national level, without accounting for the availability of land for conservation and land use conflicts. It requires significant long-term investments in scientific conservation expertise, human resources and financing. Another essential is shared conservation purpose among stakeholders coordinated by a management authority. These conditions are atypical of tropical islands. Land use is usually heavily contested by multiple natural resource-based interests with biodiversity conservation being low on the priority list. This status is unlikely to change in the long run as many tropical islands are classified as developing countries whose economic survival is closely connected with their capacity to exploit their natural resources. Biodiversity conservation is likely to be more socially acceptable where religious and cultural perceptions are strongly in favour of conserving the natural environment.

The Jamaica-Dominican Republic case study advances the theorizing of protected areas management for effective biodiversity conservation in two ways. It provides initial evidence that vertical links between system and site levels of management play a critical role in realizing conservation outcomes. It also shifts the analysis and evaluation of effective biodiversity conservation away from a "universal" to a national scale reference by taking a national (i.e. system level) to local (i.e. site level) scale perspective. Recalling the distinct biogeographic features of islands and the socio-economic contextual issues highlighted in discussion, there seems to be a 'scale mismatch' between contemporary perceptions of effective biodiversity conservation and that which seems likely to ensure protection of centres of endemic and endangered island biodiversity, protect the biological integrity of island forest ecosystems and freshwater networks, reduce human threats to biodiversity through better regulated natural resource use on tropical islands. Rather than choose any one strategy for island biodiversity conservation, by all indications, the natural distribution patterns for tropical island biodiversity, the landscape and land use context should determine the system design(s) and supporting conservation policies to be utilized.

Recalling the purpose of developing an island-specific framework for effective biodiversity conservation, there was partial success with respect to framework criteria that address biogeographical features. The biophysical data included as part of the research findings provided compelling evidence for the high percentage of endemism, the common occurrence of restricted range species and the rarity of large land mammals. Less data was available on alien invasive species, responses to tropical storms, and fires, indicating the high vulnerability of islands to these threats and disturbances. The latter has gone relatively unaddressed by local scientists and protected areas managers. Additionally, declaring large, contiguous areas for protection seems less pragmatic in the island context considering the high levels of habitat fragmentation and multiple land uses which are natural resource-based. The "few very large" approach to protected areas design is most applicable to countries such as Canada that have extensive areas of relatively uninhabited lands. The remaining criteria in the final conservation assessment framework are also applicable to other countries and not particularly unique to tropical islands. The final framework is consequently best described as an island –sensitive framework based on the biogeographic criteria and less emphasis on large protected areas.

6.3 Recommendations

It is recognized that the argument for an island-specific framework would benefit from the inclusion of more case study locations worldwide. Therefore, a recommendation is the further development and testing of the framework by conservation scientists over a wider variety of ecological and socio-economic contexts on tropical islands. Future research should include not only Caribbean islands from the Greater and Lesser Antilles but also Pacific and Indonesian islands. The magnitude of such a research project would require substantial funding from international donor agencies and in-island support for the project.

If effective biodiversity conservation in national protected areas systems is to become a reality for tropical islands, then there is an urgent need to build their capacity for educating and training protected areas and conservation scientists and practitioners. Greater in-island attention needs to be paid to strengthening the scientific knowledge base by advancing conservation protected area management programmes in the curriculum of the tertiary education institutions that exist on tropical islands. Research institutions could also be provided with a research prospectus which identifies ecological and socio-economic research topics which would benefit protected area management by increasing the inventorying and mapping of species and ecosystems, threats to biodiversity and provide baseline data on under-studied species and their uses. Collaborative research with better funded overseas institutions that conduct conservation studies or biodiversity monitoring is one opportunity for overcoming the knowledge gap challenge. A consistent effort must be made to collect research or study reports from both local and foreign researchers as required in the research permit for protected areas in both Jamaica and the Dominican Republic.

Several research contacts in Jamaica and the Dominican Republic indicated that human and financial resources have been repeatedly invested public education activities and programmes about protected endemic species and their habitats, and relevant laws. However, this study highlights a gap in public education activities and programmes that needs to be urgently addressed. Conservation educators need to tackle the lack of understanding about a national system of protected areas with respect to the different categories in the system, the responsibilities to biodiversity conservation under the categories, national conservation strategies and their desired conservation outcomes. This study provides evidence that, in general, members of communities within and adjacent to protected areas in Jamaica and the Dominican Republic are not familiar with the aforementioned aspects of protected areas management. By expanding the conservation knowledge of local communities, protected areas management will benefit from improved articulation of conservation matters by community members during public consultations on management plans and greater support for management activities in protected areas.

Another significant recommendation emerging from this study, and specific to protected areas policy-makers, is that a policy of periodically evaluating biodiversity conservation outcomes, as a part of wider management effectiveness assessments, be strongly promoted. These evaluations should investigate conservation effectiveness at both the system and site levels of protected areas management. Such a policy would greatly minimize the risk of biodiversity conservation being obscured by other protected area priorities. Incorporating an adaptive management approach would facilitate better problem-solving as a result of the lessons learned from past conservation experiences. Outcome evaluations would also assist in updating lists of species and ecosystem conservation targets and guide the declaration of new protected areas.

A goal-outcome oriented process for biodiversity conservation planning, with the joint participation of management authorities for the protected area system and the component sites, would greatly improve conservation planning and implementation. Particular attention should be paid to establishing a common vision for biodiversity conservation, explicit in delegation instruments and communicated to management stakeholders and community groups. Without, at minimum, an indication in delegation instruments of the acceptable conservation approaches and values, there is opportunity for site managers to define their own concept of biodiversity conservation which may or may not cause conflict with protected area system plans. Tangible evidence of coordinated conservation planning could include a requirement by the delegating authority for management plans to clearly state how their expected conservation outcomes over the management period will contribute to the wider goal of national biodiversity conservation.

Protected areas system managers along with relevant stakeholders in Jamaica and the Dominican Republic could compensate for insufficient enforcement staff and financing by capitalizing on opportunities to 1) conduct collaborative enforcement and 2) access funding from a variety of sources (e.g. Trust Funds, debt-for-nature-swaps, project funds and income-generating ventures). Where a park ranger, forest warden and an environmental enforcement officer may be assigned to the same protected area under different jurisdictions, cost-effective sharing of enforcement responsibilities and logistics could be a part of a coordinated, collaborative management process. In order to realize a coordinated process to the management of the protected areas systems in Jamaica and the Dominican Republic, system level managers should have a clear understanding of the roles played by practitioner and community stakeholders involved in biodiversity conservation planning, enforcement and financing of a national protected areas system.

My last recommendation is directed to international environment and development agencies. Based on dialogue with Caribbean colleagues, the expense of conducting an assessment of biodiversity conservation effectiveness in a national protected areas system has led to a reliance on international conservation and funding agencies for such tasks. These agencies can greatly increase the likelihood of evaluation recommendations realistically reflecting the geographic scale and context of tropical islands by encouraging the use of island-sensitive biogeographical criteria and context-sensitive socio-economic criteria in the conservation evaluations that they fund.

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APPENDIX A. Letter of Invitation to Jamaican Experts for Delphi Participation

Wilfrid Laurier University
Information Letter

Dear ___________________:
(Participant's name)

This letter is a request for your voluntary participation in a research project conducted by Suzanne Davis and entitled *Evaluating Biodiversity Conservation in the Protected Areas of Tropical Islands: The Case of Caribbean.* This study is part of a Doctor of Philosophy thesis which is supervised by Dr. Scott Slocombe of the Department of Geography & Environmental Studies, Wilfrid Laurier University, 75 University Ave West, Waterloo, Ontario N2L 3C5, Canada.

The purpose of the research is the development of an evaluation scheme for biodiversity conservation in protected areas that assesses management outcomes with respect to the ecological and socio-economic contexts of tropical islands. It is hoped that the research will lead to a better planning and coordination of protected areas systems and better resourcing of management sites for biodiversity conservation on tropical islands.

This research uses the "Delphi" method, communicating with about twenty to twenty-five persons via questionnaires and providing feedback to all participants. This means that you, as a respondent, will actually participate in shaping the research findings. Please indicate your willingness to participate by hitting the reply button of your email invitation and typing "Yes" in the first line. The first of two questionnaires will be sent to you in January 2007. All persons who respond to this first questionnaire will receive a second one in mm/2007, containing the collated, summarized results of the first questionnaire. You will be asked for your views on the collated group results presented in the second questionnaire. Later, respondents will be provided with a summary of the collated results from the second and final round of Delphi questions.

During the Delphi process participants are anonymous to each other and feedback should be emailed directly to this researcher. This gives every one the opportunity to freely express themselves. Only S. Davis and S. Slocombe will have access to the Delphi responses and our interest is in collated data rather than individual opinions. Consequently, individual identity is not required for reporting on research findings and will be kept confidential. However, confidentiality cannot be guaranteed when email responses are in transmission across the Internet. Also note that quotations from any of the participants' responses will not be used.

We hope that you will enjoy participating in this relatively unusual kind of survey. In addition, your participation will be valuable for the development of an island-specific evaluation scheme for biodiversity conservation. However, you may withdraw your participation at any time and omit answering questions.

If you have questions at any time about the study you may contact the researcher, Suzanne Davis at davi2804@wlu.ca. This project has been reviewed and approved by the

University Research Ethics Board at Wilfrid Laurier University. If you feel you have not been treated according to the descriptions in this form, or your rights as a participant in research have been violated during the course of this project, you may contact Dr. Bill Marr, Chair, University Research Ethics Board, Wilfrid Laurier University, (519) 884-0710, extension 2468, email: bmarr@wlu.ca.

At the end of this research project, a seminar will be held for research participants with the purpose of sharing research findings and responding to questions about the evaluation framework.

Thanks in advance.

Yours sincerely

____

Suzanne Davis

APPENDIX B. Letter of Invitation to Dominicano Experts for Delphi Participation

Department of Geography & Environmental Studies
Wilfrid Laurier University
75 University Ave West, Waterloo
Ontario N2L 3C5, Canada
Correo electrónico: davi2804@wlu.ca
Febrero 19, 2007

Estimado Sr./Sra.,

Por medio de esta carta le pido a usted su participación voluntaria en un proyecto de investigación realizado por Suzanne Davis y titulado *Evaluando la Conservación de la Biodiversidad en las Áreas Protegidas de Islas Tropicales:El Caso del Caribe.* Este estudio es parte de la tésis doctoral de filosofía supervisada por el Doctor Scott Slocombe del Departmento de Geografía y Estudios Ambientales de la Universidad Wilfrid Laurier, 75 University Avenue West, Waterloo, Ontario N2L 3C5, Canadá.

El propósito de la investigación es el desarrollo de un esquema de evaluación para la conservación de la biodiversidad en áreas protegidas que valora los resultados de la administración con respecto a los contextos ecológicos y socioeconómicos de las islas tropicales. Se espera que la investigación resulte en una mejor planificación y coordinación de los sistemas de áreas protegidas y en mejores métodos de administración de recursos de los sitios para la conservación de la biodiversidad en islas tropicales.

Esta investigación utiliza el método "Delphi", que consiste en comunicarse con veinte a veinticinco personas vía cuestionarios y proporcionando los resultados a todos los participantes de la investigación. Esto significa que usted, como un participante, tomará parte realmente colaborando con las conclusiones de la investigación. Indique por favor su consentimiento en participar al escribir su nombre y "Si" al fin de esta carta. El primero de dos cuestionarios será enviado a usted en febrero 2007. Todas las personas que respondan a este primer cuestionario recibirán un segundo en marzo 2007, conteniendo los resultados cotejados y resumidos del primer cuestionario. Se pedirá la revisión de los resultados cotejados del grupo presentados en el segundo cuestionario. Más tarde a los participantes les será proporcionado un resumen de los resultados cotejados del segundo y la serie final de preguntas "Delphi".

Durante el proceso "Delphi", los participantes son anónimos el uno para el otro y la reacción no debe ser transferida de uno al otro. Esto da a cada uno la oportunidad de expresar a si mismo libremente. Sólo S. Davis y S. Slocombe tendrán acceso a las respuestas "Delphi"y nos interesa más los datos cotejados que las opiniones individuales. Consecuentemente, no se requiere la identidad individual al hacer el análisis de las conclusiones de investigación y todo será mantenido en confidencialidad.

Esperamos que usted tome parte en este tipo de estudio que es relativamente excepcional. Además, su participación será valida para el desarrollo de un esquema "isla-específico" para la evaluación de la conservación de la biodiversidad. Sin embargo, usted puede retirar su participación en cualquier momento y omitir el responder a preguntas.

Si usted tiene preguntas sobre el estudio, usted puede contactar a la investigadora, Suzanne Davis a través del correo: davi2804@wlu.ca. Este proyecto ha sido revisado y ha sido aprobado por la Tabla de Moralidad de Investigación Universitaria en la Universidad de Wilfrid Laurier. Si usted se siente que no ha sido tratado según las descripciones en esta forma, o que sus derechos como un participante en la investigación han sido violados durante este proyecto, usted puede contactar el Doctor Bill Marr, Catedra, de la Tabla de Moralidad de Investigación Universitaria, la Universidad de Wilfrid Laurier, (519) 884-0710, extension 2468, correo electrónico: bmarr@wlu.ca.

A los fines de este proyecto de investigación, habrá un seminario para participantes de investigación con el propósito de compartir conclusiones de la investigación y responder a preguntas acerca de la estructura de la evaluación.

Gracias en avance.
Atentamente

____
Suzanne Davis

APPENDIX C. Delphi Questions, Round 2

EVALUATING BIODIVERSITY CONSERVATION
IN THE PROTECTED AREAS OF TROPICAL ISLANDS:
THE CASE OF THE CARIBBEAN

Delphi Questions Round 2

Round 2 of the Delphi process requires that you determine your level of agreement or disagreement with the collated responses to the questions posed in Round 1 on protected areas management and biodiversity conservation.

You will see each Round 1 question below followed by the responses of the Delphi group. Please read each statement carefully. Where more than one response was very similar, the responses were combined into one statement to avoid duplication. Otherwise, there has been minimal editing of responses with the exception of making a statement clearer.

Please indicate your level of agreement or disagreement with each statement using the following numerical scale:

1	2	3	4	5
Strongly disagree	**Disagree**	**Neutral**	**Agree**	**Strongly agree**

Please assign a number to <u>each</u> statement and type your choice between the provided brackets. Each numerical rank can be used more than once. Please complete the questionnaire before **11/06/2007** and return your <u>saved</u> responses to <u>davi2804@wlu.ca</u>

****

Question 1. How would you define biodiversity conservation?

Generally, Delphi participants agreed that biodiversity conservation is the protection and/or maintenance of the variety of living organisms and their areas of occurrence. However, the definitions also included different opinions on the specific focus for biological variety and the approach to biodiversity conservation. These opinions are presented below for ranking.

Statement	Rank
• Protection and care of different types of plants and animals	[ ]
• Maintenance of species and their genes at local, regional or global scales	[ ]
• Protection of naturally occurring wildlife and their habitat	[ ]
• Preservation and maintenance of the relative proportions of existing flora and fauna and their associated habitats	[ ]
• Maintaining vulnerable, threatened or endangered species and ecosystems	[ ]
• Conservation of biologically diverse or environmentally sensitive areas	[ ]
• Sustainable management of all living organisms and their ecological complexes	[ ]
• Ensuring a comprehensive set of representative ecosystems, species and natural processes	[ ]
• Protection and preservation species, restoration habitats, maintenance of healthy ecosystems, for both intrinsic and human values	[ ]
• Maintenance of niche function for genes, species and ecosystems	[ ]

Question 2 . What biodiversity conservation goals and objectives do you think are priorities for an effective national protected areas system?

Statement	Rank
Goals:	
• Long-term financial sustainability	[ ]
• Decision-making based on sound and current ecological data	[ ]
• Public awareness and understanding about the value of protected areas and their direct and indirect contribution to national development	[ ]
• An integrated network of linked protected areas	[ ]
• Maintenance and protection of a representative range of habitats and their associated communities (i.e. biological representation)	[ ]
• Protection of reproductively active populations	[ ]
• Up-to-date assessments of species and ecosystem status with a focus on endemic species and their habitats	[ ]
• Assessment of threats and vulnerabilities	[ ]
• Reduction of threats	[ ]
• Rehabilitation of degraded or destroyed areas	[ ]
• Conservation strategies for threatened animal species	[ ]
• Maintenance of endemic and native species of flora and fauna and of natural habitat/vegetation	[ ]
Objectives:	
• Conservation of genetic diversity	[ ]
• Conserving species diversity	[ ]
• Conserving community/ecosystem diversity	[ ]
• Sharing of resources across the entire protected areas system, complemented by dedicated resources for individual areas	[ ]
• Establishing legislative and institutional frameworks, and organizational mechanisms to support the financial and management needs of the system.	[ ]
• Creating a system based on scientific knowledge and data	[ ]
• Evaluation of conservation success	[ ]
• Use of collaborative and adaptive management methodologies	[ ]
• Identification and protection of resilient populations.	[ ]
• Biological representation	[ ]
• Population redundancy (different sites protecting different populations for same species)	[ ]

- Attaining human benefits (direct and indirect) from ecological services and conservation activities [ ]
- Control or removal of invasive species [ ]
- Controlled introduction of non-native species [ ]
- Reduce encroachment (urban and agriculture) [ ]
- Re-establishing degraded areas as close as possible to their original state or replanting these areas with native species [ ]
- To prevent extinction and reduce the number of threatened species [ ]
- Determine specific areas and species to be protected and mark protected areas with defined boundaries [ ]

Question 3. What institutional issues at the *protected areas system level* do you think have the greatest influence on biodiversity conservation in protected sites?

Statement	Rank
• Institutional leadership that encompasses a mixture of technical and environmental knowledge, and business management skills with a strong accountability focus	[ ]
• Lack of appropriately trained, experienced staff with scientific background	[ ]
• Low levels of financial resources	[ ]
• Developing the capability to attract funding from government, private sector and international and local donor agencies to ensure sustainability and growth.	[ ]
• Trained staff with the ability to identify, monitor and manage the areas	[ ]
• Supply of adequate number of staff for policing protected areas	[ ]
• Numbers and training of enforcement staff	[ ]
• Support equipment (e.g. boats or trail bikes as well as fuel)	[ ]
• Limited collaboration in conservation planning and coordination of activities between organizations	[ ]
• Need for a zero tolerance approach towards illegal activities	[ ]
• Sufficient research and public education resources to raise public awareness	[ ]
• Community participation in site management from the earliest stage	[ ]
• Absence of incorporated jurisdictions and organizational resources of different protected area management authorities (e.g. Fisheries Dept., Heritage Trust, Forestry and NEPA)	[ ]
• Ability to influence policy-making and problem-solving processes	[ ]
• The higher value placed on economic development at national and individual levels	[ ]
• The perception of biodiversity conservation as an expense instead of an asset	[ ]

- Lack of real investment in sustainable development and sustainable livelihoods by government, private sector and individuals [ ]
- Land tenure [ ]
- Lack of clarity as on issues relating to protected area boundaries [ ]

Question 4. What governance issues at the *protected areas system level* do you think hav the greatest influence on biodiversity conservation in protected sites?

Statement	Rank
• Political support for biodiversity conservation from a dedicated national conservation authority or strong lead organization, and environment Ministry	[ ]
• Financial support	[ ]
• Support from local and international conservation groups	[ ]
• Awareness and support from communities within or neighbouring protected areas	[ ]
• Public participation	[ ]
• Effective education programmes	[ ]
• Legal and management frameworks	[ ]
• Numbers and training of enforcement staff	[ ]
• Need for clear policies and management plans, and sufficient resources for effective site management	[ ]
• Lack of agreed measures/indicators for success at biodiversity conservation	[ ]
• Low levels of tracking conservation efforts and reporting to government entities	[ ]
• Few biodiversity monitoring programmes except for time-limited, project funded activities	[ ]
• Lack of clearly demarcated boundaries for protected areas	[ ]
• No obvious immediate benefit to stakeholders	[ ]
• Large number of diverse stakeholders	[ ]
• Low level of accountability of those delegated to manage protected areas on behalf of the GOJ	[ ]
• Low levels of capacity within government entities, non-governmental organizations to engage in conservation activities	[ ]
• Low willingness of private sector to engage in conservation activities	[ ]

Question 5. Please consider the following evaluation criteria for assessing biophysical outcomes and associated inputs and actions for protected areas management and governance. Which ones do you consider to be of greatest importance?

The criteria below include those in the original list as well as additions of criteria considered of greatest importance by the Delphi group. Criteria that were regarded as least important have been excluded. As requested, I have provided clarification (in italics) for some criteria.

Please rank the revised list of criteria in terms of your level of agreement/disagreement with criteria of greatest importance.

Biophysical Features	**Management Institutions**	**Governance**
• Biological representation (full range of native biodiversity) [ ] • Congruence (or overlap) of species distribution ranges for endemics[ ] • Ecosystem complementarity (no. of unrepresented ecosystems that a new site adds) [ ] • Population redundancy (different sites protecting different populations for same species) [ ] • System threats *(i.e. threats to the PA system as a whole)* [ ] • Disturbances *(disruptions that either temporarily change the state of or result in adaptation of species and ecosystems e.g. storms)* [ ] • Species indices: endemism, co-adaptation, richness, threat status [ ] • Level of deforestation [ ] • Control of invasive species [ ] • Land cover *(i.e. vegetation types & land use)* [ ] • Population pressure [ ]	• Conservation strategy (species and/or ecosystem focus) [ ] • Implementation of conservation strategies [ ] • Designation of management authority [ ] • Training for PA managers & staff [ ] • Staff (existence &/or level) [ ] • Salaries [ ] • Biodiversity surveys & research [ ] • Partners/ collaborators for scientific surveys & research [ ] • Stakeholder/ actor participation [ ] • Funding sources/ Partners [ ] • Coordination between management agencies [ ]	• Networking with various environmental sectors [ ] • PA policy [ ] • Implementation of PA laws [ ] • System planning [ ] • Community awareness [ ] • Park ranger patrols [ ] • PA demarcation & zoning [ ] • Site planning [ ] • National land use policies [ ] • Plans for external influences *(e.g. change in national economy)* on the protected areas system [ ] • Land tenure and use arrangements [ ] • Types of natural resource use regimes [ ] • Local/ community incentives [ ] • Willingness of courts to prosecute [ ] • Existence of mechanisms for conservation on private lands [ ]

Comments (optional):

APPENDIX D. Letter of Invitation to Community Representatives for Workshop Participation

Department of Geography & Environmental Studies
Wilfrid Laurier University
75 University Ave West
Waterloo, Ontario N2L 3C5, Canada
November 29, 2007

Dear _________________,

This letter is a request for your participation and members of your organization/council/household in a research project conducted by Suzanne Davis and entitled *Evaluating Biodiversity Conservation in the Protected Areas of Tropical Islands: The Case of Caribbean*. This study is part of a Doctor of Philosophy thesis which is supervised by Dr. Scott Slocombe of the Department of Geography & Environmental Studies, Wilfrid Laurier University, 75 University Ave West, Waterloo, Ontario N2L 3C5, Canada.

This is an environmental study about the conservation of biodiversity in protected areas. More specifically, it focuses on developing a way of measuring the success or failure of protected areas management in achieving effective conservation of biodiversity. Both ecological and socio-economic factors are of interest. It is hoped that the research will lead to a better planning and coordination of protected areas systems and better resourcing of management sites for biodiversity conservation on tropical islands.

This research uses a community workshop to involve persons living within and just outside protected areas in the research process. This means that if you and members of your organization/council/household attend the workshop, all of you will actually participate in shaping the research findings.

You are being invited to a two-hour workshop to publicly express your views on what the protected area has done for community awareness about the natural environment, land tenure and use, natural resource use, local community incentives to protect nature and other protected area matters of interest to you. More information will be provided about this research study at the workshop. The major points of discussion will be noted on flip charts by a workshop assistant.

Workshop details are provided below.

DATE: ___________
VENUE: _____________________
TIME: __________________
Please confirm your attendance by calling (JCDT Office #)

At the end of this research project, a seminar will be held for research participants with the purpose of sharing research findings and responding to questions about the research.

Thanks in advance.

Yours sincerely

Suzanne Davis

Appendix E. Interview Protocol for Evaluation Interviews in the Case Study Locations

Ecosystem and Conservation

1) My understanding is that [Organization's name] is aligning itself with the Convention on Biological Diversity (CBD). This raises the concept of ecological representation. What do you think your country status is with respect to ecological representation in its protected areas?

2) How are biodiversity conservation priorities determined, especially for protected areas?

3) Do you find existing legislation adequate to conserve biodiversity?

4) Is there a list of resource use in all the protected areas?

Protected areas

1) What is your official job title?

2) What are your responsibilities with respects to national protected areas system?

3) Is there a document which is the plan for the national system of protected areas? If yes, what are the biodiversity conservation goals and objectives for your country's national protected areas system? If no, is there any document that is used to guide planning for biodiversity conservation in protected areas? Does it state goals and objectives?

3b) Yesterday I was told that the estrategia I had reviewed and analyzed was never used.

4) Do you see this as an achievement for national protected areas system? In order to know if ecological representation is being achieved, there would have to be a list of major ecosystem types, major plant and animal groups on the island. Does the government agency have such a list?

5) I see strong support for sustainable development in the documents I have reviewed on protected areas management in this country. Which raises a question – What is the range of different uses of species and ecosystems in each protected area across the country? Has a survey been done or is there information on this?

6) How would you define co-management?

b) How are responsibilities/decision-making shared with non-governmental organizations (NGOs)?
c) Do you see any benefits from co-management for conserving biodiversity?

7) Has co-management in any way helped with the funding aspects or decision-making in biodiversity conservation?

8) Is there a budget for either biodiversity conservation or protected areas management that is approved by cabinet? Annually?

9) What are the different funding options available for the protected areas, example, debt-for-nature swaps, international funding?

10) How are these funds made available to the individual protected areas?

11) How does the government agency decide what programmes / projects to fund? How are conservation priorities determined?

12) How would you say the current surveys and monitoring have helped the government agency understand the status of the country's biodiversity?

13) Legal enforcement is difficult. Are you able to actually enforce laws? For example make arrests, fines?

APPENDIX F. Excerpts from the National Heritage Trust Act

13-- (1) The Trust may, for the purposes of this Act, designate--

(a) any place name, thing or any species of animal or plant life; or

(b) any place or object which has not been declared a national monument, to be a protected national heritage

15- Where the Trust is of the opinion that action should be taken to prevent a national monument or protected national heritage from falling into a state of disrepair, it shall be lawful for the Trust-

(a) to notify the owner or person in possession that the protected national heritage or national monument is in need of repair;

(b) to provide such assistance as may be necessary (whether financial or otherwise) to the owner or person in possession for the purpose of maintaining it; or

(c) to maintain the protected national heritage or national monument.

"Maintenance" includes the fencing, repairing and covering of a national monument and the doing of any other act or thing which may be required, for the purpose of repairing the national monument or protecting it from decay or injury, and the expression "maintain" shall be construed accordingly;

APPENDIX G. Excerpts from the Natural Resources Conservation Authority Act

Functions of Authority **4.-** (1) The functions of the Authority shall be-

(a) 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;

(b) to promote public awareness of the ecological systems of Jamaica and their importance to the social and economic life of the Island;

(c) to manage such national parks, marine parks, protected areas and public recreational facilities as may be prescribed,

(d) to advise the Minister on matters of general policy relating to the management, development, conservation and care of the environment; and

(e) to perform such other functions pertaining to the natural resources of Jamaica as may be assigned to it by the Minister or by or under this Act or any other enactment.

(2) In performing the functions specified in subsection 1) the Authority may-

(a) develop, implement and monitor plans and programmes relating to the management of the environment and the conservation and protection of natural resources;

(b) construct and maintain buildings and other facilities for public recreational purposes

(c) in relation to prescribed national parks, marine parks, protected areas and public recreational facilities-

(i) carry out or cause to be carried out such improvements as it thinks fit; and
(ii) provide for the zoning thereof for specified purposes and for the licensing of persons carrying on any trade or business therein;

(d) formulate standards and codes of practice to be observed for the improvement and maintenance of the quality of the environment generally, including the release of substances into the environment in connection with any works, activity or undertaking;

(e) investigate the effect on the environment of any activity that causes or might cause pollution or that involves or might involve waste management or disposal, and take such action as it thinks appropriate;

(f) undertake studies in relation to the environment and encourage and promote research into the use of techniques for the management of pollution and the conservation of natural resources;

(g) conduct seminars and training programmes and gather and disseminate information relating to environmental matters;

(h) do anything or enter into any arrangement which, in the opinion of the Authority, is necessary to ensure the proper performance of its functions.

Designation of national park, protected area, etc

5.- (1) The Minister may, on the recommendation of the Authority after consultation with the Jamaica National Heritage Trust, by order published in the Gazette designate-

(a) any area of land as a national park to be maintained for the benefit of the public;

(b) any area of land or water as a protected area in which may be preserved any object (whether animate or inanimate) or unusual combination of elements of the natural environment that is of aesthetic, educational, historical or scientific interest; or

(c) any area of land lying under tidal water and adjacent to such land or any area of water as a marine park.

(2) The Authority shall cause any order made under subsection (1) to be published once in a daily newspaper circulating in Jamaica.

Delegation

6.- (1) The Authority may delegate any of its functions under this Act (other than the power to make regulations) to any member, officer or agent of the Authority.

(2) Every delegation under subsection (1) is

revocable by the Authority and the delegation of a function shall not preclude the performance of that function by the Authority.

APPENDIX H. Excerpts from the Forestry Act, Forest Policy and National Forest Management and Conservation Plan

The Forest Act, 1996

6. Purpose of forest reserve.

6. (1) Forest reserves shall be used primarily for the following purposes -
(a) the conservation of forests existing naturally in the area of those forest reserves;
(b) the provision of land for the development of forest resources, including the establishment of forest plantations;
(c) the generation of forest products;
(d) the conservation of soil and water resources;
(e) the provision of parks and other recreational amenities; and
(f) the protection and conservation of endemic flora and fauna.
(2) A lease of any parcel of land in a forest reserve shall be regulated by the following conditions -
(a) the land may only be used for purposes compatible with subsection (1); and
(b) if the parcel of land includes any Crown lands, the Commissioner of Lands shall not grant lease without the approval in writing of the Conservator.

7. Declaration of forest management areas.

7. (1) The Minister may, by order, declare to be forest management areas -
(a) any Crown lands not in a forest reserve;
(b) any private lands, if he is satisfied that the use of the land should be controlled for the protection of the national interest.
(2) Forest management areas shall be used primarily for the purposes specified in section 6 (1) in relation to forest reserves.

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Forest Policy 2001 *(Updated Forest Land Use Policy, 1996)*

1.1 Conservation and Protection of Forests

- Forest lands, especially the last remaining areas of natural forests, will be conserved to protect and enhance the native and endemic flora and fauna of the Island. No harvesting will be permitted of primary closed natural forest in forest reserves, national parks, or protected areas.[1]
- Mangrove forests must be conserved in order to protect coastal diversity and near shore marine environments from sedimentation, land-based pollution and irregular fresh water input.
- Forest management will support the development of the National Park and Protected Areas System that will assist in the conservation of all natural resources.
- Forests must be protected from all threats including damage from fires, illegal cutting and theft of trees, illegal hunting of birds and animals, soil erosion and other processes which damage soil, water, plants, birds, animals and landscape features.
- No net loss of forest cover will be permitted on lands owned by the Government

of Jamaica. Where forest stands are wholly or partially cut or otherwise damaged, they should be promptly reforested with the same, or other suitable species. Where destruction of forest cover is unavoidable, the loss will be compensated by reforesting an equivalent area elsewhere.

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National Forest Management and Conservation Plan

18.0 STRATEGY 11: CO-ORDINATION AND MONITORING (p.86)
18.1 Review Process
The Forest Act, 1996 requires that the Forest Plan be reviewed and amended as necessary at intervals not exceeding five years. Performance will be monitored against the specific objectives of the Forest Plan, using measurable and verifiable indicators. This task will be conducted and reported to the Minister and the public by an independent Forestry Planning and Development Committee (referred to in the draft plan as the "Strategic Planning and Development Committee"), with technical monitoring and evaluation support from the Forestry Department. The indicators will be refined by the Committee, but are essentially predicated by the objectives of the Forest Plan (see Table 15). These are listed below by goal:

Goal: Protect forest resource/biodiversity conservation
- hectares reserved and effectively patrolled;
- current biophysical inventory and vegetation change data provided;
- hectares of private forest acquired or under protection agreement;
- km of new and existing forest reserve boundaries surveyed;
- km of boundaries, trails and fire breaks maintained;
- number of Local Forest Management Plans (LFMPs) approved by Minister and endorsed by Local Forest Management Committee (LFMC);
- number of LFMCs appointed and functioning;
- the percentage of critical emphasis areas covered by LFMPs;
- forest policy update completed;
- percent of Nation's school children receiving environmental forestry education; percent of residents in critical emphasis areas receiving local public awareness programme;
- number of residents in critical emphasis areas participating in forest management activities; and
- km of forest roads maintained or restored.

Goal: Restore tree cover
- hectares planted and maintained to defined standards;
- hectares of Crown land leased for suitable agroforestry use;
- number of seedlings produced;
- hectares of forest, disturbed by mining and related activities, reclaimed/replaced; and
- hectares of mangrove forest protected or restored.

19.0 IMPLEMENTATION OF THE FOREST PLAN

It is recognised that formal commitment to the Forest Plan is implied by its approval, but explicit commitment by the Government of Jamaica to donors and other investors, including commitment to a budget contribution sustained for at least the 5-year period of the Forest Plan, will be sought. Forestry Department will seek broad-based endorsement from both political and civil sectors of society for the Forest Plan.

19.1 Activities and Objectives

Table 15 below itemises the activities and targets by goal, consistent with strategies stated in the Forest Plan; feedback received from the general public and reviewers of the Forest Plan; and Forestry Department's interpretation of required or achievable targets. The targets relate to a 5-year implementation period which commences from the approval date of this Forest Plan by the Minister of Agriculture.

Table 15: Activities and Quantified Objectives of the Forest Plan

ACTIVITY	OBJECTIVE (Indicators and Targets)
GOAL: PROTECT FOREST RESOURCE	
Establish and operate protection system	100,000 ha currently reserved, plus additional remaining closed broadleaf forest (approximately 23,000 ha), and mangrove (5,600 ha), effectively patrolled and protected by staff of 60 trained wardens
Establish and maintain inventory and monitoring system	Current broad biophysical inventory of all forest land; detailed inventory of critical emphasis areas; change detection system in place for assessing forest cover change at 5-year intervals
Protection/forest conservation on private lands	Preservation of threatened undisturbed forest on private land in critical emphasis areas (assumed 5000 ha) through acquisition or incentives to landowners
Survey existing forest reserve boundaries	400 km (consisting of the 100 km being surveyed at present by FD plus an additional 300 km)
Survey new forest reserve boundaries	75 km
Maintain boundaries, trails, fire breaks	300 km per year
Produce Local Forest Management Plans (LFMPs)	LFMPs approved by Minister and endorsed by public for all forest reserves in critical emphasis areas within 5 years (including new declarations and forest management areas)
Establish and support Local Forest Management Committees	10 committees appointed and functioning, focussed on critical emphasis areas
Forest policy update	Updated Forest Policy
Public awareness	Local public awareness programme reaching all residents and stakeholders within critical emphasis areas; national public awareness programme reaching all school children
FD training	All FD staff trained and functionally competent in areas of responsibility
Community training	Effective community participation in forest management in 10 critical emphasis areas
Forest road maintenance and restoration	100 km per year

ACTIVITY	OBJECTIVE (Indicators and Targets)
GOAL: RESTORE TREE COVER	
Reforestation (planting, maintenance, silviculture)	1000 ha per year planted and maintained (20% Government: 80% private)
Survey Crown land for leasing	1100 ha of suitable Crown land leased for approved agroforestry use
Establish nursery system	3 nurseries with combined capacity of 1.5 million seedlings per year
Operate nursery system	1.1 million seedlings per year (to support 1000 ha per year); includes 65,000 seedlings for urban use
Develop and implement research programme	Reforestation programme supported by trials evaluating and verifying species selection, silvicultural and agroforestry systems and productivity
Mining reclamation support	No net loss of tree cover
Mangrove protection and restoration	Protect or restore mangrove forests to maintain at least 10,000 ha
GOAL: BIODIVERSITY CONSERVATION	
The activities for this goal are encompassed within the goals for "Protect Forest Resource" and "Restore Tree Cover"	Habitat for native flora and fauna is maintained by increasing the extent of forest reserves and other protected areas together with effective patrolling and protection of these areas.

APPENDIX I. Survey Results for Dominicano Experts

22 statements

1. How would you define biodiversity conservation?

A platform that is used to protect the living beings - the flora and fauna

It is the protection and preservation of the entire ecosystem that exists in certain places

Protection of all the ecosystems, plant species, and animals and their relationship with humans.

A strict supervision of the flora and fauna

To conserve life, trees, animals that we have and the forest, etc.

Preserving the diversity of life species

It is a way of increasing, every day, the quality of life preserving a great variety of life

Preservation of the current environment through long term planning

Contribution to the preservation of the species of a determined area.

Long-term maintenance of the integrity and health of the different elements that compose different types of life on earth

Protection of the natural resources

Most essential part of conservation in the National System of Protected Areas, since it is there where the most representative samples of biodiversity are found

It is the best legacy that we can provide to future generations, so to offer them the opportunity to enjoy this natural treasure.

Conservation of biodiversity would be defined as the first priority in reference to conservation of the human kind, because biodiversity has a direct impact on the quality of our health.

We have it in a medium scale, since there are some areas that have been altered due to the lack of political correction of conservation and biodiversity.

It is in a good state, still, but it is constantly threatened. The biodiversity is not that big; it is a very dry area. The part that is used by the public is very protected, since the supervision services are more frequent.

It is the starting point for humanity, the essence of life of the planet and the continuation of life on earth.

The conservation of biodiversity is strongly related to the degree of education of the local inhabitants and the policy employed by the authorities of the Environment (Ministry of) in providing that the citizens obtain economic benefits from the sustained

Collective and participative integration of all sectors that are involved, knowing and appreciating all the elements of conservation, flora, fauna and water resources, etc.

Daily routine patrolling to have a positive conservation

Depending on flora, fauna and natural aspects

It is a good conservation for the environment and the protected areas and for the biodiversity to protect the world.

63 statements

2. What biodiversity conservation goals and objectives do you think are priorities for an effective national protected areas system?

- Forestation

Reforestation with native and endemic species

To reduce human intervention

Develop organic gardens

- Fire prevention
- Human predators

To achieve better protection with an effective administration, integrating more areas of the system including more ranger stations and park rangers. Actually, out of 86 only 34 parks have park keeper personnel.

To increase the number of park rangers

The patrols for the park rangers

To have ranger stations in the park area for the control of infractions

A system with better park rangers and technical staffs

- More patrolling in the protected areas

Supervision of the area through patrolling

- Larger budget from the government

To provide more economic resources.

- Maintenance of financial resources to support in situ activities of control and supervision

Mainly the salary of the park rangers

- Creation of economic alternatives to the surrounding communities.

Protection and investment of economic resources for a sustainable use of the natural resources. The population agrees that support is needed.

Only the Ministry of Environment would provide technical staff to reform and apply the sectors law of protected areas.

To have employees specialized in the area, that are not related to politics (the government)

To create an understanding and make them (the members of the community) part of the system of the protected area for its conservation.

To integrate adjacent communities in the care and protection of the parks through the rational use of the resources.

The need of a conservation plan that integrates the communities that are invading the protected areas.

- To train not only the park personnel but also the community
- Community participation

The development of management plans in which the communities that live in the protected area would be involved, not only in the development of these plans, but also in its execution.

To involve the community for the better survival of the areas.

Involvement of the general population for the conservation of all the ecosystems in the protected areas.

- Major (extensive) research

To monitor endangered species.

- To determine (quantitative and qualitative) the species that we possess (in land and sea)
- To do more research in the protected areas.

- Research. Support to research
- Access to information
- To support the local and international institutions' conservation projects

To better train and educate the personnel, together with the community and the different organizations that are part of the community.

- The education of the communities

Provision of knowledge to the people related to the protected areas. That would provide good results.

To provide an environment education plan regarding the importance of the protected areas.

Environment-related conferences

- To develop environmental education programs for the schools and the communities

To create an awareness in the people

- Environmental consciousness and integral vision
- Knowledge of different elements (biological knowledge, technical knowledge, information)

Education of the personnel, and the surrounding communities that in one way or another have an influence in the conservation of the protected areas.

- To apply the management plans

Actualizing the management plans and rigorously implementing the operating plans with the involvement of key people that are relevant to the protected areas.

To follow rigorously the applied environmental policies

- Environmental policies, ethical, operational and functional and equalitarian. Clear environment legislation- State's commitment.
- Respect for and clear government policies for the protection of the protected areas.
- To form conservationists teams to supervise, evaluate and fine the entities that oppose conservation
- To develop effective programs for the protection of biodiversity
- Proper signaling of limits and clarification regarding the appropriation of land

Logistics in the general sense. The lack of quick responses has caused detriment to the areas.

More logistic support

More support from the Ministry

Logistic support (ranger stations, tools, etc.)

- To improve the participation of the State with respect to the preservation of the protected areas.

Political will and initiative

There should be better protection of the areas

Be disciplined when in a protected area

Perform cleaning projects whenever necessary.

37 statements

3. What institutional issues at the protected areas system level do you think have the greatest influence on biodiversity conservation in protected sites?

- The prioritization if biodiversity conservation in government policies, in other words, that the government recognize and value the ecological importance of the protected areas.

The Ministry of Environment, Protected Areas and ONGs that are dedicated to the protection of the environment.

- To continue the support of the formulation of management plans.

The development of a long term plan on the vision of biodiversity.

- To develop a program and plan that will allow us to minimize the impact of the actions in the protected areas

An integration plan for the locals into the protected areas' activities as a mean to generate economic benefits.

The society, the community, the Ministry of Environment, everyone that lives around the protected area, the administrators of the protected area, the National Police, the volunteers, NGO such as SoProeco, SAVAMACA.

The not-for-profit organizations have an influence because these organizations are the only ones that fund and do biodiversity studies. The Ministry (government) administers and tries to protect these areas, but they lack a proper budget and better technical staff.

The fundamental role of institutions in the conservation of biodiversity as promoters of conservation strategies, education and sustainable use of biodiversity.

The intervention of local institutions is very important because they can supervise the areas in a more active way.

The establishment of relationships with national and international organizations (NGOs, associations, groups, etc).

Co-management agreements between the Ministry of Environment and Natural Resources and not-for-profit organizations (NGO). These allow the participation of the citizens of the surrounding areas, making them protectors and supervisors of the protected area

The Moscoso Puello Foundation is present in a protected area and PROCARYN is a joint project: they are working to conserve natural resources. Neighbors Associations as well as Farmers Associations are also present in the area.

The laws and policies

Firstly, legislation in favor of the protected areas. There should be strong laws for the preservation of biodiversity.

The sector law of Protected areas

Sector law of Protected Areas

The sector law of Protected areas

To integrate the community into the system of protected areas (PA), through conferences in private schools, public schools, and churches, to let them know the importance of the park and why do we have to take care of it.

Creating an awareness is ideal for the conservation of biodiversity. An example of this is what the Sub-Ministry of Protected Areas is doing. It has shown the true value of our natural resources, even with the scarce budget that they possess.

The community groups play an important part in the protected areas. These groups comprise all the sectors that affect the area where natural resources are being protected.

- To support the special operations that have been set
- The nation's budget should include conservation
- Increase the salary of the park rangers so that they are motivated to work in the preservation and conservation of the biodiversity
- Insufficient economic resources
- Insufficient capacity to engage in certain activities

To assign more economic and human resources

- Insufficient personnel (a lot of work and little personnel to accomplish all the duties)

Training for the technical staff and better preparation of the administrators and park rangers.

Very little training in economy, business and marketing

- Training of the users of the protected areas in the importance of its use.
- Political and economic influences from certain powerful sectors (some institutions are less influential or are less strong because they have less influence)

Logistic support to maintain an effective supervision of the protected areas.

- Quick response to emergency such as money for fuel, and stipends to protect the biodiversity.

To assure transportation and other necessary logistic support from the relevant authorities

The patrolling, especially sending special commissions to the areas.

Secondly, global education, not only in the Dominican Republic. To teach people to love nature because it is life.

47 statements

4. What governance issues at the protected areas system level do you think have the greatest influence on biodiversity conservation in protected sites?

Economic interests of the politicians.

- Appropriation of land in the protected areas by people with political and economical power.
- The governmental authorities don't value the protected areas in the ecological aspect but in the economical aspect instead.

Political agenda of national development

- Party in power at the moment
- Political influences with some powerful sectors or relationships with businesses
- Agenda of action or plans of action of the tourism sector, mine sector and other ministries

The SEMARN has an interest in protecting areas

Firstly, there should be more human resources.

More materials or adequate logistics for preservation.

The law of Protected Areas and Biodiversity.

The implemented laws at the government level are strategies that can only be seen in printed documents; in practice they are very limited, due to the government interest in exploiting the tourist-zones of the country.

- Modification of the law in favor of politicians and businesses
- To respect the environmental laws without taking into account the interests of public or private functionaries
- Influence of the legislative and judicial power.

Sectorial law of Protected Areas

Legal framework of the protected areas (legislature).

Modification of the laws.

The application of the law 202-04 or the sectors law of protected areas. With this law, administrators of these areas are appointed, constantly monitoring and applying the law to those that destroy the protected areas.

Proper application of the laws, such as 64-00 and 202-04

Protection and sustainable use of the protected areas in benefit of the citizens and those involved in the protection of biodiversity.

The incentives to the local communities, through the use of the resources that these areas provide have a great influence in the conservation. If there is a direct benefit for the community, this would be more motivated to contribute in the conservation

- To improve the structures of control and supervision of the areas.
- Prevent modifications that decrease the size of the protected areas.

Presence of government's employees in the protected area for its supervision and conservation.

Education/training campaign at the national level

Ministry of Environment, Protected Areas.

The Ministry of Environment and Biodiversity

Ministry of Protected Areas and Biodiversity

The State's Ministry of Environment and Natural Resources (SEMARN), the Sub-Ministry of Protected Areas and Biodiversity are the institutions that have to protect the biodiversity

Its strategies for its conservation system

The administration of the protected area including environmental police, Ministry of the Environment, volunteers, small private properties and NGOs (SAVAMACA and SoProeco).

Submit a program of reforestation with agro-forestry products and include the people from the community as the main workers.

- Budget

Direct budget for conservation

A budget to develop and execute all the actions proposed in the operating plan

Increase the park rangers' salary.

- Foreign policy and relations

Mainly "co-management" e.g. Progressio [an organization in a co-management arrangement]

- Improve internal relations.

I think there is government support or priority for flora and fauna resources, as well as the cultural existence of each one of the conservation units.

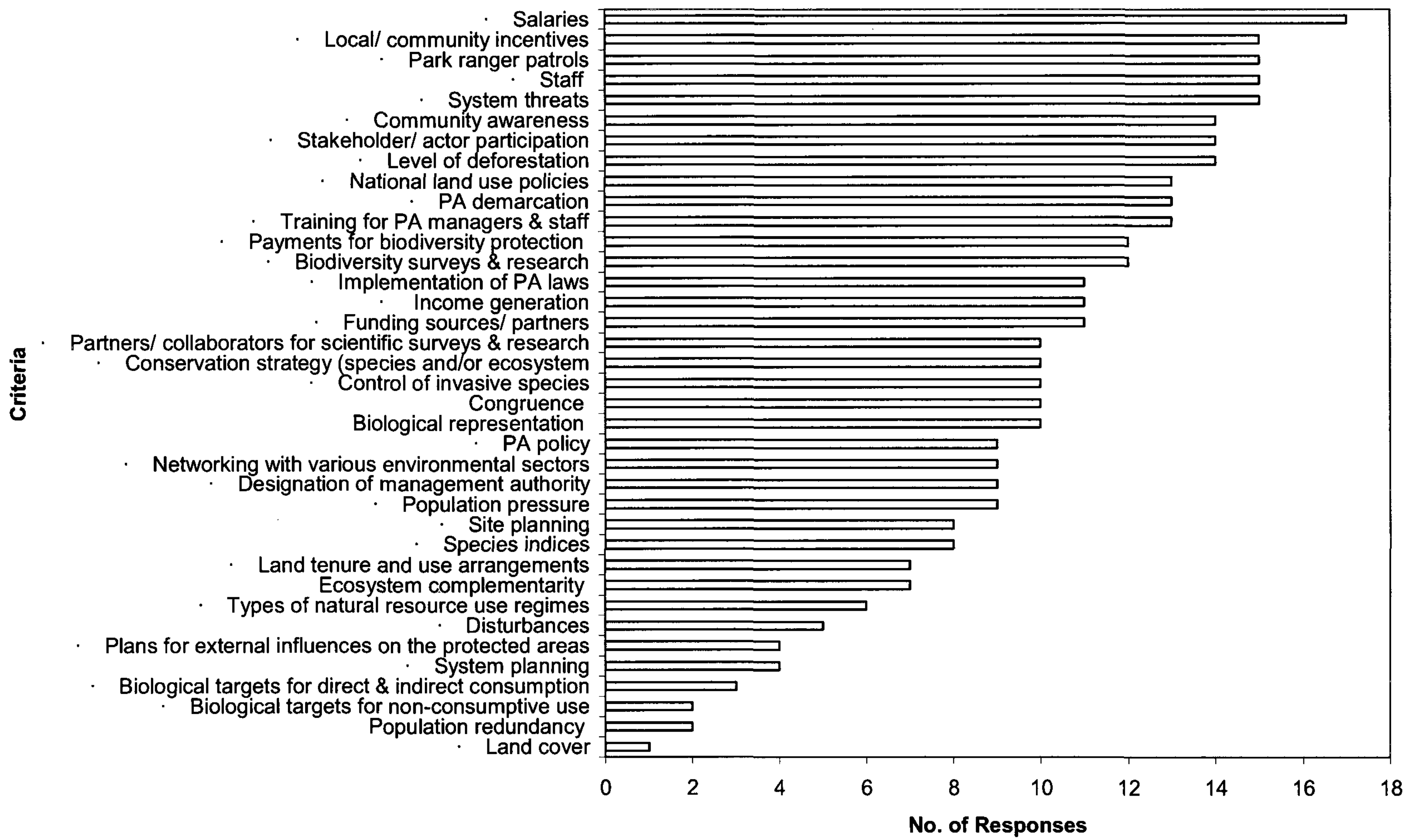
There is a lack of policy from the government and support from institutions.

- The Ministry of Tourism wants to develop the areas
- The territorial organization plan is being elaborated for the municipalities of Constanza, La Vega.
- Training of the working personnel in the protected areas

Permission from the State to organizations for work in the protected areas regarding its conservation

Creation of protected areas

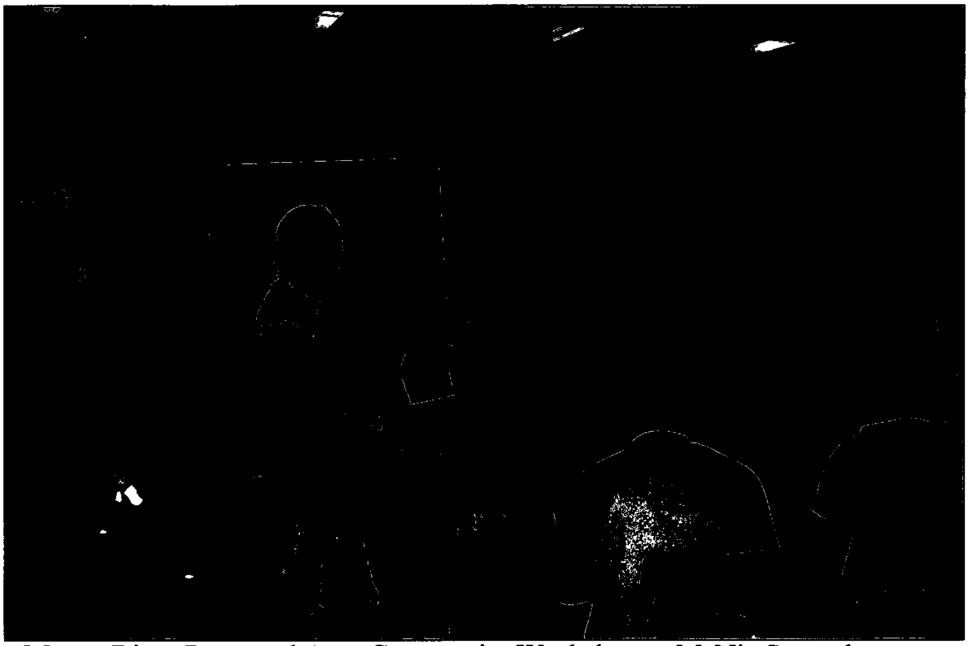
THEORETICAL CRITERIA CONSIDERED OF GREATEST IMPORTANCE
BY DOMINICANO RESPONDENTS



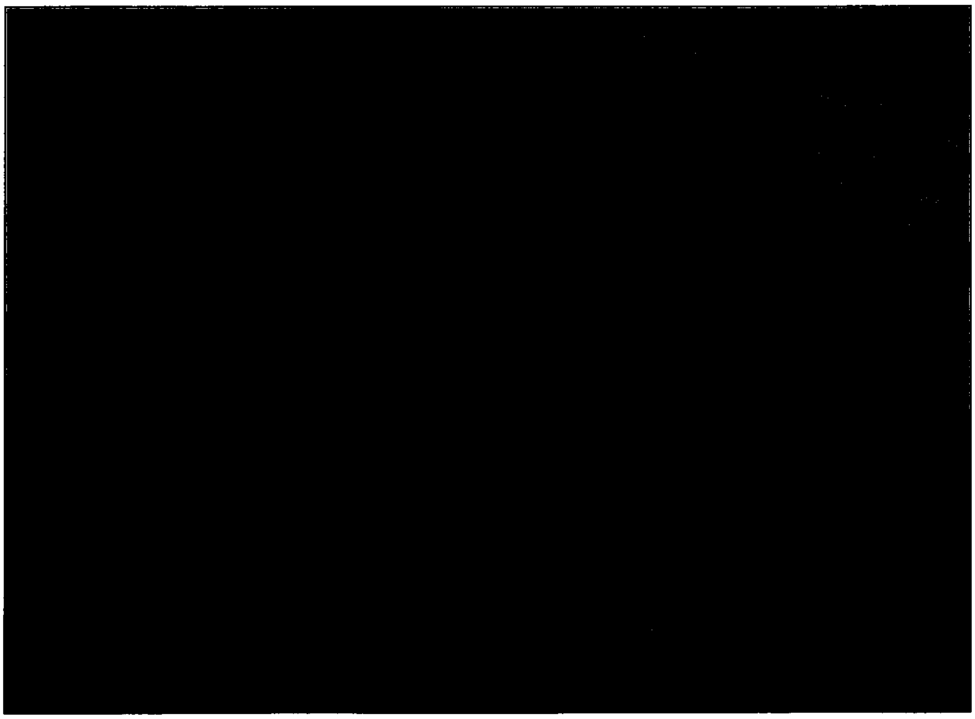
APPENDIX J. Scenes from Fieldwork in Jamaica and the Dominican Republic

Blue & John Crow Mountains National Park, Jamaica viewed from cultivated buffer zone in Portland

Mason River Protected Area, Clarendon, Jamaica showing rare tropical scrub savanna ecosystem



Mason River Protected Area Community Workshop at McNie Secondary School



Laguna Cabral freshwater lake, south-western Dominican Republic

Sierra de Bahoruco National Park, Puerto Escondido, Dominican Republic

Community Workshop at a ranger station in Cabral, Dominican Republic