Biodiversity Conservation and Adaptive Collaborative Management in Jamaica's Blue and John Crow Mountains National Park

by

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ABSTRACT

This interdisciplinary project examines community participation in conservation management by assessing the impact of land use practices on biodiversity in the buffer-zone of Jamaica's Blue and John Crow Mountains National Park. Our project looks to provide an independent assessment of how biodiversity conservation in the agricultural matrix of the park's buffer zone could be improved. One of the park's primary ecological threats is the spread of non-native species, which is facilitated in part by land clearance for agriculture. However, the communities surrounding the park are marginalized in terms of social services, economic development, and land access. We conducted surveys and interviews in three local communities and with the co-managing organizations and agencies of the park to assess attitudes and behaviors that affect land use decisions and to evaluate how management could encourage greater local participation in conservation efforts. To better understand community perspectives we measured variables to assess social and economic diversity within the three communities. We also compared field data on non-native invasive versus native vegetation to assess the impacts on biodiversity through the trophic level interactions of plants, insects, and birds. Our results demonstrate that community residents' attitudes towards conservation and park management are generally quite positive, but that marginalization along with limited and inconsistent community outreach has hampered sustainable livelihood development. Ecologically, our results indicate that moderate levels of forest disturbance increase insect food resources and support greater biodiversity at higher trophic levels. This suggests that the specific role of invasives as a mechanism for trophic alteration remains unclear. Our recommendations include a localized approach to conservation outreach, focused attention in building local capacities, greater attention on sustainable local forestry management, and more collaboration with local farmers.

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ACM: Adaptive Collaborative Management

BJCMNP: Blue and John Crow Mountains National Park

BPFA: Bowden Pen Farmers Association

CBD: Convention on Biological Diversity

CBNRM: Community-Based Natural Resource Management

CBO: Community-Based Organization

CEPA: Communication, Education, and Public Awareness

CIDCO: Coffee Industry Development Company

CoL: Commissioner of Lands

FAO: Food and Agriculture Organization of the United Nations

FD: Forestry Department

FIDCO: Forest Industries Development Company

GIS: Geographic Information Systems

GPS: Global Positioning Systems

ICDP(s): Integrated Conservation and Development Project(s)

JAS: Jamaica Agricultural Society

JCDT: Jamaica Conservation and Development Trust

LAC(s): Local Advisory Committee(s)

MOU: Memorandum of Understanding

MP: Members of Parliament

NGO: Non-Governmental Organization

NEPA: National Environmental Planning Agency

NRCA: Natural Resources Conservation Authority

PARC: Protected Areas Resource Conservation

RADA: Rural Agriculture and Development Authority

SDC: Social Development Commission

CHAPTER 1: INTRODUCTION

View of the park from Penlyne Castle

The Blue and John Crow Mountains National Park (BJCMNP) protects Jamaica's largest remaining tract of intact, closed-canopy broadleaf forest, which harbors some of the greatest species diversity and endemism in the Caribbean. The park is made up of two connected mountain ranges, the shale based Blue Mountains and the John Crow Mountains (Jamaica Conservation and Development Trust [JCDT], 2006). The park is managed by the Jamaica Conservation and Development Trust (the JCDT) in collaboration with the Forestry Department (FD) and the National Environment and Planning Agency (NEPA). The JCDT is a non-governmental organization, founded in 1987 (JCDT, 2008). The JCDT's stated mission is "to promote environmental conservation and sustainable development, with particular emphasis on the Blue and John Crow Mountains National Park, for the benefit of Jamaica and our people" (JCDT, 2006, p. 2).

After its incorporation, one of the first projects the JCDT undertook involved the Protected Areas Resource Conservation (PARC) Project, a collaborative project between USAID, the Natural Resources Conservation Authority (NRCA), and the Government of Jamaica to establish conservation under the framework of the 1989-1995 island-wide System of Protected Areas (JCDT, 2006). JCDT's objectives include biodiversity protection, degraded areas restoration, insurance of ecosystem services, recreation, and the promotion of sustainable livelihoods in the park buffer-zone. One of the goals stated in the JCDT's management plan is to

ensure the ecological integrity and health of native species that are currently threatened from coffee-farming, slash-and-burn agriculture, hunting, and invasive species. Threats such as deforestation on steep, mountainous slopes leading to soil erosion, degradation of water quality, loss of habitat for endemic species, and the introduction of invasive plant species are of paramount concern for the JCDT and its management partners.

Our project's aim is to gather baseline data to better guide and inform collaborative management for biodiversity conservation in the BJCMNP. We hope to better elucidate links between local attitudes and land use behaviors through the collection of ecological field data in combination with interviews and surveys of local residents living in the buffer zone communities. Specifically, the project sets out to improve the knowledge base of the management agencies associated with the BJCMNP and to better inform their decision-making practices. The immediate objectives of this project are to: 1) gather baseline data on the relationship between forest disturbance and the spread of non-native invasive plants; 2) assess the impact invasive vegetation has on biodiversity at higher trophic levels; and 3) gauge opportunities for improving local participation in conservation and sustainable livelihood projects in and around the BJCMNP. Findings from this research will be presented to the JCDT, Social Development Commission (SDC), Rural Agriculture and Development Authority (RADA), NEPA, and Forestry Department to better inform park management of the relationship between the invasive ability of non-native vegetation and impacts on park biodiversity and ways to overcome barriers to local community support for conservation objectives and opportunities for sustainable natural resource management in buffer-zone communities.

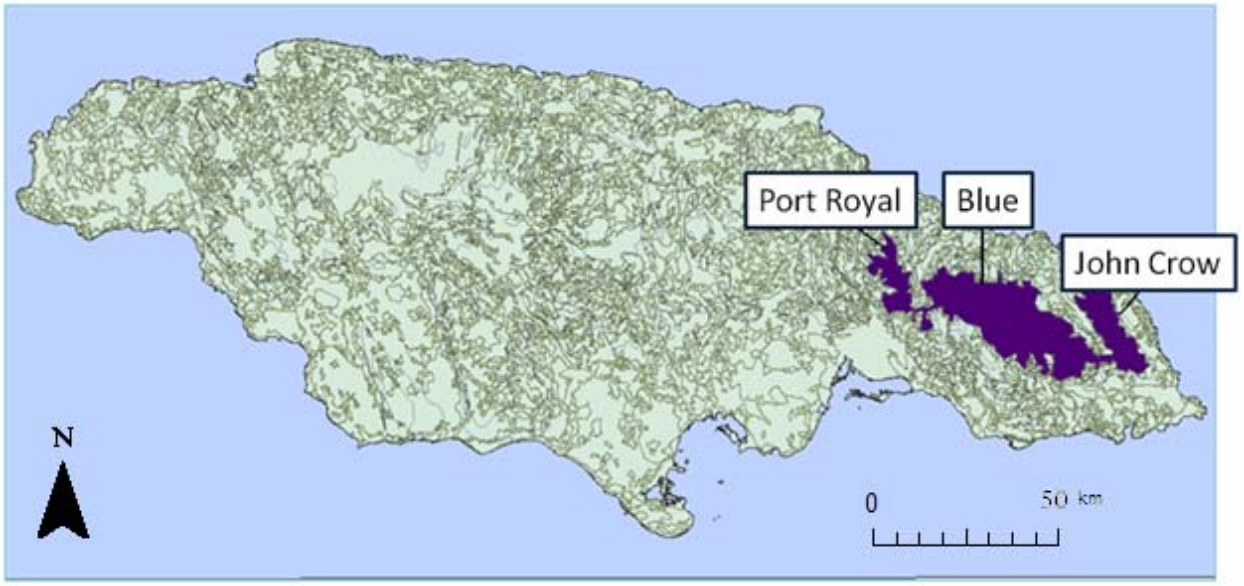
This research will provide the JCDT with further insights into both social and ecological influences shaping the landscape of the Blue and John Crow Mountain National Park. We hope that we will be able to fill knowledge gaps on critical issues identified in the BJCMNP's Management Plan and the JCDT's research prospectus.

Geography of the Blue and John Crow Mountains National Park

The BJCMNP is located on the eastern side of Jamaica, just northeast of the capital of Kingston (see Figure 1). The park stretches over approximately 196,000 acres, containing an estimated one third of the island's remaining natural forest, defined as closed-canopy broadleaf woodland. The park is also the island's largest remaining tract of intact forest, accounting for

4.5 percent of Jamaica's total land surface (JCDT, 2005). The park is composed of two interconnected mountain ranges, the shale-based Blue Mountains and the limestone-based John Crow Mountains (see Figure 1). The Blue Mountains, which represent the only shale- based montane rainforest biome on the island (The Nature Conservancy [TNC], 2008), rise steeply within five km of the coast and are characterized by steep-sided valleys with deeply gorged rivers. The Grand Ridge forms the backbone of the Blue Mountain range, reaching the highest elevation in the country: 2,256 meters (7,402 feet). The John Crow Mountains rise gently to a lesser elevation from the east but end abruptly on their western side (JCDT, 2005). The park is characterized by high levels of precipitation, with a mean annual rainfall of 2,700 mm, although this amount can vary greatly. An additional source of moisture is the thick mountain mist, which can cover approximately 70 percent of daylight hours on Northern slopes (JCDT, 2005).

Figure 1: Topographic map of the island of Jamaica, highlighting the location of the BJCMNP and the three mountain ranges within it.



Views of the Blue Mountains (left) and John Crow Mountains (right)

Biological Diversity in the Park

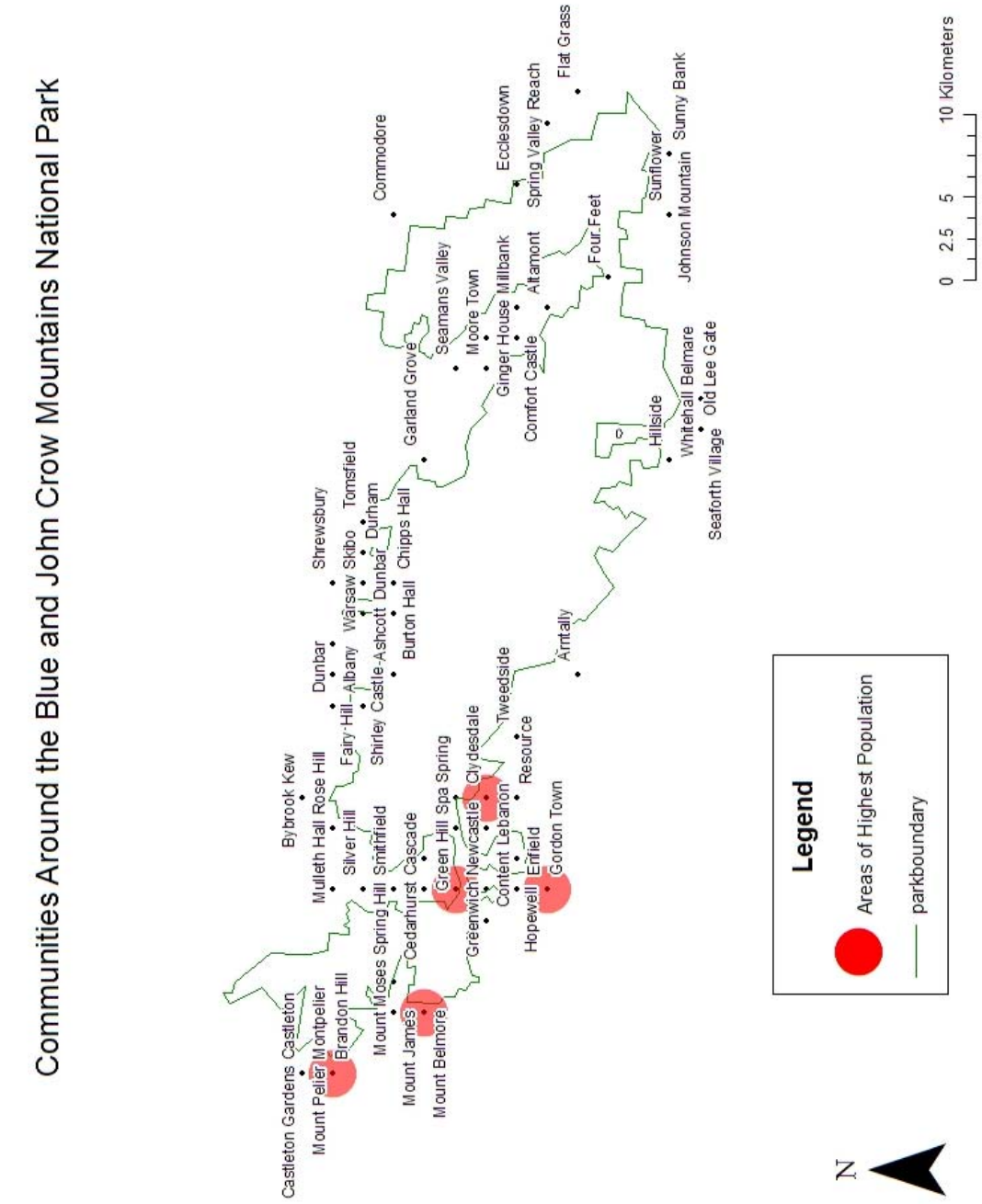
Jamaica is a large island isolated from continental landmasses that contains a variety of different ecosystems, from mountains to coastal lowlands. As a result, the island has a striking proportion of endemic flora and fauna (TNC, 2008). The BJCMNP itself boasts a diversity of different substrate types, soils, high and variable rainfall patterns, and high altitude in the mountain environment (JCDT, 2005), which have led the park to possess not only numerous species of plants and animals but also an exceptional number that are endemic only to Jamaica (JCDT, 2008). Tanner (1986) found that 41 percent of plants were endemic in research plots in the Blue Mountains. The Blue and John Crow Mountains are home to approximately 150 resident and migratory species of birds (JCDT, 2008), including 28 that are endemic to Jamaica. The mountains are also prime habitat for tree frogs, particularly the *Eleutherodactylous* group, which have not been fully identified at the present time. Other species of particular interest to the JCDT include the rare Jamaican Yellow Boa (*Epicrates subflavus*), Giant Swallowtail Butterfly (*Papilio homerus*), and the Jamaican Coney or Hutia (*Geocapromys brownii*), a large groundhog-sized rodent and one of the island's few living endemic mammals. There are also a diversity of rare and valuable trees such as mahogany (*Swietenia mahagoni*, *Meliaceae*), cedar (*Cedrela odorata*, *Meliaceae*), and Blue Mahoe (*Hibiscus elatus*, *Malvaceae*) (TNC, 2008). Approximately half of the island's ferns are found in the park and 40 percent of the park's angiosperms are endemic to the area (JCDT, 2005).

In addition to being globally and nationally recognized for its high level of biological diversity, the park is critical for the water it supplies to the capital city of Kingston and the

communities of eastern Jamaica (JCDT, 2005). The park comprises parts of four distinct parishes: Portland, St. Thomas, St. Andrew, and St. Mary. Park management has defined a one kilometer wide band outside the park along its boundary as a buffer zone which is maintained in the current management plan. An early Area Assessment (Muchoney, Grossman, & Iremonger, 1993) identified 59 communities in the BJCMNP buffer zone with a total population of almost 40,000 people (see Fig 2).

School children in a buffer zone community

Figure 2: Communities close to the park must be taken into account by park management in decision-making



History of the BJCMNP

Like many nations struggling with a legacy of colonialism, Jamaica has a rich and complex history that is mirrored by the history of the Blue and John Crow Mountains National Park. The Taino (or Arawak) people, a society of farmers and fishermen living along the coastal plains, were the island's first settlers. With the arrival of the Spanish in 1492, those Tainos who did not escape to the hills and mountains were quickly decimated by disease and forced labor. When the Spanish brought African slaves in 1517, many escaped and took refuge in the mountains and became known as Maroons (JCDT, 2005). The cultural heritage of the Windward Maroon people still exists in the park, particularly in the music, dancing, and cuisine of the communities surrounding the park. The surviving Taino people are believed to have been absorbed into this population of Maroons in the mountains (Sherlock and Bennett, 1998).

After a series of protracted battles, the British wrested control of the island from the Spanish in 1670. The importation of slaves continued unabated for the next 200 years. According to Higman (1976) the importation of slaves to Jamaica had virtually ceased by 1817, but a census in 1844 revealed a total population of 377,433 – 78 percent black, 18 percent 'mulatto' and 4 percent white (Sherlock and Bennett, 1998). Slaves were necessary to supply the work force, particularly on the sugar plantations in the lowlands, but also on the coffee estates in the mountains. On August 1, 1834, the British Parliament abolished slavery and declared universal emancipation. The population of freed slaves grew rapidly from 311,000 in 1838 to 553,000 in1881, a doubling in population over a 40 year period (JCDT, 2005). This population increase was paralleled by an increasing demand for land, but there was little farmland available in the low regions of the country where most plantations were located. The mountains were largely unoccupied except for large coffee estates, many of which had begun a process of decline (Higman, 1988) due to decreasing property values following a crash in the value of exports (Sherlock and Bennett, 1998). Freed slaves took up agriculture and coffee cultivation in the mountain land, often renting land allotments divided from previous coffee estates (Higman, 2005). Coffee is still the principal large scale crop in the Blue Mountains, with an estimated 12,000 acres of land currently under coffee cultivation (JCDT, 2008). The British established the Forest Reserve, later codified under the Forest Act of 1937, to protect the watershed for the city of Kingston. After a long period of direct British colonial rule, Jamaica gained a degree of local political control in the late 1930s and held its first election under full universal adult

suffrage in 1944. However, issues of land tenure continued to plague the Forest Reserve area, and settlement within its boundaries was often actively supported by the government; for example, soldiers returning from World Wars I and II were rewarded with land in the Blue Mountains (particularly in the Rio Grande Valley) upon their return to Jamaica. The Blue Mountain Forest Reserve, along with the Jamaican Forest Service, was officially formed in 1950.

Jamaica gained independence from Great Britain in 1962, remaining a member of the Commonwealth, and both funding and management of protected areas became a challenge for the fledgling government. In 1979, the Forest Industries Development Company (FIDCO) was established with the mandate to develop industrial forestry plantations, particularly Caribbean Pine (*Pinus caribaea*). Under this privatized approach to management, 11,250 hectares were cleared and replaced mainly with Caribbean Pine which is native to Central America (Headley, Owen et al. 2000). FIDCO also built many roads into the forests that still provide access to ecologically sensitive areas. In 1988 Hurricane Gilbert reduced the Caribbean pine plantations to 5,200 hectares. This altered the Forestry Department's outlook, as they then began focusing on native broadleaf species. FIDCO ended their operations in 1999, but the legacy of non-native species and fragmentation remains. At present there remain large tracts of land with mature pine in need of harvesting and more environmentally appropriate reforestation.

In February 1993 the Blue and John Crow Mountains were declared a National Park through the Natural Resources Conservation Order under the Natural Resource Conservation Act of 1991, "out of local and international concern for biodiversity and other natural resources, as it was recognized that the destruction of this unique ecosystem was taking place at an alarming pace" (JCDT, 2008, p. 3). The actual deforestation rate is a subject of debate, with estimates ranging from 0.1 percent, as proposed by the Forestry Department in 1999, to 11.3 percent, as estimated by the FAO in 1995 (FD, 2002). However, even the smaller estimate represents a loss of 3,063.6 hectares of forest land from 1989 to 1998.

Current Management of the Park

The management of the BJCMNP was delegated to the Jamaica Conservation and Development Trust (JCDT) by NEPA in 1996. Table 1.1 summarizes key legislation that influences park management. As the site is also a Forest Reserve, a collaborative management (co-management) agreement was signed in 2000 by the NEPA/NRCA, JCDT, and the Forestry

Department. These three organizations are the main co-management partners for the site, but the JCDT manages the day-to-day operations. The only official community-based management partner is the Bowden Pen Farmers Association, who signed a memorandum of understanding with the JCDT in 2005.

Table 1: Legislation with Bearing on the BJCMNP

Act (Year)	**Relevant Objectives**
Wild Life Protection Act (1945)	The only statute that specifically protects designated species of animals and regulates hunting in Jamaica. Criminalizes the possession of any part of a protected animal, liable to a $100,000 fine. Sets license structure of hunting, fishing, and authorizes game wardens.
Watershed Protection Act (1965)	Provides a framework for the management of 26 designated watersheds. Provisions for government intervention in regulating uses of private land including the clearing of land and implementing appropriate agricultural practices. Also allows for assisted improvement agreements to protect watersheds. As of 2004 there are no regulations, or provisions for soil conservation or land use management, that can be implemented.
National Land Policy 1996	Underscored the need for a more complete understanding and appreciation of the finite nature of land resources and advocacy for its sustainable use. Establishes the framework for the planning, management, and development of Jamaica's resources.
Forest Act (1996)	Sets out the role and function of the Forestry Department and the Conservator of Forests. Provides a mandate recognizing the importance of preserving forests for biodiversity, watershed protection, and ecotourism in addition to sustainably meeting the country's needs for timber and forest products. Mandates forest inventory to determine biodiversity potential. Private lands may be acquired for declaration as forest reserves. Mandates forest management plans to stipulate allowable annual cut, conservation, and protection measures. Allows for the establishment of recreational sites in management areas.
Forest Regulations (2001)	Enables the Forestry Department to carry out its mandated functions as elaborated in the Forest Act, 1996. Regulations cover permitted use of roads, burning, trespass, timber extraction, removal of produce, protection of wildlife, conditions for leasing. Enables Minister to provide incentives to encourage private forestry.

Natural Resources Regulations (2003)	A person shall not enter the recreational area of the Park unless they hold a valid pass. The fees for entry into the recreational areas are set out in the Schedule. The Park will establish an account in which the fees are to be deposited. In addition within three months after the end of each calendar year the Park Manager is required to present an audited report on the account to NRCA.

Source: Protected Areas System Plan, Legal Framework (2004).

Table 2: National Treaties with Bearing on the BJCMNP

Act (Year)	**Relevant Objectives**
Convention on Biological Diversity (1992)	-Development of a master plan for strategies and implementation. -Threats: Mechanisms in place to address key threats. -Indigenous and local communities: Policies and mechanisms to support indigenous and local community participation and equitable sharing of costs and benefits. -Effective system of protected areas: Comprehensive, ecologically representative, and effectively managed systems of protected areas.
Convention on International Trade in Endangered Species (1973)	CITES parties must identify species that are, or may be threatened by trade, and may become threatened unless trade is regulated.
United Nations Convention to Combat Desertification (1994)	-Establish strategies and priorities to combat desertification and mitigate the effects of drought. -Promote awareness and facilitate participation in efforts to combat desertification.

Source: Situation Analysis of Jamaican Protected Area Systems Plan (2005).

While Jamaica has ratified the Convention on Biological Diversity (CBD), in Jamaican law a treaty does not become a law until the accompanying implementing legislation is passed. Up until now, this has not occurred. However, Jamaica has developed a *National Biodiversity Strategy and Action Plan* (NBSAP). Under the *Program of Work on Protected Areas*, CBD member countries developed key goals for protected area managers to meet the objectives of conservation, sustainable use, and equitable sharing of benefits of biological resources (Brown and Edwards 2005). During the years 2007-2008, the program has identified policies and mechanisms to support local community participation and equitable sharing of costs and benefits. The results of this study could help inform future policies and mechanisms to provide structure for the implementation of biodiversity conservation legislation.

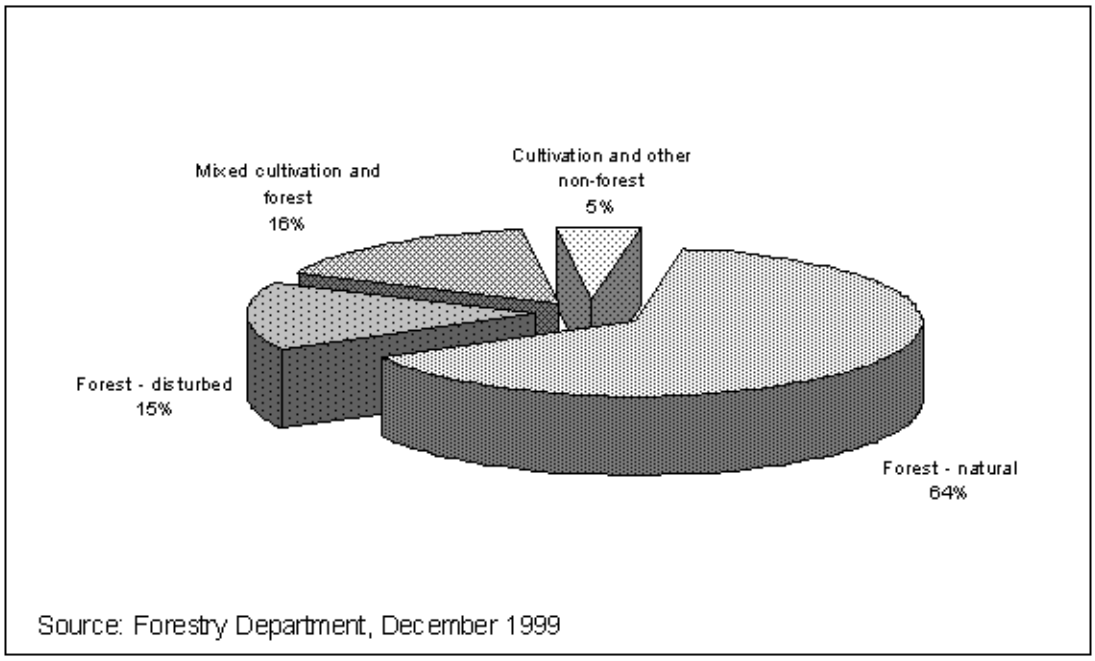
Threats to the Park

As with many national park systems in developing nations, the managers of the Blue and John Crow Mountains National Park face inadequate funding and a deficit of institutional resources (JCDT, 2008). The JCDT and the Forestry Department identified the key threats to the park; determining that deforestation for agriculture and the growth of non-native species head the list (2005). Much of the agricultural activity remains relatively small-scale, individual farming operations (Weis 2006).

Blue Mountain coffee is the most expensive coffee on the international market. Coffee was introduced into Jamaica in 1728 from Martinique after the British had wrested control of the island from the Spanish. Because of the altitude and climate, the slopes of the BM were found to be an ideal place for growing high quality coffee, and it is still a significant cash crop today. The majority is sold to Japan, with very little being available for the remainder of the market. The high price commanded by Blue Mountain coffee is resulting in the clearing of more land for this crop; it sells in Japan for $62 per pound (International Coffee Association, 2005). Shade coffee, which allows for the conservation of tree cover, is seldom practiced due to the perceived threat of leaf spot disease and the belief that shade from the mist is sufficient (personal communication, May 2008).

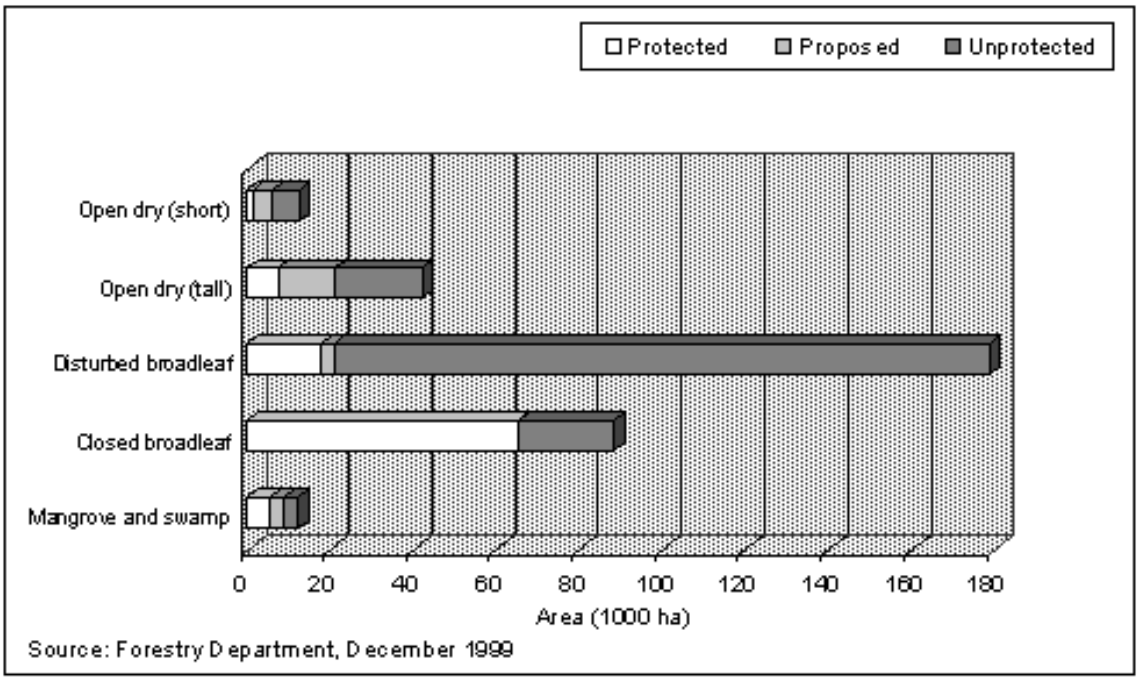
Deforestation is also caused by landslides, timber harvesting, and fires (Forestry Department, 2002), as well from the clearance of land roads, housing, and other development. The problem is exacerbated on steep slopes, where soil loss is likely to be greatest. The National Forest Management and Conservation Plan of the Forestry Department (2001) developed guidelines for protected areas to limit such deforestation. These include specifying that closed-canopy broadleaf forest should be preserved for biodiversity conservation, while "disturbed forests," defined as those areas that have been altered by human activities should retain forest cover for industrial use, selective harvesting, or biodiversity protection, depending on slope and soil depth (steep slopes and shallow soil are considered vulnerable, while gentle slopes and deep soil are considered more appropriate for commercial use). However, with few institutional resources available, such policies have proved difficult to enforce in and around the BJCMNP. As seen in Figure 3 and Figure 4, the ownership and use of the land, even within forest reserves, is not a complex issue; much of the forest area is unprotected.

Figure 3: Present Land Use Within Forest Reserves.



Source: Headley and Evelyn, 2000

Figure 4: Forest Area by Type and Protection Status.



Source: Headley and Evelyn, 2000.

The park ranges in altitude from 150 meters above sea level on the eastern side, to 2,256 meters at the highest point in the Blue Mountains. In a recent area assessment, the JCDT determined that the proportion of remaining natural forest is closely linked to altitude; in the lowest sections of the park, less than 10 percent of the area has retained natural vegetation, while at middle altitude, about 50 percent of the area has remained natural, and above 80 percent at higher elevations. The majority of the park is classified as mid-altitude. Overall, a large percentage of the lower montane forest has disappeared, while much of the upper montane forest and most of the summit vegetation remains intact (JCDT, 2005). Disturbed and anthropogenic habitats strongly dominate the periphery of the park, while the natural forests form a relative compact core of well preserved forest across the interior and upper sections of the mountains.

Non-native species are regarded as the second most critical threat to the park's ecosystem after deforestation, according to JCDT's 1999 Experts Workshop (JCDT, 2008). According to the JCDT (personal communication, May 2008), the most threatening non-native plant species include wild coffee (*Pittosporum undulatum*), a native of eastern Australia, wild ginger (*Hydicum spicatum*) of South Asia, red bush (*Polygonum chinnense)*, and bamboo (*Bambusa vulgaris*). These four species are invading and quickly spreading throughout the park (Stohlgren, Binkley et al. 1999). According to the park rangers, the Cinchona Botanical Garden located on the periphery of the park, has unfortunately served as a source for the spread of exotic plants in the past (personal communication, May 2008). These non-native plants represent a threat to the many native and endemic species in the park by competing for resources and changing the structure of the forest ecosystem. So far, attempts to eradicate or slow the spread of such non-native species have met with little success (JCDT, 2005).

The park also faces other threats such as inadequate waste disposal systems and waterway pollution, both from agricultural runoff and factory waste and from the deliberate contamination of the waters to harvest fish and crayfish (JCDT, 2008). With relatively few rangers and a lot of ground to cover, JCDT and its management partners struggle to respond to the threats posed by human activities in and around the park. Complicating the issue is the confusing situation of land tenure, since the official designation of all land within the park is controlled by the Commissioner of Lands (CoL) and not the co-management partners. There are numerous leases and sub-leases issued to private individuals, including many through FIDCO's leases to the Coffee Industry Development Company (CIDCO), who in turn leased land to

private individuals. Private individuals may also hold leases directly from the government, as in the case of retired WW I and II soldiers, or have been grandfathered to individuals whose families may have been unofficially using the land the emancipation of the slaves (JCDT, 2005). Additionally, the boundaries of the park itself are unclear, even to park management officials, and are often unmarked or contested. Enforcement of park rules is therefore obviously difficult.

The JCDT (2005) has identified the following as contributing factors of environmental degradation in and around the BJCMNP:

- insufficient environmental education;
- lack of environmentally sustainable income-generating activities;
- insufficient enforcement;
- insufficient "Conservation-on-the-Ground";
- conflicting policies between government agencies and insufficient support of conservation initiatives;
- unclear boundaries;
- inadequate resources and management
- climate change.

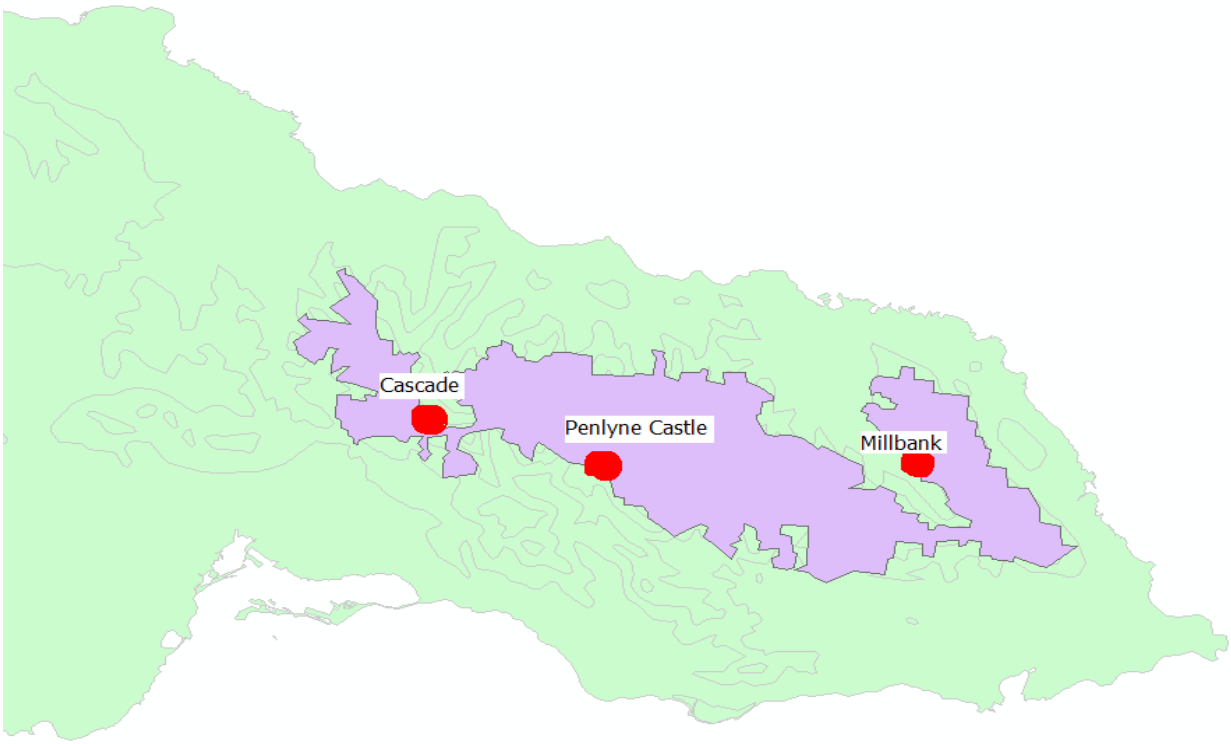
Deforested slopes threaten the integrity of the park ecosystem

With these problems in mind, the JCDT has determined that the most important objectives for park management include "increased enforcement of environmental legislation, particularly relating to boundary encroachment, adoption of more environmentally sustainable livelihoods by resources users, and rehabilitation of degraded forest penetrating the core natural areas" (JCDT, 2008).

The Role of the Research Team

The research team was invited by the Jamaica Conservation and Development Trust to conduct research on biodiversity conservation and community participation in and around the buffer zone of the Blue and John Crow Mountains National Park. Our research team was comprised of five students from the University of Michigan's School of Natural Resources and Environment, under the direction of Professor Ivette Perfecto and with the assistance of Kevin Hill, Ph.D. Candidate. With help from the JCDT, we selected three field sites in and around the buffer zone of the park: Millbank, Penlyne, and Cascade. Millbank is located in the Rio Grande Valley, adjacent to the John Crow Mountains, while Penlyne Castle and Millbank are located in the Blue Mountains (see Figure 5). All three communities largely rely upon agriculture as their economic base.

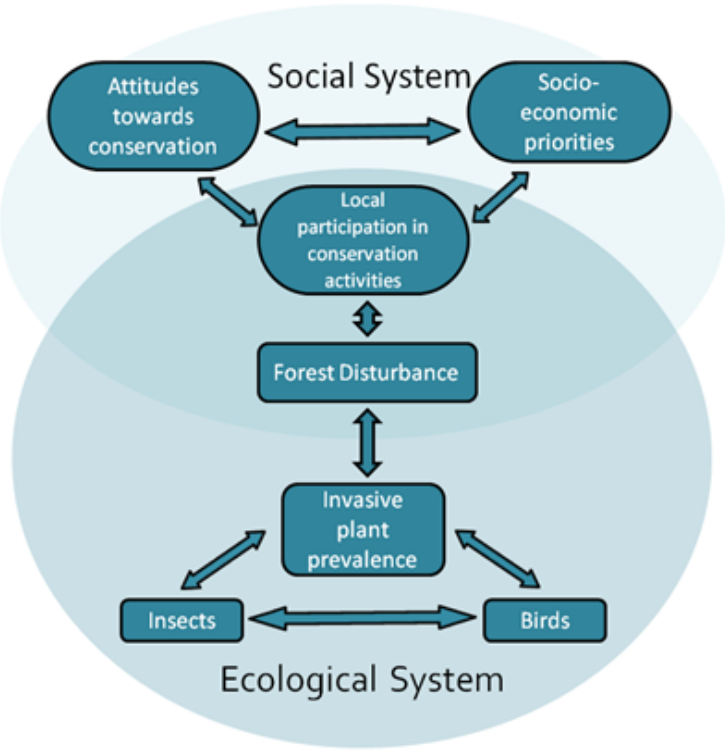
Figure 5: The Study Sites on the Periphery of the Blue and John Crow Mountains National Park



Based on the information the JCDT provided regarding what they consider to be the major threats to the park, our research group developed a multidisciplinary research project to address both social and ecological concerns. In chapter two we present the results of the sociological study on perception and attitudes towards the park, conservation, and sustainable management. This study has two objectives: 1) to establish the socio-economic context of each community and how poverty affects decision-making; and 2) to answer the question, "How have attitudes and behaviors toward the park influenced land use decisions in the park and surrounding areas?" Connecting the results of these two objectives will allow us to make recommendations on providing greater opportunities for local involvement in management and decision-making. The goal of greater decentralization of resource control and the application of the subsidiarity principle is reflected in the tenets of the 2003 *National Strategy and Action Plan*

on Biological Diversity in Jamaica. In chapter three we present the results of the ecological study regarding the impact of disturbance and invasive species on biodiversity. The ecological study addresses the following questions: 1) what is the relationship between forest disturbance and presence of non-native plants in the buffer-zone of the BJCMNP; and 2) what are the bottom-up community effects of the alteration of the native vegetation? Finally, in chapter four we integrate the results from both studies to develop recommendations about management strategies. Figure 6, below, demonstrates how the two aspects of the project are designed to relate.

Figure 6: A flowchart describing the way our project relates the social and ecological components through the impact of local activities on forest disturbance.



CHAPTER 2: ADAPTIVE COLLABORATIVE MANAGEMENT OF THE BLUE AND JOHN CROW MOUNTAINS NATIONAL PARK

Introduction

The complexity of socio-ecological problems, such as biodiversity conservation, calls for an integrated approach to problem-solving that recognizes the roles of local institutions, politics, economics, and policies in shaping decisions that affect ecosystems. In this chapter we assess how issues of poverty and political marginalization affect the resource-use of residents of three communities within the BJCMNP's buffer zone. Next, we provide an analysis of community attitudes and behaviors towards conservation goals and evaluate the effectiveness and equitability of collaborative management. In doing is we hope to create a clearer understanding for our client, the JCDT, of how participatory approaches are working, what may be improved, and how attitudes and behaviors affect land-use decisions.

We have three objectives in this chapter. First, we want to provide the JCDT with baseline data of the socio-economic priorities and levels of participation in each community. We will use this information to answer our research question: How do socio-economic priorities influence attitudes, behaviors, and participation in conservation? Lastly, we will evaluate the participatory approach and provide recommendations to the JCDT.

Although our research questions are focused on local attitudes and behaviors towards protected area conservation and the effectiveness of the park management's participatory approaches, much of our data helps to explain how rural poverty may affect decision-making. In so far as we could, we tried to uncover the social, infrastructural, economic, and political factors that affect the way local communities impact their ecosystems. Our hope is that by providing a clearer picture of these important social contexts, coupled with ecological surveying of the impact of invasive plants species on biodiversity,[1] park management can better allocate limited resources towards creating programs that build local capacity to achieve sustainable livelihoods in areas that are predominantly agricultural. To achieve this, we surveyed and interviewed community residents, NGO employees, and government agents. We framed our analysis with a combination of social movement theories while reassessing participation through the practice of

[1] This separate study, with different methods, is the basis for chapter 3.

adaptive collaborative management. From this analysis, we provide recommendations for the JCDT that reflect our conclusions.

With mounting evidence that Integrated Conservation and Development Projects (ICDPs) often fail in achieving biodiversity conservation and meaningful community participation (Barrett et al., 2001; Wells & McShane, 2004), emphasis is being placed on approaches such as adaptive collaborative management in which local communities share management responsibility and whose collaboration contribute to adaptive management practices (Ruitenbeek & Carter, 2001). Acknowledging the successes and failures of the ICDPs and their role in informing the adaptive collaborative management approach provides a framework through which we address participatory approaches currently used by park management in Jamaica. Theories on gaining increased participation in biodiversity conservation are informed by a number of social science theories including social capital, resource mobilization, political process, social network, and recruitment. Social capital and social movement theories elucidate specific ways collective action towards biodiversity conservation can be improved in the BJCMNP. Jamaican environmental non-governmental organizations have been working with local communities to bring about social change in the environmental context through three primary approaches: promoting education and awareness-raising campaigns, government and policy advocacy, and rehabilitation programs (Lundy, 1999b). Critiques of the preservationist approach to biodiversity conservation are used to contextualize environmental movements within Jamaica.

The Protected Areas Paradigm

The number of protected areas has increased dramatically worldwide in the latter half of the past century, as governments, NGOs, international organizations, and civil society seek to conserve biodiversity and maintain critical ecosystem services. This rapid growth has occurred mostly since 1982, when the World Parks Congress in Bali recommended that all nations set aside at least 10 percent of their land for protection (Naughton-Treves, Holland et al., 2005). A decade later at the Earth Summit in Rio De Janeiro, 167 nations, including Jamaica, signed the Convention on Biological Diversity, formally acknowledging the importance of biodiversity conservation, while simultaneously endorsing the creation of protected areas (Naughton-Treves, Holland et al., 2005). While most of the newly allocated areas for protection were in developing countries, massive international funding support has been an enabling factor. From 1990 to 1997,

U.S. governmental agencies, private foundations, and NGOs spent $3.26 billion on biodiversity conservation in Latin America alone, 35 percent of which went to protected areas (Naughton-Treves, Holland et al., 2005). As of 2005, there were over 100,000 protected areas covering 17.1 million km^2, or 11.5 percent of the earth's terrestrial surface (Naughton-Treves, Holland et al., 2005).

The theory and practice of biodiversity conservation, which began with national parks in the nineteenth century, has evolved from preservationist approaches that excluded local communities entirely, towards a wider suite of strategies that encompass the socioeconomic development of local communities into protected area policy, planning, and management. This has produced a lively debate among academics, managers, policy-makers, and other stakeholders on the effectiveness of balancing conservation and development in various political, social, economic, and ecological contexts (Naughton-Treves, Holland et al., 2005). Preservationists contend that protected areas need strict enforcement in order to preserve biodiversity. Biodiversity conservation is seen as essential not only for potential human use, but as a moral imperative to protect other species (Wilshusen, Brechin et al., 2002). The traditional methods of protected areas relied upon strict enforcement of boundaries along with penalties, such as fines, that were imposed on violators. While sometimes effective, they demanded significant financial and human resources and were rarely supported by local populations, incurring significant political costs (Pimbert & Pretty, 1997). While enforcement remains integral to the success of protected area management, ethical and political considerations led to a paradigm shift towards the integration of biodiversity conservation with the resource and development needs of communities living near protected areas.

This shift in governmental and NGO policy came from an acknowledgement that local communities are burdened with an inequitable share of the costs of lost access, while receiving little or no direct benefits in return (Wells, Brandon et al., 1992). The inequities created by denying local communities access to forest resources such as land, firewood, timber, and wildlife exacerbated the poor and marginalized conditions that these communities often experienced. International support for integrating livelihoods with conservation was marked by the World Conservation Union's publication of the *World Conservation Strategy* in 1980 and then at the World Congress on National Parks in 1982, where it was stated that "protected areas in

developing countries will survive insofar as they address human concerns"(Pearl & Western, 1989)

Integrating Conservation with Development

Integrated Conservation and Development Projects are not the focus of our research because the JCDT is managing the Blue and John Crow Mountains National Park primarily as a refuge for biodiversity and recreation, not for sustainable use. However, while their management priorities do not include development goals for the buffer-zone communities, the JCDT does state that building local participation and developing sustainable livelihood opportunities are a necessary part of environmental management. Since ICDPs are inextricably linked with the history of protected area management and are the first large-scale approach to incorporate local participation, we felt it was important to provide an overview of the conception, implementation, criticism, and reappraisal of ICDPs and related participatory approaches. The lessons learned from ICDP failures inform our framework for evaluating participatory approaches and how they can be more meaningful in helping to achieve the goals of both local and external stakeholders.

Understanding the assumptions behind ICDPs can inform contemporary participatory approaches in several key ways. First, communities are heterogeneous socio-economically and politically, and these differences can mean power differentials between groups along with a diverse array of stakeholder interests even within a community. This means that understanding the socio-economic context and evaluating stakeholder interests before implementing participatory approaches is crucial to avoid reinforcing power structures, neglecting significant interests, and further marginalizing segments of the community. Secondly, the willingness and ability for local communities to sustainably manage resources depends upon informal institutions, such as social values and norms. While the scope of our study does not include an institutional analysis, we do assess attitudes and behaviors towards conservation and park management. Lastly, ICDPs, and participatory approaches in general, have been criticized for not gaining legitimacy by excluding community members from the actual decision-making process. It is widely acknowledged that the language of participation is frequently needed to obtain funding for projects, but that participation can vary drastically in how efficacious it is in empowering community members in decision-making (Mosse, 2001).

While the original scope of ICDPs has since been criticized for being overly ambitious, the intent of combining biodiversity conservation and economic development excited development agencies and led to increased funding for conservation projects during the 1980s and 1990s (Christensen, 2004; Wells & McShane, 2004). From the start, however, the concept of ICDPs was questioned, particularly as to whether sustainable use could be feasibly aligned with biodiversity conservation (Robinson, 1993; Naughton-Treves, Holland et al., 2005). Even during the early popularity of the ICDP approach, critics and cautious proponents alike pointed out that the hypothesis that rural development would promote biodiversity conservation was untested and that direct links between conservation and development goals had not been adequately established (Wells, Brandon et al., 1992; Robinson, 1993; Kremen, Merenlender et al., 1994). Another clear concern was how to satisfy the diversity of stakeholder interests that ranged from human rights to ensuring the composition of natural variation at multiple ecological scales (Kremen, Merenlender et al., 1994). While these concerns have been validated by case-study analysis of the early outcomes of ICDPs in various contexts, there is still much debate as to whether the approach of combining conservation and development is fundamentally flawed or whether the implementation can be more adaptively managed for better outcomes (Brown, 2003; Christensen, 2004).

Challenges to ICDP Implementation

Criticism of the quixotic early approaches of ICDPs focuses upon misguided assumptions on the relationships between conservation and development and problematic implementation (Christensen, 2004; Wells & McShane, 2004). One such assumption was that protected areas could provide significant enough benefits that they could be shared among stakeholders and contribute to sustainable development (Wells & McShane, 2004). This was often linked to the assumption that increased rural development would automatically lead to improved biodiversity conservation. Numerous studies have shown that without strong local institutions, development may not curtail and may even increase resource use (Brown, 2003). Other scholars have cautioned against the assumption that local communities will always use resources sustainably (Agrawal & Gibson, 1999; Barrett, Brandon et al., 2001). Many early ICDP projects did not achieve full community involvement or support because of the misguided assumption that communities were homogenous in access to political power, economic status, and cultural

institutions (Wells, Brandon et al., 1992; Agrawal & Gibson, 1999). Additionally, many projects over-emphasized the importance of local threats, without fully accounting for the effects of mining, logging, road-building, dam-building, and other environmental threats that originate outside local communities (Wells, McShane et al., 2004). Coupled with those direct threats are institutional arrangements such as laws and policies as well as social changes and macroeconomic factors that can pressure local populations (Wells, Brandon et al., 1992). The lessons that have come from these mistaken assumptions could improve future implementation of conservation programs.

Many of the changes in implementation called for by scientists and practitioners relate back to the problematic assumptions of the expectations placed on ICDPs. Multiple studies have recommended that future approaches be tailored to the biophysical, socioeconomic, political, and institutional contexts of the site (Barrett, Brandon et al., 2001; McShane & Newby, 2004). A better understanding of institutional arrangements is key in accounting for the complex interactions between policy, laws, local rules, and how decisions are made (Leach, Mearns et al., 1999). Rather than concentrate decision-making authority on one scale, some are suggesting that authority be distributed across scales, where the institutional capability is strongest (Barrett, Brandon et al., 2001). Oftentimes, capacity building over a long period is necessary to strengthen local institutions and management capabilities, contributing to social capital (Berkes, 2004). Many of these programmatic changes can be implemented by applying the recommendations of adaptive collaborative management.

Adaptive Collaborative Management

Adaptive collaborative management (ACM) is a management paradigm in which stakeholders share management responsibility over a specific area of natural resources and are able to learn and apply their experiences to ensure adaptability (Ruitenbeek & Carter, 2001). Adaptive collaborative management relies on feedback mechanisms to respond to the successes and failures of different approaches while relaying the information across organizational scales. This can be implemented under the subsidiarity principle, which says that there should be as much local rights and responsibilities as institutionally feasible with a minimal amount of government regulation (Berkes, 2004). To produce collaboration and allow for adaptation, horizontal linkages are essential to bond groups while vertical linkages connect these groups

with state agencies, NGOs, or funders (Berkes, 2004). In a certain sense, adaptation and collaboration are inherently linked. Successful collaboration often requires the flexibility to adapt to changes in stakeholder structures while adaptation requires the sharing of information between stakeholders who have the closest access to the source.

The collaborative element of ACM requires that there be actual sharing of responsibility and power in decision-making, rather than token consultation or passive participation (Berkes, 2004). One typology, developed by Jules Pretty (1995), identifies six types of participation, including: 1) passive, 2) consultative, 3) purchased, 4) functional, 5) interactive, and 6) self-mobilization. Pretty and Smith (2004) assert that positive conservation outcomes do not result from types one through three, and that social learning to build local capacity in understanding complex ecosystems is necessary to achieve types four through six. This connects to the adaptability of management, the sharing of information, the importance of local institutions, and the overall institutional arrangements. Social learning is identified by Ruitenbeek and Cartier (2001) as an alternative to direct economic incentives to inducing behavioral change. Their example of demonstrating sustainable farming techniques with a well-respected farmer in the community and using social learning as tool for dissemination is aptly applied to the rural Jamaican context.

Adaptive collaborative management has been applied in several contexts in ways that acknowledge earlier misconceptions in protected area management. Colfer (2005) describes the ACM approach towards collaboration used in several CIFOR field studies as one that looks at "intracommunity variation . . . to amplify the voices of communities that are marginalized by more powerful external stakeholders, *as well as those who are marginalized within communities* [italics added]" (Colfer, 2005). Trust building between community groups may be as important as trust between these groups and park management. By applying the concept of social capital and analyzing community organizational capacity, we will discuss how this could lead to increased participation and social equity among communities in the BJCMNP.

In their operational framework for protected areas, White et al. (2001) establish an "enabling institutional environment" that would rely on adaptive capacity for uncertainty, politically effective constituencies, and effective collaboration between stakeholders to negotiate inevitable conflicts. To achieve this, the authors call for a legal and institutional framework and capable representation of governmental and civil society interests, all of which are assumed to be

represented by NGOs. The authors state that collaboration must occur at multiple levels, with full stakeholder representation in a balanced structure that is founded on trust, reciprocity, transparence, fairness and "near equal standing in terms of power to effect the outcome" (White, Gregersen et al., 2001) Without perceived fairness, the authors contend that antagonism and resistance are inevitable. They also lend support to social capital as a basis for collaboration among groups over protected area issues (White, Gregersen et al., 2001). Olsson and others emphasize, among other things, the importance of charismatic leaders in building social networks that enable information flow across groups and scales. Collaboration and networking provides more opportunities for feedback and learning when managing complex ecological systems (Olsson, Folke et al., 2004).

Transparency and Legitimacy

One of assumed benefits of building a more equitable sharing of management powers through extensive collaboration is that by incorporating community representatives throughout the decision-making, planning, and evaluation processes, legitimacy will be gained for conservation objectives. If stakeholders are able to shape the process and negotiate trade-offs, the transparency in the management structure should lead to better outcomes. Fisher (2001) notes that regulations and management practices are more likely to be followed by people who had a say in shaping them. However, he also notes that these are rare cases and that protected area managers may argue that community needs may be met without sharing the decision-making process.

Within the analysis of our research in the Blue Mountains, we tried to evaluate the meaningfulness of participation as a new paradigm in conservation approaches by reflecting upon recent criticisms. Specifically, Mosse (2001) describes how the formation of local knowledge can occur within the participatory setting, and is shaped both by project managers and internal power relations and politics within the community group. Frances Cleaver (2001) scrutinizes the assumptions behind participation and identifies areas that need to be addressed in implementation such as the over-reliance on formal institutions to the detriment of informal ones, a lack of information on the actual costs and benefits of participation to local residents, and a clearer understanding of the norms and representation that affect decision-making within communities.

While democratization and social justice are issues that go beyond the scope of the park co-managers' responsibilities, they can still contribute by promoting representation across politically and socio-economically heterogeneous communities. These agencies help develop social and human capital through skills-training workshops such as proposal-writing. While capacity building will not solve the problems of representation and democratization itself, it can improve access to the tools needed by would-be community leaders to build local institutions for resource management. Through this research we hope to identify the social context in which diverse community members make decisions that impact their environments. Incorporating the lessons from problematic past attempts that failed to build equitable participation, we hope to provide valuable information to the JCDT and community stakeholders, which could help clear the way for future efforts to more fully involve local communities in localized resource management.

Social Capital and Social Movement Theory

Strategies for gaining support for biodiversity conservation projects are informed by a broad set of social science theories, specifically, those of political science and sociology. These social capital and social movement theories use empirical data to explain the how, the why, and the outcomes or potential results of social movements. Broadly construed, social movements include any type of group action and can take the form of cooperation, collective action, informal networks, shared goals, common identity and desire for social change (Lundy 1999). Drawing on each of these theories, a general approach to reducing the loss of biodiversity involves gaining the collaboration of individuals, groups, and organizations to take action. To better understand how participatory approaches to biodiversity conservation in the BJCMNP can be improved, we are analyzing our data with the use of social capital, resource mobilization, political process, social network, and social constructionist theories. We chose this specific combination of social movement theories because they compliment the social capital discussion and are relevant to the data we collected. These theories inform our subsequent discussion section and recommendations chapter (see chapter 4).

Social Capital

Social capital can be thought of as: 1) relations of trust; 2) reciprocity and exchange; 3) common rules, norms, and sanctions; and 4) connectedness in networks and groups (Pretty & Smith, 2004). Trust can lead to greater cooperation while lowering monitoring costs. Reciprocity and exchange build mutual obligations between community members, lessening the likelihood of the free-rider problem in collective resource management (Pretty & Smith, 2004). Social capital can occur between individuals with similar outlooks, termed "bonding," groups form at a local level. "Bridging" is the horizontal connection between groups with different viewpoints across communities. Lastly, linking signifies the ability of groups to make vertical connections with external agencies, such as funders (Pretty & Smith, 2004). While social capital may lead to greater socioeconomic development through improved social cohesion, the same study also warns that communities may be well organized with reciprocal relationships, but be strictly hierarchical and based on fear rather than trust (Pretty & Smith, 2004). Other studies have cautioned that there may be reverse causality—that greater wealth increases access to social networks (Harriss, 2001). Social capital may be better understood within its cultural and political contexts when assessing how it may offer potential for collective action (Mansuri & Rao, 2004).

In the context of protected areas, the strong networks, trust, and reciprocity can improve monitoring and reduce the free-rider effect when communities are included in the management of local natural resources (Pretty & Smith, 2004). However, one must account for community heterogeneity in that certain individuals may be better organized due to wealth, land holding, or political clout, and thus be able to control the benefits from community-based natural resource management (CBNRM) otherwise referred to as "elite capture" (Mansuri & Rao, 2004). A World Bank study in Jamaica demonstrated that building social capital through government-funded community projects led to increased collective action, but that the process was more autocratic, with community leaders making the decisions. However, the same study notes that elite capture may be benevolent, as in the case when the majority of community members are satisfied with the outcome (Rao & Ibanez, 2003).

Social Movement Theory: Resource Mobilization

Previous collective behavior theories, Smelser's (1963) strain theory or Kornhauser's (1959) mass society theory for example, regarded collective action such as social mobilization as irrational and disorganized. Theorists were increasingly frustrated with these earlier psychologically-based theories and their lack of explanatory power. Resource mobilization theory differs from these previous theories in that it explains action towards social mobilization as planned, organized and rational behavior. Protesters were no longer seen as irrational beings, randomly reacting to issues beyond their control. Resource mobilization theory explains how a core group of strategists involved in a social movement work to assemble affected peoples, attract money and supporters, gather media attention and create positive relationships with those individuals in positions of power to enact social change (McCarthy & Zald, 1977). This theory was prominent in the 1970s and continued as such until the 1980s, when its explanatory power was questioned and consequently improved upon. Specifically, it was thought that resource mobilization theory focused too heavily on countering Olson's (1971) free rider problem (Feree, 1992) and thus also focused greatly on the institutional features of social mobilization while overlooking the role of social, psychological, and political factors.

Social Movement Theory: Political Process

Political process theory tries to incorporate the important role of political factors in the explanation of social mobilization. With this view, social mobilization is not just a psychological phenomenon, but rather, a political phenomenon as well (Eisinger, 1972; Kitschelt, 1989). McAdam (1982) wrote specifically about the emergence of social mobilization as being contingent on the role of institutionalized political processes. McAdam hypothesized that socioeconomic situations create the basis from which political opportunities and the development of social mobilization occurs. Rather than focusing solely on the movement's external or internal issues as being integral to its success, McAdam suggests that both factors play an important role. More specifically, three factors are integral to developing social movements: expanding political opportunities, indigenous organizational strength, and the presence of shared cognitions. McAdam suggests that the rise of social mobilization is possible due to transformations in both behavior and consciousness of involved individuals. The term "cognitive liberation" is used by McAdam to describe the growth of the consciousness among

mobilized participants, eventually leading to collective action. Cognitive liberation occurs through three events: the loss of legitimacy of a once trusted system, the exercising of a new found political efficacy, and the beginning of demands for social change.

Social Movement Theory: Social Networks

Some scholars would argue that social networks and micro-structural recruitment are critical factors in social movement mobilization. These scholars argue that individualistic models of psychological or attitudinal accounts of activism and social movement participation are not adequate (McAdam & Paulsen, 1993). McAdam and Paulsen's argument is that structural location facilitates movement participation more than other factors. The two major factors influencing individuals and their involvement in social mobilization are interpersonal ties and membership in organizations (McAdam & Paulsen, 1993). It also appears that people with membership in many organizations feel a stronger sense of efficacy and are also more likely to participate in a social movement. In addition, participation in a social movement relies on a conceptual linkage between participation and identity amplification.

Social Movement Theory: Social Constructionism and Frame Alignment

The advent of frame alignment theory has also redefined social movement theory by going beyond political opportunities and resource mobilization to explain the construction of social mobilization. The use of frame alignment theory often requires the adoption of a social constructionist perspective. Environmental problems can be seen as collectively identified and defined social issues. Furthermore, groups in society identify, define, and perceive problems collectively to create a reality unique to their experience and perspective (Hannigan, 1995; Taylor, 2000). Frame alignment theory rests on the idea that the framing of environmental problems can be explained as a major force in meaning and reality construction for individuals or groups (Taylor, 2000). More recent frame alignment scholars emphasize that the processes of framing an issue has dramatic effects on the creation of collective action frames. Collective action frames are "action-oriented sets of beliefs and meanings that inspire and legitimate the activities and campaigns of a social movement organization" (Benford & Snow, 2000).

The creation of a collective action frame involves three processes: diagnostic framing, prognostic framing, and motivational framing (Benford & Snow, 2000). The diagnostic framing process refers to the identification of an event or individual to blame for the problem or injustice

at hand and appropriately became named the injustice frame (Gamson, 1997). Gamson adds to this discussion by offering analysis of the role of media discourse in the creation of collective action frames, as it can play a special role in the manufacture of the injustice frame. However, Gamson (1997) also warns that large mass media efforts to establish collective action framing cannot replace the importance of direct interaction between mobilization organizers and potential recruits. Prognostic frames explain the way in which the movement intends to solve the problem at hand and attempts to articulate a strategy by which to achieve its goals (Benford & Snow, 2000). The final step is the construction of a motivational frame. The motivational frame provides the justification for becoming involved in the collective action. Important in the motivational framing process is the identification of vocabularies of motive that provide possible adherents with reasons to become and stay involved in the movement (Benford & Snow, 2000).

Klandermans and Oegema (1987) have proposed theories focusing on the recruitment process and its role in participation in social mobilization. They hypothesize that four steps are required at the individual level to achieve social mobilization participation, the first of which is becoming part of the mobilization potential. The mobilization potential is the people in society who are capable of being mobilized by a social movement. These individuals would be the ones who are willing to take a stand toward a particular issue and become engaged in action. People can be targeted by mobilization efforts through the use of a variety of avenues including mass media, mail, and friendship or organizational ties. The third step in achieving movement participation is becoming motivated enough to participate. An individual has to acknowledge the perceived costs and benefits of participation, including identifying both collective and selective incentives. Lastly, an individual must overcome their restrictive barriers in order to participate in a social movement.

Criticisms of Preservationist Approaches

Criticism of the preservationist ideology of protected areas has contended that it is an imposition of Western concepts of “pristine” natural environments that are isolated from human disturbance and that human populations are inherently inimical to their environments (Pimbert & Pretty, 1997). Furthermore, literature on new social movements such as environmentalism, suggests that such a concept originates in the “First World” where affluence contributes to a different set of values regarding such things as wilderness areas and clean air. Another common

critique is that overconsumption of natural resources often originates in the same countries that have pushed for protected area preservation in developing countries (Guha, 1989). Critics have also attacked the positivist perspective that experts are inherently more capable of making protected area management decisions, asserting that indigenous knowledge has often been ignored (Pimbert & Pretty, 1997). Coupled with this criticism was a challenge to the belief that local communities, and not outside actors, such as illegal loggers or international extractive corporations, were the main drivers behind environmental degradation (Guha, 1989; Wells & McShane, 2004).

The current paradigm of protected areas management relies partly on the Communication, Education, and Public Awareness (CEPA) approach for curbing biodiversity loss. Some, however, question the use of this program, criticizing its problematic framework. Robin Broad (1994) for example, argues that the current paradigm plaguing international environment and development programs is the view that poor people are the primary agents of environmental degradation. Using this framework, low income countries therefore appear to be uninterested in environmentalism (Lundy, 1999). This traditional view is challenged by examples where the poor have become environmental activists such as the Landless Workers' Movement in Brazil (Robles, 2001) and the Assembly of the Poor in Thailand (Baker, 2000). According to Broad (1994) the three conditions necessary for poor people to become environmental activists are: 1) that environmental degradation is threatening the natural resource base off of which the poor live; 2) that the poor have lived in an area for some time or have some sense of permanence there; and 3) that civil society is politicized and organized.

Similar research has been conducted in Jamaica. Those given primary responsibility for forest degradation are poor farmers, and likewise, they are viewed as "ignorant" and in need of environmental "awareness" campaigns (Weis, 2001). The poor and the marginalized are both more likely to be affected by environmental degradation and less likely to be meaningful participants in environmental NGOs and/or community-based projects. NGOs in Jamaica have been given lead roles in community-based conservation initiatives as they are often thought of as the organizations with more participatory and less bureaucratized approaches, as compared to governmental organizations. Furthermore, NGOs are thought to be better able to meet the needs of people at less cost than other organizations. However, NGOs and their ability to provide change have been recently questioned. According to Lundy (Lundy, 2000), community

participation is a standard inclusion in Jamaican project proposals as it is seen to be a necessity for the success of development or conservation projects. Participation is, however, a contentious word that oftentimes each individual interprets differently. Moreover, Jamaican and foreign donors alike have failed to closely examine directives for community participation in their funding efforts (Lundy, 2000). As a result, NGOs are getting funding for projects that are criticized as furthering elite's environmental ethics. These circumstances may be "unintentionally reinforcing unequal social relations, as opposed to empowering or giving a voice to marginalized groups" (Lundy, 2000).

Many of Jamaica's environmentally active citizens have been shown to be members of the middle class, and furthermore, it has been found that poorer communities generally do not initiate environmental protest or social mobilization (Lundy, 1999; Lundy, 2000). The poor are unlikely to mobilize for environmental causes because they generally do not have the resources (Lundy, 1999). Weis (2001) furthers the discussion by offering the advanced age of many of Jamaica's farmers as hindering an eco-social movement, stating that young people are more likely to become involved in social protest. Lundy (1999) and Weis (2001) hypothesize that the increasingly degraded status of Jamaica's ecosystems as well as political exclusion are motivational factors in causing a new environmental social movement.

The JCDT Approach to Community Involvement

Jamaican environmental non-governmental organizations have been working with local communities to bring about social change in the environmental context primarily through three approaches: promoting education and awareness-raising campaigns, government and policy advocacy, and rehabilitation programs (Lundy, 1999). They have worked towards promoting educational and awareness-raising campaigns through curriculum interventions, school competitions, cultural fairs, conferences, field trips, the use of media (e.g., radio), and calendar events (e.g., International Biodiversity Day, Earth Day) (JCDT, 2005). Secondly, Environmental NGOs are also attempting to change the government's attitude and policy towards the environment. To varying degrees, environmental NGOs have done this through advocacy, lobbying, and gaining representation on government agencies and committees. Lastly, Jamaican environmental NGOs have developed community projects related to rehabilitation initiatives (e.g., tree-planting, conservation of fisheries, soil conservation).The JCDT takes a two pronged

approach in their efforts to gain community support and involvement through their Education and Public Involvement Program and a Recreation and Tourism Program. Many of the JCDT's efforts are focused on education with the hope of eventually changing destructive behaviors and practices through first fostering concern and then motivation on an environmental issue to change the status quo. Under the recognition that involvement by a variety of stakeholders is necessary for the success of the BJCMNP, the JCDT's program includes three sub-programs within their Education and Public Involvement Program: the Community Conservation and Sustainable Livelihoods Sub-Program, the Communication Sub-Program, and the Interpretive Sub-Program.

The JCDT's Communication Conservation and Sustainable Livelihoods Sub-Program tries to empower community members and organizations through the use of both youth programs and community conservation and environmental stewardship programs. Three Local Advisory Committees (LACs) were established in the park's main administrative areas—near Penlyne Castle, Cascade, and Millbank—and operated between 1993 and 2000. These groups were created with the goal of involving local communities in park management activities. Unfortunately, the amount of environmental education and capacity building required to sustain the LACs was underestimated. As funding for the park decreased, the level of assistance from park management also dwindled so that the LACs are no longer meeting. Alternatively, JCDT's current route for community involvement involves collaboration with existing community-based organizations.

The BJCMNP Communication Sub-Program creates and delivers messages regarding the park's resources, importance, and management. Each campaign is developed and targeted to different constituents such as individual communities, government agencies, and the wider public through the use of brochures, posters, radio promotions, websites, newsletters, and media releases. The Interpretive Sub-Program aims to foster park support through the encouragement of relationship and meaning-building between stakeholders and the park. The JCDT fosters meaning-building through the use of signs, brochures, exhibits, interactive presentations, guided tours, a visitor's center, and children's playgrounds. Additionally, the JCDT emphasizes primary and secondary school visitations and school environmental stewardship as specific strategies for achieving conservation promotion. The JCDT's second approach to inclusion and outreach includes their Recreation and Tourism Program, which promotes support for conservation

through recreation and tourism in four sub-programs and will not be discussed in further detail as it is beyond the scope of this project.

During the development of their five-year management plan, the JCDT organized stakeholder consultation meetings in eight communities in the BJCMNP's buffer zone. These meetings were used to elicit community stakeholders' understandings and values on the park and why the park should be protected. These consultations employed consensus discussion methodology to moderate or eliminate extreme views and to settle on practical solutions (Bedasse, 2005). While this technique may be helpful and efficient, it may also reinforce power differentials between community members and stifle dissent. It is not clear how participants were invited, and while it is may be easier to invite already-formed community groups, it is unlikely that this would represent the community's diverse interests. Our analysis and recommendations may echo those of Bedasse (2005) at times, but also may diverge. Through our surveys and interviews we hope to build upon the valuable stakeholder reports that Bedasse (2005) and the JCDT have completed and to provide site-specific assessments of community needs and attitudes and behaviors with regards to participation in conservation management.

Methods

Site Selection

The study was conducted in three communities bordering the BJCMNP: Penlyne Castle, Cascade, and Millbank. The location of the three research sites were chosen by the JCDT and coincide with the three communities where the LAC were once active and where the JCDT has ranger stations. The research questions were developed by the project team after reviewing the JCDT's *Research Prospectus*.

The JCDT identified three levels of outreach and engagement that they had initiated at each site. These experiences, along with the JCDT's perceived level of self-organization within the communities, provided a basis for conducting our research. The JCDT described Penlyne Castle as the community with the least recent involvement in JCDT programs, Millbank as the community with the most involvement and self organization, and Cascade as somewhere in between the other two communities. It should be noted that as research to determine the socio-economic context for local institutions and their effects on conservation efforts at these three sites had not been performed, this is largely an exploratory study which will establish a baseline to evaluate future collaborative management efforts.

To accomplish the community-based research, we used a mixed-methods approach that employed focused interviews and survey questionnaires to collect data from informants in each of the three communities (see figure 1.5). While our interviews spanned community residents, organization leaders, NGO employees, and government agency personnel, the survey questionnaires were designed for community members only. We chose this methods because it seemed best suited for both obtaining a wide range of respondents (surveys), while still being able to contextualize this information through tailored interviews with key informants. While we did participate in community functions, such as community based organizations (CBO) meetings and church services, we do not consider participant observation to be a major component of our research methodologies. The short time frame of our research did not permit us to feel comfortable interpreting the participants' actions at these events.

Survey Questionnaire

To fit the needs and context of our study, the questionnaire was primarily self-designed. A few questions were adapted to the Jamaican setting from field-tested instruments including the

2005-2006 World Values Survey (WVSA, 2005). The following topics were covered with the survey questionnaire: 1) demographics including, gender, occupation, age, household size, income, and education level; 2) land acquisition/use; 3) farming methods; 4) perceived access to local resources including health care, transportation, clean water, and lumber; 5) personal involvement in community activities; 6) degree of concern over current community issues including biodiversity loss, lack of available employment, air pollution, and flooding; 7) knowledge of invasive plant species and their potential uses (e.g., Wild Coffee, Net Fern, Wild Ginger, Red Bush); 8) opinions on current BJCMNP management, regulation, and enforcement; and 9) if applicable, context and nature of interaction with the JCDT and other park managers (see Appendix 1 for a copy of the survey questionnaire). We tested the survey questionnaire in the field on two individuals, both of whom resided in one of the park's buffer zone communities, and suggested changes were incorporated into the survey instrument before we began data collection. We employed convenience sampling methods for data collection due to a number of logistical constraints. To ensure the inclusion of a variety of individuals, we frequently varied the time and location of our data collection. The survey questionnaires were administered to any individual, 18 years or older, who was willing to partake in the study, could understand our questions, and was a resident of the community.

Our goal was to gather data from at least 50 adults in each of our three research sites for a minimum total of 150 completed questionnaires. Due to the continuity of communities in this area of Jamaica, the effective questionnaire sampling area was extended to include neighboring communities. At these research sites it was not always noticeable to outsiders, such as ourselves, where one community ended and another began. Moreover, individuals frequently traveled between neighboring communities to visit friends, shop, or attend church. Because of this continuity

Jesse Worker discussing farming methods with a local resident

between communities, the Cascade sampling area effectively included the communities of Cascade and Section, the Penlyne Castle sampling area included Penlyne Castle and Epping Farm, and the Millbank sampling area included Millbank and Comfort Castle. According to the 2000 Census in Jamaica (data provided by JCDT), the combined adult population of Cascade and Section is 339 individuals, the estimated adult population of Penlyne Castle and Epping Farm is 335 individuals (Penlyne Castle is not included in the available Census data, therefore, an estimate of 100 adults was used), and the combined adult population of Millbank and Comfort Castle was 290 individuals. We collected a total of 161 questionnaires, 51 in Cascade, 50 in Penlyne Castle, and 60 in Millbank. Of the 964 adults living in these three communities, we administered the survey questionnaire to 16.7 percent (see Table 3).

To gain more comprehensive responses regarding conservation attitudes and behaviors, a number of open-ended questions were asked in the survey questionnaire. After the survey questionnaires were administered and before entering data, a coding scheme for each question was developed. The variety of responses for each open-ended question was compiled and a relevant coding schema was then created to encompass the range of responses received.

Table 3: Count of Adult Population and Sample Size by Location

COMMUNITY	TOTAL AVAILABLE ADULTS	SAMPLED INDIVIDUALS	PERCENTAGE OF TOTAL SAMPLED
Cascade	248		
Section	91		
Subtotal	*339*	51	15.04
Penlyne Castle	100*		
Epping Farm	235		
Subtotal	*335*	50	14.92
Millbank	218		
Comfort Castle	72		
Subtotal	*290*	60	20.69
TOTAL	**964**	**161**	**16.70**

* 2000 Census data is not available for this small community. Therefore, an estimate of 100 adults was made.

Interviews

We employed the interview methodology with buffer-zone community members, NGO employees, and officials from each of the BJCMNP collaborative management organizations, including the JCDT, FD, and NEPA. The purpose of the interviews was to allow for open-ended responses to questions that may elicit a variety of perspectives. These responses often gave us a historical account of community events, the relationship between community members and the protected area, and the impact of collaborative park management. They also allowed us insight into the reasoning behind attitudes and behaviors towards conservation and the role conservation played in the interviewees' lives. The interviews differed from the survey in that we developed multiple categories of interview questions to address the diverse collection of interview participants, which included: 1) community leaders, 2) farmers, and 3) park rangers.

Key informants typically included leaders or involved members of community organizations, church pastors, business owners, school principals, teachers, and in some cases, the local police. However, in part to avoid obtaining a limited spectrum of perspectives, we also interviewed farmers at each site, some of whom farmed land within park boundaries. Informants outside of the buffer-zone communities included government officials, JCDT employees, and other NGO employees. Our goal was to interview roughly 50 key informants during the course of our fieldwork (see Table 4). The number interviewed at each site varied depending upon the number of suitable and willing informants. (see Appendix 2 for a complete list of topics discussed with different interview participants). We administered 165 surveys and 54 interviews throughout our fieldwork but due to the theft of our research notebook, the number of usable surveys and interviews was reduced to 161 and 44, respectively.

Table 4: Summary of Viable Data by Method and Location of Collection

	Cascade	Penlyne Castle	Millbank	Other	TOTAL
Questionnaire	51	50	60	0	**161**
Interview	16	8	13	7	**44**

Analysis

Survey questionnaire data was entered into the Statistical Package for the Social Sciences (SPSS) using SPSS Date Entry Builder, version 4.0. All statistical data analysis was performed in SPSS, version 15.0. We began by running descriptive statistics such as mean, median, range, standard deviation, frequency, percent total, and sample size on all the variables to acquaint

ourselves with the data and determine normalcy. Since each of the three surveyed communities had large enough sample sizes, we conducted more in-depth tests for cross-tabulation, correlations, and associations to determine differences in responses to survey questions. These procedures were also used to compare opinions on farming, park management, conservation, individual environmental concerns, and access to resources (natural and social) between the three communities and different demographic groups such age, income, education level, and gender.

We used appropriate statistical tests that were based on the design of our survey questionnaire and the distribution of the data. When comparing two categorical variables we used the Pearson Chi-square test to check for association. When data was sparse, as our data was in a 2X2 table, we used Fisher's Exact test instead of a Chi-square test. To analyze relationships between one categorical variable and one continuous variable we used T-tests and ANOVA to assess differences in mean between two or more groups. We used T-tests or non-parametric Mann-Whitney tests for comparing two samples and ANOVA or non-parametric Kruskal-Wallis tests when we compared more than two samples. The Tukey Post Hoc test was used to conduct multiple comparisons.

Interviews were used to contextualize the survey questionnaire results and elucidate nuanced themes and topics we may have overlooked with the survey questionnaire. After transcription, relevant themes were gathered from the interviews, categorized by topic, and summarized.

Limitations

While this project aimed for the highest possible standards, there were some limitations that must be acknowledged. These limitations fall broadly within the following areas: methodological, logistical, and epistemological.

- Survey questionnaires were administered using convenience sampling methods. The lack of access to a map of households or viable roads, a list of current community residents, or a phonebook made random sampling difficult.
- We did not conduct farm site visits and therefore had no ability to see farming practices in action. Nor did we have an extensive agro-ecology background to properly assess farming methods employed in these communities.

- Differences in survey questionnaire administration styles and techniques may have introduced variability in responses. Some of the individuals surveyed were unfamiliar with the survey questionnaire format which may have also introduced variability in responses.
- The theft of a research notebook and interview recorder made recovery of either notes or transcripts for some interviews difficult. As a result, the Penlyne Castle community is under-represented in the interview data.
- We were unable to interview other important stakeholders such as the Ministry of Lands and Environment, the Commissioner of Lands, RADA, or SDC.

Results and Analysis

In this section we assess how issues of poverty and political marginalization affect the resource-use of residents of three communities within the BJCMNP's buffer zone while providing an analysis of community attitudes and behaviors towards conservation goals. We then characterize and evaluate the effectiveness of collaborative management in providing equitable opportunities for participation. While we administered the survey questionnaire to any willing community member, it was our intention to gain expert opinion regarding community organization and park participation, which resulted in interviews with community leaders and government officials. These two sample populations, however, complement each other and can elucidate certain nuances that targeting one population for both interview and survey methodologies would not have been able to accomplish. The interview results throughout this section are used to contextualize the survey questionnaire results.

Survey Questionnaire and Interview Sample Demographics

The demographics of the interview and survey questionnaire samples differ on nearly all measures. The interview sample was smaller, composed of disproportionately more males than females, had a higher percentage of people with high school degrees, more commonly held occupations outside agriculture, came from slightly smaller households, and had higher median monthly incomes (see Table 5).

Small business owner in Millbank

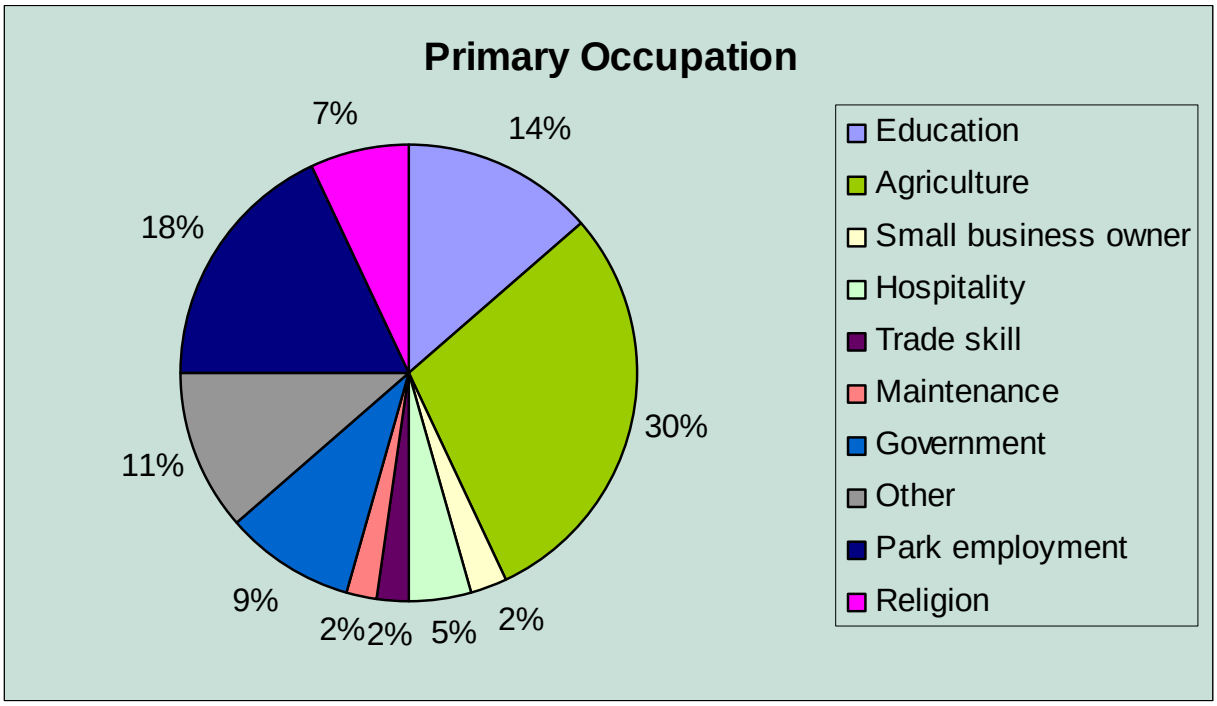
Table 5: Demographics of Survey and Interview Sample

Demographic		Survey Community			Total Survey Sample (n=161)	Interview Sample (n=44)
		Penlyne (n=50)	Cascade (n=51)	Millbank (n=60)		
Gender	Female (%)	21 (42.0)	32 (64.0)	19 (31.7)	72 (44.7)	17 (36.2) (n=47)
	Male (%)	29 (58.0)	18 (36.0)	41 (68.3)	88 (54.7)	30 (63.8) (n=47)
Education Level	Frequency (%) with no school or completed basic school	6 (12.2)	8 (15.6)	10 (16.9)	24 (15.1)	3 (9.7) (n=31)**
	Frequency (%) completed 6^{th} – 9^{th} grade	27 (55.1)	23 (45.1)	39 (66.1)	89 (56.0)	13 (41.9)**
	Frequency (%) completed high school	16 (32.7)	20 (39.2)	10 (16.9)	26 (28.9)	15 (48.4)**
Median monthly income in Jamaican dollars (1 $US = $70.4 Jamaican) +		22,500 (n=24)	15,000 (n=23)	15,000 (n=23)	14,000 (n=80)	35,000 (n=12)**
Mean household size		4.3±1.9	5.2±2.8	3.98±2.0	4.5±2.3	3.8±2.4 (n=32)**
Mean age		42.1±14.8	41.3±14.3	44.5±17.0	42.8±15.5	45.6±14.7 (n=31)**

** These data were collected from Penlyne Castle, Cascade, or Millbank community members.
+ Income distribution was highly right-skewed and therefore median income is provided as the measure of central tendency. Additionally, many informants were understandably not willing to share income data with us.

Nearly 81 percent of the surveyed individuals listed agriculture as either their primary or secondary occupation. Nearly a third of the interview informants (13 individuals or 30 percent) listed agriculture as their primary source of income (see Figure 7) and an additional 18 percent (eight informants) mentioned agriculture as a secondary source of income (not reflected in Figure 7).

Figure 7: Primary Occupation of Interview Informants (n=44)



The Concept of a Heterogeneous Community

Community Definitions

Since one of the major criticisms of community outreach in conservation management is the assumption that community members are homogenous in interests , socio-political, and economic status, we asked a variety of questions in our interviews to better understand these dynamics. Our interview respondents nearly always based their definitions on geographical boundaries, but often would continue to list important values that community members were expected to share. These values can be themed under reciprocity, cooperation, and shared ideals for community development. These definitions included people who interact regularly, work together, cooperate, have shared goals, shared aspirations, shared resources, or promote unity. A few interviewees, usually those who had backgrounds as community leaders, divided residents between “active” and “passive” members based on their participation in community affairs. Notably, three interviewees (out of 44) stated that the natural environment helped define the community.

Out-of-service health clinic (left) and extensive soil erosion on steep slopes (right)

Community Concerns

The surveyed populations were given a list of predetermined issues (environmental, social, and political), and asked to rate them on a scale from 0 to 4, with 4 being the highest level of concern (see Table 6). Lack of jobs and the threat of soil erosion appear to be of greatest concern to the survey sample (N=161) with an average rating of 2.8 and 2.5 respectively. Waste disposal is a secondary concern with a mean rating of 2.1, while invasive species received, on average, the lowest score of 0.8. It is important to note that the list of concerns was created *a priori* by the researchers causing environmental concerns to be disproportionately represented. Furthermore, this list of concerns may not be representative of the actual concerns of these communities, but they do give us an idea of how these concerns rank relative to one another.

Using Kruskal-Wallis tests, the data indicate mean concern over current environmental, social, and political issues significantly differs between communities on eight issues: lack of employment, environmental degradation, loss of traditions, illegal hunting, soil erosion, forest fire, flood, water pollution. Tukey Post Hoc tests for multiple comparisons show the direction of the differences between communities (Table 6 and Figure 8). The Kruskal-Wallis tests are confirmed by one-way ANOVA, except for differences in mean concern for soil erosion.

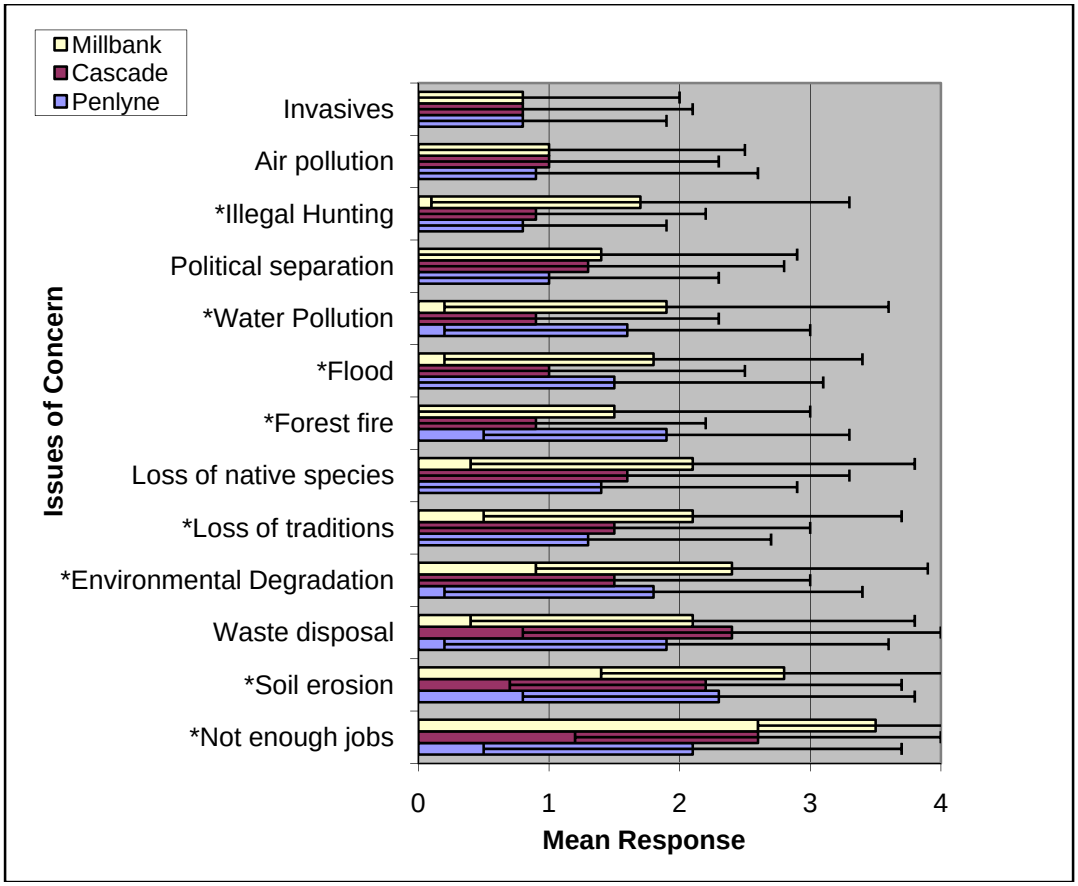
Table 6: Kruskal-Wallis Test to Indicate Significance Difference to Issues of Concern between Communities

Issue of Concern	X^2	df	Significance
Lack of Employment	27.54	2	<0.001*
Environmental Degradation	9.53	2	0.009*
Loss of Traditions	6.96	2	0.031*
Political Separation	0.95	2	0.636
Illegal Hunting	11.53	2	0.003*
Invasive Species	0.30	2	0.859
Loss of Native Species	5.72	2	0.057
Soil Erosion	6.11	2	<0.001*
Forest Fire	15.91	2	<0.001*
Flood	8.96	2	0.011*
Water Pollution	10.43	2	0.005*
Air Pollution	0.92	2	0.633
Waste Disposal	1.99	2	0.369

* significance<0.05.

Using Tukey Post Hoc tests for multiple comparisons, the Millbank sample has a higher mean concern than either the Penlyne or Cascade samples for lack of employment (sig.<0.001 and sig.=0.001, respectively). The Millbank sample has a higher mean concern for general environmental degradation than the Cascade sample (sig.=0.006) and the Millbank sample has a higher mean concern for loss of traditions than the Penlyne sample (sig.=0.031). The Millbank sample also has a higher mean concern for illegal hunting than either the Penlyne or Cascade samples (sig.=0.003 and sig.=0.010, respectively). The Penlyne sample has a higher mean concern for forest fires than the Cascade sample (sig.=0.001), while the Millbank sample has a higher mean concern for floods than the Cascade sample (sig.=0.011). The Millbank sample also has a higher mean concern for water pollution than the Cascade sample (sig.=0.005). Using Kruskal-Wallis tests, there were no significant differences (sig.>0.05) in mean concern by income.

Figure 8: Mean Individual Concern with Current Environmental, Social, and Political Threats by Community. (0: Not at all concerned; 4: Very concerned)



* Kruskal-Wallis test indicates significant differences in mean response between communities.

The interview format was used to elucidate the concept of community concerns. Unlike the survey, this gave the informant the opportunity to bring up issues of concern without having structured options from which to choose. The interviews provided an opportunity for informants to elaborate on issues that were of importance and provide explanations that could clarify results within the survey. The problems that troubled community members the most, across demographic boundaries and community lines, were infrastructural disrepair, lack of available secondary education, and concern over market prices for their farm goods. Much of this information was mentioned during the surveys, but the interviews offered a more detailed perspective. Environmental problems, while rarely the first mentioned concerns, were still often raised, especially in the context of agricultural livelihood or water availability. In the discussion section, we will analyze these issues in terms of their influence on local attitudes and behaviors towards conservation efforts.

Socio-Economic Priorities

When asked what their concerns were for their community, nearly every interviewee emphasized the miserable state of the roads as a major community-wide concern. Two of the three communities were reliant on a road that accessed the community from only one direction, leaving them vulnerable to being stranded by road disrepair. In all three communities the roads leading to and from them were in dire conditions, suffering from enormous pot holes, erosion on steep slopes, or in some cases, complete collapse from landslides or hurricanes.

> "Presently the road is obviously in a deplorable condition. They're working on it for the last year. There's a health center around here that they've been trying to build a new one for some time now. Based on what I've learned since I've been here for five years. For five years it's been where it is. No other work has been done…It was the separation that actually caused the project to fail. And numerous attempts were made thereafter to restart it…They don't have a community center. There's nowhere for social organization. In fact the only organization that breaks all the barriers is the school."
>
> -Cascade school teacher

These conditions create difficulties in receiving supplies, transmitting information, welcoming outsiders (i.e. tourists) to the community, and transporting farm goods to the market. Road repair often does not begin for months or even a year after a landslide and may take several years to complete. During this time, community members face the costs of losing access to a variety of social and economic services. Additional infrastructural deficiencies that dominated the informants' list of concerns included a lack of community centers for organizing and skills training, faulty water storage tanks, broken bridges, little transportation, and intermittent health care.

The lack of secondary education, both in terms of nearby high schools and young adult training centers, was a predominant issue contributing to the marginalization of these communities. Secondary schools are all located outside the communities, and require paid transportation to reach, creating financial and logistical problems for would-be high school students. We spoke with many capable individuals whom were unable to finish high school because of the high schools' locations, unaffordable public transportation, and poor road condition. Interviewees often mentioned how a community center with skills workshops would

improve trade skills and lead to greater employment. Employment options or opportunities, aside from farming, are rare in these communities. The lack of employment and other opportunities encourages outward migration of educated individuals in search of work to Kingston or abroad. The JCDT, through their YouthPATH program, offers training and workshops targeted towards younger residents. These programs include computer literacy, eco-tour guide classes, and other skills training. In our discussion, we will assess how these programs relate to social capital, changing attitudes and behaviors, and conservation management capacity for communities.

Other community concerns fall broadly under issues related to the environment, such as lack of waste management, deforestation for a variety reasons, and water quality. With no waste management services, individuals are instructed to either burn or bury their garbage and some throw trash in the gulley or streams. During our interviews, several older informants attributed changing rainfall and climate patterns to local deforestation. A few interview informants expressed concern that change in rainfall is adversely affecting the productivity of their crops. Water quality was also highlighted as a specific area of concern. Intentional river poisoning and runoff from farming were frequently mentioned as responsible culprits for water contamination. However, this did not appear to alter many farmers' decisions to use fertilizers and pesticides in steeply-sloped watersheds.

Disputes over environmental management were not common, but occurred more frequently among community members than between community members and park management. The community where the most conflicts were reported was Millbank, where dependence upon fishing is higher due to the adjacent Rio Grande River, than in the other communities. The intentional dumping of toxins in the adjacent river in order to harvest shrimp and crayfish was an issue that almost everyone we interviewed in Millbank identified as an environmental problem that they wanted to solve. This problem highlighted institutional issues, as one offender had been released by a judge who decided that the contamination of a local waterway did not merit a penalty. Park rangers, JCDT officials, and a few community interviewees remarked on this phenomenon. They suggested that education needs to occur at multiple institutional scales; judges are not educated about the seriousness of environmental offenses such as river poisoning, which can render enforcement ineffective. There is currently a joint effort between the Nature Conservancy, the JCDT, and community groups to address this

problem. Informants also mentioned that there were disagreements between residents on washing cars in the river, which has been the target of educational campaigns. While water quality issues were not a focus in our study, we find it useful to highlight how environmental problems have created widespread concern and led to collaboration between community members and outside agencies.

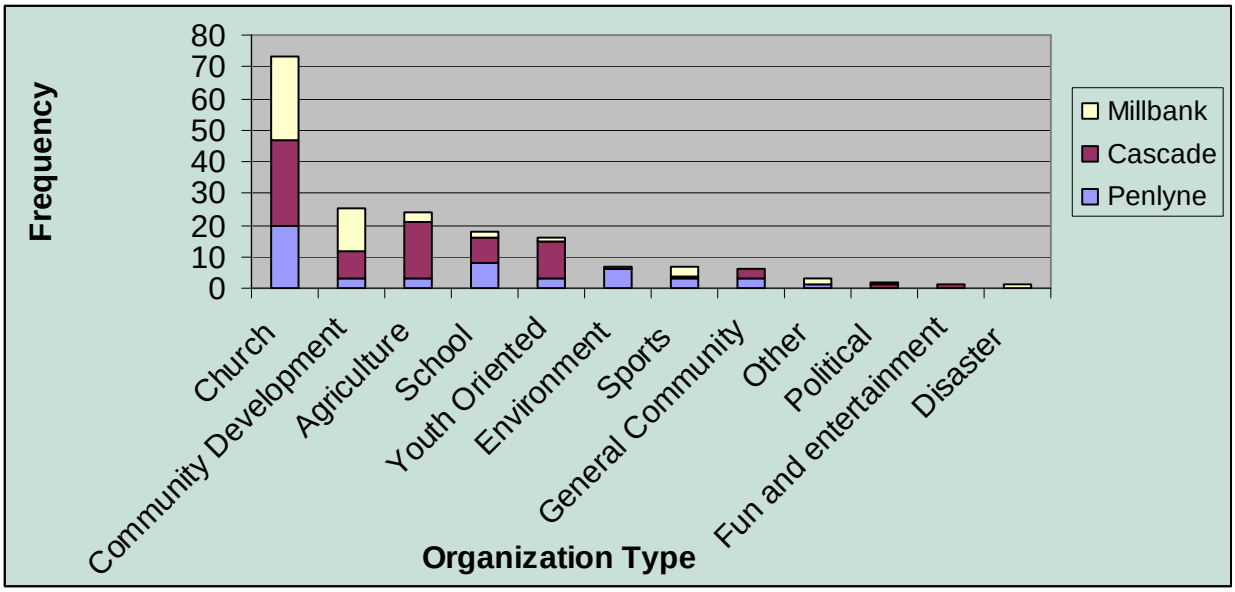
When asked what is needed to build a stronger community, interviewees presented a variety or responses. On the one hand, many interviewees felt that building a strong community requires sound infrastructure such as functioning water supply systems, good roads, and housing. Many interviewees expressed hopelessness that they could obtain the political representation needed for this to occur. These interviewees suggested that their parish—either Portland or St. Andrew—was neglected because the tourism economy was not developed. The majority, however, did not mention the role of outsiders in community building, emphasizing instead the role of community members' cooperation and communication as necessary for a stronger community. A few interviewees see the role of specialized knowledge sets, such as leadership or technological skills, as necessary for building a stronger community.

Community Organizing

Over seventy percent of the surveyed individuals claimed membership in at least one community organization. On average, they were members to 1.66±0.88 community organizations including community-based organizations, sports teams, and church groups. Our survey data indicate the most common area people participate in or organize around is church related (39.89 percent), followed by community development (13.66 percent), agricultural (13.11 percent), school (8.94 percent), and youth related (8.74 percent) (see Figure 9). Less than four percent of the surveyed individuals reported participating in environmentally-related community groups. Interestingly, the level of involvement in environmental organizing does not correspond to the gradient of community involvement given to us by the JCDT. The data indicate that individuals are more likely to be involved in community organizations in Cascade than either Millbank or Penlyne Castle. Additionally, there is also a low level of involvement in politically-oriented community groups. The organizational types represented here were grouped and coded by the researchers after data collection. There was considerable overlap in category between

community development, general community, and agricultural groups and often the missions of these groups included overlapping objectives.

Figure 9: Frequency of Membership by Organization Type and Community



By examining organizational membership and the frequency of group meetings in our surveys, combined with more in-depth questions in our interviews, we attempted to reveal social capital and how it affects organizational capacities. We did not have, nor have we found within the literature, a measuring mechanism for social capital. However, we asked questions to elicit their organizational strengths and trust and cooperation within and between groups. While there was at least one community development organization in each community we visited, in our interviews with residents, many former community groups were mentioned as no longer being active. Among some interviewees there was a prevailing sense that little had been accomplished by these groups with the blame being widespread. Some said that the

> "You have to interact with the church, the school, and the community at large. You have to interact with non-governmental agencies and stuff like that. Because I see that you can be an active or a passive member for a community. And to be an active member for a community you've got to interact. And as an active person you would want to see your community being built."
>
> –Cascade community leader

community lacked the resources to do significant organizing without sufficient government support, reiterating the sentiment of neglect from public agencies. Park management officials we interviewed recognized that the government should be more proactive, but suggested that communities could also become more self-reliant. However, others felt that this was a symbolic problem of community dependence on outside support to solve problems. In response to our interview questions regarding the effectiveness of community organizations and barriers to greater participation, residents spoke to issues of mistrust and skepticism of the organizations' structures. As examples of successful community-organized activities, one older resident in Cascade recounted community efforts to bring a health clinic, reopen a post office, and convince the government to fund school repairs.

> "We need more cooperation, you will live in the community, we need to join up more. We don't need to forget everything and sit like at home and settle because look again to the government to the project, to the project, look what we do up at the road and it will cost probably, if everybody cooperate what will it cost?"
>
> –Cascade farmer

Others commented on the difficulty of generating sustained involvement from the youth. One local teacher suggested that potential leaders among the younger generation usually leave the community, signaling a "brain drain." In our conversations with some of the younger residents, there seemed to be ambivalence towards the productivity of these meetings, or a sense that they were usually dominated by the same outspoken members.

The Bowden Pen Farmers' Association

The Bowden Pen Farmers' Association (BPFA) is a community-based organization in Millbank that focuses on ecotourism, local livelihood development, cultural and historic preservation, and conservation. While the group has over 50 members, one actively involved member said that only 25 are active, with 12 shouldering most of the responsibility. BPFA members spoke positively of their experience with the BPFA, listing benefits such as: group interaction, fundraising experience, increased responsibility of the environment, working with the JCDT, monitoring for illegal hunting and river poisoning, and ecotourism. In addition to this the BPFA has advocated for the community by writing letters to the media and demonstrating in Port Antonio with other community members over the dilapidated condition of the local road.

They have circumnavigated protracted governmental support and have successfully sought funding for projects from national and international sources.

The BPFA has a long standing relationship with the JCDT. In 2005, the JCDT and the BPFA signed a co-management agreement which makes the BPFA an official management partner. However, this has been regarded with ambivalence among BPFA members, who say increased rights and responsibilities have not been forthcoming. A few long-time members confessed to not understanding what they gained from being an official management partner, specifically indicating that they have never been invited to a meeting of co-managers, and that the JCDT did not contribute resources to the Cunha Cunha Pass restoration.

Members of the BPFA expressed pride in the accomplishments that their organization has achieved with little governmental intervention. They pointed out that their work has benefitted the whole community, at least indirectly. While some members admitted that they prefer a smaller number of members who are reliably committed, they also suggested that many community members are not willing to make an individual sacrifice for a group effort that does not bring quick financial dividends. However, some interviewees who were not involved with the BPFA expressed reservations about their role in the community. These complaints revolved around the belief that the BPFA does not disperse financial benefits or tourism opportunities around the community.

Politics

Conflicting Agencies

Despite the Blue and John Crow Mountains National Park being a national park and a forestry reserve, it is actually the Commissioner of Lands and Members of Parliament who retain the rights to lease land within the park. The Commissioner of Lands[2] was criticized by multiple stakeholders as being uninformed and unconcerned with environmental sustainability. On multiple occasions squatters were allowed to take up residence within the park. According to the Forestry Department, any attempt to evict squatters is met with negative media attention. However, in one frequently cited example, a Rastafarian community of several hundred has taken residence within in the park, which has led to several environmental problems, including pollution that has affected nearby communities. While the JCDT, NEPA, and FD all agree that

[2] We were unable to interview the Commissioner of Lands.

land tenure is a serious social problem in rural areas, JCDT and FD officials point to a lack of understanding and interest from other levels of government for instituting sustainability and protecting biodiversity. This has frustrated their efforts to gain funding or to find institutional support for sustainable forestry management. This apparent lack of concern by the Commissioner stands in opposition to the international treaties that Jamaica has signed, such as the Convention on Biological Diversity. These issues highlight the challenges in institutional arrangements that are facing biodiversity conservation in Jamaica.

Political Representation

A common theme in all the communities was the perception that members of parliament do little to represent rural needs and interests. They were harshly criticized on several occasions for only paying lip service to rural areas, using them for their votes and never following up on promises. Moreover, many interviewees did not see any avenue for making their demands heard besides street protest. The JCDT has made clear that because of the volatility of Jamaican politics, they will not advocate for policy or legislation.

A few informants, when discussing park management and decentralization, stated that while non-profits were sometimes given more responsibility in environmental management, the resources needed to be effective were rarely allocated. As a result, expectations were not always met. While decision-making is supposed to be devolved at multiple scales from community to parish, one park official stated that it is often overly bureaucratic and cumbersome. Overall, community members expressed the theme that their interests were not represented by politicians, with some explaining that they were neglected for tourist-rich areas.

Community Politics

While political rivalries on a national scale in Jamaica are notoriously violent and divisive, most interviewees felt that these factious elements did not appear to have much of a role in segregating the community. Indeed, the church and school, from our observations and from conversations, were able to bring people of various political ideologies and income levels together. However, some community leaders believed that a few residents were suspicious of the political leanings of the organizers of community groups and used that as an excuse to not get involved. One representative, who was not a resident but taught at the local school, believed that

politics was a major divider within the community and that he/she noticed political separation even at the school. However, it should be noted that this was not corroborated by any residents. In Penlyne Castle we observed an interaction where one community development organizer tried to convince a skeptical resident that the organization was not politically motivated.

Livelihoods

In our discussions with farmers, we found that while farmers value the independent nature of farming, they also revealed their vulnerability to factors outside of their control. This paradox was highlighted in that the farmers depended upon stable world markets and favorable trade agreements for Jamaican foodstuffs, while coffee-farmers were reliant upon a consistent demand from the Japanese market and fair prices from the Coffee Industry Board. Secure access to farmland varied by site, with more squatters self-reported in Millbank, while in Penlyne Castle the vast majority of farmers inherited their land.

Informants from the coffee-producing areas of Penlyne Castle and Cascade seemed to be more secure in the market demand for their products than in Millbank, but felt undercompensated for their work considering the high world market price of Blue Mountain coffee. Farmers were well aware of the large price difference between what they are paid for their coffee ($4/pound) and what it is often sold for on global markets ($40-$60/pound). In Millbank, where hardly any coffee was grown, farmers had been hit hard by recent WTO negotiations that limited the demand of Jamaican bananas that are shipped overseas. Particularly in Millbank, farmers experienced difficulties selling their crops for a number of reasons including, lack of foreign markets to sell their crops, the cheap prices of subsidized international produce, and degraded road conditions.

We asked the surveyed individuals to rate their level of agreement to a series of statements regarding coffee farming using a Likert scale. With “1” being *strongly agree* and “5” being *strongly disagree*, the surveyed individuals agreed that farming provides a good living and will sustain them into the future. The same surveyed individuals *slightly agreed* that restrictions should be placed on farming for the protection of the environment. This sentiment may indicate the willingness of the surveyed individuals to protect the environment, even if it involves making a personal sacrifice. There was *slight disagreement* in the statement that people would be happy if their children were to become coffee farmers or that coffee farming was bad for the

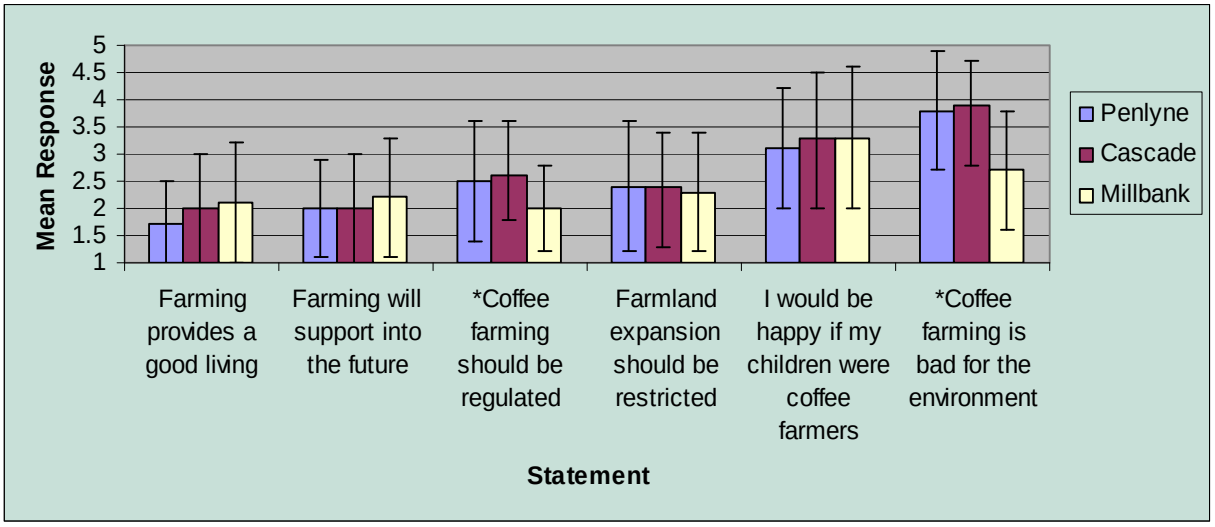
environment. While responding to the question regarding their children being coffee farmers, many individuals commented that coffee farming was hard work and that they hoped their children would not have to do such difficult work to earn a living. On average, the surveyed individuals *disagreed* that coffee farming practices affect the environment in negative ways. One indication from these responses was the notion that coffee farming, which almost always involves insecticides, land-clearing, and sometimes herbicides, was not harmful to the environment. The emphasis on coffee farming for some of these questions came from the incorrect assumption that coffee was the primary crop grown at each research site. Though this was the case for Cascade and Penlyne Castle, Millbank depends on lower-altitude crops.

Using the Kruskal-Wallis test to compare mean response across communities, there were significant differences in agreement over coffee farming being bad for the environment (X^2=34.04, df=2, sig.<0.001). A one-way ANOVA test confirms these results. Using the Tukey Post Hoc test for multiple comparisons, the Millbank sample agreed that farming was bad for the environment while both the Penlyne and Cascade samples disagreed. There are significant differences in mean response for this statement between the Millbank and Penlyne samples, and the Millbank and Cascade samples (sig.<0.001; sig.<0.001). Similarly, mean response regarding coffee farming and its regulation produced significant differences (X^2=10.44, df=2, sig.=0.005). Multiple comparisons with the Tukey Post Hoc test indicate there are significant differences in mean response between the Millbank and Penlyne samples (sig.=0.026), and the Millbank and Cascade samples (sig.=0.012). A possible explanation for this could be that Millbank is not dependent on coffee-farming and therefore is more likely to criticize it as a source of income.

Table 7: Likert Scale Response to Statements about Farming (n=161)

Statement	1 Strongly Agree	2 Agree	3 Neutral	4 Disagree	5 Strongly Disagree	Median Response (inter-quartile range)	Mean Response (±s)
Farming provides a good living	56 (34.8%)	80 (48.7%)	6 (3.7%)	15 (9.3%)	4 (2.5%)	2.0 (1.0-2.0)	2.0±1.0
Farming will be able to support your community many generations into the future	44 (27.3%)	90 (55.9%)	3 (1.9%)	19 (11.8%)	5 (3.1%)	2.0 (1.0-2.0)	2.1±1.0
Coffee farming should be regulated to protect the environment	22 (13.7%)	97 (60.2%)	8 (5.0%)	31 (19.3%)	2 (1.2%)	2.0 (2.0-3.0)	2.3±1.0
Farmland expansion should be restricted to protect the environment	30 (18.6%	82 (50.9%)	11 (6.8%)	35 (21.7%)	3 (1.9%)	2.0 (2.0-3.0)	2.4±1.1
I would be happy if my children were to become coffee farmers	12 (7.5%)	44 (27.3%)	21 (13.0%)	64 (39.8%)	19 (11.8%)	4.0 (2.0-4.0)	3.2±1.2
Coffee farming is bad for the environment	8 (5.0%)	36 (22.4%)	17 (10.6%)	75 (46.6%)	23 (14.3%)	4.0 (2.0-4.0)	3.4±1.1

Figure 10: Mean Response by Community to Statements about Farming (1: Strongly Agree; 5: Strongly Disagree)



* Kruskal-Wallis test indicates significant difference in mean response between communities.

Land Tenure

Land tenure was not a focus of our study, although we did determine through the surveys how farmland had been accessed and how difficult it was to acquire. Just over fifty percent of the surveyed individuals received their farmland through family means, while 14.3 percent

acquired their land through squatting (see Table 8). The remaining 31.1 percent of the sample received their land through their spouse, purchase agreements, renting, gifts, CIDCO agreements, or other formal or informal agreements in which they are allowed to farm a friend or another individual's land. Many farmers (as well as government officials) accuse the land tenure system of being inequitable in terms of access to land and the proportion owned by absentee landowners in Kingston. A few community leaders stated in interviews that the lack of land ownership discourages residents from considering the long-term environmental impacts of farming practices.

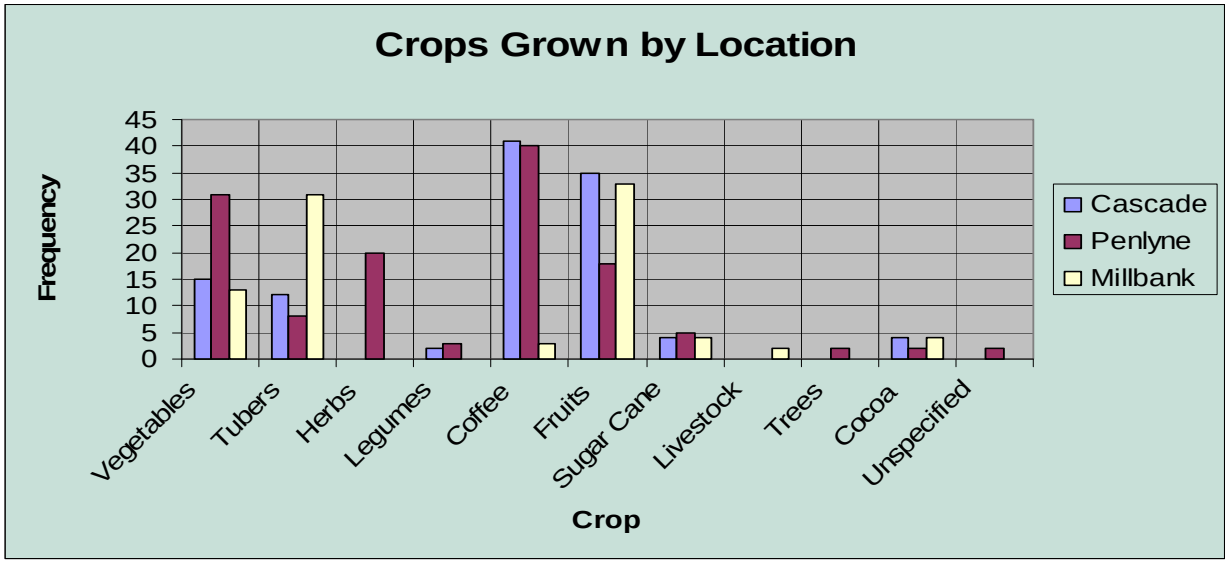
Table 8: Frequency of Land Acquisition by Community (n=119)

Land Source	Community			Total	% Total
	Penlyne	Cascade	Millbank		
Family Land	28 (42%)	26 (39%)	13 (19%)	67	56.3
Squatted	6 (35%)	3 (18%)	8 (47%)	17	14.29
Purchased	3 (30%)	4 (40%)	3 (30%)	10	8.4
Gift	2 (25%)	3 (37.5%)	3 (37.5%)	8	6.72
Rent/Lease	2 (33%)	2 (33%)	2 (33%)	6	5.04
Government Sold/Lease	0	1 (20%)	4 (80%)	5	4.2
Given Permission	1 (25%)	0	3 (75%)	4	3.36
Unclear	0	0	2	2	1.68
Total	**42 (35%)**	**39 (33%)**	**38 (32%)**	**119**	**100**

Farming Practices

Farmers in all three communities relied upon a variety of land-clearing techniques and often used them in combination. Chemical use and burning are frequently used because of the ease and brevity of the practice as compared to hand cutting. Several interviews with farmers revealed that most felt clearing land by machete was tedious and that hiring help was too expensive. According to our survey data, Penlyne and Cascade are the main coffee producers, while Millbank produces more tubers (e.g.,dasheen) and fruits (e.g., bananas). Penlyne produces more herbs than either Cascade or Millbank (see Figure 11).

Figure 11: Frequency of Crops Grown by Community



The practice of burning land to release nutrients into the soil before planting is common in many traditional farming societies that practice shifting agriculture. However, in the Blue Mountains where slopes are commonly over 50 degrees and farmers do not have land to shift to, burning has contributed to soil degradation through erosion. Our interviews point to a diversity of opinions within the three communities on the use of fire to clear land. While many interviewees recognize the ill effects of such practices, they engage in it because it is faster, easier, and sometimes cheaper than clearing land by hand. These respondents were quick to point out that burning is only necessary during the initial land clearing and does not need to be undertaken in

> "The best [role] that I play is cultivating and farming. That's the basic. Protect our water, springs and wherever to our farm. I didn't need a sign; these are basic rules and I just do it. Because you know water is life and from the tree you get oxygen and not just oxygen from trees, there's a lot of things from trees; you get food from trees, whatever. You understand I do coffee farming and we get coffee from the trees."
>
> —Cascade farmer

subsequent growing periods. Some interviewees make a concerted effort to avoid burning and viewed it as community behavior that needed to change.

Practices regarding pesticide use depend on the crops grown. Many farmers use chemical pesticides while acknowledging that they degrade the land, cause soil erosion, are expensive, and have negative health effects. Some informants expressed outright concern for their use. Data regarding pesticide use were difficult to address using the survey format as many farmers could not remember the type of pesticide used, but we were usually able to determine if synthetic chemicals were used. Around 55 percent of all the farmers use pesticides, including 30 percent of farmers in Cascade and 65 to 69 percent in Millbank and Penlyne Castle respectively.

> "You see the berry borer spray? That a f* up thing. You see any, the grass chemical? When it spray upon the grass, it kills the grass, yes, the grass dead. You know where the chemical go? Into the f*ing water under the earth, you see me? So, if me, me no spray me coffee with the coffee spray now brethren."
>
> -Cascade farmer

There are signs that some farmers are taking action to reduce chemical use or employ alternative methods. Included in this are good agricultural practices associated with coffee-farming, such as removing old berries at the end of the growing season that may be harboring pests. These techniques were traditionally used, and are being revived by some, though certainly not a majority of farmers, who are concerned about pesticides. However, farmers have been subjected to the promotion of pesticides from the Coffee Industry Board as well as chemical companies. The researchers observed poster advertisements for chemical pesticides that offered no precautions for their use.

Changing Established Farming Practices

Many interviewees initially learned their farming techniques from their parents or by observing other farmers. Farmers have acquired further techniques from outreach and education programs such as the Jamaican Agricultural Society, the Rural Agricultural Development Authority, Blue Mountain Coffee Cooperative, the Forestry Department, and the JCDT. Interviewees expressed a willingness to learn and attend workshops held by these agencies; however, some criticized their contradictory messages. For example, one organization suggests cutting back on chemical use while another endorses chemical use. Some informants however,

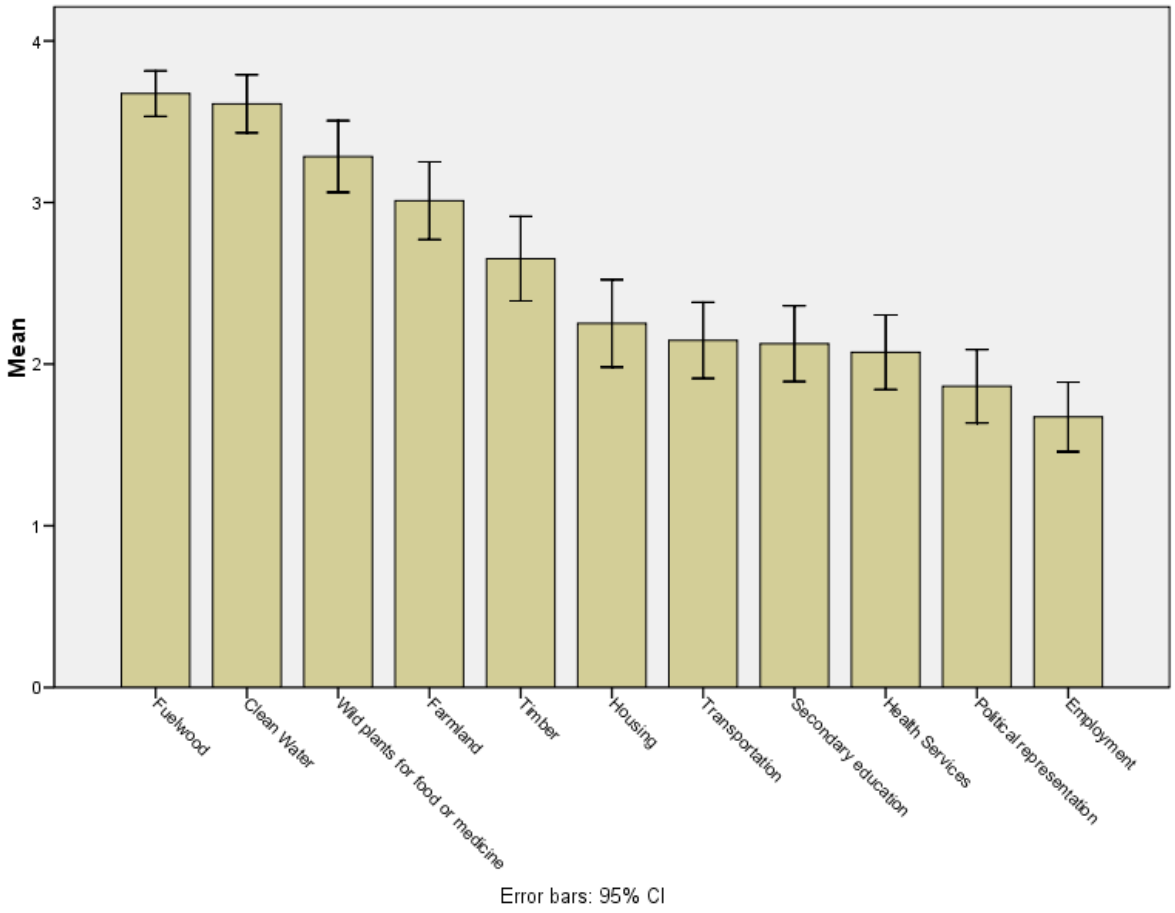
say that these agencies are responsible for teaching them to change their environmentally problematic practices.

In our interviews, respondents provided perspective as to why organic farming methods are not the norm. The underlying reason appears to be that without value-added markets, farmers do not see any additional benefit to growing coffee or food organically. Others suggested that farmers were unwilling to change their habits for fear that their yields would fall drastically. This lack of food and livelihood security directly influences environmental behaviors. However, several key informants suggested that while education was an important first step, only through demonstrations would farmers be likely to change their practices. Utilizing the notion of social learning, we will discuss later how this could be applied to JCDT extension programs.

Local Values of the Park Environment

Since assumptions about how reliant local communities are on protected area resources has proven problematic in past projects, for our baseline analysis we assessed the difficulty for residents to access different social services and environmental resources. We asked the surveyed individuals to rate their perceived access to an a priori created list of resources and services (both natural and social) using a Likert scale. With "1" being *least difficult* and "4" being *most difficult*, the surveyed individuals placed access to fuel wood as the most difficult and employment as the least difficult (see Figure 12). While it is interesting to examine these results, they probably do not accurately measure the access to resources as we had hoped they would. For example, fuel wood, while rated as the most difficult to access, may reflect the fact that fuel wood is not often used rather than its lack of availability or difficulty to access. Many survey informants and interviewees stated that almost everyone uses gas for cooking—that there has been an almost complete substitution. Similarly, while administering the survey questionnaire we became aware that individuals generally do not rely on wild plants for food or medicine. The fact that this resource rates fairly high on this list may not indicate that it is difficult to access but instead that it is not regularly used. In retrospect, the answers of individuals whom do not use fuel wood or wild plants for food or medicines should not have been recorded.

Figure 12: Mean Perceived Access to Social Services and Environmental Resources (1: Least Difficulty; 4: Most difficult)



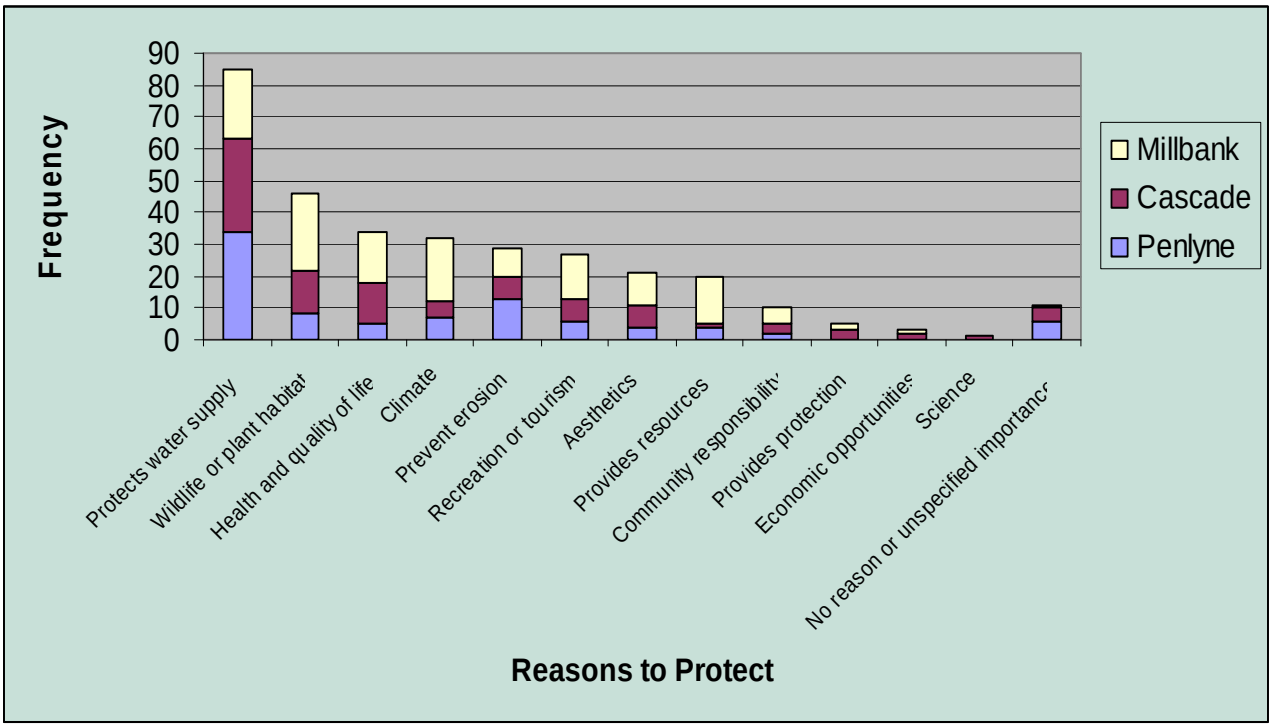
When asked how often they perceived other members of their community using the park to collect resources such as lumber, fuel wood, farmland, food or medicine, the average response was 3.02 (±0.84) on a scale of 1 to 4 with "1" being *most frequent* and "4" being *never*. In this manner we tried to discern between personal attitudes and the perceived behavior of others. When asked about their personal use of forest resources, the average response was lower (2.21 ± 1.14). This suggests that residents portrayed themselves as being less likely to take resources from the park than their fellow residents.

Jamaican Tody (top left); cloud covered Blue Mountains (top middle); Cascade waterfall (top right); hibiscus flower (bottom left); farmland (bottom middle); Caribbean pine forest (bottom right)

Importance of Protecting the Park

When the surveyed individuals were asked if the BJCMNP was worth protecting, people in all three communities agreed overwhelmingly. When asked why, the most common response was that the watershed was important to protect (see Figure 13). Individuals surveyed also emphasized the wildlife habitat, a favorable climate, and the quality of life provided by the park as reasons to protect it. Individuals were allowed to list more than one reason why the park was important to protect. Surprisingly only six individuals (out of 161) expressed no interest in protecting the park. Reasons provided against protection included: the park should be free access, people are more important to protect than the park, there are no benefits to protecting the park, and that the park was not useful. Even though our sample sizes were nearly identical in each community surveyed, more reasons for protecting the park were offered by the Millbank sample than either the Cascade or Penlyne samples. Millbank is also the community where the most participation with the JCDT has occurred. The distribution of responses by community differs more significantly than expected by chance ($p<0.01$, $df = 24$), however, this is probably due to the fact that the calculated expected values are less than five in some cells.

Figure 13: Reasons to Protect the Park by Community (n=161)



Environmental Values

Residents from all three community sites listed several aspects of the local environment that they valued for various reasons, including ecosystem services, aesthetics, economic opportunities, climate preservation, and wildlife habitat. Many interviewees spoke about this being part of their children's heritage, and wanted to see it sustainably managed. Others couched their value of the park in terms of the importance it held for tourists, scientists, and other

> "We want the watershed to be protected because if we don't protect the watershed, sooner or later we will not have any rivers and we need to protect our rivers. Also the trees. The trees is important so we would not like them all to be destroyed. We would not like to see the forest being replaced by coffee plantations. We think we need forest to ensure that we have wildlife. And there is a poem that I always say 'What has become of these birds?' that we always say '*Flaimart*' he was reminiscing from his Jamaican experience he said 'what time of the year the ground doves brown the field and fill the air with their curious fluting?' When I came here that was a common thing to see, the ground doves. And after time they were gone, they disappeared. And I'm just seeing them come back."
>
> –Cascade community leader

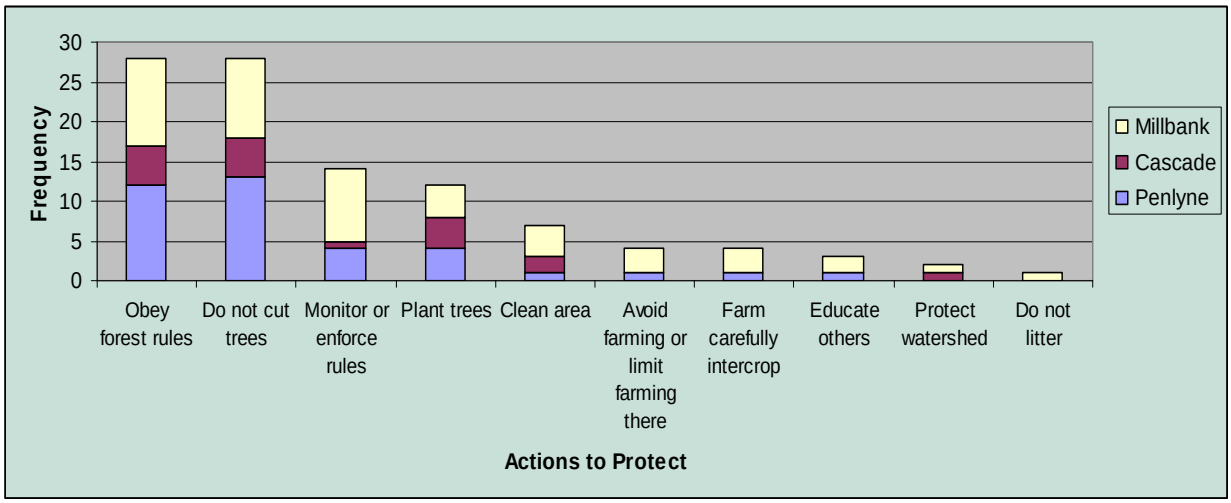
visitors. Most saw the presence of trees as directly connected with the rainfall that they needed for their livelihood. Residents from all three communities welcomed and took pride in the birds that can be found in their communities. A few interviewees collected medicinal plants, but overall, wild plants were not a resource that the communities depended upon. While a few noted that there had been failed ecotourism ventures in the past and that the park used to employ more people, the majority felt that the park brought an economic gain, mostly from ecotourism prospects and the opportunity to sell local goods to tourists.

These responses are illustrate how the community residents relate to their environment and overwhelmingly support the protection of the park. That their reasons ranged from aesthetics and ethical reasons to scientific value and wildlife habitat, suggests that community members place a high value on integrating ecological sustainability with their livelihood choices.

Actions to Protect the Park

When the individuals in the sample were asked to list ways in which their community helps to protect the forest, ten actions emerged (see Figure 14). At the community level, individuals from Millbank were able to identify more actions taken to protect the park than either Cascade or Penlyne. It is interesting to note that although protecting the watershed was most frequently listed as a reason why the park should be protected, it was offered less frequently as an action taken to protect the park. This demonstrates a clear disconnect between attitudes and behaviors because while people agree that the park is important due to the fresh and clean water it provides, only 2 percent of people listed watershed protection as something people consciously do. Educating others and monitoring or enforcing the park rules came up with some frequency, suggesting that unofficial monitoring of park rules occurs in these communities.

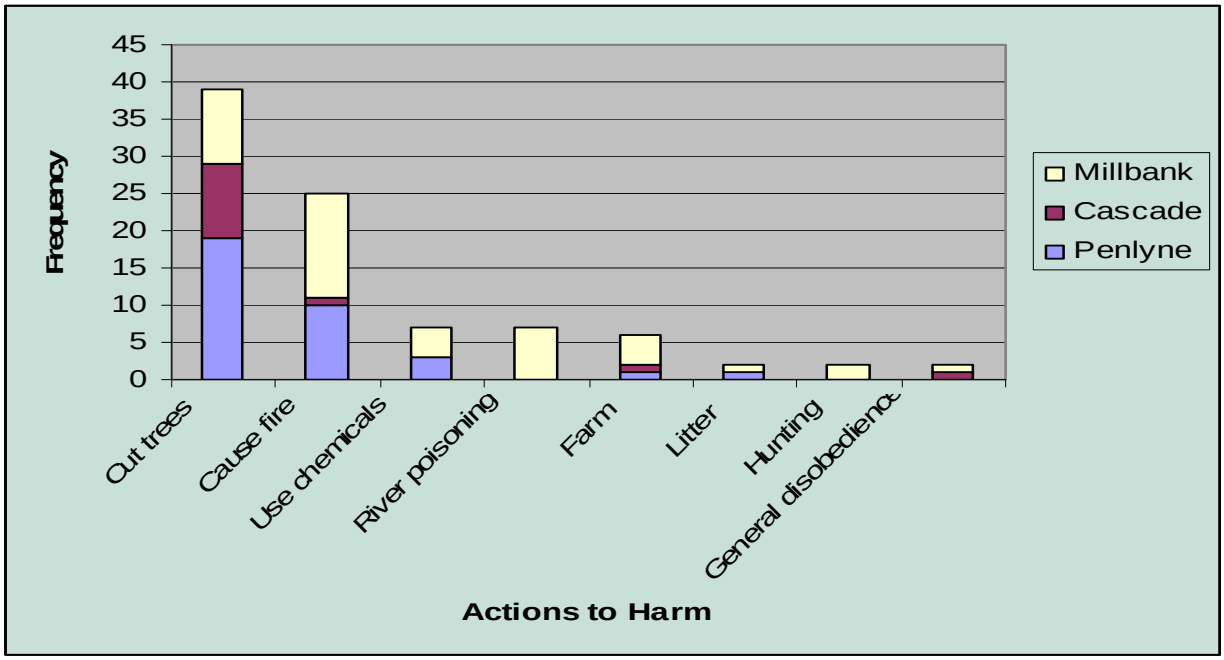
Figure 14: Frequency of Actions Mentioned to Protect the Park by Community (n=161)



Actions to Harm the Park

We asked survey informants what actions they thought might be damaging the forest in order to see if their perspective of local impacts was the same as the park co-managers. This information could be useful in determining unstated disagreements in local and external philosophies towards environmental management and help to guide future interactions. When individuals in the sample were asked to list ways in which their community contributes to the degradation of the forest, eight actions were identified. The most common action was cutting trees and the least common actions were littering, hunting, and general disobedience (see Figure 15). It is not surprising that cutting trees and causing fires are most frequently cited as actions that harm the park as these two topics were frequently mentioned by the JCDT as the causes of park degradation. The variation in regional problems related to the park is noticeable in these data. For example, river poisoning was mentioned more often in the Millbank sample than in Cascade or Penlyne Castle, which reflects the degree of public awareness and the greater frequency of these occurrences.

Figure 15: Frequency of Actions Mentioned that Harm the Park by Community (n=161)



One community resident who works with JCDT used the phrase "Waaya dash away, no wash away," meaning that "What you throw away is never completely washed away," in order to show how people needed to recognize that pollution can affect their downstream neighbors. Other informants also expressed an awareness and concern for the downstream effect of local environmental impacts.

> *Interviewer:* "Why do you want the birds to stay?"
> *Respondent:* "Well it's a part of our environment. Birds, bees, that—it's living. Everything that's living . . . we need to have it around. For instance, if we chop down all the trees and no birds around . . . I don't really get a kid yet at the age of 23, so maybe in the next three or four years yet, I do. But if I chop down all the trees and birds, I don't have a bird to really tell my kid that 'see this is the type of bird that feed off this and that' so that's eventually why we keep the birds.
>
> -Cascade farmer

Conservation Ethic

In our interviews we found much evidence to support a conservation ethic among community members which was unrelated to economic incentives. Some wanted to protect the forest to preserve wildlife habitat and expressed a conservation ethic that the forest exists for more than just human welfare. Others directly expressed their connectedness

with the environment by likening the destruction of the forest with the destruction of the community. Many phrased this in terms of human health; that an unhealthy environment would compromise their own health. Another interviewee viewed environmental protection as an obligation—that they are the keepers of paradise. These views revealed a pride that many felt in living adjacent to a beautiful, fecund area, as well as seeing their own lives as directly connected to the forest's biodiversity.

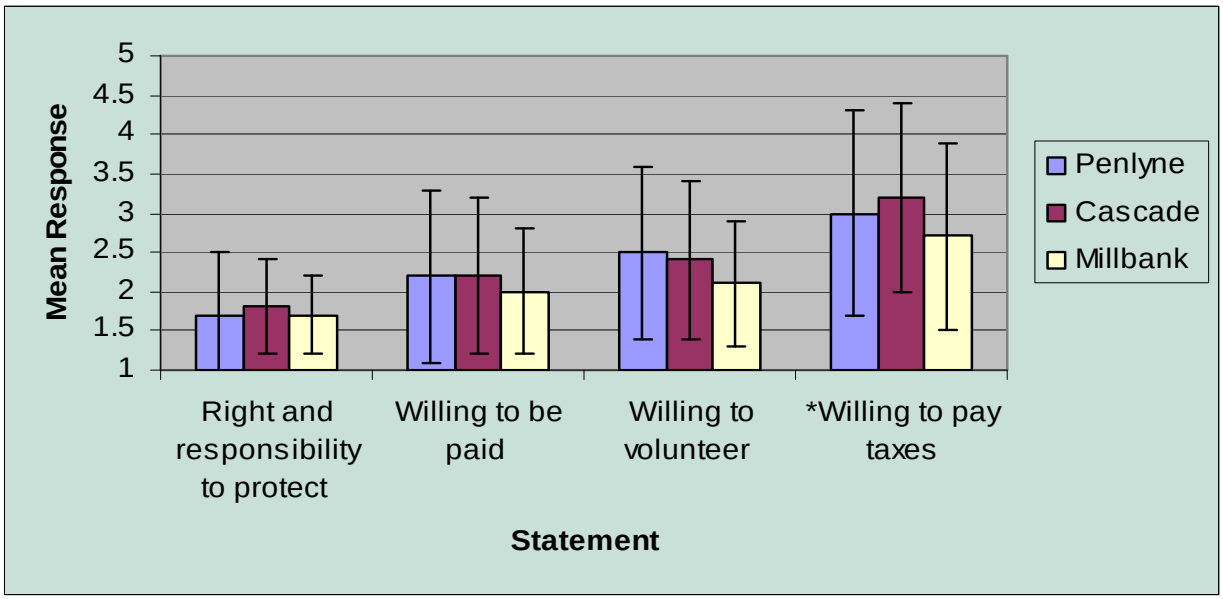
Community Attitudes towards Regulation and Enforcement

We asked the surveyed individuals to rate their level of agreement to a series of statements regarding willingness to participate in conservation activities using a Likert scale. With "1" being *strongly agree* and "5" being *strongly disagree*, the individuals surveyed generally agreed that they are willing to volunteer or be paid to support the monitoring of park rules, regulations, and boundaries (see Table 9). Surveyed individuals were ambivalent regarding their willingness to pay more taxes for the ensured regulation and enforcement of park rules. Responses to this set of conservation statements seem to reflect the desire for local employment opportunities. On average, there was the strongest agreement to the statement that the communities have the right and responsibility to protect the park. While this is an encouraging finding, the question should have been broken down to represent the two constructs—right to protect the park and responsibility to protect the park—separately. Using the Kruskal-Wallis test to determine differences in mean response between communities, attitudes regarding willingness to pay taxes differs between communities (X^2=6.22, df=2, sig.=0.045, N=161). One-way ANOVA tests confirm these results. Tukey's Post Hoc test indicates the Millbank sample agrees more to paying taxes for park protection than the Cascade sample (sig.=0.037) (see Figure 16).

Table 9: Likert Scale Response to Statements towards Conservation (n=161)

Statement	1 Strongly Agree	2 Agree	3 Neutral	4 Disagree	5 Strongly Disagree	Median Response (inter-quartile range)	Mean Response (±s)
My community has the right and responsibility to protect the park	58 (36.0%)	88 (54.7%)	10 (6.2%)	2 (1.2%)	0 (0.0%)	2.0 (1.0-2.0)	1.7±0.6
I would be willing to be paid to ensure the monitoring of park rules, regulations and boundaries	39 (24.2%)	89 (55.3%)	12 (7.5%)	17 (10.6%)	3 (1.9%)	2.0 (2.0-2.0)	2.1±1.0
I would be willing to volunteer my time to ensure the monitoring of park rules, regulations and boundaries	19 (11.8%)	103 (64.0%)	10 (6.2%)	24 (14.9%)	4 (2.5%)	2.0 (2.0-2.0)	2.3±1.0
I would be willing to pay taxes to support more regulation and enforcement of park rules	15 (9.3%)	67 (41.6%)	11 (6.8%)	48 (29.8%)	19 (11.8%)	2.0 (2.0-4.0)	2.9±1.3

Figure 16: Mean Response by Community to Statements towards Conservation Action (1: Strongly Agree; 5: Strongly Disagree)



* Tukey Post Hoc tests indicate significant differences in mean response between the Cascade and Millbank samples (sig.=0.037).

Attitudes towards regulation and access to the park are mixed. Through the interviews we learned that some informants expressed support of maintaining or even furthering restricted access to the park in order to protect ecosystems and watersheds. Other interviewees though, did

not believe that the park should have restricted access. Some felt that people need area to farm for reasons of livelihood, and furthermore, they felt that if individuals are using sustainable practices on park land, they should be able to stay. This raises a complicated issue, as at least one Forestry Department official indicated that they would not necessarily be opposed to sustainable forestry, but that community members currently lack the knowledge required to manage the forests. At least two informants felt that the forest's large size allows the area to have multiple uses, especially when it appears that the FD and the JCDT do not make regular use of the park. One informant pointed to the hypocrisy of restricting access to park land, especially in areas around water sources, when government agencies can be seen polluting along water sources too.

There is the sentiment among park management officials and community members that there is a sizeable portion of residents who see government land as open-access. However, several interviewees, both in management and in the communities, noted that access to land has always been a problem and that complete exclusion could only exacerbate the situation and make people less likely to comply. The idea of an institution of open-access was contradicted by statements demonstrating people's understanding of forest regulations and their frequent tacit support of them. One informant felt that it was better to emphasize education rather than to restrict access and others expressed a desire for more responsibility to be handed to community members for monitoring and reporting offenses. Yet others felt that the park should have more regulations but be that local communities should be allowed access to whatever they needed. We did not frequently broach the topic of land reform and land distribution in our interviews and similarly, interviewed individuals did not either.

> "Yeah they think it is government land, and if it's government land, it's everybody's land. That's an attitude we have in Jamaica. Anything that's government is for us. And we don't care of it, we abuse it."
>
> –Cascade community leader

Park Enforcement

While the JCDT rangers are responsible for most of the day-to-day monitoring and enforcement, in cases of illegal activities within the park, they collaborate with the FD and

NEPA. We asked questions of survey respondents on their awareness of park boundaries and their opinion on the current level of park enforcement. We wanted to gauge attitudes towards the regulation and enforcement of environmental resources near to where they lived. The majority of surveyed individuals were not very aware of the locations of park boundaries. In total, 21.2 percent of surveyed individuals (n=161) said that they know where the park boundaries are located, 49.4 percent said that they do not know, and 29.5 percent said that they know where some of the boundaries are located. Using a Pearson Chi-square test, the data show there are no significant (sig.>0.05) relationships between opinions on park enforcement and gender or education level. Using ANOVA tests there are no differences (sig.>0.05) in mean age or income in opinions on park enforcement.

The interviews indicate that some individuals use ecological markers such as older Mahoe trees or the presence of Eucalyptus to distinguish park land from other land. An elder informant believes the younger generations are more unaware of the park boundaries than the older generation as education on this has not been emphasized. Park rangers do not always know locations of park boundaries either, making enforcement difficult. Adding to the complexity is the history of unclear land leases and sub-leases of forest reserve land that further obfuscates land ownership and boundary issues.

> "Even in the forest, you have a farmer who go in illegally, clear a spot and do their coffee. We kind of turned him against another farmer, so we said 'Brethren, by right, you shouldn't be here'. But what we are actually doing is 'if you could stay, but don't kill off these trees, keep them, and do no chemicals within it. If you could do organic farming, you can stay, but don't let anybody else come.'"
>
> —Park Ranger

Attitudes are generally favorable towards park regulation in all three of the communities. Fifty percent felt that enforcement levels were "just right", while almost 38 percent wanted to see an increase in enforcement levels. This is compared to only 11.5 percent who felt enforcement was too strict. The JCDT's fleet of rangers has declined in recent years due to funding cuts and interview informants have noticed the decrease in their presence. Additionally, interviewees remarked that rangers engaged community members through meetings and workshops more often in the past. Generally, respondents demonstrated good will towards the rangers, which may originate from the "soft" approach that the rangers use to enforce park rules. One ranger remarked that they

prefer that communities see them as educators and not enforcers so as to garner more trust from the community. Park rangers generally come from buffer-zone communities and often are respected members of those communities. Many informants mentioned that they appreciate the lenient enforcement protocol of park enforcement. In some cases, instead of evicting people from park land, the rangers educate individuals on more sustainable farming practices. Rangers will often require that farmers not cut trees or use pesticides but will be allowed to stay. In return, besides changing his/her farming practices, the farmer is expected to report to the ranger any other violators in the area.

From our conversations with park rangers, it became clear that building a solid working relationship with the community is fundamental to their success, as a mere five rangers are charged with patrolling the 200,000 acre park on dirt bikes. Thus, the park rangers rely on community members to keep them informed of transgressions or community issues, which they in turn report back to the JCDT. This information sharing is one of the primary benefits of collaborative management. The rangers themselves feel as though their work is ingrained in their behavior. Even when not working, one informant told us that he finds himself reprimanding individuals who are littering or doing something that he feels is inappropriate.

Community Monitoring

> "Even though we're not getting paid but…(laughter). It's our duty to protect our mountain. Both the trees and the water. For instance, as I said neighborhood watch. I myself is not really a ranger, but I have to say that I live in the park because I have to go through the park to get to my home."
>
> -Cascade small farmer

Since this is often self-reported, it is of course impossible to say with certainty how frequently people would address violations of their environment. Some of our interviewees who expressed the sentiment that community members should protect their area provided examples of how they would try to deter people from littering or hunting birds. Rangers confirmed that residents approach them at meetings and report violations they have seen. In Millbank, where the intentional poisoning of rivers to kill crayfish and shrimp in mass was a recurrent problem, most residents were vehemently against the practice and claimed they would report a perpetrator. This willingness to monitor against local transgressions of park rules which harm local environments

came both from past JCDT participants, but also from those who had no interaction with the JCDT, suggesting that community management may be a developing institution.

Feedback on Collaborative Management

In our interviews with park management officials, we asked them to assess the collaborative management process and its effectiveness from the vantage point of their agency. FD representatives admitted that community groups are not involved in the actual management of the BJCMNP, but may serve advisory roles. The FD representatives did not believe that community groups have the capacity for upper management roles and that they "don't have enforcement abilities." While Forestry Department representatives know that communities want local tree harvesting rights, the FD recognizes that it cannot provide communities the capacity they need to fill this role successfully.

According to the FD representatives, most of the benefits of the co-management agreement have come from having more protection for the area. Our interview with FD representatives indicates that the FD views their burgeoning partnerships with local NGOs as one of the bright spots in the development of forestry management in Jamaica. A decrease in external funding for the JCDT has placed the FD in a position of having to fill a gap for which they currently do not have the resources. The FD plainly states that the viability of the park depends on the inclusion of CBOs in the co-management agreement. When asked, a FD representative said that they were open to the idea of attending a meeting of co-management partners with CBO representatives.

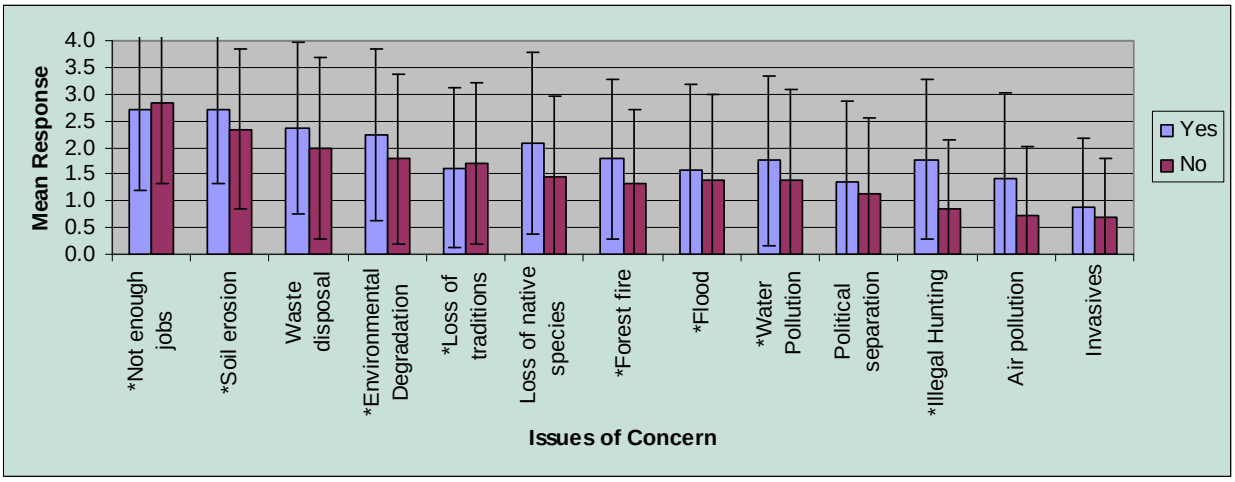
Our interviews with representatives from NEPA indicate that they see collaborative management positively and believe that participation in park management should be as inclusive as possible, but they rely on the JCDT to do this. From the perspective of NEPA, the benefit of co-management for the government is having more people working "on the ground." Also, since NEPA is under-funded by all accounts, they see collaborative management as advantageous in that it allows more organizations to be eligible to receive funding. All co-management partners approve of community involvement, at least in theory, but JCDT representatives acknowledge the difficulty in generating self-sustaining community involvement.

Local Involvement with Park Management

Nearly 34 percent of the surveyed individuals (n=161) had prior involvement with park management. Involvement included anything from reforestation projects or community meetings and workshops to more involved participation with a Local Advisory Committee. As expected, Millbank had the highest rate of resident involvement with park management (40 percent) while Cascade and Penlyne Castle were both equal with roughly 30 percent of the sample population having previously been involved. We did not inquire through which park management organization (FD, NEPA, or JCDT) surveyed individuals participated. Some of them may not have participated with the JCDT, therefore accounting for the divergence from the gradient of involvement suggested by the JCDT. After transforming the monthly income of the surveyed individuals to create a normally-distributed dataset, there is no difference in mean monthly income when we used a two-sample t-test between those that have participated with park management and those that have not (sig.=0.191). Using the t-test for difference in means, there is no significant difference in age or household size between those that have participated with park management and those that have not (sig.=0.152 sig.=0.949, respectively). A Pearson Chi-square test indicates that there is no relationship between gender and participation with park management (sig.=0.078), education level and participation with park management (sig.=0.161), nor community and participation with park management (sig.=0.454).

Using Mann-Whitney tests for a two-sample differences in means, the data show there are no significant differences (sig.>0.05) in mean rating of access to resources (natural and social services) between those that have participated in park management programs and those that have not. Using Mann-Whitney tests for two-sample differences in means, the data show there is significant differences between those that have participated with park management and their level of concern over three issues: illegal hunting (Z=-3.92, sig.<0.001), loss of native species (Z=-2.06, sig.=0.040), and air pollution (Z=-3.16, sig.=0.002) (see Figure 17).

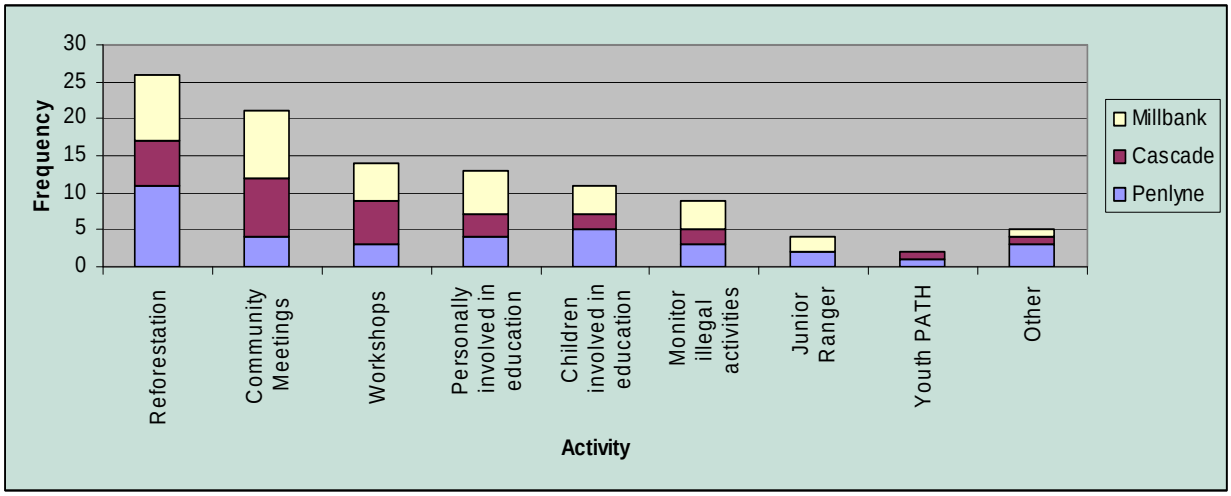
Figure 17: Involvement in Park Management and Mean Concern over Environmental and Social Issues (0: Not concerned; 5: Very Concerned)



* Mann-Whitney U test indicates significant difference in mean response (sig.<0.05).

Of the 33.9 percent of surveyed individuals that were involved with park management, the majority of participation came from involvement in reforestation projects (41.9 percent), followed by attendance of a community meeting (34.4 percent) or a workshop (23 percent) (see Figure 18). Surveyed individuals were asked to list all of the contexts of their interaction with park management. Using a Pearson Chi-square test, there is no significant relationship (sig.>0.05) between community and participation activity.

Figure 18: Frequency and Context of Park Management Involvement by Community (n=61)



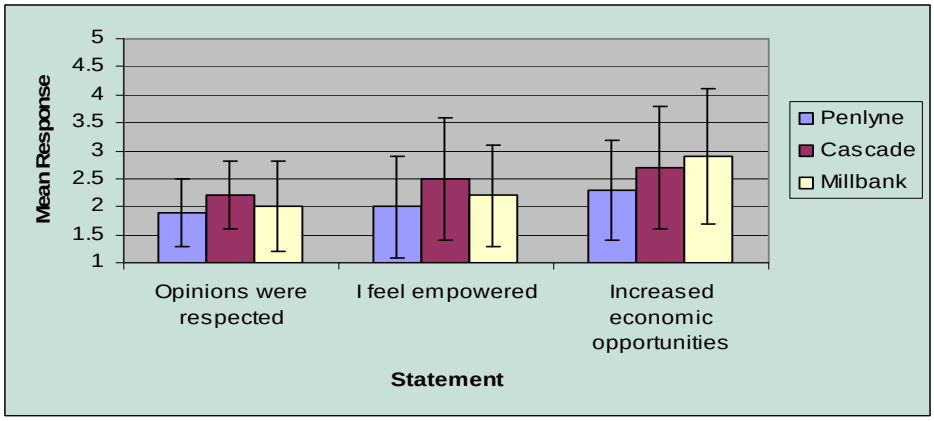
Views on Park Management

We asked the 33.9 percent of surveyed individuals involved with park management to rate their level of agreement to a series of statements regarding their interaction with park management using a Likert scale. With "1" being *strongly agree* and "5" being *strongly disagree*, the individuals surveyed were in general agreement that their opinions were respected, that they felt empowered, and to a lesser degree, that they had experienced increased economic opportunities due to their participation (see Table 10). It appears that very few of the surveyed individuals harbor ill feelings towards park management. Using the Kruskal-Wallis test for differences in mean response between community, there were no significant differences (sig.>0.05) (see Figure 19).

Table 10: Likert Scale Response to Statements Regarding Participation with Park Management (n=55)

Statement	1 Strongly Agree	2 Agree	3 Neutral	4 Disagree	5 Strongly Disagree	Median Response (inter-quartile range)	Mean Response (±s)
My opinions were respected when I met with representatives from park management	8 (5.0%)	39 (24.2%)	5 (3.1%)	3 (1.9%)	0 (0.0%)	2.0 (2.0-2.0)	2.1±0.7
I feel empowered by my involvement with park management	11 (6.8%)	29 (18.0%)	5 (3.1%)	9 (5.6%)	0 (0.0%)	2.0 (2.0-3.0)	2.2±1.0
I had increased economic opportunities due to my participation with park management	5 (3.1%)	28 (17.4%)	3 (1.9%)	19 (11.8%)	0 (0.0%)	2.0 (2.0-4.0)	2.65±1.1

Figure 19: Mean Response by Community to Statements Regarding Participation with Park Management (n=55) (1: Strongly Agree; 5: Strongly Disagree)

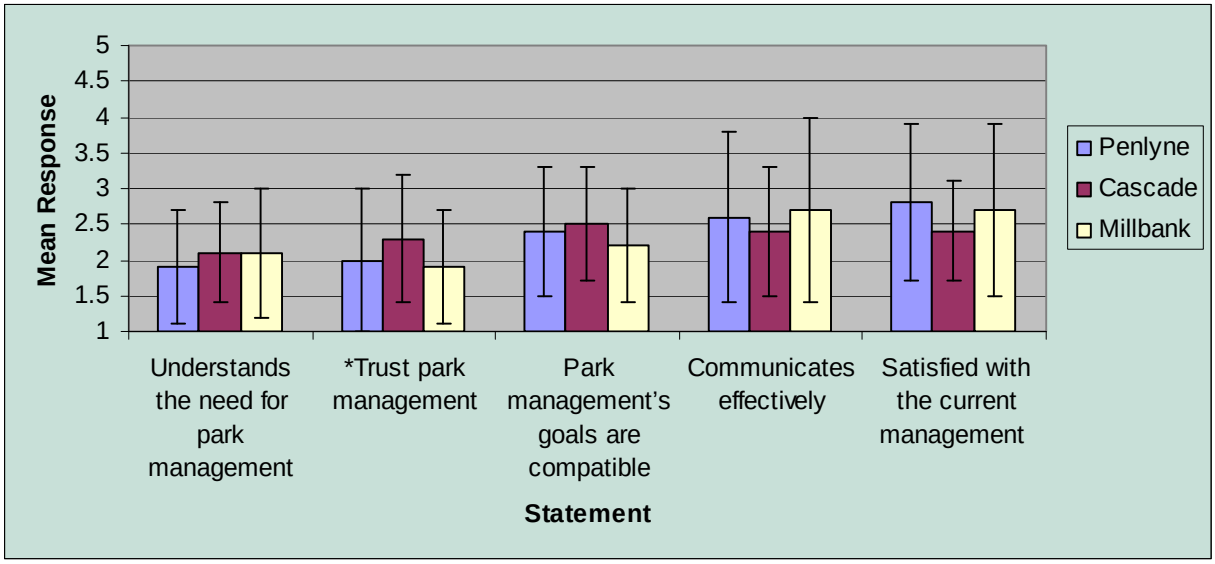


We also asked all of the individuals surveyed (n=161) to rate their level of agreement to a series of statements regarding park management using a Likert scale. With "1" being *strongly agree* and "5" being *strongly disagree*, the individuals surveyed generally agreed that: park management communicates well with them, they are satisfied with the current management of the park, there are not diverging goals between park management and the communities, and they understand the need for the park (see Table 11). While these results are encouraging, they indicate that more work could be done to improve communication between park management and the surrounding communities as well as to improve residents' satisfaction with park management. Using the Kruskal-Wallis test to compare the mean response to these statements by community, trust in park management significantly differed (X^2=9.85, df=2, sig=0.007). One-way ANOVA tests confirmed these results. Tukey's Post Hoc test for multiple comparisons indicates the Cascade sample agrees to a greater extent than the Millbank sample (sig.=0.021) (see Figure 20).

Table 11: Likert Scale Response to Statements Regarding Park Management

Statement	1 Strongly Agree	2 Agree	3 Neutral	4 Disagree	5 Strongly Disagree	Median Response (inter-quartile range)	Mean Response (±s)
My community understands the need for park management and its programs (N=151)	30 (18.6%)	96 (59.6%)	14 (8.7%)	10 (6.2%)	1 (0.6%)	2.0 (2.0-2.0)	2.1±0.8
I trust that park management looks out for the interest of the community when they make decisions (N=156)	39 (24.2%)	89 (55.3%)	10 (6.2%)	17 (10.6%)	1 (0.6%)	2.0 (1.25-2.0)	2.1±0.9
Park management's goals are compatible with my community's local customs and traditions (N=150)	15 (9.3%)	88 (54.7%)	28 (17.4%)	18 (11.2%)	1 (0.6%)	2.0 (2.0-3.0)	2.4±0.8
Park management communicates effectively with my community (N=161)	24 (14.9%)	72 (44.7%)	19 (11.8%)	34 (21.1%)	10 (6.2%)	2.0 (2.0-4.0)	2.6±1.2
I am satisfied with the current management of the park (N=161)	12 (7.5%)	86 (53.4%)	21 (13.0%)	30 (18.6%)	9 (5.6%)	2.0 (2.0-3.25)	2.6±1.1

Figure 20: Mean Response by Community to Statements Regarding Park Management (n=161) (1: Strongly Agree; 5: Strongly Disagree)

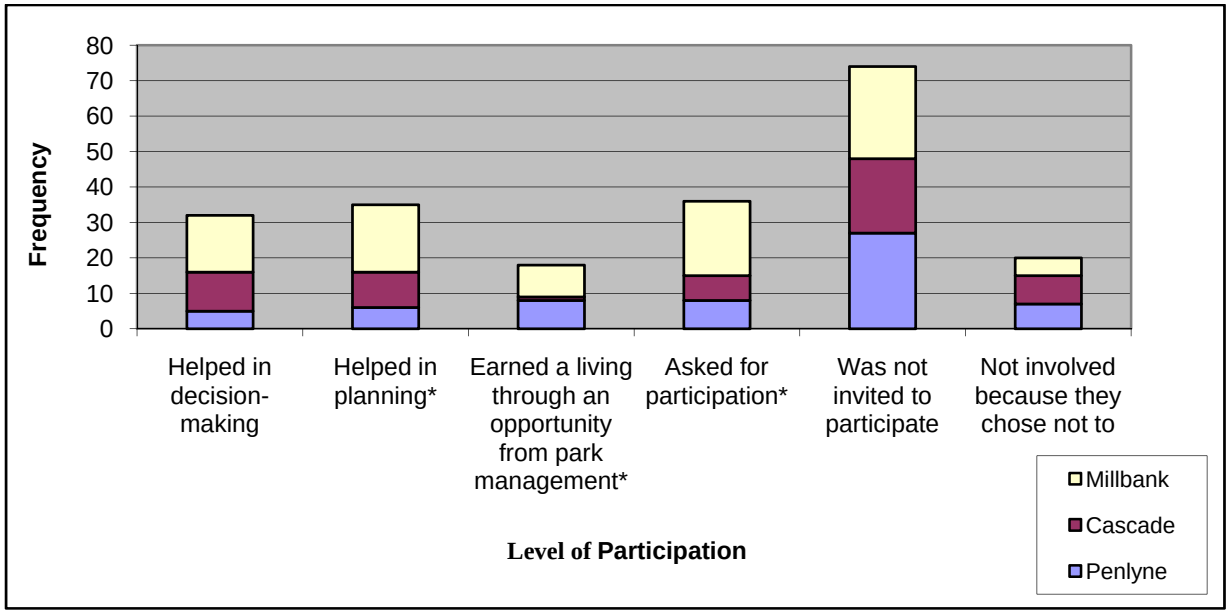


* Tukey Post Hoc indicates significant differences in mean response between the Millbank and Cascade samples (sig.=0.021)

Type of Participation

Surveyed individuals were asked to describe their type of participation in park management activities as they related to our predefined criteria (see Figure 21). Nearly 22 percent of the individuals surveyed indicated that they had helped in decision-making contexts whereas 50 percent said that they did not participate because they had not been asked to participate. Using the Pearson Chi-square test there is a significant relationship between community and the frequency of individuals who helped in park planning (X^2=6.40, df=2, sig.=0.041, N=161). There is also a significant relationship between community and the frequency of individuals who earned a living through an opportunity created through park management (X^2=6.42, df=2, sig.=0.040, N=161), and between community and individuals who were asked for their participation in park management activities (X^2=8.88, df=2, sig.=0.012, N=161). Surveyed individuals were allowed to identify more than one way in which they had participated with park management. One quarter of the sample described their level of participation as encompassing more than one of the options available.

Figure 21: Frequency of Type of Participation or Non-Participation by Community (n=161)

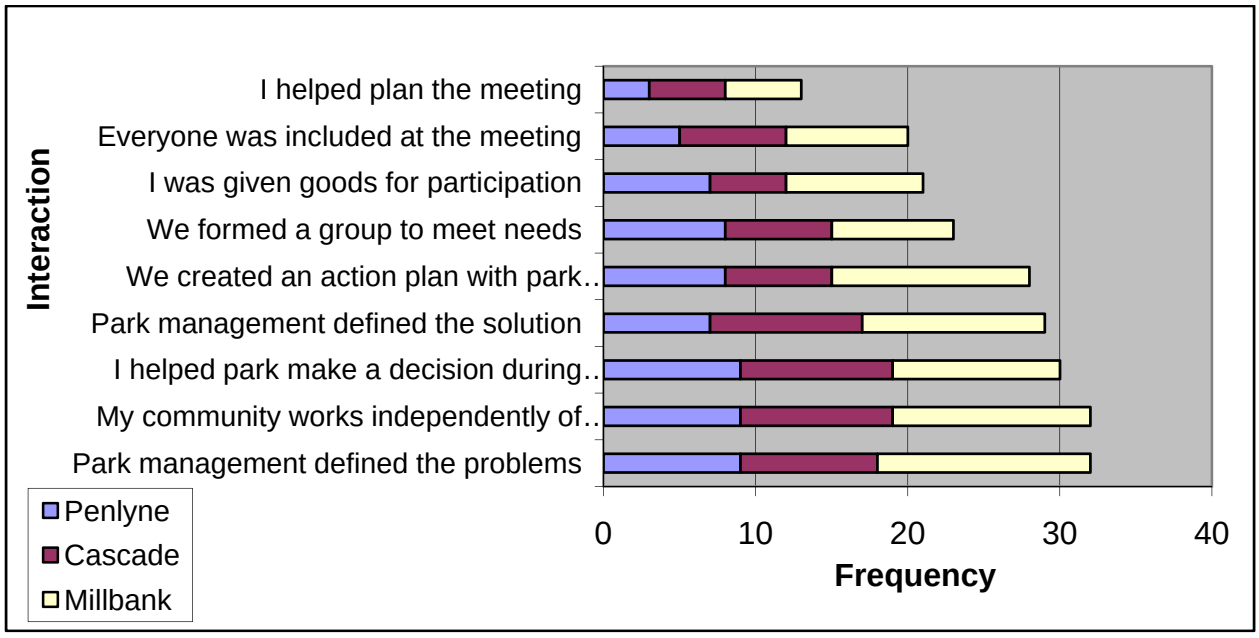


*Pearson Chi-square test indicates relationship between community and type of participation (sig.<0.05)

Description of Participation

Framing the survey results in Figure 21through the Pretty (1995) typology, it appears that survey respondents who had been given, and had taken the opportunity, to participate with JCDT management activities were included during the latter stages of the management decision-making. The overwhelming majority of respondents confirmed that management had defined the problems and the potential solutions that were discussed at the participation encounters, which would be best aligned with Pretty's Consultative Participation (Type 3). However, the majority of positive responses indicating community members formed a group and created an action plan with park management. According to responses to this set of questions, nearly 80 percent of those who participated in park management said that they had helped park management make a decision. This would suggest that in fact the participation levels would be somewhere between consultative and functional, where community members contribute to decision-making. The co-creation of an action plan was confirmed by nearly 74 percent of those that had participated with park management. A slight majority felt that everyone was included at the meeting, while a vast majority indicated that the community works independently to solve problems discussed at these meetings (see Figure 22).

Figure 22: Frequency and Type of Interaction with Park Management (n=37)



The Jamaica Conservation and Development Trust

Activities with the JCDT

Of individuals surveyed, 58.9 percent were knowledgeable of the JCDT. A Pearson Chi-square test indicates there are no diverging trends when this is looked at per community (sig.>0.05). Our interviewees indicate that most of the participation with the JCDT occurred during the time where the JCDT organized LACs at each of the three community sites. Several community members, usually the most involved, reported attending these meetings and found them informative and helpful. Since the demise of the LACs, most of these residents have had little contact with anyone from the JCDT. Many community members found the LACs to be very helpful and lamented their discontinuation. One resident described them as a "social ground" for different groups to exchange information. However, there were some members who did not see any measurable difference from the group's work. Others seemed to expect that there would be direct monetary benefits from LAC participation. A representative from the FD felt the LACs were helpful, but generally, were not well attended. Some residents felt that the current amount education outreach was not sufficient.

Discussions with JCDT staff members highlighted that they have had trouble employing people for certain positions, such as employment in JCDT's nursery. When asked why this phenomenon occurred, a ranger suggested that it may be that farmers are used to temporary, seasonal jobs, and enjoy their freedom from work when the coffee is not being harvested.

The JCDT, with limited resources, offers some programs that promote community networking and development. The Youth Path program, organized by the JCDT, is a free opportunity for youth throughout the buffer-zone area to take workshops in computer literacy, ecotourism, craft-making, communications, and environmental education. Interviewees were generally positive about their experiences with the program, but one interviewee commented that many youth are not interested in participating. Several community members expressed hope that more could be done to help the community develop economically through the selling of local foods and crafts to tourists. Other residents who understand the JCDT's funding shortcomings suggested that the JCDT could help build capacity in proposal-writing so that communities could become more independent.

Discussion

Through our surveys and interviews our goal was to determine how socio-economic priorities influence the attitudes and behaviors of community residents as well as their participation in conservation management. We found that these rural communities were marginalized in their access to good roads, social services (such as schools or clinics), and employment outside of agriculture. We then analyzed how attitudes towards the importance of protecting environmental resources, park regulation, conservation, and collaborative management vary between communities and demographics.

Our data indicates local residents may be more likely to make short-term decisions for the environment when their basic needs are neglected and they are vulnerable to outside influences, such as world markets for their crops. Local farmers appear to make land-use decisions based on the costs and benefits that are apparent to them. Our results demonstrate that the JCDT, with limited resources, has shown success in building trust for park management in these communities. However, they are criticized for having reduced their outreach in recent years, suggesting that outreach and public involvement are essential to building more support for conservation.

Within discussion we will apply our analytical framework to our results and analysis with the goal of making informed recommendations (see chapter 4) to the JCDT regarding improvements to their participatory approaches to community involvement. Specifically, we will apply the principles of the adaptive collaborative management approach and then use social capital and social movement theories to inform our analysis and subsequent recommendations section.

Improving Collaborative Management

In some ways the JCDT is already implementing features of adaptive collaborative management by reassessing their public involvement strategies in order to learn from mistakes and to gather new information on how to improve their programs. Previous stakeholder involvement that contributed to the JCDT's five-year management plan demonstrated the JCDT's willingness to consult extensively with community members during the planning process. While it was not clear how stakeholders were invited and how the results of those meetings have affected the JCDT's programs, these information gathering processes are a form

of learning and collaboration that have helped maintain good relationships within the buffer-zone communities. This community collaboration is especially impressive when considering the funding cuts that have forced the JCDT to reduce their ranger staff. However, the JCDT openly admits that public involvement could be improved upon.

The JCDT seems to have considerable legitimacy in the eyes of most residents in the three communities we assessed. While in most cases, the JCDT's right to regulate the park resources was not disputed; its capabilities were sometimes questioned. Residents in some cases seemed unwilling to report violations because they felt that the JCDT was unable to effectively deal with violators. In these responses, community members highlighted the failure of institutional arrangements in that the JCDT lacks sufficient enforcement and community members lack the resources, authority, and incentive to enforce park regulations themselves. Even if enforcement is present, overly lenient judges may dismiss violators' cases. Although this action may be couched in sympathy for the impoverished, it also disregards community members' efforts to protect their environmental resources. While recent legislation, including the Forestry Act and Protected Areas System Plan, are a step in the right direction, the integration of legislation, policy, and management can still be undermined by politicians and ministries who are not interested in the mandates of the Forestry Department and NEPA. At the national level, sustainability initiatives still do not weigh as importantly in budgeting decisions as tourism or education, perhaps understandable for a country with many social and infrastructural problems. Although these are macro-level problems, their effects can be seen on the ground in how the community assesses the capacity of management and makes decisions on whether or not to participate in outreach programs.

By applying Pretty's typology (1995) to our results and interview themes, it seems the majority of the opportunities to participate with the JCDT have been consultative/functional in nature. Judging from the stakeholder documents, the focus groups appeared to be more directly involved with the planning process. However, only one of our sites (Millbank) was included in that process, so we cannot make a direct comparison between those processes and our data. Although we do not have particular examples of decisions that community members claimed to have contributed towards, their inclusion in the park management's decision making process can help produce plans and programs that reflect the needs of community members. However, roughly 50 percent of our survey respondents did not feel that everyone had been included at the

meeting. That, along with the fact that less than 50 percent of respondents had actually had the opportunity to participate suggests that the JCDT can do more to reach a broader swath of the community.

Social Capital

We included social capital so prominently within our framework for analysis in order to assess how interactions between community groups and park management could be improved by better understanding the decision-making context of each community. Social capital can be thought of as a combination of: relations of trust; reciprocity and exchange; common rules, norms, and sanctions; and connectedness in networks and groups (Pretty & Smith, 2004). In the context of protected areas, strong social capital can lead to improved monitoring and reduce the free-rider effect. Interview participants frequently cited lack of trust, cooperation and participation at the community level as a secondary concern, after general infrastructural deficiencies (e.g., roads and proper waste management) indicating that social capital could be stronger in these areas.

Our data does not speak particularly well to the second tenet of social capital—reciprocity and exchange. Further research should be done to identify examples of reciprocity and exchange and their potential for strengthening and/or inclusion in park management approaches. While identifying rules, norms, and sanctions was not a primary research objective, community monitoring came up in interview contexts. There were interviewees who actively discourage littering, tree cutting, river poisoning, bird hunting, and park boundary encroachment. Since this is often self-reported, it is of course impossible to say with certainty how frequently people would address violations of their environment. We also may have interviewed outspoken community members who had strong feelings about environmental protection. However, in communities lacking public services like trash removal and who are very dependent on supply and quality of their local water source, it is not difficult to believe that social norms would arise that would disapprove of flagrant disregard of local resources.

Already, it was clear that there existed disagreement amongst farmers on whether or not to use pesticides, cut trees, or burn land before planting. While these disagreements have not produced intra-community conflicts, they suggest a diverse array of attitudes on proper stewardship of farmland. This can be of use to the JCDT if they can identify farmers who are

experimenting or are open to experimenting with more agro-ecological farming practices. However, the problem of unsustainable land use cannot be confronted without acknowledging the problem of land tenure and the scarcity of job opportunities. Unquestionably, there are areas that are being farmed that are untenable due to the soil, geology, and the slope's drastic degree. However, convincing these farmers to set aside pieces of land for reforestation will require economic substitution. Just as the JCDT has been forced to adjust their programs based on limited resources, community members make decisions on whether to collaborate with the JCDT or to alter farming practices by assessing the costs and benefits that they see. The majority of farmers that we spoke with admitted that they use fertilizers and pesticides because they believe that their yields depend on them and because traditional, non-chemical methods are either too time-consuming or require paying for help.

Social capital can occur at the community level and/or between the community and larger institutions (i.e., vertically). Social capital between individuals with similar outlooks, termed "bonding," can be seen in community organizations for a variety of causes, most notably the BPFA. Our survey data demonstrates that membership in community organizations is quite high (70.6 percent) and therefore that social bonding may be occurring. However, the effect to which bonding in this context leads to the creation of social capital is debatable. In our questions regarding the effectiveness of community organizations and the barriers to greater participation, residents spoke about issues of mistrust and skepticism of the organizational structures. Specifically, they commented on local community politics, vocal domination by a few key individuals, and ineffectual meetings and outcomes. It appears that collaborations between community organizations are limited as agricultural groups within a single community were not always communicating with each other according to the President of one chapter of the Jamaica Agricultural Society. Further research could be done to investigate the exact nature of cross-community and organizational collaboration and its potential for social capital building in this context. For instance, the JCDT could promote collaboration between interested community residents at the sites where previous stakeholder outreach has been performed. Providing community groups with potential collaborators to share information, materials, and other resources could be a valuable and cost-efficient way of building local capacities and bottom-up organization.

One result of our interview conversations was that the general economic malaise may be affecting community structures as young adults migrate to find work. This reality should be considered carefully for the future of park stewardship and outreach programs. Perhaps the young, unemployed members of the community can be used as a resource. Those that stay in their community mentioned that the peacefulness of the rural life compared to Kingston, one of the most violent cities in the western hemisphere, made the employment situation tolerable. The Youth PATH program appears to be well-received by enrolled individuals and the continuation and expansion of this and similar programs could be beneficial. In our interviews with three Youth Path participants, two seemed especially motivated by conservation work and how it applied to their community. Social capital can be promoted by helping local residents build capacities that are needed to be more efficacious citizens. However, effort also has to be simultaneously placed on providing opportunities for the use of newly acquired skills through expanded tourism ventures or other outlets. These programs could be better coordinated and promoted with other organizations such as the Social Development Commission, a non-profit that also performs rural outreach. Most importantly, free training programs could be expanded to demonstrate more agro-ecological farming techniques on a community plot.

The communities and the JCDT are able to link primarily through ranger interaction, education and outreach programs, and JCDT attendance at community meetings and events. Many times, instead of evicting people from land, the rangers educate individuals on more environmentally sustainable farming practices with the preface that they must adopt these practices in order to remain on park land. Additionally, these individuals serve as “eyes” for the park rangers and contact them when park rules are violated. From our conversations with park rangers, it became clear that they prefer communities to see them as educators and not enforcers so as to create a cohesive network based on mutual trust. Rangers are reliant on community members’ information regarding transgressions which they relay back to the JCDT and FD. The rangers are often members of the buffer-zone communities, which builds greater trust between the JCDT and local communities. In addition to gaining trust, reciprocity between rangers and land squatters is demonstrated in their informal agreements. This information sharing is an excellent example of an informal institution in which community members assist a ranger who is from that community. Perhaps further informal extensions of trust and reciprocity can be created to link communities and external agencies. For example, park management could occasionally

donate goods for community activities. The acknowledgement of the role of social capital and the inclusion of incentives for increasing community monitoring could help achieve park management's goals of biodiversity conservation.

One major critique of both social capital and participatory approaches is that they may unwittingly reinforce social power hierarchies by relying on formal organizations. When looking at the demographics of those that are involved in community organizations, as compared to those that are not, there were no significant differences in age, income, gender, or education level. Furthermore, those that identified with having played a role in decision making in the context of park management activities were not significantly different than those who had not participated with respect to demographics such as age, gender, education level, and income. Since our survey data demonstrates that almost 50 percent of residents are ignorant of the JCDT and that most have not been involved, the JCDT could expand their outreach programs.

Our survey data indicate that "elite capture" of benefits or participation in park management activities is not occurring. However, there was specific concern, uncovered through interviews, in Millbank regarding the BPFA and their disproportionate collection of benefits from tourism and attention from park management. While our survey data does not provide evidence for elite capture, the interview data suggest that some residents who are not affiliated with the BPFA resent their monopoly of community development activity. Clearly, the BPFA benefits from the talents of their organizer, but the JCDT should be aware that they are not representative of the surrounding populations of Millbank and neighboring Comfort Castle. The JCDT may offer to provide a template based upon past successes of the BPFA or other organizations to help provide guidance to other groups.

In order to be more inclusive of community members outside of organizational structures, the JCDT could focus on working with existing cultural institutions (Mansuri & Rao, 2003). The Misty Bliss Festival is no doubt a great way to build and sustain social capital through the acknowledgement of cultural practices. This and similar festivals and celebrations can be used to build social networks, thus increasing social capital. These opportunities could also serve as recruitment for future educational workshops and skills-training events. The use of LACs for local participation in park management activities could have served similar mechanisms for social and knowledge exchange, and thus also the building of social capital in both the horizontal and vertical directions. Many informants who were previously LAC members lamented their

discontinuation. However, a representative of the FD (whom attended the LAC meetings) did not believe they were well attended and others complained of a lack of direct benefits and measurable outcomes. Open forums should be coordinated with local churches and schools in order to reach a wider audience.

A lack of trust in community organizing and in participation with governmental or non-profits was expressed in some interviews as a result of stagnant development. One major source for lack of trust, which hinders community networking and accessibility to external agencies, is the role of national politics. Decision-making capacity is supposed to be devolved at multiple scales from community to parish, but interview informants say it is often an overly bureaucratic and cumbersome process. Members of Parliament (MP) were harshly criticized on several occasions for only paying lip service to rural areas, using them for their votes and never following up on promises. Moreover, respondents did not see any avenue of making their demands heard besides street protest, which had been recently done over the poor state of road conditions. According to the FD, a parish's MP has more power to grant land access in the forest reserve than the FD. Land rights can become very political with negative attention towards the protected area cast by the media. Overall, community members expressed the theme that their interests were not represented by politicians, with some referencing how they were neglected for tourist-rich areas.

There is little political will to stop deforestation and farming within the park. The CoL was criticized by multiple stakeholders for being uninformed and unconcerned with environmental sustainability. This has frustrated stakeholders, since the CoL has the final say in how lands are leased, squatters or illegal leases in ecologically sensitive areas are validated. The FD's control of the Forest Reserve has been undermined in this manner. The JCDT is careful not to advocate political alliances to avoid being seen as affiliated with a political party.

From our interviews and observations, one emergent theme, highlighted in the literature, was the effectiveness of having a charismatic leader. The importance of the social capital gained from the experience of the BPFA facilitator is apparent in several ways. First, long-time members often credited her with the organizational abilities and long-term outlook that has helped the BPFA become the longest-lasting and most productive environmental CBO in any of the three communities that we visited. Besides building a strong core unit that contributes regularly to group activities, she has helped the BPFA develop a multi-faceted mission around

improving farming practices through sustainable methods and diversification, promoting ecotourism, and preserving cultural heritage through an event called “Ole time Sinting,” which celebrates dance, food, crafts, and other traditions of Maroon culture. Perhaps most notable in the group’s success is her ability to create linkages with external funding organizations so that the BPFA is less reliant on NGO assistance to implement community-based projects. Similarly in Cascade, several informants lamented the dismissal of the former JCDT employee who was widely viewed as having a huge impact on the organization of the community. While creating leaders for natural resource management is not easy, tapping into existing leaders and co-opting them for park management purposes could prove beneficial.

Social Movement Theory

While using social capital theory to examine collective action and participation in park management activities is fruitful, social movement theories can be incorporated to identify specific strategies to gain support for park management objectives. There appear to be two ways in which social movement theory can be applied to this situation. The JCDT, for example, can be seen as an organization looking to enact change in behaviors within the buffer-zone communities that are thought to threaten park ecosystems. The JCDT can also be seen as a “linking” organization that helps buffer-zone communities enact and mobilize themselves towards actions that aid in the continued protection of park resources. In other words, the JCDT may be able to aid buffer-zone communities in enacting the change that the JCDT and local communities want to realize. Although not mutually exclusive, social movement theory can be used to explain local level mobilization towards biodiversity conservation goals, without the input of park management.

Resource mobilization theory emphasizes the importance of assembling affected peoples, attracting money and supporters, gathering media attention, and creating positive relationships with those in power in achieving social change (McCarthy & Zald, 1977). The JCDT, while constantly finding themselves short on financial resources, is able to gather funds for communication programs through the use of radio, website, brochures, posters, newsletters, and media releases; each of these programs, however, being targeted to different sub-populations of Jamaica (e.g., government agencies, buffer-zone communities, and the wider public). We cannot speak to the success the JCDT has had in educating and attracting people and agencies to their

cause through such avenues but suggest this as an area for further investigation. While our data does not indicate that the demographics of those involved in park management programs differs from the rest of our sample in terms of age, gender, education level, and income, the potential for the disproportionate representation of other buffer-zone sub-populations is possible. For example, local power structures, the increased involvement of individuals who are comfortable with official or bureaucratic language and settings, seasonal interest (i.e., interest that follows cycles of park resource use) and seasonal obligations (i.e., those involved with harvesting crops), and the geographic dispersal of stakeholders (i.e., individuals down-stream of pollution epicenters may not be represented) are all important to consider.

The JCDT, being a co-management partner of the BJCMNP, regularly meets with government agencies such as NEPA and the FD. Each of these organizations has their legal responsibilities to fulfill regarding park management, but other governmental entities, such as the CoL with its authority over crown-land leases, may not be regularly involved with the co-management partners. With this said, we are not clear as to the mechanisms by which the JCDT can create relationships with the relevant agencies with decision-making power. The JCDT can also provide ways for local communities to link with other co-management partners but may need to change the location or facilitate their attendance at co-management meetings. We did not attend a co-management meeting but suggest research into the organizational behavior at these meetings to more thoroughly analyze participatory approaches to park management.

Application of resource mobilization theory in the BJCMNP area would suggest that the poor are unlikely to mobilize for change due to their limited ability to gather financial resources and link with those in power such as the government. However, social movement theorists, such as Robin Broad (1994), suggest that resource mobilization is limited in its explanatory power. Broad (1994) highlights three conditions that are necessary for poor people to become environmental activists: 1) that environmental degradation is threatening the natural resource base off of which the poor live; 2) that the poor have lived in the area for some time or have some sense of permanence there; and 3) that civil society is politicized and organized. While our survey data does not speak to this first tenet of social change, a portion of our interview informants emphasized their awareness of changing climate such as less rainfall, mostly attributing this to deforestation. With emphasis on subsistence farming, members of these communities surely notice changes that relate to their source of livelihood. When the survey

sample was asked how many generations their family had lived in the area, nearly 50 percent said three or more generations—indicating sufficient time to assert a sense of permanence in the area. However, this information does not speak to the influence of the less-than-adequate land tenure situation through which people may have been in the community for generations but do not necessarily have access to a secure piece of land. This is an even larger issue for younger generations. The final condition described by Broad can also be partially addressed through our data. Communities are organized, at least to a certain degree as 70.6 percent of the survey sample belongs to a community organization. The extent to which these organizations effect change or the effectiveness of their organizational capacity is not known and further research should be done. While political rivalries on a national scale in Jamaica are notoriously violent and divisive, most interviewees felt that these factious elements did not appear to have much of a role in segregating the community.

Political process social movement theory speaks specifically to socioeconomic conditions, their lending to political opportunities, and the role these two factors play in the development of social mobilization (McAdam, 1982). In our previous paragraphs, we have demonstrated the constraints socioeconomic conditions have on decision-making and also that opportunities for political action in Penlyne Castle, Cascade, and Millbank are inadequate. Aside from voting, many residents in these three communities appear to have little opportunity for engaging in politically-oriented action. Our data indicate that some Cascade and Millbank residents have engaged in street protest regarding the road conditions, but this has been the only outlet for political action. From this, expanding political opportunities, organizational strength, and the presence of shared cognitions are areas to investigate further in the future but our exploratory data seem to indicate these factors are not particularly strong. "Cognitive liberation", then, does not appear to necessarily have occurred as our informants rarely spoke about loss of legitimacy of a once trusted system, new found political efficacy, or demands for social change. While these criteria seem difficult to attain, they may serve as guidelines to inform the JCDT's approach for gaining participation in conservation activities in the park's buffer zone.

McAdam and Paulsen (1993), main proponents of social network theory, argue that individuals' social location facilitates their participation in social movements. Forming relationships with others in organizations, personal membership in organizations and a

subsequent stronger sense of efficacy, increases the likelihood that individuals participate in social movements. While 70% of the survey sample is member to at least one community organization, we do not know the relationships between members and non-members to comment on the micro-structural recruitment and social networks that exist. Social network theory suggests that the current method employed by the JCDT for gaining community collaboration might be appropriate for eliciting collective action. Social network theory is helpful in highlighting the importance of networks in social movement mobilization, but needs to be combined with discussions of social capital and meaningful participation to generate appropriate conclusions.

The use of frame alignment theory suggests that a social movement's ability to create mobilization is contingent upon the framing process (Taylor, 2000). Collective action frames construct meaning and reason for individuals or groups to become involved in a movement (Benford & Snow, 2000). The diagnostic frame refers to the identification of an event or person to blame for the injustice for which the social movement is mobilizing against. The JCDT has organized an Interpretive Sub-Program within their Education and Public Involvement Program that utilizes mass media to frame diagnostic, prognostic, and motivational frames regarding biodiversity conservation and sustainable use. While these may work to establish, or begin to establish, collective action frames, the important role interaction between mobilization organizers and potential recruits plays cannot be underestimated (Gamson, 1997). Furthermore, the motivational frame that keeps recruits involved in the movement by offering collective and individual incentives may be difficult to maintain through mass media efforts; therefore supporting the need for face-to-face interaction between movement organizers and recruits.

Conclusion

We had three objectives in this chapter. First, we wanted to provide the JCDT with baseline data of the socio-economic priorities and levels of participation in each community. We then used this information to answer our research question: How do socio-economic priorities influence attitudes, behaviors, and participation in conservation? Lastly, we evaluated the participatory approach and provided recommendations to the JCDT.

Our results indicate that community members are extremely dependent upon agricultural for their livelihoods and the primary factor in land-use decisions is the economic benefit provided by adhering to certain destructive practices. In only a few cases did we find interview respondents who employed farming methods informed by agro-ecological principles. Many respondents expressed concern for the environment in terms of deforestation, soil erosion, water quality, and in some cases, wildlife. However, farmland, followed by timber, is the park resource that residents most value.[3] Informants across all three communities generally expressed support for the regulation of park resources and in some cases encouraged greater enforcement. Confusion over boundaries and leases makes effective monitoring and enforcement very difficult.

In general, people expressed a willingness to participate in conservation efforts, and took pride in the park. Infrastructural problems, such as bad road conditions, inadequate community centers and tele-communication lines in all three communities, however, occupy most of the discourse in community meetings, therefore not allowing conservation concerns receive ample attention. These infrastructural problems in turn limit the development of social capital by preventing communities from networking with each other and easily accessing external resources, such as educational opportunities. While actions taken by some community members would suggest otherwise, this disconnect between attitudes and behaviors may be better understood once the JCDT is able to tailor their outreach towards specific valuations of the environment. These results indicate that greater potential for participation exists, at least fundamentally in that there are shared goals.

[3] Fuel wood was rejected because of the bias in the sample. Interviews and observation revealed that hardly anyone cooked with fuel wood anymore. Gas had effectively replaced fuel wood.

Participation with the JCDT has had positive impacts when it has occurred and can be classified as consultative/functional. However, a large proportion of our sample had not even heard of the JCDT, and many have not had the chance to participate in park planning or decision making. In order to better facilitate adaptive learning between social and ecological systems, more fluid collaboration needs to be fostered across a more diverse community body. While formal organizations are a cost-effective way of accessing community members, they may obscure important community dynamics, which if not heeded, could impede future progress. The various interests of local stakeholders, whether in capacity building or resource access, should be brought to the table in order to initiate dialogue that will lead to more meaningful resolutions.

CHAPTER 3: BIODIVERSITY IN THE BUFFER FORESTS OF THE BLUE AND JOHN CROW MOUNTAINS NATIONAL PARK

Introduction

Tropical islands often posses a unique assemblage of species, but they have also been shown to be especially susceptible to invasions by alien plant species when compared to mainland ecosystems (Denslow, 2003). Factors predisposing tropical island ecosystems to invasion include low resource availability, limited habitat range, missing functional groups, low species diversity, and frequent natural disturbances (Bellingham, Tanner et al., 2005). In addition, human impacts in the form of deforestation and agricultural land conversion further fragment vulnerable island ecosystems and promote invasion by alien plants that are able to outcompete native plants through better resource utilization (Denslow, 2003). With the introduction of non-native plants the native community structure becomes altered, and in the worst case scenario what follows is extinction of native and often endemic island organisms that are limited in their habitat range (Vitousek, D'Antonio et al. 1996).

Invasion resistance is often measured as a function of species diversity, and it is often hypothesized that high species diversity prevents alien plants from establishing themselves and thriving in the new ecosystem (Shea & Chesson, 2002). Niche opportunities vary between communities but might be greatly increased by disruption, especially if the original community members are less well adapted to new conditions (Shea & Chesson, 2002). However, species diversity of a given site does not always predict whether the site will be easily invaded by exotic

species. Observations and experiments have shown that sites with both low and high species diversity can be successfully occupied by non-native plants (Stohlgren, Binkley et al., 1999). Conditions that promote invasions also depend on resources, natural enemies, physical environment, and interactions between these factors, and are often independent of species richness (Stohlgren, Binkley et al., 1999).

Habitat disturbances can be natural or anthropogenic and can vary in their intensity and effect on the ecosystem. The island of Jamaica is frequently battered by hurricanes that bring down trees and create canopy gaps over large areas of the Blue and John Crow Mountains, opening spots for fast growing colonizing species to move in. Steep slopes combined with heavy rains and vegetation clearing often leads to soil erosion and localized landslides. Landslides wipe out existing plant communities and create space for new colonizers adjusted to nutrient poor soils left after a landslide (Dalling, 1994). Logging, conversion of forest to agricultural land, and road construction all greatly contribute to anthropogenic habitat disturbances. Resulting forest fragmentation is accompanied by the reduction of immigration rates of native species, forest edge effects, changes in community structure, reduction of population sizes, and increase in immigration of exotic species (Turner, 1996). These combined forces make habitat degradation one of the main threats to forest biodiversity in the Blue and John Crow Mountains National Park.

Non Native Plants in the Blue and John Crow Mountains National Park

The BJCMNP is located in the eastern Jamaica. Variations in such factors as elevation, aspect, soil type, precipitation, and moisture retention support a multitude of species adapted to different conditions. Numbers relating to actual plant diversity vary, but according to Bellingham (1997) about 550 flowering plant species can be found in the park with an estimated 85 species being endemic. The park's biodiversity is threatened by various non-native and potentially invasive plants, of which *Pittosporum undulatum* (wild coffee), *Hedychium gardnerianum* (ginger lily), *Polygonum chinnense* (red bush), *Gleichenia bifidia* (net fern), and *Bamboo vulgaris* (common bamboo) are of utmost concern to the park management (Shuana Chai, personal communication). These fast growing alien species are able to easily establish themselves in the disturbed forest areas that are not rehabilitated and prevent growth of native plants, thus leading to further degradation of the forest habitat. They can also spread further into

the forest, displacing endemic plants and leading to loss of biodiversity (Bellingham, Tanner et al. 2005). This in turn leads to serious and sometimes unclear negative impacts on different levels of forest communities dependent on plants for their survival, such as insect and bird communities higher up in the food chain.

Pittosporum undulatum (family *Pittosporaceae*), or wild coffee, is a tree native to Australia (Bellingham, Tanner et al., 2005). The tree was introduced to Jamaica in 1870 as an ornamental species in the Cinchona Botanic Gardens (Healey et al., 1995). It reaches between twenty and forty feet in height and has wavy, waxy leaves, fragrant white flowers, and yellow fruit. Fruits are available year-round and attractive to birds, the main dispersers of *Pittosporum* seeds (Bellingham, Tanner et al., 2005). The plant is intolerant of drought and thrives in moist soils. Wild coffee forms dense shade canopies that prevent the sprouting of shade-intolerant native vegetation. It also has lower hurricane mortality than native vegetation as there is less crown damage and fallen trees resprout easily (Bellingham, Tanner et al., 2005).

Wild coffee

Hedychium gardnerianum (family *Zingberaceae*), also known as wild ginger or ginger lily, is native to India but has become a serious invasive plant on many islands. It can grow up to two meters tall with leaves reaching half a meter in length and readily reproduces through rhizomes, resulting in dense patches of wild ginger monocultures. A study performed in New Zealand shows that wild ginger prevents tree seedlings and other ground-cover plants from growing and that this invasive is able to acquire a disproportionate amount of essential resources within an ecosystem (Williams, 2003). The plant is currently a highly problematic invasive plant in Hawaii (Funk, 2005). Wild ginger can lead to changes in nutrient cycling in an ecosystem since its leaves are high in nutrients while those of long lived perennial species are often low in nutrients. Changes in community structure from trees to wild ginger may alter the quality of litter input and rates of nitrogen cycling through the soil within a site. This can facilitate new growth

forms such as grasses, herbs, and woody shrubs into systems that have been dominated by large trees (Funk, 2005).

Gleichenia bifida (family *Gleichniaceae*), commonly known as net fern, reproduces vegetatively by rhizomes and forms thick canopies that can be up to one and a half meters tall. In Puerto Rico, a study performed by Guariguata (1995) looked at landslide disturbances and net fern interactions under conditions similar to those found in the BJCMNP with its steep slopes, heavy rainfall, and shallow soils. The study reported that more than 80 percent of the plant cover on the upper zone of the landslide may be composed of net fern but it can be very scarce in the lower, shadier zone. The seeds are probably dispersed through wind and the spores are viable for a few weeks. The thick fern canopy may inhibit regeneration of woody plants on the upper layers of landslides (Guariguata, 1990).

Bambusa vulgaris (family *Poaceae*), or the common bamboo, thrives in moist soils and moist climates. It reproduces vegetatively between flowering periods using rhizomes, and it can form monocultures in riparian habitats, as is the case with bamboo introduced in Brazil and Puerto Rico (Blundell, 2003). In the BJCMNP bamboo has been planted along roads and trails to control soil erosion and in some areas it is used for construction, crafts, and as "yam sticks," trellises for growing tubers.

Polygonum chinense (family *Polygonaceae*), or red bush, has been introduced to Jamaica from the East Indies and Japan. It is found along both open and shaded banks, in elevations ranging from 800 to 1,600 meters above sea level (Rozema, Chardonnens et al., 1997). Red bush forms dense tangles in open areas and it is also found colonizing landslides, and usually it is not

able to establish itself under dense canopies (Goodland, 1997). It is considered a major weed in some areas of the BJCMNP (Goodland, 1997).

Impact of Non-Native Plants on Insect Communities

The composition and dynamics of ecosystems extend far beyond the plant composition of the community. Plants directly influence insect diversity by providing food and habitat for insects, and a diverse plant assemblage should support a higher and more diverse number of insects. Since ecosystem dynamics are influenced by insects serving as decomposers, herbivores, predators, and food sources across multiple trophic levels, changes in the assemblage of insect communities can have a cascading effect felt throughout the system (Miller, 1993).

In a species-rich plant ecosystem, herbivory rates will become predictable since there will be a balance between species with low and high herbivory rates, and both monophagous and polyphagous insects will be supported (Brown & Ewel, 1987). In monocultures, especially those composed of invasive plants, herbivory rates may be low if the plant employs defense mechanisms that insects in the novel environment cannot overcome. On the other hand, if the plant is palatable and there is lack of other, more palatable plants in the surrounding vegetation, the herbivory pressure will be high (Brown & Ewel, 1987). Thus, herbivory in monoculture vegetation greatly depends on the types of plants present.

Non-Native Plants and Trophic Cascades

As part of our research we looked at insect herbivory to learn whether invasive plants can act as a food source to support insect communities and at food web interactions, since decreased insect abundance can have a negative effect on insectivorous bird species.

Many studies have shown positive correlations between disturbance and non-native plant invasions, which in turn can alter the trophic organization of local food chains and impact the diversity and abundance of organisms at higher trophic levels (Duffy et al, 2007; Hughes et. al, 2007; Walker et al, 1996).

Birds are often used as a bio-indicator because they are easy to quantify and a number of studies have outlined the effects of disturbance on tropical bird populations (Price, 2006; Terborgh, 2002). Despite myriad studies documenting bird vulnerability to disturbances at multiple habitat and land use types there has of yet been little synthesis of these studies to tie

together common themes and consensus. Recently a study by Waltert et al. (2007) attempted to analyze data from 57 published studies (1,214 bird species) investigating the response of tropical bird assemblages to moderate levels of habitat disturbance (Gray et. al, 2007). The results showed that the mean abundance of species from six commonly reported feeding guilds responded differently to disturbance and that evolutionary relationships may influence responses in some guilds. Synthesis of these studies indicated that granivore (grain eater) abundance increased significantly with habitat disturbance and insectivores and frugivores (insect and fruit eaters) decreased significantly following disturbance. Focusing on bird guilds can offer greater insights into dynamic trophic relationships occurring across taxa and how land alteration affects biodiversity both through top down and bottom up processes.

Methodology

In this study we examined the impact of forest disturbance on non-native invasive plants and how this alters the native plant community structure leading to bottom up trophic alterations in local food chains. To measure the extent of degradation caused by non-native plants we looked at proportion of area covered by five main invasives in disturbed, intermediate, and primary forest habitats. To understand how non-native plants impact insect and bird diversity through trophic-level interactions we measured insect and bird abundance and diversity in areas with varying amounts of non-native plant coverage.

Study Site

The Blue and John Crow Mountains National Park

Research was conducted inside and within the buzzer zone of the Blue and John Crow Mountains National Park of eastern Jamaica. The park comprises roughly one third of Jamaica's remaining natural closed-canopy broad leaf forest and stretches over approximately 196,000 acres (TNC, 2008). Collectively the park encompasses the only shale based montane rain forest on the island (JCDT, 2005)

Description of the Buffer Zone Communities

Research was conducted in the vicinity of three local communities in the park's buffer zone. These included the communities of Cascade and Penlyne Castle in the Blue Mountains and Millbank in the John Crow Mountains. All three of these communities are located along the exterior boundaries of the park and are best represented by farming, primarily growing Blue Mountain coffee and subsistence crops. These communities can be thought of as a collection of families distributed throughout the local roads and hillsides that keep small plots of land, rather than centralized towns or villages in most cases. The surrounding landscape is made up of forest patches within a predominantly agricultural matrix of farming for coffee, bananas, and other crops. The amount of forest disturbance typically followed a pattern of greater disturbance located lower and closer to communities and decreasing disturbance with ascending elevation and access into park boundaries.

Description of Forest Habitat Types

Points were selected along the trails in and around the BJCMNP. Same points were used for vegetation and bird sampling. In each community the goal was to sample an equal number of forest habitats with varying levels of canopy disturbance, roughly classified as, disturbed, intermediate, and undisturbed (see Table 12). The qualitative classification of forest habitats was defined by ecological factors such as the presence or absence of understory vegetation, tree size, as well as history of the area. The historical record, as gained from conversations with local community members, helped to distinguish undisturbed forest from areas that have experienced logging and planting in the past. Since the presence of invasive plants was a factor measured in this study it was not used as a criterion for classifying different forest types. Sampled points were distributed throughout the different habitat classifications in the following way: disturbed (59 sites), intermediate (55 sites), and undisturbed (44 sites). Points were located at least one hundred meters apart and the location of each was mapped using a Global Positioning Satellite (GPS), Garmin® Forerunner 301 unit.

Table 12: Distribution of sites for non-native vegetation sampling and bird point counts

Community	**Habitat Type**			
	Disturbed	**Intermediate**	**Undisturbed**	**Total**
Cascade	24	20	3	**47**
Penlyne	14	15	15	**44**
Millbank	23	20	25	**68**
Total	**61**	**55**	**43**	**159**

Non-Native Vegetation Sampling

All sample points were taken next to the trails since the steep slopes and thick underbrush greatly limited access to areas outside of the established trails. At each sample point, aspect and slope were measured with a compass and elevation measurements were obtained from the use of a GPS unit. A ten meter line transect was laid out along the trail and the amount of canopy cover was measured continuously along the transect line with canopy densitometer (Geographic Resource Solutions). One 10 X 10m^2 plot, of which the line transects formed one side, was set up on the down slope side of the trail. The area covered by non-native plants inside the 10 x 10m^2 plot was estimated by adapting Daubenmire system (see Table 13), creating classes of coverage based on the percentage of occupied area (Daubenmire, 1966) The non-native plant species of interest included wild ginger (*Hedychium gardnerianum*), net fern (*Gleichenia* sp), wild coffee (*Pittosporum undulatum*), red bush (*Polygonum chinnense)*, and bamboo (*Bambusa vulgaris*). Tree diversity was measured by recording the number of different tree species inside the plot.

Table 13: Daubenmire system of classification

Daubenmire Class	Percent of Ground Covered
1	1-5 %
2	6-25 %
3	26-50 %
4	51-75 %
5	76-95 %
6	96-100 %

Insect Sampling and Herbivory Estimates

Insect samples were taken from the five non-non-native plant species of interest as well as native forest vegetation (see Table 14). Plants were sampled randomly. Either the whole plant (wild ginger, red bush) or part of the plant (net fern, wild coffee, bamboo, and native vegetation) was enclosed into 13-gallon white plastic bags, with care taken to minimize the loss of insects resting on a plant. The top of the bag was closed off and the sample was cut with a

knife. The bag interior and the sampled leaves were then examined for insects. All collected insects were classified into orders and their body-length measurements were recorded. Estimates of the diversity of the insect orders were calculated using the Shannon-Wiener index of diversity. Total leaf area was measured as an aggregated sum of all leaves per plant sampled and a picture with all aggregated leaves laid out was taken to allow for future estimations of herbivory damage.

Insect Sampling in Non-Native Net Fern

Table 14: Summary of Plants Sampled for Insect and Herbivory Damage

Plant	Number of Plants Sampled	Pictures Analyzed
Wild Ginger	30	10
Net Fern	25	0
Wild Coffee	18	10
Red Bush	19	10
Bamboo	23	0
Native	26	9
Total	**141**	**39**

Herbivory damage was estimated from field pictures using analysis tools in Photoshop (version 10.0). Only pictures of wild ginger, wild coffee, red bush, and native forest vegetation were analyzed (see Table 14). The complex structure of fern leaves prevented accurate

background removal and area estimation in net fern pictures. Leaves of bamboo were not arranged properly for the photographs as they contained too much overlap between individual leaves and thus couldn't be analyzed either. *Bird Sampling*

Bird species diversity and abundance was sampled in the plots previously sampled for non-native plants in order to gain a better understanding of how the presence of non-native plant species and resulting insect composition impact biodiversity at ascending levels of trophic organization. A twenty-five meter fixed-radius point count method was used to measure bird abundance and diversity for ten minutes at each sampled point (Hutto et al, 1986). All bird counts were conducted in the early morning when birds are most active and no later than 10:30 in the morning. All bird counts taken were located at least one hundred meters distant from one another as the literature review indicated that this would be sufficient in most cases for our study (Hutto et al, 1986).

All birds seen or heard were recorded by species and number (diversity and abundance) for each point count conducted. Birds were identified using 8 X 42 range Eagle Optic binoculars. Due to the difficulty of identifying many small, fast, and elusive bird species in dense vegetation, sound identification was employed in many instances. This was greatly facilitated by studying individual species recordings from *The Birds of Jamaica* CD, produced by Cornell Ornithology Laboratories. This CD is comprised of field recordings of the various birdsongs unique to all species found within Jamaica.

Generally, all bird counts were taken at the same points in which vegetation sampling was done in order to overlap data and show relationships between non-native plant and bird species present. Although it wasn't always possible to obtain an equal number of points for each level of disturbance within sites and across sites, accurate comparisons were generally able to be made throughout the study.

Analysis

All statistical data analysis was performed in SPSS (version 15.0). The strength and direction of correlation between variables was obtained using Pearson's correlation. General linear model analysis (UNIANOVA) was performed to test for interactions between non-native

plants and community, canopy gaps, elevation, slope, and aspect. The general linear model was also employed in bird abundance and diversity analysis. In order to see how bird composition changes with the amount of disturbance in canopy cover, birds were classified into one of six guilds (Omnivore, Nectivore, Insectivore, Granivore, Frugivore, Carnivore) for each sampled plot and the canopy gaps were classified into high disturbance (100-51 percent canopy gaps), medium disturbance (50-11 percent canopy gaps), and low/no disturbance (10-0 percent canopy gaps). An ANOVA test (with a complimentary Tukey Post-Hoc test) was performed to test for differences between the mean abundance of birds between the six bird guilds. When analyzing insect diversity and abundance, insect abundance was standardized based on the leaf area obtained from each of the sampled plants and an ANOVA analysis (with Tukey Post-Hoc test) was used to test differences in means. EstimateS was used to compute the Shannon diversity index for insect orders (Colwell, 2005).

Results

To test our research questions we measured: 1) factors affecting growth of non-native plants; 2) correlations between non-native plants and tree diversity; 3) impact of non-native plants on insect abundance and insect herbivory rates; and 4) correlations between non-native plants and bird abundance, bird diversity, and bird guilds.

1. Factors affecting growth of non-native plants

In each of the sampled plots the percentage of ground covered by the five non-native plants of interest was recorded. Table 15 shows the percent of sampled plots that contained non-native plants and the average percent of ground covered by that plant, broken down by community (Cascade, Penlyne, and Millbank). Figure 28 provides a GIS map of the results for the three communities. Wild ginger and net fern were predominantly found in Cascade and Millbank. Sampled plots were usually dominated by only one of these plants, and wild ginger and net fern were found to be mutually exclusive of each other ($p<.001$). Wild coffee was found in Cascade and Penlyne, but not in Millbank. Red bush was only found in Penlyne, and even though it was often seen growing along roads it was rarely seen in the sampled plots. Bamboo was only found in plots sampled in Millbank.

Table 15: Distribution of Non-Native Plants in Cascade, Penlyne, and Millbank

Plant	Cascade (N=47)		Penlyne (N=44)		Millbank (N=67)	
	% of plots	% ground covered	% of plots	% ground covered	% of plots	% ground covered
Wild ginger	47	31.5	3	15	57	30
Net Fern	56	41	2	15	7	26
Wild Coffee	4	15	11	7.5	0	0
Red Bush	0	0	2	15	0	0
Bamboo	0	0	0	0	43	34

Factors potentially affecting growth of non-native plants included canopy gaps, slope, aspect, elevation, and community. Tests of moderation between these factors showed that they are not significantly affecting each other. Canopy gaps showed a significant correlation with

non-native plant coverage (p<.002) in absence of other variables, and the effect was especially evident for wild ginger (p<.034), as illustrated in Figure 29. However, the effects were not evident when all the factors were considered together. Results for multiple linear regression showed that when the aforementioned five factors were considered together for each of the non-native plants (see Table 16), growth of wild ginger was significantly correlated with aspect (p<.042) and growth of bamboo was correlated with canopy cover (p<.010).

Table 16: Results for Factors Potentially Impacting Growth of Non-Native Vegetation

		p value				
	R squared	**Community**	**Aspect**	**Cover Gaps**	**Slope**	**Elevation**
Total non-native	.448	.000	.105	.539	.432	.008
Wild ginger	.328	.177	.042	.453	.590	.100
Net fern	.341	.417	.491	.590	.859	.417
Wild Coffee	NA	NA	NA	NA	NA	NA
Red bush	NA	NA	NA	NA	NA	NA
Bamboo	.460	NA	.482	.010	.527	.122

2. Impact of Non-native Plants on Tree Diversity

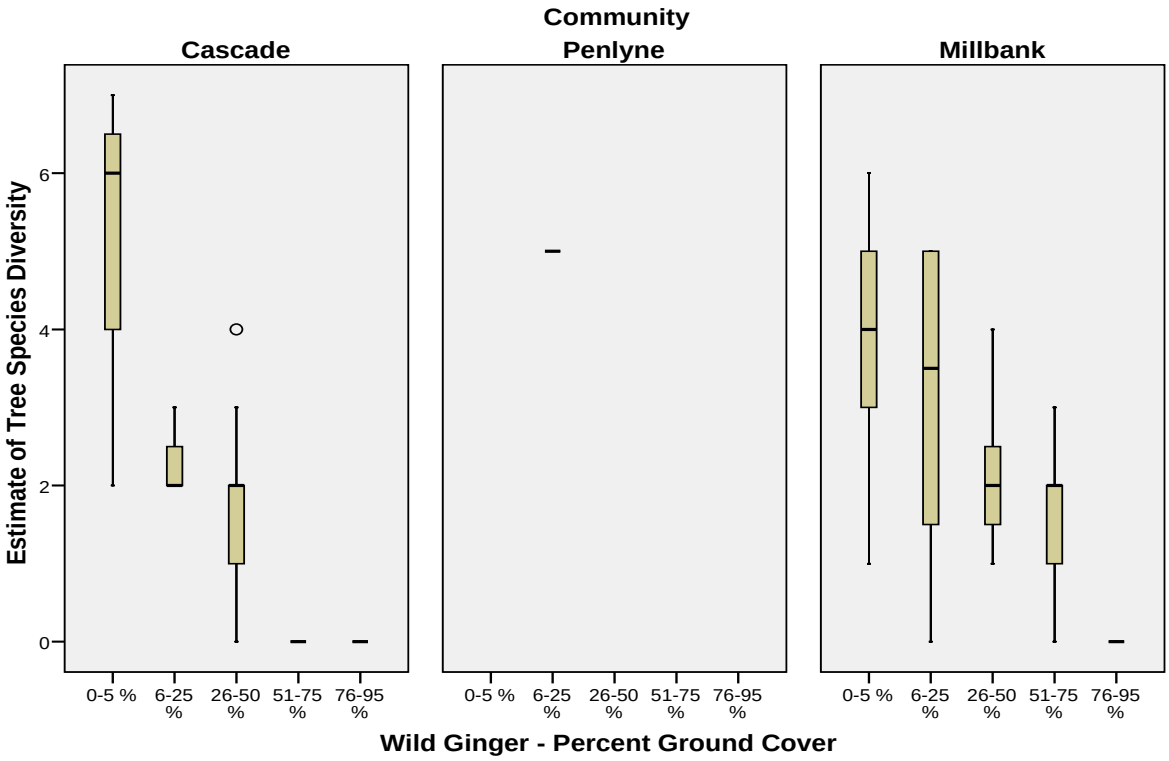
Plots with greater total non-native plant presence demonstrated a negative correlation with tree diversity (p<.001) (see table 3.6). However, this effect can be mostly attributed to wild ginger. When regression calculations were carried out between each of the individual non-native species and their effect on tree diversity, only wild ginger was significantly correlated to diminishing tree diversity (P<.001) (see Table 17).

Table 17: Regression Results Between Non-Native Plants and Tree Diversity

Independent Variable	**Dependent Variable**	**Pearson Correlation**	**Slope**	**Significance (p value)**
Total Non-native Coverage	Tree Diversity	-.556	-.040	.000
Wild Ginger	Tree Diversity	-.656	-.049	.000
Net Fern	Tree Diversity	-.140	-.010	.444
Red bush	Tree Diversity	0	0	0
Wild Coffee	Tree Diversity	.626	.160	.184
Bamboo	Tree Diversity	.181	-.017	.397

Since wild ginger was the major predictor of decreased tree diversity, box-plots were constructed to show the effect of wild ginger on tree diversity. Results were broken down by community since wild ginger was not distributed evenly across all three communities (see Figure 23).

Figure 23: Wild Ginger and Tree Diversity



3. Impact of Non-Native Plants on Insect Abundance and Insect Herbivory Rates

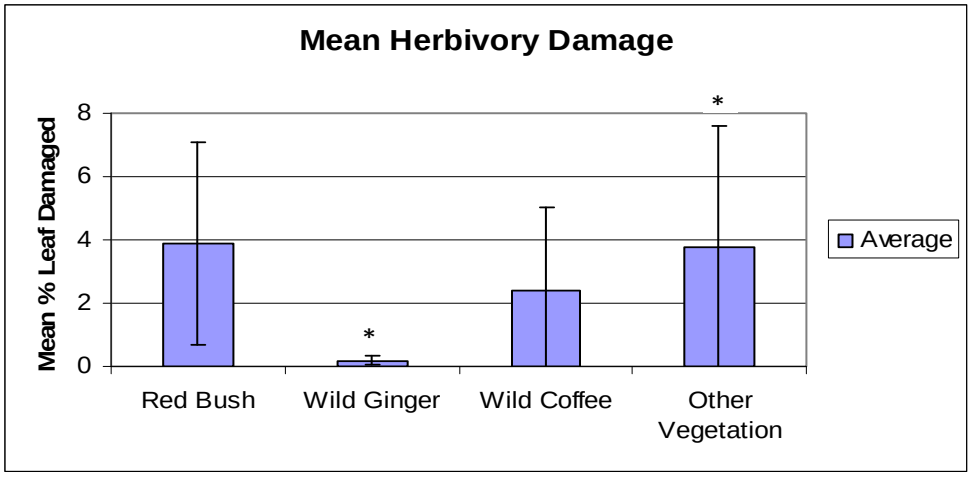
The abundance of insects found on non-native plants was compared to the abundance of insects on other (native) vegetation, and no statistically significant difference was found (see Table 18). The diversity of insect orders differed significantly between wild ginger and native vegetation ($p<.000$) and between wild coffee and other (native) vegetation ($p<.000$).

Table 18: Summary Table of Collected Insects

	Wild Coffee	Wild Ginger	Net Fern	Red Bush	Bamboo	Other Vegetation
Plants Sampled	18	30	25	19	23	26
Total Leaf Area (m^2)	1.82	5.45	2.45	1.22	1.08	2.68
Total Abundance (# of Insects)	42	107	51	36	38	60
Mean Abundance per Sampled Plant	2.33	3.57	2.04	1.89	1.65	2.31
Abundance per Leaf Area (Insects/m2)	23.04	19.64	20.83	29.61	35.33	22.36
Shannon-Wiener Index of Diversity (Order-Level Classification)	1.51	1.82	1.89	1.92	1.93	1.95

Analysis of herbivory damage (see Figure 24) showed that wild ginger had the least amount of damage, while wild coffee had an amount of damage comparable to the native vegetation. Red bush had the greatest amount of damage. Independent sample t-test showed that difference in herbivory rates between wild ginger and native vegetation was found to be significant ($p<.018$), but the herbivory rates for red bush and wild coffee were not significantly

Figure 24: Summary of Insect Herbivory Damage



* $p<.05$

4. Impact of Non-native Plants on Bird Abundance, Bird Diversity, and Guild Distribution

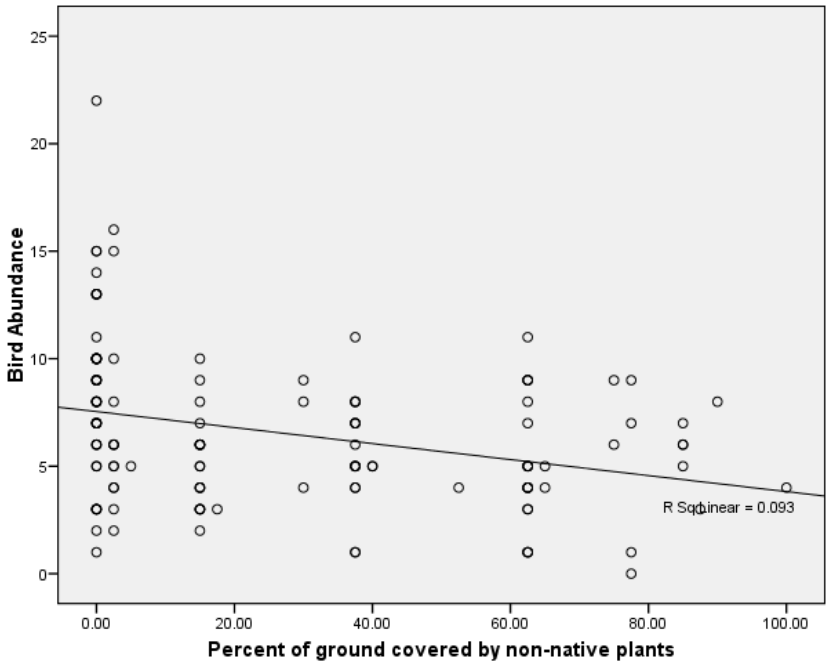
Fifty different bird species were recorded across all three sites and habitat types making up a total of over 1,230 individuals. Multiple linear regressions were performed between bird abundance and tree diversity, canopy coverage, and non-native plant coverage (see table 3.8).

Non-native plant coverage was the only factor significantly correlating with the abundance of birds ($p<.001$). The negative correlation shows that as non-native coverage increases, bird abundance decreases (see Figure 25). GIS map was used to illustrate the results (see Figure 30). Tree diversity and canopy coverage had a positive association with bird abundance, but the association was not significantly correlated.

Table 19: Regression Results for Factors Possibly Influencing Bird Abundance

Independent Variable	Dependent Variable	Slope	Significance (p value)
Tree Diversity	Bird Abundance	-.075	.690
Canopy Gaps	Bird Abundance	-.004	.697
Non-native Coverage	Bird Abundance	-.039	.001

Figure 25: Regression Line Between Non-Native Coverage and Bird Abundance



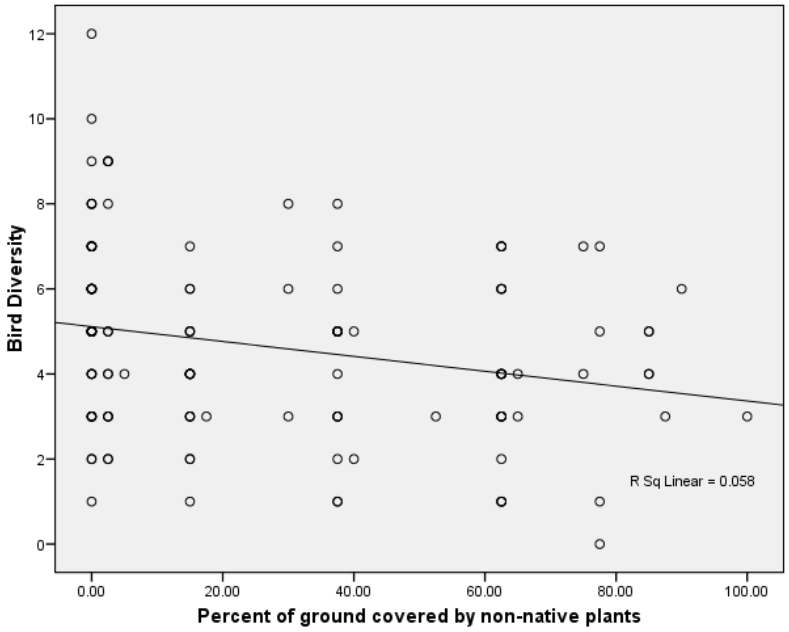
Linear regressions were performed between bird diversity and tree diversity, canopy coverage, and non-native plant coverage (see Table 20). Tree diversity and canopy coverage showed a positive association with bird diversity but were not significant. Total non-native plant

coverage had a negative effect on bird diversity with significant correlation (p<.001) (see figure 3.4).

Table 20: Regression Results for Factors Possibly Influencing Bird Diversity

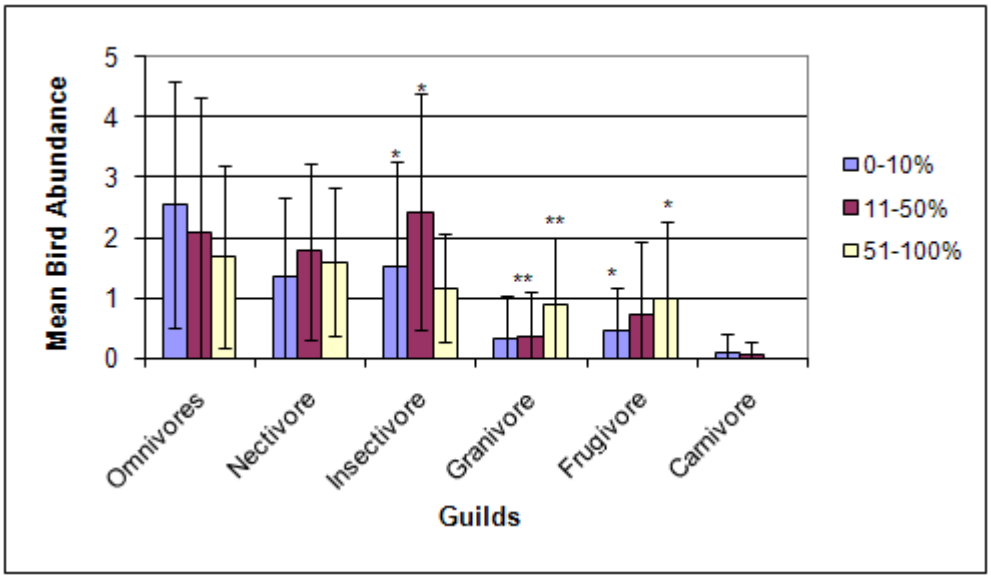
Independent Variable	Dependent Variable	B (Slope)	Significance (p value)
Tree Diversity	Bird Diversity	-.138	.891
Canopy Gaps	Bird Diversity	-.004	.518
Invasive Coverage	Bird Diversity	-.019	.007

Figure 26: Regression Line Between Non-Native Coverage and Bird Diversity



Mean abundance was calculated for each of the guilds across the three disturbance classes and an ANOVA analysis with Tukey Post-Hoc test was used to compare means (see Figure 27): abundance of insectivorous birds increased from highly disturbed sites to sites with intermediate disturbance (p<.023); abundance of granivorous birds decreased from highly disturbed sites to intermediate sites (p<.027), and from highly disturbed sites to low disturbance sites (p<.002). GIS map was used to illustrate the results (see Figure 31). Testing for correlation between increased coverage of non-native plants and effect on bird guilds did not produce significant results.

Figure 27: Distribution of Bird Guilds in Habitats with Varying Amounts of Canopy Cover



* p<.05
** p<.01

Discussion

Throughout the BJCMNP's forest buffer zone, reliance on agriculture and accompanying habitat conversion for agricultural land, particularly for cultivation of Blue Mountain coffee, (see Chapter 2) is leading to a high level of forest disturbance. Disturbance of tree canopy cover results in creation of canopy gaps that increase the availability of sunlight and may create favorable conditions for non-native plant growth. This research appears to confirm that disturbance has a significant positive effect on the presence of invasive plants. As canopy coverage decreases, non-native plants appear to be better able to colonize and outcompete native vegetation.

This research shows that a significant negative correlation was found to exist between invasive plants and tree diversity. Although the specific relationship between invasion resistance and tree diversity remains unclear and in need of future research, studies of montane forest restoration after net fern invasion in the Dominican Republic found that natural woody plant succession tended to be species poor in areas of larger patch size and high dispersal distance from parent trees and that net fern may degrade soil conditions after removal, allowing only certain tree species to grow based upon physiological traits (Slocum et al, 2006). Studies performed in New Zealand demonstrated that areas covered by wild ginger had a lower woody seedling richness (Williams, 2003). This suggests that non-natives, specifically net fern may limit tree diversity by degrading soil nutrients necessary for many tree species to successfully re-colonize. Since we did not study changes occurring in tree diversity and non-native plant growth over a period of time, the designation of non-native plants as an independent variable that has a direct effect on tree diversity is based on results of other studies (Slocum et al, 2006, Bellingham, Tanner et al. 2005) Results also showed that net fern and wild ginger were the most predominant invasive plants sampled throughout all three sites. This may be explained in part by both net fern and wild ginger's ability to form dense mats that rapidly spread vegetatively through rhizomes crowding out native vegetation

completely where they are then able to establish. This can lead to dense monocultures of these non-natives in areas of higher disturbance.

Significant differences in relationships were found to exist between insects and non-native plants, particularly wild ginger and wild coffee, as compared to native vegetation. Wild ginger does not appear to serve as a food source for herbivorous insects as it showed significant negative effects on insect herbivory rates. The composition of insects on wild ginger and wild coffee, as identified into order level, differed from the insect composition found on native vegetation. Wild ginger also correlated negatively with bird diversity and abundance. This demonstrates a uniform negative association of wild ginger across two trophic levels, while wild coffee may negatively impact insects directly but not frugivorous birds. Wild ginger appears to crowd out diverse native vegetation and does not serve as a food source for insects, thereby disrupting and diminishing insect and bird diversity through bottom up trophic alteration in the community. Many studies have documented the role of structurally diverse vegetation in providing a wide variety of food resources and greater niche opportunities for organisms at ascending trophic levels of the food chain (Tscharntke, 2003), particularly in agricultural landscapes (Johnson, 2000; Perfecto et al, 2003).

Wild ginger functions as a monoculture in many sites we sampled where it has taken over large areas of degraded forest habitat. Wild coffee was not correlated with diminishing bird diversity or abundance, probably because it does act as a food source for many birds (Bellingham, Tanner et al. 2005) However, changes in insect composition on wild coffee may have an impact on distribution of insectivorous birds. Our research indicates that some non-native plants, such as wild ginger, are predominant and threatening invasive plants in the BJCMNP and should be the focus of greater eradication and control efforts.

Invasive coverage throughout all sites showed a significant negative effect on bird diversity and abundance. In corroboration, tree diversity and canopy coverage showed a significant positive effect on bird species richness throughout all sites. These results support other studies that have shown the importance of canopy coverage and structural diversity for bird species richness (Gaston et al,

2003; Rodewald et al, 2004; Waltert et al, 2002) Taken together this data suggests that the predominance of these non-native plants, particularly wild ginger, negatively affects species richness indirectly at higher levels through alteration of the food chain. Food and habitat structural alteration then can be thought to adversely impact bird diversity and abundance through bottom up indirect effects.

Results for bird guilds indicated insectivorous and granivorous birds were most significantly correlated with forest canopy light gap disturbance. Insectivorous bird abundance was highest in intermediately disturbed forest canopy gaps (11-50 percent) and least in highly disturbed forest canopy gaps (51-100 percent). Granivorous birds were found in greatest abundance in highly disturbed forest canopy gaps and least present in relatively undisturbed forest canopy gaps (0-10 percent). These results closely corroborate research by Gray et al (2007) which found that analysis across a wide variety of bird disturbance studies worldwide showed that insectivores declined after disturbance, whereas granivores increased (Gray et al, 2007). This points to a species' feeding guild as a potentially useful indicator of disturbance. Results from this research suggest that different responses to disturbance across feeding guilds reflect changes in community composition and trophic organization. Evidence of these patterns could be a valuable basis for further conservation research.

These results suggest a correlational relationship between canopy gap disturbance and non-native presence while also suggesting that moderate levels of forest disturbance may provide greater insect food resources and support greater overall biodiversity across trophic levels. Though our results show a marked relationship present between canopy gap disturbance and insectivorous bird species higher up in the food chain, the specific role of invasives as a mechanism for trophic alteration remains unclear. Research defining threshold levels of disturbance that may actually benefit species diversity in the buffer zone compared to factors promoting the spread of non-natives in disturbed areas is worthy of future investigation.

Although our results indicate that light availability from forest canopy gaps does seem to impact the growth of non-native species overall, we acknowledge there are many other factors that can also impact growth that our study was not able to address. When other factors were considered it became obvious that canopy gaps are not the only factor responsible for the spread of non-native species. Factors which were not measured in this study, but that could have significant impacts on non-native colonization, include nutrient availability, distance from

introduction site, and competitive advantage through vegetative growth and reproduction through rhizomes. We recommend more research be done in these areas to compare with results from our study.

Finally, in acknowledgement of the limited areas sampled and complex heterogeneity of the BJCMNP and buffer zone landscape we suggest more research be done over a broader area since our results cannot be extrapolated to the whole park and different areas of the park may have more localized ecologies and may be threatened by different non-native and potentially invasive species. There was no pilot research or baseline data available prior to conducting this study and so we hope that future research may build and expand upon our data. We believe the results from this research are best viewed as a snapshot of current conditions in the BJCMNP and as a case study of a complex and dynamic ecosystem in flux.

Conclusion

Understanding how anthropogenic disturbance alters trophic organization and biodiversity through bottom up processes is of great significance to conservation efforts in the Blue and John Crow Mountains. This research sought to better elucidate links between forest disturbance, the presence of non-native invasive plants, and biodiversity through trophic alteration of local food chains. We hope this research may be useful in assisting the Jamaica Conservation and Development Trust, the Natural Resources and Conservation Agency, and the Forestry Department in their planning, decision-making, and collaborative organization for habitat restoration and rural social development, including ways to focus on invasive control efforts and local land use practices that may mitigate the spread of invasive species. Ultimately we hope this research can help better inform additional partnerships and programs that can bolster community participation to create better park conservation programs, conservation management, and ecological restoration projects in the Blue and John Crow Mountains National Park and surrounding buffer zone.

Ania Ruszaj, Errol Francis & Jesse Lewis, Millbank, Jamaica

Figure 28: GIS Analysis of Plant Distribution, Organized by Community. For satellite images, see Appendix 3

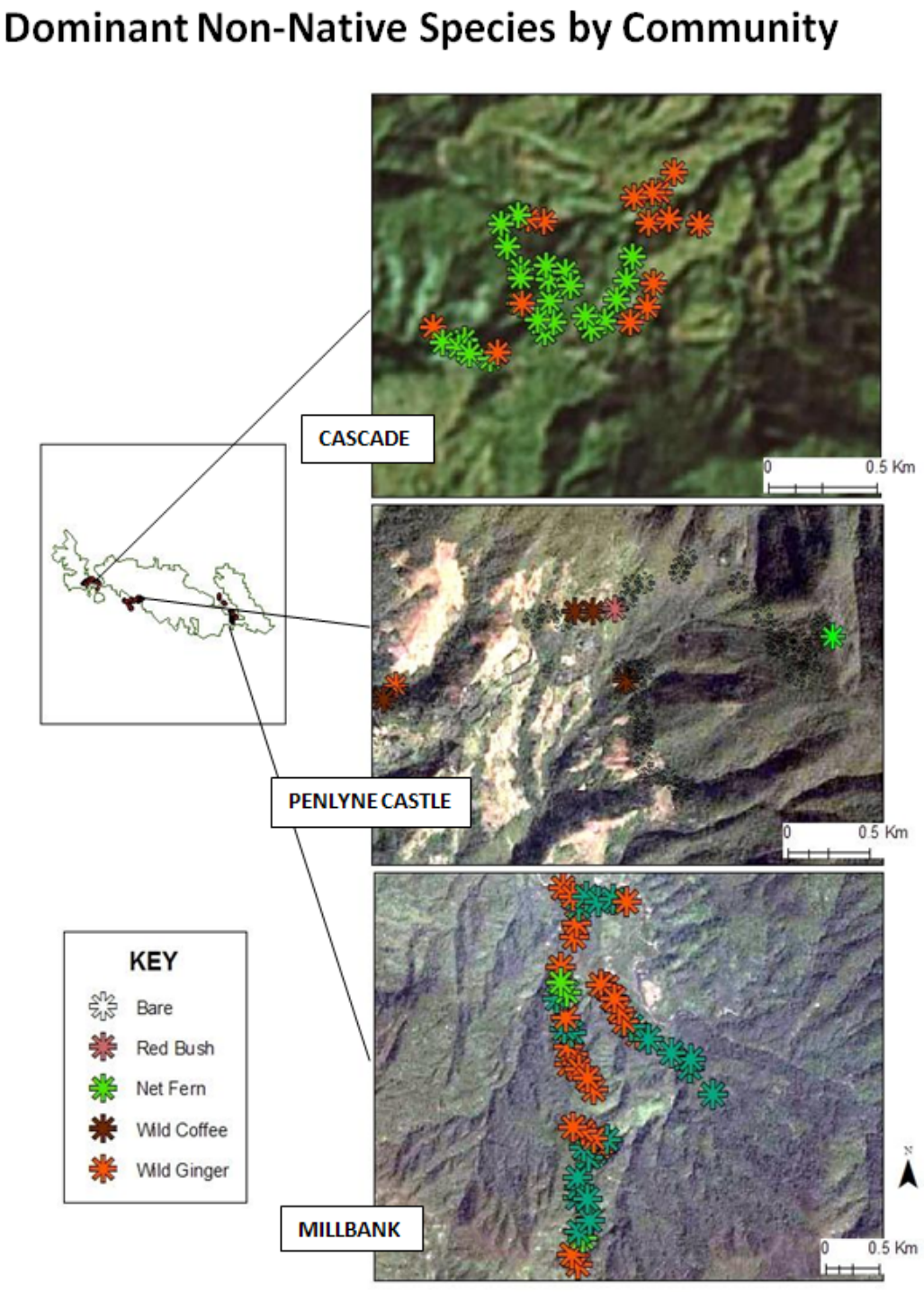


Figure 29: Interpolation of Canopy Gaps and GPS Position of Wild Ginger

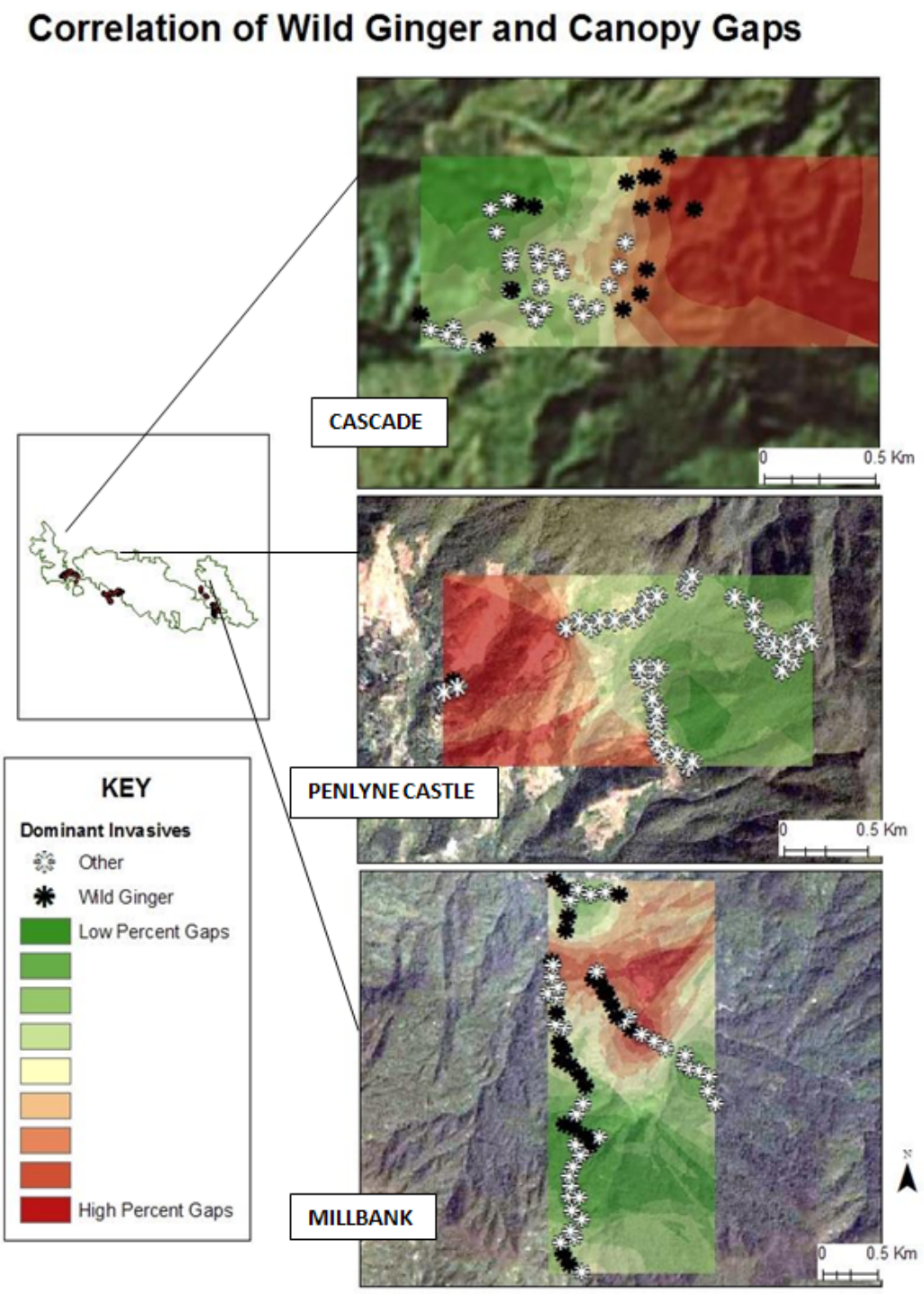


Figure 30: Interpolation of Non-native plants and GPS Location of Point-count Results for Bird Abundance

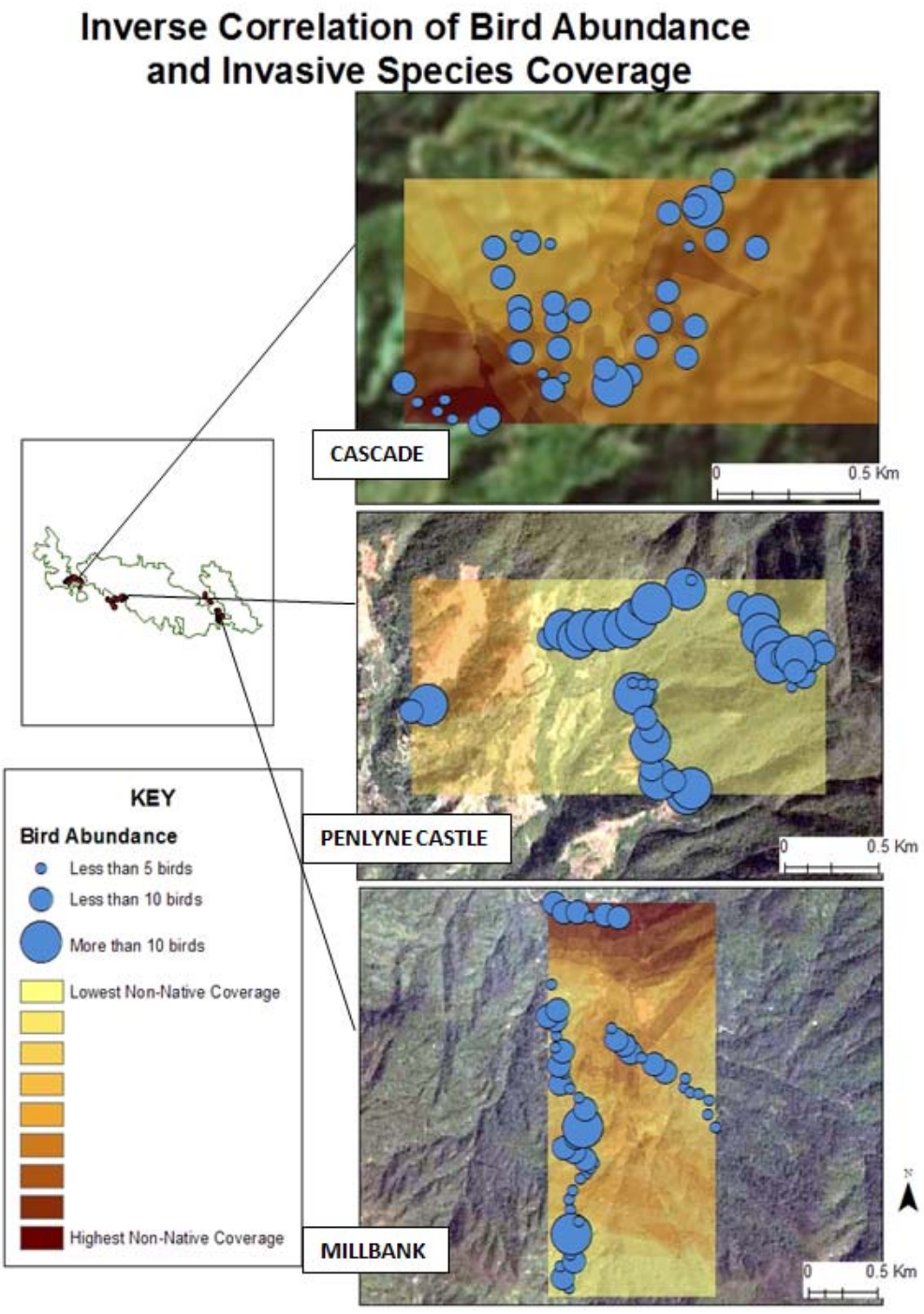
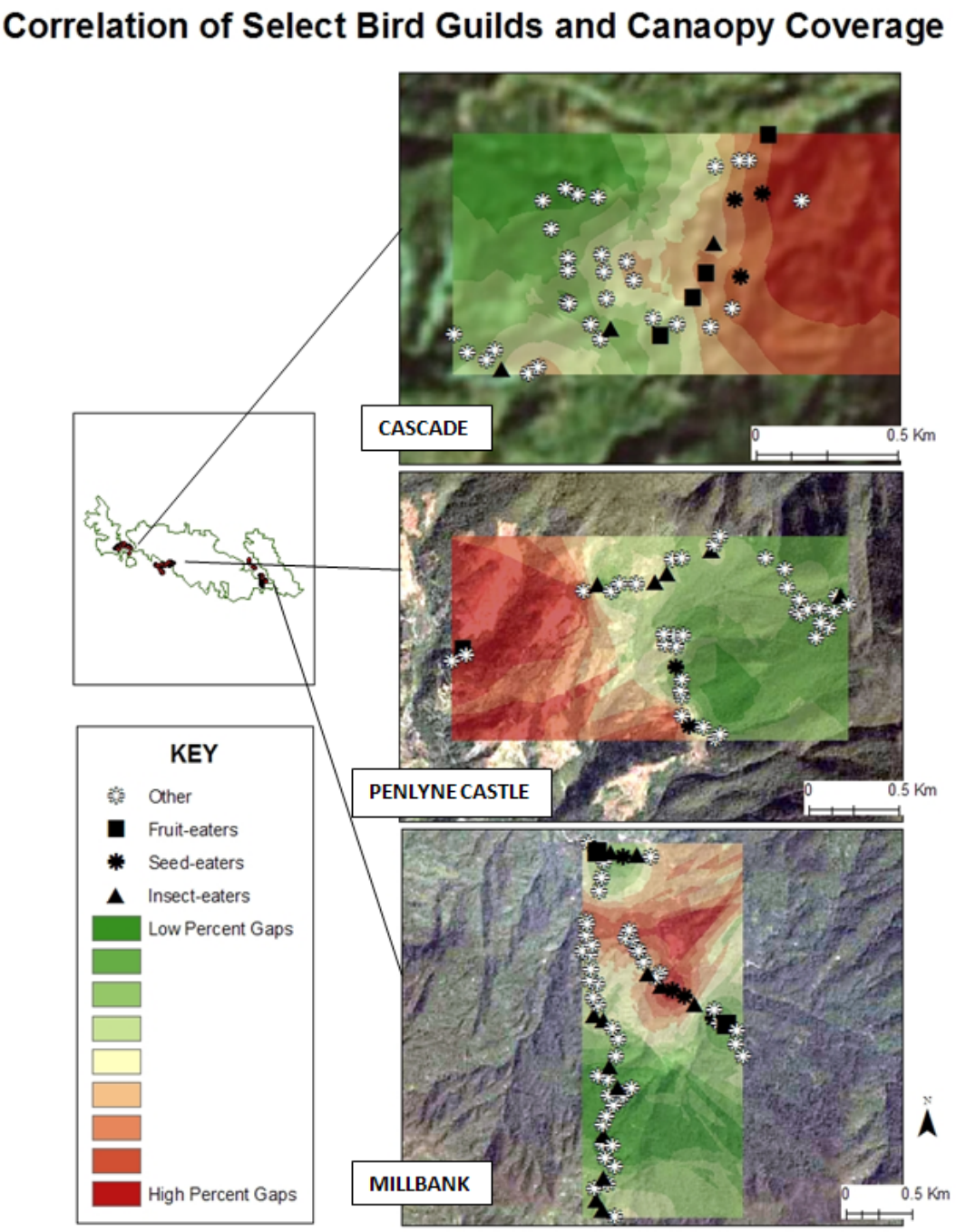


Figure 31: Interpolation of Canopy Coverage and GPS Location of Point-count Results for Bird Guilds



CHAPTER 4: RECOMMENDATIONS FOR INTEGRATING CONSERVATION WITH ADAPTIVE COLLABORATIVE MANAGEMENT STRATEGIES

Introduction

Linking community priorities with biodiversity conservation is not a new strategy, it is one that has been tested and studied for over 30 years, most notably through ICDPs. However, this strategy is now widely viewed as a failed strategy, largely due to inadequate conservation impact and inadequate community participation (Brandon et al., 2001; Wells & McShane, 2004). More recent studies have suggested that adaptive management, although a useful strategy in modifying program activities to meet expected outcomes, has continued to be applied through a trial and error mentality, with limited integration of expertise and priorities from local communities early on in program development (Borrini-Feyerabend, 1996; Christensen, 2004; Pimbert & Pretty, 1997; Ruitenbeek & Carter, 2001; Wells, Brandon et al., 1992. These and other studies have suggested that the integration of adaptive management and collaborative management strategies, known as adaptive collaborative management, increases the value of community participation early on in the design and implementation of conservation programs (Buck, 2001; Hill, 2008).

The JCDT, a co-management partner for the BJCMNP, identified key areas of concern based on their most recent management plan and presented a number of research topics to our Master's project team based at the University of Michigan. One particular research need called for an evaluation of their strategies in encouraging community participation and understanding the impact of disturbance on plants and wildlife in the park. While the JCDT manages the park primarily for biodiversity conservation, ecosystem services and recreation, they recognize that these objectives are unlikely to be reached without the support of local communities.

The aim of our research was to make some inferences about the priorities and opportunities of communities to participate in conservation activities, and to make an assessment of the actual state of forest disturbance and invasive species in the BJCMNP. Using multiple research methods, we collected both biological and sociological data, but these could not adequately be analyzed to make causal inferences as to how community attitudes and priorities impact forest disturbance and invasive species spread in the BJCMNP.

Recommendations for Further Conservation Focus

The issues and recommendations we present below are not unknown to the JCDT. Based on our findings discussed in the chapters two and three, our recommendations serve to strengthen existing programs and reiterate the importance of hard work that has already been done by park management. Here we propose four areas for greater conservation focus and action: 1) an emphasis on localized approach towards community outreach and conservation; 2) capacity-building at the local level; 3) selective logging and reforestation activities; and 4) greater emphasis on collaboration with local farmers and other agencies.

1. A Localized Approach to Community Outreach and Conservation

In order to be successful at the local level with limited resources, the JCDT could use our baseline data to better understand the specific socio-economic and ecological conditions that affect each community. One undeniably linked problem that affects almost every aspect of these communities is the lack of local secondary education and the dilapidated condition of the roads. All of these communities need at least some sort of local high school, since even with improved roads, the transportation costs would be financially prohibitive. Certain needs play prominent roles at each site. For example, the risk of floods with inadequate bridges and a malfunctioning water supply are two problems which are specific to Penlyne Castle. In Millbank, on the other hand, a noticeable decrease in world market demand for Jamaican foodstuffs, such as locally produced bananas, has increased the pressures of poverty on local farmers. In this instance, the JCDT could target crop diversification programs capable of increasing adaptability to market fluctuations while providing better wildlife habitat within the agricultural matrix. In Cascade, invasive plants such as net fern and wild ginger pose a potential threat to the biodiversity of the area, and efforts can be focused on engaging community members in invasive plant removal.

We believe that the JCDT can use this information to group communities by areas of common concern and tailor appropriate programs to each situation. Instead of having one general approach for all 59 buffer zone communities, the JCDT can create several different approaches that target specific groups of communities with similar issues. The JCDT could hold forums to discuss these local problems, suggest remedies, and encourage action. Understanding these local needs while facilitating solutions to local problems could greatly enhance social

capital between community groups and the JCDT while increasing local capacities for collective action.

2. Capacity-Building at the Local Level

We suggest that park management secure increased social capital from communities with greater focused interaction at the local level. Indeed, the JCDT recognizes this and sought research findings to identify priorities for increasing local communities' interest in participating in conservation activities. Acknowledging the inherent difficulty in managing the entire BJCMNP with a limited staff and budget, we suggest prioritizing human resources in key areas of concern, namely local communities within the buffer zone which overlap with areas of principle conservation value.

A greater presence by the JCDT in the form of rangers, agricultural extension agents, and other staff collaborating with the community has the potential to build considerable social capital that can support conservation and development activities. In our research, we noticed remarkable, broad-based support across demographic levels for the JCDT as regulators of the park. What was noticed and appreciated about the rangers was their understanding that farmers' financial needs and the how lack of cultivatable land outside of the park boundaries was a factor in this. Park rangers may allow farmers within the park to stay on park land, but they also provide education on how to use the land in a sustainable manner, while requiring the farmers to monitor any further encroachment. This approach builds trust and respect between park management and local community members. This method could be extended to other areas, such as recruiting poachers who are very familiar with wildlife to become ecotourism guides. Since one of the primary criticisms of the JCDT from the community members was their lack of presence in recent years, we suggest that allocating more employees to outreach efforts could help maintain legitimacy.

Lacking adequate educational services and community centers, many youth in these communities have become disenchanted and have no outlet for income other than to expand their farming into ecologically vulnerable areas. The Youth Path program appears to have produced positive results and is a fine example of building local capacities for decision-making. Our results suggest that these programs should be expanded and promoted in other communities, perhaps with the collaboration of other interested stakeholders with resources and ideas, such as

the Social Development Commission. However, the limited opportunities present to apply the skills learned through Youth Path will prohibit further growth. Although outside the scope of our project, we feel that expanding the opportunities for the use of these skills, for example through development of ecotourism, would allow youth to make a living in their own community.

Park management could focus training sessions on practical skills such as proposal writing and networking with international agencies that could fund community projects similar to what the Bowden Pen Farmers Association has done. Proposal writing programs should be promoted and expanded, perhaps in collaboration with the SDC. These efforts could also work to promote adult continuing education by building skills relevant to writing and communication. Having local community organizations obtain outside funding would ease the pressure on the JCDT to garner all the necessary capital. Continuing education and mutual exchange of knowledge can give community members more opportunities, better capacity to organize, and tools for greater empowerment in decision making.

Our survey results indicate that just over 70 percent of residents are involved in community organizations, but only a small fraction with environmental organizations (3.8 percent of our survey sample). Our recommendation to produce more meaningful participation with a wider variety of community members is to network with existing church, agriculture, and community development organizations that include approximately 39, 13, and 13 percent of the sampled population, respectively. These organizations have a larger member base than other organizations, thus allowing the JCDT to target over 66.7 percent of our survey population. Within these organizations, successful community organizers could be approached to facilitate workshops and discussions in conjunction with the JCDT.

3. Selective Logging and Reforestation

Since both the FD and the JCDT promote native tree planting through various incentives to both local farmers and private land owners, sustainable selective logging could be a joint venture for the harvesting of non-native Caribbean pine and reforestation with diverse native tree species. For example, in Penlyne Castle and Epping Farm there is a large stand of mature Caribbean pine originally planted by FIDCO that could be harvested and replanted with native tree species by community members trained in sustainable forestry. In surveys and interviews, a

number of respondents voiced a desire to have easier, though not unconditional, access to local lumber.

Reforestation programs should be maintained as they serve to stabilize the park's buffer zone and forest margins. Our results indicate that forest disturbance from associated light gaps may help facilitate the spread of non-native plants that, in turn, affect insects and birds through trophic level interactions. These results directly point to the important role of tree cover and tree diversity in conserving native species in the buffer zone. Reforestation can be prioritized to areas that would benefit from it the most by building resilience against soil erosion and landslides on steep slopes in areas most affected by natural and anthropogenic disturbances. This could further connect forest fragments while increasing tree diversity and habitat structural diversity for wildlife.

4. Collaboration with Local Farmers

Oftentimes local community members are portrayed as a major source of park degradation and lacking environmental awareness. While this may be true in some instances, local farmers can also be seen as potential contributors to reaching conservation goals. Significant conservation gains could be made by actively collaborating with local farmers on strategies to promote the retention of tree cover and landscape connectivity while at the same time incorporating farming techniques based on agro-ecological principles in current farmland. Examples include the intercropping of diverse crops to better mimic natural heterogeneity, the incorporation of shade tolerant crops into current farming, increased fallow periods for soil regeneration and retention, and organic farming practices independent of heavy fertilizer and pesticide inputs (Harvey et al., 2007).

These suggestions should also be coupled with greater attention focused towards non-local threats of deforestation. While local members might be responsible for the actual removal of trees, the pressure to do so often originates from Kingston based on logging companies. Additionally, water pollution is not always the result of actions by community members. Community members recognize that government industries, such as coffee processing plants, can pollute waterways and may resent outreach and enforcement efforts that are solely focused on community actors.

To implement these changes we feel it would be useful to expand partnerships, identify influential farmers, and design workshops to be more inclusive and relevant for farmers. To accomplish this, the JCDT should continue or begin to collaborate with non-local stakeholders such as the SDC, RADA, JAS, and the Coffee Industry Board to form a clear action plan on sustainable agriculture. Farmers cannot be expected to change behaviors when extension services are adamant that chemical-intensive methods are necessary to secure yields. It is also important to note that the JCDT's funding problem could be addressed by relying on social learning and collaboration with respected farmers within the community to help accomplish conservation goals.

These influential farmers could be supplied with the materials and techniques in an experimental, and likely long-term growth plot that could be used to demonstrate successful alternative techniques. The message behind this should be designed around the problems and benefits that have been identified by community members themselves. If community members are most concerned with landslides and changes in rainfall, these consequences should frame the JCDT's approach to influence behavioral change in farming practices. However, erosion was understood in terms of dramatic landslide events and not as the gradual loss of soil quality. Education and outreach efforts should focus on this problem, but also should target interventions based on farmers' concerns in preventing landslides. Educating local farmers of potential benefits in production gains, both long and short term, through traditional agro-ecological farming practices could help empower them as both farmers and conservation stewards. We believe that this may be best implemented through regular agricultural extension activities such as demonstration plots, greater collaboration with farmers, and dissemination of sustainable farming techniques.

Limitations of Research

The findings and recommendations reported in this project are only as good as the data collection and analysis that support them. Our research is only the first step for data collection that would be required to truly understand and appreciate the BJCMNP and the subtleties that make up its management. We recognize that our project faced many limitations, namely:

1. Small Number of Sampled Communities

The sampled communities might not be representative of the social and ecological factors at play throughout the whole BJCMNP region. Notwithstanding, research in three of the 59 communities in the BJCMNP buffer zone is a legitimate research design, as each community is faced with unique challenges and ecological threats. Therefore studying more communities would be necessary to gain a more accurate assessment of community attitudes and priorities towards their participation in conservation activities.

2. Logistical Constraints

Inability to perform site visits ahead of time meant that the team did not possess an accurate understanding of logistical constraints. The time permitted to carry out field research introduced trade-offs between the number of communities sampled and the depth of insights gained at each site. The time constraint precluded any pilot studies that would allow us to assess our research approach and to more specifically tailor questions and research goals. Sampling three communities meant that the group was only able to spend a limited time at each site (about two to three weeks), and more time would have been necessary to gain a deeper understanding of the community and to perform in-depth research. During the research design phase, the team discussed the number of research sites with the JCDT and academic advisors, recognizing that a more in-depth analysis of the issues could be undertaken with one or two communities.

3. Limited Communication During Data Collection

The group had limited ability to adapt some aspects of the project due to a lack of access to research materials while in the field. Working in remote areas meant that there were only a few times during the entire field season when the group had internet access for further research and consultation with faculty advisors or to buy materials needed to modify research methods.

4. Inter-Disciplinarity

We struggled to fully integrate our two areas of study, the sociological and the biological, and at times fell short of our expectations. These fields have different approaches from setting hypotheses to presenting the final data, which made communication across disciplines difficult. As a result, our research is more multi-disciplinary than inter-disciplinary.

5. Broad Research Questions

Our research questions were perhaps too broad to be feasible for a Master's research project. Despite having a team of five researchers, the breadth of our research made it difficult to focus our data collection and thoroughly address all the information we collected.

6. Single Sampling Period

The relatively scarcity of previous baseline data and confinement of the project to only one field season prevented us from drawing strong conclusions about causal relationships. For this reason, our project is primarily descriptive.

7. Coordination with the JCDT

In some cases, communication between the JCDT and the research group was limited, thus limiting the coordination of the JCDT's management priorities with our research needs. While we hope our research will benefit the JCDT, more communication and coordination might have made the results more useful.

8. Outside Perspective

Looking at the problems from the outside provides benefits of a new perspective, but it also limits full understanding the problem. For this reason, we might have over-looked or under-estimated a number of important factors such as specific community concerns. In our analysis, we tried to respect these differences and acknowledge them, rather than pretend that we are able to fully understand a community of people in a cultural context that is different than our own.

9. Need for Understanding Agriculture

While we recognized the need for research on the role that agriculture plays in biodiversity conservation, the limitations of the project did not allow for studying farming practices.

Recommendations for Future Research

The recommendations for further conservation focus and action outlined above are based on the limited scope of our research design. In addition to these, we have identified further areas of study for the JCDT to consider as opportunities to improving shared benefits of conservation and community development:

1. Varieties of Shade-Tolerant Coffee to Be Grown As Part of A Shade-Friendly Blue Mountain Coffee Farming Effort

The environmental benefits of shade grown coffee include increased biodiversity and reduced inputs such as fertilizers and herbicides. However, discussions with farmers show that shade coffee is not seen as a viable option since clouds and mist already reduce available sunlight and the addition of more shade will promote leaf rust. Research should be done to demonstrate whether such views hold any scientific merit and demonstration projects could be carried out.

2. Regionally-Specific Agricultural Practices That Encourage Biodiversity Conservation and Soil Erosion Control

Conversion of land for agricultural practices is considered one of the park's main threats. Since much of the buffer zone surrounding the park is composed of a patchwork mosaic of small-holder agriculture, it seems relevant to promote biodiversity by focusing on agricultural practices within this matrix. In addition to serving as a buffer for biodiversity loss and extinction outside of park boundaries the agricultural matrix is also a significant source of biodiversity itself. Many have pointed out the need to view the agricultural matrix not only as a potential reserve of biodiversity but also as a medium through which migrations must happen in order to ward off the process of local extinctions to regional and global levels (McNeely & Scherr, 2007). Thus research focusing on the agro-ecological matrix is worthy and of great value to an environmentally sustainable agricultural future and the conservation of biodiversity (Vandermeer & Perfecto, 2007).

3. Research Options for Direct Payment/Credit Plans for Biodiversity Conservation

While requiring large initial financial resources, the outcomes of direct payment plans are favorable. Paying individuals directly for their continued conservation behaviors may result in

adherence to conservation goals in the park buffer zone. Payment or potential investment can include subsidies for reduced-impact on land and resource use, support for the marketing of biodiversity through eco-tourism, payment for maintenance of ecosystem services, conservation easements, concessions, and reforestation carbon credits. While some of these options are more feasible than others, the possibilities are interesting and worth researching.

4. Research Methods for Sharing Benefits of Ecotourism and Avoiding "Elite Capture" of Ecotourism Plans

While eco-tourism is an area of increased support on behalf of the JCDT and is an issue of concern for local residents, efforts could be made towards investigating the possibilities for growth, development, and capacity building for local businesses and cottage industries in these communities. Many of these communities had potential for developed infrastructure to support eco-tourism ventures, but lacked the capacity and networking to carry out the projects. While the potential for increased economic opportunities for local communities and minimizing environmental impacts are promising, there are some concerns with ecotourism development. Research into mechanisms for sharing the benefits of ecotourism before such ventures get started may help avoid "elite capture" within this context.

5. Inlcude More Inter-Disciplinary Projects to Bridge the Gap Between Natural and Social Sciences in Conservation of the BJCMNP

As many have pointed out, landscapes that are composed of many small farms, much like the lanscapde of the BJCMNP's buffer zone, often demonstrate a high potential for sustaining both biodiversity and rural livelihoods (Castillo & Toledo, 2000; Rosset, 1999). Biodiversity conservation issues are both social and natural science issues. Integrating both ecological and social science methodologies may be difficult, but it is the only way to contribute to new knowledge creation beyond the confines of a single discipline. While our research attempted to be interdisciplinary in design, in practice our results are more indicative of a multidisciplinary approach. Nonetheless, interdisciplinary research remains a valuable research strategy to make strong inferences about the value of existing programs and policies, and necessary for the creation of new ones that meet the needs of local communities while also upholding the goals of biodiversity conservation.

Conclusion

The JCDT and collaborating park management authorities recognize the importance of securing local community commitment to park management. However, the limitation of resources, financial and human, constrain the ability to collect empirical data to link community attitudes and behavior to ecological degradation in the BJCMNP, and subsequent adaptation of park management activities to mobilize community collaboration in conservation activities. Our hope is that by providing data on the social context of local communities, coupled with ecological surveying of the impact of invasive plant species on biodiversity, park management authorities can better allocate limited resources towards strengthening and adapting programs to meet conservation and development objectives.

LIST OF APPENDICES

Appendix 1 Survey Questionnaire

Hello. We are a group of students from the US. We have come to your community because you live very close to the Blue and John Crow Mountains National Park. If you live near the Park, we are interested in your opinions and experiences with the park, its resources, and its management. Answering the questions in this survey should take about 20-30 minutes of your time. Your responses will be kept confidential. Thank you!

1. Is protecting the forest important to you? If so, why? If not, why not? (*open ended*)

_____

_____

(NOTE: code but do not read aloud here and throughout the interaction: **N/A = Not Applicable**
DK = Don't Know)

(*Show card A*)

2. Are any of the following difficult for you to access here?:

	Very difficult	Sometimes	Rarely	Not difficult
a. Education	**1**	**2**	**3**	**4**
b. Employment	**1**	**2**	**3**	**4**
c. Political representation	**1**	**2**	**3**	**4**
d. Health services	**1**	**2**	**3**	**4**
e. Housing	**1**	**2**	**3**	**4**

3. How difficult is it for you to access the following environmental resources, if you use them?

	Very Difficult	Sometimes Difficult	Rarely Difficult	Not Difficult
a. Farmland	**1**	**2**	**3**	**4**
b. Fuel Wood	**1**	**2**	**3**	**4**
c. Plants for food and medicine	**1**	**2**	**3**	**4**
d. Clean water	**1**	**2**	**3**	**4**
e. Timber	**1**	**2**	**3**	**4**

4. Has there been a change in the availability of any of these resources during your lifetime? If so, which one(s)? (i.e. Has there been an increase, decrease, or no change at all?)
(*Write resource and check under change listed*)

Resource	**Increase**	**Decrease**

5. If so, in your opinion, what factors have caused this change? (*open ended*)

6. How often do you go into the forest to collect these resources?
(*Read choices aloud and circle an answer*)

Frequently	**Sometimes**	**Rarely**	**Never**
1	**2**	**3**	**4**

7. How often do members of your community go into the forest to collect these resources?

Frequently	**Sometimes**	**Rarely**	**Never**
1	**2**	**3**	**4**

Next, we are going to ask you some questions about making a living in your community.

8. What do you do for a living? (*open-ended)*

If they farm:

A. Do you own the land you farm? **YES** **NO**
B. Do you lease the land? **YES** **NO**
C. Do you work on someone else's farm? **YES** **NO**
D. Is it government (forestry) land? **YES** **NO**
E. Is there another circumstance? (*fill in blank*) _____
F. How did you acquire the land? _____

G. What do you grow? (*open ended*)

_____

H. How do you prepare the land? (*open ended*)

_____

I. Do you terrace? Why/why not? _____

J. What kind of fertilizers and pesticides do you use?_____

K. What portion of your income comes from farming? (*Read choices aloud and circle an answer*)

All	**Most**	**Some**	**None**
1	**2**	**3**	**4**

9. Could you give an estimate of your monthly income? (write "annual" if figure is yearly) (*Show card B*)
10. To what extent do you agree/disagree with the following statements (*circle the most appropriate response*):

Strongly agree	**Agree**	**Neither agree nor disagree**	**Disagree**	**Strongly disagree**
1	**2**	**3**	**4**	**5**

a. Farming provides a good living	**1**	**2**	**3**	**4**	**5**
b. I believe farming will be able to support my community many generations into the future.	**1**	**2**	**3**	**4**	**5**
c. Farmland expansion should be restricted to protect the environment	**1**	**2**	**3**	**4**	**5**

11. We would also like to understand your views on coffee farming. To what extent do you agree/disagree with the following statements (*circle the most appropriate response*):

a. Coffee farms take the best land for farming.	**1**	**2**	**3**	**4**	**5**
b. Coffee farming, as practiced around my community, is bad for the environment	**1**	**2**	**3**	**4**	**5**
c. I would be happy if my children were to become coffee farmers	**1**	**2**	**3**	**4**	**5**
d. Coffee farming should be regulated to protect the environment	**1**	**2**	**3**	**4**	**5**

12. How many people are in your household?

13. In what ways do members of your community help to protect the forest? On the other hand, can you think of things people do that may harm the forest? (*open-ended*)

_____

_____

14. Next, we would like to know more about your involvement in activities around your community. Have you participated in any of the following activities in the past 12 months. (*place an "X" by all that apply*)

a._____ Voted in an election
b._____ Signed a petition
c._____ Became involved in a boycott
d._____ Participated in a peaceful demonstration
e. _____Attended a community meeting

15. Are you a member of any organizations? **YES** **NO**
(ex. church group, social movement, labor organization)

If no skip to question 18

16. If so, how many?

1	2	3	4	5	More than 5

17. What kind of organizations? (*open-ended*)

_____

18. How often do groups of people in your community get together to work on community problems?

1. Frequently **2. Sometimes** **3. Rarely** **4. Never**

(*Show card C*)

19. Now I am going to list some concerns that your community might be facing. What level of concern do you feel towards the following threats:

	None	Very little	Some	Quite a bit	A great deal
a. Not enough jobs	0	1	2	3	4
b. Environmental degradation and/or pollution	0	1	2	3	4
c. Political separation of community	0	1	2	3	4
d. Loss of traditions/culture	0	1	2	3	4

20. (using same scale) What level of concern do you feel towards the following environmental threats?

	None	Very little	Some	Quite a bit	A great deal
a. Illegal Hunting	0	1	2	3	4
b. Foreign plant invasion	0	1	2	3	4
c. Loss of native Jamaican species	0	1	2	3	4
d. Soil erosion	0	1	2	3	4
e. Air pollution	0	1	2	3	4
f. Improper waste disposal	0	1	2	3	4
g. Forest fire	0	1	2	3	4
h. Flooding	0	1	2	3	4
i. Water pollution	0	1	2	3	4

21. Do you recognize any of these plants? (Show Wild Ginger, Wild Coffee, Net Fern, Red Bush, if applicable to site.)

Wild Coffee: YES NO **Wild Ginger: YES NO**

Net Fern: YES NO **Red Bush YES NO**

22. Have you noticed a change in the amount of these plants in your community?
(*Read choices aloud and circle an answer*)

Wild Coffee: **Increase** **Decrease** **No change** **Wild Ginger:** **Increase** **Decrease** **No change**

Net Fern: **Increase** **Decrease** **No change** **Red Bush:** **Increase** **Decrease** **No change**

23. Are there any good reasons to have these plants around the community/environment? Do they pose any problems to the community/environment?

_____

I am now going to ask questions about the management of the forest.
24. Are you aware of the locations of the forest boundaries? **YES** **NO** **SOME**

(*Show card B again*)
25. To what extent do you agree/disagree with the following statements:

Strongly agree **1**	**Agree** **2**	**Neither agree nor disagree** **3**	**Disagree** **4**	**Strongly disagree** **5**

a.	Park management communicates effectively with my community.	**1**	**2**	**3**	**4**	**5**
b.	I am satisfied with the current management of the park.	**1**	**2**	**3**	**4**	**5**
c.	I would be willing to pay extra taxes to ensure the enforcement of park rules, regulations, and boundaries.	**1**	**2**	**3**	**4**	**5**
d.	I would be willing to volunteer my time to ensure the monitoring of park rules, regulations, and boundaries.	**1**	**2**	**3**	**4**	**5**
e.	I would be willing to be paid to personally ensure the monitoring of park rules, regulations, and boundaries.	**1**	**2**	**3**	**4**	**5**

26. How well do you think the forest rules and regulations are currently enforced?

1. Not enough **2. Just Right** **3. Too strictly**

27. *Circle the appropriate answer:*

a. Gender: **Male** **Female**

b. What is the highest level of education you have completed (*open-ended*):

a. No formal schooling
b 6th grade
c. 8th grade
d. High School completed
e. Some college
f. College degree
g. Vocational degree
h. Graduate degree

28. What is your age? _____

29. For how many years has your family lived in this area? (*open ended*) _____

30. How important is it for people to restrain their use of the forest? (*Read answer choices aloud)*

Very Important Rather important Not that important Not at all important

31. How do you personally restrain your use of the forest? (*open-ended)*

_____

32. Have you been involved in any meetings, workshops, educational programs, etc. with park management? **YES NO**

(*NOTE: if yes, ask question 32 a-c; if no, skip to 33d*.)

(*Show card B again*)

33. To what extent do you agree/disagree with the following statements about your involvement/relationship with forest management: (*circle the most appropriate response*)

Strongly agree 1	**Agree 2**	**Neither agree nor disagree 3**	**Disagree 4**	**Strongly disagree 5**

a.	I feel empowered by my involvement and communication with park management.	**1**	**2**	**3**	**4**	**5**
b.	I have had increased economic opportunities from participating with park management	**1**	**2**	**3**	**4**	**5**
c.	My opinions were respected when I met with a representative from park management.	**1**	**2**	**3**	**4**	**5**
d.	My community understands the need for the park management and its programs.	**1**	**2**	**3**	**4**	**5**
e.	My community has the right and responsibility to protect the park.	**1**	**2**	**3**	**4**	**5**
f.	I trust that park management is looking out for my best interest when making decisions regarding park policies, procedures, programs and rules.	**1**	**2**	**3**	**4**	**5**
g.	My community's local customs and traditions are compatible with the goals of the park management	**1**	**2**	**3**	**4**	**5**

(*Show card D*)

34. How would you describe your level of participation in managing the natural resources in your area? (*circle the appropriate answer*)

a. I have helped in decision-making
b. I have helped in planning
c. I have earned a living through an opportunity created by park management.
d. I have been asked for my participation in park management meetings.
e. I have not been involved because I was not asked.
f. I have not been involved because I chose not to.

(*NOTE: If the informant has not been involved in park management activities, ask the following question and then skip to the end*).

35. Do you know the Jamaica Conservation and Development Trust (the JCDT)?

YES **NO**

36. *[Place an "X" by all of the appropriate options]* How would you characterize your previous interaction or participation with the JCDT or its programmes?

a. _____ Reforestation projects
b. _____ Junior ranger programs
c. _____ Community meetings
d. _____ Workshops
e. _____ My children were involved in a park education program
f. _____ I was involved in an educational program
g. _____ Monitoring illegal activities
h. _____ Youth PATH
i. _____ Other: _____

37. Finally, if you have attended a meeting or workshop with park management, we would like to know more about your experience.

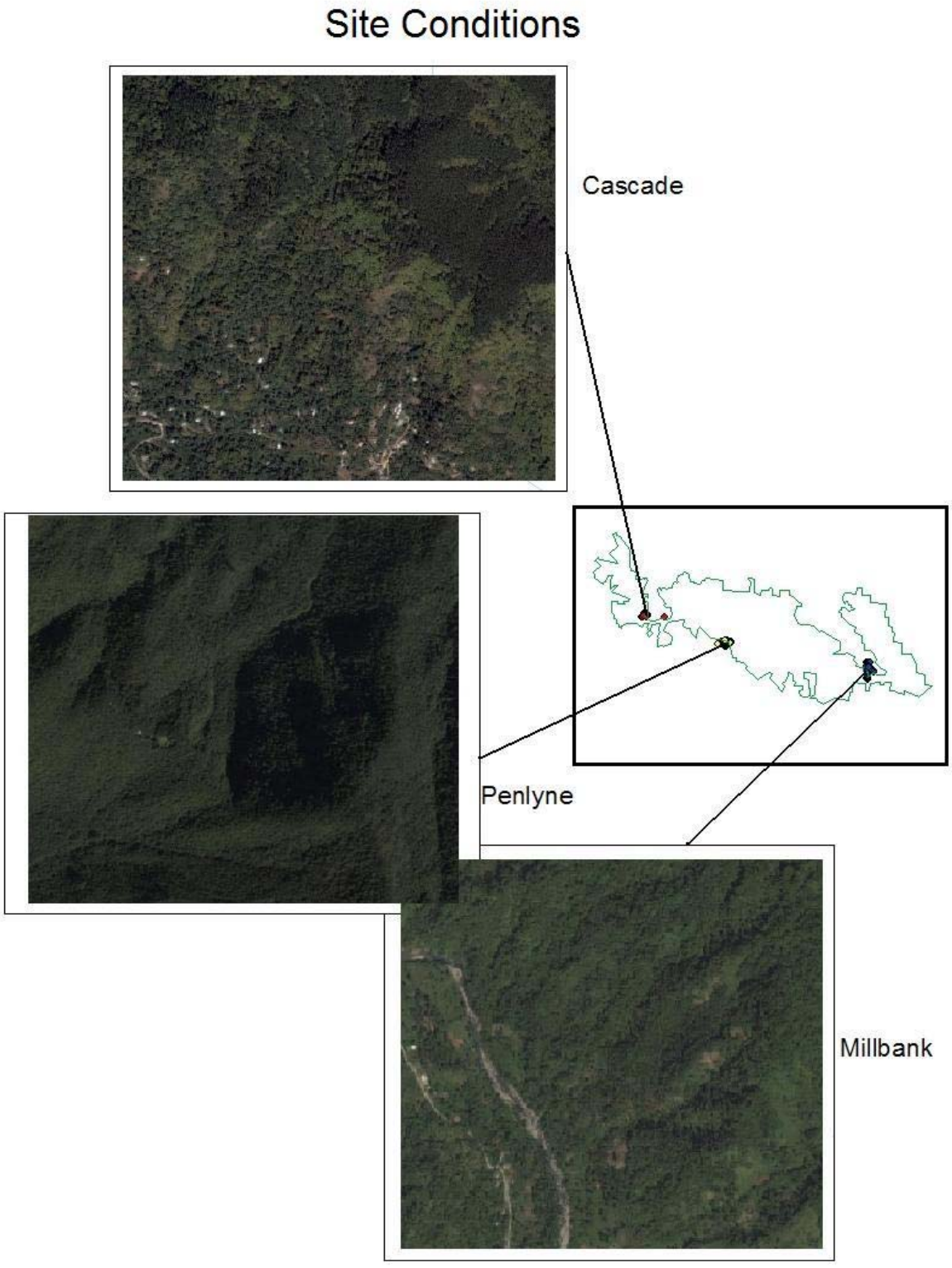
a.	Park management defined the problems that were discussed.	**YES**	**NO**
b.	Solutions to those problems were defined by park management	**YES**	**NO**
c.	You helped the park management make decisions.	**YES**	**NO**
d.	You helped plan the meeting/workshop agenda.	**YES**	**NO**
e.	You were given things, such as food, cash or other materials in return for your labor and/or input.	**YES**	**NO**
f.	You formed a group to meet park management's project objectives.	**YES**	**NO**
g.	You created an action plan with park management to help address resource protection.	**YES**	**NO**
h.	Everyone was included at the meeting/workshop.	**YES**	**NO**
i.	Your community works independently of the park management to find solutions to these problems	**YES**	**NO**

Thank you for your time. Is there anything we did not ask you about but you feel we should know?

Appendix 2 Summary of Interview Topics, Examples, and Targeted Informants

TOPIC	DESCRIPTIVE EXAMPLES	TARGETED INFORMANTS
Demographics	Age, gender, education, occupation, income (if forthcoming), household size	Community members
Community definitions	Geographical boundaries and other criteria; perceived strengths and weaknesses	Community members
Attitudes towards park regulations	Limited access to land, benefits of ecosystem services, wildlife protection	Community members
Intra-community disagreements	Designed to probe at conflicts and power struggles within community in managing natural resources	Community members
Social capital/organizational levels	Membership and role in community-based organizations	Community members
Experience with JCDT (park management)	Familiarity, level and type of participation in park management activities	Community members
Likelihood for further participation	Expressed interest in collaborating with park management and what that should entail	Community members
Farming questions	Methods—terracing, chemical use; land acquisition and tenure; land quality changes; perceived inequalities between large/small farmer	Farmers
Environmental ethic	Personal and organizational	Government or NGO employees
Policies	Effects of international/domestic policies on conservation and sustainable development	Government or NGO employees
Conservation and development	How poor infrastructure and social policies have affected conservation	Government or NGO employees
Community participation	Challenges and successes from governmental perspective	Government or NGO employees
Adaptive collaborative management of the BJCMNP	Improvements to make, budgetary constraints	Government or NGO employees

Appendix 3 GIS Visualization of Three Study Sites



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