Proceedings of the Fourteenth Meeting of Caribbean Foresters
in Dominica
April 29-May 2, 2008

LINKING CONSERVATION, TOURISM AND SUSTAINABLE DEVELOPMENT IN THE CARRIBEAN.

A Publication of the USDA Forest Service
International Institute of Tropical Forestry
Río Piedras, Puerto Rico
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INTERNATIONAL INSTITUTE OF TROPICAL FORESTRY

Caribbean foresters enjoy an excursion on the Sindicate Nature Trail located at 550 m in the Lower montane rain forest of north central Dominica. The recreation site, managed by the Dominican Forest Service, contains several majestic, centuries-old specimens of gommier (*Dacryodes excelsa*) and the elaborately buttressed Chataignier (*Sloanea* spp.).

Cover photo: Cabris National Park encompasses a peninsular coastal dry forest of >500 ha in northwestern Dominica overlooking Prince Rupert Bay near the town of Portsmouth. The ruins of Fort Shirley, an 18th century British garrison that housed 600 soldiers, is one of the island's favorite tourist attractions.

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LINKING CONSERVATION, TOURISM AND SUSTAINABLE DEVELOPMENT IN THE CARIBBEAN

PROCEEDINGS OF THE FOURTEENTH MEETING OF CARIBBEAN FORESTERS INDOMINICA

APRIL 28-MAY 2, 2008

Compiled and Edited by
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International Institute of Tropical Forestry

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PREFACE

The afternoon before the start of the 14th meeting of Caribbean Foresters I checked into my hotel room at Dominica and enjoyed the beautiful ocean view from my hotel room. Clearly we were staging our meeting in a tropical island paradise. The next day as soon as I woke up, I opened the windows to enjoy the view, and to my surprise, there was what appeared to be a gigantic building obstructing my view to the ocean. Quickly I realized that it was not a building but a cruise ship that had arrived during the night and moored in front of my hotel room. With that shock, I realized that Dominica had changed dramatically since Caribbean Foresters met there in 1988. Walking the streets of Roseau, the capital city of Dominica, I could see the new economic activity in the vicinity of the docks, where these gigantic ships arrived periodically with a great number of tourists that could temporarily increase and even double the human population of the island, thus increasing the pressure on its natural resources.

The nature and magnitude of the effects of tourism in the Caribbean Islands was the subject of the meeting that took me to Dominica, and this publication summarizes what each island representative had to say about the subject. The picture that emerges is that Caribbean Islands have an enormous appeal to tourists and have a lot to offer and benefit from tourism. However, the natural resources are vulnerable to intensive use and are beginning to show the wear and tear of overuse. When is too much enough? Could tourism kill the goose that lays the golden egg in the Caribbean? What are the plusses and minuses of this economic activity that clearly has a lot to offer to the well-being of islanders and their governments?

The meeting and this publication culminated with a call to action (p 104), which clearly states the issues and provides reasonable and urgent actions that all governments in the Caribbean should consider. There are ways for Caribbean Islands to benefit from the marvelous natural resources that they possess, for the world to share this natural wealth, and to do so without destroying the resource or impoverishing the region. For me, I very much enjoyed the view from my room the day after the ship left, and the whole experience made me realize the difficult issues facing resource managers in the region and how difficult the discussions must be when governments plan the critical balance between social, economic, and ecological sustainability. I trust this publication will help enlighten the discussion.

Ariel E. Lugo
Río Piedras, Puerto Rico
October 10, 2009.

LINKING CONSERVATION, TOURISM AND SUSTAINABLE DEVELOPMENT IN THE CARIBBEAN -- BARBADOS

Michelle Wilson

INTRODUCTION

Barbados, situated approximately 480 km north of South America, is the most easterly of the chain of islands in the Caribbean Sea. It is located at a latitude of 13° 10' N and longitude 59° 35' W. The island is pear-shaped and has a total land area of 432 km^2. Barbados measures 54 km from north to south and 22 km at its widest point from east to west. Barbados has a tropical maritime climate. The average annual rainfall is 1500 mm and average daily temperatures range between 24 and 29 °C. The prevailing north easterly trade winds average 14 to 24 km/hr.

Barbados is an oceanic island which is made up of coral limestone overlaying base materials of sand, shale, and mudstone. The topography is undulating, rising from the south to west in a series of gently sloping coral terraces interrupted by deep gullies with almost vertical cliffs. Mount Hillaby, located in the north-central area at the edge of the Scotland District, rises to 336 m and is the highest point on the island.

The Scotland District, shaped like a triangle, is located in northeastern Barbados. Accounting for 14% of the island's area, the topography of the District is somewhat different from the rest of Barbados. The terrain is naturally rugged and houses the only remaining primary forest on the island. Recently, ecotourism has increased within the District.

Barbados, with a population of approximately 281,000, is one of the most densely populated islands in the Caribbean. Historically, its economy was chiefly based on agriculture and related activities. Today, however, the mainstay of the economy is tourism and light manufacturing while agriculture plays a supportive role.

TOURISM IN BARBADOS

Barbados is considered to be one of the more mature Caribbean tourism destinations and it is believed to be one of the first islands in the West Indies to recognise the potential of tourism as a business. The island was an attraction for wealthy British nationals before World War II; however, large scale tourism development only dates back to the late 1950s and early 1960s (Ministry of Tourism and International Transport 2001).

In the mid-1950s, political leaders supported the gradual move of the economy from agriculture to tourism through a range of government supported initiatives to encourage private investment in tourism. In 1958, the Barbados Tourism Board was established and the government promoted loans for the construction and purchase of hotels and associated real estate. In the early 1960s and 1970s, there was an upsurge in the tourism industry with total tourist arrivals increasing from 17,829 in 1956 to 222,080 in 1973 (Table 1). Steady growth in the industry increased tourist arrivals from 369,915 in 1980 to 461,259 in 1989. Hotels and infrastructural development also increased. During this expansion, little attention was given to long-term integrated planning or to environmental and social carrying capacities. Achievement of economical objectives was emphasized rather than sustainable

Table 1. Visitor arrivals in Barbados from 1956-2005.[1]

Year	UK	Canada	USA	CARICOM Countries	Other	Total Tourist Arrivals	Cruise Ship Passengers	Total Visitor Arrivals
1956	1170	1859	4133	7380	3287	17829	12391	30220
1957	1398	2142	6721	9461	4051	23775	10802	34575
1958	1523	2499	7072	9335	4516	24495	12145	37090
1959	1735	3359	8554	11668	4933	30249	17044	47293
1960	2102	3755	9716	14638	5324	35535	24172	59707
1961	2901	5429	10322	13985	4423	37060	26943	64003
1962	3363	7944	11688	16220	4843	44058	24658	68716
1963	4765	9991	13154	16975	5712	50597	27184	77781
1964	6174	10923	15138	19261	6129	57625	41671	99296
1965	6673	14212	19811	20842	6880	68418	52664	121082
1966	8304	16372	23827	23149	7452	79104	51593	130697
1967	9622	18293	29813	24713	9124	91565	45451	137016
1968	11493	27879	41287	24117	10921	115697	75981	191678
1969	10168	31617	52689	25517	14312	134303	80899	215202
1970	12083	39609	57111	33450	14164	156417	79635	236052
1971	13621	53690	68487	33892	19385	189075	79159	268234
1972	14851	61918	75525	36608	21447	210349	100086	310435
1973	17690	68639	74779	36349	24623	222080	114469	338549
1974	23782	77246	66237	38139	25314	230718	119524	350242
1975	24802	75517	54984	38070	28203	221486	98546	320032
1976	25843	73005	56041	38515	30910	224314	99406	323720
1977	25481	83749	70389	47491	42204	269314	103077	372391
1978	35718	91192	85473	54333	50167	316883	125988	442871
1979	49430	92745	91354	75966	61421	370916	110073	480989
1980	56226	84934	85971	84398	58386	369915	156461	526376
1981	72090	69897	74472	86859	49237	352555	135782	488337
1982	51145	56619	75511	81577	35943	303795	110753	414548
1983	47662	53198	113989	83789	29700	328338	102519	430857
1984	46274	67307	140201	83774	30096	367652	99166	466818
1985	38822	70573	148093	70884	30763	359135	112222	471357
1986	47590	60285	166250	61471	34174	369770	145335	515105
1987	79152	64349	175093	63455	39810	421859	224778	646637
1988	101231	65667	170773	63380	50434	451485	290993	742478
1989	118122	65564	154269	62840	60464	461259	337100	798359
1990	94890	57841	143295	62298	73768	432092	362611	794703
1991	88166	46287	119069	57988	82712	394222	372140	766362
1992	88759	49999	110685	52831	83198	385472	399702	785174
1993	100071	49190	112733	52462	81523	395979	428611	824590
1994	123455	52286	109092	51487	89312	425632	459502	885134
1995	126621	53373	111983	58635	91495	442107	484670	929777
1996	139588	54928	111731	56752	84084	447083	509975	957058
1997	155986	58824	108095	63581	85804	472290	517888	990178
1998	186690	59946	106300	70358	89103	512397	506610	1017007
1999	202772	57333	104953	86127	63429	514614	432854	947468
2000	226787	59957	112153	87424	58375	544696	533278	1077974
2001	217466	52381	106629	80085	50517	507078	527597	1034675
2002	192606	46754	123429	89611	45433	497899	523253	1021152
2003	202564	49641	129326	96809	52871	531211	553119	1090330
2004	213947	50032	129664	104564	53295	551502	721270	1272772
2005	202765	47690	131005	114511	51563	547534	563588	1111122

[1]Source: Ministry of Tourism and International Transport 2005.

tourism. The expansion had negative impacts on the marine, coastal, and terrestrial environment, as manifested by beach erosion, and the degradation of wetlands, coastal woodlands, forests, and wildlife habitat. The expansion also threatened fisheries and caused a decline in corals.

In the early 1990s there was a steady decline in tourist arrivals and Barbados had no choice but to review the tourism industry in a holistic manner. It was determined that the industry needed sustainable development through the wise use of the country's resources.

SUSTAINABILITY OF TOURISM IN BARBADOS

It is often said that tourism is an industry that destroys the resources that it needs for its existence. Finding the balance between economic development and natural resource protection has been a challenge for both developed and developing nations. The challenge in Barbados is greater because several sectors are competing for a limited land resource.

During the years 1995 to 2006, Barbados received 6.1 million stay over visitors and 6.5 million cruise passenger visitors (Ministry of Tourism and International Transport 2008). The threat posed to the environment is not difficult to imagine when the daily operation and waste disposal of the various hotels, resorts, and cruise ships are considered. Because of tourism's large contribution to the gross domestic product, Barbados' only option is to ensure the sustainable development and wise use of its natural resources. To ensure the orderly and progressive development of land, and to preserve and improve related amenities, the government of Barbados: (1) revised the Physical Development Plan in 2003; (2) compiled a National Park Plan; and (3) began to implement both the Integrated Coastal Zone Management Plan and the Scotland District Development Plan.

The Ministry of Tourism saw the need for a policy framework to guide the sustainable development of the industry and thus developed a "Green Paper" (Ministry of Tourism and International Transport 2001). The document highlights the need for conservation of the island's natural and cultural heritage, and recognises that sustainable tourism can be a catalyst for conservation and improvement of the natural environment.

For many years the beaches of Barbados were polluted by waste water seepage from residences and hotels along the coastline. To alleviate this problem, the government constructed the Bridgetown and South Coast Sewerage Treatment Plants. Moreover, it proposed to develop a West Coast Treatment Plant for the collection, treatment, and reuse of effluent for golf courses and agricultural irrigation. This would reduce pollution on the beaches and promote the conservation of scarce water resources. The move towards conservation has also extended to the private sector where several hotels and resorts have adopted self-imposed environmental initiatives. Seven hotels and resorts have gone further by being Green Globe certified.

Green Globe 21 is a voluntary certification system which ensures the sustainable development of the travel and tourism industry worldwide by quantitatively measuring economic, social, and environmental development. It provides tourists with the assurance that their tourism operator honours their commitment to conservation and sustainability.

Case Study # 1 – Scotland District

The Scotland District is a part of the proposed national protected area and has been designated as a special development area. It occupies 57 km^2 and contains 15% of the island's potential arable land (Agricultural Planning Unit 2002). The Scotland District, because of geological and hydrological factors, has been seriously affected by landslides and erosion. Realising the fragile nature of the environment, the government developed a comprehensive agricultural plan for the District. The Soil Conservation Unit, one of the departments of the Ministry of Agriculture and Rural Development, played a major role in reducing soil erosion within the District. The comprehensive agricultural plan seeks to: (1) increase land productivity owned by the crown; (2) conduct land conservation activities; (3) maximise marketing opportunities for agricultural commodities and related services; and (4) create linkages with other sectors of the economy to maximise economic opportunities in the District. The plan recommends the development of agricultural activities in conjunction with forestry to ensure sustainable development within the District. This Plan, in conjunction with the Special Development Area Act and several government incentives, provides tax rebates and other benefits to businesses and individuals who are operating or are willing to operate businesses in the District. Entrepreneurs have taken advantage of the opportunities during the past 6 years, increasing ecotourism activities within the District.

Case Study # 2 – Almond Resorts

Barbados has three Almond Resorts - the Almond Casuarina Beach Resort, the Almond Beach Village, and the Almond Beach Club Resort and Spa. The first is located on the south coast in a lush tropical setting at Dover Woods, Christ Church. Before associating with the Almond Brand, the resort was operated as the Casuarina Beach Club. It was renowned worldwide for its environmental policies and was one of the first on the island to receive Green Globe certification. Subsequently, the hotel has received several prestigious environmental awards both locally and worldwide. The Almond Beach Village is in a former sugar plantation located in St. Peter on the west coast. It offers an all inclusive 395 guest room facility for adults and children. The Almond Beach Club Resort and Spa, also located on the west coast, has 161 guestrooms with accommodations for adults only. All of the Almond hotels and resorts in Barbados are green globe certified. This certification assures guests that hotel management plays a crucial role in the protection and enhancement of the environment as well as a role in the social enhancement of the local communities. The hotels have made a commitment to (Loreto Duffy-Mayers 2008, pers. comm., see endnotes):

- Apply sound environmental practices in all their operation while complying with laws, regulations, and industry standards.
- Utilise programmes which minimise the use of energy, water, and non renewable resources without compromising services.
- Minimise hazardous chemical use by using natural alternatives.
- Reduce the quantity of waste produced.
- Encourage guest and business partners to participate in enhancing and protecting the environment.
- Adopt a purchasing policy that supports environmental products and local products and services, and communicate all environmental policies and practices to employees, guests, and suppliers.
- Mitigate environmental impacts to eco-

systems.

- Regularly monitor their environmental performance relative to policies, objectives, and targets.
- Continuously improve their environmental practices on a yearly basis.

SUMMARY

The case studies illustrate that sustainable tourism development has made progress in Barbados. They also highlight the roles that both the government and the private sector can play in linking conservation, tourism, and sustainable development. Many believe that considerable development is required for tourism to be viable but the case study of the Scotland District shows that nature based tourism is a viable option in some areas. In fact, landowners would be less inclined to sell to developers if they could participate in nature based ecotourism. The case studies also highlight that tourism can be linked with conservation and sustainable development through responsible planning and management practices consistent with the environment.

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THE CONTRIBUTION OF NATIONAL PARKS AND ECOTOURIST SITES TO THE SOCIO-ECONOMIC DEVELOPMENT OF DOMINICA

Cyrille John

INTRODUCTION

Dominica, the "Nature Island," is distinguished by an extremely rugged landscape, with towering mountains shrouded in mist, narrow valleys, deep gorges, abundant freshwater in cascading streams and waterfalls, grey volcanic sand beaches, luxuriant tropical rainforest, and a diverse flora and fauna. The island's relatively unspoilt landscape is considered to be the most dramatically beautiful and pristine in the Eastern Caribbean.

Dominica is approximately 750 km^2 in area and is the largest of the English speaking islands in the Eastern Caribbean. The island's principal economic base is agriculture. However, given the difficulties of the banana industry, tourism is seen as a viable area for economic growth, and is rapidly emerging as one of the dominant sectors in the national economy.

Dominica's conservation efforts began as early as 1949 when Forestry and Wildlife Division, the island's primary resource management agency, was established as a unit within the Department of Agriculture. A few years later it became a separate department. Efforts for the development of Dominica's national park system began as far back as the 1960s. In 1975, the island established its first national park, Morne Trois Pitons National Park. The second unit, Cabrits National Park, located on the northwest coast, was established in 1986. The third, Morne Diablotin National Park, in the north central part of the island, was set side in 2000. These three national parks are managed under the legislative framework of the National Parks and Protected Areas Act (Chap. 42:02). Subsequently, various regulations have been enacted to support the parent Act.

Recognizing that Dominica is not the traditional "sun, sea and sand" destination, and that its real competitiveness lies in the diversity of its natural resources, the country took a conscious decision to promote nature-based tourism as its own special niche in the market place. Consequently, its approach to tourism is one geared at marketing and positioning the island as an ecotourism destination. Dominica's approach to ecotourism was born out of a tradition of strong conservation practices and the realities of a fragile environment base. Visitors have the opportunity to experience a wide range of land based activities associated with forest resources combined with the island's cultural heritage.

In June 1997, to help diversify the economy and to capitalize on increased visitor arrivals, Dominica implemented a system of fees for access to 11 selected ecotourism sites on the island. Major infrastructural investments were made at these sites, including the construction of visitor centers, and in some cases, washroom facilities. Fees are collected at the following sites, under Statutory Rules and Orders No.27 of 1997: Boeri Lake, Boiling Lake, Botanic Gardens, Cabrits National Park, Emerald Pool, Freshwater Lake, Indian River, Middleham Falls, Soufriere Sulphur Springs, Syndicate Nature Trail, and Trafalgar Falls. Seven of the 11 sites are located within established national parks.

The success of the tourism sector and ecotourism in Dominica depends on the extent to which residents in local communities are able to share the benefits. Today, many are benefiting either directly or indirectly in and around ecotourism sites. As of April 11, 2008, the island had 265 certified taxi operators, 215 certified tour guides, and 195 certified vendors, a large percentage of which to do business at tourism sites. National parks, in addition to tourism, contribute to domestic water supply and hydroelectric generation, which represents approximately 45% of the island's power supply.

DOMINICA'S NATURAL RESOURCE BASE

Mountains, forests, fresh water, and fauna make up Dominica's natural resource base. The following list of natural assets indicates why experienced travelers rate Dominica at the top of their list for sheer beauty and adventure.

Mountains

Major volcanic piles include: the Morne Diablotin (1447 m), Morne Trois Pitons (1424 m), Morne Watt (1225 m), Morne Macaque (1221 m), Les Resources (1156 m), Morne Anglais (1123 m), Morne Aux Diable (862 m), Morne Plat Pays (804 m), Morne Turner (714 m), and Morne Espagnol (365 m).

Forests

The forests of Dominica consist of the following major vegetation types: Dry scrub woodland, Littoral woodland, Seasonal forest, Tropical rain forest, Montane rain forest, and Elfin woodland. Other vegetation types include: Savannah, Fumarole vegetation, Wetlands, and Secondary rain forest. Approximately 155 families, 672 genera, and 1,226 species of vascular plants are found on the island. Currently, vegetation covers >60% of the island.

Freshwater Resources

The major water resources include:

- Lakes: Boeri (1.82 ha), Boiling (0.37 ha), Freshwater (3.64 ha), and Woodford Hill (0.88 ha).
- Rivers: Blanc, Castle Bruce, Hampstead, Indian, Layou, Melville Hall, Pagua, Rosalie, and Roseau.
- Waterfalls: Brandy, Bwa Nef, Emerald Pool, Fond England, Jack, Middleham, Penrice, Sari Sari, Victoria, and Trafalgar Falls,

Fauna

Dominica's fauna includes: 15 species of mammals; 179 species of birds, including two endemic parrots; 13 species of reptiles; 4 species of amphibians; 20 species of crabs; 55 species of butterflies; and 11 species of stick insects.

NATIONAL PARKS

The development of a National Parks System for Dominica was first proposed in the late 1960s when the Canadian Timber Company DOMCAN TIMBERS began logging and sawmilling operations on the island. In 1970, a United States based foundation recommended that about 7300 to 7700 ha should be established as a national park in the south-central part of the island.

Morne Trois Pitons National Park (MTPNP)

In 1975, the MTPNP was established through the National Parks and Protected Areas Act (Chapter 42:02 of the 1990 revised laws of Dominica). The Park covers an area of about 6880 ha, 380 ha of which were donated to Dominica through The Nature Conservancy by Mr. John D. Archibald, former owner of the Middleham Estate. Some features within the Park include lakes and waterfalls such as: Boiling Lake (largest boiling lake in the world), Boeri, Emerald Pool, Fond England, Freshwater, and Middleham lakes, and a large area of fumaroles called the Valley of Desolation. Major vegetation types include Rain forest, Montane rain forest, Palm brake, and Elfin woodland. There is also a laval tube commonly known as "Tou Santi." The park is the source of six major rivers and has an impressive trail network. In 1997, the MTPNP was enlisted as a World Heritage Site by the United Nations Educational Scientific and Cultural Organization (UNESCO). In August 1998, the Park was formally inscribed as a World Heritage Site, the first in the Eastern Caribbean.

Cabrits National Park (CNP)

Cabrits, Dominica's second National Park as of December 1986, covers an area of 532 ha, 81% of which is marine. The Park contains the remnants of Fort Shirley, an extensive 18th century garrison. In addition, Cabrits protects the island's largest tract of dry coastal forest as well as its largest wetland. Many migratory bird species visit the Cabrits wetlands during North American winters. Two of the more recent projects at Cabrits include the construction of the Cruise Ship Berth and the Visitor Center during the 1990s. Currently, restoration of the officer's quarters at Fort Shirley is underway.

Morne Diablotin National Park (MDNP)

Dominica's National Park System was expanded in January 2000 to include the MDNP, the first declared national park of the new millennium. MDNP covers an area of 3410 ha, which includes 3328 ha of the Northern Forest Reserve and the 82 ha of Parrot Preserve created from the former Dyer and Syndicate Estates. In addition, two parcels of land were acquired by the Rare Species Conservatory Foundation but have not formally been added to the park. Primary forest (i.e., mature tropical Rain forest, Montane rain forest, Montane thicket, and Elfin woodland) as well as secondary rain forest covers most of the park. The primary rain forest habitat of MDNP is believed to support the highest diversity of plant and animal life in Dominica and is the stronghold for Dominica's two endemic species of parrots, the Sisserou (*Amazona imperialis*) and the Jaco (*Amazona arausiaca*), both of which are endangered. MDNP also contains several species of endemic plants.

Elevations within MDNP vary between 213 and 1447 m. Rainfall is abundant and landslides occur because of steep terrain. The park contains 15 species of mammals, 51 species of birds, 9 species of reptiles, 2 species of amphibians, and 24 species of butterflies.

IMPORTANCE OF NATIONAL PARKS

The importance of National Parks to Dominica can be clearly seen in terms of several functions, including:

- Protection of biodiversity - Tropical rain forests provide a rich source of genetic material. Plants and animals are fully protected within the island's parks.
- Tourist attraction and development - Visitors wanting a wilderness experience find national parks and other natural areas as at-

tractive sites to visit. Nature tourism is expanding very rapidly and Dominica must take advantage of this growth.

- Watershed protection - Water is essential in quantity and in quality. Forest cover reduces erosion and increases the infiltration of water into the soil.
- Nature conservation - Forests protect wildlife.
- Environmental education and research- National Parks and protected areas are living laboratories where students can undertake studies of nature and tropical forest ecology, such as the ongoing parrot monitoring programme.
- Recreation - Parks provide opportunities for hikers, photographers, birdwatchers, and biologists, among others.
- Carbon sink - Forests have the capacity to help absorb carbon dioxide emissions.
- Economic value - Public and private sectors benefit from Dominica's national parks

In summary, national parks and ecotourism sites offer many benefits and have become a source of revenue for Dominica. Since June 1997, all non-residents require an entry ticket to access eco-tourism sites. The private sector generates revenue through the tours they offer in parks and other sites. Other beneficiaries include vendors, taxis and bus operators, artisans, and tour operators. Park ticket vendors receive 5% commission on their ticket sales.

PARK ADMINISTRATION AND MANAGEMENT

The administration, management, and control of the National Park System are vested in the Minister of Agriculture under the provision of Section 3 of the National Parks and Protected Areas Act. The Director of Forestry, Wildlife and Parks currently exercises administrative control over the other officers within the Parks Unit. In 1997, the National Park Unit was strengthened to facilitate the implementation of a use fee system.

Other sections within the division assist the National Parks Unit in the implementation of its programmes. The Forestry Wildlife and Parks Division regularly maintains trails and other infrastructure within the park and at ecotourism sites. However, the Ministry of Tourism maintains visitor facilities at Emerald Pool, Freshwater Lake, Middleham Falls, and Trafalgar Falls. Other sites have been ear-marked for development under the site development project. The island government is in the process of exploring management (e.g., community management) options for these sites.

MAIN ECOTOURISM ACTIVITIES ON DOMINICA

Bird Watching

Bird watchers find their way to the nature island to have a glimpse of the Sisserou Parrot, which is the largest species in the Amazona genus. The mere sighting of this bird is breath taking. Its close relative the Jaco Parrot is charming but less colourful. Tours are conducted to various habitats, preferably in early morning or late afternoon hours, to see select bird species.

Soft Adventure Tourism

Some adventure activities provided by Wacky Rollers and Cobra Tours are designed for physically fit tourists. The tours listed below allow for the discovery of virtually unknown places on the island, deservedly famous for being the greenest and wildest in the

Lesser Antilles:

- River hiking (i.e., descend river, includes walking, swimming, jumping, and sliding) at Belfast, River Blanc, and Titou.
- River rafting and tubing (i.e., descend river with special inflatable boats or tubes) at Layou, Pagua, and Roseau.
- Rowing wooden boats, particularly on the Indian River, where outboard motors are banned.

Hiking

This activity involves walking trails that vary in distance and degree of difficulty. Some of the more popular trails include Boeri Lake, Boiling Lake, Emerald Pool, Middleham Falls, Morne Diablotin, and Syndicate Nature Trail.

Sightseeing and Special Interest Tours

These activities involve traveling either across the country or to specific sites on mini-buses or coaches to enjoy scenery. Tours go to places such as the Carib Territory (i.e., Carib Indian Reservation), Emerald Pool, and Trafalgar Falls. Special interest tours are available for botanists, (e.g., floral exploration), ecologists, ornithologists, and other groups.

Other Activities

Scuba diving and snorkeling offers visitors opportunities to see underwater plants and animals just as diverse as the island's terrestrial component (e.g., the marine section of the Cabrits National Park). Horseback riding and all terrain vehicles are relatively new outdoor activities in Dominica and are restricted to private forests.

SOCIO-ECONOMIC IMPACT

The Dominican economy continuously benefits from >50 years of protecting its natural environment. To date approximately 20% of the island's land mass is under some form of legal protection which will help balance future human needs with resource conservation. There is a growing interest in nature conservation around the world and Dominica is no exception. Tourist arrivals on the island have shown a steady increase during the past 5 years, particularly within the cruise ship sector, where numbers have almost doubled since 2001 (Table 1).

Revenue generated from the collection of user fees at selected ecotourist sites has benefited both the state and private sector. The state collects a net revenue of just above $EC 1 million annually (Table 2) whereas commissions paid to vendors over the past 5 years average about $EC 53,000 (Table 3). The tourism sector continues to show a steady increase to the island's gross domestic product over the last five years (Table 4). Many individuals and private sector businesses also benefit from national parks and ecotourist sites either as vendors, tour guides, tour operators, or in other related services. For example, community groups have emerged within and around national parks such as Wammae L'etang to provide boat and kayak tours on Freshwater Lake.

The Cabrits National Park is a demonstration site for the Organization of Eastern Caribbean States (OECS) Protected Areas and Associated Livelihood Project (OPAAL Project). OPAAL recognizes that people are an essential part of ecosystems and must be accommodated in plans for biodiversity conservation. OPAAL, therefore, embraces human activity with protected areas and encourages opportunities for sustainable livelihoods.

Table 1. Tourist arrivals in Dominica.

Visitor Type	Year				
	2003	2004	2005	2006	2007
Cruise Ship	177,044	383,614	301,511	379,643	354,515
Stay Over	73,190	80,087	79, 257	84,041	----[1]
Excursion	3,928	2,577	650	926	----

[1]Data not yet available

Table 2. Net revenues from user fees.

Year (July-June)	Net revenue (EC$)
2002-2003	670,504
2003-2004	1,058,424
2004-2005	1,085,060

Table 3. Commission paid to user fee ticket vendors.

Year (July-June)	Net revenue (EC$)
2002-2003	35,003
2003-2004	55,549
2004-2005	56,549
2005-2006	56,808
2004-2007	61,664

Table 4. Contribution of key sectors to gross domestic product.[1]

	Year			
Sector	2003	2004	2005	2006
Agriculture	106.24	114.49	115.22	118.39
Tourism	15.06	17.66	18.81	21.63
Forestry	3.70	3.71	3.71	3.72

[1]In millions of EC $. Data for 2007 not yet available.

CONCLUSIONS

Dominica's conservation efforts through the Forestry, Wildlife and Parks Division have resulted in 20% of the island's land mass being protected as forest reserves and national parks. The island is now a major ecotourism destination in the Caribbean. Moreover, national parks and complimentary ecotourism sites have contributed to the social and economic well being of persons working in the tourism sector. Some have been certified as tour guides, taxi drivers, and vendors while others have found employment in related services. Finally, communities around these ecotourist sites may create employment opportunities that will lead to an improvement in their standard of living.

ACKNOWLEDGEMENT

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TOURISM AND SUSTAINABLE DEVELOPMENT IN FRENCH GUYANA

Jean Obstancias

GEOGRAPHICAL CONTEXT AND TOURIST ASSETS

French Guyana has belonged to France since 1663 and today it is an overseas department of France, or an overseas peripheral region of the European Community. Virtually all of French Guyana survives as a natural area, or pristine rain forest. The population density is very low with only 200,000 inhabitants living on 80,000 km^2 (2.5 inhabitants/km^2). During the past 10 years, the country's population doubled from 100,000 to 200,000 people.

Ecological and human diversity

French Guyana has an extraordinary natural and cultural wealth. The diverse flora includes sources of precious woods, perfume, biological medicines, and rain forest fruits. Moreover, many different communities exist within its boundaries: Amerindian (Wayanas, Wayampis, Kalinas, Palikurs, Emerillons), Creole, Bushinengue (maroon: Alukus, Djukas, and Saramakas), Europeans ("metropolitans"), Brazilian, Caribbean, H'mong (from the mountains of Indochina, Laos, and Vietnam), Chinese, and Libanese.

Unique Economic History

In the past, French Guyana suffered from a lack of workers. Indian populations had been decimated by new diseases and the number of slaves was insufficient for many economic activities. France tried to compensate for the lack of workers through the creation of large prisons (i.e., "bagnes de Cayenne, Kourou, and Saint Laurent) but that program never succeeded. About 30 years ago, the space industry provided new opportunities. Today, the country hosts a large military presence to protect the space facilities and to maintain order (e.g., eradicate illegal gold mining). The tourist industry benefits from the space museums, which attract many visitors, and from the political stability guaranteed by European support and a military presence.

ACTUAL TOURISM

The tourist industry currently cannot accommodate many visitors. Most of tourist sites are near waterways, some in deep rainforest. Comfortable hotels or lodges are lacking as is the capacity to host large groups. Sleeping in a in a shelter on a hammock, with a palm roof and no walls ("carbet"), is exotic but not conducive to stays of more than a night or two.

Image of Adventure

Guides lead groups deep within the forest along footpaths without signposts or interpretation. Visitors usually sleep in temporary shelters like hammocks under a tarpaulin. About 1000 visitors per year enjoy this type of experience. Most stay in the pirogues and see only butterflies and trees. Large animals, hunted by local folks, are absent in areas frequented by tourists.

"Affinity tourism"

About 90% of the visits to tourist sites in French Guyana are made by users visiting for business or familial affairs. Residents also frequent tourist sites with acquaintances during holidays or week ends.

Current Ecotourism

The current ecotourism program is characterized by good intentions but with bad habits and no control. Some poor practices relate to game hunting, observing sea turtles with dogs or cameras, and handling young crocodiles to show them to visitors. Guides do not have training or diplomas, and do not present background information regarding the environment and wildlife. Moreover, they do not provide a meaningful message regarding sustainable development. Lastly, security problems exist (e.g., equipment used by guides does not conform to legal standards).

Traditional communities are not yet ready and not willing to welcome visitors. Some lack the financial means to maintain infrastructure, even in large towns. Moreover, private enterprise is very limited. The state administration offers fiscal support but new laws and regulations are hard to implement.

FUTURE TOURISM

Future tourism calls for new networks of tourist facilities and new ways to maintain them.

Green Belts

The Littoral Conservatory, the French National Forest Service (ONF), and local communities are planning a network of sites near towns and villages to educate youth and the public about the environment and sustainable development. Until today, however, financial resources for their maintenance have been insufficient. Attempts are being made to create economic activity by contracting private operators to maintain sites that highlight natural or archaeological patrimony. At each site, "discovery paths" or short trails are planned. Booklets will explain and illustrate features of interest along the trails and guided or free tours will be available.

Maintaining forests in the landscape helps to promote tourist activities in populated areas. Unfortunately, urban and land developers view the forest as an unlimited resource that they can remove. Given that settlers ask for land to deforest and squatters don't, green belts are viewed as an alternative to help protect forests near towns. Private enterprise will be obligated to comply with environmental clauses and ONF will review and approve all contracts and agreements.

New Sustainable Tourism Products

Among the new sustainable tourism products are footpaths, canoe trips, and other types of trails. Two long distance footpaths were studied in eastern and western French Guyana near Cayenne and Saint Laurent. Two others, in the east and south, will be studied next soon. At each stop along the path, a "carbet," or an inn or lodge with beds and bathrooms will be managed by private operators. An organisation composed of private operators and a public institution will develop and maintain the footpaths. The organisation will derive income by selling the tourist package to travel agencies, and will maintain the paths and other common areas. It will also be in charge of logistical matters (i.e., movement of people and materials between accommodations), as well as cultural and environmental activities, including sports. The project has an economic base (e.g., an international market of trekking

like "Amazonian trek") and social and environmental certification. Paths are studied to determine plausible routes through forests yet avoid sensible areas. Guidebooks, short field tours, and cultural activities are proposed as part of the program.

A guidebook for canoeing down the Maroni River was recently prepared. This is the first of a proposed collection designed to discover the country's most attractive water ways. With this initiative, tourist operators can develop other products, including hiking, canoe travel, and ventures with a pirogue escort. Also planned are extended horse trails and mountain bike paths. Similar products could be prepared by any of the communes along the various routes in the forest.

LINKING CONSERVATION, TOURISM AND SUSTAINABLE DEVELOPMENT IN GUADELOUPE F.W.I.

Samuel Lardeux, René Dumont, and Fabien Chelles

INTRODUCTION

The Guadeloupe archipelago offers a variety of natural landscapes and ecosystems, including sandy beaches, cliffs, rain forest, coastal forest, lakes, wetlands, rivers, volcanoes, and stunning coral reefs. Timber production is not a goal for the island. The natural areas such as forests, however, are frequented by local people and also tourists from all over the world, each one seeking a specific goal such as rest, enjoying lunch, learning, and sports.

The main aim of this paper is to show how Guadeloupe's foresters are working in order to link conservation, tourism, and sustainable development. The first part presents the Guadeloupe archipelago with its assets and its weakness followed by two approaches:

- A global approach including all of Guadeloupe.
- A focal approach on a single site, the Petite-Terre Nature Reserve.

BACKGROUND INFORMATION

Archipelago of Guadeloupe

The archipelago of Guadeloupe is composed of six main islands: Basse-Terre and Grande-Terre, which are separated by a narrow salt river; Les Saintes, including Terre-de-Haut and Terre-de-Bas; and the islands Marie-Galante and Desirade. Guadeloupe occupies 1,700 km^2 and is inhabited by 447,000 persons, giving it a population density of about 258/km^2. Until 2006, Saint Barthélemy and part of Saint Martin were dependants of Guadeloupe. Today, they are French overseas territories that have no administrative relations with Guadeloupe.

Economic situation and tourism in Guadeloupe

The local economy is characterized by >27% unemployment and an unfavourable trade balance. Most of Guadeloupe's economy depends on agriculture, including banana and sugar cane production. Presently, the local economy is in crisis because these products are not competitive with produce from Africa and South America.

Tourism is virtually the only sector contributing to the economy. In 2007, about 1.2 million passengers from France and 140,000 foreigners went in Guadeloupe (INSEE, 2006). Eco-tourism or green tourism motivates many to spend holidays in Guadeloupe. Several natural sites are frequently visited throughout the year, including:

- Crayfish waterfall with >400,000 visitors per year.
- Carbet waterfalls.
- Soufrière mountain, the highest summit of the Lesser Antilles at 1467 m.
- Footpaths covering >300 km through different islands of the archipelago.

- New "green" activities such as canyon, trail, mountain bike, and cultural or historical footpaths with interpretative information.

Conservation tools for natural space management

Guadeloupe is a French department with all French and European experience needed to manage natural space. Managers must combine aims such as ecosystem conservation, tourism, and other land uses to establish different types of protection. The main local protected areas are:

- One of nine French National Parks, Guadalupe National Park was created in 1989. It is composed of a central zone of 17,300 ha with good protection and low human impact (i.e., II on IUCN protected area categories) and a peripheral zone of 16,200 ha with some inhabitants. The forests, ranging from dry to rain forest, contain 300 species of trees, 270 different ferns, and 100 species of orchids, and include several endemic plants and animals.
- Two Nature Reserves (i.e., II on IUCN protected area categories), including: (1) Grand Cul de Sac Marin Nature Reserve, created in 1987 and managed by National Parks, which covers 3706 ha and has a marine area of 2115 ha. Since 1993, this area has also been a Biosphere Reserve and a RAMSAR wetland; and (2) Petite-Terre Nature Reserve, created in 1998 and co-managed by the French National Forestry Service (ONF) and a local NGO Ti-té. The reserve covers 990 ha, including a marine area of 841 ha. Conservation, tourism, and sustainable development will be linked in this reserve.
- Most of the coastline in Guadaloupe is public space: (1) one-third is "Forêt Domaniale du Littoral" or littoral public forest, protected and managed by the National Forestry Office (ONF); and (2) one-third is non-wooded natural space, mainly beaches and grasslands, which are protected by law and managed by another French public organisation, the "Conservatoire du Littoral," or Littoral Conservatory.
- The main part of Guadeloupe wetlands are also public spaces, with >5000 ha of mangroves, saline swamp forest, and herbaceous ponds known as "Domaine Public Maritime and Lacustre." These areas are managed by Conservatoire du Littoral with help from the ONF and National Parks.
- Centre Basse-Terre with 27,754 ha is managed by the "Forêt Départementalo-Domaniale" which belongs to a Guadeloupe authority and the French State. The ONF and National Parks currently manage this area.

Guadeloupe also contains open spaces that are exposed to human activities, and experience a different level of nature protection and conservation. In all cases, within each part of the archipelago, land managers have to reconcile ecosystem conservation and tourism with socio-economic development.

GLOBAL STRATEGY LINKING CONSERVATION AND TOURISM AT THE ARCHIPELAGO SCALE

The ONF is one of the main actors developing and managing natural areas in Guadeloupe. To manage well, the characteristics of the areas and interests of the public must be known. In May 2006, two landscape architects working with the ONF carried out a 3-month study.

Study Goals

The manager's work is tempered by the diversity of natural areas in Guadeloupe, the complexity of their management, and public involvement. The principal aim of the study was to obtain a global vision of the managed natural areas so that the ONF could pursue a coherent management policy and harmonize the developments, especially with regard to parking areas and facilities. The study was divided into three phases:

- An inventory of the main natural areas of Guadeloupe (exhaustively for those managed by the ONF). An information sheet and photographs were completed for each site with data on the number of visits, parking areas, and furniture along with spatial information.
- Classification of each area into different site groups. Each natural group classification was described and explained for use by the public.
- Specific management actions were proposed according to site groups.

Results and Limitations

Eighty natural sites were inventoried and described, 71% of which are managed by the ONF and the remainder by National Parks and local authorities. Most are located on coastlines (i.e., 28% beaches, 23% coastal forests, 15% wetlands, and 10% cliffs). The others are in rain forest, frequently close to rivers. With regard to public visits, 73% of the sites were used for picnics, 70% for sunbathing, and 61% for walking. Sometimes visitors combined uses and certain sites were more frequently visited than others. Analyses were then conducted based on all parameters:

- Main use – bathing, walking (trails), discovery (vistas), aquatic sports.
- Location – rivers, beaches.
- Number of visits – low, medium, or high.
- Importance of forest cover.

Subsequently, 10 site classes were described- by combining parameters:

- Sport beaches (2 sites) – infrequently visited natural sites welcoming mainly kite-surfers.
- Popular urban beaches (14 sites) - beaches with a poor vegetation cover frequently visited for picnics and sunbathing.
- Popular beaches with vegetation (7 sites) - beaches highly frequented for picnicking and sunbathing, but the presence of vegetation (i.e., forest, swamp, mangrove).
- Secondary urban beaches (9 sites) - less frequented beaches with little vegetation.
- Wild beaches (9 sites) – less visited beaches with vegetation cover, used mainly by outdoor enthusiasts.
- Vistas (3 sites) – vistas, usually coastal and near roads or parking areas, but without picnic areas.
- Picnic and discovery areas (7 sites) - areas mainly for picnics (i.e., benches and tables) but also with vistas.
- Trailheads (11 sites) - areas with different types of trails (i.e., botany, discovery, sport loops, or walking).
- Trailhead and picnic areas (9 sites) – sites mainly for walking, resting, and picnicking.
- River bathing (9 sites) - river sites used for bathing and picnics.

Information was proposed for development, tourism, and conservation within each class of sites. These included suggestions for parking areas, site access, regeneration of vegetation, illumination, facilities for picnic and resting areas (benches, tables), waste disposal, diversification of activities, and handicap access. Several limits of the study were also listed:

- Results for the ONF managed sites were exhaustive but not for other areas. Unfortunately, the island of Desirade and the Saintes archipelago were not inventoried.
- Time was insufficient to analyse site visits quantitatively.
- Sociological aspects of users were not analysed (i.e., differences between local people and tourists).
- The inventory needs to be updated regularly.

Territorial Approach Optimal?

Is the territorial approach useful to optimise conservation, tourism, and sustainable development? A global vision of Guadeloupe's natural sites and their attributes allows the ONF to optimize its policy in terms of:

- Adapting equipment and materials to each site.
- Focusing visits on targeted sites to better conserve others.
- Improving the information and advice on landscape and environmental protection made available to visitors.
- Conserving the identity, or particular attributes, of each site.

Tourism

- Providing quality information and equipment in sufficient quantities.
- Linking natural sites with known attributes.
- Managing visitors reception and adapting equipment to the amount of use.

Sustainable development

- Controlling the level of visit use by infrastructure (i.e., size of parking areas and amount of equipment).
- Locating small restaurants and souvenir stores on targeted areas to foment employment.
- Improving systems (equipment and information).

PETITE TERRE NATURE RESERVE

The Petite Terre Nature Reserve, one of the most famous tourist destinations in the archipelago, is one of the few protected areas where site analyses were finished. For European tourists, Petite-Terre is a perfect "picture" of the Caribbean: an unoccupied island with sunny weather all year, large sandy beaches, a clear water lagoon, underwater wildlife, and easily photographed iguanas.

Brief History

The Nature reserve area is composed of two small islands, Terre-de-Bas and Terre-de-Haut together occupying 170 ha, and a surrounding marine zone of 830 ha. The reserve lies off of the eastern coast of Guadeloupe and is managed from Desirade. From 1750 to 1850, Europeans occupied Petite-Terre where they built houses and harvested cotton. Guadeloupe's first lighthouse was built on Terre

de Bas in 1840 when the island had 28 people. In 1972, the last inhabitants of the island, the lighthouse guardian and his wife, departed. In 1990, the Littoral Conservatory bought the islands and in 1998 the Nature Reserve was created. Today, a local NGO Ti-tè and the ONF co-manage the reserve.

Reasons for the Nature Reserve

These two islands, distant from the coastline of Guadeloupe, are naturally protected from human activities and contain many different ecosystems within a small area, including sandy beaches, salt ponds and a lagoon, beach-rocks, dry forest, and coral reefs. Visiting scientists have observed numerous important species such as:

- Sponges, gorgonians, corals, molluscs, sea urchins, and shell fish.
- Sea turtles (*Chelonia mydas*, *Eretmochelys imbricata*, and *Dermochelys coracea*).
- Marine mammals (*Megaptera novaeanglica* and *Tursiops truncatus*).
- 135 bird species, including and 28 shorebirds and 28 terrestrial migratory birds, and *Sterna antillarum*, *Dendroica petechia*, and *Phaeton aethereus*.
- The most important population of *Iguana delicatissima*, about 8000 individuals, in the Caribbean.
- Animals such as *Hémidactyle mabouia* and *Scinque mabouya*.
- *Guaïacum officinale*, a rare tree in Guadeloupe.

Linking conservation and socio-economic aspects

Before the creation of the nature reserve, the most important visits to the islands were made by tour operators on pleasure cruises. Many problems arose: (1) boat anchors damaged the lagoon bottom; (2) visitors cut wood cut for barbecues; (3) visitors wandered around without interpretative materials; (4) inadequate structures were built on the beach; and (5) wastes were left at the site. Conflicts arose among stakeholders. Management began after creation of the Nature Reserve in 1998 with a manager from the ONF and 3 wardens belonging Ti-tè. Different equipment, facilities, and structures were acquired or built:

- Six yellow buoys to demarcate the nature reserve boundary.
- Five moorings for visiting professionals and 10 moorings for tourists.
- An office, storage room, tables, barbecues, a wooden house for wardens, and an exhibition room in the lighthouse.
- A foot path on Terre de Bas with interpretative information.
- A 7-m patrol boat and a small motor boat.

Today, nothing can be removed from any part of the reserve and tourists may not visit Terre de Haut. Research and tourism may occur elsewhere but activities are designed to minimise human impact on wildlife. Ten companies, with all or part of their activities on Petite Terre, provide 15 direct jobs. In 2007, about 40,000 people visited the reserve. About 20% of them came from Guadeloupe

or other Caribbean islands and arrived in their own boats. The remaining 80% visited with commercial tour operators. Restrictions exist to protect the reserve (e.g., day charters are limited to 50 visitors, with no more than 200 per day for the entire reserve). Each visitor is charged a tax.

Several important fishermen communities are working around the reserve, Desirade being the most important. Also, scientists from universities and other institutions conduct studies in the reserve. A balance exists among several uses -- nature protection, scientific activities, tourism, and local interests. The nature reserve team must continue to interact with stakeholders and adopt a management program encouraging sustainable development. Local and national TV reports, publications, and radio broadcasts provide positive feedback regarding the reserve.

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SUSTAINABLE FOREST MANAGEMENT IN GUYANA

Jagdesh Singh

BACKGROUND

Guyana, a country of exceptional natural beauty, is a splendid combination of the Caribbean and South America. The country has a population of about 700,000 and a land area of 216,000 km^2. Guyana has six major groups of people: the Amerindians (Guyana's first group of people), East Indians, Africans, Europeans, Portuguese, and Chinese.

The nation's capital and primary port is Georgetown. Guyana was first a Dutch colony and later a British colony. It gained its independence on May 26, 1966 and became a republic on February 23, 1970. Guyana consists of three major counties -- Essequibo, Demerara, and Berbice.

GUYANA'S FORESTS

Guyana is situated on the northern coast of South America and is considered an integral part of the Guiana Shield (Figures 1 and 2). Due to its proximity to the Amazon Basin, about 76% of Guyana (i.e., 163,777 km2) is still covered with tropical forests. Guyana's forested area is composed of a blend of seasonal, dry evergreen, montane, swamp, marsh, mangrove, and mixed forests. The forests contain approximately 8000 plant species and >1000 species of terrestrial vertebrates.

The forest resources of Guyana are used for multiple purposes, including the forest produce, agriculture, research, eco-tourism, protected areas, biodiversity reserves, and Am-

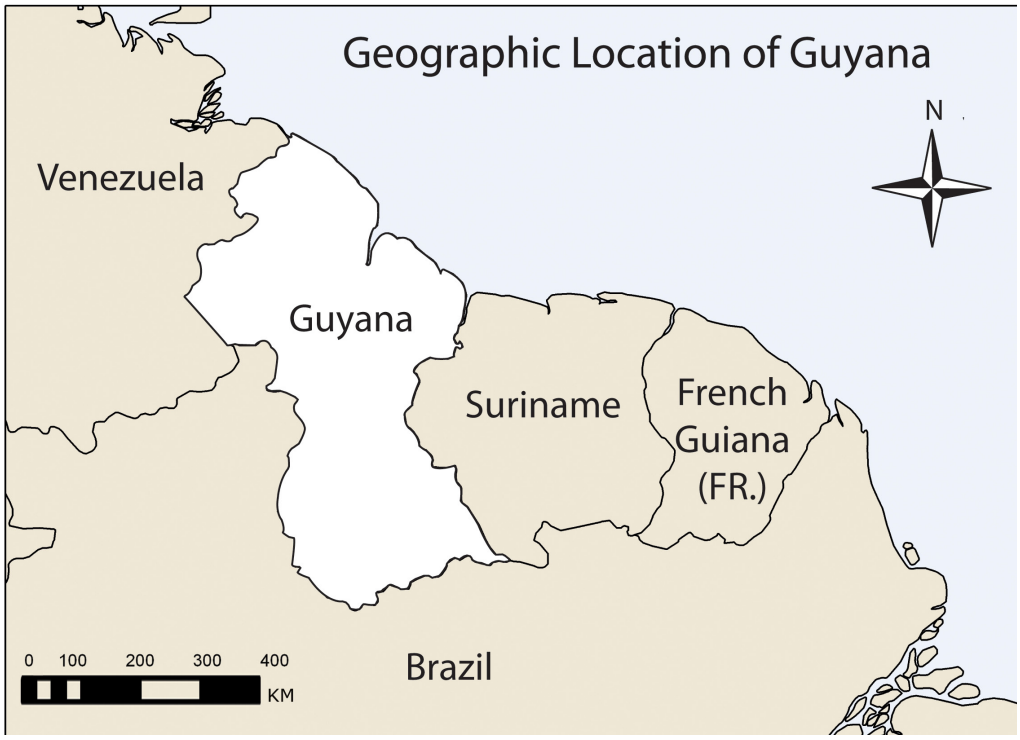

Figure 1. Geographic location of Guyana

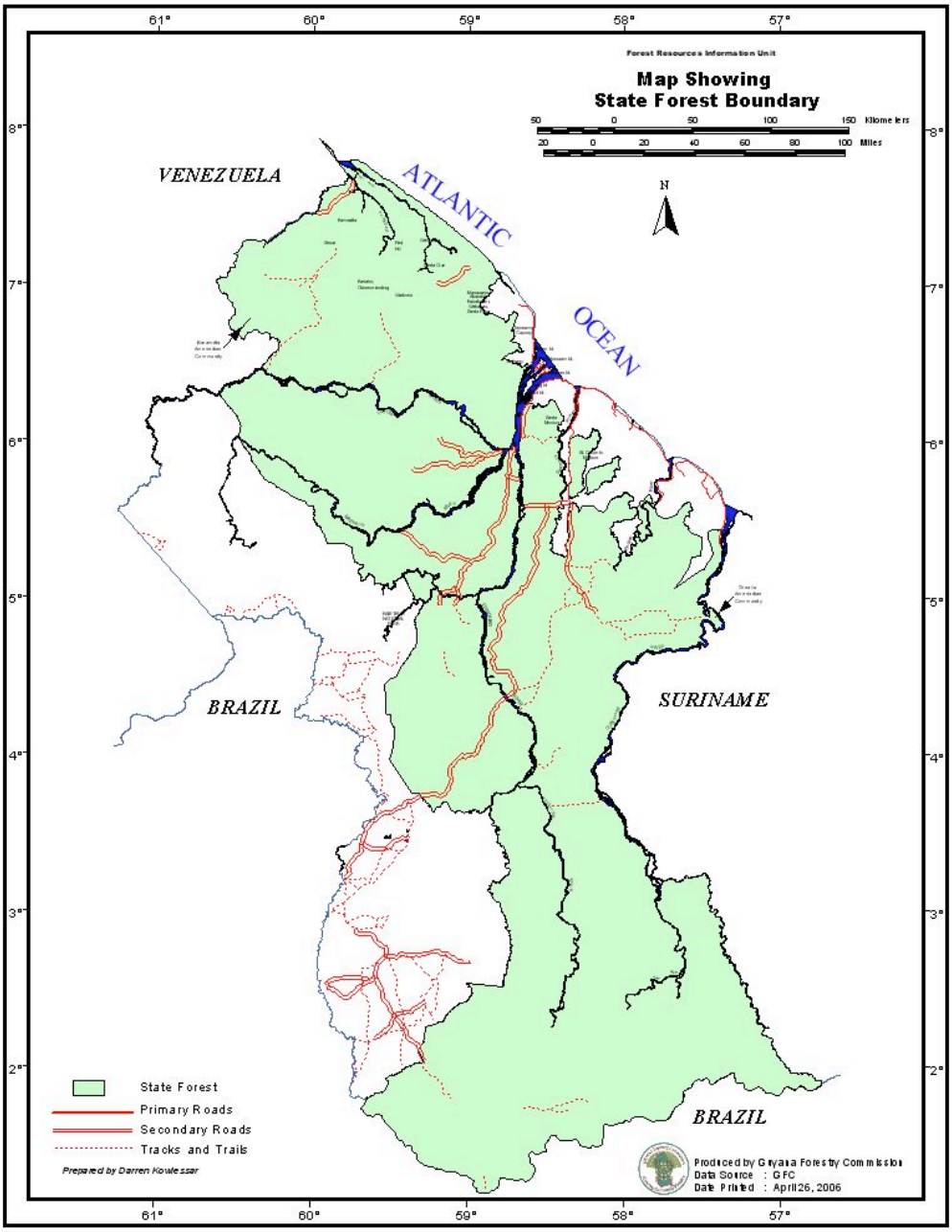

Figure 2. State forest boundary and transportation in Guyana

erindian reservations. Forests are an integral part of Amerindian culture, and communities make use of forest resources as a source of food, building materials, fibers for textiles and weaving, medicine, tanning, and dyes. Several communities are involved in commercial harvesting and utilization of forest resources.

Guyana Forestry Commission (GFC)

The management of Guyana's rainforest comes under the jurisdiction of the GFC. Formed in 1979, the GFC is a semi-autonomous organization that is governed by the Forestry Act of Guyana and guided by National Forest Policy. The GFC is governed by a Board of Directors appointed by the Minister and has responsibility for the forestry sector. The GFC is headed by the Commissioner of Forests who is the Chief Executive Officer. The Commissioner, an ex-officio member of the board, is responsible for the daily management of the Commission.

The GFC consists of five divisions and an internal audit unit which allows it to execute its mandate. The divisions are: (1) Planning and Development Division; (2) Forest Resources Management Division; (3) Forest Monitioring Division; (4) Finance Division; and (5) Human Resources and Administration Division.

National Forest Policy

The National Forest Policy was approved in 1997 and mandates the Commission to emphasize the importance of multiple uses in Guyana's immense forest; moreover, it must also focus on forest product diversification and value-added processes to promote a vibrant industry. The stated objective of national forest policy is "the conservation, protection, management and utilization of the nation's forest resources, while ensuring that the productive capacity of the forests for both goods and services is maintained or enhanced." A national forest plan and new forest legislation were also developed outlining programmes necessary for the achievement of the national forest policy. The process of approving legislation in Parliament, however, is very tedious.

Timber Harvesting and the Code of Practice for Timber Harvesting.

The Amerindians and Dutch have been harvesting timber in Guyana for many years. Selective, low intensity logging has been the traditional approach used to extract commercial species above a specific diameter. A draft Code of Practice (CoP) for forest operations was developed by the Commission to guide concession operators during logging activities. The CoP is currently voluntary; however, the commission will be in a better position to monitor forest resources once the new draft forestry act is approved by the government.

GFC's Forest Monitoring Division monitors harvesting practices through regular field visits. In addition, 30 forest stations located strategically around Guyana monitor forest concessions, sawmills, and lumber yards. One major system of forest monitoring is log tagging where tags are issued to concessionaires based on quotas for each forest concession. Three types of forest concessions are allocated based on size of areas and duration:

- Timber sales agreements (TSA) – granted for up to 25 years for areas >24,000 ha.
- Wood cutting leases – granted for up to 10 years for 8000 to 24,000 ha.
- State forest permissions – granted for 2 year periods on ≤8000 ha.

Training

Formal training in forestry for diploma, certificate, and BSc. and MSc. levels is offered by the University of Guyana and the Guyana School of Agriculture. The certificate in Forestry provides practical forestry skills for industry in areas such as tree identification and timber grading. The GFC has a memorandum of understanding with University of Guyana, Forestry Department. Curriculum development, staff training, and increased field exposure for students have benefited the Forestry Department. GFC also provides in-house training for its staff on technical issues, and also provide the staff with opportunities for training overseas when available.

The Forestry Training Centre Incorporated (FTCI) results from a partnership between the GFC and the Forest Products Association of Guyana and the Tropical Forest Foundation (Virginia, USA) with funding from International Tropical Timber Organization (ITTO) and the Department of International Development in England. The FTCI was established to implement a reduced impact logging programme focusing on demonstration and training during timber harvesting operations in Guyana and the region.

Research and Conservation Programmes in Guyana

The GFC works in close collaboration with other research programmes in Guyana:

Iwokrama -- The Iwokrama International Centre for Rain Forest Conservation and Development is an autonomous non-profit institution established by Guyana and the Commonwealth. The Centre manages the 371,000 ha Iwokrama Forest in central Guyana. The purpose is to demonstrate tropical forest conservation and sustainable use by providing ecological, social, and economic benefits to local, national, and international communities.

Tropenbos International (TBI) – TBI is a non-governmental organization based in the Netherlands. TBI facilitates the formulation and organization of participatory, objective-oriented, multidisciplinary research and development programmes to meet the needs of policy makers and forest users. The Tropenbos-Guyana Programme was established in 1989 to continue collaboration between the University of Guyana and the Utrecht University. Its objectives were to develop guidelines for conservation and sustainable utilization of Guyana's forests for timber, other forest products, and services, and also to strengthen research capacity in Guyana. The programme ended in 2001 when TPG formally handed over all assets to the Guyana Forestry Commission, which in turn, established a Research Unit within the GFC to promote forestry research Guyana.

Conservation International Guyana Foundation (CIG) – CIG, active as early as 1990, was officially established in Guyana in 1996. CIG was allocated a TSA of 80,000 ha of State Forest for 25 years in 2002 (Figure 3). No logging will be carried out on this concession; however, the GFC will be compensated based on a timber concession valuation. CIG is also very active in projects located in the Kanuku Mountains, and in the Koashen District with the WaiWais.

Kanuku Mountains - CIG is the lead agency for the Kanuku Mountains Protected Areas project and has been working for the last 5 years with 18 Amerindian communities which will benefit from the establishment of the Kanuku Mountains as a protected area. The Kanuku Mountains, located in the Rupununi Savannahs, are believed to be one of the

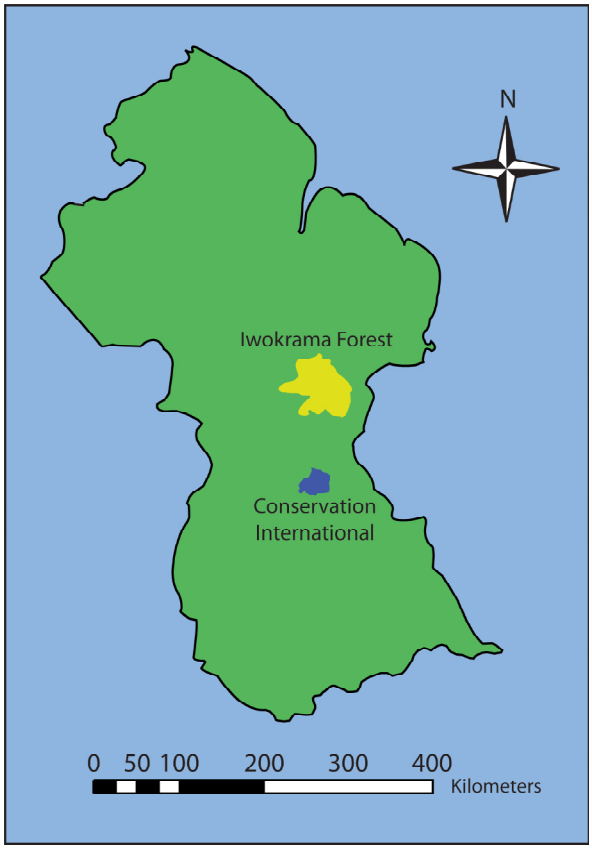

Figure 3. Iwokrama Forest and Conservation International in Central Guyana.

most biologically diverse regions in Guyana. This area includes savannahs, as well as gallery, lowland, and montane evergreen forests. The area has about 350 species of birds, one-half of the species found in Guyana. Threatened animals of the Kanukus include the harpy eagle, the giant river otter, the black caiman, and the jaguar.

Koashen District - the Koashen District lies in the southern most part of Guyana and is owned by the Wai Wais Amerindian tribe of Guyana through an absolute grant by the Government of Guyana. The Wai Wais requested that CIG work with them to help protect their lands and to have them established as a community owned conservation area to be included in the National System of Protected Areas. The area contains >600,000 ha of pristine rainforest with spectacular biodiversity and the Wai Wais are afraid that outside threats may put their lands at risk. CIG is currently working with the Wai Wais to develop a management plan for the area, with the long-term goal of having it included to the National System of Protected Areas.

GFC Reserves and Pilot Plantation Sites

Forest concession holders are required to set aside 4.5% of their concessions as biodiversity reserve. The GFC also has 10 forest reserves where various types of research were conducted. At seven of these sites, attempts were made to establish *Pinus caribaea*, and to a lesser extent, *Acacia mangium* (Figure 4). In 2005, the GFC established enrichment plots and three research plots with indigenous trees species. Currently, information is being collected on survival rates, and diameter and height growth for future use.

Forest Certification

The Certification process in Guyana began in 2000 with technical support of United Nations Development Programme for Forests (PROFOR). An interim working group representing stakeholders from social, environmental, economic, and institutional interests was formed to select a certification option for Guyana. In 2001, the working group voted to start the development of a national standard based on the FSC principles and criteria. To date only one large TSA is certified. Other companies are rapidly working towards certification.

Forestry and Social Development

In 2000, the GFC reaffirmed its commitment to social forestry issues by launching a Social Development Programme. This programme has an overall objective to "contribute to the effective realization of social re-

sponsibilities, satisfaction of social needs and attainment of social benefits by the stakeholders of the forestry sector."

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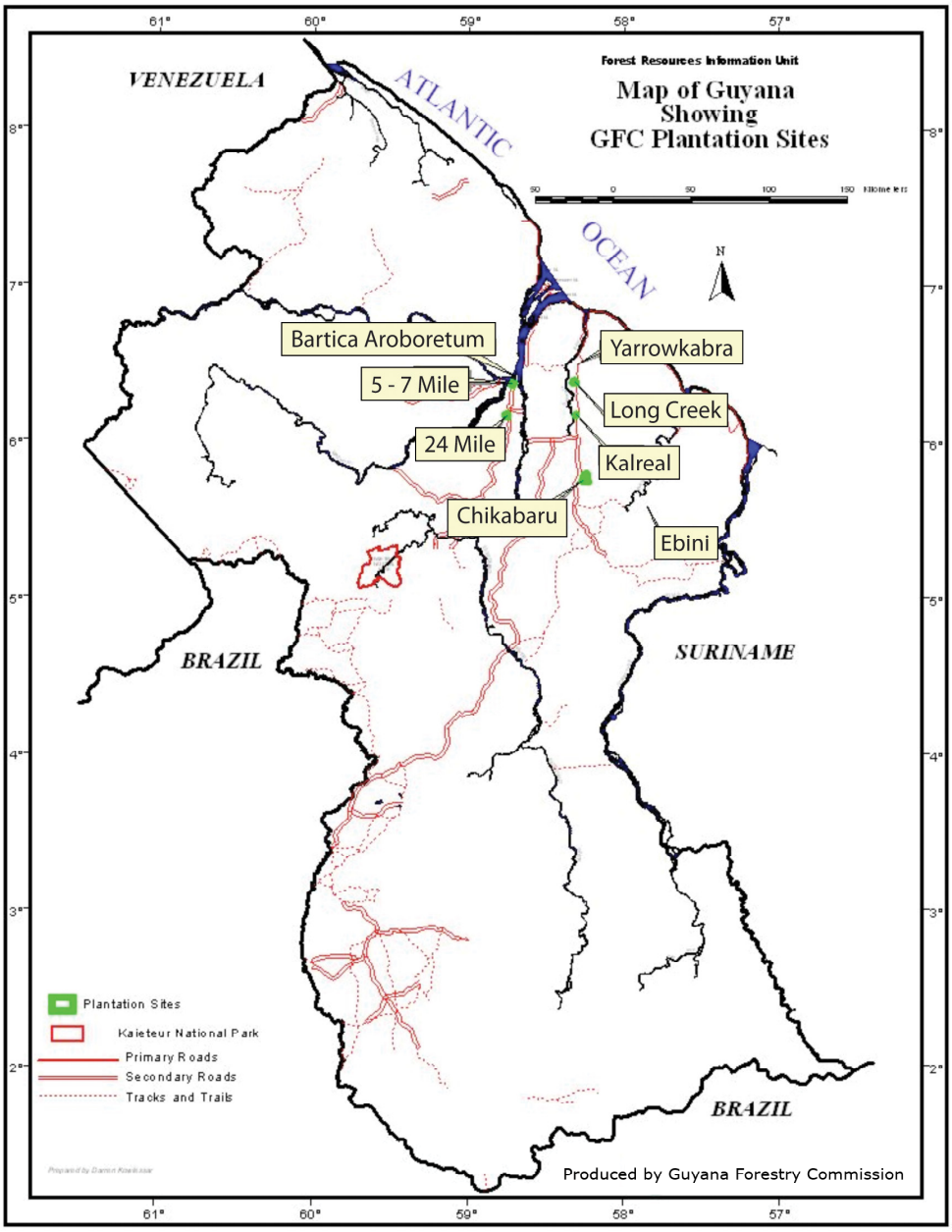

Figure 4. Government Forestry Commission plantation sites in Guyana.

LINKING CONSERVATION, TOURISM AND SUSTAINABLE DEVELOPMENT IN THE CARIBEBAN – JAMAICA

Glen R. Ivey and Ainsworth D. Grant

INTRODUCTION

Jamaica is an island nation of the Greater Antilles, 240 km in length and as much as 85 km in width, situated in the Caribbean Sea. It is 635 km east of the Central American mainland, 150 km south of Cuba, and 180 km west of the island of Hispaniola. It is the third largest Caribbean Island and the fourth largest Caribbean country. Highlands occupy the interior and a narrow coastal plain, where most major towns are located, surrounds the island. The chief towns include the capital city Kingston, Spanish Town, Mandeville, Ocho Rios, Port Antonio, and Montego Bay.

Jamaica's climate is tropical, with hot and humid weather, although inland regions have more temperate conditions. Some regions on the south coast, such as the Liguanea Plain and the Pedro Plains, are relatively dry rain-shadow areas. Jamaica's geographic location, climate, and topography, make the island a major tourist destination. The government and the Forestry Department have implemented strategies to encourage the participation of all stakeholders in the conservation and sustainable development of the environment, including environmental groups, local forest management committees, and non-governmental organizations (NGOs).

Bauxite, followed by tourism and agriculture, are Jamaica's chief foreign exchange earners. A recent study of land use in Jamaica showed that nearly one-third (336,000 ha) of the island's 1.08 million ha of land area is in forest cover (Figure 1).

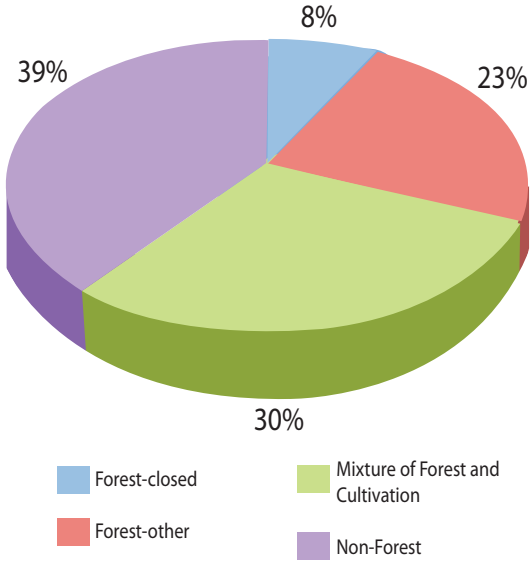

Figure 1. Forest cover in Jamaica, 1999.

FORESTRY DEPARTMENT GOALS

The functions of the Forestry Department are mandated by the Forest Act of 1996 and focus on managing Jamaica's forests on a sustainable basis to maintain and increase their environmental benefits and services (Figure 2). The goals of the forestry sector address four broad values to society: environment; national wealth and rural development; energy; and, recreation and tourism. Some of the essential functions include:

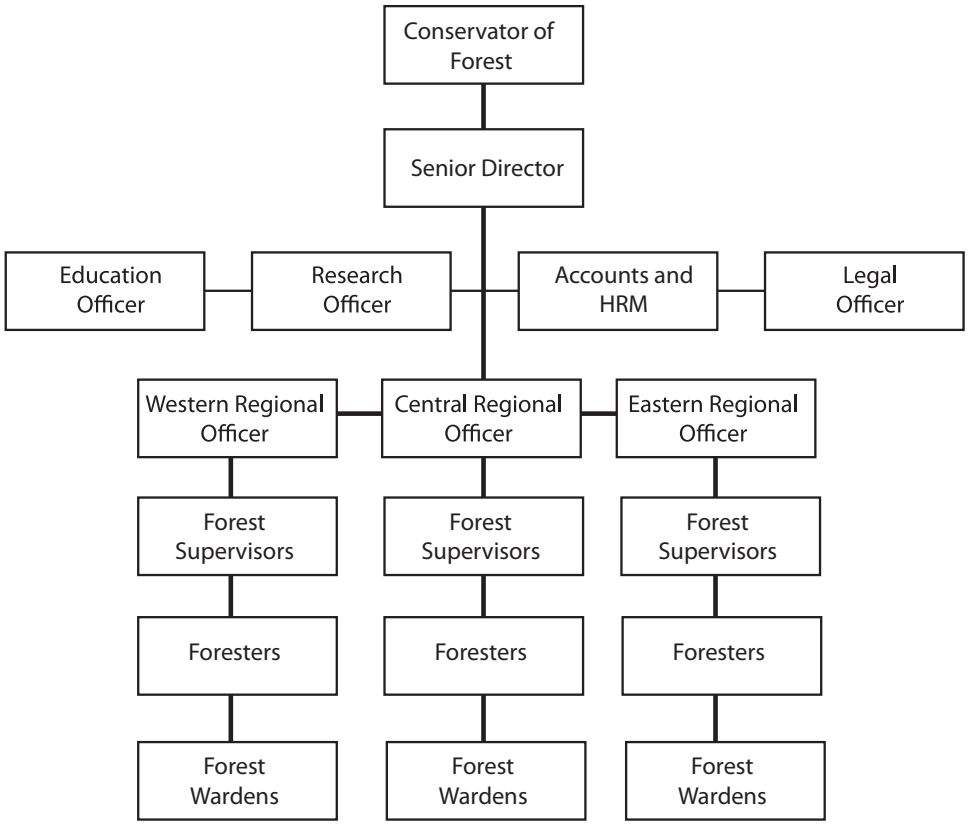

Figure 2. The Forest Department in Jamaica.

- Sustainable management and effective conservation of forests on Crown lands and forest reserves.
- Controlling the harvesting of forest resources through the establishment of adequate systems for the renewal of those resources.
- Controlling and supervising the cutting, harvesting, milling, and sale of timber and other forest products.
- Granting licenses and permits described under the Forest Act.
- Enforcing compliance with the provisions of the Forest Act.
- Promoting the development of forests on private lands.
- Establishing and maintaining a forest research programme.
- Promoting agroforestry and social forestry programmes for the benefit of farmers, schools, and other interested individuals and groups.
- Developing and promoting public education programmes to increase awareness of the contribution of forests to the well-being and development of the nation.

Forest Awareness Programme

The purposes of the Forest Awareness programme are to gain support from the public, to inform stakeholders regarding the sustainable management of forests in upper watersheds, and to improve the image and visibility of the Forestry Department. The programme works closely with other organisations involved in environmental awareness. Activities undertaken by the programme include:

- Annual school competitions and the annual production of calendars.
- Presentations to schools, service clubs, and summer camps.
- Setting up information centres at agricultural shows.
- Regular media submissions on forest-related topics.
- Development and production of forestry educational resources.
- Production of the community drama "Magic Trees."
- Development of the Forestry Department web site.
- Production of a video for children called "You are tree."

Other activities underway include the production of a series of 3-minute videos based on a "forest heroes" theme and the production of a dendrology manual for the trees of Jamaica.

Forest Land Use Data Bank

A forest resources data bank has been designed and is being implemented. A Geographic Information System (GIS) Unit has been established in the Forestry Depart ment with trained personnel and the required equipment. Information is readily available and is being provided to outside users, in cluding government agencies, NGOs, consultants, research institutions, and students. The success of the GIS Unit was internationally recognised when the Forestry Department was presented with a "Special Achievement in GIS" award at the Environmental Systems Research Institute's 20th annual conference held in California in 2000.

Collection and Analysis of Forest Resource Information

This activity is intended to provide the Forest Department with the capacity to continue a periodic forest inventory and to provide the forest land use and inventory information required for national and local forest management plans. Outputs include:

- Black and white aerial photography of the island (1:40,000).
- One nation-wide biophysical forest inventory (1:100,000).
- A detailed forest inventory of selected forest reserves (1:15,000).
- Forest Department personnel trained in image interpretation and sampling procedures.
- Technical manuals on procedures.

The biophysical inventory and mapping of the Buff Bay-Pencar Watershed Management Unit (WMU) has been completed. The inventories of the Rio Minho WMU and Dolphin Head Mountain, which has been proposed for a national park, are also completed. Work has also begun for areas in the cockpit country.

Reforestation Programme

The purpose of the reforestation programme is to promote tree planting initiatives and to develop the capacity to produce, distribute, and successfully plant tree seedlings. The main achievements reported under this activity are:

- Upgrading the Mt. Airy, Williamsfield, and Moneague nurseries.
- Restoration of the mango germplasm bank at Orange River Experimental Station.
- Establishment of a germplasm bank at Hope Gardens in collaboration with the National Arboretum Foundation and the Environment Foundation of Jamaica.
- Preparation of a Five-Year National Reforestation Plan.

The production and distribution of seedlings as well as the provision of technical assistance to tree growers is one of the key functions of the Forest Department and an activity that is crucial to watershed protection and management.

Local Forest Management Plans

The purpose of management plans is to promote sustainable management of forests on Crown land and in forest reserves, to provide for the effective conservation of forests, and to develop and protect forests on private land. This is to be achieved through the development of:

- A participatory methodology for planning forestry and other land uses.
- A plan of action for land use, forest management, rehabilitation of critical areas, and soil and water conservation in the selected pilot area of Buff Bay-Pencar WMU.
- A monitoring system designed to meet the needs of watershed management.

Two Local Forest Management Committees (LFMC) were convened, one for the Buff Bay sub-watershed and another for the Pencar sub-watershed. Membership in the committees was drawn from government agencies and organisations, NGOs, and the private sector. Both committees held several meetings as well as elections, and they ratified their constitutions. The process to convene the LFMCs involved discussions with other parish and national level agencies working with the local government. Moreover, a draft Local Forest Management Plan (LFMP) for Buff Bay-Pencar WMU was prepared and is ready for review. The process to consolidate the LFMP will include a series of meetings in the watershed to inform and receive input from the general public on the draft local plan. A participatory monitoring system still needs to be developed. Feedback will be required to guide the actions in the pilot area and in other areas where the Forestry Department intends to replicate the model (e.g., the next LFMP is scheduled for the Rio Minho WMU).

Forestry Extension

The development and implementation of technological packages are essential for the management of the watershed by its inhabitants. These packages must be compatible with traditional land uses, human needs, biological limitations, and economic constraints in the market place. The Forest Department's extension programme is now well developed in the Buff Bay-Pencar WMU and is being set up in the Rio Minho watershed. Activities to date include:

- Agroforestry and forestry extension programs that have reached schools, NGOs, and individual farmers.

- Organization of eight demonstration farms.
- Involvement of four schools in agroforestry demonstration plots and activities.
- Training sessions reaching 157 farmers and 7 schools.
- Distribution of >32,000 seedlings to >100 farmers.
- Establishment of 20 m of live fences and 9 m of windbreaks.
- Preparation and printing of the extension procedures manual.

The extension programme works closely and in collaboration with other institutions such as the Jamaica Agricultural Society, the Rural Agricultural Development Authority, the Coffee Industries Board, and local NGOs.

WATERSHED MANAGEMENT IN JAMAICA

Since the 1980s, greater emphasis has been placed at the international level on utilising an integrated approach, which combines soil conservation and rural development elements with strategies to improve conditions for the land and people. A number of proposals to implement environmental protection have come from various United Nations initiatives.

Jamaica's awareness of the need for soil conservation and watershed protection dates as far back as the 1930s. In 1945, an economic policy committee report noted that steps must be taken to combat widespread watershed degradation. During the past three decades, Jamaica has had one of the highest rates of deforestation in the world, resulting in serious problems of soil erosion and loss of biodiversity. The management crisis pointed to a need for a new approach, especially government-led initiatives such as the preparation of a new watershed policy -- the 2001 Policy and Legislative Framework for Watershed Management in Jamaica. This plan divides the island into 26 WMUs and includes >100 streams and rivers. These WMUs are essentially watershed composites which fall within 10 regions.

CONSERVATION, TOURISM AND SUSTAINABLE DEVELOPMENT IN MONTSERRAT

Lloyd Martin

INTRODUCTION

Several elements link conservation and tourism to sustainable development in Montserrat, including: protected areas, new legislation, economic evaluation, tourism, hiking, bird watching, diving, volcano viewing, monitoring, research, species action planning, and mining of volcanic products. Terrestrial natural resource management, and in particular biodiversity conservation, are the responsibility of Montserrat's Department of the Environment (DOE).

PROTECTED AREAS

Protected areas on Montserrat help conserve the island's biodiversity, watersheds, and tourism.

Centre Hills

As a result of volcanic activity starting in the late 1990's, about 60% of Montserrat's forest ecosystems were destroyed. The Centre Hills contain the largest remaining intact forest on Montserrat. The Centre Hills forest provides a number of important environmental goods and services to the island's people. The Hills also provide habitat for three endemic and potentially endangered species: the Montserrat oriole, the national bird; the Montserrat galliwasp, a lizard; and, the Montserrat orchid.

Pipers Pond Wetland

Pipers Pond is the largest wetland remaining on Montserrat. It provides habitat for a large number of bird species, including waders, waterfowl, and North American migrants. It also harbors a number of species of fish and marine crustaceans.

NEW LEGISLATION

Existing laws pertaining to the management of the Centre Hills were revised and updated through the Centre Hills project, which is now called C.E.M.A (Conservation and Environmental Management Act 2008). This act will improve species protection in and around the Centre Hills. The Act also allows for setting aside other protected areas and strengthens regulations so that the act can be updated when necessary.

ECONOMIC EVALUATION

An economic evaluation was completed under Montserrat's Centre Hills Project to assign a monetary value to natural resources and ecological services that the Centre Hills provide. This was done through a survey using questionnaires that targeted people living in different parts of Montserrat. Focus groups were also used as a tool to capture input from people directly involved with the management of Centre Hills.

TOURISM

Tourism in Montserrat is focussed on nature. A number of sustainable activities are available for visitors to the island.

Hiking

There are 14 hiking trails on Montserat, 12 in Centre Hills Protected Area, some of which are frequented by visitors. Trail usage is monitored on some trails using automated data loggers. The information is used for planning and management. Exit surveys at the airport show that 57% of the visitors hike on these trails. Montserrat's main tour guides are provided by the DOE staff.

Bird watching

Some visitors come to Montserrat mainly for bird watching. Typically they look for rare or endemic species such as the Montserrat Oriole, the Forest Thrush, and the Bridled Quail Dove.

Diving

There are two main dive operators on Montserrat that attract numerous visitors. They conduct boat tours to view the island from the sea, including the volcano. These operators also run diving courses and host excursions to coral reefs.

Volcano Viewing

After several relocations, a state-of-the-art building was constructed to monitor ongoing volcanic activity. The new building houses the latest instruments to monitor volcanic activity on a 24-hour basis. Visitors are permitted to tour the building, which showcases Montserrat's volcanic experience. When volcanic activity is low, taxi tours allow visitors to see the volcano and its remnants from closer viewpoints.

RESEARCH

Research has played a big part in Montserrat since volcanic eruptions began in July 1995. Much of this research has involved DOE partnering with overseas research and conservation agencies, including the Royal Society for the Protection of Birds, the Durrell Wildlife Conservation Trust, and the Royal Botanic Gardens at Kew. Continuous monitoring of the frog known locally as the Mountain chicken, the Montserrat Oriole, and 40 other species of forest birds, began in the late 1990s.

Species Action Planning

In October 2007, after years of monitoring and the preparation of a biodiversity assessment, species action plans were initiated. Five endemic and endangered species were included: the Mountain chicken, Montserrat galliwasp, two endemic plants (an orchid and a shrub), and the Yellow-shouldered volcano bat. The species action plan for the Mountain chicken has been completed and the one for the Montserrat galliwasp is in progress. The project ends in 2009 by which time all plans will have been successfully completed.

National Biodiversity Database

DOE and the Physical Planning Unit are constructing a database to store past and future biodiversity monitoring data. The final product will be accessible through ArcView GIS and improve information flow and outputs between local ministries and a wide range of users.

MINING VOLCANIC PRODUCTS

Although the volcano did tremendous damage to the island, it also produced valuable ash and lahars (mud flows). Six operators have been mining these volcanic products for about 4 years. They are used locally for making concrete blocks and construction activities, and are also exported within the region.

CONSERVATION, TOURISM AND SUSTAINABLE DEVELOPMENT ACROSS THE CARIBBEAN: COUNTRY REPORT – SAINT LUCIA

Michael Bobb

INTRODUCTION

Conservation, as defined and advocated, is an indispensable requirement for development that is equitable, sustainable, and harmonious. Natural and cultural resources are the capital upon which a country's development can be built, and this is particularly true in the context of Saint Lucia and the Caribbean where economies are largely based on the use of natural resources. Maintenance and enhancement of that capital -- soils, forests, landscapes, water, and culture -- are indispensable if development is to be achieved and sustained.

This responsibility for conservation belongs to the present generation, which aspires to a higher quality of life and seeks to meet needs beginning with such essentials as food, shelter, health, and education. The conservation of a country's biodiversity and cultural heritage must be the cornerstone of its development strategy, because conservation aims to maintain and sustain the delivery of essential goods and services. Saint Lucia, as a developing island, is faced with a number of environmental issues which are exacerbated in a rapidly evolving world. The economic challenges of shifting from agriculture to tourism require infrastructural development and significantly impact coastal resources. Factors of size, openness, fragility, and interrelatedness all combine to threaten a scarce and impoverished resource base. Moreover, they undermine a vulnerable cultural foundation and maintain the dependent nature of an economy, which was built to serve distant fluctuating interests.

COUNTRY BACKGROUND

Saint Lucia, a small tropical developing state, is the second largest of the Windward Islands. It has an area of 616 km^2 and lies 39 km south of Martinique and 34 km north of Saint Vincent. The island is of volcanic origin, with Mount Gimie at 960 m being the highest peak. The most spectacular landmarks are the Pitons, two conical-shaped tree-clad volcanic dikes rising nearly 800 m out of the sea. Rain forest lies in the mountainous interior where it shelters a wide variety of tropical plants and birds, including wild orchids, giant ferns, and the endemic Saint Lucian Parrot (*Amazona versicolor*). Native forests comprise about 20% of the island.

ENVIRONMENTAL CONCERNS – SAINT LUCIA

For people in small island states of the Caribbean, environmental concerns are a real life challenge. Small island states are concerned about the loss of biodiversity, water shortages, and air pollution; moreover, individuals feel incapable of solving such problems. People in developing countries are also more likely than those in industrialized nations to be dissatisfied with their country's environmental regulatory system. This is due to many factors -- limited natural resources, the choice of particular areas for development, and the effects of climate change and natural disasters on the landscape (Figure 1). The public of Saint Lucia is showing concern for the environment (e.g., hotel development in coastal areas) but these same activities also improve the social and economic conditions

of the average family by providing infrastructural development and job security.

Land use policy

Land ownership is a major issue in strategic planning for development. St. Vincent has three main categories of land ownership: government forest reserves, 15%; Crown Lands, 10%; and private lands, 75%. The latter group contains agricultural lands and private forest, including tropical dry forest (Figure 1). Many of the private lands are very scenic and will attract local or overseas investors.

With tourism being a lucrative business, private lands are sold at astronomical prices to overseas investors making it impossible for government to purchase them for conservation. While this is disturbing, tourism and development have yielded a positive growth in the country's gross domestic product. Many believe that during the first stages of development, pollution grows rapidly because people are more interested in jobs and income than they are in clean air or the loss of biodiversity. Regulation is weak, and communities, government agencies and NGOs do not have the finances to alleviate the situation.

TOURISM AND SUSTAINABLE DEVELOPMENT

Despite the warm and friendly "Saint Lucia Simply Beautiful" greeting for visitors, strong debates about sustainable development (wise use) and tourism persist. By definition, sustainable development is "economic development without polluting the environment" (Encarta dictionary). Likewise, tourism is "travel to benefit from a particular service or activity that is unavailable at home." Some suggest that economic growth and environmental quality are incompatible. If so, a na-

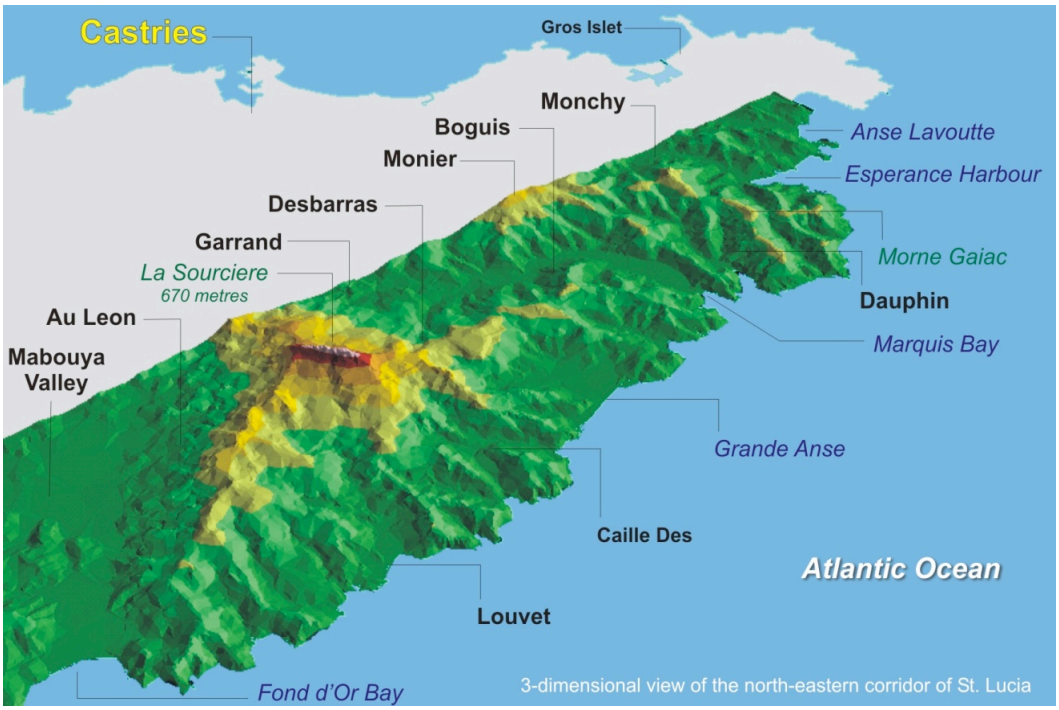

Figure 1. The northeast cost of Saint Lucia, a main area for ecotourism development and home of the iguana.

tion that opted for growth would eventually find that it had become unsustainable because the natural resources had run out, or because the assimilative capacity of the environment for waste had been exhausted, or both. Managers on Saint Lucia, a small island state with limited resources and threats of natural disasters like hurricanes need to know when to stop development. Current policy allows ecotourism to develop all major coastal areas. These actions violate the protocols of wise use management and international conventions that the island has signed. If trade-offs are not recognized, the tourism vs. sustainable development debate will continue to run. With the development of a strategic management plan, however, tourism can be sustainable.

CHALLENGES AND OPPORTUNITIES

Islands like Saint Lucia must work with major stakeholders to simultaneously protect natural resources for economic growth and expand infrastructure. Sustainable land use and management policies must be integrated into government planning to advance local capability and improve the regulatory framework (Figure 2). Environmental issues must be adequately addressed in environmental projects and partnerships.

Monitoring environmental trends is important but costly. Monitoring provides information on air and water pollution, deforestation, erosion, and sedimentation, as well as their impacts on ecosystem services. It also builds environmental capacity for programs dealing with wise use. Education and advocacy must promote stakeholder participation, and help build consensus in society. Environmental authorities should become more accountable for their services.

CONCLUSIONS

Saint Lucia's Forestry Department will continue to work together with stakeholders and communities to make tourist development sustainable. This is critical since most of the island's biodiversity is on private lands. Saint Lucia's land use policy must be completed so that it will serve as a management tool for sustainable development.

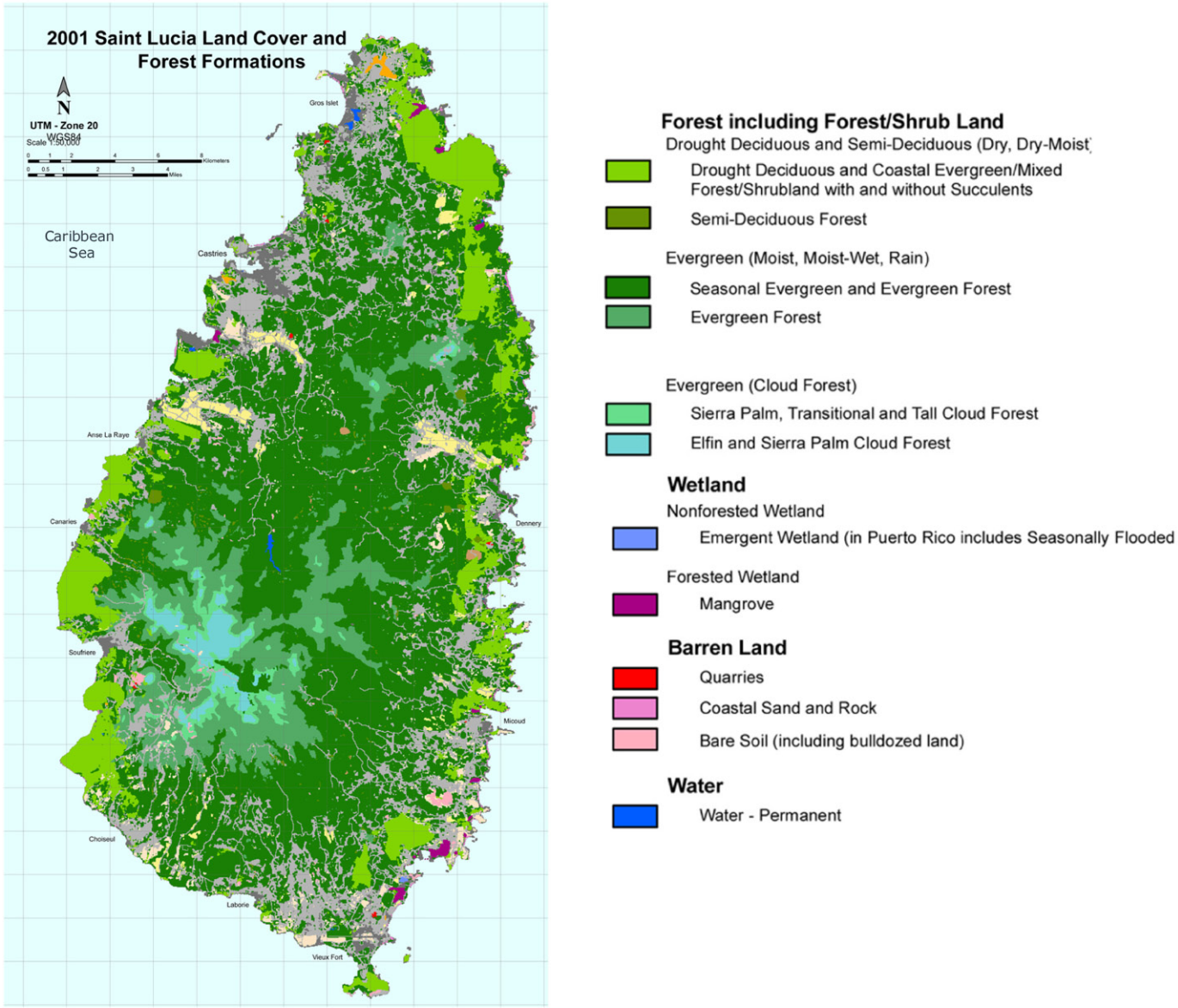

Figure 2. Land classification map of Saint Lucia.

FORAGING LINKAGES WITH CONSERVATION, TOURISM AND DEVELOPMENT IN ST. KITTS AND NEVIS

Ronel Browne

INTRODUCTION

The economies of the small island states of the Caribbean are very fragile and narrowly based and, among other things, are highly vulnerable to external economic and political influences. More and more, governments are taking advantage of obvious linkages as part of their strategic plans for sustainable development. From all indications, the services sector offers significant scope for forging linkages among tourism, conservation, and sustainability.

July 2005 marked the demise of the sugar industry that had dominated the socio-economic landscape of St.Kitts and Nevis as the main stay of the economy for >350 years. The government is now faced with the task of diversifying the economy and improving the operation of other traditional sectors to generate increases in productivity and exports. The main challenge is to sustain economic and social development programs. This will be done by drawing on existing resources and embracing new opportunities to be derived from service industries like tourism. This is the new strategy designed in response to new conditions.

CONSERVATION, TOURISM, AND DEVELOPMENT

Economic Activities

St. Kitts and Nevis was the last sugar monoculture in the Eastern Caribbean until the government decided to close the industry in 2005 after decades of losses in the state-run company. To compensate, the government embarked on a program to diversify the agricultural sector and stimulate the development of other sectors of the economy. Tourism, which has been developing for two decades showed the greatest growth and is now a major foreign exchange earner. This is evidenced by an 83% increase in direct foreign investment in a range of tourism-related projects, including the five star Marriott Hotel and Convention Center that opened in December 2002. The manufacturing and financial services sectors have also grown.

The economy of St. Kitts and Nevis experienced strong growth for most of the 1990s, but hurricanes in 1998 and 1999, and the September 11, 2001 terrorist attacks hurt the tourism sector. Economic growth picked up again in 2004, with a real gross domestic product growth rate of 6.4%, followed by 4.1% growth in 2005. In 2006, the economy posted a growth of 4.6%, mostly as a result of diversification in tourism and a boost in the construction industry.

Tourism

Formerly on St. Kitts, tourism development was characterized by small operations scattered around the island such as small hotels or former plantation houses converted to luxury accommodations. This has now shifted toward cruise ship tourism and resort complexes on the South East Peninsula. Visitor statistics indicate a general trend in growth, with a temporary depression after the Sep-

Table 1. Visitors statistics for St. Kitts and Nevis, 1998-2004

Item	1998	1999	2000	2001	2002	2003	2004
Stay-over arrivals	95,973	87,008	76,350	74,227	728052	94,617	124,158
Cruise Passenger Arrivals	151,475	139,338	170,887	259,134	171,814	156,284	260, 566
Number of calls	322	284	343	358	263	270	373
Estimated visitor expenditure[1]	75.9	67.8	58.5	61.9	56.3	75.6	96.7

[1]In millions of $US. Source: Statistics Department, Ministry of Sustainable Development, taken from St. Christopher and Nevis National Physical Development Plan.

tember 11, 2001 terrorist attacks in the United States (Table 1).

The St. Kitts Tourism Authority announced on 16 April 2007 that cruise arrivals will increase by over 70% in 2008, largely due to a cruise line which will be added to the island's cruise ship roster. This will be the first cruise ship to call weekly on a year-round basis. Both independent travelers and disembarking cruise ship passengers may chose from a selection of tours and activities, including shopping excursions, fishing, horseback riding, scuba diving, snorkeling, rainforest hikes, plantation tours, and beach relaxation. Tourism is one of the principal benefits derived from protection since it depends on the environment. Protection also benefits the sugar lands, structures in water catchment areas like Wing Field, trails like the Rain Forest Trail, and historical structures like Brimstone Hill National Fortress. In St. Kitts there are several water catchments which provide potable water. The government's land use policy considers the need to protect them notwithstanding the phenomenal expansion in the housing sector that is also part of government's development programme. The increasing population pressure coupled with a rising demand for agricultural lands could lead to an increase in the rate of deforestation. Safeguarding water quality by proper management of forested watersheds is of vital importance. A couple of measures have been adopted to assure the protection of catchment areas:

- Restricting development in certain areas of the island such as the Basseterre Valley Aquifer which sustains the major portion of potable water on St. Kitts.
- Establishing an integrated system of hiking trails, interpretative stations, camping sites, scenic viewpoints, and picnic areas not only for tourist recreation but also as avenues for income generation.

Forest Conservation and Sustainability in Protected Areas

The introduction of legislation in the late 1990s was premised on its potential impact on sustainable development. The implementation of the National Conservation and Environment Protection Act (NCEPA) not only raised the level of priority given to forestry but confirmed the government's awareness of

the importance of conservation in economic diversification. The legislation provides the framework for promoting conservation as part of long-term development planning as well as for the selection and establishment of protected areas (i.e., National Parks, Nature Reserves, Botanic Gardens, and Historic Sites). The legislation's major objectives reflect the institutionalization of this all important initiative which protects wildlife and historical structures. Section 3(4) (a)-(d) of NCEPA states that "Any protected area designated under the Act shall have one or more of the following broad purposes and objectives:

- To preserve biological diversity of wild flora and fauna species that may be endemic, threatened, or of special concern and the land and marine habitats upon which the survival of these species depend.
- To protect selected examples of representative or unique biological communities, both on land and in marine areas, and their physical environments.
- To sustain natural areas important for protection and maintenance of life-support systems (air, water) and basic ecological processes including water recharge and soil regeneration.
- To protect selected natural sites of scenic beauty or of special scientific, ecological historic or educational value, including sites that are already degraded and need protection for restoration or sites that may become degraded if not protected."

In addition, NCEPA is the principal law governing the environment in St. Kitts and Nevis. The major initiatives in national environmental reporting and policy planning include:

- Preparation of a national Environmental Profile in 1991 – a compilation of natural resources data, an examination of the key environmental issues, and recommendations for policy directions.
- Preparation of a National Environmental Action Plan in 1994 – identification of the major environmental problems of the country and recommendations for appropriate policies and actions to address problems.
- Preparation of a National Biodiversity Strategy and Action Plan.
- Preparation of the National Environmental Management Strategy and Action Plan, 2005-2009.

With the closure of the sugar industry, the government decided to shift its focus to maximizing the tourism sector. Several initiatives were undertaken to protect and conserve natural resources and historical structures. With the introduction of the Organization of Eastern Caribbean States Protected Areas and Associated Livelihoods (OPAAL), the Federation tailored its tourism sector into rainforest guided tours to the crater and to Dos D'ane Pond, which lies within the mouth of one of the many volcanic vents. The government took the initiative to protect the lands above the 305 m contour (1000 feet) which fell within the boundary of the Central Forest Range. With the implementation of the OPAAL management scheme, forest rangers stationed at several interpretation centres will brief tourists about various rare species found within the Protected Central Forest Reserve as they explore the forest.

Central Forest Management Plan, Tourism, and Sustainable Development

The Central Forest Reserve National Park (CFRNP) is designated to include all the land on the island ≥305 m contour, a total of approximately 5060 ha, or about 25% of St. Kitts. Because the CFRNP is so large and centrally located relative to the island, its area of influence is effectively the entire island, except for the South East Peninsula.

One of the main priorities of the development policy makers is the need to coordinate for the proper management of protected areas. In the Central Forest Reserve, part of the government's priority is to prevent pollution of spring water and to develop the necessary infrastructure (e.g., access roads, trails), objectives that are linked to the tourism plan. The area is experiencing significant trail use, especially during the winter season when visitor arrivals increase. The boost in future tourism marketing initiatives and anticipated increases in cruise ship arrivals in 2008 could drastically increase demand for access to the Forest Reserve. Tourists would see the CFRNP as a unique destination, and in turn, increase the demand for visits to the area.

Wildlife Management

The government has tried to protect wildlife by declaring lands above the 305 m contour, where several endemic species are found, as reserves. Wildlife management in St.Kitts is regulated under the NCEPA. The act placed responsibility on the Department of Physical Planning and Environment to educate and to incorporate constant dialogue among farmers and other forest users. In keeping healthy relationships and constant community consultations with individuals, the Department is able to improve its capability to regulate activities in the Central Forest. Forest rangers are better able to monitor the forest with the assistance of individuals who depend on the forest for their livelihood (e.g. fishermen making fish pots, craftsman, or charcoal producers).

In the pre-1980s, much criticism was leveled at the government for not establishing a competitive edge in the new paradigm linking sustainability, conservation, tourism, and development. Indeed, St. Kitts became the central backbone of the Federation after the sugar industry ended. The economy benefits greatly from scenic trails and tours. From all indications, the institutionalization of coordinating mechanisms has impacted economic growth. Tourism continues to develop as a major foreign exchange earner for St. Kitts-Nevis as evidenced by the 83% increase in direct foreign investment. Braving the devastation by destructive hurricanes and the loss of the principal income earner 'King Sugar," the Federation continues to register economic growth, drawing on a promising tourism industry. The government will continue to mainstream conservation management into its development plan to sustain economic growth.

LINKING CONSERVATION, TOURISM AND SUSTAINABLE DEVELOPMENT: ST. VINCENT AND THE GRENADINES

Andrew Lockhart

INTRODUCTION

Conservation denotes the 'wise use' of resources. The term emerged in the late 19th century and was linked to the establishment of national parks, wildlife sanctuaries, and game reserves for the protection of environmental resources. Today, conservation is viewed in a wider framework because of human population growth, competing demands for land, and the goods and services provided by natural systems like forests. The sphere of conservation has widened from the protection of wildlife species and habitats to embrace rural development, outdoor recreation, and tourism.

Indeed, tourism is the lead economic sector in St. Vincent and the Grenadines (SVG). The nation's landscape and seascape combined with a rich culture and history have made the country an enviable tourism destination. The pristine waters, white sand beaches, and coral reefs of the Grenadines beckon to sailors, scuba divers, and sea-bathers, while the lush rainforests, waterfalls, and rugged mountain trails on mainland St. Vincent offer opportunities for various forms of nature-tourism, including ecotourism. A vibrant sustainable tourism sector is intricately linked to healthy, well-managed ecosystems. Forests are visually appealing, provide habitats for a diversity of wildlife, protect soils, and prevent siltation of coral reefs while providing water for hydro electricity, cooking, drinking, and recreation. Destructive practices such as deforestation and reclamation of mangrove swamps and salt marches are the antithesis of conservation and sustainable development. Often, negative practices occur in the absence of a focused public awareness programme, or where law enforcement is ineffective.

One must appreciate the foreign exchange earnings from tourism and the positive 'trickle-down' effects into other areas of the economy and society. Simultaneously, the potential negative impacts of tourism on vulnerable groups and communities must be kept in mind. While not a major contributor to the country's gross domestic product (GDP), the forestry sector of SVG plays a significant supportive role to other economic sectors such as agriculture, tourism, water, and energy.

Sustainable development is aimed at empowering local communities to benefit socially and economically from tourism while ensuring that monies are made available to support integrated conservation efforts. This report highlights some of the initiatives being taken to conserve and promote national forest and wildlife resources for recreation as part of the SVG tourism product within a sustainable framework. It also presents some opportunities and challenges that may impact efforts to support, promote, and develop sustainable tourism.

COUNTRY PROFILE

Location

SVG is an archipelago situated at 13° 00´ N and 61° 15´ W in the Windward Islands of the Caribbean. It is bounded on the north by St. Lucia, on the south by Grenada, and to the east by Barbados. The nation comprises 32 islands and cays, nine of which are inhabited: mainland St. Vincent, Young Island, Bequia, Mustique, Canouan, Mayreau, Union Island, Palm Island, and Petit St. Vincent, at south-western end of the island chain.

Demographics

The country measures 389 km^2. Mainland St. Vincent is 345 km^2, and the Grenadines occupy 44 km^2. The 2001 census estimates the national population at 110,000 with a density of 284/ km^2. Tourism, agriculture, and light manufacturing are the major economic sectors, and contribute 18, 11, and 4%, respectively, to the GDP. Agriculture occurs mostly on the mainland while tourism, boat building, and fisheries are the main activities in the Grenadines.

Geology and Vegetation

Volcanic in origin, St. Vincent is one of the youngest Caribbean islands. Its principal peak, La Soufriere at 1234 m is one of the region's most active volcanoes. Eruptions occurred in 1718, 1812, 1902, 1971, and 1979. The mainland's topography is characterized by a central ridge from which emanates a series of steep, rugged peaks, lush valleys, and a narrow coastal plain. Conversely, the Grenadines are primarily low-lying coral islands that consist mainly of coastal dry vegetation consisting of low trees and shrubs. A 1993 inventory shows that forests occupy approximately 38% of SVG, with 5% being mature, undisturbed primary forest. Mangroves, coastal dry scrub, Montane, rainforest, Palm brake, and Elfin woodland are the main forest types.

Biodiversity Assets

Notwithstanding its small size, SVG possess a relatively wide diversity of local and regional endemic flora and fauna. These include 400 species of plants, 90 species of birds, and 18 species of terrestrial amphibians and reptiles.

CONSERVATION, LEGISLATION AND POLICY

Efforts to conserve the nation's biodiversity and support outdoor recreation began as early as 1765 with the establishment of the 16-ha St. Vincent Botanic Gardens, the oldest of its kind in the western hemisphere. Also, the Kings Hill Enclosure Ordinance of 1791 is one of the oldest pieces of environmental legislation enacted for the conservation of a forest reserve to protect the hydrology of the surrounding lands "…to increase the clouds and rains [thereto]…" Essentially, the Act established the Kings Hill Forest Reserve as one of the oldest of its kind in the western hemisphere. This legislation was repealed and replaced by the National Forest Resource Conservation Act (NFRCA) No. 47 of 1992.

National Forest Policy, the Wildlife Protection Act No. 16 of 1987, the amended Wildlife Protection Act No. 16 of 1991, and the NFRCA provide for the protection, conservation, management, development, and enhancement of the country's forest resources in harmony with national programmes and development plans. The laws emphasize wildlife and watershed protection, the maintenance of biological diversity, and the sustainable use

of the national forests for recreation, tourism, education, interpretation, and research, among others.

Forest Recreation

During the early 1980s, the Forestry Division began a programme to expose nationals and visitors to forest recreation. The programme involved the establishment and maintenance of trails to vistas, such as La Soufriere, Trinity Falls, and the Falls of Baleine. Financing for these early efforts were provided by the government's consolidated funds. In 1988, the Nicholls Wildlife Complex was established in the Botanical Gardens. This facility houses breeding and display aviaries for captive St. Vincent Parrots (*Amazona guildingii*), the national bird of SVG and flagship species for conservation. The Jersey Wildlife Preservation Trust and the Los Palmitos Park provided funding for the construction of the wildlife complex.

From 1989 to 1994 was a major turning point for forest recreation in SVG. Buoyed by funding under the SVG-Canadian International Development Agency Forestry Development Project, major work was done to enhance the physical appearance and amenities of three premier outdoor recreation areas: Owia Salt Pond (1989);Vermont Nature Trails (1991); and the Bamboo Range picnic site and La Soufriere Trail (1992). Similar work was done later at Walliabou and Trinity Falls, and at the Falls of Baleine. In addition, the Forestry Division maintained various beaches through weekly clean ups and by planting ornamentals. Several ornamental gardens were also established on the fringes of Kingstown and in suburban areas. All these activities took place from the 1980s through 2001. The National Parks, Rivers and Beaches Authority now manages beaches and nature-based outdoor recreation sites in SVG.

National Tourism

Tourism is the lead economic sector of SVG. This represents a change from the previous economy based on agriculture, and was occasioned primarily by falling prices and the end of preferential treatment for Caribbean bananas in European markets. From January to August 2007, visitor arrivals to SVG totaled 253,112, an increase of 25% over the corresponding period in 2006. Cruise ship and yacht arrivals were the main growth earners. Total gross visitor expenditure in 2006 was US$112.5 million compared with US$103.2 million in 2005. The projection for 2007 was US$119.4 million.

Tourism Development Project

SVG has embraced sustainable tourism as an effective means of macro-economic diversification. Natural and cultural heritage resources which form the basis for national tourism are fragile and irreplaceable; therefore, tourism development must be carefully planned and managed. In 2005, to help move the sector forward, the government initiated a 3-year Tourism Development Project (TDP) with major funding from the European Union. The TDP aims to strengthen the management and sustainable development of the tourism sector so that it can contribute to the long-term development of SVG. In this regard, sustainable development is viewed as the optimal use of natural and cultural resources for national development on a self-sustaining basis. Development will provide pleasant experiences for visitors and improve the quality of life on SVG through partnerships among government agencies, the private sector, and communities.

The TDP has two main components, the establishment of: (1) the National Parks, Rivers and Beaches Authority (NPA) and (2) the National Tourism Authority (NTA). The NTA will have responsibility for overall planning, coordination, and management of tourism development in SVG. It is also expected to address pertinent issues like standards, compliance, and certification in the industry. These issues will feature prominently in a tourism master plan to be developed and implemented by the NTA. In the capital budget estimates for 2008, US$1.8 million is budgeted for the development of recreational sites and to establish the operational framework for the NPA and the NTA.

National Parks, Rivers and Beaches Authority (NPA)

SVG was traditionally a 'sun, sea and sand' destination. Accordingly, most emphasis was placed on developing tourism infrastructure in what was then the 'tourist belt', or the southwestern end of mainland St. Vincent, and in the Grenadines. Recently, however, with the government's thrust to diversify the national economy, particularly the tourism product, the National Parks, Rivers and Beaches Authority Act 2002 was enacted to establish the NPA. The NPA was formalized as a statutory body in 2007. The Act outlines the powers and functions of the NPA, and includes the following:

- Control over all rivers, streams, springs, swamps, waterfalls, water pools, and beaches in the State.
- Management and maintenance of all national parks inclusive of the above, and other national and historic resources of the state as assigned by the minister.
- Advocate and promote conservation.
- Foster the use of natural and historic resources for recreation and tourism.
- Establish priorities and mechanisms for selecting, establishing, and managing a national park.
- Ensure permanent protection of species and habitats, especially those that are threatened, rare, endemic, or commercial species, as well as representative habitats.
- Maintain the natural beauty of national parks as a tourist attraction.
- Prepare management plans for each national park, including information gathering and research, to provide the scientific basis for the plans.
- Establish and operate an effective interpretation programme.
- Regulate use in national parks and their adjacent buffer zones.
- Provide security and enforce regulations.
- Establish public information and education campaigns to create conservation awareness at the national level.

Institutional Arrangements

In 2004, a report suggested that modalities of cooperation should be developed where there was a potential for overlapping jurisdiction among State agencies. It was also recommended that the government should embrace the principle of "delegation of management" where responsibilities for recreation sites would be delegated to non-governmental organizations (NGOs), community groups, and to other government agencies already involved in management. This is currently thought to be the best management practice for national parks systems worldwide. The government and all stakeholders in tourism should realize its enormous potential and help transfer it from a "sun, sea and sand" model and to consolidate and extend it to take advantage of emerging market segments. The following are viewed as

current challenges:

- The under-developed condition of some tourism sites.
- The less than optimal coordination between various government agencies that work on tourism issues.
- The lack of public consciousness about the importance of tourism in the daily lives of people in SVG.

LINKING CONSERVATION TOURISM AND SUSTAINABLE DEVELOPMENT IN SURINAME

Bryan R.I. Pinas

INTRODUCTION

There is a logical connection between nature conservation, tourism, and sustainable development when nature in its pristine state is viewed as a tourist product. Tourists are willing to pay people living in pristine areas so that they may enjoy an encounter with nature, and local people, in turn, will sustain that aspect of nature to protect their livelihoods. At this point, conserving nature through tourism is possible. The purpose of this report is to provide a short description of Suriname and then clarify the above assumption by answering three questions:

- What is worth conversing in Suriname?
- How is Suriname conserving nature?
- Which are the ingredients for the sustainable development of Suriname's tourism industry?

DESCRIPTION OF SURINAME

The Republic of Suriname is situated along the north coast of South America. It is the second of the three Guianas in size and population. About 450,000 people live in an area of 163,250 km^2 making the country one of the least densely populated tropical rainforest areas in the world

About 90% of the inhabitants of Suriname are concentrated in and around the capital city of Paramaribo near the mouth of the Suriname River, and in smaller settlements along the coastal lowlands. The remaining 10% live in small villages, mainly along big rivers. About 90% of the country is uninhabited.

Land Surface in Suriname

Mainland Suriname may be divided into four major ecological zones: (1) young coastal plain, divided into the estuarine zone, an area influenced by coastal changes and tidal action, and farther inland, freshwater wetlands, where rains prevail over tidal intrusions; (2) old coastal plain; (3) savanna belt; and (4) interior (residual) uplands, covering 132,000 km^2, or 80% of the Suriname's land surface.

Tourism in Suriname

Direct flights arrive at the Suriname International Airport from North America, Europe, Brazil, and the Caribbean. Suriname's eastern and western borders can be crossed by ferry.

Tourism is steadily growing in Suriname and employs circa 6000 people. The current value of tourism revenue is difficult to ascertain but estimates for 1997 range from $17 to 42 million, or 3 to 8% of foreign exchange earnings. More than 3/4 of international air arrivals are Dutch citizens, virtually all of them with historic or familial ties to Suriname. Also, the number of Dutch interns is increasing dramatically. They characteristically stay for long periods but spend little. True tourists, those coming primarily to Suriname for a holiday, probably do not number >3000 annually.

WORTH CONSERVING

Pristine Tropical Rainforest.

Suriname is well-situated to preserve its unique tropical rainforest. Although relatively small, Suriname is important internationally because it has the highest proportion of tropical rainforest in the world (>80% of the total landscape). Moreover, the deterioration rate is <0.1% per year.

Endangered Wildlife

The country's ecosystems provide habitat for a number of species including the Cock-of-the-Rock, the flagship species of the Guiana avifauna. Suriname contains some of the best sea turtle nesting beaches in the world and is one of the best places to view giant river otters, black caiman, tapir, and harpy eagles.

Cultural Diversity

Surinamese culture is unique and different from the rest of South America. It is a colorful mix of ethnic groups, including: indigenous peoples or Amerindians (3%), and Maroons (Bushnegroes), the descendants of early runaway African slaves (9%). Most indigenous peoples and Maroons live south of the coastal plain. Other groups include: Creoles, or the descendants of plantation slaves (30%), the Chinese (3%), Indians (33%), and Javanese (14%), all of whom settled in the coastal plain. Brazilians, mainly garempeiros or gold miners (6%), recently settled in the interior uplands. The remaining 2% of the population lives mainly in Paramaribo and has roots in Europe, Lebanon, Korea, Japan, or the United States. Together they form a multi-cultural community with exotic food, traditional costumes, rituals, and music. Most emphasis in this paper, however, is placed on the conservation of nature.

CONSERVATION OF NATURE

The government is aware of the importance of diversity in Suriname. There are protected areas together covering a combination of ecosystems, each with it own valuable flora and fauna. Wildlife is regulated by legislation, not only in the protected areas but also in the rest of the country.

Conservation through Legislation

Nature conservation activities in Suriname started >50 years ago with the publication of the Game Law and the Nature Preservation Law. Wildlife management inside of the nature reserves focuses on the protection of all fauna. Wildlife management outside the nature reserves and in Multiple Use Management Areas is regulated by the Game Law and by game resolutions. Enforcement of these laws -- the Law on Forest Management, the Fish Protection Law, and related laws -- is done by game wardens of the Nature Conservation Division of the Suriname Forest Service.

Another organization responsible for nature conservation is the Foundation for nature Conservation in Suriname (STINASU). STINASU is a non-profit, semi-government agency founded in 1969 for the explicit purpose of stimulating and implementing the use of the nature reserves for scientific research, education, and nature tourism. Suriname has 16 protected areas accounting for 14% of the country, among them 11 Nature Reserves, three Multiple Use Management Areas, and one Nature Park.

INGREDIENTS FOR SUSTAINABLE TOURISM

Development of Sustainable Tourism

Surinamers have long recognized the potential of their country as a tourism destination. In the 1970's, Suriname was one of the first countries in the Americas to develop rainforest tourism. However, after political unrest in the 1980s, Suriname's early market was lost, and today the country finds itself far behind in a very competitive tourism market. During the past 10 years, Suriname has benefited from the technical and financial support of foreign donor organizations. Guidelines were drafted for the integrated development of tourism programs highlighting nature tourism in protected areas.

Tourism Planning and Development

Constraints to tourism development still exist, ranging from the lack of legislation to ineffective marketing. In 1997, a national tourism policy was established to promote sustainable tourism development benefiting communities. All tourism facilities at several destinations are small in scale, owned by Surinamers, and involve local communities in their operations. These are the basic ingredients for sustainable development.

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LINKING CONSERVATION, TOURISM AND SUSTAINABLE DEVELOPMENT IN THE CARIBBEAN – TOBAGO SITUATION

William A. Trim

INTRODUCTION

The Republic of Trinidad and Tobago became independent in 1963 and a republic in 1976 (APA Productions 1987). The country is part of the wider Caribbean, bounded on the windward by the Atlantic Ocean and on the leeward by the Caribbean Sea. Tobago, the smaller of the two islands, is located at approximately 11° N and 61° W (Phillip 1998). Tobago's name was derived from its resemblance to that of a cigar. The island is roughly 302 km^2 (about 45 km long and 10 km at its widest point). The island, shaped topographically like a turtle's back, is 35 km from northeastern Trinidad.

The northeast trade winds constantly fan Tobago and the island experiences occasional hurricanes and tropical storms (Phillip 1998, ffrench 1991). The seasonal variations of Tobago are a dry season from December to April and a wet season from May to November. The average minimum temperature is 22° C and the average maximum temperature is 32° C. Rainfall averages 2250 mm/yr (Bacon 1978, APA Productions 1987). According to the 2000 census, the island has about 55,000 persons. Tobago is a small and for purposes of promotion it is referred to as "clean, green, safe, and serene"

THE RESPONSIBLE AGENT

The Department of Natural Resources and the Environment (DNRE), Tobago House of Assembly (THA), is responsible for the management of natural resources in Tobago. DNRE is made up of four units, namely: Wildlife, Parks and Recreation, Environment, and Watershed. Some responsibilities of the watershed unit are: (1) rehabilitating degraded watersheds, (2) providing extension services in agro-forestry systems and practices, (3) establishing plantations and enrichment stands with mixed hardwood species, (4) implementing wild land fire detection and suppression programmes, (5) managing a site with forest recreation activities, (6) sensitising the public in public awareness programmes, (7) representing the THA on national committees, (8) enforcing laws, (9) reviewing environmental impact statements and providing comments, and (10) implementing commemorative activities for World Forestry Day, World Environment Day, and others. Despite these programs, Tobago is developing rapidly with typical consequences -- natural resources are over-harvested, lands are degrading, wildlife is becoming rare and extinct, and endemic species are threatened.

LOCAL SITUATION

The following are examples of the local situation as they relate to conservation, tourism, and sustainable development:

- Revisition of the old and outdated forest policy of Trinidad and Tobago, and the development of a protection area policy for the islands.
- Management of St. Giles Island and Little Tobago, previously set aside as bird sanctuaries, but now with visitors at Little

Tobago.

- Maintenance of the Botanic Gardens in the main town of Scarborough.
- Protection of Turtle Beach Open Park, a major site for turtle watching and turtle nesting.
- Demonstration of agroforestry practices with trees, apiaries, and handicrafts.
- Reforestation along the popular Argyle Waterfall using hardwood species in an enrichment system.
- Use of the Louis D'or Wetland for birding.
- Private management, offering of major tourism services at: Tobago Plantations Ponds, Mt. Pleasant Credit Union Sewer Ponds, Adventure Farm, Arnos Vale Hotel Grounds, and the Cuffie River Resort.
- Wise management of terrestrial resources to help prevent damage to beaches such as Englishman's Bay and Man-of-war Bay, and to help protect five major reefs, including the Buccoo Reef.
- Management of Bloody Bay Recreational Site and Nature Trails within the MRFR.

BLOODY BAY RECREATIONAL SITE AND NATURE TRAILS

The Bloody Bay Recreation Site and Nature Trails are located within the Main Ridge Forest Reserve (MRFR) and are accessible from both ends of the Roxborough-Bloody Bay Main Road. The MRFR is about 4050 to 5670 ha in size and spreads along the central ridges of Tobago. The reserve, the first and oldest of its kind in the Western Hemisphere, was declared a protected reserve in 1765 to capture rainfall and provide watershed benefits (Hart 1965, Beard 1944). For the past four consecutive years, Tobago has been seen as home to the best eco-destination of the region, winning the #1 Eco-Destination Award in the Caribbean. Tourism contributes 56% of Tobago's revenues yet tourism and agriculture contribute less than 3% of Trinidad and Tobago's GDP.

Three types of rain forests exist within the MRFR (Beard 1944). Of these, only the Lower montane rain forest still exists and it is a major feature within the reserve (Thelen and Faizool 1980). The major features of the Bloody Bay Recreation Site and Nature Trails are (Bacon 1978; ffrench 1991; Kaiser et al. 1995; THA 2004):

- A Lower montane rain forest containing the Licania-Brysonima forest association (Beard 1944) within the oldest forest reserve in the Western Hemisphere.
- Center Hill, the highest point on the island at 547 m.
- A cool micro-climate, high rainfall, and numerous cascades.
- The outstanding White-tailed Sabre-winged Hummingbird, one of 210 species of birds in Tobago, ranking the island as one of the top 10 islands with high bird density.
- Seventeen species of bats, including one nocturnal fish-eating species.
- Fourteen species of frogs, including the Bloody Bay Poison Frog.
- A visitors' center with both guided and self-guided tours.

Some of the tourism services associated with the site are: photography, birding, hiking, relaxation, solitude, painting, video taping, bathing, swimming, fishing, camping, catering of local food and beverages, educational classes (biology, research, geology, lecturing, dendrology, and visiting the interpretative centre), and cultural and religious activities.

CONCLUSION

Because of Tobago's small size and vulnerability, the island must link conservation, tourism, and sustainable development. The forest and protection policies that are being developed, with input from stakeholders, will set the guidelines for future sustainable development.

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INTEGRATING BIODIVERSITY CONSERVATION INTO THE TOURISM SECTOR IN TRINIDAD – A CASE STUDY OF EFFECTIVE LOCAL COMMUNITY PARTICIPATION

Kathleen Belcon

INTRODUCTION

The nations of the world have come to recognise diversity among living organisms - at the levels of genes, species and ecosystems – is of vital importance to human well being. Accordingly, the United Nations Convention on Biological Diversity (**CBD**) (see Appendix Table for acrynoms), which entered into force in December 1993 (Article 6), calls upon subscribing nations to develop national strategies and plans for biodiversity conservation and to integrate biodiversity concerns into relevant sectors of the economy.

Under the leadership of United Nations Environment Programme (**UNEP**), a Biodiversity Planning Support Programme (**BPSP**) has been established to strengthen national capacity to prepare and implement National Biodiversity Strategies and Action Plans (**NBSAP**). The BPSP encompassed eight thematic studies, including the integration of biodiversity into: (1) the national agriculture sector, (2) the national fisheries sector, (3) the national forestry sector, (4) the national tourism sector, and (5) environmental assessment procedures. It also included: (6) improved use of economic tools in national biodiversity planning, (7) improved financial planning for the national biodiversity strategy and action plans, and (8) harmonisation of legal obligations under biodiversity-related multilateral environmental agreements.

Study 4 above on tourism is germane to this paper. Tourism is one of the world's largest industries, generating an estimated 11% of global gross domestic product (**GDP**), employing 200 million people, and transporting more than 700 million international travelers per year. The preliminary results of the World Tourism Organization (**WTO**) indicated that the number of international tourist arrivals recorded worldwide grew by 5.5% in 2005 and exceeded 800 million for the first time ever, despite various terrorists' attacks, a tsunami, and long and strong hurricane seasons. The WTO's 2020 vision forecasts that international arrivals are expected to reach 1.26 billion by 2015.

International arrivals from the Americas are expected to grow at a rate of 3.0% from 338.4 million in 1995 to reach 611.2 million by 2015. The Caribbean is expected to receive 88 million of these arrivals. Tourism arrivals to Trinidad and Tobago (**T&T**) grew from 144,521 in 1990 to 398,559 in 2000, and to 442,555 in 2004. Given the strong correlation between visitor arrivals and the world real GDP for the period 1970-2004, T&T tourism arrivals are expected to grow at a rate of 4% to 509,349 in 2006, to 635,591 in 2011, and to 755,498 by 2015.

T&T, rich in natural and cultural assets, has excited the tourism sector, particularly ecotourism and cruise ship tourism. Side by side with the development of sectors has been the preparation of a (NBSAP) for T&T. One of the principal strategies incorporated in the plan is the institutionalisation of public participation in the development of government policy for the conservation and management of biodiversity.

STRATEGIES AND PLANS FOR T&T

In 1992, T&T was one of 157 countries that signed the CBD at the United Nations Conference on Environment and Development in Brazil. Ratification took place in 1996 signaling T&T's intention to conform to the articles of the Convention. The NBSAP of T&T is aimed at increasing knowledge about natural resources, and the sustainable management and conservation of biological diversity in the context of its socio-economic development.

The size, location, and geological relationship shared with the South American continent are primarily responsible for T&T's abundance and variety of biological resources. The island's population has historically been closely linked to those biological resources through agriculture, fishing, recreation, tourism, and culture, thus the necessity of sustainable use of natural resources.

The preparation of the NBSAP in T&T was conducted through working partnerships with the Environmental Management Authority (**EMA**), the national focal point for the CBD, in collaboration with the Ministry of Agriculture Land and Marine Resources (**MALMR**). These two agencies spearheaded process that involved the participation of stakeholders across the nation.

During the past 17 years rural communities have organised themselves into formal groups for the purpose of making a more effective contribution to resource management. This relationship has resulted in an improved cooperation among the state, private enterprise, and communities through co-management of natural resources. This form of management has enhanced the ownership of the NBSAP by the stakeholders.

OVERVIEW OF TOURISM DEVELOPMENT

Relative Importance in National Economy

T&T are the two main islands of an archipelagic state situated at the southern end of the Windward Islands. Both islands lie on the South American Continental Shelf and are directly influenced by the Orinoco and the South Equatorial Current. Separation from the continental mainland occurred in recent geological times, about 11,000 years ago for Tobago and 1,500 years ago for Trinidad. Trinidad lies 32 km from Tobago at its closest point but only 13 km from the Venezuela. The two islands have a combined land area of 5,126 km^2 and have an "exclusive economic zone" of roughly 75,000 km^2. The climate is tropical, with annual rainfalls between 1200 and 3500 mm and a mean temperatures ranging between 22 to 31 °C. The climate is characterised by distinct wet and dry seasons. Marine conditions are heavily influenced by rainfall, nutrients, and the large freshwater volume flowing out of the Orinoco River.

The terrestrial habitats and biota of Trinidad reflect the ecology of equatorial South America unlike the other Windward Islands which are more isolated. The terrestrial ecosystems include: (1) evergreen seasonal, semi-evergreen seasonal, deciduous seasonal, and littoral woodlands; (2) lower montane, montane, seasonal montane, and summit elfin woodlands; and (3) swamp forests, including mangrove woodlands, palm swamps, marshes, and savannahs. These ecosystems support considerable diversity on T&T -- 2500 species of plants, 420 birds, 100 mammals, 25 amphibians, and 85 species of reptiles, including 55 snakes.

The economy of Trinidad is based on the hydrocarbon industry. Historically, oil production and refining have dominated the island's economy. Recently, natural gas has increased. This sector is projected to grow based on new finds and the establishment of liquefied natural gas plants during the past few years. It is not surprising, then, to find that the tourism sector has been eclipsed by the hydrocarbon sector. However, changes seem apparent. The creation of the T&T Tourist Board in 1946 reflected the official recognition and encouragement for the development of a tourist industry. In recent times, state agencies have been very supportive of tourism as a source of generating revenue for the country. Although the tourism industry contributes just 3% to the GDP, its potential as a sustainable environmentally friendly industry has been recognised and is being promoted.

The tourism industry to date owes its success to the Tobago House of Assembly. A healthy balance exists whereby Trinidad promotes the hydrocarbon and manufacturing industries while Tobago, with its superior beaches, reefs, moist tropical forests, and sport fishing concentrates on the tourism industry. The T&T government, mindful of the vulnerability of a hydrocarbon dominated economy and the vicissitudes of fluctuating oil prices, continues to work towards diversifying the economy to include manufacturing and tourism. This new impetus by the state is reflected in an increase in stay-over arrivals and cruise ship visitors to the island.

IMPORTANCE OF BIOLOGICAL DIVERSITY

Current data indicate that T&T has a high percentage of species diversity to surface area ratio. The biological resources of the country play a major role in the lives of all sectors of society at both national and local levels. Rural communities depend upon wild flora and fauna for their sustenance via hunting, fishing, craft manufacture, tour guiding, and other nature-based activities.

The flora and fauna of T&T offers several opportunities for environmental tourism. The numerous ecosystems provide habitat for terrestrial mammals and waterfowl species like the Scarlet ibis *(Eudocimus ruber)*, which are popular with scientists and nature lovers. Nature tours to bird sanctuaries and hiking forest trails generate revenue for rural communities living nearby. A few communities on the northern and eastern coasts of Trinidad (Matura, Grand Riviere, Fishing Pond) and on Tobago (Mt. Irvine, Grafton, and Great Courland) are nesting sites for marine turtles, particularly the Leatherback. Because of these large nesting areas, T&T has been included in international studies on turtle conservation and recovery.

Trinidad has five terrestrial species of game animals that have traditionally supported a hunting industry worth hundreds of thousands of dollars annually. Wildlife fauna and flora have also been a source of stock for the pet (i.e., tropical fish, reptiles, and birds) and horticultural markets. However, the capture of wild stock for the pet trade is illegal and remains a threat to biological diversity, as does illegal hunting.

Historical Perspective

Prior to T&T's ratification of the CBD, environmental management was carried out through a number of governmental ministries and statutory bodies. This type of management often resulted in the duplication of efforts, uncertainty regarding resource utilisation, overlap among agencies involved in the management of resources, conflicting legislation in the area of enforcement, penalties, identifiable gaps, and legislation of some vintage.

The daily management of biological resources falls within the purview of the MALMR, which has various divisions for specific resources. Wildlife and the National Parks fall under the Forestry Division. The former regulates hunting, conducts wildlife research, and implements the CITES and Ramsar Conventions while the latter oversees all state lands that have been designated as national parks or recreational areas.

The Forestry Division through the line ministry MALMR has the responsibility to manage wildlife conservation. The University of the West Indies has been collaborating with the Forestry Division, non-governmental organisations (**NGOs**), and community-based organisations (**CBOs**) to conduct research of biological resources.

Environmental Management Act and the CBD

In response to the need for a singular and integrated approach to management of the environment, the Environmental Management Act was passed by Parliament in 1995. The EMA was established as the body with the responsibility for coordinating and co-operating with private and state agencies and to meet the goals and requirements of the Act. The Act essentially provides for the EMA to set environmental standards, regulate activities that impact on the environment, and protect vulnerable habitats (and species), and to institutionalise national policy for the environment. The Certificate of Environmental Clearance provisions of the Act are intended to regulate activities across the country.

The Environmental Management Act allows the EMA to enter into a Memorandum of Understanding with state and private agencies and institutions to establish jurisdiction and guidelines for integrated environmental management programmes. In the context of this Memorandum, EMA can appoint environmental officers to assist with environmental management as well as inspectors to examine premises to ensure that clients comply with the prescribed standards and regulations of the Act. In addition, the Act allows the Authority to designate any defined land area and any living species of plant or animal as "environmentally sensitive." This designation gives the state the authority to determine the type of activities that are permissible when managing the resources.

Types of Tourism Practiced

Numerous recreational activities are available in T&T, but ecotourism is the most sought after activity.

Ecotourism

This segment continues to grow annually and correlates directly T&T's rich biological resources. Some of the major activities sought after by eco-tourists are:

- Hikes in: the range of mountains along the north coast from Toco in the northeast to Chaguaramas in the northwest; Central Range, Trinity Hills; Aripo savannas; Caroni and Nariva swamps; Buccoo; Speyside Reefs; and waterfalls in Tobago.
- Bird viewing at: Asa Wright Nature Centre; PAP Wildfowl Trust; Pax St. Benedict; Caroni and Grafton Bird Sanctuaries; and Little Tobago Island.
- Turtle nesting: Grande Riviere Beach; Orosco Beach, Matura; Fishing Pond; Manzanilla Beach; and Mt. Irvine Bay.
- Educational ecology tours: Pointe-A-Pierre Wildfowl Trust; Asa Wright Nature Centre; Caroni Bird Sanctuary; Botanic Gardens; and Tobago Main Ridge.

- Community life experiences: Brasso Seco Village, Matura; and Grand Riviere --Blanchisseuse and Lopinot.
- Nature Parks and recreation visits: Caroni Swamp; Cleaver Park.
- Sporting activities: Deep sea fishing and diving; golf, tennis, cricket, hockey, and football.

Public Sector

The Ministry of Tourism develops policy and plans and helps with the drafting of applicable laws. The principal law governing activities in the tourism industry is the Tourism Development Act of 2000. The Act facilitates the development of tourism by providing incentives and concessions to entrepreneurs and investors. The Tourism and Industrial Development Company (**TIDCO**) administers the incentives and concessions under the Act and implements the Ministry's policies and plans. TIDCO's Tourism Division implements action plans in three functional areas: (1) marketing, (2) product development and consumer relations, and (3) destination information and administration.TIDCO's Division of Government Policy and Special Projects has engaged in a number of tourism infrastructure developments, including: (1) enhancement and development of beach and river facilities; (2) construction of Caroni Swamp National Park headquarters; and (3) refurbishment of the visitor facilities at Pitch Lake.

Private Sector

The principal role of the private sector is the ownership and operation of tourism facilities. These include accommodationfacilities (hotels, guesthouses, and eco-lodges), marinas, water sport facilities, charter boats, transportation, convention centers, and golf courses. Companies involved in destination management and ground tour operations also belong to the private sector.

Non Governmental Organisations (NGOs)

The principal role of NGOs lies in the work of advocating sustainable tourism. The Caribbean Forest Conservation Association, for example, lobbies for the conservation of forest ecosystems as a basis for sustainable ecotourism. The Crusoe Reef Society, and Fishermen and Friends of the Sea are NGOs with a special interest in the conservation of the marine environment.

Apart from advocacy work, two NGOs stand out as ecotourism operators. The Pointe-A-Pierre Wildfowl Trust has successfully developed a wetland into a site for captive breeding of avifauna, as well as a highly visited tourism and environmental education centre. The Asa Wright Nature Centre operates a highly successful lodge that is frequented by international bird watchers.

Local Communities

Nature Seekers Inc. (**NSI**) is the most visible local community activity in the tourism industry. This group is involved in the protection of the Leatherback turtle nesting beaches. NSI has won numerous international awards for their turtle protection programme. In like manner to the NSI, the Grande Riviere Environmental Awareness Trust (**GREAT**) has also gained international recognition for their work in protecting Leatherback turtles on north coast beaches. Both these groups also engage in guided tours of turtle beaches during the March through September nesting season.

TIDCO has sponsored a thrust to have local communities profitably manage their tourism resources through a community tour-

ism action programme. This thrust has led to the creation of a number of tourism action committees which are now grouped under an umbrella body called the Foundation for Sustainable Community Tourism.

Tourism Education and Training

The principal institution for tourism education and training is the T&T Hospitality Training Institute. This Institute is the successor to the T&T Hotel School that was set up in 1996 with an International development Bank grant administered by the T&T Hotel, Restaurants and Tourism Association. The Institute has campuses in Trinidad and in Tobago. The institute offers Associate Degrees in Tourism Management and Hospitality Management, and Certificate Programmes in Food and Beverage Supervision, Culinary Arts, Customer Service, Front Office Operations, and Travel Operations. The Institute, also awards certificates to tour guides trained by accredited private sector tour operators. The Institute has entered into arrangements with tertiary educational institutions in North America to have their certification accredited and applicable there.

TIDCO's Division of Government Policy and Special Projects held special courses, including one on Sustainable Tourism Best Practice. The Division also provided training for communities in tourism planning and education. Other tourism trainers include:

- SERVOL (a self-development group) - hospitality at the vocational level.
- University of the West Indies (**UWI**) Faculty of Social Sciences – hotel management.
- UWI Institute of Business (under contract to TIDCO) – service excellence, management development, training of trainers (for personnel in public agencies).
- UWI School of Continuing Studies – small hotel and institutional management, and tourism management and development.
- Youth Training Employment Partnership Programme (tour guiding).
- Forestry Division (nature interpretation and turtle beach guiding).

APPLICATION OF SUSTAINABLE TOURISM

At the level of tourism-related activities, sustainable tourism can be compromised by the improper design and construction of tourism sites, the unsatisfactory operation of tourism facilities, and the recreational behaviour of the tourist. Best practices to minimise impacts in all these areas are well documented and available to private sector owners and operators of tourism sites. New tourism facilities are subject to the development approval process of the Town and Country Planning Division, which invariably demands an Environmental Impact Statement.

The environmental assessment process is overseen by EMA. Under the enabling legislation that established the EMA, provision has been made for follow-up environmental compliance auditing. At the level of government policy and planning, best practice guidelines for sustainable tourism are in a state of evolution.

The International Union for Conservation of Nature (**IUCN**) approaches for the sustainable use of biological resources in a tourism regime might be termed best practice guidelines for integrating biodiversity into tourism planning. Expressed as critical conditions that enhance the sustainability of biodiversity uses, they are:

- Institutional structures for appropriately scaled management and control that provide positive incentives, negative sanctions, and good governance.
- Management and control systems that take account of land tenure, access rights, regulatory systems, traditional knowledge, and customary law.
- Local peoples' participation in all phases of the operation from planning to implementation.
- Equitable sharing and greater in situ concentration of benefits
- Effective monitoring and feedback mechanisms.
- The capacity to adjust management in light of monitoring results.

MAIN ECOTOURISM ATTRACTIONS

T&T offer a unique diversity of ecotourism potential. Together they contain some spectacular scenery areas, birds, wildlife, and historical sites.

Asa Wright Nature Centre

This world famous nature resort has functioned both as a wildlife sanctuary and nature lodge since its inception in 1967, and has received many of the world's leading ornithologists and naturalists. Asa Wright has become a model for sustainable development and ecotourism projects in the Caribbean.

Caroni Swamp Bird Sanctuary

Covering an area of about 5000 ha, the Caroni Swamp represents the best example of a mangrove swamp in the country. It provides optimum habitat for the Scarlet ibis, one of the national birds. It is also an important and readily accessible recreational and educational resource. Caroni serves as a nursery ground for fish and crustaceans and contributes to the subsistence of fishermen in surrounding villagers. The area is a legal protected area and visits to the Scarlet ibis nesting area are conducted by approved boat tour operators. The area is controlled by the Forestry Division.

Nariva Swamp

Located on the east coast, the Nariva Swamp is the largest freshwater ecosystem within the country. It provides a habitat for numerous wildlife species, including 171 birds and 55 mammals, and is also used for kayaking. The area is a legally constituted Forest Reserve that the Forestry Division has recommended for national park status.

Pointe-A-Pierre Wildfowl Trust

This 33-year-old Trust is a non-governmental, non-profit organisation that encompasses two lakes in a 26 ha area nestled in the heart of an oil refinery. The Trust has active programmes in research, captive breeding, and re introduction of wetland birds to the wild.

Pitch Lake

This natural landmark covers about 36 ha and is located in the oil belt of the south. It is a geologically unique phenomenon and is reputed to be the world's largest source of natural asphalt. Historically it is linked to Sir Walter Raleigh when he landed in the early 1500s to caulk his ships with material from the lake.

Matura and Grande Riviere Turtle Nesting Beaches

Visitors flood these beaches during the Leatherback nesting season. The Forestry Di-

vision has had to step in and facilitate the development of community-based organisations to control the local situation – NSI at Matura and GREAT at Grande Riviere. These organisations monitor activities for local and international agencies, including nightly beach patrol during the nesting season, and the conduct organized tours for both local and foreign visitors.

Waterfalls: Maracas, Paria, Rio Seco, and Edith Falls

Waterfalls in the Northern Range are visited for scenery, photography, and river bathing: Maracas Falls, in the proposed Maracas National Park; Paria Falls, in the sphere of influence of the Brasso Seco-Paria Tourism Action Committee; Rio Seco Falls, in the Matura National Park; and, Edith Falls, in the Chaguaramas National Park.

BIODIVERSITY CONSERVATION -- ROLE OF NGOS AND LOCAL COMMUNITIES

There is a wide cross section of NGOs and CBOs actually participating in biodiversity conservation, such as service clubs, environmental organisations, trusts, and community groups. Many of the environmental organisations are affiliated through an umbrella group known as the Council of Presidents of the Environment, which facilitates collaboration among members. The NGOs and CBOs are engaged in biodiversity conservation through initiatives in research, management of species and ecosystems, and education, despite inadequate funding.

The T&T Field Naturalists' Club has a long tradition of scientific research on the biota of the islands. This organization has contributed knowledge in their areas of interest, for example, horticultural species, orchids, birds, and game fish. The Zoological Society of T&T and the Pointe-a-Pierre Wildfowl Trust carry out ex-situ species management whereas the Fishing Pond Environment and Community Group, GREAT, NSI, and the Toco Foundation all conduct within habitat species protection. Ecosystem management is conducted by the Asa Wright Nature Centre on their forested lands in the Arima and Aripo Valleys. The Caribbean Forest Conservation Association has been involved in biodiversity planning as consultants to the World Bank on the project to establish pilot national parks.

OVERVIEW OF NATIONAL PARKS AND PROTECTED AREAS

Legal Basis

The first wildlife sanctuary in T&T was created in 1928. An ordinance to protect wildlife was passed in 1933 under which forest reserves were set aside as game reserves and all forms of hunting were prohibited. This ordinance was superseded by the Conservation of Wildlife Ordinance No.16 of 1958 which provides for the establishment of wildlife sanctuaries. Under this legislation, all forest officers are wildlife wardens and the Chief Game Warden, with the Minister's approval, may modify sanctuary boundaries.

A comprehensive policy (i.e., legislation, objectives, categories, and procedures) for the establishment and management of a national park network was initiated in 1979-1980 in conjunction with the Organization of American States (OAS). At that time, existing legislation governing protected areas was found inadequate to ensure proper protection. The Forestry-OAS project identified 61 areas -- irrespective of actual land use or ownership – that were worthy of protection. They covered about 69,000 ha and were classified under six different categories, as follows: 13 scientific re-

serves; 8 national parks; 8 natural landmarks; 13 nature conservation reserves; 6 scenic landscapes; and, 13 recreation parks. At the time, 31% of the lands were forest reserves and another 12% were game sanctuaries. In addition, several marine reserves were proposed. The eight proposed national parks, Caroni Swamp, Chaguaramas, Madamas, Maracas, Matura, Nariva Swamp in Trinidad and Buccoo Reef and Eastern Tobago in Tobago, cover almost one-half the proposed protected areas system. The T&T government agreed in principal with the proposals, but legislation was not enacted. Subsequent amendments were made to existing wildlife and land use legislation, however, to control poaching, squatting on forested lands, and agricultural fires.

LINKAGES -- TOURISM DEVELOPMENT, BIODIVERSITY, CONSERVATION AND PLANNING

Economic

The economic policies operating in the various sectors of the economy primarily target development. Planning for the environmental consequences of economic development policy is still in its infancy. Economic incentives exist for tourism but there is a need to ensure that they will foster sustainable development. There is also a need to develop a regime of disincentives aimed at discouraging unsustainable tourism practices.

The use of financial instruments as management tools to achieve the aims and objectives of the CBD, and nationally for the conservation and sustainable use of biodiversity, needs attention. Financial instruments can facilitate conservation efforts by demonstrating the monetary value of ecosystems and their components. Biodiversity's contribution to the national economy must be quantified if its management and sustainable use are to become national priorities. Difficulties in determining the real value of these services, however, has contributed to the low priority previously given to them at the macro economic level. Failure to allocate financial resources to biodiversity causes the loss of life and property. These "hidden costs" are then passed onto the society through the destruction of biodiversity. Two examples are flooding due to the loss of forests and pollution of rivers, and potable water supplies, by industry. The repercussions for agencies that manage and maintain infrastructure and public utilities are serious and expensive.

Social

There are several active NGOs and CBOs involved in environmental and biodiversity conservation issues with focuses as varied as the groups themselves:

- Public education and advocacy for changing national legislation for conservation.
- Projects that affect wildlife populations or habitats
- Lobby and developmental groups for specific resource users (e.g., fishermen).
- Promotion of practices that lessen human impacts on the environment like organic farming.
- Organisation of communities to adopt low impact environmental activities (e.g., tourism and tour guiding) or to represent user groups (e.g., hunters associations and logging interests).

Most of these organisations are relatively small and traditionally receive funding for their operations from members' contributions and donations. These funding sources are being superseded in some groups by environmental consultancies, grant funding, and participation in ecotourism. To have a greater

impact on conservation, a more proactive approach is required. The general view among groups is that their efforts are not appreciated, that they are not consulted on matters, and that they are perceived as a nuisance by state managers. Several of them have complained of no support from state officials when they report illegal activities.

The growth and capacity of NGOs and CBOs in terms of biodiversity conservation is also constrained by a lack of support by some state agencies, and this limits their effectiveness. NGOs and CBOs have tremendous potential and need be encouraged. They represent a committed constituency that could form productive partnerships with state institutions. Their continued growth and strength is tied to the state's perception of them and collaboration with them.

The capacities of state agencies and NGOs to jointly manage and conserve biodiversity are linked. Strengthening linkages would benefit the country's biodiversity resources. Neither state agencies nor NGOs will ever have the resources required to manage biodiversity independently. The mutual development and support of stakeholders and their institutions is required to build the country's capacity to manage biodiversity in its broadest sense.

Technical (Managerial)

The legal authority for the conservation of biodiversity in T&T resides with government agencies. Their efforts are often frustrated by their inability to effectively enforce laws and they are, therefore, constrained in their efforts to achieve their objectives. Some of the factors that inhibit the state agencies are: (1) the inability of many institutions to adapt to environmental, social, and economic changes; (2) failure to keep abreast with changing global trends in management; (3) gaps in the collaborative efforts of agencies (public sector, private sector, NGOs, CBOs, and research institutions); and (4) resistance to change in some sectors of public service. This resistance or inability to change is reflected in: (1) poor staffing levels, dearth of motivation, and personnel commitment; (2) low training levels and gaps in training; (3) inadequate and inappropriate deployment of finances; (4) inappropriate prioritisation within departments; (5) non-participatory approaches to planning and management; and (6) insensitivity to community needs.

BIODIVERSITY CONSERVATION, TOURISM AND SUSTAINABLE DEVELOPMENT

The advent of nature based tourism has forced authorities to scrupulously examine ways to protect the environment. One of the most pressing issues confronting administrators is how to cope with increasing tourist demands while protecting the ecosystems that attract them. The consequences of increasing demands for resources may result in the: (1) inability to maintain an adequate waste disposal system; (2) destruction of ecosystems by exceeding carrying capacities; and (3) possible introduction of harmful exotic pathogens. Unplanned tourist activities such as hiking, camping, horseback riding, and mountain biking may contribute to the loss of ground cover as well as wildlife. Clearing of areas for campsites and picnic spots even if done with care can also adversely affect biodiversity through the loss of the ground cover.

Proposed Strategies and Solutions

Some of the priorities and strategies stated in the NBSAP for the integration of biological diversity into all sectors of devel-

opment, including tourism, are:

- **Education and awareness:** (1) build education and awareness programmes in biodiversity conservation on existing initiatives and fill gaps in formal and informal approaches; (2) foster greater collaboration in conservation and education initiatives between all the stakeholders; and (3) heighten the sensitisation of communities to biodiversity concerns by involving them directly in the planning and management phases for these resources.
- **Legislation and enforcement:** (1) make legislation and regulations more effective management tools through harmonisation, and by incorporating the use of new technologies and greater stakeholder involvement; and (2) improve law enforcement and utilise it as an important tool for management and biodiversity conservation.
- **Capacity:** (1) establish a structured mechanism for sharing information, training, and experiences amongst agencies and their stakeholders; (2) develop advocacy tools for building consensus on biodiversity issues at the highest political levels; and (3) strengthen NGOs and CBOs so that they may play a greater role in the conservation and management of biodiversity towards sustainable livelihoods .

Policy and Commitment

Policy objectives for biodiversity conservation must be integrated into policy statements for all sectors. This could be achieved by:

- Establishing a national commission for sustainable development to integrate T&T's obligations under the CBD and other agreements into the country's policies.
- Organising ministerial workshops to consider the integration of biodiversity concerns into sector policies, discussing their implications for plans, programmes, and projects in all Ministries.
- Initiating a systematic review of government policies which affect biodiversity and conservation, and adopt proactive policy interventions to ensure biodiversity concerns are addressed.
- Conducting periodic assessments to determine how institutions can be strengthened to develop an integrated policy process.
- Developing a policy process for adoption by the government and NGOs to ensure that strategic action plans incorporate conservation issues regarding biodiversity and the environment as a whole.

CASE STUDY – NSI IN TRINIDAD

Introduction

Matura Beach Protected Area, an 8 km stretch of beach on Trinidad's northeast coast, is one of the five most valuable nesting rookeries on earth for the endangered Leatherback sea turtle. In the last 3 years, >7000 nesting Leatherbacks have been documented. Until recently, hundreds of nesting Leatherbacks were killed and thousands of their eggs were poached annually.

In the late 1980s, the annual slaughter of turtles by subsistence hunters during the nesting season was beyond the capacity of local wildlife authorities to handle. Since it was impossible to compensate the villagers financially, a strategy was developed to reward them by linking turtle protection with a sustainable livelihood. The authorities organised the local villagers and provided them with training to combine beach patrolling with

tour guiding. NSI was formed and it helped to make the beach safe for turtle nesting since the livelihood of the villagers depended on it. NSI members were both ecotourism guides and environmental educators.

Participatory Approach for Sustainable Leatherback Management

For >20 years, the efforts of the Forestry Division to prevent nightly slaughtering of Leatherback turtles and egg poaching during the nesting period at Matura Bay, Trinidad, was ineffective. This was due to the paucity of officers to patrol the beaches and the scarce financial resources allocated to wild life conservation. In 1989, through the efforts of Carol James, the Head of the Wildlife Section, approaches were initiated with community activists to assist with turtle protection. The state offered little support for the new initiative. The response from the community, however, was overwhelming and a genuine dialogue continued between the Forestry Division and community youths, women, teachers, political activists, and other villagers. This was followed by 18 months of information sharing, education, and training, culminating in 1990 with the creation of the NSI, a CBO. This transformed a sleepy little village into a proud group of people whose efforts were appreciated and supported by foresters who, without realizing it, had changed forever relations between the state and communities. Subsequently, this partnership developed into an ecologically sustainable turtle management programme with strong economic and social benefits for the state and for the community of Matura.

NSI's involvement reversed the scenario from the slaughter of 60 turtles per month to protection of turtles along the 8-km beach. Today, state assistance continues in the following areas: (1) training in basic biological conservation and benefits from sustainable use of the resource; (2) training in ecologically sensitive tour guiding with emphasis on turtle nesting sites; (3) declaring the beach as a Protected Area; (4) developing basic research and resource assessment programmes in collaboration with the community; and (5) supporting national and international scientific investigations. The government now responds to community requests for guidance, enabling new policy measures to be implemented as they evolve. In turn, the community receives socio-economic and conservation benefits that have accrued from its effective participation.

Participatory Approach and Villager Ownership

NSI consists mainly of villagers from Matura who share a concern and love for the turtles. In 1990, the proclamation of Matura Beach as a prohibited area evoked protests from the villagers who felt that it was unfair. The beach was, and still is, a recreational site for most of them. Prior to the ban, the annual nesting season represented a part-time income for some through the sale of turtle meat. NSI was born as a response to the possible loss of seasonal income and a recreation site.

The first step was taken when villagers participated in joint discussions with government for access to the beach. An agreement was reached when villagers were given permits to conduct tours in the protected area, protecting both turtles and the beach. A few villagers were appointed as Honorary Game Wardens and the number will likely increase. With the acquisition of training in tour guiding skills, NSI earned income from the programme.

Although guides started making a sustainable living from turtle tours, villagers who

previously sold turtle meat were disgruntled. Poaching continued and could not be curbed since the Wildlife Section did not have enough guards. The NSI then decided to provide volunteer assistance by working a patrol roster. During peak nesting season, as many as 10 guides were out on any given night with the patrols. The NSI realized, however, that their efforts were not enough to ensure the survival of the turtles. In response, the group started a community outreach programme to sensitise villagers about turtle protection. When the NSI could not reach adults, they targeted children through discussions at school feeling that youngsters could influence the adults. The NSI boasts that the programme has been successful. Today, villagers constantly look for threats and call the NSI if they suspect poaching. NSI has also managed the growth of spin-off industries in Matura, such as bed and breakfast accommodations to encourage visitors to overnight in the village.

As a member of the Wider Caribbean Sea Turtle Conservation Network, the programme of NSI has become a model for sea turtle conservation, and its methods have been used with success elsewhere in the region. But such success is not prevalent everywhere. The United States and the World Conservation Union classify the Leatherback as endangered and critically endangered, respectively. In the Pacific, Leatherback populations have plummeted, and some nesting beaches are practically deserted. Matura is now a model for ecotourism development, and tourism officials show up regularly to study its methods. Some local tour guides were former poachers or came from poaching families.

NSI began as a tour guide service for visitors who came annually to see Leatherback turtles nesting on Matura Beach. Today they are recognised by the United Nations as an NGO. During their 18 years of existence, they have managed to win several impressive ecotourism and conservation awards, including: (1) in 1993, enrollment in the Global 500 Award Roll of Honour; (2) in 1995, the Caribbean Conservation Association Award; (3) in 1997, the government of T&T Environmental Achievement Award; (4) 1997, EMA certificate of appreciation; (5) in 1998, British Airways Regional Award of the Americas; (6) in 2000, Caribbean Conservation Association Award for innovation in tourism management; and also (7) in 2000, an EMA Green Leaf Award.

CONCLUSIONS – NSI

Tourists to Matura Beach disturbed nesting Leatherback turtles, an endangered species. Moreover, local fishermen slaughtered turtles for meat and eggs. The creation of patrols to monitor beaches during the nesting season promoted conservation while involvement with tourism activities generated economic benefits for the area's residents. NSI, a community-based organization, worked in cooperation with the Wildlife Section of the Trinidad Ministry of Agriculture, Land and Marine Resources in the Matura programme. Training programs for tour guides were established, generating employment and securing greater protection by involving the private sector. The NSI improved the local community by blending sustainable tourism, nature conservation, and economic growth.

The Matura programme has already had an impact on other communities in Trinidad as well as internationally. Programme achievements include: (1) creating a model for the protection of natural resources through a joint government-community effort; (2) replicating the pilot initiative in Trinidad as well as in Sri Lanka; (3) promoting heritage tourism and ecotourism as a means to achieve sustainable forms of economic development; (4) ca-

pacity-building through training programmes for tour guides and wildlife conservationists resulting in increased economic development opportunities; and (5) reversing a trend that was leading to the destruction of an endangered species while making it possible to share and exchange lessons learned with others.

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Appendix Table. Abbreviations used more than once in text, or cited in references.

Acronym	Meaning
BPSP	Biodiversity Planning Support Programme
CBD	United Nations Convention on Biological Diversity
CBO	Community-based Organization
GDP	Gross Domestic Product
CITES	Convention of International Trade in Endangered Species of Wild Fauna and Flora
EMA	Environmental Management Authority
GREAT	Grande Riviere Environmental Awareness Trust
IUCN	International Union for Conservation of Nature
MALMR	Ministry of Agriculture Land and Marine Resources
NBSAP	National Biodiversity Strategies and Action Plans
NGO	Non-governmental Organization
NSI	Nature Seekers Inc. (a CBO)
OAS	Organization of American States
TIDCO	Tourism and Industrial Development Company
T&T	Trinidad and Tobago
UNEP	United Nations Environment Programme
UWI	University of the West Indies World Trade Organization
WTO	World Trade Organization

PHOTO GALLERY

Figure 1. Folk dancers entertained the delegates at the opening session.

Figure 2. Caribbean Foresters discussion during the country report session.

Figure 3. Maria Jose Edtwards from Dominica was an invited speaker at the CFM.

PHOTO GALLERY

Figure 4. Attractive entrance sign to the Syndicate Visitor Center and Nature Trail in the Morne Diablotin National Park.

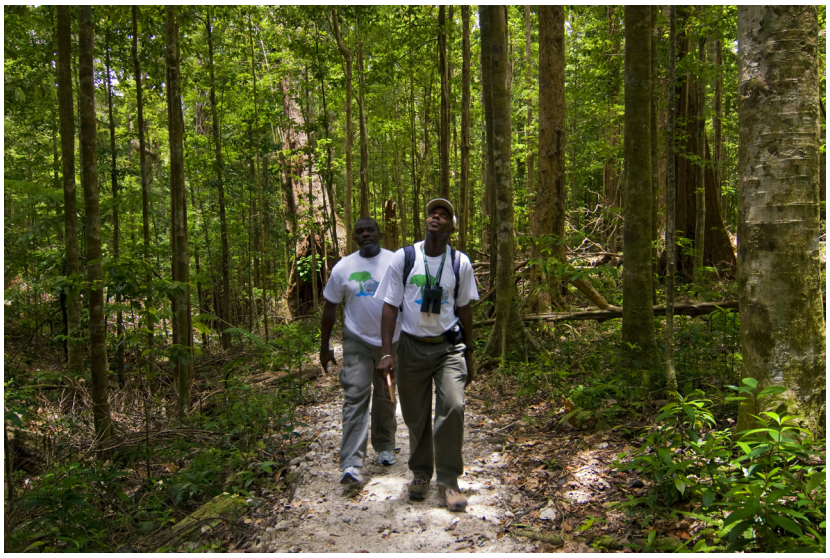

Figure 5. Caribbean Foresters hiking the Syndicate Nature Trail.

Figure 6. Caribbean Foresters pose for group photo along the Syndicate Nature Trail.

PHOTO GALLERY

Figure 7. Ancient trees dominate the landscape along the Syndicate Nature Trail.

Figure 8. Large chataignier (*Sloanea* sp.) along the Sindicate Nature Trail.

Figure 9. Northwest coast of Dominica.

PHOTO GALLERY

Figure 10. Local historian Dr. Lennox Honeychurch led a field trip to Cabrits National Park.

Figure 11. Dr. Lennox Honeychurch interpreting the history of Fort Shirley, Cabrits National Park to the Caribbean Foresters.

Figure 12. An original cannon lays on the grounds of Fort Shirley, Cabrits National Park.

PERMANENT PLOT MONITORING IN GRENADA'S MONTANE RAIN FOREST

Peter L. Weaver, Dean Jules and
the Grenada Forestry Department staff

ABSTRACT

Long-term monitoring of Montane rain forest in Grenada showed that mean dbh (diameter at 1.4 m above the ground) for all surviving stems ≥4 cm averaged 0.09 cm/yr between 1994 and 1999, and 0.12 cm/yr between 1999 and 2007. Hurricane Ivan of 2004 had a major impact on the forest, damaging all but an estimated 25 of the 2800 trees on a hectare basis. Measurements from 1999 to 2007 showed a 23% reduction in basal area and an estimated 54% loss in total aboveground biomass due to tree mortality or damage. Biomass mortality was >29 times greater and biomass ingrowth nearly 11 times greater during the second measurement period than during the first measurement period.

INTRODUCTION

Grand Etang lies in south central Grenada where the highest mountains rise to about 750 m in elevation (Beard 1944a, 1944b). In 1906 the area around Grand Etang, including the peaks known as Fedon's Camp, Morne Quaqua, and lands to the south, were set aside as the Grand Etang Reserve (Marshall 1932). Today, Lower montane rain forest, Montane rain forest, and dwarf forest occupy much of the 1750 ha reserve (Weaver 1989a).

The climate of Grand Etang is cool and humid, with a brisk breeze characterizing the more exposed areas. Rainfall on the peaks approaches 4000 mm/yr, with about 20% falling during the months of February through May, and 80% the rest of the year (Beard 1944a). Due to its location south of the major hurricane belt, Grenada has escaped most major storms. The exceptions were Hurricane Janet in 1955 and Hurricane Ivan in 2004. In addition, seven gales were recorded between 1768 and 1921 (Knight 1946).

During the 1940s, several of Grenada's forests were surveyed (Beard 1944a, 1949). Trees in Montane rain forest rarely exceeded 12 m in height or 60 cm in dbh. Of the tree species that were tallied, *Micropholis guyanensis* was dominant, accounting for 30% of the total (Beard 1944a). Although Beard visited the different forest types, his field surveys were limited to general ecological observations and tree species identification by forest type (Beard 1949). No permanent plots were established.

The Lesser Antilles have no tradition of natural forest monitoring; some efforts, however, have been made to re-measure forest plantations. The purpose of this report is to show the results of 13 years of permanent plot monitoring within Montane rain forest at Grand Etang. Changes in forest structure and tree growth after the passage of Hurricane Ivan were topics of special interest.

METHODS

In 1994, all trees with a dbh (diameter at 1.4 m above the ground) ≥4.0 cm were identified to species and measured to the nearest 0.1 cm on a 0.04 ha (20 x 20 m) plot located in Montane rain forest about 100 m above Grand Etang along the trail to Mt. Quaqua. Trees were permanently marked using aluminum nails and tags placed 15 cm below dbh, a prac-

tice which averts future errors in case of swelling. Subsequent measurements were made in 1999 and in 2007. At that time, survivors from 1994 were re-measured and ingrowth (trees attaining the minimum dbh class) and mortality were also tallied. Height was estimated in 1994 and 2007. Small trees were included to provide information on their early survival and growth.

Stem density and basal areas were determined; moreover, total aboveground biomass (hereafter, biomass) was estimated using equations de rived for Montane forest in Puerto Rico (Weaver and Gillespie 1992):

$$Y = 4.7962 + 0.0310\ D^2H,\ (r^2 = 0.86,\ n = 18),$$

where Y equals total above ground biomass (kg), D equals dbh (cm), H equals height (m), r^2 equals the coefficient of determination, and n equals the number of observations. All measurements were carried out with the help of the Grenada Forestry staff and collaborators (Figures 1 and 2).

Some measure of caution should apply to the results of this study. The sample area was small and was not replicated. Moreover, the biomass equation was derived from trees sampled in pre-hurricane conditions in a Puerto Rican Montane rain forest.

RESULTS

In 1994, the plot had 13 species with a dbh range between 4.2 and 32.3 cm (Table 1). *Micropholis guyanensis* was the dominant species with about 75% of the stems and 80% of the basal area. Hurricane Ivan had a major impact on Montane rain forest, damaging all but an estimated 25 of the 2800 trees on a hectare basis, as follows: leaning = 100 trees, snapped = 900, leaning and snapped = 375, uprooted = 125, and dead (i.e., snapped, uprooted, or standing dead) = 1275 trees. In addition, the

Figure 1. Montane rain forest during the second measurement in 1999. The forest understory was easy to walk through.

Table 1. Ranking of species by density and basal area (BA) dominance on a 0.04 ha Montane forest plot in Grenada. Measurements: initial in 1994, intermediate in 1999, and final in 2007.

Species	Initial		Intermediate		Final		Stem		Growth	Growth	Initial
	Stems	BA	Stems	BA	Stems	BA	Ingrowth	Mortality	94-99	99 - 07	dbh range
	(no./ha)	(m^2 /ha)	(no./ha)	(m^2 /ha)	(no./ha)	(m^2 /ha)	(no./ha)	(no./ha)	(cm/yr)	(cm/yr)	
Survivors from 1994											
Bagui[1]	50	0.62	50	0.72	50	0.80	0	0	0.14	0.80	10.4-14.7
Cacoli[1]	150	2.88	150	3.02	75	2.62	0	75	0.07	0.14	9.8-20.7
Cassipourea guianensis	25	0.02	25	0.02	25	0.05	0	0	0.08	0.08	4.2
Cross grain[1]	50	0.15	50	0.15	25	0.05	0	25	0.03	0.02	4.6-7.4
Dacryodes excelsa	50	0.12	50	0.12	50	0.15	0	0	0.00	0.07	5.0-6.1
Damaween[1]	25	0.30	25	0.30	0	0.00	0	25	0.06	NA[2]	12.5
Laurier caca[1]	25	0.25	50	0.25	25	0.33	25	25	-0.02	0.18	11.5
Laurier santai[1]	100	1.35	100	1.35	25	0.23	0	75	0.01	-0.01	6.1-20.0
Micropholis guyanensis	2100	28.90	1900	31.92	1125	23.82	25	1000	0.10	0.13	4.2-32.3
Penny piece[1]	50	0.92	50	0.92	25	0.70	0	25	-0.01	0.06	11.6-18.4
Santai big leaf[1]	50	0.12	50	0.12	25	0.10	0	25	0.00	0.06	4.3-6.5
Santai sml leaf[1]	75	0.12	75	0.15	50	0.13	0	25	0.01	0.05	4.6-5.5
Unknown	50	0.03	50	0.02	25	0.01	0	25	0.01	0.01	5.2-13.4
Subtotals/Means	2800	35.81	2625	39.06	1525	28.98	50	1325	0.09	0.12	4.2-32.3
New Species in 2007[3]											
Cecropia peltata[4]					475	0.85	475	0	0	1.58	4.2-6.0
Ocotea sp.[4]					50	0.01	50	0	0	NA	4.4
Simarouba amara[4]					25	0.05	25	0	0	1.83	5.5
Subtotals					550	0.91	550	0	0	NA	NA
Totals	2800	35.81	2575	39.06	2075	29.89	550	1275	NA	NA	NA

[1]Data were initially recorded using common names, some of which remain to be identified to species.
[2]NA = not applicable and blank spaces = no data.
[3]Ingrowth was recorded in 1999; however, all species had been previously noted (see stem ingrowth column).
[4]Hurricane Ivan occurred in 2004. Dbh growth rates for Cecropia and Simarouba were based on 3 years only, assuming immediate reproduction after the storm. Ocotea sp. may have already been present in the stand when the Ivan passed over Grenada.

amount of post-storm foliage on standing trees was considerably less in some instances due to the snapping or pruning of branches or parts of the crowns. Stem numbers were reduced by 45% and basal area by 20%.

After Hurricane Ivan, *Cecropia peltata* accounted for 86% of the ingrowth. Assuming that it regenerated immediately, its dbh growth averaged nearly 1.6 cm/yr during the post-hurricane period (Table 1). *Simarouba amara* also grew rapidly after the storm. Dbh growth averaged about 0.10 cm/yr for *Micropholis guyanensis* before the passage of Ivan, and 0.13 cm/yr afterwards, a pattern also noted for other species. *Micropholis guyanensis* grows very slowly when <10 cm in dbh but rapidly when ≥15 cm (Figure 3).

Basal area increased by 9% between 1994 and 1999, and then declined by 23% between 1999 and 2007 (Table 1). Total aboveground biomass increased by about 10%, or 3.5 t/ha/yr between 1994 and 1999 (Table 2). Between 1999 and 2007, after Hurricane Ivan, the decline in biomass was about 54%, with most of the loss due to tree mortality (Table 1). Biomass ingrowth after the hurricane was nearly 11 times greater than before the storm, and biomass mortality >29 times greater than the pre-storm amount.

DISCUSSION

Hurricane Ivan, the first hurricane to pass over Grenada in nearly 50 years, had a major impact on the Montane rain forest, leaving much of the area virtually inaccessible (Figure 4). Considerable damage was also done to other native forest types, cultivated crops, homes, business establishments, and infrastructure.

The 13 species tallied in this study approximate the 16 tree species noted during an earlier 0.3 ha survey in the same area (Beard 1949). In Puerto Rico's Montane rain forest, species numbers averaged 15 on many 0.05 ha plots, and up to 40 to 45 on a few 0.4 ha plots (Weaver 1989b, 2000). Although the sample size in Grenada is extremely small, the relative paucity of species was noted earlier and attributed to past logging of the best timber species (Beard 1949).

Table 2. Changes in aboveground biomass on the Montane rain forest plot.

Visitor Type	Year				
	1994	1994-99	1999	1999-2007	2007
Standing biomass	174.90		193.26		88.57
Ingrowth		0.38		4.12	
Survivor change[2]		21.88		-35.01	
Mortality[3]		-3.72		-73.42	

[1]Blank spaces indicate no data or not applicable.
[2]Damage equals biomass loss due to snapping of stems, reducing their length.
[3]Biomass mortality equals the total biomass of all dead stems that died during the measurement period using tree dimensions at the beginning of that period (i.e., for mortality between 1994-99, the biomass of stems as determined in 1994)

Figure 2. Survey crew during June 2007 on the trail to Mt. Quaqua near the entrance to the Montane rain forest plot.

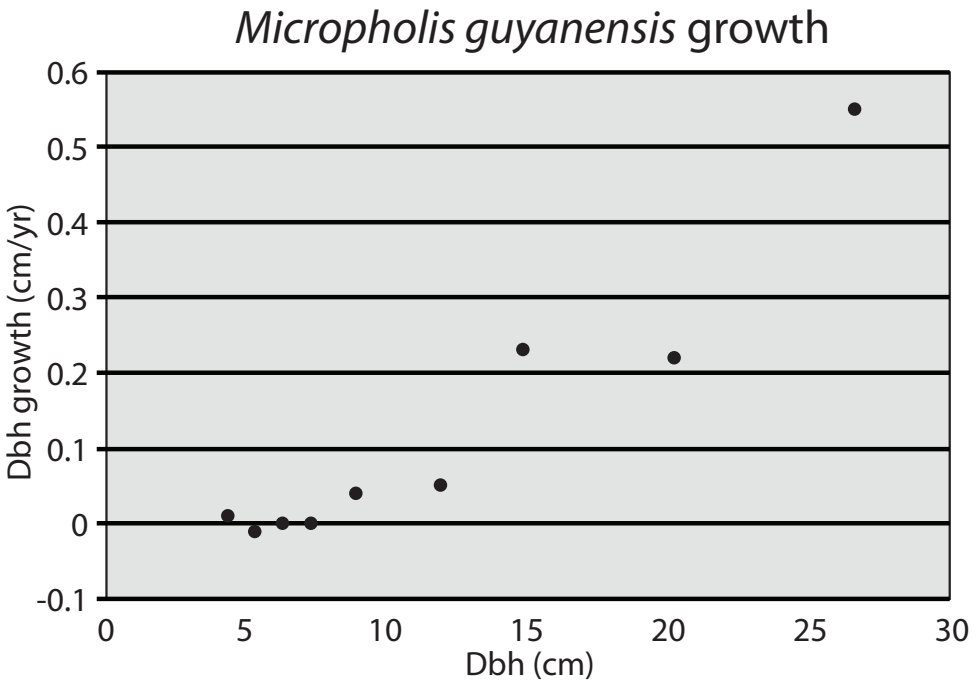

Figure 3. Mean diameter growth rates by size class for *Micropholis guyanensis* in Grenada's Montane rain forest.

Figure 4. Secondary growth, including sawgrass to more than 3 m, makes surveying the Montane rain forest extremely difficult after Hurricane Ivan of 2004.

How do the native forests of Grenada, which are less exposed to hurricanes than forests on islands farther north in the Caribbean Basin, compare with regard to amounts of damage and subsequent recovery? Meaningful comparisons would depend on the existence of similar data sets – that is, about the same number of well-distributed permanent plots of similar size that encompass comparable periods of measurement; unfortunately, such data sets do not exist.

Some observations, however, may be made. Pre-Ivan conditions on the Grenada plot (about 40 years after Janet) compared with 0.05 ha plots sampled in a Puerto Rican Montane rain forest (about 50 years after Hurricane San Ciprián in 1932) showed that the stem density and total aboveground biomass estimates in Grenada were about 15 to 20% greater (Weaver 2000). Basal areas tallied on larger 0.4 ha plots from 15 to 45 years after San Ciprián, however, were similar (Weaver 1989b).

The post-hurricane increase in dbh growth rates observed in Grenada (Table 1) was also noted in Puerto Rico. Dbh growth rates declined from 0.14 cm/yr in the period 15-20 years after San Ciprián to 0.09 cm/yr in the period 44 to 49 years later (Weaver 1989). It is likely that dbh growth on survivors will remain comparatively rapid until stem density increases.

The >50% loss of biomass by Grenada's Montane rain forest may have been approached after San Ciprián in Puerto Rico's montane rain forest. Biomass recovery from 1946 to 1981 on seven 0.4 ha plots was 23.5 t/ha (i.e., from about 120 to 145 t/ha) (Weaver 1989b). Therefore, damage was about 23.5/120 t or about

20%. In addition, an unknown amount of biomass accumulated between 1932 and 1946 at a time was increment was undoubtedly rapid.

Grenada has the only regularly monitored permanent plots in native forests of the Lesser Antilles. Continued work on these plots could provide much valuable information on forest structure, species composition changes, and dynamics, including dbh and biomass increment. An interesting story could be told about post-hurricane recovery to visitors at the Grand Etang Visitor Information Center.

ACKNOWLEDGMENTS

Many individuals have helped with plot establishment and data collection: Martin Barrriteau, Kester Charles, Alban Clark, William Hawthorne, Quentin Holden, Alan Joseph, Dean Jules, Shawn Philbert, and Augustus Thomas. This work was done in cooperation with the University of Puerto Rico, Río Piedras, Puerto Rico.

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CONSERVATION STRATEGIES: LONG-TERM MONITORING OF PERMANENT PLOTS IN CARIBBEAN FOREST RESERVES

Peter L. Weaver

ABSTRACT

Permanent plot monitoring has a long history in the Caribbean region. The earliest plots were established in various forest types of Puerto Rico and Venezuela during the 1940s and 1950s. In 1980, Puerto Rico initiated an inventory of secondary forest throughout the island, and in 1984 a similar inventory was set up on the island of St. Vincent. The Institute staff and its collaborators also established permanent plots in the U.S. Virgin Islands, Grenada, Nicaragua, and the Dominican Republic. The plots provide valuable ecological information on tree occurrence, species composition, stand structure, and forest dynamics. They also facilitate cooperative activities among environmental groups and agencies, and present research and educational opportunities for teachers and students in botany, ecology, forestry, and related sciences. Permanent plots may also provide a novel experience for ecotourists. Finally, the plots provide useful environmental information for the management of natural areas, and importantly, a friendly presence in and surveillance of the natural areas by those who recurrently conduct the measurements.

INTRODUCTION

The International Institute of Tropical Forestry (IITF) has a long history of permanent plot monitoring in Puerto Rico. Long before today's permanent plot enthusiasts began taking measurements in Caribbean forests, the earliest pioneers of monitoring -- Wadsworth (1951) in Puerto Rico and Veillon (1957, 1983) in Venezuela -- were already responsible for nearly one-half of a century of data collection. The Puerto Rican plots were located mainly in the Luquillo Experimental Forest and the Commonwealth forest reserves, including mangrove, karst, and interior mountainous sites, and ranged from sea level to nearly 1000 m in elevation. The eight Venezuelan sites included plots ranging from tropical deciduous forest at low elevations up to Andean cloud forest at 2,700 m. Judged by the aforementioned efforts, it would seem that tagged trees on forest plots with <15 or 20 years duration, especially if they have not been re-measured, would have to be judged as attempts at long-term measurements rather than permanent plot monitoring.

The purpose of this report is to briefly review natural forest monitoring on permanent plots in the greater Caribbean Basin, highlighting sample plot designs and major results. Some previously unpublished results from recently established plots are also included. The reference material, although not exhaustive, calls attention to the existing literature on forest monitoring and provides current information for a variety of sites.

METHODS -- DESIGN AND MEASUREMENTS

The methods for plot establishment and measurement are basically the same regardless of site. All trees on the plot with diameters at or above a specified dbh (diameter at 1.4 m above the ground) class are measured. All trees are tagged and identified by common and scientific names using local references. In Puerto Rico, many plots included all stems ≥4 cm dbh. A diameter tape and rangefinder (or

height pole) were used to measure dbh (to the nearest 0.1 cm) and to estimate heights (to the nearest 0.5 m), respectively. Trees were tagged using aluminum nails placed 15 cm below dbh, a practice used to avert future measurement errors in case of swelling around the nail. Trees in small dbh classes (i.e., classes between 4 and 10 cm) were included to provide information on their early survival and growth.

Subsequent measurements were made at intervals, usually 5 to 10 years, at which time all survivors were measured again. Moreover, ingrowth (trees attaining the minimum dbh class) and mortality were also noted. The plots may also be surveyed rapidly to assess damage after major disturbances like hurricanes. Stem density and basal area are determined from the basic data, and total biomass is calculated in cases where local biomass equations are available. Plot size has varied by vegetation type and with sampling objectives. In some cases, plots were established along environmental gradients (elevation and topography) because of an interest in species-site relationships or growth differences by site.

Permanent monitoring plots were first established in several of Puerto Rico's moist forests (Tables 1 and 2). Later, plots were set up in secondary forest throughout the island, at specific Puerto Rican dry forest sites, in the U.S. Virgin Islands, and in other countries (Table 3).

MAJOR RESULTS AND BRIEF DISCUSSION

Monitoring in Puerto Rico

Researchers at the IITF began using permanent plots to gather information on species composition and growth rates as early as 1937 in several different forested areas throughout the island (Table 1). The major' effort in the Luquillo Experimental Forest (LEF) began in the mid-1940s (Table 2; Figures 1, 2 and 3). After determining basic species compositions and growth rates in the mid-1950s, measurements were discontinued until the mid-1970s. In 1980, permanent plots were established throughout Puerto Rico's secondary forests (Weaver and Birdsey 1982; Franco et al. 1997). Fortunately, both dendrology and taxonomy began early in Puerto Rico and the U.S. Virgin Islands and continued into the new millennium. For nearly a century, researchers published several comprehensive texts describing plants that are found throughout the Caribbean Islands (Acevedo-Rodriguez and Strong 2005; Acevedo-Rodriguez et al. 1996; Britton 1918; Britton and Wilson 1923-26; Howard 1979; Howard 1988-1989; Liogier 1985-97; Little and Wadsworth 1964; Little et al. 1974).

Among the most recent studies in Puerto Rico are those set up in subtropical dry forest in two widely separated locations – at Las Cabezas de San Juan in the northeastern tip of the island and at Tinaja in the island's southwestern corner (Table 4). At Las Cabezas de San Juan, *Leucaena leucocephala* invaded and grew rapidly in small openings after Hurricane Hugo in 1989 (Weaver and Coll Rivera 2002; Weaver et al. 1999). Leucaena, however, did not regenerate in the understory as the residual trees on the plot recovered their canopies indicating that the species will decrease considerably, or disappear altogether in the absence of additional disturbance.

Table 1. Past permanent plots of the International Institute of Tropical Forestry (IITF) in the forests of Puerto Rico[1].

Location	Description - Forest type, soils, elevation, silviculture (dates measured)
Subtropical moist forest life zone	
St. Just	early secondary, volcanic, 60 m, thinned (1952, 1954)
Cambalache	secondary, limestone, 40 m, natural regeneration, (1950, 1976)
Carite	late secondary volcanic, 725 m, thinned (1951, 1987)
Piñones mangrove	mangrove, deep organic, sea level, cleared in 1937, some thinned (1938, 1945, 1949, 1951, 1955, 1975)
Subtropical wet forest life zone	
Maricao	late secondary, volcanic, 930 m, thinned (1951, 1976)
Toro Negro	mature, acid clay, 670 m, selective thinned (1951, 1975)

[1]Weaver 1979, 1982, 1983.

Table 2. Current permanent plots of the International Institute of Tropical Forestry (IITF) in the forests of Puerto Rico[1].

Location	Size (ha)	Elevation (m)	Dates measured (1943 to 2003)
Lower montane forest[1]	2.32	340-600	~9 times from 43 to 03
Lower montane forest[2]	16.00	150-350	3 times since 90
Lower montane forest[3]	24.00	180-600	57, 62, 75, mid -90s
Palm brake[4]	1.05	500-570	~6 times from 46 to 90
Montane forest[5]	3.60	640-880	~7 times from 46 to 90
Dwarf forest			
Plane wreck [6]	0.08	1000	72, 86, 98, 05
Summit plots[7]	0.15	1000	90, 95, 01, 05

[1]Six plots: one of 0.720 ha, three of 0.40 ha, and two of 0.20 ha (Crow 1980; Weaver 1998, 2002).
[2]Pan-tropical network of forest dynamics plots (Soil Survey Staff 1995; LTER Sites-Luquillo LTER-LUQ 2007 (internet)).
[3]The 300-plot study of crop trees in Sabana 4, Sabana 8, and Río Grande 3 (Crow and Weaver 1977).
[4]Two plots 0.40 ha, and one 0.25 ha (Frangi and Lugo 1985; Lugo et al. 1995).
[5]Nine plots 0.40 ha (Weaver 1986, 1987, 1989).
[6]Plane crash site, 1968 (Byer and Weaver 1977; Weaver 2000).
[7]Six plots, each 0.025 ha, stratified by topography (ridge, slope, and ravine).

The permanent plots at Tinaja were set up in area that had been recurrently burned and grazed for nearly a century (Weaver and Chinea 2003; Weaver and Schwagerl 2005; Figure 3). Grass and scrub woodland dominated the landscape. After the elimination of fire and grazing in the mid-1990s, native tree species along with Leucaena regenerated successfully, greatly increasing the woody cover within 10 years. Although Leucaena is widely maligned as an invasive species, it should also be recognized for its capacity to establish rapidly on degraded sites and ultimately shade out grass cover in fire-prone areas.

Table 3. Permanent plots established since 1980 by the International Institute of Tropical Forestry in Puerto Rico, the U.S. Virgin Islands, and other countries[1].

Location	Size (ha)	Elevation (m)	Dates measured
Puerto Rico and U.S. Virgin Islands			
Las Cabezas de San Juan[1]	0.10	50	94, 98
Cartagena Lagoon (Tinaja)[2]	3.42	20-290	98
Guanica Forest[3]	1.40	175	early 80s
Secondary Forest [4]	---	5-600+	80, 85, 90, 02
Cinnamon Bay, St.	0.80	60-240	83, 88, 93, 98, 03
Other Countries			
Guaconejo, Dominican Republic[6]	1.00	150-450	99
Grand Etang, Grenada[7]	0.44	500-600	94, 99, 07
Volcan Mombacho, Nicaragua[8]	2.78	900-1150	98

[1]One plot 50 x 10 m in secondary semi-evergreen seasonal forest at Cabezas de San Juan Natural Reserve.
[2]Inventory with 109 circular 0.0314 ha plots in the 110 ha in the Cartegena Lagoon National Wildlife Refuge (Weaver and Chinea 2003). Partially remeasured in 2003.
[3]One plot in secondary Subtropical dry forest (Lugo and Murphy 1986).
[4]Island inventory, 437 ground locations with fixed and variable radius plots (Birdsey and Weaver 1982).
[5]Sixteen plots 500 m^2 in late secondary forest (Weaver and Chinea-Rivera 1987).
[6]Nine plots 1000 m^2 plus a transect 50 x 20 m in mature forest in the Cerro Guaconejo Reserve (University of Alicante, Spain; PRONATURA; SODIM) (Pastor 1999).
[7]Plots of 0.4 ha in lower montane and 0.04 ha in montane forest (Weaver 1997).
[8]Five plots 0.50 ha and one plot 0.28 ha on Mombacho Volcano (Weaver and Díaz Santos 2002).

Figure 1. Permanent plot monitoring in Lower montane rain forest in the Luquillo Mountains of Puerto Rico. The first measurements of the El Verde III plot were carried out in 1943.

Figure 2. Permanent plot monitoring in Montane rain forest in the Luquillo Mountains of Puerto Rico. The first measurements on Colorado slope date to 1946.

Figure 3. Permanent plot monitoring in Dwarf Forest at the summits of the Luquillo Mountains in Puerto Rico.

Figure 4. Permanent plot monitoring in secondary dry forest on the Tinaja tract of the Laguna Cartagena Wildlife Refuge in southwestern Puerto Rico.

Table 4. Changes in stem numbers and diameter growth at Las Cabezas de San Juan Reserve.

	Number of stems/ha				
	Total 1998	Ingrowth 1998	Mortality 2004	Total 2004	Mean growth (SE), n (cm/yr)[1]
Plot composition in 1998					
Bourreria succulenta	390	70	20	440	0.20 (0.03), 37
Bursera simaruba	40	10	0	50	0.12 (0.04), 4
Capparis hastata	90	0	0	90	0.09 (0.01), 9
C. indica	20	0	0	20	0.06 (0.02), 2
Cassine xylocarpa	200	10	10	200	0.09 (0.02), 19
Citharezylum fruticosum	30	0	0	30	0.03 (0.02), 3
Coccoloba microstachya	50	0	0	50	0.06 (0.02), 5
Erythroxylum rotundifolium	40	60	0	100	0.06 (0.04), 4
Ginoria rohrii	370	20	50	340	0.03 (0.01), 32
Guapira fragrans	10	10	0	20	0.25, 1
Leucaena leucocephala	180	280	50	410	0.24 (0.02), 13
Maytenus cymosa	10	0	0	10	0.15, 1
Pictetia aculeata	110	0	0	110	0.03 (0.01), 11
Pisonia subcordata	320	40	50	310	0.15 (0.02), 27
Securinega aciditon	30	60	0	90	0.14 (0.10), 3
Tabebuia heterophylla	160	0	20	140	0.06 (0.01), 14
Zanthoxylum monophyllum	120	30	30	120	0.10 (0.02), 9
Subtotal	2170	590	230	2530	0.11 (0.01), 194
New species: 1998-2004					
Croton astroites		10	0	10	
Eugenia biflora		10	0	10	
Total	2160	620	230	2550	

[1]SE = standard error; n = number of trees sampled.

Monitoring on St. John, U.S. Virgin Islands

In 1982, the Virgin Islands Resource Management Cooperative was formed among 14 agencies to initiate baseline research in the Park; by 1988, 29 reports had been completed (Anonymous 1988; Rogers and Teytaud 1988). In 1992, the integrated approach to marine and terrestrial research and status of several on-going studies was reviewed in the Park Science bulletin (Rogers 1992).

The first step toward the establishment of long-term research in the U.S. Virgin Islands was undertaken in 1982 when the vegetation of St. John and Hassel Islands was surveyed and mapped (Woodbury and Weaver 1987). In 1983, partially based on the survey, several sites were selected for continuous monitoring within the Cinnamon Bay watershed (Figure 5). The 20-year period of observation on the 16 Cinnamon Bay plots included two major hurricanes -- Hugo of 1989 and Marilyn of 1995. Among the major types of information available from the monitoring were (Weaver 1990, 1992, 1994, 1996, 1998, 2006; Weaver and Chinea-Rivera 1987):

Vegetation structure and diversity in 1983

- about 2700 trees and 70 tree species were identified;
- the mean height and diameter for all stems was 8 m and 9 cm, respectively;
- the 10 most common tree species accounted for 65% of the stems and nearly 50% of the basal area;
- stem density for all plots averaged about 3430 trees/ha, and varied as follows: 2540/ha in ravines, 2720/ha on slopes, 4390/ha on ridges, and 6600/ha at the summit;
- stem biomass for all plots averaged 150 t/ha, and varied as follows: 159 t/ha in ravines, 147 t/ha on slopes, 135 t/ha on ridges, and 206 t/ha at the summit; and
- the occurrence and relative abundance of tree species varied with elevation and topography within the watershed.

Vegetation dynamics between 1983 and 1988, and Hurricane Hugo impacts

- diameter growth rate averaged 0.07 cm/yr for all surviving trees, and varied by species, topography, elevation, and crown class;
- net primary productivity was 10.6 t/ha/yr;
- the impact by Hurricane Hugo varied significantly by tree species, with the Bay rum tree (*Pimenta racemosa*) showing exceptional resistance to damage (Figure 5);

Figure 5. *Pimenta racemosa* (Mill.) J.W. Moore (Bay Rum tree) in dry evergreen woodland at Cinnamon Bay on the Island of St. John.

- the tallest tree on 7 of the 16 plots was eliminated by Hugo;
- 10 and 19 months after the initial damage caused by Hurricane Hugo, mortality eliminated 210 and 228 trees/ha, respectively, and total biomass was reduced by >10%; and
- tree damage varied by environmental factors with greater damage on: (a) high elevation than on low elevation plots, (b) on valley and summit plots than on ridge or slope plots, and (c) on north-facing plots than on east- or west-facing plots.

Between 1984 and 1986, collaborators with the New York Botanical Garden set up permanent plots on Bordeaux Mountain, L'Esperance, and Hawknest (Earhart et al. 1988; Reilly et al. 1990; Table 5). After Hugo, these plots were assessed for damage (Reilly 1991, 1992, 1994, 1998; Rogers and Reilly 1998). In 1988, species diversity and forest structure were studied on plots at Mary Point, Lameshur, Cinnamon Bay, and Caneel Hill in cooperation with the University of Wisconsin (Brown and Ray 1993; Ray and Brown 1995a). Finally, between 1991 and 1994, collaborators in the Smithsonian Institution's Man and the Biosphere Program set up permanent plots on Caneel Hill and Cob Hill to determine species composition, stand structure, and dynamics (Dallmeier and Ray 1992; Dallmeier et al. 1993; Ray et al. 1998).

The monitoring plots on St. John represent differences in vegetation age (i.e., the time elapsed since agriculture was abandoned), plot sizes, and sampling design and procedures (Table 5). The Cinnamon Bay plots, in forest at least 125 years old, totaled 0.8 ha, initially contained 69 species, averaged 3378 trees/ha, and had an average basal area of 30.4 m^2/ha. The other monitoring sites on St. John, between 35 and 125 years in age, varied in species numbers from 8 to 62, in stem numbers from 1660 to 8574/ha, and in basal areas from 4.9 to 31.6 m^2/ha on plots between 0.1 and 1.0 ha in size.

As part of the same research initiative, a systematic approach to dry forest restoration was explored using preliminary analyses to determine factors that limit natural regeneration on different sites (Brown and Ray 1993). Seed ecology and the use of propagules (seeds, seedlings, and rooted cuttings) were tested for restoration of degraded lands (Brown et al. 1992; Ray 1993; Ray and Brown 1995b). Fruiting and flowering events for 66 woody species were observed in several areas during a 4-year period (Ray and Brown 1994). A survey of fruit dispersal of 148 native woody species showed that 74% was by animals, 18% by wind, 4% by sea currents, and 4% by self dispersion. Nearly 60% of the 29 woody species tested in shade house conditions showed >80% germination. The use of seedlings proved to be the most efficient method for restoration of abandoned pasturelands.

Monitoring Initiative in Grenada

Much of the initial ecological work in Grenada was done >50 years ago when tree species lists and abundances were reported for different forest types on the island (Beard 1944a, 1944b, 1949). In the interim, however, little has been done in the Lesser Antilles to determine forest dynamics, which would call for permanent plots and monitoring. In 1994, the IITF cooperated with the Grenadian Forestry Department and the U.S. Peace Corps to establish permanent forest plots in both the lower montane and montane rain forests at Grand Etang (Weaver 1997; Figure 6). Initially, all trees were tagged and an attempt was made to identify each species using published lists of common names (Marshall 1932, 1939; Beard 1949; Groome 1970); later, many of the species identities were confirmed and others

Table 5. Monitoring plots on St. John[1].

Forest type	Location	Age (yr)	Date[a]	Plots Size (no.)		Species[a] (no.)	Basal area (m^2/ha)	Source
Dry evergreen to gallery moist	Cinnamon Bay	125	1983	0.05		69	30.4	Weaver and Chinea 1987
Upland moist	Bordeaux	110	1984	1.00	1	62	31.2	Earhart et al. 1988
Gallery moist	L' Esperance	90	1985	0.50	1	56	31.6	Reilly et al. 1990
Dry evergreen woodland	Hawksnest	>70	1986?	0.50	1	52	26.5	
Secondary	Mary Point	35	1988	0.05	2	8	4.9	Brown and Ray 1993
Secondary	Lameshur	50	1988	0.05	2	23	17.9	Ray and Brown 1995a
Secondary	Caneel Hill	100	1988	0.05	2	27	22.9	
Secondary	Caneel Hill	100	1988	0.05	2	29	25.8	
Dry evergreen	Cinnamon	125	1988	0.05	2	30	25.3	
Dry evergreen woodland	Caneel Hill	80-100	1991	1.00	1	49	23.7	Dallmeier et al. 1993
Dry evergreen woodland	Cob Hill[b]	100-120	1994	1.00	1	45	21.8	Ray et al. 1998

[1]Adapted from Rogers and Reilly 1998. The minimum dbh varied by site: Set 1, Cinnamon Bay, 4.1 cm; Set 2, Bordeaux, L' Esperance and Hawksnest, 5.0 cm; Set 3, Mary Point, Lameshur, Caneel Hill, and Cinnamon. 4.0 cm; Set 4, Caneel Hill, 4 cm and Cob Hill, 2.5 cm.
[a] Initial survey data.
[b] Also called Minna Hill.

Figure 6. Plot monitoring in Lower montane rain forest at Grand Etang on Grenada.

corrected by visiting botanists.

In 1994, 27 species were recognized on the lower montane plot and >10 on the montane plot; basal areas were 51.5 and 35.8 m^2/ha, respectively (Table 6). *Dacryodes excelsa* accounted for 18% of the stems and nearly 45% of the total basal area in the lower montane forest and *Micropholis chrysophylloides* for 75% of the stems and nearly 80% of the basal area in the montane forest. Species diversity for both forests appears low (Beard 1949) and the basal area of the lower montane forest high when compared to similar stands in Puerto Rico (Weaver 1983). Many tree species grow on both plots.

During the 5-year period of measurement, stem density declined by 8% in the montane forest and 1% in the lower montane forest (Table 7). In the montane forest, virtually all of the stems lost were the common dominant, *Micopholis guyanensis*; in contrast, in the lower montane forest, most of the losses were in species other than the common dominant, *Dacryodes excelsa*. Preliminary estimates show typically slow growth rates for trees in closed forest (Table 7).

The Grand Etang area has some of the finest rain forest in the West Indies (Beard 1944b). The forests, although physiognomically mature, are floristically impoverished, a fact that was attributed to past logging (Beard 1949). The occurrence of major logging during the 19th century, however, is questionable. Extraction would have required the transport of sawn lumber over considerable distances using draught animals. Another possible explanation for low species diversity may be the lack of major disturbances in Grenada which lies south of the major hurricane belt (Knight 1946). In an environment where disturbance is infrequent, species such and *Dacryodes excela* and *Micropholis guyanensis*, the largest, most common, and possibly the oldest trees in the lower montane and montane rain forests, respectively, could persist as stand dominants for considerable periods. In September 2004, however, Hurricane Ivan passed over Grenada causing considerable damage to all forest types in Grand Etang (Figure 7). Continuous monitoring will provide answers to questions regarding the survival and growth of Grenada's principal forest species.

Table 6. Stem data for Grenada's montane and lower montane forests in 1994.

Category	Stems no./ha	Basal area m^2/ha	Dbh range (cm)
Montane Forest	2100	28.5	4.2 - 32.3
Micropholis guyanensis	700	7.7	4.2 - 19.6
Remaining 11 species	2800	35.8	
Total			
Lower montane forest			
Dacryodes excelsa	238	23.1	4.2 - 80.3
Palm spp.	210	9.4	5.3 - 44.3
Remaining 23 species	852	18.9	4.1 - 73.1
Total	1300	51.4	

Table 7. Changes in stem numbers and basal area on the lower montane forest permanent plot at Grand Etang, Grenada

	Stems (no. /ha)		Basal area (m^2/ha)		Mean dbh growth
Species	1994	1999	1994	1999	cm/yr (SE), n
Residual (1994) stand					
Micropholis guyanensis	260.0	237.5	9.79	10.36	0.05 (0.02), 93
Dacryodes excelsa	237.5	235.0	23.13	24.09	0.10 (0.02), 95
Licania ternatensis	202.5	197.5	4.38	4.61	0.05 (0.01), 79
Sloanea caribaea	125.0	120.0	2.24	2.56	0.05 (0.01), 47
Roystonea oleracea	120.0	97.5	5.68	5.81	0.04 (0.01), 36
Euterpe dominicana	90.0	85.0	3.67	3.73	0.02 (0.01), 34
Maytenus grenadensis	52.5	52.5	0.78	0.84	0.09 (0.03), 21
Richeria grandis	45.0	45.0	0.81	0.88	0.09 (0.03), 18
Sloanea sp.	37.5	37.5	0.17	0.18	0.03 (0.02), 15
Byrsonima trinitensis	20.0	20.0	0.12	0.13	0.02 (0.01), 8
Cassipourea guianensis	20.0	20.0	0.15	0.17	0.08 (0.05), 8
Myrcia platycada	15.0	15.0	0.06	0.06	0.01 (0.01), 6
Simarouba amara	12.5	10.0	0.17	0.16	0.09 (0.05), 4
Myrsine trinitatis	10.0	10.0	0.03	0.03	0.03 (0.01), 4
Guatteria caribaea	7.5	7.5	0.03	0.04	0.07 (0.06), 3
Unonopsis umbilicata	7.5	7.5	0.02	0.02	0.07 (0.01), 3
Erythroxylum squamatum	5.0	5.0	0.01	0.01	0.05 (0.05), 3
Ilex sideroxyloides	5.0	5.0	0.01	0.01	0.04 (0.13), 2
Ocotea martincensis	5.0	5.0	0.03	0.03	0.05 (0.03), 2
Pithecellobium jupunba	5.0	5.0	0.07	0.07	0.08 (0.05), 2
Euphorbiaceae sp.	2.5	2.5	0.01	0.01	0.06 (0.00), 1
Guarea macrophylla	2.5	2.5	0.01	0.01	0.00 (0.00), 1
Ilex sp.	2.5	2.5	0.01	0.01	0.02 (0.00), 1
Quararibea turbinata	2.5	2.5	0.01	0.01	0.02 (0.00), 1
Sloanea massoni	2.5	2.5	0.01	0.01	0.00 (0.00), 1
Unknowns	5.0	5.0	0.03	0.03	0.04 (0.00), 2
Subtotal	1300.0	1235.0	51.43	53.87	
Ingrowth (1994-1999)[2]					
		22.5		0.03	
Micropholis guyanensis		12.5		0.02	
Licania ternatensis		5.0		0.01	
Sloanea caribaea		2.5		0	
Cassipourea guianensis		2.5		0	
Dacryodes excelsa		2.5		0	
Erythroxylum squamatum		2.5		0	
Guarea macrophylla		2.5		0	
Maytenus grenadensis		2.5		0	
Sloanea sp.		55.0		0.08	
Subtotal					
Total	1300	1290	51.41	53.95	

[1]SE = standard error; n = number of survivors.
[2]Zeros in basal area ingrowth indicate values less than 0.005 $m^{2.}$

Figure 7. Damage caused to Lower montane rain forest at Grand Etang in Grenada by Hurricane Ivan in September 2004.

Monitoring Initiative in Nicaragua

In 1998, the IITF helped to establish permanent plots in Nicaragua (Table 3). In Nicaragua, six plots totaling 2.78 ha were set up along an elevational gradient between 900 and 1175 m in elevation in the Mombacho Volcano Natural Reserve (Weaver and Díaz Santos 2002). Fifty-five tree species and 12,615 individual stems were sampled. The 10 most common were: *Alsophila firma, Ardisia costarricense*, *Clusia salvinii*, *Conastegia oerstediana*, *Palicourea padifolia*, *Psychotria panamensis*, *Sapium macrocarpum*, *Senecio arborescens*, *Trophis mexicana*, and *Verbesina oerstediana*, along with *Hedyosmum* sp. Stand density for all plots averaged 2100 stems/ha, and basal area 28.7 m^2/ha. The plots were measured again in December 2003 to determine growth rates and stand changes.

Monitoring Initiative in the Dominican Republic

In 1998, the IITF helped with the establishment of 1 ha of permanent plots in the Dominican Republic within the 53 km2 forest reserve called "La Reserva Científica Loma Guaconejo." Sixty tree species were tallied. The 23 most common species were: *Bombacopsis emarginata*, *Calyptronoma dulcis*, *Chionanthus domingensis*, *Clusia rosea*, *Coccoloba pubescens*, *Cyathea arborea*, *Cyrilla racemiflora*, *Didymopanax morotootni*, *Hirtella rugosa*, *Manilkara bidentata*, *Miconia mirabilis*, *Mora abbottii*, *Ocotea leucoxylon*, *Ormosia krugii*, *Tabebuia ricardii*, *Prestoea montana*, *Manilkara gonovensi*, *Ficus aurea*, *Casearia arborea*, *Lasianthus lanceolanthus*, *Smilax dominguensis*, *Smilax havanensis*, and *Tetragastris balsamifera*. Stem density averaged 1544/ha, varying little by topography (Pastor 1999). Future plans include plot remeasure-

ment to determine growth rates and changes in forest composition and structure. In the interim, the Sociedad para el Desarrollo Intergral del Nordeste (SODIN), a local NGO responsible for management of the area, will use the current information in the development of the management plan for the reserve.

Past Work on St. Vincent

In 1984, a reconnaissance survey, including field samples and photo interpretation, was carried out on St. Vincent to provide information for the planning, research, and potential use of the island's forests (Birdsey et al. 1986, Weaver et al. 1988). Nearly 3,200 photo samples were classified, 88 ground locations were checked, and 57 plots were marked and sampled at 19 separate field locations (Figure 8). The sampled data were used to provide information on forest types, forest areas, tree sizes (saplings, pole timber, and saw timber), species' composition, and estimated timber volumes. Although established initially to serve as a permanent monitoring system, subsequent inventories were never carried out.

PLOTS AND MONITORING – COMMENTARY

Monitoring plots may be established jointly by environmental groups and agencies to provide information for the management of natural areas. When properly designed, maintained, and monitored, the plots yield baseline information on stand structure, species composition and diversity, growth rates, forest dynamics, variation along environmental gradients, estimates of tree ages, and the impacts and changes caused by of major climatic events (Table 8). After several cycles of data collection, forest modeling could provide useful scenarios of changes in stand structure, composition, and dynamics under several assumptions, including the impacts of major climatic events such as prolonged droughts or recurrent hurricanes.

Most permanent plots designed to collect research data, in particular growth or successional changes, could be used for more detailed studies (e.g., nutrient cycling, phenology, or modeling). Increased traffic on the plots, however, could negatively impact regeneration, or in the case of regional surveys, infringe on the privacy of land owners. Temporary plots, in contrast, provide a less expensive opportunity for certain types of data collection (e.g., along gradients for phytosociological information) where continuous monitoring would be difficult or expensive. Simple plot designs with geo-referenced center stakes could provide a viable alternative for data collection.

Among the advantages of plots in protected areas, either permanent or temporary, is that they provide recurrent surveillance of the sites by the individuals working there. In addition, the plots may provide specific data on rare or endangered species and educational opportunities for teachers and students in botany, ecology, forestry, and related sciences. The plots could also provide a novel experience for ecotourists interested in learning about field research, tree life histories, or possibly plant medicinal uses. In all cases, plot monitoring uniquely provides data to help characterize the role of particular tree species along environmental gradients within the forest as they respond to inter-specific competition and recurrent natural events (i.e., tree mortality, hurricanes, and droughts).

Permanent plot monitoring, if it is to succeed, requires money, an efficient sample design, and a feasible program of recurrent measurements. Climatic events may damage the plots or monitoring equipment located on them adding to the work load and costs.

Figure 8. Field crew working on the inventory of St. Vincent forests in 1983.

Table 8. Types of information available from permanent plots

Stand characteristics: stem density; species composition; species diversity; information on rare or endangered species; typical and maximum tree and stand measures (diameters, heights, basal areas, volumes, and biomass); soil organic matter

Plots along a gradient: species-site relationships; species-structural relationships; changes in species or structure according to elevation, aspect (windward, leeward), exposure (protected, exposed), and topography (ridge, slope, and ravine)

Stand dynamics: changes in stem density (tree ingrowth, mortality, and survival), species composition, species diversity, tree sizes (heights, diameters), and stand measures (basal areas, volumes, and biomass); changes in stand specific gravities; and productivity (litterfall, biomass change, herbivory rates); post-disturbance recovery and rates of change; estimates of tree ages; nutrient dynamics with recovery

Climatic impacts: impacts of persistent wind, heavy rains, drought, and hurricanes; post-hurricane mortality, both immediate and delayed; variable resistance to windthrow and uprooting by tree species

Changing the frequency of re-measurement, or sampling portions of the permanent plots in different years, may be alternatives under which a sampling regime for permanent plots could be economically maintained. Monitoring also calls for continuous evaluation, and in cases where objectives have been achieved, possible modification or termination of measurements in favor of other research priorities.

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SUMMARY OF WORKING GROUP PRESENTATIONS: Linking forest, ecotourism, and sustainable development

Constance Carpenter

Attendees identified issues, concerns, and opportunities and sought areas of commonality among them. The four issues of common concern were:

- A need for a better understanding of climate change and possible implications for the islands' forests.
- A need to identify forestry's role in dealing with important island issues such as food security, human health, and water quality.
- Concern over the future of coastal forests in light of rapid development.
- A need to secure funding for cooperative forestry programs and projects.

A formal call to action was then developed linking forestry, ecotourism, and sustainable development. Discussion yielded several management approaches to help meet the challenges facing Caribbean islands. The enclosed notes do not necessarily reflect consensus although there was considerable overlap among issues. The results were organized into five categories.

Conservation education and stakeholder involvement in decision-making

- Make conservation education a strong component of the forestry program, including conservation education in schools and tourist information on a host of topics using different approaches (e.g., education stations, posters).
- Educate local people on the consequences of proposed changes (e.g. the trade-offs between fisheries and marina development in areas such as Cabrits).
- Help local people to benefit from learning about local resources and tap into their sense of belonging to conservation efforts. Encourage residents to go to the field using site visitation as a management tool.
- Involve local people in conservation initiatives.
- Survey tourists for their knowledge about natural resources and their impacts on them. Look for opportunities to make them aware of their impacts and how they can contribute to conservation of the areas that they visit.
- Link conservation in forests with coastal conservation to educate people already concerned about coastal resources
- Cooperate with other managers and stakeholders in the process of strategic development plans.
- Visit other associations dealing with related to topics in order to share perspectives.

Technology transfer and professional training needs

- Use the internet to increase the ability of Caribbean foresters to exchange and ex-

information and expertise by developing web pages, social networking sites like yahoo groups, and maintaining of e-mail lists current.

- Develop exchange programs among Caribbean forestry experts to share research and monitoring techniques suitable to the islands (e.g., management of mountain chickens, or mangrove forests).
- Identify and share available expertise to ensure adequate review of complex Environmental Impact Assessments prepared by developers.
- Fill the emerging need to recruit and train new foresters in the Caribbean.
- Seek training relevant to the islands regarding the effects of development, the importance of watersheds and biodiversity, and island perspectives on climate change.
- Reinstate the training program at the International Institute of Tropical Forestry, including basic field and research techniques for young professionals, and forest management with respect to climate change and biodiversity.
- Develop project management techniques to keep stakeholders involved, and include successful volunteer recruitment and publication of documents.

Management

- Use updated approaches in agriculture and agro-forestry.
- Work on a watershed basis to achieve conservation, linking with surrounding waters and reefs.
- Direct technical reforestation assistance to private abandoned agricultural land.
- Implement agro-forestry to address food security issues.
- Reduce imports by using local foods to capitalize on economic opportunities.
- Develop a strategy to identify conservation areas where mining is prohibited.
- Increase integration among Caribbean Foresters during emergencies to increase accurate and relevant information.

Information needs

- Monitor and evaluate critical resource areas in light of on-going development and tourism.
- Determine the impacts of ridge to reef management.
- Determine the economic values of forest resources.
- Update technical information on forest practices.
- Integrate social scientists into resource management issues.
- Determine forest practices that take into account global warming and climate change.

Policy and funding

- Interchange resource laws, acts, and regulations for mutual benefit.
- Revisit and revise legislation to incorporate into future plans (i.e., protection of sensitive areas).
- Establish private land regulations that allow foresters to comment on proposed land uses and provide authority to stop illegal activities.

- Develop community strategies to accommodate the shift from industry to tourism.
- Help other institutions involved in forestry with strategic planning.
- Deal with intellectual property issues to facilitate the availability and use of research carried out elsewhere.
- Help focus decision–makers on the forestry sector, which is a basis for tourism.
- Keep ministers and policy–makers informed and involved in conservation matters, including tourism planning, and sustainable management of forests and marine resources. Develop a "Caribbean Certification" of green development (e.g., Green Globe).
- Seek support for forestry programs from other sectors of the economy (i.e., water commissions, agro-industries) that benefit from forest management.
- Help protect the investments of agroforestry practitioners.
- Indentify funding sources to purchase land for protection
- Establish a mechanism to distribute revenue from national parks among stakeholders.
- Collect user fees from communication facilities on public lands.
- Act regionally to establish a common rate to invest tourism money into conservation efforts.
- Provide feed-back to tourism official not in attendance.

LINKING FORESTRY, ECOTOURISM AND SUSTAINABLE DEVELOPMENT: A CALL TO ACTION

Caribbean Foresters from 17 countries meeting the week of April 28 to May 2, 2008 in Dominica observed and resolved the following:

Dramatic changes in land cover and level of socioeconomic activities typify the Caribbean. Economic conditions in the region have improved while conserving vital natural resources such as forests. Today, according to the Food and Agriculture Organization, the area of forests and lands dedicated to conservation in the Caribbean are at their highest levels since 1990.

The Caribbean is a "hot spot" of the world's biodiversity and it also harbors a rich cultural and historical heritage dating back millennia. The conservation of the historic and cultural heritage as well as forests, coral reefs, mangroves, freshwater wetlands, rivers, estuaries, coastal dry forests, flora, fauna, the night sky, and other vital natural resources in the Caribbean is a responsibility of the people of the Caribbean.

The economic importance of forests and other natural resources of the Caribbean become demonstrably significant to economic development as the economic strategy of the region focuses on ecotourism.

Sustainable tourism[1] depends on a sustainable environment and both make possible sustainable development. Paradoxically, as the protection of forest resources in the Caribbean reaches historic high levels, the region faces a wave of environmental change in the form of climate change and historic high levels of tourist visitations, which could threaten these forests and jeopardize the tourism industry and the economy of countries in the Caribbean.

If not careful, the tourist industry could undercut the natural wealth that attracts tourists to the region in the first place. It would be like killing the goose that lays the golden eggs.

The forests and natural resources of the Caribbean are vital to assuring water supplies to increasing populations, improving quality of life, providing buffers to natural disturbances such as hurricanes, landslides, droughts, sea level rise, and climate change, and supporting the tourism industry and the economy.

We recommend that:

- Hotel developers and cruise ship companies to assert their environmental responsibility by working collaboratively to avoid irreversible losses of forests and natural resources and negative environmental impacts of their projects and operations.

- Government to obey existing laws, sensitize population on environmental issues, and promote public disclosure and discussion of development projects in sensitive locations such as the coastal zone,

steep slopes, river margins, mangroves, freshwater wetlands, public lands, coral reefs, and watersheds.

- The public to be vigilant of the use of natural resources, and consider the long-term consequences of development projects and increased crew ship arrivals with short-term benefits.

- Tour operators, hotel operators, and communities to help educate the public on the sound stewardship of forests and the natural resource base of the Caribbean.

- The establishment of a tourism alliance among governments of the Caribbean. The alliance would develop regional environmental standards and operating procedures to assure the viability of the Caribbean as a sustainable destination for tourism.

We also recommend that:

- More of the revenue generated by tourism in the Caribbean is feedback to the acquisition, management, and protection of forests and the natural resource base that supports the tourism activity and the economy.
- Environmental monitoring programs are implemented to assure a healthy forest environment and a high quality experience to the tourist and the people of the Caribbean.
- Active management is used to sustain healthy forests for tourists and avoid degradation of natural resources.
- The nightlights are aimed towards the ground to maintain the night sky of the Caribbean and minimize artificial light effects on sea and terrestrial organisms.

- The cruise ship industry voluntarily creates a "head tax" and creates an environmental fund, which supports conservation efforts throughout the region.

- Hotels obtain global green certification to demonstrate their commitment to a healthy environment.

- Food security is not compromised by development projects.

- New legislation is developed to deal effectively with climate change and changing environmental and socioeconomic conditions in the Caribbean.

- Crew ships will not dump wastes at sea.

- A standard tax for tourists arriving in the Caribbean and an independent organization to manage this money on behalf of the natural resources of the region.

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[1]By sustainable tourism, sustainable development, and sustainable environment we mean that tourism, development and environment are activities and conditions that occur for the benefit of today's generations without affecting the well being of future generations.

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Linking Conservation, Tourism and Sustainable Development in the Caribbean

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