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**THE STATUS OF BIODIVERSITY AND BIOPROSPECTING EFFORTS  
IN THE CARIBBEAN SUBREGION**





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## **THE STATUS OF BIODIVERSITY AND BIOPROSPECTING EFFORTS IN THE CARIBBEAN SUBREGION**

### **Introduction**

Biodiversity, as the name implies, is the term used to describe the differences that exist between and among the various species of organisms on the planet earth. Biodiversity can be measured on a worldwide basis, on a regional basis, on a national basis, as well as on a zonal basis. The interactions of these various species provide the basis for sustaining life, human life in particular. On that basis then, it is of utmost importance that the biodiversity of any area be preserved and this can only be done by a proper understanding of the organisms, their relative positions and interactions, and their contribution to life processes.

Unfortunately, the activities of man, the highest form of life in the biodiversity equation, are the most dangerous to the maintenance of the biodiversity equilibrium. In pursuit of food, shelter and economic greed, man has not only changed the natural populations, but the activities of man have also significantly reduced the number of species in a given area through large-scale agricultural activity, poor agronomic practices, poor soil and water conservation measures, wasteful irrigation practices, the introduction of inorganic pesticides, insecticides, fertilizers and packaging materials, deforestation, alterations to the seashore and the "concretization" of once low-lying lands.

A possibly worse mistake, especially for developing countries, has been the replacement of the word "ecology" with "environment". This replacement has led to a cursory study of the relationships between and among organisms and their environment and has moved to a more confrontational approach to the understanding of these relationships. In addition, an in-depth knowledge of the various organisms interacting in their environment which was a prerequisite for the study of ecology seems to have been lost in the "environment" agenda. Decision-making based on environmental data rather than on ecological studies can be particularly damaging to the very ecosystems that we want to preserve through biodiversity preservation.

The best guarantee of biodiversity is to do nothing to the environment. However, that is not an option since man has to find food and shelter. The next best option, therefore, would be to reduce, as much as possible, the effects of our actions on the species and gene pools. It must be pointed out that the provision of basic food and shelter for man is not in itself detrimental to the biodiversity of any region. In fact, that quest for food and shelter may help the process of biodiversity preservation as the natural culling process will establish homeostatic situations in populations. This is part of the natural cycle of growth. It is the excess of food, shelter and economic greed that seriously disturbs the natural balance and leads to habitat degradation that is detrimental to biodiversity preservation. In the Caribbean, especially in the small States of the subregion, it is probably not fully appreciated that tropical ecosystems are more fragile than their temperate counterparts, in that while there is an abundance of species, the relative number of organisms per specie is quite small. Thus, carrying capacity and over-exploitation levels are reached very quickly and changes in specie numbers occur quite dramatically over time. It is in this context that we need to examine the various activities in the subregion to understand their role in the biodiversity equation.

## **Global warming and biodiversity**

It is safe to say that the phenomenon of global warming, resulting from the activities of man, will affect biodiversity in several ways. It has been suggested that higher temperatures resulting from global warming will produce increased rainfall in areas located near oceans and other large bodies of water. However, inland regions will experience dry conditions. Low-lying areas will be inundated by sea-level rise and hurricanes will increase in both incidence and intensity. The overall effect of all the above will be an alteration in the diversity of organisms and some species could be eradicated as changes in habitat occur.

## **Forestry and biodiversity**

Although the tropical forest remains the largest land-based source of biodiversity it is not the only source. Unfortunately, early efforts at forest conservation were not aimed at the preservation of biodiversity, but primarily water conservation. There were also economic considerations. This approach has run into the dual problem of agricultural land encroachment and depletion of wood products at the expense of the preservation of species habitat. Although there is a concerted effort to preserve forests in the subregion, the pressures of finding virgin lands to replace nutrient-depleted fields, coupled with the lack of adequate resources and proper management policies continue to deplete forested acreages. Unfortunately, the new lands coming into cultivation are usually for mono-cropping practices, which add to the problem of species loss and a reduction in biodiversity richness. Habitat loss, therefore, either through poor forestry practices or otherwise, continues to be the single most serious challenge to biodiversity in the subregion, and in fact, worldwide.

## **Agriculture and biodiversity**

The first claim on nature's resources is to maintain itself and the second claim is to provide food for the population. Of the relatively large number of plant species, perhaps a few thousand, have been used as foodstuff, and only a percentage of these are nutritionally significant on a global level. Only a very few of these have been intensively managed on a commercial scale. Similarly, very many animal species are eaten, but only a small percentage are globally of nutritional significance. A few dozen species, mostly mammals, are managed in some kind of husbandry system and a handful of these are globally significant. Agricultural activities therefore become an important determinant in the biodiversity discussion and the approach to agriculture becomes critical as either benefit or bane. It is clear that successful cultivation of agricultural crops on a large scale requires a suite of other organisms. Highly productive agricultural systems also require the virtual absence of some elements of biological diversity. Whereas subsistence agriculture utilized a small amount of land and generally allowed land to fallow during cultivation, economic agriculture as practiced in the subregion brought in a tremendous amount of land into cultivation, which sometimes was unsuitable for agricultural purposes. It is now being recognized that some early agricultural practices were more sustainable than some new techniques introduced to farmers, especially with regard to pest and disease control.

Early agriculture in the Caribbean began as a major economic concern in distinctive phases with the production for export of sugar, cocoa, coffee at various times. Sugar was the most prominent and the earliest crop to be established. Sugar was grown on the best agricultural land and a large amount of organic fertilizer was employed to maintain soil fertility. With the islands still virgin territory much of the land area, especially the more mountainous parts, were covered with trees and generally not disturbed by the sugar plantations. With the minimal introduction of pesticides the ecological balances were hardly disturbed, therefore biodiversity was almost intact.

It can be said that the abolition of slavery and the introduction of tree crops for commercial use began the first major phase of change with an increase in peasant farming on the hillsides. The arable bottom land was at that time still owned by the estate owners. The estates also began to encroach on the gentler slopes for the cultivation of coffee, cocoa and coconuts. The estate cultivations required cutting down large areas of forest and for the peasant farmers it involved farming higher and higher on the slopes with "slash and burn" farming methods. Both activities resulted in drastic changes to the ecosystem as micro organisms were destroyed, trees felled and soil erosion became a prominent feature.

This period can be recognized as the beginning of the process of biodiversity metastasis in the region, but up to this time there was not the large-scale introduction of chemicals in agricultural enterprise. It must be pointed out that the peasants cultivated multi-crops on their small parcels and this practice helped, to some extent in the preservation of the biodiversity. In addition, on both the estates and on the peasant farms, there were sufficiently large numbers of animals to provide manure for soil fertility maintenance.

The next stage was the ascendancy of tree crops as the major export crops and the introduction of pesticides, weedicides, and inorganic fertilizer as larger acreages came into cultivation and the supply of manure could not meet the growing demand. At this stage though, there was still a considerable amount of intercropping but the introduction of different varieties considerably affected the biodiversity equation. Unfortunately, with little concern for biodiversity issues, no studies were done to determine specie extinction or other aspects of speciation. For example, some years ago the mongoose was introduced into Saint Lucia in an attempt to reduce the deadly fer-de-lance snake population on that island. The mongoose did an effective job but with a reduced snake population and an increasing mongoose population, the mongoose turned their attention to chicken, small livestock and some crops.

The large-scale introduction of chemicals into the subregion was also devastating to the biodiversity equation and the subregion never got out of that vicious cycle. Not only were micro organisms on land destroyed, but the inorganic chemicals used played havoc on the fauna in the rivers and seas. Although as a subregion there was still diversity of agricultural activities - since only Barbados, Antigua and Barbuda and St. Kitts and Nevis had large-scale monocrop cultivation - the situation changed drastically when banana was introduced as a major cash crop in a mono-culture mode in the Windward Islands and Jamaica. This served to complete what sugarcane had done to Barbados, Antigua and Barbuda and St. Kitts and Nevis and, to a lesser extent Trinidad and Tobago and Guyana. Economics again gained precedence over ecology,

without the recognition that a balanced ecological situation was necessary to sustain economic activity.

Thus, poor planning and policy reduced the very factors that were important to the sustained provision of food and fiber in the Caribbean. It may be argued that the subregion is still able to supply the necessary food and fiber. However, on a country-by-country basis there are visible signs of deterioration in soil fertility, soil erosion and poor crop returns.

### **Housing and biodiversity**

Faster population growth not only puts pressure on agriculture but also on the land area available for housing. For a while increases in agricultural output through monoculture provided the impetus for the demand for housing in the rural areas. The need for a more balanced approach to development was becoming increasingly evident. Also, with the decline in agricultural output, there was migration from the villages to towns and growth of concentrated housing schemes. In time, with increased economic activity these schemes grew not only landward for the beginning middle class but also up the slopes and towards the seashore for the upper class. This acceleration in housing construction created an increased demand for sand, most of which, especially in the smaller islands, came from the seashore. Thus changes in microclimates were affected in both the terrestrial and the marine ecosystems.

### **Water and biodiversity**

Water is the source of life and therefore an important component in the biodiversity equation. In fact, the species diversity of tropical forests is due in large measure to their high rainfall. On small islands though, the water equation is delicate and so is the measure of diversity. With increasing population the same pressures that are exerted on the land area are also exerted on the water supply to meet growing demands. At the same time increased acreage under agriculture decreases the forested areas and reduces the water supply. In addition the introduction of sprinkler technology in irrigation not only adds to the growing water demand but also creates new micro-climates that could bring about species change.

While the damage has been done to the fresh water sources in terms of supply, a different kind of damage is being done to the marine environment that would seriously affect its biodiversity stock. The large-scale introduction of insecticides and pesticides in the agricultural sector results in a large amount of residues being washed into both ground and surface waters and eventually ending up in the sea. With the resulting toxic effect a number of organisms are destroyed and habitats such as reefs and wetlands adversely affected. These changes bring about a decrease in biodiversity or at least an alteration in the biodiversity equation.

### **Industrial development and biodiversity**

Efforts at small-scale industrial development to offset the reducing returns from agriculture brought with it new problems for diversity preservation. Industrial waste added to the toxic residue problems in the water equation thus hastening its effects and seriously altering habitats. The exploitation of natural resources, e.g., bauxite, gold and oil in the subregion also



added its share of toxic chemicals, problems of waste disposal and ecological disasters that further added to the erosion.

### **Tourism and biodiversity**

The same basic mistakes that were made in agriculture in terms of lack of ecological information and consideration for policy making are repeated in the tourism sector with devastating effect on the biodiversity of the subregion. Wetlands, swamps and mangroves are quickly giving way to marinas and hotel sites, thus destroying fish nurseries and water barriers. Areas of accretion and relief are altered in the near-shore to make beaches for the sunbathers. The construction of large hotels near the shoreline has resulted in considerable earth change, and the discharge from these hotels, not properly treated, ends up directly in the sea. With these factors the tourism industry in the subregion has probably done the most damage to the ecosystem and, by extension, the diversity equation while, of course bringing in considerable foreign exchange to the subregion. The question is whether the economic benefits could ever compensate for the loss in biodiversity.

### **Fishing and other marine activity and biodiversity**

Already burdened with increasing toxic substance in the marine environment, the disappearance of nurseries and reefs, the fish stocks in the subregion was considerably decimated. However, the problem began long before that. Bad fishing habits such as the very small mesh sized fish traps, dynamiting of fish, non-return of small fish to the sea and the poaching of turtle eggs were all early practices long established in the subregion that contributed to diversity erosion. In more recent times the use of scuba for lobster and conch fishing has resulted in a drastic depletion of these species. Increased scuba diving, snorkeling and other water sport activities by tourists on reef sites add to water turbidity problems that are already major concerns from terrestrial run-off. Fortunately, regulating these are much easier than in the agricultural sector and some steps are being taken to address some of the problems.

### **Health and biodiversity**

Medicinal drugs derived from natural sources make an important contribution to health care. An estimated 80 per cent of people in less-developed countries rely on traditional medicines for primary health care. This shows no signs of decline despite the availability of western medicine. Some 120 chemicals extracted in pure form from around 90 species are used in medicines throughout the world. Many of these cannot be manufactured synthetically. For example, the cardiac stimulant digitoxin, the most widely used cardiotoxic in western medicine, is extracted directly from *Digitalis* (Foxglove); synthetic vincristine, used to treat childhood leukaemia is only 20 per cent as efficacious as the natural product derived from the rosy periwinkle. At present, however, only a very small percentage of the world's biodiversity contributes on a global scale to health care. The role of herbal medicines in the maintenance of proper health of a population is therefore recognised worldwide, although it is seen to be applicable mainly to poorer communities. However, the growing interest in health foods and herbs must be seen as a trend that will eventually gain greater impetus and may assist with the preservation of biodiversity in the region. In recognition of the role of herbal medicines, the

Organization of American States (OAS) funded a number of projects under the Economic Botany of Underutilized Tropical Plants (EBUTROP). This project helped Caribbean States to identify the plants that have been used for medicinal and nutritional purposes, and to publish information about them. Unfortunately, while all this information is available, the next phase of the project that will focus on analytical work and other requirements to provide links with the pharmaceutical sector remains undone. The efforts of TRAMIL in this regard, should be commended, as it seeks to systemize the issue of herbal medicine and suggest possible avenues for advancing programmes that would make such preparations readily available to the very poor of the region. TRAMIL is an investigation programme, applied to the popular traditional medicine of the Caribbean, whose purpose is to rationalize the practices of health based on the use of medicinal plants. This ethno-pharmacological investigation has been extended to practically all the territories of the Caribbean, through the conduct of surveys using uniform methodology. It should be pointed out that this is not a call to return to “bush” medicines. Rather, it is a recognition that a number of synthesized drugs are derived from plants and that some innovative approaches to health care can be made more readily available in poor communities.

### **Education and biodiversity**

Fortunately for the subregion the situation, though critical, is not irreversible. However, for a positive approach to be undertaken, education will have to play a critical role in policy and decision-making. Already there are signs of change, as governments have begun to put legislation in place to protect some marine areas, species of animals, (though not plants), and fisheries legislation is quite progressive in the subregion. Legislation, though, is not enough to ensure success. A vigorous education campaign, beginning with primary schools and non-formal classes must be mounted to explain the relationships between plants, animals, the environment and the activities of the population to the welfare and well-being of the State and our own existence.

### **Conservation efforts in the Caribbean and Latin America**

Early efforts at conservation efforts in the Caribbean were not prompted by a concern for diversity, but focused primarily on forestry programmes. These efforts were implemented to protect the watershed areas and consisted mainly of designating hillside forests as protected areas. However, policy was ineffective, and the need for virgin lands for cultivation resulting from poor agronomic practices of “slash/burn/grow/move”, coupled with the need for charcoal energy by the poor sector of the population, contributed to further reduction of forested acreages. Attempts to arrest the trend of dwindling forests were initiated through programmes of forestry management, but a lack of trained professionals and financial resources severely limited the success of these programmes. It was not until the signing of the Convention on the Law of the Sea (UNCLOS), December 1982, that serious attention was given to the marine environment as an area that also needed conserving. The emphasis was primarily on fisheries management. Biodiversity, however, was again not a reference point at this stage.

With the signing of the Convention on Biological Diversity (CBD) in 1992, governments of the world, including those of the Caribbean and Latin America, committed themselves to

creating policy and legislation to simultaneously regulate and facilitate access to genetic resources in the interest of three interrelated goals – biodiversity conservation, sustainable economic development and socioeconomic equity. As stated in the objectives of the CBD, in order to conserve biodiversity, any use of its components, including genetic resources, must be sustainable. Sustainable use, as defined by the CBD, means using biodiversity in a way that does not cause its long-term decline, and preserves its potential to meet the needs of future generations. Sustainable use can only occur when the rights of different user groups are specified, when human needs are met, and when the losses in biodiversity and natural resources occur at rates within their capacity for renewal. The criterion of ecological sustainability is directly related to conservation through the concepts of harvest and yield. At a species level, ecological sustainability is achieved when the harvest from the population does not exceed potential yield. At ecosystem level, ecological sustainability is accomplished when harvest does not degrade the capacity of the ecosystem to sustain itself.

The Caribbean and Latin America region therefore faces a daunting array of environmental challenges, from conserving its biodiversity to cleaning up its polluted air and water. It should be noted that the region is the most biologically diverse on the planet. The Amazon Basin alone harbours about 90,000 known species of higher plants, 950 bird species, 300 reptile species, 3,000 fish species, and uncounted millions of insect species. Within the Caribbean there are varying degrees of effort at conservation. It is often an uphill task, given the competing need to create employment, earn foreign exchange and attract foreign investment. The following highlights some of the efforts being made at regional and national levels.

### *Regional initiatives*

#### Caribbean Conservation Association (CCA)

One of the oldest groups working towards conservation of the environment, the Caribbean Conservation Association (CCA) was established 30 years ago at a time when the impact of development activities on Caribbean environments was beginning to be visible, intrusive and troublesome. With support from Laurence Rockefeller, a regional survey of conservation problems was carried out. The findings of the survey generated a sequence of activities throughout the subregion relating to conservation programmes and environmental activities. In particular, it recognized the need for international planning and cooperation in meeting the conservation requirements of the region and concluded its deliberations by recommending the establishment of a regional body to help meet these needs. This paved the way for the founding of the CCA, which was subsequently formed in 1967 at an inaugural meeting in Grenada. In 1969 the Association took a country by country, island by island, recruiting effort to seek advice and support from within the region aimed at development of a needs statement and establishment of a support base and commitment from a broad professional, international and institutional base.

Thirty years later, with headquarters based in Barbados, the CCA's membership is comprised of 20 regional governments, 86 Caribbean-based non-governmental organizations, 17 non-Caribbean institutions, as well as individual sponsoring and student members. The Association's activities span five major programme areas, specifically: the formulation and

promotion of environmental policies and strategies; information collection and dissemination services; promotion of public awareness through environmental education activities; research about, support for, and implementation of natural resource management projects to foster sustainable development; and assistance for cultural patrimony programmes. The Association retains a regional focus and is dedicated to promoting policies and practices which contribute to the conservation, protection and wise use of natural resources in order to enhance the quality of life for present and future generations. In its mission, the CCA establishes partnerships with organizations and groups which share common objectives. It focuses attention on activities designed to anticipate and prevent, rather than cure and react. Currently, the CCA has three programmatic areas of focus. They are marine and coastal resources, protected areas, and multilateral environmental agreements (MEAs).

#### Caribbean Planning for Adaptation to Global Climate Change (CPACC)

The CPACC is a regional project funded by the Global Environment Facility (GEF), implemented by the World Bank and executed by the OAS. The regional project implementation unit is located in Barbados. The project's overall objective is to support Caribbean countries in preparing to cope with the adverse effects of global climate change, particularly sea level rise, in coastal and marine areas through vulnerability assessment, adaptation planning and capacity building linked to adaptation planning. More specifically, the project is designed to assist national governments and the University of the West Indies Centre for Environment and Development (UWICED) to:

- (a) Strengthen the regional capability for monitoring and analyzing climate and sea level dynamics and trends, seeking to determine the immediate and potential impacts of global climate change;
- (b) Identify areas particularly vulnerable to adverse effects of climate change and sea level rise;
- (c) Develop an integrated management and planning framework for cost-effective response and adaptation to the impacts of global climate change on coastal and marine areas;
- (d) Enhance regional and national capabilities for preparing for the advent of global climate change through institutional strengthening and human resource development; and
- (e) Identify and assess policy options and instruments that may help initiate the implementation of a long-term programme of adaptation to global climate change in vulnerable coastal areas.

#### Natural Resources Management Unit – Organisation of Eastern Caribbean States

The Natural Resources Management Unit (NRMU) was established in 1986 to coordinate and facilitate natural resource management in the Organisation of Eastern Caribbean States (OECS) member countries. The NRMU started as a project funded by the German government and was eventually established as part of the environment arm of the Secretariat. The Unit

provides technical assistance and develops tools and techniques for the management of the natural resources of the subregion. The NRMU is currently embarked on two major initiatives that significantly impact on member States' efforts at managing the scarce natural resources base within a framework geared towards their sustainable development.

Member States have begun a process of reaffirming the Principles of Commitment to sustainable development contained in the Rio Declaration and Agenda 21, the SIDS Programme of Action, the Declaration of Santa Cruz de la Sierra and Plan of Action for the Sustainable Development of the Americas and the First Caribbean Ministerial Meeting on the Implementation of the SIDS Programme of Development. This process involves the development of an Eastern Caribbean Environmental Management Charter, predicated on the fact that environmentally sustainable development is essential for the creation of jobs, a stable society, a healthy economy and the natural systems on which all life depends. The charter incorporates the concept that land and marine areas in the region constitute a single unit and that the close inter-relationship among the various ecological systems and the impact of human intervention on these warrant the adoption of an integrated approach to the management of the use of natural resources, defined as Island Systems Management (ISM). To this end the Eastern Caribbean Management Charter and associated Eastern Caribbean Environment Management Strategy incorporates among other features:

- Integrating social, economic and environmental considerations into the national development and planning policies within the framework of ISM;
- Fostering broad based environmental education, training and awareness;
- Ensuring the sustainable use of available natural resources;
- Preserving and conserving biological diversity ; and
- Protecting cultural and natural heritage.

### *National initiatives*

#### Belize

The 260,000 acre Rio Bravo Conservation and Management Area in northwestern Belize is the site for an experiment on low-impact forestry and regeneration of mahogany and other hardwoods. The effort is part of a Programme for Belize (PFB) to help local residents find sustainable economic alternatives to destructive logging. In addition the Toledo Institute for Development and the Environment (TIDE) recently convinced the Belizean Government to declare Port Honduras a marine reserve. Port Honduras is a critical part of the Maya Mountain Marine Corridor, a million-acre stretch of protected areas from the crest of the Maya Mountains to the Caribbean Sea. At Gladden Spit, one of the largest and healthiest known spawning sites, a group known as Friends of Laughing Bird Cay is collaborating with local fishermen to study the phenomenon and develop a management plan for the area. They ultimately hope to create a marine reserve that establishes catch limits during critical spawning times and sets tourism guidelines for divers and other visitors. By emphasizing economic alternatives and cooperative management of shared resources, Belizeans are seeking to create long-lasting prosperity for their communities.

### Costa Rica

With one of the world's best records in conservation, Costa Rica lives up to its Spanish name of "rich coast". Costa Rica comprises only 0.01 percent of the earth's land mass but is home to 5 per cent of its diversity. Expanding agricultural activities and forestry, both legal and illegal, pose significant threats to Costa Rican natural areas. For example, clear-cutting and excessive harvesting of natural resources plague the Talamanca region, which is made up of a patchwork of protected private lands. On the Osa peninsula, less than 10 per cent of the land is under secure title, leading loggers and some residents to "cut and run" rather than invest in conservation. The rapid development of resorts and other tourism facilities threaten coastal areas throughout the country. There are several areas however, that have been declared as national parks and protected areas, including the over 100,000 acre Corcovado National Park on the Osa Peninsula, the Talamanca-Caribbean Corridor and the 23,000 acre Gandoca-Manzanillo Wildlife Refuge, part of the Talamanca-Caribbean Corridor.

### Dominica

In Dominica, the Nature Conservancy helped establish that country's 17,000-acre Morne Trois Pitons National Park. The programme is currently aimed at preparing a compilation of the first natural vegetation map of Dominica, which will guide conservation efforts for years to come. In addition, funds are provided to train tour guides, taxi drivers and other locals in sensitive tourism and sound resource management. Dominica is also home to the last of the indigenous Carib people who live on a 4,000-acre reserve on the eastern side of the island. The Carib Council requested and received assistance to help the tribe conduct biological inventories of the lands, monitor endangered species and plan for eco-tourism.

### Guyana

The Iwokrama Forest is located in central Guyana some 300 km south of Georgetown, the capital. The forest is bounded mainly by rivers and creeks, including the Essequibo and the Siparuni, Takatu and Siparparu rivers. The terrain is generally rolling with the major physical features being the Iwokrama mountains rising to about 1000 metres and the Pakatau Hills rising to about 300 metres. The area encompasses about 3,600 square kilometres and is covered in lush tropical forest. Much of the area is characterised by tall tropical trees with dense canopy 20 – 30 metres high. Half of the forest is maintained as a Wilderness Preserve and half allocated to Sustainable Utilization. Iwokrama's fundamental objective is to define the extent to which sustainable utilization of forest resources is conducive to conservation and to determine the impact of such utilization on their biodiversity.

The area covers six distinct land systems – the undulating plains of the Kurupukari Sand Terraces, the Moco Moco Undulating Plain, the steep, granitic Iwokrama Hills and valleys and the steep basic doleritic intrusion of the Pakatau Hills and Turtle Mountain. The differences in the forest types across the Reserve contain about a dozen classified types (forests) in which no particular species dominates. Rather, there are changes in the relative abundance of the suite of canopy species which include commercial species such as greenheart and mora which grow on sites with impeded drainage around river and creek margins. Wallaba grows on the free-draining

white sand terraces of the Kurupukari Sands. In localized white sand areas, the Wallaba forest is replaced by low xeromorphic scrub, which can be prone to burning after extended droughts. Areas that are permanently water logged are habituated by palm marsh forest.

The wide range of intact habitats in the Iwokrama Forest supports a diverse flora and fauna. This includes 450 species of birds, 206 species of fish, 120 species of snakes, lizards and frogs, among a relative abundance of a number of large animals (jaguar river otter, harpy eagles, caiman, giant river turtles, tapirs and wild hogs).

Many of the large animals are close to extinction in other parts of Guyana, but have managed to thrive in that area mainly due to the Iwokrama International Rain Forest Programme. The Programme has its origins in an offer by the then President, Honourable Desmond Hoyte, on behalf of the people of Guyana to identify an area of undisturbed forest in central Guyana. The offer was made at the 1989 Commonwealth Heads of Government Meeting in Kuala Lumpur, Malaysia whereby the land was to be used for conservation of biodiversity, for training and research leading to the development of techniques for sustainable and equitable utilisation of forest resources. A Commonwealth Group of experts assisted an inter-agency team headed by the Guyana Natural Resources Agency (GNRA) in developing the overall concept for the Programme, including identification of the forest site.

Guidelines for the management of this large site were subsequently outlined by consultants. The Natural Resources Institute (NRI), of the United Kingdom, assisted by Guyanese and international scientists carried out a preliminary survey of flora and fauna, soil and vegetation types, geology and ethno-botanical aspects of the site, funded by the British Overseas Development Administration (ODA) in 1992. In 1993, the Global Environment Facility (GEF) provided a grant of US\$3 million as seed funding to initiate the United Nations Development Programme (UNDP)/GEF Project, the "GEF Assistance to the Iwokrama Rain Forest Programme", planned to last three years, starting from April 1993. The funds were administered by UNDP and the project was executed by the Government of Guyana, which contributed funding for the construction of a field station and for other logistic purposes. The Commonwealth Secretariat, through the Commonwealth Fund for Technical Cooperation, agreed to provide technical specialists and in 1995, the International Development Research Centre (IDRC) of Canada also became a partner in Iwokrama and established an information and communications unit. At present, an international board of trustees jointly appointed by the Government of Guyana and the Commonwealth Secretariat governs the Centre. Board members have qualifications and experience in a wide range of disciplines ranging from the biological sciences to economics and the law. As well as representatives from Guyana and the Commonwealth Secretariat, Board members have been appointed from UNDP, Commonwealth countries such as India, Jamaica, Ghana, Trinidad and Tobago, the United Kingdom, Brazil and Japan.

Iwokrama's innovative features include the fact that governance is international, it focuses on all forest values and that the Centre follows an integrated approach to conservation development. With direct responsibility for the management of 360,000 hectares of pristine rain forest, focus on pluralistic partnerships and on achieving financial sustainability, Iwokrama stands at the cutting edge of sustainable forest conservation, management and development.

### Jamaica

The Jamaica Conservation and Development Trust (JCDDT) has established the Blue and John Crow Mountains National Park, Jamaica's first terrestrial park. The nature Conservancy arranged a debt-for-nature swap, in which the United States government decreased Jamaica's debt to free up funds for a national Parks Trust Fund managed by JCDDT. JCDDT is taking a leadership role in conservation in the region, with the creation of a model management plan for the park, hosted a workshop for expert ornithologists throughout the Caribbean and met with members of Belize's Toledo Institute for Development and Environment (TIDE) to discuss their similar challenges in protecting watersheds that affect coastal areas.

### Trinidad and Tobago

There exists in Trinidad and Tobago, a number of groups and organizations, mainly non-governmental, that seek to address conservation issues. These include *the Asa Wright Nature Centre*, the oldest nature centre in the West Indies. The Asa Wright Centre is relatively inexpensive and provides expertly guided bird-watching and natural history tours throughout the year. The *Caribbean Forest Conservation Association* is a national, non-governmental and non-profit environmental organization addressing concerns of deforestation in Trinidad and throughout the Caribbean region. *Environment Tobago*, a non-government organization is working to conserve and restore the natural environment of Tobago. The *Environmental Management Authority (EMA)* is a statutory body established by the government of the country to address the country's environmental problems. The National Herbarium of Trinidad and Tobago is responsible for the collection of scientific plant specimens and some of the history behind one of the oldest herbaria in the world.

### **Biotechnology, bioprospecting and biodiversity**

The jury is still out on the role of biotechnology in biodiversity preservation but based on present evidence biotechnology may in fact hasten the reduction in biodiversity even though it may provide some important answers to health and food problems. It is argued that technological advances within the pharmaceutical industry, and in particular those involving the design and manufacture of synthetic drugs, will mean that this contribution is more likely to fall than rise. However, natural diversity might be increasingly valued for the "blueprints" it provides for new synthetic drugs. Therefore, for biodiversity preservation to benefit from biotechnology, a conscious effort must be made to employ the technology in the preservation of the gene pools. The present focus on economic biotechnology is not advancing in that direction.

Although the attrition rate of biodiversity is large in the tropics where the Caribbean is located there is still a sufficiently high figure to warrant the search for new products from the flora and fauna of the subregion. This search for new products is what bioprospecting is all about and it is important to understand its consequences if the region is to benefit both financially and ecologically from this new venture. Given the mistakes that have been made in the past, particularly with new initiatives for development, it is necessary to ensure that the economic arguments do not again overwhelm the ecological arguments, so that the resources upon which the region depends for its economic survival will still be available to succeeding generations.



To ensure the above then, it is necessary to understand how other countries in similar positions have dealt with the issue and, through collaboration and cooperation, make the most of technology and knowledge transfer critical to the management of a fragile natural resource.

The preceding paragraphs present some ideas of the effect of the dominant activities of the region and their early effect on biodiversity without going into too much detail as to how these effects are manifested. The absence of supportive research to quantify the effects, however, do not negate the effects, as the visible signs are there as testimony. Water tables, rivers flows and water quality have been reduced considerably in the region; agricultural productivity is down, waste and pollution are everywhere, the sprawling towns and villages and back-filled near shores with their buildings are visible to the naked eye. At the same time species of plants and animals that were once abundant are now scarce. We simply need to ask any person over 50 years of age, from any State in the region to confirm these findings.

From a regional basis the countries of Central American are probably the best case studies for our situation and the initiatives undertaken by them will be highlighted here. There is also the need to review activities in the Pacific where there are countries similar that those of the Caribbean to compare notes. That however will be the subject of another paper.

### **Bioprospecting agreements and their possible benefits**

Bioprospecting agreements, according to Janet Bell, are being widely hailed as the way forward for meeting the twin goals of conserving biodiversity and sustainable development. Bioprospecting is promoted as a “win-win-win” opportunity for all involved. Corporations and research institutions gain from the exploitation of the world’s genetic bounty; countries and communities providing the raw materials and knowledge share in the profits; and biodiversity conservation is promoted through increased value attributed to genetic resources and a share of the profits being directed towards conservation programmes.

It has been perceived that the international flow of genetic material and its potential use is a significant source of income for developing countries. It is unlikely though that bioprospecting will generate nationally significant levels of revenue, or even create a powerful enough incentive for conservation, but a strategic approach by developing countries might enable them to derive a number of benefits from biodiversity and bioprospecting.

The very nature of genetic resources complicates valuation, a necessary step in establishing the genetic resource market that the CBD aims to utilize. According to the CBD, genetic resources are any material of plant, animal, microbial or other origin that contains functional units of heredity of actual or potential value. The material and geographic aspects of genetic resources pose an extraordinary challenge to national and international policymakers, because most living organisms reproduce and disperse naturally, irrespective of the restrictive measures that policy makers wish to lay on them.

Scientists and policy makers agree that there are two types of “values” that may be ascribed to genetic resources. The *option value* i.e. the value of certain characteristics known in

plant and animal varieties which may prove useful in facing new environmental and health challenges. There is also the *exploration value* that is inherent in the possibility of finding a useful natural compound. The latter is the value with which parties are concerned when negotiating agreements on benefit sharing derived from bioprospecting.

Assessments of genetic resource ownership are therefore extremely complicated. Although it is relatively easy to determine ownership of a cow, for instance, or the production from a sugar cane field, the equivalent operation for fungi, frogs or previously undescribed plants is significantly more difficult. Part of the problem may lie in the fact that knowledge of behaviour, life cycle, yield, feeding habits or distribution remains scant for most species, with the exception of a few domesticated living organisms. To date, no scientist can claim to fully understand what a living organism is. Ignorance, therefore, about genetic characteristics and potential is even greater.

In addition to ignorance on the nature of life are questions of rights of ownership and tenure of natural resources. These have always been subject to dispute, with individuals, peoples and nations willing to face wars if such an extreme measure seemed necessary. Genetic resources are not an exception, with further complications stemming from the lack of knowledge regarding living organisms, the widespread occurrence of certain species and processes and the different levels of geographic jurisdiction over areas of endemism.

The CBD recognises the sovereign rights of individual countries, with the national government in charge of assigning property rights over resources. Tenure and ownership systems, however are not uniform across all countries, nor are they clearly defined in any given country. For example, legal systems in modern states can be divided between those based on English Common Law and those founded on Roman Law. The first system views natural resources as private property, with the state having little participation in regulating access<sup>i</sup>, whereas the latter system grants property to the State, holding natural resources as national patrimony<sup>ii</sup>. Based on this legislative heritage and each country's own cultural traditions, biodiversity-rich countries exhibit a mixture of ownership arrangements that range from common tenure to state-enforced private rights to land and natural resources, including biodiversity.

Globalisation further complicates the issue, signaling as it does a new phase in regulation efforts as international cooperation accelerates due to improved communications. Hence, "global" initiatives propounded by agreements among signatory nation states constitute a hitherto unknown form of property regime where mankind is granted heritage of certain resources, for example, designated germplasm. In the last decade, this concept of common heritage has been eroded by the actions of industrialized countries where strict intellectual property rights (IPRs) are enforced, as well as concerns from underdeveloped countries, where biopiracy undermines the contribution of local communities to the conservation of genetic resources.

As if there are not enough complications to the drafting and enforcement of bioprospecting agreements, there is a growing conflict between the World Trade Organization (WTO) and the CBD over intellectual property rights.

It is no wonder, that given all the issues that need to be considered in the drafting and implementation of bioprospecting agreements, that, to date, few countries, notably the Philippines, Costa Rica and Andean Pact signatories, have enacted regulations in response to the CBD mandate concerning access to genetic resources. Many other States have formulated draft legislation that is now in the lengthy process of ratification, subject to intense review and lobbying by stakeholders, whose interest have yet to be reconciled. A May 1998 workshop in Bratislava, Slovakia, noted that the perspective of users of genetic resources differs greatly from that of providers. Whereas the former are interested creating quick and simple procedures to obtain the prior informed consent of providers to bioprospect, the latter want to ensure that the access to genetic resources regime that is created ensures that their interests are well represented.

### **The status of bioprospecting in the region**

It is significant to note that the first major bilateral contract for bioprospecting was made public in September, 1991 and involved a Central American country. This was prior to the CBD, when Merck and Company, a United States-based pharmaceutical corporation, announced a two-year, \$1.135 million deal with the Instituto Nacional de Biodiversidad (INBio) of Costa Rica, a private, non-governmental research institute. INBio agreed to provide Merck's drug-screening programmes with chemical extracts from wild plants, insects and micro-organisms. In return, Merck agreed to give INBio a two-year research budget of \$1.135 million, an undisclosed share of royalties on any resulting commercial products, and technical assistance and training to establish in-country capacity for drug research. INBio also agreed to contribute 10 percent of its up royalties it may eventually receive to Costa Rica's National Park Fund.

The International Conservation Biodiversity Groups (ICBG) Programme is one NGO that is working towards implementation of the CBD mandate. The specific goal of the ICBG programme is to develop and implement innovative strategies for the conservation and sustainable management of biodiversity through the screening of organisms for the discovery of compounds active against diseases common to both developing and developed countries; and agricultural and veterinary purposes. It is expected that such screening would lead to sustainable economic activity in the form of sharing benefits.

To date the ICBG programme has implemented several programmes. Three United States universities are bioprospecting for pharmaceuticals and crop protection agents from plants of arid and semi-arid regions in Mexico, Argentina and Chile, with their national counterparts and the American Cyanamid Company. Ethnobotanical and random sampling is employed. Collections are evaluated for potential biomedical applications and commercial production of biologically active compounds as specialty cash crops is also a goal. Training is given to United States and Latin American students in chemistry and the extraction and processing of plant materials.

Countries with bioprospecting agreements include:

### Costa Rica

Cornell University, in cooperation with the INBio of Costa Rica and Bristol-Myers Squibb, is examining tropical insects and other invertebrates as potential sources of drugs against a range of diseases. INBio prepares extracts and trains Costa Rican Scientists to conduct field and drug-discovery studies. Cornell University is involved in research and training for Costa Rican scientists while Bristol-Myers does the screening.

### Guyana

While not a replica of the Panama situation, the Iwokrama International Centre in Guyana has direct responsibility for the management of the Iwokrama Forest. This forest covers some 360,000 hectares in the centre of Guyana and covers a wide variety of rain forest environments. Giving the Centre direct forest management responsibility ensures that any research undertaken will find immediate application in its management.

### Panama

In 1988, the Proyecto de Estudio para el Manejo de Areas Silvestres de Kuna Yala (PEMASKY) and the Asociación de Empleados Kunas (AEK) of Panama produced a manual to regulate scientific research in their area. The manual requires researchers to:

- Develop a proposal outlining the timing, extent and potential environment and cultural impact of a research programme, for approval by the scientific committee of PEMASKY;
- Secure approval for the collection of species from the scientific committee of PEMASKY. In this regard, collections may not include any endangered species, may not be used for commercial purposes and must be done in a non-destructive manner;
- Undergo an orientation into the culture of the Kuna Yala, and respect the norms of the communities in which they work;
- Include Kuna collaborators, assistants, guides and informants in their research programme and provide them with training in relevant scientific techniques;
- Leave samples of all specimens and copies of photographs or slides taken during the research programmes;
- Provide written reports of the research;
- Avoid the introduction of exotic plant or animal species or manipulate genes.

In addition, research is restricted to certain areas of the reserve and is prohibited in some sites.

### Peru

Ethnobotanical sampling and investigation in the tropical rain forests of the northeastern Andes by Washington University. Other partners are Peru's Natural History Museum and the Cayetano University, Missouri Botanic Garden and Searle-Montano.

## Suriname

Random sampling by Missouri Botanic Garden; ethnobotanical sampling and extension work by United States-based non-profit group Conservation International; extract preparation by the Surinamese pharmaceutical company Bedrijf Geneesmiddelen Voorziening Suriname; screening and analysis by Bristol-Myers Squibb and Virginia Polytechnic Institute and State University.

## **Conclusion**

As illustrated by the examples above, few Latin American and Caribbean countries have been able to successfully enter into bioprospecting agreements. While there are attempts to conserve the environment by the various organizations, there is very little evidence to suggest that there is a awareness of the link between, conservation, biodiversity and bioprospecting. This is evidenced by the fact that less than 10 per cent of these areas have been set aside as protected areas. As a result the protected areas network is often too small, too fragmented and not representative enough to fully maintain the biota of the country or biogeographic region in which they are set. Thus the future of biodiversity will depend on how areas outside protected areas are managed. The challenge for resource managers and land use planners is to design and effectively manage multi-purpose landscapes, focussing on the need to conserve representative landscapes and high value areas of particular conservation interest. If the goals of the CBD are to be achieved, then, as the examples of "successful" bioprospecting agreements show, conservation is a major, if not the only single activity that must be undertaken.

Because the interaction and interrelationships between plants, animals and man are not sufficiently understood by and emphasized to the general population the task of preserving the biodiversity in the region, whether at the national level or regional levels will be difficult. While the activities of the poor have often been blamed for biodiversity loss the truth of the matter is that greater damage is down by the uninformed policies of decision makers who destroy habitats, which is the single most important factor of species loss.

Efforts at preservation are haphazard, uncoordinated and do not usually take a developmental approach. It is not unusual to have decisions reversed by succeeding administrations and even when laws are passed enforcement is difficult since resources are not made available.

A major constraint to biodiversity preservation is the development strategy based on employment at any cost, which seems to be the motto of Caribbean governments. For the promise of some jobs swamps have been drained, mangroves have been filled in and even reefs have been blasted to make channels for pleasure boats. Efforts to redress some of these ills, for example artificial reef building, are woefully uninformed since the problem of water pollution remains the critical factor in reef destruction. Unless concerted efforts are made through stringent standards and enforcement to reduce the levels of pollutants that reach the sea one of the most diverse habitats of the Caribbean, the reef, will be lost as a habitat for the sustaining of biodiversity.

At present the level and nature of biotechnological activity in the Caribbean is not high enough to cause serious concerns about changes in mutation rates that can affect speciation and biodiversity loss. However, any large-scale effort at gene manipulation and or alteration in the region must be done after serious consideration given the lack of resources for policing. Having said that though, a judicious use of biotechnology can assist in the fight against the proliferation of harmful chemicals for insect and pest control. Research on and programmes in biological pest and disease control must be increased at the tertiary institutions of the region using the host of plants materials that have been identified as having these properties.

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