

2. Conservation and Environmental Data System (CEDS) to coordinate data gathering efforts and maximize data sharing among members.
3. The Geographic Information System (GIS) to be used to assist planning and environmental management efforts. The GIS forms an integral part of both systems above allowing for the integration of data.

The LIS is now being maintained and expanded through the Land Administration Project funded by the IDB and GOB. The LIC houses some key GIS datasets that are important to biodiversity conservation and its sustainable use, namely: land resource assessment reflecting land suitability, land use/cover, natural vegetation, special attention areas, protected areas and other base coverages. In addition to this, there are various satellite images for different time periods.

*The Conservation and Environmental Data system (CEDS)* is directly in line with Article 17 of the CBD. The CEDS is a component of the Land Information Center (LIC) intended to formalize data gathering and exchange relationships among Government Departments and organizations outside government (Fairweather & Gray, 1993). The idea is to form a common, effective distributed network consisting of a central clearing house and its members for data collection, organization, and sharing; the emphasis being on environmental data. The LIC acts as the clearinghouse (central node) for the network receiving and disseminating data. All members should be able to dial in to the central data catalog over a wide area network to query the availability of data. The CEDS concept is to ensure that decisions are made with access to all existing information and that scarce resources are not wasted by duplication of efforts to collect data. Some of the key functions of CEDS include (LIC, 1993):

- co-ordinate data collection, indexing, computerization
- institute standards for data collection & exchange, hardware/software
- establish baseline datasets and update regularly
- research co-ordination
- act as a central repository for environmental data
- education and training
- reports and publications
- develop linkages with regional programs.

To date, CEDS has not been able to address all of its duties and the few being addressed are still in need of improvement. Nevertheless, it presents a good infrastructure to implement many of the CBD's objectives on information management and exchange.

*The Belize Biodiversity Information System (BBIS)* is a component under the CEDS being developed by the Wildlife Conservation Society (WCS) with a focus on biodiversity information, more specifically, the zoological component. The BBIS is an AREV database linked to a GIS housing information on species of importance in Belize. It benefits from the resources of the WCS. The WCS has a well-equipped and networked computer lab with GIS capability. Main software include PC Arc/Info, archive, CAMRIS and IDRISI. A key goal of the BBIS is the development of the most complete species distribution data as existing sources allow, for all taxa of conservation concern (Tillett, 1998). In accordance with the governing principles of CEDS, much of the biodiversity information is restricted to use by the GOB and CEDS members. However, in accordance with the Rio Convention on Biodiversity on making biodiversity information public, the BBIS has information available for all interested parties on the WWW at the URL - <http://fwie.fw.vt.edu/wcs/>.

As a GIS member of CEDS, the *Central Statistical Office (CSO)* has been equipped with a basic PC Arc/Info GIS. However, the system is not yet operational due to insufficient training. Through support from the UN Fund for Population Activity (UNFPA) the CSO plans to get all enumeration districts digitized along with the development of an electronic atlas to share on the Internet. Traditionally, environmental and conservation information has not been a subject at the CSO. However, current efforts of the CSO are focusing on the development of an Environmental Statistics Section to produce periodic environmental statistics to guide environmental considerations in decision making. A CSO support officer recently undertook a four-month course on "Statistics for Environmental Policy" in Germany. The Government is in support of this new section

and efforts are underway to secure funding for this (Tillett, 1998).

*University College of Belize (UCB):* University College of Belize (UCB) is a GIS member of CEDS and has a basic PC based Arc/Info GIS. The system recently became operational and is currently used by Coral Caye Conservation (CCC) to collect marine data. As a GIS member of CEDS, the *Department of the Environment (DOE)* has also been equipped with a PC Arc/Info system, however this is not yet operational due to lack of in-house expertise.

*The Belize Center for Environmental Studies (BCES)* recently closed its doors in the latter part of 1996. As a conservation NGO with interest in environmental research, policy and planning, it had significant investments in information collection and management. It has one of the best libraries and a well-equipped GIS laboratory. The lab supports both PC and UNIX based GIS packages including Arc/Info, ArcView, ERDAS, and ATLAS. It also has infrastructure for Global Positioning System (GPS) data collection and processing. GIS data development was mainly site-specific results of Rapid Ecological Assessments in areas of conservation concerns (Tillett, 1998). Questions about the relocation of the library and GIS lab are currently being discussed with UCB and other interested groups.

*Programme for Belize (PFB)-* as a GIS member of CEDS, the PFB was equipped with a basic PC based Arc/Info GIS facility. It is staffed with one person who has had some local training, however, the lab benefits from access to in-house personnel with advanced GIS training. They are able to map to a resolution of the individual species level and record information relating to tree growth in specific plots.

As a forest produce, medicinal plants have received quite a bit of attention from several institutions and organizations with varying degrees of capacity (Annex 15 a-c). The *Belize Association of Traditional Healers (BATH)* was quite active in community awareness, the promotion of research, data base management and the management of medicinal plant resources. BATH no longer exists and has evolved in to the Traditional Healers Foundation. The *Belize College of Agriculture* provide courses on ethnobotany, promote the cultivation of medicinal plants, maintain a herbarium collection and provide guidance for the Medicinal Plants Sub-Sector. The *Belize Enterprise for Sustainable Technology* promote the sustainable and efficient use of medicinal plants. The *Belize Rural Women's Association* promotes public awareness and seeks to legitimize traditional healing practices and to incorporate them into the national health care system. *Ix-chel Research Foundation* promotes *in-situ* and *ex-situ* conservation of medicinal plants, conducts scientific research, prepares and maintains a collection of medicinal plants, conduct outreach programmes and document information on traditional healing. *Rainforest Remedies* prepare dried herbs, extracts, salves and tinctures for commercial use. *Rainforest Rescue*, another local company, processes medicinal plants for sale. The *New York Botanical Gardens Institute of Economic Botany* collects and identifies useful plants, document and manage database on medicinal plants and their uses, conducts basic and applied research on medicinal plants, information dissemination, teaching, training, and the initial screening of plants for the National Cancer Institute (NCI). The *Traditional Healers Foundation* is involved in public awareness campaigns, documentation and database management, and the management of medicinal plants resources (O'Brien, 1998).

The *National Library Service* is also a member of CEDS.

There are a number of institutions with functions and roles that are not primarily conservation-focused, but which certainly impact on biodiversity and therefore should be mentioned. The role of the Agriculture Department is to regulate and guide the sustainable development of the Agricultural Sector. However, it lacks personnel, research capability, training facilities and finance to effectively influence farmers to engage in sustainable practices. Infrastructural support to the Agricultural Sector is generally poor. The roles of a number of other Ministries indirectly impact on biodiversity: the Ministries of Economic Development, Finance and Trade.

The main industries - sugar, citrus and bananas - each have their Statutory Body or Control Board and Growers Association. However, most of the activities of these associations are not conservation oriented and rather pro-exploitation. The Banana Growers Association is known to have recently introduced organic

fertilization techniques in an effort to reduce the use of inorganic fertilizers. The Citrus and Banana industry have their own research programmes and extension services to members. Their level of expertise is commensurate with the importance and complexity of the industry. Other large Private Sector companies purchase expertise as needed and when problems arise. Research efforts, however, are more development-oriented and are not necessarily designed to address any particular environmental concern. A number of NGOs (including BEST, Help for Progress and NDFB) provide technical assistance to individual small farmers or in groups (Briggs, 1998). Again, the nature and focus of their assistance are not clear.

The tourism industry has a wide array of institutions which should have sufficient capacity to guide the sustainable development of the industry. They include the Belize Tourist Board, Belize Tourism Industry Association (BTIA), Belize Tour Operators Association & Belize Hotel Association. As a result of different agendas by key players in the industry, there have been divisions and a loss of coordination. The Belize Tourist Board, although equipped in number of personnel, does not have expertise in marketing, which is one of its main functions. Personality differences have led to a power struggle in the main Private Sector organization - the BTIA, and this has affected the vision and the efficiency of the organization. At the branch level, the BIA has functioned to varying degrees of success. Cayo District Branch was instrumental in encouraging, coordinating and assisting in the rapid expansion of the tourism sector in that district (Briggs, 1998).

The physical infrastructure and operational framework of most institutions mentioned above, government and non-government, are inadequate to meet programmed objectives usually resulting in poor productivity and reduced enforcement activities. Probably in all cases, institutions are under-staffed and under-budgeted. A partial assessment of funds invested in biodiversity conservation is presented in Annex 15, likewise management costs and investment needs for Protected Areas are presented in Annex 16 a & b, respectively. Compliance with most regulations is very much voluntary by stakeholders, since institutions are unable to meet their enforcement responsibilities. For example, the enforcement section of the Fisheries Department is practically dormant most of the time due to the lack of necessary infrastructure and funding for enforcement activities. The lack of properly defined roles of individual institutions has resulted in legislative overlaps, in which several institutions might have the legal mandate to address a particular management need. This causes confusion and usually result in 'turf protection' and poor inter-ministerial coordination, with the end result being ineffective implementation of laws and regulations. These realities, coupled to the lack of political will and undesired political interference have done much harm to Belize's natural resources.

#### **5.4. Important Existing Programs for the Conservation of Biodiversity**

Many organizations and institutions are engaged in projects and other activities focused at understanding and managing Belize's biological resources. For easy reference, activities are described below according to the institution or organization responsible for their implementation. Medicinal plants and revisions to existing legal framework merit special attention and are presented separately.

##### **5.4.1. The Fisheries Department**

The Fisheries Department collects and organizes data on the socio-economic and biological aspects of the commercial fishery in Belize. This data is organized in the Trip Interview Program (TIP), an information and data management system being established under the CARICOM Fisheries Resource Assessment and Management Program (CFRAMP). There are currently between 10,000 to 12,000 records on commercially landed species since the last five years. The type of data that is collected is biased towards the management of the fisheries industry; biodiversity concerns has not been featured as a component of this data collection program to date. The socio-economic information collected includes national catch statistics by species and location of catch, and production costs. The biological information collected gives an indication of stock and includes length of individuals, aging status, maturity, etc. In addition to the TIP data collection and organization program, the department also collects periodic population data in some key sites, particularly in Hol Chan and Bacalar Chico, on key commercial species. In addition to this, Fisheries manages two of the

three CARICOMP sites in Belize; the third managed by the Smithsonian Institution. Systematic data are collected from these sites on seagrass and mangroves to provide estimates of biomass, growth, health, etc. A series of GIS datasets were developed in 1993 by the World Conservation Union (IUCN) in collaboration with the Coastal Zone Management Unit (CZMU) of the Fisheries Department (Tillett, 1998). An overriding goal was the provision of information on the biological resources within the coastal zone to guide in its planning and management. This represents the first ever endeavor to map habitat and ecosystem across the country for incorporation into a GIS, although its efforts were concentrated in the coastal zone. Datasets includes Fishery Resource, Critical Habitat for Species, Key Coastal Ecosystems, Marine and Coastal Protected Areas, Major Coastal Uses, Human Impacts, Transport and Concession Blocks, and Physical Features (Gibson, 1993). The mapping for Fishery Resource includes point or polygon (area) distribution of shrimp, lobster, stone crab, conch, deep water fish, reef fish, grouper, and mutton snapper. This data has had limited use since its development. This is primarily due to mapping limitations and insufficient documentation. The main limitation of these data was insufficient field verification, their small scale, and insufficient documentation of sources and methodology for data creation. Nevertheless, they represent a valuable template for further detailed mapping and update.

The Fisheries Department also oversees marine scientific research activities by several organizations. The *Caribbean Coral Reefs Ecosystems Program (CCRE) of the Smithsonian Institution* is involved in research on coral diversity; coral bleaching; sponge ecology; mangrove ecology; sedimentology; trophic relationships; redox potentials in mangrove peat; larval ichthyology, fish and sponge taxonomy. *Oceanic Society Expeditions* is involved in research to determine the distribution, abundance and behavioural patterns of the bottlenose dolphin. *Raleigh International* is involved in the mapping of coral communities as well as in research to determine the types and concentrations of land-based pollutants in coastal sediments. *EARTHWATCH* is involved in studies to determine species diversity of fish in shallow reef habitats and seagrass beds. The Department is the focal point for one component of the *Caribbean Climate Change Project (CPACC)*, involved in coral reef monitoring using GIS data and ground truthing. A Coral Reef Monitoring Committee has been established to conduct a *National Coral Reef Monitoring Program*. The Fisheries Department chairs this committee and is involved in a permanent program to collect data on coral health using internationally accepted methods. The Fisheries Department, with assistance from the Belize Tourist Board, is currently implementing a *National Mooring Buoy Program*, which involves in the installation of mooring buoys for dive boats and other tourist boats in an effort to minimize anchor damage to coral heads. The *Toledo Institute for Development and Environment (TIDE)* in conjunction with the *University of South Carolina* are engaged in research on snapper spawning aggregations, as well as environmental variables in the proposed Port Honduras Marine Reserve. The *Strengthening Fisheries and Biodiversity Management Project* is funded by the EEC and was started in December 1997. It focuses on human and institutional capacity building of agencies active in the management of fisheries and marine biodiversity using the ecosystems approach. The project promotes modern management techniques such as ecosystems modeling using highly advanced software. The *Siwa-ban Foundation of Caye Caulker* and *Green Reef of San Pedro* are two community-based organizations promoting co-management, environmental public awareness and biodiversity conservation. The latter is anticipated to initiate research activities in the near future on artificial reefs using 'reef balls', with financial assistance from the GEF Small Grants Programme (Jacobs, 1998).

#### **5.4.2. Coastal Zone Management Project**

The Coastal Zone Management Project (CZMP) is a UNDP/GEF funded five year project with the objective to assist with the development of an integrated coastal zone management plan for Belize (World Bank, 1996). The program was to conclude in March of this year but was granted an extended funding for nine months to consolidate the endorsement of a proposal to establish the Coastal Zone Management Authority and Institute. The CZMP has been increasing its focus on planning for the cayes. It has responded to the lack of resources by the relevant government planning authority by providing assistance to develop land use guidelines for important cayes where plans are non-existent. The planning instruments used are Development Guidelines. These are not as detailed as comprehensive development plans; they serve mainly as a general guide for development (Tillett, 1998). The CZMP has a reasonably well equipped PC based Arc/Info GIS lab. Associated software include ArcView and IDRISI. The CZMP has recently employed the use of Global

Positioning System (GPS) to map distribution of Manatee sightings from overflight reconnaissance. Time series mapping is also being conducted such that patterns may be developed to identify important habitats. GIS databases has also been developed reflecting crocodile sightings and nesting. In addition to this, there is a focus on the development of baseline information for the coastal zone. The CZMP, in collaboration with the University of Sheffield and the University of New Castle, last year produced the first countrywide GIS dataset of marine community from Landsat TM imagery. As a result of this, a National Marine Habitat Classification Scheme is being proposed for development. A unique feature of CZMP's work is to customize the GIS technology to make it accessible by managers and scientists in the field. While these efforts are still in their infancy, it represents a positive move at increasing the accessibility of GIS to scientist and managers. The CZMP has made significant contributions to the creation of new datasets for the coastal zone (Tillett, 1998). However, when compared to the terrestrial environment, the coastal zone still remains deficient of most of the key datasets.

The CZMP has collected a significant amount of data on water quality parameters along Belize's coast and has done some preliminary analyses of these data. Much more data need to be collected before trends with meaningful interpretation can be developed for inorganic nutrients in coastal waters. The CZMP has also conducted joint aerial surveys of manatees (*Trichechus manatus*) with ECOSUR in Chetumal, Mexico and the Belize Fisheries Department, in an effort to estimate population size, distribution and migratory patterns of the species, in both Chetumal Bay and along Belize's coast. A crocodile nesting project was also supported with funds from the CZMP to document and map nesting locations along Belize's coasts. An important portion of efforts during this study focused at the crocodile population at Turneffe (Jacobs, pers. comm.).

#### **5.4.3. Coral Caye Conservation**

Coral Caye Conservation (CCC) has also been collecting marine data since 1989. Collection effort has focused on key sites requiring management, mainly: South Water Caye, Laughing Bird Caye, Sapodilla Caye, Snake Cayes, Bacalar Chico, and Turneffe Atoll (Tillett, 1998). The distribution data is presented as transect lines showing species presence, abundance and substratum types (Phillips, 1992; Robertson, pers. comm.). The key uses for this data has been to guide photo and image interpretation to develop marine habitat maps. The data is collected by UK volunteers trained and supervised by CCC staff. Training and field mapping may extend from two weeks to three months, one week being for training in marine identification and survey techniques. The raw data is organized in the UK in AREV database using a similar format as that used by the UK's Marine Nature Conservation Review (MNCR) marine survey program (Phillips, 1992). While this program provides a valuable resource to collect much needed data in the coastal zone, the results are not as effective due to questions of data accuracy. This skepticism undermines the value to be had from volunteers as a chief avenue to fill data gaps. The role of volunteers such as CCC needs to be revisited to define the areas where they can contribute to data collection and address the credibility issue.

#### **5.4.4. Department of the Environment**

Data collection efforts of the Department of the Environment (DOE) are presently limited and focus on threats to the environment (Compliance Monitoring), primarily from pollutants. Data collected includes basic water quality parameters recorded generally on a quarterly basis from some of the major industries: textile, banana, sugar, battery (Mendoza, pers. comm.). Most data is presently collected by the industries themselves and passed to the DOE. The collection efforts of the DOE are limited to spot checks as a check and balance to the collection efforts of the companies. This approach is good as it reduces cost of monitoring for the DOE and places the burden on the companies. The existing data collection effort is sporadic, of limited geographic coverage and not sufficiently standardized to allow for effective monitoring and important analysis such as trend analysis etc. However, the DOE plans this year to implement a more comprehensive compliance monitoring program targeting all the main industries countrywide. This is a good first step since it would serve to regulate the polluting industries, although, a key gap still remains for baseline monitoring to define the existing conditions against which to measure change. As the DOE expands its monitoring efforts, it will need to acquire capability for data management and analysis to maximize the use of such data. The DOE has produced a National Environmental Action Plan with assistance from the World Bank which seeks to establish

a program of policy reform, institutional building, studies and investments that will improve the state of the environment and put the country on a path to sustainable development.

#### **5.4.5. Hydrology Department**

The Hydrology Department, like the DOE, collects information that may be used for monitoring threats to biodiversity. The focus has traditionally been on water quantity, with water quality being of lower priority. This focus had been influenced by the bias placed on the economic benefits of monitoring such as flood risks and water source (Lee *et. al.*, 1995). The present data collection includes twice daily water levels for 14 of the 16 major water catchments, sporadic measurements of flow discharge, and ad-hoc measurements of water quality parameters (basic parameters only) (Williams, pers. comm.). Data is organized and managed in an application specific software called Hydrological Operational Multipurpose System (HOMS) promoted by the World Meteorological Organization. With the existing data collection efforts the Department's analysis is limited to the production of the general water quantity statistics. More resources are required to expand the current data collection and analysis efforts to produce information that is more meaningful to resource management. In particular, there is the need for increased distribution of sampling sites in the upper reaches of the catchments along with increased personnel to regularize data collection efforts (Williams, pers. comm.). Traditionally, environmental concerns have not been a priority, however, current efforts are underway to secure funding to initiate sediment monitoring and improve upon current water quality and quantity parameters sampled (Williams, pers. comm.). Such efforts should be coordinated and strive to comply with recommendations in the Environmental Water Quality Monitoring Report (Lee *et. al.*, 1995).

#### **5.4.6. Forest Department**

The Forest Department in conjunction with the Forest Planning and Management Project (FPMP) has embarked on a project to organize and computerize the plant collection samples in the Forestry Herbarium. The database called BGbase is built on AREV and currently holds 5,993 records for specimens collected throughout the country (Tillett, 1998). Although the existing database is textual, it contains a "geographic location" field that provides the opportunity to link the samples to a field location thus building a distribution of plant samples throughout the country. It is possible to aggregate and dis-aggregate the distribution data at varying resolutions: regional, country, district, locality (site descriptor), grid reference, latitude/longitude. Of the 5,993 records, 5,306 have an entry for some type of location description, however, it must be noted that the degree of resolution varies for different entries. This lack of standardization in the degree of detail recorded for location of samples greatly limits the extent of dis-aggregation possible. Nevertheless, the herbarium represents the most extensive collection and documentation of plant taxonomy and distribution information for Belize (Tillett, 1998). It is complementary to the efforts of the CEDS and the BBIS. However, there needs to be a concerted effort focused on synthesizing and reformatting the data to make it integrative with the CEDS/BBIS. The Ministry of Natural Resources and the Environment, with regional coordination of the CCAD, has developed a National Biological Corridors Program as a strategy for regional biodiversity conservation as part of the Regional Alliance for Sustainable Development (ALIDES).

*The Central American Commission on Environment and Development (CCAD)* is undertaking a regional initiative to establish and operate an environmental information network in Central America (Mexico to Panama) with a focus on Biodiversity. The objective is the establishment of a system for information management and sharing to ensure that decision-makers have appropriate information for environmental management and sustainable human development in Central America (Tillett, 1998). The CEDS will act as the national node and its existing infrastructure used and developed further to advance this project. CEDS will benefit from hardware, software, training and salary support for one full-time staff. The training component is quite significant; three persons will be trained abroad in system development, management and use. A series of workshops will subsequently be conducted by the trainees to distribute knowledge. Funding for this strategy is from a number of different organizations, but mainly from the World Bank and USAID.

The Forest Department is the National Focal Point of the *International Clearing House Mechanism (ICHM)* under the *CBD*, which states that the Conference of the Parties (COP) shall "...establish a clearing-house

mechanism to promote and facilitate technical and scientific cooperation" (pp.15, CDB). The ICHM is fulfilling this objective by developing mechanisms to provide global access to and exchange of information on biodiversity and its sustainable use (UNEP, 1997). The concept is to develop a clearinghouse to act as a meta-data bank, that is, acting only as a pointer to information. As such information structuring will be a first stage in this initiative. However, in addition to this, a second stage will focus on ways to bring about tighter collaboration between parties in their implementation of the different objectives of the convention so as to improve technology transfer and capacity building (UNEP, 1997). Funding for this project is requested by the COP from the Global Environmental Facility (GEF) at the national, sub-regional, and regional levels. The concept of the ICHM is directly in line with existing national efforts to develop the Conservation and Environmental Data System (CEDS). CEDS provides the fundamental infrastructure necessary for implementation of the ICHM concept at the national level. As such, there may be opportunities to build on and improve the existing CEDS through this channel.

#### **5.4.7. Belize Biodiversity Information System**

Efforts under the Belize Biodiversity Information System (BBIS) have been focused primarily on the collection and storing of species distribution data. Information include species distribution, protected and legal status, habitat associations, trophic levels, and other categories of associated information (Miller, 1997). The database contains information for over 2,586 species (Miller, 1997). To date, this represents the most significant effort to collect species distribution data in Belize. Point and range distribution are being developed using data and information from a variety of sources including field research, reports, museum collections, etc. Precision ranges from actual GPS point locations to within 25km (Miller *in* Ellis, 1997). The database contains varying levels of detail for different species, however, it is possible to create/produce some form of distribution map for all species in the database (Miller, pers. comm.). According to Miller, the best distribution data exists for birds followed by mammals and the worst exists for fish. This is partly due to the historical focus on the terrestrial environment and the increased complication in working in the marine environment.

The progress of the BBIS so far has been impressive, however, there still remains the need for data verification and refinement. The British Museum and the American Museum of Natural History are two key data sources that still remains untapped due to lack of computerization of the data of interest to the BBIS by these institutions (Miller, pers. comm.). On the verification side, there still remains a lot to be done. Much of the distribution data has been constructed using GIS analytic techniques such as habitat association models to fill gaps. As such there still remains the need for fieldwork to verify the distribution data developed in addition to filling of data gaps. The work of the WCS/BBIS is directly in line with the requirement for "Identification and Monitoring" under Article 7 of the CBD. However, there is still the need to place this and all other data collection and compilation efforts into a monitoring context from the earliest such that data will be guided by monitoring needs.

The WCS along with the LIC/CEDS has established a biodiversity information WEB page to provide access to much of the data from the BBIS. The URL is <http://fwie.fw.vt.edu/wcs/>. Types of information to be included on the WEB includes legal status and species distribution by elevation, 15' blocks, eco-regions, Holdridge life zones and protected area. The WCS is producing a Compendium of Biodiversity of Belize in the latter part of this year. This will include textual information, distribution maps and photographs of species at risk or of conservation concern. The original intention was to produce a more comprehensive compendium but due to shortage of funds it only allows for the development of an abbreviated version. The US Man and the Biosphere, Tropical Ecosystems Directorate (MAB-TED) has existing projects for the Selva Maya (the forested areas historically inhabited by the Maya) that include Mexico, Guatemala and Belize. A week long workshop to develop priorities for monitoring biodiversity in the region was held in 1997 in Flores, Guatemala. Regional priorities were agreed upon at this meeting. Biodiversity monitoring protocols are being finalized and will be made available to all interested parties in the Selva Maya. A regional biodiversity database is being established at ECOSUR (Colegio de la Frontera Sur) in Chetumal, Mexico. Belize is a participant in all aspects of these initiatives. A mammal monitoring project is being established in NW Belize by WCS and will serve as a control site for the region. Portions of the Belize Biodiversity Information System (CEDS) will serve as a model for the regional biodiversity database (Miller in lit., 1998).

#### **5.4.8. National Meteorological Service**

The National Meteorological Service (NMS) has a mission to provide climatic information, agro-meteorological advisories and weather news that impact on the socio-economics of Belize and the region. It collects and manages a tremendous amount of agro-climatological and astronomical data in Belize. Data is organized in the application specific CLICOM software. The application of data for environmental management has been an increasing focus since the last five years via the new Agro-met Unit. There are increasing efforts to use agro-climatic data to assist the agricultural sector. One such application is the use of this data to estimate timing and quantity of pesticides. Data is also used to provide information for controlled burning and fire prevention.

#### **5.4.9. Programme for Belize**

Programme for Belize (PFB) collects site-specific GIS data, focusing on the management of the Rio Bravo Conservation and Management Area (RBCMA). Data management has focused on refining and increasing the detail of existing datasets to assist planning and management. Included in these are vegetation, landuse, roads, and rivers. The collection and organization of biodiversity-related information in the GIS to date is quite limited. However, recent efforts have focused on the use of GIS and GPS technology for silvicultural and agro-forestry studies. PFB has submitted a proposal of US \$750,000, through the World Bank, to the GEF to initiate the consolidation of the Northern Biological Corridor as one of the major links within the National Plan for the Belizean component of the regional or Mesoamerican Biological Corridors Program coordinated by the CCAD. PFB is the Belize partner to *The Wings of the Americas Program*, which is a habitat conservation program for the protection of migratory birds in the Americas, sponsored by The Nature Conservancy. One of their tasks is the development of a National Bird Conservation Strategy and Action Plan. An Avian Risk Assessment has recently been conducted to compliment this. As part of the overall program and subject to funding, the PFB plans to develop a Wings Information System (WIS). The concept is a database to organize all bird related data in the Caribbean and Latin America to guide bird conservation actions. It is the intention that the proposed WIS would liaise and collaborate closely with the existing CEDS.

#### **5.4.10. Environmental, Social and Technical Assistance Project**

The Environmental and Social Technical Assistance Project (ESTAP) is a four year (1997-2001) project funded by the Inter American Development Bank (IDB) for Southern Belize. This includes the area from Silk Grass to the Sarstoon, east of the Maya Mountain divide. The goal is the development of a Regional Development Plan for the immediate area that may be affected by the new Southern Highway. The project has three components: Community Participation Unit, Environmental Protection Unit, and the Land Use Unit (Tillett, 1998). The Land Use Unit is making a significant contribution to planning in Belize. Three distinct planning tools will be developed by this unit (McGill, pers. comm.):

- land use potentials plan at scale of 1:100,000;
- a zoning plan for the two mile corridor along the Southern Highway; and
- a set of new SDAs for the area

This project benefits from an integrated planning team consisting of highly qualified staff. The establishment of planning units specifically for community participation and environmental protection reflects the project's commitment to addressing much of the associated issues important to biodiversity conservation and plan implementation. Issues of the legality of resulting plans and relevant government bodies to be responsible to oversee their implementation have not yet been addressed. The LIC is spearheading the updating of the Land Use data for southern Belize, mainly in the region of the Environmental and Social Technical Assistance Project. This information could be used to assist in the identification of potential threats to biodiversity in the south and assist in the planning currently in process by ESTAP.

#### **5.4.11. Lands Department**

The existing IDB/GOB "Land Administration and Secured Transactions Project" started in January of 1998



and is being executed by the Department of Lands and Surveys of the Ministry of Natural Resources and the Environment (MNR&E). It has three key tasks: land records management, land tenure clarification, and land policy and legal reform (MNR&E, 1998). Together, these three components may provide some opportunity for improvements in the existing leasing process. At present, the leasing process occurs almost totally outside the controls of planning instruments which exists. Important in this is the need for the existing SDAs to be used to guide lease applications. Currently, the SDAs are rarely used and there is no legal mechanisms for ensuring that this will happen. This project will also improve the computerization and management of land records. This will provide valuable land tenure information to be used in planning.

#### **5.4.12. Programmes Specific to Medicinal Plants**

The Belize Ethnobotany Project (1988-1996) was coordinated by the Institute of Economic Botany (IEB) at New York Botanical Gardens (NYBG). Locally, the project was facilitated by Ixchel Research Foundation. Collaborators included the Belize Center for Environmental Studies (BCES), Belize College of Agriculture (BCA) and Belize Association of Traditional Healers (BATH). This project was a long-term study of the uses of forest plants with a focus on collecting and documenting of plant specimens and preserving local medicinal knowledge. A total of 2,300 plant species from Belize were collected, identification and description of the plants were conducted, and herbarium specimens were prepared and lodged at the National Herbarium (Forest Department), Ixchel and BCA (O'Brien, 1998). The active ingredients of some of the plants were determined and extracts of these plants were sent under contract to the National Cancer Institute (NCI) to screen for anti-cancer and anti-AIDS activity. This project has contributed significantly to the knowledge pool that exists on medicinal plants of Belize.

Two (2) medicinal trails exist in Belize, the Rainforest Medicine Trail at Ixchel Research Foundation and the Original Panti Trail in San Antonio. The Rainforest Medicine Trail was established in 1983 as the Panti Maya Trail but was renamed in 1995 when the Original Panti Trail was established. The Rainforest Medicine Trail is a half-mile trail that has more than 35 useful plants growing in their natural habitat. These plants are labeled with a brief description of their use and a field guide is available for more detailed description. The other trail, the Original Panti Trail, is located one (1) mile from San Antonio and is managed by Messrs. Angel and Ladis Tzib. This trail is found on 40 acres of private land and had over 100 medicinal plants labeled with local and scientific names. The site is inaccessible during the rainy season and in early 1997, a forest fire destroyed much of the reserve and its limited infrastructure. The Rainforest Medicine Trail is a self-sustaining entity that is widely visited (ie. over 2,000 visitors each year) whilst the Original Panti Trail has less than 50 visitors per year and lacks marketing, infrastructural and other developments (O'Brien, 1998).

Most of the educational programmes in schools are conducted by Ixchel Research Foundation (Ixchel). A special outreach programme organized by Ixchel includes an annual exhibit of useful plants, followed by classroom games in the schools and ending with competition projects (focusing on "My Backyard Plants") between schools. The exhibit lasts for five (5) days and more than 1,800 school children, mostly between ages 6-18, visit the display each year. The first exhibit was conducted in 1994 and has been conducted yearly since then. In 1997, seven (7) schools participated in the school competition, and prizes were awarded to the first and second place winners. In collaboration with Ixchel, a one (1) credit course entitled "Ethnobotany of Medicinal Plants " is taught at BCA. This course has been incorporated into the curriculum and has been taught since 1992.

During the period 1989-1992, two (2) national and three (3) regional traditional healer's conferences were held in Belize. These conferences provided a forum for information sharing, reflection on the status of traditional healing, analysis of the strengths and weaknesses, and expression of needs and concerns on traditional healing. The main objectives of the conferences were to promote conservation and sustainable use of medicinal plants. A total of 355 individuals attended the two (2) national conferences and 223 individuals attended the three (3) regional ones. Participants included mostly traditional healers, community health workers, Government personnel, students, and other interested persons. Following from the healers conferences, four (4) issues of the Plant Press, a newsletter on traditional healing in Belize, were produced. Recently, newsletter publication was revived through the collaborative efforts of the THF and Ixchel. Two

(2) issues of this newsletter i.e. Tree of Life, have been published and the third issue is in preparation (O'Brien, 1998).

Since 1988, field trips by primary and high school students to the Rainforest Medicine Trail have been encouraged. Most of these trips are paid for by Ixchel, a free guided tour is given to the group and a copy of the colouring book of the Maya Rainforest is given to each student. In 1996 and 1997, a total of 55 schools trips were made to Ixchel Research Foundation and the Rainforest Medicine Trail.

BATH and Ixchel conducted a seven (7) day youth camp at Terranova for 20 youths from Belize City in 1994. The programme was scheduled to be yearly, but was discontinued after the first camp. In 1998, another camp for school children (i.e. ages 9 - 12) is scheduled to be held at Ixchel.

In June 1993, 6,000 acres of forest in the Yalbac area of the Cayo District were established as a Forest Reserve, a category of Protected Area that allows for multiple use of the resources within the reserve. Terranova was established primarily as a medicinal plant resource and was to be managed by the Belize Association of Traditional Healers (BATH). During the period February 1993 to May 1994, BATH obtained financing for specific activities (e.g. surveying the reserve) and raised additional funds by encouraging individuals/organizations to adopt-an-acre or adopt-a-tree. This allowed BATH to carry out the following activities at Terranova during the short time frame: survey and mark the boundaries of the reserve; begin fencing; construct a campsite; transplant over 500 seedlings of various medicinal plants; conduct a youth camp; support plant collection and research on harvesting methods being conducted by NYBG scientists; employ a caretaker/warden; and prepare and submit to the Natural Resources Management Project (NARMAP) a proposal to manage Terranova (NB. this proposal and \$ 67,500 was approved by NARMAP, on the condition that the management plan be approved by the Ministry of Natural Resources and Environment). Terranova was established to serve the following:

1. *In-situ* conservation of medicinal plant resource that would complement the activities of traditional healers: this would include identification and labeling of medicinal plants, establishment of trails, conducting training and youth camps, rescuing plants threatened by forest clearing elsewhere and transplanting them at Terranova, and regulated harvesting of medicinal plants in line with sustainable practices.
2. Ethno-botanical research: research on ecology, growth and development, sustainable harvesting methods, value of the forest resource, cataloguing of economically important plants and determination of active principles.
3. Ecotourism: with proper facilities and infrastructure, Terranova would eventually be used for eco-trails, nature walks, guided tours, seminars and classes. This would help make Terranova economically sustainable.

Controversy over the management of Terranova and BATH arose in March/April 1994 and two (2) groups claiming to be BATH emerged. This led to the resignation of all the Directors of the "old BATH", the withdrawal of registration from the Attorney General's Office, and effective dissolution of BATH. The other group declared themselves as the new "BATH" and established a new Board of Directors. Since the controversy in 1994, the work at Terranova came to a standstill and has led to encroachment in the reserve, increased logging, degradation of infrastructure and the destruction of transplanted seedlings and experiments (Nolan, 1996). However, a recent assessment on the status of Terranova concluded that despite "some negative developments" Terranova Forest Reserve has maintained its integrity and remains a healthy and viable ecosystem" (Nolan, 1996).

In December 1996, the Conservation Division of the Ministry of Natural Resources brought together members from the two factions of BATH. It was agreed that "none of the previous BATH's should be considered to manage Terranova, and that a neutral organization which is credible, accountable and transparent be selected". This organization must command national respect and be able to harness support and inputs from all stakeholders. BEST was selected as the most suitable organization and a pro-tem advisory committee was nominated to guide the process. During the course of 1997, the original management plan for Terranova was re-written and was submitted to the Ministry of Natural Resources and the Environment in December 1997. The consideration is for BEST to manage Terranova under a co-management policy under the guidance of

a Board of Advisors which will include traditional healers. This initiative is being supported by the Ministry of Natural Resources and the Environment and a decision on this matter is expected soon. A summary of programs and budgets specific to medicinal plants is presented in Annex 17a-b.

#### **5.4.13. Programmes to Revise the Existing Legal Framework**

The Land Utilization Act is currently in the process of being amended. The focus has been on the section regarding subdivision. Key proposed improvements include increasing fines, fees and penalties, wider representation on the LUA, improvements in guidelines for provisional and final approval, and a strengthening of its powers to enforce compliance with proposed land use (Tillett, 1998). More recently, the proposed amendment is being expanded to address the section dealing with land utilization and the existing SDA process. This, however, is still in its infancy stages. Focus will likely be on institutional coordination for planning and the strengthening of the legal framework for SDAs.

The Central Housing and Planning Authority (CHPA) is spearheading the revision of a Model Physical Planning Bill. This bill has been prepared by the UNDP/UNCHS (United Nations Center for Human Settlements) as a guide to improve planning legislation in the Eastern Caribbean (UNDP/UNCHS, 1994). The Bill seeks to promote the harmonization of planning legislation and integrate planning into the wider context of sustainable development. A significant feature of the Bill is its attempt to co-ordinate the different permitting procedures under one central body. Such a practice would serve to address much of Belize's present problems with planning and plan implementation.

A first workshop was held in January of this year to present and discuss the Bill. The general consensus from the workshop is that an entirely new Bill should not be proposed. It was agreed that the Bill would serve to guide the amendment of the existing related legislation, so that together, the amended legislation would support the essential objectives of the Bill. The focus for amendments would be institutional coordination, clarification of roles, relationships and procedures (Tillett, 1998). A task force has been formed to facilitate this process. The UNDP and the UNCHS are prepared to provide technical assistance to the country to allow for modifications of the Bill.

The Fisheries Act is presently being reviewed. It is anticipated that the revision will bring about major changes to the original Act drafted in 1948. Specific regulations on Aquaculture, shrimp trawling, sportfishing, license fees, gear restrictions and fines for violations will highlight the changes. It is expected that the proposed Cayes Development Policy, inclusive of the Turneffe Development Guidelines and the Belize City Cayes Development Guidelines will be adopted shortly by Cabinet. The Forest Act, the Wildlife Protection Act and the National Parks Systems Act are also to be reviewed. Anticipated changes include the requirement of management plans before establishing Protected Areas, the legal requirement of community participation in the elaboration of management plans and in the establishment of Protected Areas, and the elimination of legislative overlaps between the Wildlife Protection Act and the Fisheries Act. Amendment to Mines and Mineral Act will also be necessary to make EIAs mandatory for dredging activities (Jacobs, 1998).

Another Act which might soon be subject to review is the Protected Areas Conservation Trust Act, which establishes a funding mechanism for the management of Protected Areas. This Act requires that fees be distributed as follows: 20% to the PACT, 10% to GOB, 10% to a village council or group, the remainder 60% remains with the Society to put into its management costs for the particular area. At present only the Crooked Tree Village Council and a women's group near the Cockscomb Basin Wildlife Sanctuary benefit from the apportionment of entrance fees collected. The Hol Chan Marine Reserve is encountering major difficulties in sustaining its operations after contributing 20% of its visitation fees to PACT. The Hol Chan example is one reason why PACT might need to be reviewed in the near future. Revision will have to be focused on whether contributions to PACT should be deducted from surpluses after salaries and other operational expenses have been cleared or on the possibility of reducing the percentage contribution. This revision may also need to focus on the need to conduct feasibility studies on a case by case basis for Protected Areas, on which percentage contributions should be derived, as opposed to a 20% across-the-board approach (Jacobs, 1998).

## 5.5. Threats to Biodiversity and Root Causes of the Loss of Biodiversity

### 5.5.1. Threats to Biodiversity

#### 5.5.1.1. Industrial and Infrastructural Developments

##### *Land Clearing and Agriculture*

Physical destruction of areas of natural vegetation in the process of clearing for agricultural production is a primary threat to biodiversity. The rate of deforestation has increased from about 9,000 hectares per year in the late 1980's to as high as 25,000 hectares per year in the late 1990s (Briggs, 1998). The clearing of riverside forests threatens the survival of important medicinal plants such as the conchite *Aristolochia tribolata*, greenstick *Eupatorium morifolium* Mill., provision bark *Pachira aquatica* Aubl., fig *Ficus radula* Willd., and callawalla *Phlebodium* sp. (O'Brien, 1998).

The use of broad spectrum chemicals for pest, disease and weed control are a major cause of biodiversity loss in agricultural systems. Not only is the pest or disease controlled, but many beneficial forms of wildlife are also eliminated. Such chemicals upset the ecological balance by eliminating the natural predators of other pests, which then have to be controlled chemically (Briggs, 1998). Ground and surface water contamination by fertilizers, other chemicals and effluents impact negatively on biodiversity. Excess nitrogen runoff results in nutrient overload and algal blooms, de-oxygenation of the waterway and kills of freshwater organisms. These excess nutrients can also end up on the coast, contributing to algal cover and doing major damages to coral reefs. Pesticide residues enter the food chain and occasionally result in loss or endangering of species at the top of the food chain. Areas of particular concern known to receive pollutants from land-based sources are the New River, South Stann Creek River, Placencia Lagoon, Sennis River and Chetumal Bay (Jacobs, 1998).

Major threats to biodiversity are presented in subsistence or shifting cultivation (Briggs, 1998). An estimated 2,700 farmers practice this form of agriculture. The majority are concentrated in the Toledo and Cayo districts among the Maya, Mopan, and Kekchi peoples. The influx of "refugees" from Central America in the 1980's and early 1990's has added a further dimension, expanding this practice in the Stann Creek and Cayo Districts, where their main populations have settled. The traditional milpa cycle with a fallow or regrowth period of 30 - 40 years has given way to as little as five to seven years in some areas. This reduction in the regeneration cycle has reduced the inherent fertility of the soils for each crop cycle. Thus farmers have to cut ever larger areas to achieve a certain level of total production. It is estimated that some 6,000 to 7,000 acres of forest/wamil are felled each year for the milpa crops of corn and rice in the Toledo District. The inclusion of a cash crop in the milpa cycle some forty years ago, when rice production was introduced to the Toledo District has had a deleterious effect on the milpa system and the way of life of the Maya peoples. The traditional milpa system included multi-cropping, including legumes and cover crops which reduced the erosion of the soils. The move towards monocropping has resulted in a greater degree of erosion of top soil during the crop cycle. No erosion control measures have been adapted to mitigate the losses. The traditional Maya obtained a higher proportion of their subsistence (food etc.) from what was in effect agro-forestry - the harvesting of forest products which had been encouraged to produce through selective felling or cleaning around useful species over a period of time. The introduction of the "Reserve" areas took away the individual's responsibility for sustaining the land he used. The land was his, only for the cropping cycle of one to two years, the rest of the time it belonged to the community. Any individual effort expended in sustaining useful species could be lost as that plot might be allocated to another family for the next crop cycle. The system discouraged the planting of permanent crops, even the traditional cacao. The families depended more and more on the annual crops, including cash crops, which placed the pressure on the milpa cycle. This has resulted in the deforestation of relatively large areas in southern and western Toledo districts. Steeper and steeper slopes have been cleared resulting in greater degrees of erosion which is not replaced during the shorter regeneration phase. The "wamil" regrowth tends to comprise vines and creepers which produce an impenetrable barrier to many forms of wildlife. The loss of biodiversity is very significant.

##### *Logging*

Logging activities in Belize have been classified as 'selective logging', and are interpreted as an example of successful forest management (Rosado, 1998). Probably targeted timber species have been well managed, but the effects on the associated biological diversity have not been quantitatively assessed. Saprophytic, parasitic and epiphytic species, as well as birds and other wildlife occupying the canopy of the forest are most likely affected by logging and needs to be assessed. Many species of medicinal plants are destroyed during logging exercises (O'Brien, 1998).

#### *Aquaculture*

Aquaculture activities have increased at an accelerated rate over the past decade with 8 farms and in excess of 700 hectares of shrimp ponds in production along Belize's coastline (Annex 18a). Of the farms in operation, only one has a water treatment facility and only four intend to install one in the future (Annex 18b). Aquaculture pond construction in Belize, unlike many countries in South America and Asia, has had minimal effect on mangroves (Jacobs, 1998). Ponds are constructed behind the mangrove fringe and <5% of the total area under construction was once mangroves. The potential threat of aquaculture, however, is the disposal into coastal waters of excess uneaten feed and fertilizer-rich pond water, which can result in eutrophication. Pond water is presently deposited in coastal mangroves (with the exception of one farm), which are assumed to perform a filtering role, before the water actually ends up into the sea. Mangroves do assimilate large quantities of phosphates and nitrates, however, the rate of assimilation is fixed, and total assimilation potential will be determined based the carrying capacity of the mangroves in the area receiving the pond water (Jacobs, pers. comm.). Quantitative assessments to determine the carrying capacities or the effects that pond water has had on mangroves have not been conducted. However, an increase in the number of farms or a change in culture technology from the present semi-intensive to intensive, may result in major eutrophication on Belize's coast. Of concern as well are the chlorine-rich waste water from processing facilities located on shrimp farms. Again, and like pond water, data are not available to demonstrate what has been the effects, if any, of chlorine-rich waste water.

#### *Tourism*

Probably in excess of eighty percent of all tourism activities occur in coastal and marine areas as well as the majority of residential developments. The construction of hotels and other infrastructure for tourism and residential purposes have resulted in the destruction of littoral forests, mangrove clearance, alteration of beaches and destruction of turtle nesting sites, shoreline instability and destruction of habitats for benthic beach communities (Jacobs, 1998). Mangrove clearance for tourism purposes occur on all levels along the coastline and cayes of Belize, both legally and illegally. Mangrove clearance result in critical habitat destruction for hundreds of species that live in the arboreal, subtidal, intertidal, nektonic and benthic communities associated with mangroves. Major part of Belize's coastal diversity depends on mangroves. Seagrass beds and the reef system receive much of its biomass from the mangrove community that acts as a nursery and protective habitat for many fish, crustacean and mollusks. Other physical alterations to Belize's littoral topography such as erosion and shoreline instability can also occur as a result of mangrove clearance (Jacobs, 1998). Tourist visitation interrupts bird and turtle nesting activities, and increased demand for boat transportation increases propeller damage to manatees. Mechanical damage to coral heads from dive boats, anchors and trampling by snorkelers appear to have taken their toll on frequently visited areas on the reef, to the extent that the word 'pristine' is becoming less common when referring to the condition of frequently visited areas on the reef (Jacobs, 1998).

Tourist visitation to inland sites also interrupts nesting of birds and interference with wildlife activities. An increase in tourism and travel to forests, parks and Protected Areas causes increased physical damage to the environment whether it is be by hand, foot, or vehicle (Briggs, 1998). Some areas are more sensitive than others, hence the threat to biodiversity associated with larger numbers of tourists vary from site to site. Road construction to create access to tourist sites results in land clearing and soil disruption. The construction of lodges and hotels also requires land clearing, increased use of ground water, the need for fuel-powered generators, etc. More tourist means more solid and liquid waste. The present inadequate waste disposal systems cannot support additional waste. Incorrect disposal of waste materials can have a substantial impact on biodiversity. Birds and other creatures become entangled in plastic beer can rings, bags etc. Spills of fuels, oils and chemicals on land and in rivers and waterways result in kills of wildlife.

#### *Dredging and Sand Mining*

Dredging occur in river mouths, rivers, streams and cayes, and mining occur in many river mouths along Belize's coast. Depending on the hydrodynamics in the area where the activity is taking place, and depending on the distance to the reef from the activity, sediments can remain suspended in the water column long enough to be transported offshore where they can block the respiratory units of corals resulting in coral death (Jacobs, 1998). Sedimentation levels in excess of 50 cm can result in mass seagrass mortalities. Dredging in polluted areas can also result in the resuspension of once settled pollutants, creating threats to non-polluted areas.

#### *Oil Spills and Bilge Disposal*

These activities pose a major threat to coastal habitats of Belize due to the high rate of sealane traffic by fishing crafts, tourist boats, cruise ships, oil tankers and ships transporting grains and other commodities. Of major concern is the unregulated traffic by oil tankers and the absence of an Environmental Compliance Plan for these vessels. Oil spills can result in catastrophic effects on both benthic and nektonic communities, as well as mass mortalities of species including many marine birds (Jacobs, 1998). The threat of oil spills to terrestrial biodiversity also exists from oil disposal into Belize's rivers and streams by both light and heavy industries. On-land transport of oils and other oil products and their associated threats to biodiversity in Belize is small when compared to maritime transport and the catastrophic effects that oil spills at sea can cause.

#### *Inadequate Municipal Waste Disposal*

Domestic sewage and solid waste disposal is a problem of constantly increasing magnitude in all communities with evident population growth. Nutrient overload result in eutrophication and its associated algal blooms, alteration to the species hierarchy in the ecological structure of communities in rivers, lagoons, wetlands and coastal areas, toxicity from excess ammonium compounds, increased algal cover on corals and ultimately coral destruction and contamination of groundwater (Jacobs, 1998). Areas of particular concern are Belize City, Ambergris Caye, Caye Caulker, Dangriga, Placencia, Chetumal Bay, the Sarstoon-Temash region, the Belize River, the New River, the Mopan River and the Macal River.

### 5.5.1.2. Unsustainable Exploitation Practices

#### *Over-harvesting and Inappropriate Harvesting*

The increased demand for medicinal plants has resulted in herb gatherers (especially those concerned only with economic gain) practicing unsustainable harvesting (O'Brien, 1998). In the Cayo district, at least 10 instances have been seen or reported where whole balsam (*M. balsamum*), billiweb (*Sweetia pacillate*) have been harvested by stripping of the bark from the stems and branches. In other cases, especially for older trees, harvesting of the bark at chest height, right around the tree, has resulted in ring barking and the death of large mature trees. The harvesting of conribio (*A. trilobata*), guaco, and other medicinal vines at ground level and the harvesting of the tuberous root of cocolmecca (*Dioscorea aff. belizensis Lundell*) and red china root (*Smilax aff. lanceolata L.*) is also a threat to the availability of these resources (O'Brien, 1998). Unsustainable harvesting of non-timber forest products such as palms and orchids also occur quite frequently and requires better regulatory measures (Rosado, 1998).

#### *Unsustainable Fishing Practices*

Illegal fishing and many of the fishing methods used are not sustainable. Gill nets for fish, trammel nets for lobster, spear fishing of lobster, exploitation of spawning aggregation sites and trawl shrimping all result in major exploitation of targeted species, but also in the destruction of non-targeted species and their habitats (Jacobs, 1998). Up to 72 species of non-targeted species have been described in the by catch of the trawl shrimp fishery (Gardener, 1996), many of which are of commercial importance, but too small to be marketed. The other species in the by catch are non marketable at this time and are simply wanton waste. The physical damage to the sea floor by the nets result in habitat destruction for many gastropods and echinoderms. Unsustainable fishing practices can result in species extinction linked to over-exploitation and habitat destruction, ecological imbalance, human hunger and unemployment, and reduction of genetic diversity. Mass mortalities of freshwater turtles by nets are also known to occur in many of Belize's rivers and lagoons. These freshwater resources are thought to be over exploited in many areas, and fishing efforts are moving to other

unexploited areas (Jacobs, 1998).

#### *Indiscriminate Killings and Hunting*

Even though species such as the crocodile and the manatee have legal protective status, manatee slaughtering are still frequent in the Port Honduras area and in other areas not officially reported. The American crocodile is frequently killed for its skin. Illegal aliens have been reported to be setting gill nets across river mouths and across inland rivers, trapping and killing everything in its path, both usable and non-usable. Many bird species with protective status are hunted with total disregard for the provisions of the Wildlife Protection Act (Jacobs, 1998).

#### *Poaching*

A considerable part of Belize's coastal and marine resources is exploited illegally both by aliens and locals. Disrespect for closed seasons, size limits and Marine Reserves result in the exploitation of juveniles and egg-bearing organisms, minimizing the reproductive potential and long term biological sustainability of the species. These actions can ultimately lead to species extinction and reduction in genetic diversity (Jacobs, 1998). Illegal logging in the border region between Belize and Guatemala and between Belize and Mexico has also been reported. Illegal logging in Forest Reserves by locals also occurs infrequently and is steadily increasing. Disrespect for closed seasons is quite common, both for marine species and for terrestrial species.

#### 5.5.1.3. Introduction of Exotic Species

Two species of exotic shrimp, one species of freshwater lobster, and one species of freshwater fish have been introduced into Belize for aquaculture purposes directed at human consumption. Fifteen species of freshwater aquarium fish were introduced several years ago for production in aquaculture ponds. No specific studies have been conducted to qualitatively or quantitatively determine the effect that these species have had in Belize (Jacobs, 1998). However, experiences of the effects of exotic species in other parts of the world have created major concern for species introductions in Belize. Introduction of exotic species can result in species competition, alteration of community structure, species displacement and extinction. Domestic pigeons appear to be spreading in urban Belize and may pose both health risks to people from fecal contamination of rainwater collection systems as well as the potential health risk to native avifauna. Many urban communities in other countries expend hundreds on thousand of dollars for control measures in an effort to eradicate domestic pigeon populations (Miller in lit., 1998). An evaluation of the extent of introduced species throughout Belize should be undertaken to provide a baseline estimate for future monitoring (Miller in lit., 1998).

On the other hand, over 90% of the species (both animals and plants) used in agriculture are exotic species, introduced over a hundred years ago. No documentation is available which can demonstrate that these introductions have had negative impacts on native species with which they compete. This however, is not justification for species introductions, since many factors will determine the effects, if any, that the introduction of a certain exotic species might have.

#### 5.5.1.4. Natural Disasters

Flood waters caused by excessive rains result in major soil erosion, destroying top soil and its associated flora and fauna. Sediments produced from erosion are deposited in rivers and finally end up in seagrass beds resulting in mass mortalities of the seagrass, along with all the epiphytes that live on them. Off-shore transport of sediments can reach the reef and block the respiratory pores of reef-building corals, resulting in coral death. Hurricanes can cause physical damage to coral reefs and the destruction of critical habitats on beaches and cayes (Jacobs, 1998).

Wild fires can also cause major destruction to biodiversity. The frequency, magnitude and effects that wildfires have had on biodiversity in Belize have not been documented. However, the dimension of areas destroyed during these fires strongly implies major destruction of flora and fauna (Rosado, 1998). Drought can also result in significant damage to terrestrial biodiversity. Studies are necessary to properly document the effects of drought on biodiversity in Belize.

## **5.5.2. Root Cause Analysis**

### **5.5.2.1. Human Population Growth and Immigration**

The exponential growth of the world's human population and the consequential demand for food, clothing and medicine has resulted in substantial pressure on the earth's natural resources. In most parts of the globe, the exploitation of natural resources holds an intimate relationship with high population density, resulting in irreversible depletion and even extinction of some species in areas where sensitive habitats have been destroyed to provide food and housing for an ever increasing number of human beings (Jacobs, 1998). In Belize, this observable trend is becoming increasingly evident.

Belize has one of the lowest population densities in the world, but a high population growth rate of 2.6 % per annum. In rural areas the rate of growth is 3.4 % and is affected largely by inadequate family planning and immigration (17 % of the current rural population is reported to have been born abroad). Rural areas are known to have a high degree of poverty and are nearest to forest and medicinal plant resources. Poor rural communities are usually engaged in farming and in the exploitation of forest products and wildlife. The result is an increasing pressure on these finite resources which have to be shared amongst an increasing population. This means more land clearing and change in land use causing more deforestation and loss in biodiversity (O'Brien, 1998).

The high cost of health care in its present form, combined with the high level of poverty, is making health care increasingly inaccessible, especially to rural and disadvantaged urban people. This is contributing to the increased use of medicinal plants for common ailments. One of the aims of those promoting traditional healing in Belize is to assist the Ministry of Health in developing a modified health policy that includes the use of herbal remedies. If this occurs, there will be more pressure exerted on medicinal plant resources in Belize. Population increase and poverty are intimately linked to a reduction in biodiversity (O'Brien, 1998).

Policies are necessary to promote strategies to reduce population growth, to encourage sedentary agriculture, to improve technologies so as to increase production from areas already in use, and to avoid continued large-scale clearing for agriculture on new land. Better land allocation is required and deliberate efforts put into providing alternative areas available that can be reused without allocating new areas. This calls for greater coordination between Government and the Private Sector. In general, there is much room for improvement in the management of renewable resources.

### **5.5.2.2. Lack of Knowledge on Biological Resources ( Bio-literacy)**

Proper policies and measures for the management of biological resources can only be developed if at least the basic information is available on which to do so. Basic information lacking include representative data on species diversity, distribution and abundance; data on habitat preference, niche overlap, trophic relationships, population dynamics, ecosystem function and permissible exploitation levels.

Very little research has been carried out on the habitat, diversity, growth and development of medicinal plants. As a result, information in these areas is lacking, making it difficult to assess the effect of human and other actions on this biodiversity. Knowledge on cultivation and sustainable harvesting techniques is also lacking and therefore any commercial use of these plants may put a strain on natural supplies. The erosion of medicinal plant knowledge is increasing due to cultural invasion and the use of modern medicine. Most traditional healers are very old, often more than 70 years of age, and are partially reluctant to share their knowledge. Meanwhile greater than 50 % of the national population is under 18 years of age. While there is respect for the use of herbal remedies, the desire to learn and practice is not earnest. Dr. Michael Balick of the New York Botanical Gardens, who has been working with traditional healers in Belize since 1987, summarizes this threat by saying, "Knowledge about the use of plants is probably in greater threat of extinction than are the plants themselves" (O'Brien, 1998). There is a lack of knowledge on the growth and development of native plants in general.



Very little is known of the biology and ecology of wildlife species, except for research being done at the Belize Zoo and few other captive breeding experiments. There are large areas of Belize where distributional knowledge gaps exist for resident fauna. It is critical and necessary to fill these gaps as a first step, before sound management decisions can be made regarding the biodiversity of Belize (Miller and Miller, 1995; Miller in lit., 1998).

The basic problem is that it is difficult to protect something that you know practically nothing about. While the precautionary approach might be an option to consider, influences of socio-economic and political origin may take precedence over the sustainable use of the resources, at the expense of biodiversity loss.

Similarly, the imminent diversification of the fishing industry warrants the development of new management approaches. However, proper management tools can only be developed if information is available on which to base these decisions. There is a serious lack of basic biological data for species being exploited and those with exploitation potential, including those in the Exclusive Economic Zone. Data on maturity and reproduction, aging, habitat requirements and feeding are indispensable for developing proper management measures, and ultimately an effective Fisheries Policy. Again, the precautionary approach has been suggested for managing certain aspects of the fishing industry, but this approach does not address the socio-economic needs of the sector and is prone to generate numerous social, economic and political conflicts. The end result being constant biodiversity loss, while management measures are being developed.

The other dimension of bio-literacy is that which relates to the general knowledge and appreciation of biodiversity by the community at large. This is addressed in Section 5.7.

#### 5.5.2.3. Lack of Appropriate Laws, Policies and Enforcement

To a certain extent, the lack of laws and regulations specific to biodiversity is a root cause for biodiversity loss. However, many laws address activities which impact on biodiversity and the continued loss of biodiversity is therefore not entirely due to an inappropriate legal framework, but rather to a problem of enforcement.

Responsibility for the management of Belize's biodiversity is largely in the hands of various Government Departments and few NGOs. Enforcement of existing laws is quite poor due to inadequate human resources, finance and infrastructure. This is compounded by 'legislative overlaps', in which more than one agency has the legal mandate for managing the same resource. This usually results in 'turf protection' and poor coordination between agencies, both Government and non-government, the end result being ineffective implementation of laws and regulations and ultimately constant biodiversity loss (Jacobs, 1998).

Increased funding for monitoring and surveillance is not forthcoming and alternative mechanisms for ensuring compliance with regulations must be developed. Exemplary fines for violations should be built in to regulations as a disincentive. Fines for different violations can be built in to the law, so that the quantity to be paid by the violator is not determined by the magistrate, but rather by the law itself. Knowledge of what the fines will be for committing a violation will serve as a deterrent, therefore including the fine in the regulations is thus an enforcement mechanism which does not require the physical presence of an enforcement officer. The current fines under the Fisheries Act, the Forest Act and the Wildlife Protection Act are too small and do not serve as a disincentive to repeated violations. On the other hand, many fiscal incentives are available for developments and these have been exploited to the maximum by developers, thus making it easy for increasing threats to biodiversity. Incentives are available under the Fiscal Incentives Act, the Export Processing Zone Act and the Commercial Free Zone Act. However, no incentives are available for Private Sector participation in biodiversity conservation. Reduced taxation or exemption could be considered as incentives for ecologically sound developments, but likewise, exemplary fines should be imposed as a disincentive for delinquencies. The 'developer pays' approach should be encouraged to discourage negligent harm to biological resources.

The absence of development policies which are cognizant of biodiversity conservation is a root cause of biodiversity loss. Present economic policies make no provisions for the depletion of natural resources to be

included in the indicators for economic growth (e.g. Gross Domestic Product). Little or no value is assigned to natural resources in national accounting systems. The standard of living is judged by material and financial wealth, life expectancy and other parameters but has little to do with the aesthetic value of the environment and real economic value of natural resources. The absence of adequate land use plans and inadequate mechanisms for zoning have resulted in much unguided use and development of lands resulting in the destruction of critical habitats. Low land taxation has undoubtedly contributed to land speculation and disregard its ecological importance and aesthetics. This practice has caused habitat destruction, soil erosion from unsustainable agricultural practices, and increased environmental vulnerability. Similarly, the absence of an Integrated Coastal Development Policy which incorporates tourism and fisheries activities is resulting in arbitrary use of coastal and marine resources.

#### 5.5.2.4. Culture of Consumerism

Western influence and television is transforming many Belizeans to a culture of consumerism. Consumerism is desire of multinational corporations trying to maximize profits, and a desire to have by consumers trying to satisfy a never-ending, insatiable demand. Business under the Western free enterprise model brings together the desire to sell and the desire to have in a form that promotes products that have 'apparent quality' but have a very short life and/or are disposable, drives credit as a way to have that which is wanted, and tramples natural resources in the name of competitiveness. Consumerism results in a demand for income and economic activity far above threshold levels, and ultimately puts greater pressure on our natural resources.

A summary of threats to coastal and marine biodiversity is presented in Annex 19.

## 5.6. Cross-Sectoral and Inter-Sectoral Issues

### 5.6.1. Agriculture and Forest Resources

The agricultural sector has the greatest impact on Belize's plant resources. The transition of agriculture from subsistence to commercial monocrops in the early 1980's, supported by attractive prices for some of the major commodities contributed to the rapid expansion of the sector. The clearing of intact forest to allow for the expansion was done primarily by bulldozers, which was found to be rapid and cost-effective. The objective was to obtain a soil surface free of obstructions for the planting of monocrops. In many cases, particularly for citrus, bananas, and to some extent beef cattle and grains, fertile riverine alluvial soils were used. These soils support a species rich ecosystem and clearing the vegetation destroys valuable biodiversity. The transformation of agriculture from milpa farming to monocropping, the increased use of herbicides, pesticides and biocides and the replacement of natural pastures with improved pastures, also reduce the population of medicinal plants that prefer these environments (O'Brien, 1998).

The preferred habitat for numerous medicinal plants is disturbed forest, wamil, open fields, pastures and agricultural fields (as weeds). Commercialization of agriculture and the use of monoculture as the dominant cropping system is reducing the diversity of volunteer and other species in agricultural fields. Conventional land preparation, high density planting, and herbicides are used to maintain weed free fields before and after planting. The opportunity for jackass bitters (*Neurolaena lobata* (L.) R.Br.), chichibe (*Sida rhombifolia* L.), vervain (*Stachytarpheta cayennensis* (L. Rich) Vahl), trumpet tree (*Cecropia peltata* L.), wild poinsettia (*Euphorbia pulcherrima* Willd. ex. Klotzsch) and others to grow is becoming increasingly restricted. The improvement of pastures by planting few selected species of grasses and/or legumes is also affecting volunteer populations in the pasture ecosystem (O'Brien, 1998).

Medicinal plants are classified as a non timber forest product (NTFP). Management policies and practices for forest management (notably timber extraction and wildlife management) influence this resource. The fact that mahogany (*Swietenia mahagoni* Jacq.) and cedar (*Cedrela odorata* L.), two (2) of the most common timber extracted from Belize's forests, are also used as medicinal plants clearly demonstrates the sectoral

linkage. Balsam (*Myroxylon balsamum* Harms), billiweb (*S. panamensis*), copalchi (*C. guatemalensis*) and sapodilla (*Manilkara zapota* v. Royen) which are all used in local medicine, are also logged. Current attempts are to promote sustainable harvesting of extracted timber resources and to maintain parts of the country for the conservation of medicinal plants (O'Brien, 1998).

There are also inter-sectoral issues of interest within the Agriculture Sector. The effluents created by the agro-industries pose a significant danger to the environment. The sugar, citrus and banana industries all produce significant volumes of organic waste. The proper treatment and disposal of those wastes is essential to prevent contamination of the environment. Simple dumping of the waste on "unused" ground is not proper waste disposal. Citrus waste is extremely acidic and thus contaminates the soil preventing its use for agricultural production for several years. Occasional contamination of ground and surface water has occurred in both the citrus and sugar industries.

Higher yielding varieties, inorganic fertilizers, chemicals for control of pests and diseases places pressure on the sustainability of the agricultural production systems, especially the subsistence and shifting cultivation system. The high yielding varieties are not able to compete effectively with other inter-planted crops and weed species (resulting in monocropping) and at the same time extract higher levels of nutrients from the soil. The depleted soil requires a longer regeneration period to regain former nutrient levels.

#### **5.6.2. Immigrant Populations and Forest Resources**

In 1993 UNHCR estimated that 30,834 immigrants were in Belize and 6,121 undocumented immigrants were considered to be illegal. Efforts in obtaining updated figures have not been successful, but from other information available, it would seem that in general there has been a reduction in the level of immigrants entering the country. The increase in demand for land for agriculture and housing results in changes in land use and clearing occurs in areas that were not cleared before. New settlements have appeared in the seven miles region of the Mountain Pine Ridge road, which is adjacent to the Tapir Mountain Nature Reserve, the Slate Creek Preserve and the Mountain Pine Ridge Forest Reserve. Fear exists that inhabitants of this area will begin to clear land within the boundaries of the reserves (Rosado, 1998). These immigrants have a culture that includes the use of medicinal plants, but their knowledge of sustainable harvesting practices is unknown. Since most of the immigrant population live in rural areas and near to forests, the possible impact on medicinal plants and biodiversity in general is greater. The infringement into Protected Areas by established and illegal immigrants is a constant threat to natural resources. Some herb gatherers speculate that cutting down mature medicinal trees to harvest the bark for sale is a common practice among Central American immigrants, but this could not be verified. However, it is known that another tree (i.e. mammey - (*Mammea americana* L.), though not considered medicinal, is commonly cut down by Central American immigrants to harvest fruits for sale in the local market (O'Brien, 1998).

#### **5.6.3. Tourism and Forest Resources**

While most tourists visit the offshore cayes, some are eco-tourists, and the bio-cultural nature of medicinal plants and traditional healing draws special attention of tourists. Tourist visitations to the two (2) medicinal trails existing in Belize are the main source of income for these trails. Tourists and international visitors are also the most important financial contributors to educational and other traditional healing programmes in Belize. On the other hand, tourist visitation interrupts nesting of birds, require more land clearing for the construction of lodges and hotels, more waste disposal facilities and noise pollution that affects forest wildlife.

#### **5.6.4. Fisheries and Tourism**

User conflicts are quite evident in coastal Belize and the urgent need for policies that address conflict resolution is imminent. Probably the most obvious is that of tourism activities within the coastal zone. Eighty percent of tourist accommodation facilities are located on the coast, with diving on the reef and the blue hole being the greatest attraction. While eco-tourism seem to be gaining strength as a major avenue for development, the effects caused by residential and tourism developments compounded by human population

growth are real and must be addressed urgently if the desired eco-tourism growth is to be achieved. Development pressures are having detrimental effects on coastal habitats, diminishing the aesthetic appeal of many natural attractions on the coast. Large numbers of tourists means more solid and domestic waste and thus increased threats to coastal and marine habitats (Jacobs, 1998).

Mangrove systems that are destroyed during developments on the coast for tourism and residential purposes have deleterious effects on the health of the country's fisheries. Most species of commercial importance to the fishing industry depend on the mangrove as a nursery and as a protective habitat. Likewise, the over-exploitation of fished species can lead to the unsustainability of the fisheries, reduced income for fishermen, increased unemployment and imbalances in the community structure of coastal species. Oil spills will definitely have negative impacts on wildlife and ultimately on tourism (Jacobs, 1998). The possible development of marine cage cultures on Belize's coast can create conflicts with many resource users. The most important of these are fishing, tourism, sea lane traffic and marine conservation. In addition, cages used in coastal aquaculture are usually very visible from a distance, and is contrary to the 'wilderness' that the eco-tourists seek (Huntington and Dixon, 1997). When the quantity of nutrients in aquaculture waste exceed the carrying capacity of coastal lagoons and mangroves, eutrophication will result in a 'dirty green' appearance of the area receiving the waste water, removing its potential tourist attraction. Inland freshwater aquaculture competes for land and water with agriculture, but on the other hand coastal agriculture and other anthropogenic wastes such as pesticide residues and organic substances can reduce the productivity of sites that are potentially suitable for aquaculture development (Jacobs, 1998).

#### **5.6.5. Environmental Planning and Biodiversity Conservation**

##### *Institutional Collaboration*

Planning is fragmented among many institutions with little coordination. There is no clarification of roles or relationships. Further, there is no mechanism to allow for some standardization of plans or planning processes. This results in the increase of plans that are not necessarily "accepted" or supported by the relevant implementing institutions. The overlaps in legislation coupled with the unequal distribution of resources to match institutional responsibilities has greatly contributed to the proliferation of institutions involved in environmental planning. The institutions having the legislative authority to plan does not have the human or financial resources to embrace their large mandate. Increasingly, different interest groups are responding to this by filling planning responsibilities where they are lacking. However, this is done without legal authority resulting in a reduction in the effectiveness of resulting plans (Tillett, 1998).

##### *Plan Implementation*

There are many different types of plans providing good coverage of the country. While management plans do not exist for most of the protected areas their designation significantly controls land use and activities within them. The problem is not our inability to make plans, but our inability to effectively implement them. Much land use and management activities are occurring outside of the existing planning instruments. Various factors contribute to the inefficient implementation of plans. Primary in this is the lack of adequate human and financial resources. The little resources that are available have been channeled towards plan development, with little left over to address plan implementation. The participation component in planning has also suffered from this lack of resources. The resulting situation is one where plans are prepared but little is known about them, consequently, non-compliance results. The legal system does not contribute positively to this situation either. The overlapping legislation and their sectoral implementation has provided opportunities for the regulations in plans to be circumvented. Most permits for land use related activity occurs outside the authority of the planning institutions. Together, the permitting agencies provide the primary channel for plan implementation. However, these permitting agencies are not administered under one central body; they occur across many ministries and departments. The existing human resources and legislative framework in planning does not provide opportunities to ensure plan compliance from these institutions (Tillett, 1998).

##### *Institutional Strengthening*

Planning has never been featured as a priority in Belize. Belize is probably still too young to experience first hand the severe negative effects that may arise from having no plans in operation. Quality of life issues and

the economic justification for planning has still not been grasped by the society at large. The level of resources dedicated to planning by the Government reflects this lack of appreciation for the importance of plans. All institutions with responsibility for planning is grossly understaffed and unequipped. SDAs are the only strategic plans available for the non-urban areas which falls outside the Protected Area. This represents the primary tool to address much of the objectives of the CBD relating to conservation and sustainable use of biodiversity. Yet, there is only one person dedicated to the SDA process. The EIA requirement is directly in line with the requirement of the CBD for "Impact Assessment and Minimizing Adverse Impacts". The existing infrastructure to facilitate the EIA process is good, however, the associated requirement for compliance monitoring is severely underdeveloped. Furthermore, the opportunity exists for the relevant permitting agencies to by-pass the DOE's requirement for EIAs (Tillett, 1998).

#### *Biodiversity Conservation*

The conservation of biodiversity has not been an explicit objective in the activities of all planning institutions in Belize and is usually addressed in the broad category of environmental consideration. The attitude of planners has been positive towards environmental protection. However, there are still some important changes that need to be made if biodiversity concerns are to be more adequately addressed. Currently, all planning units are dictated solely by socio-economic and political factors. There has been no direct effort to include ecological factors in the delineation of planning boundaries. Even the existing Protected Areas do not have ecological factors as the primary factor guiding boundary definition. Due to problems with physical demarcation of planning boundaries on the ground, it has become a practice to use easily identifiable features as boundary definition. While land tenure does play a crucial role in planning units definition, efforts should be made to incorporate ecological factors wherever possible (Tillett, 1998).

It is evident that all of the cross-sectoral issues are linked to the need for economic growth and employment generation, and is probably a reflection of the level of poverty in Belize. The imminent growth of Belize's population and its consequential increase in user conflicts calls for a special approach to conflict resolution in the sectors of primary social and economic importance: the tourism, fisheries and agriculture sectors. However, since most tourism activities take place within coastal areas, a formal Tourism Policy must be developed parallel to a Coastal Development Policy, both of which should be compatible with a National Fisheries Development Policy (Jacobs, 1998). However, since most of the pollution ending up in rivers, lagoons and coastal areas are from land-based sources (mainly from agriculture), a comprehensive Land Use Policy and Agriculture Policy must also be given priority. A summary of identified gaps and suggestions for action is presented in Annex 20.

#### **5.7. Community Participation**

Community participation in natural resource management is minimal, but steadily increasing. This increased role however, is occurring in an unguided fashion, and occasionally results in duplication of effort, unjustified investments and unnecessary tensions between Government agencies and NGOs. Nevertheless, there is a proven need for community participation in plan formulation and implementation. Maximizing community participation in plan formulation maximizes the probability for successful implementation (Jacobs, 1998).

As the people are in closest direct contact with the resources, they are probably the major stakeholders in land use interests. Plans should provide communities with a valuable tool to address their needs. However, without their active participation in the process local communities become mere antagonists to plans. Government lacks sufficient resources and the possibility that increased resources will be found to increase the participation component in planning is minuscule. As such, the onus is left on the local community to effectively organize and mobilize themselves to ensure their active participation and contribution to planning. Another key requirement for active community participation is information. Information is required not only about the surrounding resources, but also on procedures and the legal context for action (Tillett, 1998).

Poverty and lack of information can become obstacles to community participation and must be addressed. The Support for Sustainable Human Development (SSHHD) project under UNDP and the Ministry of Human

Resources, Women and Youth has poverty reduction as its goal. The approach is to reduce poverty by assisting communities to organize and manage themselves. Access to relevant information is considered an essential element for meeting this objective. As such, a main focus of the project is the collection and organization of information to be used as a tool to assist decision making at the local level. District and community profiles with accompanying databases are being developed as a planning tool for communities. Information is compiled on the socio-economic, demographic, environmental and land use potentials of the area. The project is made possible due to resources from the Belize government, the United Nations Office of Project Services, UNDP, with the major contribution coming from the Government of Italy. Such a project has the potential to contribute greatly to efforts at decentralization of authority for plan implementation to local communities (Tillett, 1998).

Communities can play an important role in the management of Protected Areas. A mechanism is required to provide guidance to those community initiatives which are focused at Protected Areas management and other activities conducive to biodiversity conservation. Policy direction in the area of community involvement and co-management of Protected Areas is lacking. There is an increasing trend for communities and other agencies to express interests in becoming co-managers (Ellis, 1998). Government does not and will not have the resources for effective monitoring and management. A possible solution to this problem lies with local communities. Planning in Belize has started to explore the possibilities for decentralization of powers to local communities for plan implementation and Protected Areas management. It is envisaged that co-management will be part of an overall Protected Areas Policy to strengthen Protected Areas management in Belize. While the concept appear to be the most realistic solution, it raises questions about capacity and accountability (Tillett, 1998). There are only two community-based organizations managing Protected Areas: The Friends of Five Blues Lake managing Five Blues Lake National Park and Friends of Laughing Bird Caye managing Laughing Bird Caye National Park.

The role of members of the community to act as special constables to assist in the enforcement of laws impacting on biodiversity is also being explored. Government agencies do not have the man-power or financial resources to monitor the biological resources of Belize. Besides, the users of the resource should be able to manage the resource on which they depend (Jacobs, 1998).

Laws and policies relating to natural resource management must be reviewed to ensure community participation in the planning and management of biological resources. The role of the community is indispensable for successful management.

## **5.8. Access to Genetic Resources**

### **5.8.1. Framework for Ownership of Genetic Resources in Belize**

Even though Belize has signed and ratified the Convention on Biodiversity, a national definition of Genetic Resources, which has been enshrined in the law, has not been defined nor has there been any substantial development in the definition of what constitutes genetic resources in the Belizean context. (The definition of Genetic Resources contained in Article 2 of the CBD states that genetic resources are genetic material of actual or potential value and genetic material is defined as any material of plant, animal, microbial or of origin containing functional units of heredity.)

Whilst there has been a great deal of local use of genetic resources for medicinal purposes in its natural state, there has not been very much systematic documentation of the material or its uses. As a result no clear legal or institutional framework exists in which genetic resources, *per se*, can be placed. As reflected in the legislation, there is often very generalized references to flora and fauna or wildlife or other such general terms. However, there is very little direct reference to genetic materials or genetic resources. Generally speaking, however, genetic resources would either be considered as intellectual property which is intangible or as commercial/physical property which can be tangibly bought and sold. At present genetic resources are either used in their natural state for medicinal purposes or transformed through simple methods for storage and

sale. Within the context of the Biodiversity Convention, however, it cannot be said that within Belize there exists any conscious framework for the identification and registration of the biological resources used for their genetic material.

**5.8.2. Most Common Uses of Genetic Resources: investigation, pharmaceuticals, commercial, cosmetic, food, agriculture etc.**

Within Belize, genetic resources are mostly utilized for two main purposes. Firstly, they have been utilized in the field of agriculture by the Ministry of Agriculture, Fisheries and Cooperatives for investigation and related purposes. In the Department of Agriculture there has been a long history of systematic development of various strains of plants and animals to improve the quantity and quality of agricultural produce. This research has been geared towards selection of high yielding varieties and for examining various varieties for resistance/tolerance to pests and diseases and other detrimental environmental conditions. Progress has been made in the development of breeds of pigs, beef cattle, and dairy cows; and strains and varieties of corn, rice, beans, pasture grasses and in some local vegetables. Another common use of genetic resources has been for medicinal purposes. Some medicinal healers have managed to study and understand the chemical and healing properties of many plants and parts of some animals.

Outside of these two main uses there is some limited use of genetic resources for cosmetic purposes, food and general scientific investigation.

Plant health falls under the responsibility of the Ministry of Agriculture, Fisheries and Cooperatives. A Plant Protection Unit is responsible for monitoring plant health issues and the control of diseases which could affect the growth and development of local species of plants. This unit conducts research, extension, and education in all matters relating to Plant Health. It also provides backup services to the Quarantine services and maintains a post-entry quarantine facility at the Government's Central Farm Agricultural Station. This station also collaborates closely with private institutions working with plant health in Belize such as the Banana Growers Association, the Citrus Growers Association and the Belize Sugar Industries.

Whilst Belize has not yet the resources to directly address the genetic development of indigenous species, the measures listed above have enabled the country's stock of indigenous plants and animals to maintain a certain level of healthy growth and development. In addition, it also has allowed for the monitoring of introduced species.

Small-scale efforts are underway to catalog, preserve and propagate some of the plant biodiversity of Belize. The Program for Belize, an environmental NGO, has developed a micro-propagation facility. This activity is monitored by the Conservation Department of the Ministry of Natural Resources and Environment. To more effectively monitor this activity as well as bio-prospecting, more trained technicians are required. The Ministry of Agriculture, Fisheries and Cooperatives also has a facility at Melinda Agricultural Station where tissue cultured propagative materials can be hardened-off and the disease free materials are then distributed to farmers.

**5.8.3. Identification of the Legislation Linked to Intellectual Property (specifically patents) and its Possible Implementation for the Protection of Intellectual Property Rights with Respect to Biodiversity**

Intellectual Property Rights Legislation in Belize consists of the Copyright Act, Chapter 198 of the Laws of Belize which was passed in 1915; the Patents and Designs Act, Chapter 212 of the Laws of Belize, and the Merchandise Marks Act Chapter 209 of the Laws of Belize enacted in 1888.

Legislation in Belize with respect to intellectual property laws relating to biodiversity is clearly non-existent although there is a growing awareness that this gap needs to be addressed. Currently, Belize is now examining the implications of membership of the Free Trade Area of the Americas (FTAA) and the demands to be made on the Country by the World Trade Organizations (WTO) Trade Related Intellectual Property Rights (TRIPS) Agreement. The responsibility for intellectual property falls under the Attorney General

Ministry, however, the Ministry of Trade and Industry has responsibility for administering the World Trade Organization matters and it is understood that a move is being considered to revise the Intellectual Property Rights Legislation in order to have Belize become a member of the World Intellectual Property Organization (WIPO). Most relevant to the present discussion is the Patents and Designs Act, Chapter 212 of the Laws of Belize. This Law was originally passed in 1862 and has not been revised since. Clearly the passage of more than a century has made this Law extremely anachronistic to the modern pace of Belize's National development and the international context. Within this Law an invention is defined as "any manner of new manufacture, the subject of letters patent and grant of privileges within the meaning of the Act of the Imperial Parliament passed in the twenty-first year of the reign of King James the First, Chapter three, entitled an act concerning monopolies and dispensations with penal laws and the forfeiture thereof (Sec. 2)". As the Act only makes reference to manufacture it can be argued that genetic materials do not fall within this terminology since these are usually found within the traditional farming systems or forests and are considered the common heritage of humankind. Interestingly enough, the Act makes provision for the re-registration of UK Patents as well as other foreign patents (Section 47). It is therefore possible through this avenue to have plants, seeds and other inventions registered under Belize Law. There is however, no strict prohibition of the patenting of plants or animals under the Law. The Act gives the applicant of the Patent monopoly rights to use and commercialize the invention for a term of fourteen years (14) (Sec. 16).

As it stands, this legislation is extremely inadequate to address the highly complex issue of intellectual property rights with respect to biodiversity, especially as it relates to Belize's genetic resources which are, to a large extent unimproved and for which a strong case may have to be made in order for them to fall within the definition of an invention. In the context of the WTO TRIPS Agreement, therefore, it is perhaps more important to discuss what possibilities exist in Belize for the inclusion of environmental considerations within any new proposals for intellectual property rights legislation at this point in time before innovations are introduced which only take into consideration harmonization with international commercial and trade requirements.

Very serious and important areas of conflict may exist between the WTO TRIPs Agreement and the objectives of the Convention on Biodiversity and these will eventually have to be addressed. The Trips Agreement as it stands could constrain the development of incentive systems promoting the in situ protection of plant genetic resources. Furthermore, TRIPs has the potential to seriously undermine traditional agricultural systems, by preventing farmers from having access to good seed. Farmers could be prevented from saving seeds for the next year's crop and from exchanging seeds with their neighbours. Farmers and local breeders could also be discouraged, either by law or by virtue of increased costs, from using protected varieties. TRIPS also discourages governments from using compulsory licensing systems to ensure that technologies are available and can be used for the public good.

### **5.9. Equity and Benefit Sharing**

Within Belize, there first needs to be a public recognition of the role of local and indigenous communities in preserving Biodiversity. Farmers and persons living in local communities have over the past centuries been the stewards of the forests, rivers and swamps which contain the genetic resources. There is an urgent need for public education and awareness on these seemingly complex issues of access to genetic resources in order for local communities to understand the importance of their roles. At present there is competition from other development priorities such as mechanized agriculture, the exploitation of medicinal plants, housing and industry. This is still at a manageable stage in the country, however, where there are no direct policies in place to provide incentives for continued stewardship of genetic resources or access to benefits, then the possibility exists that the communities will not be interested in preserving traditional knowledge or lifestyles. Their short term economic survival will come to depend on the destruction of biodiversity instead of its preservation.

Numerous applications have been received for access to both terrestrial and marine genetic resources with bio-prospecting objectives. Government has been hesitant to entertain such applications, as a precautionary