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**Tropical Forestry
Action Plan:
Belize Conservation
Issues and
Recommendations**

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INTRODUCTION

The major part of Belize's economy, including agriculture, forestry, fisheries and tourism, depends upon natural resources. Compared to other countries in Central America and the Caribbean, the natural resource base, the environment and the wildlife of Belize are in a healthy state. There is no reason for complacency, however. This situation is beginning to deteriorate as the development of Belize increases. Development can and must be consistent with conservation. A strong, far-sighted policy of conservation of natural resources is the only sound basis for continuing economic and social progress in Belize.

In a recent address, the president of the Belize Audubon Society, Dr. Victor Gonzalez, emphasized the most important feature of the conservation strategy for Belize. He said that the time to take conservation measures is now, when a still healthy environment can be studied and alternative management choices are practical; not later, when environmental crises will force the issue and alternatives are limited.

This study describes the current state of habitats and organisms in Belize, current conservation policies and the system of protected areas, the roles of various institutions and organizations in conservation practice, conservation problems, and, most importantly, provides recommendations for management to preserve biological diversity.

Preserving Biological Diversity

The fundamental conservation goal is to preserve biological diversity. Biological diversity refers to all living things and the ecological systems they form. It includes all species of wild plants and animals, the genetic variation within each species and the ecosystems (the total complex of organisms and physical factors) that support these species (USAID 1987). But deforestation and development for merely short-term gains threaten to exterminate many species and disrupt ecological systems in much of the tropics.

There are compelling reasons to be concerned with saving species from extinction and ecosystems from damage. Belizean citizens depend on the food, medicines and industrial materials that are derived from biological organisms. This exploitation of nature is a continually developing process; plants and animals that are not currently used will prove valuable in the future, if they are still extant. Wild relatives of species already in use will be needed for genetic improvements. Also, Belize depends vitally on intact ecosystems for climate control, soil development and retention, as well as nutrient and hydrological cycles. The possibility of massive extinctions and the necessity of preserving biological diversity have been amply demonstrated in much recent literature.

To preserve biological diversity requires protection of habitats and organisms. This is accomplished through laws and policies for protection of wildlife, study and regulation of how land uses affect biological diversity, establishment of a system of nature reserves that includes adequately sized areas of all habitat types, establishment of agencies for management of protected areas and enforcement of regulations, continuing research on the status of habitats and wildlife as the basis for management practices, and education of the public about the value of biological diversity, healthy habitats and viable wildlife populations.

CURRENT SITUATION

Background

Belize is fortunate to have an environment in good condition together with the institutional commitment to protect that environment. Although the official statistic that 93 per cent of Belize is forested land is too high, it realistically indicates that much of the country is wild and little exploited. It is a frequently celebrated fact that wildlife species endangered or extinct elsewhere in Central America, are fairly common in Belize. Belize has two natural features that are highly unusual: the barrier reef, largest in this hemisphere and second largest in the world (Perkins 1983), and the limestone caves of the Chiquibul drainage area, including the largest cave room in this hemisphere and second largest in the world. But what is truly

unusual, and of more importance than particular natural features or the status of certain species, is the fact that the overall environment is so little damaged.

Opportunities to protect and manage this estate are enhanced by the fact that more than 50 per cent of the land is owned by the government. Some 6,322 square km (30 per cent of the country) are in forest reserves. The marine continental shelf and the majority of the cays are also public land. Management plans can be based on results from research in the large area of comparatively undisturbed habitat within the country. Belize has excellent natural laboratories for studies of wildlife, ecosystem processes and alternative agricultural and forestry practices.

Belize's Mayan archaeological heritage is also substantial. The philosophy and benefits of protecting archaeological and natural resources are similar.

To perpetuate this positive situation, Belize has enacted legislation for the establishment of reserves and protection of wildlife. Belize has a modest system of completely protected areas, and it also has a large area set aside as forest reserves, in which timber is harvested but which remain as largely intact ecosystems. The country benefits from a number of non-governmental organizations that manage reserves or otherwise play a constructive role in conservation. In addition, Belize receives financial support from numerous foreign donor agencies as well as attention from many individual conservationists and biological researchers eager to provide expertise and information to formulate conservation policy. Finally, there is national pride in Belize's natural heritage and awareness among government and the citizens of the connection between the quality of the environment and economic and social welfare.

Conservation Laws, Regulations and Conventions

The National Parks System Act was enacted in 1981. It is administered by the Ministry of Agriculture, Forestry and Fisheries and provides for the preservation and protection of important natural and cultural features and regulates the scientific, educational and recreational use of such features. It defines and provides for the

establishment and regulation of national parks, nature reserves, natural monuments and wildlife sanctuaries. The Act provides for civil enforcement of its regulations.

A flaw in the Act is that parks, reserves, monuments and sanctuaries can be de-reserved by a simple decree, putting them on a precarious foundation. The de-reservation of forest reserves suggests the possibility of such reverses. Another flaw is that there are no provisions for reserve management in the Act.

The Wildlife Protection Act was also passed in 1981. It likewise is administered by the Ministry of Agriculture, Forestry and Fisheries and provides for the conservation, restoration and development of wildlife. The Act protects all wild animals from unregulated taking. Some 30 mammal and reptile species and all but six bird species are protected from all hunting. The Act provides for the establishment of hunting seasons, licensing, royalties, restricted areas, bag limits and civil enforcement of its regulations. In addition, a moratorium on harvesting of wildlife for commercial purposes for seven years (which expired in 1988) was declared, to provide time to study the potential and problems of commercial uses of wildlife. More recently a Tentative Wildlife Policy Plan for Belize was adopted which reiterated the cultural and economic importance of conserving wildlife and identified several goals of research on wildlife that will form the basis of rational wildlife policy.

Belize is party to the Convention on International Trade in Endangered Species of Wild Animals and Plants (CITES). All species listed as endangered by CITES are protected in Belize. Belize is not a party to The World Heritage Convention, The Convention on Protection of Wetlands of International Importance, nor UNESCO's Man and the Biosphere Program.

The Fisheries Ordinance was revised in 1958. It applies to all rivers and territorial waters, prohibits fishing with poisons or explosives, and establishes authority to regulate the size of net meshes. This ordinance has been used to set seasons for various species, minimum sizes, and to prohibit fishing with traps or other devices constructed with net or wire within 550 m of the barrier reef.

Flaws in wildlife laws include lack of protection for some species that need it and lack of regulation of internal trade in wildlife. There seems to be no legal authority for protection of reptiles and amphibians, freshwater fish and plants.

The Forest Ordinance was revised in 1958. It provides for the establishment of forest reserves and for licensing and regulating forests in the reserves. A stated policy is that the forest estate be managed to ensure protection of ecosystems and wildlife.

In June 1988 The minister of agriculture stated that the Ministry was soon to issue regulations concerning use and protection of mangroves.

Institutional Responsibility for Conservation

The Forest Department, within the Ministry of Agriculture, Forestry and Fisheries, is responsible for the administration of the forest reserves and government-declared protected areas. The Department has temporarily delegated the management of the protected areas to the Belize Audubon Society (BAS). Private protected areas are managed by a variety of organizations. Much technical and financial assistance for government and private protected areas comes from international conservation organizations and donor agencies of foreign governments. Details are given in the section on reserves below.

The Forest Department is also responsible for wildlife management and enforcement of wildlife laws, for which two positions of conservation officer have been designated. In reality, the Department has not allotted sufficient manpower or funds to have any impact on hunting and the wildlife trade. There is only one conservation officer, whose work, in fact, mostly concerns wood products marketing.

The Fisheries Department in the Ministry of Agriculture, Forestry and Fisheries is responsible for fisheries policy, enforcement and research.

The Ministry of Agriculture has delegated responsibility for management of government-declared reserves to the BAS. To manage the reserves BAS has secured

funding from international conservation organizations. The arrangement between the Ministry and BAS is not entirely satisfactory. The terms of the agreement do not guarantee BAS enough authority over the long term for it to feel secure in making long-term plans. Clear lines of authority are lacking. Most informed people, including BAS officials, feel that ultimately an Office of Conservation in the Ministry of Agriculture should assume responsibility for protected areas.

Non-Governmental Organizations Dedicated to Conservation

Non-governmental organizations are currently doing most of the conservation work in Belize.

The Belize Audubon Society is the oldest conservation organization in the country. Under the authority of the Ministry of Agriculture, and working with the Forest and Fisheries Departments, it manages six government-declared protected areas and supports in various ways the Community Baboon Sanctuary. BAS maintains visitor centers and develops brochures and plans for the reserves. BAS has an important role in identifying and promoting establishment of new reserves. It also educates the public about wildlife, habitats, hunting laws and the benefits of conservation. Most financial support comes from several international conservation organizations.

The Belize Center for Environmental Studies promotes the rational, sustainable use of Belize's natural and cultural resources. The Center works to inform the public about conservation issues, compile and disseminate information about the state of the environment, create a forum for discussion of environmental issues, and assist others in research, education and development.

The Belize Heritage Society was formed to identify the most valuable natural habitats in Belize and to promote their establishment as reserves.

The Belize Institute for Agricultural Sciences engages in research toward environmentally sound land use.

The Belize Zoo and Tropical Education Center maintains a collection of Belizean wildlife to educate the public about conservation, through visits to the zoo, travelling exhibits, radio and television.

The Programme for Belize represents a consortium of conservation organizations. The goals of the Programme are 1) to assist in building a national system of conservation or multiple-use resource management areas; 2) to gather the necessary information to set priorities for natural resources development; 3) to expand environmental education; 4) to enhance national capability for development planning; and 5) to build technical capability in resource management through training. The Programme manages the 64,752 ha Rio Bravo Resource Management and Conservation Area to conserve tropical forest and to maintain a site for research on forest ecology and sustainable agriculture and forestry.

Protected Areas

There are 11 formally protected areas in Belize (Fig. 1) and one scenic area, Thousand Foot Falls, which is protected by the government but has no declared reserve status. The Rio Grande Nature Reserve, established in 1968, no longer exists. It was irrevocably damaged by farmers who later abandoned the area.

Government-Declared Protected Areas

Blue Hole National Park. Established in 1986 and located on the Hummingbird Highway near Belmopan, it covers 233 ha of tropical moist forest (life zone classifications are from Hartshorn et al 1984), rivers and caves. The Park includes Blue Hole Natural Monument, where the roof of a cave collapsed, exposing part of an underground river. The Park is a popular place for recreation and may face problems of overuse in the vicinity of the Natural Monument. It is managed by BAS.

Cockscomb Basin Wildlife Sanctuary. Established in 1986 on the eastern slope of the Maya Mountains, it consists of 1,473 ha of second growth subtropical wet forest. It was created primarily as a reserve for wild cats, especially the jaguar, for which it is good habitat. It is too small by itself to maintain a viable jaguar

population, but the reserve is surrounded by the much larger Cockscomb Basin Forest Reserve, in which hunting is prohibited. Because the Sanctuary is identified with the spectacular jaguar, it attracts many Belizean and foreign visitors and has publicized the environmental assets of Belize and the enlightened attitude of the country toward conservation. A detailed short-term management plan was prepared for this sanctuary. A chief potential problem is overuse. The Sanctuary is managed by BAS.

Crooked Tree Wildlife Sanctuary. Established near the Northern Highway in 1984, 53 km from Belize City, it contains 1,470 ha of freshwater lagoon, marsh and swamp forest. It supports large numbers of resident and migratory birds. Being near Belize City, this Sanctuary attracts many Belizeans and educates them about wildlife conservation. Visits have greatly increased in the past year, benefitting local people who rent boats. Lack of transport makes patrolling difficult, consequently poaching is a problem. BAS manages the area.

Crown Reserve Bird Sanctuaries. These were established in 1977 on seven small cays located mostly along the Caribbean shoreline and among the outer cays, with one site in Northern Lagoon. They have supported colonies of nesting waterbirds. It has been very difficult to protect these sites; bird colonies have been destroyed on three of them; the condition of others is damaged or unknown, and only one has remained undisturbed. The Sanctuaries are managed by BAS.

Guanacaste Park Crown Reserve. Established in 1973, it consists of 21 ha of riparian forest between the Western Highway and the Belize River near Belmopan. This location makes Guanacaste a likely site for recreation and education about conservation and the purposes of reserves. The Reserve has been disturbed by farmers and woodcutters in the past but is now better patrolled. It has a well-developed systems of trails and is managed by BAS.

Half Moon Key Natural Monument. Established in 1982, it is an 18.2 ha sand cay on Lighthouse Reef, 80 km southeast of Belize City. The cay is half covered with a coconut palm grove and half covered with a denser, more species-rich vegetation that supports thousands of nesting seabirds. The BAS, which manages the Monument, has developed a five-year plan for it in which several problems are

described, among them: isolation and low visitation rates and consequent neglect, lack of enforcement of fishing regulations and lack of trained managers.

Hol Chan Marine Reserve. Established in 1987 and located about 6 km south of San Pedro, Ambergris Cay, it consists of 1,295 ha of open water, reef, mangroves and seagrass beds. Proximity to rapidly developing San Pedro will make Hol Chan well known and an educational tool. At the same time, development pressure around San Pedro may adversely affect Hol Chan. The Reserve has received a major grant from USAID, which supports a manager, biologist and two wardens. Hol Chan is privately managed, with assistance from the Fisheries Department.

Society Hall Nature Reserve. This Reserve was established in 1986 and is made up of 2,728 ha of tropical moist forest located 16 km southwest of Belmopan. Society Hall was donated to the government. It is the largest government-declared, strict reserve, and thus the largest such reserve of the species-rich forests of Belize. The Reserve is difficult to reach and penetrate and has not been explored by biologists. It has suffered incursions of farmers on one edge. Society Hall is privately managed.

Management of some reserves is inadequate, due to the lack of funding, training, and technical information. A lack of training in reserve management, wildlife management, and concepts of conservation biology extends through all levels of the Forest Department and BAS. Under the aegis of BAS, US Peace Corps volunteers with conservation training have managed some of the reserves. This program has been phased out, at least temporarily. Thus the reserves are without technically trained managers. Moreover, there is little information on the ecology of the reserve habitats on which to base management decisions.

Private Protected Areas

Each of the private reserves represents a different, novel and enterprising approach to conservation.

Community Baboon Sanctuary. Established in 1985, it covers 777 ha of riparian forest, pasture, and farmland along the Belize River at Bermudian Landing. The Sanctuary consists of 75 land parcels whose owners have signed a non-binding agreement to manage their properties such that they remain suitable habitat for howler monkeys, locally called baboons. Nearby communities on the river are interested in joining the Sanctuary. This community agreement is unique among wildlife sanctuaries and is a model that may be extended to other situations. The Baboon Sanctuary is managed by one paid employee, with support from BAS. Tourist facilities are needed to accommodate visitors.

Shipstern Wildlife Reserve. Just established in 1987, it is an area of 8,288 ha of subtropical moist forest, mangrove and saltwater lagoon near Sarteneja, 32 km east of Corozal. The forest has regenerated after a devastating hurricane in 1956. Shipstern is owned by British entrepreneurs whose goals are to preserve this habitat by making the reserve self-supporting through tourism and butterfly farming. The attempt to make the reserve self-supporting is an important experiment in the field of natural resource conservation. Shipstern is managed by two biologists and employs several workers.

Rio Bravo Resource Management and Conservation Area. Newly established, in 1988, this consists of 64,752 ha of subtropical moist forest and savanna in the northwest corner of Belize, north of Gallon Jug, bounded by Guatemala on the west and on the east by a line paralleling, and about 4 km east of, Booth's River. The Area includes tall forest, as well as low forest on poorly drained areas, rivers and small lakes. It is also the site of a large complex of Mayan temples. The Rio Bravo Area will be used for applied research in forestry and agriculture, basic research in tropical biology, as well as training in research and conservation. The results of this program should have far-reaching salutary effects on conservation and economic development in Belize. This reserve is managed by the Programme for Belize.

Gap Analysis

The strict nature reserves (no hunting, logging, etc.) in Belize have been established to protect particularly threatened or valuable areas, such as vulnerable

natural features and bird nesting sites (e.g. Hol Chan, Crooked Tree, Half Moon Key), recreation areas and interesting geologic features (Blue Hole), or symbols of the conservation ethic (Guanacaste). Many forest types and other habitats, and thus many species and the ecosystem processes that support them, are not represented in the strict reserve system. These habitats and ecosystems are "gaps" in the system of strict reserves. To enumerate them one conducts a "gap analysis." This technique is described by Burley (1988):

"...conservation biologists for years have...used the process called gap analysis to establish short-term and longer-term conservation priorities. The concept is deceptively simple...: within a particular country or region, first identify and classify the various elements of biological diversity in several ways. Then examine the existing and proposed systems of protected areas and other land-management units that help conserve biological diversity. Finally, using various classifications, determine which elements (e.g., major ecosystems, vegetation types, habitat types, species) are unrepresented or poorly represented in the existing system of conservation areas. Once this is known with reasonable precision, priorities for the next set of conservation actions can be established. The process continues indefinitely, and the conservation system is refined as land use changes and as better information about distribution and status of species and ecosystems is obtained."

The underlying rationale is that by ensuring that all habitat types are well represented in a system of conservation areas, it is assumed that much if not most of the biological diversity (species and ecosystems) will be protected. Thorough gap analyses have been conducted in Great Britain, Peru, Australia and South Africa (Specht et al. 1974, Sattler 1986).

This report presents an elementary gap analysis of the terrestrial habitats of Belize, to illustrate the process and indicate the deficiencies and the most glaring gaps in the terrestrial reserve system.

Wright et al. (1959) lists 34 major vegetation types (Wright's classification) found in Belize. The following are represented by some hectareage, however small, in the strict reserves:

- Broadleaf forest rich in lime-loving species,
deciduous seasonal forest 15-21 meters tall
deciduous seasonal forest 21-30 meters tall
- Broadleaf forest moderately rich in lime-loving species,
evergreen and semi-evergreen seasonal forest
- Broadleaf forest with occasional lime-loving species,
semi-evergreen seasonal forest
- Broadleaf forest with few lime-loving species,
semi-evergreen seasonal forest
- Transitional broadleaf forest poor in lime-loving species,
semi-evergreen seasonal forest
- Transitional low broadleaf forest and scrubland,
poor in lime-loving species (one of two types)
- Pine forest and orchard savanna, without lime-loving species
(one of two types)
- High marsh forest (two of three types)
- Low marsh forest
- Herbaceous marsh and swamp (two of two types)
- Mangrove swamp (two of three types)
- Littoral forest
- Littoral swamp
- Cohune palm forest

The major vegetation types not found in strict reserves include:

- Broadleaf forest rich in lime-loving species,
deciduous semi-evergreen seasonal forest 24-30 meters tall
deciduous semi-evergreen seasonal forest 30-37 meters tall
- Broadleaf forest with occasional lime-loving species,
evergreen seasonal forest

- Transitional broadleaf forest rich in lime-loving species
- Transitional broadleaf forest poor in lime-loving species, evergreen seasonal forest
- Transitional low broadleaf forest and shrubland, rich in lime-loving species
- Transitional low broadleaf forest and shrubland, poor in lime-loving species (one of two types)
- Shrubland with pine
- Pine forest and orchard savanna, with lime-loving species without lime-loving species (one of two types)
- High marsh forest (one of three types)
- High swamp forest (two of two types)
- Palm swamp
- Mangrove swamp (one of three types)

A preliminary interpretation of this gap analysis, together with consideration of the hectareage and importance of the vegetation types, yields several points:

- Eighteen of 34 major vegetation types are represented in the strict reserves, but actually only very small areas of many of these habitats are included.
- Sixteen major vegetation types are not included in any strict reserve.
- There are many additional, minor vegetation types not found in reserves.
- The tall evergreen forests of southern Belize, the most species-rich forests in the country, are poorly represented. Particularly rich are the wet forests of Toledo District, southeast of the main divide of the Maya Mountains.
- Pine ridge, a widespread, important vegetation type, is poorly represented in strict reserves.
- Mangrove swamp, another widespread, important vegetation types, is poorly represented.

- Wetlands in the high rainfall region of southern Belize are not represented.

Forest Reserves

The 16 Forest Reserves cover 6,322 km², or 30 per cent of Belize. Nearly all this reserved land is in the south of the country, and most of it comprises the Mountain Pine Ridge, the Maya Mountains, and the Vaca Plateau, which lies between the main divide of the Mountains and Guatemala. A stated policy is that the forest reserves be managed to ensure protection of ecosystems and conservation of wildlife. To the extent that these areas are managed for selective logging, with careful control of logging practices such that the Reserves remain essentially as wild lands with their ecosystem processes intact, the forest reserves will serve to protect much of Belize's biological diversity. However, adequate plans addressing the biological diversity questions do not exist for the forest reserves.

Parts of the Forest Reserve system have been de-reserved for agriculture. While this may be advisable in some cases, it should be done only after considering conservation objectives. The most recent addition to the system was the Cockscomb Basin Forest Reserve, established in 1984.

Wildlife

As evidence of the current healthy state of Belize's wildlife, all but four of the 22 animal species listed by the Convention on International Trade in Endangered Species (CITES) for Central America are still common in Belize. Notable species that are extinct or endangered elsewhere but are common in Belize are the jaguar, tapir, curassow, Morelet's crocodile, and manatee. Some species have dangerously low populations. The Belize Country Environmental Profile (Hartshorn et al. 1984) discusses the status of individual species. (See Frost 1974, 1977, 1981 for discussion of the wildlife situation in Belize.)

But the conditions that allow wildlife to flourish in Belize are changing. As Belize's human population increases and development pushes into formerly wild land,

hunting laws are commonly ignored and wildlife suffers as a result. A study of hunting practices in the recently settled areas near the Hummingbird Highway showed that many Belizeans are ignorant of the hunting laws, or profess to be, and the laws are routinely broken (Bliss et al. 1987). Populations of game species and other animals are reputedly much reduced in the area. BAS is working to inform the public of the hunting regulations. But enforcement is nearly impossible given the lack of staff assigned to that task. Enforcement of fisheries regulations is difficult for the same reason, and some commercial fish stocks are reportedly significantly reduced.

Protected species at risk due to inadequate enforcement include the sea turtles, the ocellated turkey, and the great curassow and crested guan in some areas. Populations of important species that are not protected and are reportedly suffering, include the iguanas, whose eggs and gravid females are especially sought, and the river turtle, or hickaty.

The Wildlife Act declared a seven-year moratorium (which ended in 1988) on commercial trade in wildlife. This has mostly succeeded in stopping export of animals and animal parts. The intent of the moratorium was to allow time for research into sustainability of wildlife trade, but that research has not been done. Some observers feel that there is still a damaging amount of internal trade in wildlife. Of particular concern is the internal and export trade, legal by license in Belize, of black coral (Antipatheria sp.). It is nearly extinct elsewhere in its range, such as Mexico, which adds to the pressure on Belizean populations.

Private investors have proposed developing commercial sport hunting of domestic and exotic species on game farms in Belize. Their plans were rejected by the Ministry of Agriculture on advice of BAS. In theory, game farming can preserve habitat, benefit native wildlife and contribute to the Belizean economy. But there are possible dangers from exotic animals and diseases. If the potential environmental impact of a game farming plan is explored and shown to be benign, and if proposals demonstrate careful foresight and guarantee effective management and adequate safeguards, game farming may be beneficial.

Tourism and Natural Resources

There is a direct connection between tourism and the current healthy state of Belize's environment. In 1987, about 55,000 tourists visited Belize. This is a large number relative to Belize's population of 180,000. The majority of these tourists came to stay on the cays, one of the outstanding natural features of Belize, but increasingly tourists are attracted to the interior. About 70 tours of birdwatchers (6-18 people each) came to Belize in 1987. Other tours come for orchids and archaeology. There were also numerous small groups interested in natural history but not connected with tour organizations, and whose numbers are not recorded as natural history tourists.

The economic benefit of natural history tourism is illustrated by the situation in Kenya, where game parks attract thousands of visitors annually; in India where tiger reserves generate large revenues; and, closer to Belize, in Costa Rica, where an excellent system of parks brings scores of tour groups each year. It is estimated that each natural history tourist to Belize injects about US\$1,300 into the economy. About 800 such tourists would contribute more than US\$1,000,000 (Thering 1988).

The number of natural history tour groups in Belize is increasing, and tourism experts feel that, given the environmental assets of Belize, the nature tour business can expand greatly. Scouts for tour companies are looking for additional sites to visit in Belize. There is also an incipient industry of adventure tourism, including rafting, caving and backpacking, which depends on the natural setting. The established reserves are attracting many visitors, especially Crooked Tree, Cockscomb and the Community Baboon Sanctuary. Expanded facilities are needed at some reserves. The influx of visitors can benefit the reserves financially, but could also damage them, if not managed correctly. (See Healy 1988 for discussion of natural history tourism in Central America.)

Environmental Education

It is important that the public understand the relationship between sustainable development and conservation. Environmental education has a small share of school

curricula in Belize, but most of the non-governmental conservation organizations are active in teaching natural history and conservation principles. The Belize Audubon Society and the Belize Zoo and Tropical Education Center are the most prominent. Together their programs include public lectures, bird walks, displays at nature reserves, school slide shows, radio programs, posters, pamphlets and the Zoo itself. Belizeans may have a greater appreciation of the natural environment than some other cultures in developing countries, but most are probably unaware of the threat to the environment and to long-term economic well-being from uncontrolled, short-sighted development. The Programme for Belize recently sponsored a study of environmental education in Belize. The results are not yet published.

RECOMMENDATIONS

Biological Diversity, Economics and Planning

The most important general recommendation is that decisions bearing on use of natural resources should be consistent with the goal of preserving the full range of Belize's biological diversity, to include habitats, wildlife and supporting natural processes. This principle does not translate into a strict preservationist ethic. It need not conflict with development of natural resources for economic purposes. Indeed, its aim is to ensure that natural resources are exploited in ways that ensure their perpetual benefit to Belize.

Diversity can be preserved by following the guidelines of a comprehensive conservation and land-use plan. This plan would be based on an inventory of Belize's habitats, wildlife and natural resources and on an understanding of how habitats, organisms and environmental processes are affected by particular land uses. The plan would provide the rationale for legislation and a framework for a system of reserves. It would embrace the need for economic development and be a reference point for devising environmentally-sound development methods. The plan would be formulated, and continually revised in light of new information and changing circumstances, with input from all informed and interested constituencies. Comprehensive planning would include both terrestrial and marine habitats.

Laws and Conventions

Parks, Reserves and Land Use

The National Parks System Act provides a firm legal basis for the establishment of parks and reserves. Yet their status as conservation areas is insecure, because declarations under the Act are rescindable by simple ministerial fiat. This situation undermines the confidence needed to make long-term plans for reserves and to attract funding to support them. It is recommended that legislation be enacted that requires a fully justified rationale, in terms of optimal land use, for any de-reservation.

The establishment of parks and reserves can require lengthy consideration. It is recommended that a provisional protective status be created to apply to land under consideration for reserve status. This will protect land while plans are made and will forestall preemptive exploitation of resources, or the intentional destruction of natural features to reduce an area's value as a reserve (as has happened on occasion in the United States).

If a Conservation Office is established (see below) and its responsibilities include managing reserves, that responsibility should be placed on a firm legal basis. This will provide confidence for planning, consistency in administration and clear lines of authority.

A body of regulations for particular habitats is needed. The Minister of Agriculture's intention to regulate use of mangroves merits support. The marine habitats and offshore islands are especially fragile, important economically (fisheries and tourism) and require protection (Perkins 1983).

Belize should investigate the advantages of joining the World Heritage Convention, the Convention on the Protection of Wetlands of International Importance, the UNESCO Man and the Biosphere Programme, the United Nations Environmental Programme, the FAO Gene Conservation Program, and RAMSAR.

Joining these programs would require commitments from Belize but would also qualify the country for technical and financial assistance from these programs.

Wildlife

It is recommended that the moratorium on commercial trade in wildlife, declared in 1981 which expired in 1988, be reinstated. The purpose of the moratorium was to allow time for study of wildlife populations and the pros and cons of commercial trade. Some commercial trade in wildlife may benefit Belize, but the needed studies have not been carried out. Meanwhile, it is certain that Belize is benefitting economically from the status quo of wildlife, because the current healthy animal populations bring in tourists. It is best not to tinker with this positive situation until there is a good understanding of the impact of commercial trade. The wise course is to reinstate the moratorium.

The moratorium has chiefly affected the export trade in wildlife. Control of internal trade, chiefly of parrots, is needed.

The fairly active internal and external trade in black coral should be scrutinized and probably closely regulated. This species has been eliminated elsewhere in its range.

Concerning the hunting laws, the mission feels that, lacking sound information, the conservative approach, as with commercial trade, is the best approach. There are several species not currently protected in Belize whose survival is known, from experience in other countries, to be very precarious in the face of heavy hunting pressure; namely, the crested guan, great curassow, iguana, gibnut and hickaty. These species should receive at least partial protection (bag limits, seasons).

Legislation should be enacted concerning the protection of plants, amphibians and freshwater fishes, and an institution to implement those laws should be designated.

Regional wildlife treaties, which affect Belize and its neighbors, will be to Belize's advantage, since its wildlife populations are generally in better shape than those of the surrounding countries.

Institutions

Proposed Office of Conservation

It is recommended that the Government establish an Office of Conservation, probably within the Forest Department in the Ministry of Agriculture, Forestry and Fisheries. Incorporation within the Forest Department will permit close coordination of activities and exchange of views between agencies with major responsibility for use of land. The Office's responsibilities would include overseeing: management of reserves and wildlife, enforcement of parks and wildlife laws, research on the environment and maintenance of a conservation data base (see below). Establishing such an office would legitimize and publicize the concept of conservation in Belize, as well as bring the energy of full-time, trained personnel to bear on conservation issues.

The Office would be located in Belmopan and would have two professional employees, including specialists on reserves and wildlife. Also needed would be district officers analogous to the District Forest Officers. Enforcement of the parks and wildlife laws will require a staff of game wardens.

The reserves specialist would be trained in the theories of reserve design and the practice of reserve management. He or she would be charged with guarding against infringements on reserve land, with monitoring incompatible land uses adjacent to reserves and with resolving conflicts between permissible uses of multiple-use reserves. This position would also include investigating possible new reserves and making recommendations for their establishment, as well as continuing research on management of established reserves.

The wildlife specialist would be trained in wildlife management. Responsibilities would include continuing research on ecology and population dynamics of wildlife, administration of management practices, and enforcement of wildlife laws concerning hunting and trade. Because a major problem in wildlife management is lack of enforcement of wildlife laws, it will be important to maintain a trained crops of game wardens attached to the Office of Conservation.

It is recognized that no Belizeans have the training to fill the main or district office positions of the proposed Office of Conservation, or to act as game wardens. For the time being qualified persons will have to be sent abroad to train for the administrative and research positions. Commitment by the Government to establishing an Office of Conservation will attract technical and financial assistance from foreign and international conservation organizations. It is also recognized that there is currently no office space, equipment or vehicles for this proposed Office of Conservation. This is another financial problem.

The Office of Conservation would house the Conservation Data Center where information is assembled concerning the status of habitats and wildlife in Belize. This Office should also regulate and assist research by foreign scientists in Belize.

Proposed Conservation Advisory Board

The management of natural resources concerns many constituencies in Belize, and many types of information and points of view must be considered in making resource decisions. Therefore it is recommended that a Conservation Advisory Board be created. This would be a non-statutory board, acting in an advisory capacity only, to assist the Office of Conservation with information, discussion and recommendations. This board could be made up of people from the resource-based industries (forestry, agriculture, fisheries, tourism) and the various non-governmental organizations concerned with conservation. The Board could include foreign experts. Such a pluralistic advisory committee would help avert the adoption of extreme policies on resource issues, and it could develop alternative proposals for consideration by the Office of Conservation. The first job of this Board might be to consider a comprehensive land-use and conservation plan for Belize.

Other Advisory Groups

Committees dealing with a smaller scope of problems are also needed. It is suggested that a committee be formed to advise on marine issues and to consider a comprehensive plan for marine habitats and wildlife. Natural jurisdictions overlap in the case of the mangroves. Coordinated study of mangrove issues could be carried out by representatives of the government offices dealing with forestry, fisheries and tourism, with the help of informed non-government people.

Non-Governmental Organizations

The proposed Office of Conservation would take over only a small part of the conservation work currently done by non-governmental organizations in Belize. Those organizations will continue to play a major role. Each of them has a particular role not filled by the government or by other non-governmental organizations. Relieved of managing the reserves, the Belize Audubon Society would still have a major, crucial responsibility in environmental education. The non-governmental organizations will be needed for technical expertise and advice, research, fund-raising and contacts with foreign conservation organizations, education and aid to visiting researchers. As mentioned above, representatives from non-governmental organizations should be included on the Conservation Advisory Board and other committees.

The Government should continue to cooperate with, and encourage the participation of, non-governmental organizations in conservation policy decisions and conservation action.

Reserves

Complete protection for certain areas is needed. Some species can only survive in undisturbed habitat. Such habitats also provide a laboratory for research on undisturbed ecosystem processes, benchmarks for comparisons with the effects of development. Also, pristine habitats are tourist attractions. It should be

emphasized, however, that many land uses other than strict reservations are compatible with conserving biological diversity. Conservation is not simply land preservation; its goals and methods can be consistent with wise, sustained-use development.

Gap Analysis

Now that some areas of special importance have been designated strict reserves the fundamental goal of conserving biological diversity in all its forms is best accomplished by a systematic, comprehensive analysis of gaps, i.e. habitats and organisms not included in the reserve system. A rough, preliminary gap analysis revealed major deficiencies in the system. A thorough inventory and mapping of Belize's habitats is needed to help choose future reserves. Of course, the ideal of strictly reserving an area of every type of habitat in Belize will not be attained. Compromises and trade-offs with other land uses will have to be made. But habitat types can be ranked for conservation priority according to the extent that they contain endemic species, i.e. species not found elsewhere. For example, there is an area of high plant species endemism in southern Belize (Toledo 1982).

Proposed Reserves

Proposals for new reserves should be based on the sound reasoning of gap analysis and a comprehensive plan. It is useful, however, to present a list of sites that have already been proposed, with notes on their status and valuable features. Some of these sites are so clearly important, or threatened, that designation need not await a comprehensive plan.

The following 24 sites (Figure 2) are listed in order of decreasing priority for reservation, as determined at a meeting in Belmopan in October, 1987, of Government, private, and expatriate individuals concerned with conservation in Belize. They include natural and archaeological sites.

Caracol; important archaeological site, forest, cave system; reserve might be modelled on the Tikal design.

Upper Bladen; little-disturbed, species-rich forest of southern Belize, much wildlife, remarkable scenery; preliminary biological survey and plan completed.

Glover's Reef; good cross-section of marine habitats, colony of threatened brown noddies (terns); detailed management plan being drawn up.

Blue Hole and Long Cay, Lighthouse Reef; unique areas to be added to Half Moon Key Natural Monument.

Thousand Food Falls; tourist attraction.

Double Waterfall; tourist attraction.

Caves Branch - Petroglyph - Mountain Cow Cave; cultural sites; should be included in Blue Hole National Park.

Cockscomb Basin; extend current Cockscomb Basin Wildlife Sanctuary to include more area of species rich southern forest and jaguar habitat.

Crooked Tree; extend boundaries to include additional habitats in the current Crooked Tree Wildlife Sanctuary, provide a buffer, and add an archaeological site.

Southern Lagoon; provide sanctuary for the manatee; might be established on Baboon Sanctuary model.

Raspaculo River; a particularly wild, undisturbed area, with scarlet macaws, caves.

Mussel Creek; connects Crooked Tree and the Community Baboon Sanctuary; could be managed jointly; bird survey completed.

Northern Lagoon and Turneffe Islands; breeding areas of the endangered American crocodile.

Northern Cays and Lighthouse Reef; breeding areas of the endangered American crocodile.

Shipstern Lagoon; adjacent to the current Shipstern Wildlife Sanctuary, manatees and vulnerable rookeries, archaeological sites.

Sibun River Karst Area; interesting landforms, unusual vegetation, archaeological sites, near Belize City and new road.

Temash River; fine stand of mangroves.

Lamanai; archaeological site.

Other proposed sites (Hartshorn et al. 1984 and personal communications) are:

Laughing Bird Cay; undisturbed natural vegetation (uncommon on the cays).

Carrie Bow Cay; scientific reserve, currently used by the Smithsonian Institution.

Forest south of Union Camp and west of Little Quartz Ridge; some of the "best forest in Belize," unusual plants, perhaps unique highland avifauna.

Upper Guacamayo River Valley; least disturbed pine forest in Belize, adjacent to Raspaculo Creek area.

Silver Creek Bank; fine stand of pines, near Cockscomb sanctuary.

Baldy Beacon; unique geological features, plants and butterflies.

Reserve Design and Management: International Designations and Parks

Complete protection of an area does not guarantee the survival of its component species. For example, areas can be too small to support viable gene pools for some populations over the long run, or may have too few individuals of a species for some to survive epidemics, or may not contain the variety of habitats or interacting species that are needed by some species during an annual cycle of seasonal changes. These problems are acute in the tropics, where many species are represented by few individuals in a given area. There are no standard recipes for reserve design, and some principles are controversial, but it is clear that size, habitat diversity, the nature of buffer zones and other factors, must be considered in reserve design. Experienced conservation biologists should be consulted in planning reserves. (For background in conservation biology see: Soulé and Wilcox 1980, Soulé 1983, Simberloff 1988).

Management needs for each reserve vary according to the local situation, but there are several in common. These include training for managers and the formulation of short- and long-term management plans, as BAS has accomplished for some sites. Management decisions should be based on continuous monitoring of habitat and wildlife status and of potential inimical activity on reserve boundaries. All reserves must be managed with the needs of local people in mind.

The Belize Audubon Society recommends that reserves become partially self-supporting by charging admission fees. Fees could be levied according to income: less for children and Belizeans, more for adults and foreigners.

The southern Maya Mountains and Belize's barrier reef are large and valuable enough as natural resources on a global scale to qualify as a Biosphere Reserve and a World Heritage Site, respectively. These designations are made by UNESCO and bring technical and financial assistance, as well as publicity and tourist income. Such reserves are managed for multiple uses, not strict habitat preservation alone, and specific reserves are carefully designed to incorporate and sustain local economies.

Also in the international sphere, 15 wetland sites in Belize have been identified by Scott and Carbonell (1986) as potentially eligible for designation as Wetlands of International Importance under the Convention on the Protection of Wetlands of International Importance. For this designation Belize must join the convention.

A Further possibility is that Belize join with Mexico and Guatemala in establishing an international boundary park centered on the area where the three countries adjoin each other, known to some as the Azul Triangle. This is a vast, mostly uninhabited region, with many Mayan ruins. On the Belize side the 64,752 ha Rio Bravo Conservation Area (managed by the Programme for Belize) has already been dedicated to conservation and environmentally sound, sustainable exploitation.

Biological Diversity and Land Use Outside Reserves

For conservation goals there is a tendency to think solely in terms of national parks and wildlife sanctuaries. In fact it would be impractical and undesirable to put enough land in strict reserves to contain all Belize's species. Fortunately, other land uses are compatible with the aim of preserving biological diversity. For example, successful, sustained-yield management for timber of the forest reserves will maintain suitable habitat for most forest species.

By themselves, some reserves will be too small for certain species, therefore wise management of surrounding areas not dedicated to strict preservation is critical. For instance, the Cockscomb Basin Wildlife Sanctuary (1,473 ha), popularly known as the "Jaguar Reserve," is probably too small to contain continuously more than one or two jaguars. But the surrounding area, a large Forest Reserve, is currently managed as good jaguar habitat. Areas surrounding reserves and under conservation management that includes multiple uses are known as "buffer zones," or "Areas peripheral to national parks or reserves which have restrictions placed on their use to give an added layer of protection to the nature reserve itself and to compensate villagers for the loss of access to strict reserve areas." (Mackinnon 1981).

Management systems for buffer zones should be developed within the context of: 1) the plan for protected area as whole; 2) regional planning and development policies; 3) traditional land use systems operating in the area; 4) appropriate and sustainable use of land and biological resources (Oldfield 1988). Case studies and guidelines for buffer zone management are presented in Oldfield (1988).

All land use should be evaluated in terms of its impact on biological diversity. How will various timber harvesting schemes affect forest species? What animals frequent plantations of tree crops, such as citrus and cacao? How much coastal wetland can be converted to shrimp farms before there is a serious decline in the richness and population viability of coastal organisms?

Tourism

Much can be done to enhance the mutualism between conservation and tourism. While improved roads, accommodations, and services throughout the country will help, there is a particular need for tourist facilities and services at current reserves (e.g. Cockscomb and the Baboon Sanctuary). Training of guides and wardens will improve the experience of visitors to reserves.

Tourists can help pay for conservation. Evidence from other countries suggests that tourist development of spectacular areas like Caracol, Bladen and Glover's Reef can create jobs, generate income, and conserve biological diversity. Natural history

tourism provides good returns on investments because promoting this type of tourism requires less capital outlay than other sorts of tourist enterprises. Of course, tourist development should be carefully planned and regulated according to local conditions, so as not to damage habitat or adversely affect wildlife.

Research Needs

This section draws together the topics for research that have been indicated above.

Reserves and Land Use

Gap analysis is central to decisions on land use. It is a process that is continually refined, but there is an immediate need for a "broad brush" analysis to identify potential areas for conservation management and imminently threatened habitats. Such an analysis was illustrated above.

Management policies for reserves depend on knowing what species inhabit the reserves, on understanding the habitat and food requirements of important species and determining what their natural population fluctuations are. Thus floral and faunal inventories, periodic censuses and basic ecological studies on selected species are needed in the reserves.

Land use adjacent to reserves should be monitored to anticipate potential effects on reserve habitats and wildlife that ranges outside reserves.

Land use outside reserves should be studied to determine its impact on biological diversity and to develop management practices that are consistent with conservation goals. Ways to enhance the natural history tourist trade need study, while the impact of tourist development and tourist activity on reserves and other natural areas should be investigated.

Wildlife

For management purposes, information is needed on the basic biology of important species. For example, the data gathered by the New York Zoological Society has helped form management policy for the jaguar. Basic questions in wildlife biology concern habitat needs, habitat locations and population size and dynamics. It is especially important to learn what factors regulate population size.

Studies of the effect of hunting and collecting on species of potential commercial value are needed before commercial trade of wildlife is permitted. The animals most sought for meat need study; these are the hickaty, iguana, gibnut, curassow, guan and many marine species, including sea turtles. Other vulnerable species such as the jabiru, manatee and raptorial birds need study.

Basic and Applied Studies

Reserve management, wildlife management and management of other land uses depend on, or benefit greatly from, understanding the structure and function of natural systems. For example, discovering the natural causes of fluctuations in commercial fish populations will help to evaluate the effect of fishing and to devise fisheries policy. Studies should be undertaken of basic processes such as biogeochemical cycles, vegetation dynamics, animal population dynamics; seasonal patterns of growth, reproduction and resource abundance. Long-term studies (of 10 years or so, depending on the research question) are especially informative. Ideally, long-term studies would take place in the major habitat types: coral reef, mangrove, savanna, pine ridge and several of the hardwood forest types. This kind of research must take place in areas secure from disturbance. The larger reserves are likely locations.

The most convincing and valuable results come from experimental studies, in which a manipulated habitat or population is compared with an unmanipulated control. The opportunity for such experiments in basic ecology, forestry and agriculture in the large, secure Rio Bravo Conservation Area has much promise for conservation, resource management and economic development in Belize. As one example,

mahogany and Santa Maria trees are fairly common in the Rio Bravo area; experimental, long-term studies on their regeneration could aid the forest industry.

Conservation Data Center

The most important tool for conservation decisions is a system and institution for gathering, cataloguing and supplying information on Belize's biological diversity: a conservation data center. In it are kept such things as maps of vegetation, land use and animal and plant distributions; aerial imagery; reports on flora and fauna organized by species and cross-referenced to locations; copies of laws pertaining to natural resources. A good deal of information on Belize is available, but it needs to be assembled and organized for use. Information is continuously updated and used for purposes such as gap analysis. Accumulated information can help to identify areas of particularly high species richness or areas that contain species of limited distribution. Such areas should have priority as reserves. The Center can be a starting point for basic ecological studies. The Center would also be a clearinghouse of data and interpretations for other organizations.

Both the Belize Center for Environmental Studies and the Programme for Belize function as conservation data centers. Eventually this function could be taken over by the trained personnel of the proposed Office of Conservation. Two US organizations, The Nature Conservancy and Conservation International, operate conservation data centers, in the US and in Tropical America, respectively. They are sources for more details about managing and using conservation data.

Environmental Education

School curricula in environmental education can be expanded and improved considerably, at primary, secondary and technical school levels. Teachers likewise need training in environmental principles. Less formally, the Government can participate in environmental education through the Government Information Service, which reaches many Belizeans. Both Government and NGOs can use assistance from international conservation organizations which develop and disseminate educational materials. Coordination and specialization of effort among groups may improve

overall efficiency. Those interested in promoting environmental education in Belize should refer to the forthcoming recent study of the subject carried out by the Programme for Belize.

Role of Outside Aid

Much of the conservation work in Belize has stemmed from outside aid and expertise, and most of the basic research underlying conservation is done by foreigners. Also, the development of the natural history tourism industry, a natural partner in conservation, is aided by foreign capital and knowledge. All of these relationships will continue, but additional inputs will be needed if there are to be new reserves, more research, and most important, an Office of Conservation. The Office will need financial and technical assistance. Its personnel will need training abroad, and new facilities may be required. Other specific initiatives meriting financial and technical aid are the Conservation Data Center and improved environmental education. Budgets for carrying out these proposals are given in the following section.

An important tactic to attract funding for conservation is for the Government of Belize to demonstrate clearly its commitment to conservation. Creating an Office of Conservation is one such demonstration. Explicit statements by the Government, or relevant Departments, of needs for particular kinds of research or other assistance help win grant support from foreign government and non-governmental organizations. It is emphasized that this commitment to conservation is not a commitment to locking up land; it is rather a commitment to the wise use of natural resources.

The need for outside aid stems in part from the lack of appropriately trained Belizeans. This situation will improve as personnel in the Office of Conservation and reserve managers pass on their skills, if visiting researchers take on Belizean counterparts and with projected increases in environmental education.

Summary of Major Recommendations

1. Establish an Office of Conservation to manage reserves and wildlife, enforce regulations, coordinate research and operate a Conservation Data Center. Staff for the Office should include a reserves specialist, a wildlife specialist and an officer in each of the districts. Game wardens also are needed.
2. Establish a non-statutory Conservation Advisory Board of people with many perspectives on resource issues. This would act in an advisory capacity only to aid the Office of Conservation.
3. Conduct a comprehensive and systematic review of life zones, vegetation types, natural habitats and the distribution of selected wildlife species on protected areas and public lands and waters to determine areas in Belize that should be considered for some form of conservation management.
4. Develop a comprehensive conservation and land use plan to guide the development and management of Belize's natural resources. This policy should specifically address the conservation of biological diversity and the long-term sustainable management of Belize's forests and marine environments.

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APPENDIX

PROPOSALS

It is proposed that three major conservation-related projects receive funding: training of staff for the Office of Conservation, establishment of a conservation data center, and a one-year consultancy to improve environmental education. Each of these and their respective estimated budgets are discussed below.

Office of Conservation Staff Training

The purpose, structure and responsibilities of an Office of Conservation and its benefit to Belize have already been discussed above. Establishing such an office would legitimize and publicize the concept of conservation in Belize, as well as bring the energy of full-time, trained personnel to bear on conservation issues. The Office's responsibilities would include: management of reserves and wildlife, enforcement of parks and wildlife laws, research on the environment and maintenance of a conservation data center.

The Office would be located in Belmopan and would have two professional employees, a specialist each on reserves and wildlife. Also needed would be District Conservation Officers, analogous to the District Forest Officers. Enforcement of the parks and wildlife laws will require a staff of game wardens.

The reserves specialist would be trained in the theory of reserve design and the practice of reserve management. He or she would be charged with guarding against infringements on reserve land, with monitoring incompatible land uses adjacent to reserves and with resolving conflicts between permissible uses of multiple-use reserves. This position would also include investigating possible new reserves and making recommendations for their establishment, as well as continuing research on management of established reserves.

The wildlife specialist would be trained in wildlife management. Responsibilities would include overseeing research on ecology and population dynamics of wildlife, administration practices and enforcement of wildlife laws concerning hunting and trade. Because a major problem in wildlife management is the lack of enforcement of wildlife laws, it will be important to maintain a trained corps of game wardens attached to the Office of Conservation.

It is recognized that no Belizeans have the training to fill the main or district office positions of the proposed Office of Conservation or to serve as game wardens. For the time being qualified persons will have to be sent abroad to train for the administrative and research positions. Game wardens could be trained by a visiting instructor. Training needs and estimated costs are given below.

<u>Position</u>	<u>Training Duration and Site</u>	<u>Estimated Cost (US\$)</u>
Wildlife Specialist	3 years, abroad	120,000
Reserves Specialist	3 years, abroad	120,000
3 District Officers	1 year, abroad, each	120,000
6 Game Wardens	3 months, in country	50,000
<u>Total</u>		\$410,000

The Government of Belize would undertake to provide personnel to be trained.

Conservation Data Center

A Conservation Data Center is the most important tool for conservation decisions. The Center can be a starting point for basic ecological studies; it would be a clearinghouse of data and interpretations for other organizations.

Methods of establishing and operating a conservation data center could be based on practices devised by The Nature Conservancy or Conservation International. The Center could be established with the aid of an outside consultant, working with a full-time assistant and a government counterpart. The cost of a long-term consultant, salary, personal expenses and local transportation included, is estimated at US\$10,000 per month. The consultant would work in Belize for about one year to establish the center, then return a few times to monitor progress. Estimated costs for this consultancy are as follows:

<u>Item</u>	<u>Cost US\$</u>
Consultant, salary and expenses, 1 year	120,000
Return visits	30,000
Assistant, salary	40,000
2 vehicles	40,000
Remote sensing imagery	10,000
Supplies	30,000
Miscellaneous costs	20,000
Contingency	20,000
<u>Total</u>	\$310,000

The Government of Belize would provide office space and a full-time counterpart from the Forest Department.

Environmental Education

The need for improved environmental education was described above. To accomplish this task, it is recommended that a consultant be hired for one year to work with institutions involved in environmental education to develop curricula, courses, and materials; to present workshops; and to coordinate efforts among the several governmental institutions and non-governmental organizations involved in environmental education. Estimated costs of the consultancy are as follows:

<u>Item</u>	<u>Cost US\$</u>
Consultant, salary and expenses, 1 year	120,000
Vehicle	20,000
Materials	30,000
<u>Total</u>	\$170,000

The Government of Belize would provide office space for the consultant and part-time counterparts from the Ministry of Education and the Forest Department.

FIGURE 1
PRESENT RESERVES

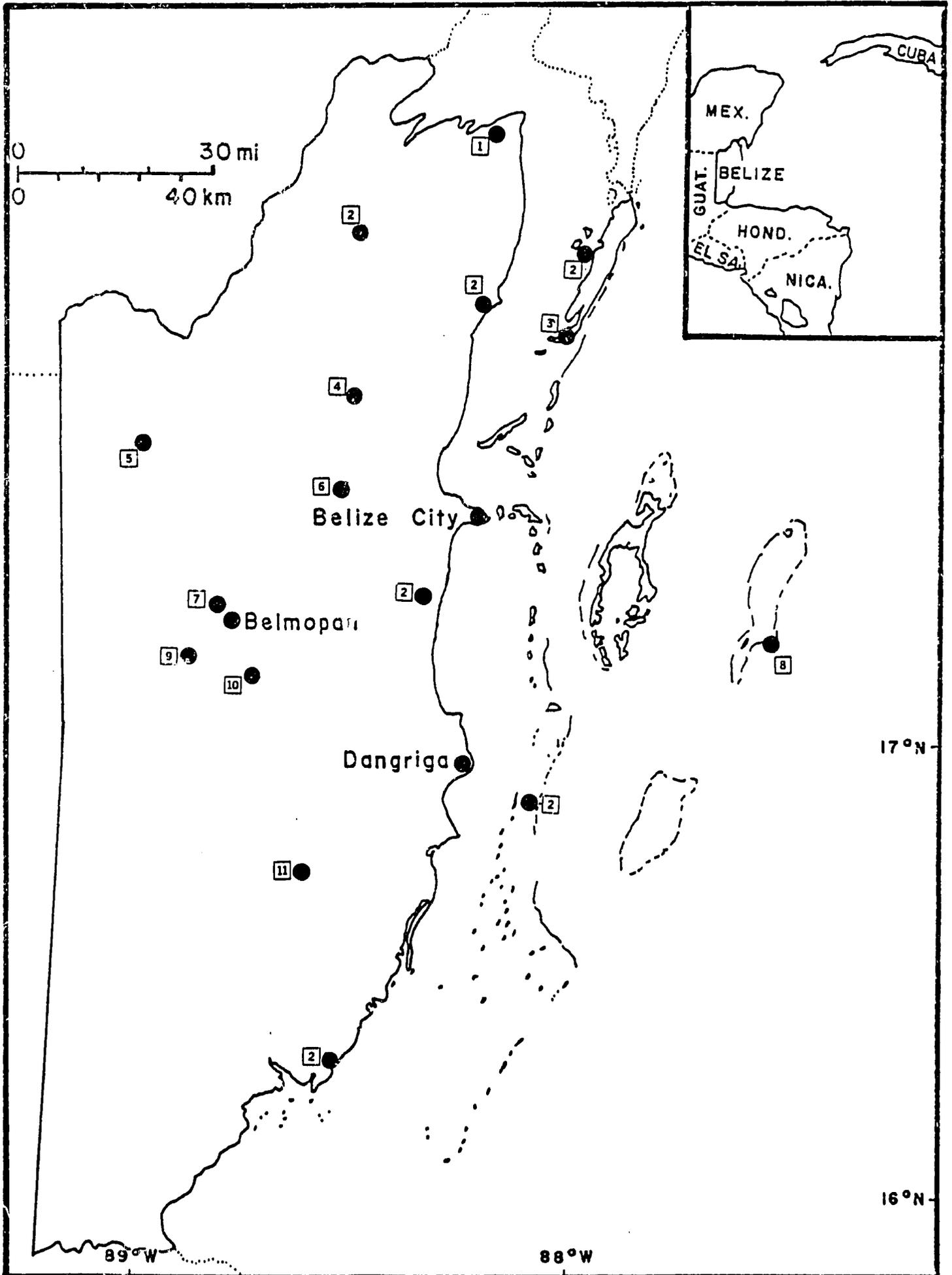
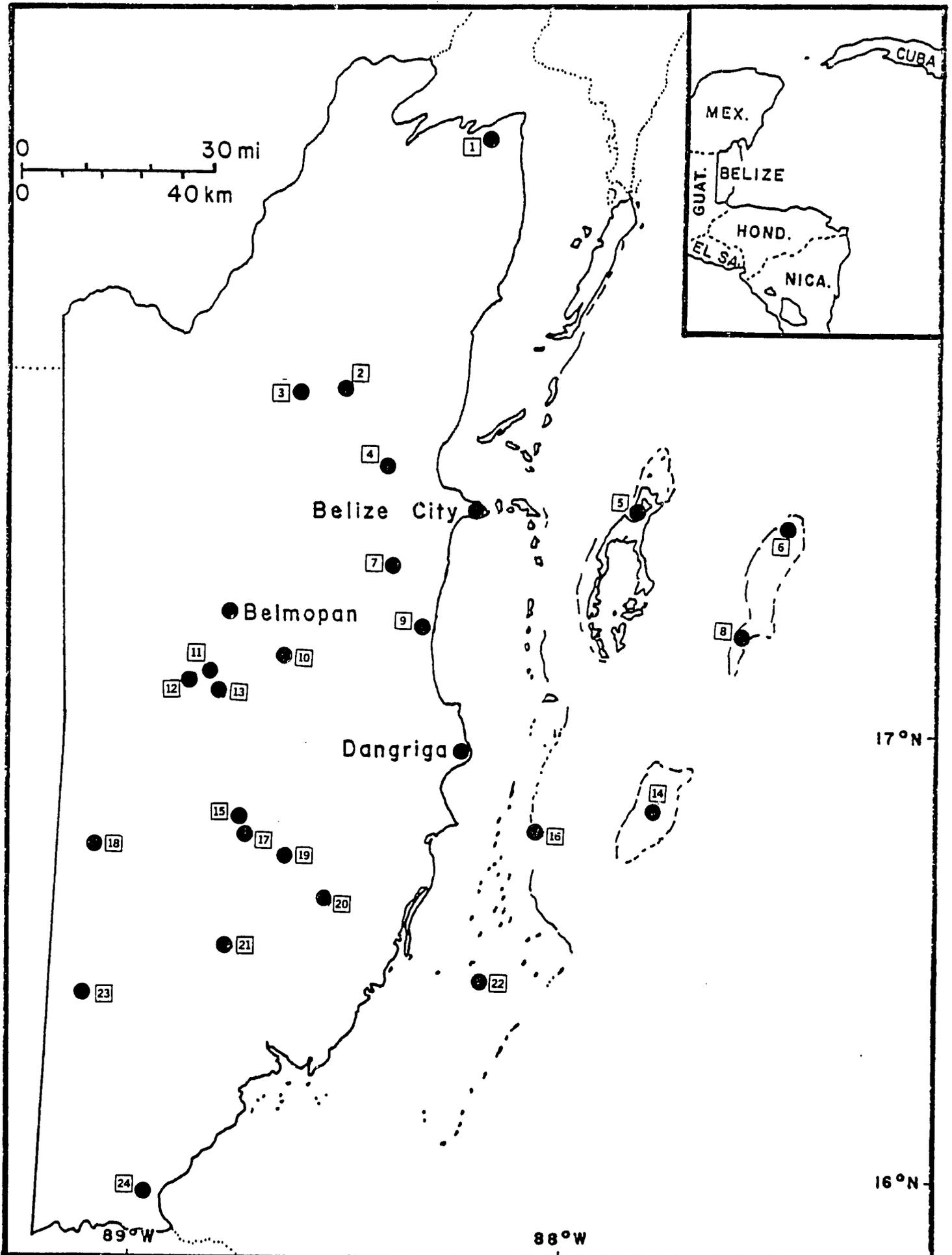


FIGURE 2
PROPOSED RESERVES



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Figure 1 - Present Reserves (Key)

1. Shipstern Wildlife Reserve
2. Crown Bird Reserves (six shown)
3. Hol Chan Marine Reserve
4. Crooked Tree Wildlife Sanctuary
5. Rio Bravo Resource Management and Conservation Area
6. Community Baboon Sanctuary
7. Guanacaste Park Crown Reserve
8. Half Moon Key Natural Monument
9. Society Hall Nature Reserve
10. Blue Hole National park
11. Cockscomb Basin Wildlife Sanctuary ("Jaguar Reserve")

Figure 2 - Proposed Reserves (Key)

1. Shipstern Lagoon (expansion of current reserve)
2. Crooked Tree (expansion of current reserve)
3. Lamanai
4. Mussel Creek
5. Northern Lagoon (Turneffe Islands)
6. Northern Cays (Lighthouse Reef)
7. Sibun River Karst Area
8. Blue Hole and Long Cay (Lighthouse Reef; expansion of Half Moon Key Natural Monument)
9. Southern Lagoon
10. Caves Branch, Petroglyph, Mountain Cow Cave
11. Thousand Food Falls
12. Double Waterfall
13. Baldy Beacon
14. Glover's Reef
15. Raspaculo River Valley
16. Carrie Bow Cay
17. Upper Guacamayo River Valley
18. Caracol
19. Cockscomb Basin (expansion of current reserve)
20. Silver Creek Bank
21. Upper Bladen
22. Laughing Bird Cay
23. Forest south of Union Camp and west of Little Quartz Ridge
24. Temash River