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BIODIVERSITY IN GUATEMALA

Biological Diversity and Tropical Forests Assessment

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EXECUTIVE SUMMARY

Introduction

This document assesses the status of biological diversity and tropical forests in the Republic of Guatemala by describing the nation's biological resources, identifying pressures that affect them, and proposing actions that can be taken to improve their sustainable use. The document also examines the condition and management of Guatemala's national parks and wildlands areas, endangered species, tropical forest ecosystems, germplasm conservation, and the conservation of economically important plant and animal species.

Biological diversity is the variety of living resources and the genetic diversity they represent. **Tropical forests** include all forests and shrublands within the geographic tropics. Thus, all the forests of Guatemala are tropical forests. **Humid tropical forests** are those tropical forests with a continuous canopy comprised of single or multiple layers found in the geographic tropics where the annual biotemperature in the lowlands is greater than 24 degrees centigrade and where annual rainfall equals or exceeds potential evaporative return of water to the atmosphere.

Biological diversity and tropical forests are vital to human welfare for three major reasons: (1) to sustain and improve agriculture and forestry, (2) to provide opportunities for medical discoveries and industrial innovations based on natural organisms, and (3) to preserve choices for addressing problems and opportunities in the future. A nation that has conserved its biological diversity and tropical forests is better prepared to provide for the welfare of its citizens than a nation whose biological diversity and tropical forests have been impoverished.

If we seek to achieve sound, sustainable development in Guatemala, biological diversity and tropical forests must remain a central focus of research and action. Strategies to conserve biological diversity and tropical forest must be based on the fact that the development of natural resources is imperative for human well-being. At the same time, development planners and government officials must acknowledge that the conservation of biological diversity and forests is the foundation for future economic development and the basis of human life itself.

The loss of biological diversity is not an inevitable process, nor is it a lamentable but necessary side effect of economic development. The destruction of biological diversity and tropical forests is sometimes rationalized as the price of progress, but it results not from progress but from a lack of understanding or from greed. Rather than being a necessary step in achieving economic development, the eradication of biological diversity and tropical forests undermines the foundation upon which sustainable economic development is constructed.

This assessment makes it clear that the goals of biological diversity conservation and economic and social development are not in conflict, but are instead the same--namely, improving human welfare for present and future generations.

Overview

Some of the most significant points identified by the biodiversity and tropical forests assessment team are these:

(1) Guatemala's natural environments are small in comparison to those of some Latin American countries, but they are exceptionally diverse. As repositories of biological diversity, Guatemala's ecosystems are among the world's richest. Guatemala's location as a bridge between two continents and between two oceans makes it one of Latin America's foremost repositories of biological diversity. With almost 1,500 vertebrate species, Guatemala's vertebrate fauna is the most diverse in Central America.

(2) Guatemala's natural resources and biological diversity are the focus of a dynamic interaction between human populations and economic development. The well being of a majority of the population depends directly on renewable natural resources--soils, water, forests, and wildlife. Agriculture, forestry, and fishing, all of which are dependent upon the maintenance of biodiversity, provide more than half of Guatemala's employment and more than half of its export earnings.

(3) As a result of physical, demographic, and economic pressures, Guatemala's natural environment is being rapidly altered. The nation's tropical forests are being harvested, cleared, and burned at ominous rates, its hillsides converted to farmland, and its fishing industry threatened by chemical pollution and the destruction of mangroves.

(4) In a nation as dependent on biological resources as is Guatemala, these changes in environment and biological diversity will have serious consequences. The eradication of ecosystems and biodiversity will hamper agricultural development, export earnings, jobs, and peoples' health.

(5) The rate of deforestation and environmental degradation in Guatemala is alarming. Although quantified scientific data on the disruption of natural ecosystems and communities is limited, what is known indicates an increasing fragmentation and loss of tropical forest habitat and reduction in biological diversity.

(6) Appropriate conservation actions must be implemented in the immediate future to prevent the continued loss of Guatemala's natural forests and the irreversible extinction of species and reduction of socio-economic options for the future development of the country.

(7) The Government of Guatemala and the Guatemalan people are receiving only limited information on the importance of the nation's natural resource base and the consequences of its destruction. Environmental management and biodiversity conservation rank low on the list of pressing priorities. Where the political will exists, positive attempts at change are hindered by inadequate budgets and a shortage of trained professionals.

(8) Major international lenders and development agencies are only beginning to aid Guatemala in its efforts to improve the management of natural resources and biological diversity. International organizations are beginning to demonstrate their awareness that Guatemala's economic and political future rest on an eroding foundation of biological resources. Their activities in the future--in cooperation with Guatemalan citizens--will help determine the nation's economic, social, and biological future.

Status and Management of Biodiversity and Tropical Forests

All of Guatemala's remaining tropical forests can be considered critical habitat for endangered and endemic species. Most of Guatemala's forested areas are concentrated in the Petén and parts of the interior highlands, and the major opportunities for protecting tropical forests exist in these areas. The Department of the Petén contains the largest, unaltered tract of humid tropical forest in Guatemala, and one of the largest tracts in Central America. However, of all forests in the country, the Petén tropical forest is under the most serious pressure from road construction, logging, colonization, and cattle ranching.

The highland forests surrounding the volcanic peaks of southern Guatemala are also severely threatened. The fragmented remnants of their former extension provide critical habitat for a range of native species. These highland montane forests have an estimated 70 percent animal endemism, meaning that these animals appear no where else in the world. However, colonization, fuelwood extraction, and agriculture are common on these sites, and these rare animals are threatened with extinction.

The forested peaks of the Sierra de las Minas, the Sierra del Merendón, Cerro San Gil, and the Sierra de Santa Cruz form critical habitat for many endemic species of plants, reptiles, and amphibians. Lumber extraction and agricultural expansion threaten the species of these areas. The Sierra los Cuchumatanes and Sierra de las Minas contain extensive coniferous forests considered by some forest geneticists to be the most important source of tropical pine germplasm in the world. Seeds from these forests have been used in reforestation programs in tropical regions of Africa, Asia, and South America.

The Pacific coast mangrove forests, which are also tropical forests, are critical habitat for many economically important species. However, these mangrove forests are being converted for artificial shrimp hatcheries, salt ponds, and agriculture, as well as being overexploited for lumber, charcoal, mollusks, and crustaceans. This conversion will have serious economic repercussions.

Tropical mangrove forests serve a number of ecologically and economically important functions, including the support of marine life. As an important component in the lifecycle of many shrimp and whitefish species, mangroves merit strict protection. The Guatemala's Pacific coast mangrove forests are critical habitat for many economically important species. Shrimp yields are closely correlated with the abundance of mangrove forests, and some researchers believe that up to 90 percent of commercial fish pass at least part of their life cycles in mangrove forests. The root systems of Guatemala's red mangroves also serve as nursery grounds for commercially valuable lobsters, crabs, mussels, and oysters. The mangrove is also home to an assorted fauna of reptiles, mammals, and native and migratory birds.

At the same time, mangrove trees are used by human populations for water-resistant timber, charcoal, dyes, and medicines, and they are being exploited relentlessly in some coastal regions of Guatemala. Many hectares of mangroves are cut each year, for example, to produce fuel for drying salt from seawater. Between 1965 and 1978, 31 percent of Guatemala's Pacific mangroves were degraded. The economic impacts of this destruction are substantial. The value of the fishing industry protected by mangroves surpasses millions of dollars per year. Guatemala's mangroves also bring in recreation and tourism income through such areas as the Biotopo Monterrico, managed by the Centro de Estudios Conservacionistas (CECON) of the Universidad de San Carlos.

Although Guatemala's mangroves must be protected to preserve their particular biological diversity and their economic contribution to the nation's citizens, alternatives will have to be found to cover local human needs for fuelwood, charcoal, and building materials. These alternatives could include fuelwood plantations, use of solar energy for drying salt, and alternative employment opportunities in tourism and fishing.

Status and Protection of Endangered Species

Little is known about the status of endangered or endemic species in Guatemala. We lack quantitative information on the status, distribution, habitat requirements, and degree of threat for many species. Although scientific references on Guatemala's flora and fauna exist, many of these studies have been made obsolete by recent deforestation and other transformations of the Guatemalan landscape. Efforts to update these publications have been limited by lack of funds and by the difficulty of travel in

regions of political unrest. Scientists have not visited some regions of the country for 20 years.

A variety of activities are leading to the decimation of Guatemala's native flora and fauna. The principal threat is destruction of habitat. Deforestation for timber, fuelwood, agriculture, cattle ranching, urbanization, and road construction have decimated native species, causing direct or indirect impact on almost all types of plants and animals. Subsistence and commercial hunting is also pressuring species, in particular cats and crocodilians. Another problem is the illegal trade in wildlife. Although Guatemala is a member of CITES, animal products continue to be exported both legally and illegally to Mexico, Belize, and Honduras.

Guatemala has many forms of plants and animals that deserve protection because: (1) they are unique in the world (various salamanders, toads, fish, snakes, and at least four mammals), (2) because they have restricted territories with small populations (tapirs, jaguars, manatees, monkeys, ocelotes, horned guan, macaws, quetzals, etc.), (3) because they suffer from aggressive exploitation at the hands of human communities (mangroves, mahogany, cedar, and various species of fish, shrimp, and mollusks), (4) because they serve as national symbols and part of the nation's cultural heritage (the quetzal, monja blanca orchid, chicle tree, and breadnut ramon), or (5) because they remain unknown to western science.

Overall, management efforts to protect endangered, endemic, or migratory species in Guatemala are minimal. Lack of political will to assign the necessary authority and resources, lack of up-to-date scientific information, and the limited number of qualified wildlife management personnel are major limitations. Scarce human and financial resources will continue to hinder the implementation of effective wildlife management programs for years to come.

Guatemala has an impressive range of wildlife due to its unique position between the Neoartic and Neotropical biogeographical realms. Scientists have reported 1,453 vertebrates for the country, not including saltwater fish species. The country's known list of fauna includes 250 species of mammals, 664 species of birds, 231 species of reptiles, 88 species of amphibians, and 220 species of freshwater fish. At least 133 animal species are considered threatened or endangered with extinction, due principally to habitat destruction or overexploitation for subsistence or export.

Wildlands and Wildlife

Guatemala is noted as much for the diversity of its flora as for its fauna. As with its animal life, Guatemala's location between two continents and between two oceans has given the nation vegetation that is characteristic of both North and South

America, as well as plants that appear no where else but Guatemala.

Several of Guatemala's natural ecosystems are considered to be critical habitat for conservation of plant biodiversity, due to ongoing threats from human activities. The nation's mangrove forests, for example, are under serious stress from cutting for construction poles, firewood, and charcoal. As well, the Pacific coastal plain has seen almost all of its natural vegetation altered or destroyed for plantations of sugar cane, cotton, and beef cattle. Only small remnant areas of original vegetation remain, mostly on private land holdings.

On a global level, Guatemala is considered to be a storehouse of useful germplasm. In terms of the conservation and wise use of biological diversity, one of the most important aspects of Guatemala's plant life is the existence of the wild germplasm of some crucial domesticated food and fiber crops.

Central America and Mexico (Mesoamerica) were the original site for the development of such important food crops as maize (corn), tomatos, scarlet runner beans, cotton, avocados, papayas, and cacao. In addition, the common bean, manico, and the sweet potato were apparently developed in Mesoamerica as well as in South America (OTA 1987:176). Conservation of the wild ancestors of these plants is vital to the continuing improvement of the crops into which these species developed. As well, the conservation of traditional varieties of these crops--for example, the many types of corn found in some Mayan families' fields--can lead to the development of crop varieties that are resistant to diseases.

To cite another telling example, the avocado industry of California and Florida owes its existence to avocado seeds and cuttings gathered in Mexico and Guatemala during 1916 and 1917 by Wilson Popenoe, an agricultural explorer employed by the U.S. Department of Agriculture. Popenoe sent back 24 Guatemala avocado varieties to the United States, many of which proved useful in the development of today's avocado types (Smith 1985:30). Preservation of the wide variety of avocado types in Guatemala is a benefit not only to local farmers, but to avocado producers in the United States as well.

Protected Areas

Biological diversity is best preserved *in situ* within functioning natural ecosystems. The most cost-effective means to accomplish this is through the establishment of an integral system of wildland areas which identifies, protects, and manages the full array of natural communities, habitats, and species. The recent Government of Guatemala (GOG) initiative to establish an expanded wildlands system is to be commended. However, GOG financial resources are not currently available to successfully implement priority actions. Over the next five years, additional support will be required to strengthen governmental and

non-governmental conservation organizations, to improve conservation information systems, and to protect and manage wildlands and wildlife.

Although some of Guatemala's wide range of plant and animal species are already protected, much more remains to be conserved and managed if the nation's biological diversity is to be maintained for future options. Unfortunately, on-site protection of the nation's biodiversity has been hampered by a lack of manpower and funding. Efforts are further hindered by the fact that responsibility for Guatemala's protected areas is divided among three different government and non-governmental organizations. The Dirección General de Bosques y Vida Silvestre (DIGEBOS), known until 1988 as the Instituto Nacional Forestal (INAFOR), maintains legal or on-the-ground control of 21 areas; the Centro de Estudios Conservacionistas (CECON) controls seven, including the four biotopos in the Petén; and the Instituto de Antropología e Historia controls 24, all of them archaeological sites located in natural areas.

International conservation organizations and bilaterial development assistance agencies can provide valuable assistance to Guatemala in the development of policies and programs to preserve biological diversity and conserve tropical forests in Guatemala. They can be of special assistance in assisting Guatemala during the initial phases of establishing a protected wildlands system. These international organizations can be catalytic in allowing Guatemala to obtain additional resources from national and international governmental agencies and private voluntary organizations.

Economic Value and Sustainable Use of Biodiversity

The research team found few existing studies that analyze the economic benefits of conserving and sustainably useing Guatemala's renewable natural resources and tropical forests. To convince the nation's decision-makers of the value of these resources, more such studies must be conducted.

One of the concerns of biological diversity specialists is the loss of genetic diversity in human food crops. Around 15 food crops stand between humanity and starvation. We depend on five cereals, three root crops, three seed legumes, two sugar crops, and two tree crops for the majority of human food supplies (rice, wheat, corn, sorghum, barley; potoato, manioc, sweet potato; bean, soybean, peanut; sugar cane, sugar beets; bananas and coconuts). Of these categories, corn, potatoes, manioc, beans, sweet potatoes, and peanuts have valuable wild relatives or traditionally cultivated varieties (landraces) in Guatemala. Accordingly, Guatemala's traditional agricultural crops play an important role in maintaining crop production in Guatemala and as germplasm for crop development throughout the world.

Oldfield and Alcorn point out that, "Much of the world's biological diversity is in the custody of farmers who follow age-old farming and land use practices." They argue that conservation of landrace varieties within traditional agroecosystems, in situ conservation, is the best way to maintain the dynamic evolution of plant-human interactions. In situ conservation of traditional agriculture also maintains the weeds and wild crop relatives associated with cultivated species.

Economic Use of Flora and Fauna

To date, Guatemala has insufficient protection and management of native species of plants and animals to ensure their continued existence, much less their sustainable use. The lack of protection of native species leads to wanton local use and illegal commercialization, particularly of endangered species such as macaws and crocodiles.

Guatemala exports many of its biological resources as raw materials with no value added in-country. Yet, the economic potential for management and sustainable harvest of wild flora and fauna is tremendous. Experiences in other tropical countries demonstrate the possibility of native species propagation--including iguanas, crocodilians, frogs, butterflies, turtles, deer, peccaries, and other species with potential skin or meat value. Also, birds, felines, monkeys, and other exotic species have value for pets, zoos, and research centers. Another benefit is wildlife management in wildland areas for tourism value.

Halting Guatemala's illegal wildlife trade will not be easy. During interviews conducted for this biodiversity assessment, more than one government official alleged that Guatemalan military personnel are involved in the illegal wildlife trade. According to one official, members of the military sell Guatemalan wildlife skins to middlemen in Honduras. Other workers stated that military aircraft are used to export live parrots and macaws, as well as the skins of spotted cats, from the Petén to Guatemala City.

Among the economic benefits of tropical forests are stablilization of hydrological functions, soil protection, tourism, and creation of employment opportunities. For example, the potential for additional income from tourism in Guatemala is substantial, and much of this potential depends on the conservation of the nation's tropical forests and biodiversity.

The potential for additional income from tourism in Guatemala is substantial, and much of this potential depends on the conservation of the nation's tropical forests and biological diversity. The potential for expanded nature tourism in the Department of the Petén is especially promising. In 1988, only 11 percent of the yearly half million visitors to Guatemala visited the Petén. With additional promotion, tourism to the

area could easily be increased. The Petén has more than 70 significant archaeological sites, including Tikal, which many people consider to be the most spectacular ruin in the world. The biggest draw for tourism in the Petén, however, is the combination of Mayan history and the tropical forest environment. The Guatemalan Petén is one of the few places in the world where visitors can look up from a 1,000 year-old temple to watch spider monkeys scampering across the treetops. It is this combination--not the stone cities alone--that must be conserved and promoted.

Another factor that could draw increased tourism to the Guatemalan Petén is the strategy being developed by the National Geographic Society, "the Ruta Maya." Led by magazine editor Wilbur Garrett, the National Geographic Society plans to work with national governments to develop a tourist route similar to the Inca Trail in South America. The Ruta Maya will connect the major archaeological sites and national parks of Guatemala, Belize, Honduras, and Mexico with the goal of stimulating economic development through tourism. National Geographic magazine will print a lead article on the Ruta Maya in June, 1989, and increased tourism interest in the Petén should be one of the results. By 1990, at least 75,000 tourists per year are expected to be spending about US$22.5 million each year in the Petén.

In preparation for this increasing influx of visitors, much remains to be done. One of the factors that currently hinders tourism in the Petén is the lack of quality accomodations. Only 224 hotel rooms exist in the Petén, down from a peak of 367. (Part of this decline is due to flooding of lower floors in Flores, Santa Elena, and San Benito--a result of rises in Lago Petén Itzá; some researchers have linked the lake's rise to increased runoff caused by deforestation.) Few of the Petén's existing hotel rooms are of the more appointed type international tourists request, meaning that few have air conditioning and comfortable beds. This need creates a point where sustainable development and private industry converge, and a point where international funding can have expanding positive impact. Tourism in the Petén already provides more than 5,000 jobs, and this total could increase with the promotion of the Ruta Maya.

Overall, the development of the tourist sector offers the most attractive known opportunity for the economic development of the Petén. Tourism can generate employment, generate income for local populations, and reduce pressures on the region's tropical forests.

The conservation of tropical forests and biodiversity has other economic benefits as well, for example, the provision of water in sufficient quantity and quality. Tropical forests, natural grasslands, and other natural areas act like a sponge, absorbing rainfall and holding it to release it gradually and evenly into river systems for the benefit of downstream

activities such as irrigation and urban water supplies. These functions are lost when tropical forests or other natural vegetation are eradicated, leading to increased flooding during the rainy season and drought during the dry season. Loss of these functions also leads to soil erosion and sedimentation of hydroelectric reservoirs and coral reefs.

The cost of not protecting tropical forests and their water production potential can be estimated by the value of lost electric production capacity due to sedimentation and decreases in agricultural and fisheries production.

Tropical forest zones perform a valuable service for neighboring agricultural areas by safeguarding against floods and providing water through dry periods. The forests that protect the Valley of the Río Motagua and the farmlands of the Pacific slopes provide examples of this situation.

More than 6,000 people in the Guatemalan Petén are involved in the extraction of renewable natural resources from the tropical forest. Their activities focus on the harvest of three different products:

(a) Approximately 6,000 individuals harvest xate palm (*Chamaedorea elegans* and *C. oblongata*) from the Petén tropical forest. Another 200-500 individuals work in the industry as sorters, contractors, and exporters. Guatemala exports hundreds of millions of leaves of this palm every year to the United States and Europe for use in the floral industry. Florists use the xate palm leaves as green backgrounds for arranging cut flowers. Properly cut, each xate palm can be harvested four times per year without damaging the resource. The fact that xate grows beneath the canopy of undegraded tropical forest makes the industry of special interest. Xate exports produce $3.7 million in total annual export value.

(b) Chicle production for 1988 was estimated to reach 300,000 pounds. Guatemala sells each pound for Q3 (US$1.11), indicating that this year's harvest will be worth $333,000.

(c) The third product harvested on a sustainable basis from the Petén tropical forest is allspice (pimienta gorda; *Pimienta dioica*). Collected June through August of each year, allspice is gathered by coppicing seed-bearing trees and boiling and drying the seeds. The allspice trees begin to resprout after they are cut, and the tree can be harvested again after six years of regrowth. Enough trees exist in the Petén to support the export of one million pounds of allspice each year. Guatemala's exports are worth $16 million retail in the United States and Europe, although only $1 million to $2 million of this amount accrues to Guatemalans.

One of the most interesting aspects of the harvest of these three renewable resources is that they promote conservation and

sustained use of the Petén tropical forest. Knowing that their economic future lies in the sustained use of xate, chicle, and allspice, families who harvest these resources are strong promoters of forest protection. Equally interesting is the fact that, combined, these renewable resources represent an income of at least US$6 million each year from undegraded tropical forest.

Sustainable Versus Non-Sustainable Economic Activities

Economic activities that involve natural resources in ways that are not sustainable can also be considered activities that reduce biological diversity. The reverse is also true: economic activities that reduce biological diversity are rarely sustainable. Non-sustainable activities eventually result in negative net benefits to the producer and the country at large. The net benefits of sustainable production, no matter how small at the beginning, will eventually outweigh those of non-sustainable production.

Major Issues in Tropical Forests and Biodiversity

The most serious threats to Guatemala's tropical forests and biodiversity are loss of habitat caused by colonization, conversion to agriculture, cattle ranching, wildlife poaching, overexploitation of aquatic resources, and contamination of water. Underlying all of these issues is the nation's rapid population growth. Given Guatemala's current population growth rate, the degradation of biodiversity will continue until land use patterns change. Continued population growth in Guatemala without concurrent changes in land use patterns will be the largest single obstacle to protecting the nation's biodiversity and tropical forests. Sustainable development is dependent on management of both population growth and natural resources.

Of Guatemala's original forest cover, approximately 40 percent (45,000 km2) remains uncleared. However, driven by population growth and inequitable land distribution, rural families are colonizing forested areas marked by steep slopes, poor soils, or both. Combined with road construction, logging, clearing for agricultural exports, fuelwood cutting, cattle ranching, petroleum exploration, and hydroelectric projects, colonization leads to the deforestation of hundreds of square kilometers each year.

Méndez Dominguez (1988) estimates a deforestation rate of between 1 and 1.5 percent annually, an amount equivalent to 1,080 and 1,620 km2, respectively. Meanwhile, reforestation over the past 10 years has amounted to a total of 490 km2. At these rates of deforestation and reforestation, Guatemala's forest cover could disappear in 25 to 40 years.

Cutting for fuelwood is likely the number one cause of forest destruction in the highlands. More than 63 percent of forest clearing is thought to be the result of fuelwood

collection; 29 percent results from colonization, 6.5 percent from fires and forest diseases, and 1.1. percent from industrial use. It is important to point out that deforestation for fuelwood collection is a problem in all areas of the country except the lowland moist forest (i.e., the Petén). In the Petén, trees are cleared and burned in place so that colonists and ranchers can gain access to the soil. Deforestation for fuelwood collection is not a problem in the Petén.

As a result of the destruction of Guatemala's forests, natural ecosystems are degraded, crucial habitats are lost, and numerous species of plants and animals are led to the edge of extinction. Deforestation caused by inappropriate land use practices also results in increasing flooding, droughts, sedimentation of hydrelectric reservoirs, soil erosion, and degradation of fisheries.

Underlying and reinforcing all of the threats to Guatemala's biological diversity is the nation's rapid population growth. Standing at 8.7 million people in mid-1988, Guatemala's population is the largest in Central America. Its growth rate (rate of natural increase) of 3.2 percent per year is exceeded in all of Latin America only by Nicaragua's 3.5 percent per year. At its current rate of growth, Guatemala's population will double in 21 years.

In mid-1988, more than 5.8 million women, men, and children were living in rural Guatemala, most of them forced to exploit natural resources for a living. As the nation's rural population increases, demands on these natural resources will also increase. Population growth and biodiversity destruction do not necessarily proceed hand in hand. But, usually, when populations expand rapidly in resource-dependent nations, serious environmental disruption results. The sad truth is that throughout most of Guatemala, rural population growth condemns farm families to perpetual poverty and dooms biological resources to continuing degradation.

Population growth can not be blamed for all environmental deterioration in Guatemala or any other nation. Easy access to natural resources may have a greater impact on resource depletion than population growth, but the combination of easy access and growth can double the impact of access alone.

Deforestation, for example, is caused by a number of factors, including mismanagement of timber land and government loans or subsidies that encourage conversion of forest to pasture and cropland. But population growth also places direct demand on forest in the case of fuelwood. Under the same living conditions, twice as many people will use twice as much fuelwood. If this wood is gathered from natural forest, a growing population has serious impact on forest resources. As well, population increases must be matched directly by increases in food production.

When, as in the case of Guatemala, food production is increased by bringing additional land under cultivation, population growth leads to the degradation of forest and wildlands resources. Guatemalan agricultural growth continues to be fueled mainly through an expansion of the amount of land under cultivation, rather than through increasing yields on land already cleared. The need to increase food production in response to population growth leads to an emphasis on short-term yields at the expense of long-term sustainability of food production.

Given Guatemala's current population growth rate, the degradation of biodiversity will continue until land use patterns change. Even with a rapid drop in birth rate, a drop that Guatemala has yet to achieve, the nation's population will continue to expand well into the 21st century. As increasing numbers of Guatemalan women reach childbearing age during the next few decades, even essential steps to reduce the long-term population growth rate will not alleviate critical biological resource problems in the near future. The millions who may soon be clearing the forests, polluting the rivers, and altering coastal habitats in Guatemala have already been born.

Continued population growth in Guatemala without concurrent changes in land use pattern will be the largest single obstacle to protecting the nation's biological diversity and tropical forests. To avoid this fate, government and international planners must concentrate on increasing agricultural production from existing farm lands and the creation of other employment and income opportunities. Increased production would be possible though irrigation technology, improved production methods, improved plant materials, and more efficient use of under-utilized export-oriented lands. Sustainable development is dependent on management of both population growth and natural resources.

Legislative and Institutional Structure

Guatemalan organizations related directly or indirectly to biological diversity and tropical forests are mainly government institutions. Nonetheless, non-governmental organizations dedicated to these issues are, in fact, more numerous and are playing an increasingly active role in biodiversity and tropical forest conservation.

At least 60 institutions have some impact on Guatemalan biodiversity, but only four have formal, direct, and major impact: (1) the Dirección de Bosques y Vida Silvestre (DIGEBOS), (2) the Dirección Técnica de Pesca (DITEPESCA), (3) the Instituto de Antropología e Historia (IDAEH), and (4) the Centro de Estudios Conservacionistas (CECON).

DIGEBOS (formerly the Instituto Nacional Forestal, INAFOR) is the government institution responsible for the administration of forest resources, some national parks, and the nation's

wildlife. DIGEBOS came into being during June, 1988, when it took the place of the Instituto Nacional Forestal, INAFOR, which had carried out these functions until that time. Unlike INAFOR, DIGEBOS is a centralized entity directly dependent upon the Ministerio de Agricultura y Ganadería (MAGA).

The budget for DIGEBOS's Departamento de Parques Nacionales during the second half of 1988 was Q290,477 (US$107,584). Due partly to this low budget, the department has not achieved much success in protecting the parks and wildlife under its control. Instead, several parks (Laguna del Pino, Atitlán, Río Dulce) have been invaded and colonized. Although 14 new personnel have been hired for the Departamento de Parques Nacionales under the recent reorganization, only four have been contracted for the Wildlife section. However, in neither case have the new personnel had extensive experience in these fields.

The continuing resistence to increase the number of personnel working in the field calls into question the role that DIGEBOS plays in the protection and conservation of Guatemala's biodiversity and tropical forests. At least one Guatemalan conservationist notes that the organization still has not grasped the meaning of its responsibilities in this area. However, the recent change in DIGEBOS's organization provides the opportunity to place more emphasis and more personnel in areas that have significant biological diversity to protect.

DIRECCION TECNICA DE PESCA (DITEPESCA)

DITEPESCA is the government organization responsible for the administration of fishery resources. It falls under the Dirección General de Servicios Pecuarios (DIGESEPE), and is directly dependent upon the Ministerio de Agricultura y Ganadería. DITEPESCA has a Director and four departments--Departamento de Acuacultura, Departamento de Piscicultura, Departamento de Pesca Marítima, and Departamento de Pesca Continental.

None of these departments is directed toward the conservation of biological diversity; instead, the Departamento de Acuacultura is oriented toward extension work in shrimp cultivation, Piscicultura provides technical assistance to small-scale fish farmers, Pesca Continental promotes fish farming, and Pesca Marítima regulates and issues licenses for commercial fishing. DITEPESCA also has a marine turtle reproduction program on the Atlantic coast, which includes one part-time biologist and three field workers. The marine turtle project does not receive sufficient funding nor does it have sufficient personnel.

INSTITUTO DE ANTROPOLOGIA E HISTORIA (IDAEH)

IDAEH falls under the recently created Ministerio de Cultura y Deportes and is the institution responsible for administering

the cultural heritage of Guatemala. Created in 1946, IDAEH has direct influence on Guatemala's biodiversity because many of the nation's archaeological sites are located in undisturbed natural areas, especially in the tropical forest of the Department of the Petén.

Although IDAEH has a significant relationship with biological diversity and tropical forests in Guatemala, its primary role is protection of cultural (archaeological) monuments. The Institute does cooperate with the goals of natural resource conservation, but critics point to the fact that forest resources continue to be exploited within Tikal Park as an indication that protection of biodiversity is not the Institute's principal function.

CENTRO DE ESTUDIOS CONSERVACIONISTAS (CECON)

CECON is the academic unit of the Universidad de San Carlos responsible for promoting the field investigation and conservation of renewable natural resources. CECON's structure also allows it to develop environmental education and interpretation programs by means of exhibitions and publication, conferences and audiovisual materials for students. Investigation is conducted by a group of experienced researchers and focuses on fish, birds, plants, reptiles and amphibians, and the planning and management of protected areas.

As well, CECON directly administers seven biotopos (wildlife areas focused on protection, investigation, and education) and the national botanical garden. With control of a total of 136,052 hectares of mangroves, cloud forest, tropical forest, and wetlands, CECON has direct and significant impact on the conservation of biological diversity and tropical forests in Guatemala. CECON is currently developing a Conservation Data Center to bring together all possible information on the nations' biological resources.

CECON is the Guatemalan organization which has achieved the most success in the management and protection of biodiversity and tropical forests. Although in existence for only seven years, CECON has well trained professional and technicians, though it lacks sufficient personnel in middle levels and in research. Although scientific research is one of CECON's principle charges, the need to manage wildlands areas has taken scarce personnel out of this field into strict management.

COMISION NACIONAL DEL MEDIO AMBIENTE (CONAMA)

CONAMA was created in December, 1986 by Congressional decree No. 68-86, as a dependency of the Presidency. The organization consists of a Coordinador named by the president, 10 members made up of other government organization, a team of technical specialists, and an administrative team.

CONAMA's function is to assess and coordinate all actions related to national policies on the protection and imporovment of the environment. Since its creation, CONAMA has promoted the creation of a Comisión del Medio Ambiente within the National Congress, promoted environmental aspects of the National Development Plan, hosted a series of seminars on the environment, and promoted several laws in favor of environmental protection, including the still pending Ley de Areas Protegidas. CONAMA is performing a vital role in governmental organization and coordination on environmental issues. Although still in the process of organization, CONAMA has nonetheless been able to achieve positive actions and influence within the Government of Guatemala.

COMISION LIQUIDADORA DE FYDEP

The government organization formerly charged with absolute power in administering and developing the Department of the Petén, the Empresa Nacional de Fomento y Desarrollo Económico del Petén (FYDEP) existed between 1959 and 1987. During April, 1987, FYDEP began a process of liquidation and was replaced by the Comisión Liquidadora de FYDEP. Originally, the Junta Liquidadora was given six months to transfer all activitities to other ministries of the Guatemalan government, but an appeal extended that period for an additional year.

As a result, the Junta Liquidadora can currently use the natural resources and biodiversity of the Petén at its discretion. The organization has huge impact on the nation's tropical forests, because it continues to allow large logging concessions to extract mahogany and Spanish cedar. Because both FYDEP and the Comisión Liquidador have been operated by the Guatemalan Armed Forces, little control has been exercised on the organizations by other entities or individuals of the government.

INSTITUTO NACIONAL DE TRANSFORMACION AGRARIA (INTA)

INTA is related to biodiversity and tropical forests because its charges include the inventory, surveying, expropriation, and distribution of "unused" lands (tierras ociosas). INTA is in charge of land distribution in the Franja Transversal del Norte and, now that FYDEP is being disbanded, of the Department of the Petén, as well as of all unused lands in Guatemala, whether nationally owned or not. Accordingly, INTA is the state agency in control of national lands, much of which lies in the Petén tropical forest and much of which have the broadest and best protected biological diversity in the nation.

<u>Analysis</u>

In general, there are no specific institutions charged with the protection of biological diversity, though at least one organization, DIGEBOS, is charged with wildlife protection. Overall, Guatemalan legislation related to biological diversity

and tropical forests can be said to be ineffective for the following reasons:

* Legislation is not up to date, especially when applying fines, most of which are so low that violators have no trouble paying them and, thus, are not deterred from committing the infraction.

* Legislation is too disperse. Regulations are found in a variety of laws, some of which seemingly have little relation to the topic. For example, forestry regulations are found in the Ley Forestal, Ley de Gobernaciones, Código Civil, and Ley de Minería e Hidrocarburos.

* Institutions charged with applying the laws are debilitated by insufficient personnel, equipment, or financial resources. For example, the Departamento de Parques Nacionales y Vida Silvestre of DIGEBOS assigns its scant personnel directly to one of the eight parks they administer, leaving no one to control illegal hunting, fishing, or traffic of wildlife in areas outside of these parks. Overall, DIGEBOS is unable to enforce the illegal traffic in wildlife due to lack of personnel and resources. A total of three individuals are charged with protecting wildlife in Guatemala, and they are assigned no vehicles. The actual need is for at least four individuals in each of Guatemala's political departments.

DIGEBOS personnel have no manual for wildlife management, and personnel are not sufficiently trained to handle the organization's enforcement mandate. Moreover, DIGEBOS has but one vehicle asigned to the division of Parques Nacionales y Vida Silvestre and only half a dozen boats.

In another example, the Junta Liquidador del FYDEP has no way of controlling the use of renewable natural resources in the Petén because they have no personnel dedicated to the job.

* Where appropriate fishing, hunting, and forestry laws exist, no regulations are specified to structure their enforcement.

* The laws are not known by the public or responsible public officials. There is no diffusion of laws concerning renewable natural resources, for example, concerning protected areas and off-seasons of hunting or logging. Public officials fail to apply existing laws because they are unaware of them.

* Laws are blatantly violated. Commercial interests are sometimes superior to the morality of individuals involved in exploiting forests and wildlife.

* Laws are not enforced due to lack of backing of responsible authorities. Technicians file reports on illegal activities, but no follow-up is forthcoming due to negligence, lack of interest,

or compromises among the maximum authorities of the responsible institutions.

* Judicial authorities have little experience in applying laws concerned with biological diversity and tropical forests. Few cases arrive before judges, with the result that the few that do are pardoned or dismissed due to "lack of proof."

* Legal force laws has been weakened. Violations have occurred with such frequency without penalty that citizens fail to respect regulation and potential legal repercussions.

* Fees for hunting and fishing are not collected, nor has a standardized form for licensing ever been developed.

Public education in Guatemala has no specific programs in biological conservation, environmental studies, or the relationship between the environment and human communities. A few concepts of ecology are included in elementary and high school science courses, but emphasis is on memorization of basic principles. No consideration is given to social or economic implications, nor are attempts made to create an environmental ethic among public school students.

Several Guatemalan government organizations are attempting to incorporate environmental themes into public school programs, but, to date, most environmental education has been conducted outside schools among the general public.

Reflecting Guatemala's lack of institutional and educational capacity for the conservation of biodiversity and tropical forests, the public assigns low priority to these issues and is more concerned with security, employment, and nourishment. However, environmental degradation contributes to social and economic problems, a fact that must be brought to the attention of the public through greater emphasis on education and training of natural resource professionals.

Recommendations

This document concludes with a list of recommended policy, program, and project activities designed to promote the sustainable use of tropical forests and biological diversity in Guatemala.

A. Policy Recommendations

1. Develop a national strategy on biological diversity and tropical forests. Increase Government of Guatemala resources dedicated to the wise use and conservation of biological diversity and tropical forests.

2. Establish a national system of 25 priority protected areas that represent Guatemala's diversity of ecosystems. Place

these areas under a single Government of Guatemala institution. Develop management plans for each of the priority areas.

3. Focus development efforts on the sustainable economic development of renewable natural resources.

4. Focus additional sustainable development efforts on the Department of the Petén.

5. Focus conservation and sustainable development efforts on the Guatemalan volcano chain.

6. Emphasize Guatemala's positive potential in the conservation of tropical forests and biological diversity.

7. Encourage debate on the relationship between population growth and environmental degradation.

8. Focus on necessary changes in institutional and legislative structure.

B. Project Recommendations

1. Train and create jobs for additional conservation workers.

2. Require environmental impact statements for all projects which affect natural resources, tropical forests, or biological diversity.

3. Preserve the biological diversity and economic contributions of Guatemala's Pacific Coast mangrove forests.

4. Promote the sustainable harvest of renewable natural resources (xate palm, allspice, chicle) from the Petén tropical forest.

5. Increase the number of protected area guards and guides.

6. Stablilize agricultural expansion in the buffer zones around protected areas.

7. Assist Guatemalan gene banks in the *ex situ* conservation of economically important plants.

8. Establish a series of botanical gardens throughout Guatemala.

9. Develop a Mayan Agroecology System near an archaeological site in the Petén to produce agricultural discoveries of benefit to local farmers and to promote tourism.

10. Increase the educational and research capabilities of the National Museum of Natural History.

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PREFACE

Amendments to Sections 117 (Environment and Natural Resources), 118 (Tropical Forests), and 119 (Biological Diversity) of the U.S. Foreign Assistance Act of 1985 specify that the President of the United States shall require all agencies and officials responsible for programs or projects, "to prepare and take fully into account an environmental assessment of any proposed program or project under this chapter significantly affecting the environment of any foreign country" (Committee on Foreign Affairs, Committee on Foreign Relations, 1986:45).

The requirements also state that, "Each country development strategy statement or other country plan prepared by the Agency for International Development shall include an analysis of
(1) the actions necessary in that country to achieve conservation and sustainable management of tropical forests, and
(2) the extent to which the actions proposed for support by the Agency meet the needs thus identified."

Finally, the record also notes that, "In order to preserve biological diversity, the President is authorized to furnish assistance under this part to assist countries in protecting and maintaining wildlife habitats and in developing sound wildlife management and plant conservation programs" (Committee on Foreign Affairs, Committee on Foreign Relations, 1986:49).

This assessment of the biological diversity and tropical forests in the Central American Republic of Guatemala is a response to these requirements. The report has four distinct objectives:
(1) to describe Guatemala's biological diversity and tropical forests,
(2) to evaluate the status of the nation's biological diversity and tropical forests,
(3) to identify pressures affecting the nation's biological diversity and tropical forests, and,
(4) to propose cost-effective and feasible actions to assess and achieve the sustainable use of Guatemala's biological diversity and tropical forests.

As well, recent amendments to United States Agricultural Trade and Development Act of 1954 (Public Law 480) expand the range of activities that can be developed using local currency under the Agricultural Aid and Trade Missions Program to include activities beneficial to the conservation of biological diversity

(State 1988). Specifically, Section 109 of PL480 has been amended to include activities such as the following:

"(1) Research on threatened or critical ecosystems and species, especially in tropical developing countries;

(2) Establishment of national conservation data centers to determine conservation priorities and to review environmental impacts of development projects;

(3) Development of national conservation strategies;

(4) Identification of areas of high species endemism, and centers of origin of important crop plants;

(5) Acquisition of biologically important lands to establish parks, agricultural reserves, or other types of conservation units;

(6) In-country training in resources management and support for institutions that do such training;

(7) Public awareness campaigns involving local and international non-governmental organizations to promote the conservation of biological diversity; and

(8) Restoration of degraded ecosystems."

I. BIOLOGICAL DIVERSITY AND TROPICAL FORESTS IN GUATEMALA

A. Overview

Guatemala's location as a bridge between two continents and as a bridge between two oceans makes it one of Latin America's foremost repositories of biological diversity (definition in Appendix I). Its geographical location within the tropics defines Guatemala as a tropical country, yet most of its ecosystems are subtropical, following Holdridge's Life Zone classification. With characteristics of both the Nearctic and Neotropical biogeographical zones, Guatemala serves as an ecotone--a fulcrum between two biological regions, sharing characteristics of both. The lowlands of the Petén and Caribbean are decidedly Neotropical, yet the interior highlands and high Pacific mountains are classically Nearctic. This intermediary situation is reflected in Guatemala's abundant and varied biological diversity.

Guatemala's ecosystems are home to a wealth of wildlife associated with North America's Nearctic region (deer, wild turkeys, cardinals, racoons, and coyotes) and South America's Neotropical region (tapirs, anteaters, monkeys, parrots, boa constrictors, and jaguars) (Leonard 1987:26). The country has an estimated 250 species of mammals, 664 species of birds, 319 species of reptiles and amphibians, and 220 species of freshwater fish. While Guatemala shares many of these species either with North America or South America, no fewer than 45 species of vertebrates are endemic to the country, meaning that they appear nowhere else in the world (Perfil Ambiental 1984).

With almost 1,500 vertebrate species, Guatemala's vertebrate fauna is the most diverse in Central America. The number of endemic vertebrates (45) is the second highest in the region, and its list of 133 endangered species is second only to Costa Rica's 138 endangered species. As the World Wildlife Fund - U.S. has noted, from a biodiversity standpoint, Guatemala is one of the most important nations in Mesoamerica, because it has the highest vertebrate faunal diversity of the Central American nations and the second greatest expanse of broadleaved forest (WWF 1987:1).

With Costa Rica, the Republic of Guatemala also shares the distinction of having the most diversified plant growth in Central America. The nation's forests hold 17 species of coniferous trees and 450 species of broadleaved trees (Perfil Ambiental 1984; Veblen 1976).

B. Physical Regions and Their Plants and Animals

Guatemala's surface relief can be classified in a number of ways. The Perfil Ambiental produced by Universidad Rafael Landivar for the U.S. Agency for International Development (1984) divides the nation into eight physiographic regions based on geological structure (1984:27-29). The same document also classifies Guatemala according to the Holdridge Life Zone system,

under which the nation is divided into 14 zones according to temperature, precipitation, and altitude (1984:46; 285-289).

Here, we present a more simplified view, one which divides the country into its four basic physical regions, each of which contains its own particular flora and fauna.

(1) On the country's southern coast lies **the Pacific coastal plain**, with an average altitude of 850 meters above sea level. Until 40 years ago this was a region of dense forests filled with a variety of mammals and birds. Today, most of the region's forest have been transformed into pastures and swamps; its original mangrove forests have been seriously impacted, and its animal life in general has been drastically reduced. Some species have been exterminated from the area--the bear, (oso real; Myrmecophaga tridactyla) and ocelote (Felis pardalis), to mention only two.

However, the Pacific coastal plain still holds a variety of mammals, fish, and birds, as well as reptiles such as crocodiles, caimans, iguanas, and fresh water turtles. It is also a major wintering ground and migratory path for numerous North American breeding birds, including Buteo swainsoni, Cathartes aura, Muscivora forficata (scissor-tailed flycatcher), five species of swallows, and at least 40 smaller species of birds.

In general, though, the region's ecosystems have suffered radical change during the past 30 years, and its fauna have been seriously degraded, due mostly to the creation of farmland and pasture for export products. At the same time, illegal hunting and overexploitation of animal life have led to the loss of both species and sizes of animal populations. For example, the sandy beaches of the Pacific coast are critical habitat for the annual migration of marine turtles that lay their eggs above the high water line. Hunting and egg predation by local residents, dogs, and natural predators are decimating these populations in Guatemala, as well as elsewhere in the turtles' range.

(2) Moving inland, **the Pacific mountain chain** consists of a strip of 33 volcanos paralleling the Pacific Ocean. The region extends from 850 meters above sea level to a height of 4,211 meters at the peak of Volcán Tajumulco, the highest point in Central America. Two sub-regions are recognized within this area--the boca costa or "foot" of the mountains, and the cloud forests of the mountains' highest reaches.

The Pacific mountain chain still holds broadleaved forest where visitors and hunters find curassows (Crax rubra) and chachalacas (Penelope purpurascens). In the highest and rainiest parts of the boca costa live relic populations of the rare horned guan (pavo de cacho; Oreophasis derbianus) and resplendent quetzal (Paromachrus mocinno).

Polochic. Physically, the region is mostly flat with karst (broken limestone) relief. Guatemala's only true tropical rainforest (very humid tropical forest life zone) is located on the eastern Caribbean extreme of the Petén-Caribbean lowlands. The region is inadequate for the development of agricultural activities and is best left in its natural forest cover.

Much of the Peten-Caribbean lowland region is still covered by dense broadleaved forests (as well as some tropical pine communities), with well-known tropical trees such as Spanish cedar (Cedrela sp.), mahogany (Swietenia macrophyla), breadnut ramón (Brosimum alicastrum), and chicle (Manilkara zapota). Wildlife in these forests is rich and varied, with such animals as jaguars (Panthera onca), pumas (Felis concolor), tapirs (Tapirus bairdii), monkeys (Ateles geoffroyi and Alouatta palliata), potos (micoleón, Potus flavus), and peccaries (Tayassu pecari and T. tajacu). At least 333 species of Guatemala's 664 species of birds appear in these forests, including the colorful macaw (guacamaya, Ara macao), the Harpy eagle (Harpia harpyja),and the ocellated turkey (pavo del Petén; Agriocharis ocellata), to mention only the most spectacular. These lowland forests also serve as nesting sites for the jaribu stork (Jaribu mycteria) and orange-breasted falcon (Falco deivoleucus).

Herpofauna include five species of turtles, the deadly barba armarilla (Bothrops asper), coral snakes, crocodiles, and in the Caribbean subregion, marine turtles such as Chelonia mydas, Eretmochelys imbricata, and Dermochelys coriacia.

Fish of considerable scientific, cultural, and nutritional value also appear in the region. Finally, great scientific value is given to the fact that many birds and mammals endemic to the Yucatan peninsula appear in the Petén-Caribbean lowlands, especially in the dense forests of the Petén. Animals such as the Petén turkey (Agriocharis ocelata), blue-crowned parrot (Amazona farinosa), red-eared parrot (Pionopsitta haematotis), and Guatemalan ivorybill (carpintero real, Campephilus guatemalensis) deserve special conservation attention as endangered species.

The wetlands of Laguna del Tigre, the Río Polochic, and Lago Izabal are critical components of the migratory route of many bird species. Río Dulce is critical habitat for the endangered manati, and for crocodilian species, as well as for other reptiles and amphibians. Punta Manabique is another important coastal wetland on the Caribbean and is critical habitat for crocodilians and migratory shorebirds. Agricultural conversion, pesticide runoff, and hunting are placing severe pressures on these areas.

With this brief physical division of Guatemala in mind, we can now examine some of the more important ecosystems for the nation's biological diversity.

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II. STATUS AND MANAGEMENT OF BIODIVERSITY AND TROPICAL FORESTS IN GUATEMALA

A. Tropical Forests and Their Protection

All of Guatemala's remaining tropical forests can be considered critical habitat for endangered and endemic species. Tropical forests are extremely complex ecosystems in which species share interrelated biological functions established through millions of years of evolution. Little is known about the size and configuration of habitats necessary to preserve viable populations of these tropical forest species. For the habitats of the larger vertebrates (cats, monkeys, tapirs, and forest raptors such as the Harpy eagle, for example), the common rule of thumb is "the bigger the better." Vaughn (1983) indicates for Costa Rica that wildland areas must be more than 100,000 hectares in size to preserve large vertebrate gene pools over long periods of time. A great deal of additional research is needed in conservation biology to assist the selection, design, and management of protected tropical forest areas. In the meantime, Aldo Leopold's dictum still holds: "The first rule of successful tinkering is to keep all the parts."

Most of Guatemala's forested areas are concentrated in the Petén and parts of the interior highlands, and the major opportunities for protecting tropical forests exist in these areas. The Department of the Petén contains the largest unaltered tract of lowland tropical forest in Guatemala, and one of the largest tracts in Central America. Today, this forest conserves a full array of natural communities and species common to the subtropical life zones found there, including healthy populations of endangered cats, monkeys, tapirs, birds, bats, reptiles, and amphibians. At the same time, of all forests in Guatemala, the Petén tropical forest is under the most serious pressure from road construction, logging, colonization, cattle ranching, and petroleum exploration. The priority protected areas listed in a later section of this report may be sufficient to safeguard the Petén's endangered biological diversity, but only if adequate management can be established immediately.

The highland forests surrounding the volcanic peaks of southern Guatemala are also severely threatened. The fragmented remnants of their former extension provide critical habitat for a range of native species. The highland montane (mountain) forests have an estimated 70 percent animal endemism and serve as nesting habitat for the resplendent quetzal, Guatemala's national symbol and one of the world's most beautiful birds. Federal law calls for the protection of the forests on high slopes of all volcanic peaks, but this law is not enforced. Colonization, fuelwood extraction, and agriculture are common on these sites.

The forested peaks of the Sierra de las Minas, the Sierra del Merendón, Cerro San Gil, and the Sierra de Santa Cruz form critical habitat for many endemic species of plants, reptiles, and amphibians. Lumber extraction and agricultural expansion

threaten the species of these areas. The Sierra los Cuchumatanes and Sierra de las Minas contain extensive coniferous forests considered by some forest geneticists to be the most important source of tropical pine germplasm in the world (Veblen 1978). Seeds from these forests have been used in reforestation programs in tropical regions of Africa, Asia, and South America. Lumber extraction and the lack of viable forest reserves in the Cuchumatanes and Sierra de las Minas are a threat to the long-term viability of these important economic species.

B. **Mangroves**

Guatemala's mangrove forests are being converted for artificial shrimp hatcheries, salt ponds, and agriculture, as well as being overexploited for lumber, charcoal, mollusks, and crustaceans. This conversion will have serious economic repercussions.

Tropical mangrove forests serve a number of ecologically and economically important functions, including the support of marine life. As an important component in the lifecycle of many shrimp and whitefish species, mangroves merit strict protection. The Guatemala's Pacific coast mangrove forests are critical habitat for many economically important species. Shrimp yields are closely correlated with the abundance of mangrove forests, and some researchers believe that up to 90 percent of commercial fish pass at least part of their life cycles in mangrove forests. The root systems of Guatemala's red mangroves also serve as nursery grounds for commercially valuable lobsters, crabs, mussels, and oysters. The mangrove is also home to an assorted fauna of reptiles, mammals, and native and migratory birds (Rützler and Feller 1988:17). Mangroves continually produce large quantities of leaf detritus that is a basis for nearshore and estuarine food webs (Lahmann, Snedaker, and Brown 1987:240).

At the same time, mangrove trees are used by human populations for water-resistant timber, charcoal, dyes, and medicines, and they are being exploited relentlessly in some coastal regions of Guatemala. Many hectares of mangroves are cut each year, for example, to produce fuel for drying salt from seawater. Between 1965 and 1978, 31 percent of Guatemala's Pacific mangroves were degraded (Morales Calderon 1979). This figure represents a reduction from 234 square kilometers to 160 square kilometers in only 13 years. The economic impacts of this destruction are substantial. The value of the fishing industry protected by mangroves surpasses millions of dollars per year. Guatemala's mangroves also bring in recreation and tourism income through such areas as the Biotopo Monterrico, managed by the Centro de Estudios Conservacionistas (CECON) of the Universidad de San Carlos.

Although Guatemala's mangroves must be protected to preserve their particular biological diversity and their economic contribution to the nation's citizens, alternatives will have to be found to cover local human needs for fuelwood, charcoal, and

building materials. These alternatives could include fuelwood plantations, use of solar energy for drying salt, and alternative employment opportunities in tourism and fishing. For example, mangroves are estimated to produce 12.5 cubic meters of wood per hectare per year (Godoy 1985). This figure provides an estimate of the replacement values that will be needed to establish fuelwood plantations outside protected mangrove forests. Silvicultural information on the sustainable management and reneration of mangroves in Gomez Cruz (1980) could support this effort.

One key observation by researchers is that mangrove protection will be successful only if it focuses on an area much larger than the mangrove itself. Rapidly expanding agricultural lands subject to fires, pesticide use, and fertilizer application negate the value of establishing protected mangrove areas in small coastal areas.

Among the proposed protection areas for mangrove forests are Las Lisas, Tilapa, and Manchón. A number of sources for the evaluation of coastal lands and mangroves are available for Guatemala, e.g., Godoy (1985), Gomez Cruz (1980), and Morales Calderon (1979).

C. **Status and Protection of Endangered Species**

Little is known about the status of endangered or endemic species in Guatemala. We lack quantitative information on the status, distribution, habitat requirements, and degree of threat for many species. Although scientific references on Guatemala's flora and fauna exist, many of these studies have been made obsolete by recent deforestation and other transformations of the Guatemalan landscape. Efforts to update these publications have been limited by lack of funds and by the difficulty of travel in regions of political unrest. Scientists have not visited some regions of the country for 20 years (Ismael Ponciano, personal communication, 1988). The northern slope of the Cuchumatanes is biologically unexplored, as is most of the northern side of the Sierra de las Minas (Peter Hubbell, personal communication, 1988).

At the same time, Guatemala has many forms of plants and animals that deserve protection because: (1) they are unique in the world (various salamanders, toads, fish, snakes, and at least four mammals), (2) because they have restricted territories with small populations (tapirs, jaguars, manatees, monkeys, ocelotes, horned guan, macaws, quetzals, etc.), (3) because they suffer from aggressive exploitation at the hands of human communities (mangroves, mahogany, cedar, and various species of fish, shrimp, and mollusks), (4) because they serve as national symbols and part of the nation's cultural heritage (the quetzal, monja blanca orchid, chicle tree, and breadnut ramon), or (5) because they remain unknown to western science.

A variety of activities are leading to the decimation of Guatemala's native flora and fauna. The principal threat is destruction of habitat. Deforestation for timber, fuelwood, agriculture, cattle ranching, urbanization, and road construction have decimated native species, causing direct or indirect impact on almost all types of plants and animals. Subsistence and commercial hunting is also pressuring species, in particular cats and crocodilians. Another problem is the illegal trade in wildlife. Although Guatemala is a member of CITES, animal products continue to be exported both legally and illegally to Mexico, Belize, and Honduras. TRAFFIC, the wildlife trade research group of the World Wildlife Fund-U.S., estimates that more than 50,000 reptiles were legally exported during 1987. Ornithologist Peter Hubbell of Antigua, Guatemala, suggests that some illegal bird traffic could be ended if Guatemala became party to the Migratory Bird Treaty.

Overall, management efforts to protect endangered, endemic, or migratory species in Guatemala are minimal. Lack of political will to assign the necessary authority and resources, lack of up-to-date scientific information, and the limited number of qualified wildlife management personnel are major limitations. Scarce human and financial resources will continue to hinder the implementation of effective wildlife management programs for years to come.

1. **Fauna**

Guatemala has an impressive range of wildlife due to its unique position between the Neoartic and Neotropical biogeographical realms. Scientists have reported 1,453 vertebrates for the country, not including saltwater fish species. The country's known list of fauna includes 250 species of mammals, 664 species of birds, 231 species of reptiles, 88 species of amphibians, and 220 species of freshwater fish (Perfil Ambiental 1984:53). At least 133 animal species are considered threatened or endangered with extinction, due principally to habitat destruction or overexploitation for subsistence or export (WWF-US 1987:125-126). Table 1 presents a list of Guatemalan species which appear in the CITES Appendix of Endangered Species. (CITES = Convention on International Trade of Endangered Species.)

a. Mammals

Guatemala has 10 orders of terrestrial mammals representing 30 families and 184 species. The most numerous mammal orders in Guatemala are bats (Chiroptera order), with 89 species representing 48.4 percent of the total mammals in the country. Bats are followed by mice, rats, squirrels, and other rodents (Rodentia order), with 52 species, representing 28.3 percent of the nation's mammal species.

In an intermediate position lie the carnivores, represented by 19 of the 62 known carnivore species (10.33 percent of Guatemala's mammal species). The least represented groups are

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the Perisodactilos--tapirs--(with 0.54 percent), lagomorfos--rabbits--(1.09 percent), and primates (two species making up 1.09 percent of total mammals in the country).

Of the 184 land mammals known for Guatemala, only a few ba can be considered abundant; the majority are rare, and some are exceptionally rare. Among the primary reasons for this situati are loss of habitat, illegal hunting, overexploitation, and general lack of ecological conscience among Guatemalan citizens Guatemala's mammals are losing habitat to deforestation, conversion of forest lands to farmland and pastures, forest fires, human pressure to obtain fuelwood, and environmental contamination from chemical defoliants.

Many of Guatemala's mammal species are hunted for skins or bushmeat, especially the larger species such as spotted cats and tapirs. But smaller species are killed as well, namely agoutis, pacas, and squirrels. Hunting in itself would not have such severe impact on the nation's mammals, but Guatemalans continue to hunt females during periods of reproduction and species with severely reduced populations.

Mammal species are classified as threatened when their numbers have been reduced to a critical point through radical changes in their habitat or through direct pressure on their populations. Guatemala has already lost mammal species to local extermination, especially in the Pacific coastal plain and Pacific volcanic chain. There, the majority of original mammal species are now totally absent. In the north and west of the country--in the Petén-Caribbean lowlands--quantities of wild mammals hold out, but they are under constant pressure from rapid rates of deforestation. But many of this region's species are undoubtedly declining in number, and their future may be grim if immediate measure are not taken to protect their habitats.

Over all, Guatemalan scientists consider 40 of the nation's 250 land and sea mammal species to be seriously threatened with extermination. These 40 mammals represent 93 percent of all Guatemalan fauna in serious condition. Bats and rodents (141 species of the 250 total) are considered stable, as well as rabbits (Sylvilangus brasilensis), and the opposum (Didelphis marsupialis). The highland rabbit, Sylvilangus floridanus is probably down in number and is reported to have become almost exclusively nocturnal (Hubbell, p.c., 1988).

The deterioration of fauna in Guatemala is echoed in other regions of the tropics. Many of the species listed as endangered in the country also appear on international lists such as that of CITES.

TABLE 1

GUATEMALAN ANIMAL SPECIES LISTED IN CITES APPENDIX AS ENDANGERED

Scientific Name	Common Name
Mammalia	
Primates	
Alouatta villosa	howler monkey
Ateles geoffreyi	spider monkey
Felidae	
Felis concolor	puma
Felis pardalis	ocelote
Felis wiedii	margay cat
Pantera onca	jaguar
Perssodactyla	
Tapirus bardii	tapir
Avifauna	
Psicormes	
Compehilus guatemalensis	Guatemalan ivorybill
Harpia harpyja	harpy eagle
Galliformes	
Oreophasis derbienus	horned guan
Penelopina nigra	chachalaca (guan)
Phasionidae	
Colinus virgianus	
Cyrtonyx ocellatus	
Trogoiforme	
Pharomachus moccino	resplendent quetzal
Podicipediformes	
Podilybus gigas	Atitlán grebe
Psitaciformes	
Ara macao	scarlet macaw
Amphibia	
Salienata	
Bufo sp.	toad
Reptilia	
Crocodrylia	
Crocodylus moreletti	Moreletti's crocodile
Crocodylus acutus	American crocodile
Caiman crocodylus	caiman
Rhunchocephalin	
Iguana rincophala	iguana
Heloderma horridum	beaded lizard
Serpentes	
Boa constrictor	boa constrictor

(Source: Perfil Ambiental 1987:55, corrected by Peter Hubbell, 1988).

b. Birds

Better documentation exists for Guatemala's birds than for any other group of wildlife in the country. The nation has a significant avifauna composed of 46 families grouped into 394 generas and 664 species. Of these 664 bird species, 480 are permanent residents; 184 are migratory species.

Many of Guatemala's bird species are threatened by uncontrolled hunting, destruction of their nesting areas, forest fires and deforestation, and the transformation of forest to pastures and agricultural land for export or subsistence. No detailed studies have been conducted on the conservation status of Guatemala's bird life, but many species are considered endangered and at least one, the Atitlán giant grebe (*Podilymbus gigas*), an endemic species, is thought by some researchers to now be extinct.

Guatemala is a signatory to the international CITES treaty (via Decreto No. 63-79), and 78 of the nation's bird species are listed on the CITES Appendix I list, meaning that they may not be legally exported from the country. Additionally, Guatemala's hunting law (Ley No. 8-70) prohibits hunting or capture of bird species such as the quetzal (*Pharomachrus mocino*), horned guan (pavo de cacho, *Oroeophasis derbianus*), ocellated turkey (pavo ocelado, *Agriocharis ocellata*), or Atitlán giant grebe (zambullidor de Atitlán, *Podilymbus gigas*). The same law also prohibits hunting or capture of beneficial insectivorous birds and ornamental birds, though the law is interpreted to permit the hunting and commercial export of any species not protected by the law or by CITES. As a result, at least 102 of Guatemala's 664 bird species are hunted. Some are migratory species that are abundant in other nations, although rare in Guatemala. Other species are Guatemalan residents and endangered within the country. Table 2 presents the numbers of birds exported from Guatemala between 1981 and 1987.

c. Amphibians and Reptiles

Like the major part of wildlife resources in Guatemala, the nation's amphibian and reptile species are threatened with extermination. The causes are the same as with mammals and birds--uncontrolled hunting and habitat destruction through deforestation and forest fires. The threats to amphibians and especially reptiles, however, are also based on public ignorance of the biology, use, and dangers of these animals.

The IUCN lists a total of 330 species of reptiles and amphibians in Guatemala--99 species of amphibians (mainly frogs and salamanders) and 231 species of reptiles (including lizards, snakes, turtles, and crocodiles). The majority of these species are little known, and new species are still being discovered. Among the most threatened are species of frogs (Hylidae family) and salamanders (Pletodontidae family) that live in the humid tropical forests and highland cloud forests regions of the country (the Petén-Caribben lowlands and the interior highlands).

These threats come chiefly from the elimination of tree cover for fuelwood and lumber, and from deforestation for agriculture and pasture land.

Of Guatemala's 128 species of snakes--belonging to seven families--19 are poisonous (from the families Elapidae, Hidrophidae, and Viperidae), and some are extremely rare due to their systematic elimination by humans.

Three groups of Guatemalan reptiles are considered economically important--marine turtles, crocodiles and caimans, and iguanas. Of these, the marine turtles are the most important: their eggs are favored food among human populations on the Atlantic and Pacific coasts (species = Lepidochelys olivacea, Dermochelys coriacea, Eretmochelys imbricata, and Chelonia midas agassizi). The rarer crocodiles and caimans (Crocodylus moreletti, Crocodylus acutus, and Caiman crocodylus) are hunted principally for their skins, and increased commercial interest in them during the past few years had led to seriously reduced populations. The Petén crocodile (Crocodylus moreletti) is especially threatened by uncontrolled hunting in the wetlands of the western Petén. Mexicans cross over the border from nearby populated areas in the State of Tabasco to kill crocodiles and sell their skins in Mexico.

Iguanas (Iguana iguana) and garrobos (rock or spiny-tailed iguana, Ctenosaura similis) are in great demand for both rural and urban consumption, a tradition that has led to serious decline in the animals' populations, because they are usually hunted precisely when the females are filled with eggs. As a result, populations have little chance to increase, and in many areas of the southern coast they are actually being exterminated. Table 3 documents the threats to Guatemala's reptiles and amphibians from legal and illegal exports.

TABLE 2

Known Wildlife Exports from Guatemala

Birds

Year	Number of Specimens
1981	1,158
1982	1,248
1983	83
1984	3,138
1985	5,680
1986	4,957
1987	none

Bird exports include the families: Psitacidae, Tinamidae, Cracidae, and Fringilidae. Source: CITES report, 1988.

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TABLE 3

Known Wildlife Exports from Guatemala

Reptiles and Amphibians

Species	1984	1985	1986	Totals
Iguana iguana	33,420	26,640	5,050	65,110
Basiliscus vittatus	13,540	5,755	2,400	21,695
Ameiva ameiva	7,400	2,839	none	10,239
Boa constrictor	6,450	2,830	2,250	11,530
Caiman crocodylus	116,234	269,010	none	385,244 *

* Data for caimans include skins "laundered" through Guatemala, but originally from Venezuela and/or Colombia.

Source: Escobar 1987.

2. **Flora**

a. Overview

Guatemala is noted as much for the diversity of its flora as for its fauna. As with its animal life, Guatemala's location between two continents and between two oceans has given the nation vegetation that is characteristic of both North and South America, as well as plants that appear no where else but Guatemala.

Guatemala's orchid flora is especially diverse. The country has at least 527 species and 25 varieties grouped into 89 genera; of these 527 species, 57 are endemic. Guatemala's orchid diversity is especially surprising considering that Mexico, with 18 times as much territory, has only slightly more species of orchids--600.

Ferns and mosses are also surprisingly diverse in Guatemala. The nation has 110 species of ferns in 67 generas beloning to 9 families. Mosses are represented by 519 species in 205 genera, some of them species shared with Mexico, the northern United States and Canada, Andean countries, and species from Brazil and the Caribbean. But the nation also has 55 species of mosses that are endemic.

Several of Guatemala's natural ecosystems are considered to be critical habitat for conservation of plant biodiversity, due to ongoing threats from human activities. The nation's mangrove forests, for example, are under serious stress from cutting for construction poles, firewood, and charcoal. As well, the Pacific coastal plain has seen almost all of its natural vegetation altered or destroyed for plantations of sugar cane, cotton, and beef cattle. Only small remnant areas of original vegetation remain, mostly on private land holdings. This situation is especially lamentable, because the Pacific coastal plain's particular soil and climate conditions produced an especially diverse plant diversity there. Similarly, deforestation in the Sierra de las Minas is pushing several plant species toward extinction, among them *Taxus baccata*, and *Drymis granadensis*.

As a result of habitat destruction and selective harvesting of some plant types, 12 species of Guatemalan plants are cited on the CITES Appendix I and II lists of endangered species. They are: pinabete (Guatemalan fir), *Abies guatemalensis*; palo colorado, *Engelhartia pterocarpa*; skinner orquid, *Cattleya skinneri*; the monja blanca orchid, *Lycaste virginalis* var. *alba*; *Balmea stormae*; *Rhypsalis ramulosa*; *R. micrantha*; *R. bartletii*; *R. cassutha*; the tree ferns, *Cyathea spp*. (known as chipe, the blocked trunks of which are used as supports for house plants); Honduran mahogany, *Swietenia humilis*; and madera santa, *Guaiacum sanctum*.

b. Guatemalan Plants of Economic Benefit

Guatemala's combination of rich genetic heritage and rich cultural heritage have produced valuable interrelationships

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between plants and humans. On a global level, Guatemala is considered to be a storehouse of useful germplasm. In terms of the conservation and wise use of biological diversity, one of the most important aspects of Guatemala's plant life is the existence of the wild germplasm of some crucial domesticated food and fiber crops.

Central America and Mexico (Mesoamerica) were the original site for the development of such important food crops as maize (corn), tomatos, scarlet runner beans, cotton, avocados, papayas, and cacao. In addition, the common bean, manico, and the sweet potato were apparently developed in Mesoamerica as well as in South America (OTA 1987:176). Conservation of the wild ancestors of these plants is vital to the continuing improvement of the crops into which these species developed. As well, the conservation of traditional varieties of these crops--for example, the many types of corn found in some Mayan families' fields--can lead to the development of crop varieties that are resistant to diseases.

To cite another telling example, the avocado industry of California and Florida owes its existence to avocado seeds and cuttings gathered in Mexico and Guatemala during 1916 and 1917 by Wilson Popenoe, an agricultural explorer employed by the U.S. Department of Agriculture. Popenoe sent back 24 Guatemala avocado varieties to the United States, many of which proved useful in the development of today's avocado types (Smith 1985:30). Preservation of the wide variety of avocado types in Guatemala is a benefit not only to local farmers, but to avocado producers in the United States as well.

Other domesticated crops which have wild germplasm in Guatemala include chile peppers (*Capsicum annum*), squashes, amaranth, tomatoes, manioc, sweet potatoes, macal (*Xanthosoma violaceum* is the domesticated species), annonas, papayas, annato (achiote, *Bixa orellana*), and cacao. Azurdia (1988:21-22) provides a detailed list of domesticated crops and their Guatemalan natural ancestors.

Guatemala also has numerous plant species useful in forestry development. Geographer Thomas Veblen notes that highland Guatemala is one of the few tropical highland regions on the world where conifers are well represented in the flora. "Seven genera of conifers --*Abies*, *Cupressus*, *Juniperus*, *Pinus*, *Podocarpus*, *Taxodium*, and *Taxus*--which include 17 species, occur in highland Guatemala. No other area of equally low latitude has such great variety of coniferous taxa (Veblen 1976:142). Veblen write that, "Given the tremendous pressure on the remaining forests of highland Guatemala, it is likely that the Guatemalan population of several of these conifers will disappear before their potential as exotic plantation trees is ever tested." He notes that, in Africa, plantations of the Guatemalan cypress *Cupressus lusitanica* yield 11 times as much wood per hectare as the native species.

Veblen states that "The conifer which is in most imminent danger of disappearing from the forests of Guatemala is Abies guatemalensis, the Guatemalan fir, "known in Guatemala as the pinabete and much in demand for Christmas trees." Guatemala's pinabete represents the southern-most extension of the Abies genus. Undisturbed, pinabete forests tend to maintain their natural composition, but once cleared, they return to a previous stage of sucession, thus eradicating pinabete from the range of forest trees present there.

Veblen also points out that Taxus globosa is the only species of yew found south of the United States, and that the two southernmost American species of Juniperus--J. comitana and J. standleyi--occur in Guatemala. Finally, he notes that 26 species of oak (Quercus spp.) occur in Guatemala, and that some, such as Q. acatenangensis rival the famed Copey oak (Q. copeyensis) as the tallest in the world.

Putting all these data together, Veblen writes that there is an urgent need for an immediate commencement of collections which would include a wide range of Guatemala's coniferous species, especially those of the higher altitudes. "If the initiation of a program aimed at the preservation of this gene pool is delayed much longer," he writes, "the options available to future generations for afforesting much of the world's tropical highlands will be tragically reduced" (1976:150).

Another groups of economically important plants are the medicinal species. According to the World Health Organization, 80 percent of the world's women, men, and children depend on traditional medicine for their primary health care, and 80 percent of the medications they receive under this system contain plant extracts (Farnsworth 1988:83-84). With its high percentage of indigenous people, Guatemala is especially dependent on medicinal plants for health care. These plants deserve special conservation attention not only for their direct use among Guatemala families, but also for their potential development into world-class medicines. One-quarter of the medicines in use in the United States today derive partly or totally from tropical plants (Farnsworth 1988). Aguilar (1966) describes the medicinal properties of 179 native Guatemalan plant species and reports the use of 74 others.

Guatemala also wild germplasm that may prove useful in the development of new oils, fibers, spices, dyes, and insecticides, to name only a few potential uses. The seeds of some wild plants are expected to produce new oils of use to humans: zapote, Pouteria mammosa; cacao volador, Virola guatemalensis; jaboncillo, Sapindus saponaria; peine de mico (monkey's comb), Apeiba tibaurbou; chilindrón, Thevetia peruviana.

Other plants produce bark that could be used as new industrial fibers: Corchorus capsularis, Heliocarpus mexicanus, Belotia mexicana, Luehea candida, and Triumfetta speciosa. The

leaves of still other wild Guatemalan plants hold potential use as spices: apazote, Chenopodium ambrosoides (already used as a flavoring and helminth medication); alcapa or coriander, Eryngium foetidum, and laurel (bay) Litsea guatemalensis.

Still other wild plants find use as natural stimulants--subsitutes for coffee: diente de león, Taraxacum officinate; nescafé, Dolichos lablab. Some Guatemalan families use the leaves or mashed leaves of wild plants to kill or stupify fish for easy harvesting: Paullinia frutescens, Dioscorea spp., Jacquinia aurantiaca, Salmea scandens.

And others, too numerous to mention, provide natural insecticides and pesticides to combat termites, lice, rodents, cockroaches, and mosquitoes (Azurdia 1988 lists a full page of such plants). Still other plants provide natural dyes, coagulants, enzymes, forrage foods, aphrodisiacs, and ornamentals.

C. **Priorities in Species Protection**

Knowledge of individual species in Guatemala is insufficient to allow us to make judgements about real or potential values or to decide which among all species should be given highest priority. Some species are of no current recognized value, though they may turn out to be valuable in the future. Our tendency is to want to preserve all species for this reason alone. But not all species of plants and animals are equally valuable to humankind, and some selective bias must be given to those of known value or species which already have been identified as having future potential.

Following recommendations provided by the IUCN (1986:35), the following list of priority species can be suggested for Guatemala:

* wild plant species related to man's domesticated food crops: cacao (ancient feral trees), vanilla, avocado, corn.

* wild relatives or forms of domestic animals: Petén turkey.

* species with recognized potential for domestication: mamey, xate, allspice.

* species harvested from nature for food or important for recreational hunting: pacas, agoutis, deer, crocodiles, variety of wild fruits.

* species harvested by humans for other forms of use: dyes, medicines, construction materials such as balsa, cane.

* species whose value for food or other useful products is increasing because of expanding rarity: mahogany, Spanish cedar, palm hearts, xate.

* fodder plants for domestic animals: breadnut ramón.

* species vital for fulfilling functions on which other harvests depend: pollinating bees and bats, natural control of insects by bats and insectivorous birds.

* species with capacity to improve soil structure, stability, or fertility: leguminous trees, microrizae (SP).

* animal species which are useful research models for studies of human behavior, physiology, or human diseases: monkeys, armadillos.

* species providing utilized or potentially useful drugs: <u>dioscoria</u> (barbasco vine used in contraceptive pills), pericon.

* species with a high capacity to modify their environment: fast growing tree species, useful for fuelwood production, such as leuceanas, mangroves.

* species with specialized tolerance to extreme living conditions (salinity, temperature extremes, deep shade, drought, fire, wind): Pacific mangroves, Río Motagua valley thorn tree species.

* species with special significance as national symbols and for tourism: macaws (guacamayas), monkeys, jaguars, manatees, monja blanca, quetzal.

III. STATUS AND MANAGEMENT OF PROTECTED AREAS

The multiple threats to Guatemala's biological diversity require the Government of Guatemala and private conservation groups to take decisive actions to ensure the survival and sustained management of the nation's wildlands and wildlife resources. Currently, there is no adequate protection for mangroves and coastal habitats, freshwater lakes and wetlands, headwaters of rivers, or the habitats of endemic, endangered, or migratory species. As long as Guatemala's wildland resources remain unidentified and unprotected, the nation will face the irretrievable loss of both biodiversity and future economic options.

The most effective way to conserve maximum biological diversity over the long term is to maintain plant, animal, and genetic diversity in their natural environment (OTA 1987:101). Researchers refer to this concept as in situ, or on-site, conservation. To date, techniques for on-site conservation of biodiversity have focused chiefly on protected areas--areas commonly classified as national parks, wildlife reserves, or multiple use reserves.

A. Existing Parks and Reserves

The Guatemalan Forestry Law of 1945 created the opportunity for designating areas of the country as national parks. Ten years later, in 1955, the nation's first 10 national parks were created and placed under the direction of the Instituto Nacional Forestal (INAFOR), an organization renamed the Dirección General de Bosques y Vida Silvestre (DIGEBOS) during 1988. Within DIGEBOS, the Departamento de Parques Nacionales y Vida Silvestre has traditionally focused its management resources on small recreation areas that do not meet international criteria as national parks. In Guatemala, as in most tropical nations, the protection of biological diversity often has not been the primary objective in the creation of protected areas. Instead, the location and design of protected areas have more frequently been determined by social, economic, and political factors. Some areas listed in legal documents as national parks are, in reality, recreation areas focused on swimming pools or jogging trails.

To date, most of Guatemala's protected areas have been set aside for the protection of scenic landscapes, pre-Columbian Mayan ruins, or more recently, the protection of specific plant or animal species. By 1988, however, the department was turning more attention to larger, internationally recognized national parks such as Lachuá, Atitlán, and El Rosario.

Some of these areas protect undisturbed wilderness filled with animals such as Harpy Eagles, tapirs, monkeys, and endangered birds; others are small pockets of semi-disturbed habitat surrounded by human populations and environmental degradation.

Since 1955, Guatemalans have declared (or protected without legal declaration) 52 conservation areas, representing 2.72 percent of national territory. Of this total, 2.09 percent are found in the Petén. There, Tikal and four biotopos--Cerro Cahuí, Río Azul/Dos Lagunas, San Miguel/El Zotz, and Río Escondido/Laguna del Tigre--protect a range of humid tropical forest ecosystems, swamps, savannahs, rivers, and tropical lakes. Of these five areas, only Tikal National Park and Cerro Cahuí have existed as protected areas for more than one year. The other 47 of Guatemala's 52 current conservation areas represent less than one percent of national territory, a clear indication that too little of the country's range of biological diversity has been given protected status (Godoy 1988).

Although some of Guatemala's wide range of plant and animal species are already protected, much more remains to be conserved and managed if the nation's biological diversity is to be maintained for future options. Unfortunately, on-site protection of the nation's biodiversity has been hampered by a lack of manpower and funding. Efforts are further hindered by the fact that responsibility for Guatemala's protected areas is divided among three different government and non-governmental organizations. The Dirección General de Bosques y Vida Silvestre (DIGEBOS), known until 1988 as the Instituto Nacional Forestal (INAFOR), maintains legal or on-the-ground control of 21 areas; the Centro de Estudios Conservacionistas (CECON) controls seven, including the four biotopos in the Petén; and the Instituto de Antropología e Historia controls 24, all of them archaeological sites located in natural areas.

Table 4 lists Guatemala's legally declared on-site conservation areas, indicating their size and number of on-site personnel. Table 5 lists areas that are protected on the ground, but which have not received legal status as conservation areas. The 25 areas considered to be of highest priority for biodiversity protection are described in detail in Appendix V.

The data presented in Tables 4 and 5 show clear evidence that the conservation areas that have received governmental support are not sufficient to guarantee the protection of Guatemala's biodiversity. Even more, those areas which can help protect the nation's biodiversity have received the least amount of material and human support for their protection. The situation calls both for the legal establishment of more protected areas and for heightened management of areas that do exist.

TABLE 4

GUATEMALAN PROTECTED AREAS WITH LEGAL STATUS

No.	Name	Delimited	Personnel	Area(ha)	Control
1	Río Dulce	yes	6	9,610	DIGEBOS
2	Volcán Pacaya	no	0	4,800	DIGEBOS
3	Lago Atitlán	no	8	3,250	DIGEBOS
4	Cones of volcanos	no	0	unknown	DIGEBOS
5	Sipacate Naranjo	no	0	2,000	DIGEBOS
6	El Rosario	yes	8	1,105	DIGEBOS
7	Bahía de Sto. Tomás	no	0	1,000	DIGEBOS
8	Santa Rosalía	no	0	1,000	DIGEBOS
9	Cerro Miramundo	no	0	902	DIGEBOS
10	Cerro del Baúl	no	0	240	DIGEBOS
11	Naciones Unidas	yes	25	158	DIGEBOS
12	Las Victoria	yes	10	82	DIGEBOS
13	Laguna del Pino	yes	5	73	DIGEBOS
14	El Reformador	no	0	60	DIGEBOS
15	Ruinas de Iximché	no	0	50	DIGEBOS
16	Los Aposentos	no	0	10	DIGEBOS
17	Grutas de Lanquín	no	2	underground	DIGEBOS
18	Momostenango	no	0	4	DIGEBOS
19	Cuevas del Silvino	yes	0	8	DIGEBOS
20	Biotopo Monterrico	no	4	2,800	CECON
21	Tikal National Prk.	yes	172	57,600	IDAEH
22	Aguateca	yes	4	1,700	IDAEH
23	Ceibál	yes	4	1,700	IDAEH
24	Dos Pilas	yes	4	3,100	IDAEH
25	Najtunich	yes	3	49	IDAEH
26	Quiriguá	yes	36	34	IDAEH

Source: Godoy 1988

TABLE 5

AREAS PROTECTED ON-THE-GROUND BUT WITHOUT LEGAL STATUS

No.	Name	Delimited	Personnel	Area (ha.)	Control
1	Laguna Lachua	yes	1	10,000	DIGEBOS
2	Hawaii	no	2	100	DIGEBOS
3	Biotopo de Quetzal	yes	15	1,200	CECON
4	Biotopo de Chocón	yes	7	7,000	CECON
5	Biotopo de Cahuí	yes	5	700	CECON
6	San Miguel/Zotz	no	6	49,300	CECON
7	Río Escondido/Tigre	no	6	45,900	CECON
8	Dos Lagunas/R. Azul	no	6	45,950	CECON
9	Río Azul	yes	24	28,990	IDAEH
10	Uaxactun	yes	50	------	IDAEH
11	Ucanal	yes	4	2,200	IDAEH
12	Tziquintzacán	yes	4	100	IDAEH
13	Sacul	yes	2	300	IDAEH
14	El Chal	yes	3	20	IDAEH
15	Xutilha	yes	2	269	IDAEH
16	Ixcun	yes	4	400	IDAEH
17	Cuevas de San Miguel	yes	4	400	IDAEH
18	Ixtonton	yes	4	36	IDAEH
19	El Peru	no	4	8,000	IDAEH
20	El Zotz	no	6	-----	IDAEH
21	Nakum	no	6	-----	IDAEH
22	Naranjo	no	8	1,200	IDAEH
23	Motul	no	4	25	IDAEH
24	Machaquilá	no	2	2,500	IDAEH
25	Itzán	no	3	-----	IDAEH
26	Yaxhá	no	6	-----	IDAEH

A. **Proposed parks and reserves**

During the past several decades, Guatemalan conservationists have proposed the creation of a number of new national parks and wildlife reserves to increase both the types and area of ecosystems under protection (Godoy 1987). During 1988, these discussions emerged as a proposed law, the "Ley de Areas Protegidas." Section C, below, cites several of the proposed conservation areas as among the 25 priority areas for the conservation of Guatemala's tropical forest and biodiversity. The proposed law calls for the creation of 50 new conservation areas, although some of those 50 areas are already under management without legal standing. The document also proposes the creation of a new organization to manage these areas.

As of early December, 1988, the Ley del Areas Protegidas had not been passed by the Guatemalan National Congress, though lobbying efforts and meetings with congressional environmental committees continued.

C. **Priority Conservation Areas**

Table 6 and Appendix V of this report present a list of the 25 existing and proposed conservation units considered to be of highest priority for the protection of the nation's biological diversity. To ensure that the complete array of Guatemala's wildlands were identified, evaluated, and considered for inclusion in this list of priority protected areas, the biodiversity assessment team used a rapid analisis technique adapted from similar studies conducted elsewhere in Latin America--Chile 1972, Brazil 1979, Ecuador 1979, Trinidad and Tobago 1980, Costa Rica 1984, and Panama 1987. This methodology involves the use of overlays of thematic maps at a consistent scale (1:500,000) of soils, forest cover, life zones, physiographic regions, and hydrologic resources.

The biodiversity assessment team developed a matrix to evaluate biological and ecological values (size, uniqueness, species diversity, absence of alteration, etc.), socio-economic values (land use and cultural values), and management factors (legislation, funding, local participation, on-site protection). Guatemalan and U.S. experts on wildlands conservation reviewed the results, and the team visited selected sites to verify on the ground conditions. Still, the evaluation is at best a "coarse filter" to determine priority areas. Additional scientific information and field reconnaisance will be required to determine appropriate boundaries before the proposed protected areas system is complete.

TABLE 6
LIST OF PRIORITY PROTECTED AREAS

Name and Category[1]	Area (has.)	Decree	Agency	Stat
1. Tikal National Park	57,400	1955/57	IDAEH	+
2. Laguna del Tigre Biotopo	45,900	1987	CECON	0
(proposed expansion)	(460,000)	---		
3. San Miguel/Zotz Biotopo	49,300	1987	CECON	0
4. Nakun/Yaxjá/Yaloch	6,000	1970	IDAEH	0
(proposed expansion)	(97,500)	---		
5. (Uaxactun/Carmelita)	(479,000)	---		
6. Río Azul/Dos Lagunas	73,000	1987	CECON/IDAEH	0
(proposed expansion)	(220,000)	---		
7. (Sierra de las Minas)	(91,500)	---		
8. Quetzal Biotopo	1,200	1976	CECON	+
9. (Sierra del Lacandón)	(280,000)	---		
10. Lachuá National Park	10,000	1980	DIGEBOS	0
(proposed expansion)	(130,000)	---		
11. (Manchón/Ocosito)	(24,500)	---		
12. (Cerro San Gil)	(10,320)	---		
13. Atitlán/other volcanoes	3,250	1955	DIGEBOS	-
14. (Bisis Cabá)	(255,275)	---		
15. (Cuchumatanes)	(345,000)	---		
16. (Yolnabáj)	(55,000)	---		
17. Río Dulce/Chocón Biotopo	9,000	1955/79	CECON/DIGEBOS/ INGUAT	0
18. Monterrico Biotopo	4,000	1978	CECON/DIGEBOS	0
19. El Trifinio	8,000	1988	DIGEBOS	0
20. (Montañas Mayas)	(69,000)	---		
21. (Río Polochic)	(20,000)	---		
22. (Punta de Manabique)	(38,500)	---		
23. Sipacate National Park	2,000	1967	DIGEBOS	-
24. Cerro Cahuí Biotopo	700	1979/87	CECON	+
25. (Sierra de Santa Cruz)	(29,000)	---		

Source: Houseal 1988; Billy 1988

NOTES TO TABLE 6

The priority areas are listed here in Table 6 and presented again in more detail in Appendix V. Note the following about Table 6:

1. Management categories are given only if the area is defined by legal decree; otherwise, additional study is recommended to determine the proper management category. Proposed areas and proposed expansions of existing areas are included in the pending legislation, "Ley de Areas Protegidas." They are indicated here in parentheses ( ). All sizes are approximate.

2. Management status is indicated by three symbols (+, 0, and -). Positive status (+) indicates the permanent presence by sufficient numbers of trained and equipped park directors and park guards with field equipment, communications, mobility, and basic protection facilities to control incompatible uses.

Symbols are defined as follows:

+	=	adequate protection established
0	=	minimum personnel on-site
-	=	integrity of area or resources threatened.

Management status is left blank in the case of undeclared, unprotected areas.

D. **International Boundaries Protected Areas**

For a variety of reasons, members of the biodiversity assessment team also consider it important to focus on a series of protected areas along Guatemala's international boundaries. Reasons such as territorial politics and illegal cross-boundary commerce are sufficient to promote the studies necessary to guarantee proper development of these frontier zones. Led by team member Godoy, the team presents this preliminary list of 17 zones that should be developed to assure the restoration, regeneration, protection, and rational, sustainable development of natural and cultural resources along Guatemala's international frontiers.

These 17 areas are:

A. With El Salvador
   - A.1 Río Chalchuapa
   - A.2 Trifinio or Fraternidad

B. With Honduras
   - B.1 Trifinio or Fraternidad
   - B.2 Cumbre Alta
   - B.3 Merendón or Espiritu Santo
   - B.4 Río Negro-Sierra Caral

C. With Belize
   - C.1 Río Sarstun
   - C.2 Montañas Mayas-Najtunich
   - C.3 Caracol-Río Chiquibul
   - C.4 Kinal-Río Azul-Río Bravo

D. With Mexico
   - D.1 Río Azul
   - D.2 Mirador-Dos Lagunas
   - D.3 Río Candelaria-Laguna del Tigre
   - D.4 Sierra del Lacandón-Piedras Negras
   - D.5 Altar de Sacrificios
   - D.6 Laguna del Yolnabaj
   - D.7 Volcán Tacaná

Areas that should receive priority attention in regard to technical and financial assistance are Trifinio, between Guatemala, El Salvador, and Honduras; Montañas Mayas between Guatemala and Belize; Río Azul between Guatemala, Mexico, and Belice, and Mirador-Dos Lagunas-Calakmul between Guatemala and Mexico.

Of these areas, wildland resources in the Guatemala-Mexico borderlands area of Río Azul, Mirador, and La Muralla are currently under protection of the Instituto de Antropología e Historia (IDAEH), while the Centro de Estudios Conservacionista (CECON) of the Univeridad de San Carlos, has personnel in the areas of Dos Lagunas and Río Escondido-Laguna del Tigre, where they are beginning natural resource inventories and the construction of camps to guard these vital frontier areas. Nonetheless, to date, no corresponding activities have been initiated within Mexico, although there exists a preliminary

protocol to guarantee protection of frontier zones under the aegis of an agreement signed between Mexico and Guatemala in April, 1987.

Considerable international attention is already being placed by national and international conservation organizations on the frontier regions of the Department of the Petén. Through CECON, the Universidad de San Carlos de Guatemala earmarked US$100,000 for the study and management of three new biotopos in the region--Dos Lagunas (459 km2), Río Escondido-Laguna del Tigre (459km2), and Zotz-San Miguel (493km2). Another US$100,000 has been promised for 1989-1990 to conduct research on ecologically sound development in the Petén by the World Wide Fund for Nature (Switzerland), World Wildlife Fund - United States, Conservation International (U.S.), and the International Union for the Conservation of Nature and Natural Resources (IUCN, of Switzerland). Nonetheless, Guatemalan conservationists consider these efforts only the beginning; additional technical and financial support is necessary from international and bilateral institutions to properly protect natural resources along the Mexico-Guatemala international boundary and ensure the proper development of both natural resources and international relations.

IV. VALUE OF WILDLAND AREAS

A. Ecological and Biological Values

The long-term viability of Guatemala's protected areas is a function of their size, configuration, and variety, and their connections to other natural areas. The majority of declared and proposed Guatemalan wildlands that best fulfill these characteristics are found in the northern Petén. Wildlands in other regions of the country are being reduced to isolated remnants. The subtropical, tropical, and montane forest life zones outside the Petén are rapidly becoming "biogeographical islands" unable to maintain viable populations of species. Unless relatively large areas of continguous forest can be maintained or restored in the southern two-thirds of Guatemala, additional species will be lost in these life zones.

These losses must be viewed with concern, especially in the case of coniferous and montane forests. No other area of equally low latitude--aproximately 14 to 16 degrees N--is characterized by as great a variety of coniferous taxa (Veblen 1976:142). Loss of this gene bank would damage industrial forest production on both national and international levels, because Guatemala produces high quality seed stock for export to other countries. The montane forests of the high volcanic peaks of Guatemala have an estimated 70 percent endemism, in addition to high value for watershed protection. These forests also serve as critical habitat for Guatemala's national symbol, the resplendent quetzal.

Only the forest life zones of the northern Petén are currently of sufficient size to maintain a full array of natural ecosystems, communities, and species. Nonetheless, road construction, petroleum exploration, logging, cattle ranching, and colonization are rapidly converting this region's forests as well.

The declared and proposed system of protected wildlands described here incorporates representative samples of all of Guatemala's life zones and physiographic regions. In the southern half of the country, particularly along the Pacific coastal plain, assemblages of viable habitat will have to be identified, protected, and restored to natural forest conditions if we hope to assure the long-term protection of the biotic resources they contain. One example of pressing need is the Biotopo del Quetzal. Quetzals protected in the biotopo are forced to migrate to unprotected areas in order to satisfy their food requirements. If these adjoining food-producing areas are converted to other uses, these quetzals will be lost. Equally critical is the fact that the biotopo's quetzal population is not able to maintain contact with other quetzal populations due to the deforestation of contiguous habitat. This situation further endangers maintenance of the population's survival. A similar situation is becoming increasingly common for large vertebrates (e.g., felines, monkeys, tapirs, anteaters, forest raptors,

understory birds, bats, etc.) and many species of reptiles, amphibians, and invertebrates.

B. **Socio-Economic Values of Guatemala's Wildland Areas**

A key factor in the conservation and development of Guatemala's wildland areas is access. A forest road can mean improved services for rural communities and the possibility of entering regional markets with their products--a process that can imply the sustainable use of resources if well managed. At the same time, a road cut through a forest can create an access route to extract commercial hardwoods and an access route for colonists and cattle ranchers to enter and deforest the area. Such as sequence eliminates any future use of the area's renewable natural resources.

In Guatemala, the penetration of roads into wildland areas should be preceded by a battery of questions about the long-term effects of the road on biological diversity. If past experiences serve as an indication, road building implies the loss of many forested areas which are ill-suited for agriculture or cattle grazing.

The tropical forests of the Petén are being criss-crossed by roads for lumber extraction, petroleum exploration, and military control. The environmental constraints of the Petén--poor soils, lack of water, etc.--make the region unsuitable for land uses introduced from other regions of Guatemala. The best use of the region's natural resources is conservation, tourism, and extraction that can be sustained under forest cover, for example, the harvest of xate, chicle, allspice, and rattan.

C. **Existing and Potential Land Use**

Few studies are available on the economic values of Guatemala's functioning terrestrial and marine ecosystems in terms of the biological, ecological, and environmental goods and services they provide, or the lost opportunity costs involved in their degradation. Many of these values are intangible and are not easily evaluated by traditional economic models. Still, the following section illustrates some of the existing and potential economic uses of Guatemala's wildlands.

1. Conservation: The 25 declared and proposed wildland areas presented here can ensure the future ecological needs of Guatemala if adequate protection can be established. The country's soil capacity studies (Perfil Ambiental 1984:83) indicate that at least 14 percent of national territory is best suited for protected areas. Wildlands provide goods and services such as clean air and water, soil conservation, watershed production, wildlife and forest products, and educational, research, and tourism opportunities. Conversely, their loss may have severe impacts on local and national economies. Among the consequences of inappropriate natural resource use are reduction of water resources and air quality, soil erosion, sedimentation of waterbodies and damage to engineering works, floods, droughts,

loss of wildlife for subsistence purposes, degradation of fisheries, loss of forest crops, and decreased tourism. Conservation of forest resources is a logical and relatively inexpensive action which can ensure future benefits.

2. Scientific investigation: There is, as yet, no complete inventory of Guatemalan flora and fauna, nor a clear understanding of the ecological functions that support them. Little information is available on the status, distribution, degree of threat or appropriate management techniques for endangered, endemic, or migratory species. Hundreds, if not thousands, of species still wait to be identified by science and evaluated for their potential economic importance. Nor have necessary analyses been conducted to determine which locally-used species could be produced on a national level for their agricultural, chemical, industrial, or medicinal values.

As well, Guatemala's wildland areas have been under-utilized as natural laboratories for scientific investigation and environmental monitoring. The United Nations Food and Agriculture Organization (FAO) financed a Petén forest investigation center with impressive agroforestry plantations at El Rosario National Park, but the facilities fell into disrepair after the station was transferred to Government of Guatemala management. The University of San Carlos' Centro de Estudios Conservacionistas (CECON) encourages the use of the university-managed biotopos for research, and both national and international scientists occasionally use these and other wildlands to conduct biological research. Still, a great amount of research remains to be done. The 25 existing and proposed wildlands described here have excellent potential for continuous research and monitoring activities.

3. Environmental Education and Rural Extension: Guatemala has no continuous environmental education activities inside its existing wildland areas, with the notable exception of activities inside CECON's biotopos. There, CECON and volunteers of the U.S. Peace Corps attempt to educate local residents about sustainable resource use and involve them in management programs. One impressive example is the Biotopo Monterrico, where a marine turtle propagation project is underway with community support and humble resources. Great potential exists to improve similar activities in parks with high visitation rates--Tikal, Ceibal, Atitlán, and others--in order to expand environmental education about Guatemala's tropical forests and biodiversity.

4. Recreation and Tourism: Guatemala's existing protected areas are under-utilized for the potential income they could generate for local and national economies. The Tikal National Park and World Heritage Site receives tens of thousands of visitors each year. (The Tikal Park Director claims a visitor rate of 250,000 people annually; INGUAT statistics indicate that 40,000 to 60,000 of these visitors sleep there each year.) These visitors' spend millions of dollars per year on internal travel, food, entrance

fees, guides, and hotels, and have a significant multiplier effect on the Petén's regional economy. Tourism studies in Panama (Houseal 1985; Weber 1986) indicate that people on bird watching and other outdoor excursion tours stay up to 15 days in-country. Adequate tourist infrastructure in or near Guatemala's protected wildlands can generate income well in excess of the costs of maintaining these areas.

5. Water Resources: Guatemala's declared and proposed wildlands protect the headwaters of the country's principal rivers. This protection is important for downstream hydroelectric power generation, irrigation, potable water, and industrial water supplies, as well as other uses. Already short of water, Guatemala City depends for water on highland forests to both the east and west of the urban area. Because of the scarcity of other commercial sources of energy in Guatemala, hydroelectricity is one of the highest economic values provided by the nation's wildland areas. Conversely, the deforestation now taking place in Guatemala threatens existing and potential downstream investments in hydroelectricity, agriculture, and industry.

6. Forest Resources: The declared and proposed wildland areas of Guatemala do not currently permit the possibility of extractive forestry practices. One exception to this rule would be the proposed multiple-use-reserve in the Petén, where harvest of xate palm, chicle, allspice, rattan, and other products would be permitted on a sustainable basis. Use of protected wildlands for seed and root stock has also been considered by the nation's conservationists. In the majority of areas, the steep slopes and soil conditions (USDA Class VIII) make the areas ill suited for commercial use. Guatemala's soils capacity classification (Perfil Ambiental 1987:83) indicates that approximately 37 percent of the land is apt for production forestry, yet there is only one declared forest reserve in the country--the Petén's 17° 10" reserve. Only eight forest engineers are reported for Guatemala, and only one of these individuals works for the nation's forestry agency, DIGEBOS.

7. Agriculture: Soils in the majority of Guatemala's declared and proposed wildland areas are of Class VII or Class VIII (USDA Soil Classification System) and will not support sustainable agricultural use. Nonetheless, subsistence cultivation is encroaching on wildland areas throughout the country. An urgent need exists to stabilize the rural agricultural sector through proper land tenure policies and appropriate agroforestry techniques adapted to local social conditions and environments.

8. Visual Landscape Resources: Guatemala's declared and proposed wildland areas contain terrestrial and marine landscapes of outstanding beauty. The nation's beaches, volcanic peaks, tropical forests, lakes, archaeological sites, and traditional communities are all components of a valuable natural and cultural diversity, and this diversity is the basis for much of the country's economic income from tourism. Additional attention

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should be place on policies and management guidelines to evaluate and protect these natural and cultural landscapes.

D. **Protected Area Management Considerations**

1. Protection: Although legislation has declared 53 protected areas in Guatemala, the majority are "paper parks" due to lack of political will to authorize the funds necessary to protect and manage these areas. The limitations confronted by the parks department of the Dirección General de Bosques (DIGEBOS), the Instituto de Archaeología e Historia (IDAEH), and the Centro de Estudios Conservacionistas (CECON) include: the lack of physical boundaries around protected areas, insufficient number of trained park guards, and lack of mobility, field equipment, and communications equipment. As a result, these institutions are unable to protect declared wildlands areas from hunting, clearing, burning, agriculture, colonization, cattle ranching, and other abuses.

Guatemala's entire protected areas system has only five directors who have minimum qualifications in wildands management. These individuals are located in Tikal National Park (IDAEH) and in four biotopos (CECON). Many declared areas also have manual laborers who carry out patrol acivities, but few of these individuals have been trained in wildlands or wildlife protection, public relations, or environmental education techniques.

Directors and guards do not have sufficient uniforms, boots, backpacks, tents, compasses, canteens, firt aid equipment, or weapons. With the notable exceptions of Tikal National Park and CECON's biotopos, protected areas are without boundary signs, administrative headquarters, personnel housing, base radios, 4-wheel drive vehicles, repair parts, or operational support.

2. Funds: The Parks Department of DIGEBOS received approximately Q30,000 (US$11,111) for operations in 1987. Of this total, 97 percent went for salaries (Enma Díaz, personal communication, 1988). As of September, 1988, no funds had been assigned to the department for Fiscal Year 88, and some personnel had been without salary for two months. CECON receives approximately Q405,000 (US$150,000) per year to manage their biotopo system. In addition, international conservation groups donated another $50,000 to CECON during 1988 to aid the protection of three new biotopos in the Petén: Dos Lagunas, San Miguel/Zotz, and Laguna del Tigre. Including the approximately US$1,500,000 assigned by IDAEH to the protection of archaeological sites with wildlands components, Guatemala's total amount for wildlands protection in 1988 was US$1,711,000 (Godoy, personal communication, 1988).

3. Institutional Collaboration: There is limited collaboration among the various institutions responsible for managing Guatemala's protected areas. Public sector agencies are underfunded and protective of their institutional mandate. The

private sector conservation movement is characterized by energetic leadership and diverse activities, but their cooperation with other private voluntary organizations and government organizations has been minimal. CECON has assisted DIGEBOS and INGUAT in joint management of Río Dulce National Park and aids other organizations where possible with its limited resources. Additionally, the U.S. Peace Corps provides four volunteers to DIGEBOS parks. The Comisión Nacional del Medio Ambiente (CONAMA) has the organizational structure to permit wide public and private participation but also suffers from limited funds. Only during 1988 has CONAMA begun to build a strong conservation constituency.

One obvious area for improved collaboration exists between IDAEH and the DIGEBOS parks department. IDAEH has caretakers on most major archaeological sites, and these workers could also protect and manage natural resources. Conversely, some sites--such as Tikal, Ceibal, and Aguateca--could benefit from the work of wildland management specialists rather than being narrowly managed for archaeological values.

4. Local Participation: Many local residents appear to be unaware of the existence of declared or proposed wildlands and their potential benefits for employment, education, and resource use. CECON attempts to hire local workers and educate them about the value of biotopos. IDAEH also hires from local communities where possible. However, much work remains to be done regarding the incorporation of local leaders and residents into the planning and management of wildlands and wildlife areas.

TABLE 7

PHYSICAL INPUTS REQUIRED IN MOST WILDLAND MANAGEMENT AREAS

1. Personnel

2. Initial and periodic training for personnel

3. Headquarters building and guard post at entry points

4. Staff Housing

5. Visitor information center, including educational and interpretive exhibits where appropriate

6. Research facilities, including laboratory and housing for scientists

7. Roads and trails (amount will vary according to intensity of managment desired)

8. Fencing and signs, adquare to ensure proper demarcation and to control access

9. Communications, internal and external to the wildlife management area: radio, walkie-talkies, mail, and telephone (where appropriate)

10. Electricity, gas, or other energy systems

11. Sewage and waste systems

12. Four-wheel drive, motor bikes, or other vehicles

13. Boats, outboard motors, and docking facilities, where needed

14. Appropriate tools, maintenance equipment, and spare parts

15. Fuel

16. Management-oriented publications: maps, species lists, pamphlets for visitors, etc.

(Source: adapted from World Bank 1986)

VI. CONSERVATION OF ECONOMICALLY IMPORTANT SPECIES

This section describes activities being undertaken for the conservation of economically important species and germplasm in Guatemala. It reviews the status of gene banks for crop species, and examines in-situ conservation of the wild relatives of important crops.

A. Ex Situ Conservation of Economically Important Species

As Peter Ashton, Director of the Arnold Arboretum at Harvard University, has noted, ex situ conservation, the conservation of plants and animals outside their original habitat, "is a refuge of last resort: a high-risk refuge, perhaps of no escape" (Ashton 1987:276). Nonetheless, the preservation of living species and germplasm in ex situ situations such as gene banks, zoos, and botanical gardens has its place in the panoply of conservation measures.

1. Genebanks

a. Agricultural Gene Banks

Agricultural crops periodically require enrichment through cross-breeding with fresh genetic materials from other stains or races of the plant. Traditionally, this fresh germplasm has been gathered by gathering seeds from active farms. However, as Nigel Smith has noted, "All too often plant collecting expeditions when returning to sites to recollect material have found a settlement, highway, or reservoir instead" (1985:35). Faced with actual or imminent loss of living plant material in the field, scientists have turned to genebanks as a constant and reliable supply of germplasm.

Three types of germplasm collections are found at agricultural research institutes: (1) working collections are planted and harvested every year, and seeds are kept at room temperature or in air-conditioned rooms; (2) in medium-term storage, seeds are dried and kept at 0 to -5 degrees Centigrade; they remain viable for 10 to 30 years; and (3) under long-term storage, samples are dried and sealed in airtight containers at -20 degree Centigrade; these should last from decades to a century (Smith 1985:35).

Although plant collectors and breeders have demonstrated active interest in Guatemalan germplasm since the 1950s, it was not until 1981 that a systematic rescue program was proposed, this being a proposed program to include ICTA, INCAP, the Facultad de Agronomía of the Universidad de San Carlos, and the Dirección General de Servicios Agrícolas (DIGESA). Nonetheless, Guatemala still lacks a gene bank with controlled conditions that would permit the storage of seeds for long periods of time. The only existing gene banks provide for short-term storage, meaning that the plants must periodically be grown to preserve their germplasm.

Still, some progress has been made in preserving Guatemala's valuable agricultural genetic material in short-term gene banks.

A project that combines the forces of the Instituto de Ciencia y Tecnología Agrícolas (ICTA), the Consejo Internacional de Recursos Fitogenéticos (CIRF), and the Facultad de Agronomía of the Universidad de San Carlos was begun in 1982 to collect, conserve, evaluate, and document useful food germplasm in the country. Earlier collections were taken out of Guatemala without leaving duplicate collections behind (McBryde of Ohio State in 1941), and one Guatemala collection of 1,054 maize (corn) entries was lost in Quetzaltenango during 1963 due to improper preservation and lack of funds. A duplicate of this latter collection still exists in CIMMYT, Mexico, however, and ICTA has access to seeds it may need.

Today, the three institution program has an active gene bank of maize races in Bárcena, Villa Nueva, with capacity for 9,000 entries, which are renovated every two years. Additionally, during 1982-85 this same three institution program collected 1,200 samples of cultivated species of Amaranthus, Capsicum (chile peppers), Cucurbita (squashes), Ipomoea (sweet potatoes), Manihot (manioc), and others.

Since 1972, Guatemala has had a collection of native cultivars (cultivar = cultivated variety) of common beans, currently with 501 entries. Also, ICTA's bean program has an active (short-term) collection from the medium and high altiplano in Chimaltenango, but there is no humidity or temperature control where the seeds are stored.

Since 1955, the experimental station Los Brillantes, located on the Pacific coastal plain, has had a collection of cacao trees from seeds collected in Suchitepéquez. From this collection have merged 171 hybrid cacao cultivars, some of them now grown commercially. Azurdia (1988:38-39) lists Guatemala's other short-term gene banks for food crops and describes the conditions under which the germplasm is stored.

Guatemala has a Comisión Guatemalteca de Recursos Fitogenéticos made up of various national institutions, but the organization disintegrated following the change of government and officials in 1986. As a result, the lack of a national institution to coordinate and execute activities related to germplasm results in a situation in which only a few national and private institutes conduct germplasm conservation projects. Accordingly, the projects tend to be small and isolated, without follow through. On the other hand, the lack of national funds to conduct such work means that the majority of activities in germplasm conservation are funded by international institutions such as CYMMIT en Mexico, CIAT in Colombia, and CATIE in Costa Rica.

b. Forestry Gene Banks

DIGEBOS is currently carrying out a program, BANSEFOR, designed to collect seeds of forestry tree species, store them, distribute the seeds, commercialize the germplasm at

international levels, investigate genetic improvements, and, in the future, conserve native species in danger of extinction. The program has four cold rooms for seed storage with a total capacity of 8,000 to 10,000 kg. Currently, they store 38 species, among them coniferous and broadleaves trees, both native and introduced.

The Facultad de Agronomía of the Universidad de San Carlos de Guatemala has initiated two projects designed to preserve the germplasm of fruit and forestry trees. Both projects focus on planting trees at the Faculty's finca at Bulbuxyá, San Migual Panán, Suchitepéquez. There, since 1983, university personnel have planted 200 samples of native and exotic species important to internal and external fruit markets. All of these samples were produced from seed stock growing in Guatemala. Similarly, the same finca has two areas dedicated to 100 forestry tree species, both native and introduced. During 1988, efforts focused on finding new genetic material for these collections. As well, in 1987, the Facultad de Agronomía began to plant forestry tree species on the USAC campus in Guatemala, Zona 12, toward the goals of ornamentation and conservation of germplasm.

Forestry researchers Dvorak and Brouard report that seeds from more than 200 selected trees of Pinus chiapensis, a white pine gathered from eight locations in Guatemala and Mexico, have been collected by the CAMCORE Cooperative since 1983 (CAMCORE = Central American and Mexican Coniferous Resources Cooperative, based at North Carolina State University). This protected germplasm will help "preserve threatened populations and enlarge the existing genetic base of the species.". Pilot plantings of Pinus chiapensis were established during the mid-1960s and early 1970s in Brazil, Colombia, New Zealand, South Africa, and Zimbabwe, using seeds of Mexican origin. Dvorak and Brouard report that, "On a good site, Pinus chiapensis will produce more than 20 cubic meters/ha/year of wood" (Dvorak and Brouard 1988:165).

2. Living Repositories

a. Aurora National Zoo

Officials of Guatemala's National Zoo, located in Parque Aurora in Guatemala City, state that the National Zoo lacks sufficient space, material resources, and above all, true programs of reproduction and reintroduction of fauna, to properly serve as a living repository of animals. Although the zoo has effected some sucesses in the reproduction of endangered species, this development may constitute even larger problems because of lack of sufficient space, food, and medicines.

b. Botanical gardens

Ashton writes that, "The immediate role of botanical gardens in the ex situ culture of rare and endangered species lies in research and education rather than in conservation per se" (Ashton 1987:277). Recreation and public education about biological diversity can be important functions of botanical

gardens (Smith 1985:37). Guatemala has an official, national botanical garden, and has plans for creating perhaps a dozen more located in various departments of the country.

The National Botanical Garden was established 29 December, 1922 on Avenida Reforma in Guatemala City. Currently under the direction of the Centro de Estudios Conservacionistas (CECON) and the site of CECON's offices, the botanical garden is owned by the Facultad de Ciencias Químicas y Farmacia of the Universidad de San Carlos de Guatemala. The garden occupies an area of 17,611m2 and houses 546 taxa (species, varieties, or forms) of plants from 112 families (Poll 1987). Although the CECON Botanical Garden performs an important function in providing a tranquil space in the midst of urban confusion, its role in the conservation of biological diversity is not large. However, because the many plants and trees the garden holds are labeled with their scientific and common names, the garden is an excellent educational tool for teaching students and the general public about Guatemalan plant species. In coordination with the Instituto Nacional de Electrificación (INDE), the Universidad de San Carlos is also developing a new Botanical Garden, el Jardin Botánico Medio Monte, in Palín, Escuintla.

During 1988, the Comisión Nacional del Medio Ambiente (CONAMA) began work toward the establishment of a series of departamental botanical gardens located around the country. CONAMA has made contact with alcaldes in a half dozen municipios and has been successful in convincing them to set aside areas for the development of botanical gardens dedicated to the plant species of their local areas.

3. Natural History Museum

Following the 1988 Work Plan of the Museo Nacional de Historia Natural, the museum's primary function is to educate the public about Guatemala's natural heritage (Ibarra et al. 1988). Other functions include ecological investigation and recreation. More than 100,000 visitors--most of them students--pass through the museum each year, a fact that clearly earmarks the institution as vitally important to environmental education.

Housed in a building completed in 1986, the museum operates on an annual budget of only Q8,500 (US$3,148), including salaries. As museum staff point out, this sum is obviously inadequate for the museum to fulfill its function of environmental education and research. Independent observers have concluded that the museum's role has not been aided by its recent adoption under the Ministry of Culture and Sports. Since being incorporated into that ministry, the museum has been unable to obtain direct grants from international insitutions; instead, finances are routed through the Ministry of Culture, and funds directed toward the museum have sometimes been appropriated for other organizations within the ministry.

In additional to serving as a potentially powerful force in environmental education in Guatemala, the Museo de Historia Natural should also be performing a role in systematics, the study of biological diversity, sometimes narrowly defined as the identification and classification of species. Wilson (1985:1) points out that systematics is the basis of new discoveries and new ideas in biology. Additional information on the museum's role in education and systematics is presented in the recommendations section of this document.

B. In Situ Conservation of Economically Important Species

One of the concerns of biological diversity specialists is the loss of genetic diversity in human food crops. Around 15 food crops stand between humanity and starvation. We depend on five cereals, three root crops, three seed legumes, two sugar crops, and two tree crops for the majority of human food supplies (rice, wheat, corn, sorghum, barley; potoato, manioc, sweet potato; bean, soybean, peanut; sugar cane, sugar beets; bananas and coconuts). Of these categories, corn, potatoes, manioc, beans, sweet potatoes, and peanuts have valuable wild relatives or traditionally cultivated varieties (landraces) in Guatemala. Accordingly, Guatemala's traditional agricultural crops play an important role in maintaining crop production in Guatemala and as germplasm for crop development throughout the world.

Preserving germplasm from as many species and strains as possible, says Arthur Fisher, promises "among other things, the ability to overcome a crop epidemic" (Fisher 1982:48). "The continued existence of wild and primitive (landrace) varieties of the world's crop plants," Fisher continues, "is the best insurance against destruction of the human food supply" (Fisher 1982:48). Less dramatically, wild and primitive germplasm can allow the development of markedly improved crop plants. The perennial corn (Zea diploperennis) discovered in Mexico a dozen years ago is the only source of resistance to three major corn viruses.

Seed stored in gene banks is one way to conserve the germplasm of wild and primitive food crops. But gene banks are dulnerable to accidents, power failures, and destruction during civil strife. "Moreover," according to botanist Dr. Hugh Iltis, "species in storage do not evolve, while their enemies in the real world continue to do so" (Fisher 1982:52). As a result, there is an increasing interest in the conservation of landrace varieties within their native agricultural landscape. Oldfield and Alcorn point out that, "Much of the world's biological diversity is in the custody of farmers who follow age-old farming and land use practices" (1987:199). They argue that conservation of landrace varieties within traditional agroecosystems, in situ conservation, is the best way to maintain the dynamic evolution of plant-human interactions.. In situ conservation of traditional agriculture also maintains the weeds and wild crop relatives associated with cultivated species.

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The Committee on Germplasm Resources of the U.S. National Academy of Sciences has, in fact, recommended that the United States facilitate the maintenance of traditional agroecosystems to conserve in situ germplasm of major U.S. crops (Oldfield and Alcorn 1987:199). This would include Guatemalan sources of corn, potatoes, manioc, beans, sweet potatoes, and peanuts.

The extinction or depletion of traditional cultivars and wild crop relatives is extensive, due to the adoption of modern crop cultivars within areas of ancient agriculture, the replacement of mixed-crop subsistence farming by commercial agriculture, and war (Oldfield and Alcorn 1987:200). Seed stocks stored in institutional gene banks are not easily available to traditional farmers.

To optimally maintain genetic resources, Oldfield and Alcorn (1987:206) suggest a three-pronged approach consisting of:

(1) In situ conservation linked with economic development efforts, in which scientists participate with farmers to maintain adaptable, economically viable farming systems that include traditional cultivars. Such efforts are compatible with cultural parks such as the proposed Cuchumatanes Cultural Park, and with other types of protected areas.

(2) In situ conservation and research centers independent of private farmers, in which processes identified in traditional agroecosystems are studied and emulated in rural development projects based on indigenous knowledge. Such centers would be appropriate in buffer zones of biosphere reserves, for example.

(3) ex situ reserves, such as gene banks.

Oldfield and Alcorn also report on a specific program for action by U.S. AID, developed by the Interagency Task Force on Biological Diversity (ITFBD). The program focuses on encouraging host governments (and providing funding) to evaluate the potential of traditional agroecosystems. Via AID, the United Nations, and the multilateral development banks, ITFBD reported, the U.S. government should provide long-term support for research to create highly productive, sustainable agricultural systems that include subsistence farmers and indigenous species.

In addition to reserves that incorporate traditional peoples and agriculture, other proponents have recommended development of a system of village-level landrace custodians by subsidizing farmers to continue traditional agriculture in selected zones (Oldfield and Alcorn 1987:204).

Non-crop species of economic importance are also conserved in situ through the operation of extractive reserves focused on renewable natural resources such as xate, allspice, chicle, and medicinal plants. This concept is discussed in full in a following section on extractive reserves (VI B 4 a).

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VI. ECONOMIC VALUE AND SUSTAINABLE USE OF BIODIVERSITY AND TROPICAL FORESTS IN GUATEMALA

Environmental problems are inextricably linked with economic development policy in Guatemala. In the United States and many industrialized countries, environmental goals such as protecting endangered species or wildlife habitats are often seen as ends in themselves, removed from their broader social or economic implications. By contrast, environmental questions in Guatemala must be viewed in the broader context of economic and social policy. Bruce Rich, Director of International Conservation for the Environmental Policy Institute in Washington, D.C., describes an experience that illustrates this difference. Preparing to leave for a trip to India, Rich heard this statement from a U.S. environmentalist:

"Of course, the environment can't be a priority in a country like India because people have to think first about eating and survival."

But when Rich arrived in India, he says, "my Indian hosts immediately launched into a lecture on how environment was only a luxury for people in the U.S., whereas in India it was a question of conserving the resource base on which the rural poor--hundreds of millions of people--depend for their very survival" (Rich 1988:4).

Rich's story illustrates the point that natural resources and biological diversity <u>are</u> the basis for economic growth and social progress in Guatemala. Yet, this basis continues to be squandered through short-sighted planning or through the actions of individuals willing to sacrifice the national good for their personal benefit. Gradually, however, Guatemalan development officials are coming to realize that the goals of natural resource conservation and economic development are not in conflict, but instead are the same--namely, improving the quality of life for present and future generations of Guatemalans (Barbier 1987:101).

With this concept in mind, making choices among competing uses of limited natural resources requires a careful assessment of the trade-offs associated with each of the possible choices (U.S. AID 1987). Economic analysis provides an organized procedure for assessing these trade-offs. Although many complex questions must be addressed, the economic project analysis manual (U.S. AID 1987) provides examples of how to approach these questions.

For example, to choose between two possible development projects--one with protection of biodiversity, one without--we must identify the costs and benefits of each project. Because external pressures such as colonization may threaten resources in the project's geographic area, project analysis can not be viewed in isolation; it must be examined in the context of a whole

region. For the economic analysis, this implies that costs and benefits must be identified and quantified for the whole region affected by the project.

Table 8 presents a simple framework for identifying key impact categories. Filling out this table for each development alternative will help identify the major categories of impact and trace their effect on project outputs.

TABLE 8

FRAMEWORK FOR IDENTIFYING MAJOR IMPACT CATEGORIES OF REGIONAL DEVELOPMENT --WITH AND WITHOUT PROTECTION OF BIODIVERSITY AND TROPICAL FORESTS

Categories	Without Protection	With Protection
Physical Effects		
soils		
water quantity		
water quality		
vegetative cover		
species diversity		
aesthetics		
Output Effects		
agriculture		
forestry		
livestock		
fisheries		
wildlife		
germplasm		
tourism		
recreation		
production costs		
income		
employment		
health		
education		
standard of living		
Development Climate		
employment opportunites		
development options		
stability		
planning flexibility		
education		

A. Economic Use of Flora and Fauna

To date, Guatemala has insufficient protection and management of native species of plants and animals to ensure their continued existence, much less their sustainable use. The lack of protection of native species leads to wanton local use and illegal commercialization, particularly of endangered species such as macaws and crocodiles. This problem is evident in all sectors of Guatemalan society, from subsistence hunting to the illicit export of plants, animals, and skins in direct violation of the Convention in Commerce on the International Trade in Endangered Species (CITES), which Guatemala has signed. Active trade of parrots, macaws, crocodile skins, and reptiles continues with both Honduras and Mexico. Guatemala's existing wildlife export laws are outdated, lack restrictive penalities, and are unenforceable due to lack of trained personnel.

Guatemalans have not yet placed adequate values on their biological resources. During 1988, hunters in the Petén were selling young spider monkeys to hotels and individuals in Santa Elena and Flores, Petén for Q70 ($28). Jaguar skins sold for Q80 ($32), and macaws sold for Q200 to Q250 ($75 - $100). In Europe, the same macaw would sell for $2,500 - $3,000, and a jaguar coat in Germany sells for $40,000.

Guatemala exports many of its biological resources as raw materials with no value added in-country. Yet, the economic potential for management and sustainable harvest of wild flora and fauna is tremendous. Experiences in other tropical countries demonstrate the possibility of native species propagation--including iguanas, crocodilians, frogs, butterflies, turtles, deer, peccaries, and other species with potential skin or meat value. Also, birds, felines, monkeys, and other exotic species have value for pets, zoos, and research centers. Another benefit is wildlife management in wildland areas for tourism value.

Halting Guatemala's illegal wildlife trade will not be easy. During interviews conducted for this biodiversity assessment, more than one government official alleged that Guatemalan military personnel are involved in the illegal wildlife trade. According to one official, members of the military sell Guatemalan wildlife skins to middlemen in Honduras. Other workers stated that military aircraft are used to export live parrots and macaws, as well as the skins of spotted cats, from the Petén to Guatemala City. One native resident of the Petén told a member of the biodiversity research team that he could ship him any animal product he wanted from the Petén to Guatemala City, though the assistance of a relative in the Guatemalan air force.

Guatemalan flora also tends to be undervalued within the country. During 1988, rough-cut mahogany sold in the Petén for $0.25 per board foot; meanwhile, the U.S. price was $10-$12 per

board foot. Finished furniture would, of course, be worth far more.

Although proteins from aquatic sources--mostly fish, but also crustaceans, mollusks, and others--provide about one-quarter of all animal products in direct human consumption worldwide, many aquatic proteins in Guatemala appear to be under-utilized. Ponciano reported in 1987 that 10,000 pounds of fish from the Atlantic Ocean were wasted due to lack of buyers (Ponciano 1987). There is no fish consumption tradition in Guatemala, Ponciano explained, and, "Even when fish cost one-half the price of chicken, it is still difficult to sell it." At the same time, the amount of shrimp harvested for export on Guatemala's Pacific coast is said to be threatening this coastal resource. Ponciano reported that, in 1984, the Government of Guatemala was aware that over-harvesting was going on in the shrimping industry, and that, in 1985, the shrimp catch declined--a fact attributed to the previous year's over-harvest (Ponciano 1987).

On the other hand, fresh-water fish appear to be a highly utilized resource. More than 600 metric tons of fish are harvested from Lago Izabal each year, and 1,000 metric tons are taken from Lago Petén Itzá (Ponciano 1987).

B. Economic Use of Protected Areas and Tropical Forests

The International Union for the Conservation of Nature and Natural Resources (IUCN 1986:74-76) lists 16 major ways that national parks and other protected areas can bring economic benefits to regional communities. Following this list, we examine some of the more important of these benefits for Guatemala.

* Stabilization of hydrological functions.

In some areas, such as the Biotopo del Quetzal, these hydrological functions may be worth millions of dollars a year per watershed.

* Soil protection.

Good soil protection by natural vegetation prevents dangerous landslides, prevents costly siltation of fields, irrigation canals and hydroelectric dams, safeguards coastlines and riverbanks, and prevents destruction of coral reefs and coastal fisheries by siltation.

* Climate stability.

Undisturbed tropical forest helps maintain rainfall in its immediate vicinity by recycling water vapor at a steady rate back into the atmosphere. This may be especially important in the production of dry season showers critical for settled agriculture.

* Conservation of renewable harvestable resources.

Biological productivitiy under natural conditions is "cost free" and generally higher than for any form of artifically planted alternative.

* Protection of genetic resources.
Many thousands of undiscovered species may be of use to humankind. All domestic plants and animals were originally derived from the wild, and many can only be maintained and improved by regular recrossing with wild forms and relatives. The short- and long-term values of these genetic resources are enormous. Most improvements in tropical agriculture and silviculture depend on the preservation of wild genetic resoruces.

* Preservation of breeding stocks, population reservoirs, and biological diversity.
Reserves may protect crucial life stages or elements of populations that are widely and profitably harvested outside the reserves. They are sources of seed dispersal, wildlife, and fish spawning areas. Mangroves are a good example of this benefit, for they serve as breeding sites for dozens of kinds of commercial fish.

* Tourism.
Local economies can benefit considerably from tourism. At the national level, tourism brings valuable foreign exchange into the country. At the local level it stimulates profitable domestic industries--hotels, restaurants, transport systems, souvenirs, handicrafts, and guide services.

* Recreational facilities.
Local communities as well as other domestic and foreign visitors benefit from recreational facilties provided by protected areas.

* Creation of employment opportunities.
Apart from employment created within the protected area itself, additional employment is generated by auxiliary services, tourism, road improvements, and professional services. These benefits are especially valuable where the land within the protected area has little or no value for agriculture.

* Provision of research and monitoring facilities.
Protected area provide excellent living laboratories to study high, stable productivity on poor soils.

* Provision of educational facilities.
Protected areas provide valuable sites for school classes and university students in the fields of biology, ecology, geology, geography, and socio-economics.

* Maintenance of a quality living environment.

Inhabitants close to a protected area often enjoy a quality living environment. Values of property adjoining protected areas may become enhanced.

* Advantages of special treatment.
  Local residents near parks and reserves may be eligible for special treatment--improved social services, communications, loans, irrigation, and housing projects.

* Preservation of traditional and cultural values.
  Protection of natural reserves can result in preservation of locally important cultural sites and traditional practices which would otherwise be destroyed. The proposed cultural park in the Cuchumatanes is directed toward these values; Atitlán National Park is another example.

* Natural balance of environment.
  Protected areas afford sanctuary to birds which control insect and mammal pests in agricultural areas. Bats, birds, and bees which roost and breed in reserves may range far outside their boundaries to pollinate trees in surrounding areas.

* Regional pride and heritage value.
  Development of sources of regional and national pride have benefits which are not easy to evaluate but which are nonetheless real credits.

1. Tourism

The potential for additional income from tourism in Guatemala is substantial, and much of this potential depends on the conservation of the nation's tropical forests and biological diversity. The highest number of tourists recorded in Guatemala for a single year--502,908--occurred in 1979. During that year, tourism contributed US$200.6 million to Guatemala's economy, just after coffee and cotton in economic importance. This amount represents expenditures of $399 per tourist per visit, not counting airfares that may accrue to Guatemalan companies (Perfil Ambiental 1984). Tourism declined by 58 percent between 1979 and 1983, in reaction to the country's political unrest. The impact of this reduction in tourism can be calculated using the 1979 figure of amount spent per tourist. The potential income lost surpassed $123.2 million per year.

The impacts of reduced tourism and the positive benefits of increased tourism is important for Guatemala's regional development strategies. Increased environmental awareness in the U.S. and Europe--the home area of most visitors to Guatemala--as well as increased interest in activities such as bird-watching, tropical nature hiking, and archaeological tours, indicate that tourism to Guatemala should continue to increase during the coming years. Although tourism normally focuses on primary attractions such as Lake Atitlán, Tikal, or the biotopos, all regions of the country can share in the economic benefits of

increased tourism if Guatemala effects appropriate marketing mechanisms for handicrafts and services.

The potential for expanded nature tourism in the Department of the Petén is especially promising. In 1988, only 11 percent of the yearly half million visitors to Guatemala visited the Petén. With additional promotion, tourism to the area could easily be increased. The Petén has more than 70 significant archaeological sites, including Tikal, which many people consider to be the most spectacular ruin in the world. The biggest draw for tourism in the Petén, however, is the combination of Mayan history and the tropical forest environment. The Guatemalan Petén is one of the few places in the world where visitors can look up from a 1,000 year-old temple to watch spider monkeys scampering across the treetops. It is this combination--not the stone cities alone--that must be conserved and promoted. In the future, neighboring countries, namely Mexico, which have focused on ruins at the expense of surrounding natural areas, will likely see many of their potential visitors pass on to Guatemala to enjoy the combination of history and conserved tropical forests.

Another factor that could draw increased tourism to the Guatemalan Petén is the strategy being developed by the National Geographic Society, "the Ruta Maya." Led by magazine editor Wilbur Garrett, the National Geographic Society plans to work with national governments to develop a tourist route similar to the Inca Trail in South America. The Ruta Maya will connect the major archaeological sites and national parks of Guatemala, Belize, Honduras, and Mexico with the goal of stimulating economic development through tourism. National Geographic magazine will print a lead article on the Ruta Maya in June, 1989, and increased tourism interest in the Petén should be one of the results. By 1990, at least 75,000 tourists per year are expected to be spending about US$22.5 million each year in the Petén (INGUAT, interviews, 1988).

In preparation for this increasing influx of visitors, much remains to be done. One of the factors that currently hinders tourism in the Petén is the lack of quality accomodations. Only 224 hotel rooms exist in the Petén, down from a peak of 367. (Part of this decline is due to flooding of lower floors in Flores, Santa Elena, and San Benito--a result of rises in Lago Petén Itzá; some researchers have linked the lake's rise to increased runoff caused by deforestation.) Few of the Petén's existing hotel rooms are of the more appointed type international tourists request, meaning that few have air conditioning and comfortable beds. This need creates a point where sustainable development and private industry converge, and a point where international funding can have expanding positive impact. Tourism in the Petén already provides more than 5,000 jobs, and this total could increase with the promotion of the Ruta Maya.

TABLE 9

Number of Hotel Rooms in Guatemala

Year	1980	81	82	83	84	85	86	87
Country	7,513	7,337	7,514	7,615	7,871	7,751	7,678	7,656
Petén	367	367	367	367	367	243	238	224

The number of rooms required for tourists to the Petén can be estimated using the following simple formula:

$$\text{No. of rooms} = \frac{\text{No. of tourists X avg. length of stay}}{\text{365 days X avg. no. of persons/room X occupation rate}}$$

The occupation rate adjusts for the fact that tourist arrivals are not evenly distributed throughout the year and that provisions for the seasonally higher number of tourists must be made. It is clear that substantial expansion of hotel facilities in the Petén will be needed to accommodate the numbers of tourists expected by 1990. Programs should be initiated without delay.

Beyond being a sustainable, non-destructive industry, tourism is also a significant producer of vital foreign exchange. Tourism is a major employer, and it diversifies the overall economy, creating corrollary industries and employment in handicrafts, jobs as park guards, guides, and in other services that have a powerful secondary effect on the economy. For example, small boat pilots in the southern Petén town of Sayaxché charge Q150 ($60) to take tourists from Sayaxché to nearby archaeological sites and parks. Making one trip per day, they guide 30-50 visitors per month, producing a gross local income of Q4,500 ($1,666) per boat pilot per month. If we assume that at least two boat pilots provide this service every day, we arrive at a local income of more than $3,333 per month--no small sum for a town such as Sayaxché. Similarly, even more boat pilots ply Lago Petén Itzá, offering trips to the nearby island zoo of Petencito and the lookout tower on the archaeological ruins of Tayasal, though at considerably less expense.

Before more tourists will visit the Petén, however, the area must be seen as politically stable and environmentally interesting. It is vital to understand that political instability contributed to the decline in the number of tourists during the early 1980s, and that political instability is prolonged by social problems linked to environmental degradation. Promoting the sustainable use and protection of the Peten's tropical forests and wildlife is a positive force for tourism and, in the long run, a positive force for political stability. Few tourists will visit an area they think is dangerous, and few

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tourists will visit an area where the natural resources have been destroyed.

Overall, the development of the tourist sector offers the most attractive known opportunity for the economic development of the Petén. Tourism can generate employment, generate income for local populations, and reduce pressures on the region's tropical forests. While some tourism can be developed even if large areas of the Petén are deforested and only key archaeological sites protected, the potential for developing a regional tourist industry including recreation, sports, and nature observation would be severely limited. INGUAT (Instituto Guatemalteco de Turismo) is the government agency in charge of planning and administering tourism activities in Guatemala, and close cooperation with them is vital for the proper development of tourism in the Petén.

In 1981, INGUAT established four major objectives for the Petén:

(1) Preservation of Tikal National Park

(2) Protection and preservation of the natural resources and cultures of the Petén in general.

(3) Providing visitors with the best possible accommodations and modern tourist installations.

(4) Insuring that tourists extend their stays by offering the most varied attractions, from recreation to scientific investigation.

A checklist provided by the IUCN (1986:44-45) cites the following attributes as indicators for high tourist potential in protected areas. The list is useful in considering the proper development of Petén tourism.

1. Is the protected area
   - close to an international airport or major tourist center
   - moderately close
   - remote
2. Is the journey to the area
   - easy and comfortable
   - a bit of an effort
   - arduous or dangerous
3. Does the area offer
   - "star" species attractions
   - other interesting wildlife
   - distinctive wildlife viewing, on foot, by boat, etc.
4. Is successful wildife viewing
   - guaranteed
   - usual
   - with luck or highly seasonal
5. Does the area offer
   - several distinct features of interest
   - more than one feature of interest
   - one main feature of interest
6. Does the area have additional

- high cultural interest
- some cultural attractions
- few cultural attractions

7. Is the area
   - unique in its appeals
   - a little bit different
   - similar to other visitor reserves
8. Does the area have
   - a beach or lakeside recreation facilities
   - river, falls, or swimming pools
   - no other recreation
9. Is the area close enough to other sites of tourist interest to be part of a tourist circuit
   - outstanding potential, other attractive sites
   - moderate potential
   - low or no such potential
10. Is the surrounding area
    - of high scenic beauty or intrinsic interest
    - quite attractive
    - rather ordinary
11. Are standards of food and accommodation offered
    - high
    - adequate
    - rough

This list indicates that, with increased international promotion, far more tourists could be drawn to the Petén, as well as to Guatemala's national parks and protected areas in general. Tourism is the world's second largest industry in terms of international trade, second only to oil and just edging out the arms industry for second place. Tourism generates some $95 billion annually, worldwide (Abrahams 1983:12). Geographer Douglas Pearce has reviewed the relationship between tourism and the environment, pointing out that countries should integrate environmental considerations into their tourism development policies at the earliest possible stage (Pearce 1985:251).

2. Water Production

The conservation of tropical forests and biodiversity has another economic benefit, the provision of water in sufficient quantity and quality. Tropical forests, natural grasslands, and other natural areas act like a sponge, absorbing rainfall and holding it to release it gradually and evenly into river systems for the benefit of downstream activities such as irrigation and urban water supplies. These functions are lost when tropical forests or other natural vegetation are eradicated, leading to increased flooding during the rainy season and drought during the dry season. Loss of these functions also leads to soil erosion and sedimentation of hydroelectric reservoirs and coral reefs.

The cost of not protecting tropical forests and their water production potential can be estimated by the value of lost electric production capacity due to sedimentation and decreases in agricultural and fisheries production. In the tropics as a

whole, 90 percent of all farmers cultivate valley bottomlands, and are therefore dependent on the activities of the 10 percent of the population who live in watershed areas (IUCN 1986:46). Water supplies are vital to human life, to agriculture, and to industry, and protection of tropical forests' water regulation is of much greater value than alternative uses of the land (IUCN 1986:46). Some of the costs of forest eradication are related to poorer public health caused by poor water quality, as well as decreases in coastal and inland fisheries production and lost recreation and tourism potential.

3. Tropical Forests and Agriculture

Tropical forest zones perform a valuable service for neighboring agricultural areas by safeguarding against floods and providing water through dry periods (IUCN 1986:88-89). The forests that protect the Valley of the Río Motagua and the farmlands of the Pacific slopes provide examples of this situation. Also, many wild species resident in tropical forests are vital to the well-being of surrounding agricultural lands. Birds help control levels of insect and rodent pests, and bats control insects and pollinate many tropical fruits.

As well, tropical forests protect the wild precursors of some commercial crops, such as cacao, avocados, mamays, vanilla, and lesser known fruits.

4. Renewable Natural Resources from Extractive Reserves

More than 6,000 people in the Guatemalan Petén are involved in the extraction of renewable natural resources from the tropical forest. Their activities focus on the harvest of three different products:

(a) Approximately 6,000 individuals harvest xate palm (*Chamaedorea elegans* and *C. oblongata*) from the Petén tropical forest. Another 200-500 individuals work in the industry as sorters, contractors, and exporters. Guatemala exports hundreds of millions of leaves of this palm every year to the United States and Europe for use in the floral industry. Florists use the xate palm leaves as green backgrounds for arranging cut flowers. Properly cut, each xate palm can be harvested four times per year without damaging the resource. The fact that xate grows beneath the canopy of undegraded tropical forest makes the industry of special interest. Xate exports produce $3.7 million in total annual export value. The fact that 50 percent of the xate leaves harvested in the forest are discarded during sorting and selection indicates that the efficiency of the industry could be greatly improved. The need exists for education programs for xate harvesters to improve their harvesting techniques, and for Guatemalan decision makers should also be reminded that sustained harvest of xate palm is worth far more than the corn or beef temporarily produced on cleared tropical forest land.

(b) Many xate harvesters also work during February to June in the harvest of chicle (*Achras zapote*), a latex gathered from

trees in the Petén tropical forest. Chicle is exported to Europe and Japan for use in the chewing gum industry. Properly cut, the chicle trees are not harmed by harvesting. Official statistics indicate that, in 1969-70, exploitation of chicle produced Q1.4 million ($518,518) in the Petén (INGUAT 1981). However, official statistics on forest products from the Petén are notoriously under-reported, due to attempts to prevent paying taxes on extracted products. Chicle production for 1988 was estimated to reach 300,000 pounds. Guatemala sells each pound for Q3 (US$1.11), indicating that this year's harvest will be worth $333,000.

(c) The third product harvested on a sustainable basis from the Petén tropical forest is allspice (pimienta gorda; Pimienta dioica). Collected June through August of each year, allspice is gathered by coppicing seed-bearing trees and boiling and drying the seeds. The allspice trees begin to resprout after they are cut, and the tree can be harvested again after six years of regrowth. Enough trees exist in the Petén to support the export of one million pounds of allspice each year. Guatemala's exports are worth $16 million retail in the United States and Europe, although only $1 million to $2 million of this amount accrues to Guatemalans.

One of the most interesting aspects of the harvest of these three renewable resources is that they promote conservation and sustained use of the Petén tropical forest. Knowing that their economic future lies in the sustained use of xate, chicle, and allspice, families who harvest these resources are strong promoters of forest protection. Equally interesting is the fact that, combined, these renewable resources represent an income of at least US$6 million each year from undegraded tropical forest.

5. Sustainable Versus Non-Sustainable Economic Activities

Economic activities that involve natural resources in ways that are not sustainable can also be considered activities that reduce biological diversity. The reverse is also true: economic activities that reduce biological diversity are rarely sustainable. Non-sustainable activities eventually result in negative net benefits to the producer and the country at large. The net benefits of sustainable production, no matter how small at the beginning, will eventually outweigh those of non-sustainable production. Production alternatives that are not sustainable should not be accepted by planning agencies. The key task for planners is to identify beforehand what makes a project sustainable or non-sustainable. Planners must identify economic development alternatives that are cost-effective as well as sustainable, while still meeting their specific development objectives. In some cases, outright protection of the natural resource will be the most efficient action. Following the World Bank's newly enlightened policy on wildlands and biological diversity, Guatemalan planners should keep in mind the Hippocratic Oath's first axiom: "First, do no harm."

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Only alternatives that coincide with the productive capacity of soils, terrain features, and climatic conditions should be supported. Lands classified as forest sites should stay under forest cover. If land use in an area is non-sustainable, it should be replaced quickly with sustainable production alternatives. Local populations should receive the financial and technical support they need to switch to the recommended alternative without jeopardizing their short-term livelihood.

Indicators of sustainability fall into categories such as soil productivity, water quality and quantity, biological diversity, population density, health and education levels, size of external debt, etc. Within each of these categories, certain reactions act as warning flags to indicate to development specialists that current land use activities are not sustainable. Among these possible reactions are: loss of species, high levels of erosion and sedimentation, declines in water quantity, increased human mortality, decreasing soil productivity, increased incidence of pests and diseases.

As an example, extensive cattle ranching is not a sustainable use of Guatemala's tropical forest lands. The current pattern of cattle ranching in Guatemala's tropical forest areas begins with the construction of roads into forested areas for the extraction of mahogany and tropical cedar, or for petroleum exploration. Colonizing families and cattle ranchers use these penetration roads to move into the area and clear the remaining vegetation. Cattle ranchers may clear-cut the forest in order to plant introduced, usually African, grasses; or, farmers may plant one or two years of corn, beans, and other food crops before seeding the area in grass to create pasture.

The average yield for beef cattle ranching in the Petén tropical forest is 10 kilograms of beef per hectare per year (Duayhe 1979). Even this meager production plummets after 7 to 10 years, when soils are so degraded and weeds so prolific that production is no longer viable. Clearing of the tropical forest for cattle ranching increases flooding, soil erosion, and sedimentation of rivers and streams. It also wipes out vital habitat for tropical forest species, thus reducing biodiversity.

Cattle production in tropical forest areas also decreases employment among local populations. Once the forest is cleared, raising cattle requires less labor than most other production systems, so few jobs are created (Price and Hall 1983). In neighboring Chiapas, Mexico, tropical forest cattle ranching requires an average of only one worker per 100 hectares of pasture (Romanini 1978:4). Cattle raising requires only six worker-days per hectare, while beans need 37, rice 60, and coffee 130 (CEPAL 1980:175).

Cattle production also fails to justify itself in terms of its contribution to export receipts in relation to the amount of land it occupies. In 1980, for example, Guatemala's export

receipts per square kilometer reached $1,745.97 for coffee, but only $47.24 for beef cattle production (Leonard 1987:101). In addition to eradicating tropical forest and wild species, beef cattle production also uses land inefficiently in comparison to other agricultural activities. This situation is further exacerbated by the fact that, in Guatemala, cattle production occupies fertile soils on the Pacific coastal plain that could be used to produce food crops or more lucrative cash crops (Leonard 1987:102-103). The fact that the country's most fertile soils are dedicated to cattle ranching and export crops means that rural families are pushed onto marginal lands such as hillsides and tropical forests in order to produce their own food and cash crops.

Accordingly, on many grounds, including inefficient production, decreased employment, increased soil erosion, and destruction of biodiversity, extensive cattle production can be judged a non-sustainable activity in tropical forest regions.

VII. MAJOR ISSUES IN BIODIVERSITY AND TROPICAL FOREST MANAGEMENT

A. Loss of Habitat / Deforestation

Of Guatemala's original forest cover, approximately 40 percent (45,000 km2) remains uncleared. However, driven by population growth and inequitable land distribution, rural families are colonizing forested areas marked by steep slopes, poor soils, or both. Combined with road construction, logging, clearing for agricultural exports, fuelwood cutting, cattle ranching, petroleum exploration, and hydroelectric projects, colonization leads to the deforestation of hundreds of square kilometers each year. A 1981 United Nations Food and Agriculture Organization study concluded that Guatemala loses 720 km2 of forest each year, but the study did not consider areas as deforested if they were allowed to regrow in secondary growth once cleared, used, and abandoned (Lanly et al. 1981:151). Other studies would call these areas deforested. Méndez Dominguez (1988) estimates a deforestation rate of between 1 and 1.5 percent annually, an amount equivalent to 1,080 and 1,620 km2, respectively. Meanwhile, reforestation over the past 10 years has amounted to a total of 490 km2. At these rates of deforestation and reforestation, Guatemala's forest cover could disappear in 25 to 40 years.

Cutting for fuelwood is likely the number one cause of forest destruction in the highlands (Méndez Dominguez 1988). More than 63 percent of forest clearing is thought to be the result of fuelwood collection; 29 percent results from colonization, 6.5 percent from fires and forest diseases, and 1.1. percent from industrial use (Rose 1988:29). It is important to point out that deforestation for fuelwood collection is a problem in all areas of the country except the lowland moist forest (i.e., the Petén). In the Petén, trees are cleared and burned in place so that colonists and ranchers can gain access to the soil. Deforestation for fuelwood collection is not a problem in the Petén.

As a result of the destruction of Guatemala's forests, natural ecosystems are degraded, crucial habitats are lost, and numerous species of plants and animals are led to the edge of extinction. Deforestation caused by inappropriate land use practices also results in increasing flooding, droughts, sedimentation of hydrelectric reservoirs, soil erosion, and degradation of fisheries.

B. Hunting, Fishing, and Poaching

Guatemala has a range of laws designed to protect fish and animal species from overexploitation through hunting and fishing, but the laws are rarely enforced due to lack of field personnel. When Guatemalans hunt, they do so chiefly for subsistence, but the practice is not widespread. Few rural farmers, for example, own rifles, and those who do are careful about where and when they carry them due to Guatemala's history of guerilla warfare.

As one farmer in the Petén pointed out to a member of the research team, he doesn't want to be spotted carrying a rifle in the forest by either the army or a band of guerrillas.

At the same time, serious poaching of Guatemala's wildlife occurs in the northwestern reaches of the Petén. This corner of Guatemala borders on the Mexican State of Tabasco, and the Tabasco side of the border has been almost totally cleared for farmland and pasture. Little wildlife remains on the Mexican side. As a result, families in the Mexican communal villages called ejidos in Mexico buy the meat of wild animals killed by professional hunters who illegally enter the Guatemalan Petén. Mexican hunters load food, salt, and weapons onto mule teams and cross the border unobserved. There are no guardposts nor controls along this section of the Mexico-Guatemala border. The hunters spend days within the Petén, killing every edible animal they see. They also take any animal, such as jaguars and ocelots, whose skin can be sold. The hunters butcher the animals they kill and preserve the meat in salt. When they have loaded their mule team to capacity, they travel back across the border into Mexico, again unobserved, and sell the meat to their fellow ejidatarios. In a nutshell, having eliminated the edible wildlife from their own region, the Mexican hunters are now eliminating the wildlife from the neighboring region of Guatemala.

Alternatives to this pattern exist, but Guatemala can do little to promote them beyond cajoling Mexican authorities into action. Foremost among the alternatives would be to establish wildlife production facilities within the Mexican communities so that they could produce meat rather than steal it from Guatemala. Until these activities are put into place, Guatemala's best course of action is to hire guards to patrol the border and prevent poachers from crossing illegally into the area. This region of Guatemala is currently under consideration for protected area status as Parque Nacional Laguna del Tigre. If this park is declared, park guards should be able to prevent further encroachments.

Fishing, as reported elsewhere in this report, is common in Guatemala's lake and rivers, and appears to prevent few problems to the nation's species. In Lake Atitlán, however, the use of gill nets by local fishermen is cited as one of the causes of the demise of the giant grebe (pok; Podilymbus gigas), a flightless water bird found only on this lake. Because the pok dives for its food, it may become trapped in the gill nets and drown.

Biologists have also pointed to heavy use of gill nets along the Río de la Pasión as destructive to sustainable fish populations there. Residents of the town of Sayaxché, on the Río de la Pasión, report that fishermen from other areas of the country camp along the river and spread gill nets as a screen in front of the vegetation where fish hide and feed. When the fish emerge, they become entrapped. Unfortunately, this fishing

systems captures and usually kills all types of fish--whether edible or not--thus, diminishing all fish populations within the river.

Fishing by dynamiting rivers and lakes has been reported in some regions of Guatemala, but does not appear to be as widespread as in some Latin American countries. Again, the persistence of Guatemala's armed civil strife probably prevents rural families or weekend fishermen from carrying quantities of explosives.

C. Sedimentation, Contamination, and Overexploitation of Water Resources

Freshwater rivers, wetlands, and lakes in southern Guatemala are under severe pressure from sedimentation and runoff containing sewage effluent and toxins from urban, industrial, agricultural, and rural uses. Although data are limited, it can be assumed that water quality is generally poor and that native freshwater species are being adversely impacted. Guatemala has one of the highest use levels of insecticides in the world, due mostly to heavy application on cotton along the Pacific coastal plain (Leonard 1987:145).

In addition to the impoverishment of aquatic biodiversity, the direct health impact of contaminated water on human populations has a high social cost. The Río Motagua, in particular, is severely contaminated by untreated effluent from the Guatemala City metropolitan area. The Río Polochic wetlands and Lago Izabal are also adversely affected by agricultural pesticide runoff. In the Petén, Lago Petén Itzá receives raw sewage from the towns of Flores, Santa Elena, and San Benito, with resulting damage to its water and biological resources. A less understood, but dangerous, long-term impact is the passage of toxins through mollusks, crustaceans, fish, and wetland birds through the food chain to the human populations that consume them.

Coastal and marine ecosystems are also being subjected to pesticide runoff, removal of mangrove forests, and overexploitation of marine species. Mangrove forests along Guatemala's Pacific coast are one of the most threatened, yet economically most important, ecosystems in Guatemala. Only 10 percent of the original amount of mangroves remain (J.C. Godoy, personal communication, 1988), and these are rapidly being converted to agriculture, artificial shrimp hatcheries, and salt ponds, in addition to being overexploited for construction poles and charcoal. Several shrimp and fish species that remain in the mangroves until their juvenile stage form the basis for Guatemala's marine fishing industry, as well as subsistence for local residents. Mangroves also provide other important environmental services, such as filtering waste and buffering storm tides.

The sandy beaches on both the Atlantic and Pacific coasts of Guatemala serve as nesting grounds for several endangered species of marine turtles, including the parlama (Lepidochelys olivacea) and baule (Dermochelys coriacea). Both the meat and eggs of these animals are overharvested by local residents, and populations are declining (Higginson, et al. 1987).

D. **Population Growth**

Underlying and reinforcing all of the threats to Guatemala's biological diversity is the nation's rapid population growth. Standing at 8.7 million people in mid-1988, Guatemala's population is the largest in Central America. Its growth rate (rate of natural increase) of 3.2 percent per year is exceeded in all of Latin America only by Nicaragua's 3.5 percent per year. At its current rate of growth, Guatemala's population will double in 21 years (Population Reference Bureau 1988).

By the year 2000 A.D., the nation is expected to be home to 12.2 million people; by 2020 A D. it may have 19.7 million, meaning that Guatemala will probably add 11 million people--more people than live there today--during the next 32 years.

Although a growing proportion of the population may end up in the nation's cities (where 33 percent of the people now reside), the absolute numbers of Guatemalans who remain tied to the land will continue to grow rapidly for the foreseeable future. In mid-1988, more than 5.8 million women, men, and children were living in rural Guatemala, most of them forced to exploit natural resources for a living. As the nation's rural population increases, demands on these natural resources will also increase. Population growth and biodiversity destruction do not necessarily proceed hand in hand. But, usually, when populations expand rapidly in resource-dependent nations, serious environmental disruption results (Nations and Leonard 1986:75). The sad truth is that throughout most of Guatemala, rural population growth condemns farm families to perpetual poverty and dooms biological resources to continuing degradation.

Population growth can not be blamed for all environmental deterioration in Guatemala or any other nation. Easy access to natural resources may have a greater impact on resource depletion than population growth, but the combination of easy access and growth can double the impact of access alone (Krahl and Cook 1988:1).

Deforestation, for example, is caused by a number of factors, including mismanagement of timber land and government loans or subsidies that encourage conversion of forest to pasture and cropland. But population growth also places direct demand on forest in the case of fuelwood. Under the same living conditions, twice as many people will use twice as much fuelwood. If this wood is gathered from natural forest, a growing population has serious impact on forest resources. As well, population increases must be matched directly by increases in

food production (Krahl and Cook 1988:2-3). When, as in the case of Guatemala, food production is increased by bringing additional land under cultivation, population growth leads to the degradation of forest and wildlands resources. Guatemalan agricultural growth continues to be fueled mainly through an expansion of the amount of land under cultivation, rather than through increasing yields on land already cleared (Leonard 1987:100). The need to increase food production in response to population growth leads to an emphasis on short-term yields at the expense of long-term sustainability of food production (Krahl and Cook 1988:5).

The relationship between population growth and deforestation in Guatemala is demonstrated by the fact that, as population grew from 4.3 to 8.7 million between 1964 and 1988, 25,000 square kilometers were deforested (Méndez Dominguez 1988). In 1960, 68 percent of the nation was under forest cover; by 1981, this figure was down to 39 percent. The linkage of population growth and deforestation becomes clear by examining the principal causes of forest loss. More than 63 percent of deforestation in Guatemala is due to fuelwood collection; 29 percent results from colonization of forest lands. Around 6.5 percent of forest loss is due to fires, and 1.1 percent is lost to industrial uses (Méndez Dominguez 1988).

Ominously, Guatemala's population is growing most rapidly in the nation's low-lying tropical forest regions, where soils are generally poor and where most of the nation's remaining forests are located. Rates of population increase in these tropical forest regions are high partly because rural women tend to have more children than urban women. However, another factor is in-migration. The tropical forest regions of Guatemala--especially the Petén--are being rapidly colonized by families from the more populated agricultural zones of the altiplano (highlands) and the dry south-east.

Given Guatemala's current population growth rate, the degradation of biodiversity will continue until land use patterns change. Even with a rapid drop in birth rate, a drop that Guatemala has yet to achieve, the nation's population will continue to expand well into the 21st century. As increasing numbers of Guatemalan women reach childbearing age during the next few decades, even essential steps to reduce the long-term population growth rate will not alleviate critical biological resource problems in the near future. The millions who may soon be clearing the forests, polluting the rivers, and altering coastal habitats in Guatemala have already been born (Nations and Leonard 1986:76).

But to claim that population growth <u>causes</u> the degradation of biological diversity is to oversimplify. As environmental writer Erik Eckholm has noted, "The uncontrolled spread of people over the landscape is obviously fueled by population growth, but skewed landownership, too, contributes to the problem" (Eckholm

1979:11). Combined, however, the factors of population growth and inequitable land distribution prompt increasing numbers of rual families to migrate to cities or to colonize such environmentally sensitive areas as hillsides and tropical forests. If the pressure is severe enough, renewable biological resources can quickly become nonrenewable (Nations and Leonard 1986:76).

Continued population growth in Guatemala without concurrent changes in land use pattern will be the largest single obstacle to protecting the nation's biological diversity and tropical forests. To avoid this fate, government and international planners must concentrate on increasing agricultural production from existing farm lands and the creation of other employment and income opportunities. Increased production would be possible though irrigation technology, improved production methods, improved plant materials, and more efficient use of under-utilized export-oriented lands. Sustainable development is dependent on management of both population growth and natural resources (Krahl and Cook 1988:7).

VIII. INSTITUTIONAL AND LEGISLATIVE STRUCTURE

A. Institutions

Guatemalan organizations related directly or indirectly to biological diversity and tropical forests are mainly government institutions. Nonetheless, non-governmental organizations dedicated to these issues are, in fact, more numerous and are playing an increasingly active role in biodiversity and tropical forest conservation.

At least 60 institutions have some impact on Guatemalan biodiversity, but only four have formal, direct, and major impact: (1) the Dirección de Bosques y Vida Silvestre (DIGEBOS), (2) the Dirección Técnica de Pesca (DITEPESCA), (3) the Instituto de Antropología e Historia (IDAEH), and (4) the Centro de Estudios Conservacionistas (CECON).

As well, at least 10 institutions conduct planning, coordination, or make political decisions that affect the protection and use of renewable natural resources. As such, these 10 organizations affect biodiversity and tropical forests. They are:

1. Secretaría General de Planificación Económica (SEGEPLAN)
2. Unidad Sectorial de Planificación Agropecuaria y de Alimentación (USPADA)
3. Comisión Nacional del Medio Ambiente de la Presidencia (CONAMA)
4. Comisión Nacional de Tierras
5. Proyecto de Desarrollo Rural Integral Trifinio
6. Comisión del Medio Ambiente del Congreso de la República
7. Comisión de Agricultura del Congreso de la República
8. Gobernaciones Departamentales
9. Municipalidades
10. Dirección de Asuntos de Límites y Aguas Internacionales.

Four other institutions have programs or actions that strongly effect biodiversity and tropical forests:

1. Oficina de Control de Reservas de la Nación (OCREN)
2. Instituto Nacinal de Transformación Agraria (INTA)
3. Comisión Liquidador del FYDEP
4. Servicio Nacional de Erradicación de la Malaria (SNEM)

Eight institutions can be pointed to as controlling projects or actions which could eventually have impact on biodiversity and tropical forests:

1. Dirección de Sanidad Animal
2. Dirección General de Obras Públicas (DGOP)
3. Dirección General de Caminos (DGC)
4. Cuerpo de Ingenieros del Ejército
5. Comité de Reconstrucción Nacional (CRN)
6. Ministerio de Energía y Minas (MEM)

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7. Instituto Nacional de Electrificación (INDE)
8. Corporación Financiera Nacional (CORFINA)

At least three other institutions have programs which depend strongly on the maintenance of tropical forests:

1. División de Saneamiento Ambiental, Ministerio de Salud Pública
2. Unidad Ejecutroa del Programa de Acueductos Rurales (UNEPAR)
3. Dirección de Riego y Avenamiento (DIRYA)

Four organizations that can or should cooperate with state institutions working toward the conservation of biodiversity and tropical forests are:

1. Comandancia de Capitanías de Aeropuertos y Puertos
2. Policía de Hacienda
3. Dirección General de Fuentes Nuevas y Renovables de Energía
4. Instituto Guatemalteco de Turismo (INGUAT)

As well, two institutions work to record the dynamics of some factors or components of biodiversity and tropical forests:

1. Instituto de Sistomología, Vulcanología e Hidrología (INSIVUMEH)
2. Instituto Geográfico Militar (IGM)

And, finally, 10 organizations are charged with education and investigation in the environment field in general and renewable natural resources specifically:

1. Comisión Nacional Permanente de Educación Ambiental (CONAPEA)
2. Area de Sistemas Naturales de la Facultad de Agronomía, Universidad de San Carlos
3. Escuela de Biología de la Universidad de San Carlos
4. Escuela de Biología de la Universidad del Valle
5. Centro de Estudios del Mar y Acuacultura (CEMA)
6. Dirección General de Investigación de la Universidad de San Carlos (DIGI)
7. Escuela Regional de Ingenieria Sanitaria (ERIS)
8. Centro Universitario de Petén de la Universidad de San Carlos de Guatemala (CUPETEN)
9. Centro Universitario de Nor-Occidente de la Universidad de San Carlos de Guatemala (CUNOROC)
10. Escuela Nacional Central de Agricultura (ENCA)

There are eight principal non-governmental organizations focused on biological diversity and tropical forests:

1. Asociación Amigos del Bosque (AAB)
2. Asociación Guatemalteca de Historia Natural (AGHN)
3. Asociación Pro-defensa del Medio Ambiente
4. Defensores de la Naturaleza
5. Comité Departamental de Defensa del Medio Ambiente, Baja

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Verapaz (CODEMAB)
6. Fundación Interamericana de Aves de Rapiña
7. Asociación Audubon de Guatemala
8. Asociación Guatemalteca de Orchideología

Also, six international programs or organizations have some influence on biological diversity and tropical forests in Guatemala:

1. MOSCAMED
2. United States Peace Corps
3. Instituto Interamericano de Ciencias Agrícolas (IICA)
4. Centro Agronómico Tropical de Investigación y Enseñanza (CATIE)
5. United Nations
6. Partners of the Americas

The following section analyses the most important of these institutions and the impact they have on Guatemala's biodiversity and tropical forests.

DIRECCION GENERAL DE BOSQUES Y VIDA SILVESTRE (DIGEBOS)

DIGEBOS (formerly the Instituto Nacional Forestal, INAFOR) is the government institution responsible for the administration of forest resources, some national parks, and the nation's wildlife. DIGEBOS came into being during June, 1988, when it took the place of the Instituto Nacional Forestal, INAFOR, which had carried out these functions until that time. Unlike INAFOR, DIGEBOS is a centralized entity directly dependent upon the Ministerio de Agricultura y Ganadería (MAGA). DIGEBOS is organized into a Dirección, Subdirección General, and five departments with their respective sections: Departamento de Administración, Departamento de Planificación, Departamento de Manejo Forestal, Departamento de Recursos Naturales, and the Departamento de Vida Silvestre y Areas Protegidas (with a Parques Nacionales section and Vida Silvestre section).

The departments most closely related to the conservation of biodiversity and tropical forests are the Departamento de Manejo Forestal, charged with proper management of public and private forests; the Departamento de Protección, charged with combating forest fires and plagues; and the Departamento de Parques Nacionales, charged with management of wildlife and the parks under its jurisdiction.

The Departamento de Parques Nacionales y Vida Silvestre has the following personnel:

1 biologist
1 biologist <u>in fieri</u>
1 veterinarian
3 agricultural engineers
7 agricultural engineers <u>in fieri</u>
3 topographers

2 graphic specialists
1 secretary
80 workmen in 8 national parks, recreation areas and natural monuments.

Field personnel are distributed in the department's protected areas in the following fashion:

Laguna del Pino National Park (caporal), 4 workers = 6	1 manager, 1 foreman
Naciones Unidas National Park workers = 21	1 manager, 1 foreman, 19
Las Victorias National Park workers = 12	1 manager, 1 foreman, 10
San José La Colonia N. Park	8 workers = 8
Río Dulce National Park	1 manager, 4 workers = 5
Lachua National Park	1 manager, 2 workers = 3
El Rosario National Park	1 manager, 3 workers = 4
Atitlán National Park	1 manager, 8 workers = 9
Zipacate-El Naranjo Reserve	1 U.S. Peace Corps volunteer

DIGEBOS hopes to hire 12 additional workers for their protected areas during 1988. In the transformation of INAFOR to DIGEBOS, no changes were effected of field personnel. Thus, the experience and training they received through the Centro de Estudios Conservacionistas (CECON) during two recent workshops were not lost.

The Departamento de Parques Nacionales y Vida Silvestre of DIGEBOS has prepared an ambitious plan to carry out the management of their protected areas and the nation's wildlife. According to Guatemala conservation workers, the shortcomings of this plan are that it was elaborated without knowledge of the background of management in the areas and therefore tend to be utopic. Other criticisms focus on the fact that more personnel are assigned to recreation areas (69 percent) than to areas which protect more biological diversity. For example, Lachua National Park has the highest quality of biological resources and is the largest of the areas under DIGEBOS's control, yet it has only three workmen as its total personnel.

The budget for the Departamento de Parques Nacionales during the second half of 1988 was Q290,477 (US$107,584). Due partly to this low budget, the department has not achieved much success in protecting the parks and wildlife under its control. Instead, several parks (Laguna del Pino, Atitlán, Río Dulce) have been

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invaded and colonized. Although 14 new personnel have been hired for the Departamento de Parques Nacionales under the recent reorganization, only four have been contracted for the Wildlife section. However, in neither case have the new personnel had extensive experience in these fields.

The continuing resistence to increase the number of personnel working in the field calls into question the role that DIGEBOS plays in the protection and conservation of Guatemala's biodiversity and tropical forests. At least one Guatemalan conservationist notes that the organization still has not grasped the meaning of its responsibilities in this area. However, the recent change in DIGEBOS's organization provides the opportunity to place more emphasis and more personnel in areas that have significant biological diversity to protect.

DIRECCION TECNICA DE PESCA (DITEPESCA)

DITEPESCA is the government organization responsible for the administration of fishery resources. It falls under the Dirección General de Servicios Pecuarios (DIGESEPE), and is directly dependent upon the Ministerio de Agricultura y Ganadería. DITEPESCA has a Director and four departments--Departamento de Acuacultura, Departamento de Piscicultura, Departamento de Pesca Marítima, and Departamento de Pesca Continental.

None of these departments is directed toward the conservation of biological diversity; instead, the Departamento de Acuacultura is oriented toward extension work in shrimp cultivation, Piscicultura provides technical assistance to small-scale fish farmers, Pesca Continental promotes fish farming, and Pesca Marítima regulates and issues licenses for commercial fishing. DITEPESCA also has a marine turtle reproduction program on the Atlantic coast, which includes one part-time biologist and three field workers. The marine turtle project does not receive sufficient funding nor does it have sufficient personnel.

INSTITUTO DE ANTROPOLOGIA E HISTORIA (IDAEH)

IDAEH falls under the recently created Ministerio de Cultura y Deportes and is the institution responsible for administering the cultural heritage of Guatemala. Created in 1946, IDAEH has direct influence on Guatemala's biodiversity because many of the nation's archaeological sites are located in undisturbed natural areas, especially in the tropical forest of the Department of the Petén. The offices most closely related to biological diversity and tropical forests are:

(1) the Departamento de Monumentos Prehispánicos, which is charged with protecting archaeological sites;

(2) the administrative offices of Tikal National Park; and

(3) the Flora and Fauna section of the Tikal Project.

The Departamento de Monumentos Prehispánicos has one archaeologist who serves as department head, one secretary, and 100 workmen for 32 archaeological monuments throughout the country (20 of which are located in the Petén). The department lacks sufficient personnel, communication equipment, and vehicles.

Tikal National Park has 153 personnel, including 1 administrator, 1 sub-administrator, 53 park guards, and 150 workmen, among others.

The Departamento de Flora y Fauna of the Tikal Project was created 10 years ago primarily to deal with vegetation on areas to be excavated for archaeological purposes. Two years ago, however, the department took responsibility for environmental education and management of fauna and flora in Tikal Park. The department has one department head and 28 workmen. Its budget is sufficient only to pay the necessary salaries.

Although IDAEH has a significant relationship with biological diversity and tropical forests in Guatemala, its primary role is protection of cultural (archaeological) monuments. The Institute does cooperate with the goals of natural resource conservation, but critics point to the fact that forest resources continue to be exploited within Tikal Park as an indication that protection of biodiversity is not the Institute's principal function.

CENTRO DE ESTUDIOS CONSERVACIONISTAS (CECON)

CECON is the academic unit of the Universidad de San Carlos responsible for promoting the field investigation and conservation of renewable natural resources. CECON's structure also allows it to develop environmental education and interpretation programs by means of exhibitions and publication, conferences and audiovisual materials for students. Investigation is conducted by a group of experienced researchers and focuses on fish, birds, plants, reptiles and amphibians, and the planning and management of protected areas.

As well, CECON directly administers seven biotopos (wildlife areas focused on protection, investigation, and education) and the national botanical garden. With control of a total of 136,052 hectares of mangroves, cloud forest, tropical forest, and wetlands, CECON has direct and significant impact on the conservation of biological diversity and tropical forests in Guatemala. CECON is currently developing a Conservation Data Center to bring together all possible information on the nations' biological resources.

CECON has 80 personnel, including 15 biologists, one forester, two engineers, 13 resource guards, and 34 workmen. CECON is funded principally by the Universidad de San Carlos; its 1988 budget was Q629,000. The organization has also received funding from INGUAT, Cooperación Guatemalateca-Alemana Alimentos

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por Trabajo (COGAAT), and the World Wildlife Fund. As well, the International Union for the Conservation of Nature and Natural Resources (IUCN), The Nature Conservancy, Conservation International, CATIE, U.S. Fish and Wildlife Service, U.S. National Park Service, International Wetland and Waterfowl and Bird Preservation, and the Center for International Development and Environment of the World Resources Institute are very close cooperative institutions. During 1988, these latter institutions provided Q110,000 in funding to CECON.

CECON is the Guatemalan organization which has achieved the most success in the management and protection of biodiversity and tropical forests. Although in existence for only seven years, CECON has well trained professional and technicians, though it lacks sufficient personnel in middle levels and in research. Although scientific research is one of CECON's principle charges, the need to manage wildlands areas has taken scarce personnel out of this field into strict management.

COMISION NACIONAL DEL MEDIO AMBIENTE (CONAMA)

CONAMA was created in December, 1986 by Congressional decree No. 68-86, as a dependency of the Presidency. The organization consists of a Coordinador named by the president, 10 members made up of other government organization, a team of technical specialists, and an administrative team.

CONAMA's function is to assess and coordinate all actions related to national policies on the protection and imporovment of the environment. Since its creation, CONAMA has promoted the creation of a Comisión del Medio Ambiente within the National Congress, promoted environmental aspects of the National Development Plan, hosted a series of seminars on the environment, and promoted several laws in favor of environmental protection, including the still pending Ley de Areas Protegidas. CONAMA is performing a vital role in governmental organization and coordination on environmental issues. Although still in the process of organization, CONAMA has nonetheless been able to achieve positive actions and influence within the Government of Guatemala.

COMISION LIQUIDADORA DE FYDEP

The government organization formerly charged with absolute power in administering and developing the Department of the Petén, the Empresa Nacional de Fomento y Desarrollo Económico del Petén (FYDEP) existed between 1959 and 1987. During April, 1987, FYDEP began a process of liquidation and was replaced by the Comisión Liquidadora de FYDEP. Originally, the Junta Liquidadora was given six months to transfer all activitities to other ministries of the Guatemalan government, but an appeal extended that period for an additional year.

As a result, the Junta Liquidadora can currently use the natural resources and biodiversity of the Petén at its discretion. The organization has huge impact on the nation's

tropical forests, because it continues to allow large logging concessions to extract mahogany and Spanish cedar. Because both FYDEP and the Comisión Liquidador have been operated by the Guatemalan Armed Forces, little control has been exercised on the organizations by other entities or individuals of the government.

INSTITUTO NACIONAL DE TRANSFORMACION AGRARIA (INTA)

INTA is related to biodiversity and tropical forests because its charges include the inventory, surveying, expropriation, and distribution of "unused" lands (tierras ociosas). INTA is in charge of land distribution in the Franja Transversal del Norte and, now that FYDEP is being disbanded, of the Department of the Petén, as well as of all unused lands in Guatemala, whether nationally owned or not. Accordingly, INTA is the state agency in control of national lands, much of which lies in the Petén tropical forest and much of which have the broadest and best protected biological diversity in the nation.

During the 1970s, with funding from U.S. AID, INTA carried out a large colonization project in the humid tropical forests of the Franja Transversal del Norte, a strip of land that stretches across the base of the Petén. Over 15 years, the organizations promoted the colonization of 13,900 square kilometers of tropical forest. Of this area, the only section protected for its biodiversity was the already declared Lachua National Park.

OFICINA DE CONTROL DE RESERVAS DE LA NACION (OCREN)

OCREN is charged with the administration of lands declared National Reserves (Reservas de la Nación), which include three kilometers of land in from all ocean coasts, 200 meters of the shores of lakes, 100 meters of all navigable rivers, and 50 meters around all sources of water. OCREN is allowed to rent out these zones for up to 25 years at a time.

OCREN has determined that Guatemala's National Reserve lands are presently in the following conditions: 25 percent in recreation, 52 percent in agriculture, 1 percent in towns, 1 percent in national parks, and 21 percent not yet utilized (Ing. Oslec Rojas, personal communication, OCREN).

Note that non-governmental organizations related to biological diversity and tropical forests are discussed in the following section on Environmental Education and Training.

B. Legislation Related to Biodiversity

Because biological diversity and tropical forest conservation is a recent focus of attention, Guatemala has little legislation directly specifically toward this goal. Nonetheless, like many Latin American countries, Guatemala has abundant legislation that touches on the theme, much of it disperse, circumstantial, and debilitated by its lack of enforcement.

1. International Treaties

Of the most important and effective international treaties concerned with biodiversity and tropical forests, Guatemala is a signatory to Convention on International Trade in Endangered Species (CITES) via Decreto 63-79; the Convention on Protection of Natural and Cultural World Heritage of UNESCO; and the Convention on Conservation of Birds and Aquatic Environments via Decreto Congresional 4-88.

2. National Laws

Constitución de la Republica de Guatemala (14 January, 1986)

The Guatemalan National Constitution includes sections on environmental conservation, protection of wildlife areas and forests, rational use of resources, the obligation to create a Ley de Patrimonio Natural, and the determination that national parks and other protected areas are inalienable.

Código Civil

The Civil Code refers to property in general, but also determines limitations on private land. It also regulates hunting and fishing by noting where and when they may be practiced and under what conditions, in regard to the owner of the property where hunting and fishing take place. The code also notes that land users must conserve and replant felled trees.

Código Penal

This legislation includes specification on illegal exploitation of natural resources.

Dirección Técnica de Pesca (DITEPESCA)

DITEPESCA is supported by a range of laws that originated in the 1930s to regulate fishing by declaring off-seasons (vedas) as well as by specifying allowable forms of fishing. In general, the legislation does not contain conservation elements despite the fact that Guatemala has several zones of endemic fish species, especially in the Petén.

There are also deficiencies in the law in regard to regulation of fishing licenses. For example, licenses are valid for both fresh-water and marine fishing throughout the country. Fishing licenses are provided by municipalities without cost with the result that it is almost impossible to control their distribution. As well, the fishing off-season is May to August, without taking into account differences in species and ecological zones.

Ley General de Caza, Decreto No. 8-70 del Congreso

This General Hunting Law established rules and technical and legal conditions for hunting, and establishes and delimits national parks, wildlife refuges, and reserve zones. The law prohibits hunting of the Quetzal and endangered species. It specifies fines and determines licences and hunting seasons.

Acuerdo de Junta Directiva de INAFOR

Created 10 January, 1986, this agreement prohibits the export of Guatemalan wildlife and cancels authorizations for "granjas de cria," reproduction facilities for an indefinite period.

Ley Forestal, Decreto No. 58-74

Regulates forest management, reforestation, conservation, and rational use of forest resources. Specifies illegal forestry activities, penalties, and fines. (A proposal to modify the Ley Forestal is before the Guatemalan National Congress as of December, 1988.)

Ley que Reglamenta la Piscicultura y la Pesca, Decreto Gubernativo No. 1235

Limits fishing rights, regulatesd conservation and propagation of fish, shellfish, etc. Establishes fines, allows municipalities to issue fishing licenses for the entire country. Establishes yearly off-season from May to August each year.

Propuesta de Ley de Areas Protegidas

The Guatemalan Congress is currently debating a proposal for the Ley de Patrimonio Natural, or Ley de Areas Protegidas, which is dedicated to the protection, conservation, and rational use of wildlife and protected areas. Stemming from a presidential request of 2 September, 1987, the proposal follows up on Article 64 of the Constitution, which calls for a Ley de Patrimonio Natural. The proposal has been read twice in Congress and lacks only its third and final reading, congressional vote, and signature by the President to become national law.

Analysis

In general, there are no specific institutions charged with the protection of biological diversity, though at least one organization, DIGEBOS, is charged with wildlife protection. Overall, Guatemalan legislation related to biological diversity and tropical forests can be said to be ineffective for the following reasons:

* Legislation is not up to date, especially when applying fines, most of which are so low that violators have no trouble paying them and, thus, are not deterred from committing the infraction.

* Legislation is too disperse. Regulations are found in a variety of laws, some of which seemingly have little relation to the topic. For example, forestry regulations are found in the

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Ley Forestal, Ley de Gobernaciones, Código Civil, and Ley de Minería e Hidrocarburos.

* Institutions charged with applying the laws are debilitated by insufficient personnel, equipment, or financial resources. For example, the Departamento de Parques Nacionales y Vida Silvestre of DIGEBOS assigns its scant personnel directly to one of the eight parks they administer, leaving no one to control illegal hunting, fishing, or traffic of wildlife in areas outside of these parks. Overall, DIGEBOS is unable to enforce the illegal traffic in wildlife due to lack of personnel and resources. A total of three individuals are charged with protecting wildlife in Guatemala, and they are assigned no vehicles. The actual need is for at least four individuals in each of Guatemala's political departments.

DIGEBOS personnel have no manual for wildlife management, and personnel are not sufficiently trained to handle the organization's enforcement mandate. Moreover, DIGEBOS has but one vehicle asigned to the division of Parques Nacionales y Vida Silvestre and only half a dozen boats.

In another example, the Junta Liquidador del FYDEP has no way of controlling the use of renewable natural resources in the Petén because they have no personnel dedicated to the job.

* Where appropriate fishing, hunting, and forestry laws exist, no regulations are specified to structure their enforcement.

* The laws are not known by the public or responsible public officials. There is no diffusion of laws concerning renewable natural resources, for example, concerning protected areas and off-seasons of hunting or logging. Public officials fail to apply existing laws because they are unaware of them.

* Laws are blatantly violated. Commercial interests are sometimes superior to the morality of individuals involved in exploiting forests and wildlife.

* Laws are not enforced due to lack of backing of responsible authorities. Technicians file reports on illegal activities, but no follow-up is forthcoming due to negligence, lack of interest, or compromises among the maximum authorities of the responsible institutions.

* Judicial authorities have little experience in applying laws concerned with biological diversity and tropical forests. Few cases arrive before judges, with the result that the few that do are pardoned or dismissed due to "lack of proof."

* Legal force laws has been weakened. Violations have occurred with such frequency without penalty that citizens fail to respect regulation and potential legal repercussions.

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* Fees for hunting and fishing are not collected, nor has a standardized form for licensing ever been developed.

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IX. ENVIRONMENTAL EDUCATION AND TRAINING

"Conveying the importance of biological diversity requires formulating the issue in terms that are technically correct, yet understandable and convincing to the general public" (OTA 1987:13).

Public education in Guatemala has no specific programs in biological conservation, environmental studies, or the relationship between the environment and human communities. A few concepts of ecology are included in elementary and high school science courses, but emphasis is on memorization of basic principles. No consideration is given to social or economic implications, nor are attempts made to create an environmental ethic among public school students.

Several Guatemalan government organizations are attempting to incorporate environmental themes into public school programs, but, to date, most environmental education has been conducted outside schools among the general public.

Reflecting Guatemala's lack of institutional and educational capacity for the conservation of biodiversity and tropical forests, the public assigns low priority to these issues and is more concerned with security, employment, and nourishment (Perfil Ambiental 1987). However, environmental degradation contributes to social and economic problems, a fact that must be brought to the attention of the public through greater emphasis on education and training of natural resource professionals.

During interviews conducted by research team members, representatives of 19 Guatemalan-based organizations concerned with the environment identified the following themes as the major difficulties and necessities for the country in relation to training and education on biodiversity and tropical forests:

(1) a general lack of professors and trained professionals to teach courses,
(2) lack of awareness on the part of national authorities,
(3) difficulties in carrying an environmental message to a largely rural population, and
(4) lack of a national environmental strategy.

The following analysis cites the organizations interviewed, gives their current annual budget <u>for conservation training and environmental education</u>, provides their own assessment of their programs' effectiveness, lists their priorities for Guatemala's tropical forests and biodiversity, and cites the costs of proposed projects:

1. Asociación Amigos del Bosque (AAB)

Created in 1959, the Asociación Amigos del Bosque has the goals of protection, restoring, and rationally using the land, water, flora, and fauna of Guatemala for the benefit of the economy and wellbeing of its inhabitants. During its almost three decades of existence the AAB has developed forestry plantations, conducted environmental education, and published information in the form of its periodical, Nuestro Bosque. With 800 members and nine regional affiliates, it is the organization with the largest number of members.

Annual budget: difficult to measure because many are volunteer workers

Current biodiversity/tropical forest projects:

publication of posters

audiovisual programs for school groups, communities, and institutions; developing course for primary school teachers with printed materials and audiovisuals.

AAB also hopes to found five additional affiliates and develop five tree nurseries in cooperation with affiliates and municipalities.

To whom are projects directed: rural families and city families who consume fuelwood and other forest products

Number of people affected: around 400/month

Are projects considered effective?: calculate that 50 percent of those reached become more aware of problems and seek to do something about them

Priority proposed projects for future: provide assistance in developing econimic alternatives for forest areas, such as xate, chicle, and allspice; training and marketing assistance for artesana based on wood

Estimated budget for priority projects: difficult to measure because many workers are volunteers

Comments: Projects and organizations should focus on community autosufficiency so that projects continue even after formal programs have ended.

2. Asociación Guatemalteca de Historia Natural/National Zoo (AGHN)

Founded in 1960, the AGHN studies and promotes investigation about nature and natural resources and their conservation. The organization includes among its activities the operation and maintenance of the Zoologico Nacional la Aurora, with more than one million visitors per year.

Annual budget: Q8,112 (salaries); other Q500
Current biodiversity/tropical forest projects:
courses and motivational speeches; research; training of volunteer zoo guides; assembly of audiovisuals
To whom are projects directed: general public, school, zoo visitors
Number of people affected: approximately 18,000/yr
Are projects considered effective?: yes
Priority proposed projects for future: fieldwork and implementation of alternative uses of ecosystem resources
Estimated budget for priority projects:
research and planning--Q100,000/yr
education--Q100,000/yr
Comments: Permanent annual inputs are necessary to guarantee results. Otherwise there is no continuity. When significant, regular quantities can not be provided, it is better to donate equipment such as computers and vehicles.

3. Asociación Guatemalteca Pro-defensa del Medio Ambiente
Since its creation in 1974, the Asociación Guatemalteca Pro-defense del Medio Ambiente has focused on the defense, conservation, and restoration of the Guatemalan environment. Through its founding members Ingeniero Guillermo Pacheco and Marta Pilón de Pacheco, the group has has special significance in written constructive criticism and in organization seminars of environmental consciousness raising.
Annual budget: no response
Current biodiversity/tropical forest projects:
seminars for decision-makers
formation of affiliates in departmental cities and municipalities to create groups designed to halt destruction of natural resources and the environment in local communities
To whom are projects directed: general public
Number of people affected: unknown
Are projects considered effective?: yes
Priority proposed projects for future: environmental education and organization in rural areas
Estimated budget for priority projects: $100,000/yr

4. Asociación de Investigación y Estudios Sociales (Así Es)
Annual budget: depends on specific programs
Current biodiversity/tropical forest projects:
contributions to process of curriculum improvement
sesign or programs for non-student education
pilot project on environmental education in teachers' college
environmental legislation work
three seminars on environmental policies
To whom are projects directed: general public
Number of people affected: unknown, except approximately 500 people in each seminar
Are projects considered effective?: yes

Priority proposed projects for future: contribute to the training of post-graduate personnel, for example, help develop a Master's degree at University of San Carlos in environmental management
Estimated budget for priority projects: $20,000 per post-graduate trained

5. Asociación Pro-bienestar de la Familia (APROFAM)
Annual budget: no specific budget for these topics
Current biodiversity/tropical forest projects:
programs on population and development
To whom are projects directed: students and decision makers
Number of people affected: unknown
Are projects considered effective?: in education aspects, yes
Priority proposed projects for future: economic assistnace for educational materials to institutions with active projects
Estimated budget for priority projects: depends on project

6. CARE
Annual budget:
Current biodiversity/tropical forest projects:
soil conservation; tree nurseries; reforestation; forest extension work
To whom are projects directed: small farmers located in east, west, and central regions of Guatemala
Number of people affected: approximately 60,000
Are projects considered effective?: yes
Priority proposed projects for future: use of mass media to spread environmental message; establish model fincas to demonstrate advantages of sustainable use
Estimated budget for priority projects:

7. Centro Agronómico Tropical de Investigación y Enseñanza (CATIE)
Annual budget: approximately $20,000
Current biodiversity/tropical forest projects:
diagnosis of Guatemalan watersheds and of Yaxjá Pixcayá; region of Petén
To whom are projects directed: mid-level technicians (health and agricultural extensionists) and professionals
Number of people affected: more than 200/year
Are projects considered effective?: unable to evaluate
Priority proposed projects for future: develop and carry out internal plan to define objectives and policies
Estimated budget for priority projects: unknown until plan is developed

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8. Centro de Estudios Conservacionistas (CECON)
Annual budget: Q35,000 ($12,962)
Current biodiversity/tropical forest projects:
environmental interpretation/education in biotopos; Taller Nacional de Interpretación y Educación Ambiental (25 de septiembre al 3 de agosto de 1988); environmental education programs in communities next to biotopos
To whom are projects directed: all sectors and levels
Number of people affected: 40,000 visitors/yr to Biotopo del Quetzal; 90,000 visitors/yr to Monterrico Reserve.
Are projects considered effective?: yes, but we could do more with assistance
Priority proposed projects for future: help develop effective environmental education programs in coordination with credible national and international organizations; push politically for such projects
Estimated budget for priority projects: undetermined
Comments: We believe that this is an appropriate time to plan, assist, and implement projects and program on the environment, but care must be taken to work with the proper organizations. Any program begun or assisted by the U.S.A. in a community should be done through inducement rather than coerzion, allowing communities to determine their own future.

9. Centro Universitario del Petén (Universidad de San Carlos)
Annual budget: Q1 million ($370,370)
Current biodiversity/tropical forest projects:
cooperation in management, conservation, and development of wildlands administered by University of San Carlos (CECON), beginning with Zotz or Dos Lagunas-Naachtún; awards degrees in Ambiente y Conservación
To whom are projects directed: university students, teachers, and Petén public in general
Number of people affected: currently 150 students
Are projects considered effective?: yes, but do not reach enough due to conditions in Petén and latent warfare
Priority proposed projects for future: design protected areas; promote development of ecotourism in tropical areas; help train technicians in environmental education
Estimated budget for priority projects: no response
Comments: The solution could be to educate our government officials about the reality of the Petén. Ecotourism and scientific investigation in protected areas should be developed as a way to make these areas self-sufficient.

10. Comisión Nacional de Adecuación Curricular
Annual budget: Q 1 million ($370,370)
Current biodiversity/tropical forest projects:
elaboration of material for teachers, students, and general public
To whom are projects directed: teachers, students, technicians, directors of educational sector
Number of people affected: approximately 45,000
Are projects considered effective?: yes
Priority proposed projects for future: train technical personnel in educational process; produce technical teaching material to assist in training teachers in environmental education
Estimated budget for priority projects: $500,000

11. Comisión Nacional del Medio Ambiente (CONAMA)
Annual budget: Q100,000 ($37,037)
Current biodiversity/tropical forest projects:
curriculum revisions; public education programs (radio, television); project on law to create Sistema Nacional de Areas Protegidas; interinstitutional coordination with private sector on environmental projects
To whom are projects directed: to students, housewives, decision makers, politicians, university students
Number of people affected: unknown
Are projects considered effective?: not for everyone
Priority proposed projects for future: creation of national system of projected areas to preserve representative samples of Guatemala's biodiversity; environmental education and personnel training to increase number of people in the field
Estimated budget for priority projects: $5 million (four years)

12. Comisión Nacional Permanente de Educación Ambiental (CONAPEA)
Annual budget: none
Current biodiversity/tropical forest projects:
assistance and advise to Comisión Nacional de Adecuación Curricular of the Ministry of Education to introduce environmental materials in school curriculum; teacher training
To whom are projects directed: teachers, students, and general public
Number of people affected: undetermined
Are projects considered effective?: yes
Priority proposed projects for future: develop a program in environmental education
Estimated budget for priority projects: Q500,000 ($185,185)

13. Cuerpo de Paz / U.S. Peace Corps

In Guatemala, the U.S. Peace Corps works with national institutions on soil conservation, reforestation, and national park and biotopo planning and management.

Annual budget: undetermined

Current biodiversity/tropical forest projects:

various--from administration and creation of marine turtle reproduction programs to tree nurseries; creation of local committees for defense of the environment; public education in volunteers' local communities.

To whom are projects directed: rural population in general

Number of people affected: around 20,000

Are projects considered effective?: yes

Priority proposed projects for future: establish national system of parks and protected areas and providing technical and financial resources for their operation; design and execute environmental education plans at all levels

Estimated budget for priority projects: $500,000

14. Defensores de la Naturaleza

Created in 1983, Defensores is one of the most active conservation groups in Central America. Most of its activities are aimed at environmental education, especially through written materials for students and citizens. Defensores has developed excellent exhibitions, posters, and publicity campaigns. Personnel include an Executive Director, a manager, a secretary, and one messenger.

Annual budget: no annual budgets, works by projects

Current biodiversity/tropical forest projects:

work toward creation of Sierra de las Minas reserve; working with CECON toward protection and management of three biotopos in Petén

To whom are projects directed: private sector, government officials, decision makers, universities and private colleges

Number of people affected: unknown

Are projects considered effective?: fifty-fifty

Priority proposed projects for future: assist in development of reserve areas, diagnosing necessities for environmental education and environmental problems that must be addressed

Estimated budget for priority projects: undetermined

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15. Dirección General de Bosques (DIGEBOS)
Departamento de Areas Protegidas y Vida Silvestre
(within Ministerio de Agricultura y Ganadería)
Annual budget: undetermined
Current biodiversity/tropical forest projects:
environmental education in Lake Atitlán area; elaboration of pamphlets on marine turtle breeding; environmental education project for Naciones Unidas National Park
To whom are projects directed: communities
Number of people affected: unknown
Are projects considered effective?: not completely
Priority proposed projects for future: training for Guatemalan technicians
Estimated budget for priority projects: undetermined

16. Instituto Guatemalteco de Turismo (INGUAT)
Annual budget: Q82,000 ($30,370)
Current biodiversity/tropical forest projects:
campaign for protection of flora and fauna; consolidation of existing biotopos; zoning of Lake Izabal area; restoration and reconditioning of tourist attractions; working agreement with Peace Corps and CECON on management of natural resources and environmental education; currently has eight Peace Corps volunteers
To whom are projects directed: to particular communities, especially to their schools and local committies
Number of people affected: unknown
Are projects considered effective?: yes, with conditions
Priority proposed projects for future: training of school teachers in environmental education; scholarships to train personnel in environmental education
Estimated budget for priority projects: Q300,000 ($111,111)

17. Museo Nacional de Historia Natural
Annual budget: Q8,500 ($3,148)
Current biodiversity/tropical forest projects:
proposed display on 10 ecosystems or life zones of Guatemala; increase in number of teacher guides for museum; environmental education courses for school teachers
To whom are projects directed: students, teachers, general public
Number of people affected: more than 100,000 students/yr
Are projects considered effective?: very effective
Priority proposed projects for future: environmental education courses for teachers; basic publications in various languages; scholarships to train more professional conservationists; radio and television campaigns on the environment
Estimated budget for priority projects: Q6 million ($2.22 million) to initiate projects

18. Sociedad Audubon de Guatemala
(Peter Wolfe Memorial Audubon Society of Guatemala)
One of the youngest of non-governmental conservation organizations in Guatemala, Audubon focuses on the study of nature and administration of protected areas. The organization is currently working on lands newly deeded to them in the Sierra de las Minas.
Annual budget: not available; volunteer organization
Current biodiversity/tropical forest projects:
printing educational poster about tropical forest
audiovisual presentations to different public and private institutions
distribution of nature-oriented magazine
developing 900 hectare reserve in Sierra de las Minas
To whom are projects directed: decision makers
Number of people affected: approximately 500
Are projects considerad effective?: yes
Priority proposed projects for future: no response
Estimated budget for priority projects: no response

19. Universidad del Valle
Departamento de Biología
Annual budget:
Current biodiversity/tropical forest projects:
research on orchids and ecosystems of Sierra de las Minas; management plan for Reserva Cerro Silleb; limnology study on water quality in Lake Atitlan, Lago Chixoy; orchids of Tikal; study of diversity of insects, especially Hyserophera and Coleoptera; research on Biotopo del Quetzal, Volcán Atitlán; research on composition of cloud forest in various areas; study of coniferous plagues in Guatemala and their biological control; development of guides for environmental education guides for Ministry of Education
To whom are projects directed: university and college students
Number of people affected: hundreds
Are projects considered effective?: yes
Priority proposed projects for future: no response
Estimated budget for priority projects:

20. Comité del Lago de Amatitlán
(no interview conducted)
Goals include protection and restoration of Lake Amatitlán ecosystems.

21. Comité Departamental de Defensa del Medio Ambiente
(no interview conducted)
Created in 1983, this is a group of 12 to 18-year-old youths who focus on environmental education in and around the Biotopo del Quetzal. The organization has trained the first groups of volunteer guides for the biotopo, and organized the Taller Anual de la Federación Latinoamericana de Jovenes Ambientalistas (FLAJA) in Salamá, Baja Verapaz, Guatemala.

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22. Fundación Centroamericana de Aves de Rapiña
(no interview conducted)

A private organization authorized by the government in 1987, this foundation's goals are to rescue and reproduce endangered animals to reintroduce them into their natural habitat and to promote environmental education programs. Its initial actions are dedicated to reproduction of raptors. The organization also administers a private finca, El Faro, on Volcán Santiaguito, for nature protection. According to Juan Mario Dary, the organization is changing its name to Fundación Centroamericana de Bosques Tropicales.

23. Compañeros de las América (Partners of the Americas)

Dedicated to projects that improve relations between Guatemala and the United States, this organization is currently working on natural resource investigation projects and the creation of protected areas in the Petén.

XI. RECOMMENDATIONS FOR PROPOSED ACTIONS

This section presents policies and programs recommended by the biodiversity assessment team to improve the sustainable use and conservation of biological diversity and tropical forests in Guatemala. Each recommendation is presented in detail according to the following format.

A. Policy Recommendations

1. Develop a national strategy on biological diversity and tropical forests. Increase Government of Guatemala resources dedicated to the wise use and conservation of biological diversity and tropical forests.
2. Establish a national system of 25 priority protected areas that represent Guatemala's diversity of ecosystems. Place these areas under a single Government of Guatemala institution. Develop management plans for each of the priority areas.
3. Focus development efforts on the sustainable economic development of renewable natural resources.
4. Focus additional sustainable development efforts on the Department of the Petén.
5. Focus conservation and sustainable development efforts on the Guatemalan volcano chain.
6. Emphasize Guatemala's positive potential in the conservation of tropical forests and biological diversity.
7. Encourage debate on the relationship between population growth and environmental degradation.
8. Focus on necessary changes in institutional and legislative structure.

B. Project Recommendations

1. Train and create jobs for additional conservation workers.
2. Require environmental impact statements for all projects which affect natural resources, tropical forests, or biological diversity.
3. Preserve the biological diversity and economic contributions of Guatemala's Pacific Coast mangrove forests.
4. Promote the sustainable harvest of renewable natural resources (xate palm, allspice, chicle) from the Petén tropical forest.
5. Increase the number of protected area guards and guides.
6. Stablilize agricultural expansion in the buffer zones around protected areas.
7. Assist Guatemalan gene banks in the ex situ conservation of economically important plants.
8. Establish a series of botanical gardens throughout Guatemala.
9. Develop a Mayan Agroecology System near an archaeological site in the Petén to produce agricultural discoveries of benefit to local farmers and to promote tourism.
10. Increase the educational and research capabilities of the National Museum of Natural History.

A. POLICY RECOMMENDATIONS

1. DEVELOP A NATIONAL STRATEGY ON BIODIVERSITY AND TROPICAL FORESTS

Objectives: To create a national strategy for the conservation of Guatemala's biological diversity and tropical forests.

Action:

* Organize a strategy seminar on natural resources and biological diversity with interaction between decision makers and top technical specialists of Guatemala, attended as well by international planners and biodiversity specialists familiar with Guatemala.

* Publish and promote the strategy plan that results from the strategy session(s).

* Place the resulting national strategy for biological diversity and tropical forests into action.

Institutions:
CONAMA, CECON, SEGEPLAN, IDAEH, all conservation NGOs

Anticipated benefits:
Improved coordination and definition of the nation's stance on conservation of biological diversity and tropical forests.

Estimated Cost:
$10-15,000 depending on airplane flights and location of meetings.
Government of Guatemala institutions could fund parts of the resulting strategy plan, as well as some of the following specific recommendations, by applying for PL480 funds available for biodiversity protection through the United States Agency for International Development.

2. ESTABLISH A NATIONAL SYSTEM OF PRIORITY PROTECTED AREAS

The number one issue in sustainable use and conservation of Guatemala's biological diversity and tropical forests is the creation and protection of a system of priority protected areas that will conserve representative samples of all important ecosystems in the country. The biodiversity assessment team decided to concentrate on Guatemala's 25 top priority areas, as determined through analysis and discussions. The list of these 25 top priority areas is presented in Appendix V.

Objective:

The establishment of adequate protection for an integrated system of wildlands areas is a logical and cost-effective way to safeguard Guatemala's biological diversity and tropical forest resources. To accomplish this goal, actions should focus on three principal components:

Actions:

* Institution building is required in both the public and private sectors to expand Guatemala's cadre of skilled conservationists and provide them with the support they need to carry out effective programs and research.

* Conservation information on Guatemala's terrestrial and marine ecosystems, communities, species, and protected areas must be compiled, analyzed, and distributed to decision-makers in a useable form to assist them in defining options for the sustainable development of the nation's natural resources.

* Direct wildland management action will require support to create a physical presence in priority areas, to directly protect land and species, and to promote the sustainable use of each area's natural resources. One of the most immediate needs is to produce management plans for each of the priority areas.

(Appendix II presents a series of detailed recommendations required to establish a system of 25 priority protected areas over a five-year period.)

Estimated Costs:
(Full budget presented in Appendix II)

1.	Personnel	$ 7,575,000
2.	Training	915,000
3.	Technical Assistance	990,000
4.	Material, Equipment, Ops	6,250,000
	TOTAL	$15,730,000

3. SUSTAINABLE ECONOMIC DEVELOPMENT OF RENEWABLE NATURAL RESOURCES

Objective: To develop the renewable natural resources of Guatemala in such a way that they benefit the economic and social development of the nation's citizens in perpetuity without threatening the continued existence of the nation's biological diversity and tropical forests.

(Some of the following recommended activities are repeated under specific programs.)

Actions:

* Focus development efforts on long-term use of biological resources such as forests and wildlife rather than on producing quick income by "mining" these resources for short-term gain.

* Emphasize non-destructive use of biological resources in the form of nature tourism.

* Cease colonization of the nation's tropical forests where they are located on soils inadequate for annual cropping.

* Direct agricultural colonization toward non-fragile areas with appropriate soils and water.

* Develop sustainable agroecosystems and extractive reserves in cooperation with local communities. Encourage alternatives to slash-and-burn agriculture.

* Halt government or bilateral agency subsidies to the currently destructive logging industry in the form of road construction, subsidized credit, and laws that promote the export of commercial hardwoods.

* Promote the creation of an extractive reserve in the Guatemalan Petén by convincing government officials to designate the proposed Carmelita/Uaxactún multiple-use-reserve as an extractive reserve.

* Establish agroforestry systems or other stable agricultural systems in colonization zones around protected areas.

Institutions:

DIGEBOS, CONAMA, IDAEH, Comisión Liquidadora del FYDEP, INGUAT, INTA, international development and aid agencies.

Anticipated Benefits:

Long-term economic, social, and political benefits to Guatemala and its citizens, both current and future; more equitable distribution of economic benefits of natural resources.

4. FOCUS ADDITIONAL SUSTAINABLE DEVELOPMENT EFFORTS ON THE DEPARTMENT OF THE PETEN

The Government of Guatemala, bilateral assistance agencies, and international conservation organizations must focus increased emphasis on the sustainble use of the natural resources of the Guatemalan Petén. Not only is the Petén the site of most of Guatemala's tropical forests, but it is also the area of the country that contains the highest diversity of plants and animals. As Dr. Peter Raven, Director of the Missouri Botanical Garden, has noted, "In any discussion of biological diversity, tropical forests must occupy center stage" (Raven 1988:119).

Establishing a national system of priority protected areas is the first step toward maintaining the important natural resources of the Petén, but additional measures must be taken. The Petén is the most rapidly growing area of the country in terms of population, due mostly to in-migration. Coming from different types of ecosystems into a lowland forest, many of this families are at a loss of how to use the region's resources. As a result, they end up destroying the natural resources their new lives are based upon. This pattern of destruction is illogical for the families themselves and also eradicates future options for the Petén's resources. Creation of aggressive, positive programs of agricultural intensification, creation of sustainable resource-based industries, and improved, sustainable harvesting of natural resources such as timber, chicle, and other natural products is mandatory.

Moreover, the potential for sustained economic development based on the conservation of biological diversity and tropical forests in the Petén is exceptional. As much of two-thirds of the area is still in forest. The region's unique combination thousand-year-old Mayan ruins and undegraded tropical forest creates a potential for tourism development unmatched anywhere else in Latin America. At the same time, the region is marred by a struggle for land and natural resources that pits a movement for sustainable development that would benefit many individuals against schemes to generate quick, one-time profits for the benefit of the few and at the expense of biological diversity.

Objective: To conserve the tropical forests and biological diversity of the Department of the Petén in order to promote economic development based on the sustainable use of forests and other natural resources.

Action:

* Establish a network of effective protected areas in the Petén, with adequate personnel and equipment

* Direct agricultural colonization toward non-fragile areas with appropriate soils and water

* Halt the clearing of tropical forest for extensive beef cattle production. Promote bushmeat production instead: tepesquintle (Agouti paca), agouti (Dasyprocta mexicana), brocket deer (Mazama mexicana), and non-cattle domestic animals: pigs, rabbits, goats, turkeys. Raise fish in rivers and lakes.

* Develop sustainable agroecosystems and extractive reserves in cooperation with local communities. Encourage alternatives to slash-and-burn agriculture.

* Halt government or bilateral agency subsidies to the currently destructive logging industry in the form of road construction, subsidized credit, and laws that promote the export of commercial hardwoods.

* Cease the poaching of mahogany and tropical (Spanish) cedar by illegal Mexican logging operations along the Petén's northern border.

* Promote the development of sustainable timber production not in primary forests, but in already disturbed secondary growth forests and played-out agricultural lands that can be reforested. Where primary forests are to be logged, activities should ensure both long-term timber production and sustainable production of other forest goods (xate, allspice, chicle, orchids), which can far exceed timber in economic value.

* Promote value-added timber based industry only if they focus on secondary growth forests and reforested lands--not on primary forests to be "mined" for one-time profits.

6. EMPHASIZE GUATEMALA'S POSITIVE POTENTIAL IN THE CONSERVATION OF TROPICAL FORESTS AND BIOLOGICAL DIVERSITY

Objective: To promote the sustainable use of Guatemala's biodiversity and tropical forests by focusing on its positive assets.

Action:

* In discussions with Government of Guatemala officials and international conservation and development organizations, emphasize four themes:

1. Guatemala's richness of diversity, due to its position as a land bridge between North America and Central/South America,

2. Guatemala's dedicated core of conservationists, many of them in positions to influence policy and activities,

3. Guatemala's germplasm base for important food crops such as maize (corn), avocados, papaya, beans, cacao, and cotton, and

4. Guatemala's rare combination of thousand-year-old Mayan archaeological ruins within areas of undegraded tropical forest and tropical wildlife.

7. ENCOURAGE DEBATE ON THE RELATIONSHIP BETWEEN POPULATION GROWTH AND ENVIRONMENTAL DEGRADATION

Government of Guatemala institutions and international organizations should initiate debate and scientific discussion among scientists, government officials, and the general public on the link between rapid population growth, development, and the eradication of natural resources and biodiversity. Guatemalan leaders, including some of the nation's foremost conservation researchers, resist the idea that population growth is negatively linked to environmental degradation or the depletion of natural resources such as forests and wildlife. This topic should be opened up for serious discussion in a series of seminars and conferences so that the debate can be elevated to higher level of discourse.

Objectives: To allow Guatemalan scientists and decision-makers to examine the relationship between population growth and environmental deterioration.

Action:

- Encourage Guatemalan conservation and population organizations to hold one or more seminars or conferences on the topic of population growth, development, and the environment.

Institutions:

CONAMA, DIGEBOS, DITEPESCA, CECON, Aprofam, Amigos del Bosque, Audubon, Defensores de la Naturaleza, Así Es, Population Reference Bureau (Washington, D.C.).

Anticipated benefits:

Scientific response to political and religious beliefs that environmental degradation is not related to population growth.

Increased awareness of relationship between population growth and environmental deterioration.

Search for solutions specific to and agreeable to Guatemalan society.

Estimated Cost:

$10,000 per seminar or conference, including airfare and housing for invited speakers from Latin America, United Nations, international organizations, etc.

8. FOCUS ON NECESSARY CHANGES IN INSTITUTIONAL AND LEGISLATIVE STRUCTURES.

Objectives: To improve the institutional and legislative structures of Guatemalan organizations and laws related to the sustainable use and conservation of biological diversity and tropical forests.

General Recommendations:

* Unify the institutions dedicated to the protection and conservation of biodiversity and tropical forests into one with sufficient human, material, and financial resources to carry out its mandate. All parks which serve to protect biodiversity and tropical forests should be placed under a single Government of Guatemala institution. The proposed Ley de Areas Protegidas aims at such unification and should be supported. Recreation parks which have insignificant impact on biological diversity (Laguna del Pino, Naciones Unidas, etc.) need not be included under this single institution.

* Unify legislation dealing with biodiversity and tropical forests under the proposed Ley de Areas Protegidas (Ley de Patrimonio Natural) so that the proposed institution can efficiently promote knowledge and application of the law.

* Aid the organization and development of CONAMA in such a way that its policies, programs, and projects are transformed into permanent activities independent of whichever national government is in power.

* Fortify as quickly as possible the capability of non-governmental conservation organizations to act effectively, especially by assisting them in hiring full-time salaried professionals; help these organizations increase their membership so that their points of view will be not only signficant but also representative of the Guatemalan public.

* Fortify organizations dedicated to investigation of biological diversity and tropical forests and the proposed Conservation Data Center so that decisions can be based on adequate information among both government officials and the private sector.

* Develop regulations to allow enforcement of existing hunting, fishing, wildlife, and forestry laws. Upon developing of these regulations, establish an immediate campaign to educate the public about their existence.

* Carry out the following specific recommendations for these institutions:

DIGEBOS

1. Develop a training program for all incoming personnel in the Departamento de Parques Nacionales y Vida

6. Fortify ongoing initiatives on marine turtles.

IDAEH

1. Develop appropriate means to protect the biological diversity and tropical forests found within archaeological protection areas administered by IDAEH, for example, by assigning additional trained personnel as natural resource guards.

CECON

1. Support the planned program for new protected areas in the Petén: Laguna del Tigre, San Miguel/Zotz, and Dos Lagunas so that they become models of conservation for other potentially protected areas in the Petén.

2. Support the development of the Conservation Data Center so that it becomes one of the principle instruments in the sustainable use of Guatemala's biodiversity and tropical forests.

INTA

1. Coordinate with other relevant organizations to balance agricultural development and colonization with the need to protect biological diversity and tropical forests.

INDIVIDUAL MUNICIPALITIES

1. Develop a compaign of information and education within each municipality to demonstrate the links between human communities and the wildland areas within their jurisdiction.

2. Create or support a Departamento de Conservacion y Medio Ambiente within each municipality to allow positive action in the conservation of natural resources.

UNIVERSITIES

1. Support training and research programs within public and private universities, diversifying and increasing them, in order to solve the problem of lack of trained personnel working for the conservation and rational use of biodiversity and tropical forests.

NON-GOVERNMENTAL CONSERVATION ORGANIZATIONS

1. Support one or two principle programs of each institution to improve their credibility with their membership, with international funding organizations, and with the Guatemalan public in general.

B. PROJECT RECOMMENDATIONS

1. TRAIN AND CREATE JOBS FOR ADDITIONAL CONSERVATION WORKERS

One of the most serious problems facing Guatemala's efforts to conserve its tropical forests and biological diversity is the lack of sufficient personnel to address the problem. This situation was brought home very clearly during an informal interview with a Guatemalan wildlife biologist. Asked what the biggest problem in conservation was in Guatemala, he held up the fingers of both hands and said, "That's how many full-time conservationists there are in the country. You know the problems we're facing. Now you know what the problem is."

The institutional capacity of the country to evaluate, implement, and monitor biodiversity protection projects is extremely low. Only eight forest engineers live in the country, and only one of these works in the government sector; the rest are in private industry. As well, only 30 trained biologists work in Guatemala. This lack of trained personnel will be a major obstacle to the effective management of protected areas and biodiversity protection projects.

Objective: To increase the number of Guatemalans involved in full-time conservation and sustainable development careers

Action:

* Provide a minimum of three fully-paid scholarships each year for Guatemalan students to complete work leading to a Master's degree in conservation/environmental sciences for universities in Latin America (CATIE, in Costa Rica) or the United States.

* Fund salary and infrastructure requirements to create one new position in each appropriate Guatemalan conservation organization, preferably with stipends provided through international non-profit conservation organizations such as World Wildlife Fund, Nature Conservancy, Conservation International, World Resources Institute, International Union for the Conservation of Nature and Natural Resources, UNESCO, U.S. Agency for International Development. Select these new personnel through objective competition.

* Create and fund one job position in each of Guatemala's major bioregions (Pacific coast, volcanic chain, highlands, and Petén-Caribbean lowlands), which requires the individual to remain in the bioregion to develop conservation and sustainable development projects for that region. Individuals should be selected for the positions by an objective national or international conservation/development organization.

Institutions:

CECON, CONAMA, Defensores de la Naturaleza, Amigos del Bosque, Audubon, Así Es, DIGEBOS - Dept. of National Park and

Wildlife, international organizations listed above, universities in Latin American and U.S.

Anticipated benefits:
Additional Guatemalan personnel working full-time on natural resource sustainability and biodiversity.

Estimated Cost:
Approximately $10,000 per job per year = $70,000 / yr
Approximately $10,000 per student per degree = $30,000 / yr

2. REQUIRE ENVIRONMENTAL IMPACT STATEMENTS FOR ALL PROJECTS WHICH AFFECT NATURAL RESOURCES

Objective: To prevent the needless destruction of biological diversity and tropical forests through development activities by government or private sector entities.

Actions:
* Enact legislation that requires the filing of an environmental impact statement prior to initiation of any project which may have impact on biological resources or tropical forests. These documents would be required of government organizations, development institutions, and private enterprises.

Institutions:
CONAMA, Congreso Nacional de Guatemala

Anticipated Benefits:
Reduced incidence of biological resources destruction through development activities and commercial activities.

Estimated Cost:
Costs would be borne by organizations required to file the environmental impact statements.

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3. MANGROVE FOREST PROTECTION

Objectives: Preserve the biological diversity and economic contributions of Guatemala's coastal mangrove forests; Protect the economic benefits produced by mangrove forests through fish, lobsters, crabs, and protection against coastal erosion.

Action:

* Expand protection of mangrove areas by establishing protected areas.
* Promote tourism and fishing industries in the region.
* Educate local communities on role of mangroves in life cycles of economically important resources such as fish, lobsters, crabs, and oysters.
* Inventory marine resources--fish, mollusks--that depend on mangroves
* Establish a national policy for updating of marine and fisheries legislation
* Provide alternatives to human communities to prevent destruction of mangroves for fuelwood and construction materials, i.e., fuelwood lots and community forests.
* Develop alternative energy sources to replace fuelwood for drying salt, e.g. solar energy, methane from sewage or biogasse.

Institutions:

CECON, Dirección Técnica de Pesca y Acuacultura (DITEPESCA), Centro de Esutdios del Mar y Acuacultura (CEMA), DIGEBOS, OCREN, U.S. Peace Corps, CARE. (Fuelwood plantations would fit well into U.S. Agency for International Development/ROCAP/CATIE Madraleña program.)

Anticipated benefits:

Protection of economically important fisheries industry--sustainable fish production
Sustainable shrimp and lobster production
Employment opportunities in fisheries
Employment opportunities in tourism
Protection of coastal water quality
Flood protection
Bird habitat
Increased income from tourism to Biotopo Monterrico and other proposed protected mangrove areas such as Manchón and Manabique
Protection against coastal erosion
Commercial value of sustained resin harvests

Estimated Cost:

Inventory: $18,000 salary and expenses during one year
Policy: none if conducted by existing institutions
Fuelwood alternatives: $50,000 / yr, including salaries, tree stock, maintenance

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4. EXTRACTIVE RESERVES

Objectives: To promote the sustainable harvest of renewable natural resources, such as xate palm, allspice, and chicle from the Petén tropical forest. To conserve remaining tropical forest by demonstrating its economic benefits to Guatemala as undegraded forest.

Action:

* Promote the creation of an extractive reserve in the Guatemalan Petén by convincing government officials to designate the proposed Carmelita/Uaxactún multiple-use-reserve as an extractive reserve.
* Organize training and education programs among harvesters to eliminate destructive harvesting of xate palm, allspice, and chicle.
* Organize cooperatives among natural product harvesters to improve incomes by eliminating inefficiencies and profit gougers.
* Develop a system to assign concession rights for particular areas of xate, chicle, and allspice to eliminate the "tragedy of the commons" problem.
* Educate political and financial decision makers on economic value of extractive reserves.
* Use NGO's as education arms for general public, Radio Tikal, Radio Petén for broad education.
* Futher investigate biology and economics of extracted products (xate, chicle, pimienta gorda)

Institutions:

Universidad de San Carlos in Santa Elena, Petén.
Comisión Nacional del Medio Ambiente
Centro de Estudios Conservacionistas
NGOs (Amigos del Bosque, Defensores de la Naturaleza) for educational programs.
FYDEP liquidation committee.
Universidad de San Carlos Herbarium.

Anticipated benefits:

Reduced waste, increased income from sustainable natural resource harvesting in the Petén tropical forest, sustainable economic benefits from natural tropical forests, creation of economic allies in conservation and sustainable use of tropical forests, maintenance of corollary benefits of tropical forests: water, wildlife, tourism.

Estimated Cost:

$500,000 over first five years.

5. PROTECTED AREAS TRAINING CENTER

Objectives: Increase the number of protected areas guards and managers and improve their capacity to monitor and conserve the areas' biological diversity.

Action:

* Develop a training center and training program for park guards and resource managers.

* Establish a training program of periodic short-courses for protected area guards and managers.

* Refurbish the abandoned FAO research center at El Rosario National Park (Sayaxché, Petén).

Institutions:
USAC (Petén), CECON, DIGEBOS, CATIE, CONAMA.

Anticipated benefits:
Additional park guards and resource managers for protected areas.

Improved management of protected areas and biological diversity.

Estimated Cost:

Refurbish El Rosario: $25,000

Establish training center and program: $175,000 per year

6. BUFFER ZONES FOR PROTECTED AREAS

Objectives: Stabilize agricultural expansion in the buffer zones around the nation's parks and protected areas; Prevent degradation of protected areas by working with resident and neighboring communities.

Action:

- Establish agroforestry systems or other stable agricultural systems in colonization zones around protected areas.

- Promote the creation and operation of extractive reserves based on renewable natural resources.

Institutions:
DIGEBOS, CARE, Peace Corps, DIGESEPE, IDAEH

Anticipated benefits:

Improved agricultural production and income for rural families.
Sustainable use of soils not suitable for annual cropping without forest cover.
Prevention of destruction of protected areas for short-term agricultural use.

Cost:
Approximately US$500 per hectare, depending on size of buffer zone and local conditions.

7. CONSERVATION OF GERMPLASM FOR HUMAN USE

Objectives: To preserve the range of Guatemalan plant germplasm of actual and potential use to humanity.

Action:

* Assist existing genebanks that conserve agricultural, medicinal, and forestry species by improving storage conditions, personnel training, and general funding

* Create a long-term storage genebank capable of storing plant germplasm for decades.

* Assist in the reactivation of the Comisión Nacional de Recursos Genéticos de Guatemala to serve as the coordinating institution in germplasm conservation efforts.

Institutions: Facultad de Agronomía de la Universidad de San Carlos de Guatemala; Instituto de Ciencia y Tecnología Agrícolas (ICTA); Consejo Internacional de Recursos Fitogenéticos (CIRF); CIMMYT (Mexico); DIGESA; Comisión Nacional de Recursos Genéticos de Guatemala.

Anticipated benefits:

conservation of germplasm of use to both Guatemalan and international crop breeding and medicinal plant breeding efforts and improvements.

Estimated cost:

$50,000/yr during 5 years

8. GUATEMALAN BOTANICAL GARDENS

Objectives: Establish a series of botanical gardens in as many as possible of Guatemala's 14 different life zones in order to conserve living specimens of the diversity of the nation's plant life.

Action:

* Work with the Comisión Nacional del Medio Ambiente (CONAMA) in their efforts to establish a botanical garden in each department of the nation.

* Help broaden this effort to establish botanical gardens in each of 14 life zones of the country.

* Support the creation of the J. B. Medio Monte in Palín, Escuintla, designed by CECON and INDE.

Institutions:
CONAMA, Botanical Garden at CECON.

Anticipated benefits:

Conservation of living specimens of valuable and potentially valuable crop plants, medicinal plants, and fiber crops.

Public education on value and importance of Guatemala's plant germplasm.

Estimated cost:

$45,000 per garden during first year, $25,000/yr thereafter until well established.

9. MAYAN AGROECOLOGY PROJECT

Objectives: To produce sustainable agricultural spin-offs and promote nature tourism.

Action:
* Establish a close approximation of a Classic Maya subsistence/agroforestry/sustainable agricultural system at a suitable unexcavated Maya archaeological site in the Petén.

* Utilize knowledge from agronomy, archaeology, and economics to approximate the type of agricultural ecosystems the Maya employed to sustain their civilization in the Petén tropical forest for more than one thousand years.

Institutions:
IDAEH, DIGESEPE, MAGA, CECON, CONAMA, National Geographic, Ruta Maya Commission

Anticipated benefits:
Agricultural spin-offs of sustainable agricultural techniques, increased tourism, increased income for farm families and tourism industry.

Estimated Cost:
US$ 1 million during five years.

11. INCREASE TRAINING AND RESEARCH CAPACITY OF THE SCHOOL OF BIOLOGY OF THE UNIVERSITY OF SAN CARLOS DE GUATEMALA

Actions:

* Provide scholarships for students to attend the School of Biología

* Provide scholarships for students to attain post-graduate degrees in other countries

* Provide laboratory equipment

* Provide vehicles for field investigation.

Estimated cost:
US$50,000/yr during five years.

C. ADDITIONAL RECOMMENDATIONS

The book, Technologies to Maintain Biological Diversity (U.S. Office of Technology Assessment 1987), cites a list of general recommendations that can be adapted for Guatemala. Among them:

1. Enact legislation that recognizes the importance of maintaining biological diversity as a Guatemalan national objective.

2. Amend the legislation of Government agencies to make maintenance of biological diversity an explicit part of their activities.

3. Promote public education about biological diversity by establishing a National Conservation Education Act.

4. Closely examine the actions available to Guatemala in regard to the international exchange of genetic resources.

APPENDIX I

WHAT IS BIOLOGICAL DIVERSITY? Ecosystems, Species, and Genes

The variety of biological resources and the genetic diversity they represent is known as biological diversity (IUCN 1986:144). In 1986, Walter Rosen, of the U.S. National Academy of Sciences, abbreviated this term to biodiversity, and the word was quickly adopted by researchers. Biodiversity, in brief, refers to the number and relative frequency of different kinds of living organisms. The term includes the number and abundance of ecosystems, species, and genes; biodiversity can be classified on these three different levels.

Our planet is home to millions of kinds of living organisms interacting with the physical world that surrounds them. We refer to these interactions as "ecological systems," or ecosystems. We speak of forest ecosystems, mountain ecosystems, and the ecosystems of deserts, oceans, and savannahs. The biodiversity of ecosystems refers to the variety of living organisms that occur within a landscape. A landscape interspersed with croplands, grasslands, and forest has more biological diversity than a landscape that is mostly grass (OTA 1987:3).

Within particular ecosystems, the number and variety of different types of plants and animals is referred to as species biodiversity. Species diversity decreases when the number of kinds of plants or animals in an area is reduced, or when some species abound as others decline in number. When a species is wiped out in a local ecosystem, it is said to be locally eliminated, and when it is eliminated in all its ecosystems, the species is extinct. Species that appear only in the ecosystems of a particular region are called endemic species. The pok, Guatemala's flightless giant grebe, for example, is endemic to Lake Atitlán (and therefore to Guatemala). It appears nowhere else on earth.

Genetic biodiversity is the variety of genes (the chemical unit of hereditary information) within a particular species, variety, or breed of a plant or animal. Genetic diversity allows a species to adapt to changing conditions through time, thus sustaining both ecosystem and species diversity. The greater the amount of genetic diversity within a population, the faster its potential rate of evolution. As a result, genetic diversity helps produce plants and animals that will support increasingly productive agriculture and forestry for human needs (OTA 1987:43).

Combined, these three levels of biological diversity are vital to human welfare for a variety of reasons: (1) to sustain and improve agriculture and forestry, (2) to provide opportunities for medical discoveries and industrial innovations based on natural organisms, and (3) to preserve choices for

addressing problems and opportunities in the future (OTA 1987:37). A country that has conserved its biodiversity is better prepared to provide for the welfare of its citizens than a country whose biodiversity has been impoverished.

On one level, the benefits of biological diversity take the form of immediate economic income through activities like wildlife harvesting, tourism, and maintaining agricultural production. On another level, they focus on unfulfilled potential--new crops, new medicines, new industrial products. Taken together, the benefits of biodiversity provide short-term income to individual people and improve the long-term well-being of our species as a whole.

The International Union for the Conservation of Nature and Natural Resources (IUCN) provides a list of danger points to aid identifications of the loss of biological diversity (1986:145). In order of increasing severity, these points are:

1. local loss of a breeding population
2. loss of a distinct subspecies
3. loss of a species
4. loss of a genus
5. loss of a block of habitat
6. loss of a whole habitat type
7. loss of a biological sub-province.

In seeking to aid the sound, sustainable development of individual nations, we must keep biological diversity as a central focus of research and action. Strategies to maintain biodiversity must acknowledge that the development of natural resources is imperative for human well-being. At the same time, development planners and scientists must acknowledge that the conservation of biodiversity is the foundation for future economic development and the basis of human life itself (OTA 1987:102).

APPENDIX II

INPUTS AND COST ESTIMATES FOR A PROGRAM OF WILDLANDS PROTECTION AND MANAGEMENT

This program of wildlands protection is directed toward:
(1) institution building activities,
(2) creation of a conservation data center, and,
(3) implementation of 25 priority areas.

A. Policy and Planning

Objective: To create an effective legal base to achieve Guatemala's national conservation objectives.

Actions:

* Promote legislation to create an Instituto Nacional de Areas Protegidas y Vida Silvestre.
* Define and implement policies for the protection and management of wildland areas and wildlife.
* Prepare a National Parks Systems Strategy Plan which defines priority activities, costs, and implementation sequence to assure adequate protection of the nation's biodiversity.
* Prepare or revise long-term management and development plans and annual operative plans for priority areas to guide implementation activities.

B. Protection Personnel

Objective: To develop the institutional capacity to adequately protect and manage Guatemala's wildland areas and wildlife.

Actions:

* Increase the number of personnel in natural resource conservation fields to the following approximate numbers over the next five years

Park directors	30
Park guards	300

* Assign sufficient numbers of qualified park directors and park guards to establish a permanent presence in priority wildland areas as follows:

Area	Directors	Park Guards
1. Tikal National Park	1	20
2. Laguna del Tigre	2	25
3. San Miguel/Zotz	2	25
4. Nakum/Yaxjá/Yaloch	2	25
5. Uaxactún/Carmelita	2	25
6. Río Azul/Dos Lagunas	2	25
7. Sierra de las Minas	1	10
8. Quetzal Biotopo	1	5
9. Sierra del Lacandón	1	20

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10. Lachuá	1	10
11. Manchón/Ocosito Biotopo	1	5
12. Cerro San Gil	1	5
13. Atitlán/other volcanos	1	10
14. Bisis/Cabá	1	15
15. Cuchumatanes	1	15
16. Yolnabáj	1	5
17. Río Dulce/Chocón Biotopo	1	5
18. Monterrico/Hawaii Biotopo	1	5
19. Trifinio	1	10
20. Montañas Mayas	1	10
21. Río Polochic	1	5
22. Punta de Manabique	1	5
23. Sipacate	1	5
24. Cerro Cahuí	1	5
25. Sierra de Santa Cruz	1	5
Total Protection Personnel	30	300

* Establish an integrated training program for management of wildlands and wildlife for park directors, park guards, and associated conservaton professionals through on-site workshops, mobile training seminars, and curricula improvements at national universities. When appropriate, international institutions which offer training programs should be used to achieve training objectives.

* Focus central office administrative activities on the provision of operational support for protection personnel in the wildlands areas.

C. Management

Objective: To establish the appropriate protection and management of biological resources and ecological processes to ensure their integrity in perpetuity.

Action:
* Establish a permanent presence in priority wildands through the provision of sufficient quantitites of trained and equipped director and park guards with adequate mobility, communications, and basic facilities. These may include:

parks headquarters with workshops and maintenance areas
personnel housing
entrance stations and remote area patrol huts
trails
communications equipment (phones, radio, etc.)
transportation equipment (vehicles, boats, mules)
field patrol equipment (Backpacks, hammocks, boots)
basic tools and repair parts
general construction materials
utilities (water, power generation, spetic system)
fuel and lubricants

* As appropriate, initiate active management programs to recuperate degraded areas and endangered species, eliminate introduced species, and control fires.

D. Scientific Investigation and Monitoring

Objective: To promote scientific research and monitoring to improve wildland and wildlife mangement and to assist in decisions about natural resource development.

Action:
* Establish a Conservation Data Center to provide a continually updated, readily available source of basic scientific information on ecosystems, communities, species, and wildlands, and their management requirements, and to distribute the information in a useable form for decision-makers.

* Promote applied investigation on the management of wildlands and wildlife and the solution of basic human needs of the local communities in the regions adjacent to the protected wildland.

E. Rural Extension

Objective: To assist in the improvement of socio-economic conditions in the rural communities inside or adjacent to protected wildlands through the implementation of appropriate eco-development techniques and their incorporation in the management activities of the area.

Action:
* Initiate and maintain open communications with the residents and neighboring communities of the protected areas to assist in clarifying management objectives and to search for local strategies of sustained resource use to satisfy local human needs.

* Assist local communities in the design and implementation of appropriate forestry, agroforestry, and wildlife management programs which provide practical results and enhance the conservation of biological diversity.

F. Environmental Education

Objective: To provide the public with an understanding of Guatemala's natural heritage and encourage appropriate use and support of the protected wildlands system.

Action:
* In cooperation with INGUAT, promote the diffusion of information on Guatemala's system of protected wildlands and biotic resources through the public media.

* Install basic outdoor interpretation facilities (e.g., trails, signs, etc.) in the most visited protected areas.

G. Recreation and Tourism

Objective: To promote the development of a wide range of outdoor recreation and tourism opportunities within the protected wildlands which are compatible with the conservation of natural and cultural resources.

Action:
* Through INGUAT, promote increased visitation of the protected wildlands system.

* Foment appropriate private sector investments which serve to increase public use of protected areas.

H. Public Participation

Objective: To increase public participation in the planning and management of the protected wildlands system, in order to better incorporate the conservation of natural resources into the socio-economic development of the surrounding region and the nation in general.

Action:
* Establish mechanisms to include local residents in the planning and management of wildland areas.

* Obtain support of the local and national conservation groups for the protection and management of protected areas through training, workshops, seminars, and direct project activities.

* Strengthen the capacity of indigenous groups in the protection and management of wildlands and wildlife.

I. Institutional Collaboration

Objective: To strengthen the cooperation among government institutions and other groups whose activities can affect biotic resources and protected areas and obtain their collaboration for the implementation of management and development programs.

Action:
* Strengthen the Comisión Nacional del Medio Ambiente (CONAMA) as a council composed of government agency and private sector representatives to assist in the definition and coordination of conservation and development actions which affect wildlands, wildlife, and other environmental topics.

* Obtain the review and approval of long-term management and development plans for individual wildland areas from

governmental agencies which have potential impact on their ecosystems or biotic resources.

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The program will require the following inputs over a five-year period.

Component		Cost (US$1988)
1. Personnel		
Central Office Personnel, Wildlands Unit, 10 individuals, x $9,000/yr x 5 yrs		$ 450,000
Park Directors 30 individuals x $7,500/yr x 5 yrs		1,125,000
Park guards 300 individuals x $4,000/yr x 5 yrs		6,000,000
Subtotal 1. Personnel	$7,575,000	
2. Training		
Wildlands Planning and Management 180 person months x $1,500/mo		270,000
Wildlife Management 90 person months x $1,500/mo		135,000
Environmental Education 90 person months x $1,500/mo		135,000
Conservation Information Systems 60 person months x $1,500/mo		90,000
Natural Resoruce Administration 90 person months x $1,500/mo		135,000
Park Guard Skills 600 person months x $250/mo		150,000
Subtotal 2. Training	$ 915,000	
3. Technical Assistance (short- and long-term)		
Senior Natural Resource Advisor 24 person months x $10,000/mo		240,000
Wildlands Management Specialist 24 person months x $7,500/mo		180,000
Wildlife Management Specialist		

24 person months x $7,500/mo		180,000
Environmental Education Specialist 18 person months x $7,500/mo		135,000
Conservation Information Specialist 18 person months x $7,500/mo		135,000
Park Guard Training Specialist 24 person months x $5,000/mo		120,000
Subtotal 3. Technical Assistance	$	990,000

4. Material, Equipment, and Operation Support

Central Office (vehicles, computers, photocopiers, furniture, base radio, publications, office supplies, correspondence, phone, utilities, maintenance, repairs, gasoline, lubricants, etc.) $100,000/yr x 5 yrs	$	500,000
Conservation Data Center (vehicles, computers, photocopiers, furniture, fax, base radio, publications, office supplies, correspondence, phone, utilities, maintenance, repairs, gasoline, lubricants, etc.) $40,000/yr x 5 yrs		200,000
25 Wildland Areas (boundary surveys and signs, vehicles, field equipment, radios, construction of park headquarters, personnel housing, control stations, gates and fences, supplies, maintenance, repairs, gasoline and lubricants, etc.) $50,000/yr (average) x 25 areas x 5 yrs		6,250,000
Subtotal 4. Materials, Equipment and Operation Support		$8,200,000
GRAND TOTAL		$15,730,000

Cost Estimate Summary

1.	Personnel	$ 7,575,000
2.	Training	915,000
3.	Technical Assistance	990,000
4.	Material, Equipment, Ops	6,250,000
	TOTAL	$15,730,000

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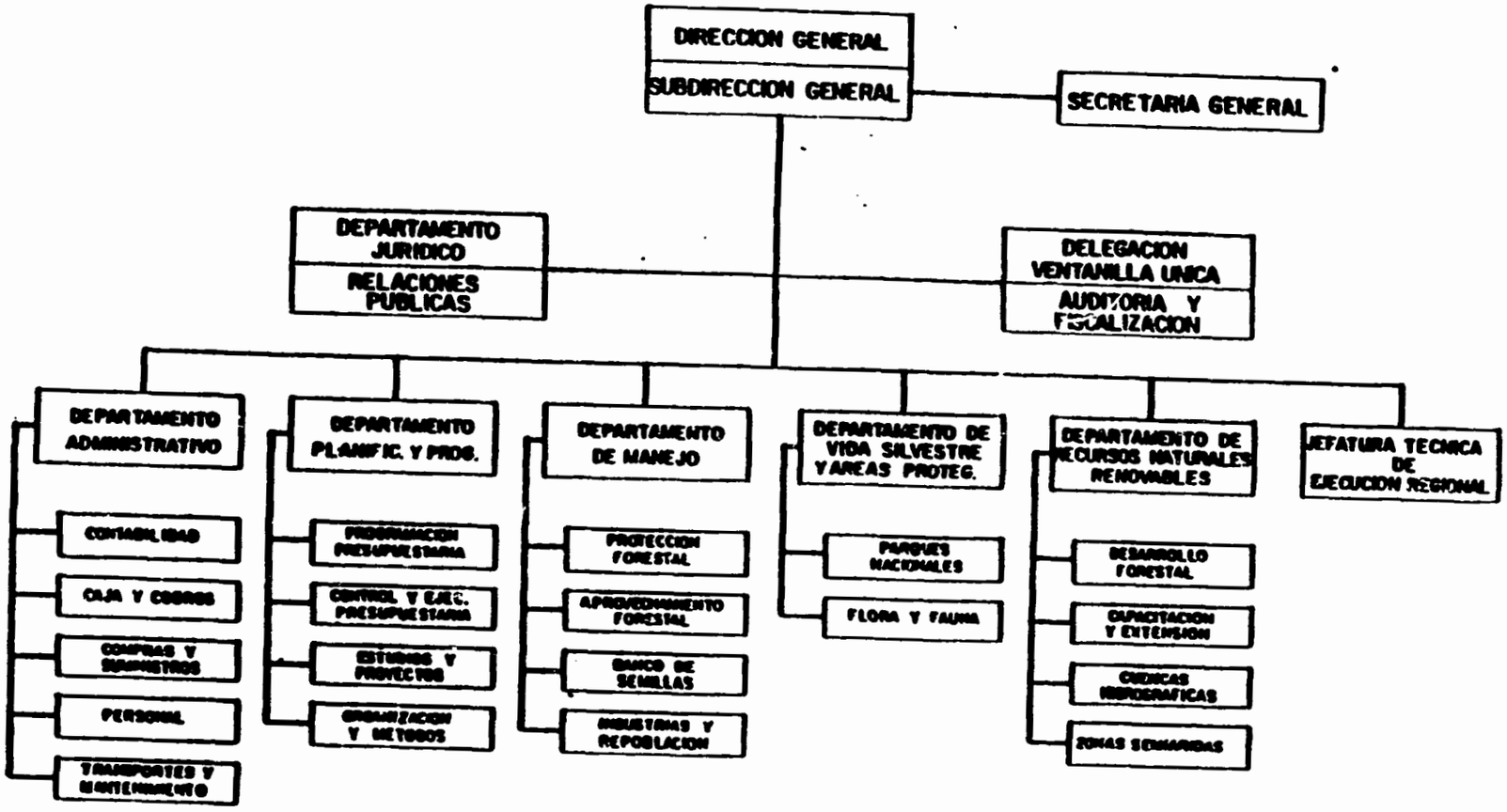
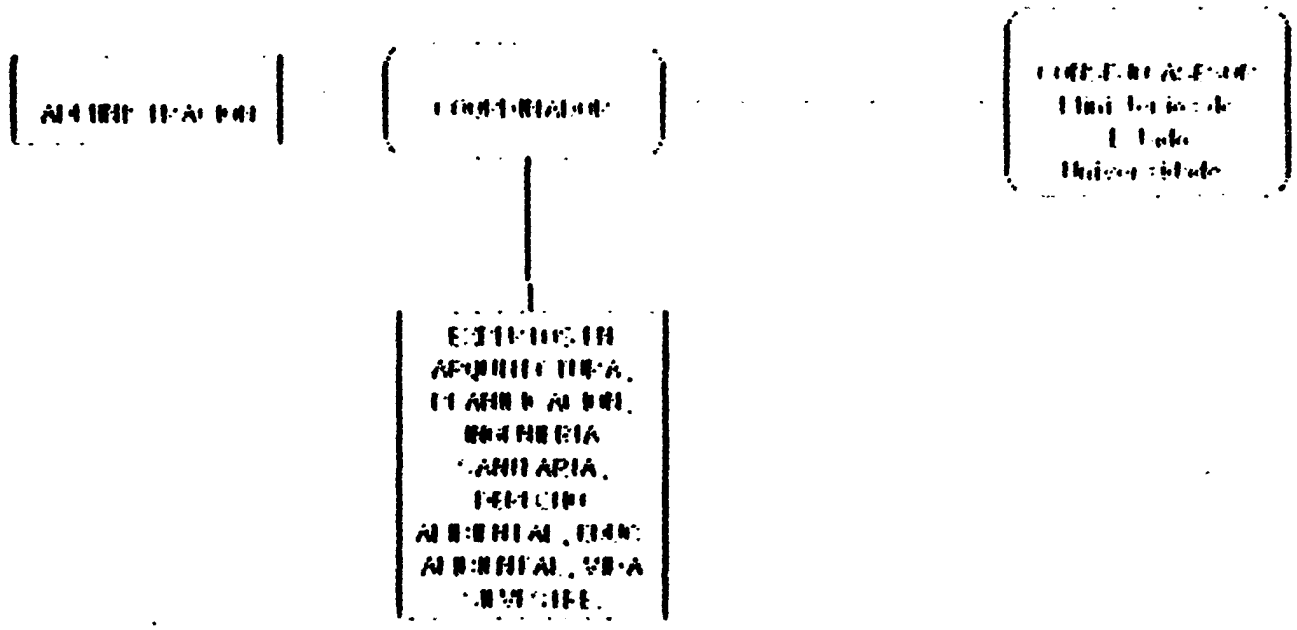

DIRECCION GENERAL
SUBDIRECCION GENERAL
SECRETARIA GENERAL
DEPARTAMENTO JURIDICO
RELACIONES PUBLICAS
DELEGACION VENTANILLA UNICA
AUDITORIA Y FISCALIZACION
DEPARTAMENTO ADMINISTRATIVO
CONTABILIDAD
CAJA Y COBROS
COMPRAS Y SUMINISTROS
PERSONAL
TRANSPORTES Y MANTENIMIENTO
DEPARTAMENTO PLANIFIC. Y PROG.
PROGRAMACION PRESUPUESTARIA
CONTROL Y EJEC. PRESUPUESTARIA
ESTUDIOS Y PROYECTOS
ORGANIZACION Y METODOS
DEPARTAMENTO DE MANEJO
PROTECCION FORESTAL
APROVECHAMIENTO FORESTAL
BANCO DE SEMILLAS
INDUSTRIAS Y REPOBLACION
DEPARTAMENTO DE VIDA SILVESTRE Y AREAS PROTEG.
PARQUES NACIONALES
FLORA Y FAUNA
DEPARTAMENTO DE RECURSOS NATURALES RENOVABLES
DESARROLLO FORESTAL
CAPACITACION Y EXTENSION
CUENCAS HIDROGRAFICAS
ZONAS SEMIARIDAS
JEFATURA TECNICA DE EJECUCION REGIONAL

COMISION NACIONAL DEL MEDIO AMBIENTE, CONAMA, [illegible]



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APPENDIX IV

THE BIODIVERSITY ASSESSMENT TEAM: BIODATA

An ecological anthropologist, **Dr. James D. Nations** (Team Leader, Editor, and Sustainable Development Specialist) is Director of Research, Center for Human Ecology, Austin, Texas, and during 1987-89, a Fulbright Senior Research Scholar in Guatemala.

Brian Houseal, a landscape architect and wildlands planner, is head of the Stewardship Program of The Nature Conservancy, International Program, Arlington, Virginia. He spent nine years as a conservation specialist with the Kuna Indians and various conservation organizations in Panama.

Juan Carlos Godoy (Specialist in Natural Resource Management) is Director of the Centro de Estudios Conservacionistas (CECON), Universidad de San Carlos de Guatemala. He holds a Masters degree from the Centro Agronómico Tropical de Investigación y Enseñanza (CATIE), Turrialba, Costa Rica.

Ecologist **Santiago Billy** (Specialist in Protected Areas Planning), is Encargado del Patrimonio Natural, Comisión Nacional del Medio Ambiente, Guatemala. He formerly served in the Department of Ecology and Department of National Parks and Wildlife, Instituto Nacional Forestal (now DIGEBOS).

Ismael Ponciano (Institutional and Legal Specialist) is Assistant Director of the Centro de Estudios Conservacionistas of the University of San Carlos de Guatemala. A wildlands planning and management specialist, he was formerly Director of the Biotopo Universitario para la Conservación del Quetzal in Purulhá.

Dr. Dietmar Rose is Professor, College of Forestry, University of Minnesota. A specialist in natural resource economics, he has worked throughout Latin America.

Now Director of Science for The Nature Conservancy's Conservation Data Centers, **Dr. Gregg Miller** was formerly Assistant Environmental Advisor to the Bureau for Latin America and the Caribbean, Agency for International Development, Washington, D.C.

Biologist **Fernando Castro** is Director of Biotopos for the Centro de Estudios Conservacionistas, University of San Carlos de Guatemala. He is presently organizing CECON's three new biotopos in the Guatemalan Petén.

Magalí Rey Rosa is Vice-President of Defensores de la Naturaleza, one of Guatemala's most prominent non-governmental

conservation organizations. She is a specialist in environmental education.

César Azurdia is Professor of Botany at the Universidad de San Carlos de Guatemala and one of Guatemala's most respected botanical researchers and teachers.

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APPENDIX V

25 TOP PRIORITY EXISTING AND PROPOSED PROTECTED AREAS

Areas not yet legally protected are indicated by parentheses.

1. Tikal National Park
2. Laguna del Tigre Biotopo
3. San Miguel/Zotz Biotopo
4. Nakun/Yaxjá/Yaloch
5. (Uaxactun/Carmelita)
6. Río Azul/Dos Lagunas Biotopo
7. (Sierra de las Minas)
8. Quetzal Biotopo
9. (Sierra del Lacandón)
10. Lachuá National Park
11. (Manchón/Ocosito)
12. (Cerro San Gil)
13. Atitlán/other volcanoes
14. (Bisis Cabó)
15. (Cuchumatanes)
16. (Yolnabáj)
17. Río Dulce/Chocón Biotopo
18. Monterrico Biotopo
19. El Trifinio
20. (Montañas Mayas)
21. (Río Polochic)
22. (Punta de Manabique)
23. Sipacate National Park
24. Cerro Cahuí Biotopo
25. (Sierra de Santa Cruz)

Each protected area is described in detail in the following pages.

Listings are organized according to information headings of the Protected Areas Data Unit of the International Union for the Conservation of Nature and Natural Resources' (IUCN) Commission on National Parks and Protected Areas (Harrison 1983:4).

1. Name of Protected Area Parque Nacional Tikal
Management Category National Park and World Heritage Site with on-site management and full protection
Legal Protection legally protected by IDAEH in coordination with DIGEBOS
Date Established 1953-577
Geographical Location Municipalidad de Flores, north-central Department of El Petén
Altitude 450 meters above sea level
Area 57,600 hectares (has.)
Vegetation lowland tropical rainforest
Noteworthy fauna all typical Central American rainforest species
Principle reference material Plan Maestro Tikal
Budget $300,000 per year, including water plant, electricity generating plant, salaries, etc.
Comments Declared a National Park in 1957, Parque Nacional Tikal is controlled not by INAFOR's Department of National Parks and Wildlife, but by the Institute of Archaeology and History. This situation results from the fact that the original impetus for protecting the area was the location there of the ruins of the Classic Maya city known today as Tikal--one of the New World's most important archaeological sites. At the same time, however, the park protects a large section of the Petén's tropical rainforest and the animals which inhabit it. Between 20 and 25 percent of the park contains logwood swamp forest; most of the rest is dominated by ramón, zapote, and mahogany, though a zone of pine (Pinus caribaea) appears in the park's eastern region.

The park's abundant wildlife includes at least 280 species of birds, most notably tinamous, curassows, guans, parrots, hummingbirds, trogons, honeycreepers, and tanagers. Mammals include howler monkeys, spider monkeys, coatimundis, white-tailed deer, brocket deer, agoutis, grey fox, anteaters, peccary, weasels, armadillos, tayras, opposums, jaguars, margays, ocelots, jaguarundis, pumas, ringtailed cats, pacas, kinkajous, grisons, and tapirs. The park also supports 64 species of reptiles and amphibians, including 3 turtles, 1 crocodile, 20 lizards, and 27 snakes.

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2. Name of Protected Area Laguna del Tigre (Proposed National Park)/Biotopo Río Escondido (existing)
Management Category Presently a biotopo: proposed as national park. During September, 1987, CECON took possession of the Biotopo Río Escondido (45,900 has), which lies within the area that will be called the Laguna del Tigre National Park if authorized by the Guatemalan Congress.
Biogeographic Province Neotropical, Central American subregion, Campeche province
Legal Protection part is Biotopo of CECON; rest is proposed for protection as part of RAMSAR wetlands agreement (1988) and in Ley de Areas Protegidas (1988)
Date Established biotopo-1987
Geographical Location northwestern extreme of Petén.
Altitude 50 - 100 meters
Area as existing biotopo: 44,500 hectares; as proposed national park: 461,140 hectares
Land Tenure national land; biotopo part under control of CECON-USAC
Physical Features Yucatan platform, tropical lakes, Río Escondido, Río San Pedro Martir.
Vegetation Subtropical humid forest (hot); broadleaved tropical forest, swamp, natural savannah.
Noteworthy fauna tapir, jaguar, puma, Petén turkey, jabiru stork, harpy eagle, solitary eagle, *Cocodrilus moreleti* crocodile, *C. acutus* crocodile, macaw, deer
Disturbances and deficiencies Poaching of wildlife by Mexican hunters; oil exploration drilling and roads, oil contamination
Scientific research geological surveys by Texaco, Basic Resources oil companies
Special scientific facilities guard house on Río San Pedro Martir being constructed fall, 1988
Principle reference material

1. Mapa Forestal, 1:250,000, Dept. del Petén, 1968, FAO-FYDEP
2. Mapa de los Suelos del Petén, Relacionados con su Uso y Potencialidades, 1:500,000, 1965, FAO-FYDEP
3. Mapa sobre las Condiciones Físico-Mecánicas de los Suelos del Petén, para Construcción de Caminos, 1:500,000, 1965, FAO-FYDEP
4. Mapa Preliminar del Uso de Tierras del Petén, Según los Estudios del Proyecto de Evaluación Forestal, 1:500,000, 1963-1968, FAO-FYDEP
5. Mapa de la Cobertura Vegetal de Guatemala, 1:500,000, 1982, INAFOR-IGM
6. Mapa de Zonas de Vida de Guatemala, Holdridge, 1:600,000, 1983
7. Mapa Hipsométrico de Guatemala, 1:500,000, 1979, IGM
8. air photos, approx. 1:50,000, February, 1987, IGM.

Staff 6 biotopo guards; as national park would have 2 directors and minimum 25 guards
Budget currently $57,000/yr (as park: US$200,000/yr)

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Comments An area rich in tropical forest, wetlands (swamps, rivers, and lakes), and natural savannahs, the Laguna del Tigre area may be the most biologically diverse region in Guatemala.

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3. Name of Protected Area Biotopo San Miguel/La Palotada; proposed as Parque Nacional El Zotz
Management Category currently a biotopo; proposed as national park
Biogeographic Province Neotropical, Central American subregion, Campeche province
Legal Protection part is biotopo of CECON, under agreement with FYDEP; rest is proposed for protection as part of Ley de Areas Protegidas (1988)
Date Established 1987
Geographical Location Dept. of Petén, an amplification of Tikal National Park and shares western border of that park
Altitude 250-325 m
Area 35,000 hectares as biotopo; would be 49,300 hectares as national park
Land Tenure national and CECON-USAC
Physical Features Cinturón Lacandón
Vegetation sub-tropical humid forest (hot); broadleaved tropical forest
Noteworthy fauna tapir, jaguar, puma, jabali stork, pecarry, deer, Petén turkey, pajuíl (*Crax rubra*), cojolita, orange breasted falcon; *Cocodrilus moreleti* crocodile
Disturbances and deficiencies Logging roads, one caliche road cuts diagonally through the biotopo, some clearing by colonists.
Special scientific facilities none
Principle reference material
1. Mapa Forestal, 1:250,000, Dept. del Petén, 1968, FAO-FYDEP
2. Mapa de los Suelos del Petén, Relacionados con su Uso y Potencialidades, 1:500,000, 1965, FAO-FYDEP
3. Mapa sobre las Condiciones Físico-Mecánicas de los Suelos del Petén, para Construcción de Caminos, 1:500,000, 1965, FAO-FYDEP
4. Mapa Preliminar del Uso de Tierras del Petén, Según los Estudios del Proyecto de Evaluación Forestal, 1:500,000, 1963-1968, FAO-FYDEP
5. Mapa de la Cobertura Vegetal de Guatemala, 1:500,000, 1982, INAFOR-IGM
6. Mapa de Zonas de Vida de Guatemala, Holdridge, 1:600,000, 1983
7. Mapa Hipsométrico de Guatemala, 1:500,000, 1979, IGM
8. air photos, approx. 1:50,000, February, 1987, IGM.
Staff 6 CECON guards; proposed 2 directors and 25 guards
Budget for biotopo US$5,000; as national park US$57,500/yr
Local administration has protection by archaeological guards in sites of el Zotz', guards within CECON's biotopo.
Comments especially important as extension of Tikal National Park, almost doubling its size. Includes archaeological site of El Zotz. Excellent for tourism and archaeological research.

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4. Name of Protected Area Nakun/Yaxjá/Yaloch
Management Category proposed national park
Biogeographic Province Neotropical, Central American subregion, Campeche province
Legal Protection pending; archeological sites protected by law
Date Established pending
Geographical Location Petén, northeast of Tikal
Altitude
Area proposed 97,460 hectares
Land Tenure national
Physical Features Cinturón Lacandón and Yucatán platform
Vegetation humid sub-tropical forest (hot), broad-leaf
Noteworthy fauna tapir, jaguar, javali, Petén turkey, currasow, eagles, caimans.
Zoning none
Disturbances and deficiencies logging of mahogany and cedar
Scientific research some archaeological work
Special scientific facilities 2 guard camps at sites of Nakum and Naranjo
Principle reference material
1. Mapa Forestal, 1:250,000, Dept. del Petén, 1968, FAO-FYDEP
2. Mapa de los Suelos del Petén, Relacionados con su Uso y Potencialidades, 1:500,000, 1965, FAO-FYDEP
3. Mapa sobre las Condiciones Físico-Mecánicas de los Suelos del Petén, para Construcción de Caminos, 1:500,000, 1965, FAO-FYDEP
4. Mapa Preliminar del Uso de Tierras del Petén, Según los Estudios del Proyecto de Evaluación Forestal, 1:500,000, 1963-1968, FAO-FYDEP
5. Mapa de la Cobertura Vegetal de Guatemala, 1:500,000, 1982, INAFOR-IGM
6. Mapa de Zonas de Vida de Guatemala, Holdridge, 1:600,000, 1983
7. Mapa Hipsométrico de Guatemala, 1:500,000, 1979, IGM
8. air photos, approx. 1:50,000, February, 1987, IGM.
Staff proposed 1 director and 30 guards
Budget proposed US$150,000/yr
Comments Includes three important archaeological sites--Nakum, Yaxjá, and Yaloch.

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5. Name of Protected Area Uaxactun/Carmelita
Management Category proposed multiple-use-reserve and/or extractive reserve
Biogeographic Province Neotropical, Central American subregion, Campeche province
Legal Protection
Date Established
Geographical Location Petén
Altitude
Area 478,882 hectares
Land Tenure national
Physical Features
Vegetation humid sub-tropical forest (hot); broad-leaf
Noteworthy fauna tapir, jaguar, javali, peccary, harpy eagle, solitary eagle, Petén turkey, crocodile
Zoning
Disturbances and deficiencies overexploitation of forest for mahogany, cedar, palms, and allspice
Scientific research
Special scientific facilities three airstrips
Principle reference material
1. Mapa Forestal, 1:250,000, Dept. del Petén, 1968, FAO-FYDEP
2. Mapa de los Suelos del Petén, Relacionados con su Uso y Potencialidades, 1:500,000, 1965, FAO-FYDEP
3. Mapa sobre las Condiciones Físico-Mecánicas de los Suelos del Petén, para Construcción de Caminos, 1:500,000, 1965, FAO-FYDEP
4. Mapa Preliminar del Uso de Tierras del Petén, Según los Estudios del Proyecto de Evaluación Forestal, 1:500,000, 1963-1968, FAO-FYDEP
5. Mapa de la Cobertura Vegetal de Guatemala, 1:500,000, 1982, INAFOR-IGM
6. Mapa de Zonas de Vida de Guatemala, Holdridge, 1:600,000, 1983
7. Mapa Hipsométrico de Guatemala, 1:500,000, 1979, IGM
8. air photos, approx. 1:50,000, February, 1987, IGM.
Staff currently has guards in major archaeological sites; proposed 2 directors and 25 guards.
Budget proposed US$250,00/yr
Comments Includes valuable renewable natural resources of Chamadorea palms, chicle, allspice; includes major archaeological sites of Uaxactún, El Delirio, San Bartolo.

6. Name of Protected Area Río Azul/Dos Lagunas Biotopo
Management Category part is currently CECON-USAC biotopo; proposed as frontier national park
Biogeographic Province Neotropical, Central American subregion, Campeche province
Legal Protection CECON-FYDEP for biotopo
Date Established 1987
Geographical Location Petén, northeast corner
Altitude
Area 44,500 hectares.; proposed expansion to 73,000 hectares
Land Tenure national
Physical Features Río Azul river
Vegetation humid sub-tropical forest (hot); broad-leaf
Noteworthy fauna jaguar, tapir, javali, spider monkey, howler monkey, Petén turkey, solitary eagle
Zoning
Disturbances and deficiencies poaching of mahogany and cedar by Mexican logging operations; illegal excavation of Mayan ruins
Scientific research archaeological
Special scientific facilities one airstrip; guards at sites or Río Azul, protection in biotopo by CECON guards
Principle reference material
1. Mapa Forestal, 1:250,000, Dept. del Petén, 1968, FAO-FYDEP
2. Mapa de los Suelos del Petén, Relacionados con su Uso y Potencialidades, 1:500,000, 1965, FAO-FYDEP
3. Mapa sobre las Condiciones Físico-Mecánicas de los Suelos del Petén, para Construcción de Caminos, 1:500,000, 1965, FAO-FYDEP
4. Mapa Preliminar del Uso de Tierras del Petén, Según los Estudios del Proyecto de Evaluación Forestal, 1:500,000, 1963-1968, FAO-FYDEP
5. Mapa de la Cobertura Vegetal de Guatemala, 1:500,000, 1982, INAFOR-IGM
6. Mapa de Zonas de Vida de Guatemala, Holdridge, 1:600,000, 1983
7. Mapa Hipsométrico de Guatemala, 1:500,000, 1979, IGM
8. air photos, approx. 1:50,000, February, 1987, IGM.
Staff proposed 2 directors and 25 guards
Budget proposed US$300,000/yr
Comments Would be site of archaeological and natural history research station proposed as part of Ruta Maya development. Includes archaeological sites of Río Azul and Mirador.

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7. Name of Protected Area Sierra de las Minas
Management Category proposed national park
Biogeographic Province
Legal Protection
Date Established
Geographical Location eastern Guatemala, various depts--Baja Verapaz, El Progreso, Alta Verapaz, Zacapa
Altitude
Area 91,631.25 hectares
Land Tenure mainly private
Physical Features high mountains
Vegetation humid subtropical forest (hot), very humid temperate forest, lower montane forest
Noteworthy fauna Quetzales, horned guan, tapir, howler monkey
Zoning
Disturbances and deficiencies massive deforestation for fuelwood, agriculture, cattle, logging
Scientific research
Special scientific facilities
Principle reference material maps of Instituto Geográfico Militar
Staff proposed 1 director and 25 guards
Budget proposed US$25,000/yr
Comments Defensores de la Naturaleza and Universidad del Valle are active in promoting conservation of the Sierra de las Minas.

8. Name of Protected Area Biotopo Universitario para la Conservación del Quetzal "Mario Dary Rivera"
Management Category Biotope with on-site protection
Biogeographic Province Neotropical region, Central American subregion
Legal Protection Long-term lease between CECON and Municipality of Salamá
Date Established 1976
Geographical Location near Purulhá, Baja Verapaz
Altitude 1,600 to 1,940 meters above sea level
Area legally 1,153 hectares; expanded to 2,300 hectares by adjoining private lands
Land Tenure uninhabited, except for guards
Physical Features mountains with cloud forest
Vegetation life zone = very humid subtropical forest (cold), better known as upper montane rainforest or cloud forest
Noteworthy fauna Quetzal
Special scientific facilities research cabin, visitors' center, water supplies, nature trails, camping spots
Principle reference material Ponciano 1980; CECON 1983; van den Brule 1982
Staff 1 master guide, 5 guards, 10 workers
Comments The Biotopo Mario Dary Rivera protects a small section of the cloud forest habitat of the rare Guatemalan Quetzal (Pharomachrus mocinno), the Guatemalan national bird and symbol of Guatemalan independence. The long-term goals of the biotopo are (1) to conserve the Quetzal, (2) to convert the bird from a civic symbol to a symbol of life and, by so doing, to achieve the perpetual survival and conservation of the Quetzal's habitat, and (3) to help create a national ecological consciousness.

The Biotopo Mario Dary was created, and is maintained, by the Centro de Estudios Conservacionistas (CECON). The reserve was brought into being in 1976 with the aid of the Asociación Guatemalteca de Historia Natural, through a lease/donation agreement between the Municipality of Salamá and the Universidad de San Carlos, represented by CECON. Officially, the Biotopo Mario Dary covers a surface area of 1,153 hectares (11.53 km2) in a life zone classified under the Holdridge system as Very Humid Subtropical Forest (cold) [Bosque Muy Húmedo Subtropical (frío)], but better known as montane rainforest or cloud forest. In addition, the reserve has been unofficially extended to 2,300 hectares (23 km2) through the purchase of adjoining forest parcels by the late Lic. Mario Dary Rivera, formerly Guatemala's foremost conservationist and the man for whom the biotope is named.

Bromeliads, mosses, and ferns are abundant in a setting of oaks, wild avocados, sweet gums, figs, and white pines. In addition to the Quetzal, the reserve is home to the emerald toucanet, black chachalaca (black pajuil), barred parakeet, scaled antpitta, white-throated wood partridge, howler monkey, white-tailed deer, Brocket deer, kinkajou, and numerous amphibians and reptiles, including rare green Botrops (B. aurifer).

9. Name of Protected Area Sierra del Lacandón
Management Category proposed national park
Biogeographic Province
Legal Protection
Date Established
Geographical Location western Petén
Altitude
Area proposed 280,180 hectares
Land Tenure national, some agricultural cooperatives
Physical Features Río Usumacinta, Sierra del Lacandón mountains
Vegetation humid sub-tropical forest (hot), broad-leaf
Noteworthy fauna macaw (Ara macao), jaguar, puma, tapir, harpy eagle, king buzzard, jabiru stork, Petén turkey, crocodiles, caiman
Zoning
Disturbances and deficiencies illegal colonization, oil exploration, logging
Scientific research
Special scientific facilities 2 airstrips
Principle reference material
Staff proposed 2 directors and 25 guards
Budget proposed US$300,000/yr
Comments Much of area currently (1988) inaccessible due to civil conflict between guerillas and Guatemalan armed forces. Biologically unexplored and unknown, but potentially one of the biologically riches areas of Guatemala.

otected Area Parque Nacional Lachuá
gory national park with no on-site management
n legally protected by DIGEBOS
i 1976
ation surrounding Lake Lachuá, northwestern
tment of Alta Verapaz
eters above sea level
ctares
dand rainforest
a full range of tropical rainforest and aquatic

ence material Ponciano 1982e and DIGEBOS Plan de

e Nacional Lachuá was created by the Instituto
nsformación Agraria (INTA) in 1976 as part of the
the Franja Transversal del Norte. INTA has
rea by declaring it off limits to colonization.
es of a square, 10 km on each side, surrounding
the center.
s little altered by human activities and, thus,
e diversity of lowland rainforest species,
iety of water birds, two species of crocodiles,
es, three species of large cats, and monkeys.
e is still forested, though parts have been
est. Road construction and colonization menace
e the park. Oil exploration could prove to be a
future, although legal protection from INTA may
ent such a problem.

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11. Name of Protected Area Manchón/Ocosito
Management Category Biotopo
Biogeographic Province
Legal Protection CECON
Date Established
Geographical Location San Marcos and Retalhuleu
Altitude
Area 24,525 hectares
Land Tenure mainly private, some national lands
Physical Features coastal plain
Vegetation dry sub-tropical forest and humid sub-tropical forest (hot), mangroves
Noteworthy fauna aquatic birds
Zoning
Disturbances and deficiencies overexploitation of mangroves and overfishing, cattle ranching
Scientific research
Special scientific facilities highways
Principle reference material
1. Mapa de la cobertura vegetal de Guatemala, 1982, INAFOR-IGM
2. Mapa de Zonas de Vida de Guatemala, 1983,
3. Mapa Hipsométrico de Guatemala, 1979, IGM
Staff proposed 1 director, 20 guards
Budget proposed US$75,000/yr
Comments

rotected Area Cerro San Gil
egory ecological reserve
Province
on
ed
ocation Izabal, near Puerto Barrios

5 hectares
0 percent private, 50 percent national
res Montañas del Mico
ry humid tropical forest
ma tapir, howler monkey, spider monkey, ocelote

nd deficiencies massive deforestation for
attle, logging
narch
ific facilities
rence material
cobertura vegetal de Guatemala, 1982, INAFOR-IGM
nas de Vida de Guatemala, 1983,
métrico de Guatemala, 1979, IGM
d 1 director, 20 guards
nd US$50,000/yr
o San Gil is threatened by ongoing agricultural

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13. Name of Protected Area Parque Nacional Atitlán/other volcanos
Management Category National Park with on-site management by INAFOR
Legal Protection legally protected National Park
Date Established 1955
Geographical Location Department of Sololá
Area 3,250 hectares
Land Tenure surrounding area heavily populated by Maya Indians
Physical Features large highland lake surrounded by volcanos
Vegetation both broad-leaved and coniferous trees
Noteworthy fauna Resplendent Quetzal, Horned Guan, Giant Pied-Bill Grebe
Disturbances and deficiencies lower reaches for volcanos under cultivation by local population
Scientific research considerable research on Giant Pied-Bill Grebe
Special scientific facilities INAFOR maintains research station with living quarters
Principal reference material Cazali y Prado Plan Maestro
Staff permanent workers and guards; students in residence
Comments Declared a National Park in 1955, Parque Nacional Lago Atitlán is a large, mile-high lake surrounded by volcanos in Guatemala's mountainous region. The setting is considered by many world travelers to be one of the most beautiful places on earth. Lake Atitlán is one of the most visited sites in Guatemala. Parque National Lago Atitlán consists of the watershed of the lake, and the sides of the adjacent volcanoes, Atitlán and San Pedro Tolimán. [The lake itself is approximately 130 km2.] The forests on the upper reaches of these volcanoes support numerous species of wildlife, including the Quetzal and Horned Guan (Pavo de Cacho, Pavón; Oreophasis derbianus). The lake is the only known habitat of the flightless Giant Pied-Billed Grebe, known in Guatemala as the Zambullidor or poc (Podylimbus gigas). All three of these bird species are endangered.

The upper reaches of all volcanos in Guatemala were declared protected areas in 1956, from their craters to a gradient of 30 degrees. As a result, timber exploitation and clearing for agriculture are prohibited on this portion of Atitlán and all other volcanos in the nation.

tected Area Bisis Cabá
ory proposed national park
ovince

ation Quiché, north of town of Chajul

hectares
ional
s mountains
humid montane tropical forest
puma, king buzzard, deer, ocelote

deficiencies civil conflict zone
rch
ic facilities three airstrips
nce material
bertura vegetal de Guatemala, 1982, INAFOR-IGM
s de Vida de Guatemala, 1983,
trico de Guatemala, 1979, IGM
one director and 15 guards
US$300,000/yr

15. Name of Protected Area Cuchumatanes
Management Category proposed multiple-use-reserve
Biogeographic Province
Legal Protection
Date Established
Geographical Location Huehuetenango
Altitude
Area 346,375 hectares
Land Tenure national and private
Physical Features Cuchumatanes Mountains
Vegetation very humid montane tropoical forest, pine and cypress
Noteworthy fauna crows, deer, coyotes
Zoning Disturbances and deficiencies overgrazing by sheep, deforestation for fuelwood and construction materials
Scientific research
Special scientific facilities
Principle reference material
Staff proposed one director, 15 guards
Budget proposed US$150,000/yr

ected Area Yolnabjäj
ry proposed biological reserve
vince

tion Huehuetenango

rtares
onal

humid sub-tropical forest (hot), broad-leaf
jaguar, puma, deer, king buzzard

deficiencies some subsistence farms
th
facilities
re material
director, 25 guards
US$25,000/yr

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17 a. Name of Protected Area Parque Nacional Río Dulce
Management Category National Park with on-site management
Legal Protection legally protected by DIGEBOS; declared a National Park in Acuerdo Ministerial of 1955
Date Established Declared May 26, 1955; limits established by Acuerdo Ministerial August 23, 1968
Geographical Location Department of Izabal, southeastern Guatemala
Altitude sea level to 1,267 meters above sea level
Area 9,610 hectares
Noteworthy fauna only site in Guatemala for manatee
Comments Created in 1955 by President Castillo Armas, Parque Nacional Río Dulce consists of the watershed of Río Dulce from its mouth in the Atlantic Ocean, including the Golfete and the Watershed of Lake Izabal, until the Ruins of the Castle of San Felipe, Department of Izabal. In 1968, its size was established as including the river itself and a strip one kilometer back from each shore, following the river for its full 39 kilometers. The park is frequently sited as one of the few national parks in Guatemala which meets international criteria for this designation.

The area is notable for its mix of aquatic and terrestrial tropical vegetation, a mix that includes tropical cedar and mahogany as well as periodically inundated plant species. Wildlife includes typical lowland rainforest species, as well as the manatee (*Trichechus manatus*).

Land tenure in the park is complicated by some encroachment by local farmers, but DIGEBOS has adopted these settlements as areas of intensive use within a multiple use system.

A two volume master plan for Río Dulce (Ponciano 1981) provides full details on park boundaries, vegetation, wildlife, land tenure, and other topics.

PART OF BIOTOPO CHOCON MACHACAS FALLS WITHIN RIO DULCE NATIONAL PARK; DISCUSSION OF CHOCON MACHACAS FOLLOWS AS (17b).

Protected Area Biotopo para la Conservación del
n-Machacas"
tegory Biotope with intermittant on-site

Province Neotropical region, Central American
rib-Pacific province
ion Partially overlaps with legally protected
al Río Dulce; supported by Acuerdo de INGUAT Number
9
hed 1981
Location Department of Izabal, northeastern
rthern margin of El Golfete, between Castillo de
Lara and the town of Livingston
o 250 meters above sea level
ectares, of which 1,500 hectares lie inside Parque
Dulce
small communities of Kekchí Maya inside limits
ures system of rivers, lakes, canals, with flat,
andated land with a few small mountains
uatic vegetation, including mangroves and swamps,
ations: humid and very humid tropical and
orest on uplands, including associations found no
Guatemala
una manatees, though not abundant; other large
due to hunting--jaguar, howler monkey, and deer
d; many birds, including macaw, parrots, 126
ous reptiles and amphibians
ferent zones, including administrative, intensive
roposed nature trails, absolute conservation
mit), and controlled use (see CECON-INGUAT 1981b

nd deficiencies vegetation mostly intact despite
to El Petén, oil pipeline, and bridge over Río
rounding areas being rapidly deforested
search ongoing by CECON
ific facilities workers' house, visitors' center
tion, one nature trail (land), one nature trail

rence material CECON-INGUAT 1981b
3 guards, 5 workers; Projected: 1 director, 1
guards, 8 workers
: salaries and $3,000.00 ongoing work; Projected:
nually
cated to the conservation of the manatee and
itat, the Biotopo Chocón-Machacas exists today as
combined efforts of CECON, INGUAT, INTA, and
S). Similarly, the biotope illustrates the
nature of Guatemalan wildlands. The principle
Lake Itzabal, then the Río Dulce, and thus
otope Chocón-Machacas, is the Río Polochic, which
mountains that constitute the Biotope
para la Conservación del Quetzal "Mario Dary

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18. Name of Protected Area Proposed Biotopo Monterrico
Management Category proposed biotope
Biogeographic Province Neotropical, Central American subregion
Legal Protection government act
Date Established 1978
Geographical Location Pacific coast, near towns of Papaturro and Monterrico, almost due south of Guatemala City, Department of Santa Rosa
Altitude sea level
Area approximately 6,000 hectares
Land Tenure problematic--many nearby fishing communities use the area as source for fish, fuelwood, and construction materials
Physical Features beach, estuary features
Vegetation red mangrove, associated estuary vegetation, dry sub-tropical forest
Noteworthy fauna variety of fish, other estuary wildlife, two marine turtles, rich bird life
Zoning defined by Plan Maestro, viz.
Disturbances and deficiencies see Land Tenure above
Scientific research presently used as fish culture site by CECON, CEMA
Principle reference material Plan de Manejo by Juan Carlos Godoy, 1981, CECON
Comments The Biotopo Monterrico lies almost due south of Guatemala City on the shore of the nation's southern coastal plain. When finalized and delimited, this conservation unit will protect approximately 60 km2 of the region's rich estuary flora and fauna, including red mangrove (*Rhizophora harrisonii*, *R. mangle*), part of Guatemala's estimated 200 km2 of coastal mangrove forest.

Many local communities continue to utilize the area as a fishing zone. Additionally, local families fell the area's mangroves for use as fuelwood and construction materials.

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otected Area Parque Internacional Trifinio, part
l Biosphere Reserve La Fraternidad
gory International Park
rovince Neotropical, Central American subregion
n legal protection as International Park by

d 1987
tation at juncture of Guatemala, Honduras, El

ectares, of which 45 % is in Guatemala, 40 % in
5 % in El Salvador. Part is protected forest.
es mountainous region
Internacional Trifinio constitutes the
ion of International Biosphere Reserve La
ween Guatemala, El Salvador, and Honduras and
hose three nations come together. The project
forest area, surrounded by an area proposed for
ation. Outside these zones is a multiple-use
c and social development projects designed to
conditions for the 572,000 Guatemalans,
Hondurans who live there (57 % Guatemalan, 19 %
Honduran). More than 60 % of these families
poverty; two-thirds are agriculturalists.
ss than 20 % of the total area. The
rk has not been delineated on the ground, but
ternational agreements were signed during
The section of the proposed park which lies in
m as Monte Cristo, constitutes one of the only
ted areas in that nation. Neither Guatemala nor
gun protection of their section of the park.

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20. Name of Protected Area Montañas Mayas
Management Category proposed frontier national park
Biogeographic Province
Legal Protection
Date Established
Geographical Location Petén, on Belize border
Altitude
Area 68,712.5 hectares
Land Tenure national
Physical Features Maya Mountains
Vegetation very humid sub-tropical forest (hot)
Noteworthy fauna jaguar, puma, ocelote, margay, deer, curassow
Zoning
Disturbances and deficiencies
Scientific research
Special scientific facilities
Principle reference material
Staff proposed 1 director, 10 guards
Budget proposed US$30,000/yr

Protected Area Río Polochic
tegory proposed biological reserve
Province
ion
ned
Location Lago Izabal

hectares
private and natinoal
ures Motagua depression
ery humid sub-tropical forest
una crocodile and aquatic birds

and deficiencies agriculture
search
tific facilities
rence material
ed 1 director, 5 guards
sed US$25,000/yr

168

22. Name of Protected Area Punta de Manabique
Management Category biological reserve
Biogeographic Province
Legal Protection
Date Established
Geographical Location Izabal, on Atlantic Coast
Altitude
Area 38,406.25 hectares
Land Tenure national and private
Physical Features coastal zone
Vegetation very humid tropical forest
Noteworthy fauna manatee, tapir, marine turtles, spider monkey, howler monkey
Zoning
Disturbances and deficiencies
Scientific research
Special scientific facilities DITEPESCA Marine Turtle project
Principle reference material Preliminary Plan de Manejo, CECON
Staff proposed 1 director, 25 guards
Budget proposed US$45,000/yr

Protected Area Sipacate National Park
ategory
c Province
tion
shed
Location Pacific coast, Dept. of Escuintla

hectares
national, but at least 50 percent occupied by

tures
dry sub-tropical forest, mangroves
fauna

and deficiencies human communities, massive
fincas
esearch
ntific facilities
ference material

propriate for tourism, research, fishing potential

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24. Name of Protected Area Biotopo Cerro Cahuí
Management Category Biotope with on-site protection and management
Biogeographic Province Neotropical, Central American subregion, Campeche province
Legal Protection Agreement between CECON, INGUAT, FYDEP
Date Established 1981
Geographical Location Northeastern shore of Lake Petén Itzá, Department of the Petén: 17° latitude north and 89°13' latitude west.
Altitude 110 meters to 360 meters above sea level
Area 650 hectares
Land Tenure national land, uninhabited
Physical Features lake shore, mountains; Cerro Cahuí at 248 meters
Vegetation humid sub-tropical forest (hot); life zone = humid tropical and humid subtropical (hot)
Noteworthy fauna crocodiles, deer, howler monkeys, tapir, pacas, small cats, bats
Zoning intangible zone: natural vegetation, little alteration, 700 hectares; extensive use zone: with severe human alternation, small section on southern edge; location of nature trails; intensive use zone: relatively altered by human activities, cultivated by local people, orientation area will be located here; recuperation zone: severely affected by human activities, three small areas; special use zone: altered zone, to be used as site of administration structures; buffer zone: thin strip 20 meters wide surrounding entire biotope (for details, see CECON-INGUAT 1981a:68).
Disturbances and deficiencies some accidental burning from nearby agricultural fires
Scientific research flora and fauna surveys only; no complete studies
Special scientific facilities Administration house (palm-roof structure)
Principle reference material CECON-INGUAT 1981a
Staff 3 part time guards and workers; part time administrator in Guatemala City
Budget Actual: salaries and $4,000.00 for infrastructure;
Local administration 3 local men work as guards
Comments The Biotopo Cerro Cahuí protects a mixed zone of natural, cleared, and regrowing lowland tropical rainforest on the northeastern shore of Lake Petén Itzá, Department of the Petén, Guatemala. It receives 80 foreign visitors per year; focus is on local populations (Flores, Santa Elena, San Benito) rather than on international tourism.

The area is inhabited or visited by an estimated 300 species of birds, 40 species of mammals, 20 species of reptiles and amphibians, and innumerable insects. Approximately 20 species of fish swim in the adjoining Lake Petén Itzá. Much of the vegetation remains unaltered, especially on the hillsides. Though the biotope's large cedars and mahoganies have been extracted by loggers, small specimens of these species remain and will be allowed to reseed the area.

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rotected Area Sierra de Santa Cruz
egory proposed national park
Province
ion
ed
Location Izabal

5 hectares
ational and private
ures
mid sub-tropical forest (hot)
ma macaw, toucan, puma, ocelote, margay, spider
r monkey

and deficiencies deforestation by illegal

search
ific facilities
erence material
ed 1 director, 25 guards
sed US$35,000/yr

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APPENDIX VI
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APPENDIX VII

PROGRAM RECOMMENDATIONS TO USAID/GUATEMALA REGARDING BIOLOGICAL DIVERSITY AND TROPICAL FORESTS

This special section of the Biological Diversity and Tropical Forests Assessment is directed to USAID/Guatemala. It appears only in the English version of the document.

The Agency for International Development's environmental and natural resource policy, approved in April, 1988, is based on the premise that environmental protection and conservation of natural resources are essential to sustained economic and social developoment. The policy's central objective is to assist developing countries in conserving and protecting their environment and natural resources and to promote economic growth by managing these resources for sustainable yields. The policy makes clear that growth in agricultural productivity must occur without depleting the natural resources on which it depends.

As well, the Agency's Agriculture, Rural Development and Nutrition (ARDN) program recognizes that maintaining and enhancing the natural resource base is critical to the goal of expanding the availability and consumption of food and increasing the income of the poor.

Tropical Forests

Recognizing the unique role and special environmental characteristics of tropical forests, AID issued policy and program guidance on humid tropical forests (STATE 328482) in 1984. In this guidance, AID defines tropical forests as, "all forests and shrublands within the geographic tropics and in frost-free areas outside the geographic tropics." AID's policy reflects broader congressional concern for all tropical forests, giving priority to conserving undisturbed forests, finding sustainable ways to manage natural forests in tropical countries, and finding alternatives to the conversion of tropical forests.

Concerning tropical forests, it is AID's policy to: (1) engage in policy dialogues; (2) promote the management of existing forests for sustainable yields; (3) provide alternatives to forest destruction; (4) conserve natural forests; and (5) restore forest resources. Appropriate projects should support: (1) training and education, and alternatives to destructive farming practices; (2) agroforestry on marginal lands to provide permanent, sustainable alternatives to slash-and-burn agriculture; (3) creation of productive buffer zones surrounding protected forests; and (4) research that will expand knowledge on tropical forests.

Of equal importance are activities that support conservation of forested watersheds, extablishment of forest

research on natural processes, and the designation that protect ecosystems representative of certain s.

<u>iversity</u>

cognizes the importance of maintaining and protecting rapidly eroding biological diversity and biological se. Biological resources are critical to worldwide public health, economic growth, and social However, only by successfully integrating the of biodiversity into development projects will AID ificant impact on these resources. AID has focused the protection of biodiversity by emphasizing

resource inventories and conservation strategies ify ecosystems or regions worthy of protection;

ge the establishment and maintenance of wildlife reserves, and parks, and promote anti-poaching

the development of buffer zones;

resource management or land uses which protect and extant flora and fauna;

in-country training, education, public awareness, tional building to preserve habitats and manage wild imal resources to prevent species loss; and

policies and policy dialogue which increases the y's national committment and long-term ability to logical diversity.

egislation during the past few years has singled out rests and biological diversity from other al problems in order to focus attention on these portant areas of concern. However, in order to struction of tropical forests (and coastal ecosystems) biological diversity, these issues must be addressed components of AID's broader efforts in environmental natural resources management, and agricultural

III of the Special Foreign Assistance Act of 1986, 99-529, amends the Foreign Assistance Act (FAA), AID missions to analyze in each Country Development tement (CDSS) or other country plan: (1) the essary in that country to achieve conservation and management of tropical forests (Section 118); (2) necessary in that country to conserve biological Section 119); and (3) the extent to which the

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actions proposed for support by the Mission meet the needs thus identified. Information pertaining to these requirements and guidance are contained in STATE 037076, STATE 118324, STATE 150862, and STATE 032584.

The AID Administrator has decided that the Agency will maintain its international leadership role in supporting the conservation of biological resources. In FY 1989 and beyond, the Bureaus must support biological diversity from their respective regional and bilateral budgets. Activities for FY 89 may be obligations for new activities, continuations of current activities, or components of already planned or ongoing activities, and must clearly meet the FAA Sections 118 and 119 criteria established by Congress.

The objectives of AID activities in biological resource conservation are to undertake practical, results-oriented, sustainable, on-the-ground activities that:

(1) Maintain ecosystems processes and species which are important for economic development and improving the livelihood of people in lesser developed countries (LDCs);

(2) Incorporate biological resource conservation and management into ongoing and new development projects, particularly large scale forestry, agriculture, and rural development projects;

(3) Increase the committment and ability of host country government and non-governmental organizations (NGOs) to conserve biodiversity, and educate and train them to support the three main elements of the World Conservation Strategy:

(a) To maintain essential ecological processes and life support systems;

(b) To preserve genetic diversity;

(c) To ensure the sustainable utilization of species and ecosystems.

(4) Demonstate the economic benefits of conserving biological diversity.

Recommendations to USAID/Guatemala

The environmental problems of Guatemala are outlined in the previous sections of this assessment. These problems, degradation of forest, water, soil, and biological resources, are common to most all developing countries. The intensity of stress being placed on Guatemala's natural resoruce base is such that helping find solutions to these environmental problems is one of the major tasks facing USAID/Guatemala.

ght of these responsibilities and the promising
ies for USAID/Guatemala to participate in the
on of biological diversity in Guatemala, the following
ovides a list of feasible short- and long-term
ptions for the mission.

(Immediate) Assistance Required

tic Support to Protected Areas

mediate need exists for on-the-ground logistic support
nagers and guards to improve their park management,
ty protection, and enforcement activities. The
mala mission should respond to the needs outlined in
nment by providing the necessary funds for writing
plans and purchasing boots, uniforms, tents, radios,
and other indispensible field equipment for park

second, though still short-term step in assistance,
mala should support the development of necessary park
infrastructure. The list of 25 priority protected
uded in the assessment identify the areas that most
need this kind of support. Realistic support will
ilding, nature trails, water supplies for personnel
ts, latrines, and basic research facilities.

rt to Environmental NGOs

-term technical assistance is needed to organize the
alan NGOs identified in this assessment. This would
oviding infrastrucutre capabilities, designing
conservation strategies that are compatible with the
of a given NGO, and improving project design and
riting capabilities. At present, Guatemala has a
environmental groups that with financial and technical
could more efficiently manage and advance their
on priorities.

D/Guatemala can provide this assistance through two
hanisms. The first is through the Environment and
Management Project from AID/S&T. The second represents
rtunity for AID Missions worldwide. This opportunity
d by the AID/S&T Biodiversity Project, which is
the World Wildlife Fund, in conjunction with The
nservancy and the Center for International Development
ment of the World Resources Institute. Either
can provide USAID/Guatemala with the short-term
ded to promote NGO development.

gical Diversity Research

D/Guatemala should consider as a priority the
or enhancement of Guatemalan research and

development facilities related to the identification, study, and cataloging of nature plant and animal species. This support should include:

--Provision of essential research equipment

--Financial support for the publication of new surveys and information on flora and fauna

--Financial and logistic support for a Conservation Data Center to oversee the collection and dissemination of biological resources information. These data should be provided to both academic and development organizations, and should be in a form that facilitates environmentally sound development decisions, and

--Implementation of a small grants program to stimulate and support in-country research projects within protected areas of Guatemala. This could be modeled after USAID/Ecuador's biodiversity research grant program, which is part of the Napo Province Forestry Project. In Guatemala, this program would serve two purposes: (1) supply desperately needed baseline biological data, and (2) enable botanists, zoologists, and other scientists to become active, paid participants in the conservation process.

(4) Training and Public Awareness

Workshops and training programs must be developed for protected area personnel in park management and natural history interpretation. Special emphasis must be placed on educating host country personnel in programs directly related to biological diversity conservation, such as: ecology, zoology, fisheries, natural resources management, forestry, and nature tourism.

Support is needed for an environmental training/awareness program for Guatemalan decision makers. USAID/Guatemala should support the efforts of Guatemalan NGOs in their public environmental awareness campagin. This short-term assistance is essential to the success of the long-term policy dialogue recommendations outlined below.

Long-Term Assistance

If implemented, the short-term actions listed above will begin to alleviate some of Guatemala's most immediate biodiversity problems. However, these acitons are only a starting point for more comprehensive, long-term strategies that will benefit the majority of Guatemala's citizens. USAID/Guatemala must make a firm committment to the long-term sustainable management and conservation of Guatemala's natural

gical resources. We suggest the following long-term
sponses as the basis for a sound conservation strategy:

cy Dialogue

lopment of a successful, sustainable biodiversity
ion program in Guatemala will require a committed
alogue between USAID and the Government of Guatemala.
ontext, several areas of active policy development and
should yield steady, productive growth of a national
nt to biodiversity conservation in Guatemala. These

ronmental Legislation

the infrastructure and enforcement capabilities of the
on which is placed in charge upon passage of the
Ley de Areas Protegidas.

the enforcement capabilities of the Dirección General
s (DIGEBOS).

nto a policy dialogue with the Government of Guatemala
in the formation and enforcement of other
ntal legislation and civil laws concerned with rural
nt, wildlife protection, and conservation of
ity and tropical forests.

sh a policy dialogue with the Government of Guatemala
le legislation to control the unauthorized use of
nds. USAID/Guatemala should explore the complex and
lationship between land tenure, land use patterns, and
abitat with concomittant loss of biological diversity.

ronmental Education

of the major factors accounting for loss of biological
is the lack of any coherent environmental education
o foment a more informed public. USAID must encourage
rt a strong public sector movement to increase the
sciousness of the need for environmental education
in the state and private schools. Once public opinion
this need, USAID will have an enhanced position when
the issue with the Ministry of Education.

l Currency

t amendements to P1480 effectively expand the range of
rency activities to include a broad range of biological
conservation measures. USAID/Guatemala is now
to include such activities in its portfolio. While
rency funds are clearly controlled by the Government of
, USAID/Guatemala should exercise an active role in
the government to fund biodiversity projects.

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USAID/Guatemala should support environmental NGOs and stimulate public awareness of environmental issues to gain sufficient public leverage to shift government opinion towards the conservation of biological resoruces as necessary for sustainable economic development in the country.

(2) Integrating Biodiversity into USAID Projects

USAID has made significant progress in addressing its responsibility towards protecting biological resources in developing countries. Several conservation and natural resource management projects have been implemented world-wide, giving USAID a leadership role among development agencies. However, only by successfully integrating the conservation of biological diversity into future and ongoing projects will the agency make a lasting impact.

USAID/Guatemala must look to its present and proposed project portolio to find ways in which environmentally sound management practices can become integral and indispensible project components. The Mission's Environmental Officer should have as his mandate an active role in project planning and design to incorporate biodiversity conservation and sustainable resource management into all projects. These issues must be addressed as integral components of USAID/Guatemala's broader environmental protection, natural resources mangment, and agricultural production efforts.

(3) Nature Tourism

A long-term development goal of USAID/Guatemala should be development of the country's tourism potential. Convincing evidence has been presented in this report that nature-based tourism is an economically viable development alternative for Guatemala. USAID/Guatemala must look for ways to support infrastrucutre capabilities, education and training of tourist guides, and conservation of protected areas. Tourism in Guatemala represents an attractive economic development programs that supports both sustainable development and efforts to conserve biological diversity and tropical forests.

ATEMALA PROJECTS WITH POSSIBLE ENVIRONMENTAL IMPACTS
ON TROPICAL FORESTS AND BIOLOGICAL DIVERSITY

D/Guatemala has taken an important step in assessing
onmental impacts of its development projects by
to conduct a pesticide/pest management Environmental
t (EA). This EA has been developed to assure
ntal soundness and human safety for the use of
s, as well as for the broader impacts of agricultural
cation activities within the Highlands Agricultural
nt (HADS) project and other Office of Rural Development
jects.

objective of the EA are: (1) to evaluate the
ntal impacts of the proposed amendment to the HAD
and (2) to evaluate the environmental impact of
use and/or procurement under other USAID/Guatemala ORD
. The specific review of the HAD amendment will conform
ions 118 (Tropical Forests) and 119 (Biological
) of the amended Foreign Assistance Act and will also
mitigative measures to assure that ongoing and
activities do not endanger wildlife or critical
or have other adverse impacts on biological diversity.

mber of ORD projects directly or indirectly provide
e for the procurement and/or use of agrochemicals,
pesticides. All of these projects share the common
xreasing small-scale marketing and intensifying
ral production. These projects are:

-0255 Small Farmer Diversification Systems
-0274 Highlands Agricultural Development
-0274 HADS II Amendment
-0276 Agribusiness Development
-0286 Cooperative Strengthening
-0343 Commercial Land Markets
-0363 Agriculture Production and Marketing

of these ORD projects has been subjected to different
of environmental review. Of the projects listed, four
IEEs completed, with three being granted a negative
ation--Small Farmers Diversification Systems, Highlands
ral Development, and Agribusiness Development. After
AID project documents and disucssing the projects with
managers and engineers, we can make the following
ions about the potential environmental consequences of
jects.

all Farmer Diversification Systems (520-0255) was
negative determination on its IEE on the basis that no
nt effect on the human environment was expected. In
to possible environmental impacts of pesticide use
ocurement, the EA must also determine whether sites

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chosen for terracing and irrigation activities damage or alter fragile natural habitats with significant biodiversity. Monitoring is necessary to determine whether or not small farmers have used credit provided by the project to clear previously forested lands.

As well, Section 118.C.15.A of the FAA prohibits AID from providing assistance to any activity that ". . .would result in the conversion of forest lands to the rearing of livestock" unless an EA determines that ". . .the activity will be conducted in an environmentally sound manner which supports sustainable development."

* The Highlands Agricultural Development Project (HADS) (520-0274) was also granted a negative IEE based on the low to non-existent environmental impact of project components. The project is designed to improve the productive base of the rural poor in the Highlands. Project activities with possible positive impact on conserving biological resources include: soil conservation; establishing forest plantations with species for energy production, thus conserving renewable natural resources; forest fire control and prevention; and control of arboreal diseases and insects.

Project activities that should be assessed in the EA as having possible negative impact on natural habitats and biodiversity include (1) the direct effects that pesticides may have on non-target organisms and water contamination and (2) determining whether or not rural access roads have exposed formerly intact forest/wildland areas to unlawful timber extraction or to wildlife poaching and other harmful human influences.

* The five year HADS Project Amendment will consolidate the Small Farmer Diversification Systems Project and the HADS Project (520-0274) for the purpose of extending commercial, diversified agriculture into the highlands subsistence areas through irrigated farm systems. The HADS Amendment EA will examine some of the broader natural resource management and conservation issues in the proposed geographic area of the HADS project. Included will be assessments of watershed management and water use practices, soil conservation measures, downstream impacts, forest protection issues, changes in land use, promotion of safe pesticide use and alternative pest management programs, and proximity to sensitive or ecologically important areas.

In addition to the impact of pesticides, areas of concern that should be emphasized in the EA include: potential impacts on existing and proposed national parks and protected areas and construction and maintenance of roads through the Farm-to-market Access Roads Project (520-0332).

tion 118.C.15 B and C of the FAA also specifically
ID assistance to activities such as "(B) The
tion, upgrading, or maintenance of roads (including
y haul roads for logging or other extractive
es), which pass through relatively undegraded forest
these activities will be approved only if the proposed
ates that these activities, "will contribute
antly and directly to imporving the livelihood of the
or and will be conducted in an environmentally sound
hich supports sustainable development."

ribusiness Development Project (520-0276) is designed to
small farmers with profitable outlets for fruit and
e production through new and expanded enterprises in
eas. This project was granted a negative IEE
ation based on the condition that the project would
formal links to the ROCAP IPM Project (596-0110) and
rm technical assistance for training on safe use and
of pesticides. To date, no formal links have been
hed between these projects. Thus, the project does not
e in any way the choice and/or use of pesticides
d with the production credit.

rpose of the Commercial Lands Markets Project (520-0343)
tablish and expand the Penny Foundation's activities to
the agricultural productivity and incomes of the rural
d to identify and promote additional instruments to
production and reduce pressure on agricultural land.
ject received a Positive IEE Determination, with the
EA expected to review pesticide procurement and/or use
cts on natural resources.

operative Strengthening (520-0286) and Agricultural
ion and Marketing (520-0363) projects both involve direct
rograms, which include technical assistance and some
supervision of pesticides selection and/or use. The EA
ectly address pesticide management capabilities for each

eral other USAID/Guatemala project activities have been
ied as having potential impacts on the conservation of
l forests and biological diversity. These projects are
d below:

ral Electrification Project (520-0248) provides
fication to rural areas where there is adequate access to
ion, markets, health, education, and agricultural
s, and where electrification will enable an increasing
productive utilization of these resources. Of
lar concern are: (1) What guidelines, if any, does the
nt of Guatemala (INDE) use to determine where power
hould be located? (2) Are tropical forests or other
abitats being degraded by the installation of power

lines; and (3) Could the location of power lines be altered to go around, not through, areas of great ecological importance?

Again, Section 118 of the FAA denies AID assistance to any activities that degrade forested lands. The Project Evaluation Summary for this, and all projects, should have a section concerned with Environmental Impacts. The monitoring process regarding degradation of natural and biological resources must be strengthened.

* The purpose of the Farm to Market Access Roads Project (520-0332) is to expand the network of all-weather farm-to-market and tertiary roads to provide a better transportation system and to institutionalize the national program to construct and maintain low-cost, labor-intensive, rural farm-to-market roads. The broadening of existing trails and construction of rural roads requires forest trees to be cut and increases the risk of erosion damage, both of which may require mitigative measures.

In response to the risk of negative environmental impacts resulting from these project activities, an environmental expert will provide technical assistance, as recommended by the LAC Chief Environmental Officer and the Central America REMS. This environmental expert will be a U.S. PSC environmental engineer hired by USAID/Guatemala for two years and assigned to the General Directorate of Roads. Responsibilities for the PSC will include performing an EA on each road system constructed, as well as training and stimulating environmental awareness within the beneficiary communities and road workers.

* The PACT/ASINDES PVO Development Project (520-0348) and amendment assists ASINDES (a consortium of local and international PVOs) in building its insitutional capacity to offer technical and financial assistance to the PVO community in Guatemala. Fifteen sub-grants for productive or socioeconomic infrastructure have been undertaken to date. Unfortunately, no environmental or conservation oriented PVO has received support from this project. Given the urgent need for coordinated, effective programs fomenting public awareness of environmental issues, the PACT/ASINDES project should be expanded to include support for the infrastructure capabilities of environmental NGOs in Guatemala.

* Both the Rural Potable Water and Sanitation II (520-0335) and the CARE Rural Potable Water (520-0336) projects provide support for the construction and use of potable water systems and improve environmental sanitation in rural communities. Project activities include the digging of wells, establishment of water transfer systems, and sanitary latrines. While the environmental impact resulting from these activities is small, care should be taken that water canals are constructed to minimize damage to natural habitats and to preserve local hydrological conditions.

roposed Technification of Traditional Export Crops
(520-0381) will increase the productivity of 4,000 small
producers through the introduction of a comprehensive
ogy management package. Project activities will focus on
g agricultural lands, but the possibility may exist for
de procurement using credit funds. If this is the case,
hat examines pesticide procurement and use will be
d.

f the fundamental causes of loss of biological diversity
formed public actions tht lead to unsustainable
ture practices and environmental degradation.
atemala has not supported any programs that support
mental education in the primary or secondary school
. The Mission is, however, supporting one project, the
Education Management Improvement Project (520-0320),
urpose is to strengthen the program management capacity
onal offices of education and improve in-service training
ool supervision, particularly for rual primary shcools.
nvironmental education is not a component of this
, Mission personnel feel that this would be an option
xploring in the future. There are several problems faced
project, such as the language barrier many rural
n face and the associated high student dropout rate.
roblems may make it difficult for USAID/Guatemala to
e environmental education as a new, discrete activity.

at is needed is a strong public sector movement for an
mental education curriculum in Guatemala schools.
with an initiative from the Ministry of Education, this
ake AID participation feasible in integrating
mental education into existing course curricula of public
.

e establishment and enforcement of environmental
tion and civil laws is fundamental to the protection and
able management of Guatemala's biological resources.
Guatemala has one on-going project, Guatemala Judicial
ment (520-0376), whose purpose is to strengthen the
tional capacity of the Supreme Court and other
tions of the Judicial Branch. This project must have, as
iority, an education effort within the Government of
ala to support enforcement of civil laws and policies
ed with rural development, wildlife proection, and
ation. At present, few civil regulations are actually
d to discourage illegal timber extraction or poaching and
in wildlife areas. USAID/Guatemala must enter into a
dialogue with the government to assist in the formulation
forcement of these statutes.

ic Law 480 declared it U.S. policy to use the agricultural
ivity of the United States to combat hunger and
ition, and encourage growth and development in developing
es. Recent amendments to PL480 expand the range of

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activities that can use local currency under the agricultural aid and trade missions program. These include activities aimed at the conservation of biological diversity. Activities suggested by the Senante Committee Report to further the conservation of biological diversity in developing countries area outlined in STATE cable 239423.

At the present time, no PL480 local currency funds are used for projects in natural resource management, environmental education, support of environmental NGOs, or conservation of biological diversity. It is instructive, however, to keep in mind that a clear understanding exists between USAID and the GOG that local currencies generated under either ESF, PL480, or Section 416 Sugar Quota Set-Aside agreements are owned by the GOG. Since the Ministry of Agriculture has major control over all local currencies and has yet to show any interest in the conservation of biological resources, the Mission must first convince the GOG that biodiversity activities are in their long-term interest. Only then can USAID hope to suggest and direct local currency project activities toward conservation issues. Through support of environmental NGOs, development of environmental education programs and public awareness, USAID could foment public opinion to influence the GOG's position on biological diversity.

* One completed USAID/Guatemala project, the IXCAN Colonization Project (520-T-026) deserves special attention. The original design of the IXCAN Project called for the relocation of landless Guatemalan families on approximately 10 hectare parcels of land in a previously undeveloped tropical forest sector of northern Guatemala. This project failed to undertake land use studies or develop adequate infrastructure prior to the placement of colonists. No consideration was given to the considerable differences in the productive potential of land within the project area before settlements were established.

Colonization activities that include road construction and relocation of settlers into undegraded tropical forest lands are now clearly prohibited under Section 118 of the 1986 amended FAA. No Environmental Assessment was required at the time of the IXCAN Project, and if an EA had been prepared, the IXCAN project would have been denied funding on environmental grounds. This is an instructive example that AID's environmental policies have evolved in response to host-country needs, initiatives of AID staff, concerns of the environmental community, and new legislation.

* Finally, it should be made clear that AID/Guatemala should not allow Economic Support Funds (ESF) or PL480 funds to be utilized to effect electification, irrigation, or rural road construction projects without the prior development of an Environmental Impact Assessment.

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