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# NICARAGUA COUNTRY ANALYSIS OF TROPICAL FORESTS AND BIOLOGICAL DIVERSITY

FAA 118/119 ASSESSMENT

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## FAA 118/119 ASSESSMENT

Prepared By

Kathleen McGinley, Ph.D.  
Research Forester

US Forest Service, International Institute of Tropical Forestry

Wayne J. Arendt, Ph.D.  
Research Wildlife Biologist

US Forest Service, International Institute of Tropical Forestry

Jerry Bauer  
Biological Scientist

US Forest Service, International Institute of Tropical Forestry

Jose Manual Zolotoff  
Research Director  
Fundación Cocibolca

In collaboration with  
Fundación Cocibolca

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## ACRONYMS FOUND IN TEXT

ADS	USAID Automated Directives System
CCAD	Central American Commission on Environment and Development ( <i>Comisión Centroamericano de Ambiente y Desarrollo</i> )
CINCO	Center for Communication Research ( <i>Centro de Investigación para la Comunicación</i> )
CIP	Center for International Policies
CITES	Convention on the International Trade in Endangered Species
CONAFOR	National Forest Commission ( <i>Consejo Nacional Forestal</i> )
DGAP	General Directorate of Protected Areas ( <i>Dirección General de Áreas Protegidas</i> )
FAA	Foreign Assistance Act
FAO	UN Food and Agriculture Organization
FSC	Forest Stewardship Council
GDP	Gross Domestic Product
GNI	Gross National Income
IMF	International Monetary Fund
INAFOR	National Forest Institute ( <i>Instituto Nacional Forestal</i> )
IUCN	International Union for the Conservation of Nature
MAGFOR	Ministry of Agriculture and Forests ( <i>Ministerio Agropecuario y Forestal</i> )
MARENA	Ministry of the Environment and Natural Resources ( <i>Ministerio de Ambiente y Recursos Naturales</i> )
NGO	Non- Governmental Organization
RAAN	Northern Atlantic Autonomous Region ( <i>Region Autónoma del Atlántico Norte</i> )
RAAS	Southern Atlantic Autonomous Region ( <i>Region Autónoma del Atlántico Sur</i> )
SINAP	National Protected Areas System ( <i>Sistema Nacional de Áreas Protegidas</i> )
SINIA	National System of Environmental Information ( <i>Sistema Nacional de Información Ambiental</i> )
TNC	The Nature Conservancy
UCA	Central American University ( <i>Universidad Centroamericana</i> )
UNAN	National Autonomous University of Nicaragua ( <i>Universidad Nacional Autónoma de Nicaragua</i> )
UNESCO	United Nations Educational, Scientific, and Organizational Organization
UNDP	United Nations Development Program
USAID	United States Agency for International Development
WCMC	World Conservation Monitoring Centre
WWF	World Wildlife Fund

## EXECUTIVE SUMMARY

### **Purpose of the Report**

In compliance with Sections 118 on Tropical Forest Conservation and 119 on Biodiversity Conservation of the U.S. Foreign Assistance Act (FAA) (as amended), this report describes Nicaragua's tropical forests and biological diversity and determines the associated needs and opportunities for their enhanced conservation. It provides important information for USAID/Nicaragua as they identify and determine the extent to which planned actions and investments in Nicaragua address identified threats and conservation and sustainable management needs associated with the country's tropical forests and biological diversity.

### **Status of Forests and Biodiversity**

Nicaragua extends over 130,000 km<sup>2</sup> and encompasses sixty-three natural ecosystem types, including 28 types of forest (Meyrat 2001). Forests cover nearly 57,000 km<sup>2</sup> of Nicaragua (43.5%) (MARENA 2007). Nonetheless, forests are being lost at a rate of about 1.3% per year (total forest loss from 2000 to 2005 = 70,000 ha) (FAO 2007). Forest loss is largely attributed to conversion to agriculture and grazing lands, which encompass over 37% of the territory (MARENA 2007). Forests have also been subject to uncontrolled and destructive logging practices that have led to the degradation and fragmentation of forests throughout the country. In an effort to control these practices and clean up the forest sector, the Nicaraguan Legislature produced a Law Banning Logging in 2006. However, to date, its interpretation and implementation has been problematic and complicated.

The diversity of ecosystem types in Nicaragua is associated with a high level of species diversity. Documented species include 225 mammals (Saldaña and Medina 2008), 709 birds (Martínez-Sánchez 2007; Acosta et al. In prep.; Arendt and Tórrez In press [a,b]; Muñoz et al. In prep), 8,514 insects (Maes 1999), and nearly 5,800 plants (Stevens et al. 2001). Nicaragua also harbors numerous endemic species (167 documented). However, 120 animal and plant species, including numerous endemic species, are listed by the IUCN as critically endangered, endangered, or threatened.

Aquatic systems, such as crater lakes, estuaries, cypress swamps, and coral mangroves, are some of the most highly impacted and threatened ecosystems in Nicaragua (MARENA 2001). Impacts on aquatic systems are largely associated with the ongoing deterioration of the hydrological cycle often caused by the removal or degradation of natural vegetative cover, and the subsequent erosion across the landscape and sedimentation and contamination of water ways and bodies. The most threatened vegetative systems in Nicaragua include deciduous and semi-deciduous forests, submontane pine and evergreen forests, cloud forests, and riparian forests. These ecosystems are threatened by limited extension, high levels of fragmentation, and other human-induced impacts (Meyrat 2001; MARENA 2001).

The government of Nicaragua has designated over 17% of its territory (72 units totaling 22,000 km<sup>2</sup>) with some form of protection through its National Protected Areas System (SINAP) (MARENA 2008). In 2000, nine natural ecosystem types had at least 70% of their total area within the SINAP, including montane evergreen forest, moderately drained lowland evergreen forest, Caribbean coral mangrove forest, perennial grassland on organic deposits, and lower montane evergreen forest. In contrast, in 2000, deciduous broadleaf shrubland was not protected and 14 ecosystem types had less than 9% of their range located within the SINAP (Meyrat 2001). Furthermore, according to an assessment by Castañeda et al. (2004), less than 10% of the protected areas in the SINAP are adequately managed, staffed, and financed.

### **Identification of Conservation Threats and Opportunities**

In this assessment, we identified significant direct and indirect threats to Nicaragua's forests and biodiversity. Direct threats include habitat conversion; contamination; sedimentation; overexploitation; illegal harvest of plants and animals; hurricanes; fires; climate change; and the introduction of exotic species. The indirect threats or drivers of the direct threats to Nicaragua's forests and biological diversity encompass poverty; political and institutional weaknesses; insufficient information on the status and changes in forests and biodiversity; and insecure land tenure. We also identified opportunities for the

mitigation of these threats and for the conservation of forests and biodiversity. These threats and opportunities are presented in detail in Sections VIII and IX of the report and in summary below.

- **Habitat Conversion** - In Nicaragua, the advancing conversion of natural ecosystems to agriculture and grazing lands is considered the greatest overall direct threat to forests and biodiversity (MARENA-SINIA 2003; Rodriguez Quiros 2007; MARENA 2007). Furthermore, conversion to agriculture and settlement is taking place within the SINAP, where these processes are largely prohibited without authorization, but left uncontrolled due primarily to weaknesses in the institutional framework and in the enforcement of related environmental legislation.

Opportunities to mitigate this direct threat and enhance conservation efforts include: support for governmental and non-governmental conservation organizations that promote habitat conservation and sustainable integrated resource use at the community level; promoting conservation-based land use and urban planning efforts; and strengthening protected area management through, for example, improved park ranger professionalism, and enhanced linkages between, and ecosystem representation among, the county's protected areas.

- **Contamination and Sedimentation** - Conversion of natural habitat to agriculture and development, and habitat fragmentation have lead to high levels of soil and water contamination, and sedimentation in lakes, lagoons, mangroves, coral reefs, underwater savannahs, and other coastal and marine systems in Nicaragua (MARENA 2007). Furthermore, intensive agriculture has lead to deteriorated soil quality and accelerated soil degradation.

Opportunities to mitigate these direct threats and enhance conservation efforts include: program development focused on sustainable, holistic farming practices, particularly in areas where intensive agriculture is dominant and/or the agricultural frontier is expanding; enhanced coastal and marine ecosystem protection through local-level community incentives and involvement; and development and implementation of education campaigns and other strategies aimed at reducing litter, waste, and contamination in urban and natural settings and waterways.

- **Overexploitation and Illegal Harvest** - In Nicaragua, the tendency to overexploit and illegally harvest key natural resources is increasing. These activities can lead to degraded gene pools that limit the success of species regeneration, particularly when extraction outpaces reproduction, and that ultimately, can result in species loss. The prevalence and increase in the overexploitation and illegal harvest of plant and animal species are closely linked to the state's lack of capacity (e.g. financial and human resources; political will and support) to monitor and enforce related legislation and bans (MARENA 2008).

Opportunities to mitigate these direct threats and enhance conservation efforts include: policy and strategy development, technical assistance, and training for improved monitoring and control of the overexploitation and illegal harvest and trade of flora and fauna within the agencies responsible for protected area (MARENA-DGAP) and forest (MAGFOR-INAFOR) administration; development of incentives and training programs for Nicaraguan customs officials to effectively monitor and control illegal international wildlife trade; training and support for private wildlife reserve management and staff to effectively monitor and reduce illegal trade of wildlife at the local level; management and monitoring of important indicator biota (e.g., endemics, specialists); creation and implementation of incentives for the protection of critical wildlife at the local/community level that deter the proclivity for wildlife poaching and trade; and development of education and awareness campaigns that focus on the threats of overexploitation and trade of Nicaragua's natural resources directed at and specialized for the general public, visitors, and tourists.

- **Hurricanes, Fire, and Climate Change** – Other direct threats to Nicaragua's forests and biodiversity include abiotic processes, such as hurricanes, fire, and climate change. Nicaragua has experienced severe hurricane impacts in each of the past three decades. Forest and other

ecosystem fires are increasing in number and extent. These may be ignited from lightning strikes and other natural sources, but are increasingly associated with uncontrolled shifting and other agricultural and farming practices. The frequency and impact of hurricanes, fires, and other climate events are expected to increase with the predicted changes in global climate. According to the Global Climate Risk Index (CRI), Nicaragua was ranked number three (following Honduras and Bangladesh) in terms of countries most affected by extreme climate events from 1998 to 2007 (Harmeling 2009). Nicaragua's ranking was significantly associated with increasing numbers and impacts of hurricanes in the Caribbean and increased susceptibility to these impacts due to limited development and resources for mitigation and response.

Opportunities to mitigate these direct threats and enhance conservation efforts include: development of enhanced hurricane and other natural disaster planning, mitigation, and adaptation measures, as well as advisory, response, and recovery programs; improved land use planning and management that mitigate the vulnerability of communities and natural resources to hurricanes and other natural disasters and that make communities and natural resources more adaptive to hurricanes, fires and other climate events and their impacts; development of education and awareness campaigns focused on sustainable agricultural practices and the impacts of fires on natural systems; and support for the protection of critical watersheds and coastal systems that include efforts to mitigate and/or adapt to the potential impacts of climate change.

- **Poverty** – Among the indirect threats to forests and biodiversity is the extent of extreme poverty in Nicaragua. This level of poverty has produced significant pressures on natural resources, particularly as sources of fuel, food, and income, which eventually lead to the degradation and conversion of natural habitat. This is often the case with forests in Nicaragua, whose market value is not reflective of their multiple values, and as a result are increasingly converted to shifting or permanent agriculture or grazing lands.

Opportunities to mitigate this indirect threat and enhance conservation efforts include: development of and support for programs that create opportunities for conservation-related micro- and community- enterprises, particularly in rural settings; development of financial incentives that support forest and biodiversity conservation (e.g., payments for ecosystem services, carbon finance, watershed protection payment schemes); development of and support for conservation programs that encourage private-public partnerships and that ensure the inclusion of local communities and the use of local labor forces (e.g. training and employment for guides and other staff at private wildlife reserves); and the design and marketing of long-term, sustainable tourism programs, particularly those that involve local communities.

- **Institutional and Political Weaknesses** – Institutional and political weaknesses also represent significant indirect threats to tropical forests and biodiversity in Nicaragua. These include insufficient institutional resources and capacity for forest and biodiversity conservation, instability and workforce turnover in governmental institutions, and implementation challenges and contradictions in the environmental and natural resources legislative framework.

Opportunities to mitigate these indirect threats and enhance conservation efforts include: capacity- building in terms of organizational management, leadership, financial management, and organizational ethics for the governmental agencies responsible for protected area (MARENA-DGAP) and forest (MAGFOR-INAFOR) administration; promotion and support for decentralized conservation actions that partner with municipal governments and other local institutions involved in forest and biodiversity conservation and protection; and technical and material support for the Private Wildlife Reserve Network

- **Insufficient Information on Forests and Biodiversity** – There are significant gaps in information on forests and biological diversity in Nicaragua. Outdated information makes conservation assessment, planning, and evaluation very difficult. Moreover, disparities in baseline biological information at the country-level significantly add to existing challenges in forest and biodiversity conservation.

Opportunities to mitigate these indirect threats and enhance conservation efforts include: establishment of a nationwide, standardized program for biological monitoring that involves governmental and non-governmental organizations, universities, and local communities; promotion of international scientific exchange and the linking of monitoring programs internationally; and the development of a permanent program for the retrieval, compilation, storage, and sharing of widely dispersed, biodiversity-related information from all major sources specializing in conservation information and stewardship.

- **Insecure Land Tenure** – Land tenure insecurities in the public and private sector are a threat to forest and biodiversity conservation in Nicaragua. Private landholdings make up much of the National Protected Areas System. Conflicting land use perspectives in these areas present a significant challenge for conservation through protected area management. In eastern Nicaragua, much of the forest area is located in communal or indigenous lands, few of which possess complete or even partial land title and/or boundary demarcation, posing further challenges for conservation and sustainable resource management.

Opportunities to mitigate this indirect threat and enhance conservation efforts include: the delimitation and titling of untitled indigenous, community, and other lands; determination and delineation of land tenure status throughout the SINAP; and the promotion and implementation of sustainable land use practices in the private landholdings within the protected areas system.

## **I. Introduction**

### **I.1 Purpose**

The purpose of this report is to carry out an assessment of Nicaragua's tropical forests and biodiversity, along with the associated conservation needs and opportunities, in compliance with sections 118 and 119 of the U.S. Foreign Assistance Act of 1961 (as amended) and country strategy guidelines under ADS 201.3.4.11 and ADS 204.5. The US Foreign Assistance Act (FAA) was issued on 4 September 1961. It separated the military and non-military aspects of US foreign assistance programs and called for the creation of a governmental agency to administer economic assistance programs around the world, which led to the creation of the US Agency for International Development later that year (USAID 2005a).

In 1987, the FAA was amended by the U.S. Congress to include Section 118 - Tropical Forest Conservation and Section 119 - Biodiversity Conservation. Section 118 requires that each USAID Country Development Strategy Statement or other country plan include (a) an analysis of the actions necessary for achieving the conservation and sustainable management of its tropical forests and (b) an assessment of the extent to which USAID proposed support for actions meet the identified forest conservation and sustainable management needs. Section 119 requires that each Country Development Strategy Statement or other country plan include (a) an analysis of the actions necessary to conserve biological diversity in the country, and (b) an assessment of the extent to which USAID support for actions meet the identified biodiversity conservation needs.

In compliance with the FAA, and as part of its ongoing efforts to design and program a new assistance strategy for Nicaragua for the period 2009-2014, USAID/Nicaragua requested an assessment of tropical forests and biodiversity in Nicaragua under the USAID-PASA No. 524-P-00-07-00007-00 Conservation and Sustainable Tourism in Critical Watersheds. As requested in the Scope of Work (App. A.), a team of tropical forest and biodiversity experts (App. B) were contracted to carry out a complete assessment (as opposed to an update from the most recent assessment as carried out by Weaver et al. 2003) of the status and conservation of biodiversity and tropical forests in Nicaragua and associated implications for USAID or other donor programming and environmental monitoring. This report is also expected to provide important information for the Mission in their identification and determination of the extent to which planned actions and investments in the 2009-2014 Strategy will address the threats to Nicaragua's tropical forests and biodiversity, as well as meet the conservation needs identified in the assessment.

### **I.2 Methods**

The primary methods implemented in this assessment of tropical forests and biodiversity in Nicaragua encompassed the review and assessment of relevant literature and documentation, including the 2003 assessment of forests and biodiversity by Weaver et al. (2003) and the 2003 – 2008 USAID Nicaragua Country Plan, as well as interviews with key informants. In particular, review and analysis of scientific literature and important archival data and documentation were carried out to determine the status of Nicaragua's tropical forests and biodiversity and associated conservation threats, initiatives, and opportunities (see Section X: References). Semi-structured and structured interviews were also carried out with (a) key USAID officers and staff in Nicaragua and Washington, D.C.; (b) representatives of Government of Nicaragua agencies involved in conservation and cross-cutting themes; (c) representatives of national and international conservation and other key non-governmental organizations (NGOs) working in Nicaragua; and (d) local and international biodiversity and forest experts (App. C).

Information from the interviews and literature review were summarized and analyzed to report on the status of Nicaragua's biodiversity and tropical forests, as well as the social, economic, institutional, legal, and policy context for their use and conservation, including actions currently being taken by government, other donors, NGOs, and the private sector. Analysis included the identification of significant direct and indirect threats to biodiversity and tropical forests, advances and inactivity following the 2003 FAA 118/119 assessment (Weaver et al. 2003), and proposed actions for their conservation and sustainability.

### **I.3 Presentation**

This report follows the outline set out by USAID/Nicaragua (2005b; App. A). The next section of this report presents the status of biodiversity in Nicaragua, including ecosystems, species, and genetic diversity; and associated ecosystem services. Section III reports on the status, diversity, and ecosystem services of forests, in particular. Section IV presents the values and economics of biodiversity and forests in Nicaragua. Section V describes the country in a socio-economic and political context. In Section VI, the institutions, policies and laws affecting conservation are presented and assessed. In Section VII, key governmental, NGO, and donor programs associated with conservation are described. Section VIII presents the assessed direct and indirect threats to biodiversity and forests, and Section IX presents the proposed opportunities and actions for biodiversity and forest conservation and sustainability.

## **II. Status of Biodiversity**

The Convention on Biological Diversity (1992: web) defines biological diversity, or 'biodiversity', as the "variability among living organisms from all sources including, *inter alia*, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems." As human activity increases the world over, biodiversity at every level and scale is also increasingly prone to adverse effects when human activity is not well planned and carried out. "Due to the decline and the interconnected nature of biodiversity and human well-being, the conservation of biodiversity is an international development priority for USAID" (USAID 2005b: 10). As such, and as discussed in Section I, this report focuses on the status of ecosystem, species, and genetic diversity in Nicaragua.

Nicaragua is the largest country in Central America with an extension of 130,373 km<sup>2</sup> and a land surface area of 119,867 km<sup>2</sup>. Two freshwater lakes, Lake Nicaragua (8,254 km<sup>2</sup>) and Lake Managua (1,020 km<sup>2</sup>), comprise more than seven percent of the national territory (MARENA 2007). From a biodiversity perspective, 63 types of natural ecosystem have been identified in Nicaragua, including 28 forest types (Meyrat 2001). Unique ecosystems have developed in Nicaragua as a result of distinct biophysical conditions. These include two large tectonic lakes, Managua (Xolotlán) and Nicaragua (Granada or Cocibolca); underwater prairies and coral mangroves; and seasonal evergreen submontane pine forests, which form the southern boundary of the natural range of *Pinus caribaea* (MARENA 2001). In terms of species diversity, 225 mammals (Saldaña and Medina 2008), 709 birds (Martínez-Sánchez 2007; Acosta et al. In prep.; Arendt and Tórrez In press [a,b]; Muñoz et al. In prep), more than 8,500 insects (Maes 1999), nearly 5,800 plants (Stevens et al. 2001) and numerous endemic species have been documented in Nicaragua. Moreover, many agree that actual species numbers and diversity are much higher and will continue to rise with increasing investigation (see for example: Perez et al 2005; Martínez-Sánchez et al. 2007; Arendt and Tórrez In press [a,b]; Morales et al. 2008).

The remainder of this section of the report discusses and analyzes key data and information on Nicaragua's biodiversity. In particular, the status of ecosystem, species, and genetic diversity are addressed, as well as the ecosystem services derived from biodiversity.

### **2.1 Ecosystem Diversity**

Ecosystem diversity is an integrated reflection of the physical, chemical, and biological factors that shape and characterize the environment of a given land area (Whittaker 1965; Noss 1990). In terms of Nicaragua's biogeography, the country can be divided into three main biogeographic zones (Fig. 1). The Pacific zone extends 38,700 km<sup>2</sup>, stretching along and out from the Pacific coast to encompass dry coastal lowlands up to the central volcanic range; the Central-Northern zone (42,400 km<sup>2</sup>) includes the mountainous interior; and the Atlantic zone, comprises a wide belt of rolling plains along the Atlantic coast (46,600 km<sup>2</sup>) (Incer 1973; Oviedo 1993).

Climatic conditions, such as precipitation and temperature, interact with biophysical characteristics, such as those characterized by the major biogeographic zones, and influence ecosystem diversity. In Nicaragua, mean annual rainfall ranges from less than 1,500 mm in the Central region to more than 6,000 mm in the southeast (IEA-

MARENA 2001). In addition, there are two drainage systems in Nicaragua, one that flows into the Pacific, which captures just seven percent of annual rainfall, and one that flows into the Caribbean Sea, capturing 93% of annual rainfall (Fenzl 1989). Mean annual temperatures in Nicaragua exhibit a moderate range, from lows of 57 – 63°F (14 - 17°C) in the Highlands of the interior (e.g. Jinotega, Matagalpa), to highs of 95 - 104°F (35 - 40°C) in the low-lying areas of the Pacific and the Atlantic plains (Fenzl 1989).

Meyrat (2001) considered vegetative structure and physiognomy, along with precipitation, temperature, landform, soil, and other key biophysical characteristics in the identification of Nicaragua's ecosystems. He utilized the UNESCO (1973) International Vegetation Mapping and Classification system as a basis for identifying ecosystem types in Nicaragua. The UNESCO system is principally based on the physiognomy (e.g. size and shape of plant biomass) and structure (e.g. horizontal and vertical distribution of plant biomass) of terrestrial vegetation, and is supplemented by information on climate, soil, and landform (UNESCO 1973). This system establishes a hierarchy of categories to identify ecosystem types (Table 1). For example, "closed forest" is a first-order category defined as one "formed by trees at least five meters tall with their crowns interlocking" (UNESCO 1973: 17). Other first-level category formation classes include woodland, scrub, dwarf-scrub, herbaceous vegetation, desert, and aquatic formations.

Based on Meyrat's (2001) work, MARENA (2001) mapped 68 ecosystem types in Nicaragua, excluding marine ecosystems. Eleven of these are highly intervened systems such as agriculture, shrimp farms, and salt mines. There are also two inland water ecosystems that encompass lakes and lagoons and two systems with no vegetation. There are 53 natural terrestrial ecosystems, including forest (28), savanna (7), shrubland (2), grassland (2), scarce vegetation (6), and aquatic ecosystems (7) (MARENA 2003) (Fig. 2). Other descriptions of Nicaraguan ecosystems also have been developed (see for example Salas 1993), though the classification by Meyrat (2001) and the map developed by MARENA (2001) are most commonly referred to in the literature and in use in 2008.<sup>1</sup>

MARENA (2001) reports that in 2000, the three major land uses were farmland (agricultural and grazing lands), which covered 37.5% of the national territory, followed by closed broadleaf forest (24.3%) and open broadleaf forest (14.9%) (Table 2). Notably, urban areas covered less than a quarter of a percent of the country. In terms of specific ecosystem types, Meyrat (2001) determined that well-drained, lowland evergreen forest (7,452.8 km<sup>2</sup>; 5.7%); moderately drained, lowland alluvial evergreen forest (6,876 km<sup>2</sup>; 5.3%); and saturated savannah with short grasses and pine trees (3,090.4 km<sup>2</sup>; 2.4) were the most extensive natural ecosystems in Nicaragua in 2000 (App. D). Moderately intervened, moderately drained, lowland seasonal evergreen forests (7,152.1 km<sup>2</sup>; 5.5%); moderately intervened, moderately drained lowland alluvial evergreen forest (3,410 km<sup>2</sup>; 2.6%); and moderately intervened, submontane or lowland deciduous forest (2,172.3 km<sup>2</sup>; 1.7%) were the most extensive, intervened natural ecosystems in 2000. Farming systems with 10-25% natural vegetation (26,958 km<sup>2</sup>; 20.7%); farming systems with 25-50% natural vegetation (22,959.0 km<sup>2</sup>; 17.6%); and intensive farming systems (5,255.2 km<sup>2</sup>; 4.0%) represented the most intensively managed systems in Nicaragua. In contrast, the natural systems with the least area and range include: short cypress swamp (9.7 km<sup>2</sup>); perennial grassland on organic deposits (14.8 km<sup>2</sup>); savannah with short grasses and without submontane or montane vegetation (16.5 km<sup>2</sup>); Caribbean (17.9 km<sup>2</sup>) and Pacific (28.5 km<sup>2</sup>) open estuary; crater lagoon (31.4 km<sup>2</sup>); Caribbean coral mangrove (33.4 km<sup>2</sup>) and Caribbean semi-closed estuary (34.4 km<sup>2</sup>) (Meyrat 2001) (App. D).

With regard to the status of Nicaragua's ecosystems, the least impacted and threatened tend to be those that are the most difficult to reach, or from which to extract natural resources. Among these are scarcely vegetated lava flows, semi deciduous swamp forests of the Pacific region, seasonally flooded alluvial seasonal evergreen forests, and flooded grasslands (MARENA 2001). Conversely, aquatic systems are some of the most highly impacted, and thus threatened, ecosystems in Nicaragua. This is largely due to increasing deterioration of the hydrological cycle often caused by the removal or degradation of natural vegetative cover, and the resultant erosion across the landscape and sedimentation and contamination of water ways and bodies. Nicaragua's marine ecosystems, such as Caribbean coral reefs and Pacific marine

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<sup>1</sup> As of 2007, efforts were underway to update the identification and mapping of ecosystems in Nicaragua through the TNC-MARENA-DANIDA Gap Analysis Project (GAP).

grasslands, are subject to degradation through contamination, sedimentation, and overfishing, though the degree of impact has been poorly studied and is relatively unknown (MARENA 2001).

At the largest scale in Nicaragua, highly impacted and threatened aquatic ecosystems include crater lakes, alluvial coastal lakes, and freshwater vegetation mosaics (MARENA 2001). Scarcely vegetated beaches of the Pacific, and Pacific and Caribbean estuaries are among the most threatened aquatic ecosystems at the intermediate scale, and perennial grasslands on organic deposits, cypress swamps, and coral mangroves of the Caribbean are among the most threatened aquatic ecosystems at the smallest scale (MARENA 2001). Vegetative ecosystems that are threatened due to limited extension, high levels of fragmentation, and human impacts include deciduous and semi-deciduous forests, submontane pine and evergreen forests, cloud forests, and riparian forests (Meyrat 2001; MARENA 2001). Direct and indirect threats to Nicaragua's ecosystems and other aspects of biodiversity are discussed in detail in Section VIII.

In addition to identifying ecosystems at the national level, efforts to define conservation-associated ecoregions of Mesoamerica were carried out in the mid-2000s (Pérez 2006; TNC 2007, various). Ecoregions are described by Dinerstein et al. (1995) as a large terrestrial or aquatic area that contains a geographically distinct assemblage of natural communities. These communities share a large majority of species, ecological dynamics, and environmental conditions. Additionally, these natural communities serve well as conservation units at global and continental scales (Dinerstein et al. 1995). The ecoregions of Nicaragua are identified in Figure 3. According to MARENA (2003) and Pérez (2006), the most highly threatened ecoregions in Nicaragua are: lowland and submontane deciduous forests, mangroves, and seasonal evergreen montane and submontane broadleaf forests. Notably, these are similar to the threatened terrestrial ecosystems identified by MARENA (2001) and Meyrat (2001).

## 2.2 Species Diversity

“Species are fundamental components of ecosystems, and their diversity is one key element of overall biodiversity” (USAID 2005b). In Nicaragua, there are more than 18,000 documented animal and plant species, including 225 species of mammals, over 700 birds, over 8,000 insects, over 1,900 mollusks, and nearly 5,800 plants (Table 3). However, there is a significant asymmetry in existing data on the taxonomy and geographic distribution of species in Nicaragua (Pérez et al. 2005). For some species groups there is very little or nothing known, such as annelids, crustaceans, sponges, and echinoderms. For other groups, information is incomplete and largely consists of species lists without distribution maps or data on species abundance. Nonetheless, there are groups for which considerably more information is known, such as birds, mollusks, and some insects (see for example: Gillespie et al. 2001; Martínez-Sánchez 2007; Arendt and Tórrez 2008, in press(a, b); McCrary et al. In press; Morales et al. 2008, Pérez et al. 2005).

Birds are the most studied taxonomic group in Nicaragua (see App. E). Some 512 bird species have been identified as resident species, and another 197 as migratory (e.g. migrants, migrants from the south, latitudinal migrants) (Martínez Sánchez 2007; Acosta et al. In prep.; Arendt and Tórrez 2008, in press(a, b); McCrary et al. In press). Insects are the most diverse group of species in Nicaragua, with more than 8,500 species and 100 new species having been identified in Nicaragua since 1985 (Maes 1999; MARENA 2007). The 5,796 plant species that have been documented in Nicaragua are associated with 225 families and 1,699 genera. In addition, these include 898 rare plant species (MARENA 2007).

### 2.2.a Endemic Species

Nicaragua has a significant number of documented endemic species. Endemic species are those that are exclusively native to a particular territory or biota (Brown and Lomolino 1998; Dudley and Parrish 2005). Existing data on Nicaragua's endemism is presented in Table 4. In total, there are 159 documented endemic species in Nicaragua (App. F). However, there is general agreement that the documentation of endemic species is incomplete for Nicaragua, particularly in the case of invertebrates (especially insects), and of aquatic and terrestrial lower plants (Maes 1999; pers. comm. J.M Pérez).

There are two documented endemic mammal species in Nicaragua, though it is noteworthy that endemic mammal records have not been updated since the late 1990s (Zolotoff & Lezama 2007). One of these endemic mammals is the Richmond's squirrel (*Sciurus richmondi*), a species of rodent whose natural habitat

is subtropical or tropical dry forests (Baillie 1996a; Thorington and Hoffmann 2005). The Nicaraguan Rice Rat (*Oryzomys dimidiatus*) is also endemic to Nicaragua (Baillie 1996b). Only two known specimens have been collected; the first was captured in a banana plantation and the second in a sugar cane field (Weksler et al. 2006).

With regard to birds, the Nicaraguan grackle (*Quiscalus nicaraguensis*) was once considered endemic to the margins of the large lakes in Nicaragua, yet due to agricultural and farming expansion and subsequent degradation of the grackle's native habitat, this species has extended its range to Costa Rica (Zolotoff & Lezama 2007). It is also noteworthy that the lack of endemic species in Nicaragua cannot be attributed to a lack of research. Birds have been highly studied in Nicaragua, owing in large part to a growing group of local ornithologists and permanent monitoring programs in many parts of the country (Bauer et al. 2008). Nonetheless, there are some high elevation areas, such as Cerro Kilambé, Saslaya and Peñas Blancas, with little ornithological study and where discoveries of endemic or new bird species may still be made (Zolotoff, pers. comm.).

The number of documented endemic fish species (19) in Nicaragua is largely attributed to freshwater fish that have evolved in crater lakes and lagoons through sympatric speciation (i.e. genetic divergence of various populations from a single parent species inhabiting the same geographic region) (Barluenga et al. 2006). Additionally, freshwater fish have been highly studied in Nicaragua since about the 1950s (Stauffer et al. 2008); reptiles and amphibians much less. Consequently, documented endemic reptile (4) and amphibian (4) species, such as the Little Corn Island frog (*Lithobates miadis*), are expected to increase with increased study of remote and geographically isolated areas of the country, particularly in the Atlantic region (Zolotoff and Lezama 2007).

Arthropods demonstrate a relatively high number of species endemic to Nicaragua (49). Zolotoff and Lezama (2007) indicate that some of these species may exist elsewhere, but have yet to be identified, due to comparably fewer studies of insects throughout the region and the higher overall number of species in this taxonomic group. As for endemic mollusk species (15), many are found in the central highlands and northern part of Nicaragua, in secondary forest and agricultural lands, e.g. Santa Maura (sub-basin of the river Tuma, Jinotega), Fuente Pura (limit of the sub-basin Jigüina River, Jinotega-Matagalpa) and Selva Negra (sub-basin Mill River North, Matagalpa) (Zolotoff and Lezama 2007).

Of the 73 documented endemic plant species in Nicaragua, 18 represent the only known Nicaraguan species within an entire family of plants. The majority (68%) of endemic plant species are found in the mountainous regions of the Central North (e.g. Santa Maria de Ostuma, Volcán Mombacho, Volcán Concepcion, Volcán Maderas in the isla de Ometepe) (MARENA 2007). Endemic plant species, particularly orchids, are abundant in highland ecosystems, such as cloud forests, due to their relative isolation, but are also found in other habitats such as dry and humid forests. The National Herbarium of Nicaragua maintains collections of many endemic plant species from the highlands of Matagalpa and Jinotega. These include Santa Maria de Ostuma, Cerro Peñas Blancas, Miraflores lagoon, Quisuca and Tepesomoto hill in Estelí, Kilambé hill, Volcán Mombacho, Volcán Maderas and Volcán Concepción in the Pacific (Zolotoff and Lezama 2007).

### 2.2.b Threatened Species

The number and range of threatened and endangered species in Nicaragua is also important to understanding the status of forest and other biodiversity, and for devising strategies for conservation. The IUCN identifies rare and threatened plant and animal species worldwide. These species are widely considered to be of global and local importance for conservation. In 1999, the Central American Commission on Environment and Development (*Comisión Centroamericano de Ambiente y Desarrollo* (CCAD)) reported on the number of threatened species per taxonomic group according to the IUCN categories of threat (e.g. from extinct to limited risk) for Central America and Mexico. Eighty-four species were listed for Nicaragua, 41 of which were considered threatened<sup>2</sup> (Table 5). Mollusks

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<sup>2</sup> The IUCN identifies 'threatened' species as those falling in the critically endangered, endangered, and vulnerable listing categories (IUCN 2008, web).

represented the taxonomic group with the greatest number of threatened species in 1999 (24), followed by reptiles (7), and mammals (6) (CCAD 1999).

Recent studies suggest that the number of threatened species has increased considerably since 1999 (from 41 to 120) (MARENA, In litt.; Pérez, In Press). This increase is due, in part, to the increase in information and data on species diversity in Nicaragua, but is also attributed to increasing pressures on native habitats and species. According to MARENA (In litt.) and Perez (In press), in 2008, there were a total of 279 species listed by the IUCN (Table 6) (See App. G for complete list). The taxonomic groups with the highest number of threatened species were plants (39), followed by mollusks (24), fish (22), amphibians (10), and birds (9) (App. G). Threats to listed Nicaraguan species vary, yet, many are associated with specific habitats that are under increasing pressures from conversion or degradation, and/or are largely susceptible to hunting, capture, or other direct anthropogenic pressures (IUCN 2008).

An important example of a threatened mammal species in Nicaragua is the Baird's Tapir (*Tapirus bairdii*). It extends from Mexico, throughout Central America, to parts of Colombia and Ecuador. It is generally found in humid habitats from sea level up to 3,600 masl. "The species is strongly associated with water and is found in marsh and swamp areas, mangroves, wet tropical rainforest, riparian woodland, monsoon deciduous forest, dry deciduous forest, montane cloud forest and páramo" (Castellanos et al. 2008).

Baird's tapir is threatened primarily by habitat loss, fragmentation, and hunting. Their low reproductive rate combines with hunting threats and habitat loss to result in serious threats to population levels (Matola et al. 1997). In addition, some evidence suggests that susceptibility to infectious diseases may also contribute to further decline of the species. And, while key protected areas throughout the tapir's range may represent strongholds for distinct populations, increasing pressure from hunting and the lack of enforcement of protected area and species laws are expected to result in continuing declines in, and increasing fragmentation of, existing populations throughout the tapir's range. Baird's tapir is already considered locally extinct in El Salvador (Castellanos et al. 2008).

The recently rediscovered Golden-Cheeked Warbler (*Dendroica chrysoparia*) (Morales et al. 2008) is an example of a threatened bird species found in Nicaragua that is listed as 'endangered' by the IUCN (2008). It is a migratory species that nests and breeds in the juniper-oak woodlands of central Texas (Ladd and Gass 1999). During migration and temperate winter months, it is found in montane pine or pine-oak forests of Central America (Vidal et al. 1994; Rappole et al. 1992), but has also been recorded in lower montane wet and tropical broadleaf forest (Rappole 2000; Morales et al. 2008). Habitat destruction and degradation in both its breeding and winter habitats are considered the primary causes of population decline (Ladd and Gass 1999).

The Great Green Macaw (*Ara ambiguus*) is also listed as 'endangered' by the IUCN (2008). This species occurs from Honduras to northwest Colombia. In Nicaragua, *Ara ambiguus* is found primarily in lowland, tropical and rain forest as well as pine barrens, primarily in the Bosawas Reserve and around the Indio-Maíz and San Juan rivers (Martínez-Sánchez 2007; Birdlife 2008). It is threatened throughout its range by extensive habitat destruction and capture for the cage bird trade, as it is one of the most popular and demanded species in the domestic pet trade. The Yellow-naped Parrot (*Amazonas auropalliata*) is found along the Pacific coast from southern Mexico, south to northern Costa Rica. The Scarlet Macaw (*Ara macao*) is found from eastern Mexico south to Amazonian Peru and Brazil (IUCN 2008). Though both are listed as species of 'least concern'<sup>3</sup> by the IUCN, each is considered threatened by illegal trade and habitat destruction, particularly in Nicaragua. *Ara macao* disappeared between 2005 and 2006 from the northern Caribbean region of the country, and the status and distribution of *Amazona auropalliata* is currently under study (Lezama-López 2008).

In terms of threatened plant and tree species, the three critically endangered plant species in Nicaragua (*Lonchocarpus phaseolifolius*, *Lonchocarpus yoroensis*, *Mollinedia ruae*) are trees associated with lowland dry forest habitats and are threatened by habitat loss and degradation (IUCN 2008). Many other endangered

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<sup>3</sup> "Least Concern is noted when a species has been evaluated against the criteria of Critically Endangered, Endangered, Vulnerable or Near Threatened and does not qualify for any of these. Widespread and abundant taxa are included in this category" (IUCN 2001).

and vulnerable dry (e.g. *Lonchocarpus miniflorus*, *Ocotea jorge-escobarii*, *Zanthoxylum ferrugineum*), moist/wet (e.g. *Eugenia salamensis*, *Terminalia bucidoides*), and cloud (e.g. *Amphitecna molinae*) habitat plant and tree species are also threatened by the loss and degradation of their associated habitats (IUCN 2008).

Other listed herbaceous and tree species in Nicaragua are associated not only with habitat pressures, but threats from overexploitation as well. These are typically timber species, and are discussed in Section III. Finally, given the trade-related threats to some IUCN listed Nicaraguan species, many of these are also listed by the CITES. This convention, its ramifications, and application in Nicaragua are discussed in Section VI.

### **2.3 Genetic Diversity**

The genetic diversity that exists within species is also an important aspect of biodiversity, as it is considered to be essential to long-term species survival and resistance to extinction (Gillies et al. 1999). With specific regard to this report, USAID guidance on the analysis of genetic diversity states that the “conservation of economically important species and germ plasm (including land races and wild relatives of agriculturally important crops and livestock) should be considered and discussed where appropriate” (USAID 1988, cited by USAID 2005b).

In Nicaragua, there is limited information on and study of genetic diversity of Nicaraguan species and landraces. Some studies have been carried out to assess the genetic diversity of common bean landraces, which are an important component of the cultivated crops in small-scale farming systems of Nicaragua (see for example Llano et al. 1998; Gómez 2004). Common bean production occurs throughout the country and occupies more than 60% of the total agricultural area (Llano et al. 1998 cited by Gómez 2004). “In the [Nicaraguan common bean] landraces studied, the genetic diversity was distributed within, as well as, among populations. It was also found that changes have occurred in the genetic diversity of the populations stored ex situ.” (Gómez 2004).

Studies also have been carried out to understand the genetic diversity of cichlid fish species found in Nicaraguan lakes (see for example: Barluenga et al. 2006; Bunje et al. 2007). One such study indicated that “the genetic diversity of derived crater lake (cichlid) populations is lower than that of the source population regardless of when and how each population was sampled. Furthermore, changes in various estimates of genetic diversity of cichlid populations within lakes are minimal and provide no evidence for drastic changes during the last 20 years, supporting the hypothesis that the processes which have resulted in rapid speciation (of Nicaraguan cichlids) are primarily historical. In contrast, there is some evidence for ongoing evolution, particularly selection, in all lakes except crater Lake Masaya” (Bunje et al. 2007). Other genetic studies on the timber species, such as Big Leaf Mahogany are discussed in Section III.

### **2.4 Ecosystem Services Associated with Biodiversity**

Nicaragua’s ecosystem, species, and genetic diversity provide important ecosystem services at local, national, regional, and global levels. These include soil and water resource protection, nutrient cycling, plant and crop pollination, pest control, carbon sequestration, etc. Such services are important not only to the natural processes and productivity of the country, but may also be key factors for improving and reducing poverty, which is a widespread challenge throughout much of Nicaragua (see Section IX).

Some scientists have attempted to value the ecosystem services associated with Nicaragua’s natural resources. Hurtado (1999) approximated the value of environmental goods and services and their contribution to the national economy in Nicaragua. He found that in 1997, the estimated value of Nicaragua’s environmental services were approximately US\$6.33 billion. In another estimation, Barzev (2001) suggests that the total contribution of environmental goods and services to the national economy was about US\$126 million, or 6% of Nicaragua’s GDP, in 1998. However, Barzev (2001), did not take into account carbon sequestration, which could contribute up to US\$3.6 billion (Hurtado 1999). Though these two studies are important contributions to understanding the value of ecosystem goods and services in Nicaragua, much more must be done to understand their value and contribution to the country’s productivity and development.

Other studies have focused on specific ecosystems and the services that they provide. Pagiola et al. (2007) studied ecosystem services of agricultural activities in Nicaragua. They contend that agricultural landscapes can provide ecosystem services, but that these are rarely understood by farmers and other producers, and as such, are typically under produced. They examined the disbursement of payments for ecosystem services through the Regional Integrated Silvopastoral Ecosystem Management Project in the Matiguás-Río Blanco region of Nicaragua. This project was implemented to promote the adoption of silvopastoral practices that improve the provision of ecosystem services, such as biodiversity conservation and carbon sequestration, while retaining agricultural production. They found that the project has “succeeded in inducing farmers to increase substantially the use of practices that generate higher levels of ecosystem services. In the project's first two years, ...the area of degraded pasture fell by two thirds, while pastures with high tree density increased substantially, as did fodder banks and live fences.” Based on their findings, the authors suggest that this project continue, expand, and incorporate long-term payments for environmental services, which could be financed, at least in part, through payments by water users and carbon buyers, though additional financial support would also be needed (Pagiola et al. 2007).

In another study that examined biodiversity conservation in farming systems, Pérez et al. (2006) documented 212 bird species (30% of total bird species in Nicaragua), 56 mollusks (22%), and 170 tree species (2.6%) across 41 farms in central Nicaragua. The authors demonstrate that farms, which constitute more than 37% of the national territory (MARENA 2004) can provide important ecosystem services, such as biodiversity conservation. Studies such as these by Pérez et al. (2006) and Pagiola et al. (2007) demonstrate the potential for the conservation of biodiversity and other ecosystem services in farm systems. Other studies have been carried out to understand ecosystem services from forests and are discussed in Section III.

### **III. Status of Tropical Forests**

#### **3.1 Forest types, area, and change**

There are 28 documented forest types in Nicaragua (Meyrat 2001) (see App. D). These range from dry deciduous forests, to wet broadleaf and swamp forests, up to montane cloud forests. In 2000, forest area totaled 56,685 km<sup>2</sup> in Nicaragua, which represented about 43% of the territory (MARENA 2001) (Fig. 4; Table 7). In 2000, about 5% of the total forest area was found in the Pacific Region, 17% in the Central Region (Madriz, Nueva Segovia, Matagalpa, Jinotega, Boaco, Chontales, and Estelí), and 78% in the Atlantic Region (RAAN, RAAS, Río San Juan) (MAGFOR 2001). The Atlantic Region is predominated by lowland broadleaf forest, and, at the country level, is noted for harboring the largest expanse of tropical broadleaf forest north of Amazonia (approx. 23 million ha) (Roper 2003).

The FAO (2007) estimates that nearly 5.2 million ha of forest covered Nicaragua in 2005 (42% of the land base). According to this estimate, Nicaragua lost nearly 1.35 million ha of forest between 1990 and 2005 (Table 8). This is equivalent to about 20% of the original forest area in 1990 (FAO 2007). Figure 5 illustrates the change in forest cover from 1983 to 2000 in Nicaragua. Likewise, the average annual rate of forest change in Nicaragua from 1990 to 2000 was -1.6%, which slowed slightly to -1.3% between 2000 and 2005 (FAO 2007). This rate is greater than the average annual rate of forest change in Costa Rica (+0.1%), Belize (0%), and Panama (-0.1%) for the same time period, equal to that of Guatemala (-1.3%); and less than El Salvador (-1.5%) and Honduras (-3.1) (Table 8). In terms of total forest loss from 2000-2005, Nicaragua lost more forest (-70,000 ha) than all other Central American countries, with the exception of Honduras (-156,000 ha) (FAO 2007).

In comparison to South America, Nicaragua's average annual rate of deforestation from 2000 to 2005 (-1.3%) was greater than the regional average (-0.5%) and than all countries in the region, with the exception of Ecuador (-1.7%). Conversely, the total loss of forest in Nicaragua (-70,000 ha) during that time period was less than many countries in South America. These include: Peru (-94,000 ha; -0.1%), Argentina (-150,000 ha; -0.4), Paraguay (-179,000 ha; -0.9), Ecuador (-198,000 ha; -1.7%), Bolivia (-270,000 ha; -0.5%), Venezuela (-288,000 ha; -0.6%), and Brazil (-3,103,000 ha; -0.6%) (FAO 2007).

As discussed in Section II, the least impacted and threatened of Nicaragua's natural ecosystems, including forests, tend to be those most difficult to reach, or from which natural resources can be extracted. In terms of forests, these include semi deciduous swamp forests of the Pacific region and seasonally flooded alluvial seasonal evergreen forests (MARENA 2001). Conversely, more accessible forest systems that have been highly impacted, degraded, or destroyed include deciduous and semi-deciduous forests, submontane pine and evergreen forests, riparian forests, and cloud forests (Meyrat 2001; MARENA 2001).

Forest loss in Nicaragua is largely due to the expansion of agricultural and grazing land, as well as slash-and-burn agricultural practices that create a mosaic of forest and cultivated patches across an increasing expanse of the landscape (Global Witness 2007) (Fig. 6). Forest degradation in Nicaragua is attributed in large part to indiscriminate overexploitation of forests for timber resources. Deforestation and forest degradation are also attributed to forest fires, pests (e.g. pine bark beetle (*Dendroctonus* sp.) and hurricanes, though to a much lesser degree than to anthropogenic factors (Rodríguez Quiros 2005). Direct and indirect threats to Nicaragua's forests and other ecosystems are discussed in further detail in Section VI.

### 3.2 Forest diversity

Nicaragua's forests harbor significant levels of the country's biological diversity. Many of the 167 documented endemic species (App. F) and 120 threatened species (App. G) are associated with forest ecosystems. For example, Big Leaf Mahogany (*Swietenia macrophylla*) is an important timber species in Nicaragua that is listed as vulnerable by the IUCN (2008). Big Leaf Mahogany has an extensive natural distribution that extends from Mexico to Brazil and is found in various forest types throughout its range (Weaver and Bauer 2000; Bauer and Francis 1998). Regeneration of this species is stochastic and it is naturally dependent upon large-scale disturbance. As such, Big Leaf Mahogany is vulnerable to selective logging regimes that do not typically open the canopy sufficiently for the regeneration requirements of this species. This has made Big Leaf Mahogany susceptible to extensive and long-term exploitation that have led to significant depletion, and in some places, the exhaustion of local populations, particularly in the northern parts of its range (Weaver and Bauer 2000; WCMC 1998).

Spanish cedar (*Cedrela odorata*) is another important tropical timber species found in Nicaragua (Weaver and Bauer 2000). It is listed as vulnerable by the IUCN and is in the same family (*Meliaceae*) as Big Leaf Mahogany (IUCN 2008). It is found from Mexico to Brazil and throughout the Caribbean, occurring in moist and dry lowland forest and preferring well-drained soils. This species has also been harvested throughout its range for more than 200 years and continues to be harvested for timber production at a large scale today. Due to similar regeneration requirements as mahogany, it is also vulnerable to over-exploitation (Weaver and Bauer 2000; IUCN 1998).

'Pochote' (*Bombacopsis quinata*) is another vulnerable timber species that is native to Colombia, Costa Rica, Honduras, Nicaragua, Panama, and Venezuela. *B. quinata* is found in fragmented subpopulations within remaining areas of seasonally dry lowland forest in its native range (Sandiford 1998). It is considered to be threatened at the provenance level, "most notably in the Choluteca valley in Honduras, eastern Nicaragua and northern Colombia", due to overexploitation for timber production, increasing settlement and conversion of its native habitat, and human-induced fires associated with slash-and-burn and other forms of agriculture (Sandiford 1998).

### 3.3 Genetic diversity of forest species

There is very limited information on the genetic diversity of forest associated species in Nicaragua. Yet, one regional level study of the genetic diversity of Big Leaf Mahogany (*Swietenia macrophylla*) included Nicaragua. Gillies et al. (1999) quantified the genetic diversity of *S. macrophylla* to better understand the impacts of selective logging on Mesoamerican populations of this species. They found that "population diversity values for *S. macrophylla* in Mesoamerica are somewhat lower than those determined for other tree species using similar methodologies" In particular, populations of Big Leaf Mahogany in logged areas of Nicaragua demonstrated lower genetic diversity than populations in areas that had not been intervened. Furthermore, "results indicate that selective logging significantly reduces genetic diversity

within *S. macrophylla*, which could pose a serious threat to the future viability of the species if these practices continue unchecked. Effective conservation and sustainable management programs for the species are an urgent priority” (Gillies et al. 1999). Given the pressures of harvest and trade on this species, *S. macrophylla* is also listed by CITES.

### **3.4 Forest ecosystem services**

Nicaragua’s forests provide important ecosystem services at local, national, regional, and global levels, including soil and water resource protection, biodiversity conservation, and carbon sequestration. While there has been limited study and quantification of forest ecosystem services in Nicaragua, Leguia et al. (2007) examined the potential of Nicaraguan forests for hydroelectric and ecosystem services. They considered vulnerability at the watershed level, location and future power potential of hydroelectric plants, as well as existing land uses and the capacity to produce ecosystem services. They identified approximately 8,300 km<sup>2</sup> of forest ecosystems, as well as 1,425 km<sup>2</sup> of perennial crops, located in upper watersheds and considered of high and very high importance for hydroelectric power projects or plants. What’s more, less than 10% of the forest ecosystems identified were found within the existing protected areas system. As such, the authors concluded that there is a significant need and opportunity for the protection of forests for water resource and other ecosystem services protection in Nicaragua’s critical watersheds (Leguia et al. 2007).

## **IV. Values and Economics of Biodiversity and Forests**

Much of Nicaragua’s historical and current economic activity and development depends on the supply, use, and harvest of its natural resources (MARENA 2003). Among the principal goods that contribute to the national economy are: water for consumption, fish, timber, artisan materials, medicinal plants, etc. Among the key services that contribute to the national economy are: water, soil, and biodiversity conservation; carbon sequestration; scenic beauty; etc. (MARENA 2003). Nonetheless, most of these natural goods and services are not wholly quantified, valued, nor considered within national accounting systems, which results in the omission of important information for decision- and policy- making. Furthermore, these goods and services are often valued differently by rural and urban populations, which can lead to conflicts of interest and use.

### **4.1 Exports and Employment**

Nicaragua’s economic development is dependent in large part on its productivity and export of natural and processed goods. Twenty products make up 75% of Nicaragua’s exports (i.e. in order of importance: coffee, beef, sugar, gold, peanuts, live cattle, lobsters, farm shrimp, cheese, red beans, fish, sea shrimp, bananas, plantains, timber, ethyl alcohol, instant coffee, cigars, peanut oil and sesame seeds) (US State Department 2008). Most of these products include, or are dependent upon, natural goods and services. In recent years, exports of additional products, such as vegetables, fruits, flowers, black beans, and wheat, have increased significantly (US State Department 2008).

Since the establishment of the Central America – Dominican Republic Free Trade Agreement (CAFTA-DR) in 2005, exports from Nicaragua have improved. This agreement between the U.S., Nicaragua, the Dominican Republic, Honduras, Costa Rica, Guatemala, and El Salvador permits duty free import and export among the signatory countries. Since 2005, Nicaraguan exports have increased throughout the region. In 2007, exports reached approximately US\$ 2.9 billion (US\$1.202 billion in traditional exports; US\$ 1.808 billion in free trade zone exports) (US State Department 2008). Fifty-five percent of these went to the U.S., followed by El Salvador (14.5%), Honduras (7.5%), and Costa Rica 6.7% (US State Department 2008).

Production and harvest of natural resources also represent important sources of employment for Nicaragua’s population. Agriculture and farming make up more than 25% of the employment sector (Table 9). Fishing (about 1%) and agriculture (about 0.5%) represent much less of the employment sector, but are considered important employment opportunities nonetheless (BCN 2008).

## 4.2 Tourism

The tourism industry is a very important and growing source of income and employment in Nicaragua, depending largely on natural resources and sound conservation. Income from tourism has grown to represent the third-largest source of foreign exchange, after livestock and textiles (Aleman 2007). According to the Central American Tourism Commission (*Comisión Centroamericana de Turismo (CCT)*) (2008), over 800,000 tourists visited Nicaragua in 2007, representing US\$188.8 million in foreign exchange. Tourism has steadily increased in recent years, from about 444,000 visitors and just over US\$100,000 million in 2000, reflecting an average annual tourism growth rate of nearly 10% from 2000 to 2007. In addition, Central Americans represent almost 46% of visitors to Nicaragua, followed closely by North Americans (40%) and then by Europeans (13%) (CCT 2008).

## 4.3 Forest values and economics

Forests, in particular, represent an important economic resource in Nicaragua, though one that is incompletely understood in terms of all of its associated use values. For example, forests are a significant energy source in Nicaragua. In 2005, more than 5.9 million m<sup>3</sup> of fuelwood was harvested from Nicaragua's forests (FAO 2007). That year, fuelwood represented more than 55% of the net energy consumption in the country, however this forest use is not quantified nor incorporated in national accounting systems (Rodríguez Quiros 2005).

Forests are also important sources of timber and other wood products. Timber production from forests is concentrated in four regions of Nicaragua: the conifer forests of Nueva Segovia, and the predominantly broadleaf forests in Río San Juan, the RAAN and the RAAS (Rodríguez Quiros 2005). In all, the wood products sector contributes about three percent to Nicaragua's GDP. However, it should be noted that some of the wood used in the wood products sector does not come from natural forests, but from agroforestry systems (Fairby 2005).

Until a 2006 governmental decree banned all mahogany harvest, Nicaragua was the fourth largest exporter of mahogany in the world (CINCO and CIP 2006). In 1976, all wood product exports were valued at approximately US\$70 million, dropping to less than US\$500,000 in 1986 (Roper 2003). Since then, the value of wood exports from Nicaragua has increased, albeit inconsistently, reaching about US\$ 15 million in 2005, but dropping to less than US\$ 7.2 million in 2006. This decrease was largely due to a governmental decree banning logging of major timber species (MARENA 2007) (Table 10) (see Section VI for detailed discussion of this legislation). Today, Nicaragua exports nearly half of its reported industrial roundwood and sawnwood production (FAO 2007). Yet, the country remains a net importer of wood products, reflecting the underutilization of Nicaragua's forests as renewable sources of valuable timber and other wood products (Pommier 2002).

Overall, the timber production sector in Nicaragua has ebbed and flowed throughout recent history, and has yet to represent a stable and growing economic sector. Rodríguez Quiros (2005: 122) describes the Nicaraguan forest production sector as "economically dormant", given its access to extensive resources and limited initiative to invest in long-term production. Del Gatto et al. (2006) report that there was some significant investment in forest production in Nicaragua in the 1950s and 1960s, but this mainly focused on large-scale, unrestricted timber extractions. They also note that once the regulation of timber harvests began in the late 1970s, investment in the timber industry reduced significantly as mostly outside investors feared regulations would render business unprofitable. Fitful starts to the sector have been noted since then, resulting in a small number of enduring forest products industries that produce finished products like floors, doors, and tongue-and-groove wood products. Nonetheless, for the most part, the timber products sector aggregates little value to harvested wood products and remains poorly organized and invested in the long-term (Del Gatto et al. 2006).

In addition to timber, forests are harvested for non-wood products as well. There is very limited production, marketing, and trade of these products, though they are slowly increasing as additional economic opportunities throughout Nicaragua, and for forest-associated communities in particular. Examples of sustainable non-wood product forest use includes the harvest and sale of the ojoche fruit (*Brossimum alicastrum*) in communities in the northern part of Chinandega, orchid and bromeliad harvest

and cultivation in communities in Tisey, Esteli; artisan products produced in Masaya and Isla de Solentiname, Río San Juan (Rueda Pereira 2007); and medicinal plant collection. Rueda (2006) cites 34 medicinal plant species commonly collected and used in Nicaragua (Table 11). He notes that there are possibly many more, though these are the most common.

#### **4.4 Other biodiversity uses and economics**

Nicaragua's natural resources are also used and harvested to generate income at local, national, and higher levels. This often involves the harvest of plant or animal species for consumption or sale within a specified market. Regulation of these species and their uses has a broad range from no regulation at all to explicit monitoring and oversight. Increased regulation for specific species has increased with greater national and international focus on the impacts of harvest and trade on biological diversity (e.g. Mahogany, Cedar, parrots and other bird species) (MARENA 2007).

In general, the legal export of wildlife species from Nicaragua decreased significantly between 2002 and 2006, particularly for birds and reptiles, as enhanced legal instruments and controls on harvest from natural ecosystems, as well as on breeding and stocking centers were put into place (MARENA 2007) (Table 12). One exception to this downward trend is the export of queen conch (*Strombus giga*), which experienced an increase in harvest and legal export in recent years. This increase is attributed in part to increasing demand for its meat and shells, yet also to the development and implementation of administrative procedures for its sustainable management and export (Resolución Ministerial No. 037-2005) (MARENA 2007).

Illegal capture and trade of wildlife species is another source of income associated with Nicaragua's biodiversity. However, these systems are largely uncontrolled and therefore, can represent significant threats to biodiversity conservation. The principal species involved in illegal trade are: Scarlet Macaw (*Ara macao*), Yellow-naped Parrot (*Amazona auropalliata*), plumed (basilisk) lizard (*Basiliscus plumifrons*), iguana (*Iguana iguana*), two-toed sloth (*Choloepus hoffmanni*), olive Ridley sea turtle eggs (*Lepidochelys olivacea*), hawksbill (carey) sea turtle shells (*Eretmochelys imbricata*), black conch (*Anadara tuberculosa*), spectacled Caiman (*Caiman crocodilus*), shrimp larvae (*Litopeneus vannamei*; *L. stilirostris*) and black coral (*Antiphatas* sp.). Most of these species are exported out of Nicaragua, as well as, traded and consumed domestically (Robinson et al. 2008).

## **V. Socio-Economic Context**

### **5.1 Population**

Encompassing more than 128,000 km<sup>2</sup>, Nicaragua is the largest country in Central America (FAO 2007). With a population just under 5.5 million people, it has the lowest population density (42 persons/km<sup>2</sup>) and lowest population growth rate (1.31% 2005-2010) in the region. In addition, Nicaragua's population growth rate is slowly decreasing (1.34% 2000-2005) (PD/DESA/WB 2007), as average reproductive rates decreased from five children to three children per woman between 1995 and 2005 (MARENA 2007). Finally, almost 51% of the population is female and just over 49% is male.

Forty-one percent of Nicaragua's population is considered rural. The rural population is growing at an average annual rate of 1.1% (2005-2010), which is much higher than most countries in South America and the Caribbean, but similar to Honduras and Guatemala (PD/DESA/WB 2007). Forty-nine percent of the population is urban and largely located in the Pacific region (152 persons/km<sup>2</sup>). The Central and Northern regions are slightly above the national population density (48 pers./km<sup>2</sup>) and the Atlantic region is the least densely populated by far (10 pers./km<sup>2</sup>). The departments with the highest population densities are Masaya (475 pers./km<sup>2</sup>), Managua (364 pers./km<sup>2</sup>), Granada (162 pers./km<sup>2</sup>) and Carazo (153 pers./km<sup>2</sup>) (MARENA 2007).

## 5.2 Economy

With regard to the national economy, in 2005, Nicaragua's GDP was slightly more than US\$4.9 billion. From 2000 to 2005, the average annual GDP growth rate was 3.25%, which was stronger than the average GDP growth rate throughout the Americas for the same time period (2.8%) (DDG/WB 2007). As described in Section V, exports have been one of the key engines driving economic growth in Nicaragua since the end of the civil war in the early 1990s. Coffee, meat, and sugar continue to be important exports, while the export of non-traditional products like vegetables, gold, and textiles have increased significantly in recent years (US State Department 2008).

In comparison to other developing countries around the world, fairly stable macro-economic policies help rank Nicaragua 93rd out of 177 countries on the World Bank's Ease of Doing Business Index (World Bank 2007). Yet, despite a steadily growing economy, Nicaragua remains the second poorest country in the hemisphere, with a GDP per capita less than US\$900 (higher only than Haiti in the western hemisphere) (DDG/WB 2007; UNDP 2006). The level of poverty in Nicaragua has led to extensive debt relief, particularly under the IMF Initiative for Heavily Indebted Poor Countries (HIPC) (US State Department 2008). It is also reflected in more than 15% of Nicaragua's gross national income (GNI) attributed to foreign assistance in 2005, and averaging 20% per year between 2000-2005. Nicaragua demonstrates the highest proportion of GNI from foreign aid throughout Central and South America (DDG/WB 2007).

Nearly 80% of Nicaragua's population lives on less than two dollars a day, and more than 45% of the population lives on less than one dollar a day (DDG/WB 2007; UNDP 2006). Nonetheless, social indicators on health and education are relatively high compared to some of Nicaragua's economic indicators. Nicaragua spends 2.91% of its GNI on education and has a literacy rate of 77% (UNESCO 2006). These counteracting factors to the level of poverty are reflected in its human development score (0.710) and rank (110th), which, regionally are higher than Guatemala and El Salvador (World Bank Group 2007).

## 5.3 Politics

Nicaragua is governed under a constitutional democracy with executive, legislative, judicial, and electoral branches of government (US State Department 2008). The electoral branch is specifically "in charge of the organization, direction and vigilance of the elections (whether national or municipal), plebiscites, and referendums" (Blandino 2007). Compared to many of its neighbors, the legislative branch in Nicaragua has considerable power in relation to the executive branch (e.g. power to override a presidential veto through a simple majority vote; elimination of the presidential pocket-veto on legislative bills). Yet, the judicial branch in Nicaragua is characterized as being encumbered by a "largely ineffective, often partisan, and overburdened system" (US State Department 2008).

Nicaragua is geographically divided into fifteen departments (geographic administrative units) and two autonomous regions. The departments are administrative divisions only, while the two autonomous regions along the Atlantic coast (the Northern Autonomous Atlantic Region (RAAN) and the Southern Autonomous Atlantic Region (RAAS) have autonomous controls over various aspects of government and are governed by a popularly elected governor. The autonomous regions exercise decentralized and increased control over local resources and their governance. Additionally, there are 153 municipalities throughout Nicaragua that have some degree of decentralized control and are governed by a publicly elected municipal council (Merrill 1993).

Throughout much of the 20th century in Nicaragua there was interminable conflict over governance between Conservatives and Liberals, leading to civil war on several occasions. Nicaragua has also experienced significant outside intervention, from the United States on behalf of the Conservatives who held power for more than 80 years during the 1900s, and from Cuba and the Soviet Union on behalf of rebels and civilians who fought against dynastic rule and oppression. Yet, since popular elections were re-established in 1990, Nicaragua has held three presidential elections, each considered free, fair, and peaceful by international observers, and "reflecting the maturing of Nicaragua's democratic institutions" (US State Department 2008). Yet, given its history of conflict, violence, and political volatility, as well as

executive-level scandals involving money-laundering, corruption, and threats of impeachment in the early 2000s, much work remains to be done for Nicaragua to achieve lasting governmental stability and transparency. This is reflected, in part, in a strong perception of corruption in Nicaragua, as evaluated by Transparency International (2008) (score: 2.6 (scale: 1 (highest perception of corruption) to 10 (lowest); rank: 123<sup>rd</sup>/179 whereby 1<sup>st</sup> is the least corrupt and 179<sup>th</sup> is the most corrupt country). Nicaragua was perceived as the fourth most corrupt country in the Americas (Transparency International 2008).

## VI. Institutions, Policies, and Laws Affecting Conservation

In general terms, Nicaragua has made some significant advances in the development of policies, laws, and norms oriented toward the sustainability of natural resources and environmental quality (e.g. the General Law of the Environment; the long-awaited Forest Sector Law). However, despite advances in the legislative framework, there remains limited development of related strategies and of supporting organizational structures, mechanisms, and social processes that permit the effective implementation of these laws and evaluation of their impacts on the socioeconomic development of the country (MARENA 2007a). Below, is a synthesis of the legislation most relevant to biodiversity and forest conservation in Nicaragua (see App. H for a complete list of conservation related laws and policies).

- Organic Law on the Institute of Water and Sewage (*Ley Orgánica del Instituto de Aguas y Alcantarillados*) (No. 275) published in 1979. The objectives of this law are to regulate, supervise, and control the potable water and sanitary sewage sector; and to protect consumers' and users' rights.
- Soil Protection and Erosion Control Law (*Ley de Protección de Suelos y Control de Erosión*) was published in 1983. The objectives of the law are to protect, preserve, and control the effects of soil erosion throughout the national territory, in order to favor the protection of watersheds and sustainable development in harmony with the environment.
- Municipalities Law (*Ley de Municipios*) (No. 40) was published in 1988. It defines a limited role of the municipality regarding control and oversight of natural resources within its boundaries. Nonetheless, this law permits municipalities to create and oversee Municipal Ecological Parks, which are an important tool for conservation in the country.
- General Law of the Environment (*Ley General del Medio Ambiente*) (No. 217) was published in 1996. It establishes the requirement for environmental impact assessments, the protected areas system, norms and procedures for export, import, and re-export of flora and fauna.
- Incentives for Tourism Industry Law (*Ley de Incentivos para la Industria Turística de la República de Nicaragua*) (No. 306) was published in 1999. This law was intended to promote a better use of natural resources in the development of tourism by exempting related activities from taxes on imports and the sale of goods and services.
- Presidential Decree No. 1499, first published in 1999 and later amended in 2003. This decree permits recreation and tourism in protected areas (Articles 46-47), opening a space for the development of activities.
- Conservation, Promotion, and Sustainable Development of the Forest Sector Law (*Ley de conservación, fomento y desarrollo sostenible del sector forestal*) (No. 462) was published in 2003. The objective of this law is to establish the legal framework for the conservation, promotion, and development of the forest sector in Nicaragua, founded on the management of natural forests, the promotion of plantations, and the protection, conservation, and restoration of forested areas. This law was later accompanied by regulations for its implementation and technical norms to guide forest management in the field.
- Special Law on Crimes against the Environment and Natural Resources (*Ley Especial de Delitos contra el Medio Ambiente y los Recursos Naturales*) (No. 559) was published in 2005. It defined environmental crimes and related punitive measures.
- Law Banning Cutting, Harvest, and Commercialization of Forest Resources (*Ley de veda para el corte, aprovechamiento y comercialización del recurso forestal*) (No. 585) was published in 2006. This law bans the extraction and commercialization of listed tree species throughout the country and bans all timber extraction from within 10km of the national borders and within 15km around protected areas, for a period of 10 years.

- The Nicaraguan Penal Code (Law No. 641) was published in December 2007. It includes crimes against the environment such as genetic manipulation, environmental contamination, illegal harvests of natural resources and protected species, etc. and supersedes Law No. 559.

## 6.1 Ministry of the Environment and Natural Resources

Many of the previously cited laws formed and/or designated governmental organizations with specific duties and obligations related to biodiversity and forest conservation. The Ministry of the Environment and Natural Resources (*Ministerio del Ambiente y los Recursos Naturales* (MARENA)), created in 1979, replaced the former Nicaraguan Institute of Natural Resources and Environment (*Instituto de Recursos Naturales y Ambiente* (IRENA)). MARENA is a key governmental institution involved in biodiversity and forest protection. It is specifically charged with environmental protection, and natural resource administration and monitoring, throughout the country. MARENA manages programs associated with national parks and protected areas, wildlife conservation, watershed protection, pollution control, reforestation, species and genetic diversity conservation, environmental and geographic information systems, and environmental education (MARENA 2008).

### 6.1.a National System of Protected Areas

Nicaragua's National System of Protected Areas (*Sistema Nacional de Áreas Protegidas* (SINAP)) is administered by MARENA through the General Directorate of Protected Areas (DGAP), which has territorial delegations throughout the departments of Nicaragua. The administration of the SINAP also benefits from cooperation and participation of municipal governments, non-governmental organizations, and international donors. According to the Protected Areas Law (Law No. 217: 1996) and its Regulations (Exec Decree 01-2007), the SINAP is comprised of National Protected Areas, Municipal Ecological Parks, and Private Wildlife Reserves of "ecological and social relevance at the local, national, and international level, defined in conformance with the law, and designated according to management categories that permit compliance with national policies and objectives of conservation" (Protected Areas Regulations: Art. 3).

As defined by the Convention on Biological Diversity (BOE 1994), a protected area is "a geographically defined area that has been designated or regulation and administered to achieve the specific objectives of conservation." According to the IUCN (1994), a protected area is "an area of land or sea dedicated specifically to the protection and maintenance of biological diversity, natural resources, and associated cultural resources, managed through legal or other effective means." As defined by Nicaragua's General Law on the Environment and the Regulations for Protected Areas, a protected area has "an objective of conservation, rational management, and restoration of flora, fauna, and other forms of life, such as biodiversity and the biosphere, which are intended for the restoration and conservation of geomorphological phenomena, or important historical, archeological, cultural, scenic, and/or recreational sites." However, with the exception of volcano craters at the Masaya National Park, the vast majority of the land within the SINAP is privately owned, resulting in a fundamental conflict of interest in the protection and management of Nicaragua's protected areas.

The first protected area in Nicaragua was declared in 1958 in the Peninsula of Cosiguina. As of 2008, the SINAP encompassed 72 national protected areas that covered more than 2.2 million hectares and over 17% of the country (MARENA 2008). With 51 units and totaling more than 1.7 million ha, Natural Reserves represent the national protected area category with the greatest number of units and area (Table 13). According to the Regulations for Protected Areas, a Natural Reserve permits interventions and is described as an area that generates environmental benefits of national or regional interest. This protected area category is comparable to the IUCN Protected Area Category IV: Habitat or Species Management Area. There are three categories of national protected area that do not permit interventions (i.e. Biological Reserve, National Park, and Historical Monument), of which there are a total of six units that cover a total of 343,057 hectares (MARENA/DGAP 2006). Another category of national protected areas is the Biosphere Reserve, which permits interventions and encompasses different categories of management and integrated administration to achieve sustainable development. Nicaragua has two such reserves (i.e. Bosawas and Río San Juan), recognized by the UNESCO, that together, encompass nearly 1.6 million hectares (MARENA 2008),

Information on the national protected areas in Nicaragua is summarized in Table 13. Distribution of protected area categories throughout the country is depicted in Figure 7. As noted above, most protected areas in Nicaragua are not without inhabitants, and these residents harvest forest-related, agricultural, and other types of resources. Such disparate uses can generate conflicts over the objectives of the protected areas and among the different user groups (Rodríguez Quiros 2005). As one government official observed: “Protected areas in Nicaragua have historically had very porous borders and been susceptible to significant land use change.”

#### 6.1.a.i Ecosystem representativeness in the National Protected Areas System

In terms of the representation of Nicaragua’s natural ecosystems in the SINAP, Meyrat (2001) analyzed related data from 2000 (Table 14; Fig. 8). Nine natural ecosystems were considered to have ‘excellent’ representation (*i.e.* at least 70% of the total ecosystem area is located within the boundaries of (a) protected area(s)) in the SINAP. These included montane evergreen forest; moderately drained lowland evergreen forest; Caribbean coral mangrove forest; perennial grassland on organic deposits; and lower montane evergreen forest. In contrast, deciduous broadleaf shrubland was not found anywhere within the protected area system in 2000, and 14 ecosystem types had less than nine percent of their range located within the SINAP (Meyrat 2001) (Table 15). Within an overall natural resources conservation strategy, ecosystems with minimal representation in the SINAP should obviously be the focus of increased protection through the establishment of new national protected areas and through the promotion of their inclusion in Private Wildlife Reserves and Municipal Ecological Parks.

Almost 19,000 km<sup>2</sup> (35%) of Nicaragua’s forested area was estimated to be located within the SINAP in 2000 (Table 16) (FAO 2003). Closed broadleaf forest represented the greatest forest area in the protected areas system (~ 15,000 km<sup>2</sup>), whereas closed pine forest had the least area under protection (283 km<sup>2</sup>). Most forestland outside protected areas is considered ‘private’, much of which is found on indigenous land (del Gatto et al. 2006). However, there is no clear data on forest ownership at the country level (FAO 2005). This is largely due to ongoing problems over land tenure, such as incomplete titles, complicated inscription processes, and conflicts over boundaries. Some indigenous lands with large expanses of forest have been titled, though the boundaries often remain in dispute and squatter invasions are common and difficult to remove. Yet, “with or without clear title, the majority of natural forest is in the hands of indigenous communities in Nicaragua” (del Gatto et al. 2006: 3).

#### 6.1.a.ii Financial and Human Resources for the National Protected Areas System (SINAP)

With regard to the financial resources available for the administration and oversight of the SINAP, the allocated budget in 2007 was US\$ 7,975,207 (US\$3.61/ha) (Tijerino 2006). Nonetheless, the estimated minimum annual cost of basic operations of the SINAP is US\$ 18,757,616 (US\$8.50/ha), while optimal level of annual operations of the SINAP would require US\$ 42,182,008 (US\$19.10/ha). Almost 66% of the 2007 budget was to be distributed to the national protected areas, 34% to the Biosphere Reserves, and less than 1% to the DGAP. In addition, financial resources for SINAP were to be invested disproportionately by region: 49% in the Pacific Region, followed by the Caribbean (34%) and Central (17%) Regions (Tijerino 2006).

With regard to the human resources available for the administration and stewardship of the protected areas system, there were 225 SINAP employees in 2006 (Tijerino 2006). Fifty-six percent of these were park guards (126; 17,531 ha/park guard), 62 (27.6%) were technical personnel, 21 (9.3%) were administrative personnel, and 16 (7.1%) were personnel with other occupations. MARENA/DGAP estimates that the number of employees needed for operations of the SINAP is significantly more than current staffing. The minimum number of staff for basic operations is estimated at 690 employees (443 park guards (4,986 ha/guard); 196 technical personnel, 35 administrative personnel, and 16 other occupations). And, optimal operations of the SINAP would require a total of 977 employees (615 park guards (3,592 ha/guard); 217 technical personnel; 67 administrative personnel; and 16 other occupations) (Tijerino 2006). Reflecting the level of human and financial resources for SINAP, a study by Castañeda et al. (2004) demonstrated that only five national protected areas were adequately managed and offered services to the public (*i.e.* Volcán Masaya, Chocoyero, Mombacho, La Flor and Chacocente). They report another six areas that were partially attended by park guard patrols, while the remainder (61 protected areas) had very limited management and protection on the ground (Castañeda et al. 2004).

The overall protection and administration of the SINAP is significantly hindered by limited and inadequately administrative, financial and human resources. This is reflected by the statistics above, as well as in deficiencies in planning, inventory, and monitoring of the country's protected areas. Table 17 presents the number of protected areas in which inventories of some major taxonomic groups have been carried out as part of the protected area management plans. Perhaps most notable is that no region is near complete in terms of species inventories. Moreover, the regulations for protected areas underscore the importance of and requirements for management plans, inventories, and monitoring, as key components in the sustainability of the SINAP. However, of the 72 national protected areas, only 23 had approved management plans in 2008, another 19 were in some phase of the approval process, and 30 protected areas had no management plan at all (MARENA 2008). Certainly, without these tools and basic human and financial resources, many of the nation's protected areas ultimately result in parks on paper only.

#### 6.1.a.iii Protected Area Co-Management

Given the state's limited capacity for protected area administration in Nicaragua, innovative arrangements for shared administration have been developed to mitigate these limitations towards a more sustainable management of the SINAP. One such arrangement is the shared or 'co-' management of protected areas with non-governmental organizations, landowners, and local governments to permit greater institutional presence in a greater number of protected areas, as well as to promote local participation in protected area management and conservation. MARENA's partners in protected co-management can include non-profit organizations, municipalities, universities, scientific institutions, or cooperative, indigenous or community organizations. As of 2006, there were nine protected areas under co-management (Table 18). These include five Natural Reserves, three Wildlife Refuges, and one protected landscape.

#### 6.1.a.iv Private Wildlife Reserves

Another mechanism for ecosystem and natural resource protection in Nicaragua are Private Wildlife Reserves. These are defined as "private land designated by the property owner as a Private Wildlife Reserve that is recognized by MARENA in accordance with criteria related to their potential for biodiversity and ecosystem conservation. The property owner is responsible for their administration in compliance with norms and procedures established by MARENA" (Protected Areas Regulations Art. 3). To be recognized by MARENA, Private Wildlife Reserves must have completed studies on the status and potential of biodiversity in the proposed area, and include processes for management and protection. Recognition of private reserves is prioritized according to criteria, such as an area's proximity to existing protected areas, potential to form or contribute to biological corridors, and its overall potential impact on ecosystem protection.

As of 2005, there were 47 recognized Private Wildlife Reserves (PWR), covering nearly 6,900 hectares in Nicaragua (Table 19a; Fig. 9) (MARENA 2007), however in 2007 the Private Reserve Network reported 32 member in their association (Table 19b). Most PWR are small in size (the majority less than 100 ha) and occur within larger mixed use landscapes, which pose challenges to long-term conservation management. Nonetheless, PWR represent an important and increasing conservation tool in Nicaragua. Reserve owners are organized through the Private Wildlife Reserve Network. This Network promotes integrated projects related to the preservation and conservation of biodiversity and natural resources, and has established efforts to secure and provide compensation to landowners for the protection of environmental services through the Private Wildlife Reserves system (MARENA 2007). According to Sepúlveda (Pers. Comm. 2008), many of Nicaragua's Private Wildlife Reserves prohibit hunting and human intervention, incorporate ecological management practices in productive activities, and carry out reforestation projects. The integration of such aspects not only contributes to increased conservation and connections between protected areas in the SINAP, but also builds positive examples of private participation in the conservation and sustainable use of biodiversity in Nicaragua (Sepúlveda, pers. comm. 2008). It is expected that with increased incentives for enrollment and promotion of the benefits of private conservation efforts, more landowners will choose to participate in this growing program.

#### 6.1.a.v Municipal Ecological Parks

Municipal Ecological Parks are another conservation mechanism in Nicaragua. These are defined as “areas protected by a municipality for the conservation of biodiversity and the generation of municipal and inter-municipal social and environmental goods and services. They are legally established according to the Law of Municipalities and the MARENA Technical Resolution on Protected Areas” (Protected Areas Regulations Art. 3). These Parks represent an alternative for municipalities to conserve natural spaces that possess singular importance to municipal development, such as the production of water, conservation of soils, interest for tourism, and importance to biodiversity, and that are not protected through the SINAP or other protection measures. As of 2008, there were eight registered municipal ecological parks totaling over 8,000 hectares (MARENA/DGAP 2008) (Table 20), and an additional 16 municipal ecological parks on Ometepe Island (La Gaceta 29/09/05).

#### 6.1.b Endangered Species Protection

MARENA is a key agency with responsibilities related to conservation at the species level. At the country level, MARENA issues permanent and partial bans on the use, harvest, and hunting of specific species as a measure of species protection. In 2008, 123 species were permanently banned from harvest or use, and another 61 species were partially banned (Resolución Ministerial 000-2008) (Table 21). Many of these banned species are also listed by the IUCN as threatened species and/or by the CITES as vulnerable to international trade. Nonetheless, these national species protection bans are rarely applied and enforced. Since their publication there have been very limited cases of decommissioned wildlife specimens or products. Moreover, we were unable to find a single case in which the application of the law led to fines or penalties for harvesting or trading banned species.

6.1.b.i The Convention on International Trade in Endangered Species of Wild Fauna and Flora  
Nicaragua is a signatory party to the United Nations Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). CITES is an international agreement among signatory governments aimed at ensuring that international trade in wild flora and fauna does not threaten species survival (CITES 2008). CITES works by creating and promoting controls on the trade of select species that are documented and proposed for CITES protection by signatory parties. CITES Appendix I listing refers to species that are threatened with extinction and are, or may become, negatively affected by trade. CITES Appendix II listing refers to species that are not necessarily threatened with extinction, but may become extinct if their trade is not subject to regulation and oversight (CITES 2008). MARENA is the governmental agency in charge of CITES enforcement in Nicaragua.

According to the Central American Commission for the Environment and Development (*Comisión Centroamericana del Ambiente y Desarrollo* (CCAD)) (1999), in 1999 there were 182 Nicaraguan plant and animal species on the CITES Appendix I and II lists (Table 22). At the time, birds represented the taxonomic group with the greatest combined number of species on Appendices I and II, whereas mammals represented the group with the greatest number of species on Appendix I. In 2006, MARENA reported that the total number of species on both appendices had increased to 245, which was attributed in large part to the inclusion of plant species (60), which were not reported in 1999 (Table 22). In 2006, birds continued to represent the greatest number of species on Appendices I and II (109), with one bird species moving from Appendix II to Appendix I (i.e. Yellow-naped Parrot *Amazona aurapalliata*). Birds were followed by plants (60), corals (35), and mammals (22) in terms of species groups with high numbers on Appendices I and II, whereas gastropods and arachnids were the species groups with the least number on both Appendices (2) (MARENA 2006).

In terms of the actual implementation of CITES at the country-level, Nicaragua recently reviewed its national wildlife trade policy in partnership with the CITES Secretariat and the United Nations Environment Program (MARENA 2008). Among the findings are the conclusion that Nicaragua’s adoption of CITES has led to improvement in the management and regulation of domestic and international wildlife trade. However, the existing legal framework was considered inadequate for the protection and sustainability of domestic and international wildlife trade, particularly in terms of legislation on the associated degradation of habitat and biological productivity. Furthermore, the authors found that non-regulatory instruments, such as monitoring, research, education, and information, are poorly, if at all, used

in the oversight of commercial wildlife trade in Nicaragua. It was also concluded that significant economic losses at the local and national level have resulted from poor regulation and oversight of wildlife trade. For example, the severe degradation of some high-commercial-value CITES species, such as the bigleaf mahogany is attributable, in part, to the inconsistency of laws on harvesting, poor enforcement and oversight, and the lack of capacity for in situ monitoring – all of which facilitate illegal logging and trade (MARENA 2008).

## **6.2 The Ministry of Agriculture and Forestry & the National Forest Institute**

The Ministry of Agriculture and Forestry (*Ministerio Agropecuario y Forestal* (MAGFOR)) and the National Forest Institute (*Instituto Nacional Forestal* (INAFOR)) are also key governmental organizations with responsibilities related to natural resource conservation in Nicaragua. MAGFOR is responsible for overseeing plant and animal food health and safety, supervision and promotion of the agricultural and forestry sector, and administration of tax and trade policies on agricultural and forestry production. In terms of the forest sector in particular, the Conservation, Promotion, and Sustainable Development of the Forest Sector Law (No. 462) (from this point forward referred to as ‘the Forest Law’) designated MAGFOR with the responsibilities of “formulating forest policy and norms, supervising forest promotion programs, maintaining and sharing information about the forest sector, and defining the reference prices for timber species and products” (Forest Law Art. 6). The Forest Law also designates the National Forest Institute (*Instituto Nacional Forestal* (INAFOR)) as a ‘semi-autonomous’ agency within MAGFOR in charge of authorizing and overseeing forest activity throughout the country (Forest Regulations Art. 2). INAFOR’s responsibilities include: “the authorization of forest harvest permits and supervision of their execution; development of technical norms for forest management and their proposal to MAGFOR; and accreditation of Forest Regents and Municipal Forest Technicians” (Forest Law Art. 7).

The Forest Law also institutionalizes the participation of the autonomous regional governments, municipal governments, and civil society in forest policy development and its oversight. It directs INAFOR to develop and carry out its responsibilities “through decentralized forest districts, in which Mayoralties, Regional Councils, local universities, the National Police, the National Army, the Ministry of Education, the Ministry of Environment and Natural Resources, and forestry groups participate in district level forest activities” (Forest Law Art. 7). In addition, this law designates the National Forest Commission (*Consejo Nacional Forestal* (CONAFOR)) as a forum for forest sector stakeholders to participate in the formulation, approval, and monitoring of national forest policy, strategy, and norms (Forest Law Art. 5). This Commission is presided over by the Minister of Agriculture and Forestry, and includes the Minister of Environment and Natural Resources; the Director of INAFOR; the Minister of Industry and Commerce; the Minister of Education, Culture, and Sports; and representatives of the Northern and Southern Atlantic Autonomous Regional Councils, forest industry, forest community groups, environmental NGOs, the National Police, and the National Army, among others. The Forest Law also calls for the formation of Regional, Departmental, and Municipal Forest Commissions in Nicaragua’s autonomous regions, departments, and municipalities to coordinate with CONAFOR and with INAFOR in the development and monitoring of forest conservation, promotion, and policy throughout the country (Forest Law Art. 5). Finally, the Forest Law indicates that the National Army and National Police are responsible for supporting the enforcement of the Forest Law and its Regulations.

### *6.2.a INAFOR’s organizational structure and resources*

As the agency in charge of implementing forest policy in Nicaragua, INAFOR is a decentralized organization, by law, which is intended to “facilitate and improve attention to the forest resource end-user” (Forest Regulations Art. 12). As of 2007, INAFOR was organized through a central headquarters in Managua and ten forest districts (a district is a “decentralized administrative- and technical- operating unit”) (INAFOR 2008: web). District offices are intended to provide a permanent agency presence through a District Delegate, who coordinates forest activities in the municipalities with other forest-sector institutions and local organizations (Forest Regulations Art. 12-13).

With regard to financial resources for forest policy execution in Nicaragua, the Forest Law establishes a timber harvest tax (*pago por aprovechamiento*), of which 35% of the collected taxes are designated to go to the local mayoralties (i.e. municipalities and regional governments), 50% to the National Forest

Development Fund for forest development incentives, and 15% to the National Treasury (Forest Law Art. 49). The Law further stipulates that the General Budget should allocate to INAFOR “either 50% of the collected income taxes from the forest sector, or 50% of the 15% of collected forest use taxes, whichever is greater” (Forest Law Art. 61).

In 2007, INAFOR’s budget totaled US\$4.2 million (C82.44 million), including US\$1.67 million (C32.885 million) (36%) from the General Budget and another US\$2.53 million (C49.555 million) (64%) from cooperative funding (principally from a joint initiative with Switzerland, Sweden, Norway and Finland) (INAFOR 2007). Additionally, in 2006, INAFOR (2007) collected approximately US\$252,000 (C\$4.671 million) from timber harvest taxes and approximately US\$28,000 (C\$514,217) in fines for forest transgressions.

In terms of INAFOR’s human resources, in 2007, INAFOR employed 301 people (INAFOR 2007). Ninety-four of those employees worked in the central office with approximately 25% in leadership positions and the remaining 75% as technical and administrative staff (INAFOR 2007). In 2007, there were 10 Forest District Delegates, 62 Municipal Forest Delegates, and another 96 people working throughout the District offices. An additional 39 people worked in specific programs or projects, such as the National Forest Seed Bank (INAFOR 2007).

As an example of district-level human resources, INAFOR District I encompasses two municipalities (Waspan, Puerto Cabezas) and a total of 14,118 km<sup>2</sup>. As reported by a forestry official, in 2007, the District Delegation included a District Delegate, two Municipal Delegates, and five forest technicians for the total area, one 4x4 pick-up truck and five motorcycles to cover the territory. The official also reported that the Delegation had some forest equipment, (e.g. four GPS units, dasometers, digital cameras, first aid kits, etc.), most of which had been donated by international assistance programs, however there was not enough equipment to ‘adequately’ equip each office or staff member. INAFOR Forest District I includes two municipal forest offices in Waspan and Puerto Cabezas. In 2007, the Waspan Municipal Office, which oversees 8,133 km<sup>2</sup> of territory was staffed with a single Municipal Delegate. As reported by a forestry official, this Municipal Office has two motorcycles, “though only one was suitable for site visits”, but did not have a boat or water transportation and many forest operations in the region are not accessible by land; nor “basic administrative equipment necessary for forest oversight, such as a laptop and first aid kits for carrying out the basic agency functions.” In sum, as with the DGAP, INAFOR is significantly limited by insufficient financial and human resources, particularly in light of the scale and significance of its mission and responsibilities.

#### *6.2.b Legislative framework for forest production*

In 2003, the Forest Law was accompanied by the establishment of Forest Regulations (Decreto 73-2003), and in 2004, by the Obligatory Technical Norms for the Sustainable Management of Broadleaf Tropical and Conifer Forests (NTON18 001-04). The Forest Regulations further define the organizational and inter-organizational structures and responsibilities of the governmental and non-governmental actors involved in the execution of state forest policy, the processes for putting policy into practice, and the means and measures for the legal harvest of forest resources. The Technical Norms define the specific aspects and practices related to forest management that must be met for legal timber harvests in broadleaf and pine forests. INAFOR is responsible for the enforcement of the Forest Law, Regulations, and Technical Norms, which together were intended to provide the legal framework that governs natural forest management in Nicaragua.

Despite these legislative advances, significant illicit forest activity in the mid 2000s ultimately led to more restrictive legislation for natural forest management. In May 2006, then President Enrique Bolaños declared an Economic State of Emergency due to the “increasing indiscriminate and illegal exploitation of our natural forest resources, making it necessary to resort to more efficient measures of control” (Decreto 32-2006). The Decree suspended all harvest, transportation, processing, storage, possession, export, and commercialization of timber in the principal timber producing departments (i.e. Nueva Segovia, Río San Juan, RAAN, RAAS) for 180 days and ordered the National Army and the National Police to detain and hold any and all forest products in those regions, overriding existing approved

documentation (e.g. harvest permits, transportation guides). As explained by one government official, the declaration of an Economic State of Emergency was intended to permit a hiatus of forest activity through heightened control of the sector and, as such, to allow INAFOR “to get its house in order.”

Then, in June 2006, the Nicaraguan National Assembly passed a Law Banning Logging (No. 585) in an effort to more permanently increase controls on forest activity in Nicaragua. The law states that:

“despite the existence of a National Forest Policy, Forest Law, and Forest Regulations, irrational and alarming exploitation of forest resources has continued, thus leading to increasing deforestation rates, through indiscriminate logging, an advancing agricultural frontier, forest fires, and illegal logging and trafficking of wood, which have taken advantage of limited human and economic resources of INAFOR as the institution responsible” for oversight and control of forest-related matters (Law No. 585).

The Law Banning Logging bans the extraction and commercialization of certain forest species throughout the country and bans all timber extraction from within 10km of the national borders and within 15km around protected areas, for a period of 10 years. It delegates the responsibilities of enforcement to the National Army and the National Police. The banned forest species are listed as “caoba, cedro, pochote, pino, mangle, and ceibo.” However, the Law Banning Logging does not list the scientific names of these species, which leaves significant ambiguity as to which specific species are banned given that ‘common names’ can often refer to more than one species. For example, as one forestry expert explained, “cedro” could refer to royal cedar (*Cedrela odorata*), which has been over-harvested for decades, or it could refer to all ‘cedar’ species including ‘cedro macho’ (*Carapa guianensis*), which is prevalent throughout the broadleaf forests of Nicaragua and is an important species for timber production.

The Law Banning Logging also exempts “wood products from approved and legal management plans that are subjected to secondary industrial transformation such as furniture and its parts, doors, assembled pieces, and plywood.” So, as another forest expert pointed out, “almost any piece of wood that comes from an approved management plan could eventually be subjected to secondary transformation.” This expert went on to question: “So, does the law just ban wood without a management plan?” Though a keen observation perhaps, this is obviously not the interpretation intended by the National Assembly. This particular point is further complicated by the lack of a clear definition of secondary transformation within the Law. Nevertheless, though there has been significant confusion and frustration as to the interpretation and implementation of the Law Banning Logging, it remains in force at the end of 2008.

Overall in Nicaragua, the execution of governmental forest policy has been significantly limited by insufficient financial, human, logistical, and material resources. A lack of resources for adequate oversight has been linked to inadequate oversight of the forest production sector and documented forest transgressions. The lack of clearly defined roles and hierarchical integration of those roles has also produced constraints on forest policy execution in Nicaragua. Many of the roles and mechanisms defined in the governmental forest policy directives represent a potential opportunity for effective policy implementation, such as forest auditors, decentralization of forest regulatory powers, and fiscal incentives for forest management. However, in practice these have either not been fully executed (i.e. the forest auditor system, forest incentives) or have been complicated to put into practice (e.g. shared oversight).

Adoption and compliance with forest legislation in Nicaragua has also been weak. Independent reviews of forest activity in Nicaragua between 2005 and 2007 revealed significantly low compliance with governmental policy directives in a large majority of forests authorized for production (CINCO and CIP 2007; Global Witness 2007). The Center for Communication Research (CINCO) and the Center for International Policies (CIP) investigated forest practices and legal compliance in the RAAN, the RAAS, and the Department of Nueva Segovia in 2005-2006. They found that of the 63 forest operations and industries evaluated, 83% (52) were noncompliant with the Forest Law, Regulations, and Technical Norms. Furthermore, they found that 40% of the operations reviewed had committed serious infractions in the forest (e.g. logging areas outside the approved forest boundaries; cutting mahogany below the diameter limit (i.e. 50 cm)) (CINCO and CIP 2006).

Between 2006 and 2007, the Independent Forest Monitoring (IFM) program carried out 15 monitoring missions across the country in coordination with INAFOR (Global Witness 2007). From these missions they concluded that “violations of the Forest Law are prevalent in all kinds of forest management plans authorized by INAFOR, regardless of ownership, size, and actors involved” (Global Witness 2007: 9). In 87% of the forest management units reviewed, poor or incorrect mapping techniques and a failure to delineate forest boundaries were documented. These transgressions were often linked to logging trees beyond the approved forest management unit boundaries, logging trees in areas that should be protected (e.g. waterways, slopes > 60%), and logging trees not included in the approved forest inventory (Global Witness 2007).

Even in the case of FSC certified forestry, there are significant challenges in Nicaragua. As of 2008, there were more than 20,000 ha of certified forest in Nicaragua, including three natural forests (13,157 ha), one semi-natural/mixed forest (4,464 ha), and one plantation (3,570 ha). However, the number of certificates had decreased from previous years due to the suspension of two operations that were not in compliance with certification standards. Some certified forest owners and managers indicate that certification has led to improvements in forest operations, such as the development of forest monitoring programs for management impacts, improved road planning and development, silvicultural treatment evaluations, wood waste minimization in the forest; financial records and planning, and community relations. On the other hand, many forest owners and operators consider the costs of certification too high, particularly when the costs of legal forest management are increasingly prohibitive due to progressively more rigorous regulatory standards and taxes on production. Some interviewees (e.g. forestry officials, forest managers/owners, forest experts) also suggested that the overall (poor) level of forest management in Nicaragua is a significant obstacle to greater adoption of forest certification in Nicaragua. Finally, as one certified forest owner indicated, there are a number of pressing issues within the forest production sector that must be resolved (e.g. ban on key timber species, lack of clarity in roles related to forest regulatory implementation) before forest certification can be effectively promoted and pursued in Nicaragua.

#### 6.2.c *Hurricane Felix – Impacts on the Forest and Associated Recovery Efforts*

Additional legislation related to forest production was passed in late 2007, following the devastating impacts of Hurricane Felix. On 4 September 2007, this Category V hurricane passed over a 75km - wide belt of Nicaragua’s Northern Atlantic region and a small part of the Department of Jinotega (Fig. 10). Hurricane Felix covered nearly 17,000 km<sup>2</sup> of mostly forested terrain and indigenous lands in Nicaragua, destroying over 20,000 homes, 57 churches, 102 schools, 43 health centers, over 86,000 hectares of farmland, and more than 40,000 head of cattle. In total, Felix affected nearly 190,000 people and resulted in approximately US\$ 850 million in damages (MARENA 2007b).

INAFOR and the Government of the Northern Atlantic Autonomous Region (GoRAAN) (2007) estimate that more than 5,600 km<sup>2</sup> of mostly broadleaf forest were destroyed (i.e. > 75% of trees knocked down), another 5,200 km<sup>2</sup> were moderately affected (> 25% of trees stripped of leaves), and about 3,100 km<sup>2</sup> were minimally affected (< 25% of trees stripped of leaves). In the RAAN alone, over half a million hectares of densely vegetated broadleaf forest were destroyed (> 75% of trees knocked down), representing nearly 11 million m<sup>3</sup> of commercial timber (>40cm dbh) (INAFOR/GoRAAN 2007).

Given the social, economic, and ecological damage from Hurricane Felix, the Government of Nicaragua searched for ways to rescue some economic value from the widespread devastation. In response, INAFOR identified two primary areas for the extraction of downed wood taking into account accessibility, impacted watersheds, and extraction capacity in the short and medium term. They selected the Río Wawa and the Río Kukalaya watersheds. These total almost 300,000 ha of broadleaf forest, which were estimated to represent nearly 6.2 million m<sup>3</sup> of downed wood, and 951 ha of pine forest, representing an additional 6,100 m<sup>3</sup> of timber. The remaining impacted area in was designated for restoration and protection (INAFOR/GoRAAN 2007). INAFOR also developed Administrative Resolutions (75-2007; 81-2007) to establish criteria and guidelines for harvesting fallen and downed wood; protection and restoration of areas not affected to moderately affected; and organization of Community Forestry Enterprises to promote greater community involvement in the process of regional recovery and recuperation.

The Government of Nicaragua obtained significant international aid for the areas affected by Hurricane Felix. This included US\$ 3 million from the US government and US\$ 1.36 million from the European Union in direct aid and response assistance, and US\$ 1.177 million from the Spanish Cooperation Agency for forest protection and the harvest of trees for community reconstruction (USAID 2007; INAFOR 2008). A portion of this aid was directed to INAFOR for post-Felix forest recovery and administration. Related activities in 2008 included: community assistance with downed wood harvest plan elaboration and permit administration; the establishment of tree nurseries (i.e. 90,000 seedlings of Cedro Real, *Leucaena*, *Pinus Caribe*, and Madero Negro) in Waspam and Puerto Cabezas; and the acquisition and distribution of 14 sawmills to the community forestry blocks of SIPBAA, Tasba Raya, Llano Norte, and Tasba Pri (INAFOR 2008).

According to Medina and Urbietta (2008) 23 Forest Harvest Plans for Downed Wood in communities affected by Hurricane Felix in Puerto Cabezas were authorized by INAFOR in 2008. From these plans, 128,223 m<sup>3</sup> of broadleaf and pine wood was extracted, much of which benefited community organizations, the Association of Retired Army Servicemen (*Asociación de Militares Retirados del Ejército*), the Ministry of Governance (*Ministerio de Gobernación*), and the Union of Cooperative of Tasba Pri (*Unión de Cooperativas de Tasba Pri*). Additional plans approved in Rosita were harvested by the timber company *Maderas Preciosas de Nicaragua* (Mapinic), totaling 9,500 m<sup>3</sup>. Nevertheless, INAFOR (2008) reports that a lack of available cooperative funding throughout the first trimester of 2008 significantly limited their capacity for related assistance and response, and ultimately for significant progress post-Felix. Furthermore, according to two local forestry experts, almost one year after the hurricane, only a small proportion of the total downed wood had been extracted from the RAAN despite new legislation to expedite the harvest process. It is generally agreed that much of the downed wood will not be worth the cost of extraction beyond two years on the ground, representing a rapidly shrinking window of some economic return on a most devastating and immense natural disaster in an already struggling region.

### **6.3 Nicaragua's Participation in International Treaties**

With regard to international treaties that support the conservation of biodiversity and forests, Nicaragua is a signatory party to the following agreements (US State Department 2008):

- The Convention on Biological Diversity
- The UN Framework Convention on Climate Change
- The Kyoto Protocol
- The UN Convention to Combat Desertification
- The Convention on International Trade in Endangered Species
- Basel Convention on Hazardous Wastes
- The Law of the Sea
- The Vienna Convention for the Protection of the Ozone Layer
- The International Convention for the Prevention of Pollution from Ships
- The RAMSAR Convention on Wetlands of International Importance
- The International Convention for the Regulation of Whaling
- The Environmental Modification Convention (signed, but not ratified)

Nicaragua is also signatory to environmental agreements at the regional level. These include the Convention for the Protection and Development of the Marine Environment in the Caribbean Sea Region (*Convenio de Cartagena*); the Central American Commission on the Environment and Development; and the Central American Agreement on Biodiversity Conservation (SINIA-MARENA 2003). Furthermore, in 2003, Nicaragua hosted the first Mesoamerican Congress on Protected Areas, which resulted in the Managua Declaration on Protected Areas. A major objective of this declaration is the promotion of integrated management of the region's protected areas to contribute to a reduction in biodiversity loss and poverty in the signatory countries. More specific objectives include regional cooperation and promotion of transboundary protected area and biological corridor management (CBD 2008).

There is a significant range in Nicaragua's participation in, implementation of, and compliance with the international and regional treaties listed above. Actions associated with the Convention on Biological Diversity, the Convention on International Trade in Endangered Species, and the UN Framework Convention on Climate Change are the most notable. Below are listed some of the key reports and planning tools that Nicaragua has developed in relation to its international commitments (MARENA/PNUD 2001; MARENA 2008).

- “Biodiversidad en Nicaragua: Un estudio de País”
- “Informe nacional de la república de Nicaragua sobre la implementación de la convención de las Naciones Unidas de la lucha contra la desertificación y la sequía”
- “Primera comunicación nacional ante la convención marco de las Naciones Unidas sobre cambio climático”
- “Primer inventario nacional de fuentes y sumideros de gases de efecto invernadero en cinco sectores priorizados: agricultura, cambios en el uso de la tierra y silvicultura, desperdicios, energía, y procesos industriales”
- “Escenarios climáticos y socioeconómicos de Nicaragua para el siglo XXI”
- Various studies on the impact of climate change on water resources, human health, and the efficiency of key economic sectors (i.e. energy, forestry, agricultural, fishing, and aquaculture)
- Various studies on the water resources sector vulnerability and adaptability to climate change
- A study on the mitigation of protected areas against climate change
- “Study Review of Nicaragua's Wildlife Trade Policy”

## **VII. Government, NGO, Donor and Other Conservation Programs and Activities**

### **7.1 Governmental programs and activities**

The Government of Nicaragua (GoN) identifies the reduction of poverty and hunger as key priorities in the National Human Development Plan for Nicaragua. This Plan is intended to serve as a guiding framework for governmental institutions and the overall governance of the country. Among the principles laid out in the Plan is the “sustainable development of the defense, restoration, and protection of the environment,” which encompasses four actions arenas: (1) environmental education for all Nicaraguans, (2) more forests for the future, (3) conservation of water sources, and (4) control and reduction of contamination (GoN 2008).

Environmental Education aims to increase public participation in environmental pursuits and protection, promote environmental youth education, and increase the availability of environmental information to the public. More Forests for the Future is promoted through the National Reforestation Crusade, which is focused on reforestation, the restoration and protection of forested areas, and the decrease of the deforestation rate from 70,000 ha/yr to 20,000 ha/yr by 2010. Specific objectives include: (1) the reforestation and restoration of areas affected by Hurricane Felix in the RAAN, with particular emphasis in the Bosawas Biosphere Reserve; (2) reforestation of sensitive and degraded zones in 35 protected areas in the Pacific, Central North, and Southern Regions of the country; (3) forest protection and promotion of reforestation in riparian zones; (4) promotion and assistance for natural regeneration management along the agricultural frontier; (5) reduction in the incidence of forest fires and agricultural burning, particularly in areas affected by Hurricane Felix; (6) *in situ* and *ex situ* forest biodiversity conservation; (7) protection of the nucleus zones of the Biosphere Reserves (Bosawas, Rio San Juan); and (8) the development and promotion of Community Reforestation Brigades (GoN 2008).

The Conservation of Water Sources is intended to be promoted and carried out through the elaboration and implementation of land use plans and watershed management and protection plans, as well as through the establishment of payments for water related environmental services. In particular, the GoN plans to: (1) put in place a National Council for Water Resources to be presided over by MARENA; (2) support Watershed Committees, at the sub-watershed and micro-watershed levels; (3) develop a National Water Resources Plan, prioritized sub-watershed and micro-watershed plans, and a National Strategy for Adaptation to and Mitigation against Climate Change at the Watershed Level; and (4) implement soil and water conservation, protection, and management measures through MARENA and INAFOR (GoN 2008).

The Control and Reduction of Contamination is intended to ensure compliance with environmental policy through verification measures carried out by MARENA. Associated initiatives include: (1) updating the governmental Resolutions for the Control of Contamination from Residual Domestic, Industrial, and Farm Water Discharge, (2) programs for reducing the contamination of Lake Managua, (3) assessment of the degree and levels of contamination of Lake Cocibolca, (4) development and implementation of Clean Production Voluntary Agreements between the GoN and the private sector, (5) implementation of the Program for the Reduction of Pesticide Runoff in the Caribbean Sea at the country level, (6) promotion and oversight of the elimination of the disposal of pesticides, toxic substances, and other dangerous substances, and (7) and the decrease in imports of ozone depleting substances, as established in the Montreal Protocol Calendar (GoN 2008).

*7.1.a MARENA: Ministry of Environment and Natural Resources*

MARENA is the governmental agency responsible for the conservation, protection, and sustainable use of the environment and natural resources through the formulation, proposal, direction, and supervision of compliance with national environmental policies, such as those for environmental quality and sustainable harvest of natural resources. Specific environmental programs and projects of MARENA include enforcement and reporting associated with CITES, oversight of the National System for the Evaluation of Environmental Impacts, and the administration of the National System of Protected Areas (SINAP) through the Protected Areas General Directorate (DGAP). MARENA is also responsible for control and oversight of environmental contamination, which includes the administration of the National Registry of Chemical Substances that have the potential to affect or harm the environment (MARENA 2008).

MARENA coordinates the National System of Environmental Information (SINIA), which serves as an important tool for collecting, organizing, interpreting, and disseminating all environmental information generated by governmental agencies and other organizations throughout the country. Information in SINIA is linked to the National Environmental Accounts that are recorded by the Central Bank of Nicaragua (MARENA 2008). This information is also intended to be made publicly available through the internet ([www.sinia.net.ni](http://www.sinia.net.ni)). However, the SINIA website was not available throughout late 2008, indicating a significant gap in the availability of information important for biodiversity and forest conservation.

The collaborative development and ongoing implementation of a national set of 26 environmental indicators for collecting and reporting information related to the state of water resources, forests, biodiversity, soils, and environmental contaminants in Nicaragua is also led by MARENA. Through this initiative important publications have been produced, such as a Methodological Guide for the Development of Environmental Indicators, the Nicaraguan Environmental and Indigenous Atlases, and the 2003 and 2006 Reports on the State of the Environment, among others. MARENA also coordinates the National Commission for Environmental Education, promoting and providing environmental information and education materials for formal and informal school and other educational programs (MARENA 2008).

*7.1.b MAGFOR: the Ministry of Agriculture and Forestry*

MAGFOR is responsible for the formulation of agricultural and forest policy, the supervision of national agricultural and forest promotion programs, maintenance and dissemination of information about the agricultural and forest sectors, and setting the reference prices for agricultural and timber products. A key role played by MAGFOR is leadership and coordination of ProRural: the Sectoral Program for Productive Rural Development. Established in 2005, ProRural was developed as a long-term process to achieve sustainable, integrated rural development through macroeconomic and sector-specific policies and programs designed for impact at the local level. ProRural receives long-term financial support from Switzerland, Finland, Denmark, Norway, and Sweden. In addition to MAGFOR, other participating governmental agencies in ProRural include: the Nicaraguan Institute of Agricultural Technology (INTA), the National Forestry Institute (INAFOR), and the Rural Development Institute (IDR). The Foundation for the Development of Agricultural and Forestry Technology (FUNICA) is a key public-private organization that also participates in this program (Pijenburg et al. 2008).

Though some progress has been made in rural development and sustainability through ProRural, the overall program goals have been slow to advance since the program was initiated in 2005. Program weaknesses have largely been attributed to insufficient institutional coordination at the central level. This is due in part to a change in administration in 2007 that led to changes in governmental organization and some loss of institutional memory and coordination. Lack of recognition of MAGFOR as the program coordinator by other participating governmental agencies has also been noted as an obstacle to ProRural's progress. These and other weaknesses have been identified and are being addressed in current program activities (Pijnenburg et al. 2008).

#### 7.1.c *INAFOR: the National Forestry Institute*

INAFOR is a 'semi-autonomous' agency, within MAGFOR, charged with the promotion and oversight of forest activity in Nicaragua. INAFOR programs are developed to address six action arenas: (1) reforestation, (2) promotion and implementation of community forestry, (3) promotion of forest land use planning at the watershed level, (4) forest protection focused on the prevention and control of forest fires, pests, and disease, (5) tree genetic improvement through strengthening of the Center for Genetic Improvement and Forest Seed Bank, and (6) the implementation of the Forest Incentives Program (INAFOR 2008).

INAFOR coordinates the Forest Governance program, which includes the participation of MAGFOR, MARENA, the National Forest Development Fund (FONADEFO), the Autonomous Regional Governments (GoRAAN, GoRAAS), municipal governments, and the private sector. This program receives financial and technical support from the German Development Cooperation (GTZ) and the FAO. It addresses the: (1) institutional consolidation and inter-institutional cooperation of the forest sector, (2) decentralization of the administration of the forest sector, (3) obstacles to legal forest activity, (4) financial mechanisms for forest production, and (5) promotion of sustainable and legal forest management. While some progress has been made through a multi-stakeholder dialogue centered on improvements to forest governance in Nicaragua, enhancements in forest governance on the ground have been much slower in advancement (INAFOR 2008).

INAFOR is the government agency in charge of the National Forest Inventory (*Inventario Nacional Forestal* (INF)). The INF is designed to evaluate the state and use of forest resources, and encompasses the collection and analysis of biophysical and socioeconomic data associated with forested land. INF is carried out under ProRural, with additional financial and technical support from the FAO. Once complete, the INF will provide important information for forest land use planning and policy-making. INF activities began in March 2007 and are projected to conclude in December 2008. INAFOR is also responsible for the National Forest Registry, which serves as a storehouse of 'publicly-available' information on the forest industry; forest plantations; tree nurseries; approved forest management plans and harvest permits; forest professionals and technicians; the national forest inventory; all public and private forest lands; and data on compliance with international forest-related accords and agreements (INAFOR 2008).

The National Forest Development Fund (FONADEFO) is a program within INAFOR intended to support and promote reforestation, sustainable forest production, and the development of markets for environmental services through activities such as: (1) financing forest sector programs and projects, (2) promotion of forest plantations and agroforestry and silvopastoral systems, (3) promotion of technological innovations in the chain of forest production, and (4) promotion of sound forest management. Since its inception in 2006, FONADEFO has funded 13 projects totaling 880 ha, largely focused on reforestation and restoration of critical areas at the municipality level. Nonetheless, further impacts of FONADEFO have been constrained by limited funds and personnel (FONADEFO 2008).

#### 7.1.d *Municipal governmental programs and projects*

Municipal governments have taken an active role in forest and biodiversity conservation. In 2000, MARENA collaborated with local governments to promote the development of Municipal Environmental Plans to serve as strategic tools in municipal planning (Perez et al 2007). As of 2008, there were 44

approved Municipal Environmental Plans and another 24 in the process of development (AMUNIC 2008). Following is a list of some other key municipal-level environmental activities in Nicaragua.

- Municipality of El Viejo: Conservation, regulation, and oversight activities in the protected areas of Volcán Cosigüina and Estero Padre Ramos.
- Municipality of León: Payments for park guards the Isla Juan Venado protected areas, beach cleaning campaigns, and support for infrastructure development in Volcán Pilas-El Hoyo.
- Municipality of Managua: Management of the Laguna de Tiscapa protected area.
- Municipalities of El Crucero and La Concha: Conservation activities in Chocoyero-El Brujo protected area.
- Municipality of Ticuantepe and Masaya: Payments for park guards in the Chocoyero-El Brujo protected area and support for municipal level environmental education.
- Municipality of Santa Teresa: Conservation activities in Río Escalante-Chacocente protected area.
- Municipalities of La Sabana and Madriz: Environmental education in Tepesomoto and support for fire brigades.
- Municipality of Estelí: Infrastructure investments in the Tisey-Estanzuela protected area.
- Municipalities of Bonanza, El Cuá, Siuna, Waslala and Waspán: Conservation activities in the Bosawas Biosphere Reserve.
- Municipality of Dipilto: Conservation activities in the Serranías de Dipilto y Jalapa protected area.

## **7.2 International Inter-governmental Programs and Activities**

The United Nations Development Program (UNDP) is the coordinating agency charged with implementing programs and projects that contribute to the achievement of the UN Millennium Development Goals (PNUD/Nicaragua 2008). Published in 2000, these goals establish clear objectives on reductions in poverty, infant mortality, and HIV-AIDS; improvements in grade school education, gender equality, maternal health, and the sustainability of the environment; and the promotion of a world development association. In Nicaragua, UNDP support for implementation of the Millennium Development Goals is focused on: Democratic Governance, Equitable Economic Development (Poverty Reduction), Energy and the Environment, and Coastal Caribbean Development. In terms of natural resources, UNDP programs in Nicaragua include efforts to develop rural renewable energy sources; hydroelectric energy; policy improvements related to water, pesticides, toxic substances and solid waste. The UNDP also incorporates cross – cutting themes associated with biodiversity, desertification, and climate change throughout its programs and projects (PNUD/ Nicaragua 2008). Nonetheless, advances in these programs have been slow due to “constant changes in authorities and a low political priority for these programs” (GoN and UNDP 2008).

The Mesoamerican Biological Corridor (*Corredor Biológico Mesoamericano* (CBM)) represents a multilateral regional initiative that encompasses and promotes an integrated vision of development between eight neighboring countries of Mesoamerica: Belize, Costa Rica, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, Panama. It is defined as “a system of land use planning that comprises protected natural areas of different management categories and their inter-connections, organized and consolidated to provide a suite of environmental goods and services, to the Central American, as well as the global, society, and which provides arenas for social collaboration and agreement on investments in the conservation and sustainable use of resources that the region possesses” (Godoy Herrera 2003). Key objectives and initiatives of the MBC include: (1) an increase and restoration of ecological connectivity at the ecosystem and landscape level to mitigate the impacts of unsustainable resource use and to reduce social and

environmental vulnerability to natural and other threats; (2) established and experimental conservation efforts, such as protected areas and biological corridors, as well as the development of market mechanisms that promote the conservation of environmental services and environmentally friendly productive systems; and (3) an emphasis on public policymaking that promotes effective and sustainable economic development across all sectors (e.g. agriculture, forestry, fishing, tourism, energy, commerce, infrastructure, etc.).

The CBM promotes social participation at regional, national, and local scales, with an emphasis on small and medium producers, rural and indigenous communities, farmers, youth, and women. It is also designed to contribute to the generation of employment, growth in family income, and decreases in rural poverty. With support from the Global Environment Facility (GEF) and the Government of Germany, the Central American Commission on the Environment and Development (CCAD) has established a program to consolidate the local, national, and regional efforts of the MBC and to promote continued international cooperation and dialogue (CCAD 2008).

### **7.3 NGO Programs and Activities**

#### *7.3.a International Non-Governmental Organizations*

Through its Critical Ecosystem Partnership fund (CEPF), Conservation International provides grants to nongovernmental and private sector organizations to protect the Earth's biologically richest, yet most endangered areas, also known as biodiversity hotspots. One area of focus is Mesoamerica. The Mesoamerican region between North and South America is considered a biodiversity hotspot, harboring important species from both continents, as well as wildlife unique to the region. The CEPF has separate but complementary strategies for the northern and southern regions of the Mesoamerica hotspot. In Southern Mesoamerica, CEPF focuses on Costa Rica, Nicaragua, and Panama, targeting three priority areas, including the Cerro Silva-Indio Maiz-La Selva corridor between Nicaragua and Costa Rica; the southern Talamanca region connecting with the Osa Peninsula in Costa Rica; and the northern Talamanca-Bocas del Toro corridor between Costa Rica and Panama. Four strategic goals guide CEPF's approach in the southern region: (1) strengthen key conservation alliances and networks within vital corridors, (2) integrate connectivity among key, critical areas through economic alternatives, (3) promote awareness and conservation of flagship species, and (4) support improved management of key protected areas.

The Nature Conservancy (TNC) directs the large part of their efforts in Nicaragua to the Nicaraguan Mosquitia, located in the north-central part of the country and encompassing the Bosawas Biosphere Reserve. The Nicaraguan Mosquitia is considered an important area of extensive lowland tropical forest that it is threatened by colonization, the advancement of the agricultural frontier, deforestation, and forest degradation. TNC programs include: (1) support for clarification and establishment of land tenure in indigenous communities in the Bosawas Reserve, (2) assist local organizations in the establishment of a community forest guard program to help protect the boundaries and resources in the Bosawas Reserve, and (3) support and technical assistance for land use planning within the Reserve (TNC 2008).

Fauna and Flora International (FFI) work in Nicaragua is focused on ecosystem and species conservation through protection, training programs, and community development. In particular, FFI focuses on (1) the protection of the leatherback, olive ridley, and other endangered sea turtles along Nicaragua's Pacific coast through community training, (2) conservation of dry forests in the Chacocente Wildlife Refuge through the development of collaborative resource management and sustainable community development, and (3) integrated management and conservation of the diversity of habitats on Ometepe Island in Lake Nicaragua (FFI 2008).

With support from USAID, the Rainforest Alliance (RA) focuses its efforts in Nicaragua on the sustainable development of forestry, agriculture, and tourism. RA has developed programs to provide training and technical assistance to coffee and banana producers, indigenous community forest enterprises (mostly in the RAAN), and hotel and lodge owners towards the certified, sustainable production of natural resources and services throughout the country. RA is also involved in collaborative programs focused on carbon financing for forest restoration and carbon sequestration (J. Guillen, pers. comm.).

Paso Pacifico focuses its efforts on the restoration and conservation of key habitats and natural resources along the Pacific coast, and in particular, in the Paso de la Sierra and Paso del Istmo of Nicaragua. Paso Pacifico (1) provides technical assistance associated with sustainable land management and development to landowners in key areas, (2) promotes and provides conservation education and outreach to landowners, policy-makers, natural resource users, and the general public, (3) carries out and collaborates in conservation science, developing baseline studies of key habitats and species, such as the Geoffroyi Spider monkey in Nicaragua's Pacific region, (4) promotes the conservation of important land areas and biological corridors, working closely with the Nicaraguan Network of Private Protected Natural Reserves, and (5) identifies and coordinates innovative sources of conservation financing, such as the Return to Forest joint initiative with Carbonfund.org, the Climate, Community and Biodiversity Alliance (CCBA), and the Rainforest Alliance, which is using carbon finance to restore hundreds of acres of moist and dry tropical forest in Central America's most critically endangered ecosystems (S. Otterstrom, pers. comm.).

Other International NGOs working in Nicaragua include: CARE, Gansos Salvajes de Holanda, Vientos de Paz, ICCO de Holanda, Ecología y Desarrollo de Conserva, Limpieza de Costas del Mundo, Catholic Relief Services, and the IUCN, among others.

#### *7.3.b National Non-Governmental Organizations*

The Nicaraguan Foundation for Sustainable Development (*Fundación Nicaraguense para el Desarrollo Sostenible* (FUNDENIC) is dedicated to reducing the deterioration of Nicaragua's natural resources through conservation and the sustainable management of protected areas throughout Nicaragua. They have developed projects associated with the redefinition and co-management of protected areas, biological training of community groups and members to support conservation of wild areas in Nicaragua, training and technical assistance for improving the quality of life in rural communities (e.g. sanitation, agricultural and milk production, environmental administration), environmental education and outreach, and research and promotion of environmental services valuation and compensation (FUNDENIC 2008).

Centro Humboldt is a national NGO in Nicaragua working in territorial development and environmental sustainability. With regard to territorial development, the organization promotes integrated development at the local level through participatory planning processes, training, and technical assistance that focus on sustainability and risk management. Centro Humboldt is also involved in the promotion and development of enhanced governmental environmental policies, providing sound and opportune information from scientific investigations and biodiversity monitoring. Significant efforts have been focused in the Bosawas Biosphere Reserve (Centro Humboldt 2008).

Fundación Cocibolca supports and promotes the network of public and private conservation and protected areas in Nicaragua. It was the first to sign a protected area co-management agreement with MARENA in November 1996. The organization has three main program areas: (1) environmental education, (2) biodiversity monitoring and protection, and (3) research. FC co-manages the Volcan Mombacho Nature Reserve, the most visited nature reserve in Nicaragua and up to 2008 it co-managed the La Flor Wildlife Refuge, both in coordination with MARENA.

Other national NGOs include the: Fundación Luchadores Integrados al Desarrollo de la Región (LIDER), Fundación de Investigación y Desarrollo Rural (FIDER), Asociación Somos Ecologistas en la Lucha por la Vida y el Ambiente (SELVA), Fundación Fuente Verde, Fundación Amigos de Río San Juan (FUNDAR), Fundación Coen, Fundación entre Volcanes, and Fundación Ometepe, among others.

### **7.4 Donor Programs and Activities**

In addition to programs supported by the United States Agency for International Development (USAID), several other donor agencies are involved in biodiversity and forest conservation in Nicaragua. The German Development Cooperation (GTZ) has been working in Nicaragua for more than 20 years and considers the country a cooperation priority (GTZ 2008). GTZ and the GoN have agreed on three key areas for cooperation: (1) water supply and wastewater disposal, (2) decentralization and strengthening the rule of law and democracy, and (3) environmental policy, conservation and sustainable management of natural resources. Associated programs include: (1) the Program on Governance and Local Development

(PROGODEL), (2) the Rio San Juan Project, (3) the Project of Support for the National Coordination System for the Implementation, Monitoring, and Participatory Evaluation of the Strategy for Poverty Reduction (PASE), and (4) the Program on Sustainable Natural Resources Management and Promotion of Business Skills (MASRENACE). MASRENACE focuses efforts and resources on improving the development and implementation of environmental policies, sustainable land use planning, and support for sustainable systems of natural resources production and commercialization. In particular, given the importance of and threats to forests in Nicaragua, significant emphasis is placed on the sound policy, sustainable use, and protection of forests, and recent program accomplishments include the participatory formulation of a new national Policy on the Sustainable Development of the Forest Sector; payments for environmental services (i.e. watershed protection) in the Gil Gonzalez sub-watershed in Belen; and support for organic cacao cooperatives of small producers in the RAAN (GTZ 2008).

The Spanish Agency for International Development (AECI) has been working with Nicaragua for more than 30 years and current efforts focus on: (1) promotion of equitable and sustainable development that permits the reduction of poverty, (2) consolidation of democracy and strengthening the Rule of Law through institutional development, administrative decentralization, defense and promotion of human rights and fundamental liberties, and (3) contribution to the durable and sustainable economic growth of the country (AECI 2008). Environmentally focused programs have included support for the sustainable development, conservation of biodiversity, institutional strengthening, and promotion of participatory environmental oversight in the Rio San Juan Biosphere Reserve; and the development of a cartographic geographic information system (GIS) focused on the multiple natural and biophysical threats to northeastern Nicaragua (AECI 2008).

The principal objective of the Swiss Agency for Development and Cooperation (COSUDE) in Central America is to contribute to the reduction of poverty and the promotion of equitable development. The associated programs and projects center on: (1) the development of micro, small, and medium enterprises, (2) good governance of public finances and at the local level, and (3) access to basic public services at the local level. “The greatest and most visible impacts of COSUDE have been in the agricultural, water, and sanitation sectors. ... For example, from 1999 to 2005, more than 100,000 people in 683 communities in Nicaragua gained access and control to water resources through support from COSUDE” (COSUDE 2008).

Other donor groups that are involved in environmental activities in Nicaragua include: the Norwegian Embassy, the Danish Agency of Cooperation (DANIDA), the Agencia Catalana de Cooperacion, and the Government of China, among others.

## **7.5 Combined Efforts for Protected Area Conservation**

Reyes (2007) evaluated the range of actors supporting the National Protected Areas System. He identified 63 actors or organizations that contributed a total of more than US\$ 3.5 million to the functions of SINAP in 2006. Donor agencies contributed 46% of the funding received by SINAP in 2006, followed by international NGOs (38%), demonstrating the crucial role these two actors play in the conservation of protected areas in Nicaragua. Municipal governments represented the greatest number of actors or organizations involved in the SINAP (18), followed by central government agencies and organizations (11), and international NGOs (7) (Table 23). Reyes (2007) also found that the greatest number of actors and organizations are involved in protected areas in the Pacific region of the country (57%), while there are an approximately equal number of actors in the Central and Atlantic regions (~ 22%). Nevertheless, despite significant financial and technical support from an array of actors and organizations, the SINAP continues to be considered severely under-staffed and -financed.

## **VIII. Threats to Biodiversity and Forests in Nicaragua**

### **8.1 Direct Threats to Forests and Biodiversity**

Through this assessment nine direct threats to forests and biodiversity and their conservation were detected. These are: habitat conversion, contamination, sedimentation, overexploitation, illegal harvest, hurricanes, fires, climate change, and the introduction of exotic species (Table 24).

### 8.1.a *Habitat Conversion*

Conversion of natural habitat can lead to ecosystem destruction and fragmentation; increased vulnerability of threatened, endemic, and other key species, and disruption in the natural flow of gene pools among species. Habitat conversion and fragmentation also lead to ecological homogenization, which can result in species-impooverished monocultures, as well as lead to soil erosion and destabilization, which can result in landslides, flash floods, and ultimately, changes in the hydrological cycle. In Nicaragua, the advancing conversion of natural ecosystems to monocultures, agricultural and grazing lands is considered the greatest overall direct threat to forests and biological diversity (i.e. ecosystem, species, and genetic) (See for example MARENA-SINIA 2003; Rodriguez Quiros 2007; MARENA 2007). Furthermore, while advancement of the agricultural frontier and the colonization of lands in conservation areas result in deforestation and the consolidation of unsustainable farming systems, these processes are largely left uncontrolled in Nicaragua, due primarily to weaknesses in the institutional framework and in the enforcement of related environmental legislation.

There are many areas in Nicaragua where the agricultural and grazing frontier dominate the landscape. For example, the municipalities of Paiwas, Muelle de los Bueyes, El Rama, and Nueva Guinea are dominated (>70%) by a consolidated agricultural frontier (i.e. established 20 or more years ago), indicating a very significant impact on the biological diversity and associated natural processes in those areas. In other municipalities, such as El Tortuguero and Cruz del Río Grande, the dynamic agricultural frontier (i.e. established in the last 10 years) occupies a significant and growing proportion of the landscape (34% and 47%, respectively). The expanding agricultural and grazing frontiers also threaten protected areas in Nicaragua. Protected areas are most often affected by dynamic (i.e. established in the last 10 years) and pioneering (i.e. established in the last 5 years) frontiers. The four National protected areas most affected by dynamic and pioneering agricultural frontiers processes are all found in the Atlantic region: Makantaka (100%), Punta Gorda (83.4%), Cerro Silva (68.2%), and Wawashan (44%) (MARENA 2007:26). Finally, with regard to ecosystems, habitat conversion is of considerable concern for Nicaragua's dry forests, particularly as tropical dry forest is considered the most endangered terrestrial ecosystem in Central America with only two percent of the original area remaining (WWF 2001).

### 8.1.b *Contamination and Sedimentation*

Conversion of natural habitat to agriculture and development, and habitat fragmentation, often lead to high levels of soil and water contamination, and sedimentation in lakes, lagoons, mangroves, coral reefs, underwater savannahs, and other coastal and marine systems. Intensive, mono-cropping (e.g. banana, sugarcane) in Nicaragua leads to the deterioration of soil quality, rapidly depleting the topsoil of nutrients and organic matter. Soil degradation is accelerated by the overuse of pesticides. Between 2002 and 2005, fungicide, herbicide, and insecticide imports all increased in Nicaragua, reflecting the increase in intensive agricultural production (MAGFOR 2006 cited by MARENA 2007). In addition, the continued use of persistent organic pollutants (POPs) as pesticides, such as DDT, Toxaphene, and Endosulfan, pose serious threats to Nicaragua's natural and human environment. In 2005, an inventory of POPs in Nicaragua demonstrated that there were more than 6,000 tons of POPs in surveyed departments: Chinandega, Sebaco, Granada, Rio San Juan, Managua, and Leon (MARENA 2007). Soil contamination has further complications when combined with soil erosion and water runoff that carry high levels of chemical substances (e.g. fertilizers, pesticides) that find their way into water ways and bodies and result in sedimentation.

In Nicaragua, many continental watersheds demonstrate increasing levels of contamination and sedimentation (MARENA 2007). These processes, in turn, result in further negative impacts on the availability and quality of water and the larger hydrological cycle. Overall, these direct threats have significant negative implications for the freshwater, coastal, and marine systems along Nicaragua's eastern coast, as 93% of Nicaragua's water drainage flows into the Caribbean Sea (Fenzl 1983). In particular, Nicaragua's freshwater bodies are highly impacted by contamination and sedimentation, as they are often the end point of large drainage systems. This is of particular concern for Lake Nicaragua and other freshwater lakes that harbor numerous endemic and yet to be identified fish species and that serve as sources of drinking water for a growing population.

The contamination and sedimentation associated with natural habitat conversion pose the most severe threat to coastal systems due to their place in the hydrological cycle (MARENA 2007). Coastal system degradation from contamination and sedimentation is not only a concern for biodiversity conservation, but is also of particular concern to indigenous and other Nicaraguan communities that depend on them as key reproductive sites for many species of socioeconomic importance. Marine ecosystems (e.g. fish habitat, corral reefs) are also affected by the contamination and sedimentation associated with habitat conversion. The most critically impacted coastal/marine systems in Nicaragua are the Pearl and Miskito Keys, which represent, among other values, important lobster habitats and breeding grounds, as well as fishing, recreation, and tourism resources (MARENA 2007).

#### 8.1.c Overexploitation and Illegal Harvest and Trade of Natural Resources

Overexploitation of natural resources can lead to degradation of species gene pools and ultimately, can prohibit harvested species from successful regeneration when extraction outpaces reproduction, resulting in species loss. Illegal harvest and trade of natural resources largely operate outside of regulated control or monitoring, and can lead to the same devastating effects as overexploitation. Furthermore, illegal harvest and trade that essentially evade taxes, fees, etc. depriving local residents and government of revenue from natural resources production. In the Atlantic region, interviewed government officials, forest agency representatives, and forest and natural resource experts noted widespread concerns for forest sustainability in the face of abusive logging practices, overexploitation, and illegal logging that had been escalating in recent years in the Atlantic region (and which led in large part to bans on production and increasingly restrictive regulations). In particular, illegal logging in Nicaragua's Atlantic broadleaf forests is estimated at around 30 - 50,000 m<sup>3</sup>/year, while in pine forests it is estimated at 110 - 135,000 m<sup>3</sup>/year (Richards et al. 2003). One forest agency official noted that illegal logging is the most important issue concerning the pine forests in the Pacific region. Finally, overexploitation and illegal forest harvests often result in unplanned roads, openings in previously contiguous forest, and increased human presence in the forest interior, leading to increased hunting pressures on wildlife species and disruptions of animal behavioral patterns.

Overexploitation and illegal harvest and trade of animal species are also significant threats to Nicaragua's forest systems and biodiversity. For example, illegal harvest and trade of birds, e.g., parrots, especially *Ara ambigua* y *Ara macao*, "chocoyos" and other parakeets (*Aratinga spp.*), and toucans (*Ramphastos spp.*) for the illegal local and international pet trade is a significant business in Nicaragua. The local and international pet trade poses a major threat to other animals as well (e.g. white faced capuchin (*Cebus capucinus*) and other primates, large cats and other carnivores, and many reptile species). Marine species, such as lobsters, shrimp, snook (*Centropomus spp.*), snapper (*Lutjanus spp.*), and shark (*Carcharhinus spp.*), are also feared to be threatened by overexploitation and illegal harvest (Ehrhardt 2003; Barnutty 2001). The prevalence and growth of overexploitation and illegal harvest of animal species are largely attributed to the state's lack of capacity (e.g. financial and human resources; political will and support) to monitor and enforce related legislation and bans (MARENA 2008).

#### 8.1.d Other Direct Threats

Hurricanes are natural occurrences that pose a significant threat to the populations, as well as to the forests and other natural systems, in their path. The impacts of hurricanes are often multiplied by poor land use planning and management (Pielke Jr. et al. 2003). Nicaragua has suffered the impacts of major hurricanes in each of the past three decades (Hurricane Joan (1988), Hurricane Mitch (1998), Hurricane Felix (2007)) and been exposed to numerous other hurricanes and tropical storms throughout recorded history (Weaver et al. 2003). In 2004, the United Nations Development Program ranked Nicaragua, along with Honduras, as the top two countries most vulnerable to hurricanes, based on the number of deaths associated with recently recorded hurricanes and inadequate prevention and mitigation policies and practices (Grupo Reforma 2004).

Natural and human-induced fires are additional threats to forests and biodiversity in Nicaragua. Fires can occur from lightning strikes and other natural sources, as well as shifting and other agricultural and farming practices. Nonetheless, in Nicaragua "the majority of forest fires are due to human intention or

neglect, while comparatively few fires originate from a natural agent” (Valdez 2006). Farmers often use fire to clear forest and scrubland in preparation for crops, and though these practices are typically intended to be limited to a specific area, they can spread to adjacent vegetation and lead to uncontrollable wildfires that result in forest and other biodiversity degradation and loss. In a study using satellite data from NOAA on fire occurrences in Nicaragua from 1996 to 2005, Valdez (2006) reports that the total number fire incidences varies annually, in large part due to climatological variations (e.g. El Niño, La Niña) (1996-2005 avg: 6,778; min: 2,609; max: 18,158). In 2005, Nicaragua demonstrated the third highest incidence of fires at the regional (Central America) level, representing 25% of the regional total, after Guatemala (36%) and Honduras (27%). The systems in Nicaragua most affected by fire in terms of the number and percent of incidences in 2005 were: pastures (1206, 30%), closed broadleaf forest (838, 21%), open broadleaf forest (772, 19%), open pine forest (339, 8.4%), and farmland (173, 4.3%). Valdez (2006) also found a high incidence of fires in national protected areas. In 2005, those most affected were the Bosawas Biosphere Reserve (295 fire incidences), the Cerro Wawashan Wildlife Refuge (136), and the Cordillera Dipilto y Jalapa Natural Reserve (46). In particular, the persistence of uncontrolled, human induced fires, in protected areas, and across the landscape of Nicaragua, represents an ongoing threat to sensitive ecosystems, and to important fauna and floral species.

Climate change is another looming threat to Nicaragua. According to the Global Climate Risk Index (CRI), Nicaragua was ranked number three (following Honduras and Bangladesh) in terms of countries most affected by extreme climate events from 1998 to 2007 (Harmeling 2009). This was largely attributed to increasing numbers and impacts of hurricanes in the Caribbean and increased susceptibility to these impacts associated with the limited development of region. In addition, extreme climate events are expected to continue to increase in frequency and intensity in the Caribbean with projected changes in the global climate (Harmeling 2009), posing an increasing threat to Nicaragua, its population, and its forests and biodiversity, in particular. With regard to forests and biodiversity in particular, Pérez et al. (2007) considered the impacts of climate change on three groups of bioindicators (i.e. mollusks, birds, trees) in Central America. They found that changes in global climate will have the greatest impact on soil biota (e.g. mollusks) and tree species with specific habitat criteria. They also determined that the continental zone around the Gulf of Fonseca, including the northeastern part of Chinandega in Nicaragua, represents an area that is potentially highly sensitive in terms of biodiversity to a scenario of moderate climate change that includes increase in average annual temperature and sea level rise. This area harbors mangrove systems, as well as black conch, shrimp, fish and other coastal species, which are particularly sensitive to temperature and other climatic changes.

Finally, the introduction of exotic species into natural habitats can also pose a direct threat to biodiversity. Though there have been few studies of the impact of introduced and exotic species on biodiversity in Nicaragua, negative impacts of exotic fish species have been found in some of Nicaragua’s lakes and lagoons. For example, the introduction of *Tilapia* in lakes and lagoons for commercial purposes has had documented negative impacts on the endemic freshwater species of Nicaragua (Zolotoff and Lezama 2007). Nonetheless, more studies are required to fully understand the impact of this threat in Nicaragua.

## **8.2 Indirect Threats**

A number of issues are considered drivers of the direct threats to Nicaragua’s forests and biological diversity discussed above. We refer to these issues as ‘indirect threats’ to biodiversity. In Nicaragua, indirect threats to biological diversity primarily include (a) poverty; (b) political and institutional weaknesses; (c) insufficient information on forests and biodiversity; and (d) land tenure insecurities.

### **8.2.a Poverty**

As discussed in Section IV, Nicaragua is the second poorest country in the hemisphere, with a GDP per capita less than US\$900 (DDG/WB 2007; UNDP 2006). Moreover, nearly 80% of Nicaragua’s population lives on less than two dollars a day, and more than 45% of the population lives on less than one dollar a day (DDG/WB 2007; UNDP 2006). Without economic alternatives, these extremes in poverty lead to significant pressures on natural resources as sources of fuel, food, income, etc. Furthermore, when the market or economic value associated with natural habitats, such as forests or mangroves, does not reflect all the goods and services that they supply, or when they are not effectively protected on public or private

land, pressures associated with poverty can also lead to the conversion of natural habitat. This is particularly true for forests, which are inadequately valued in the market and increasingly converted to shifting or permanent agricultural and grazing lands as a means for generating subsistence or income. These pressures and practices (i.e. direct threats) that result from poverty pressures (i.e. indirect threat) are widespread and relatively uncontrolled throughout much of Nicaragua.

#### *8.2.b Weaknesses at the Institutional and Political Level*

Institutional and political weaknesses also represent significant indirect threats to tropical forests and biodiversity in Nicaragua. These weaknesses include insufficient institutional resources and capacity for forest and biodiversity conservation, instability and turnover in governmental institutions, and implementation challenges and contradictions in the environmental and natural resources legislative framework. For example, governmental and non-governmental organizations often lack financial solvency and sufficient strategic plans and goals and have poor linkages to funding outside of the bilateral donor community. In addition, the larger legal framework in Nicaragua is at times contradictory to natural resource conservation, undermining natural resources legislation and agencies in support of other production practices that can lead to the conversion of natural habitat (e.g. agricultural and livestock subsidies and incentives).

In terms of institutional capacity, as discussed in detail in the sections above, the key governmental agencies responsible for natural resource protection and oversight in Nicaragua (e.g. DGAP, INAFOR) are considerably limited in terms of financial, technical, material, and human resources and capacity. This is particularly true given the vast expanses of land and associated responsibilities for which these agencies are accountable. For example, MARENA (2008a) reports that due to limited resources there is severely limited or no institutional presence in 50 of the 72 protected areas within the SINAP. This lack of institutional presence has drastic implications for the actual contribution that protected areas can make to biodiversity conservation in Nicaragua. Moreover, the budget assigned for environmental conservation (compared to health, education, and other socio-economic sectors) considerably underrates the associated potential for generating employment, revenues, and foreign exchange through tourism, environmental services, timber production and more.

In addition to limited resources for natural resource conservation in Nicaragua, there are implementation challenges related to the environmental legal framework for institutions and end-users. In particular, the legal framework for forest production has become increasingly complicated and cumbersome in recent years with the addition of new legislation such as the Law Banning Logging, the resolutions for the harvest of downed wood post-Felix, and others. These have been difficult for INAFOR, as well as forest owners and operators, to effectively interpret and put into practice, which can lead to administrative gridlock and ultimately, to economic losses for the forest industry, the State, and new players trying to enter the forest production sector. Forest agents and experts also noted that while the government has promoted a new community forestry paradigm, the Law Banning Logging prohibits many forest communities within 10 km of protected areas and 15 km of the national borders from timber production possibilities.

#### *8.2.c Limited Information and Scientific Expertise for Sound Conservation Planning and Implementation*

As noted throughout this assessment, there are significant gaps in information on biological diversity in Nicaragua. As of the close of 2008, the most recent vegetation map of Nicaragua was nearly eight years old. Outdated information makes conservation assessment, planning, and evaluation very difficult. And, while there are some groups of species that have been broadly studied, such as birds (Gillespie 2001, Gillespie et al. 2001, Martínez-Sánchez 2007, McCrary et al. In press[a,b]), there is much less known for other species groups or subgroups (e.g. primates, insects, corals, fish, plants), such as distribution and abundance studies and long-term data sets. This disparity in baseline biological information at the country level only adds to the challenges of conservation efforts. For example, many of the nation's protected areas were designated without ecosystem (e.g. habitat and species composition) or socioeconomic (e.g. land tenure, occupancy) assessments, often resulting in unprotected critical areas, management challenges and difficulty enforcing protected areas laws. Furthermore, once designated, few national protected areas have the resources to develop management plans, much less carry out monitoring or other biological studies, all basic fundamentals of protected area management.

The lack of information for conservation planning and implementation is also attributed to limited institutional development. At the country level, there does not exist an Academy of Sciences nor an institution dedicated to the study and monitoring of biological diversity. Furthermore, there is limited related scientific expertise and capacity at the higher education level. There are some key research centers, NGOs, and scientists that carry out research on tropical forests and biodiversity and a few centers of collection, such as UCA and UNAN herbariums; however, these are dispersed and poorly, if at all, coordinated.

Limited information also poses a challenge to the owners and users of natural resources. For instance, most indigenous groups, local communities, and small forest and land owners in Nicaragua have limited knowledge and/or capacity to manage their natural resources for economic production, such as forests for timber or natural areas for ecotourism. These resource owners and users have a tremendous stake in the sustainability of Nicaragua's natural resources, and as such a substantial need for training, capacity building, and tools to actively participate in tropical forest conservation.

#### *8.2.d Insecure Land Tenure*

Given that private landholdings make up much of the SINAP, conflicting land use perspectives present a significant challenge for conservation through protected area management. In addition, much of the forest area in eastern Nicaragua is located in communal or indigenous lands, few of which possess complete or even partial land title and/or boundary demarcation (Global Witness 2007; Finley-Brook 2007). There is a long history of declarations to clarify disputes over land tenure in the Atlantic regions of Nicaragua that predates Nicaragua's independence in 1821 (Finley-Brook 2007). Conflicts over land tenure there heightened during the Sandinista regime, which promised demarcation and titling of communal lands but disputed the areas claimed by indigenous and community groups. More recently, in 2003, Nicaragua issued the Demarcation Law with the intention of finally settling communal and indigenous land boundaries and tenure in the Autonomous Regions (Law No. 445). However, some suggest this law has led to increased disputes between indigenous communities who consider themselves the historical and rightful land steward or 'owner', and colonists who were promised land in the region by the Sandinista administration (Finley-Brook 2007).

By early 2008, little progress had actually been made in terms of demarcation and titling of lands in the Atlantic region. As indicated by a forestry official and forest regent, unclear and insecure land title represent obstacles for legal forest production, both for the communities who 'own' the forest and for anyone (including communities) who seeks to harvest and market those forest resources (undisclosable sources). By law, clear land title or proof of legal forest tenure is required for the authorization of forest harvest plans and permits (NFR Art. 47). So, as some interviewed forestry officials and managers pointed out, while the state has shifted focus away from industrial forestry to promote community forest management, the demarcation and titling of indigenous and community lands are obviously fundamental for any such program to move forward effectively.

## **IX. Opportunities and Proposed Actions for Conserving Tropical Forests and Biodiversity**

The National Biodiversity Strategy and Action Plan for Nicaragua was initiated in February 2000. The national strategy is based on 6 identified, immediate objectives. These objectives are further broken down into sub-targets with actions to achieve these sub-targets, the indicators to be used as well as the parties responsible for implementing the measures. The six main objectives are: improve conservation considering its integral role in the development of the country; promote the economic viability of biodiversity considering its richness and economic value, as well as the costs of its degradation to the country; improve the country's capacity in the fields of scientific investigation, monitoring and technical assistance for conservation and sustainable use of biodiversity; develop mechanisms and institutional tools that will allow an improvement of the national response capacity to the degradation of biodiversity; develop and implement legal tools that will improve the national response capacity to biodiversity degradation; and promote respect for the environment in Nicaraguan society as well as provide incentives

for a change in attitude in men and women for sustainable management of the country's biological diversity resources. Taking into account the Government of Nicaragua Biodiversity Strategy and Action Plan (MARENA 2000), the USAID Nicaragua Country Plan 2003-2008 (USAID 2003), the Forests and Biodiversity Assessment carried out by Weaver et al. (2003), and the assessment of tropical forests and biodiversity presented in this report, we recommend the following actions in association with threats identified above:

### **9.1 Direct Threat: Habitat Conversion**

- Support governmental and non-governmental conservation organizations that promote habitat conservation and sustainable integrated resource use through programs focused at the community level that incorporate community forestry, rural tourism, forest restoration, and agroforestry and silvopastoral systems, and forest restoration.
- Support conservation-based land use and urban planning efforts, particularly
  - in partnership with municipal governments and local communities.
  - in the Sierras de Managua (Managua, Ticuantepe, Crucero, Masaya, Diriamba) to reduce conversion of shade coffee to urbanizations.
- Strengthen protected area management by:
  - Improving park ranger professionalism through capacity building, enhanced mechanisms of transparency, and the establishment of incentives for park ranger performance.
  - Supporting governmental and non-governmental conservation organizations that work with communities and landowners towards enhanced ecosystem and biodiversity conservation in and around public and private protected areas.
  - Providing training and logistical and material support to private wildlife reserve management staff.
  - Supporting the creation of new national protected areas and private wildlife reserves in areas where habitat is still intact, which can serve to connect existing protected areas, and/or which are critical for terrestrial, coastal, and freshwater conservation.

### **9.2 Direct Threat: Contamination and Sedimentation of Terrestrial and Water Systems**

- Promote and support programs focused on sustainable, holistic farming practices that incorporate crop rotations; agroforestry and silvopastoral practices that integrate crops, trees and livestock; soil conservation measures, and biological and integrated pest management (IPM) approaches that minimize the use of pesticides and, for example, encourage beneficial insects, introduce natural pest predators, and incorporate intercropping of compatible plants species that reduce the potential for widespread infestation, particularly in areas where intensive agriculture is dominant and/or the agricultural frontier is expanding.
- Partner with local communities and government, national government, and conservation organizations in support of coastal and marine ecosystem protection and improvement, including programs focused on coastal community development including sustainable fishing and aquaculture; restoration of damaged or degraded coastal ecosystems; and biological monitoring in key reproductive zones such as mangroves and estuaries.
- Partner with municipal governments and local and international conservation organizations to develop education campaigns and other strategies for reducing litter and waste in urban and natural settings.
- Support international efforts by civil society to reduce contamination of natural areas and waterways,
  - For example, the International Coastal Clean-up that includes rivers, lakes and coastal cleanup projects throughout Nicaragua.
- Given the contamination and sedimentation that result from habitat conversion and fragmentation, see also the recommended actions under 9.1.

### **9.3 Direct Threat: Overexploitation and Illegal Trade of Natural Resources**

- Support MARENA in the effective monitoring and reduction of illegal trade of wildlife nationwide through policy and strategy development, technical assistance, and training.

- Support INAFOR in the effective monitoring and reduction of illegal logging and overexploitation of productive forests through policy and strategy development, technical assistance and training.
- Provide capacity building to and develop incentives for Nicaraguan customs officials to effectively monitor and control illegal international trade of wildlife.
- Equip and train private wildlife reserve management and staff to effectively monitor and reduce illegal trade of wildlife at the local level.
- Promote the development of management plans for important indicator biota (endemics, specialists—habitat, dietary, pollinator, flagship, threatened and endangered, invasive).
- Promote the creation and implementation of incentives for the protection of critical wildlife in place of wildlife poaching and trade at the community and individual level, particularly, in rural areas.
- Provide support for education and awareness campaigns on the threats of overexploitation and trade of Nicaragua’s natural resources directed at and specialized for the general public, visitors, and tourists.

#### **9.4 Other Direct Threats: Hurricanes, Fires, Climate Change, and Exotic Species**

- Promote enhanced hurricane and other natural disaster planning, mitigation, and adaptation measures, as well as advisory, response, and recovery programs.
- Support the improvement of land use planning and management that mitigate the vulnerability of communities and natural resources to hurricanes and other natural disasters.
- Support the improvement of land use planning and management that makes communities and natural resources more adaptive to hurricanes and other natural disasters.
- Support governmental and non-governmental organization efforts focused on sustainable agricultural practices and increasing public awareness on the impacts of fires on natural systems.
- Support the development of:
  - baseline studies on carbon sequestration in natural and planted forest systems
  - voluntary markets for carbon and other environmental services payments
- Provide support for the protection of critical watersheds and coastal systems, incorporating efforts to mitigate and/or adapt to the potential impacts of climate change,
- Provide support for the restoration of critical watersheds with native species to mitigate the impacts of exotic species and climate change.

#### **9.5 Indirect Threat: Poverty**

- Support programs that create opportunities for the development of conservation-related micro-and community enterprises, particularly in rural settings.
- Promote the development of financial incentives that support forest and biodiversity conservation (e.g. payments for ecosystem services, carbon finance, watershed protection payment schemes)
- Provide support for conservation programs that involve private-public partnerships and that ensure the inclusion of local communities and the use of local labor forces (e.g. training and employment for guides and other staff at private wildlife reserves).
- Support the design and marketing of long-term, sustainable tourism programs, particularly those that involve training and hiring of local labor forces and involve local communities.

#### **9.6 Indirect Threat: Institutional and Organizational Weaknesses**

- Provide capacity building opportunities to MARENA-DGAP and MAGFOR-INAFOR in the areas of organizational management, leadership, financial management, organizational ethics, etc.
- Support conservation actions that partner with municipal governments and other local institutions involved in forest and biodiversity conservation and protection.
- Provide national conservation organizations capacity building in organizational management and development and those that demonstrate transparency, accountability, and capacity with basic material and logistical support.

- Provide technical and material support to the Private Wildlife Reserve Network.

### **9.7 Indirect: Limited information and scientific expertise for conservation planning and implementation**

- Support the establishment of a nationwide, standardized program for biological monitoring,
  - that is carried out in the protected areas of the SINAP and the Private Wildlife Reserve Network, as well as unprotected lands
  - that encompasses the long-term monitoring of major habitat types prioritized by attributes, including but not limited to: (a) biological (genetic and phenotypic components of biodiversity); (b) ecological (vegetative and biotic richness and quality, complexity, heterogeneity), and physical (size, shape, connectivity, perpetuity), coupled with periodic surveys and inventories (spatiotemporal phenology and protocol would depend on the taxon). For some taxa (birds, mollusks, particular insect groups), established monitoring stations/locales would need long-term funding to continue and expand operations.
  - that involves governmental (MARENA, INAFOR, Ministry of Education) and non-governmental organizations, universities, and local communities; the establishment of internship programs and university training; and participation of local students.
- Support international scientific exchange and the linking of monitoring programs internationally (i.e. bird monitoring, sea turtle tracking).
- Support the development of an educational program specializing in biodiversity conservation. Local entities with environmental education track records such as Paso Pacifico, Fauna and Flora International and ALAS -backed by international funding- could undertake this task. And, again, compliance could be enhanced by the involvement of university students whose theses include aspects of environmental education.
- Provide support for the retrieval and compilation of widely dispersed, biodiversity-related information from governmental and non-governmental organizations, international – intergovernmental and donor agencies, and private entities. University students, sponsored by NGOs and other entities specializing in conservation stewardship, could incorporate such activities in their curricula.

### **9.8 Insecure Land Tenure**

- Promote progress and completion of the delimitation and titling of untitled indigenous, community, and other lands.
- Support MARENA in the collection and assessment of the status of land tenure throughout the SINAP and a strategy for incorporating the private landholdings within SINAP in sustainable land use practices.

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## FIGURES



Figure 1. Biogeographic zones of Nicaragua according to Incer (1973) and Oviedo (1993): (A) Pacific, (B) Central-North, (C) Atlantic.



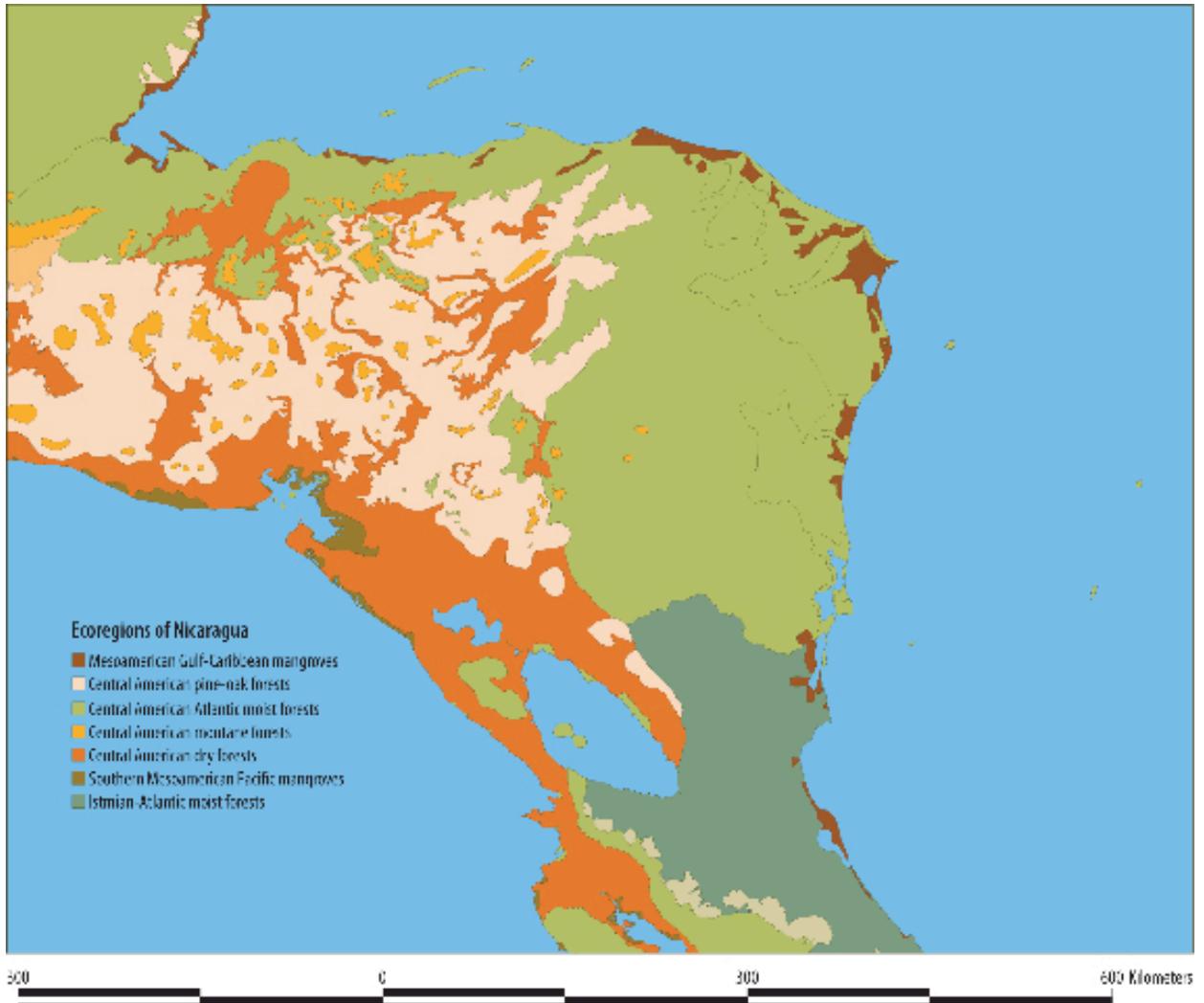


Figure 3. Ecoregions of Nicaragua (Source: WWF 2008).

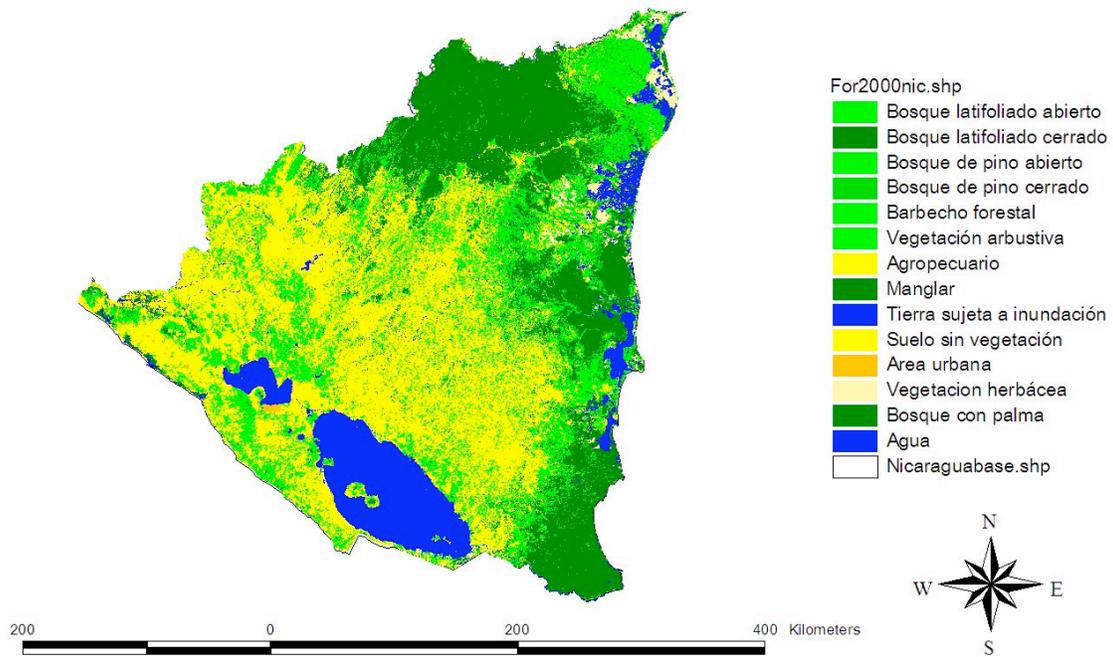


Figure 4. Map of forest cover in Nicaragua in 2000 (Source: MARENA 2003).

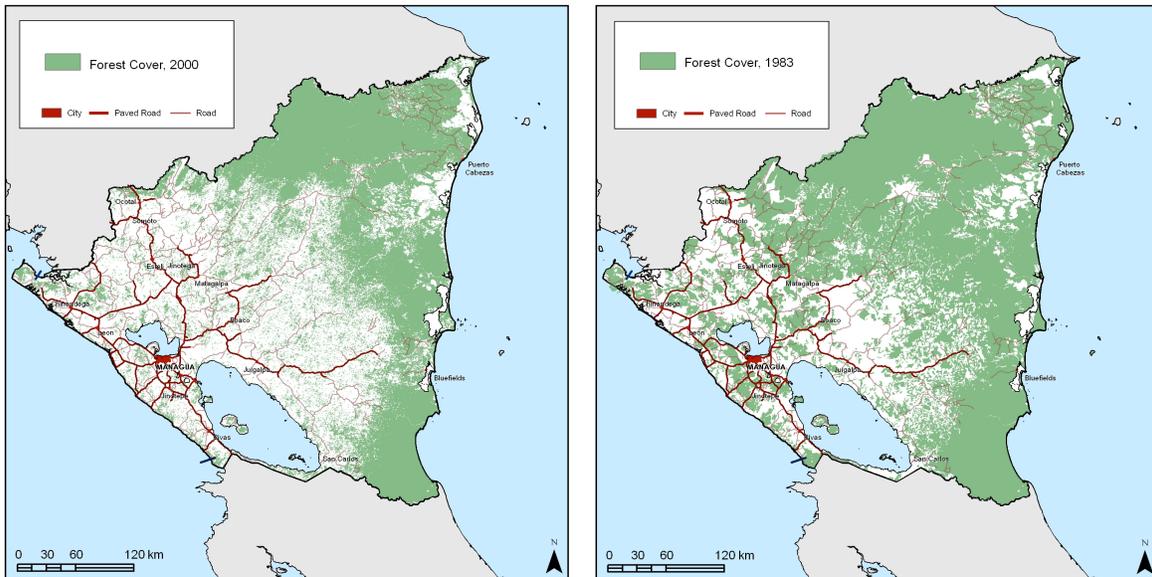


Figure 5. Change in forest cover in Nicaragua from 1983 – 2000 (Source: INAFOR 2003).



Figure 6. Aerial photograph of forest fragmentation from slash-and-burn practices in the Northern Atlantic Autonomous Region of Nicaragua (McGinley 2007).

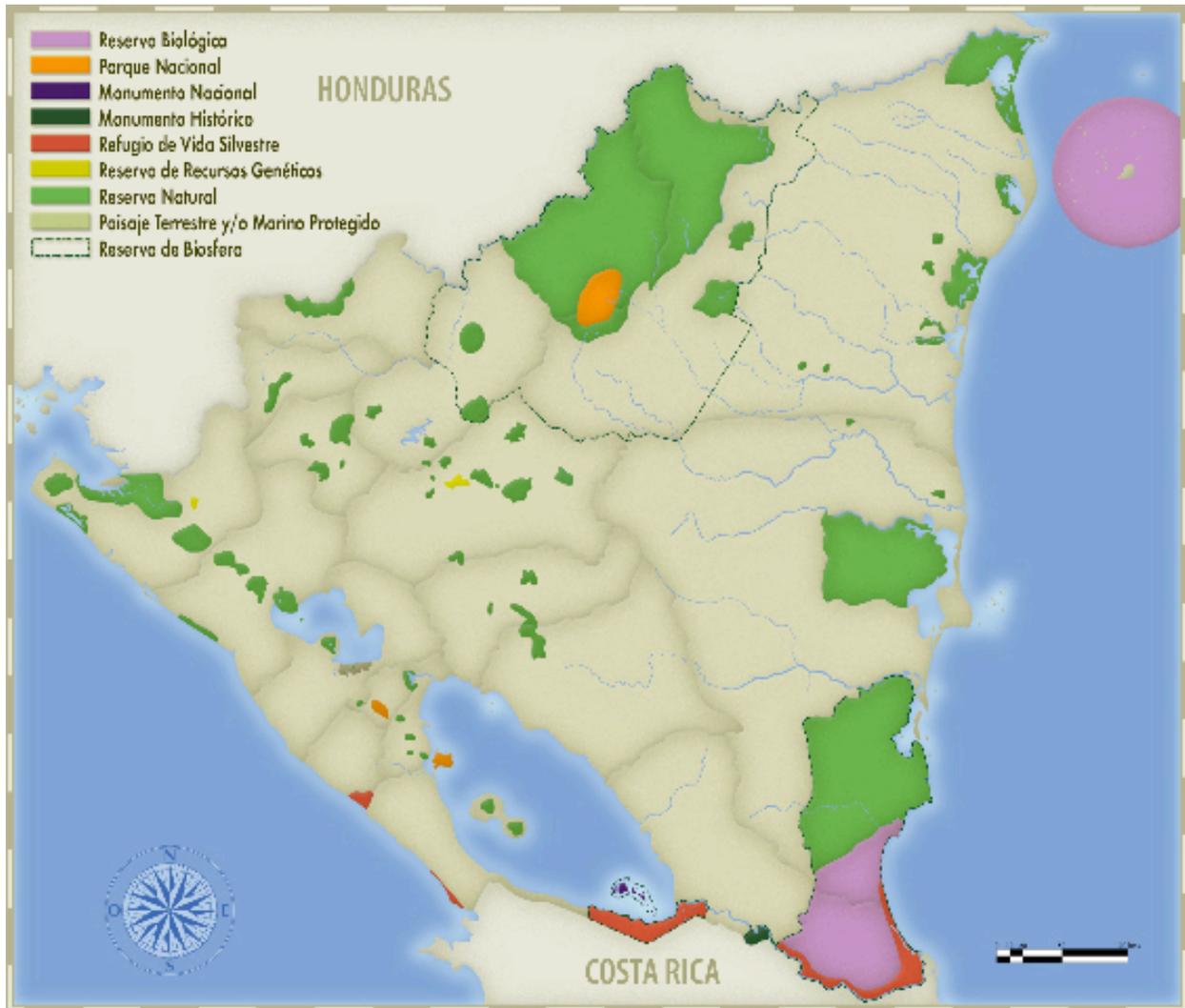


Figure 7. Map of protected areas in Nicaragua (Source: MARENA 2007, in litt.).

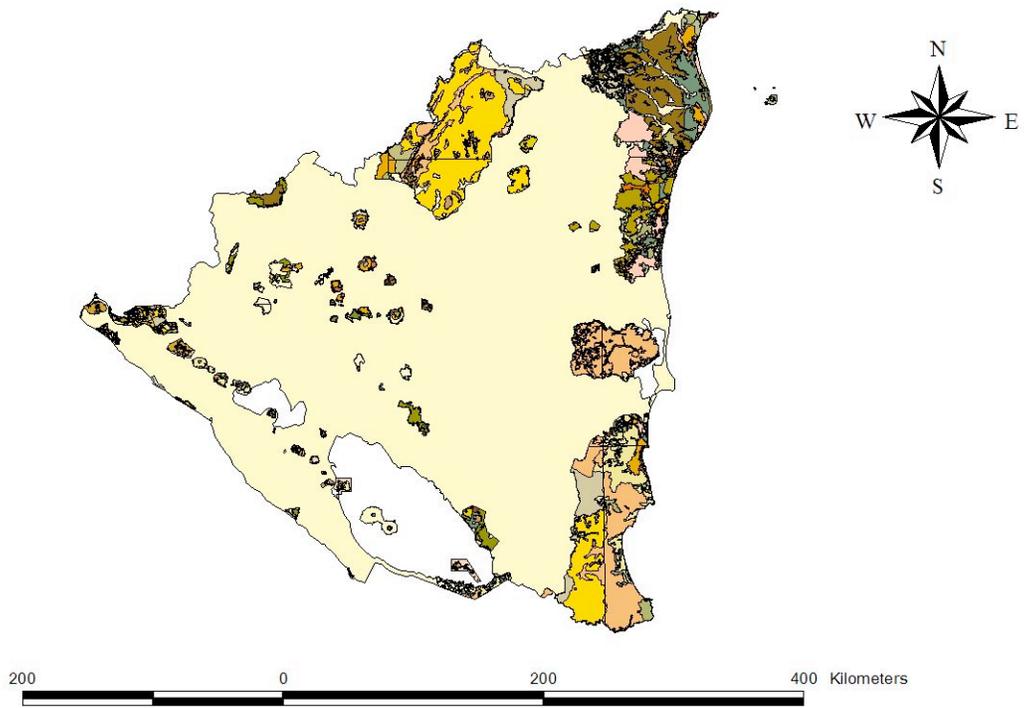


Figure 8. Ecosistemas in proteceded areas from 2000 ecosystem map (Perez 2008).



Figure 9. Distribution of Private Wildlife Reserves in Nicaragua in 2008.

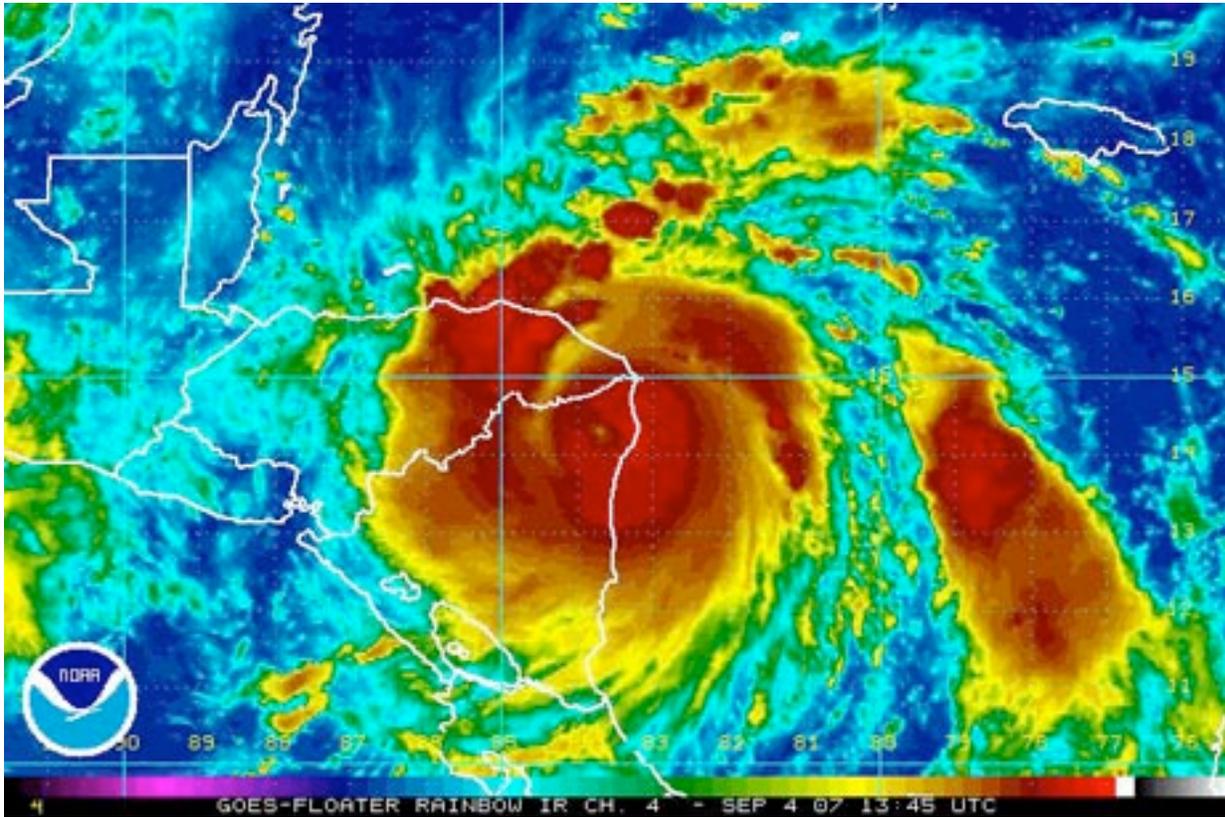


Figure 10. Satellite image of the eye of Hurricane Felix over the RAAN, Nicaragua at 13:45 on 4 September 2007 (Photo: NOAA; Source: <http://news.nationalgeographic.com/news/bigphotos/87117802.html>).

## **TABLES**

Table 1. List of principal vegetative categories and their ranks.\*

Rank	Key	Category	Example
1 <sup>st</sup>	I...n	FORMATION CLASS	I: CLOSED FOREST
2 <sup>nd</sup>	A,B,...n	FORMATION SUBCLASS	I.A: MAINLY EVERGREEN FOREST
3 <sup>rd</sup>	1,2,...n	FORMATION GROUP	I.A.I: TROPICAL OMBROPHILOUS (RAIN) FOREST
4 <sup>th</sup>	a,b,...n	Formation	I.A.I.c: Tropical ombrophilous montane forest
5 <sup>th</sup>	(1),(2),...(n)	Subformation	I.A.I.c(1) Broad-leaved tropical ombrophilous montane forest
6 <sup>th</sup>	(a), (b),...(n)	Further subdivisions	

\*Source: UNESCO 1973 (font format from source).

Table 2. Land use in Nicaragua in 2000.\*

Land Use	Area (km <sup>2</sup> )	Percentage (%)
Farmland	48,875.06	37.49
Closed Broadleaf Forest	31,683.44	24.30
Open Broadleaf Forest	19,401.53	14.88
Bodies of water	10,033.93	7.70
Fallow forest land (barbecho)	4,836.20	3.73
Shrubland	4,618.87	3.54
Open pine forest	3,950.15	3.03
Herbaceous vegetation	2,379.19	1.82
Floodland	1,419.93	1.00
Closed pine forest	1,160.21	0.90
Mangrove	690.47	0.53
Soils without vegetation	569.54	0.44
Forest with palms	486.18	0.37
Urban area	270.23	0.21
<b>Total</b>	<b>130,373.47</b>	<b>100</b>

\*Source: MARENA 2001.

Table 3. Documented number of species in taxonomic groups in Nicaragua.

<b>Taxonomic Group</b>	<b>No. Species in Nicaragua</b>	<b>No. Species in the World</b>	<b>% of Global Species</b>	<b>Source</b>
Mammals	225	4,327	5.2	Saldaña & Medina, 2008. In litt.
Birds	703	9,672	7.3	Martínez-Sánchez et al. 2007
Reptiles	163	6,550	2.5	Sunyer & Köhler, In press
Amphibians	76	4,000	1.9	Sunyer & Köhler, In press
Fish	698	22,000	3.2	Cotto, 2006, Cotto, In litt.
Insects	8,514	1,200,000	0.7	Maes, 1999
Crustaceans	88	4,000	2.2	Pérez, 2004
Mollusks	1,908	60,000	3.2	Pérez et al. 2003
Corrals	58	--	--	Ryan, 1992, 1993
Plants	5,796	240,000	2.4	Stevens, Pool, Ulloa & Montiel, 2001

Table 4. Number of endemic species in taxonomic groups in Nicaragua.\*

<b>Taxonomic Group</b>	<b>No. of Species</b>
Mammals	2
Birds	-
Reptiles	4
Amphibians	4
Fish	19
Arthropods	49
Crustaceans	1
Mollusks	15
Plants	73
<b>Total</b>	<b>167</b>

\*Source: MARENA 2007.

Table 5. IUCN listed species in Nicaragua in 1999.

Taxonomic Group**	Category of Threat*							Total
	EX	EW	CR	EN	VU	LR	DD	
Mammals	--	--	--	--	6	18	3	27
Birds	--	--	--	1	2	11	--	14
Reptiles	--	--	1	4	2	3	--	10
Amphibians	na	na	na	na	na	na	na	
Fish	--	--	--	1	--	--	--	1
Insects	na	na	na	na	na	na	na	
Mollusks	--	--	--	13	11	3	5	32
Plants	--	--	--	---	--	--	--	--
<b>Total</b>	--	--	1	19	21	35	8	84

\* Source: CCAD 1999; mollusks: Perez, In press.

\*\* EX: extinct; EW: extinct in the wild; CR: critically endangered; EN: endangered; VU: vulnerable; LR: limited risk; DD: data deficient.

Table 6. IUCN listed species in Nicaragua in 2008.\*

Taxonomic Group**	Category of Threat*							Total	
	EX	EW	CR	EN	VU	NT	LC		DD
Mammals	--	--	0	2	3	3	13	11	32
Birds	--	--	1	2	6	12	0	0	21
Reptiles	--	--	2	4	2	1	10	0	19
Amphibians	--	--	2	3	5	2	55	2	69
Fish	--	--	4	3	15	13	6	20	61
Insects	--	--	0	2	1	0	0	0	3
Mollusks	--	--	--	13	11	0	3	5	32
Plants	--	--	3	16	20	2	0	1	42
<b>TOTAL</b>	--	--	12	45	63	33	87	39	279

\*Source: MARENA, In litt.; Perez, In press.

\*\* EX: extinct; EW: extinct in the wild; CR: critically endangered; EN: endangered; VU: vulnerable; NT: near threatened; LC: least concern; DD: insufficient data.

Table 7. Land use in Nicaragua in 2000.\*

Land Use**	Area (Km <sup>2</sup> )	Percentage (%)
Forest	56,681.51	43.48
<i>Closed Broadleaf Forest</i>	31,683.44	24.30
<i>Open Broadleaf Forest</i>	19,401.53	14.88
<i>Open pine forest</i>	3,950.15	3.03
<i>Closed pine forest</i>	1,160.21	0.90
<i>Forest with palms</i>	486.18	0.37
Farmland	48,875.06	37.49
Bodies of water	10,033.93	7.70
Fallow forest land (barbecho)	4,836.20	3.73
Shrubland	4,618.87	3.54
Herbaceous vegetation	2,379.19	1.82
Floodland	1,419.93	1.00
Mangrove	690.47	0.53
Soils without vegetation	569.54	0.44
Urban area	270.23	0.21
<b>Total</b>	<b>130,373.47</b>	<b>100</b>

\*Source: MARENA 2001.

\*\*Land use categories include Major Land Use Types and, in particular, *major forest types*. Note that the sum of the *major forest type* areas and percentages sum to the total area and percent of 'Forest'.

Table 8. Forest area and change in Central America 1990-2005.\*

	Forest Area (‘000ha)	Forest Change '000 ha	Rate of Change %/yr	Forest Change '000 ha	Rate of Change %/yr
	2005	1990-2000		2000-2005	
Belize	1,653	0	0	0	0
Costa Rica	2,391	-19	-0.8	3	0.1
El Salvador	298	-5	-1.5	-5	-1.5
Guatemala	3,938	-54	-1.2	-54	-1.3
Honduras	4,648	-196	-3.0	-156	-3.1
Nicaragua	5,189	-100	-1.6	-70	-1.3
Panama	4,244	-7	-0.2	-3	-0.1
Central America	22,411	-380	-1.5	-285	-1.2

\*Source: FAO 2007.

Table 9. Employment by major employment activities in Nicaragua 2003-2006.\*

<b>Activities</b>	<b>2003</b>	<b>2004</b>	<b>2005</b>	<b>2006</b>
			%	
Agriculture and Farming	29.4	29.5	27.7	27.9
Commerce	23.4	23.6	23.1	23
Social, community, and personal services	18.6	17.1	17.3	17.4
Industrial manufacturing	13.3	12.9	14.5	13.8
Construction	3.8	4.8	4.4	4.8
Transportation and communications	3.8	4.1	4.2	4.3
Central government	3	3.5	3.4	3.5
Finance	2.7	3.1	3.4	3.3
Fishing	0.9	0.6	0.6	0.7
Forestry	0.3	0.2	0.5	0.5
Mining	0.2	0.3	0.3	0.3
Electricity, water and gas	0.6	0.3	0.4	0.3

\*Source: BCN 2008.

Table 10. *Swietenia macrophylla* and *Cedrela odorata* Exports (m<sup>3</sup>), and Total Wood Products Export Value (US\$) and Percentage of Total Exports in Nicaragua.\*

<b>Year</b>	<b><i>Swietenia macrophylla</i> (m<sup>3</sup>)</b>	<b><i>Cedrela odorata</i> (m<sup>3</sup>)</b>	<b>Total Wood Products Export Value (US\$)</b>	<b>% Wood Products of Total Annual Exports</b>
2003	7,211.61	1,084.71	13,407,500	2.22
2004	5,271.63	37.59	12,693,300	1.68
2005	7,011.63	29.48	15,038,000	1.75
2006	1,644.35	-	7,184,000	0.70

\*Source: MARENA 2007.

Table 11. Medicinal plant species of Nicaragua.\*

Scientific Name	Common Name (Spanish)	Use
<i>Abelmoschus moschatus</i>		Coffee substitute; Medicinal
<i>Aloe vera</i>	Sábila	Medicinal
<i>Ambrosia peruviana</i>		Medicinal
<i>Bauhinia guianensis</i>	Escalera de mico	Medicinal
<i>Bursera graveolens</i>	Caraño	Medicinal; Fuelwood; Live fences
<i>Bursera tomentosa</i>	Caraño	Medicinal; Fuelwood
<i>Byttneria aculeata</i>	Bebechicha	Medicinal
<i>Casearia corymbosa</i>	Cerito	Medicinal
<i>Cassia fistula</i>	Cañafistula	Medicinal
<i>Cassia grandis</i>	Carao	Medicinal
<i>Chenopodium ambrosioides</i>	Epazote	Medicinal
<i>Dorstenia drakena</i>	Contrahierba	Medicinal
<i>Heliotropium indicum</i>	Cola de alacrán	Medicinal
<i>Hymenaea courbaril</i>	Guapinol	Medicinal
<i>Hyptis capitata</i>	Albahaca cimarrona	Medicinal
<i>Kalanchoe pinnata</i>	Hoja del aire	Medicinal
<i>Matricaria recutita</i>	Manzanilla	Medicinal
<i>Moringa oleifera</i>	Marango	Medicinal; Ornamental
<i>Myroxylon balsamum</i>	Bálsamo	Medicinal
<i>Neurolaena lobata</i>		Medicinal
<i>Ocimum basilicum</i>	Albahaca	Medicinal
<i>Passiflora foetida</i>	Catapanza	Medicinal
<i>Plantago major</i>	Llanten	Medicinal
<i>Psychotria ipecacuanha</i>	Raicilla	Medicinal
<i>Quassia amara</i>	Quinina, hombre grande	Medicinal
<i>Ricinus communis</i>	Higuera	Medicinal
<i>Ruta chalepensis</i>	Ruda	Medicinal
<i>Senna alata</i>	Sorocontil	Medicinal
<i>Smilax domingensis</i>		Medicinal
<i>Smilax panamensis</i>		Medicinal
<i>Sparattanthelium amazonum</i> ssp. <i>guatemalense</i>		Medicinal
<i>Strychnos brachistantha</i>	Bejuco de curarina	Medicinal
<i>Uncaria tomentosa</i>	Uña de gato	Medicinal
<i>Vitis tiliifolia</i>	Miona negra	Medicinal; Food (fruit)

\*Source: Rueda 2006.

Table 12. Documented exports of birds, reptiles, amphibians, and conch from Nicaragua 2002-2006.

Year	Birds	Reptiles	Amphibians	Conch shells	Conch meat (Kg)
2002	5,341	82,697	21,430	-	-
2003	3,284	75,843	22,764	-	-
2004	1,565	67,054	21,345	-	-
2005	617	36,952	17,823	17,292	-
2006	67	26,314	18,094	30,104	14,500

\*Source: MARENA 2007.

Table 13. Overview of Nicaragua's national protected area system.\*

Nicaraguan PA category	Corresponding IUCN category	Distinguishing Criteria	Permits Intervention?	Quantity	Surface area (ha)	Management authority
Biological Reserve	I. Strict nature reserve/wilderness protection area	Areas that possess ecoregions or key representative species	No	2	313,980	MARENA
National Park	II. National Park	Ideal area for the protection of one or more ecosystems, habitats, or areas of cultural interest	No	3	25,327	MARENA
Historical Monument	III. Natural monument	Areas that contain one or more cultural, historical, or archeological aspects of national or international importance	No	1	3,750	MARENA
National Monument	III. Natural monument	Area that contains important natural and/or historical/cultural characteristics with exceptional value due to its rarity or esthetic qualities	Yes	3	20,758	MARENA
Wildlife Refuge	IV. Habitat/Species Management Area	Area subject to active intervention to guarantee the maintenance of habitats and/or to satisfy the needs of determined species or animal communities	Yes	6	95,433	MARENA

Nicaraguan PA category	Corresponding IUCN category	Distinguishing Criteria	Permits Intervention?	Quantity	Surface area (ha)	Management authority
Genetic Resources Reserve	IV. Habitat/Species Management Area	Area that protects some species with important genetic resources, which can be used for genetic improvement of economically or nutritional importance		2	6,226	MARENA
Terrestrial and/or Marine Protected Landscape	V. Protected Landscape/Seascape	Areas in which the interaction between man and nature has produced important esthetic, ecological and/or cultural values	Yes	2	29,408	MARENA
Natural Reserve	VI Managed Resource Protected Area	Area of special interest that generates environmental benefits of national or regional interest	Yes	51	1,714,075	MARENA and Co-managements NGO's
Biosphere Reserve	VI. Managed Resource Protected Area	Areas that integrate different categories of management and integrated administration to achieve sustainable development	Yes	2	1,580,666	MARENA and Indigenous Associations
<b>TOTAL</b>				<b>72</b>	<b>2,208,957</b>	<b>17.3% of territory</b>

\*Source: MARENA/DGAP 2006; MARENA 2008.

Table 14. Categories and representation of mapped natural ecosystems in the Nicaraguan National System of Protected Areas SINAP) (n=43).

Representation Category	% of Ecosystem within SINAP	No. of Ecosystems
Excellently represented	> 70%	9
Well represented	40 – 60%	8
Partially represented	20 – 40%	10
Poorly represented	0 – 20%	16

\*Source: Meyrat 2001.

Table 15. Natural ecosystems with minimal representation in the Nicaraguan National System of Protected Areas (SINAP) in 2000.

<b>Ecosystem type</b>	<b>% Ecosystem Range Represented within SINAP</b>
Deciduous broadleaf shrubland	0%
Deciduous shrub forests	0.4%
Evergreen riparian forests	1.6%
Evergreen riverine forests	1.8%
Deciduous savannah shrub forests	2.0%
Tectonic lagoons	2.1%
Semi-deciduous lowland forests	2.3%
Evergreen pine lowland forests	3.0%
Wet pine savannah	3.3%
Evergreen alluvial forests (dominated by bamboo)	4.2%
Inundated pine savannah	4.9%
Semi-deciduous swamp forest	6.0%
Transitional coastal vegetation (assemblage of three ecosystems)	6.7%
Semideciduous riparian forest	8.4%
Evergreen shrubland	8.6%

\*Source: Meyrat 2001.

Table 16. Total Area and Protection of Major Habitat Types in the Nicaraguan National Protected Areas System (SINAP) (km<sup>2</sup>).

<b>Habitat</b>	<b>Total Area (km<sup>2</sup>).</b>	<b>Unprotected Area (km<sup>2</sup>).</b>	<b>Protected Area (km<sup>2</sup>).</b>
Forest			
Open Broadleaf Forest	19,272.78	16,536.26	2,736.52
Closed Broadleaf Forest	31,773.76	16,825.21	14,948.55
Open Pine Forest	3,974.32	3,691.52	282.8
Closed Pine Forest	1,174.47	1,26.18	148.29
Palm forest	486.18	118.77	367.41
Fallow forestland	4,834.74	4,551.09	283.65
Shrubland	4,618.87	4,380.30	238.57
Woody vegetation	2,379.19	1,905.78	473.41
Farmland	48,875.06	46,935.45	1,939.61
Mangrove	690.47	316.57	373.90
Floodland	1,419.93	1,110.87	309.06
Soils without vegetation	569.54	207.19	9.14
Urban area	270.23	261.09	9.14
Bodies of water	10,033.93	10,033.93	0
<b>TOTAL</b>	<b>130,373.47</b>	<b>107,900.21</b>	<b>22,473.26</b>

\*Source: FAO 2003.

Table 17. Inventories of some major taxonomic groups in Nicaraguan protected areas by ecological region.

<b>Inventories</b>	<b>Atlantic</b>	<b>Central</b>	<b>Northern</b>	<b>Pacific</b>
Birds	5	1	14	21
Mammals	5	1	14	18
Reptiles	5	1	10	16
Amphibians	4	0	6	9
Mollusks	1	0	3	14
Plants	1	0	11	15

\*Source: Perez et al. 2005.

Table 18. Protected areas in co-management in Nicaragua (2007).

<b>Protected Area</b>	<b>Co-management Partner</b>	<b>Legal Agreement: Type and Year Estab.</b>
Reserva Natural Volcán Mombacho	Fundación Cocibolca	Convenio de manejo y administración a 15 años. 1996
Reserva Natural Estero Padre Ramos	Asociación Somos Ecologista en Lucha por la Vida y el Ambiente, (SELVA)	Convenio de comanejo a 10 años. 2001
Reserva Natural Tisey Estanzuela	Fundación de Investigación y Desarrollo Rural (FIDER)	Convenio de comanejo a 10 años. 2001
Reserva natural Cerro Musum	Fundación Nicaragüense para el Desarrollo Sostenible (FUNDENIC)	Convenio de comanejo a 10 años. 2001
Reserva Natural Volcán Cosigüina	Fundación Luchadores Integrados al Desarrollo de la Región (LIDER)	Convenio de comanejo a 10 años. 2001
Refugio de Vida Silvestre Chocoyero el Brujo	Cooperativa Juan Ramón Rodríguez, (CJRR)	Convenio de comanejo a 10 años. 2006
Refugio de Vida Silvestre Isla Juan Venado	UNAN-LEON	Convenio de comanejo a 10 años. 2006
Paisaje Protegido Miraflores-Moropotente	Organización Rural de Desarrollo Local UCA-Miraflor-Esteli	Convenio de comanejo a 10 años. 2006

\*Source: MARENA 2007.

Table 19a. Private Wildlife Reserves in Nicaragua in 2005, from MARENA 2007.

Department	No. of Approved Private Wildlife Reserves
Jinotega	8
Rivas	7
Matagalpa	5
RAAS	5
Managua	5
Chontales	5
Rio San Juan	3
Chinandega	3
Leon	2
Carazo	2
Granada	1
Nueva Segovia-Madriz	1
<b>TOTAL</b>	<b>47</b>

\*Source: MARENA 2007.

Table 19b. Private Wildlife Reserves in Nicaragua in 2007, from The Private Reserve Network.

Name	Location (department)	Biogeographic Zone	Area (ha)
1. Carlos Augusto	Jinotega		77
2. Domitila	Granada		224
3. Egon Borucki in Memoriam	Carazo		154
4. El Aguacate	Rivas		328
5. El Carmen	Nuevo Segovia		118
6. El Cortijo	Chinandega		1,050
7. El Edén	León		60
8. El Jaguar	Jinotega		74
9. Escameca Grande	Rivas		1,325
10. Estancia del Congo	Rivas		42
11. Finca Esperanze Verde	Matagalpa		14
12. Finca San Antonio	Matagalpa		98
13. Finca San Carlos	Jinotega		70
14. Greenfields	RAAS		240
15. Isabel Grande	Managua		771
16. La Dinamarca	Jinotega		14
17. La Máquina	Carazo		158
18. La Primavera	Rivas		9
19. La Sombra	Matagalpa		154
20. Las Brumas	Chontales		18
21. Las Cumbres	Jinotega		28
22. Las Guacamayas	Rivas		33
23. Montibelli	Managua		154
24. Nawawás	Chontales		182
25. Quelantaro	Managua		100
26. Sábalo Lodge	Rio San Juan		7
27. San José	Matagalpa		71
28. Toro Mixcal	Rivas		168
29. Hato Nuevo	Chinandega		237
30. El Quebracho	Rio San Juan		88
31. Was Tuna	RAAN		129

Source: Private Reserve Network 2008.

Table 20. Declared municipal ecological parks in Nicaragua.

Name	Location	Year Est.	Area (ha)
1) Humedal Mahogany	Rama, RAAS	2004	7,720
2) Cerro Campana y La Virgen	Muelle de los Bueyes	2004	200
3) Buena Vista	El Castillo, R. San Juan	2004	42.64
4) La Quezada	El Castillo, R. San Juan	2004	15.19
5) El Guasimo	El Castillo, R. San Juan	2004	27.25
6) Nueva Libertad	El Castillo, R. San Juan	2004	13.52
7) Área Verde Los Ángeles	Nueva Guinea, RAAS	2005	32.97
8) Talolinga	Nueva Guinea, RAAS	2005	1.20
<b>Total</b>			<b>8,053</b>

\*Source: DGAP 2008.

Table 21. Species banned by MARENA 2008.

	Complete Ban	Partial Ban	Total
Mammals	27	7	34
Birds	80	24	104
Amphibians	0	3	3
Reptiles	10	12	22
Fish	4	4	8
Plants	1	0	1
Crustaceans	0	8	8
Mollusks	1	3	4
<b>TOTAL</b>	<b>123</b>	<b>61</b>	<b>184</b>

\*Source: Resolucion Ministerial 000-2008.

Table 22. Number of Species on CITES Appendix I and II in Nicaragua in 1999 and 2006.

Class	App. I (1999)	App. II (1999)	Total (1999)	App. I (2008)	App. II (2000)	Total (2008)
Amphibians	-	2	2	-	2	2
Arachnids	-	1	1	-	1	1
Birds	7	102	109	8	101	109
Corrals	-	33	33	-	35	35
Flora	na	na	na	2	58	60
Gastropods	-	1	1	-	1	1
Mammals	11	11	22	11	11	22
Reptiles	7	7	14	7	8	15
<b>Total</b>	<b>25</b>	<b>157</b>	<b>182</b>	<b>28</b>	<b>218</b>	<b>245</b>

\*Source: CCAD 1999 and MARENA 2006.

# **APPENDICES**

**Appendix A**  
SCOPE OF WORK FOR NICARAGUA  
TROPICAL FORESTRY AND BIODIVERSITY (FAA 118 AND 119) ANALYSIS

**I. Purpose and Objective**

The purpose of this task is to conduct an assessment of biodiversity and conservation needs in Nicaragua for compliance with sections 118 and 119 of the Foreign Assistance Act of 1961, as amended, and country strategy guidelines under ADS 201.3.4.11 and ADS 204.5. The results of this assessment will assist the Mission to define how its new five-year strategy will contribute to the country's conservation needs, as required by agency regulations. This assessment will also serve as a planning tool to assist USAID/Nicaragua in better integrating environment concerns into its overall program.

**II. Background**

USAID/Nicaragua is currently in the process of developing a new country strategy for FY2009 to FY2014. The U.S. Foreign Assistance Act of 1961 Section 119 requires USAID to analyze national needs for conserving biological diversity and potential USAID contributions to these needs in all country strategy plans. Specifically, FAA Section 119(d), Country Analysis Requirements requires 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 conserve biological diversity, and (2) the extent to which the actions proposed for support by the Agency meet the needs thus identified. (FAA, Sec. 119(d)).

**III. Statement of Work**

Under the direction of the Mission Environment Officer, an assessment team will evaluate biodiversity concerns in Nicaragua. The focus of activities taken under this assignment is two fold: 1) identify actions necessary to conserve biodiversity, and 2) describe how and to what extent actions proposed in the new Country Strategy meet, or could meet, the biodiversity needs thus identified.

The assessment team will perform the following activities:

A) Data Collection:

1. Hold meetings with the Bureau Environmental Officer and LAC Bureau technical staff and other groups (such as conservation NGOs with active programs in Nicaragua) to gather relevant information on on-going or planned conservation programs and Agency environmental regulations.
2. Meet with USAID/Nicaragua staff from all technical offices to get an understanding of the Mission's ongoing sectoral assessments, program goals, and objectives under its current and proposed Country Strategy.
3. Meet with representatives from relevant Government of Nicaragua agencies, USAID partners, and host country organizations to gather information on on-going priorities and projects in Nicaragua.
4. Obtain, review and analyze existing documentation on biodiversity conservation (and tropical forest conservation) in Nicaragua, such as that prepared by government agencies, bilateral donors, and national and international NGOs. Examples of such documentation may include the National Biodiversity Conservation Strategies and Action Plan (NBSAP), National Environmental Action Plan (NEAP); Global Environment Fund (GEF) project reports; reports by FAO, UNESCO, UNEP, or UNDP; reports by conservation NGOs, etc.

5. Hold meetings with relevant ministries and agencies, donor organizations, NGOs, and other organizations which are involved in forest and biodiversity conservation, cross-cutting issues, or which are implementing noteworthy projects, and gather relevant information.
6. Conduct one to three priority site visits, if necessary, to supplement the understanding gained from interviews, literature, and other second-hand sources.

#### B) Analysis:

Summarize the status of biodiversity (and tropical forests) in Nicaragua. Summarize the social, economic, institutional, legal, and policy context for their use and conservation, including actions currently being taken by government, other donors, NGOs, and the private sector. Identify the key direct and indirect threats to biodiversity (and tropical forests). Identify the actions necessary to conserve and sustainably manage natural resources and biodiversity (and tropical forests) in Nicaragua in the current context, based on analysis of country donor and NGO responses to meet these needs. Prepare a report on the status of biodiversity conservation efforts in Nicaragua and implications for USAID or other donor programming and environmental monitoring which will define the actions necessary for conservation.

#### C) Report:

Prepare two reports describing the analysis and conclusions of the research. These reports will meet the legal requirements of FAA Sec 119 (and Sec 118) by: 1) clearly articulating the actions necessary to conserve biodiversity (and tropical forests) in Nicaragua, and 2) clearly describing the extent to which actions proposed in new the USAID/Nicaragua Country Strategy meet the needs identified. FAA Sections 119 (and 118) do not require USAID to invest in conserving biological diversity (or tropical forests), although it is encouraged more broadly to do so under these sections of the FAA.

The first report, of between 30 and 60 pages in length (excluding appendices), will follow the outline provided in Appendix A and include the following information:

- An overview of the status of biodiversity in Nicaragua , including ecosystem diversity, species diversity, threatened & endangered species, genetic diversity, agricultural biodiversity, ecological processes and ecosystem services, and values and economics of biodiversity and forests. A map of potential natural vegetation and of land use or land/forest cover should be provided if available.
- An overview of the social, economic, and political context for sustainable natural resources management and the conservation of biodiversity and forests in Nicaragua including the social and economic environment; institutions, policies, and laws affecting conservation; the national protected area system including all IUCN categories of protected areas; laws affecting the protection of endangered species; and participation in international treaties. A map of the protected areas system should be provided if available.
- A review and summary of government, NGO, and donor programs and activities that contribute to conservation and sustainable natural resources management, and an assessment of their effectiveness, strengths, and weaknesses.
- An assessment of the threats to biodiversity, including direct threats and indirect threats or root causes of the direct threats.
- A list or description of the actions necessary to conserve biodiversity and forests in Nicaragua, logically flowing from the review of the threats, and what is currently being done by government, NGO, and donor programs that address those threats.

Following the completion of the new Country Strategy, the second report will follow the outline provided in Appendix B and include the following information:

- Review of the proposed USAID/Nicaragua Country Strategy
- Analysis of the extent to which actions proposed for support by USAID help address direct and indirect threats to biodiversity in Nicaragua. This should also point out any threats to biodiversity and forests from activities proposed for USAID support, and suggest mitigating actions.

- Identify opportunities for cross-cutting, cross-sectoral linkages with proposed activities (for all proposed SOs) especially those that would be low cost and/or would enhance the effectiveness of the proposed activities.

#### **IV. Methodology**

A three-person team with the following composition and expertise is required to conduct this analysis:

**International Technical Assistance (1 or 2 persons).** Senior Level Natural Resource Management Specialists with post-graduate qualifications in biology, zoology, forestry or closely related field in natural resource management or natural resource economics. Background in tropical biodiversity and natural resource conservation. Knowledge of USAID Strategic Planning process related to Tropical Forestry and Biodiversity (FAA Sections 118 and 119). Knowledge of 22 CFR 216 and of FAA 117 is also desirable. Demonstrated expertise in assessing development programs for impacts on environment and tropical ecosystems and of environmental impact assessments. Experience in the Central America and in Nicaragua desirable.

**Local Technical Assistance (1 or 2 persons).** Senior Level Natural Resource Management Specialists with demonstrated experience in Nicaraguan environmental law, the policy and legal frameworks governing environmental management in Nicaragua and the analysis of relevant policies. Good contacts within Nicaraguan government agencies, NGOs, international donors, and private sector preferred.

#### **V. Deliverables:**

The first deliverable under this task order is an Analysis Report for USAID/Nicaragua that examines the biodiversity, natural resource management, (tropical forestry) and other related environmental issues.

The second deliverable is an Evaluation Report that identifies contributions and/or potential contributions to meeting identified conservation needs by the Mission's proposed Country Strategy.

#### **VI. Anticipated Level of Effort**

The LOE for this assignment is a total of 75 person-days.

#### **VII. Schedule and Logistics**

The first report will be due prior to the end of the FY08. The second report will be completed within 3 months of the first availability of a complete draft of the new USAID/Nicaragua Country Strategy.

The team will coordinate logistical arrangements with the USAID/Nicaragua Mission Environment Officer.

The Mission will assist the team by providing key references and contacts as well as logistical support where necessary.

USAID/Nicaragua's Program Office will also help facilitate meetings with other Mission SO Team Leaders or their staff to fully brief the team on USAID's program and future vision for their strategy.

**Appendix A**  
SCOPE OF WORK FOR NICARAGUA  
TROPICAL FORESTRY AND BIODIVERSITY (FAA 118 AND 119) ANALYSIS

**TABLE OF CONTENTS OUTLINE FOR REPORT I**

Title Page (with date)

Table of Contents

List of Abbreviations and Acronyms

Executive Summary

I. Introduction

- Purpose
- Methods

II. Status of Biodiversity

- Ecosystem Diversity
- Species Diversity (including threatened & endangered species, & species of special economic or other importance)
- Genetic Diversity
- Ecosystem Services
- Values and Economics of Biodiversity and Forests

III. Status of Tropical Forests (if a tropical country where FAA 118 analysis is required)

IV. Social, Economic, and Political Context

- Social and Economic Environment
- Institutions, Policies, Laws Affecting Conservation

V. Government, NGO, and Donor Programs and Activities

VI. Threats to Biodiversity (and to Forests if a FAA 118 analysis)

- Direct Threats
- Indirect Threats & Root Causes

VII. Actions Needed to Conserve Biodiversity

VIII. References

Appendices

- SOW for the Analysis
- Biographical Sketches of Team Members
- Persons Contacted, Their Institutional Affiliation, and Contact Information
- Other Relevant Supporting Material (such as additional maps, lists of threatened species, and any other supporting material not needed in text)

## Appendix B

### Assessment Team Biographical Sketches

**Kathleen Ann McGinley** is a Research Forester with the USDA Forest Service, International Institute of Tropical Forestry (IITF). She received her BS in Natural Resources Conservation from the University of Florida in 1996. Following graduation from the University of Florida, she lived and worked for two years with the San Miguel Association for Conservation and Development (Asociación San Migueleña de Conservación y Desarrollo (ASACODE)) in the Talamanca region of Costa Rica. In 1999, she enrolled in the graduate program at the Tropical Agronomy Center for Teaching and Research (Centro Agronómico Tropical de Investigación y Enseñanza (CATIE)) in Turrialba, Costa Rica. In 2000, she received her MS in Tropical Forest Management and Conservation from CATIE, then continued to work for the Center until 2002, carrying out research on the development of ecological criteria and indicators for evaluating sustainable tropical forest management in Central America. Kathleen has worked for IITF since 2002. In 2004, she was accepted into the USDA Forest Service Scientist Recruitment Initiative and enrolled in the doctorate program in Forestry at North Carolina State University in Raleigh, North Carolina. She completed her PhD in Forestry in 2008.

**Wayne J. Arendt** is a Research Wildlife Biologist with the USDA Forest Service, International Institute of Tropical Forestry (IITF). After completing duty in the US Army (Kentucky, Alaska & Colorado) in 1969, he achieved a B.S. degree in Biology from the University of California at Los Angeles in 1974, and then an M.S. in Biology and Zoology with a minor in Statistics at the University of Missouri-Columbia in 1983, and a Ph.D. in Wildlife Ecology with a minor in Forestry at the University of Wisconsin-Madison in 1993. After completing a two-year tour (1976-1978) in the US Peace Corps (Dominican Republic), Wayne began working at the IITF, advancing from being a volunteer on the Endangered Puerto Rican Parrot Recovery Project to his current position. He is stationed at IITF's Sabana Research Field Station in the Luquillo Experimental Forest (El Yunque National Forest) in northeastern Puerto Rico. His biological interests are broad, ranging from avian morphometrics and life histories, ectoparasitism, migratory bird ecology and population dynamics, to sustaining the biodiversity of vertebrate fauna in tropical forests by saving rare, often endemic and endangered animals from extinction. For more than 30 years, he has lived and conducted research in the Neotropics promoting international conservation and the training of natural resource stewards in the principles and techniques of wildlife ecology and avian-oriented eco-tourism throughout the Caribbean and Mesoamerica.

**Jerry Bauer** is a Biological Scientist with the USDA Forest Service, International Institute of Tropical Forestry (IITF). Jerry has more than 30 years of experience working in the Latin America and Caribbean Region with IITF, the U.S. Agency for International Development and the US Peace Corps. Jerry has developed and managed various environmental and natural resource programs throughout the region. He has worked extensively with sustainable development programs in rural development, natural resources, and parks and protected, and biodiversity areas throughout the Latin America and Caribbean Region and in training local counterpart personnel in the techniques of conservation and heritage interpretation. Currently he is Assistant Director, International Cooperation at IITF and Team Leader for the Conservation and Sustainable Tourism in Critical Watersheds project in Nicaragua. Jerry holds a B.S. degree in Forest Resource Management from Southern Illinois University and an M.S. degree in International Forestry from the State University of New York. He is also a Certified Interpretive Guide. Jerry is an Adjunct Assistant Professor in the Department of Forestry at Southern Illinois University where he advises and serves on committees for Master and Doctoral students, he is a collaborator with Colorado State University's Center for Protected Area Management and Training and with Indiana University School of Health, Physical Education and Recreation.

**Jose Manuel Zoolotoff-Pallais** is research director for Fundación Cocibolca, a Nicaraguan NGO. Jose is an ecologist, a specialist in biodiversity assessment with emphasis in ornithologist and management of protected areas. He holds a Bachelor degree in Ecology and Natural Resources (1995) from Universidad Centroamericana-Managua and diplomas from Universidad Nacional Autónoma de Nicaragua-Managua (2007) in Environmental Impact Assessment, Environmental Audit and Natural Resources and Economy. He has several scientific publications on ecology, wildlife from Nicaragua and Central America. He is editor of La Tangara newsletter. He has received awards from Partners in Flight Public Awareness and leadership for outstanding contributions to bird conservation in Latin America.

**Appendix C**  
**Persons Contacted, Their Institutional Affiliation, and Contact Information**

<b>Expert</b>	<b>Area of Expertise</b>	<b>Institution</b>	<b>email</b>
Martha Lucía Sanchez	Areas Protegidas	MARENA, SINIA	
Alejandro Cotto	Peces	FAO	
Ricardo Montoya	Biodiversidad	Biodiversidad, MARENA	
Carlos Mejía	Biodiversidad	Biodiversidad, MARENA	
Julio Castillo	Políticas Públicas	MAGFOR	
Laura Furones	Forestería	Global Witness, UK- IPADE, Nicaragua	
Roberto Araquistáin	Biodiversidad y políticas públicas	MARENA	
Francisco Gadea	Patrimonio natural	Patrimonio Natural, MARENA	
Norvin Sepúlveda	Biodiversidad y Areas Protegidas	TNC	
Liliana Chavarría	Reservas Silvestres Privadas	Red de Reservas Silvestres Privadas	
Alvaro Ponce	Negocios Rurales	CARE	
Jaime Guillén	Varios	Rainforest Alliance	
Rosario Sáenz	Aspectos legales sobre Biodiversidad y Areas Protegidas	FUNDENIC	
Sarah Otterstrom	Pacific ecosystems; conservation governance; NGOs	Paso Pacifico	
Peter Keller	Biodiversity	USAID/LAC	
Victor Bullen	Biodiversity	USAID/LAC	
Steven Fondriest	Environment	USAID/Nicaragua	
Ginger Waddel	Environment	USAID/Nicaragua	
		USAID/Nicaragua	
Sergio Sanchez	Forestry Specialist	Rainforest Alliance	
Janja Eke	Ex-Forestry Program Leader	WWF	janja@wwfca.org
Anne Larson	Consultant Researcher	CIFOR	alarson@turbonett.com
Sandra Tijerino	Directora Nacional	GFTN/Jagwood	info@jagwood.org
Francisco Mayorga	Rector	Albertus Magnus Instituto Internacional	fmayorga@aya.yale.edu
Marvin Centeno	Forestry Specialist	GTZ	centenomarvin@yahoo.com.m x; mcenteno@programas- gtz.org.ni
Jaime Guillen	Director Nacional	Rainforest Alliance	jguillen@ra.org
Mauro Salazar	Director, Programa Forestal	WWF/CA	msalazar@wwfca.org

Jader Guzman	Forest Policy Director	MAGFOR	
Guillermo Zamora	Delegado Municipal Waspan	INAFOR	guillermotiti@hotmail.com
Ali Wather	Delegado Distrital I	INAFOR	
Martin Cuadra		INAFOR	mcuadra@inafor.gob.ni
Jorge Canales	Sub-Director Ejecutivo	INAFOR	jcanales@inafor.gob.ni; jcanalescolindres@yahoo.es
Marvin Sujo		INAFOR	msujo@inafor.gob.ni
Freddy Ramirez	Director	Masangni/WWFCA	
Valberth	Regente	Masangni/WWFCA	
Sergio Miranda	Gerente General	Maderas Giron	nicaforestal@hotmail.com
Mauricio Hernandez	Regente	MADENSA	
Francisco Lemus	Dueno	MADENSA	
Hector Ramos	Dueno/Presidente	NuevoSegovia/ Camara Forestal	
Rufino Johnson	Sindico	Layasiksa	
Lesbia Cruz	Gerente General	PRADA, S.A.	
Jose Luis Garcia Ruiz	Procurador del Medio Ambiente	Procuraduria General	jgarcia@pgr.gob.ni; jolugar74@hotmail.com
General Orlando Talaveda	General, Asuntos Civiles	Ejercito de Nicaragua	
Teniente Coronel Humberto Jose Ramos Gomez	Asuntos Civiles, RRNN	Ejercito de Nicaragua	dac@ibw.com.ni
Marilu Hernandez	Natural Resources Specialist	Municipalidad de Waspan	
Hanzel Zuniga	Natural Resources Specialist	SERENA	hanzelz@hotmail.com
Major Carlos Solano Meza	Jefe de Operaciones y Planes	Ejercito de Nicaragua	

**Appendix D**  
**Ecosystems of Nicaragua** (Source: Meyrat 2001)

<b>Description</b>	<b>Total Ecosystem Area (km<sup>2</sup>)</b>	<b>Area of ecosystem in protected areas (km<sup>2</sup>)</b>	<b>Percentage of ecosystem area in protected areas (%)</b>
Farming system with 10-25% natural vegetation	26,958.8	360.2	1.3
Farming system with 25-50% natural vegetation	22,959.0	1,222.4	5.3
Tectonic lagoon	8,895.2	183.4	2.1
Well-drained lowland evergreen forest	7,452.8	6,864.0	92.1
Moderately intervened, moderately drained lowland seasonal evergreen forest	7,152.1	151.1	2.1
Moderately drained, lowland alluvial evergreen forest	6,876.5	4,709.4	68.5
Intensive farming systems	5,255.2	94.0	1.8
Areas of extensive cattle ranching with 25-50% tree coverage	4,235.1	575.9	13.6
Moderately intervened, moderately drained, lowland alluvial evergreen forest	3,410.4	922.7	27.1
Saturated Savannah, with short grasses and pine trees	3,365.0	111.1	3.3
Flooded Savannah, with short grasses and pine trees	3,090.4	150.9	4.9
Moderately intervened lowland and submontane deciduous forest	2,452.2	300.9	12.3
Semideciduous forest on undulated to rugged, well-drained soils	2,172.3	49.9	2.3
Evergreen swamp forest	1,911.6	1,115.4	58.3
Savannahs with short grasses and deciduous shrubs	1,771.7	35.8	2.0
Highly intervened, submontane seasonal evergreen pine forest	1,635.7	182.0	11.1
Permanently flooded Savannah with short grasses and no woody vegetation	1,544.5	254.7	16.5
Submontane seasonal evergreen forest	1,475.3	460.8	31.2
Intensive farming systems	1,333.1	5.6	0.4

with irrigation			
Predominately freshwater alluvial coastal lagoon	1,281.6	302.5	23.6
Coastal swamp transitional vegetation	1,278.0	204.0	16.0
Swamp evergreen forest dominated by palms	1,219.7	561.1	46.0
Principally deciduous, broadleaf shrubland	1,171.0	5.2	0.4
Lowland or submontane deciduous forest	925.1	352.8	38.1
Lowland seasonal evergreen forest on undulated to rugged well drained soils	866.5	98.9	11.4
Riverine seasonal evergreen forest	807.5	13.0	1.6
Riparian alluvial seasonal evergreen forest	663.7	11.9	1.8
Shaded coffee plantation	591.8	73.8	12.5
Riparian alluvial semideciduous forest	571.3	48.0	8.4
Savannah with tall grasses, broadleaf trees, and significant presence of palms	508.6	152.8	30.0
Riparian alluvial evergreen forest	456.4	149.5	32.8
Mosaic of freshwater aquatic vegetation	447.7	57.4	12.8
Pacific mangrove	435.6	287.4	66.0
Seasonal evergreen swamp forest dominated by palms	428.3	71.6	16.7
Well-drained, lowland seasonal evergreen pine forest	314.7	9.3	3.0
Submontane seasonal evergreen pine forest	292.9	200.4	68.4
Submontane evergreen forest	292.0	292.0	100.0
Caribbean mangrove	280.8	117.1	41.7
Moderately intervened, well-drained, lowland evergreen forest	270.7	255.8	94.5
Occasionally flooded alluvial evergreen forest	229.5	87.8	38.2
Submontane mixed seasonal evergreen forest	207.7	53.4	25.7
Intertidal loamy bank	183.4	173.4	94.5
Moderately drained lowland alluvial seasonal mixed evergreen forest	170.1	27.2	16.0

Mosaic of transitional coastal vegetation	167.3	11.1	6.7
Seasonally flooded or saturated, alluvial, seasonal evergreen forest	156.8	18.2	11.6
Lower montane seasonal evergreen forest	144.5	51.8	35.8
Urban areas	131.4	3.4	2.6
Seasonally flooded alluvial seasonal evergreen forest, dominated by bamboo	121.6	5.1	4.2
Scarcely vegetated beach	119.0	23.3	19.6
Scarcely vegetated lava flow	113.2	82.9	73.2
Deciduous swamp forest	103.2	6.2	6.0
Rock slides with scarce vegetation	79.1	9.7	12.1
Shrimp farm or salt mine	77.1	71.5	92.8
Pacific semi-closed estuary	59.3	22.3	37.7
Seasonal evergreen broadleaf shrubland	58.7	5.0	8.6
Reservoir	57.0	0.0	0.0
Savannah with tall grasses and broadleaf evergreen trees	56.4	28.5	50.6
Caribbean semi-closed estuary	34.4	29.6	86.1
Caribbean coral mangrove	33.4	33.4	100.0
Pacific open estuary	28.5	5.6	19.7
Productive forest plantations	24.4	4.7	19.1
Caribbean open estuary	17.9	2.1	11.7
Savannah with short grasses without submontane or montane woody vegetation	16.5	14.7	89.1
Perennial grassland (herbaceous) on organic deposits de crecida	14.8	14.8	100.0
Short cypress swamp	9.7	9.1	93.2
<b>Total</b>	<b>129,565.4</b>	<b>21,893</b>	<b>16.9%</b>

**Appendix E**  
**PUBLICATIONS OF AVIAN STUDIES AND ACTIVITIES RELATED TO NICARAGUA'S**  
**BIODIVERSITY AND ECO-SOCIOECONOMIC DEVELOPMENT**

- ARENDR W. J., & M. A. TÓRREZ. 2007a. Techniques for Biodiversity Training: Short Course Training for Nicaraguan Biologists. Technical Report, USAID/Nicaragua-USDA Forest Service/IITF: Conservation and Sustainable Tourism in Critical Watersheds Project, in collaboration with Montibelli Private Wildlife Reserve MARENA/COMAP Red de Reservas Privadas de Nicaragua, November 2007.
- ARENDR W. J., & M. A. TÓRREZ. 2007b. Training of Biologists and Local Youth. Technical Report, USAID/Nicaragua-USDA Forest Service/IITF: Conservation and Sustainable Tourism in Critical Watersheds Project, in collaboration with Montibelli Private Wildlife Reserve MARENA/COMAP Red de Reservas Privadas de Nicaragua, November 2007.
- ARENDR, W. J., & M. A. TÓRREZ. 2008. Primer Reporte del Híbrido Intergenérico *Vermivera chrysoptera* X *Vermivera pinus* ("Brewster's Warbler") en Nicaragua. *Zeledonia* 29:25-29.
- ARENDR W. J., & M. A. TÓRREZ. (In press{a}). First documented Central American record of the Arctic Tern *Sterna paradisaea* on terre firme (*Cotinga*)
- ARENDR W. J., & M. A. TÓRREZ. (In press{b}). First documented sightings of the Red-breasted Blackbird (*Sturnella militaris*) in Nicaragua (*Cotinga*)
- ARRÓLIGA, O. 1998. Monitoreo de aves en cafetales bajo sombra en la Reserva Natural Volcán Mombacho. En: Mesoamericana. 1998. Memorias de II Congreso y III Asamblea General de la Sociedad Mesoamericana para la Biología y la Conservación. Managua, Nicaragua. (presentation and published abstract)
- BAUER, G. P., & W. J. ARENDR. 2007. Fact Sheet, Conservación y Turismo en Cuencas Criticas ("Conservation and Sustainable Tourism in Critical Watersheds").
- BAUER, J., W. J. ARENDR, & S. CORIA. 2006a. Bird-watcher Site Guide Development for Protected Areas: a Method to Improve Conservation Awareness and Raise Funds—Experiences from Central America and the Caribbean. IV North American Ornithological Congress held in Veracruz, México (3-7 Oct. 06). (Publ. Abstr.)
- BAUER, J., W. J. ARENDR, & S. CORIA. 2006b. Science and Tourism Working together: Bird-watcher Site Guide Development for Protected Areas, a Method to Improve Conservation Awareness and Raise Funds—Experiences from Central America and the Caribbean. 3ra Conferencia Mesoamericana de Turismo Sostenible, Alianza Mesoamericana de Ecoturismo, y la Universidad de Quintana Roo, Tulum, México. Participating Agency Service Agreement. (Publ. Abstr.)
- BAUER, G. P, ARENDR, W. J., & S. CORIA. 2006c. Techniques for Bird-Watching in Nicaragua, a Flight into the Future: Short Course I for Tour Operators and Nature Guides. (Tech. Rep.)
- BAUER, G. P., ARENDR, W. J., & S. CORIA. 2006d. Techniques for Bird-Watching in Nicaragua, a Flight into the Future: Short Course II for Tour Operators and Nature Guides. (Tech. Rep.)
- GUTIÉRREZ RAMÍREZ, M. Comportamiento poblacional de aves y biometría de *Elaenia frantzii* en el bosque nuboso de la Reserva Natural Volcán Mombacho. Trabajo monográfico para optar al título de Licenciada en Ciencias Biológicas, Universidad Nacional Autónoma de Nicaragua, Recinto Universitario Rubén Darío Facultad de Ciencias e Ingeniería, Departamento de Biología. Managua, Nicaragua. 74 p.
- LEZAMA-LÓPEZ, M. 2008. Domestic trade in psittacids in Nicaragua: social and economic implications. Fourth

International Partners in Flight Conference. Tundra to Tropics: Connecting Birds, Habitats, and People. Accessed: 10 Dec 2008:  
<[http://www.partnersinflight.org/events/mcallen/PIF\\_McAllen\\_2008\\_Abstracts.pdf](http://www.partnersinflight.org/events/mcallen/PIF_McAllen_2008_Abstracts.pdf)>

- MCCRARY, J. K., W. J. ARENDT, L. CHAVARRÍA, L. J. LÓPEZ, P. A. SOMARRIBA, P.-O. BOUDRAULT, A. CRUZ, & F. J. MUÑOZ. (In press). Additions to the Nicaraguan avifauna, including species' range extensions, new distributional data, abundance information, and observations of poorly known species. (*Cotinga*)
- MCCRARY, J. K., W. J. ARENDT, S. MORALES, J. T. ARENGI, AND L. J. LÓPEZ. 2008. New avian sight records for Nicaragua, with notes on abundance, distribution and habitat use. *Cotinga* 29:102-107.
- MARTÍNEZ-SÁNCHEZ, J. C. 2007. Lista Patrón de las aves de Nicaragua: con información de nuevos registros, distribución y localidades donde observar aves. Primera edición. Managua, Nicaragua: Alianza para las Áreas Silvestres, ALÁS. 65 p.
- MARTÍNEZ-SÁNCHEZ, J. C. 2008. The Role of Organic Production in Biodiversity Conservation in Shade Coffee Plantations. Dissertation, University of Washington, Seattle. 226 p.
- MARTÍNEZ-SÁNCHEZ, J. C. , W. J. ARENDT, J. M. WUNDERLE, & J. M. ZOLOTOFF-PALLAIS. (In prep.). The Role of organic cultivation on bird diversity and abundance in shade coffee plantations (*Conserv. Biol.*).
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- MORALES, S., D. OSORNO, W.J. ARENDT, & S. HERNÁNDEZ. Bird Checklist of Ometepe Island, Nicaragua. 40p
- MORALES, S., A. MARTÍNEZ-SALINAS, W. J. ARENDT, AND M. A. TÓRREZ. 2008. Redescubrimiento de *Dendroica chrysoparia* en Nicaragua. *Zeledonia* 29: 30-34.
- PHILPOTT, S. M, W. J. ARENDT, I. ARMBRECHT, P. BICHER, T. DIESTCH, C. GORDON, R. GREENBERG, I. PERFECTO, R. REYNOSO-SANTOS, L. SOTO-PINTO, C. TEJEDA-CRUZ, G. WILLIAMS-LINERA, J. VALENZUELA, & J. M. ZOLOTOFF. 2008. A quantitative review of biodiversity loss in Latin American coffee landscapes: ants, birds, and trees. *Conserv. Biol.* 22: 1093-1105.
- SALMERÓN BELLI, P., AND W.J. ARENDT. Bird Checklist of Montibelli Private Reserve, Nicaragua. 38 p.
- TÓRREZ, M. A., & W. J. ARENDT. (In press). Aves hormigueras en bosque seco del Pacífico de Nicaragua: uso de hábitat y comportamiento. (*Ornit. Neotr.*)
- ZOLOTOFF PALLAIS, J. M., M. LEZAMA, & W. J. Arendt. (Rev. 2<sup>nd</sup> Ed). Estado de conservación de aves acuáticas y sus hábitats en Nicaragua. Rep. Fin. para Birdlife International.(zolutoff@ibw.com.ni)

## Appendix F Documented Endemic Species of Nicaragua

### Endemic Mollusks

Familia	Especie	Autor	Estatus
Poteriidae	Neocyclotus dysoni nicaraguense	Bartsch & Morrison, 1942	Subespecie endemica
Physidae	Aplexa nicaraguana	Morelet, 1851	Especie endemica
Planorbidae	Helisoma nicaraguanus	Morelet, 1851	Especie endemica
Subulinidae	Pseudopeas sp.		Especie endemica
Spiraxidae	Euglandina obtusa	Pfeiffer, 1844	Especie endemica
Spiraxidae	Spiraxis sp.		Especie endemica
Zonitidae	Glyphyalinia sp.		Especie endemica
Systrophiidae	Miradiscops opal	Pilsbry, 1919	Especie endemica
Charopidae	Radiodiscus sp.		Especie endemica
Charopidae	Strobilops sp.		Especie endemica

### Endemic Arthropods (Cuadro) (Según MAES, 1999; MAES, Com. Pers.):

Orden	Familia	Especie	Autor y año
Heteroptera	Miridae	Adfalconia nigra	Carvalho, 1990
<a href="#">Solifugae</a>	<a href="#">Ammotrechidae</a>	Ammotrechesta maesi	Armas, 1993
Diptera	Psychodidae	Arisemus maesi	
Ephemeroptera	Caenidae	Caenis diminuta ssp. Latina	Mc Cafferty & Lugo-Ortiz, 1992
Trichoptera	Polycentropodidae	Cernotina riosanjuanensis	
Heteroptera	Miridae	Colimacoris nicaraguensis	Carvalho, 1992
Coleoptera	Scarabaeidae	Copris maesi	Ratcliffe, 1998
Trichoptera	Polycentropodidae	Cyrnellus zapateriensis	
Diptera	Pipunculidae	Dasydorylas vulcanus	
		Denisella maesi	
Heteroptera	Miridae	Eccritotarsus micheli	Carvalho, 1992
Diptera	Pipunculidae	Elmohardyia nicaraguensis	
Heteroptera	Plokiophilidae	Embiophila maesi	
Odonata	Gomphidae	Epigomphus westfalli	Donnelly, 1986
Diptera	Pipunculidae	Eudorylas trichosubepandrialis	Rafael, 2004
Diptera	Pipunculidae	Eudorylas subvexus	Rafael, 2004
Diptera	Pipunculidae	Eudorylas maesi	Rafael, 2004
Psocoptera	Ptiloneuridae	Euplocania zelayensis	García Aldrete, 2001
		Eustictus membagilus	
Heteroptera	Miridae	Fulvius nicaraguensis	Carvalho and Costa, 1995
		Heteragrion eboratom	
Psocoptera	Ptiloneuridae	Loneura mombachensis	Garcia Aldrete, 2000
Psocoptera	Ptiloneuridae	Loneura maesi	Garcia Aldrete, 2001

Parachela	Macrobiotidae	Macrobiotus islandicus ssp. nicaraguensis	
Coleoptera	Cicindelidae	Megacephala nicaraguensis	
		Minagenia subacuta	
Lepidoptera	Nymphalidae	Napeogenes tolosa ssp. mombachoensis	Brabant & Maes, 1997
Heteroptera	Miridae	Neofurius nicaraguensis	Carvalho, 1987
Coleoptera	Tenebrionidae	Oxinthas nicaraguensis	Merkel, 1992
Heteroptera	Miridae	Pachymerocerista nicaraguensis	Carvalho, 1987
Odonata	<a href="#">Platystictidae</a>	Palaemnema gigantula	Calvert, 1931
Heteroptera	Miridae	Parapycnoderes membranalís	Carvalho & Costa, 1990
Amblypygida	Phryniidae	Phrynus maesi	Armas, 1995
Trichoptera	Polycentropodidae	Polyplectropus maesi	
Trichoptera	Polycentropodidae	Polyplectropus nicaraguensis	
Lepidoptera	Hesperiidae	Polytrix maizae	Hellebuyck, 1998
Heteroptera	Miridae	Prepops nicaraguensis	Carvalho & Schaffner, 1987
Heteroptera	Miridae	Pycnoderes centralis	Carvalho, 1990
Heteroptera	Miridae	Pycnoderes nicaraguensis	Carvalho, 1987
Heteroptera	Miridae	Sixeonotus nicaraguensis	Carvalho, 1990
Arachnida	Hubbardidae	Stenochrus leon	Armas, 1994
Areneae	Salticidae	Synemosyna nicaraguensis	Cutler, 1993
Diptera	Psychodidae	Syntomoza amaliae	Collantes & Martínez-Ortega, 1998
Diptera	Psychodidae	Syntomoza matagalpensis	Collantes, F. & E. Martínez-Ortega, 1998
		Triplocania saslayaensis	
Psocoptera	Ptiloneuridae	Triplocania maesi	García-Aldrete, 2000
Collembola	Hypogastruridae	Willemia meybohlæ	Palacios-Garcías, 1987
Trichoptera	Philopotamidae	Wormaldia matagalpa	Flint, 1995
Coleoptera	Bruchidae	Zabrotes maesi	
Crustacea		Potamocarcinus sp.	

**Endemic Fish (Cuadro) (Según COTTO, In litt.; STAUFFER et al. 2008):**

<b>Especie</b>	<b>Autor</b>	<b>Estatus</b>
Melaniris jiloensis	Bussing, 1980	Endemico
Astyanax nasutus	Meek, 1907	Endemico
Cichlasoma labiatum	(Günther, 1864)	Endemico
Cichlasoma maculicauda	Regan, 1905	Endemico
Amphilophus sagittae	Stauffer & McKaye, 2002	Endemico
Amphilophus amarillo	Stauffer & McKaye, 2003	Endemico
Amphilophus xiloensis	Stauffer & McKaye, 2004	Endemico
Amphilophus chancho	Stauffer, McCrary & Black, 2008	Endemico
Cichlasoma n. sp. "squid"		Endemico
Amphilophus astorquii	Stauffer, McCrary & Black, 2008	Endemico
Amphilophus flaveolus	Stauffer, McCrary & Black, 2008	Endemico
Cichlasoma (Herichthys) zaliosum	(Barlow, 1976)	Endemico
Dorosoma chavesi	Meek, 1907	Endemico

Rhamdia barbata	Meek, 1907	Endemico
Rhamdia luigiana	Villa, 1977	Endemico
Rhamdia managuensis	(Gunther, 1868)	Endemico
Rhamdia nicaraguensis	(Gunther, 1864)	Endemico
Poecilia sp.		Endemico
Pomadasys grandis	Meek, 1907	Endemico

**Endemic Amphibians** (Cuadro) (KÖHLER, ):

Familia	Especie	Autor	Estatus
Plethodontidae	Bolitoglossa monbachoensis	Köhler & McCranie, 1999	Endémico
Plethodontidae	Nototriton saslaya	Köhler, 2001	Endémico
Ranidae	Rana miadis	Barbour & Loveridge, 1929	Endémico
Hylidae	Ptychohyla sp.		Endémico

**Endemic Reptiles** (Cuadro) (KÖHLER, 2001, 2003, RUIZ & BUITRAGO, ):

Familia	Especie	Autor	Estatus
Iguanidae	<i>Norops villai</i>	(FITCH & HENDERSON 1976)	Endémico
Iguanidae	<i>Norops wermuthi</i>	KOHLER & OBERMEIER 1998	Endémico
Colubridae	<i>Rhadinaea rogerromani</i>	KOHLER & McCRANIE	Endémico
Leptotyphlopidae	<i>Leptotyphlops nasalis</i>	TAYLOR 1940	Endémico

**Endemic Mammals** (REID, 1997):

Familia	Especie	Autor	Estatus
Sciuridae	<i>Sciurus richmondi</i>	Nelson, 1898	Endémico
Muricidae	<i>Oryzomys dimidiatus</i>	(Thomas, 1905)	Endémico

**Endemic Flora** (GRIJALVA, 1999, RUEDA, Com. Pers.).

ESPECIES	Autor + año	Familia	Referencia
<i>Amyris oblanceolata</i>	A. Pool, 1998	Rutaceae	Rueda (Com. Pers.)
<i>Aldama mesoamericana</i>	N.A. Harriman, 1989	Asteraceae	Rueda (Com. Pers.)
<i>Anisacanthus nicaraguensis</i>	Durkee, 1999	Acanthaceae	Rueda (Com. Pers.)
<i>Anthurium beltianum</i>	Standl. & L.O. Williams, 1952	Araceae	GRIJALVA (1999), Rueda (Com. Pers.)
<i>Archibaccharis nicaraguensis</i>	G.L. Nesom, 1988	Asteraceae	Rueda (Com. Pers.)
<i>Ardisia brenesii</i>	Standl., 1938	Myrsinaceae	Rueda (Com. Pers.)
<i>Ardisia costaricensis</i>	Lundell, 1942	Myrsinaceae	Rueda (Com. Pers.)
<i>Ardisia ometepensis</i>	Lundell, 1979	Myrsinaceae	Rueda (Com. Pers.)
<i>Bidens oerstediana</i>	(Benth.) Sherff, 1925	Asteraceae	Rueda (Com. Pers.)
<i>Baskervilla nicaraguensis</i>	Hamer & Garay, 1982	Orchidaceae	Grijalva (1999).
* <i>Bletia purpurea</i> var. <i>alba</i>	Ariza Julia & J. Jiménez, 1960	Orchidaceae	Grijalva (1999).
<i>Bonamia douglasii</i>	D.F. Austin, 1994	Convolvulaceae	Grijalva (1999), Rueda (Com. Pers.)
<i>Caesalpinia nicaraguensis</i>	G.P. Lewis, 1998	Fabaceae	Rueda (Com. Pers.)

<i>Calyptranthes amarulenta</i>	B. Holst, 1999	Myrtaceae	Rueda (Com. Pers.)
<i>Centrosema seymourianum</i>	Fantz, 1979	Fabaceae	Grijalva (1999).
<i>Chodrorhyncha helleri</i>	Fowlie,	Orchidaceae	Grijalva (1999).
<i>Clethra nicaraguensis</i>	C.W. Ham., 1985	Clethraceae	Grijalva (1999), Rueda (Com. Pers.)
<i>Coccoloba nicaraguensis</i>	Standl. & L.O. Williams, 1953	Polygonaceae	Rueda (Com. Pers.)
<i>Coursetia apantensis</i>	M. Sousa, 1987	Fabaceae	Grijalva (1999), Rueda (Com. Pers.)
<i>Coursetia paucifoliolata</i>	M. Sousa, 1987	Fabaceae	Grijalva (1999), Rueda (Com. Pers.)
<i>Coursetia polyphylla</i> var. <i>acutifolia</i>	M. Sousa & Lavin, 1987	Fabaceae	Grijalva (1999), Rueda (Com. Pers.)
<i>Cranichis revoluta</i>	Hamer & Garay, 1982	Orchidaceae	Rueda (Com. Pers.)
<i>Cyperus chorisanthos</i>	C.B. Clarke, 1908	Cyperaceae	Rueda (Com. Pers.)
<i>Diospyros morenoi</i>	A. Pool, 1997	Ebenaceae	Grijalva (1999), Rueda (Com. Pers.)
<i>Disocactus aurantiacus</i>	(Kimmach) Barthlott, 1991	Cactaceae	Rueda (Com. Pers.)
<i>Dressleria helleri</i>	Dodson, 1977	Orchidaceae	Rueda (Com. Pers.)
<i>Echeveria</i> sp.		Crassulaceae	Rueda (Com. Pers.)
<i>Echeveria quisucana</i>	D. Brunner, 1991	Crassulaceae	Grijalva (1999).
<i>Epidendrum nicaraguense</i>	Scheeren ex Hágsater, 1993	Orchidaceae	Rueda (Com. Pers.)
* <i>Epidendrum glumarum</i>	Hamer & Garay, 1985	Orchidaceae	Grijalva (1999), Rueda (Com. Pers.)
<i>Epidendrum hameri</i>	Hágsater & L. Sánchez, 1993	Orchidaceae	Rueda (Com. Pers.)
* <i>Epidendrum hawkesii</i> A.H. Heller		Orchidaceae	Grijalva (1999).
* <i>Epidendrum vulcanicola</i>	A.H. Heller, 1968	Orchidaceae	Grijalva (1999).
<i>Eurystyles boreales</i>	A.H. Heller,	Orchidaceae	Rueda (Com. Pers.)
<i>Eugenia</i> sp.		Myrtaceae	Rueda (Com. Pers.)
<i>Eugenia zelayensis</i>	P.E. Sánchez, 1987	Myrtaceae	Rueda (Com. Pers.)
<i>Eupatorium nicaraguense</i>	B.L. Rob., 1920	Asteraceae	Rueda (Com. Pers.)
<i>Gaultheria subrotunda</i>	Sleumer, 1935	Ericaceae	Grijalva (1999).
<i>Habenaria oerstedii</i>	Rchb.f., 1855	Orchidaceae	Grijalva (1999).
<i>Heliocereus aurantiacus</i>	Kimmach, 1974	Cactaceae	Grijalva (1999).
<i>Hedyosmum goudotianum</i> var. <i>mombachanum</i>	Todzia, 1987	Chloranthaceae	Grijalva (1999), Rueda (Com. Pers.)
<i>Hoffmannia gesnerioides</i>	(Oerst.) Kuntze, 1891	Rubiaceae	Grijalva (1999), Rueda (Com. Pers.)
<i>Hoffmannia oreophila</i>	L.O. Williams, 1973	Rubiaceae	Grijalva (1999), Rueda (Com. Pers.)
<i>Jacquinia montana</i>	B. Ståhl, 1989	Theophrastaceae	Grijalva (1999), Rueda (Com. Pers.)
<i>Jatropha stevensii</i>	G.L. Webster, 1987	Euphorbiaceae	Grijalva (1999), Rueda (Com. Pers.)
<i>Justicia nicaraguensis</i>	Durkee, 1999	Endémica	Rueda (Com. Pers.)
<i>Kegeliella atropilosa</i>	L.O. Williams & A.H. Heller, 1964	Orchidaceae	Grijalva (1999).
<i>Lepanthes helleri</i>	A.D. Hawkes, 1966	Orchidaceae	Grijalva (1999).
<i>Licaria</i> sp.		Endémica	Rueda (Com. Pers.)
<i>Lobelia zelayensis</i>	Wilbur, 1991	Campanulaceae	Grijalva (1999), Rueda (Com. Pers.)
<i>Lonchocarpus bicolor</i>	M. Sousa, 1990	Fabaceae	Grijalva (1999).
<i>Lonchocarpus monticolus</i>	M. Sousa, 1987	Fabaceae	Grijalva (1999).
<i>Lonchocarpus morenoi</i>	M. Sousa, 1987	Fabaceae	Grijalva (1999).

<i>Lonchocarpus pilosus</i>	M. Sousa, 1987	Fabaceae	Grijalva (1999).
<i>Lundellianthus herramanii</i>	Strother,	Orchidaceae	Rueda (Com. Pers.)
<i>Macleania subracemosa</i>	L.O. Williams, 1965	Ericaceae	Grijalva (1999).
<i>Marsdenia nicaraguensis</i>	W.D. Stevens, 2000	Asclepiadaceae	Rueda (Com. Pers.)
<i>Marsdenia olgamarthae</i>	W.D. Stevens, 2000	Asclepiadaceae	Rueda (Com. Pers.)
<i>Masdevallia nicaraguae</i>	Luer, 1979	Orchidaceae	Grijalva (1999).
<i>Mateleia elachyantha</i>	W.D. Stevens, 2000	Asclepiadaceae	Rueda (Com. Pers.)
<i>Maxillaria mombachoensis</i>	A.H. Heller ex J.T. Atwood, 1981	Orchidaceae	Grijalva (1999), Rueda (Com. Pers.)
<i>Meliosma corymbosa</i>	A.H. Gentry, 1987	Sabiaceae	Grijalva (1999), Rueda (Com. Pers.)
<i>Meliosma nanarum</i>	A. Gentry, 1987	Sabiaceae	Grijalva (1999).
<i>Mortiniella pittieri</i>	Woodson	?	Grijalva (1999).
<i>Myrmecolaelia fuchsii</i>	Hamer, 1985	Endémica	Grijalva (1999), Rueda (Com. Pers.)
<i>Nectandra miraflores</i>	van der Werff, 1988	Lauraceae	Grijalva (1999), Rueda (Com. Pers.)
<i>Ocotea nicaraguensis</i>	Mez, 1889	Lauraceae	Grijalva (1999).
<i>Ocotea strigosa</i>	van der Werff, 1988	Lauraceae	Grijalva (1999), Rueda (Com. Pers.)
<i>Paragonia trunciflora</i>	Standl,	?	Grijalva (1999).
<i>Parathesis rothschuhiana</i>	Mez, 1902	Myrsinaceae	Rueda (Com. Pers.)
<i>Parmentiera trunciflora</i>	Standl. & L.O. Williams, 1953	Bignoniaceae	Rueda (Com. Pers.)
<i>Pentacalia matagalpensis</i>	H. Rob., 1978	Asteraceae	Rueda (Com. Pers.)
<i>Peperomia matagalpensis</i>	W. Buerger, 1981	Piperaceae	Grijalva (1999).
<i>Phoradendron molinae</i>	Kuijt, 1987	Loranthaceae	Rueda (Com. Pers.)
<i>Phoradendron zelayanum</i>	Kuijt, 1987	Loranthaceae	Rueda (Com. Pers.)
<i>Picramnia antidesma</i> ssp. <i>nicaraguensis</i>	W.W. Thomas, 1988	Simaroubaceae	Rueda (Com. Pers.)
<i>Pleurothallis chontalensis</i>	A.H. Heller & A.D. Hawke	Orchidaceae	Grijalva (1999).
<i>Pleurothallis exesilabia</i>	A.H. Heller & A.D. Hawkes	Orchidaceae	Grijalva (1999).
<i>Pouteria</i> sp.		Sapotaceae	Rueda (Com. Pers.)
<i>Psychotria hamiltoniana</i>	C.M. Taylor, 1999	Rubiaceae	Rueda (Com. Pers.)
<i>Psittacanthus minor</i>	Kuijt, 1987	Loranthaceae	Rueda (Com. Pers.)
<i>Quararibea funebris</i> ssp. <i>nicaraguensis</i>	W.S. Alverson, 1987	Bombacaceae	Grijalva (1999), Rueda (Com. Pers.)
<i>Randia nicaraguensis</i>	Lorence & Dwyer, 1998	Rubiaceae	Grijalva (1999), Rueda (Com. Pers.)
<i>Rhynchospora waspamensis</i>	Kral & W.W. Thomas, 1988	Cyperaceae	Grijalva (1999), Rueda (Com. Pers.)
<i>Rondeletia nicaraguensis</i>	Oerst., 1852	Rubiaceae	Grijalva (1999), Rueda (Com. Pers.)
<i>Rubus ostumensis</i>	A. Molina R., 1974	Rosaceae	Grijalva (1999), Rueda (Com. Pers.)
<i>Serjania setulosa</i>	Randlk, 1875	Sapindaceae	Grijalva (1999).
<i>Sobralia chatoensis</i>	A.H. Heller & A.D. Hawkes, 1966	Orchidaceae	Grijalva (1999).
<i>Sobralia helleri</i>	A.D. Hawkes, 1966	Orchidaceae	Grijalva (1999).
<i>Sobralia triandra</i>	A.H. Heller & A.D. Hawkes, 1966	Orchidaceae	Grijalva (1999).
<i>Stellilabium helleri</i>	L.O. Williams, 1962	Orchidaceae	Grijalva (1999), Rueda (Com. Pers.)
<i>Styphnolobium caudatum</i>	M. Sousa & Rudd, 1990	Fabaceae	Rueda (Com. Pers.)

Swartzia cubensis var. nicaraguensis	(Britton & Rose) R.S. Cowan, 1968	Fabaceae	Rueda (Com. Pers.)
Swartzia sumorum	A. Molina, 1952	Fabaceae	Rueda (Com. Pers.)
Viguiera molinae	H. Rob., 1977	Asteraceae	Rueda (Com. Pers.)
Zanthoxylum nicaraguense	Standl. & L.O. Williams, 1953	Rutaceae	Rueda (Com. Pers.)
Vanilla helleri	A.D. Hawkes, 1966	Orchidaceae	Grijalva (1999), Rueda (Com. Pers.)

**Appendix G**  
**2008 IUCN Red List of Threatened Species in Nicaragua**  
(last accessed 16 December 2008 at <[www.iucnredlist.org](http://www.iucnredlist.org)>)

**AMPHIBIANS**

[Bolitoglossa mombachoensis](#) (Salamandra De Mombacho)

Status: Vulnerable D2

Pop. trend: stable

[Craugastor laevisimus](#)

Status: Endangered A2ace

Pop. trend: decreasing

[Craugastor lauraster](#)

Status: Endangered B1ab(iii,v)

Pop. trend: decreasing

s

[Craugastor ranoides](#)

Status: Critically Endangered A2ace

Pop. trend: decreasing

[Dermophis mexicanus](#) (Tapalcua)

Status: Vulnerable A2ac

Pop. trend: decreasing

[Ecnomihyla miliaria](#)

Status: Vulnerable B1ab(iii)

Pop. trend: decreasing

[Lithobates miadis](#) (Rana Leopardo Isleña)

Status: Vulnerable D2

Pop. trend: stable

[Nototriton saslaya](#)

Status: Vulnerable D2

Pop. trend: stable

[Oedipina pseudouniformis](#)

Status: Endangered B1ab(iii,v)

Pop. trend: decreasing

[Ptychohyla hypomykter](#)

Status: Critically Endangered A3e

Pop. trend: decreasing

**BIRDS**

[Aphanotriccus capitalis](#) (Tawny-chested Flycatcher)

Status: Vulnerable B1ab(i,ii,iii,v)

Pop. trend: decreasing

[Ara ambiguus](#) (Great Green Macaw)

Status: Endangered A2cd+3cd+4cd  
Pop. trend: decreasing

[Dendroica chrysoparia](#) (Golden-cheeked Warbler)  
Status: Endangered B2ab(i,ii,iii,v)  
Pop. trend: decreasing

[Electron carinatum](#) (Keel-billed Motmot)  
Status: Vulnerable C2a(i)  
Pop. trend: decreasing

[Penelopina nigra](#) (Highland Guan)  
Status: Vulnerable A2cd+3cd+4cd  
Pop. trend: decreasing

[Procellaria parkinsoni](#) (Parkinson's Petrel)  
Status: Vulnerable D2  
Pop. trend: stable

[Procnias tricarunculatus](#) (Three-wattled Bellbird)  
Status: Vulnerable A2c+3c+4c  
Pop. trend: decreasing

[Pterodroma phaeopygia](#) (Galapagos Petrel)  
Status: Critically Endangered A2bce  
Pop. trend: decreasing

[Puffinus creatopus](#) (Pink-footed Shearwater)  
Status: Vulnerable D2  
Pop. trend: unknown

## **MAMMALS**

[Ateles geoffroyi](#) (Geoffroy's Spider Monkey)  
Status: Endangered A2c  
Pop. trend: decreasing

[Balaenoptera musculus](#) (Blue Whale)  
Status: Endangered A1abd  
Pop. trend: increasing

[Physeter macrocephalus](#) (Sperm Whale)  
Status: Vulnerable A1d  
Pop. trend: unknown

[Tapirus bairdii](#) (Baird's Tapir)  
Status: Endangered A2abcd+3bce  
Pop. trend: decreasing

[Trichechus manatus](#) (West Indian Manatee)  
Status: Vulnerable C1  
Pop. trend: decreasing

## **REPTILES**

[Caretta caretta](#) (Loggerhead)

Status: Endangered A1abd  
(needs updating)

[Chelonia mydas](#) (Green Turtle)

Status: Endangered A2bd  
Pop. trend: decreasing

[Crocodylus acutus](#) (American Crocodile)

Status: Vulnerable A1ac  
(needs updating)

[Ctenosaura quinquecariniata](#) (Five-keeled Spiny-tailed Iguana)

Status: Endangered B1ab(iii,v)+2ab(iii,v)  
Pop. trend: decreasing

[Dermochelys coriacea](#) (Trunkback Turtle)

Status: Critically Endangered A1abd

[Eretmochelys imbricata](#) (Hawksbill Turtle)

Status: Critically Endangered A2bd

[Kinosternon angustipons](#) (Narrow-bridged Mud Turtle)

Status: Vulnerable B1+2c  
(needs updating)

[Lepidochelys olivacea](#) (Pacific Ridley)

Status: Vulnerable A2bd  
Pop. trend: decreasing

## **ACTINOPTERYGII**

[Balistes vetula](#) (Queen Triggerfish)

Status: Vulnerable A2d  
(needs updating)

[Epinephelus flavolimbatus](#) (Yellowfinned Grouper)

Status: Vulnerable A2d+3d  
Pop. trend: decreasing

[Epinephelus itajara](#) (Goliath Grouper)

Status: Critically Endangered A2d  
Pop. trend: unknown

[Epinephelus niveatus](#) (Spotted Grouper)

Status: Vulnerable A2d+3d  
Pop. trend: decreasing

[Epinephelus striatus](#) (Nassau Grouper)

Status: Endangered A2ad  
Pop. trend: decreasing

[Hippocampus erectus](#) (Northern Seahorse)

Status: Vulnerable A4cd  
Pop. trend: decreasing

[Lachnolaimus maximus](#) (Hogfish)  
Status: Vulnerable A2d  
(needs updating)

[Lutjanus analis](#) (Mutton Snapper)  
Status: Vulnerable A2d, B1+2e  
(needs updating)

[Lutjanus cyanopterus](#) (Cubera Snapper)  
Status: Vulnerable A2d  
(needs updating)

[Pagrus pagrus](#) (Red Porgy)  
Status: Endangered A1bd+2d  
(needs updating)

[Scarus guacamaia](#) (Rainbow Parrotfish)  
Status: Vulnerable A1d+2d  
(needs updating)

#### CHONDRICHTHYES

[Carcharhinus longimanus](#) (Oceanic Whitetip Shark)  
Status: Vulnerable A2ad+3d+4ad  
Pop. trend: decreasing

[Carcharodon carcharias](#) (Great White Shark)  
Status: Vulnerable A1cd+2cd  
Pop. trend: unknown

[Diplobatus ommata](#) (Ocellated Electric Ray)  
Status: Vulnerable A2bd+3bd+4bd  
Pop. trend: unknown

[Gymnura altavela](#)  
Status: Vulnerable A2bd+4bd  
Pop. trend: decreasing

[Pristis pectinata](#) (Wide Sawfish)  
Status: Critically Endangered A2bcd+3cd+4bcd  
Pop. trend: decreasing

[Pristis perotteti](#) (Largetooth Sawfish)  
Status: Critically Endangered A2abcd  
Pop. trend: decreasing

[Pristis pristis](#) (Common Sawfish)  
Status: Critically Endangered A1abc+2cd  
Pop. trend: decreasing

[Rhincodon typus](#) (Whale Shark)

Status: Vulnerable A1bd+2d

Pop. trend: decreasing

[Sphyrna mokarran](#) (Squat-headed Hammerhead Shark)

Status: Endangered A2bd+4bd

Pop. trend: decreasing

## ARTHROPODS

[Epigomphus westfalli](#) (Westfall's Knobtail)

Status: Endangered B1ab(iii)

Pop. trend: unknown

[Heteragrion eboratum](#) (Ivory-faced Flatwing)

Status: Vulnerable B1ab(iii)

Pop. trend: unknown

[Palaemnema gigantula](#) (Elongate Shadowdamsel)

Status: Endangered; Pop. trend: unknown

## CORRALS

[Acropora cervicornis](#) (Staghorn Coral)

Status: Critically Endangered A2ace

Pop. trend: stable

[Acropora palmata](#) (Elkhorn Coral)

Status: Critically Endangered A2ace

Pop. trend: stable

[Agaricia lamarcki](#) (Lamarck's Sheet Coral)

Status: Vulnerable A4ce

Pop. trend: decreasing

[Dendrogyra cylindrus](#) (Pillar Coral)

Status: Vulnerable A4ce

Pop. trend: stable

[Dichocoenia stokesii](#) (Elliptical Star Coral)

Status: Vulnerable A4c

Pop. trend: decreasing

[Fungia curvata](#)

Status: Vulnerable A4c

Pop. trend: unknown

[Montastraea annularis](#) (Boulder Star Coral)

Status: Endangered A2ace

Pop. trend: decreasing

[Montastraea faveolata](#)

Status: Endangered A2ace

Pop. trend: decreasing

[Montastraea franksi](#)

Status: Vulnerable A4ce  
Pop. trend: decreasing

[Mycetophyllia ferox](#) (Rough Cactus Coral)

Status: Vulnerable A4ce  
Pop. trend: unknown

[Oculina varicosa](#) (Large Ivory Coral)

Status: Vulnerable A2ac  
Pop. trend: unknown

[Pocillopora elegans](#)

Status: Vulnerable A4ce  
Pop. trend: unknown

[Pocillopora inflata](#)

Status: Vulnerable A4ce  
Pop. trend: unknown

[Psammocora stellata](#)

Status: Vulnerable A4ce  
Pop. trend: unknown

MOLLUSCKS

[Adelopoma stolli](#)

Status: Endangered B1+2c  
(needs updating)

[Helicina rostrata](#)

Status: Endangered  
(needs updating)

PLANTS

[Aegiphila fasciculata](#)

Status: Vulnerable A1c, C2a

[Aegiphila panamensis](#)

Status: Vulnerable A1c

[Amphitecna molinae](#)

Status: Endangered C1

[Bombacopsis quinata](#) (Cedro Espino)

Status: Vulnerable A1cd

[Cedrela odorata](#) (Cigar-box Wood)

Status: Vulnerable A1cd+2cd

[Dalbergia retusa](#) (Cocobolo)

Status: Vulnerable A1acd

[Dichapetalum costaricense](#)

Status: Vulnerable D2

[Eugenia salamensis](#)

Status: Endangered C2a

[Guaiacum sanctum](#) (Holywood Lignum Vitae)

Status: Endangered C2a

[Ilex costaricensis](#)

Status: Vulnerable A2c

[Ilex pallida](#)

Status: Vulnerable B1+2bd

[Juglans olanchana](#)

Status: Endangered C2a

[Lennea viridiflora](#)

Status: Vulnerable A2c

[Lonchocarpus miniflorus](#)

Status: Endangered C2b

[Lonchocarpus phaseolifolius](#)

Status: Critically Endangered C2b

[Lonchocarpus phlebophyllus](#)

Status: Endangered C2a

[Lonchocarpus retiferus](#)

Status: Endangered C2a

[Lonchocarpus yoroensis](#)

Status: Critically Endangered C2b

[Machaerium nicaraguense](#)

Status: Endangered C2a

[Mollinedia ruae](#)

Status: Critically Endangered C2b

[Nectandra mirabilis](#) (Aguacate De Monte)

Status: Vulnerable D2

[Ocotea jorge-escobarii](#)

Status: Endangered C2a

[Persea schiedeana](#) (Aguacatillo)

Status: Vulnerable A1c

[Pinus tecunumanii](#)

Status: Vulnerable A2c

[Platymiscium pleiostachyum](#) (Cristóbal)

Status: Endangered C1

[Pouteria foveolata](#)

Status: Vulnerable D2

[Protium correae](#)

Status: Vulnerable A2c

[Quercus bumelioides](#)

Status: Vulnerable A1c

[Quercus purulhana](#)

Status: Vulnerable A1c

[Swietenia humilis](#) (Pacific Coast Mahogany)

Status: Vulnerable A1cd

[Swietenia macrophylla](#) (Large-leaved Mahogany)

Status: Vulnerable A1cd+2cd

[Terminalia bucidoides](#)

Status: Endangered C2a

[Tetragastris tomentosa](#) (Estómagos)

Status: Vulnerable C1

[Ticodendron incognitum](#)

Status: Vulnerable A1c

[Vitex cooperi](#)

Status: Endangered C2a

[Vitex kuylenii](#)

Status: Endangered C2a

[Zanthoxylum belizense](#)

Status: Endangered A1c, C2a

[Zanthoxylum ferrugineum](#)

Status: Endangered C2a

[Zanthoxylum procerum](#)

Status: Endangered C2a

**Appendix H**  
**Synthesis of the Environmental Legislative Framework of Nicaragua as of 2007**

<b>BIODIVERSIDAD Y ÁREAS PROTEGIDAS</b>		
<b>Convenios y Acuerdos</b>		
Convenio Internacional para la Reglamentación de la Caza de la Ballena	Decreto Presidencial 108-2002 Adhesión el 18.12.2002, fue firmada en Washington el 02.12.1946	Gaceta No.240; 18/12/2002
Convenio internacional para la conservación del atún del atlántico y sus protocolos	Decreto Ejecutivo No.62-2003 Firmado 14 de mayo de 1966 el Convenio y Julio de 1984 (París) y Junio de 1992 (Madrid) protocolos	Gaceta No.177; 19/09/2003
<b>Leyes</b>		
Ley Especial de Delitos contra el Medio Ambiente y los Recursos Naturales, 31 de octubre de 2005	No. 559	Gaceta No. 225; 21/11/2005
Aprobación de la Adhesión al Convenio Internacional Para la Conservación del Atún del Atlántico y sus Protocolos.	No. 3721	Gaceta No. 245; 26/12/2003
Ley que declara área protegida en la categoría de Monumento Nacional al Cañón de Somoto.	No. 605	Gaceta No. 240; 12/12/2006
<b>Decretos Ejecutivos</b>		
Establecer los principios, criterios, requisitos y procedimientos administrativos para la certificación de actividades y/o programas de protección y conservación de la biodiversidad y recursos naturales	No.38-2003	Gaceta No.239; 17/12/2003
Actualizar el Sistema de Vedas periodo 2004-2006 y reformar el artículo No.13 de la Resolución Ministerial 007-999 y sus reformas contenidas en la Resolución Ministerial No.023 -99	No.46-2003	Gaceta No. 1; 02/01/2004
Establecimiento de la Política Nacional de Humedales	No. 78-2003	Gaceta No.220; 09/11/2003
Actualización de Categoría y Precisión de Límites del Área Conocida como El Chocoyero-El Brujo ubicada En El Municipio de La Concepción Departamento de Masaya)	No.037-2004	Gaceta No. 105; 31/05/2004
<b>Decretos Ejecutivos (continuación)</b>		
Establecer los criterios, requisitos y procedimientos administrativos para el aprovechamiento sostenible del recurso camarón <i>Litopenaus vannamei</i> y <i>L.stylirostris</i> en sus estadios de larvas y postlarvas en las áreas protegidas del SINAP en el Pacífico de Nicaragua	No. 052-2004	Gaceta No. 47; 08/03/2005
Ratificación del convenio para la protección desarrollo del medio marítimo en la región del gran caribe y su protocolo anexo.	No. 6-2005	Gaceta No.23; 02/02/2005
Reglamento de Áreas Protegidas de Nicaragua	No. 01-2007	Gaceta No. 8; 11/01/2007
<b>Resolución Ministerial</b>		
Estrategia Nacional de Biodiversidad y su Plan de Acción	No. 27-2002	Gaceta No. 156; 20/08/2002
Aprobar los Criterios e indicadores de sostenibilidad del Bosque	No.28-2002	Gaceta No.155; 19/08/2002
Establecer las Regulaciones para el otorgamiento de Permiso Ambiental en el Sistema Nacional de Áreas protegidas	No. 9-2003	Gaceta No. ---

Establecer los criterios, requisitos y el procedimiento administrativo de la planificación física para el desarrollo del turismo sostenible en el SINAP	No. 10-2003	Gaceta No. 74; 22/04/2003
Establecer las regulaciones para el Uso Sostenible de la <i>Tillandsia usneoides</i> o Barba de Viejo	No. 15-2002	Gaceta No. 145; 05/08/2002
Establecer las regulaciones para la conservación y utilización sostenible de las especies de la Familia Delfinidos o Delphinidae	No.23-2002	Gaceta No. 206; 30/10/2002
Establecer el procedimiento administrativo y requisito para el otorgamiento del permiso especial de uso de manglares, humedales y recursos asociados	No.26-2002	Gaceta No.154; 16/08/2002
Establecer procedimiento administrativo para la obtención del permiso de exportación para la especie maderable <i>Swietenia macro piilla</i> , especie incluida en el Apéndice II del Convenio CITES	No.36-2003	Gaceta No. --- La prensa 13/11/2003
Aprobar los criterios y requisitos científico – técnicos para el establecimiento de cuotas de aprovechamiento de la vida silvestre de Nicaragua	No.37-2003	Gaceta No.239; 17/12/2003
Para Regular el Aprovechamiento Sostenible del Bejuco de la Mujer ( <i>Philodendron</i> sp.)	No. 049-2004	
Establecer los Criterios, Requisitos y Procedimiento administrativo para el otorgamiento de autorizaciones de Investigaciones Científicas	No. 051-2004	Gaceta No.47; 08/03/2005
Establecer los criterios requisitos y procedimientos administrativos para la regulación de la pesca artesanal de especies ícticas en las Áreas Protegidas del SINAP	No.053-2004	Gaceta No.47; 08/03/2005
Establecer el Calendario Cinegético Nacional	No. 010-2006	Gaceta No. 103; 29/05/2006
Caza Deportiva	No. 011-2006	Gaceta No. 103; 29/05/2006
Incluir en el Sistema de Vedas de Especies Silvestres Nicaragüenses en el Listado de Vedas Nacionales Indefinidas a la especie Almendro <i>Dipteryx Panamensis</i>	No. 029-2006	Gaceta No. 141; 21/07/2006
Establecimiento de Periodos de Veda	No.DGRN-PA-No. 424-2006	Gaceta No. 36; 20/02/2006
Oficializar la Estrategia Nacional para el desarrollo del Sistema Nacional de Áreas Protegidas, SINAP	No.059-2006.	Gaceta No.---
<b>Normas Técnicas</b>		
Norma Técnica Nicaragüense Obligatoria de Comercio Interno de Fauna Silvestre	NTON 05 -011- 01	Gaceta No. 64; 09/03/2002
Norma Técnica Obligatoria Nicaragüense de Caza Deportiva	NTON No.05 -016-02	Gaceta No. 186; 02/10/2002
Norma Técnica Obligatoria Nicaragüense para Centros de Acopio de Fauna Silvestre	NTON No. 05-018-02	Gaceta No. 186; 02/10/2002
Norma Técnica Obligatoria Nicaragüense de Coto de Caza de Fauna Silvestre	NTON No. 05-019-02	Gaceta No. 186; 02/10/2002
Norma Técnica Obligatoria Nicaragüense de Crianza en Cautiverio	NTON- No.05-020-02	Gaceta No. 186; 02/10/2002
Norma técnica obligatoria Nicaragüense para el establecimiento de Centros de rescate y rehabilitación de Fauna Silvestre	NTON No.05-023-03	Gaceta No. 64; 2003
Norma Técnica Obligatoria Nicaragüense para regular la extracción y aprovechamiento sostenible del recurso Ostras	NTON No.05-025-2004	Gaceta No.47; 08/03/2005

en el Pacífico de Nicaragua		
Norma para Regular el Aprovechamiento Forestal en Áreas Protegidas		
Norma para Regular la Autorización de Actividades Turísticas en Áreas Protegidas		
Norma para Regular el aprovechamiento de Gaspar y Camarón de Río en el Río San Juan		
Norma para Regular el Otorgamiento de Permiso de Aprovechamiento Sostenible de Camarón en sus estadios Larvas y Postlarva en las Áreas Protegidas del Pacífico de Nicaragua		
Norma para Regular el Aprovechamiento Sostenible de Especies Ícticas en las Áreas Protegidas del Pacífico de Nicaragua		

<b>TURISMO</b>		
<b>Convenios y Acuerdos</b>		
<b>Leyes</b>		
Ley General de Turismo	No. 495	Gaceta No. 184; 22/09/2004
Ley de Incentivos para la Industria Turística de la República de Nicaragua, con sus reformas y su Reglamento	No. 306	(varias reformas en los años 2005 y 2006)
<b>Decretos Ejecutivos</b>		
Reforma al Decreto No. 89-99, Reglamento de la Ley No. 306, Ley de Incentivos para la Industria Turística de la República de Nicaragua.	No.53-2003	Gaceta No.126; 07/07/2003
Declarar de Interés Nacional la Estrategia Nacional al Desarrollo Estadístico	No. 98-2004	
<b>Resolución Ministerial</b>		
Tarifas de Energía Eléctrica a las Empresas Turísticas	No. 17-2003	Gaceta No. 148; 07/08/2003
<b>EDUCACION AMBIENTAL</b>		
<b>Convenios y Acuerdos</b>		
Convenio de Cooperación entre el Ministerio del Ambiente y los Recursos Naturales(MARENA) y el Ministerio de Educación, Cultura y Deportes	Fecha de Suscripción: Mayo 3 del 2006	Convenio Inter-Institucional
<b>Leyes</b>		
Ley General de Educación	No. 582,	Gaceta No. 150; 03/08/2006
Ley que instauro la Semana del Medio Ambiente y Recursos Naturales.	No. 195	Gaceta No.
Ley Creadora de la Signatura del Medio Ambiente y los Recursos Naturales	No.342	Gaceta No. 102; 2000
<b>Decretos Ejecutivos</b>		
Lineamientos de Política y Estrategia Nacional de Educación	No. 19-2003	Gaceta No.18; 23/01/2003

Ambiental de Nicaragua		
Creación de los Premios Ecológicos Anuales <i>Semper Virens</i>	No. 53-93	Gaceta No.
Creación de la Comisión Nacional de Educación Ambiental (CNEA)	No. 27-94	Gaceta No.
<b>Resolución Ministerial</b>		
Política de Comunicación Ambiental del Ministerio del Ambiente y los Recursos Naturales y su Plan de Acción 2007-2009	No. 018-2006	Gaceta No.
Guía de Educación Ambiental para el Manejo Integrado de Cuencas Hidrográficas	No. 058-2006	Gaceta No.
Acuerdo Ministerial 156-2006 crea la Comisión técnica institucional de educación Ambiental del MECD	156-2006	Gaceta No.

<b>TRANSPORTE</b>		
<b>Convenios y Acuerdos</b>		
Convenio entre el MTI y el Instituto Nicaragüense de Cultura		Mayo de 2004
<b>Normas Técnicas</b>		
Para Regular los Bancos de Materiales de Préstamo para la Construcción	NTON 05-016-2004	
Normativa Técnica Ambiental para el aprovechamiento de Bancos de Materiales de préstamo para la Construcción	NTON 05/021/02	

<b>FORESTAL</b>		
<b>Leyes</b>		
Ley de Conservación, Fomento y Desarrollo Sostenible del Sector Forestal	No. 462	Gaceta No. 168; 04/09/2003
Ley de Veda, para el Corte, Aprovechamiento y Comercialización del Recurso Forestal	No. 585	Gaceta No. 120; 21/06/2006
<b>Decretos Ejecutivos</b>		
Criterios e Indicadores del Manejo Sostenible del Bosque.	No. 28-2002	Gaceta No. 155; 19/08/2002
Reglamento de la Ley No. 462, Ley de Conservación, Fomento y Desarrollo Sostenible del Sector Forestal	NO. 73-2003	Gaceta No. 208; 03/11/2003
Reglamento de la Regencia Forestal.		Gaceta No. 123; 27/06/2005
Reglamento de Procedimientos para el Establecimiento, la Obtención y Aplicación de los Incentivos para el Desarrollo Forestal de la Ley de Conservación, Fomento y Desarrollo Sostenible del Sector Forestal, Ley No. 462”.	No. 104 – 2005	Gaceta No. 250; 27/12/2005
Disposiciones que Regulan las Concesiones Forestales	No. 106 – 2005	Gaceta No. 04; 05/01/2006
De Emergencia Económica para atender el problema de la tala ilegal del bosque en áreas protegidas de RAAN, RAAS, Río San Juan y Nueva Segovia.	No. 32- 2006	

Aprovechamiento especial del recurso forestal derribado por el huracán Félix.	No. 92-2007	La Gaceta No. 181, 21.09.2007.
<b>Resolución Ministerial</b>		
Que Establece las Disposiciones Administrativas Para el Manejo Sostenible de los Bosques Tropicales Latifoliados, Coníferas y plantaciones Forestales	No. 35 – 2004:	Gaceta no. 158; 13/08/2004
Reglamento Interno de funcionamiento de la Comisión Nacional Forestal (CONAFOR).	No. 06 – 2005:	Gaceta No. 196; 11 de Octubre; 2005
Acuerdo Ministerial: “Reglamento de la Administración y Funcionamiento del Fondo Nacional de Desarrollo Forestal (FONADEFO)”	No. 07 – 2005	Gaceta No. 195; 10/10/2005
Normativa de Funcionamiento del Registro Nacional Forestal.		Gaceta No. 123; 27/06/2005
Aprovechamiento de madera caída en la RAAN.	No. 64-2007	Gaceta No. 210; 1/11/2007
<b>Normas Técnicas</b>		
Norma Técnica para el Manejo Sostenible de los Bosques Naturales Latifoliados y de Coníferas	NTON 18 001 – 04	Gaceta No. 250; 24/12/2004
Norma Técnica obligatoria nicaragüense para el uso sostenible del recurso forestal maderable en el bosque de manglar en el Pacífico de Nicaragua	NTON No. 00-024-2003	Gaceta No. 64; 2003

<b>PESCA</b>		
<b>Leyes</b>		
Ley de pesca y Acuicultura	No.489	Gaceta No.251; 27/12/2004
<b>Decretos Ejecutivos</b>		
Normativa de Ordenamiento de las Pesquerías de Camarón y Langosta en el mar Caribe y de Camarón en el océano Pacífico	No. 281-02	Gaceta No.164; 30/08/2002
Disposiciones Especiales Para la Pesca De Túnidos y Especies Afines Altamente Migratorias	No. 40-2005	Gaceta No. 117; 17/06/2005
Reglamento de la Ley de Pesca y Acuicultura	No.009-2005	Gaceta No.117; 17/06/2005
De Ratificación de la "Convención para el Fortalecimiento de la Comisión Interamericana del Atún Tropical Establecida por la Convención de 1949 entre los Estados Unidos de América y la República de Costa Rica"	No. 23-2006	Gaceta No.71; 10/04/2006
<b>Resolución Ministerial</b>		
Modificar el Acuerdo Ministerial 014-99 "Actualizar los Procedimientos para el Otorgamiento de los Derechos Pesqueros y Acuícolas", del 06 de mayo de 1999	Acuerdo Ministerial DGRN-PA No. 292-2002 del MIFIC,	Aprobado el 26 de Agosto; 2002
Convenio de colaboración de Funciones de pesca artesanal entre el Ministerio de Fomento Industria y Comercio y la alcaldía Municipal de Juigalpa	Convenio institucional RM	Aprobado el 06 de Noviembre; 2003 con validez por cuatro años y prorrogable

Convenio de Delegación de funciones de pesca artesanal entre el Ministerio de Fomento Industria y Comercio y la Alcaldía de Corn Island	Convenio institucional RM	Aprobado el 28 de Agosto; 2003 con validez por cuatro años y prorrogable
Convenio de Delegación de Funciones pesca artesanal entre el Ministerio de Fomento Industria y Comercio y la Alcaldía de San Carlos	Convenio institucional RM	Aprobado el 21 de Noviembre; 2003 con validez por cuatro años y prorrogable
Normativa para la Pesca y la Acuicultura en Nicaragua	Acuerdo Ministerial DGRN-PA- No. 359-2004	Aprobado 22 de Marzo; 2004
Convenio de Delegación de Funciones de Pesca Artesanal entre el Ministerio de Fomento Industria y Comercio y la Alcaldía Municipal de San Miguelito	Aprobado el 15 De Abril Del 2004 RM	Gaceta No. 127; 30/06/2004
Convenio de Delegación de Funciones de Pesca Artesanal entre el Ministerio de Fomento Industria y Comercio y la Alcaldía Municipal de Acoyapa	Aprobado El 16 De Abril Del 2004 RM	Gaceta No. 127; 30/06/2004
Convenio de Delegación de Atribuciones de Pesca Artesanal entre el Ministerio de Fomento Industria y Comercio y la Alcaldía Municipal de Morrito	Aprobado El 21 De Mayo Del 2004 RM	Gaceta No. 127; 30/06/2004
Convenio de Delegación de Atribuciones de Pesca Artesanal entre el Ministerio de Fomento Industria y Comercio y la Alcaldía Municipal de Moyogalpa	Convenio institucional RM	Aprobado el 29 de Junio; 2005 con validez por cuatro años y prorrogable Gaceta No. 19; 29/06/2006
Convenio de Delegación de Atribuciones de Pesca Artesanal entre el Ministerio de Fomento Industria y Comercio y la Alcaldía Municipal de San Juan del Sur	Convenio institucional RM	Aprobado en el año 2005 con validez por cuatro años y prorrogable Gaceta No. 18; 25/01/2006
Convenio de Delegación de Atribuciones de Pesca Artesanal entre el Ministerio de Fomento Industria y Comercio y la Alcaldía Municipal de Altagracia	Convenio institucional RM	Aprobado el 29 de Junio; 2005 con validez por cuatro años y prorrogable Gaceta No.21; 30/01/2006,
Periodos de Veda de la pesca para el año 2006	Resolución Ministerial DRGN-PA- No. 424-2006	Aprobado 10 de Enero; 2006
<b>Normas Técnicas</b>		
Para el Control Ambiental de Plantas Procesadoras de Pescados y Mariscos	NTON 05-017-2003	
Norma Técnica Obligatoria Nicaragüense para Métodos y Artes de Pesca y sus Anexos	NTON 03-045-03	Gaceta No. 173; 03/09/2004
Norma Técnica Obligatoria Nicaragüense para Regular la Extracción y Aprovechamiento Sostenible del Recurso Ostras en el Pacífico de Nicaragua	NTON 05-025-04	Gaceta No. 47; 08/03/2005

## ENERGÍA Y MINAS

### Leyes

Ley de Exploración y Exportación de Recursos Geotérmicos	No. 443	Gaceta No. 222; 21/11/2002
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Ley de Promoción al Sub-Sector Hidroeléctrico	No. 467	Gaceta No. 169; 05/09/2003
Reforma a la Ley N° 443 – “Ley de Exploración y Explotación de los Recursos Geotérmicos	No. 479	Gaceta No.192; 10/10/2003
Ley de reformas a la Ley No. 387 “Ley Especial sobre exploración y explotación de minas	No. 525	Gaceta No. 62; 31/03/2005
Ley de reformas a la Ley No. 467 “Ley de Promoción al Sub-Sector Hidroeléctrico	No. 531	Gaceta No. 101; 26/05/2005
Ley para la Promoción de Generación Eléctrica con Fuentes Renovables	No. 532	Gaceta No. 102; 27/05/2005
Ley de Reforma y Adiciones a la Ley 443 de Exploración y Explotación de los Recursos Geotérmicos	No. 594	Gaceta No. 173; 05/09/2006
<b>Decretos Ejecutivos</b>		
Reglamento de La Ley 387 Ley Especial de Exploración y Explotación de Minas	No. 119-2001	Gaceta No. 4; 07/01/2002
Reforma al Decreto No. 119-2001, Reglamento de La Ley Especial de Exploración y Explotación de Minas)	No. 92-2002	Gaceta No. 190; 08/10/2002
Política Especifica para apoyar el desarrollo de los recursos eólicos e hidroeléctricos de filo de agua	No.279-2002	Gaceta No.128; 09/07/2002
Reglamento de la Ley de Exploración y Explotación de Recursos Geotérmicos	No. 003-2003	Gaceta No. 11; 16/01/2003.
Reglamento a la Ley No. 467, Ley de Promoción al Sub-Sector Hidroeléctrico	No. 72-2003	Gaceta No. 208; 03/11/2003
Declaración de Áreas de Recursos Geotérmicos	No. 79-2003	Gaceta No. 220; 19/11/2003
Política específica de apoyo al desarrollo de los recursos eólicos e hidroeléctricos de Filo de Agua	No. 12-2004	Gaceta No. 45; 4 de Marzo; 2004
Establecimiento de la Política Energética Nacional	No. 13-2004	Gaceta No. 45; 4 de Marzo; 2004
Declaración de Área de Recursos Geotérmicos	No. 12-2006	Gaceta No.42; 28/02/ 2006
Reforma y adiciones al decreto No.119-2001 Reglamento de la Ley No. 387, Ley Especial sobre exploración y explotación de minas.	No. 57-2006	Gaceta No. 170; 31/08/2006
<b>Normas Técnicas</b>		
Para Regular la Exploración y Explotación de Hidrocarburos	NTON 05-026-2004	
Norma Técnica Obligatoria Nicaragüense para las actividades mineras no metálicas	NTON 05-029-2006	Aprobada 6 de Junio; 2006
<b>Resolución Ministerial</b>		
Reglamento Interno de la Comisión Nacional de Minería	Resolución Ministerial No.01-2003	Gaceta No. 167; 03/09/2003
Convenio de Delegación de Atribuciones de minería artesanal entre el Ministerio de Fomento, Industria y Comercio y la Alcaldía de San Fernando	Convenio institucional	Aprobado el 08 de Junio; 2005 con validez por cuatro años y prorrogable. Gaceta No.17; 24/01/2006
Convenio de Delegación de Atribuciones de minería	Convenio institucional	Aprobado el 08 de Junio; 2005

artesanal entre el Ministerio de Fomento, Industria y Comercio y la Alcaldía de Dipilto		con validez por cuatro años y prorrogable Gaceta No.14; 19/01/2006
Convenio de Delegación de Atribuciones de minería artesanal entre el Ministerio de Fomento, Industria y Comercio y la Alcaldía de Macuelizo	Convenio institucional	Aprobado el 08 de Junio; 2005 con validez por cuatro años y prorrogable. Gaceta No.15; 19/01/2006
Convenio de Delegación de Atribuciones de minería artesanal entre el Ministerio de Fomento, Industria y Comercio y la Alcaldía de Mozonte	Convenio institucional	Aprobado el 10 de Junio; 2005 con validez por cuatro años y prorrogable. Gaceta No.16; 23/01/2006
Convenio de Delegación de Atribuciones de minería artesanal entre el Ministerio de Fomento, Industria y Comercio y la Alcaldía de Ciudad Antigua	Convenio institucional	Aprobado el 08 de Junio; 2005 con validez por cuatro años y prorrogable Gaceta No.13; 18/01/2006
Convenio de Delegación de Atribuciones de minería artesanal entre el Ministerio de Fomento, Industria y Comercio y la Alcaldía de Ocotal	Convenio institucional	Aprobado el 08 de Junio; 2005 con validez por cuatro años y prorrogable. Gaceta No.20; 27/01/2006
Convenio de Delegación de Atribución de permiso especial para guiriseros entre el Ministerio de Fomento, Industria y Comercio y las Alcaldía de Bonanza, Rosita, Siuna y Waspan	Convenio institucional	Aprobado el 11 de Julio; 2002 con validez indefinido

<b>CALIDAD AMBIENTAL</b>		
<b>Leyes</b>		
Aprobación del Convenio de Estocolmo sobre contaminantes Orgánicos Persistentes (COPs) y sus Anexos	No. 4346	Aprobado el 7 de Julio; 2005
<b>Decretos Ejecutivos</b>		
Remforma del Artículo No.42 del decreto 33-95 (Disposiciones para el control de la contaminación proveniente de las descargas de las aguas residuales domesticas, industriales y agropecuarias)	No. 7-2002	Gaceta No.22; 01/02/2002
Sistema de Evaluación Ambiental	No. 76-2006	Gaceta No.248; 22/12/06
Administración del Sistema de Permiso y Evaluación de Impacto Ambiental en las Regiones Autónomas de la Costa Atlántica	No. 36-2002	Gaceta No. 67; 12/04/2002
Tratamiento en el Lago Xolotlán. Decreto de Reforma al Decreto No. 51-98, De Creación de la Comisión Nacional de Agua Potable y Alcantarillado Sanitario.	No. 75-2003	Gaceta No. 220; 19/11/2003
De Establecimiento de las Disposiciones que Regulan las Descargas de Aguas Residuales Domésticas Provenientes de los Sistemas de Tratamiento en el Lago Xolotlán	NO. 77-2003	Gaceta No. 218; 17/11/2003
Política Nacional para la Gestión Integral de Sustancias y Residuos Peligrosos..	No. 91-2005	Gaceta No.230; 28/11/2005

Sistema de Evaluación Ambiental	No. 76-2006	Gaceta No. 248; 22/12/2006
<b>Resolución Ministerial</b>		
Para Regular la ubicación e instalación de estructura de soporte para equipos de comunicación de Telefonía Celular y microondas.	No. 022-2004	
<b>Normas Técnicas</b>		
Norma Técnica Obligatoria Nicaragüense Ambiental para el Manejo, Tratamiento y Disposición Final de los Desechos Sólidos No Peligrosos	NTON 05 014-01	Gaceta No. 96.; 24/05/2002
Para el Control Ambiental de las Estaciones de Servicio Automotor	NTON 05-004-2002	
Norma Técnica Ambiental Para la Clasificación Ecotoxicológica y Etiquetado de Plaguicidas, Sustancias Tóxicas Peligrosas y Otras Similares.	NTON 02-010-2002	Gaceta No. 212; 07/11/02, Gaceta No. 213; 08/11/02, Gaceta No. 214; 11/11/02
Para el Control Ambiental de la Calidad del Aire	NTON 05-012-2002	
Para el Control Ambiental de los Rellenos Sanitarios para Desechos Sólidos No Peligrosos	NTON 05-013-2002	
Para el Manejo, Tratamiento y Disposición Final de los Desechos Sólidos No Peligrosos.	NTON 05-014-2002	
Norma Técnica Obligatoria Nicaragüense para el Manejo y Eliminación de Residuos Sólidos Peligrosos	NTON 05 015-02	Aprobada por el Comité el 07 de Junio de 2002
Para el Control Ambiental de Plantas Procesadoras de Lácteos	NTON 05-005-2003	
Norma Técnica de Control Ambiental para Plantas Procesadoras de Productos Lácteos	NTON 05 006 – 03	
Para el Control Ambiental de Sistemas de Tratamientos de aguas residuales y su rehúso	NTON 05 027-2005	
Para la protección de la calidad de los cuerpos de agua afectados por los vertidos líquidos y sólidos provenientes de los beneficios húmedos de café.	NTON 05 028-2006	

## AGUA

<b>Decretos Ejecutivos</b>		
Reforma Decreto 51-98 de creación de la comisión Nacional de agua potable y saneamiento	No. 33-2002	03/04/2002
Reforma Decreto 51-98 de creación de la comisión Nacional de agua potable y saneamiento	No. 75-2003	19/11/2003

## GENERO Y PARTICIPACION CIUDADANA

<b>Leyes</b>
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Ley de Participación Ciudadana	No. 475	Gaceta No. 241; 19/12/2003
<b>Decretos Ejecutivos</b>		
Reglamento de la Ley No. 475 Ley de Participación Ciudadana	No. 8-2004	Gaceta No. 32; 16/02/2004
Reforma al Artículo 9 del Decreto No. 8-2004, "Reglamento de La Ley No. 475 Ley de Participación Ciudadana"	No.46-2004	Gaceta No. 117; 16/06/2004
Programa Nacional de Equidad de Género.	No. 36-2006	Gaceta No. 139; 18/07/2006

<b>BIOTECNOLOGIA</b>		
<b>Leyes</b>		
Protocolo de Cartagena sobre Seguridad de la Biotecnología Moderna Bio-seguridad	Decreto Legislativo No. 3248 Aprobado el 21 de marzo de 2002 y Ratificado el 28 de Junio de 2002.	Gaceta No. 56; 21/03/2002 Gaceta No. 121; 28/06/2002
<b>Decretos Ejecutivos</b>		
Reforma al Decreto No. 5-95, "Creación del Consejo Nicaragüense de Ciencia y Tecnología"	No. 14-2002	Gaceta No. 43; 04/03/2002
Ratificar el Protocolo de Cartagena sobre Seguridad de la Biotecnología del Convenio de Diversidad Biológica y sus anexos	No.63-2002	Gaceta No. 121; 28/06/2002
Declaración de Interés Nacional Producción de Bio-combustible y Bio-energía.	No. 42-2006	Gaceta No.133; 10/07/2006

<b>PRODUCCION MAS LIMPIA</b>		
<b>Decretos Ejecutivos</b>		
Creación de la Oficina Nacional de Desarrollo Limpio	No. 21-2002	Gaceta No. 56; 21/03/2002
Política Nacional de Producción más Limpia.	No. 22-2006	Gaceta No. 68; 05/04/2006

<b>ORDENAMIENTO TERRITORIAL</b>		
<b>Leyes</b>		
Ley de Régimen de Propiedad Comunal de los Pueblos Indígenas y Comunidades Étnicas de las Regiones Autónomas de la Costa Atlántica de Nicaragua y de los Ríos Bocay, Coco, Indio y Maíz.	No. 445	Gaceta No.16; 16/01/2003
<b>Decretos Ejecutivos</b>		
Política General Para El Ordenamiento Territorial	No. 90-2001	Gaceta No. 4; 07/01/2002
Normas, Pautas y Criterios para el Ordenamiento Territorial	No. 78-2002	Gaceta No. 174; 13/09/2002
Marco General de Políticas de Tierras	No. 70-2006	Gaceta No. 217; 08/11/2006

<b>DESCENTRALIZACION</b>		
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<b>Leyes</b>		
Ley de Reforma y Adición a la Ley No. 290, Ley de Organización, Competencia y Procedimientos Del Poder Ejecutivo	No. 612	2007
<b>Decretos Ejecutivos</b>		
Reformas y Adiciones al Decreto No. 118-2001, Reformas e Incorporaciones al Reglamento de la Ley No. 290, Ley de Organización, Competencia y Procedimientos del Poder Ejecutivo.	No. 45-2004	Gaceta No. 1; 02/01/2002 Gaceta No. 2; 03/01/2002 Gaceta No. 113; 10/06/2004
Reformas al Decreto No. 59-90, Creación del Fondo de Inversión Social de Emergencia (FISE)	No. 109-2004	Gaceta No. 191; 01/10/2004
Creación del Comité Asesor para la Implementación del Capítulo Ambiental del Tratado de Libre Comercio "CAFTA".	No. 105-2005	Gaceta No.04 ; 05/01/2006
Reformas y Adiciones al Decreto No. 71-98, Reglamento de La Ley No. 290, Ley de Organización, Competencia y Procedimientos del Poder Ejecutivo	No. 25-2006	Gaceta No. 91; 11/05/2006 Gaceta No. 92; 12/05/2006
Política Nacional de Descentralización orientada al desarrollo local	No.45-2006	Gaceta No. 151; 04/08/2006
<b>Resolución Ministerial</b>		
Plan de Desconcentración de la Gestión Ambiental	No. 045-2004	

<b>PATRIMONIO CULTURAL</b>		
<b>Leyes</b>		
Que Declara Patrimonio histórico de la Nación al Municipio de Posoltega	No. 3715	Gaceta No. 212; 07/11/2003
<b>Decretos Ejecutivos</b>		
Se Reforma el Decreto No 6-96, Creación del Parque Histórico Nacional Loma de Tiscapa.	No. 35-2003 Ejecutivo	Gaceta; 74; 22/04/2003
Declaratoria de Patrimonio Histórico y Cultural de la Nación "Antiguos Cementerios de San Juan del Norte"	No. 72-2005 Ejecutivo	Gaceta No.207; 26/10/2005
Reglamento de Investigaciones Arqueológicas.	No. 10-2006 Ejecutivo	Gaceta No.41; 27/02/2006
<b>AGROPECUARIA</b>		
<b>Decretos Ejecutivos</b>		
Reformas y Adiciones al Decreto No. 2-99, Reglamento de La Ley No.291, Ley Básica de Salud Animal y Sanidad Vegetal	No. 59-2003	Gaceta No. 152; 13/08/2003
Reforma al Decreto No. 36-92, Creación del Consejo Nacional Agropecuario	No. 41-2004 Ejecutivo	Gaceta No.110; 07/06/2004

Table 23. Participation of registered actors and organizations in SINAP in 2006.

<b>Actors/Organizations</b>	<b>Total Number</b>	<b>%</b>	<b># of Protected Areas Benefiting from Collaboration</b>
Donor Agencies	5	8	5
Municipalities	18	29	9
Producer Organizations	3	5	3
Central Governmental Agencies	11	18	3
International NGOs	7	11	7
National NGOs	6	9	7
International Inter-governmental Org.	4	6	3
Local Organizations	6	9	6
Universities	3	5	3
<b>TOTAL</b>	<b>63</b>	<b>100%</b>	

Source: Reyes (2007).

Table 24. Direct threats to Nicaragua's major natural habitats.

<b>THREAT</b>	<b>Broadleaf Forest</b>	<b>Conifer Forest</b>	<b>Wetland</b>	<b>Mangrove</b>	<b>Lakes/Lagoons</b>	<b>Reef</b>
Habitat conversion & ecological homogenization	•	•				
Pollution/ Contamination			•	•	•	•
Sedimentation					•	•
Overexploitation	•	•			•	•
Illegal Harvest &/or trade	•	•		•	•	•
Hurricanes	•	•	•	•		
Fires	•	•	•			
Climate change			•			•
Introduction of exotic species	•	•			•	