

Fire Management in Central America¹

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Abstract: Information on fire management operations in Central America is scant. To evaluate the known level of fire occurrence in seven countries in that area, fire management officers were asked to provide information on their fire control organizations and on any available fire statistics. The seven countries surveyed were Guatemala, Belize, Honduras, El Salvador, Nicaragua, Costa Rica, and Panama. Information from a survey of the literature was also collected. For each of the seven countries, results of these surveys of fire management and a description of the physical geography are reported.

Statistics on fire management operations for Central America are generally unavailable. The statistics which are available include only those fires which are prescribed by managers, and those reported wildfires which may or may not be suppressed. In order to evaluate the known level of fire occurrence, a survey was sent to fire management officers in each Central American country. Information on their fire control organizations and the available fire statistics were requested. The results of the survey are presented, augmented by information from the literature. A brief description of the physical geography is included to allow for comparison of the climate and terrain among the countries.

Guatemala

Physical Geography

Guatemala's climate varies with altitude and with the influence of coastal air masses. Coastal lowlands have high temperatures, averaging 25 °C (77 °F) on the Pacific coast and 27 °C (81 °F) on the Caribbean side. Relative humidity is also typically high, averaging 80 percent. Highland climates range from warm to cool, including an occasional frost between the elevations of 1500 to 1800 m during the November-April dry season. A rainy season prevails over most of the country from April to October, the highest rainfall occurring in August or September. Rainfall varies from less than 500 mm (20 inches) annually in the Oriente to nearly 5000 mm (200 inches) on the western slopes of Sierra Madre and in the Rio Dulce Basin. Topography is diverse; hills, plateaus, and steep mountain slopes, especially common in the central and western highlands, are dissected by a network of water-courses.

Fire Management

Guatemala's fire season extends through the dry summer months from February to May. From 1983 to 1988 the annual number of fires in forested habitats has increased from 137 to

224, some reaching high intensity. This increase may reflect improved accuracy of reporting or may signal an increase in the number of fires which are escaping into the forest. Untended agriculture and pasture fires are the principal causes of these fires resulting in forest degradation and increased susceptibility to insects and diseases.

Guatemala's fire protection program was started in 1988 under the direction of the forest protection section of the Department of Forest Management. Their 1989 budget was approximately 70,080 quetzales (\$14,300). Five staff members are responsible for protecting 65,961.8 km² of *Pinus* and *Cupressus* species, as well as other mixed conifer and broadleaved species. There are some organized fire brigades and vehicles available to suppress fires, but funding is insufficient to adequately equip people in rural areas for forest protection.

Current fire program objectives are to organize, educate, and train local communities in fire suppression techniques. Major obstacles to these objectives are: 1. Guatemala's illiteracy problem. The high incidence of illiteracy among the population makes the use of written promotional materials ineffective. 2. The constant low budgets result in under-staffing and lack of adequate coverage in critical rural areas.

The fire program has attempted some prescribed burning to reduce hazards and clear land for pasture and agricultural use. Very little is known about fire effects in the tropical forests of Guatemala.

Belize

Physical Geography

Belize lies on the Caribbean coast of Central America, with Mexico to the northwest and Guatemala to the southwest. It has a subtropical climate tempered by trade winds. The average mean temperature varies little year-round, 24 °C to 27 °C (75 °F-81 °F). Annual rainfall ranges from 1290 mm (51 inches) in the north to 4450 mm (175 inches) in the south. The rainy season lasts from May to February. The country encompasses varied landscapes ranging from the fertile northern limestone plateau to the southern Maya Mountains.

Fire Management

Forest fire protection was introduced in Central America in 1927 in the coastal plains of Belize and was extended to the Mountain Pine Ridge Forest Reserve by 1945 (Hudson and Salazar 1981). Belize was the first country in the region to establish a forest fire protection program because of the importance of its forest products exports to England.

Economic development of Belize initially depended on exporting logs (*Haematoxylum* spp.). Exportation of forest products was the main source of economic development in Belize

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until the late 1940's (90 percent of total exports in 1945; 78 percent by 1946, and only 21 percent by 1961). The change was precipitated by the introduction of synthetic dyes enabling Honduran Mahogany (*Swietenia macrophilia*) to be substituted for logs from Belize. By 1977 forest exports were reduced to a trickle (only 2 percent of total exports).

Once the forestry sector no longer drove the economic development of the country, the forest fire protection program dwindled. The decrease in fire suppression efforts led to a dramatic increase in area burned. In the Mountain Pine Ridge Forest Reserve and adjacent private lands alone, 2,018, 12,119, 4,155, and 8,359 ha of pine forest were burned during 1964, 1968, 1972, and 1976, respectively (Hudson 1976).

Honduras

Physical Geography

Honduras is located well within the tropics, but temperatures are generally moderate rather than hot. A tropical climate prevails on the north coast below 600 m and near the Pacific coast below 450 m. Mean annual temperatures are approximately 25 °C (77 °F). A temperate climate, with mean annual temperatures changing from 16 to 24 °C (61 °F-75 °F), characterizes the highland areas (600-2100 m) and intermontane basins, which make up more than 80 percent of the land area (Evaluation Technologies 1981).

Rainfall averages 1500-2500 mm (60-100 inches) annually, most of it falling from mid April through October. The winter dry season lasts from November to April. Rainfall is higher on the north coast and northern mountain slopes than on the south coast and southern-facing slopes.

Fire Management

The most serious fires in Honduras occur between the months of February and June. The average annual number of fires fought over the past five years (1985 to 1990) is 2,500, but as many as 500 to 1,000 go unreported and without suppression (Salazar 1991). Over the same 5 years an average of 45,000 ha (111,150 acres) burned annually, of which more than 75,000 ha burned in 1990 alone. This area takes into account only the area burned by those fires actually reported and fought. Agricultural burning accounts for more than 50 percent of the total forest fires (Hudson and Salazar 1981). During the dry season fires and combustion columns can be seen everywhere in the fields and along the roadsides. The smoke problem is so severe during the fire season that the international airport in Tegucigalpa is closed, sometimes for up to two weeks at a time. When fire burns in young, unweeded plantations, damage to the trees can be severe because of crowning and widespread mortality.

A fire control program was started in Honduras in 1974 under the direction of COHDEFOR, the national forestry organization. Between 1980 and 1990 the budget doubled in nominal terms from 2 to 4 million lempiras (\$1,011,561 to \$755,000³), but the number of employees in COHDEFOR declined from 960 to about 600. Honduras has 45 funded fire brigades, a small cache of hand tools, and 45 vehicles which can be used to

suppress fires (Salazar 1991). The area of fire control responsibility covers 22,260 km² of mostly young pine plantations.

A prescribed fire program was initiated in 1979 to reduce fire hazard and improve silvicultural management. Research was also initiated on fire effects, but little has been published to date. Most prescribed fires are conducted in August and between December and January, early in the dry season when conditions are more moderate. The prescribed fire program has had difficulties ranging from the lack of budget to poor cooperation between institutions and civilian personnel. Although appropriate legislation exists to support the fire program, it is not adequately implemented. The public has little interest in forest protection. For example, experiments and wood lots set aside for forest preservation and improvement are typically subject to trespass for firewood, construction materials, and game.

El Salvador

Physical Geography

El Salvador has a tropical climate throughout the entire country, although temperatures tend to be cooler in the highlands. Temperatures rarely fall below 18 °C (64 °F) except on the highest slopes of the volcanic ranges. Rainfall averages 1500-2500 mm (60-100 inches) annually, most of it falling from May through October. As in Honduras, the winter dry season lasts from November to April, with virtually no rain.

Most of the country consists of volcanic highlands of moderate elevations. Two parallel chains of volcanoes extend east-west through the country—the southern or Coastal Range and the northern or Sierra Madre Range.

Fire Management

During the 2 years that data were collected for this study, we were not able to obtain any information about the fire management program in this country. Due to the ongoing civil war it is likely that active natural resource management programs of any kind have been abandoned in favor of preservation of critical resources such as dams and roads.

Nicaragua

Physical Geography

Nicaragua's tropical climate changes to mild or cool weather in a few high altitude locations in the Central Highlands. Mean annual temperatures range from 20 °C (68 °F) in the highlands to 27 °C (81 °F) on the Pacific coast. Rainfall varies from 1500 to 6250 mm (60-250 inches) annually. Most falls from May through October in the Pacific and central highlands and year-round in the Caribbean plains of the Atlantic coast.

³The smaller budget level in dollar terms for 1990 is due to the devaluation of Honduran currency. Up to 1989 the exchange rate was two lempiras to a dollar; in 1990 the rate went up to 5.3 lempiras to a dollar. In addition, the country's economy is suffering from serious inflation cutting even deeper into the fire program budget.

Fire Management

The management of natural resources in Nicaragua is organized under the direction of IRENA, the Nicaraguan Institute of Natural Resources. There is no fire control organization independent of the forest and agriculture sections of IRENA, but fire control and management of slash and burn agriculture are being promoted in conjunction with other community development and education programs.

Northeastern Nicaragua is characterized by boggy lowlands and pine savannas along the Caribbean Sea. It is adjacent to a mountainous region that stretches north to the border with Honduras. The savannas are dominated by Caribbean pine (*Pinus caribaea*) in various configurations of native stands and plantations (Munro 1966). Eighty percent of these stands are burned every year from escaped fires lit by local villagers to clear their fields for planting food crops.

The understory has a grass component which forms a basal root mass which resembles a miniature elephant trunk and serves readily as a source of firebrands. It burns like gasoline under any weather condition, even when standing in 2 inches of water. This vegetation type suggests that Caribbean pine is a seral stage that, if not caused by fire, can be maintained by fire. The pines are highly resistant to fire and, unless completely consumed, will recover after being scorched. However, their form and vigor suffer from frequent burning.

Nicaragua's fire program, like that of other Central American countries, is understaffed and underequipped. Most of the current fire control programs are aimed at reducing the loss of established plantations and demonstration areas. Natural resource officials must rely on local citizens to patrol and suppress fires. Incentives such as supplying farmers with tools and training in appropriate agroforestry techniques, including forest protection, are being used.

Costa Rica

Physical Geography

Geographically, Costa Rica can be divided into three distinct regions: the central mountainous corridor running from northwest to southeast, the Pacific coast, and the Caribbean lowlands (Caufield Vasconez 1987). Costa Rica's regional climates vary depending on elevation and prevailing winds. Mean annual temperatures can be affected by the duration of the rainy season which varies among regions. Average temperature in the central Meseta region ranges from 15 °C (59 °F) to a maximum of 25 °C (77 °F). The rainy season varies from year-round in the Caribbean lowlands to six months, May to October, in regions of Guanacaste Province on the Pacific coast. The national average rainfall is 3,300 mm (132 inches) annually. The dry season lasts from November to April.

Fire Management

Costa Rica's fire control program was founded in 1987. It is directed by the Minister of Natural Resources, Mines and Energy. Like most fire programs in this region the fire control

organization lacks financial and human resources: there is no allocated budget and only two full-time technicians. Secondary forest and plantations are the main vegetation types being actively protected. Fires in this type include surface and some crown fires which occur during the December-to-April dry period. Most fires are caused by humans, both accidentally or deliberately. Specific studies documenting the nature of the damage to these plantations are inadequately prepared or do not exist. Public information projects are being initiated to reduce ignitions by humans.

A prescribed fire program was started at the same time as the fire control organization. In 1987 and 1988, 840 and 830 ha were burned by prescription for the purposes of reducing hazard, agricultural clearing, silvicultural improvement, and forest pest reduction. Generally, burning is conducted in August and in December and January (the beginning of the dry season). The program is limited by the lack of trained personnel and equipment, and limited budgets.

Conservation Programs

More is known about the social and ecological aspects of fire in Costa Rica than in any other Central American country. The excellent research and extension work done by the CATIE staff (Center for Agricultural Research and Education) provides a source of information and academic leadership for the rest of Central America. Other environmental management and research organizations contribute to their effort, notably Dan Janzen, founder and director of the Guanacaste National Park, located near the Pacific coast in northeastern Costa Rica.

There are five parks (Parques Nacionales de Santa Rosa, Murciélago, Palo Verde, Barra Honda, and Guanacaste), two refuges (Refugios Nacionales de Fauna Silvestre Dr. Rafael Lucas Rodríguez Caballero, and de Fauna Silvestre de Ostional), and two reserves (Reserva Nacional Absoluta Cabo Blanco, and Lomas Barbudal Reserva Biológica) in Costa Rica set aside to preserve tropical dry forest habitat. Only the Santa Rosa and Guanacaste have been studied to any appreciable extent by biologists. Because of the publicity and outreach efforts of Dr. Janzen, the Guanacaste has received considerable attention in the popular and scientific press (Edgar 1989, Janzen 1986, Janzen 1988a, 1988b) and can be used as an excellent example of the type of conservation work being done to combat the unchecked effects of farming, grazing, harvest, and the persistent fires which accompany them.

The objectives of park land acquisition, protection, and management are to preserve dry forest habitat fragments and to restore the degraded pasture and agricultural lands to their indigenous fauna and flora. This forest type once occupied most of the Pacific side of the Central American landscape. Because of its accessibility and desirability for settlement, it now constitutes less than 2 percent of its original 550,000 km² area, and 0.08 percent in protected areas (Janzen 1988a).

Park management plans to develop and extend fire control and prescribed burning programs to protect the sensitive edges of the dry forest vegetation to prevent fires from spreading in burnable vegetation within the park boundaries. Much of the area has been planted with "jaragua" grass (*Hypparrhenia ruffa*)

imported from Africa because of its tolerance for overgrazing by cattle. This grass is highly flammable and reaches heights of 2 meters when left ungrazed. It burns explosively in the dry season during the high winds characteristic of this region. Until the grass can be effectively shaded out by recovering vegetation, some grazing will be permitted to limit the height growth of the grass. Remaining patches of forest habitat will be used to provide seed for natural dispersal by wind and animals. When financially feasible, intensive reforestation projects will augment the natural process of recovery.

Physical parkland development will be augmented by an education and apprenticeship program designed to teach local residents, especially children, the value of natural habitat preservation and the techniques needed for its preservation. Ongoing research will contribute to the knowledge of the dry forest ecosystem and will continue to improve its management.

When fully developed, the Guanacaste park will serve as a gene and seed bank for dry forest flora and fauna, will provide a demonstration area for use and management of dry forest species and habitats, will help protect the regional watershed, and will enhance tourism.

Panama

Physical Geography

Panama has a tropical maritime climate (warm, humid and cool nights) year-round. There is little seasonal variation in temperatures, which average 23 °C to 27 °C (73 °F - 81 °F) in coastal areas. Most of Panama is coastal plains, with its larger rivers flowing into the Pacific. The backbone of the country is formed by two mountain ranges, the Cordillera Central from the Costa Rican border almost to Panama City and the lower Cordillera de San Blás from east of Colón to the Colombian border. The northern slopes of the two mountain ranges receive most of the rainfall, 3250 mm (128 inches) a year compared to 1720 mm (68 inches) a year on the southern slopes.

Fire Management

Panama's fire problem is no different from that of any of the other countries in Central America. By and large, most forest fires are caused by humans both accidentally and deliberately. Grasslands and forest habitats are regularly burned during the transition to agriculture and pastoral land uses. These fires go unchecked because of lack of funding for personnel and equipment. They are generally surface fires of moderate intensity, occasionally crowning during the driest periods between January and April. Fires cause mortality in the tree species they encounter and delay the growth of those plants which are able to

regenerate. A general shift in species to those which are able to colonize the burned sites has been observed.

Panama currently has no fire control organization although discussions to initiate one are being held by the National Institute of Renewable Resources. Only five fire brigades and two vehicles, as well as a small assortment of hand tools, are available for fire suppression. There is no budget for protecting even small areas of Caribbean pine plantations frequently threatened by fire.

Although there is no organized prescribed burning program, two prescribed fires in 1980 and 1981 treated 50 ha (124 acres) and 60 ha (148 acres), respectively, to reduce fire hazard and improve silvicultural operations in plantations. One fire escaped and burned an additional 20 ha (49 acres). Nevertheless, the fires were successful in controlling unwanted understory vegetation in 70 percent of the areas treated and in obtaining 80 percent regeneration success. The principal objective of future burns is to treat 20-year-old plantations that contain hazardous levels of accumulated fuel.

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