

# **Fire Management Networks: An Approach for Improving Fire Management on Conservation Lands in Latin America & the Caribbean**

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## **Abstract**

Throughout the world, alteration of fire regimes on conservation lands is a significant threat to biodiversity in ecosystems that are either fire-maintained or fire-sensitive. Sources of this threat include alteration of traditional fire use, burning associated with land use changes, and fire suppression and prevention. Recent devastating fires in tropical forests, where fire normally would play a limited ecological role, and in fire-prone forests that have been subjected to effective fire exclusion, have highlighted the need for 1) a better understanding of fire's ecological role and the implications of altering historic fire regimes within conservation areas, 2) assessments of the socio-economic roots of fire, and 3) developing more appropriate responses to fires when they do occur.

Many countries in the Caribbean region and Latin America have highly significant ecosystems that depend on fire. These ecosystems stand in marked contrast to tropical and subtropical forests that are increasingly threatened by fire. Such a diversity of fire types and fire threats requires the development of varied and multi-scaled fire management approaches. With funding from the U.S. Forest Service International Programs, The Nature Conservancy's Fire Initiative and partners in Latin America and the Caribbean have formed networks of conservation areas faced with fire problems. The Networks serve to facilitate the identification of research and fire management needs, share information, provide expert consultations, and develop training, mentoring and exchange programs. Through a series of network workshops, fire's ecological role and impacts are identified at demonstration sites by developing conceptual ecological models. Then fire management needs are identified and responses to those needs are proposed and developed. Responses may include providing fire planning assistance, developing expertise in fuels, fire behavior, and fire use, designing and implementing community-based fire prevention and response programs, and identifying levels of fire risk and response strategies. Tools and experiences are shared among network participants via training courses, exchanges, websites and electronic message sharing.

Fire management networks are proving to be an effective strategy to rapidly engage land managers from many different conservation areas impacted by fire and to identify key individuals, who, if given appropriate skills and tools, can implement strategies to reduce the threat of altered fire regimes on the lands that they manage.

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## The Issue

There is a growing consensus that the incidence and severity of fires in many parts of the world are on the increase. In some countries like the United States, fire severity and fire damage are increasing because decades of successful fire prevention and suppression in fire-prone environments have led to changes in fuel loads and forest composition that now fuel more intense fires (USDA Forest Service 2000; National Commission on Wildfire Disasters 1995). These fires are difficult and expensive to control. The progression from a vegetation cover that was maintained by frequent, low-intensity, non-lethal surface fires to vegetation that now fuels lethal, forest stand-destroying fires has been coupled with a huge influx of people making their homes within these forests of high fire danger—hence the now frequent headlines of homes being lost to flames during the fire seasons in the United States and Australia.

The experience of the United States and a few other countries is in marked contrast to other regions of the world, particularly the tropics, where fire prevention campaigns and suppression capabilities are only beginning to take hold. Widespread fires throughout Latin America and the Caribbean increasingly threaten both fire-dependent and fire-sensitive ecosystems; alter regional and global climate, and foster undesirable invasive species concomitant with forest and biodiversity loss. Furthermore, fire-induced damages are affecting livelihoods, human health, and local and national economies. The *Global Review of Forest Fires 2000* (Rowell & Moore 2000) reports:

“New evidence from the Amazon has concluded that fire causes a positive feedback cycle in which the more tropical forests burn the more susceptible to future burning they become. This raises the possibility of large wildfire episodes happening more frequently and on such a scale that tropical forest ecosystems will not endure. The scientists believe the whole Amazon itself is threatened, which has global consequences for biodiversity and climate change.”

The United Nations Environmental Programme’s report *Spreading Like Wildfire—Tropical Forest Fires in Latin America & the Caribbean: Prevention, Assessment & Early Warning* (Cochrane 2002) states:

“The fire situation is severe in many tropical evergreen forests in Latin America and the Caribbean... Through logging, burning, and natural events, the once near-fire-proof forest is becoming fire-vulnerable and fire-prone... Fire has a momentum in tropical evergreen forests... Each year’s forest degradation is carried into the future... This process is under-appreciated by resident populations, policy makers, fire managers and scientists.”

The nature of fire-related threats in a wide variety of fire-sensitive ecosystems in the tropics requires the urgent and aggressive development and implementation of innovative measures to counteract the sources of the threat. Experience gained from fighting fires in temperate and boreal ecosystems may not be transferable to tropical environments primarily because of the social and economic context in which many of the fires occur and due to the costs associated

with high-technology fire suppression. Greater emphasis needs to be placed on the underlying causes of fire and developing sustainable solutions.

As governments, land management entities, and scientists address these problems through policy changes, incentives, and community-based prevention and suppression programs, there is a distinct possibility that the vital role of, and need for, fire in many ecosystems will be overlooked, as was done in the United States for nearly a century. There is a misconception (at least by fire professionals and the interested public in temperate climates) that the tropics is a vast fire-sensitive rain forest threatened by rampant logging-induced fire and agricultural burning. The tropics actually include a huge range of broadleaved forests, many of them only seasonally wet, where excessive burning is clearly a threat. The tropics are also replete with ecosystems and habitats that require fire. In the Americas, there are a wide variety of fire-maintained pine forests and pine savannas. Mexico, with its temperate and tropical environments combined, has the highest pine species diversity in the world. Most species of pines are linked to disturbance, often defined by specific fire regimes (Rodríguez-Trejo & Fulé 2003). Several of these forest types extend into Central America. The same can be said of Mexico's high diversity of oak species. Fire-maintained *Pinus caribea* savannas and woodlands range from the Bahamas, through Cuba and on to Belize, Honduras and Nicaragua. The Dominican Republic has forests and savannas of the endemic *Pinus occidentalis*, which are dependent on fire (Horn *et al.* 2000). Cuba has three species of endemic pines in fire-prone environments.

In Brazil, the *Cerrado*, once covering 22% of the country or 2 million km<sup>2</sup>, is a mosaic of savanna and shrub land molded by unique fire regimes (Miranda *et al.* 2002). Other grassland types in South America are found in the Gran Sabana and Llanos of Venezuela, and in Bolivia and Peru. Fire-maintained palm forests and palm savannas are common throughout the tropics (Myers 1990), along with a variety of coastal marshlands. Scientists are beginning to understand that fire is also an integral part of tropical alpine areas, i.e. *Paramo* (Horn 1998).

Lack of information about, and failure to understand, the role of fire in these ecosystems, coupled with the implementation of community-based and national efforts to control or prevent all fires, has the potential to lead many important conservation and forest lands down the same road of misdirected fire exclusion that the USA undertook decades ago with similar results: altered vegetation, lost habitats, species loss, destructive wildfires, and watershed degradation. IUCN, in a special fire issue in *Aborvitae* (Stolton, S. & N. Dudley, eds. 2003), states that:

“Disturbance is present in all natural ecosystems. Forest management therefore needs to be able to accommodate chance episodes of natural disturbance, including fire. Managers also need to distinguish between harmful and harmless or beneficial fires. Fire is sometimes essential for forest regeneration, or provides tangible benefits for local communities; in other cases it destroys forests and has dire social and economic consequences.”

## **Altered Fire Regimes: A Conservation & Biodiversity Threat**

Even fire-maintained ecosystems, i.e. those that depend on fire, can burn inappropriately. A fire regime is defined as a set of recurring conditions of fire that characterizes a given ecosystem. A specific range of frequency, fire behavior, severity, timing of burn, size of burn, and pattern of burn circumscribe those conditions. Eliminate fire, increase fire, or alter the components of the fire regime beyond the range of variability for a given ecosystem and that ecosystem will change to something else—habitats and species will be lost.

What is an altered fire regime and why is it a threat to biodiversity conservation? An altered fire regime is one that has been modified by human activities such as fire suppression and prevention, excessive burning, inappropriate burning, or landscape fragmentation to the extent that it effects the integrity of desired ecosystem structure and function. The Nature Conservancy, an international, non-profit conservation organization dedicated to the conservation of biodiversity by protecting and appropriately managing conservation lands around the world, has identified altered fire regimes as one of the key threats to biodiversity. The sources of the threat include human fire use and ignitions for agricultural clearing and site preparation by both rural farmers and by large commercial operations; other activities related to land clearing or land use that increase fuels and their susceptibility to ignition, e.g. logging; population increase coupled with traditional fire uses such as hunting, improving access, controlling pests, signaling, and improving forage or fruit production; ignitions related to vengeance, arson, civil unrest, and migration; grazing (which depending on the environment may increase or decrease burning); invasive species that follow logging and land clearing that change fuel characteristics; and landscape fragmentation (which may limit the spread of fires by break fuel continuity or increase the number of ignitions because of increasing human populations).

### **A Need for Integrated/Collaborative Approaches to Reducing the Threat of Altered Fire Regimes**

Addressing the threat of altered fire regimes requires placing emphasis on addressing the underlying causes of too much or too little fire, seeking sustainable solutions and developing integrated fire management approaches for protected natural areas and surrounding communities to deal with fires when they occur or when they are needed. Approaches include:

1. In places where too much fire is a problem, more resources should be directed toward reducing the incidence of ignitions, i.e. community-based education programs including incentives to either reduce the need for burning and/or reduce the probability of needed burns to escape control.
2. The beneficial aspects of traditional fire use need to be documented and promoted. Added should be the technology to apply fire where needed as a beneficial and appropriate conservation management tool.
3. Adequate cost-effective detection, prediction and response tools and procedures need to be developed and implemented to respond to inevitable unwanted fires and to manage them to minimize impacts and take advantage of benefits.

4. The sciences of fire ecology, fire behavior and ecosystem restoration need to be integral components of fire management plans.
5. A key is buy-in and support from local communities living and working in and around fire-prone or fire-affected conservation areas. Communities should be viewed as a necessary part of the solution to unwanted fire effects and sources of ignitions that are beneficial.

### **Fire Learning Networks as a Fire Threat Abatement Strategy**

Fire managers and communities need to a better understanding of fire threats and fire effects and provided with the tools and resources to develop innovative and cost-effective approaches to both desired and unwanted fires. Fire-related threats and issues cannot be effectively addressed at a significant scale without structured learning strategies. The Nature Conservancy is using Fire Learning Networks as a mechanism to effectively join forces with a variety of partners, e.g. other conservation organizations, government agencies, community leaders, and scientists, to achieve mutual goals related to fire by identifying common needs and barriers to implementation, and by developing and testing strategies that are likely to succeed in different areas. Through synthesis and shared experience, learning networks not only communicate existing knowledge but also create new knowledge as experiences and ideas are adapted to local situations.

Through learning networks participants are introduced to the best available science and management options through facilitated workshops, site assessments, mentoring & exchanges, and listservs & websites. They are guided through a process of identifying fire-related threats by developing conceptual models that illustrate ecological and social relationships affecting—and affected by—fire, identifying desired future conditions and fire management goals, and designing strategies to reach those conditions.

### **Latin American & Caribbean Fire Management Network**

The Nature Conservancy (TNC), which has a long history of managing fire and working with partners on fire issues in the United States, is now focusing some of its fire expertise on issues in Latin America and the Caribbean. TNC hopes to eventually expend its efforts to other parts of the world through a global partnership with the Worldwide Fund for Nature (WWF-International) and the World Conservation Union (IUCN). To reach and include as wide an audience of partners as possible in Latin America, beginning 2001, The Nature Conservancy, with financial support from the United States Forest Service International Programs, initiated the Latin America & Caribbean Fire Management Network, first focusing on protected natural areas in Mexico, Central America, and the Caribbean countries of the Bahamas and the Dominican Republic.

The goals of the Network are to:

- 1) Markedly and measurably reduce fire threats at participating conservation areas by maintaining those currently within the ecologically acceptable range of variation of fire regimes, and improving trends in those that are burning inappropriately; and
- 2) Increase support among decision-makers at multiple levels, as evidenced by the effectiveness of local and national institutions charged with managing fire.

The Network uses several strategies in working toward its goals:

1. Workshops focused on education and training.
2. Site-based consultations at demonstration sites and other priority conservation areas.
3. A mentoring program that links site-based managers with fire ecologists and fire management experts and includes reciprocal site visits.
4. An exchange program that assists fire managers and fire scientists in attending fire forums and formal conferences.
5. Information sharing through a listserv and website.

The network workshops focus on fire ecology, fire effects, fire behavior, and integrated fire management planning. Needs for follow-up workshops are proposed by the participants. Experts in fire ecology and fire management provide the conceptual framework for each workshop. Meetings are held at or near demonstration sites and include workshop exercises such as the development of conceptual ecological models and the presentation of fire management needs and plans. Participating experts and peers provide reviews, feedback and scientific information to the participating conservation areas. The workshops also devote time to understanding and discussing specific fire-related needs, such as public education, policies, or prevention in different regions or countries.

To date a set of four workshops have focused on 1) fire management issues in tropical Mexico, 2) fire management issues in temperate Mexico, 3) the fire ecology and management of tropical pine ecosystems throughout the greater Caribbean region, and 3) technical training in prescribed fire and fire behavior (Table 1). The next workshop, which will be held in the Dominican Republic in early 2004, will bring together conservation area managers and scientists working in highland pine ecosystems and adjacent cloud forests and tropical broad-leaved forests affected by fires that tend to originate in the pine forests or in adjacent agricultural land.

Site-based consultations and assessments focus on identifying fire management needs and evaluating fire planning and implementation at high priority conservation areas in participating countries. These assessments involve a team of experts and site managers visiting sites, evaluating fire effects and fire threats, reviewing plans and resources, and then making recommendations regarding needs, planning, training, and policy issues and suggesting strategies and assisting with implementation. Assessments have involved El Ocote Biosphere Reserve, La Sepultura Biosphere Reserve, and La Encrucijada Biosphere Reserve in Chiapas, Mexico; Chagres National Park in Panama; La Amistad International Park in Panama/Costa Rica; Rio Bravo Conservation & Management Area and Paynes Creek National Park in Belize; Madre de las Aguas Conservation Area and Bahoruco National Park in the Dominican Republic; and the

Caribbean pine forests on Andros and Abaco Islands in the Bahamas. Technical reports of each assessment are posted on the Network website <http://www.tnc-ecomangement.org/IntlFire>.

A mentoring/exchange program links site-based practitioners with fire management experts from The Nature Conservancy, the United States Forest Service, or fire-experts from participating countries who serve as mentors or advisors who make reciprocal visits to the practitioners site. The program also supports participation in formal fire training courses and fire conferences by network members.

### **Linking People and Projects: Emerging Lessons**

Though in its infancy, the Latin American & Caribbean Fire Management Network is becoming an effective umbrella under which fire management issues can be identified, discussed and addressed in a variety of countries, regions and environments, and is developing a useful methodology for identify needs, sharing information, and providing a set of steps for directly addressing needs on the ground. The steps include:

- I. Identification & Analysis**
  - A. Role and impact of fire
  - B. Economic and social context of fire
  - C. Fuels & fire behavior
  - D. Desired conditions
  - E. Desired fire regimes
  - F. Fire management goals
  
- II. Prevention Strategies**
  - A. Laws
  - B. Education
  - C. Training
  - D. Fire management planning
  - E. Prevention tools
  
- III. Fire Use Strategies**
  - A. Traditional fire uses & needs
  - B. Limiting escapes
  - C. Training
  - D. Ecological prescribed fire
  
- IV. Preparedness & Response**

- A. Wildfire response planning
- B. Training
- C. Detection
- D. Community involvement
- E. Containment and control procedures
- F. Responsibilities & procedures

**V. Restoration, Recovery & Maintenance**

- A. Community assistance
- B. Restoration plans
- C. Assessment tools
- D. Monitoring

The steps and process are allowing a set of demonstration conservations to 1) develop and implement integrated fire management plans to meet their ecological management goals; 2) have those plans and implementation reviewed by peers and experts leading to adaptive management; and 3) have their successes, problems, and failures shared with many other conservation areas and practitioners facing similar problems. Next steps for the Network are to 1) expand into South America and 2) develop country-specific networks to more effectively deal with fire laws, fire policy and unique cultures of fire use.

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Table 1. Workshops, themes, demonstration sites, participating conservation areas, and participating institutions in the Latin American & Caribbean Fire Management Network.

| <b>Workshop</b>                                     | <b>Theme</b>   | <b>Demonstration Sites</b>   | <b>Participating Conservation Areas</b>   | <b>Participating Institutions</b>  |
|---|--|--|---|--|
| 6-8 March 2001 in Tuxtla Gutierrez, Chiapas, Mexico | Analysis of fire problems in protected natural areas of tropical Mexico  | El Ocote Biosphere Reserve<br>El Triunfo Biosphere Reserve   | Manantlán Biosphere Res.<br>Sian Ka'an Biosphere Res.<br>Los Tuxtlas Biosphere Res.<br>Calakmul Biosphere Res.<br>Sierra de Alamos-Prot. Area<br>Pantanos de Centla B. R.<br>Ría Lagartos Biosphere Res.<br>Lacantun Biosphere Res.<br>Montes Azules Bio. Reserve<br>La Encrucijada Bio. Reserve<br>La Sepultura Biosphere Res. | CONANP<br>FMCN<br>IMADES<br>IHN Chiapas<br>Pronatura<br>SEMARNAT<br>TNC<br>Univ. Calgary<br>Univ. Chapingo<br>USAID<br>US Forest Service |
| 16-18 April 2002 in Hermosillo, Sonora, Mexico      | Analysis of fire problems in protected natural areas of temperate Mexico | Ajos-Bavispe Forest Reserve<br>Sierra Manantlán Biosphere Reserve<br>Sierra de la Laguna Biosphere Reserve | El Ocote Biosphere Res.<br>Sierra de Alamos Protected Area<br>Sierra San Pedro Martir National Park   | CICESE<br>CONANP<br>FMCN<br>IMADES<br>INIFAP<br>Instit. Manantlán<br>Malpai Borderlands  |

|   |  |  |   |  |
|---|--|--|---|--|
|   |  |  | Maderas de Carmen Protected Area<br>Cumbres de Majalca NP   | Michoacán For. Com.<br>Penn State Univ.<br>SEMARNAT<br>TNC<br>Univ. Chapingo<br>Univ. Washington<br>USFWS<br>US Forest Service<br>US Nat. Park Service   |
| 6-10 May 2002 at Rio Bravo Conservation & Management Area, Belize       | The ecological role and management of fire in the conservation of tropical pineland ecosystems | Rio Bravo Conservation & Management Area | Paynes Creek NP, Belize<br>Monkey Bay Reserve, Belize<br>Runaway Creek Reserve, Belize<br>Abaco Nat. Park, Bahamas<br>Andros Nat. Park, Bahamas<br>Madre de las Aguas Conservation Area, D. R.<br>Rio Platano Biosphere Reserve, Honduras | Bahamas Dept. Agric.<br>Bahamas Dept. Lands<br>Bahamas Nat. Herb.<br>Bahamas Nat. Trust<br>Belize Forestry Dept.<br>Birds without Borders<br>FL Nat. Areas Inven.<br>MOPAWI-Hond.<br>Programme for Belize<br>PRONATURA, D.R.<br>TIDE<br>TNC<br>Univ. Tennessee<br>US Forest Service<br>Yaxche Cons. Trust      |
| 16-21 February 2003 at Rio Bravo Conservation & Management Area, Belize | Introduction to fire management, fire planning, prescribed burning & fire behavior             | Rio Bravo Conservation & Management Area | Paynes Creek National Park<br>Abaco National Park<br>National Forests of Abaco<br>Madre de las Aguas Conservation Area<br>Tapir Mountain Nature Reserve, Belize   | Bahamas Dept. Agric.<br>Bahamas Nat. Trust<br>Belize Audubon Soc.<br>Belize Dept. Forestry<br>DR Min.Env. Nat. Res.<br>Friends of Abaco<br>IMADES – Mexico<br>Inst. Sup. Agric., D. R.<br>Marsh Harbor Vol. Fire<br>PREVFOGO - Brazil<br>Programme for Belize<br>TIDE<br>TNC<br>UNDP D.R.<br>US Forest Service |

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