

Wildland Fires and the Environment: a Global Synthesis

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List of Acronyms

AVHRR: Advanced Very High Resolution Radiometer
CGIAR: Consultative Group for International Agricultural Research
DMSP: Defense Meteorological Satellite Program
EEPSEA: Economy and Environment Programme for South East Asia
ENSO: El Niño Southern Oscillation
FPI: Fire Potential Index
GAC: Global Area Coverage (data from NOAA/AVHRR)
GRID: Global Resource Information Database
NASA: National Aeronautics and Space Administration
NFDRS: National Fire Danger Rating System
NOAA: National Oceanic and Atmospheric Administration
OCHA: UN's Office for the Coordination of Humanitarian Affairs
TOMS: Total Ozone Mapping Spectrometer
UNEP: United Nations Environment Programme
USDA/FS: United States Department of Agriculture/Forest Service
USGS: United States Geological Survey
WWF: World Wildlife Fund
See also Appendix 3

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Executive summary

During 1997 and 1998, relatively small-scale, human-initiated fires for land clearing and land-use change quickly developed into uncontrolled large-scale and widespread fires. These fires occurred in Southeast Asia, South and Central America, Africa, Europe, Russia, China and the United States. These uncontrolled and widespread wildfires were a consequence of extreme drought conditions apparently brought about by the 1997 El Niño. On a daily basis, these wildfires were reported on the front pages of the world's newspapers and on television and radio throughout the world. Internet websites described the daily, and in some cases hourly progress of these wildfires.

The extensive and widespread wildfires of 1997 and 1998 made the world aware of the environmental and human health impacts associated with these fires. In Southeast Asia alone, tens of millions of people were exposed to high levels of fire-produced gases and particulates for weeks at a time. The poor atmospheric visibility resulting from these fires was responsible for the crash of a commercial airplane and the collision of two ships at sea in Southeast Asia. In general, the countries of the world were not prepared to react in a timely and effective way to these fires. Fire control and air quality monitoring systems did not provide the information needed for government officials and others responsible to make decisions and take related action. Thus, the wildfires of 1997 and 1998 were a learning experience for many environmental managers.

Natural fires induced by atmospheric lightning were a regular phenomenon even before humans were present. Such naturally-induced fires remain a vital process that initiates natural cycles of vegetation succession and maintains ecosystem viability. In the tropical regions and elsewhere, human-initiated fires have also become an important and widespread tool for land clearing and land-use change. Fires initiated by human activities (which may account for as much as 90% of all fires) can have a negative impact on the composition and chemistry of the global and regional atmosphere, on our planet's climate and on human health.

Fires are a significant source of gases and particulates to the atmosphere: environmentally important gases produced by fire include carbon dioxide, carbon monoxide, methane, non-methane hydrocarbons and oxides of nitrogen. Fire also produces large amounts of small, solid particles or "particulate matter", which absorb and scatter incoming solar radiation, and hence impact the climate of our planet, as well as provoking a variety of human health problems.

This report, Wildland Fires and the Environment: a Global Synthesis was prepared to better inform decision makers about fires, their environmental and health risks, as well as those technologies available to monitor and hopefully reduce the impacts of fires in the future.

1 Introduction

Fire has been an agent of disturbance for thousands of years. Forest and wildland fires have occurred long before the advent of humans, shaping landscape structure, pattern and ultimately the species composition of ecosystems. The ecological role of fire is to influence several factors such as plant community development, soil nutrient availability and biological diversity. Forest and wildland fire is a vital and natural process that initiates natural cycles of vegetation succession and maintains ecosystem viability. Uncontrolled or misused fires can, however, cause tremendous adverse impacts on the environment and human society.

A combination of climate and human activity account for the majority of wildland fires. The contribution of natural fires such as those caused by lightning is insignificant in comparison to the number of fires started by humans. The vast majority of wildfires are intentionally set fires in forests, savannas, grasslands and other wildland areas for timber harvesting, land conversion, slash-and-burn agriculture, and socio-economic conflicts over questions of property and land use rights. In recent years extended droughts, together with the rapidly expanding exploitation of tropical forests and the demand for the conversion of forests to other land uses, have resulted in a dramatic increase in wildfire size, frequency and related environmental impacts. During 1997 and 1998, a combination of drought conditions brought on by El Niño and uncontrolled burning practices caused unprecedented levels of wildland fires across the globe.

Recent wildfires had an immense impact in Indonesia, Brazil, Mexico, Canada, USA, France, Turkey, Greece and Italy. In the latter country, for example, the government declared a state of emergency in parts of the southern mainland and the islands of Sicily and Sardinia during 1997-98. Large scale forest fires and fire hazards were also reported in eastern parts of the Russian Federation, and in China's northeastern Inner Mongolia Autonomous Region.

The number and extent of uncontrolled wildland fires during 1997 and 1998 captured the attention of the media and helped increase public awareness of issues such as biomass burning and greenhouse gases, loss of habitat for threatened and endangered plant and wildlife species, international haze and air pollution, and public health and safety. Uncontrolled fires and haze also have adverse economic impacts through the loss of industrial and agriculture production, the destruction of commercial timber, decline in tourism and increased health care costs. Yet despite the intense media attention, and dozens of international evaluation and assistance programs, a limited reliable scientific data exist to describe the extent of recent burning and its affect on the environment. The purpose of this report is to highlight global fire issues and identify opportunities to coordinate international wildland fire prevention, suppression and rehabilitation programs.

2 Significance of fire to the global environment

Forest fires, controlled or uncontrolled, have profound impacts on the physical environment including: land cover, land use, biodiversity, climate change and forest ecosystems. They also have enormous implications for human health and on the socio-economic system of affected countries.

Economic costs are hard to quantify, but a conservative estimate by the Economy and Environment Programme for Southeast Asia (EEPSEA/WWF, 1998b) put the cost of damages stemming from the Southeast Asian fires (all causes) at more than \$4 billion.

Health impacts are often serious. Estimates suggest 20 million people were in danger of respiratory problems from fires in Southeast Asia (EEPSEA/WWF, 1998a). In 1997 smoke and air pollution from fires in Mexico, Honduras and Guatemala drifted across much of the US Southeast, prompting officials to issue a health warning to residents.

A major consequence of forest fires is their potential effects on climate change. Only in the past decade have researchers realized the important contributions of biomass burning to the global budgets of many radiatively and chemically active gases such as carbon dioxide, carbon monoxide, methane, nitric oxide, tropospheric ozone, methyl chloride and elemental carbon particulates.

Biomass burning is now recognized as a significant global source of emissions, contributing as much as 40% of gross carbon dioxide and 38% of tropospheric ozone (Andreae, 1991).

The major components of biomass burning are forests (tropical, temperate and boreal); savannas; agricultural lands after the harvest; and wood for cooking, heating and the charcoal production. The burning of tropical savannas is estimated to destroy three times as much dry matter per year as the burning of tropical forests. Most of the world's burned biomass matter is from savannas, and because two-thirds of the Earth's savannas are in Africa, that continent is now recognized as

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