UNITED NATIONS
ECONOMIC COMMISSION FOR EUROPE

FOOD AND AGRICULTURE ORGANIZATION
OF THE UNITED NATIONS

INTERNATIONAL FOREST FIRE NEWS

No. 18 – January 1998

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International Forest Fire News is an activity of the Team of Specialists on Forest Fire, of the Joint FAO/ECE/ILO Committee on Forest Technology, Management and Training, and in cooperation with:

The U.S. Department of the Interior, Bureau of Land Management

The International Union of Forestry Research Organizations (IUFRO)
Subject Group S.1.09 Forest Fire Research

The International Global Atmospheric Chemistry (IGAC) Project (IGBP) Focus Impact of Biomass Burning on the Atmosphere and Biosphere "Biomass Burning Experiment" [BIBEX])

The International Boreal Forest Research Association (IBFRA) Fire Working Group

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International Forest Fire News is published on behalf of the Joint FAO/ECE/ILO Committee on Forest Technology, Management and Training and its secretariat, the Timber Section, UN-ECE Trade Division. Copies are distributed and available on request from:

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Call for contributions

Readers of the International Forest Fire News are warmly invited to send written contributions to the editor at the above address. These may be in the form of concise reports on activities in wildland fire management, research, public relations campaigns, recent national legislation related to wildfire, reports from national organizations involved in fire management, publications, personal opinions (letters to the editor). Photographs (black and white) and graphs, figures and drawings (originals, not photocopies, also black and white) are also welcome. Contributions are preferably received by **e-mail (non-encoded ASCII file, Word Perfect 5.1 or Word 6.0) or on diskettes**. Figures and photographs should be submitted by mail.

The deadlines for submitting contributions to the bi-annual issues are: **15 May and 15 November.**

EDITORIAL

Smoke over South East Asia: The Role of the Media, NGOs and the General Public

The El Niño year 1997 began as usual. Predicted by the meteorologists in late 1996, the El Niño phenomenon started to build up in the first half of 1997 and brought trouble to many parts of the globe. While excessive rains and floods covered the west coast of South America, the Australasian region went dry and became flammable. In Indonesia the early onset and long persistence of the drought led to extreme water shortage, crop failures and widespread famine. Mountain villagers in Irian Jaya were forced to eat their seed stores, and many people died due to lack of food and drinking water.

Like during the previous droughts of 1982-83, 1987, 1991 and 1994 the burning activity in the region increased. Slash-and-burn farmers and foresters took advantage of the dry conditions to clear their land which had been too wet to be burned successfully during the past two years. The smoke of these land-use and forest conversion fires moved slowly due to the weak trade winds and became trapped close to the ground due to the high pressure system. This caused an unprecedented thick smog layer. Satellite sensors and the manned space missions on board the MIR station and on the Space Shuttle STS-86 were not able to see the land and sea surface of the Indonesian archipelago and its mainland neighbours such as Malaysia. People in Sumatra, in Northern Borneo, both in the Indonesian and Malaysian provinces, and on the mainland were most affected by the air pollution. The air quality monitoring indices in Singapore and Malaysia reached record highs. Many land-use and conversion fires went out of control, escaping into forests, peatlands, agricultural and tree plantations. The smoke of wildfires mixed with both the plumes from legally planned and conducted conversion fires and those fires which were willfully ignited to hide illegal logging operations. The environmental and economic impacts of the fire episode of 1997 have not yet been assessed.

When reviewing some newspaper reports, regional and international TV coverage on the fire and smog episode, I went back to the questions that the journalists and radio reporters asked me on the situation in South East Asia. It seemed that many journalists knew more about the extent and impact of the "forest fires" than the Indonesian authorities or my research group (which has been working in fire research in Indonesia since the El Niño of 1982-83), or the foreign-assisted fire management project groups, who have been operational since a couple of years, did.

The role of the media: Helping to mediate the true picture?

The media sold the message to the international public that the extent and impact of "forest fires" in Indonesia were unprecedented. There were hardly any news reports which carefully investigated the previous fire and

smoke episodes in the region. The previous burning years had been the reason that Indonesia and international partners started to build up integrated fire management programs in the early 1990s. International Forest Fire News began to report about these programs in August 1992! In the media it was never mentioned what fire research and fire management had been achieved so far. A tremendous amount of knowledge on the fire environment of Indonesia and its surrounding countries has been available since the end of the 1980s.

The World Wide Fund For Nature (WWF) even came to the conclusion that 1997 was "The Year the World Caught Fire" (Source: WWF International News Release, 16 December 1997). Without having any look into the databases and the literature, WWF concluded that "In 1997 more tropical forests burned around the world than at any other time in recorded history".

In a recent communication with the fire historian Stephen J. Pyne (Arizona State University) on the situation in South East Asia he said: "Who will tell the true story of fire? The government agencies are distorted by politics; the corporations by profits; and the NGOs by their need for donations and memberships. All of them exploit fire (and fire imagery) to advance other ambitions and agendas. But where is the disinterested voice of fire scholarship? There aren't many of us, but we are that voice, my friend."

International Forest Fire News attempts to provide the forum for the voice. For preparing this issue I have asked knowledgeable people from inside and outside the South East Asian region to bring their views and experiences to the international readers (South East Asia Fire Special).

This issue, however, also presents a Baltic Fire Special. In early May 1998 the countries bordering the Baltic Basin will meet at the "First Baltic Conference on Forest Fire". The conference is convened jointly by the Government of Poland and the FAO/ECE Team of Specialists on Forest Fire.

Finally: International Forest Fire News is now co-sponsored by an agency outside of the UN system: The United States Bureau of Land Management (BLM) has provided funds for producing the newsletter, starting with this issue of January 1998. This is why the readers will now find the logo of BLM on page ii. Our thanks go to Mr. Les Rosenkrance, National Director of Fire and Aviation, Bureau of Land Management. His visions to stimulate international collaboration in fire management through active participation by the BLM is encouraging for the global fire science and management family.

Freiburg (Germany), January 1998 — Johann G. Goldammer

Welcome to International Forest Fire News !

Preface to the South East Asia and Baltic Fire Special

This voluminous issue of International Forest Fire News brings a focus to two distinctly different regions of the globe - to South East Asia and to the Baltic Basin. While size, vegetation patterns and the magnitude of fire occurrence in these regions are quite different from each other - they nevertheless have something in common: In the recent years more than ever the use of fire has come under crossfire. Fires and smoke in South East Asia - especially Indonesia - during the last months have entered the headlines of the world media. We all know that Indonesia's smoke is an expression of land use and land-use change.

In the forest and agricultural landscapes of the countries bordering the Baltic Sea, fire also has been an important tool in historic land-use systems shaping the European landscape. Historically the use of fire in cultivating wildlands in Central-Northern Europe was very common, like in South East Asia where fire is used as a traditional tool for land clearing. The burning of forests, bogs, and heathlands for initial conversion to agricultural and pastoral sites, and later on, the regular maintenance burning of these cultivated systems produced flames and smoke. The European smog layers were observed as far back as in the early 16th century.

In order to bring the discussion of fire and smoke back to a less emotional level, I have selected some historic documents to show that Europeans had to suffer summer smog from land clearing fires. The European cultures are based on land cleared from forests, and forest debris burning was the most common way to dispose of the vegetation, which otherwise could not be used.

In Europe and other industrialized regions of the globe we have reached a more or less "stabilized" equilibrium between forested and non-forested land. Indonesia - like many other countries in the tropics - is a country in transition from a forest nation, with low population density, towards a rapidly growing economy, becoming industrialized and urbanized in megacities. Indonesia, like many of the rapidly growing countries, seems to be dependent on converting forests into other land uses.

So, what is wrong with the smoke coming out of Indonesia and Brazil these days? Don't these countries have the same rights to do today what the industrial nations did centuries ago? Where is the difference? Are the biodiversity-rich tropical forests "more valuable" than the species-poor ecosystems of the North? Are land-use plans for the fragile tropical soils in accordance with the latest state of knowledge concerning their potential carrying capacity and sustainability for non-forest systems?

This issue of International Forest Fire News will not end the discussion, however, it is intended to present one region where there seems to be too much fire and smoke - South East Asia - and another region where nature conservationists and landscape managers are beginning to consider restoring fire in order to protect the cultivated landscape which had been subjected to fire over hundreds of years.

Clearly, there are conflicts and contradictions in the world of fire. We need to open up a fair discussion.

Johann G. Goldammer

Assessment of 1997 Land and Forest Fires in Indonesia: National Coordination

Abstract The report describes the 1997 land and forest fires in Indonesia, reviews of the control measures put in place and evaluates the national coordination efforts taken to combat the fires as the dry period extended toward what became a serious drought. A key finding is that virtually all of the fires burning in forests and lands in Indonesia are caused by man and as such are manageable and preventable. The fire disaster experienced in 1997 is a result of traditional and commercially-based broadcast burning exacerbated by the delay in onset of normal monsoon rains. The report concludes with recommendations for immediate and long-term activities to manage the land and forest fires.

INTRODUCTION

Indonesia ranks third, after Brazil and Zaire, in its area of tropical forest. Of Indonesiaš total land area of 1.9 million km^2, current forest cover estimates range from 0.9 to 1.2 million km^2, or 48 to 69% of the total. Indonesiaš forests are a major component of the national economy, providing significant wood product exports, employment, domestic usage and non-timber resources. While forests continue to dominate the landscape in Indonesia, other land use types are expanding in area, including bush and scrub lands, grasslands, areas of shifting cultivation, areas under permanent agriculture and settlements.

Large areas of land and forest in Indonesia burned in 1982 and 1983. In Kalimantan alone, the fires burned from 2.4 to 3.6 million ha of forest. Land and forest fires also burned in Indonesia during extended dry periods in 1987 (49,323 ha), 1991 (118,881 ha) and 1994 (161,798 ha). The fire areas in 1987, 1991 and 1994 were larger than during years with normal rainfall, but not nearly as large as the area burned during the extended drought from June of 1982 to April 1983 in East Kalimantan.

Monitoring and Assessment of 1997 Fires

Monitoring in Indonesia (by agencies described below) indicated that the fires burning in 1997 appeared to be mainly the result of fire used to clear forest and land for agricultural and forestry purposes. The distribution of burning activities is indicated by the presence of 'hot spots' which are monitored by detecting thermal differences (>52°C) on night-time images from the National Ocean and Atmospheric Administration (NOAA) satellite. When the satellite images are overlaid with land use and concession boundary maps, the major activities associated with hot spots are revealed. For example, in Riau Province hot spots were found mostly in small (80% of hot spots) and large (20%) scale tree crop plantations, followed by industrial forest plantations. A small percentage of hot spots occurred in transmigration settlements and areas known to contain shifting cultivation.

Based on daily monitoring the number of hot spots increased starting in May 1997, reached a maximum in September and declined rapidly from October to December (Figure 1). The greatest concentrations of hot spots in Indonesia during the 1997 dry period occurred in the seven Provinces of Riau, South Sumatra and Jambi in Sumatra, and East, South, Central and West Kalimantan. The 1997 records also show that a large number (72%) of hot spots were located in relatively few administrative Districts (11%) and over a small land area (30%) throughout western Indonesia (Fig.1).

The area of land and forest burned in Indonesia from year to year is related to both land development policies and dry season length. The dry season in 1997 extended past the normal limit of September, leading to larger fires and fires migrating from cleared land into forests. According to preliminary field observations in October by the Ministry of Forestry, approximately 1,654 km^2 of forest burned in Indonesia during 1997. A far higher "guesstimate" of up to 20,000 km^2 has been commonly stated for areas including both land and forest. An accurate determination of the extent of fire damage can only be derived from detailed analysis of aerial images combined with field checks. This type of analysis was completed in South Sumatra in December 1997 by the European Union-sponsored Forest Fire Prevention and Control Project and the Ministry of Forestry. Their analysis suggests that up to 25% (27,980 km^2) of the Province was affected by fire in 1997. The burned area includes 7,010 km^2 of forest which is 86 times greater than the preliminary estimate for the Province from the October field observations. The large burned area in South Sumatra is consistent with the 1997 hot spot pattern

for western Indonesia. South Sumatra contained five of the 15 Districts in which the greatest number of hot spots were recorded.

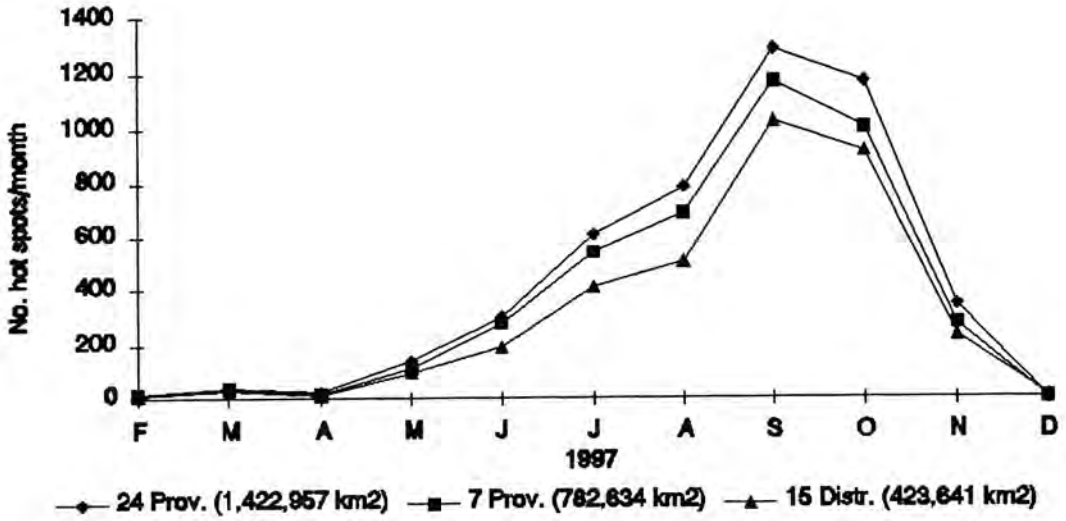

Fig.1. Pattern of hot spot occurrences in 24 Provinces and cities in western Indonesia during 1997. About 82% of the total recorded hot spots were located in seven Provinces. Moreover, about 72% were located in 15 Districts occupying an area of 423,641 km^2, or less than 30% of the total land monitored in western Indonesia.

Caution is required in using hot spot data from satellite images to detect and evaluate fire conditions. Hot spots often do not show under heavy haze or cloud cover. Also, the total number counted on images taken during the day decreases on similar images taken at night, probably due to diurnal changes in humidity. Hot spots may represent heat sources other than from land and forest fires, including burning coal seams, gas flares, and activities in and around settlements.

The impacts from uncontrolled wildfires are severe at all levels. Locally, the health and safety of the people who suffer from the effects of smoke and haze is most serious, and in some cases loss of life has resulted. At the regional and national levels, commerce is disrupted, particularly that of transportation. The damage to natural resources including soil, water, timber and wildlife is large. Land and forest burning causes several well understood impacts to Indonesiaš land and biological resources. At the simplest level, moist evergreen forests are not well adapted to fire. High heat can kill trees. Fire removes the shade required for regeneration and can eliminate seed sources. In disturbed areas, repeated burning promotes fire resistant vegetation (e.g., *Imperata, Macaranga*), soil nutrient depletion and erosion. Fire has been estimated to now affect vegetation and soils in over one third of Indonesiaš land area. Finally, the impact of the fires reaches the world stage, not only through the short term effects of smoke and haze, but of even greater concern, the loss of the carbon sequestered in peatlands that will take millennia for nature to replace. The contribution of these fires to global climate change, both in the short and long term, remains unknown.

ASSESSMENT OF NATIONAL COORDINATION DURING THE 1997 FIRES

The basis for this assessment is the internationally recognized Integrated Forest Fire Management System (IFMS). The IFMS is a modern approach to forest fire suppression that integrates all facets of fire management

and is reflective of the values at risk. It is a system used by most mature fire organizations around the globe and is based on four principles including: 1) a central command and control organization structure, 2) accurate data for decisions, 3) early detection of new fires, and 4) aggressive initial attack by ground and air.

Infrastructure and Government Policies

Following the forest fires during the 1994 dry period, the a National Coordinating Team for Land and Forest Fire Control (TKNPKHL) was formed. The Team is headed by the Minister of State for the Environment and the Director General of Forest Protection and Nature Conservation (PHPA). Members of the TKNPKHL include senior officials from the Ministries of Home Affairs, Mining and Energy, Agriculture, Transmigration, Social Affairs, National Aerospace Agency (LAPAN), National Development Planning Agency (BAPENAS), and the Agency for the Technology Assessment and Application (BPPT). The Deputy Head of the team and the Secretariat are located at the Indonesian Environmental Impact Management Agency (BAPEDAL). The Teams activities include: organizing local capability and coordination to prepare for fires; formulating regulations and guidelines for land clearing without burning; developing techniques to control fire using various management approaches; operating a fire detection and early warning system; communicating and cooperating with international agencies and foreign countries affected by smoke and haze.

BAPEDAL, in its capacity as secretariat of the TKNPKHL, established an emergency command post (POSKO) to coordinate efforts to control land and forest fires during the extended dry period in 1997. The main activities of the POSKO are to act as the central body to collect, analyze and disseminate information about land and forest fires throughout Indonesia.

Under normal fire conditions the TKNPKHL provides technical input and information to provincial coordinating teams (PUSDALKARHUTLA) which further instruct District teams (SATLAK) and units (SATGAS) in the field. Fire suppression teams are the responsibility of each individual land user or concessionaire. For example, National Parks under the jurisdiction of the Ministry of Forestry have forest rangers who also work on fire suppression when required. Commercial activities such as tree crop and forest plantations or natural forest concessions must also employ trained teams responsible for fire suppression within their jurisdiction.

With the onset of the extended dry season in 1997, it became evident to the TKNPKHL that control activities would need strengthening. The following actions were initiated since February 1997.

Elevate Status to Fire Disaster BAPEDAL began detecting, monitoring, analyzing and communicating fire and smoke information in February 1997. The TKNPKHL established in August a formal control center (POSKO) and was on 24-hour alert until November. A POSKO for fire control operations was also established by the Coordinating Agency for National Emergencies (BAKORNAS PB).

By March, several national media sources (radio, television, newspapers) were requested to allocate daily attention to fire information and warnings. Information on fire conditions was forwarded to local government agencies and local military commands for investigation and control. Several cases of burning were investigated directly by the TKNPKHL.

Place Moratorium On Land Clearing and Burning Regulations on land clearing without the use of fire were issued by several sectoral Departments. At the request of the Minister of Environment, the President of Indonesia declared a ban on all land clearing activities.

Use **Geographical Information Systems (GIS) to Identify and Coordinate Fire Control Activities** GIS was used by the TKNPKHL to monitor and track forest fire locations and to identify land owners in fire areas. The GIS integrates monitoring information regularly submitted by several Departments and Agencies including Forestry, Agriculture, LAPAN and BMG.

Publicize Names of Companies Using Fire to Clear Land Several burning cases were reported in the media. Responsible companies were required to explain their situations to BAPEDAL. Several investigations of illegal land and forest burning have were initiated. Proceedings are underway for prosecution and several licenses have been revoked.

Request Weekly Reports From Governors An emergency action plan was submitted to the Governors of the seven fire prone Provinces. The plan outlined how fire control is to be coordinated, implemented, monitored and reported. The Governors were also requested to elevate the status of the fire problem throughout government offices and in the media.

The Business Sector Must Show Initiatives to Control Fires During meetings in May and September between BAPEDAL and senior representatives of the forest industry, commitments were declared to stop all burning during land clearing. Concession owners were required to submit weekly reports of land clearing and burning in and adjacent to their concessions.

Assess and Implement Air-based and Ground-based Suppression A program was implemented to induce rain in Riau Province by cloud seeding. A similar program was implemented in Malaysia. International experts in forest fire control arrived in September to assist the TKNPKHL Team to evaluate ground-based and air-based fire suppression methods for Indonesian conditions.

Strengthen International Dialogue and Cooperation The TKNPKHL Team received daily hot spot, visibility and haze monitoring information from several government agencies in Singapore and Malaysia.

When the Government declared the fires a disaster on 15 September 1997, the National Coordinating Board for Disaster Response (BAKORNAS PB) was mobilized to serve as the focal-point for operational instructions to all government and military units. BAKORNAS is headed by the Coordinating Minister for Social Welfare. Numerous organizations became involved including the armed forces, police, local governments, youth organizations and environmental interest organizations. During this critical period, the TKNPKLH concentrated on collecting, analyzing and disseminating information about the fires.

Fire Information Management

Information about forest and land fires in Indonesia flows through several agencies. The dominant centers controlling information flow are the command posts (POSKO) operating at the Ministry of Forestry (PHPA) and at the central BAPEDAL. Information generated by Forestry flows mainly in a bottom-up direction, as fire control responsibilities within the Ministry lie with the field units. The POSKO at PHPA receives radio reports from all Provinces in Indonesia. These reports are summaries originating from the Forestry offices in the Districts and Sub Districts (Dinas) and describe fire locations, sizes, origins and current status. The reports focus mainly on Forestry jurisdictions including conservation areas, parks, forest concessions and industrial plantations. As such, the reports do not provide a full assessment of the fire conditions in the Provinces.

In contrast to Forestry, information generated by the BAPEDAL POSKO flows mainly in a top-down direction as described below. The BAPEDAL POSKO is located at the BAPEDAL Pollution Control Section in central Jakarta. A dedicated room has been equipped with telephones, faxes, modem lines, a projector and screen, and several computers equipped with image processing and geographical information system programs. During the 1997 fire period the POSKO operated on a 24-hour basis with five permanent staff and about 20 personnel seconded from other BAPEDAL Directorates. Assigned positions include duty managers, analysts, phone, fax and internet operators and support staff. Several individuals with GIS expertise also volunteered their time to strengthen the technical capabilities of the POSKO. The BAPEDAL POSKO operates permanently to respond to environmental problems and natural disasters.

Several command posts were established by the other government agency members of TKNPKHL and provided the BAPEDAL POSKO with continuous information. These were located at the Meteorology and Geophysical Agency (BMG), the Space and Aeronautics Agency (LAPAN), the Forestry Department and the National Coordination Centre for Disaster Control (BAKORNAS-PB).

The BAPEDAL POSKO receives several types of information daily including processed and unprocessed satellite images from NOAA satellites (via LAPAN and the Singapore Meteorological Service), weather reports (via BMG), smoke and haze reports (Department of Communications, Singapore and Malaysia Meteorological Services), and telephone and fax reports of conditions from regions where fires are occurring. The POSKO also receives detailed boundary maps of concessions for commercial forestry and industrial timber plantations, tree crop and other agricultural plantations, conservation areas, mining and oil and gas concessions, and

transmigration projects. Daily POSKO operations include:

* receiving and enhancing satellite images to show hot spot locations;
* using GIS to overlay hot spots on concession maps to ascertain responsible parties;
* contacting Provincial and District Government offices, and sectoral Departments to report hot spot locations for investigation and control;
* receiving phone or faxed reports of fire outbreaks from public, media and government sources, then disseminating information to Provincial and District government offices;
* providing reports to officials in BAPEDAL, the Presidentš office, other government agencies and the media.

The POSKO at BAPEDAL is in its early stages and is evolving in terms of its organization, function and application. As a result, the overall picture of the 1997 forest fires in Indonesia, particularly as it applies to number of fires and area being burned, is not available. Nevertheless, the recognition of large fires in remote and inaccessible regions (such as in Kalimantan) through the POSKO operations is useful.

THE FIRE MANAGEMENT DILEMMA

Much has been said and written about the 1997 forest fire problem in Indonesia. The debate continues as to who or what is responsible. Perhaps the question of pertinence is: What has changed or what is different from previous significant fire years? Burning the landscape, whether for removal of refuse, or clearing land has been a way of life in Indonesia for millennia. It is usually the least expensive and in some cases the only effective means to remove vegetative matter. For many rural people fire is used to prepare their land for subsistence crops. For other people, the drought affords an opportunity to accomplish land clearing objectives when burning is not possible during a normal seasonal weather pattern.

Surface or shallow ground fires are normally extinguished with the arrival of the Northwest monsoons and wet season. Under the 1997-1998 extended drought, however, the fuels became drier with each passing day, resulting in higher intensity fires with faster spread rates. In the case of organic soils, the drought lowers the water table, which in turn results in more available fuel. This allows wildfire to penetrate deeper below the surface, making the peat fires increasingly difficult to extinguish. The deep burning fires produce large amounts of smoke and haze.

Much of the burning in 1997 occurred either in fallow land cleared for the growing season which normally starts in September, or in areas where forest was felled and burned for plantation development. Until late September, few tracts of standing forest were sufficiently dry to ignite and burn. The dry conditions, however, persisted long enough for standing forest to burn. In addition, the large areas of coastal peatlands in Sumatra and Kalimantan also became sufficiently dry to burn. By the end of September hot spots (associated with fire occurrence) appeared in areas known to contain logged-over forest and peat. The dilemma of fire management occurs at this point. While fire is an important tool for land management, the smoke produced during open burning then limits the rapid detection, access and suppression of the fires moving into forested areas (Fig.2).

CONCLUSIONS

Virtually all of the fires burning in lands and forests in Indonesia are caused by man and as such are manageable and preventable. The crisis experienced in 1997 was a result of traditional and commercially-based broadcast burning exacerbated by prolonged drought.

To date, fire preparedness planning and implementation in Indonesia has tended to be more reactive than proactive. Emphasis has been placed on activating fire control organizations, at various levels from the National Forest Fire Control Center (PUSDALKARHUTNAS) through the Provincial Center (PUSDALKARHUTDA), the Executor Units (SATLAK) to the Fire Brigades (SATGAS). Fire fighting forces are also activated in forest and industrial timber concessions. There is, however, little recognition of fire danger. Fire danger rating systems are effectively used in other fire-prone countries and have been tested in the ASEAN region. Preliminary work has been done within Indonesia. Nationally, the TKNPKHL has prepared fire hazard maps. On a local basis, some Provinces have implemented a simple system of days since last rain, but have yet to correlate meteorological data with actual fuel moisture within local fuel types.

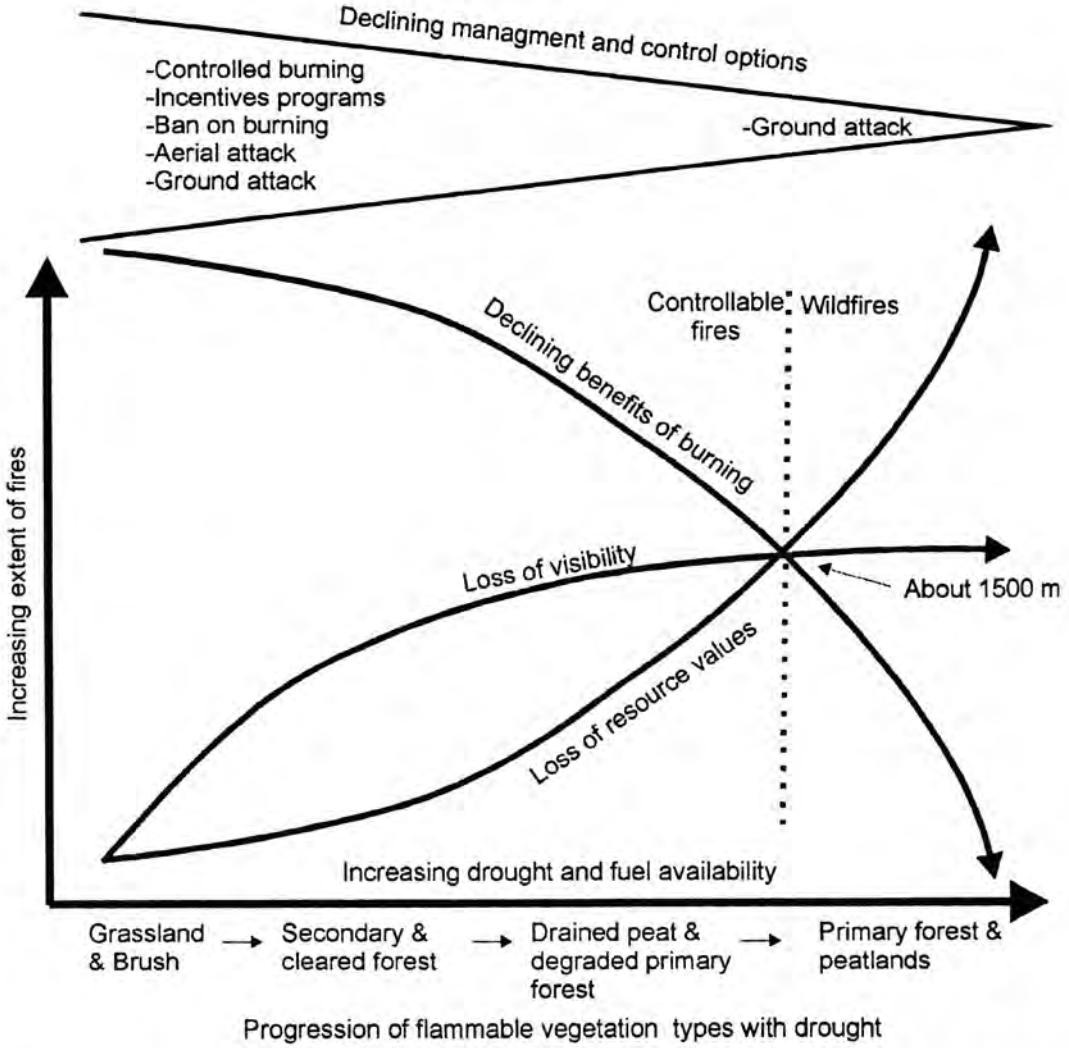

Fig.2. Conceptual diagram of the main factors affecting the control of land and forest fires in Indonesia. The rapid loss of visibility during the early stages of the fire period (grasslands and cleared forest) limits the ability to control fires during the later stages when fire moves into peatlands and standing forest where natural resource losses are high and benefits of open burning are diminished. In the diagram the boundary between controllable fires and wildfires is defined at a visibility distance of about 1500 m, below which aircraft, other transportation modes and aerial observations and monitoring are restricted.

The inability of forest fire agencies to quickly detect and take rapid and aggressive initial action on new fires, is the single most limiting factor in Indonesiaš fire management program. This is particularly true for fires that have limited vehicular access. Another primary constraint to effective control has been the imbalance between increasing fire risks due to the prolonged drought and the limited ability to raise the level of concern among public and private agencies affected. The low level of concern among institutions and the public has limited the effectiveness of any response.

Recommendations and Planned Activities

* There must be a single national institution with line authority and field infrastructure responsible and accountable for ensuring a national response for all land and forest wildfires. A single line agency for fire management is a proven structure for effective fire agencies around the world. The TKNPKHL has recently drafted a reorganization of fire management responsibilities to a single agency. Promulgation and implementation of the new organization is expected in 1998.

* Broadcast burning for land clearing purposes is necessary and will continue as an activity on the landscape in Indonesia. Alternatives to burning must be developed with technologies, incentives and sanctions to encourage safe burning or the use of alternative methods.
* Appropriate laws, sanctions and enforcement mechanisms should be incorporated into an integrated national approach to land clearing and burning over the long term. Public awareness and local extension programs should be strengthened to encourage managed burning. Prevention should receive strong enforcement capability in the field. Initial efforts should be to establish legal precedence using existing fire and burning legislation. Several legal cases are pending.
* A preparedness planning system needs to be established to facilitate proactive responses to fires. The system should have as basic components: fuels mapping and classification; fire danger rating system; fire index network and forecasting; fire prediction, fire detection and resource deployment. Several donor-assisted initiatives are underway to assist in developing these components.
* Regional cooperation should be strengthened to enhance communication of fire information and to optimize the allocation of resources for fire management and control. National Fire Management Plans are currently being prepared by several ASEAN member countries. The plans will be used as the basis for developing an ASEAN Regional Fire Management Plan.
* The data on the number of wildfires, hectares burned or burning, and forest and other values impacted are sectoral, fragmented and inaccurate, and require standardized mapping and surveying. An internationally-sponsored project is being planned to document and evaluate in detail the social, economic and environmental effects of the 1997 fires.

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Opposite page:

Conversion of forest into villages, farms, pasture lands, and plantations involves clearcutting and burning - a traditional method applied all over the world (Photos: Fire Ecology Research Group). The impacts of land-use change, i.e. the loss of biodiversity and the smoke generated during the conversion process, is causing nowadays more public concerns as compared to decades ago. Indonesia does not stand alone. The Brazilian Institute for Space Research (INPE) released in early February 1998 the deforestation figures for 1995-1996. They show that in the mid-1990s deforestation, with annually 29,059 km^2, doubled as compared to the end of 1980s.

Many of the ecologically fragile forest sites in the tropics cannot provide conditions suitable for agricultural or plantation system. After clearcutting, burning and a few year of cropping the productivity of these sites degrades and farmers abandon the land. Aggressive invading grasses, such as the *Imperata* species, occupy the sites (Upper photo). They are highly flammable, burn almost every year, thus preventing the regeneration of secondary forest.

During the El Niño droughts primary and secondary forests become flammable. The lower photo shows a surface fire in a lowland rain forest in East Kalimantan, Indonesia (Photos: Fire Ecology Research Group).

United Nations Disaster Assessment and Coordination Team (UNDAC)
Mission on Forest Fires, Indonesia, September - November 1997

Executive Summary

In September-November 1997, parts of several countries in South-East Asia, including Malaysia, Singapore, Brunei, the Philippines, Thailand, and Indonesia, were affected by heavy air pollution, primarily caused by exceptionally large-scale forest fires in Indonesia.

These fires were reportedly started as of May-June 1997 (possibly as part of land clearing operations, either for plantations or agricultural land), and because of unusually dry weather the fires spread into other areas, including peat swamps which are dried out. The forest fires were found to be mostly in the Indonesian islands of Java, Sumatra, Kalimantan, Sulawesi and Irian Jaya (neighbouring with Papua New Guinea). This year, the El Niño effect delayed the onset of the monsoon, and the forest fires, with associated air pollution, persisted for several months. The disaster has brought significant damage to the environment, and it is felt that it will have substantial long-term effects on the social, economic, health and ecological sectors.

The national authorities were taking steps to cope with the emergency situation, but became clearly overwhelmed with this large-scale disaster. The Government of Indonesia declared a national emergency and, while not formally appealing for international assistance, confirmed that it would welcome such assistance, especially in the field of fire fighting.

DHA's Relief Coordination Branch, through its Joint UNEP/DHA Environment Unit, was closely monitoring the situation and staying in close contact with the national authorities. On 27 September 1997, a United Nations Disaster Assessment and Coordination Team (UNDAC) was urgently dispatched to Indonesia, at the request of the United Nations Resident Coordinator. The Team was led by the Chief, Relief Coordination Branch, and was tasked to ensure close links between national and international relief coordination efforts, and assess needs for international assistance in connection with this disaster. The UNDAC Team has been working in Indonesia, in close cooperation with the UN Resident Coordinator, the competent national authorities, local donor country representatives, UN agencies, and relevant international non-governmental organizations. Field assessment missions were conducted from Jakarta to different affected regions, to identify specific needs for assistance. DHA has prepared and disseminated several Situation Reports on this disaster.

As a result of joint efforts to mobilize international assistance, many countries, UN agencies, international organizations and NGOs have provided different types of help, both in cash and in kind, to Indonesia. On the basis of practical experience in carrying out this operation, the following conclusions and recommendations should be highlighted:

* This emergency has an important international dimension in relation to severe transboundary air pollution, and the large-scale destruction of unique aspects of the existing biodiversity which represents a world heritage.
* International assistance, provided to Indonesia, was substantial and significant. DHA has played an important role in mobilizing and coordinating international relief efforts.
* At the present stage, the peak of this disaster is over and a large number of surface fires having been extinguished. However, risks of further fires (including peat fires) are very great, and the current situation can not be considered as stable. Moreover, if the general national policy (banning the use of fire for land clearing) is not implemented fully, a repetition of the present emergency may take place next year.
* Appropriate preventive measures should be taken at the national level as an absolute priority. The only true solution to the problem should be seen in a different approach, and effectively limiting/renouncing the use of fire (slash and burn) techniques for land clearing.
* The national authorities should considerably improve their preparedness for combatting possible future fires. A National Contingency Plan for Environmental Emergencies is clearly needed.
* Public information awareness and sharing of relevant information between major actors at both national and international levels should be improved.
* It is strongly recommended to carry out a comprehensive assessment of environmental and other damage caused by this disaster, thereby duly involving the national authorities concerned.

* Early warning capacities, at both international and national levels, should be further developed and utilized. Appropriate emergency notification procedures should be introduced by the Indonesian authorities.
* The international community should improve its preparedness for possible future fires in Indonesia and other countries.
* DHA should continue monitoring the situation, and staying in close contact with relevant national authorities.

Apart from fires, the easternmost Province of Indonesia, Irian Jaya, has been hit by a drought which has resulted in a severe famine. The drought has also led to a significant decrease in water supplies. Within the overall emergencies two UNDAC field missions were sent to Irian Jaya to investigate the impact of the drought and the forest fires, as well as problems with regard to food security, water and health. To date, the international relief activities has been focused on immediate needs, combined with steps to alleviate the famine and break the cycle of vulnerability in the medium and long-term.

Introduction

Relevant background information on the country: Geography: Straddled across 13,700 islands and 5,000 kilometres of the equator, Indonesia's total land area is 1,919,445 square kilometres (740,905 square miles). The equatorial climate, combined with the rich volcanic soil of most islands, gives Indonesia a lush, fertile character. Only 6,000 of Indonesia's 13,700 islands are inhabited, the main ones being Sumatra, Java, Madura, Bali, Sulawesi, Lombok, Moluccas and Timor as well as Kalimantan and Irian Jaya (the latter two being the only non-volcanic members of the group).

Population: With a population of over 200 million, Indonesia is the fourth most populous country in the world and is growing at 1.8% a year according to 1988 statistics, some 27% of the population is urbanised and 67% is under the age of 16. The spread of the country's territory is reflected in the number of ethnic groups; the main ones being the Javanese, Sundanese, Batak, Buginese, Minangkabau and Balinese. The Chinese comprise the largest non-indigenous group.

Environment: Indonesia has about 143 million hectares of tropical forests and the largest area of rainforest after Brazil. Like Brazil, it is struggling with the delicate, difficult balance of the forests' commercial potential and their ecological importance. Numerous concessions to logging companies have alarmed conservationists. At present rates, the World Resources Institute estimates that Indonesia would lose 12.5% of its forest in the next decade. According to other sources, the total under threat is even higher.

During September and October 1991, a series of huge fires ravaged more than 200 square miles of tropical forests in southern Kalimantan and Sumatra. Environmentalists say that many of the fires broke out in areas degraded by excessive logging, where the debris left behind is easily combustible.

Background to the recent disaster: According to official Indonesian authorities, the land, bush and forest fires were initially started by new agribusiness concessions, such as large scale plantations, that were not complying with the land clearing regulations of the Forestry, Agriculture, and the Transmigration Departments. This regulation was in effect since 1995 and stipulated that land clearing was not to be conducted by methods of burning.

In the months of September and October 1997, numerous small-scale ground fires have been caused by farmers and others clearing the land in a traditional fashion, in anticipation of the rains. Due to the prolonged drought and the very dry climatic conditions, these fires have rapidly spread out of control. Numerous fires have been burning in the islands of Java, Kalimantan, Sumatra, Sulawesi, and Irian Jaya, causing heavy air pollution in several countries in South East Asia, including Malaysia, Singapore, Brunei, and Thailand. The smoke has reached as far north as the Philippines and south all the way to Australia (and Westwards reportedly to the Maldives).

The worst smog in Kalimantan has been coming from an extensive fire in a one million hectare area of peat being drained by the government for a massive rice planting project. The peat was emitting noxious carbon fumes which have triggered health alerts throughout the region. Peat fires are considered the most dangerous.

Peat has accumulated in lowland areas for 7,000 or more years and may be as much as 20 feet deep. When undisturbed, it serves to store rain during the monsoon season, and slowly releases the moisture back into the air during drier times. When heavy rains occur, the peat prevents flooding by acting like a sponge.

When the peat is exposed, it quickly dries out. Once dry, it ignites easily. Once burning, sometimes the fire goes deeply into the earth and then cannot be extinguished, even by heavy rain. These fires can smoulder, like self-combustion, underground indefinitely.

On 25 September 1997, the President of Indonesia, through the office of the Secretary of State, proclaimed the land bush and forest fires a national disaster and ordered the mobilization of the people. The National Disaster Management Coordinating Board (BAKORNAS PB) then assumed the role of coordinating the implementation of national disaster management efforts.

Climatic Factors, Including El Niño and Drought: The current effect of the El Niño phenomenon is considered to be different from others in this century for two reasons: Firstly, for the first time the National Weather Service has successfully predicted the start and scope of El Niño. Secondly, scientists predict that it could be the worst of the century, and potentially surpass the record-breaking appearance of El Niño in 1982-83.

The current El Niño has been classified as a "type one" which means that it is the strongest of the El Niño weather patterns, with a surface temperature change greater than 2 degrees Celsius. There have been eight "type one" El Niño years since 1949, with the present one being the ninth.

This year's El Niño covers an unusually large swathe of ocean, which has warmed more quickly than usual. Furthermore, the phenomenon, which often does not occur until Christmas, started much earlier than usual during this past year.

The World Meteorological Organization (WMO) has reported that the monsoon rains in Indonesia could be delayed by 2 to 3 months because of the El Niño phenomenon, which is disrupting weather patterns throughout the world.

Health-Related Consequences and Activities: In its surveillance of air quality in 11 provinces, the Ministry of Health has found that South Sumatra and Central Kalimantan have been the worst affected areas. The Ministry is therefore monitoring the health conditions of local residents through various clinics in these two provinces and tests are being conducted on individuals who have a history of asthma, TB and other respiratory problems. This monitoring program is planned to continue throughout the year in order to ascertain and deal with the longer-term effects of the haze.

Officials in Central Kalimantan have reported that 11 people have died from respiratory diseases between July and September at five health centres, while more than 23,000 others were suffering from respiratory problems. The province of Jambi has reported 35,368 cases of upper respiratory tract infections during the month of September 1997, an increase of 50% compared to the previous month. The province of South Sumatra has reported that the number of diarrhoea cases had risen to 1,000 in September, an increase of 20% compared to the previous month.

According to the Public Relations Bureau for West Sumatra, an estimated 47,565 West Sumatrans have suffered from acute respiratory tract infections during the month of September 1997. The highest number of incidents was in Padang with 22,690 people having been affected.

The World Health Organization (WHO) warns of some rise in the number of haze-related deaths, particularly among the ill, the elderly and the very young. Nitrogen dioxide, sulphur dioxides and volatile organic compounds latch on to the suspended particulates, which go deep into the lungs because they are so fine.

Although the long-term consequences of haze have not yet been fully analyzed, over the short-term doctors state that smog can contribute to breathing discomfort and respiratory tract problems. Furthermore, this exposure can further complicate existing ailments.

The Indonesian Emergency Response System

The Coordinating Minister for People's Welfare chairs the National Disaster Management Coordinating Board (BAKORNAS PB). Members of the board include: the Minister of Social Affairs, the Minister of Home Affairs, the Minister of Health, The Minister of Public Works, the Minister of Transportation, the Armed Forces Commander in Chief as well as the Governor whose province is struck by a natural disaster.

BAKORNAS PB was established in 1979 with the following responsibilities:

(1) Formulating policy and providing guidelines and directives related to natural disaster management;
(2) Coordinating disaster management before, during and after the disaster in an integrated manner;
(3) Providing guidelines and directives on policy outlines and disaster management activities covering prevention, mitigation, response, rehabilitation and reconstruction.

On a daily basis BAKORNAS monitors the fire situation at the ground level through its provincial and district-level offices and coordinates the delivery of assistance. Daily reports from the Provincial Disaster Management Coordinating Unit are submitted to BAKORNAS summarising changes in the provincial situation and their requirements in terms of fire-fighting, medical and other assistance. Reports from the District Management Implementing Unit are also made directly to BAKORNAS. The Coordinating Minister for People's Welfare then prepares a daily report of the conditions throughout the archipelago which is submitted to the President.

A cadre of volunteers with direct linkages to POSKO BAPEDAL (see below) is also assisting BAKORNAS with logistical arrangements.

The State Ministry for the Environment Policy-Level Crisis Centre (POSKO LH) was established to gather and monitor all available data relating to the land, bush and forest fire situation and to provide policy advice regarding the mitigation of these fires. The State Minister for the Environment is responsible for the activities of POSKO LH and its sister organisation, POSKO BAPEDAL.

Throughout the course of the forest fire crisis POSKO LH has promoted the exchange of information between government departments and other organizations relating to policy implementation and ground and forest fire mitigation activities.

The Directorate General for Forest Protection and Conservation (PHPA) is the lead agency responsible for protecting conservation areas.

The National Institute for Aerospace and Aeronautics (LAPAN) is continuously accessing and reviewing NOAA 12 and NOAA 14 satellite images on potential and existing fire hot spots and transmitting data to the Environmental Impact Management Agency Crisis Center (POSKO BAPEDAL). Daily weather information is provided from the National Meteorological and Geophysical Agency (BMG). POSKO BAPEDAL, with the assistance of national experts and local volunteers, integrates this information with other spatial and baseline data using GIS/RS to develop a more complete analysis of daily developments. These data are then sent to local areas for verification and to BAKORNAS PB and other national departments and agencies. POSKO BAPEDAL also performs regular field visits to assess the ground situation in the different regions of concern.

The POSKO BAPEDAL global information system (GIS) to monitor and overlay fire hot spots with other data was developed in August 1997 with the assistance of national experts from across the country. The system was effectively monitoring and transmitting data within one week after installation.

LAPAN detects hot spots from the satellite some 850 kilometres high. Hot spots are determined according to their temperature; anything above 50 degrees Celsius is registered for further verification. POSKO BAPEDAL reports that the number of hot spots can vary significantly from day to day due to the fact that the fires may extinguish themselves or be extinguished by fire-fighters. Also thick smoke may make satellite imagery and data reports less accurate. BAPEDAL also reports that peat moss fires that burn underground may not be detected, while moving quickly and being able to easily spark a fire in a new area.

Weather modification activities have been coordinated by the Agency for the Study and Application of Technology (BPPT) in cooperation with the Indonesian Air Force and the Indonesian Navy. Air Force representatives from Malaysia and Singapore have also participated in these activities.

Over the course of the past three months, the capacity of POSKO LH, POSKO BAPEDAL, BAKORNAS PB as well as that of related ministries such as Home Affairs, Foreign Affairs, Forestry and Agriculture has been increased. Coordination and communications among the various Crisis Centres have improved and the distribution of aid - both domestic and international - has been done effectively.
Voluntary assistance by local youth organisations, environmental organisations, universities and other social institutions has been channelled to the appropriate regions. Furthermore, the Minister of Information has held briefings with international media reporters and correspondents.

The Role of the United Nations

In compliance with General Assembly resolution 46/182, the United Nations Department of Humanitarian Affairs (DHA), through its Relief Coordination Branch (RCB) in Geneva, has established an emergency response system for coordinating actions taken by the international community as a result of natural disasters and environmental emergencies, including technological accidents.

The Joint UNEP/DHA Environment Unit was set up in DHA's Relief Coordination Branch in 1994, following extensive consultations with Governments, which expressed a strong preference for a simple mechanism in the United Nations to expedite the delivery of international assistance, including a single entry point to the system, with regard to different environmental disasters.

The Joint Unit has been mandated to improve the international response to environmental emergencies by acting as a broker between affected and assisting countries, a clearing house for information and a switchboard for disaster notification and alert. This integrated United Nations response capacity of UNEP and DHA is bringing international assistance to countries facing environmental emergencies such as chemical and oil spills, industrial accidents, forest fires and other sudden-onset emergencies that cause, or threaten, environmental damage and which can have serious impacts on human health and welfare. The Unit - similarly to all other units in the Relief Coordination Branch - is available for urgent assistance on a 24-hour basis, 365 days a year.

The Joint Unit is financed by UNEP, while organizationally fully integrated in DHA's Relief Coordination Branch. DHA is providing the Unit with necessary support and backstopping, including office space and emergency response facilities. The Joint Unit carries out its activities in conformity with services traditionally provided by the Relief Coordination Branch, including arrangements for independent assessment of emergencies upon Governmental request. The joint UNEP/DHA initiative on environmental emergencies aims at improving and complementing the existing international response capacity to help countries in coping with sudden-onset disasters.

If required, and in consultation with the United Nations Resident Coordinator, DHA can field a United Nations Disaster Assessment and Coordination Team (UNDAC) to assist in emergency assessment and field coordination during the initial relief phase.

The UNDAC Team consists of qualified and specially trained national emergency management experts, as well as of RCB staff, who are on permanent stand-by. Team members can leave within hours, accompanied by a communications expert and/or with mobile satellite telecommunications equipment, as required.

In general, an UNDAC Team works under the authority of the United Nations Resident/ Humanitarian Coordinator. It cooperates with the local emergency management authorities in carrying out assessment and coordination tasks at a disaster site, and/or assists them in coordinating incoming and locally available assistance capacities in the capital, at no cost to the affected country. On request, DHA can also dispatch staff and/or experts to assist the United Nations Resident/ Humanitarian Coordinator's Office in the affected country in fulfilling its relief coordination mandate during the emergency phase.

DHA's Relief Coordination Branch, including its Joint UNEP/DHA Environment Unit, has been closely monitoring the situation in connection with the recent forest fires in Indonesia, and has been in close contact

with the national authorities. DHA has prepared and disseminated to the international community several Situation Reports on this disaster.

Response Actions by the Indonesian Government and National Relief Efforts

The Indonesian authorities have been taking steps to respond to this disaster. National efforts are coordinated by the National Disaster Management Coordinating Board (BAKORNAS). Activities have been focused on fighting fires in the first place in Sumatra (provinces of Riau, Lampung and Jambi), and in Kalimantan.

The responses made in Indonesia include:

* Activating local disaster response task forces
* "Air cleaning", as done by the National Technology Research and Development Agency in Pakanbaru, Riau (increasing visibility but only helpful for a short time)
* Cancelling land clearing licenses
* Mobilizing armed forces police, forest rangers and volunteers to fight fires on the ground including making trenches (which were not effective when applied to peatland as fire spreads underground)
* Inducing rain (not successful due to lack of moisture and shield of haze)
* Mobilizing medical personnel, health facilities and increasing health surveillance for respiratory, skin, eye, and diarrhoeal diseases.

The Indonesian Government determined the following geographical priorities in fighting the fire:

* 1st Priority: Central Kalimantan and Jambi
* 2nd Priority: West Kalimantan and Riau
* 3rd Priority: South Kalimantan and South Sumatra

The Government of Indonesia has approached the large agribusiness companies and requested their cooperation and an increase in company efforts to combat the forest fires. The companies have been asked to guarantee the prevention of additional fires and to work with local communities to extinguish existing fires.

The President of Indonesia has instructed the national police to take further action on law enforcement.

The Ministry of Agriculture gave 242 plantation companies a fifteen-day time limit to prove their non-involvement in the burning of the forests. Twenty-nine (29) of these companies had not responded by mid-November, and the Ministry of Agriculture was to follow-up accordingly.

The Ministry of Forestry has announced that another 15 wood-use permits of plantation and timber companies have been revoked, after they failed to present documentation disproving allegations that they started land and forests fires. In total, the Ministry has now revoked 166 wood-use permits. The government has accused 176 companies of violating the strict laws against the burning of forests to clear land. The Ministry of Forestry has set aside Rp. 2.8 billion for the Agency for the Assessment and Application of Technology, which has been attempting to seed clouds to produce rain (and extinguish fires). The Ministry of Forestry is also using Rp. 3.1 million of their reforestation fund to handle the fires and, in cooperation with the Indonesia Forestry Society and the Association of Indonesian Forest Concessionaires, has provided more than 500,000 face masks to people in the affected areas. The Ministry of Forestry has reported that a reforestation program would be soon launched to replant 3,283 hectares of the 61,000 hectare Bukit Soeharto Grand Forest (East-Kalimantan), which was burned by fires in the past year. The Ministry has also reported that the forestry concession holders will be obliged to replant damaged areas. The Ministry of Forestry has organized fire brigades to lead fire-fighting activities since the beginning of this crisis and has mobilized equipment consisting of 73 bulldozers, 80 tractors, 77 trucks, 92 oil tankers, 225 water pumps. 94 chain saws, 1543 hand tools and 385 radio sets for communication.

The Ministry of Health has been taking a range of measures to deal with the health problems affecting some 240,000 people. For example, since early September, the Ministry has been distributing protective face masks to the regions and has been promoting the dissemination of information on the potential impacts of the haze and public safety measures that should be followed. The Ministry of Health (DEPKES) conducted a health

assessment of several regions, which have been affected by fires. They started this assessment in Jambi Province, which is one of the worst smoke-affected areas in Indonesia.

The National Military Forces as well as the Forestry Administration and local government authorities have been involved in fire-fighting in Indonesia. The Indonesian Air Force and Navy have been conducting joint operations to reduce fires with the Malaysian and Singaporean Air Forces. These efforts were coordinated by the Agency for the Study and Application of Technology (BPPT) and included cloud seeding and smoke reduction strategies.

The following Indonesian personnel and equipment has reportedly been deployed in the field: 3,910 soldiers, 1,050 members of the Police force, 1,800 Forest Rangers, 30,700 voluntary civilians, 1 ship and 8 aircraft (including one U-610, three C-130 Hercules and one Transall) and miscellaneous equipment.

Fire fighting has not been fully effective due to the scope and type of the fires and the lack of appropriate technology to combat fires of this magnitude. One of the main difficulties in fighting the fires lies with the fact that the only truly effective way to extinguish these is to do so on the ground (even if efforts are duly facilitated by water-bombing operations) and that the necessary manpower needs to be mobilized-and trained-to that effect.

The Directorate General for Forest Protection and Conservation (PHPA) has been successful in mitigating the fires in a number of protected areas including Way Kambas, Lampung and Tanjung Putting, Central Kalimantan.

The UNDAC Mission

Terms of Reference From 28 September through 18 November 1997, the UNDAC team was working out of a Coordination Centre established in the UNDP office in Jakarta, and providing support to the Resident Coordinator in assisting the Government of Indonesia with essential disaster assessment and coordination tasks. More specifically, the team was carrying-out the following key functions:

- making independent in-country assessments of the situation the team has visited several of the most affected areas including Lampung and Jambi provinces (Sumatra), South, East, West, and Central Kalimantan and Irian Jaya;
- drawing up immediate priority requirements for assistance;
- facilitating coordination through the establishment of specific technical coordination groups;
- acting as an information clearing house for the international community (and the media);
- establishing close links with the Government; and
- resource mobilization.

Support to the Government and the UNRC UNDAC was providing support to the UN Resident Coordinator in Jakarta, as well as to the Indonesian Government, in assessing and prioritizing emergency relief needs and mobilizing appropriate international assistance. BAKORNAS PB has been designated as the principal Governmental contact point for related activities. The UNDAC Team provided inputs to regular Situation Reports on the disaster, issued by DHA Geneva. These reports were posted on Internet (ReliefWeb), and distributed to more than 1,000 addressees around the world, as well as to the Indonesian Governmental organizations and relevant Embassies in Jakarta. The UNDAC Team left Indonesia on 18 November 1997, but two DHA Delegates remain in Jakarta, until end-December 1997, to provide further support to the UN Resident Coordinator and the Indonesian Government, as required.

Field missions The UNDAC Team has fielded several assessment missions to the most affected provinces in Indonesia. As a result of these missions, the Team has formulated, together with the Indonesian Government, a list of priority needs. As a result of an assessment by UNDAC, together with UNDP staff and a number of donor country representatives, and in consultation with the Indonesian authorities, the following emergency needs have been identified (in order of priority):

a. Ground fire-fighting equipment and training
b. Health care
c. Drinking water
d. Food, water, relief items and logistics (Irian Jaya)

(a) Ground fire-fighting equipment and training Fire fighting equipment and expertise was identified as the most pressing problem. In order to mobilize international assistance, detailed requirements have been prepared and disseminated among potential donors. A Joint Technical Coordination Group on Fire Fighting has been established by UNDAC in Jakarta, which brought together, Governmental bodies (such as BAKORNAS PB, Ministry of Forestry), UNDP, the European Union and representatives of the donor community (Australia, Canada, Germany, Japan, Finland, Russia, and the United States). This Group provided a forum for exchange of relevant information, and helped to avoid duplication of efforts. The Provision of standard packages of ground fire fighting equipment as an immediate emergency support to the ongoing fire-fighting efforts in the affected provinces was considered as the highest priority. UNDAC developed the concept and the composition of standard packages, which was universally endorsed/accepted. According to BAKORNAS/UNDAC estimates, 43 basic response packages and 12 peat fire response packages were recommended as a minimum requirement for the provinces of Riau, Jambi, South Sumatra, Lampung, Kalimantan (West, East, South and Central) and Irian Jaya.

Following an initial cost estimate, about USD 1.24 million were required for the purchase of the equipment included in the 43 basic ground fire-fighting packages and 12 peat fire packages (which would equip about 1,000 firemen). This cost estimate did not include transport/distribution at the provincial level, where the equipment should be delivered and where training was to be conducted. Additional funding was required for this purpose. After a generous response from a number of donors, 7 basic fire fighting packages and 1 peat fire fighting package were still needed, as of early-December 1997.

(b) Health care Provision of medicines for the treatment of respiratory infections, asthma, conjunctivitis and diarrhoea was recommended for those districts/provinces most severely affected and where immediate shortages exist. In Jambi Province, an immediate shortage of medicines was reported to the UNDAC team. Both hospital and health clinic attendances for respiratory tract infections and asthma have increased in Kalimantan and central Sumatra. A list of medicines and medical supplies required has been prepared by the Indonesian Ministry of Health. This list has been reviewed in consultation with WHO. The Government recommended in-country procurement as the most viable option. The necessary steps were taken to purchase the needed drugs and other items, and to deliver them to hospitals. Some medical supplies have been also distributed through the Indonesian Red Cross.

(c) Drinking water The continued drought has raised concerns about the safety of drinking water in Irian Jaya, Kalimantan, Jambi and South Sumatra. With the exception of Irian Jaya, there have been no formal requests so far for emergency assistance, either through WHO or UNICEF. Prefabricated emergency type water treatment units are reportedly available on the local market and their distribution to the affected areas could be arranged. Also, one donor country (Germany) was requested to address - and was initiating the process of providing large scale in-kind contributions to assist in - the question of water purification.

INTERNATIONAL ASSISTANCE PROVIDED TO INDONESIA

A number of donors have provided important assistance to the Indonesian authorities concentrating on emergency needs in the field of fire fighting. An Australian water bombing team carried out fire fighting operations in Indonesia. It included water bombing aircraft, essential control, command and support functions as well as other necessary equipment provision. The South Australian Country Fire Service was deployed in Lampung Province, and delivered water/foam on fires in the Lampung area. In addition, a fire management team from the New South Wales Rural Fire Service undertook an expert assessment of the fire and haze situation, and a health assessment team carried out an expert assessment of the impact of the fire situation on health.

Canada sent ten basic fire fighting packages to Central Kalimantan, accompanied by professional instructors. Almost 300 hundred local personnel are being trained by Canadians in Banjarmasin and Palangkaraya districts. Canada has also agreed to co-fund 50 per cent of a CANDollars 2 million ASEAN Regional Forest Fire Cooperation project aimed at establishing a long term regional wild fire response strategy, information systems and action plans.

Fire fighting equipment donated by Japan was sent to Sumatra and Kalimantan. Two Japanese helicopters with infrared cameras were used in Lampung and Jambi provinces.

Malaysia sent two large contingents of firemen to Southern Sumatra and West Kalimantan to fight the fires. These groups were working side by side with the Indonesian Armed Forces, Police, Forest Rangers and local volunteers.

The US Air Force sent 56 personnel and 4 aircraft (three Hercules C-130 and one C-141 Starlifter) to Indonesia to provide aerial support to fire fighting. Operations started in Tanjung Putting, Central Kalimantan, and continued in the area of Surabaya. The USA fire fighting team had two objectives since its arrival; one was water bombing, while the other was an assessment of the situation and the formulation of recommendations. The USA also equipped two Indonesian helicopters with water dropping devices. For the purpose of evaluating the different water bombing methods and to minimize the time of using the satellites, a USA expert in the field of satellite imagery interpretation participated in this operation.

The European Union response included a contribution of peat fire fighting equipment from Finland, and basic packages from France (both accompanied by professional trainers). Germany provided special expertise and equipment.

Other donors have also provided valuable services and contributions, or are considering to do so in the near future. A number of countries and organizations made available in Internet relevant satellite data and interpreted information. In particular, the Canadian Forest Service has made available, through the World-Wide-Web, a prototype ASEAN Fire Weather Information System which provides daily fire weather and fire-danger indices and maps of the region (www.nofe.forestry.ca/fire/asean/inputs-e.html).

The United States assisted by providing satellite data on active fire areas (scale: 1 inch=10 km) in Indonesia as well as specialist advice on the receipt and most effective use of these data. These images are available on Internet (http://www.fs.fed.us/eng/indofire).

As part of its continuing effort to provide scientifically credible and timely information on the extent of the problem, the United Nations Environment Programme (UNEP) has requested the World Conservation Monitoring Centre (WCMC) to make available (on the Internet) materials that highlight the potential impact of the fires on the biodiversity of the region - one of the richest in the world. The address for this site is http://www.wcmc.org.uk/latenews/. WCMC also compiled the following information in order to highlight the potential impact of the fires in South-East Asia on the biodiversity of the region: locations of fires, natural ecosystems, biodiversity, protected areas, published material, other internet sites and maps. This information is available on the Web site of WCMC at the following URL: http://www.wcmc.org.uk/emergency/. In September 1997, UNEP made available on the Internet a series of satellite images that show the growing spread of the smoke throughout the region's atmosphere. These images can be viewed at: http://grid2.cr.usgs.gov/indofire/start.html.

The European Space Research Institute (ESRIN) of the European Space Agency (ESA) has informed DHA that some NOAA images of the Indonesian fires can be found on-line at the following address: http://www.manipal.org.my/manipal/haze/html. Images of the Along Track Scanning Radiometre (ATSR) (works in infra-red) can be accessed at: http://earth1.esrin.esa.it:8080/ew/, and http://pooh.esrin.esa.it/ew.

RESULTS OF RESPONSE ACTIVITIES

National efforts vis-a-vis international assistance The Indonesian authorities have taken steps to respond to this emergency, by involving professional fire fighters, military personnel, forest rangers, police officers and local volunteers. Relevant Governmental bodies, scientific establishments and NGOs have taken part in fire fighting operations. However, due to the scale of this disaster, the national authorities became clearly overwhelmed. It is recognized that primary responsibility to deal with the emergency lies with the Government, and that international assistance would supplement national efforts. At the same time, taking into account the exceptional proportions of this disaster, international help has played an especially important role.

Effectiveness of fire fighting, including water bombing Fire fighting has not been fully effective due to the scope and type of the fires and the lack of technology to combat fires of this magnitude. One of the main difficulties in fighting the fires lies with the fact that the only truly effective way to extinguish the fires is to do so on the ground (even if efforts are duly facilitated by water-bombing operations) and that the necessary

manpower needs to be mobilized and trained to that effect. Cloud seeding has been undertaken to induce rain and reduce dust and fires, but reportedly it has not been very successful. Water bombing is the most expensive type of fire fighting, and its effectiveness in this particular case was questionable.

DEVELOPMENT OF THE SITUATION

Hot spots In early-October 1997, fires were burning in three provinces in Sumatra, two provinces in Java, three provinces in Kalimantan, one province in Sulawesi and Irian Jaya. At that time, the Ministry of Environment and the Ministry of Forestry have estimated 96,693.34 hectares of forest to have burned, consisting of: 10,552.30 ha of protected forest; 70,259.20 ha of production forest; 3,896 ha of natural conservation forest; 1,724 ha of recreational forest; 10,222.09 ha of national park forest; 5 ha of provincial recreational forest; and 34.75 ha of other forest. The financial loss from Timber Plantation Estates is estimated to be equivalent to Rp. 45.7 billion.

In the beginning of October 1997, NOAA satellite readings indicated that 45.95% of the hot spots were located in agricultural and plantation areas, 24.27% in bush and peat soil areas, 15.49% in productive forests, 4.58% in protected areas, 8.51% in timber estate areas and 1.20% in transmigration sites. Smoke prevailed over the southern part of Sumatra; however, as the wind was blowing from east to west the smoke was heading towards the Indian Ocean. Smoke also accumulated in Southern and Central Kalimantan, and was moving towards West Kalimantan and the South China Sea.

The Ministry of Environment and the Ministry of Forestry have reported that efforts to extinguish the land, bush and forest fires in many parts of Indonesia were beginning to show results; the number of hot spots consequently dropped and visibility improved at a number of airports. However, new hot spots continued to be detected in West Java, South Sulawesi and East Java and there is some ambiguity about the number of hot spots in Kalimantan. This information was obtained from the satellite images of Indonesia's National Institute of Aeronautics and Space (LAPAN), field staff reports from the sites of the forest fires and data from the American National Oceanic and Atmospheric Administration (NOAA).

In mid-October 1997, data from the Environmental Impact Management Agency (BAPEDAL) indicated that the number of hot spots, or fire locations, increased in various regions of Sumatra, Kalimantan, Sulawesi and Java. Satellite images indicated that the number of hot spots in Kalimantan, Sumatra, Sulawesi and Java were 35, 23, 2 and 2 respectively. BAPEDAL projected that the increase in the number of hot spots may have been caused by the absence of rain on most of the islands.

Visibility was reduced on the island of Sumatra and the haze forced a number of airports to close down. The Centre for International Forestry Research (CIFOR) reported that there was continued problem with aboveground growth fires in the Jambi and Riau areas of Sumatra and peat fires in Central Kalimantan. Reports from Malaysia and Singapore also indicated that the haze has returned to these areas after a week of clearer skies and lighter showers.

According to information detected by Satellite NOAA 14, on 16 October 1997, smoke ranging from medium thick to thick was covering parts of Central Kalimantan, East Kalimantan, Central and South Sumatra as well as parts of North Sumatra. The total number of cities covered by haze rose from 22 to 41, with at least 4 airports shut because of poor visibility.

In the second part of October 1997, the Environmental Impact Management Agency (BAPEDAL) reported that there were 18 hot spots in Kalimantan. Visibility in many areas remained low (less than 2 kilometres) and the airports of Riau, Pekanbaru, Padang and Kota Jambi were closed. Visibility improved in both Banjarmasin and Balikpapan, and was estimated between at 5 and 7 kilometres. The airports in Samarinda and Palangkaraya remained closed with visibility less than 500 meters. There was one fire reportedly burning in the region of Kediri, East Java.

By October 28 1997, BAPEDAL reported a total of 30 hot spots throughout the archipelago. Based on NOAA 14 Satellite data, thick to moderately thick smoke continued to cover South Kalimantan, Central Kalimantan, West Kalimantan and a large part of Sumatra. Four airports were closed in Jambi, Palembang, Padang and Palangkaraya. In Sumatra, visibility was lowest in Jambi (0 km) and Rengat (0 km) and highest in Pangkal

Pinang (8 km). In Kalimantan visibility was lowest in Palangkaraya (500 m) and highest in Samarinda (7 km) whereas in Irian Jaya visibility was lowest in Timika (100 m) and Nabire (100 m) and highest in Sentani (8 km).

On 5 November 1997, LAPAN detected 13 hot spots in Sumatra and 35 hot spots in other areas (Kalimantan, Sulawesi, and Nusa Tenggara Timur). Thick to medium-thick haze prevailed over most of Sumatra (with the exception of Aceh province) and parts of Kalimantan (Central, South and West Kalimantan). Eight airports were closed in Jambi, Pekanbaru, Padang, Palembang, Lampung, Samarinda, Palangkaraya and Bengkulu.

Fewer forest fires were detected in early-November 1997, with a total of 7 hot spots reported. However, thick to medium-thick smoke continued to engulf a large part of Sumatra including the provinces of Riau, Jambi, South Sumatra, Lampung and Bengkulu. In Kalimantan, thick to medium-thick smoke continued to prevail in Central, South and West Kalimantan. Parts of Irian Jaya were covered with a thick haze, reducing visibility at different times to less than 100 meters.

Satellite pictures showed the pall of smoke from Sumatra drifting out into the Indian Ocean as the winds were blowing from east to west, keeping the unhealthy pollution away from neighbouring Singapore and Malaysia. The Department of Environment in Malaysia reported that the Air Pollutant Index readings in most regions were below 50, indicating that most of the country had been enjoying good quality air for the first time in 3 months.

SITUATION AT MID-NOVEMBER 1997

The number of forest fires detected by satellite, in mid-November 1997, remained low, with only four hot spots reported. Much of the smoke previously reported in Sumatra appears to have cleared with only parts of Kalimantan (Central and South) continuing to report the presence of a medium-thick haze. Visibility has improved throughout the archipelago and most airports remained open.

The worst smog in Kalimantan has been coming from an extensive fire in a one million hectare area of peat being drained by the government for a massive rice planting project. The peat was emitting noxious carbon fumes which have triggered health alerts throughout the region.

Peat fires are considered the most dangerous. Peat has accumulated in lowland areas for 7,000 or more years and may be up to 20 feet deep. When undisturbed, it serves to store rain during the monsoon season, and slowly releases the moisture back into the air during drier times. When heavy rains occur, the peat prevents flooding by acting like a sponge. When the peat is exposed, it quickly dries out. Once dry, it ignites easily. Once burning, sometimes the fire goes deeply into the earth and then cannot be extinguished, even by heavy rain. They may smoulder underground indefinitely.

The action of burning forests (or even clearing them) may have local, regional, and global effects. Forests act to hold carbon and, when the forest is destroyed, the result is more carbon dioxide and greenhouse gases in the atmosphere. Removing forests heats up the local area somewhat. In the case of huge releases of carbon by burning peat, the regional and global climates may be affected.

It is possible that, when the monsoon comes, it will cause flooding or acid rain. The monsoon may possibly be delayed because of El Niño.

Impact on wildlife, forests and agriculture

According to WCMC, the fires in Indonesia have been threatening at least 19 protected areas, all internationally important, including a World Heritage site (Ujung Kulon in Java), Ramsar Wetland (Berbak in Sumatra) and Biosphere Reserve (Tanjung Puting in Kalimantan). These areas are protected partly because they hold biodiversity riches. The fauna of Indonesia is considered at particular risk as the country is home to more than 100 threatened animal species including the highest number of threatened mammals and the second highest number of threatened birds of any country in the world.

The region is also notable for the wide variety of its plant life and 500 tree species were considered under threat of extinction even before the current fire tragedy. Unique forest ecosystems such as heath forest and peat-swamp forest are particularly vulnerable to fire, which destroys their fragile soils.

According to forestry officials, more than 165,000 hectares (407,000 acres) of Indonesia's national forests have been destroyed by the fires.

The Coordinating Minister for People's Welfare and Chair of BAKORNAS PB, has reported that the fires have damaged some 74,000 acres of land and ignited underground peat and coal deposits that are particularly difficult to extinguish.

Reports also indicate that besides the substantial loss of flora and fauna, the forest fires could potentially release up to one billion tonnes of carbon dioxide if they continue for the next 6 months, and destroy more than one million hectares of forest.

The amount of carbon these extensive peat fires can throw up into the atmosphere is enormous, exceeding that of what Europe emits in a year. The emissions may also impact global warming in a positive feedback loop - they will also make the forest burn more. When forests and peat marshes are normal, they are a good carbon "sink," i.e., they keep a lot of carbon from being in the atmosphere, helping to prevent global warming. The burning puts more carbon dioxide and other greenhouse gases in the air, putting more pressure on climate change. Climate change can lead to still stronger weather phenomena, including El Niños.

The State Minister for the Environment informed reporters in Denpasar on 7 November 1997 that it will take a long time to overcome the damage caused by this year's forest fires and drought. According to the Minister, the forests may be restored as absorbers of carbon dioxide within a 3 to 4 year period; however, complete restoration could take as long as 500 years.

According to the Centre for Agriculture Policy Studies, some 450,000 hectares of rice fields have already been affected by the drought. Production statistics tracking the El Niño phenomenon over the past two decades indicate that harvested rice areas could fall by at least 4%, while coffee production could be reduced by as much as 25%.

It should be noted, however, that there is no comprehensive information on the impact of the recent Indonesian fires. Hence, an independent assessment of the situation, and recommendations on appropriate short, medium and longer-term response measures, are clearly needed.

Impact on Tourism Industry

According to the Indonesian Minister of Tourism, Post and Telecommunications, about 5.19 million tourists will visit Indonesia this year, far below the initial projection of 5.3 to 5.7 million tourists. The forest fires in Kalimantan and Sumatra are being blamed for the drop in tourism as many travellers and tour groups from European and Asian nations have cancelled their trips to the country.

The growth rate would need to reach at least 5% to meet the target of 5.3 million, however, data from the first 9 months of 1997 indicate that arrivals are only up 3.7 percent. The decrease has also affected Bali, the country's most popular destination, where tourist arrivals fell 10% in October, the largest decrease ever experienced by the island.

In spite of the drop this year, the Pacific Asia Travel Association (PATA) predicts that Indonesia will remain one of the 10 key tourist markets in the Asia-Pacific region in 1998.

Meteorological forecast

Indonesia continues to show very strong signals of the freak El Niño weather pattern, which is forecast to continue suppressing delayed Monsoon rains for the immediate future. Recent sporadic rainfall in parts of Indonesia was only intermittent. According to WMO, scientific models show no evidence of a persistent and coherent rainfall in Indonesia in the immediate future.

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The National Meteorology and Geophysics Agency (BMG) has warned Indonesians that significant rains may not come until December - or even later. Although sporadic rain fell in late October, the Agency said that dry winds from Australia are still forcing back seasonal clouds from the South China Sea and Indian Ocean and delaying the onset of the monsoon rains.

In his opening remarks on Monday, 10 November 1997 at the International Conference on Science and Technology for the Assessment of Global Environmental Change, President Soeharto said that besides the drought, the people of Indonesia must prepare for floods in the coming rainy season. Flooding has already become a problem in certain areas of the archipelago. For example, more than one thousand hectares of rice fields were flooded on 7 November 1997 in the province of Northern Aceh.

The Centre for the Study of Natural Disaster at Gadjah Mada University reports that the peak of the rainy season for the provinces of Central Java, Yogyakarta and East Java will be between the months of January and February 1998. Reports indicate that heavy flooding could be expected at this time, as the soil will already be saturated by the sporadic November and December rains.

CONCLUSIONS

- The 1997 forest fires in Indonesia have turned out to be an environmental emergency of exceptional proportions. It is a man-made disaster, aggravated by climatic factors.
- The disaster has brought significant damage to the environment, and it is felt that it will have substantial long-term effects on the social, economic, health and ecological sectors.
- Fires have affected a number of special protected areas and national parks, such as Tanjang Puting in Central Kalimantan, and Way Kambas, Lampung.
- Some human settlements have been damaged by fires.
- Infrastructure, including transportation networks, are not affected.
- Risks of further fires (including peat fires) are very great.
- This emergency has an important international dimension in relation to severe transboundary air pollution, and the large-scale destruction of a unique biodiversity which represents a world heritage.
- The national authorities became clearly overwhelmed with this disaster. While welcoming international relief efforts, the government never formally appealed for international assistance.
- The lack of special fire fighting structures, equipment and expertise was evident. In this connection, international assistance became especially important.
- DHA has played a significant role in supporting the Indonesian Government in mobilizing international help. As a result, many countries and organizations have provided different types of help, both in cash and in kind, to Indonesia. Among them are Australia, Canada, China, Denmark, Finland, France, Germany, Japan, Republic of Korea, Malaysia, New Zealand, Norway, Russian Federation, Singapore, Sweden, Switzerland, Thailand, United Kingdom and USA. Australia and the United States have provided packages of aerial water bombing assistance.
- A number of UN agencies and other organizations are also involved in assisting Indonesia, in particular, UNDP, UNEP, UNICEF, UNESCO, WHO, the ICRC, the International Federation of the Red Cross and Red Crescent Societies, OPEC, and ASEAN.
- Fire fighting operations were carried out under extremely difficult conditions. Many hot spots in mountainous areas are difficult, if not impossible, to reach. Peat fires may burn for months, and special equipment is needed to put them out.
- Water bombing is very expensive and its effectiveness in these circumstances questionable.
- Fire fighting operations brought certain results, and it is now felt that the peak of this disaster is over. However, the current situation can not be considered as stable. If drought continues, an aggravation of the situation may be easily expected.
- If the general national policy on the use of fire for land clearing, slash-and-burn techniques, etc. is not implemented more forcefully, a repetition of the present emergency may take place next year.

RECOMMENDATIONS

- Appropriate preventive measures, including awareness building, should be taken at the national level as absolute priority.
- The only true solution of the problem should be seen in a different approach whereby the use of fire techniques in land clearing is effectively prevented.
- The national authorities should considerably improve their preparedness for combatting possible future fires.
- It is strongly recommended to carry out a comprehensive assessment of environmental and other damage caused by this disaster.
- Special fire fighting equipment (for both ground and peat fires) is clearly needed. Potential donors could be approached with a request to provide such equipment. It should be underlined that this equipment should obligatorily be accompanied by professional training.
- It is recommended to review the activities of the University of Palangkaraya in fighting fires, with a view to using this experience (also in awareness raising), if appropriate.
- It is recommended to approach potential donors with regard to a possible construction of a water retaining dam in Tanjung Puting.
- A National Contingency Plan for Environmental Emergencies is clearly needed. The national authorities may wish to use Guidelines for the preparation of a model Contingency Plan, that had been elaborated by the Joint UNEP/DHA Environment Unit, Relief Coordination Branch, DHA and endorsed by an international Advisory Group on Environmental Emergencies.
- Early warning capacities, at both international and national levels, should be further developed and utilized.
- Appropriate emergency notification procedures should be introduced by the Indonesian authorities. In this connection, the national authorities may wish to use a special Notification/Request form elaborated and tested by the Joint UNEP/DHA Environment Unit, Relief Coordination Branch, DHA.
- The international community should improve its preparedness for possible future fires in Indonesia and other countries. A strong need for special peat fire fighting equipment should be taken into account. Cost-effectiveness of water bombing in specific Indonesian conditions should be critically reviewed.
- DHA should continue monitoring the situation, thereby staying in close contact with relevant national authorities.
- It is recommended that DHA should review the experience learnt from the use of the UNDAC mechanism in this type of emergencies, and draw lessons for future improvement/adaptation of the UNDAC system and methodology, if required.

ACKNOWLEDGEMENTS

The members of the UNDAC Team would like to take this opportunity to express their gratitude to all those officials of the Government of Indonesia, central, provincial and local authorities, and to the United Nations Resident Coordinator in Indonesia and his staff, who extended important support, took the time to provide extensive background information and enabled visits to the affected areas. The UNDAC Team would also like to thank the diplomatic community of the donor countries represented in Indonesia, UN agencies, international organizations and NGOs for their cooperation and important assistance.

Source: *Report of the UNDAC Mission on Forest Fires, Indonesia, September - November 1997. United Nations, Geneva, 28 November 1997*

Remote Sensing of Fire and Smoke in Indonesia:

(I) Use of the NOAA AVHRR

The two accompanying Advanced Very High Resolution Radiometer (AVHRR) scenes have been selected out of several months of imagery in order to demonstrate the tremendous growth of fire activity during a three week period in August. On 5 August 1997, widespread fire activity is readily apparent in the AVHRR 1-km image. At this time fires are widespread throughout the entire island of Borneo, however the intensity of fire activity is notably greater in Indonesia. In the image of 5 August 1997, a large plume can be seen just to the west of 155 east longitude on the southern coastline.

Smaller plumes are not as visible in the greyscale images, but exist in great number in an area centred on the equator to the east of 100 east longitude and south of the Indonesian-Malaysian border. In essence, fire activity is very widespread on the southwestern side of the island with the exception of the highlands that stretch across the island's interior. On 23 August 1997, not more than three weeks later, the number of fires and the amount of smoke has increased dramatically, signalling the beginning of the severe air quality problems in the region. Some of the heaviest burning is still occurring in the same region along the southern coast as noted on 5 August. The fire activity along the southern coast has increased dramatically and now spreads about 200 km westward. In the image of 23 August, which is largely cloud free across the southeast, the smoke pall from these fires is visible. The plume from the intense burning along the southern coast can be seen to drift along the eastern side of the island and extend out over the Celebes and Sulu Seas. Smoke is now filling many of the highland valleys adding to the air quality concerns in the region. The tremendous increase in fire activity in the month of August is truly indicative of the very dry conditions that existed, leading to the even more dramatic smoke palls that encompassed the area in September and to the international attention that would soon ensue.

The AVHRR imagery for 5 and 23 August 1997, have been enhanced as multichannel images using channels 1,2, and 4. Each colour image was printed in greyscale in order to maintain many of the contrast enhancements between water, land, smoke, and clouds. The use of any single channel would lose many of the contrast enhancements and would not yield a printed result nearly as good as obtained by this method.

Many of the methods that have been used to interrogate the NOAA imagery of the Indonesian fire event are those that have been used to evaluate burning in the boreal forests (Cahoon, et al. 1994, 1996; Stocks et al. 1996). The boreal forest research project continues at NASA Langley Research Center under the guidance of Donald Cahoon (NASA), Brian Stocks (Canadian Forest Service), and Johann Goldammer (Max Planck Institute for Chemistry). The goal of this research is to use the satellite data record of the last two decades to quantify fire activity and map fire patterns in the boreal forest of Russia.

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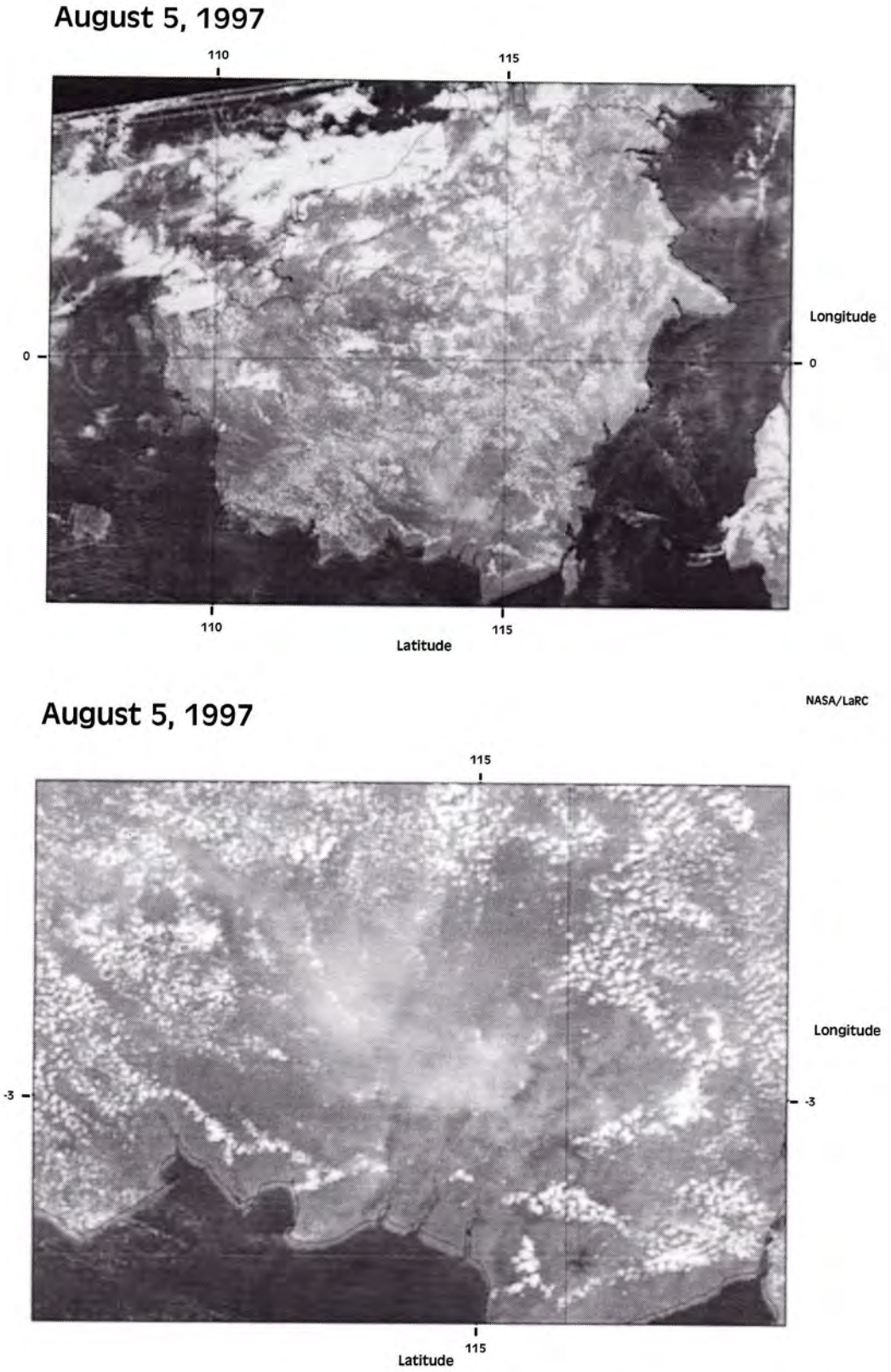
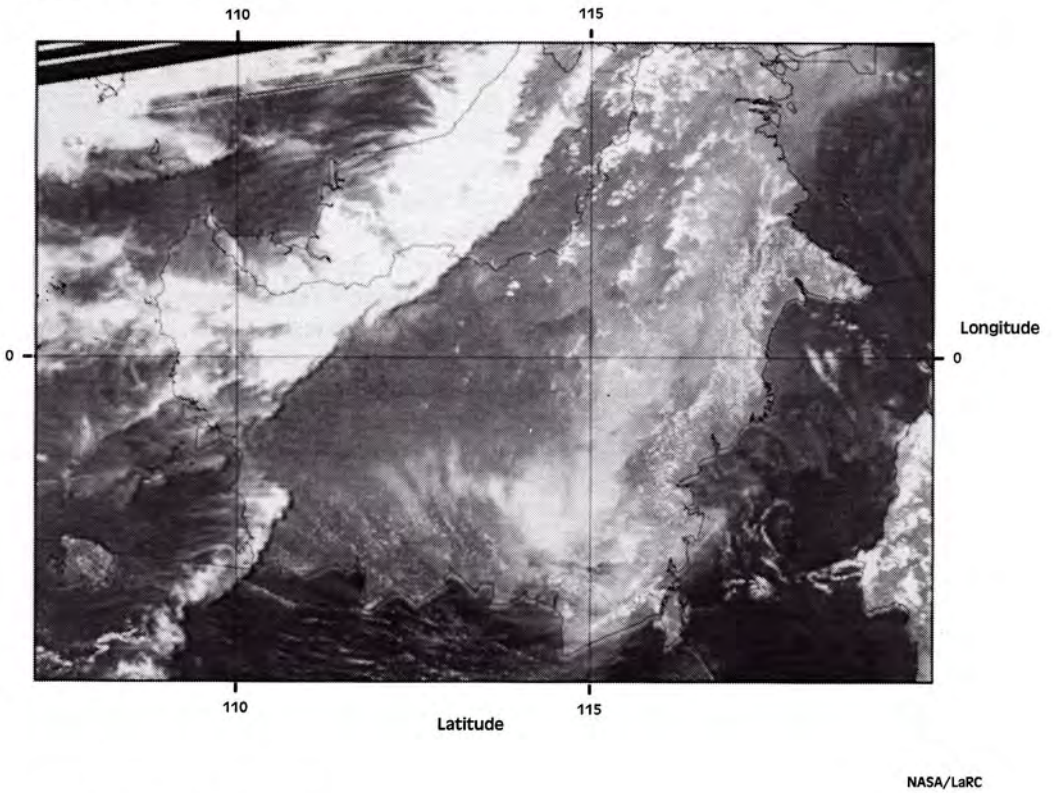


Fig.1. NOAA AVHRR image of Borneo on 5 August 1997. The white pixels in the southern part of the island are active fires while the central and northern parts are partially covered by clouds. The lower image is a close up of South Kalimantan coast near Banjarmasin. Most smoke over South Kalimantan is from the "Megarice" project in which ca. 1 million hectares of wildland, predominantly peat swamp, are converted to rice fields.



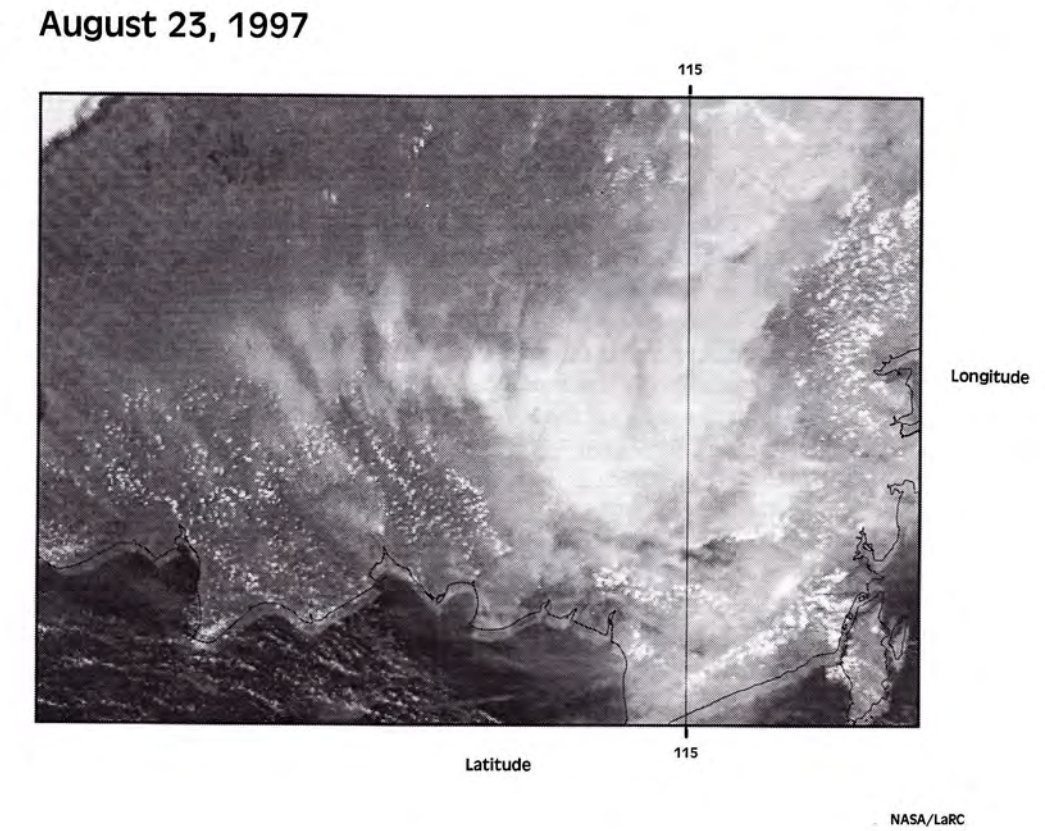


Fig.2. Same view on 23 August 1997. This image is largely cloud free across the southeast, the smoke pall from the conversion fires and wildfires is visible.

(II) The Along Track Scanning Radiometer (ATSR) Fire Product of Indonesia

ATSR instrument characteristics

The Along Track Scanning Radiometer (ATSR), developed by a consortium of laboratories led by the Rutherford Appleton Laboratory, is flying on board the ERS satellites since 1991 (ESA 1992). The ATSR-2 (Stricker et al. 1995) which has been used for this monitoring, has four visible and near infrared channels centred at 0.55μm, 0.65 μm, 0.86μm and 1.6μm, together with the mid-infrared and thermal-infrared channels centred at 3.7μm, 10.8μm and 12 μm. The ATSR is an instrument with a conical scan system producing a double view (forward view: 55 degrees to the nadir) of the same surface at 1 km resolution. The 512 km swath allows a repetitive coverage over the area of interest with about 3 days revisiting frequency at equatorial latitude. The instrument is equipped with a very precise on-board calibration system and with the Stirling Cycle Cooler, which keeps the temperature of detectors within their optimum range thus ensuring an excellent accuracy of measurement. The ATSR high radiometric sensitivity, the good signal to noise (NEDT $\sim$0.05 K, for mid and thermal infrared channels [Mason 1991]), together with the 12 bits digitisation enable the detection of fine ground structures. This is essential specifically for night time image analysis. The same instrument will fly on ENVISAT-1 to be launched at the end of 1999. This would ensure the continuity of the measurements.

Data Documentation At the request of the user community as well as for public information, a fast delivery service dedicated to fire monitoring application has been set up at ESRIN. The night time acquisitions of the ATSR-2 instrument on board ERS-2 are processed in order to visualize and localize hot spots in South East Asia. The results of the ERS-2 Indonesian fire survey are available from ESA WWW server, http://shark1.esrin.esa.it.

ATSR Data Flow and Products The hot spots detection has been performed from August to November 1997. The ATSR data stream is recorded on board ERS and dumped at ESA stations. The exact ERS-2 orbit cycle of 35 days allows to revisit the same scene with the same geometrical condition, as well as a very precise localisation (Dow et al. 1996). Night time data have been processed by the SADIST processor into Gridded Brightness Temperature (GBT) product consisting of 512 x 512 km frame rectified in along track/across-track coordinates and gridded into 1 km cells (RAL 1995).

"Hot Spot" Detection with ATSR During the night, in absence of reflected solar energy, the irradiance at 3.7μm, coming from the earth emission at 500 K is about two orders greater than the one from the earth surface at 300 K. At night and for the seasonal period observed, the average background temperature over the tropical area varies around 295K. Thus even with a fire partially filling a sub pixel surface, the 3.7μm channel of the ATSR will provide a sensitive signal (Dozier 1981). The ATSR instrument, designed initially for sea surface measurements (Mutlow et al. 1994), saturates at 312 K in channel 3.7μm. Therefore, for the rest of the paper, a hot spot will be identified each time the temperature at sensor level reaches this saturation. The high level radiometry quality of the ATSR (Mason 1991, Mutlow et al. 1994, Stricker et al. 1995), as well as the high quality orbit of ERS (Dow et al. 1996) allow it to get a high confidence in the detection and localisation of the hot spots.

Caveats and Recommendations The images processed in this way preserve all the original details leaving the user the evaluation of hot features. The detected fires can be considered as highly likely, however some fires can be missed. The user of the fire product needs to take into account the algorithm limitations due to cloud presence, atmospheric effects, bi-directionality of emissivity, fire temperature and extension, which are not taken into account in the processing.

Advantages of ATSR Night Time detection ensures that no algorithm problem is expected due to sunlight reflection. Only quasi nadir viewing pixels are analyzed: less pixel size and bi-directional problems are expected. No drift of the ERS orbit allows year to year comparison. High radiometric sensitivity allow it to pick up little/not extended fires.

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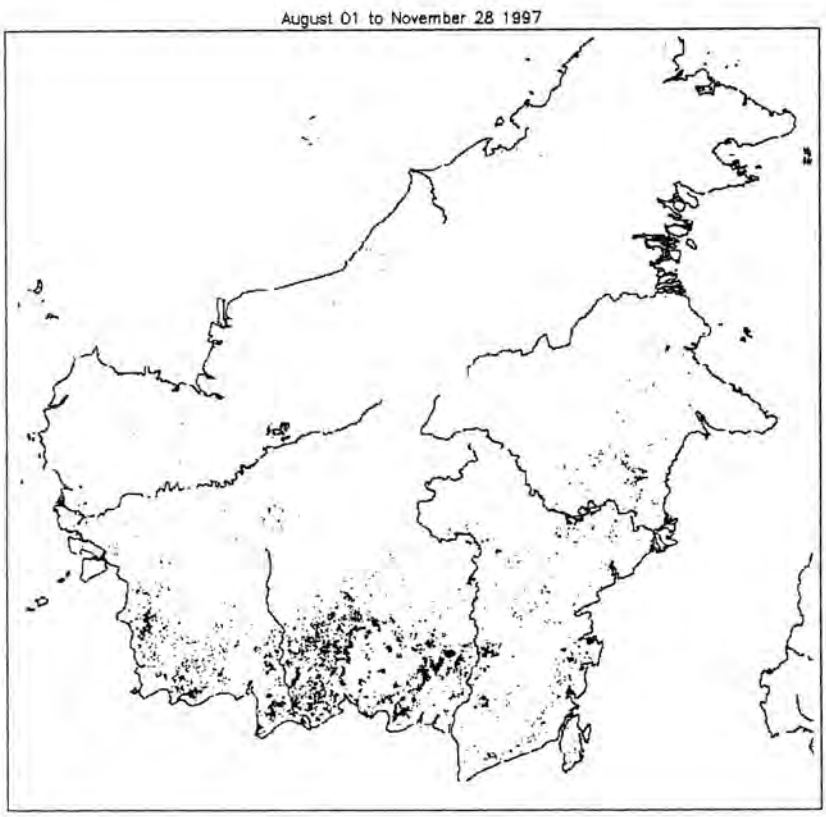

Fig.1. 1 August to 28 November 1997 ATSR fire summary of Borneo (7456 saturated pixels for the whole period)

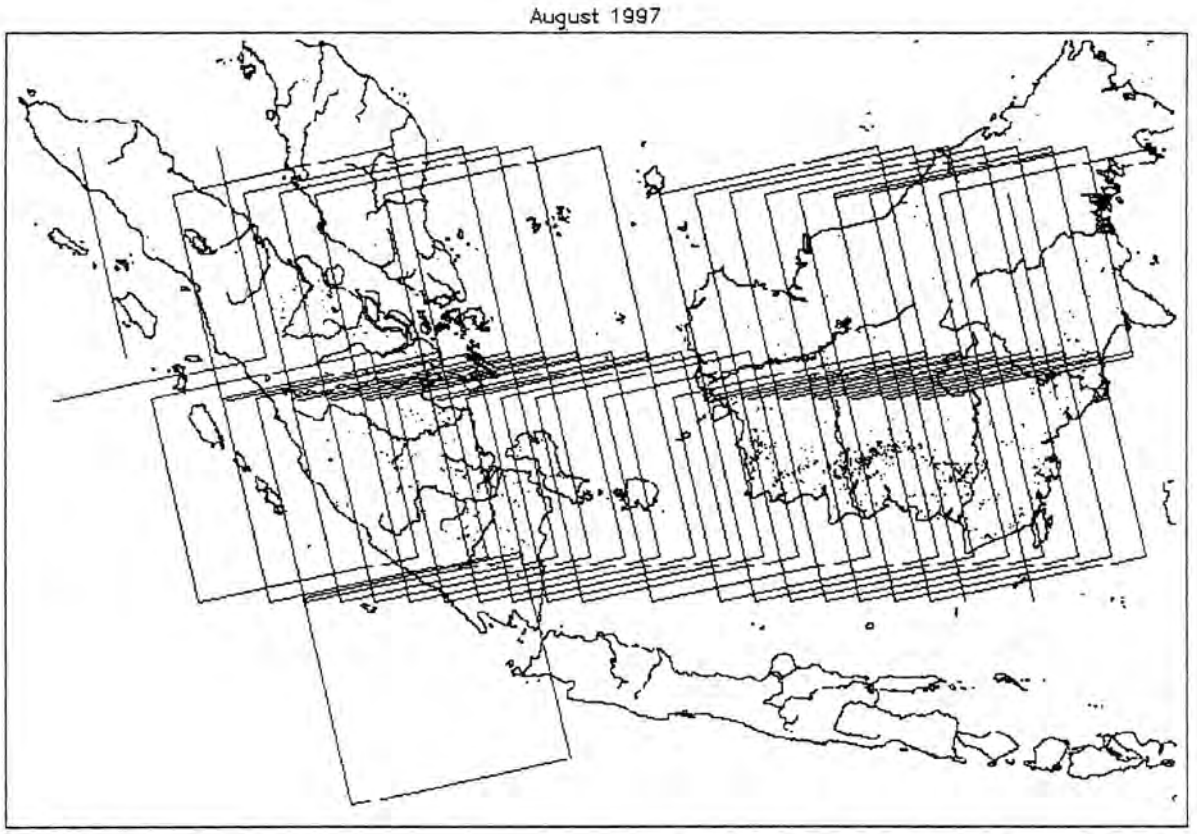

Fig.2. August 1997 ATSR fire summary of Indonesia (2042 saturated pixels on 39 frames)

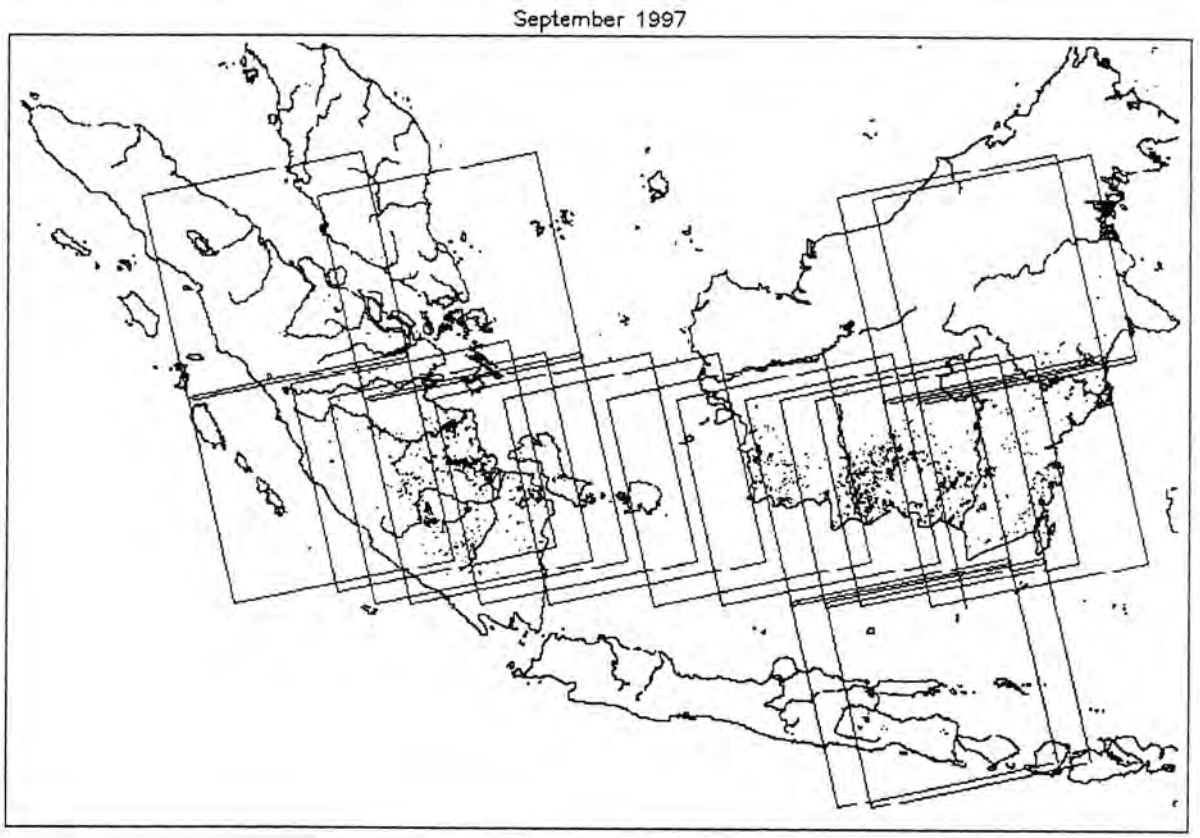

Fig.3. September 1997 ATSR fire summary of Indonesia (5012 saturated pixels on 20 frames)

Indonesian and Regional Initiatives in Fire and Smoke Management and Policiy Development

As a consequence of the smog episode of 1991 in South East Asia which was mainly caused by fires burning on the Indonesian archipelago, the Government of Indonesia called for international cooperation to support national fire management capabilities. In June 1992 an international conference on **Long-Term Integrated Forest Fire Management** was held in Bandung. Participants were national agencies involved in fire management and the international community, represented by national and international development organizations and potential donors. The objective of the conference was to develop the framework for an internationally concerted action plan on **Long-Term Integrated Forest Fire Management** for Indonesia. In this program all partners involved share expertise and resources in fire management.

The implementation of the **Bandung Strategy** is underway. In 1994 a bilateral Indonesian-German project **Integrated Forest Fire Management** (IFFM) became operational. The project is aimed at building up fire management capabilities in the Province of East Kalimantan. At the moment project duration is scheduled 1994-2000 (see contribution by L.Schindler, this issue). The IFFM system includes community-based fire management approaches. IFFM aims to produce a model for other Indonesian provinces.

After 1994 several other foreign assisted projects were established, e.g.:

* Fire management projects supported by the Japan International Cooperation Agency (JICA) in Sumatra (Jambi) and West Kalimantan
* The European Union "Forest Fire Prevention and Control Project" (FFPCP) in Sumatra (Palembang);
* The UK Overseas Development Administration (ODA) "Tropical Forest Management Project" with a fire management support component in Central Kalimantan;
* The Food and Agricultural Organization of the United Nations (FAO) at the central level (Ministry of Forestry; meanwhile terminated); and
* The fire management training courses conducted by the United States Department of Agriculture (USDA) and US AID (inter-project).

In 1995 legal provisions were made to establish a **National Coordination Team on Forest and Land and Fire Management** under the Ministry for Environment (executed by the Environmental Impact Management Agency BAPEDAL) for coordinating fire and atmosphere pollution management measures at a national level in case of large fire and smog disasters (see contribution by N.Makarim et al., this volume of IFFN). This coordination body was also active in 1996 in public awareness campaigns. Also in 1995, the Ministry of Forestry was designated to establish their national and provincial PUSDAL fire coordination committees.

The development of **National Guidelines on Protection of Forests Against Fire** is a project sponsored by the International Tropical Timber Organization (ITTO) with a present budget of ca. 1 million US-$. The guidelines were finalized after the inputs of the International Workshop (Bogor, 8-9 December 1997; see workshop report in this issue of IFFN). This project follows the development of the **ITTO Guidelines on Fire Management in Tropical Forests** which were designed to address the global problem of fires in the tropical zone (see ITTO Workshop Report, this volume).

All these ambitious projects, initiated in the first half of the 1990s, had only a limited impact on the overall fire and smog situation during the 1997 episode. In the province of East Kalimantan the institutional approach of the GTZ-assisted IFFM Project obviously had strong impacts on the provincial government. The integration of IFFM into structures of the Ministry of Forestry (Kanwil) and the provincial Forest Service (Dinas) provided direct access to the governor and the provincial PUSDAL Committee in which all agencies concerned with fire and smoke issues make joint decisions. The use of the operational Early Warning System (Fire Danger Rating System), has proven to give realistic and meaningful assessments of the build-up of fire danger during the last two years. The provincial government was alerted in early August and immediately took the necessary steps to reduce burning by concessionaires and villagers. Most important was that, on the one hand, the foreign-assisted projects had begun to create structures in the line organisation of the provincial forest service Dinas (top-down development of lines of responsibilities and command). On the other hand, the IFFM project - like the EU- and JICA-assisted projects in Sumatera - have a distinct grassroot-level (community-based, participatory) approach by involving villagers in the fire prevention program. Furthermore, IFFM assists fire users by providing extension service. In the long run it will be necessary to establish a burning permit system

in which the provincial fire management service will not only ensure law enforcement of no-burn orders, but also assist farmers and concessions to apply prescribed fire while minimizing undesired environmental damages.

In 1995 the government of Indonesia took first measures to abandon the use of fire in land clearing activities by issuing a decree which banned the use of fire in converting forests to *Hutan Tanaman Industri* (HTI). In December 1997 another ban on the use of fire in forest conversion and slash-and-burn was imposed by the government of Indonesia.

The search for alternatives to forest conversion burning and traditional slash-and-burn agriculture must receive high priority. Until 1997 only a few cases are known in which HTI enterprises developed conversion methods without involving fire. An interesting example is the system developed by Pt. Adindo Hutani for its conversion program in East Kalimantan (Tarakan). The non-fire conversion procedure involves a three-step mechanical treatment of non-commercial wood/plant biomass, the extraction of commercial timber and mechanical site preparation. Research projects are underway within the CIFOR-supported international program **Alternatives to Slash-and-Burn**. Little research and development has been devoted to utilize woody biomass for chip or briquette production and to explore potential markets.

Projects initiated during and after the fire/smoke episode of 1997

In response to the regional smog situation in 1997 a series of immediate measures and medium- to long-term projects were initiated.

Disaster Response

The immediate response of donor countries and international organisations to assist Indonesia in overcoming the effects of fire, smoke, drought, and famine during the 1997 ENSO drought was overwhelming (see report of the United Nations Disaster Assistance Commission [UNDAC] in this issue).

Science and Technology

In November 1997 the Government of Indonesia convened the **International Conference on Science and Technology for the Assessment of Global Environmental Change and its Impacts on the Indonesian Maritime Continent** in Jakarta. The conference resulted in the recommendation for a national action plan in research and technology development, calling for increasing international research cooperation, and recommending the establishment of a multinational research centre to serve the countries within the region for climate prediction, crop estimation, and disaster mitigation. This institute is being established at present as the **Indonesian Research Institute for Climate, Environment and Society** (ENRICES) under the founding initiative of the Indonesian Ministry for Research and Technology (BPPT).

New Projects and Inter-Project Coordination

Following discussions with senior government officials in Jakarta and Manila, regarding the fire and smoke situation in Indonesia, assistance from the Asian Development Bank (ADB) was requested. At present, an Advisory Technical Assistance "Planning for Fire Prevention and Drought Management and Mitigation of their Impacts" is being prepared by ADB. Under the coordination of BAPPENAS (executing agency) the program will be implemented through the Environmental Impact Management Agency (BAPEDAL) during a lifetime of 8 months starting in early 1998. The total budget (including financing by the Indonesian government, in kind) will be 1.2 million $US.

The initiative of the **Consultative Group on Indonesian Forestry** (CGIF), under the GTZ-supported program "Strengthening the Management Capabilities of the Indonesian Ministry of Forestry", restored the lost momentum of cooperation between the national agencies and foreign-assisted projects in fire management. On 12 December 1997 the CGIF convened a "Special Session on Land and Forest Fires" in which the current situation was analyzed. The objective of CGIF activities is the strengthening of inter- and intra-agency/project collaboration within Indonesia. Further discussion of national strategies will be supported by *Tim Kecil on Fire Management* (see CGIF report by G.Dieterle, this volume of IFFN).

Regional Initiatives on "Transboundary Haze Pollution"

The regional smog events of 1991 and 1994 triggered a series of regional measures towards cooperation in fire and smoke management. In 1992 and 1995 regional workshops on **Transboundary Haze Pollution** were held in Balikpapan (Indonesia) and Kuala Lumpur (Malaysia). This was followed by the establishment of a **Haze Technical Task Force** during the Sixth Meeting of the ASEAN Senior Officials on the Environment (ASOEN) (September 1995). The task force is chaired by Indonesia and comprises senior officials from Brunei Darussalam, Indonesia, Malaysia, and Singapore. The objectives of the work of the task force is to operationalize and implement the measures recommended in the ASEAN Cooperation Plan on Transboundary Pollution relating to atmospheric pollution, including particularly the problem of fire and smoke.

On 12 December 1997 Malaysia and Indonesia signed a bilateral memorandum of understanding allowing the two countries to work together to tackle the haze problem and manage any other form of disasters that may occur. On 20 December 1997 the ASOEN Task Force on Haze finalized the Regional Haze Action Plan.

In December 1996 the ASEAN Institute of Forest Management (AIFM) convened the "Conference on Transboundary Pollution and its Impacts on the Sustainability of Tropical Forests" in Kuala Lumpur. At that conference, the ASEAN Fire Forum was formed which came up with a proposal for an ASEAN-wide program in fire management and research. The Fire Forum discussed, among others, the **AIFM Plan of Action Regarding Forest Fire Management**. That proposal dated back to 1995 and aimed to fulfil the actions required by the ASEAN Cooperation Plan. Although Canada had offered ca. 50 percent of the total costs for preparing the action plan, the proposal was not accepted by ASEAN. The plan was based on an attempt to survey the forest fire situation in the ASEAN region. In late 1997 a part of the original core of the AIFM Action Plan was again submitted to the ASEAN nations. The proposed **Fire Danger Rating System for Indonesia: An Adaptation of the Canadian Fire Behavior Prediction System** is now being prepared on a cost-share basis as a joint effort between the Canadian Forest Service and ASEAN member countries. At the stage of writing this report, Indonesia (BPPT) and Malaysia (Primary Industries) have agreed to contribute to the programme while negotiations with Singapore and Brunei are underway.

In response to the ASEAN Environmental Ministers' Jakarta Declaration on Environment and Development on 18 September 1997, the Asian Development Bank is considering the provision of funds through a Regional Technical Assistance (RETA) grant to assist ASEAN in strengthening cooperation among fire- and smoke-affected ASEAN countries in the following areas: (i) catalyzing fire and haze prevention measures, (ii) improving fire and haze prediction and monitoring, (iii) improving fire management, (iv) human resources development, (v) economic and scientific studies, and (vi) institutional support and information management.

Research Initiatives

Fire research in Indonesia and the mainland of South East Asia in the 1990s largely concentrated on fire effects on ecosystem properties and ecosystem stability. Much of this research has been synoptically analyzed, including the summary of the inventory of the fire episode of 1982-83.[1]

The state of research provides a tremendous knowledge of basic fire impacts. However, it reveals yet lacking research on long-term observations of fire-affected ecosystems. While many of the publications contain information on fire causes, there are only a few in-depth studies available on the socio-economic and cultural aspects of managing the fire problem. The forest fire management system in Thailand has its strong base on a fire prevention approach which is being realized by a close cooperation with the local population. The same

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[1] Goldammer, J.G., B. Seibert, and W. Schindele. 1996a. Fire in dipterocarp forests. In: Dipterocarp forest ecosystems: Towards sustainable management (A.Schulte and D.Schöne, eds.), 155-185. World Scientific Publ., Singapore-New Jersey-London-Hongkong.

See also a comprehensive volume on tropical fires with focus on South East Asia:

Goldammer, J.G. (ed.) 1990. Fire in the tropical biota. Ecosystem processes and global challenges. Ecological Studies 84, Springer-Verlag, Berlin-Heidelberg-New York, 497 p.

refers to the IFFM approach in Indonesia. A basic study on the socio-economic and cultural background of forest fires in the pine forests of the Philippines was conducted in the late 1980s and reveals the usefulness of such surveys for further management planning (see contribution from the Philippines, this volume). Despite initial efforts it must be stated that there is a tremendous gap of expertise and available methodologies of socio-economic and cultural approaches in integrating people into operational fire management systems.

Proposed post-1997 Research Programs

The main driver of public and political concern for the 1997 El Niño drought was the transboundary pollution caused by the smoke from vegetation fires. A systematic, quantitative and qualitative regional research approach is still missing. This gap could be filled by the research activities proposed at the Jakarta Conference in November 1997. The first program which has been proposed in 1994 (but not yet operational) is the **South East Asian Fire Experiment** (SEAFIRE). SEAFIRE is a planned research activity under the scheme of the International Geosphere-Biosphere Programme (IGBP). The International Global Atmospheric Chemistry (IGAC) Project is a core project of IGBP. One of the activities of IGAC Focus 2 (Natural Variability and Anthropogenic Perturbations of the Tropical Atmospheric Chemistry) investigates the impact of biomass burning on the atmosphere and biosphere (Biomass Burning Experiment [BIBEX]). SEAFIRE will establish the fire research component within the Integrated SARCS/IGBP/IHDP/WCRP Study "Human Driving Forces of Environmental Change in Southeast Asia and the Implications for Sustainable Development".

SEAFIRE was planned to take place in the late 1990s to investigate the ecological impacts of fire in land use (fires used in forest conversion and shifting cultivation, grassland and seasonally dry [monsoon] forests) and the characteristics and regional and global transport of pyrogenic emissions. Biogenic and marine sources of trace gases and aerosols will be considered. Special emphasis will be placed on inter-annual climate variability (ENSO vs. non-ENSO) and the role of the "Warm Pool" in the global distribution of fire products.

It is intended that the implementation of SEAFIRE begin in 1998-99 with a combined ground- and aircraft-based campaign and evaluation of remote sensed data. Any further progress in SEAFIRE planning will be published in the International Forest Fire News and through the SEAFIRE Web Site: (http://tooms.arts.monash.edu.au/~seafire/).

The **Program to Address ASEAN Regional Transboundary Smoke** (PARTS) is in response to the needs and assistance requested by the ASEAN Committee on Science and Technology, Sub-Committee on Meteorology and Geophysics (ASCMG). At ASCMG's 18th meeting (Bangkok, 1995), it was agreed to initiate a project on transboundary air pollution. The World Meteorological Organization (WMO), in conjunction with the goals of its Global Atmospheric Watch (GAW) program, in 1996 reviewed and evaluated National Meteorological and Hydrometeorological Services' (NMHS) capabilities in detecting, monitoring and predicting the long-range transport of atmospheric pollution. Subsequently, WMO designed PARTS to improve regional capabilities in satellite usage, modelling long-range transport of smoke, haze, and other pollutants, and to design and implement a monitoring strategy for the region. WMO is currently considering to convene a conference on "Biosphere Burning" in Jakarta in 1998.

Conclusions

The fire-generated haze problems of 1997 have required that further national Indonesian and ASEAN-wide response strategies be developed. The foreign-assisted fire management projects in Indonesia, the ITTO-supported project "National Guidelines on the Protection of Forests Against Fire", in conjunction with the CGIF initiative, and the envisaged ADB-supported Regional Technical Assistance Project **Strengthening ASEAN's Capabilities to Mitigate Transboundary Atmospheric Pollution** will set up a strong national and regional program which builds on and coordinates with other ongoing and planned projects and activities.

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The 1997 Wildfire Season and the Impact of Fire Management Projects in Indonesia

Context

In 1982/83 one of the probably largest forest fires in this century raged for several months through the tropical rain forests of Borneo and burned an estimated 5 million ha of forest. The Indonesian province East Kalimantan was the area worst hit by these fires. Since then, fire has become a constant feature on the islands of Borneo and Sumatra. Large areas burned here again in 1986, 1991 and 1994.

Causes and Consequences of Wildfires

The fires within the rural and wildland areas of Indonesia are almost 100% caused by humans. Only in very limited areas of East Kalimantan, burning coal seams have some significance. The major share of all ignitions results from escaped agricultural burns. Fire is the only available - and cheapest - tool for smallholders to reduce vegetation cover and to prepare and fertilize the extremely poor soils. To an increasing extent the causes of fire and smoke emissions have been ascribed to large-scale forest conversion and land clearing activities (pulp wood, rubber tree and oil palm plantations) over the last couple of years.

With the process of forest degradation, which can be observed in many places in Kalimantan and Sumatra, these islands become more and more prone to fire. The visitor will still find areas of primary rain forest, but will also see millions of hectares of land converted into grassland by humans and fire. While virgin dipterocarp (*Dipterocarpaceae*) forests will normally not carry any significant amounts of fire, the widespread *Imperata cylindrica* grasslands will burn again virtually every year. No other vegetation can compete with this grass as long as fire is not excluded. In between these two extremes of vegetation, every form of transition can be found in Kalimantan and Sumatra.

Political Developments and Upcoming Fire Management

Since the 1987 fires Indonesia has been at odds with neighbouring Malaysia and Singapore, as the hazy smoke from these fires covered the South East Asian region for weeks and caused health problems and disruption of shipping and aviation, even culminating in the closing-down of international airports. In 1991 Indonesia asked for international help. In an international workshop (Bandung Conference) sponsored by the German Government, the outline of a "Long-term Integrated Fire Management System for Indonesia" was agreed upon and the German Government through the German Agency for Technical Cooperation (GTZ) committed itself to helping build up fire management capacities in East-Kalimantan.

The Integrated Forest Fire Management (IFFM/gtz) project began in 1994 and is scheduled to last for 8 years. With phase II (1997-2000), IFFM has become a cooperation project with the German Development Bank (KfW), which will provide a financial grant of 10 million DM for the purchasing of fire equipment. Additionally, GTZ who is in overall charge of the German contribution, contributes with long and short-term consultants, support staff and training. Indonesia provides the premises, personnel and the budget for operating the fire management system.

Concept

An appropriate level of fire protection, suitable equipment, necessary fire intelligence and the necessary institutional and structural support were evaluated and determined for a pilot area during Phase I. In the second and third phases local fire centres in the most fire prone areas of East Kalimantan will be equipped and the personnel trained to prevent and fight fires. The provincial fire centre will provide intelligence (satellite- borne fire detection, fire danger rating) and coordinate the fire management activities in East Kalimantan. A crucial factor is the involvement of the local population, who uses and causes fires, in a "community based fire management" scheme.

Project Components

The project supports Indonesia in its effort to build up capacities in the fields of

- Fire prevention
- Pre-suppression / fire intelligence
- Fire suppression
- Prescribed burning

by providing a basic infrastructure for fire management, training at all levels in-country and abroad, facilitating the crucial cooperation among the involved parties and by stressing the need to include local people, especially slash and burn farmers, in fire management.

Fig.1. A community-based approach in social fire management ensures the full participation of integrated fire management by the rural population. The photo shows social fire research officer Hartmut Abberger in discussion with a local fire user, in the IFFM project area. Photo: J.G.Goldammer

The 1997 Fire Season and the Impact of the IFFM/gtz Project

In 1997 Indonesia was struck again with an extremely bad El Niño event and a resulting fire season that might compare with 1982/83. Thousands of escaped agricultural burns and huge land conversion fires were burning on the islands of Borneo (Kalimantan) and Sumatra and could be detected and monitored on satellite images. The haze from forest and wildland fires covered an area almost the size of Europe, disrupted aviation and shipping for months and caused serious health problems with the visibility being down to 20 m in some provinces and an extreme level of pollutants in the air.

This year was the first time since the fire problem began in the early eighties that East Kalimantan was not the foremost burning province in Indonesia, on the contrary, "hot spots" counted on NOAA satellite images were surprisingly low compared to all other provinces in Sumatra and Kalimantan. This was not by accident but can be ascribed to the impact of the IFFM/gtz project, the successful use of a fire early warning system, and cooperation with the Indonesian authorities.

Based on El Niño predictions accessible on the Internet, IFFM started to issue warnings to the Provincial Forest Authority (Kanwil Kehutanan) since May. The East Kalimantan fire danger index, which was developed by IFFM and is calculated using basic meteorological data (rainfall, maximum temperature) reached a "high level" on 2 August 1997 (Fig.2). The Chief of the Forest Department East Kalimantan (Kepala Kanwil) immediately informed the Governor of the Province. Subsequently the logging permits in East Kalimantan were temporarily revoked and the concession companies directed the available manpower to fully concentrate on preventing and suppressing wildfires. The Governor declared red alert for the province and issued orders to all his subordinate authorities to be ready for operation. The use of fire was completely banned. This happened in East Kalimantan about a month before the other provinces and the central level followed. Though law enforcement and control is particularly difficult in a province with poor infrastructure, the results are obvious.

Prospects

This has been a modest and limited success for fire management in Indonesia in a dry season that has been rather frustrating to all those who struggle for the country's remaining forests. But it has been a success indeed and it should motivate us to go ahead. Much needs to be done and it has to be done soon. Fire is only a symptom. Therefore the problem cannot be solved by setting up fire management capabilities alone. Indonesia needs to pay attention to the needs of millions of migrants who use fire often carelessly because they don't know better. And Indonesia should revise its policy to convert millions of hectares of forests into plantations, because this can never be achieved without the use of fire. It is a shortsighted forest policy anyway, because the majority of these areas will end up as wasteland after the first rotation and burn every couple of years.

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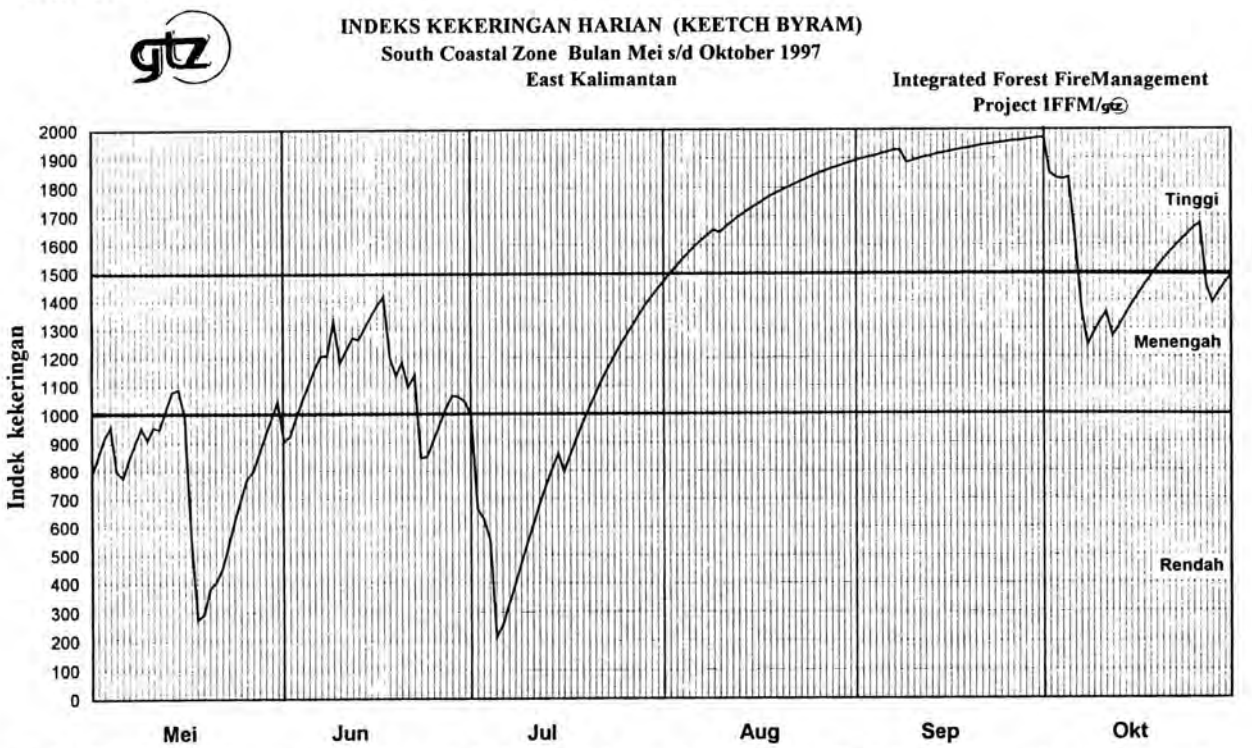

Fig.2. The East Kalimantan Fire Danger Index, which was developed by IFFM and is calculated with basic meteorological data (rainfall, maximum temperature) reached the "high level" on 2 August 1997. The IFFM Index is derived from the Keetch-Byram Drought Index. Its number represents the net effect of evapotranspiration and precipitation in producing a cumulative measure of moisture deficiency in the deep duff and soil layers. The Index is progressively increased by the computation of a daily drought factor which depends on maximum daily temperature. The Index is reduced for by the amount of daily rainfall.

The European Union Projects

The Indonesia Forest Sector Support Programme (IFSSP) is based on two Financing Memoranda signed by the European Commission (EC) and the Government of Indonesia (GoI), which undertake to provide grants (EC) and counterpart funds (GoI) to support three projects in the forestry sector:

* Forest Inventory and Monitoring Project (FIMP)
* Forest Fire Prevention and Control Project (FFPCP)
* Integrated Forestry Radio Communications Project (IFRCP) Phase II

The overall aim is to give support, guidance and enhanced technical capability, especially at the provincial level, for the rational and sustainable management of the countryš forest resources. The programme began in April 1995, will last four years and is accountable to the EC and GoI through a Programme Steering Committee.

The Forest Fire Prevention and Control Project

The Forest Fire Prevention and Control Project (FFPCP) is based in Palembang and aims to reduce fire damage, use, and risk by integrating Government, Community and commercial interests in the province of South Sumatera. Through pilot area studies the Project is obtaining a clear understanding of the causes and effects of forest fires and is developing and demonstrating practical methods for prevention and control. Activities include:

Rural Development and Social Forestry: Analysis of the occurrence of forest fires, the present institutional capacity for response, and future needs for fire prevention and control. Review, select, and recommend options to help control, reduce or eliminate the use of fire.

NOAA/GIS: Installation of a NOAA satellite fire-monitoring and early-warning system for southern Sumatera and for two eastern regions of Indonesia.

Fire Management: Development, testing and demonstration of an integrated fire monitoring, prevention and control system in three economically important forest types. The three pilot areas are (see Fig.1):

(1) Ulu Musi, upland forest in the South West of the island, 1 000 km (1 fire management centre with 39 volunteer firemen from the village of Talang Padang, 3 fire bosses from Dinas Kehutanan, fire fighting equipment, hand portable radios and a 20 m fire observation tower);

(2) Pendopo, midland forest including mainly reforestation, 4 000 km (1 fire management centre with 36 professional firemen from PT. Musi Hutan Persada, 2 fire bosses from the Provincial Forest Service Dinas Kehutanan, fire fighting equipment and hand portable radios);

(3) Pampangan, peat swamp forest, east from Palembang, 13 000 km (1 fire management centre with 18 volunteer firemen from the village of Margo Mulyo, 10 students, members of NGOs, 3 fire bosses from Dinas Kehutanan, fire fighting equipment and hand portable radios).

Fire-Fighting Organization: Selected examples of Wildfire Situations

During the forest fires of the dry season, the Fire Management Expert has directed or studied several operations in the Province of Sumatera Selatan - notably the fours fires following - and trained the fire management staff from the National Forest Service Kanwil Kehutanan. These fires are an opportunity to describe what existing resources were used by government, commercial and community sectors, and also the organisational set up and its weaknesses.

Forest fire in Subalai Conservasi Reserve MuBa (Musi Banyu Asin): 800 ha conservation area forest (Bulian, *Eusyderoxylon zwageri*), on 2 September 1997.

Case: criminal fire following an illegal cut (Bulian, Eusyderoxylon zwageri)
Duration of the fire: 2 days
Numbers and origin of first fire fighters (initial attack):
20 forest guards from Conservasi Reserve MuBa
Start time and equipment: long (several hours) with poor equipment
Numbers and origin of back-up fire fighters: 30 forest guards from Kanwil Kehutanan Palembang
Start time and equipment: very long (24 hours) with fire equipment of the Project

Forest fires in PT. Inhutani V (Bayat Ilir): 1000 ha production forest (Sungkai [*Peronema canescens*] and Mahagoni [*Swietenia macrophylla*]) and 300 ha virgin forest, on 1-2 October 1997.

Case: land clearing outside PT. Inhutani.
Duration of the fires: 10 days
Numbers and origin of first fire fighters (initial attack): 25 employees from PT. Inhutani V
Start time and equipment: 1 hour with poor equipment
Numbers and origin of first back-up fire fighters: 350 fire-fighters from Malaysia
Start time and equipment: 3rd day of the fires with good and adapted equipment
Numbers and origin of second back-up fire fighters: 40 forest guards from Kanwil Kehutanan Palembang
Start time and equipment: 4th day of the fires with equipment of the Project

Forest fire in PT. Sribunian (Pampangan area): 300 ha peat swamp and virgin forest on 21 October 1997

Case: land clearing outside PT. Sribunian
Duration of the fires: 4 days
Numbers and origin of first fire fighters: 20 employees from PT. Sribunian
Start time and equipment: 1 hour with adapted equipment
Numbers and origin of first back-up fire fighters: 35 employees from PT. Sribunian
Start time and equipment: 2 hours with adapted equipment

Forest fire in PT. Sepuluh and HL. Conservasi (Gunung Dempo): 35 ha conservation area forest and 15 ha of tea plantation, on 24 October 1997

Case: careless action inside PT. Sepuluh Gunung Dempo
Duration of the fires: 2 days
Numbers and origin of first fighters: 15 employees from PT. Sepuluh Gunung Dempo
Start time and equipment: 1 hour with poor equipment
Numbers and origin of first back-up fire fighters: 25 employees from PT. Sepuluh Gunung Dempo
Start time and equipment: 4 hours with poor equipment

Remarks and conclusions

Generally the start time of the first fighters is very long
The numbers of first fire fighters is very insufficient
Equipment is inadequate and insufficient...

... so, the fires are not quickly attacked, the suppression is not very effective, and the number and size of fires increase and become more difficult to extinguish.

Individual protection equipment is very often missing
Training of the fire fighters insufficient...

... so, fire suppression may be dangerous for the fire fighters.

Command structure and radio-communication system is weak or missing...

... so, management of a large fire is difficult and takes a long time (changing of tactics, request or distribution of back-up fighters, distribution of the means according to the "manoeuvre idea" of the Fire Boss).

During these forest fires, a few similarities had been observed:

* present authorities on the field: Bupati or Camat, and a Responsible representative from Army, Police, Dinas Kehutanan ...

... so, the necessary links with Army and Police cannot be forgotten inside the Indonesian fire fighting organisation;

* the numbers of "official" fire fighters (Dinas Kehutanan or PT. Employees) are always insufficient... consequently, farmers from around the villages are "requisitioned" ... always food and drink are given to them, sometime a little pay...

... so, it is permit to imagine a future fire fighting organisation based on the volunteers from the villages, thus the "requisitioned" will be already pointed out, trained and well equipped, for a best and more efficient action.

A Few Possible Ways and Proposals

* Because of the size of Indonesia, the area to be protected from fires is enormous. Consequently, it is possible to give priority to three different zones (see Fig.1):

Zone (1):	Virgin forest and conservation areas (forests or natural spaces)
Zone (2):	Commercial forest areas (HPI and HTI)
Zone (3):	Areas around the villages and the "places of life"

* Inside each of these zones, it is possible to set up a particular fire management and fire fighting organisation:

Zone (1):	Forest guards from Dinas or Kanwil Kehutanan
Zone (2):	Private fire fighters (following the example of PT. Musi Hutan Persada in Pendopo area: 350 permanent fighters, all year long, with adapted equipment);
Zone (3):	Volunteer fire fighters (following the example of FMC Ulu Musi involving 38 villagers from Talang Padang, also FMC Pampangan involving 18 villagers and 10 members of NGOs);

Important: All these organisations have necessarily to be controlled or commanded by Dinas Kehutanan.

* It is necessary to organise a real commandment structure, through Kanwil and Dinas Kehutanan, with indispensable links with the other concerned authorities and partners: Army, Police, chain "Governor - Bupati - Camat - Kepala Desa". The managerial staff needs higher training about forest fire management, forest fire fighting and "Tactic Reasoning Method". The staff also needs an effective and adapted radio communication system.

* It is indispensable to multiply and amplify the training efforts, integrating the new concept of "volunteer fire-fighters" and involving the villagers from the forest areas. These people have a large and useful knowledge about the use of fire (ancestral land clearing).

Their methods are safe and effective: before burning the chosen area, the farmers prepare the field for several weeks and then they always make a peripheral fire break.

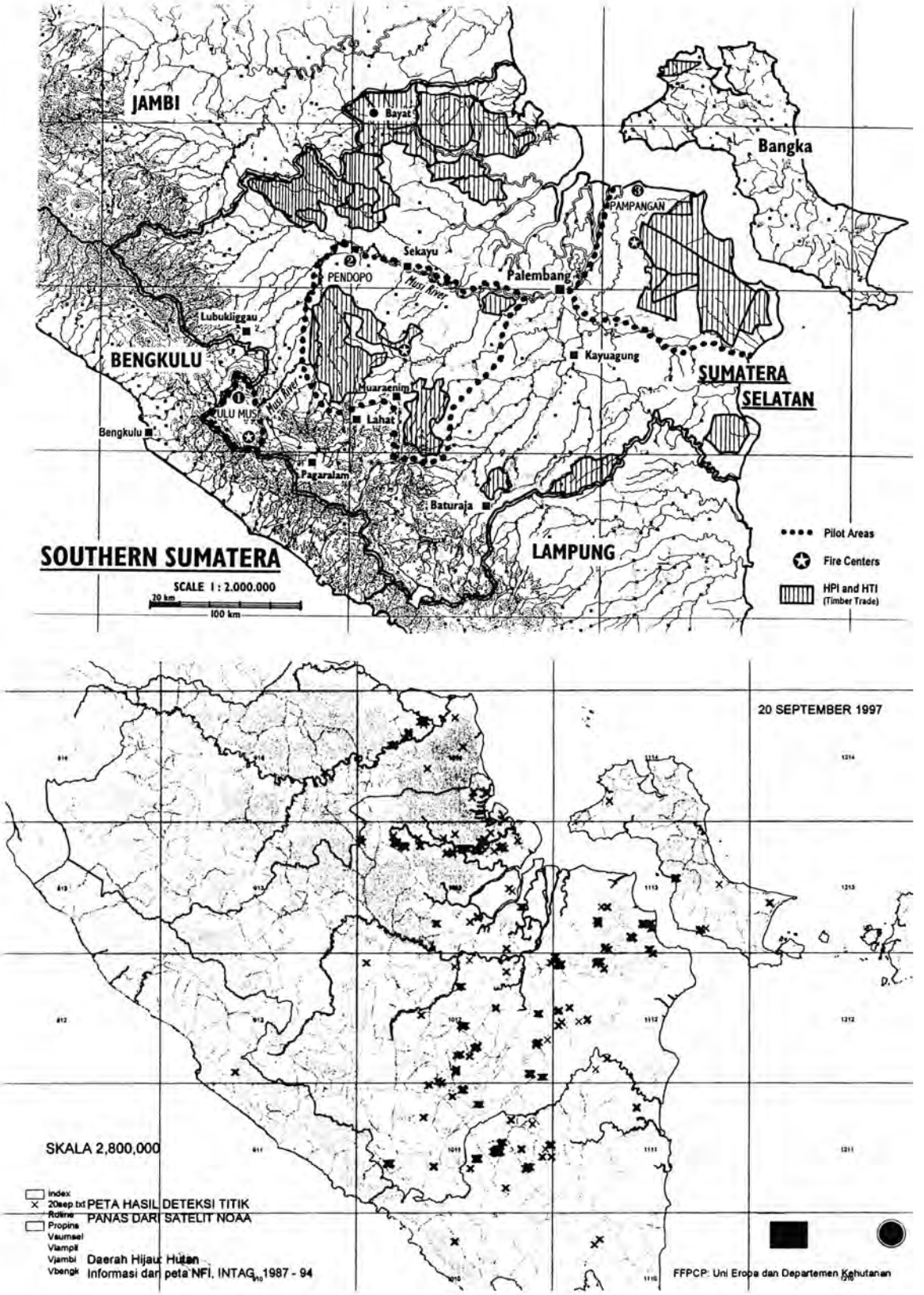

Fig.1. (upper) Three different fire management zones established in the Forest Fire Prevention and Control Project (FFPCP): Zone (1): virgin forest and conservation areas (forests or natural spaces); Zone (2): commercial forest areas (HPI and HTI); Zone (3): areas around the villages and the "places of life".

Fig.2. (lower) Active fires detected on 20 September 1997 by the Palembang NOAA AVHRR downlink.

Fig.3. (upper) Theoretical and practical course with Kanwil Kehutanan in Palembang, South Sumatra. Photo: Marc Nicolas.

Fig.4. (lower) Forest fire on 1000 ha in South Sumatra, Pt. Inhutani V, 28 September 1997, under suppression by local fire fighters. Photo: Marc Nicolas.

The complement, it is indispensable that the fire fighters (from Dinas Kehutanan, Private sector or Villages) receive **First Aid** training. Knowledge about First Aid is essential for two major reasons:

* In case of accident in the field during the fire, the fighters have to be able to rescue their injured colleagues, or other wounded civilians;

* Another important point: "Fire Brigades" will be useful for the community all year long, even out of the fire season. That is the only way to obtain regular training and work, guarantee knowledge maintenance and regular use of the equipment. This is elementary if we want to obtain a good cohesion of the team, to benefit from gratitude and recognition of all the members of the community.

The FFPCP project has prepared three special pocket books (in Bahasa Indonesia) on first aid, forest fire ands ecurity, amd treatment of burned people. Consequently, all these topics were widely tackled during the two fire management and control courses organised jointly by Kanwil Kehutanan and FFPCP. First aid training has been officially and definitively included in the normal training plan.

* It is necessary to quickly form a **National Fire Fighting Equipment Study Group**. Grouping together experienced fire fighters and manufacturers of specialised equipment will form a team that will determine and define the necessary standards about:

- Individual protection equipment (helmets, clothes, boots, gloves);
- Robust, simple and effective hand tools (rake-hoe), backpack sprayers;
- Thermal motor pumps, fire hoses and junction parts (compatible with eachother);
- Adapted fire tankers (little trucks) and new or innovator kits (slip-on tank with HP pump).

This is the only one solution to avoid the use of inadequate equipment, whose use is complex and slow, often not compatible, and sometimes dangerous for the fighters' security.

Aerial Fire Suppression

It is necessary to explore and seriously test the aerial fire suppression component in Indonesia, with its adapted helicopters and planes. Even if this method would not solve the fire problem, it could constitute the starting point of a collective awareness and initiate a real policy of change on this subject.

A coherent programme must be based upon three keys: strategy, means, and experimental application. Aerial fire fighting has to be considered and organised as a **military operation**. It is possible to imagine two steps: **experimentation** during the 1998 dry season and, later, a **national projection**.

* The experiment will tend to verify the validity of the tactical and strategic concepts of the **Aerial Fighting Task Force** within a real operational context. It will also tend to be a lesson for the future development of the system.

This experiment could be localised in Sumatera Selatan from Palembang. The action field could cover the three pilot areas with a possible extension to other risky sectors in the Province or neighbouring areas.

* Later, national integration should take place, with a National Operational Centre and several Provincial Operational Centres. A National Conception, Command and Coordination Centre in Jakarta would be in charge in establishing a national strategy and to coordinate the operational activities between provinces. Moreover, a Regional Coordination and Command Centre would be necessary for each province with a particular risk of fire (in particular Sumatera, Kalimantan and maybe Java).

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The Consultative Group on Indonesian Forests (CGIF)

The objective of the CGIF is to strengthen the communication, coordination and cooperation among all parties (Government, Donor Community, NGOs, the Private Sector, Universities and Research Institutions etc.) in forest sector development. Ministerial Decree has formalized the CGIF in 1994 as a multi-stakeholder forum. Gradually, through internalization of CGIF recommendation, the CGIF has developed as a tool for improved strategic planning in the Ministry of Forestry. The CGIF is working in Assembly Meetings, Working Groups and Small Teams according to the National Five-Year-Plan and the Indonesian Forestry Action Program and its approach is based on objective oriented, participatory and transparent discussion processes.

The CGIF is one of the few existing examples for a well structured dialogue between the donor community and the recipient party and is fully in line with the idea of partnership as recommended in the final proposals for action of the Intergovernmental Panel on Forest and as approved by UN/ECOSOC 1997.

From August to November 1997 some Regions in Indonesia, especially the Provinces of South Sumatra, Jambi, Riau, West-, South- and Central Kalimantan have been covered under thick haze from land and forest fires. Apart from the questions concerning the extent and gravity of forest fires or regarding its impacts on human health, biodiversity or global climates, now, after returning to "normality", discussions focus more and more on the institutional and organizational aspects of fire prevention and control.

At its 8th meeting on 12 December 1997 the Consultative Group on Indonesian Forests dedicated one special session to review the fire events and to draw conclusions for its future program of work.

The CGIF Special Session was attended by more than 60 representatives from the Ministries of Forestry, Environment, BAPEDAL (Environmental Impact Management Agency). BMG (Meteorological and Geophysical Agency, Donor Projects (EU, GTZ, JICA, USAID), Diplomatic Missions, ITTO, National and International Non-Governmental Organizations (WWF), CIFOR and ICRAF, the Bogor Agricultural University. The CGIF Special Session was chaired by the Director General for Forest Protection of the Ministry of Forestry. The presentations and discussions were centred around four main themes:

1. Assessment of the Land and Forest Fire Situation in the 1997 fire period
2. Prevention and Management of Forest Fires
3. Causes of forest fires and the need for new policies and strategies
4. Conclusions for the future work program of the CGIF

The CGIF Special Session recognized that there is considerable expertise, knowledge and technical infrastructure available for fire management generally, and for the analysis and interpretation of satellite images specifically. However, it was felt that the use of this expertise has been far from optimal. Isolated approaches of the different institutions and projects have resulted in the overlapping of work, the application of different interpretation methods, and thus to considerable differences in the estimation of areas and vegetation types burnt.

In contradiction to events of earlier years it is believed that in 1997 a significant percentage of the forest fires[2] was caused by land clearing operations where vegetation was burned in order to prepare the area for plantations (palm-oil, pulp-fibre, rubber, and other agri-forestry plantations). At the meeting, there was a general agreement that the situation was aggravated by El Niño, but that El Niño cannot be blamed directly for the forest fires.

The underlying causes leading to the destruction of forests and biodiversity through fires are complex and entrenched, and in many cases are caused by factors outside the forests. These are the policy, market and institutional signals which encourage the clearing of forest land through fire. They include the undervaluing of forest resources and the overvaluing of the benefits of liquidating the forest, ignoring the reflection of the social and environmental costs of the forest's use and clearance, the use of subsidies for forest conversion, the underpricing of forest goods, and unbalanced profit seeking. One presentation highlighted the aspect of solving land-tenure and land-use right problems through the burning of the resource.

With regard to the combatting of forest fires using efficient and effective measures, there needs to be an interdisciplinary and intersectoral approach at the national and regional levels. This was a clear result of the meeting. As many causes are outside the direct responsibility of the Ministry of Forestry only an improved cooperation and coordination between all major agencies will lead to an improved situation in the future.

The following important elements for a new forest fire management strategy have been discussed and highlighted: the amendment of existing laws and regulations; the need for a harmonized national system for fire detection and fire reporting; the development of a national fire danger-rating system; the setting-up of an accurate fire data base which includes verified ground information; as well as an efficient early-warning system based on advanced communication systems. A key aspect for a new forest fire management strategy is a thorough analysis of institutional roles and responsibilities. This is an essential prerequisite for improved cooperation and coordination. Also, there is a general need for simple and locally-adapted equipment and resources as well as for training, education and public awareness programs.

The draft "National Guidelines for Forest Fire Prevention" prepared with the support of the International Tropical Timber Organization (ITTO) through the Faculty of Forestry, Bogor Agricultural University, is regarded as an important basis for concrete action (see report on the ITTO Workshop, this issue, p. xxx).

Decision of the CGIF Special Session on Forest Fires

In order to address the above listed problems it was decided that a **CGIF Task Force on Forest and Land Fires** be set up under the responsibility of the Director General for Forest Protection in the Ministry of Forestry. The main purpose of such a Task Force is that all those who deal with forest and land fires should bring their expertise together and harmonize their approaches. The CGIF Meeting agreed on the following draft "Terms of Reference for the Task Force" which will be discussed in depth during the inaugural meeting of the Task Force early this year.

Draft Terms of Reference for a CGIF Task Force on Forest Fires in the Indonesian Ministry of Forestry

Overall Objective: To reduce the numbers and negative impacts of forest fires.

Goal: To assist the Director General of Forest Protection and Nature Conservation in developing a common approach /strategy through improved cooperation and coordination between all parties and groups involved in the context of forest fires

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[2] Defined as fires within the national forest estate. Fires outside the forest estate are commonly called "land fires".

Outputs

* To develop a joint proposal for a standardized fire reporting procedure, covering all Indonesia
* To compare current operational fire management procedures at the provincial, district and village levels and to evaluate its possible harmonization / standardization
* To promote and contribute to the establishment of an easy early warning and fire fighting system in Indonesian
* To compare the current administrative and organizational framework of provincial fire management projects and conclude necessary recommendations for standardization
* To contribute to the harmonization of methods of analyzing and interpretation of satellite images, and to develop a national system of information management
* To propose long-term financial planning / mechanism that integrate fire management as an element in sustainable forest management and that ensure the provision of sufficient funds in case of fire emergency
* To develop and improve harmonized curricula for training in forest fire management at all levels
* To consider how to introduce a professional attitude to fire management by setting-up and equipping provincial fire command centres in Indonesia, and manning them with full-time professionals
* Develop and coordinate national fire prevention concepts and give recommendations for their implementation in cooperation with villages, NGOs, HPH
* To develop and coordinate strategies and policies for a community based fire management
* Assess and monitor the impact of aid projects on the development of fire management in Indonesia

Method of Work

* To convene periodic meetings of the Task Force (some of them at the location of the projects)
* To prepare a draft plan of activities and targets to be achieved
* To develop a sense of mutual understanding and learning within the Task Force
* Establish a "Newsletter" for Indonesia (distribution through CGIF by hard copy / E-mail to be defined)
* Establish a mechanism so that non-restricted reports (non-internal) of all projects are distributed to all projects
* To make use of consultants and available expertise if necessary

Composition of the Task Force

The Task Force will be chaired by the Director of Forest Protection. The Secretariat is the Secretariat of the CGIF. The Chairman will coordinate Task Force activities in close cooperation with the FKK / CGIF Secretariat. The composition of the Task Force will be multidisciplinary and multisectoral. Members will come from:

* Ministry of Forestry
* Donor projects on Forest Fire Prevention in the Ministry of Forestry
* CIFOR / Universities
* NGOs
* Resource Persons from other Ministries and Agencies (Ministry of Agricultural, BMG, Barkonas, Bappedal,etc)

According to thematic issues sub groups / tim kecils can be established (remote sensing, strategies / policies, information management).

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International Workshop on National Guidelines on the Protection of Forests Against Fire
Bogor, Indonesia, 8-9 December 1997

As a consequence of the fires and smoke pollution in Indonesia between 1982 and 1994 a cooperation agreement was made to develop a project "Integrated Forest fire Management in Indonesia Phase I: National Guidelines on the Protection of Forests against Fires". The cooperation agreement between the International Tropical Timber Organization (ITTO), the Common Fund for Commodities (CFC), the Directorate General of Forest protection and Nature Conservation, Ministry of Forestry, and the Faculty of Forestry, Bogor University of Agricultural Sciences, was signed on 21 October 1996.

The project staff, in close cooperation with numerous national partners as members in the Expert Panel and Technical Review Teams, prepared a draft of the "National Guidelines on the Protection of Forests against Fires".

This project is the first following the suggestions of ITTO to fine-tune the ITTO Guidelines on Fire Management in Tropical Forests which have been released in 1997 (see report in International Forest Fire News No.17 [August 1997], pp.29-32).

The draft guidelines were presented and discussed at the International Workshop "National Guidelines on the Protection of Forests Against Fire" in Bogor, Indonesia, 8-9 December 1997. The following Closing Statement of the Workshop, which also contains information on the organizers and participants, was adopted by the participants. The final version of the National Guidelines are in preparation on the basis of recommendations from the workshop.

Johann G. Goldammer, Editor IFFN

Closing Statement
International Workshop on National Guidelines on the Protection of Forests Against Fire
Bogor, Indonesia, 8-9 December 1997

The International Workshop on "National Guidelines on the Protection of Forests Against Fire" was held on 8 and 9 December 1997 in Bogor Indonesia. The Workshop was officiated by H.E. Azwar Anas, Coordinating Minister for Peoples Welfare and Chairman of National Disaster Management Co-ordinating Board and attended by representatives of ITTO, GTZ, EU, JICA, ICRAF, CIDA, Australia, Malaysia, Singapore, Vietnam, Thailand, Brazil, New Zealand and Ministry of Forestry, BAPEDAL (Environmental Impact Management Agency), BMG (Meteorological and Geophysical Agency), Bogor Agricultural University, Gajah Mada University, Palangkaraya University, Mulawarman University, Hasanuddin University, Lambung Mangkurat University, and Tanjungpura University.

The Workshop was organised by the Faculty of Forestry, IPB (Bogor Agricultural University) at the request of the Directorate General of Forest Protection and Nature Conservation (PHPA), Indonesia, Ministry of Forestry, under the sponsorship of the International Tropical Timber Organization and the Common Fund for Commodities.

The Workshop aimed at obtaining inputs from participants, with a variety of expertise and who come from many countries, to refine the draft of National Guidelines on the Protection of Forests Against Fire, and to share their knowledge and experiences in the protection of forests against fire.

The Workshop recognised the importance of the proposed National Guidelines which will contribute to improved coordination among all parties involved in managing forest fires and related environmental problems. The Workshop agreed that the content of the draft includes all aspects of integrated forest fire management and recommended that the Guidelines be adopted by the government and implemented accordingly.

The Workshop noted the magnitude and complexity of policy issues, capacity development, institutional framework, and socio-economic aspects related to forest fires. Accordingly, the draft of the National Guidelines is a valuable attempt to clarify and provide possible solutions to the complex issues.

The Workshop presentations and discussions focused on all aspects of the Guidelines. Some issues received overall agreement, others require further discussion and some were recognised as the responsibility of other agencies. The Workshop, recognising that certain aspects require further detailed attention, also recommended that relevant manuals or standard operating procedures be produced as a complementary document to the Guidelines.

The presentation and discussions can be summarised as follows:

Law and Regulations: It was recognised that the Guidelines will provide an important basis for the enforcement of existing laws concerning forest fire, most of which focus on violation concerns, with correct practices need to be specified.

Fire Detection: The need for improvements in the accuracy, timing and geographical coverage of fire detection was discussed. The need was recognised to involve other specialised agencies (e.g., BAPEDAL, BMG and the National Aerospace and Aviation Agency-LAPAN) in fire detection and to avoid overlap and duplication. Several existing fire danger-rating systems were reviewed. The need to develop a national system was emphasised, building on the experience gained locally, in ASEAN countries and internationally.

Fire Planning and Management: There was general agreement on the need for detailed and accurate fire statistics. An example of statistics from the 1997 fire effects in South Sumatra was presented. Data bases of fire information should be implemented nationally and used for future fire management planning and the allocation of resources.

Several presentations on ongoing fire management and institutional strengthening programs (GTZ, JICA, EU, ICRAF, CIDA) throughout Indonesia indicated positive results at local levels in areas of participatory programs, suppression training and development of early warning systems. A common concern was the lack of funding at the field level. This issue must be addressed if the Guidelines are to be implemented successfully.

Communications: The use of advanced communication systems for fire management received lively debate. While the need for improved communications was recognised, there was a concern that the use of such technology did not overshadow the need to address basic fire management issues.

National Co-ordination: There were lively discussions on institutional roles and responsibilities for fire management. Issues raised included departmental jurisdictional responsibility at the national level and the working relationships among local agencies involved at the field level. A wide variety of views were expressed on the degree to which that institutional co-ordination issues should be addressed in the Guidelines. It was recognised that the coordination issue is also being addressed at the policy level outside this forum.

The Workshop acknowledged that the Guidelines address fire management in all forest types under the jurisdiction of the Ministry of Forestry and adjacent areas where fire may pose risks to forests. It was recognised that limiting the Guidelines to forest areas will not fully address the problem of smoke and haze generated mostly from land fires.

Equipment and Resources: The advantages of simple and locally-adapted fire suppression equipment were discussed. It is evident that there have been considerable efforts made throughout the South East Asian region to develop and use a variety of hand tools and field equipment, such as portable pumps and tanks. For larger and more expensive equipment to be used effectively, it was recognised that central stores and co-operative arrangements are needed among agencies and across geographical areas.

Training, Education and Public Awareness: There was strong agreement in the Workshop that training and education in all aspects of fire management is important and needs to be strengthened and expanded in scope. Presenters described ongoing training activities in several locations. It was recognised that national training standards are required as well as sources of stable and adequate funding.

The need to increase public awareness about fire and to change or modify burning practices was emphasised. It was recognised as a difficult issue and, although well represented in the Guidelines, would only be successful if structures are put in place for implementation at all levels of society.

International Cooperation: The Workshop also recommends that Indonesia cooperate in further fire management development with ASEAN member countries and international organizations and agreements such the UN International Decade of Natural Disaster Reduction (IDNDR), the International Tropical Timber Organization (ITTO), the International Geosphere-Biosphere Programme (IGBP) and others.

The issues summarised above were derived from the presentations during the two day Workshop. There were also important comments and suggestions contained in the many volunteer papers which were not presented due to time limits.

Chairman of the Organizing Committee:

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MALAYSIA — *Forest Fire in Malaysia: An Overview*

Forest fires in Malaysia have been reported especially in the pine plantations in the 1970s and in *Acacia mangium* plantations in the 1980s. However, due to the lack of systematic reporting procedures, only recent incidences were recorded. Fires also occur sporadically in natural forests, while the secondary forest areas are also prone to fires, particularly those adjoining cultivated sites. However, such fire occurrences have been smaller in size and readily brought under control.

Experiences have shown that the chances of fire occurring and the severity of a fire is greater in monocultures or in heavily disturbed forests. Most of the fires were caused by human activities during prolonged hot and dry weather. Very often, the fire stops when it reaches the undisturbed forest.

Fire Season

In the equatorial countries such as Malaysia, the general characteristics of the climate in this region are largely determined by two factors, namely its latitudinal position and its position in relation to sea and land surfaces. The most important feature of equatorial climates is the small seasonal variation in incoming solar radiation, both in its duration and intensity. There are two main seasonal tradewind systems that characterize this area, the north-east monsoon which occur from December to the end of March and south-west monsoon occurring from May to September. Between the two monsoon seasons there are the inter-monsoons. Seasonal variations caused by the monsoons are mainly apparent in wind direction and rainfall. There are two main dry periods in peninsular Malaysia, around January to March and in June to July. The first period corresponds to the season in which the north-east monsoon dominates while the second period is in the middle of the south-west monsoon season. Both periods also correspond to the period of occurrence of forest fire in the forest plantation during 1985-1995. As such, forest managers can identify high fire risk periods and allocate resources for fire control and suppression during the dry period.

Tab.1. Total burned area recorded in Peninsular Malaysia (1992-1997).

Year	Area Burned (ha)
1992	294
1993	None
1994	333
1995	155
1996	24.3
1997	426.3
Total	1232.57

Forest Fires in 1997

In 1997, news on forest fires were hotly discussed in Malaysia due to the occurrence of haze in the region. However most of the source of haze was due to forest and agricultural fires in Kalimantan and Sumatra, Indonesia. Nevertheless, this event has also opened up for a new unprecedented beginning for the cooperation between the Indonesian and Malaysian counterparts in combating forest fires. At the height of the forest fire episode, 1200 firemen from Malaysia were sent to Indonesia to help to suppress forest fires. The Government of Malaysia has also sought expertise from countries such as Canada, France and Japan to train firemen in forest fire suppression and in upgrading forest fire fighting equipment.

In 1997, four incidences of forest fire, with a total burnt area of 425.27 ha, were reported in Peninsular Malaysia (data for Sabah and Sarawak were unavailable at this time). Of the total area, 21.5 ha were forest plantation, while 404.77 ha were natural forests. Compared to the hectares of area affected by fire since 1992, the year 1997 was the highest (Tab.1). The haze event in 1997 has resulted in the increased awareness of the society as positive steps are being undertaken by relevant authorities in Malaysia and in the region to prevent a re-occurrence of the haze of that magnitude.

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THE PHILIPPINES *No Fire Bonus Plan Program of Mountain Province*

Rationale

Mountain Province is considered as one of the forest fire prone areas in the Cordillera. The three major types of forest present in the province, namely pine dipterocarp and pine forest, play a vital role in the socio-economic development. The dipterocarp stands are located along creeks and rivers mostly in the eastern part of the province, particularly in the municipality of Paracelis and Natonin. The ecosystem of the pine forest comprises the major forest vegetation covering around 53,767 hectares. On the other hand, the mossy forest covers about 37,200 hectares. The pine forest with its open crown and needle grassy understorey renders the availability of fuel during the dry season.

A region-wide special project Forest Fire Management, implemented from 1987 to 1989 has determined that 99% are human-caused. Specifically, these human activities were identified as escaped fires from **kaingin** debris, garbage burning, arson, and other indiscriminate use of fire within and nearby forested areas. This situation gave rise to the need for a strengthened fire prevention action program. An effective total fire prevention approach shall involve all sectors and encourage the unified effort of communities in preventing the occurrence of fire and the damages that it renders to the environment. Fire brings the most damaging effect to forest resources. As observed, the non-occurrence of fire enables the prolific pine forest to regenerate effectively thereby enhancing forest development. As a result, expanding the forest cover which is at the moment 59% forested reckoned from a total land area of 173,195 hectares. An effective fire prevention incentive mechanism shall ensure that the forest resource be maintained, protected and enhanced, expanded from its present status. The **"No Fire Bonus Plan"** after having been fully discussed at the provincial level is set for implementation with its corresponding objectives.

Mountain Province, having been categorized as one of the 20 poorest provinces in the country, has brought commitments from local and national leadership to focus development activities in these areas under the present administration's Social Reform Agenda. Included in this program are sustainable development strategies and human ecological security. The socio-ecological aspect of development should then be considered as the main factor in implementing development projects especially in a province with a rugged and mountainous terrain.

Objectives

The program shall aim to attain various objectives.

General Objectives: To motivate and encourage people participation in the implementation of forest conservation/protection measures against fire occurrences.

* To organize and strengthen community members to enable them to work towards a common endeavour.
* To strengthen the political will of the community and the Local Government Units towards the conservation/protection of the forest resource.
* To incorporate forest conservation/protection initiatives within the development endeavour at the community level.

Specific Objectives: To attain the general objectives, specific objectives are set as follows:

* To limit/prevent if not totally eradicate the occurrence of wild forest fires in every barangay of the province;
* To regulate the use of fire as a tool by farmers through the issuance of a permit to burn their debris so that control measures are ensured;
* To regularly monitor and record the occurrence of fire in each barangay;
* To continuously investigate the causes of fire occurrences and recommend policies to concerned agencies for implementation.

Implementing Strategy

Role of the Political Leadership: The plan aims to provide a coordinative effort between and among the Local Government Units, the community people and concerned Other Government Agencies towards the aforecited objectives. In the attainment of these, the political leadership in the province shall provide the following:

* Coordinate the regular funding of commitments to development funds for the purpose of the plan;
* Determine from the barangay development plans the proposals of all barangays where available project funds shall be utilized;
* Mobilize all barangay communities to participate in the implementation of the plan;
* The provincial government of Mountain Province shall create a selection committee for the selection of No Fire Bonus Plan recipient barangays. The committee itself shall formulate its own criteria and guidelines.
* Facilitate the awarding of projects to winning barangays.

Role of the DENR: The DENR as an office shall act as the secretariat of the program with the following functions:

* Assist the Local Government Units in the solicitation of funds from possible donor agencies;
* Provide technical assistance to barangays on fire control and management;
* Document all proceedings, activities and results relative to the No Fire Bonus Plan;
* Organize and train barangay forest protection brigades and Deputize them as Deputy Environment and Natural Resources Officer.
* Provide funds for training and maintenance and other operating expenses of the program;
* Regularly inform the participating agencies/entities on the progress and results of activities undertaken.
* Formulate and implement a burning permit system that shall regulate the use of fire in disposing of debris during the dry months.

Role of other Government Agencies: Other Government Agencies, wherein funds under the program will be coursed through, shall assist the **barangays** in the facilitation of development project implementation. The Department of Interior and Local Government through its attached agencies shall assist the barangays to avail the program benefits.

Role of Barangay Communities: The communities, through its barangay government, shall have the following responsibilities:

* Mobilize to prevent the occurrence of wild forest fires in their respective communities;
* Mobilize Forest Protection Brigades in their respective barangays;
* Incorporate in their respective barangay development plans the objectives and concepts of the plan;
* Identify development projects that shall be funded under the program and submit the same to the selection committee on or before June 30 of each year upon having been informed as a winner under the plan.

Mode of Implementation

As an absolute requirement, barangays that have not incurred any forest fire in their respective areas of responsibility during the dry season and man-made forest destruction such as illegal logging and illegal occupation within forest lands shall be awarded with development projects worth 200,000 pesos. The program shall adopt a community based approach of development project implementation, wherein the community shall be involved in decision making in the identification, planning and implementation of projects under the plan. The implementation of projects shall include, but not be limited to, environment related projects such as garbage waste disposal, water impounding projects, erosion control measures, etc. The implementation shall have the following processes:

Selection Committee: A selection committee shall be organized. The committee shall be created under the office of the CENRO with membership from participating agencies. It shall have the following functions:

* Formulate and recommend a set of criteria and guidelines for the selection of winners;
* Review and identify development projects of each barangay for the purpose of the No Fire Bonus Plan. Facilitate the release upon identification of the financial requirement of development project funds, the committee shall submit its findings to the provincial governor, who shall in turn inform those who are responsible for the financial aspects and planning of the identified projects;
* Regularly meet to assess the progress of the program implementation and recommend policies to concerned offices that will strengthen and ensure smooth implementation. The committee shall also formulate additional guidelines and amendments of the plan whenever necessary;
* Accept winning entries from the different municipalities and review, verify and deliberate the entries to be recommended as winning barangays who shall qualify as beneficiaries of the program. Only barangays that were able to meet the absolute requirement of NO FIRE shall be accepted as entries under the plan. Also, the committee shall review and recommend the corresponding development projects of the winning entries;
* Submit a list of recommended barangays with their respective identified development projects to the provincial governor within two weeks upon receipt of all winning entries.

Approval of winning barangays: The provincial governor, upon recommendation of the selection committee, shall present the results to the Sangguniang Panlalawigan who shall, together with the governor, approve the winners after a thorough deliberation. Projects that can be accommodated by provincial government funds shall immediately be approved by the Sangguniang Panlalawigan for implementation. Those that are sourced out from other entities shall be recommended to concerned agencies for implementation;

The list of winning barangays shall be officially announced by the provincial government with the corresponding approved development projects and their fund sources by no later than 31 July of each year.

Identification of Development Projects: The identification of development projects for the purpose of the plan shall be prioritized in the following manner:

* Those that are included in their respective approved barangay development plans but have not been appropriated for the previous and current year. A certification from the municipal government as priority project shall be required;

* Those that are not included in the approved development plan but need immediate implementation due to unforeseen considerations in the community. The barangay officials upon the decision of the majority of their constituents, shall recommend them for the project and the municipal mayor shall attest to its urgency.

Utilization of savings from committed financial resources: Since only barangays without forest fires shall be awarded with projects under the plan, there is the possibility of savings to be accumulated as a result of communities that shall not qualify later. These savings shall be pooled together and awarded equally to municipalities where no fire has occurred during the same period. Additional funding that may become available later shall become an augmentation fund as an incentive to the best communities who had shown active participation and other initiatives.

Project Management

The project management organization shall be comprised by DENR staff taking charge of key designations such as Forest Protection Officer, Forest Engineering and Utilization Officer and Forest Rangers. They shall be responsible, among others, for the technical investigation, survey and assessment of damaged areas.

The management phase shall be implemented through the following:

IEC: Intensive information, education and communication activities shall be conducted in every barangay geared towards the conservation and protection of natural resources. It shall focus on instilling the minds of the people of the importance of forest conservation and the effects on the local national and global environment.

These activity shall play a vital role in environmental awareness and sustainable management of the natural resources.

Organization of forest protection brigades: Forest protection brigades shall be organized in each barangay as the lead organization in the community fire prevention and suppression and the enforcement of policies pursuant to forestry rules and regulations.

Establishment of Monitoring Stations: Monitoring stations shall be established at strategic locations for the monitoring of forestry related illegal activities and other forest resource exploitations. Such stations shall serve as multisectoral stationary field stations to be manned by DENR personnel and volunteer support groups.

Institutional Strengthening: The activity shall be focused on socio-political bodies and LGU capacitation in the enforcement of forest protection activities through training and community meetings/dialogues. Training shall be conducted for those directly involved in the project implementation such as law enforcement and fire control management.

Alongside with the DENR, LGUs shall play an administrative support complementing the plan and transforming

these into official functions. Such functions should be instituted as political duties and responsibilities. Beyond its administrative support, the LGUs are confronted with a lack of understanding and eventually become equipped with a full grasp of the concept of sustainable resource management.

Law Enforcement: Created forest protection brigades shall be tasked alongside with local government units to assist in the checking and monitoring of illegal forest activities. Activities shall include investigation, seizure and prosecution. Forest patrol shall also be undertaken to detect illegal activities.

Fire Control and Management: Activities for effective fire management and control operations should be instituted at the local government level. In this, indigenous fire prevention methods shall be strengthened and fully supported.

Environmental Impacts

* Implementation of the NO FIRE program will improve the silting layer on the ground surface comprised of organic substance, facilitate rainwater infiltration and soil fertility.

* Natural regeneration will be relied upon which, in turn, will reduce reforestation investments.

* Attention will be provided for the prevention of forest destruction like illegal logging, forest fires and illegal occupation within forest lands.

* The protection of forest lands will enhance the present wildlife habitat and thereby resulting to improve biodiversity. Such preservation of biodiversity will generate direct and indirect benefits of the local community and the nation as a whole.

* Environmental awareness is enhanced with the participation of the local populace.

Project Beneficiaries

A total of 124 barangays from the municipalities of Barlig, Bauko, Besao, Bontoc, Sabangan, Sadanga, Sagada and Tadian shall be the beneficiaries of this program.

Project Status

A verbal agreement had been made between the political leaders of this province and the DENR for the implementation of the said plan. The program is thereby in the process of identifying the barangays that meet the required categories. This however, is a one year program for CY 1996 hence this proposal for the institutionalization of the project.

Budgetary Requirements

The project requires an annual budgetary requirement of twenty six million (26,000,000.00) pesos.

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BALTIC FIRE SPECIAL

In the history of land-use in the countries bordering the Baltic Sea fire has been an important element in forestry, agriculture and pastoralism. The use of fire has contributed to shape landscapes of high ecological and cultural diversity. In the Nordic countries, historic natural fires caused by lightning have also significantly influenced ecosystem development.

Today, forest fires in the region of the Baltic Basin are closely linked to modern human activities, e.g. industrialization, socio-economics (land-use change), military installations and activities, problems arising at the forest/residential interface, tourism, etc. The consequences of wildfires are severe because they threaten the limited, but very valuable, forest resources of the region. Some fire events cause new problems, such as fires in industrially polluted terrain or in radioactively contaminated vegetation (e.g. in the region around St.Petersburg [Leningrad Province]).

On the other hand, recognizing the role of historic natural and human-caused fires and other land-use tools in the formation of the cultural landscapes of the Baltic Basin, new concepts are arising to include fire as a management tool in those landscapes, including nature conservation areas, which require periodic disturbances in order to maintain or restore biodiversity (e.g., heathlands, sub-climax forest formations).

The nations bordering the Baltic Basin are now showing increasing interest to promote fire management systems in forests and open landscapes which need to be based on advanced fire science and technology development. The need has been recognized to create a forum in the Central-Northern European region in which the fire problems are entirely different from the Mediterranean region.

At the recent FAO/ECE Seminar "Forests, Fire, and Global Change" (Russia, August 1996) the issue was discussed on how to activate the process of information exchange and international policy development on the forest fire problem in the Baltic region. It was suggested that a forum on the forest fire problem in the Baltic Sea region be organized. At this conference representatives from administrations, research institutes, and other parties involved in forest fire prevention and control from the countries bordering the Baltic Basin will attend.

The first meeting of this forum will be held in Poland in May 1998, entitled "First Baltic Conference on Forest Fire". The conference will bring together scientists, managers and representatives from administrations of the host country (Poland), the Baltic States (Estonia, Latvia, Lithuania), Russia, the Nordic countries (Denmark, Finland, Norway, Sweden), and Germany. The aim of the conference will be to

* Clarify the natural and cultural history of fire (fire in land-use systems, forest wildfires) in the Baltic Basin;
* Present the state of knowledge on the impact of the modern industrial societies on forest fire, present new technologies and methods of forest fire management, and to discuss joint strategies in coping with the problem; and
* Activate a process of information exchange and international fire science, management and policy development on the forest fire problem in the Baltic Basin region.

Host of the conference will be the Polish Ministry of Environment Protection, Natural Resources and Forestry, and General Directorate of State Forests. The conference will be organized by the Forest Research Institute, Department of Forest Fire Prevention (Warsaw), in cooperation with the Fire Ecology Research Group of the Max Planck Institute for Chemistry, Biogeochemistry Department.

Co-sponsors of the conference are the United Nations, through the Joint FAO/ECE/ILO Committee on Forest Technology, Management and Training and its Team of Specialists on Forest Fire, the Polish General Directorate of State Forests, and the Polish National Fund for Environmental Protection and Water Management.

In preparation of this conference International Forest Fire News has collected and analyzed ed some update information on the state of fire research and management in the Baltic Basin. Contributions in the Special Section of this issue are presented from the host country of the conference and its neighbours Estonia, Finland, Germany, Norway, Russia and Sweden. In the context of the ecology and use of fire in European heathlands I have also added, at the end, a contribution from the United Kingdom.

Johann G. Goldammer, Editor

Fig.1. Site preparation burning in Finland in the mid of the 19th century - a commong practice which was exported by Finnish emigrants to other countries of Scandinavia and the New World. Source: Collection of the Fire Ecology Research Group, Freiburg, Germany.

Fig.2. Slash-and-burn agriculture in Germany ca. 90 years ago. The methods of cutting and broadcast burning were similar throughout Europe. Source: Collection of the Fire Ecology Research Group, Freiburg, Germany.

Environmental History: European Regional Smog from Peat-Swamp Burning in Germany

Historic Moor Cultivation

In the 18th century the landscape of Northern Germany was dominated by large uncultivated bogs and swamps. In 1770 about 1/7 of the total area of Niedersachsen was uncultivated bogs. The common people were afraid of these 'dark and wild' places and tried to stay away from these areas, which were perceived to be haunted. But with the population growth of the end of the 18th century, people were forced to enlarge the area under production and started to cultivate these areas. To fulfil their plans they began to burn the bogs.

Burning Methods

The chosen plots for the new settlement must first be drained and levelled of. This work was done in autumn with the establishment of ditches which were laid out in such a way that the plot was divided into long narrow strips. The purpose of this work was to dry out the plot for further treatment. In spring of the following year, the upper organic layer of the bog was removed with big hoes, and the duff was cut out in quadratic clods. If the year was very wet this work was done in early autumn. In these wet years the ground had to be broken up several times.

In May work requiring strong men began: the clods had to be thrown and stacked into little piles. Thereafter these piles of stacked and dried clods were ignited. As soon as the material was half-burned, the still burning pieces were distributed against the wind all over the field. The fire had to burn for several days at calm weather for several days. It was very important that the fire be watched over so that it did not penetrate the deeper organic layers. The bog area only had to burn slightly or, in other words, smoulder. This work was extremely strenuous and the workers' clothes were covered with ash and dust, while their eyes were constantly a shade of red during the burns.

The burning of the bog began mainly in mid-May and ended in June. The drying of the organic material and the heat caused the normally barely accessible plant nutrients of the bog to break up enabling the cultivation of oat and buckwheat on the freshly burned fields, without fertilization.

The burning of the bogs was however not possible on the same plot year after year, over a longer period of time. In general a single plot was burned and tilled over a period of six to seven years. After the cultivation period a fallow period of 20 years was necessary. For this reason shifting cultivation was practised, where thereafter a neighbouring plot was used for the next 6 to 7 years, after which new land was then cultivated.

The burning of bogs was first noted in the year 1583. At that time the regional administrator (Drost) of the Emsland enacted a strict ordinance against this kind of "cultivation".

In 1669 similar ordinances existed in the counties of Oldenburg and Delmenhorst. In 1720 the following was written: "In the Emsland the farmers are not willing to desist burning the bogs. They rather would pay the fine and continue to burn."

The first stimulus for the agricultural use of the moor came from the Netherlands. The upper organic layer of the moor was used for peat production and afterwards the dismantled moor was cultivated ("Fehn" cultivation.

Burning practices were introduced as well from the Netherlands to Eastern Friesland and spread from there throughout northwest German bog areas.

The "Dry Fog"

The burning of the bogs had an oppressive effect on the northwest German areas, even in areas far away. This effect, the "smell of burning" was known under the term "High Smoke". What is "High Smoke"? Why was the smoke of the bogs called "High Smoke"?

The bog researcher Racke wrote: "The dark, thick and heavy, evil-smelling smoke covered the land for miles. In the spring often in the shape of a high dark wall, it rapidly gathers like a storm-cloud and covers the sun so that it looks like a dim disc. At more favourable conditions the smoke escapes, and the longer it travels the weaker it gets, ending as haze, carried into areas far away as Hungary or Southern France. In Germany this phenomenon is called "Heerauch", "Haarrauch", "Höhenrauch" and is hardly liked. Public opinion made it responsible for all sorts of damage. It is said that it drives away rain. The farmers of the "Alte Land" said that it damages the blossoms of fruit trees, and that it should even drive melancholical people to suicide." For years the inhabitants of countries far away from the actual bog burns were puzzled over the origin of the recurring smoke. The French, for example, thought that the "brouillard sec" was dried fog. The English called the bogsmoke "dry fog". The puzzlement did not stop:

In 1657 the bog burnings began on 6 May in Northern Friesland carried by strong easterly winds. Already on the next day the smoke had reached Utrecht, and a little bit later had changed direction, passing Leeuwarden towards Den Helder reaching the sea on 15 May. There, the wind changed suddenly northwest and drove the bog smoke back, so that on 16 May it had reached Utrecht and Nijmwegen again. At the same time the smoke was also noticed in Hannover, Münster, Köln, Bonn, and Frankfurt. On 17 May the smoke reached Vienna, on the 18th May Dresden and Krakau on 19 May.

Johann G. Goldammer

Moor burning in Friesland around the turn of the century. Smoke from these land-use fires sometimes covered large areas of Europe.

ESTONIA *Survey of the forests and forest fire protection in the Republic of Estonia*

Survey of the Forests

The Republic of Estonia is situated on the eastern coast of the Baltic Sea, surrounded in the north by the Finnish Gulf. The area of the mainland part of Estonia is 4.24 million hectares. The total area of woodlands is 2.011 million hectares equalling a forest cover of about 48%. Roughly a half of the forest land is in public ownership, and the remaining half belong more than 11,000 private woodlot owners.

About 30% of state-owned forests are preservation and protection forests. The dominant tree species are pine (38%), birch (30%) and spruce (24%). For each citizen of Estonia there are nearly 1.3 hectares of forest. The volume of wood in Estonian forests is today over 284.5 million cubic metres, 169 million of which are in state-owned forests. Increment obviously varies with site class and tree species, but the average for the country is 4,98 m^3/ha. This represents a total increment in Estonia of over 9.2 million m^3 every year. The age groups of the Estonian forests are: young growth 32%, middle-aged stands 52%, maturing stands 10%, mature and overripe stands 6%.

The state supervision and control over the management of forests is carried out by the Estonian Forest Board, subordinated to the Minister of Environment.

Managing Forest Fire Protection

In Estonia forest fires constitute an inseparable part of the development of forests. On the average about 215 forest fires affecting an area of 210 ha take place in Estonia every year. Fire occurrence depends on climate variability and human activity (Fig.1).

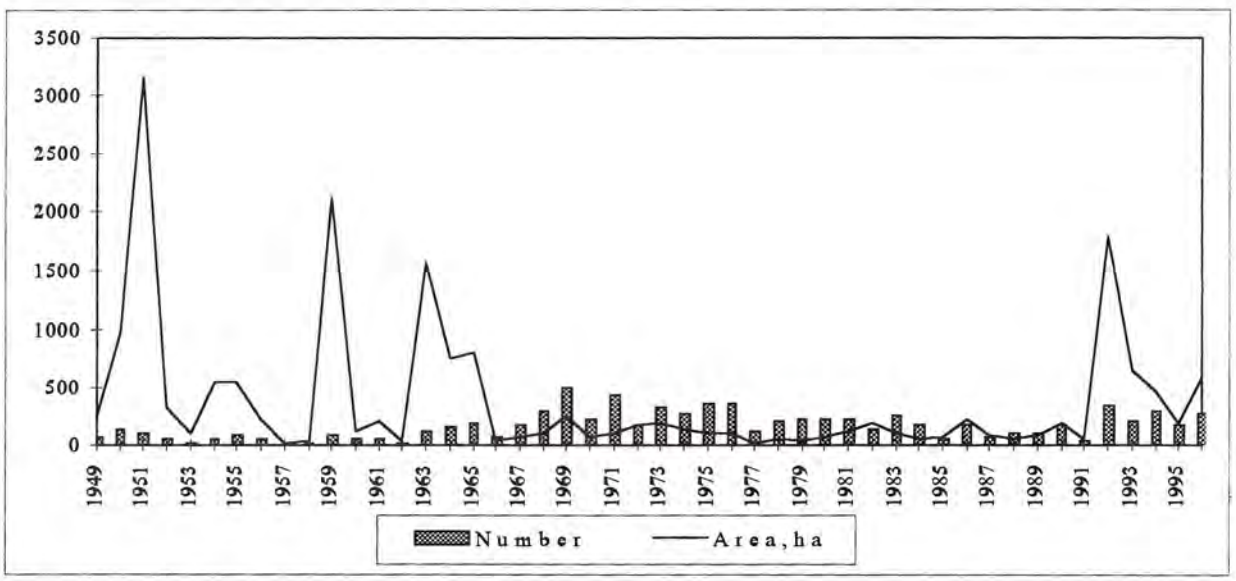

Fig.1. Forest fire statistics for Estonia for the period 1949-1996

About 98% of the forest fires in our country are caused by human negligence. Only 1-3 fires are caused by lightning. Most of the fires take place in forests situated near urban areas, predominantly near Tallinn and Kohtla-Järve. Almost half of the forest fires which take place in Estonia every year, occur in the forests of Harjumaa region surrounding Tallinn (Fig.2). The majority of human-made forest fires are caused by negligent smokers and people making campfires. Many fires begin at the roadside.

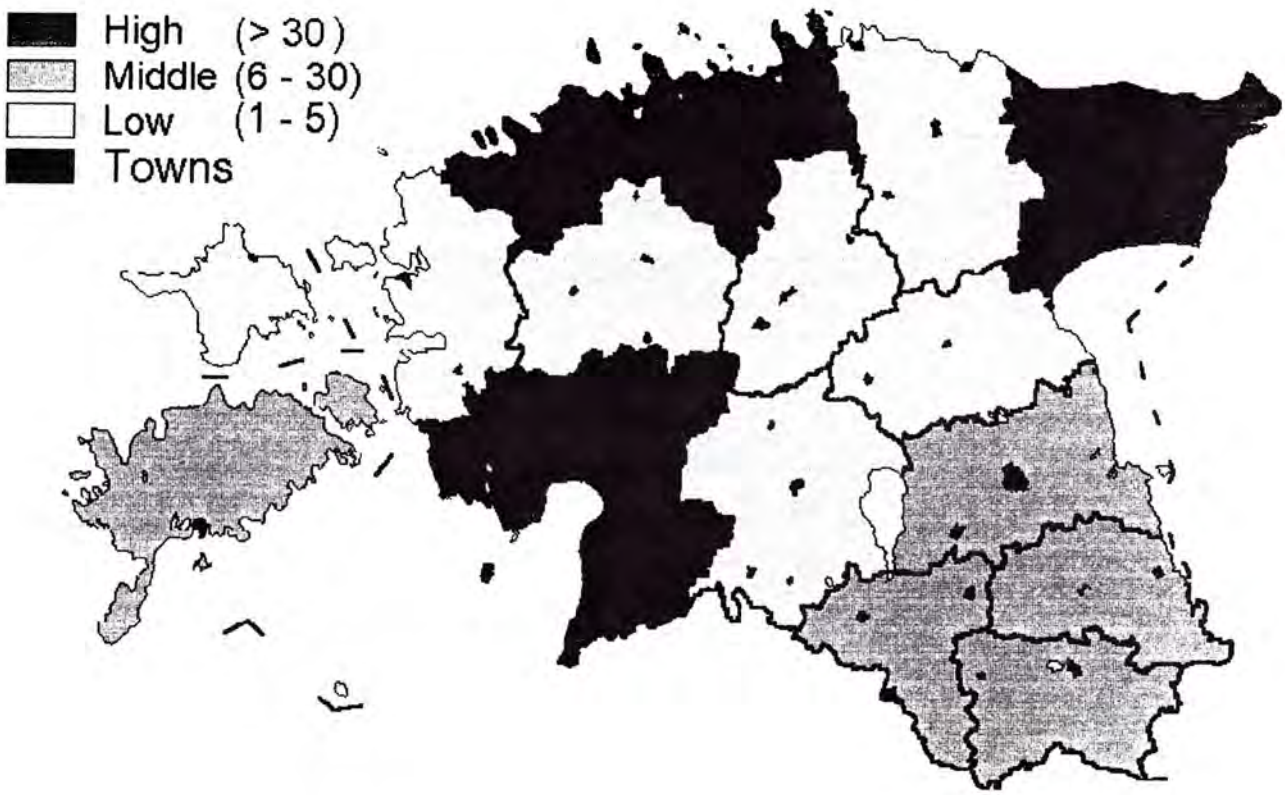

Fig.2. Average annual number of forest fires in Estonia, by counties

At present the structure of the forest fire control system is being reorganized. During the Soviet period 200 state forest districts were responsible for the detection and suppression of forest fires, and for this purpose they used such equipment as fire-engines (50 machines), motor pumps for fire fighting, portable sprayers etc. Now, however, this function is taken over by salvage teams. The number of forest districts has shrunk to 109 and their functions shall include prevention of forest fires, discovering already blazing fires, and giving assistance to the salvage teams. In the future, the state forest districts shall focus on fire protection in the state forests.

In Estonia the majority of forest fires are discovered relatively quickly and that is the reason why 95 % of forest fires take place on an area smaller than 1 ha. Very large forest fires (on an area over 50 ha) occur, on the average, once in every five years. The largest fires in the recent years have taken place at Vihterpalu in 1992 and 1997. In both cases the fire damaged an area of approximately 800 hectares. These fires were extinguished with the help of fire brigades coming from all regions of Estonia as well as the armed forces. It has never been necessary to request any assistance from other countries.

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FINLAND ***Automatic Forest Fire Alert by Satellite***

Overview

A fully automatic system has been developed to detect forest fires using data from the meteorological NOAA satellites. The system has been developed in Finland and tested in four experiments in 1994-1997 in Finland and its neighbouring countries Estonia, Latvia, Russian Karelia, Sweden and Norway. For each detected fire, a telefax including data on the location of the fire, the observation time and a map showing the location, is sent directly to the local fire authorities. The area with the smallest forest fires detected was 0.1 ha. The time delay between receiving the NOAA scene and the sending of the fire alert was 31 minutes in average. Nearly all detected fires were forest fires or prescribed burnings. In the pilot experiment of the summer 1997 a total of 363 fires were observed and alerted. 83% of the given alerts were real fires. None of the real forest fires in Finland remained undetected. The good verification results show that satellite-based detection of forest fires has potential in sparsely populated areas if continuous supply of middle-infrared satellite data can be guaranteed in the future.

Introduction

Wild fires are an essential threat to forest resources and human population in large areas of the world. Very often, the cities or villages do not continuously follow the news of the surrounding areas of the cities to get early warning of the approaching forest or bush fires. In addition, in many cases the authorities do not have telecommunications equipment e.g. telefax machines or even paper for the machine to send/receive the warning messages. Therefore, alerts to the population and to the rescue forces often come too late.

For such occurrences as forest and vegetation fires, volcanic activity or burning oil spills and coal seams a dedicated space instrumentation does not exist. The existing spaceborne instruments and the missions are not designed for fire detection, e.g. time coverage for fire management is not satisfactory. Therefore, fire management is only a by-product of the current remote sensing missions. New dedicated instruments, procedures and missions are needed.

Fire Detection Methodology

A prototype software has been developed by VTT Automation for the automatic detection of forest fires using NOAA AVHRR (Advanced Very High Resolution Radiometer) data. Fire detection is based on middle-infrared data channel 3 of AVHRR, 3.7 μm. Image data are received from an a receiving station operated by the Finnish Meteorological Institute. From each received scene a sub-scene covering the monitoring area is extracted (typically 1024 rows by 1024 columns, approximately 1150 km by 1150 km). The image data is transmitted via a computer network. Channels 2 (near infrared), 3 (middle IR), and 4 (thermal IR) of the AVHRR sensor are used.

The processing includes: detection and marking of image lines affected by reception errors, image rectification, detection of hot areas, elimination of false alarms, and generation of alert messages by e-mail and telefax. Detection of fires is based on the use of channel 3 data. The thermal infrared data is of little value in the detection of small forest fires in Boreal forests. A typical small forest fire that can be detected using middle-infrared data does not at all affect the thermal infrared data (12 μm) in channel 4. Each patch of connected "hot" pixels is considered as a potential fire.

The fires, where the imaging geometry is close to the case of specular reflection, are eliminated as false alarms. Four additional constraints are also applied: 1) a threshold on near infrared channel 2 data to eliminate clouds in day-time scenes, 2) a threshold on thermal infrared channel 4 data to eliminate clouds in day-time and night-time scenes, 3) a threshold on the number of pixels in a fire patch, and 4) a threshold on the distance to known steel factories (added in 1996).

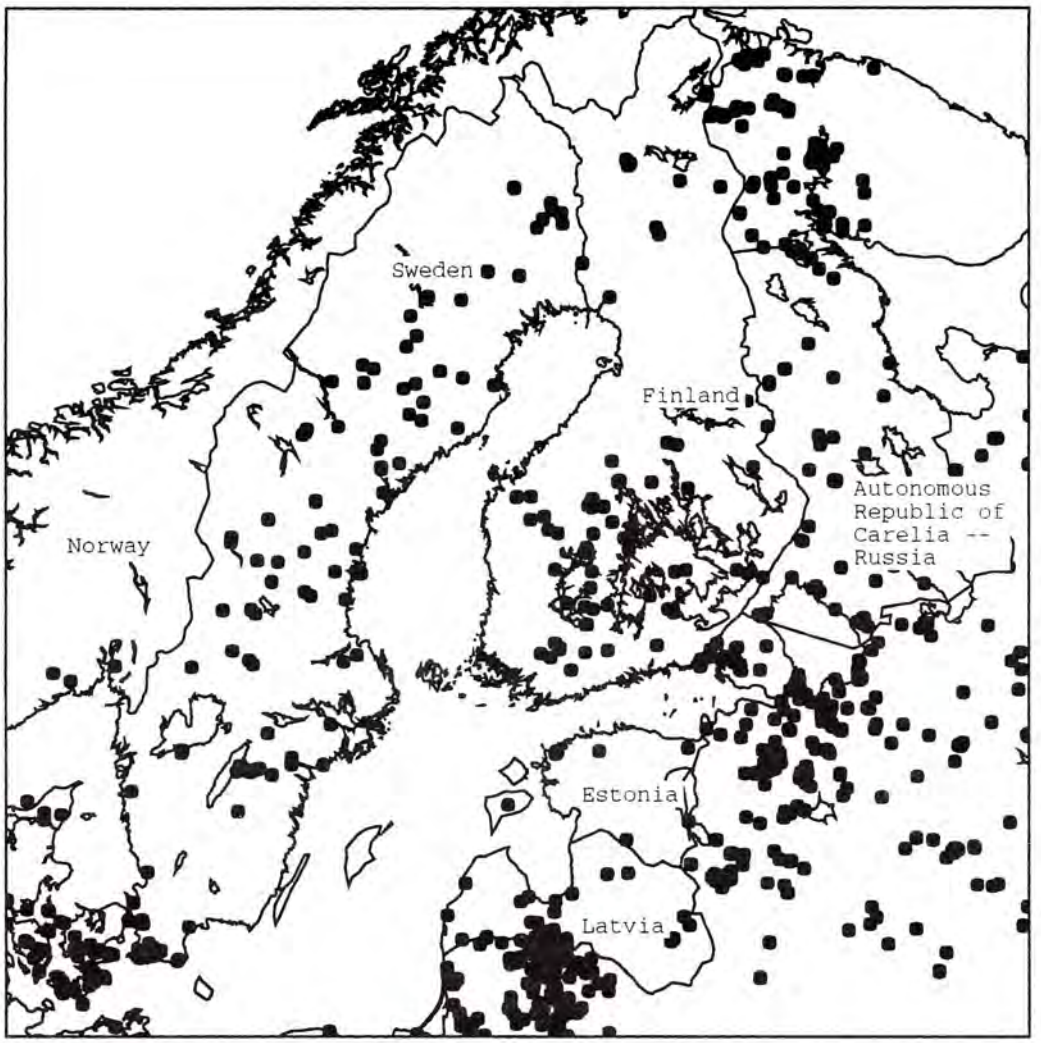
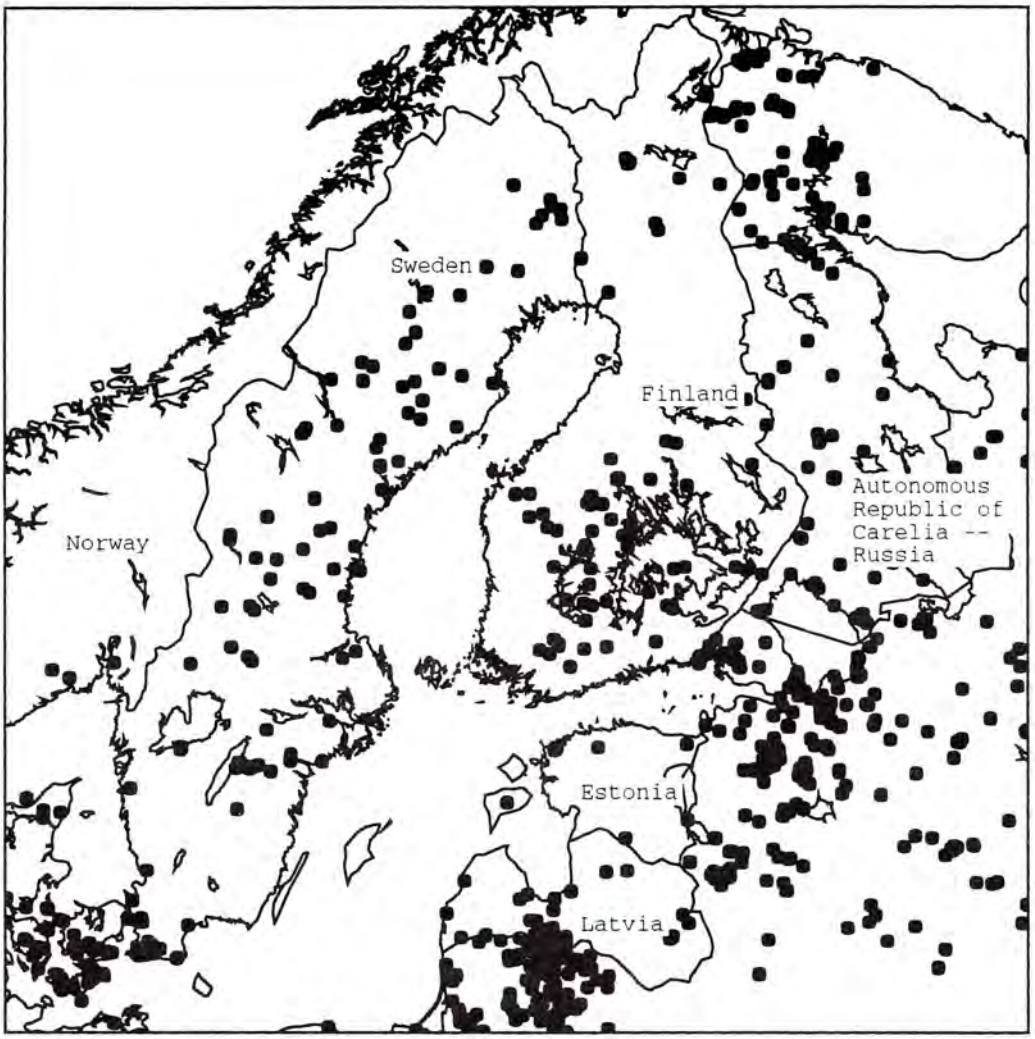


Fig.1. Satellite-based forest fire monitoring in the Eastern Baltic Region: Fires detected during the experimental period 5 May to 11 August 1997

Cooperation in Demonstration Experiments

The prototype system was tested in an experiment phase during the summers 1994-97. In summer 1995 the system was tested in cooperation with VTT Automation, the Finnish Ministry of the Interior, the Finnish Meteorological Institute, and the City of Helsinki Rescue Department. Also, local correspondents were available in the neighbouring countries.

The prototype fire detection system was run in the computer facilities of the Finnish Meteorological Institute. 205 AVHRR scenes were processed between 4 July 1995 and 8 September 1995. The system detected over 14 000 potential fires (hot areas). 85 of the potential fires were classified as fires by the automatic system. A preliminary verification was done immediately for fires located in Finland. For each detected fire, the system sent a telefax message to the City of Helsinki Rescue Department. The fire was located on a map and the telefax (equipped with a request for prompt verification of the detected fire) was further sent to the right local rescue department. Of the 16 fires detected in Finland 11 were prescribed burnings, one case was a forest fire, three cases were a steel factory, and in one case the reason of the detected fire is not known so far.



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In summer 1996, the system was running from 24 June to 16 September. After the elimination of false alarms 272 fires were detected. In 30 cases elimination was caused by the location of a known steel factory. For 79 fires real-time telefax message was sent fully automatically. Most of the detected fires were prescribed burnings. In other cases, the fires were outside of the experimental area.

For the summer 1997 the experimental area was enlarged from the original (approximately 1150 km by 1150 km) to cover the whole area of Norway, Sweden, Finland, Estonia, Latvia, and Russian Karelia, approximately 1690 km by 1690 km. In summer 1997, the system has been running from 5 May until 15 September. During that time 1013 hot areas were detected, most of them in Russia and in Lithuania outside of the project area. 363 fires were located in the area of Norway, Sweden, Finland, Estonia, Latvia, and Russian Karelia and the corresponding alerts were sent automatically. Verifications were received from local authorities in 162 cases. 83 % of the alerts were real fires, most of them forest fires. The amount of detected building fires was 6. 17 % of the alerts were false alerts or unknown fires. According to reports from the local authorities, none of the real forest fires in Finland remained undetected. The area of the smallest forest fire detected was 0.1 ha. During the summer 1997 an average of 5 NOAA images were processed daily. The average delay between the receiving of the NOAA scene to sending the fire alert was 31 minutes.

Conclusions

The screening of false alarms is an essential technique in fire detection if the results are to be used in fire control. Effective screening enables fully automatic detection of forest fires, especially if known sources of error like steel factories are eliminated based on their location. In the experiment in 1994-97, most of the detected fires were real fires. Only 17 % of the sent alerts were false alerts. None of the real forest fires is known to be undetected by the system. This shows that satellite based detection of forest fires is reliable, fast and has potential for fire control purposes. Because of its ecological and human necessity, fire monitoring and fire alert systems should be established urgently on a global scale. This can only be done by remote sensing from space, because other systems are not suitable for global applications.

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Renewing the System for Forest Fire Risk Assessment at the Finnish Meteorological Institute

Boreal forests, characterised by the dominance of conifer trees (spruce and pine), form a major economically important natural resource for countries in northern Europe such as Finland (60°-70°N). Forests cover nearly 78 % of the total land area of Finland, i.e. about 26 million ha out of which 20 million ha are managed. Forest fires in Finland cause losses in forest yield and potentially endangers public safety. Forest fire warnings have been issued and an effective survey for the early detection of forest fires has already been practised in Finland for many decades. Recently risk monitoring services have also been used to find a suitable timing for the prescribed burning of the forest floor (used as a means of forest regeneration), and to limit the use of machinery at peat milling sites under very dry and windy conditions.

In Finland a fire risk warning is issued under dry weather conditions when a fire index, specifically developed for this purpose, has reached a given threshold value. The fire risk index is also used to guide fire survey flights over the risk areas. These flights are organized by government officials in co-operation with private flying clubs. Adoption of the surveying flights in the early 1970s resulted in a significant reduction of the area burned annually (Fig.1). There are pressures to minimise the amount of flying hours due to the high cost of this surveying method. This can be achieved by providing high spatial resolution, timely and accurate information on the fire risk, thereby directing the surveying activity over those areas with the highest risk of forest fire.

Until very recently, the fire index calculated by the Finnish Meteorological Institute has been based on a statistical relationship between a number of weather variables and the occurrence of fires. Problems with the statistically based index, e.g. the difficulty to verify the index values by direct measurements, led to a development of a new physically-based index which was recently adopted for use at FMI.

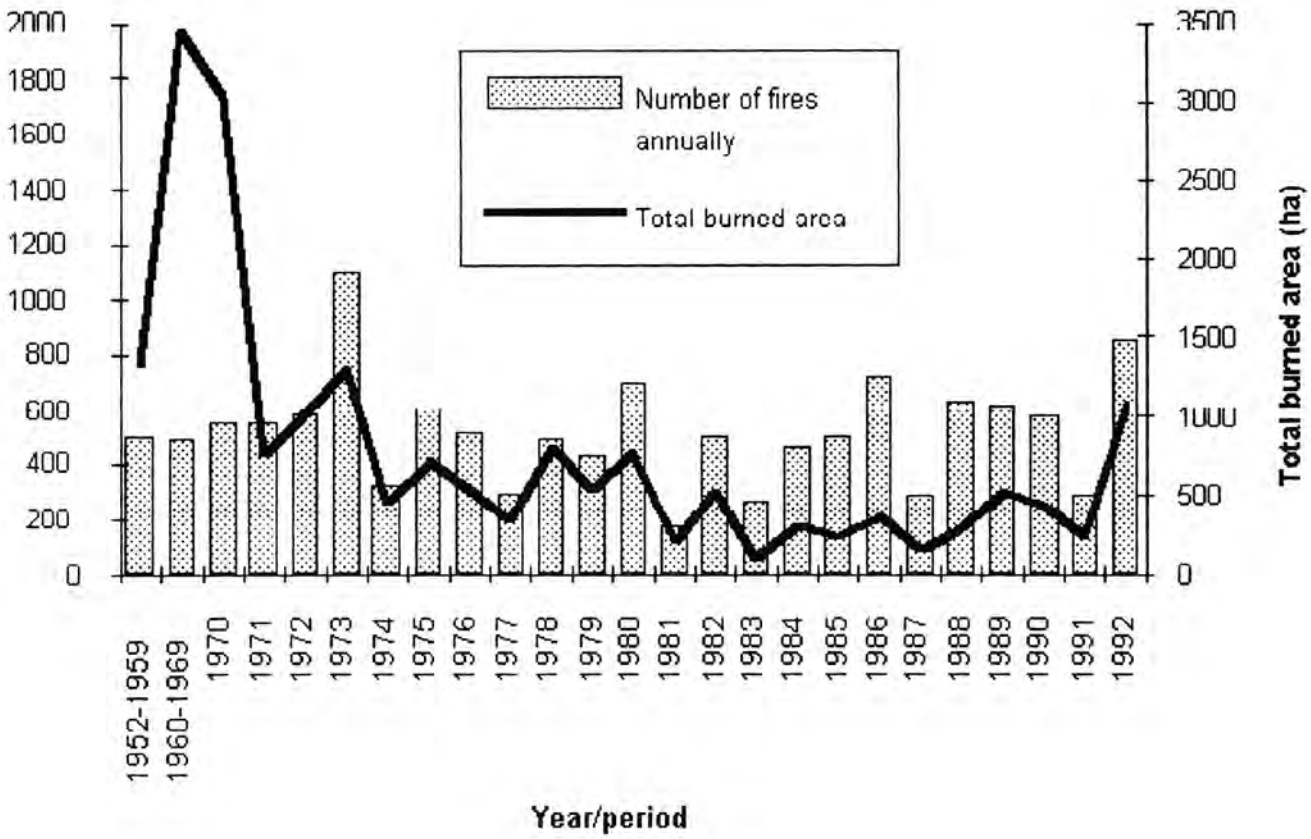

Fig.1. Number of forest fires and the total area burned area in Finland during the period 1952-1992.

The new index is based on estimates of the volumetric moisture content of the (assumed) most typical fuel in the boreal forest, i.e. the top organic soil layer (including fallen litter and small branches). The driest forest environments are clearings, thus the influence of trees on soil moisture could be ignored when developing the algorithm. Surface soil moisture is calculated with a simple physically-based model that removes water from the surface organic matter by evaporation and adds it in proportion to precipitation. Evaporation from the surface organic matter is calculated by making use of weather station data and the well known 'Penman-Monteith'-type formula for actual evaporation. The surface moisture model was calibrated and tested against measured field data during two summers under natural conditions. The organic surface soil layer is described with only two parameters: depth of the layer and soil density. Input variables required for the every three hour time interval by the model are solar radiation, air temperature and humidity, wind speed and precipitation. Except for solar radiation, all variables are reported every three hour at the standard synoptic weather stations. Solar radiation incident at the surface is not normally measured with sufficient spatial resolution, but can be calculated from cloud observations or sun shine duration data. Also satellite data on cloud characteristics can be used to estimate solar radiation, this attractive alternative is currently being investigated at FMI with very promising initial results.

The main problems in the use of soil moisture as a forest fire index are related to the poor spatial resolution of observations and the scaling of soil moisture with the realistic correspondence to fire risk. **Spatial resolution** of a fire index depends largely on the density of weather stations. With a sparse network of stations, local climate features near lakes and coasts, and on hilly terrain are poorly described. Even without terrain heterogeneity, daily precipitation during summer can vary significantly within a few kilometres distance. For instance, a shower can occur at a weather station while the surroundings remain dry, or vice versa. Weather radar networks, such as NORDRAD, covering most of Denmark, Sweden and Finland, can potentially provide good spatial coverage of summer rainfall and are increasingly being used for quantitative precipitation estimates. Use of radar networks can thus significantly improve the spatial resolution of a fire index.

A convenient way to transfer soil moisture into information of fire risk is to **scale** the volumetric soil moisture into an index that increases with increasing risk of forest fire, i.e. with decreasing soil moisture. FMI have introduced a scale between 1 and 6, where 1 indicates very wet and 6 very dry (Tab.1). Experience has shown that an index with this type of simple scaling is well adopted by public users. The threshold for fire warnings can be set to, e.g., the mid-point of the scale: when the index reaches value 4 a fire warning is issued, and when it drops below 4, a warning being in force will be removed.

Tab.1. Scaling of the volumetric moisture fraction into classes of surface wetness. Forest fire warnings for the public were issued/withdrawn when the index had increased above/decreased below a value of 4.0 (shaded area).

6.0	0.10	**Very dry**
5.0 - 5.9	0.11-0.14	**Dry**
4.0 - 4.9	0.15 - 0.19	**Moderately dry**
3.0 - 3.9	0.20 - 0.25	**Moderately wet**
2.0 - 2.9	0.26 - 0.32	**Wet**
1.0 - 1.9	0.33	**Very wet**

What volumetric soil moisture should the index value 4 correspond to? This can be determined on a national level, based on statistics of forest fire occurrence and long term climatic data; the policy was adopted in Finland that for the peak month of June, having the highest frequency of fires, forest fire warnings would be issued during 15 days out of 30 on an average year. The index was given a scale of variation such that for very dry months (less than 10% probability) fire warnings would cover the whole month, but on very wet months no fire warnings would be issued.

Public reporting of the calculated index is made via radio broadcasting. The decision of fire warnings is made by duty meteorologists based on the calculated index and the prevailing weather conditions. A spatial analysis of the index produced on a geographical map helps in deciding which administrative areas will be warned of a fire risk (Fig.2). Information of the forest fire index is also available in real time on the internet for the direction of the fire survey flights over the driest areas.

The prescribed scheme can be relatively easily calibrated for different layers of surface organic soil and litter, as may become necessary for specific purposes. For instance, during early spring, when green vegetation is still absent, the risk of grass fires may develop faster than the risk of extensive forest fires. Also fires on peat production sites form a special case for which a dedicated fire risk service could be developed.

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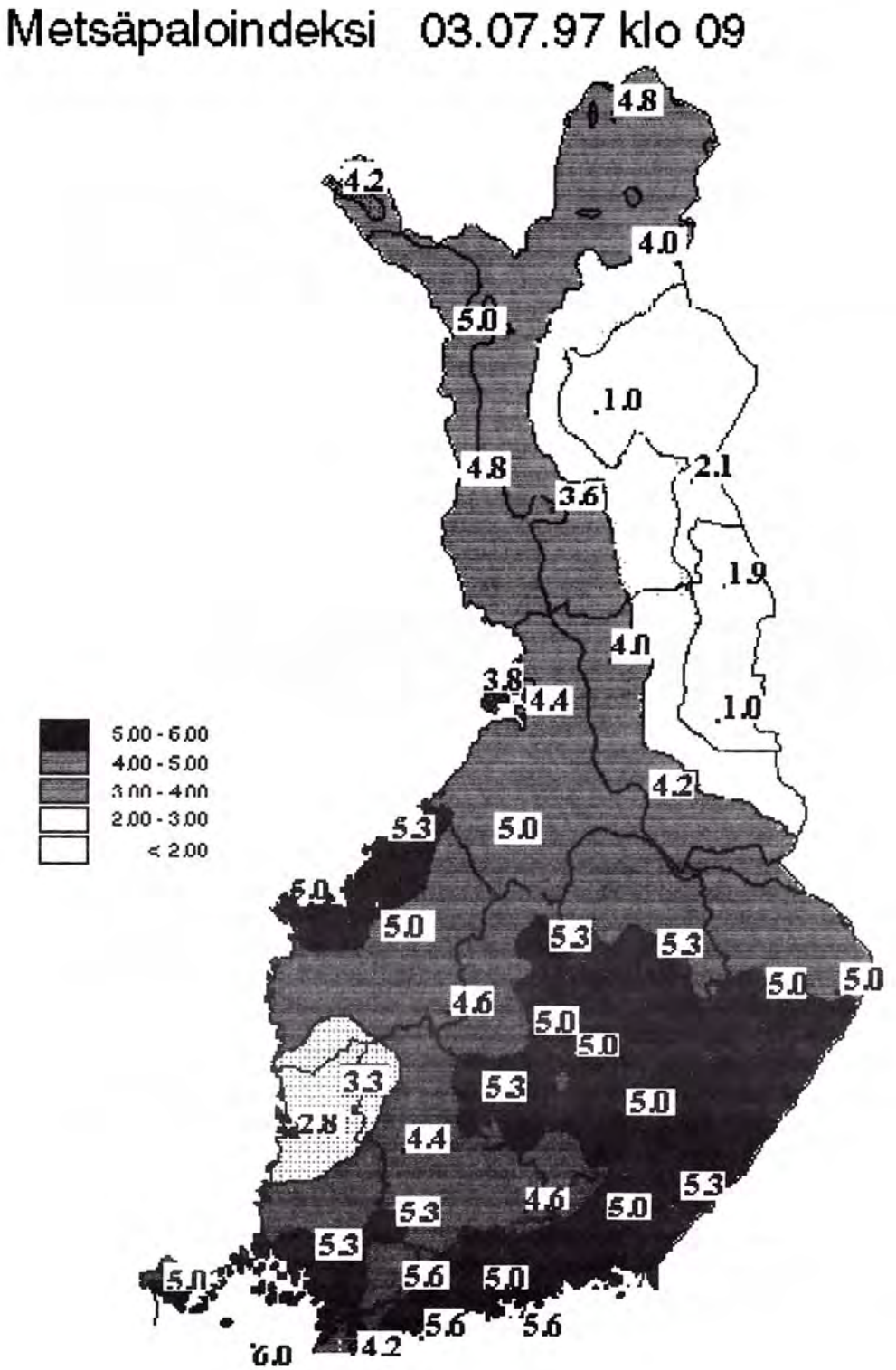

Fig.2. Forest fire index mapped across Finland based on spatial interpolation of the station data. In this situation forest fire warning would be issued to most of southern and western parts of the country.

GERMANY ***Fire in Nature Conservation and Management: Changing Paradigms?***

While no substantial changes in the field of forest fire management can be reported from Germany (see forest fire statistics update in Table 1), some recent developments in nature conservation are shaking the foundations of German landscape management. Interestingly enough, this is happening at the time of the publication of Stephen J. Pyne's comprehensive analysis of the cultural history of European fire "Vestal Fire" in which he states:

> *"Europe's peculiar geography and dense demographics, and the intensity of its agricultural reclamation, gave European fire a special character. Europe's temperate core - not shaped by well-defined fire season - granted humans an unusual degree of control over fire, and encouraged the belief that fire was, in principle, a strictly human agency, that it was a convenient tool but not an essential process. If fire's importance was instrumental and ceremonial, it could be replaced by less volatile technologies and more modern rites, much as wheat replaced weedy brome and draft oxen replaced wild aurochs. Fire was, so the saying went, a good servant but a bad master."*
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> *"The keepers of Europe's flame accepted this condition as normative. They distrusted free-burning fire and sought to cultivate it from landscape and ultimately replace it with the industrial combustion of fossil fuels. Europe came itself to resemble a fire in which a burned-out core smoldered, aglow with random embers, while flames propagated along its perimeter, not only the margins of western Eurasia but the colonial periphery to which Europe carried the torch. The geography and dynamics of fire on the contemporary Earth is largely a consequence of European expansion, the impact of an imperial Europe and an industrial Europe. Europe's fire became as much a standard of reference for fire practices as Greenwich mean time for the world's watches or SI units for global physics."*
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> *"Germany is a controlled landscape. It has to be, given its population pressures. The German nature reserves constitute only 1.1 percent of the national landmass, with 200 of them less than 5 hectares in size, other restricted landscapes amount to 18 percent. None tolerate fire. Even outside theses zones, agricultural burning is rigorously proscribed to specific seasons. The burning of hedges, in particular, has aroused strong condemnation over the centuries because it breaks down the careful borders of political and propertied world, another illustration of fire as manifestation of social disorder. That perception describes perfectly the difference between landscape organized as a house instead of an ecosystem. Behind these fears lay the memory of the war's fire catastrophe."*

His statements are right. In the very geographical centre of Europe - in Germany - the post-World War II development continued to perfectly eradicate some key factors which are vital elements of the cultural heritage of landscapes and biodiversity. The cultural landscapes and vegetation patterns of Central Europe are the result of hundreds of years of intensive utilization of the land. Cutting, mowing, grazing and burning were the methods used for harvesting timber and fuelwood, improving site conditions, growing domestic livestock by stimulating and regenerating desirable grasses, herbs and bushes, and by removing non-desirable, moribund and dead plant biomass. Like elsewhere in the world, our ancestors practised slash-and-burn methods which had a similar physiognomy all over Europe and followed principles similar to the swidden agricultural systems of the tropics.

In Germany, systems of rotating swidden agriculture were part of a forest utilization cycle, known as *Reuteberge* (*Rüttibrennen*), *Birkenberg-* and *Haubergwirtschaft*, which created a mosaic of forest, open grazing and agricultural lands, with all the successional stages in between. Within the Black Forest region (Southwest Germany) swidden agriculture was practised on ca. 70,000 ha by the middle of the 19th Century. After World War II - around 1950 - this system was still alive on ca. 10,000 ha.

Regular burning of juniper grasslands in South Germany and on heathlands (*Calluna*) in North Germany was quite common until the late 19th century. The intensive utilization of heathland by sheep grazing and the use of raw humus for stables and fuel supply resulted in the creation of nutrient-poor sites. These sites, however, provided ecological niches - habitats - for a variety of plant and animal species.

Tab.1. Forest fire statistics of Germany 1977-96: Causes, number of fires, area burned, and economic damage. Source: Federal German Ministry for Agriculture and Food.

Year	Arson		Neglicence		Other		Lightning		Unknown		Total		Damage	
	#	Area burned (ha)	#	Area burned (ha)	#	Area burned (ha)	#	Area burned (ha)	#	Area burned (ha)	#	Area burned (ha)	#	Area burned (ha)
1977 *	172	80	384	151	248	215	2	0	294	167	1,100	613	2,5	4,078
1978 *	94	32	212	76	157	103	8	0	163	78	634	289	1,2	4,152
1979 *	75	34	219	79	203	154	2	0	201	89	700	356	1,2	3,371
1980 *	132	57	471	368	375	886	4	1	388	233	1,370	1,545	3,8	2,460
1981 *	125	33	255	143	79	207	1	0	184	114	644	497	2,5	5,030
1982 *	223	138	441	164	198	327	3	1	379	121	1,244	751	3,7	4,927
1983 *	197	92	296	150	227	256	22	1	367	293	1,109	792	6,7	8,460
1984 *	183	105	460	264	148	303	2	0	370	203	1,163	875	5,1	5,829
1985 *	146	47	163	67	72	86	2	0	139	42	522	242	1,3	5,372
1986 *	146	36	151	48	121	152	5	1	195	56	618	293	1,4	4,778
1987 *	99	41	168	136	105	96	2	0	110	46	484	319	1,6	5,016
1988 *	143	21	164	48	104	86	6	0	142	127	559	282	1,4	4,965
1989 *	237	64	192	39	135	117	12	1	230	60	806	281	1,8	6,406
1990 *	225	86	311	131	152	146	28	6	285	113	1,001	481	10,5	21,830
1991	460	127	395	245	333	309	11	4	647	236	1,846	920	3,3	3,587
1992	550	309	710	680	386	1,274	133	966	1,233	1,679	3,012	4,908	25,0	5,093
1993	385	178	466	444	112	119	79	11	652	740	1,694	1,493	10,6	7,099
1994	345	170	485	352	111	84	131	50	624	459	1,696	1,114	2,6	3,334
1995	273	149	345	230	40	18	51	15	528	180	1,237	592	2,9	4,899
1996	334	204	555	477	133	300	16	1	710	400	1,748	1,381	8,2	5,937
% Change in 1996 as compared to 1995:														
	22	37	61	108	233	1552	-69	-93	34	122	41	133	184	21

Ignoring the fact that Central Europe's face has been shaped by traditional practices in agriculture, pastoralism and forestry over hundreds of years, nature conservationists and landscape planners attempted to preserve this heritage by excluding land-use methods. The creation of completely protected refugia for nature, embedded in a rapidly growing post-modern industrial society, was built on the vision that the preservation of nature and biodiversity could be reached only with the exclusion of all disturbances. This policy soon turned out to be a misconception. The heathlands of North Germany, rich in biodiversity and popularity, as mediated by the romantic writer Hermann Löns, began to change: With every hectare abandoned by sheep and shepherds' fires the forest reconquered the terrain. Monotonous pine forests began to replace the flowering heathlands.

This misconception became visible at a large scale with the changing socio-economic conditions of post-war Europe and the increasing influence of European and global markets on the national agricultural sector. High production costs - as compared to the competitive international economies and markets - and incompatibility with the demands of a modern industrial society led to a dramatic decrease in the utilization of vegetative matter. While a similar process in the Mediterranean countries provided the fuels for more and more intensive wildland fires, afforestation of abandoned farm lands became a regular practice in rural Germany. Only a restrictive practice of issuing afforestation permits halted the tendency of steadily growing forest cover and the loss of variety in traditional landscape patterns. Abandoned sites which landscape architects wanted to keep open, e.g. for recreation reasons (hiking, skiing), had to be treated through subsidies by the government. Mowing, mulching and grazing in accordance with landscape plans, however, soon became prohibitively expensive.

Ironically, all this became most visible at the end of the Cold War. The reduction of military stationed on German territory set free a tremendous amount of military surplus. Large military exercise areas in former East and West Germany were abandoned and put under nature protection laws. With the retreat of the military exercise gunfire and manoeuvres the disturbances disappeared. Soon it was recognized that the impact of fire and heavy vehicles had been most important in continuously halting and creating new succession opportunities for a rich subclimax species variety. In other words: With increasing protection and the exclusion of disturbances, diversity began to decline.

Increasing costs for large-scale landscape gardening all over Germany, the dramatic challenges of vegetation utilization on former military areas, on marginal sites and steep terrain, on extremely small patches, e.g. hedge strips, between intensively used agricultural and viticultural sites - important refugia for species that could not survive in the chemo-technical environment of industrial agriculture, created new discussions about maintaining the cultural heritage.

Fig.1. Prescribed fire in the Kaiserstuhl viticulture area, Southwest Germany: First experiments in January 1998. Photo: Fire Ecology Research Group.

It was only about two years ago that ecologists and nature conservationists in Germany began to think about restoring the use of fire in those landscapes that had been treated with fire historically and which were threatened by the exclusion of all disturbance. Within 1996-97 a fire revolution swept over the offices of the public administrations and the media. While the public is concerned by seeing the threatening smoke come out of Southeast Asia and local farmers are still punished for the illegal use of fire, fire scientists began to sort out the pros and cons of restoring fire in maintaining biodiversity and landscape aesthetics. Within less than a year four scientific workshops were held at the State Academies for Nature Conservation in Lower Saxony, Hesse, and Baden-Württemberg, and finally, in August 1997, the Federal German Nature Conservation Academy held a workshop on "Restoration of Dynamic Processes in Nature Conservation", in which fire played a key issue. In 1997 the first large prescribed burning research program began in the State of Baden-Württemberg, aiming to investigate the use of prescribed burning in the management of hedge and slope terrain in the viticulture region of Southwest Germany (Fig.1). The use of fire to maintain or restore grass cover, a habitat for endangered flora and fauna, is the objective of a program which is driven by the dramatically increasing costs for subsidized landscape gardening and the fact that many of the vulnerable sites have been lost to the succession towards bush and tree cover.

The changing paradigm in nature conservation in Germany is clearly visible. The signals emitted by nature conservation fires clearly show that the fire ban imposed on German landscapes in the mid-1970s cannot be kept any longer. The solutions, however, must consider the manifold sensitivities of an industrial society, in which a high awareness on environmental issues determines day-to-day politics.

A summary publication on the use of fire in nature conservation and landscape management in Europe is now available. Fo more information see "Recent Publications" (this issue).

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GERMANY

NORWAY *Forest Fires and Environmental Management in Norway*

A report concerning forest fire as an ecological disturbance factor, with comments on the Norwegian fire regime, is now complete. The Norwegian fire regime is determined by its ignition sources, distribution of fuel, topography and climatic conditions.

Norway constitutes the Atlantic coast of the enormous Eurasian continent. Though the length-axis represents a distance of more than 1700 km from north to south, the country is very narrow. The terrestrial ecosystems of Norway are therefore among the most oceanicly influenced on the whole continent. The topography is very rugged with great variation on both regional and local scales. Considerable differences in precipitation and climatic conditions over short distances create the ecological basis for large regional differences in vegetation and fauna. Boreal coniferous forests stretch in from the east towards the Scandinavian mountain range and its alpine ecosystems. The coastal area has been classified as a boreonemoral zone characterized by temperate coastal forests. In the south, there are smaller areas in a nemoral zone which today are strongly influenced by human activity.

The fire pattern in a region associated with natural ignition sources is traditionally referred to as a "natural fire regime". In Norway, this will mean fires ignited by lightning.

Coniferous tree species and understorey vegetation, together with humus and litter on the forest floor, constitute the best fuel. Vegetation and organic soil conditions are therefore important in determining where the majority of natural fires can occur in Norway. The natural fire regime closely follows climate. Heavy precipitation is typical, and parts of western Norway receive more that 4 m. Thunder storms can periodically move in from the sea as part of large low pressure cells, and local thunder storms can also form above the landmass during summer. Lightning is frequent, but the high humidity creates much less optimal conditions for natural ignition as compared to more continental areas. The highest frequency of natural fires is expected in the boreal forests of the country's eastern lowlands, southwestward to the divide, and in the most continental part of central Norway.

The rugged topography, with its many depressions, valleys, bogs, lakes and wetlands, creates natural fire barriers. Measured on an international scale, relatively small areas are therefore expected to burn in individual fires. Differences in frequency of lightning, distribution of fuels, and the varying climatic conditions create distinct frequency gradients with respect to the occurrence of natural fires.

However, a basic problem in defining the natural regime is that it is difficult to separate the fires ignited by lightning from anthropogenic ignition sources. The cultural fire regime, that is to say forest and range fires due to human activity, seems to have been very important in Norway, and somewhat underestimated in current fire debates. Globally, humans have used fire for more than one million years. When the first tribes of hunters and gatherers migrated into Scandinavia after the last glaciation 10,000 years ago, fire was the oldest, and together with the axe, their most important technology. Little information seems to be available , however, about the pioneer hunter and gatherer's use of fire. That they both intentionally and unintentionally ignited and burned large areas seems obvious. More uncertain is whether they also used fire in forested environments as part of the actual hunt, or to enhance herbivore populations of typical "fire followers" such as moose and roe deer.

From the period when the glaciers began to retreat, increasing human traffic influenced the coastal ecosystems. Maps showing traditional trade routes document the importance of ocean resources and the coast areas for the Norwegian population and settlements through several historic epochs. Already during the Viking Age (800 - 1000 AD) and throughout the 12th and 13th centuries, a considerable network of trade was developed with connections to the entire European continent.

This activity, which is exemplified below, has prompted forest fires of a character not commonly found in the more continental areas further east in Fennoscandia. As part of tactical dispositions associated with international timber trade, actors from the Hanseatic League in Europe (a historic trade association) burned forests in the coastal areas, destroying timber resources to prevent competition from Norwegians. The extent of such burnings was so considerable that the Danish-Norwegian king at that time (Håkon the 6th Magnusson, 1355 - 80) addressed the fires in court negotiations with the Hanseatic countries on the continent. During periods of actual unrest, tactical burning of forests was apparently common along the coast. Tactical use of fire has even been mentioned in certain places in Sweden in the north, for instance in conflicts between **Sami** reindeer herders and colonizing agriculturists.

Another example of the widespread use of fire along the coast is the burning of pastures, which has created extensive areas of *Calluna* heaths. These are purely fire-induced, man made ecosystems developed for the purpose of year-round animal grazing.

Huge forested areas have been burned in connection with the clearing of farmland during the periods of settlements. The use of fire has also been the basis for a variety of important swidden agricultural techniques (Norwegian: **"svedjebruk"**). While the natural fires are expected to have occurred in the driest and least productive forest types, swidden agricultural use has been most frequent in the forest types developed on the more fertile soils. Fire has also been used recently by modern forestry to regenerate clearcuts. The practice of such burning in Norway, however, has been rather limited.

It is concluded that even if the natural fire regime has been of a cool and moderate type, this does not mean that Norway's forests have historically burnt less than in more continental areas. A survey of available sources indicates that anthropogenic ignition, i.e. culturally induced fires, has influenced the development of vegetation and the landscape to a much greater extent than is generally realized. It should be noted that it is fully possible to start crown fires of high intensity, even in the coastal areas, if ignited during an appropriate period. When

a burn has first started in a steep area where fertile soils and high precipitation have led to a considerable accumulation of fuel over a longer period, subsequent erosion and other post-fire effects can be of an even greater ecological significance than in more levelled continental areas. It is therefore urgent for management to gain better understanding, through new research, of how the historical (natural and cultural) fire regime has shaped the soil, flora and fauna in Norway.

However, it must be assumed, due to extreme ecological variabilities, that there still may exist extensive areas of fire refugia which have never burned during the post glacial epoch. It is possible that the Norwegian coastal mountains and higher elevated forests may be important as refugia for "fire avoiders" and species dependent on continuity in Fennoscandia. This can only be evaluated through further ecological research. The attitude towards wildfires changed considerably during the middle and end of the last century due to industrialization, higher prices and a greater demand for timber resources. More aggressive fire fighting has become the core of management, and procedures today are very efficient. During the most recent period, the size of burned areas has subsequently decreased considerably.

Today, however, a more objective view of the importance of fires to flora and fauna is again on the verge of changing attitudes. We know that fire specialists, so-called pyrophilous species, are components of Norwegian flora and fauna, such as Cranesbill (*Geranium bohemicum*) and Pill-headed sedge (*Carex pilulifera*), which are almost exclusively dependent on fire for survival. The number of invertebrates associated with scorched and charred substrates, dead wood and other resources in burned areas is considerable. An example is the fire beetle (*Melanophila acuminata*), whose larvae develop in freshly burnt wood. Among the vertebrates, "fire followers" such as the moose (*Alces alces*), roe deer (*Capreolus capreolus*), woodpeckers and even the Ortolan bunting (*Emberiza hortulaua*) occur. Conservation efforts towards some of these components in the Norwegian flora and fauna will rest on a better knowledge about forest fire as a disturbance and ecological factor. The Norwegian landscape with its historical fire regime, soils, flora and fauna, is unique; and it will never be possible to apply the results of research in other countries to the understanding of the Norwegian fire regime. It is also crucial in research and management to identify the fire regime more precisely before extensive new prescribed fire management programs are eventually introduced into the Norwegian landscape.

A report on the knowledge of fire ecology and the Norwegian regime is now being printed as part of a combined effort from the Directorate for Fire and Explosion Prevention; Department of Biology, University of Oslo; Directorate for Civil Defence and Emergency; Directorate for Nature Management; and Forest Insurance Company, Skogbrand (Bleken et al. in print).

Bleken, E., Mysterud, I. & Mysterud, I. Forest fire and environmental management. A report on forest fire as ecological factor. Technical report. Directorate for Fire and Explosion Prevention; Department of Biology, University of Oslo <in Norwegian, with English summary> (In press)

A summary publication on forest fires in Norway is now available as a special issue of "Skogforsk" (Forest Research). Fo more information see "Recent Publications" (this issue).

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Tab.1. Number, area burned and average size of forest and range fires in Norway 1986-96. Source: Combined data, Statistics Norway, Directorate for Fire and Explosion Prevention.

Year	Number of Fires	Area Burned (ha)	Average Size of Fire (ha)
1986	301	595.0	1.98
1987	286	338.4	1.18
1988	448	1214.8	2.71
1989	390	992.1	2.54
1990	578	86.8	0.15
1991	972	529.8	0.55
1992	892	1370.1	1.54
1993	253	223.8	0.88
1994	471	231.7	0.49
1995	181	113.1	0.62
1996	246	513.5	2.09

SWEDEN *Forest Fire and Fire Management in Sweden*

History and present situation

Nearly all of Sweden lies within the boreal and hemiboreal zone, with most of the terrain covered by a fairly flammable vegetation of coniferous trees, ericaceous dwarf-shrubs and pleurocarpous mosses. Yet fire is not considered a serious problem today and the area burnt annually is minute in comparison with most other boreal regions. In fact, authorities did not even bother to collect fire statistics after 1975. For the last couple of years, statistics are again collected on a routine basis. These have not been reported in detail yet, but the total burnt area has been less than 5000 ha out of a total forested area of 22 million ha. There was also a special survey for the summer of 1994, which was unusually dry and hot. That summer 3500 ha burned in 2200 fires. Most fires were thus very small; only 37 were larger than 10 ha. This indicates a relatively benign situation and several factors may contribute. To begin with, high winds are rare during dry summer periods. Of the fires in 1994, only 11% started during days with noon wind speeds higher than 5 m per second and only a handful started during days with winds higher than 10 m per second. Also, the road network in the forest is very dense, which makes access for people and equipment rapid. In the southern half of the country the average distance in the forest to a navigable road is below 400 m and in the northern half of the country around 500 m. These roads have been put in primarily for timber hauling, but they most certainly also serve to reduce losses due to forest fires.

Most fires are caused by people, directly or indirectly. In 1994, arson was assumed to have caused 6% of the fires, smokers 2%, carelessness with fire (camp fires, refuse burning etc) 13% and various accidents 14%. An additional 30% of the fires were presumably human caused although the exact agent was unknown. That year lightning accounted for 35% of the fires, which is a very high figure in comparison with statistics from the period 1945-1975. It is probable that the summer of 1994 was unusually conducive to lightning ignitions. Most of these fires occurred in July, at the height of a long drought.

Historical analyses using fire-scarred trees have shown that the situation was drastically different in earlier times. As late as in the mid 1800s, on average more than 1% of the forested area in northern Sweden burned per year. Probably the situation was much the same further south, although less is known from there. The annually burnt area dropped steeply over the last decades of the 19th century and during the last 100 years there has not been any really large fire-years. The slump in area burnt coincide with the expansion of modern forestry. It is assumed that the rural people gradually abandoned old fire practices (such as burning for improving grazing conditions in the forest) and started to attack lightning ignitions aggressively as well. The contribution of man to the fire regime of the old days is not fully clear, but it most certainly varied from region to region and over time. The interior of northern Sweden was settled by farmers (mainly depending on cattle) only since the late 1600s. There is evidence that prior to this, fires were relatively few but some of them covered many thousand of hectares. With an increased number of settlements, the number of fires increased but their size went down. Therefore, the resulting area burned did not increase as much as might be expected. Instead, the most substantial change in the fire regime came with forestry towards the late 1800s, as outlined above.

Today there is a consensus among environmentalists and forestry people that the present fire situation is historically unprecedented and possibly unhealthy for biodiversity in the long run. Therefore some measures have been taken to increase the amount of fire in the landscape. Many forest companies have resumed the old tradition of burning felled areas. This is then used as an alternative to mechanical soil scarification. Still the area treated with fire is small (probably less than 2000 hectares during the last year) but it is increasing. On these areas there is often a residual stand which may serve to seed the area afterwards and increase the structural complexity of the future stand (dead wood, old living trees). There have also been some efforts to use fire in the management of forest reserves, although very little has been accomplished so far.

Forest Fire Prevention and Suppression

Since many years, Sweden has employed a modified version of an East-German fire danger rating system (WBKZ). It produces a single cumulative index and is operated by the Swedish Meteorological and Hydrological Institute. The country is divided into ca. 20 sections and, within each of these, WBKZ values from several weather stations are weighed to produce a single figure (1-5) illustrating the perceived fire danger. In case of a high index, or if otherwise called for, local authorities issue a ban to all open burning activities. This includes grass burning, camp fires and prescribed fires in the forest as well. It is up to the local fire chief, however, to make exemptions. This is nearly always needed in the case of prescribed fires, since the fire danger index is regularly at a high level when conditions are right for burning.

Many people have been sceptical towards the WBKZ ratings and during the last few years the Canadian forest fire danger rating system has been tested and will probably be in operation within a year.

During periods with high danger ratings, an aerial fire detection system in operated. Light private airplanes with a pilot and an observer/navigator are flown along fixed routes once (or sometimes twice) a day. The crew is not paid for this work, but the state pays for the airplane and the pilot gets free flying hours.

All suppression of fires is handled by the communes (townships) through their fire brigades (rescue service). There is no separate organization that especially handles forest fires. The state has little direct control over the communes and how fire suppression is organized. Communes (including cities) differ in population from 3000 to 700,000. The big communes have fire brigades that are operated by full-time professional fire fighters. In the smaller communes, fire fighters work part-time and are called in when needed.

The equipment used on forest fire operations is essentially the same as that used for fires in buildings. Very often fires can be suppressed using the water supply carried in the fire engines arriving at the site. When the distance from the road is too large, lightweight pumps and hose are carried into the forest. Usually some water source such as a tarn, lake or stream can be found within a few hundred meters from the fire. In later years there has been an increased use of helicopters, particularly if access is difficult or if the fire gets big. These are requested by the person in command of the fire. Most often they are from private air companies, but sometimes also naval or army helicopters are called in.

The costs for suppressing a forest are taken up to a certain amount by the communes, which depends on its population size (actually the amount of taxes supplied). Additional costs are reimbursed by the state. This system has created some problems for intentional burning operations in the last year. Some fire chiefs have been reluctant to grant permission for prescribed burning due to the risk of draining the communal resources, should the fire escape. Here there is a potential conflict which need to be solved if burning for biodiversity is to become successful. Another problem is the lack of experienced persons that can undertake burning operations. Forest companies today manage the forest with very few people and hardly any of these have much experience in fire management. Here there is a clear need for training courses. A five-day course involving both theory and practical training was held at Umeå by the Swedish University of Agricultural Sciences last summer and it will probably be run again in a year or two.

Fire Research

Research on forest fire has been conducted since the early 1900s. The first questions concerned the influence of fire on forest regeneration and soil productivity. Hardly anything was done on fire behaviour or risk assessment, probably because fires were no longer a significant threat. Fire history was done sporadically from the 1930s, but more systematically since the 1970s. Today, research is motivated largely by the concern for forest biodiversity, but some of the old questions are being dealt with again: what is the role of fire for the maintenance of site productivity in the long run? There have also been some research trying to connect fire history, fire behaviour and fire effects, with the aim to understanding the role of fire in earlier times at the landscape level.

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Fig.1. Low-intensity surface fire in a Swedish boreal forest: Experimental burning by the Department of Forest Vegetation Ecology, Swedish University of Agricultural Sciences. Photo: Anders Granström

RUSSIAN FEDERATION

Forest Fire Problems in the Baltic region of Russia (Leningrad Province and Karelia)

Forests of the Leningrad Province and South Karelia play an important role in the maintenance of the ecological equilibrium of the Baltic region. The peculiarity of the Leningrad Province is defined by its position in the junction of the Baltic crystalline shield, the Pribaltic depression and Valdai Hills. Here lies the watershed between the river basins of the Baltic and Caspian Seas, and that explains the most particular water protection role of the forests of this region.

The total forest area of Leningrad Province makes up 5.8 million hectares, that is 68% of the total territory of the Province. The main forest species is Scotch pine (40%). The forests of South Karelia and their influence on the hydrological regime are also inseparably linked with the river basins of the Baltic. The total forest area of this region accounts for 3.9 million hectares, out of which 80% are covered by coniferous forests, mainly by pine stands (ca. 50%).

The high share of the coniferous stands in the forests of Leningrad Province and South Karelia, and the presence of vast areas of drained peat lands create a high wildfire danger in that region. In recent years the recreation load on the forests has been constantly growing. As a rule, most of the fires are caused by people. On any one particular day of a weekend about 2 million people visit forests to pick mushrooms and berries, fish and hunt in Leningrad province. The average attendance in forests makes up 1-2 persons per hectare.

The analysis of forest fire occurrence in the Leningrad Province for the last 20 years (1977-1997) shows the strong variation of fire occurrence to depend on the aridity of the fire season. Extreme fire years occur about twice per decade. The tendency of an increase in the number of fires and area burned during the above period is evident: In the course of the last decade (1988-1997) the number of forest fires in Leningrad Province increased nearly two times per year in comparison with the previous decade (1978-1987). The average size of a fire increased from 0.5 to 2.6 hectares.

In South Karelia the number of fires for the last 16 years (on average per year) increased by 50%, and the average area burned per fire increased from 0.7 to 2.8 hectares.

The average frequency of forest fires (number of fires during one year per 1 million hectares of the forest fund land) in Leningrad Province amounts to 143, varying from 18 to 441. In South Karelia the average frequency of forest fires is 50, varying from 8 to 134. The mean percentage of forested area burnt by crown fires in Leningrad Province amounts to 8%, in Karelia to ca. 2%. The mean share of peatland affected by fire in Leningrad province is 22%, in Karelia ca. about 8%. In 1997 the share of peat fires was over 70% of the total area of fires in Leningrad province. Deterioration of the indices of forest protection from fires is the consequence of a considerable reduction in financial resources for such purposes.

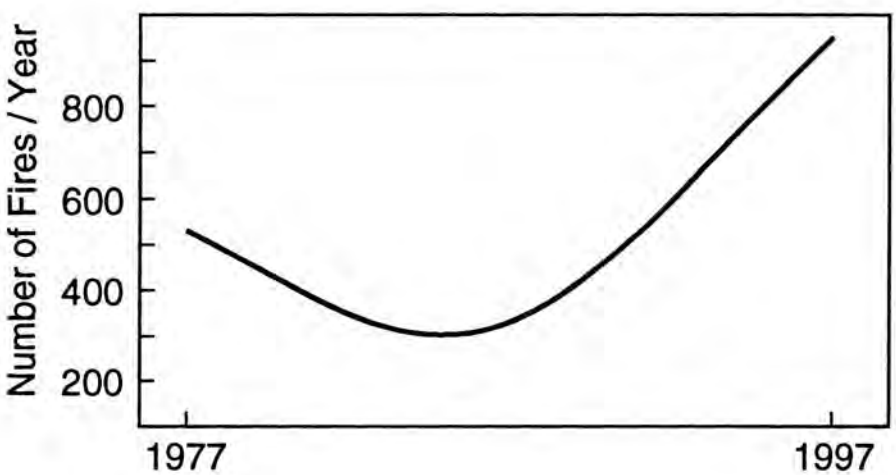

Fig.1. Tendency of fire occurrence in Karelia during the last two decades (1977-1997).

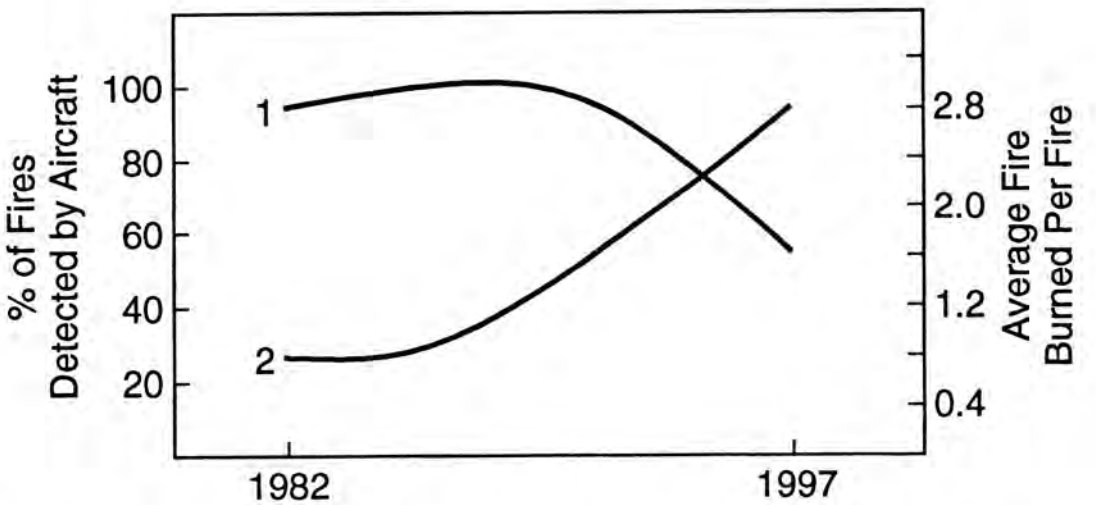

Fig.2. Forest fires in Karelia: (1) Percent of fires detected by aircraft; (2) average area (ha) burned per fire.

Taking into consideration that the regional climate is getting more variable (warmer, with longer droughts), growing influence of people on forests, reduction of the level of forest protection, and increasing forest fire danger due to swamp-draining and increase of forest plantations area, it is expected that the number of forest fires and area burned will increase.

A multitude of different environmental consequences of forest fires have been known for a long time. One of the most negative problems in the Baltic region is the bogging of burned areas due to the destruction of the forest cover. Another big problem deals with the territories contaminated with radionuclides, namely: Luga district (237,200 ha), Kingisep (177,000 ha), and Volosov (146,300 ha). According to the data of 1995 the total forest area contaminated with radionuclides in Leningrad Province accounts for 560,500 ha or 10% of the forest fund.

As is generally known, forest fires in areas contaminated with radionuclides present a special danger, creating new hotbeds of pollution by the transportation of radioactive fractions along with smoke. Once more this underlines the extraordinary importance of reliable forest protection from fires in the Baltic region.

The Federal Forest Service of Russia has developed a Programme for 1998 - 2005, which foresees the complex measures on strengthening the forest protection service. The realization of this Programme will depend on the dynamics of economic growth for Russia on the whole.

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UNITED KINGDOM

The Rôle of Fire in the Ecology of Heathland in Southern Britain

Heathlands dominated by ericaceous dwarf shrubs are widespread on acid nutrient-poor soils throughout those regions of north-western Europe with an Atlantic climate. They developed c. 4000 years ago following forest clearances and have been maintained by grazing, burning, turf (sod) cutting, and the gathering of vegetation for fuel. These activities arrest succession to scrub and woodland (Webb 1986). Heathland is burnt to improve the forage for grazing stock but some fires are uncontrolled and wildfires may occur.

Heathlands show some of the characteristics of a fire climax (Gimingham et al. 1979). The dominant species *Calluna vulgaris* regenerates freely from the stem bases when burnt and the germination of its seeds is promoted by heat. Regular burning reduces the floristic composition of heathland and species which regenerate from underground organs or rapidly from seeds (eg. *Calluna vulgaris*, *Erica tetralix*, *Vaccinium myrtillus*, *Deschampsia flexuosa*, *Molinia caerulea*, *Scirpus cespitosus* and *Pteridium aquilinum*) tend to dominate. Species such as *Juniperus communis* are eliminated by regular burning (Gimingham 1972).

During heathland fires about 95% of the nitrogen and 20-30% of the other principal plant nutrients in the standing crop and accumulated litter are lost from the system. Losses of Na, K, Ca and Mg can be replenished from precipitation within a few years but the losses of P and N cannot. Phosphorus is held in the soil organic matter, and where the adsorption capacity is low, some of the P released during the fire is lost through leaching. It takes c. 20 years for P to be replaced (Chapman et al. 1989). The nitrogen budget is not fully understood. Because losses during a fire cannot be made up through rainfall, nitrogen-fixing plants (*Ulex* spp.) may be important (Chapman and Webb 1978).

Where the fire has not been too hot *Calluna* regenerates from the stem bases and within three years enters the building phase. If the roots are killed regeneration is from seed giving a true pioneer phase, but taking longer before the building phase is reached. Over the 30-40 years of heath growth production increases but declines from about 20 years and onwards. The structure of the vegetation affects the microclimate during this process. At first, the canopy is open and the soil and litter surface dry with extremes of temperature. During the mature phase when the canopy is more or less complete, humid, still conditions with small fluctuations of temperature prevail. As the canopy opens during the late mature and degenerate phases more extreme conditions occur again.

Heathland managed by burning consists of stands of a uniform age where the bushes all have the same structure. Other forms of management create mixed-age stands where bushes of different structure grow side by side. The invertebrate fauna is dependent on the structure of the *Calluna* bushes and there is a positive relationship between invertebrate diversity and the structural diversity of the vegetation. For some ground living species (eg. ants; Hymenoptera: Formicidae) this relationship may be negative as the developing vegetation canopy reduces insolation. After a fire there is a well-marked succession of species, with some species being characteristic of the early stages and others characteristic of the mature and degenerate phases. Spiders (Araneae) and ground beetles (Coleoptera: Carabidae) are typical examples. The soil fauna is dependent on soil moisture and the presence of plant litter. After a fire the development of the fauna is closely associated with the recovery of the heathland vegetation (Webb 1994). During a fire soil temperatures are $<45°C$ because of the good insulating properties of the litter layer. Few animals are killed by the fire; however, populations decline rapidly once the vegetation canopy has been removed because the litter becomes very dry and blows away. A new layer begins to form only when the plant canopy closes c.10 years after the fire.

Heather moorland in the north of England and Scotland is burnt every 12-15 years to provide nutritious young heather shoots for sheep and grouse. Grouse moors are burnt in strips because grouse require young heather for food and taller old heather for nesting and a supply of invertebrate food for their chicks. The management aims for these moors are very clear, but for lowland heathland conservation Chapman and Webb (1978) have suggested burning every 20 years. This cycle matches the replacement rate of nutrients, particularly P, by rainfall. Although the 20-year cycle matches nutrient inputs, too large a fuel load develops causing hotter fires and affecting plant succession. Fire temperatures depend more on conditions (moisture, rainfall, wind) at the time of burning, than on fuel load (Allchin et al. 1996).

Accidental fires are common with peaks in their numbers during holiday periods in April and August. Most of the accidental fires occur near the urban areas and because of this there has been a reluctance to use controlled burning for heathland management. Strict fire protection measures have been implemented over the last 20 years and in Dorset the area burnt has declined from 1071 ha in 1978 to 451 ha in 1987. Until recently, when grazing has been introduced, fire has almost been the factor controlling succession. Because of the decline in burning the extent of scrub increased by 15% between 1978-87 (Webb 1990).

In the very hot dry summer of 1976 eleven percent of the Dorset heathlands was burnt. A landscape scale analysis over the period 1978-1987 (Bullock and Webb 1995) showed that neither the extent nor the composition of the principal heathland types was affected by these fires. The only long-term effect was in the species composition of scrub. The fires had conserved the dynamic mosaic of the heathland vegetation types by preventing the succession of heathland to scrub and by reducing the cover of woodland. At large temporal and spatial scales the heathland landscape remained stable despite catastrophic disturbance at specific locations.

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COUNTRY NOTES

CANADA — *Wildfire - Rating the Threat*

A Wildfire Threat Rating System (W.T.R.S.) has been developed for the McGregor Model Forest near Prince George, British Columbia, Canada. It provides forest resource managers with the knowledge to assess where and how fires are a potential threat and allows the exploration of fire management options. When this fire management planning system is coupled with a forest management planning system, it can be used to determine the wildfire threat associated with alternative forest management plans.

"A shift to alternative silviculture techniques means the landscape is changing as well as the fuel complex, which means the wildfire threat has also changed," said Brad Hawkes, fire research officer in the Fire Network of the Canadian Forest Service. "The W.T.R.S. will help us determine how different land use decisions will affect the wildfire threat in a given area."

Although the W.T.R.S. will be essential to determining how the wildfire threat is affected by various silvicultural techniques, its immediate use is as a tool for managing wildfires. The concerns of a fire manager include: What is the potential for fire ignition; what are the values at risk (potential loss of life, property, timber supply, aesthetic values); what is the potential wildfire behaviour; and how easily could it be suppressed? The W.T.R.S. compiles these factors to create an overall wildfire threat for a specific area.

"With GIS and the accompanying analysis system, we are able to look at many variables at once and understand how they operate together," explained Hawkes. "With such information we can make predictions for future scenarios to determine which factors would lead to, or avoid, a wildfire in the area."

Forest inventory information about the McGregor Model Forest was coupled with silviculture information to create a fuel-type map for the area. This map was overlaid with digital terrain information to determine slope and aspect which affects fire behaviour. Details such as rate of spread, fire intensity and potential for crowning were combined into another map. The suppression capability was calculated by considering such factors as access to water supplies and characteristics of the landscape. Finally, the values at risk were added into the equation. Each of these components were weighed equally to come up with an overall wildfire threat.

The McGregor Model Forest is valued by local communities for its employment, forest products, recreation, scenic qualities, ecological features, and cultural values. The 181,000 hectares of rolling plateaus and abundant wetlands (with some mountainous terrain) are dominated by spruce and alpine fir. The forest has two main rivers and has been affected by timber harvesting, wildfire, defoliating insects, bark beetles, disease, wind throw, and floods.

"It was found that although the McGregor Model Forest as a whole has a moderate to high overall wildfire threat, there were many areas that rated a much lower threat," said Hawkes. "Knowing what part of the forest is under the greatest threat allows the fire manager to assess potential fires in a strategic manner. For example, before fire season begins, the fire manager would be able to determine the optimal place to position fire-fighting resources."

The Wildfire Threat Rating System was first introduced in Australia but its application to the McGregor Model Forest was a collaborative effort between the Canadian Forest Service, the B.C. Ministry of Forests and the McGregor Model Forest. The area is one of ten Canadian model forests established by the Government of Canada to provide sites to demonstrate sustainable development.

This article is taken from Information Forestry, April 1997 issue, Natural Resources Canada, Canadian Forest Service, Pacific Forestry Centre, Victoria, British Columbia, Canada.

Citation: Hawkes, B., J.Beck, and W. Sahle. 1997. A wildfire threat rating system for the McGregor Model Forest. Final Report for the McGregor Model Forest, Prince George, B.C. (contains 5 sections, Conference Paper, Feedback Workshop, GIS Documentation, Fuel Type Photo Series, and Wildfire Threat Maps).

Retrospective Fire Study

A retrospective study of fire was initiated in the north-eastern interior of British Columbia, Canada as a part of the McGregor Model Forest Association's larger goal to determine the ecological processes that influence the forest landscape in this area. The area of study encompassed approximately 1.3 million hectares of forested and mountainous terrain stretching along the western side of the Rocky Mountains within the Sub-Boreal Spruce (SBSvk), Engelmann Spruce Subalpine Fir (ESSFwk2), and Engelmann Spruce Subalpine Fir (SBSwc3) biogeoclimatic units. British Columbia Ministry of Forests digital forest inventory data was heavily relied upon to determine the age and patch characteristics of the study landscape. Using this data the objectives have been to address the knowledge gap regarding the historical fire regime in the study area. Estimates have been derived of historical patch size, patch shape, and rate of disturbance in the study landscape. Analysis has also included comparison of historical patch size estimates with fire records for the period of 1950-1992, as well as an examination of the seasonality of fire occurrence for both natural and human-caused fires in this time period. Results of some sample plot data collected within the study area are also presented.

Results indicated that the fire cycle for these cool and wet mountainous subzones seems to be much longer than initially estimated and that both the SBSvk and ESSFwk2/wc3 biogeoclimatic units should be classified as Natural Disturbance Type 1 systems (rare stand-initiating events) in the provincial Biodiversity Guidebook. Patch sizes within the study area exhibit a north-south difference with the northern half of the study area characterized by larger disturbance patches than the southern half of the study area. It appears as though the importance of very large patches in this landscape is underestimated in the Biodiversity Guidebook. Patch shape complexity differs significantly between the northern and southern sections of the study area. It is likely that the higher proportion of very large patches in the northern portion of the study area is contributing to this north-south difference.

Citation: Hawkes, B., W.Vasbinder, and C.Delong. 1997. Retrospective fire study. Final report for the McGregor Model Forest Association. McGregor Model Forest, Prince George, B.C., 35p. (includes age class map).

Contact Information: Brad Hawkes can be reached by e-mail <bhawkes@pfc.cfs.nrcan.gc.ca>. A technology transfer note is available for the Wildfire Threat Rating System project from the author. Information about the Pacific Forestry Centre can be obtained from the World Wide Web at: http://www.pfc.forestry.ca/ and information about the Canadian Forest Service Fire Management Network can be obtained from the World Wide Web at: http://www.nofc.forestry.ca/fire/

The final reports of both studies are now available on the McGregor Model Forest Web Site at:

http://quarles.unbc.edu/mcgregor/publications.html

They can be downloaded and/or printed using the ACROBAT READER in NETSCAPE. If one does not have this add-on program with netscape there is a hot button on the MMFA web site to download a copy to view this report. If you have a colour printer, then a colour version of the figures can be printed. It can be viewed in colour with the reader.

Information on the McGregor Model Forest can be obtained at the following address:

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SPAIN *Forest Fires in 1997*

Fire Risk

A typical feature of Spain's fire weather is a short dry season by the end of winter time at the northern regions of the Iberian Peninsula. The drought gives chance to the bushfires set by the country people. Many times carelessness transforms these burnings into forest fires. In 1997 the drought lasted from mid February till April. The high risk conditions brought a very high fire occurrence with thousands of small fires registered in the Northwest. The summertime has also shown unusual conditions after a rainy spring (May, June). Rainstorms and wind blowing from the sea have limited the fire risk all around the country. Only a fire of 600 ha has been recorded by the end of July at the province of Cadiz.

Fire effects

The following table (Tab.1) shows 1996 figures in comparison with the preceding years (until the end of September).

Tab.1. Comparison of the 1996 fire statistical data with the period 1992-95.

Data	Average 1992-95	1996
No. of Fires (< 1 ha)	10.548	12.444
No. of Fires (> 1 ha)	6.551	7176
No. Large Fires (>500ha)	38	1
Burned Surface (ha)		
- Forested	83.067	19.173
- Brushland and grassland	93.491	56.773
- Total	176.558	75.946
Burned Surface as a % of the National Woodlands	0.69	0.29 *

* This percentage (0.29) is the lowest among the EU Mediterranean countries.

Fire Management

Fire management activities of the different Administrations were coordinated in the National Committee of Forest Fire Protection (Comité de Lucha contra Incendios Forestales [CLIF]). Prevention activities were developed after the III Action Plan of Priorities (PAPIF 1996-99). A general sensibilization campaign made use of all TV networks, with 900 spots. Other activities in the III Plan are:

* Increasing mobile patrolling
* Spreading preventive silviculture to private forests
* New projects of preventive infrastructure
* Stronger support to research projects in the fields of fire danger forecastings and prescribed burning combined with controlled grazing.

More than 20,000 people were involved in suppression activities, supported by the following air resources (Tab.2).

Tab.2. Aerial resources used for fire suppression activities in Spain during the fire season of 1997.

Aircraft Types	Number
Amphibious aircraft (CL-215T + CL-215)	15 + 5
Agricultural aircraft (2.500 l)	46
Helicopters for brigade transportation (5 to 20 people plus bucket of 1000-1500 l)	85
Observation aircraft (sending video images by TMA or microwaves to the Operation Centres and to Mobile Units for Meteorology and Communication	14
Helibombers (1300 to 4500 l)	17

The budget devoted by all administrations amounted to near 50,000 millions PTA (US $ 400 million approx.)

The National Committee of Forest Fire Protection CLIF has in the month of June, after a year of preparation, completed a Red Book on Prevention and another Red Book on Coordination. These documents list difficulties and deficiencies in prevention and fire fighting according to the information in the National Forest Fire Database (1968-1995).

The Red Books also list detailed recommendations to improve the efficiency of the concerned Administrations and the effectiveness of the Forest Fire Protection policies.

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SWITZERLAND *The 1997 Forest Fire Season in Switzerland*

Most forest fires in Switzerland occur in the southern part, which represents, with about 4000 km^2, 9.8% of the total national area. Normally forest fires break out during winter (December - April), in the colline-submontane deciduous forest belt. Therefore, most forest fires are surface fires. In the past 30 years (1968 - 1997) an average of 66 forest fires occurred burning 805 ha of forests and pasture land annually. This resulted in an average of 12.2 hectares of burned area per forest fire in the last 30 years. Taking in account only the last ten years (1988-1997), the number of forest fires came down to an average of 56 forest fires and 490 ha of burned area annually, resulting in an average of 8.8 ha per forest fire.

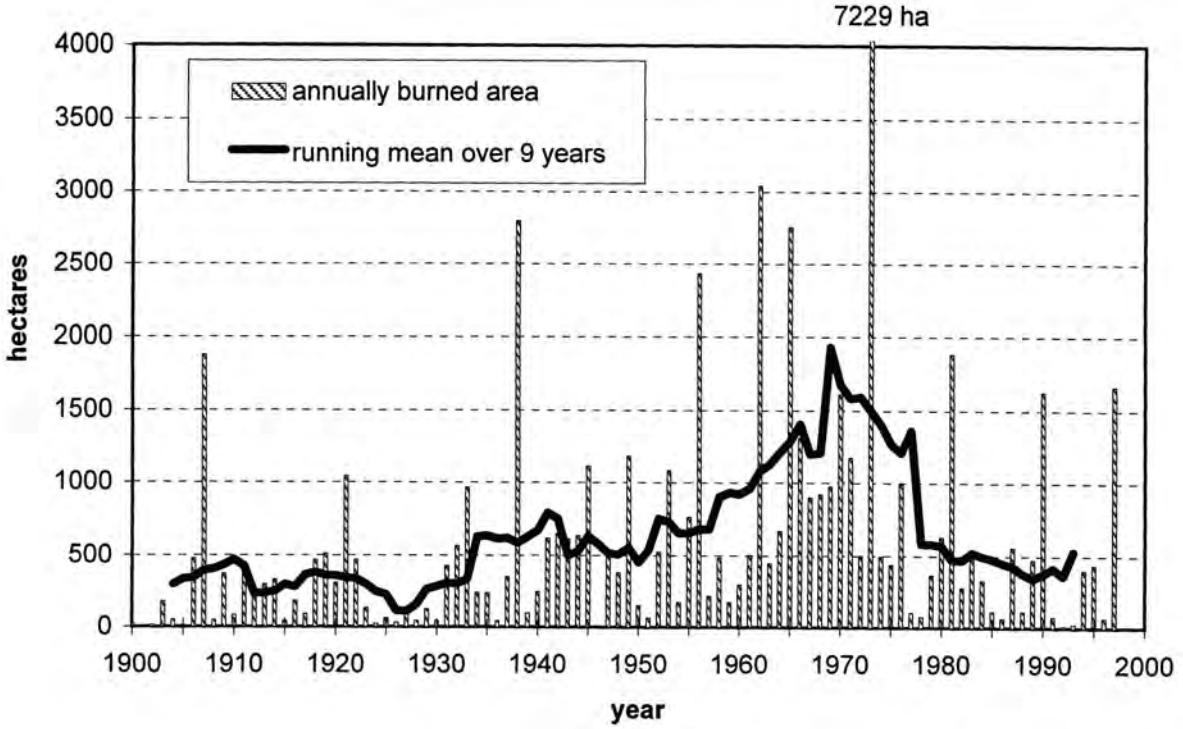

Fig.1. Evolution of area burned in southern Switzerland 1900-1997. Data of 1997 are provisional and reported until end of October. Source: Forest Fire Database FNP SdA.

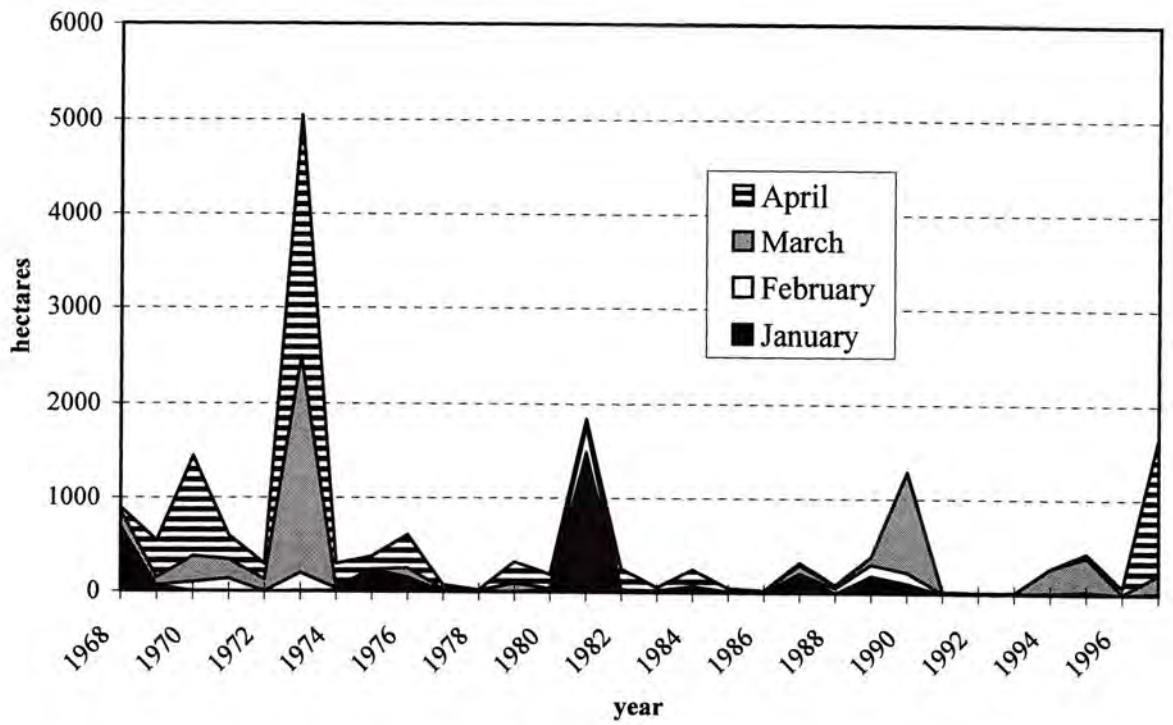

Fig.2. Burned area per month in southern Switzerland 1900-1997. Dates of 1997 are provisional and reported until end of October. Source: Forest Fire Database FNP SdA.

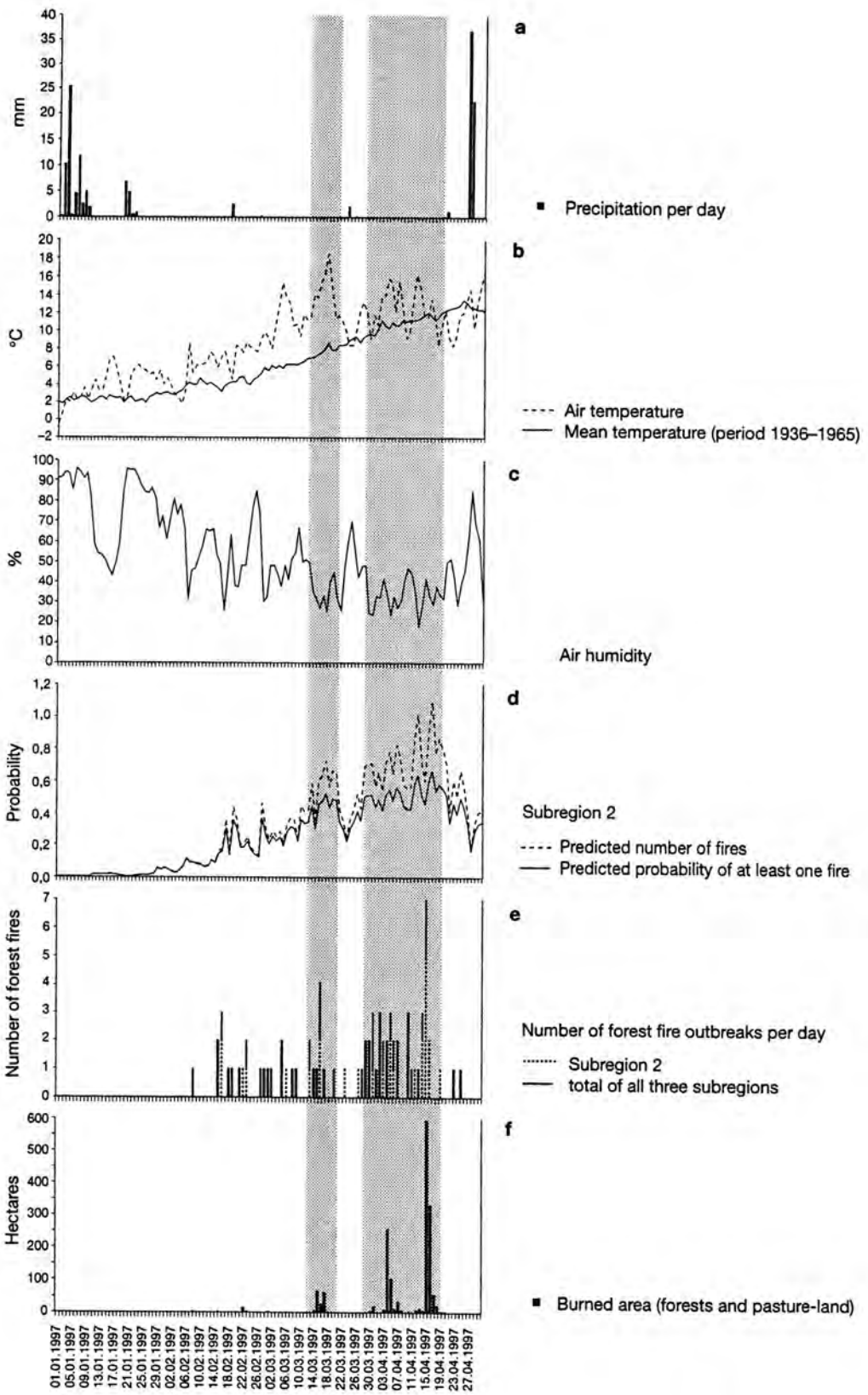

Fig.3. Statistical data of the forest fire season in southern Switzerland (January-April 1997). Source of meteo data: Swiss Meteorological Institute. Source of forest fire data: Forest Fire Database FNP SdA. probability of forest fire occurrence according to Mandallaz and Ye (1997).

After six years where the number of forest fires and the burned area dropped below the average values (Fig.1), the southern part of Switzerland experienced a relatively bad forest fire season with some dramatic fire events in 1997. Four large forest fires (> 100 ha) were recorded in March and April, of which two broke out on the same day. Up until the end of October 102 forest fires were reported to have burnt a total of about 1450 ha of forests and 250 ha of pasture land. The average of more than 16 ha burned area per forest fire is the highest since 1981. The burned forest area of 1997 represents nearly 1% of the total forested area of southern Switzerland. About 20% of these burned forests have a particular protection function because, as a rule, burned slopes in southern Switzerland are normally very steep (60-100%).

Of all meteorological parameters in the southern part of Switzerland it is especially precipitation that varies very strongly. Periods of dryness alternate with periods of very heavy precipitation. Periods of dryness are normally between December and March/April and shorter ones also between October and November. On an average of every four years there is a dry period of 30 to 40 days while every ten years there is one of more than 40 days without any rainfall. Dry periods of more than 60 days with less than 10 l/m^2 of precipitation happen every 10 to 20 years.

Due to the dryness periods, which are normally most severe between January and April, the greatest part of the area is burned within these four months (Fig.2). In 1997 more than 1650 ha of the total 1700 ha, which burned through the end of October, burned in March and April. One reason was that in 1997 the dry period lasted extremely long. Statistically, within 93 days, between January 23 and April 25, there was only 5.9 l/m^2 of rainfall (Fig.3-a). During this period, the temperature for each month was over the average values of the normal period 1961-1990 - in January 1.2 °C, in February 2.4 °C, in March 4.5 °C and in April 1.5 °C (Fig.3-b). This was caused by subtropic air masses (especially in March) as well as north foehn winds (warm winds which causes high temperatures and very low air humidity; see Fig. 3-b and 3-c). Because of high air temperature and very low air humidity, litter and the upper soil layers dry up very fast and the risk of forest fire ignition increases.

Figure 3-f shows that burned areas greater than 50 hectares per day are always related to situations where there is a north foehn and the fire risk index is high (dotted area in Fig.3). The comparison of the temperature, air humidity, and the burned area show this very clearly. During such north foehn periods there is normally more than one forest fire per day reported (Fig.3-e).

In general, the forest fire index, proposed by Mandallaz and Ye (1997), shows a good fitness in fire probability rating (Fig.3-d). In future this model could also be useful in predicting fire severity, becoming in addition an important tool in estimating the ecological problems after fire events.

In conclusion the first four month of 1997 were characterized by abnormally big fires: about 1000 persons have been involved in fire fighting (fire brigades, military, police and forest service) with an aerial support of up to 10 helicopters (civil and military) per forest fire, summing in total 800 hours of aerial fire fighting.

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U.S.A. ***American Fire Officials Expand International Activities***

Wildland fire is a natural disaster affecting most nations of the world, and there is an increasing willingness to exchange information and work toward procedures that will benefit all wildland fire organizations. On a global basis, such cooperation can provide great mutual benefit for the agencies involved from both an operational and scientific basis.

The United States Bureau of Land Management (BLM), a key public land agency of the US Department of the Interior, has become more active with international cooperation over the past several years. BLM manages over 265-million acres of public land in the western United States, and is responsible for wildland fire response on more than 355-million acres of Department of Interior lands. The major base for BLM is at the National Interagency Fire Center (NIFC) in Boise, Idaho.

During the late summer of 1997, BLM officials from the national office of Fire and Aviation at NIFC visited Germany, Russia and Norway to seek opportunities for research and cooperation. The trip provided a foundation for the BLM Fire and Aviation program to take advantage of opportunities where they best suit their long-range goals to learn from other nations and to share wildland fire expertise and enhance professionalism.

The American delegation spent time during the trip in Germany for briefings on international activities, and were given a tour of the Black Forest to look at the management and fire practices used there. As a result, some initial studies will be conducted in the US by students working on graduate studies in German universities.

The delegation travelled on to Russia and spent several days in Moscow working with Avialesookhrana (Aerial Forest Fire Protection Service) officials, then visited remote locations in central Siberia to observe Russian fire fighting equipment and procedures. They participated in meetings with a number of government and academic officials to learn about natural resource management and wildland fire issues in Russia.

As a result of the trip, an initial program of personnel exchanges was discussed, with potential for BLM smokejumpers to work in Russia during 1998, and Russian smokejumpers working in Idaho and Alaska in the US. BLM plans to use this process to gain additional technical information about Russian equipment and procedures to compare and contrast them with American systems.

Following the Russian visit, the members travelled to Oslo, Norway where the Norwegian Directorate for Fire and Explosion Prevention (DBE) provided the BLM group with a review of wildland fire issues in that nation, and hosted several meetings to exchange information about wildland fire. The series of meetings opened the possibility of future cooperation between Norway and the BLM in exchanges and possible studies.

BLM national officials are pleased with the positive results of this trip, and plan to use the results to help establish a long-term program of international cooperation and exchange.

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NEWS FROM FIRE RESEARCH: FIRE RESEARCH IN EAST AFRICA

AFARI-97 Field Campaign in Kenya Implemented in September/October 1997

The African Fire-Atmosphere Research Initiative (AFARI) is a regional expansion and continuation of the Southern African Fire-Atmosphere Research Initiative (SAFARI) which was implemented in its main campaign phase in 1992. SAFARI was the Eastern (African-borne) component of the Southern Tropical Atlantic Regional Experiment (STARE); the Western (South American/Transatlantic) component was realized as the Transport and Atmospheric Chemistry Near the Equator - Atlantic (TRACE-A) project. These projects were conducted under the scheme of the International Global Atmospheric Chemistry (IGAC) project which is a "core project" of the International Geosphere-Biosphere Programme (IGBP). One of the activities of IGAC Focus 2 (Natural Variability and Anthropogenic Perturbations of the Tropical Atmospheric Chemistry) investigates the impact of vegetation fires and biofuel burning on the global atmosphere and biosphere (Biomass Burning Experiment [BIBEX]). BIBEX has formally recognized AFARI-97 as an activity of IGBP-IGAC.

Background and Rationale

The observation of highly elevated levels of tropospheric ozone (O_3) in some tropical regions, particularly over the southern tropical Atlantic Ocean between South America and Africa, led to the hypothesis that biomass burning emissions and subsequent photochemical processes may play an important role in atmospheric chemistry over a large region of the Earth. This was supported by spaceborne observations which showed the observed ozone enrichment to coincide geographically with regions of elevated carbon monoxide (CO) concentrations.

The Southern Tropical Atlantic Regional Experiment (STARE) was designed to investigate the chemical characteristics of the ozone-enriched airmasses over the southern tropical Atlantic and to study the sources of the trace gas emissions. Forest conversion burning in South America, especially in Brazil, and savanna fires in South America and Africa were identified as the most likely sources. Consequently, STARE was aimed at characterizing the emissions from plant biomass burning in the source regions on either side of the Atlantic, the transport of the air masses from these source regions to the atmosphere over the Atlantic, and the chemical transformations occurring in the air masses.

In this first intercontinental fire experiment, a total of 15 research institutions from 9 countries, supported by 4 additional countries, worked jointly on a single, but multi-facetted fire research project. The major field phase, an interdisciplinary international research campaign, took place in 1992. It took another four years to evaluate and publish the scientific results of the research program. Publications of the scientific results of TRACE-A and SAFARI are now available. A special issue of the Journal of Geophysical Research (American Geophysical Union) was published in October 1996 (1). On 811 pages, the special issue contains 60 articles written by 178 authors and co-authors, representing some 300 to 400 scientific and technical staff involved in the project. The results of this research programme are an impressing result of an unprecedented large international, interdisciplinary and intercontinental fire experiment.

The findings confirm the hypothesis that a large portion of the southern hemispheric atmosphere is subjected to dramatic seasonal changes influenced by vegetation fires. The transport meteorology of fire emissions has been clarified by SAFARI/TRACE-A. The implications of the STARE programme findings are manifold in regard to land use systems and sustainable development. The consequences of the research on the SAFARI (=African) side of STARE will be highlighted in a synthesis monograph which is dedicated to the ecology of fire in African savannas (corresponding to the results of SAFARI) and will be available in 1997 (2).

(1) TRACE-A and SAFARI Special Issue. Journal of Geophysical Research 101, No.D19, 23,519-24,330.

(2) van Wilgen, B., M.O.Andreae, J.G. Goldammer, and J. Lindesay (eds.) 1997. Fire in Southern African savannas. Ecological and atmospheric perspectives. The University of Witwatersrand Press, 256 pp.

Whereas the atmospheric chemical importance of savanna and grassland fires in Southern Africa seem to be well understood, no information is available on atmospheric effects of fires occurring in East African savannas.

Remotely sensed data reveal that extensive fires occur in the savanna areas of East Africa. Consequently it was decided to turn research attention to that part of the world. Special focus of the AFARI-97 project was the investigation of the relationship between aerosol production and associated CO and CO_2 formation during prescribed experimental burns and wildfires of opportunity. The ecological value of these data is that aerosols formed during vegetation fires are assumed to be of significant importance for the radiation budget of the atmosphere on a global scale. The results will be used to improve the understanding of the aerosol sources and be added to the IGBP-IGAC and IGBP-DIS databases, i.e. they will be freely available to interested research parties.

Fig.1. Aerial view of a AFARI-97 experimental burning plot at Lewa Downs, Kenya, September 1997. Photo: J.G.Goldammer

Field Implementation

AFARI-97 was conducted in two sites in Kenya in late September and early October 1997 (Lewa Downs Ranch in the Isiolo district immediately north of Mount Kenya and Hopcraft Ranch on the Athi Kapiti Plains 40 km south of Nairobi). The size of experimental burns ranged between 50-200 hectares. Ground measurements included standard botanical and fuel inventories (before and after the burns), fire behaviour, and meteorological data. The airborne component concentrated on aerosol sampling. Most of the experimental burns were coordinated with satellite measurements for validation purposes. The fires were described in detail on the ground and from small aircraft during the overpass of the Advanced Very High Resolution Radiometer (AVHRR) on the NOAA weather satellite. In addition, it was tried to validate capabilities of the Space Shuttle Earth Observation System. The STS-86 mission, however, passed the burning sites at early morning hours and could not be coordinated with the experiments.

Participating institutions of AFARI-97

* Max Planck Institute for Chemistry - Germany
* University Nairobi - Kenya
* National Academy of Sciences - Kenya
* University Fort Hare - South Africa
* Canadian Forest Service, Forest Fire Research - Canada
* Division of Life Science, King's College London - United Kingdom
* Atmospheric Sciences Division, NASA Langley Research Center - U.S.A.
* Department of Environmental Sciences, University of Virginia - U.S.A.

Principle contacts for AFARI-97:

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and

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The Zambian International Biomass Burning Emissions Experiment (ZIBBEE)

The ZIBBEE experiment was organized in cooperation with the US Forest Service Fire Chemistry Laboratory, the Zambian Meteorology Department and NASA's AERONET and EOS IDS program with the primary objectives to quantify the aerosol and trace gas fluxes from the Miombo woodlands of southern Africa. Embedded within this study are objectives to quantify the consumption of biomass (carbon) from biomass burning, validation of aerosol retrievals from various satellite sensors, and direct radiative forcing by biomass burning aerosols.

Experimental Design

The main focus was to measure the carbon flux from the massive amount of burning taking place to the east of the Western Province of Zambia, estimate direct radiative forcing due to smoke from biomass burning, and validate satellite aerosol retrievals. The measurement approach established a 400 km transect of ground based sun photometers orthogonal to the prevailing easterlies and to fly an in situ aerosol and trace gas sampling system in the transect to establish a 2-D measurement plain during a variety of meteorological and burning conditions. The ground-based measurement network remained in operation for the duration of the burning season. Appropriate satellite, meteorological and ancillary ground based data were collected.

Instrumentation Involved

* Four cimel automatic sun-sky scanning spectral radiometers were maintained at Sesheke, Senanga, Mongu and Zambezi. Solar flux measurements were established at Mongu, Zambezi, and Senanga.
* Total column ozone and AOT from hand-held microtops instruments were established at Mongu, temporary, and mobile sites.
* Low volume particulate mass samples were collected on Teflon filters with a six hour replacement schedule.
* An additional site for automatic cimel measurements and micotops was established midway between Senanga and Mongu on flight days.
* Automatic weather stations were established the previous year at Senanga, in Mongu and Zambezi by the USFS.
* A 20 site network of 2-band hand-held sun photometers was established at and between the four principle sites.
* A micropulse lidar (MPL) was deployed at Mongu for the continuous monitoring of the aerosol profile.

An airborne instrument package which included in situ measurements of ozone, aerosol filter samples, canister samples, WS, WD, relative humidity, CO, CO_2, backscatter and location information was loaded onto a Cessna-206 and other small aircraft.

AVHRR imagery will be used to estimate radiative forcing, fire events, radiative properties of aerosols, aerosol optical depths and cloud droplet size distributions.

Participating institutions of ZIBBEE

* United States Forest Service, Intermountain Fire Sciences Laboratory, Missoula - U.S.A
* Zambian Meteorological Office, Mongu - Zambia
* NASA Goddard Space Flight Center, Greenbelt - U.S.A
* University of Virginia
* University of Alabama, Huntsville - U.S.A.

Principle contact for ZIBBEE:

Darold E. Ward
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US Forest Service
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Fax: ++1-406-329-4863
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e-mail: PYROWARD@aol.com

The readers of International Forest Fire News will be informed about the publication of the research results of both campaigns.

Johann G. Goldammer

RECENT PUBLICATIONS

The Use of Fire in Nature Conservation

A scientific workshop on fire ecology and fire management in nature conservation areas and in landscape management in Germany was hosted by the Alfred Toepfer Akademie für Naturschutz, Schneverdingen, Germany, October 1996. This first scientific discussion after a break of nearly 10 years brought together scientists and practitioners from heathlands, agriculture, pastoralism and forestry in Germany and neighbouring countries. The contributions cover the most important fire ecological and historical aspects of land-use fires in Central, Western and Northern Europe. The conclusions of most papers reveal that it is timely to reconsider traditional burning practices for restoring and/or maintaining those habitats and landscape types which are endangered by the lack of land-use disturbances, including fire, and the subsequent succession towards less species-rich ecosystems. The proceedings of the workshop are available now (in German). The source is:

Alfred Toepfer Akademie für Naturschutz (ed.) 1997. Feuereinsatz im Naturschutz. Alfred Toepfer Akademie für Naturschutz, Schneverdingen. NNA-Berichte 10 (5), 181 p. <in German> (ISSN 09 35-1450).

Vestal Fire
An Environmental History, told Through Fire, of Europe and Europe's Encounter With the World

"Vestal Fire is Stephen Pyne's masterpiece. In it, he offers nothing less than a retelling of all of European history from a vantage point no other historian has ever adopted so consistently before: that of the fire which in Pyne's view burns at the very heart of Western civilization." *- from the Foreword by William Cronon.*

Stephen Pyne has been described as having a consciousness "composed of equal parts historian, ecologist, philosopher, critic, poet, and sociologist." At this time in history when people are trying to understand their true relationship with the natural environment, this book offers a remarkable contribution - breathtaking in the scope of its research and exhilarating to read. Pyne takes the reader on a journey through time, exploring the terrain of Europe and the uses and abuses of its lands as well as, through migration and conquest, many parts of the rest of the world. Whether he is discussing the Mediterranean region, Russia, Scandinavia, the British Isles, central Europe, or colonized islands; whether he is considering the impact of agriculture, forestry, or Enlightenment thinking, the author brings an unmatched insight to his subject.

Vestal Fire takes its title from Vesta, Roman goddess of the hearth and keeper of the sacred fire on Mount Olympus. But the book's title also suggests the strengths and limitations of Europe's peculiar conception of fire, and through fire, of its relationship to nature. Between the untamed fire of the wilderness and the tended fire of the hearth lies a neverending dialectic in which human beings struggle to control natural forces and processes that in fact can sometimes be directed but never wholly dominated or contained.

IFFN intended to review Stephen Pyne's book in depth. We did not make it at the deadline of printing this volume. The readers are kindly asked to refer to the remarks of the editor in the contribution from Germany, this volume of IFFN.

The Editor

Pyne, S.J. 1997. Vestal Fire. An environmental history, told through fire, of Europe and Europe's encounter with the World. University of Washington Press, 672 pp., 65 illus., maps, notes, glossary, bibliography, index, cloth (ISBN 0-2295-97596-2).

Forest Fires in Norway

A summary publication on forest fires in Norway is now available as a special issue of "Skogforsk" (Forest Research), a publication of the Norwegian Institute for Forest Research, Ås, Norway. The publication contains contributions of a seminar held at the Norwegian Research Council, Oslo, 13-14 January 1997. The volume is edited by Knut Solbraa and contains 26 contributions on the general fire background, fire use and its history, and ecological effects of fire, especially on forest nutrition and fauna.

Solbraa, K. (red.) 1997. Brannflatedynamikk i skog. Sammendrag fra et seminar 13.-14.januar 1997 i Norges forskningråd, Oslo. Aktuelt fra Skogforsk Nr.2-97. Norsk institutt for skogsforskning NISK, Ås, Norway, 48 p. <in Norwegian> (ISBN 82-7169-818-4; ISSN 0803-284X).

The Forest and Man

Orazio Ciancio, Professor of Forest Management at the University of Florence, was the initiator of a round table "The Forest and Man", held in Florence, Italy, 23 May 1995. The holistic design of the conference aimed to explain the relationship over the centuries between human activities and the forest in Italy. Topics of forest history, forest management and silviculture covered Mediterranean and Alpine Italy. The closing of the gap between historic forestry practices and the current state of forestry makes the conference proceedings a valuable lecture for those who are interested in the interaction between humans and the forest environment. Special emphasis was given to the role of fire. The historical evolution of fire management along with its current development, written by Orazio Ciancio, Giovanni Bovio, and Vittorio Leone, covers a substantial part of this book.

Georg Buchholz

Ciancio, O. 1997. The forest and man. Accademia Italiana die Scienze Forestali. Florence, Italy, 331.p.

Incendios Forestales - Forest Fires

The long awaited synthesis on forest fire in México is now on the market! Authored by Dante Arturo Rodriguez Trejo, an academic forester trained in México and working on his PhD at present at the School of Forest Resources and Conservation, University of Florida (U.S.A.), a very comprehensive handbook on fire has been written. The book is mainly focused on Mexico, but many of the information included can be useful in many other countries of Latin America and Spain. The structure of the 630-pages volume reflects pretty well that it will serve to mediate general basics of fire as well as the specific importance of fire in México's ecosystems. The chapters embrace:

1. Introduction
2. Fire ecology (focused in Mexican ecosystems, mainly rainforest, caducifolious tropical forest, grasslands, pine forest)
3. History of forest fires and forest protection in Mexico
4 Basic notions about forest fires
5 Forest fires impacts
6 Some statistics (Mexico)
7 Prevention
8 Combustion and calorific power (Mexican species)
9 Fire Behaviour (including information of forest fuels inventories in Mexico)
10 Models to estimate fire behaviour (description and some applications in Mexico)
11 Presuppression
12 Prescribed burns and use of fire (general descriptions and examples in Mexico)
13 Forest fires and tree growth
14 Detection
15 Dispatch

16 Fire fighting
17 Cause determination and rehabilitation
18 Protection programs
19 Physical fitness and health of the forest fire fighter
20 Security
21 Danger indexes
22 Some financial aspects related to forest fires
23 Some special topics about forest fires
24 Forest fire and forest law
25 Epilogue

The publisher Mundi Prensa has a branch in Mexico, but its main office is in Spain, so the book is being distributed there also. More than 600 bibliographic references are included, almost 300 from Mexico. Alphabetic indexes facilitate to search for topics, species, authors, and locations.

Rodríguez-Trejo, D.A. 1996. Incendios forestales. Mundi Prensa, Universidad Autónoma Chapingo, División de Ciencias Forestales, Instiuto Nacional de Investigaciones. México, D.F. 630 p. <in Spanish> (ISBN: 968-7462-04-3 for Mundi Prensa, and 968-884-311-3 for Universidad Autónoma Chapingo).

Greenness from the Normalized Difference Vegetation Index (NDVI)

News on Satellite-derived Products for Observation of Vegetation Greenness: The Normalized Difference Vegetation Index (NDVI) provides a means to observe vegetation greenness from satellite data. By studying the resulting data and maps over time, fire managers in natural resource agencies will be better able to predict fire behaviour - and prepare! Robert E. Burgan, Carolyn H. Chase, and Larry S. Bradshaw - researchers in the Fire Behaviour Research Work Unit at the Intermountain Fire Sciences Laboratory, Missoula, Montana (U.S.A.) - have made these data and maps available on CD-ROMs.

Vegetation Greenness and Fire Danger Images: Image Archives for Greenness 1989-1996 and for Fire Danger 1996 (GIF images; one CD).

NDVI and Derived Image Data: These data archives come in eight sets, with five CDs per set. Each set is a General Technical Report and covers 1 year:

INT-GTR-354CD-1989	INT-GTR-357CD-1992	INT-GTR-360CD-1995
INT-GTR-355CD-1990	INT-GTR-358CD-1993	INT-GTR-361CD-1996
INT-GTR-356CD-1991	INT-GTR-359CD-1994	

These CD-ROMs may be purchased from the National Technical Information Service, 5285 Port Royal Road, Springfield, Virginia 22161 (U.S.A.), Tel: ++1-703-487-4650. Loan copies may be obtained from the Rocky Mountain Research Station through one of the media listed below:

Publications-Ogden Service Center
Rocky Mountain Research Station (Formerly Intermountain Research Station)
324 25th Street
USA - Ogden, Utah 84401

Fax:	++1-801-625-5129, Attn: Publications
Tel:	++1-801-625-5437
e-mail:	/s=pubs/ou1=s22a@mhs-fswa.attmail.com
Internet:	http://ww.xmission.com/~int

MEETINGS HELD IN 1996-97

SPAIN ***International Seminar on Historical Presence of Forest Fire***

In spite of the importance that forest fires have had in the historical transformation of the rural landscape all around the world, its effects and complex casuistry continue to be unknown in many places at the present. The geohistorical analysis on the presence of forest fires has often only has testimonial value, plagued by anecdotal citations without scientific rigour.

Thus, this seminar, promoted by and held at the International University of Andalusia «Antonio Machado» at Baeza (Jaén), 27-31 October 1997, exposed the most recent advances in research during the last years in Spain and other countries.

First, we expected progress from a discussion of the results and intended to formulate new hypotheses that would allow us to understand the historical importance of forest fires in all latitudes.

Second, we wanted to offer those responsible in public institutions involved in fire management some details on the traditional organisation on rural sites that can be valid in the design of future fire policies.

Directed by Dr. Araque Jiménez (University of Jaén) fifteen acknowledged specialists participated in the seminar. The analysis of the historical situation of forest fire was analyzed at national, regional and local levels.

The national perspective was analyzed for the situation in two Mediterranean countries (Spain, by Ricardo Vélez, Ministry of Environment; Italy, by Vittorio Leone, University of Bari), and the case of United States of America (Stephen Pyne, University of Arizona).

The regional analysis covered the whole Spanish territory with contributions from Galicia (Enrique Martínez, Ministry of Environment; Luis Guitián and Xesús Balboa, University of Santiago de Compostela), the central and eastern area (Josefina Gómez Mendoza, Carlos M. Manuel Valdés and Santiago Fernández, Autónoma University of Madrid) and eastern Andalusia (Manuel González y Salvador Cruz, Universities of Granada and Jaén).

Finally, the more detailed analyses dealt with the provinces of Jaén (Eduardo Araque y José D. Sánchez, University of Jaén), Málaga (José A. Vega, Center of Forestry Investigation at Lourizán) and Cádiz (José I. Jiménez, Complutense University of Madrid and Francisco Rodríguez, Departament of Environment of Andalusia Government). A study tour to historical fire sites in the forests of the Sierra of Cazorla (Province of Jaén) was part of the seminar.

For more information on seminar results please write to:

Eduardo A. Jiménez
Area de Análisis Geográfico Regional
Universidád de Jaen
E - 23071 Jaen

MEETINGS PLANNED FOR 1997-98

U.S.A. ***Symposium on Fire Economics, Planning and Policy: Bottom lines***
5-9 April 1999, San Diego, California

Rationale Wildfire management costs have escalated in the past decade, largely due to increased expenditures for suppressing large fires. Frequent siege-like fire incidents have racked up enormous losses in life, property, and natural resources. Additionally, there is growing recognition of the futility of fighting fires in ecosystems where prior fire exclusion policies have led to dangerous fuel accumulations.

Political and social pressures, such as those encountered in urban interface areas, complicate agency management options. The economic consequences of alternative management strategies are poorly understood. Cost-effectiveness comparisons between prescribed fire and other treatments are compounded by analytical difficulties. Expenditures on large fires may bear little relation to values at risk. Current analysis tools for justifying budgets and displaying tradeoffs rarely incorporate consideration of all relevant contributors to fire management costs and net value changes.

Numerous reports have recognized the importance of optimizing fire management costs, yet progress toward this end has been slow and uncertain. There is a need for policy makers, natural resource managers, and fire practitioners to exchange ideas and learn from mutual concerns.

Topics to be covered

* Large wildfire costs (how much and why?)
* Alternative approaches to fire planning in different agencies
* Economics of preparedness
* Fuel treatment (including prescribed fire-wildfire tradeoffs)
* Appropriate management response: will costs be reduced?
* Fire restoration: are the benefits worth it?
* Resource valuation requirements in strategic fire planning
* Workforce issues
* Case studies: Success stories in reducing fire management costs

Who should attend? Topics will be of interest to policy makers, analysts and planners, line officers and participants in wildland fire situation analyses, fire practitioners, consultants, environmental managers, and journalists.

Call for papers: Proposals will be solicited for papers/poster sessions. Proceedings will be published according to USDA Forest Service, Pacific Southwest Research Station guidelines.

Sponsorship: The Western Forest Fire Research Center (WESTFIRE) at Colorado State University and USDA Forest Service, Pacific Southwest Research Station will jointly sponsor a symposium aimed at fostering continued dialogue about the economics of fire management. The International Association of Wildand Fire is cosponsoring the event. Sponsorship and participation by other agencies will be encouraged. Symposium coordination: Epilobium Services, Inc.

Questions can be directed to:

Philip N. Omi
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Colorado State University
Ft. Collins, Colorado 80523

Fax: ++1-970-491-6754
Tel: ++1-970-491-5819
e-mail: westfire@lamar.colostate.edu

or

Armando Gonzalez-Caban
USDA Forest Service, Riverside Fire Lab
4955 Canyon Crest Dr.
Riverside, California 92507

Fax: ++1-909-680-1501
Tel: ++1-909-680-1525
e-mail: agc/psw_rfl@fs.fed.us

U.S.A.

21st Tall Timbers Fire Ecology Conference
Fire and Forest Ecology: Innovative Silviculture and Vegetation Management
14-16 April 1998, Tallahassee, Florida

Purpose of the Conference: This three-day conference will bring together researchers and managers from across the land management spectrum who use fire to manipulate vegetation to achieve their organizations' goals. Land managers from groups with very different objectives, whether industrial commodity production or preservation-oriented, often use fire for remarkably similar reasons. Our goal is to provide a forum to discuss fire ecology, management and effects, both within and outside of the context of silvicultural treatments.

Organization: The conference will be divided into sections that address the effects of fire on the following topics (with confirmed plenary speakers and invited speakers [in brackets]):

* Tree and vegetation physiology and implications for growth - David Weise, USFS Pacific SW Forest and Range Experiment Station, Riverside
* Silvicultural impacts - David Van Lear, Clemson University
* Forest ecology and stand dynamics - James Vose, USFS Coweeta Hydrological Laboratory
* Soil productivity and structure - Mike Weber, Canadian Forest Service, Northern Forestry Centre
* Ecological restoration - Wally Covington, Northern Arizona University
* Vegetation control: fire vs. herbicides - Shep Zedaker, Virginia Polytechnic University
* Social/policy implications - Frank Cole, Joseph W. Jones, Ecological Research Center
* Wildlife population dynamics and management - Dick Williams, CSIRO, Darwin (Australia)
* Keynote Speaker - Johann G. Goldammer, Fire Ecology and Biomass Burning Research Group, Biogeochemistry Department, Max Planck Institute of Chemistry (Germany)
* Banquet Speaker - Robert Lee Izlar, Georgia Forestry Association, Norcross

There will be a poster session/social hour during the first evening and a banquet during the second evening. Post-conference excursions will highlight the uses of fire in the management of the many unique ecosystems in the greater Big Bend area of the southeastern Coastal Plain.

Questions to be Addressed

* What is the current status of prescribed fire across different ownership categories?
* Can we quantify the economic vs. ecological trade-offs of different methods of vegetation control?
* What are the similarities and differences in using fire to manage land for commodity outputs vs. non-economic goals?
* In restoration ecology, can some combination of fire and other methods quickly and efficiently return the landscape to a predisturbance state?
* What is the impact of prescribed fire upon commodity production and quality? How will this impact influence the choice of fire by an industrial vs. non-industrial landowner?
* Will current and pending air-quality regulations influence the use of fire as a silvicultural tool?
* Does fire as a site-preparation tool add to or ameliorate the impact of intensive management upon forest soils?
* How do the organization's goals influence the choice of fire vs. herbicides?
* Is the public more accepting of the use of prescribed fire as a vegetation management tool for non-commodity reasons vs. for commodity reasons?
* How do past fire management practices influence current and future silvicultural choices?
* What is the political future and management implications for prescribed burning in rapidly urbanizing areas? Are herbicides an option?
* Can fire assist active forest management in the presence of threatened and endangered species?

Proceedings: The conference presentations will be published in the Proceedings of the 21st Tall Timbers Fire Ecology Conference by Tall Timbers Research Station, Tallahassee, Florida. Complete manuscripts from both oral and poster presentations will be considered for publication. All papers will be peer-reviewed by independent referees and published in book chapter format.

This publication will be mailed to the participants and be available for purchase by other researchers and land managers interested in fire as a management tool.

Accommodations: Several full-service hotels are located within easy walking distance or short drive to the Ramada Inn Tallahassee on North Monroe Street. Information on reservations will be mailed to all conference participants in the registration packet.

For Further Information: For a symposium brochure, registration materials, or to submit an abstract, please contact:

W. Keith Moser
Ecological Forestry Scientist
Tall Timbers Research,Inc.
Route 1, Box 678
USA - Tallahassee, Florida 32312-9712

Fax: ++1-904-668-7781
Tel: ++1-904-893-4153 x 247
e-mail: 4ester@compuserve.com

RUSSIA ***International Conference "Conjugate Problems of Mechanics and Ecology"***
Devoted to the 120th Anniversary of Tomsk State University
Tomsk, Russian Federation, 6-10 July 1998

The conference is organized by the State Committee on Higher Education of the Russian Federation, the Tomsk State University, the Tomsk Society of Mechanics-Scientists and Thermophysicists. The conference will elaborate on the following topics:

* Natural and technogenic catastrophes
* The problem of predicting motion and distribution of dangerous celestial natural and man-made dangerous objects
* The problem of celestial bodies entering the dense layers of the atmosphere and the methods of changing a flight trajectory
* Mechanisms of thermochemical destruction of celestial bodies in the atmosphere of the planets and the Earth
* Principles, methods and technical facilities of the ecological monitoring of natural complexes and geotechnical systems
* Physico-chemical foundations and control methods of contaminating media and their regeneration
* Forest fires: initiation, spread and ecological impacts
* Methodology of risk-analysis of new technologies for improving the ecological production safety
* Computer programmes and methods for predicting ecological impacts of catastrophes
* Higher ecological education
* Ecological and social aspects of the collision catastrophe problem

Working languages of the conference are Russian and English. The Conference programme is as follows:

* Round tables discussing different aspects of the conference
* Sale-exhibition of computer programmes and methods

Sponsors are invited for mutual cooperation and participation in the conference. The programme will include names of the participants and organizations which will support the conference.

To organize the conference the Tomsk State University received a grant from the Russian Research Fund. The Institute of Atmosphere Optics of the Siberian Branch of the Russian Academy of Sciences and the Institute of Mechanics of the Moscow State University will take part as the organizers of the conference.

Before the conference the abstracts of the proceedings and a programme will be published in Russian and in English. There were some changes to the terms of the conference in order to give an opportunity to the scientists, who are planning to work at the conferences in St. Petersburg and in Sneginsk of Chelyabinsk Region, to take part in our conference as well. The participants of the conference will be accommodated for in the hotels of Tomsk.

There will be a special cultural programme for the participants of the conference, including excursions to the historical places of Tomsk.

To register conference participants are to send the preregistration form to the organizing committee together with the application and report abstracts, two typed pages in English for foreigners by no later than 15 May 1998. A registration fee for foreign participants including expenses on food, hotel accommodations and cost of conference materials and books is 400 dollars.

After the conference complex experiments on investigating crown and surface forest fire spread mechanism and approbation of the new methods of fire fighting are planned. Applications will be accepted for participating organizations and persons interested in the same problems. The programme of scientific experiments can be expanded according to the interests of new participants.

Address of the Organizing Committee:

Mr. Anatoly M. Grishin
Conference Chairman
Centre on Reactive Media Mechanics and Ecology
Tomsk State University
36 Lenin Avenue
RUS - 634050 Tomsk
RUSSIAN FEDERATION

Fax: ++7-3822-222973 or 445089 or 226162
Phone: ++7-3822-232791
e-mail: fire@fire.tsu.tomsk.su

GERMANY

International Conference on
Early Warning Systems for the Reduction of Natural Disasters
7-11 September, Potsdam

By resolution 44/236 of 22 December 1989 the UN General Assembly designated the 1990s as the **International Decade for Natural Disaster Reduction (IDNDR)**. According to the 1994 "Yokohama Strategy and Plan of Action" one of the key themes of the Decade is the realistic assessment of hazard, risk and vulnerability including early warning and response capabilities. Accordingly, the UN General Assembly with its resolution A/RES/49/22B of 23 January 1995 requests the Scientific and Technical Committee (STC) of IDNDR, the UN Secretary General, and governments respectively, to:

* continue work on early warning capabilities;
* examine new scientific and experimental concepts and methodologies aiming at accurate and timely short-notice forecasting of disasters, e.g. fire;
* facilitate an internationally concerted framework for improvements in early warning capacities;
* develop a concrete proposal for an effective international mechanism on early warning;
* undertake regular reviews of early warning requirements and capabilities at national and community levels; and
* promote the transfer of technologies related to early warning to developing countries along with the corresponding training.

To achieve these goals, to consolidate the accomplishments of the IDNDR, to plan for the 21st Century, and to implement the related UN Resolution IDNDR 51/185 it has been proposed by the STC for the IDNDR to hold, on the invitation of the Federal Minister of Foreign Affairs of the Federal Republic of Germany, an International Conference on "Early Warning Systems for the Reduction of Natural Disasters" (EWC-98) in 1998 in Potsdam, Germany.

The conference invites high-level expert contributions in order to produce a synoptic interdisciplinary presentation and discussion of the use of EWS for the detection of and appropriate reaction to imminent potential threats related to geo-hazards, hydro-meteorological hazards, and other environmental hazards, such as wildfires.

Scientists and managers who are developing and working with methodologies, technologies, and systems related to the early warning of wildfire hazards should present their activities and the achievements of the fire community at the Potsdam conference. Those who wish to attend the conference or receive more detailed information write to:

GeoForschungsZentrum Potsdam (GFZ)
Secretariat of EWC-98
Telegrafenberg A 17
D - 14473 Potsdam
GERMANY

Fax: ++49-331-288-1527
e-mail: ewc98@gfz-potsdam.de

SWITZERLAND ***Wengen-1998 International Workshop on Biomass Burning and its Inter-Relationships with the Climate System 28 September - 1 October 1998, Wengen***

For the past three years specialized Workshops were held on themes related to climate and global change research in the mountain resort of Wengen (Bernese Alps, Switzerland). In each case, a number of internationally-recognized experts have actively contributed to the meetings. Along with young scientists and graduate students, the total number of participants has been about 50. Because the Wengen Workshops on Global Change Research have a strong interdisciplinary emphasis, the topic of biomass burning and its links to climate has been selected for the 1998 Workshop theme. Papers are therefore invited in the following fields:

* Anthropogenic and natural causes of biomass burning: socio-economic issues
* Modelling of interactions between smoke, aerosols and climate on regional and global scales
* Climatic conditions favourable for triggering fires: observed changes this century
* Fire magnitude-frequency relationships in a changing climate in the 21st Century
* Data sets for model validation: remote-sensing techniques; specific in situ measurements

Special sessions will be devoted to the following topics:

* The Indonesian forest fires of 1997 and their consequences for South-East Asia
* The Kuwait oil fires of 1991 and their regional and global climatic impacts
* Lessons learned from research on issues related to the Nuclear Winter

Deadline for abstract submission was 20 February 1998. Further information on the meeting can also be obtained from:

Mr. John Innes
Swiss Federal Institute of Forest, Snow and Landscape Research
Zürcherstrasse 111
CH - 8903 Birmensdorf e-Mail: john.innes@wsl.ch

To achieve these goals, to consolidate the accomplishments of the IDNDR, to plan for the 21st Century, and to implement the related UN Resolution IDNDR 51/185 it has been proposed by the STC for the IDNDR to hold, on the invitation of the Federal Minister of Foreign Affairs of the Federal Republic of Germany, an International Conference on "Early Warning Systems for the Reduction of Natural Disasters" (EWC-98) in 1998 in Potsdam, Germany.

The conference invites high-level expert contributions in order to produce a synoptic interdisciplinary presentation and discussion of the use of EWS for the detection of and appropriate reaction to imminent potential threats related to geo-hazards, hydro-meteorological hazards, and other environmental hazards, such as wildfires.

Scientists and managers who are developing and working with methodologies, technologies, and systems related to the early warning of wildfire hazards should present their activities and the achievements of the fire community at the Potsdam conference. Those who wish to attend the conference or receive more detailed information write to:

GeoForschungsZentrum Potsdam (GFZ)
Secretariat of EWC-98
Telegrafenberg A 17
D - 14473 Potsdam
GERMANY

Fax: ++49-331-288-1527
e-mail: ewc98@gfz-potsdam.de

SWITZERLAND ***Wengen-1998 International Workshop on Biomass Burning and its Inter-Relationships with the Climate System 28 September - 1 October 1998, Wengen***

For the past three years specialized Workshops were held on themes related to climate and global change research in the mountain resort of Wengen (Bernese Alps, Switzerland). In each case, a number of internationally-recognized experts have actively contributed to the meetings. Along with young scientists and graduate students, the total number of participants has been about 50. Because the Wengen Workshops on Global Change Research have a strong interdisciplinary emphasis, the topic of biomass burning and its links to climate has been selected for the 1998 Workshop theme. Papers are therefore invited in the following fields:

* Anthropogenic and natural causes of biomass burning: socio-economic issues
* Modelling of interactions between smoke, aerosols and climate on regional and global scales
* Climatic conditions favourable for triggering fires: observed changes this century
* Fire magnitude-frequency relationships in a changing climate in the 21st Century
* Data sets for model validation: remote-sensing techniques; specific in situ measurements

Special sessions will be devoted to the following topics:

* The Indonesian forest fires of 1997 and their consequences for South-East Asia
* The Kuwait oil fires of 1991 and their regional and global climatic impacts
* Lessons learned from research on issues related to the Nuclear Winter

Deadline for abstract submission was 20 February 1998. Further information on the meeting can also be obtained from:

Mr. John Innes
Swiss Federal Institute of Forest, Snow and Landscape Research
Zürcherstrasse 111
CH - 8903 Birmensdorf e-Mail: john.innes@wsl.ch

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PORTUGAL ***Third International Conference on Forest Fire Research in conjunction with the 14th Fire and Forest Meteorology Conference and the Working Meeting of the EARSeL Special Interest Group (SIG) on Forest Fires 16-20 November 1998, Coimbra***

The 3rd International Conference on Forest Fire Research will be held at Grande Hotel das Termas, in Luso, Coimbra. Luso is a thermal resort situated 20 km North of Coimbra in Central Portugal, and is well connected by road and train to Lisbon (220 km) and Oporto (80 km). The conference will cover areas related to fire weather, fire behaviour, fire ecology, fire management, human and institutional factors. General information and abstract submission for those interested in presenting oral or poster papers to the Conference should be sent to the Chairman of this Conference (as announced in the last issue of IFFN, the deadline for abstracts was 31 December 1997).

Domingos X. Viegas
ADAI - Associacao para o Desenvolvimento da Aerodinamica Industrial
Apartado 3131
P - 3000 Coimbra

Fax: ++351-39-7000-771
Tel: ++351-39-7000-732
e-mail: dxvuc@gemini.ci.uc.pt

Working Meeting of the EARSeL Special Interest Group (SIG) on Forest Fires

Taking advantage of the 3rd International Conference on Forest Fire Research, to be held in Coimbra, 16-20 November 1998, the Special Interest Group on Remote Sensing and Forest Fires (RSFF-SIG) within the European Association of Remote Sensing Laboratories (EARSeL) will organise a technical meeting on Saturday 21 November. This short meeting will be an opportunity to review current state of research in remote sensing analysis of forest fires, bringing active experts on this topic to exchange ideas and promote collaboration. Scientists who intend to present papers should send the abstracts to the organisers of the 3rd international conference, since this seminar will be structured in technical discussions but will not include formal presentations. Three keynote speeches will be addressed, summing up some controversial issues in the field of fire risk assessment, fire detection and burned land mapping.

Responsible Technical Coordinator of this meeting will be Emilio Chuvieco, EARSeL RSFF-SIG. Although no papers will be delivered at this meeting, scientists intending to contribute to the technical discussions may send a 1-2 page abstract with information relevant to the discussions. These abstracts will be copied and distributed to the participants. A small fee to cover meals and room rental will be required. Further information may be obtained from:

Emilio Chuvieco
Departamento de Geografía
Universidád de Alcalá
C/Colegios 2
E - 28801 Alcalá de Henares

Fax: ++34-1-885-4439
Tel: ++34-1-885-4438
e-mail: <ggecs@geogra.alcala.es>
http://www.alcala.es/departam/geogra/depgeo.htm

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FROM THE PRESS

Historical Steam Engine on Repair Trip Causes 20 Wildfires

Meiningen/Schweinfurt (Germany) On Monday afternoon an historical steam engine caused around 20 wildfires and kept 140 fire fighters busy between Schweinfurt and Meiningen. The historical steam engine, owned by a private company, was on its way from Stuttgart to the "Steam Engine Factory Meiningen". In the beginning several small fires were recorded between Poppenhausen and Kronungen, where the flames were burning in a hackneyed grainfield. Later on 15 other wildfires in the Rhön-Grabfeld district were recorded. Because of the accumulation of the burnings along the railroad, it was soon thereafter discovered who the responsible culprit was, since its sparks had given it away. The train was thereafter taken out of commission at the train station in Bad Neustadt. According to the police report, "the locomotive had to first let off some steam". The journey could then only be continued by the towing of another diesel engine. The factory in Meiningen is the only factory in Europe which is able to repair historical steam engines. Its main customers are private railway companies, museums, and railway clubs.

Source: ddpADN, 27 August 1997