UNITED NATIONS
ECONOMIC COMMISSION FOR EUROPE

FOOD AND AGRICULTURE ORGANIZATION
OF THE UNITED NATIONS

# INTERNATIONAL FOREST FIRE NEWS

No. 19 – September 1998

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## NOTE



**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:**

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The publication is edited and prepared by Johann Georg Goldammer, Leader of the FAO/ECE/ILO Team of Specialists on Forest Fire, at the Max Planck Institute for Chemistry, Germany. The preparation of this issue was supported by Florian Resch and Georg Buchholz (both Max Planck Institute for Chemistry, Global Fire Monitoring Center).

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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 (text as non-encoded ASCII file, Word Perfect 5.1 or Word 6.0, Word97/8; graphic files saved as .JPG or similar) 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

It looked like a global ***Ring of Fire***. In mid-1997 the first fire signals came out of the rain forests, swamps and farmlands of the Indonesian archipelago. It looked as they jumped over the Pacific and burned the rain forests of Amazonia and the neighbouring Guyanas, crossing the land bridge to Mexico where they left hundreds of thousands of hectares burned. After sending precursor warning signals - smoke - the fires seemed to leap to the Southeast of the United States. While Florida and Georgia suffered a mix of lightning fires and negligent ignitions started by people, the fire fronts which had crossed the Atlantic were driven by arsonists, right into the center of Athens, burning the hills around the Acropolis. From there it seemed that fires continued to travel East, finally ending at the Eastern edge of Siberia where they are still raging at the time of writing this editorial.

In the media the puzzle of fire reports from all over the globe produced an impression that the globe was set on fire in an unprecedented magnitude. In some cases this was true. Mexico, for instance, suffered its worst fire episode for decades, and the smoke concentration in Malaysia was never as high as it was in the last months of 1997.

There was no ***Ring of Fire***, there was no connectedness of the global fire events at all. The drought caused by El Niño in some places allowed people to burn more than usual, and more wildfires started from escaped land-use fires in drought-stressed rain forests as compared to the last 10 years. In other regions the drought reduced plant growth, thus nothing was left to burn. Ignitions by lightning storms are independent of El Niño and politics, and politically and economically motivated arson does not have any roots in climate variability.

In the public discussion and at the international political level requests for more reliable information on global fire - on good fires as well as on bad fires - increased month by month. This was the moment when several groups of internationally working fire scientists and globally oriented fire managers, which had cultivated the global fire arena in the spirit of international and interdisciplinary cooperation since more than one decade, felt challenged. The UN **International Decade for Natural Disaster Reduction** (IDNDR), new co-sponsor of **International Forest Fire News** encouraged the representatives of these groups to make global fire issues more transparent for those who make decisions and for those who suffer from the effects of fire. So did other UN organizations, like the **United Nations Environment Programme** (UNEP) by coordinating the UN response to fire in Indonesia, the **World Meteorological Organization** (WMO) in developing collaboration in mitigating the effects of transboundary smoke pollution, the **World Health Organization** (WHO) in preparing the guidelines for reducing health problems arising from smoke, the **Food and Agriculture Organization** (FAO) by discussing appropriate strategies for land-use and fire policies.

The IDNDR encouraged to realize what had been proposed by international fire specialists since many years. Through the support through of German IDNDR funds the **Global Fire Monitoring Center** (GFMC) with its core activity, the **South East Asian Fire Monitoring Center**, is now being created.

The GFMC has been established. Funded by IDNDR, implemented by the Fire Ecology Research Group in the new building at Freiburg Airport (Germany), jointly supported by the UN-**FAO/ECE/ILO Team of Specialists on Forest Fire**, their 11-years old information platform International Forest Fire News, and the fire research organizations under the umbrella of the **IGBP/IGAC, IUFRO and IBFRA** (see co-sponsor logos on page ii) the GFMC will be on the Internet starting in late September 1998. The address is:

**<http://www.uni-freiburg.de/fireglobe>**

Internet readers will find all information on global fire which is needed for assessment of current and historic fire situations in many countries, on fire research and technology development, on remotely sensed data on fire, weather and smoke, and on important events such as scientific conferences and political initiatives. The GFMC aims to systematically compile a global fire dataset, an initiative of the Global Vegetation Fire Inventory.

Freiburg, August 1998 — Johann G. Goldammer

THE GLOBAL FIRE MONITORING CENTER (GFMC)

## GUEST EDITORIAL

### *The Political Ecology of Fire*
### *Thoughts Prompted by the Mexican Fires of 1998*

by Stephen J. Pyne

The fires are nearly everywhere visible in Mexico, and nearly everywhere the population - officials, foresters, citizens - believes they will lead to important reforms. Big fires sometimes do. But not often, and frequently they propel reforms for reasons that have little to do with fire, politics, and perhaps surprisingly, economics.

Just as drought does not cause fires, so big fires do not by themselves create political change. Here as elsewhere fire's greatest impacts result from its ability to interact with other phenomena. Yet of all the varieties of fire scholarship, the political ecology of fire is perhaps the least studied. Surprisingly, granted the fire community's insistence that governments take action, the subject is almost unknown in any systematic way.

This could change. The 1997-98 ENSO-induced fires on both sides of the Pacific, the new countries created after the breakup of the USSR, major policy reforms in places as diverse as Germany, the United States, and South Africa, all offer an opportunity to study the politics of fire. Whether or not the 1997-98 fires result in practical reforms, they offer an opportunity to reconstitute our knowledge of how fire and humanity interact.

* * *

Fires create opportunities. Reviewing the aftermath of the 1983 Ash Wednesday fires in Australia, D. R. Douglas offered a "sad scenario" of postfire succession. First comes "an elaborate enquiry followed by an excellent report." On occasion some legislative reform follows, typically addressing the need for improved bushfire suppression. Bushfire research flourishes for a while, then withers away. So do many reformist enthusiasms and practices. As the years pass there is a slow, steady return to the ***status quo ante***. This scenario holds true for most countries, and it suggests the basis for a kind of general model.

The politics of fire is not unlike the ecology of swidden. The opportunities for change are greatest in the first year, drop significantly after the second, and almost disappear by the third. Sites recover quickly, memory overgrows with the weeds of everyday life, the media moves feverishly on to new disturbances. Just as a fire's effects are prolonged and more profound if the site is grazed or logged or otherwise manipulated, so if a big fire connects to some other social, intellectual, or political movement, it can leverage its consequences.

But this can be overdone. If fire is part of a general wreckage, environmental or social, its particular urgency may be lost. The fires that have accompanied revolutions or Black Death-type plagues were little more than the char left by more profound social upheaval, like the blackened stones of a sacked city. However vast their presence, they did not result in fire-specific reforms. The fires must connect to larger political movements, but not too large. It will be interesting to see, for example, the varying responses of the Asian countries that have been traumatized by simultaneous environmental and economic crises. Too little shock, and the fires can be safely ignored as an ENSO aberration. Too much - say, if accompanied by political crisis as in Indonesia - and there may be little will or institutional apparatus by which to deal with them. Burning malls in Jakarta will mean more than fired fields in East Kalimantan.

* * *

Perhaps the best known history is that from the United States. In each instance of major policy reform, large fires acted as catalysts in what was, for other reasons, a favourable context for action. The 1910 fires occurred during a time of peace and relative prosperity that was also a time (the Progressive Era) recognized as a period of political activism and reform. No other crisis obsessed the nation. The fires commanded center stage. Another era of restructuring occurred during the Great Depression in which large fires in the backcountry coincided with single-party domination of Congress and the Presidency (a coincidence rare in American history) and a President determined to merge conservation programs with public works. Policy debates and eventually changes during the 1960s and 1970s surfaced amid a de facto social revolution. It is probably no accident that the federal agencies did not complete their reforms until after the Vietnam war and the Watergate crisis had concluded. All these episodes suggest that fire reform depends on timing: it requires a general crisis, highlighted by fire, sufficient to scare the political establishment but not so damaging that it cripples the capacity to act.

Yet the political ecology of fire is more subtle and profound than this suggests. Political coincidence is not enough, as the reforms prompted by the disastrous 1994 season in America demonstrate. At nearly $1 billion suppression costs were large, but the country had not seriously questioned such expenditures before. The loss of 34 firefighters was exceptional, but crews had been burned over previously without catalyzing serious reforms. Fires had grown more intense, the area burned on public lands vaster, the imbalance between fire use and fire control more pronounced; yet these circumstances had evolved over many decades without a sense of crisis. The Republican Party's electoral take-over of Congress argued for some reform, but the party's platform advocated less, not more, government.

What made the 1994 fires significant was that two years earlier Norman MacLean had published **Young Men and Fire**, his meditation on the 1949 Mann Gulch fire that killed 13 smokejumpers. The South Canyon fires eerily recapitulated the events of that best-selling book. The media - the public - had a prism through which to view the tragedy. The events acquired political importance because they achieved a broad cultural significance. The American public knew, or thought they knew, what the fires ***meant***. There was little protest over a major policy change.

But there has been little practical outcome with regard to instituting controlled burning as a symmetrical practice with suppression. One reason, I suggest, is that behind the 1994 narrative stands another: the story of the 1910 fires. Even **Young Men and Fire** was a modern restatement of that epic, not a challenge to it. The United States has no other ***story*** to tell about wildland fire. There is no narrative for controlled burning or fire ecology equivalent to that created in the great crucible of 1910. Until there is, reforms that seek to fundamentally reposition American fire practices will not occur on the scale proposed for them. The American tragedy was not merely its postwar ambition for a program of fire exclusion, but its commitment to specialists who could no longer engage their larger culture.

Something like this will decide the long-term success or failure of fire reforms after what the World Wildlife Fund has fatuously termed a historically unprecedented year for fire. The political ecology of fire is not a science, will never be a science. But it can aspire to a rigor of scholarship at least akin to that known for history and anthropology. No responsible authority would send out a fire crew untrained in the basics of fire behaviour or without some forecast of likely risk. Yet fire institutions routinely argue for political solutions without understanding any better the political behaviour of fire reforms and without some empirically informed sense of what the odds for success and failure are.

* * *

Reform-minded Mexicans would do well to ponder these observations. They have a year, probably no more than two, to instigate official programs in response. That would coincide, moreover, with the fundamental rhythm of Mexican politics: the 6-year tenure of its powerful presidents. Traditionally every new occupant reorganizes and renames the bureaus under his direction. A fire program would have to survive that process.

This time, however, the political context has altered profoundly. Mexico is experiencing the greatest social turmoil since its revolution. It is moving away from one-party politics dominated by the PRI; it is feeling the economic impress of the North American Free-Trade Agreement; ***narcotraficantes*** in the north and rebellious peasants in the south are pushing the borders of internal politics, as immigration, legal and illegal, into the U.S. are redefining its relation with its superpower neighbour. This year's fires have burned within an extraordinary context.

In searching for a suitable response, Mexicans have several levels of analogy open to them, many drafted from America. Mexico would be wise to scrutinize the Florida fires that flared as its own were dying out. Even the U.S. with its immense firefighting resources was helpless and had to evacuate almost 100,000 residents. Mexico has a long tradition of responding to internal unrest with military force; the Florida experience suggests the limits of that option with regard to fire. While it clearly needs to improve fire control, particularly at a community level, suppression will not solve the larger problem. Undoubtedly Mexico will also look to

American science and information technology. It will use the crisis to push for satellite imagery, computer modelling, radios, air tankers. Yet this too, while necessary, may prove surprisingly limited unless they connect with a broader culture.

As Mexico looks for advice and examples, it should not only examine computer modelling of fire behaviour and risk, and explore the technology of GIS and assess the impact of the fires on biodiversity, it should develop its cultural consciousness of fire. It needs to find folk heroes among the campesinos killed fighting fire in Puebla; needs to perceive the incinerated hillsides around the Valley of Mexico as a threat to its national identity, as the smoke was to public health; needs to promote a response to the burned cloud forests at Chimalapas more culturally engaging that debris dams and reforestation; needs, finally, to find an Octavio Paz or Carlos Fuentes to incorporate the saga into its national literature. It needs, that is, to metamorphose from the hundreds of thousands of burned hectares, the grim fatalities, the opaque smoke, the helpless and stinging embarrassment into a story that speaks to its deepest desires and sense of itself.

This last January a new museum opened on the Cerro de la Estrella, a hill in the center of the Valley of Mexico and scene of the fabled Aztec "new fire" ceremony. During the rite, celebrated every 52 years, all fires in the surrounding landscape were extinguished, a new fire kindled from a special wooden drill, and its flames redistributed to all the cardinal points. The new fire drove back the threat of darkness and demons. It may seem odd to link a museum dedicated to precolumbian rituals with a profession that prides itself on its electronic gadgetry, its air tankers, its paramilitary discipline. This year's wildfires after all burned over the Cerro, as they did most the surrounding landscape. But it is precisely this linkage of new fire with old that will measure the depths and successes of Mexico's anticipated reforms.

*The author thanks Dante Arturo Rodriguez Trejo, Baldemar Arteaga Martinez, and the Forest Sciences Division of the Universidad Autonoma de Chapingo for their support on his recent tour of central Mexico.*

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## SOUTH EAST ASIA FIRE SPECIAL

### *Transboundary Haze Pollution in Southeast Asia*

During the second half of 1997 and early 1998, forest and land fires in Indonesia have dominated our daily news and conversations. Their extensive effects on neighbouring countries as well as to the global environment have been the concerns of the world-wide community. The handling of the so-called "haze" or biomass-burning problem requires a long-term, systematic and holistic approach that addresses the underlying drivers or such events are likely to occur again and again. The recent national and regional economic turbulence should not distract our efforts to find both technical and policy-wise solutions.

Fire has been used as part of the management tool in land preparation, practised by smallholder farmers for centuries. The practise is very much oriented on crop rotation, rather than land rotation, meaning that near-natural canopy cover and sustainability of soil fertility may be expected in such a relatively small-scale operation. This is particularly important for tropical environment where destructive effects of torrential rains are often encountered.

Since the forest logging operations were started in mid 1970s, the scale of land-use change was no longer small. Rotation and selective logging was rarely practised. The activities were dominated by forest conversions for the expansion of agricultural lands, settlements, and tree crop-based large-scale plantations. The logging operators own bigger capital with main objective to extract the timber. The wastes are usually massive and land degradation is very extensive resulting unproductive Imperata grasslands. At the conversions of logged-over forests waste removal is very costly and the easiest and cheapest way is burning. There is no economic instrument attractive enough to reduce waste or legal instrument that is effective enough to punish the destruction of natural resources and the environment.

**How fires have been started?**

During the Alternatives to Slash and Burn (ASB) Project administered by ICRAF and an Indonesian consortium of scientists it was identified that fire can be used as a tool but in some cases it is also used as weapon. In either case fire can escape and be wildly spread, especially when the prolonged dry season occurs.

As a tool fire has been extensively used for many years to clear the lands for traditional agriculture since it is considered as the cheapest and easiest way to do so. In the long fallow rotation of the so-called jungle rubber in Sumatra and Kalimantan fire is also used to remove most of the biomass including the woody parts before new plantations are re-established. There are no incentives to encourage smallholders to process or utilise rubber wood so that less burning will be practised. Instead, various local levies are imposed to rubber wood traders. Moreover, heavy export taxes on sawn rubber timber and other timbers produced by smallholders were introduced in 1989. The taxes, which were intended to promote downstream wood processing, are even higher for less-processed wood. In fact, rubber wood and other woods produced by smallholders are by-products. Indonesia has a large stock of old rubber trees and smallholder farmers own most of them. And yet, since 1993 only less than 30% was used compared with more than 80% in Thailand and over 60% in Malaysia. Unless the disincentives are removed, attractive markets provided, and appropriate wood-processing technologies made accessible, the large portions of smallholder rubber wood will go up in smoke and contribute to haze problems. Economic instruments and appropriate technological tools that increase the income of smallholder farmers and at the same time save the environment are urgently needed.

**Fig.1.** Scenes like this burned forest conversion site were predominant during the 1997 fire and smoke episode: The amount of plant biomass burned on clearcut forests is much higher than on wildfire-affected sites. Photo: J.G.Goldammer

Many coverages on the transboundary haze by international media have underestimated the underlying social processes. Fire may be deliberately used as a weapon to claim the lands. The actions may be taken by both smallholders and large operators, because the land titling and tenure systems remain unsolved. As soon as crops are introduced smallholders can occupy the lands. Similarly, fire set by large scale development project-related activities can be used to drive the local people out of their lands. Fires can be and have been fully controlled for centuries by those whose ownership is secured. Only in islands or provinces where land ownership is not clear do fires become widespread. Monitoring, prevention, reporting and fighting of fire community level then become a complicated task. It is a high time to think of the reconciliation between the traditional ***adat*** laws and the official agrarian laws.

During the fire-prone period dry fuels are readily ignited and lead to large wild fires. Accidentally spread fires, however, may have the same underlying socio-economic and institutional problems. In cases like this fire suppression can be very difficult and costly, especially when they reach peat-swamp areas. The smouldering smoke may last for quite a long time, blanketing the region and choking its population. The economic impacts and ecological consequences caused by the smoke and haze have been a pronounced disaster of the century

**El Niño**

The great Indonesian fires are always associated with the El Niño events. This is an oceanographic phenomenon when a strong and extensive warming occurs in the upper ocean in the tropical eastern Pacific. This is linked with a change in atmospheric pressure known as the Southern Oscillation, and the overall phenomenon is often called ENSO. The typical global impacts of ENSO is the anomaly pattern of rainfall and temperature. Rainfall is shifted eastward from Indonesia to the central Pacific causing a prolonged dry and hot weather in the archipelago, the Philippines and northern Australia.

Much speculation and many misconceptions have been built around the fire issues and the El Niño phenomena. Those who want to escape from the incompetence or negligence in using fire would find El Niño as a scapegoat. On the other hand the increasing frequency and intensity of El-Niño has been wildly speculated with climate change theory and global warming issues. During the recent COP3[1] in Kyoto, December 1997 WMO released an Update that addresses the questions and concerns of an audience that ranges from the general public to the policy makers. The document does not confirm that El-Niño is associated with the increased of greenhouse gas concentration in the atmosphere.

Quantitative expressions like Southern Oscillation Index (SOI) may be explored and used as a precautionary indicator for land clearing management or prescribed burning.

**Transboundary haze pollution**

The term transboundary pollution has become not only a technical term but also political. In the Association of Southeast Asian Nations (ASEAN) a Working Group on Transboundary Pollution was formed under the ASEAN Senior Officer on Environment (ASOEN) a few years ago. Following an ASOEN Meeting in August 1997 the Haze Technical Force was commissioned to formulate Regional and National Haze Action Plans. The plans are expected to meet the following objectives: (1) to prevent land and forest fires through better management policies and enforcement; (2) to establish operational mechanisms to monitor land and forest fires; and (3) to strengthen regional land and forest fires fighting capability and other mitigating measures. Various meetings and plans have been exercised under this important body in order to solve the problems.

The Regional Technical Assistant (RETA), ADB-funded activities will be launched to design the plans. In addition numerous technical assistance from donors/bilateral projects and studies by various organisations are being coordinated by the host countries. Most of these activities take place in Indonesia (see contribution by ASEAN on p.13 of this issue).

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[1] COP3 = 3rd Session of the Conference of Parties to the UN Framework Convention of Climate Change (UNFCC), Kyoto, 1-10 December 1997.

**Looking into the future**

The forest and land fires are not over, they will return. Therefore, there must be forward planning to manage fires and haze. International efforts and more importantly national resources should be optimised and strategies are needed to develop long term and comprehensive solutions. To a large extent fire is still needed. It is almost impossible to ban the use of fire, especially for the smallholders. A kind of prescription may be devised. Zero-burning land clearing or techniques that produce less smoke must be explored and implemented by large operators. It is too naive to neglect the long-standing land claim, especially by those who have been occupying the land inherited for centuries. Recognising the adat right will greatly minimise the conflicts over land allocation. Removing disincentives to smallholder timber production will not only alleviate poverty, but also save the environment.

Fire is not a mere technical problem. It is a complex socio-economic, cultural, as well as institutional problems that require a holistic and integrated approach and long-term strategies.

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**SINGAPORE**

***Singapore Environment Council Presents NGOs Concerns about Southeast Asian Fires to ASEAN Senior Officials***

The Singapore Environment Council (SEC) organised its first non-government International Policy Dialogue on Southeast Asian Fires on 4 and 5 June 1998. The two-day Dialogue brought together 45 representatives from 31 international and regional non-government organisations and private corporations. The Policy Dialogue made 30 suggestions for action to deal with the fires and the haze. The Singapore Environment Council has since taken up the call for action and has begun implementing some of the Policy Dialogue's recommendations. One of the key recommendations that arose from the Policy Dialogue was a need to have a dialogue session with ASEAN. Mr. Simon Tay, Nominated Member of Parliament and Director of the Singapore Environment Council was granted an opportunity to present recommendations from the non-government International Policy Dialogue today (18 June 1998) to ASEAN Senior Officials at their Regional Task Force Meeting held in Singapore. This was one of the first occasions that NGOs have addressed the ASEAN Senior Officials. In his address, Mr Simon Tay appealed to ASEAN Senior Officials to continually review the compliance of member countries as laid down in the Haze Action Plan and explore how NGOs might work with and supplement official efforts. The ASEAN Senior Officials welcomed SEC´s presentation and noted the recommendations made. SEC will work with the ASEAN Secretariat and the Asian Development Bank to establish a regular dialogue between NGOs and ASEAN Officials to improve coordination of efforts against the fires. Details of further suggestions are outlined in the attached statement (see following pages).

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*Singapore Environment Council*
*International Policy Dialogue on the Southeast Asian Fires*
*Statement to the ASEAN Senior Officials for the Environment*

**Introduction**

I would like to thank the ASEAN Senior Officials for the Environment for allowing me this opportunity to address them briefly on the fires and haze. I speak to you on behalf of the International Policy Dialogue on the Southeast Asian Fires, organized by the Singapore Environment Council on 4 and 5 June 1998.

The Dialogue brought together some forty representatives of international, regional and local non-government organizations (NGOs), think-tanks and academic institutions, and the private sector, as well as international and governmental institutions. The NGOs and think-tanks were encouraged by the statement of the ASEAN Ministers in 1998 welcoming the contributions that NGOs might make.

Let me begin by emphasizing that many of the NGOs that took part in the Dialogue have programs in Indonesia and our region. Many are working with government agencies and are well acquainted with the challenges faced. We acknowledged the limitations that larger developing countries face in dealing with environmental concerns. We also recognized that the Indonesia is experiencing a time of economic hardship, humanitarian emergencies in some regions, and political change. We are heartened that the government has promised reform. The NGOs at the Dialogue were also encouraged that ASEAN has promulgated the Cooperation and Action Plans and that, despite the economic difficulties facing many ASEAN members, ASEAN has shown commitment to regularly review the compliance with and possible improvements of the Action Plan. It is in this context that the Dialogue was held and that I present their concerns and suggestions. We wish to be constructive in our criticisms, and to offer suggestions and cooperation. A copy of the Chairman's Statement from the Dialogue is attached. The statement outlines some 30 suggestions addressed to ASEAN, Indonesia, NGOs and businesses. From these suggestions, allow me to highlight some for your attention. As I am addressing the ASEAN Officials, I will focus on those suggestions that concern ASEAN and Indonesia, and also on how NGOs might work with and supplement official efforts.

**General Perspectives**

Members of the Dialogue noted, with great concern, that the fires in Indonesia:

* were recurrent in nature, mostly of man-made origins, although worsened by El Niño climate conditions;
* related to the use and clearance of forest and other land, mainly by big business, engaged in logging and palm oil;
* could have been foreseen, given climatic forecasts and patterns of forest use;
* caused harm to human life and health, and damage to the environment, nature and to economic activity, estimated to be worth more than US$4.4 billion for Indonesia, Malaysia and Singapore alone;
* caused enormous harm and damage, not only to the region and the global environment, but first and primarily to the people, environment and economy of Indonesia.

We therefore take the view that:

* while immediate measures should be taken, medium and longer term measures are also essential for the future;
* while regional and international assistance should be given, Indonesia has a duty to act and to cooperate in taking necessary action.

**Suggestions**

Participants at the Dialogue called on ASEAN:

1. to recognize the human, environmental and economic costs of the fires;

2. to further focus plans for the sub-regional fire-fighting areas by prioritizing specific sites for strengthened fire-fighting and prevention, based on factors such as greater biodiversity, ecological value and the potential to release harmful gases if affected by fire;
3. to strengthen their existing Plans by fully recognizing international principles and laws, including those relating to state responsibility for transboundary pollution, biodiversity and climate change, and to ensure compliance;
4. to strengthen the capacity of the ASEAN Secretariat, especially in matters concerning the environment and sustainable development.

Participants at the Dialogue called on Indonesia:

1. to enforce its current laws against the use of fire by corporate offenders, effectively, and equally;
2. to coordinate their response both internally, between different agencies and ministries, and externally with countries, institutions and non-governmental organizations that offered technical and other assistance;

Participants at the Dialogue called on NGOs

1. to mobilize public concern on the fires;
2. to advocate and implement the increased use of credible environmental certification for timber and forest products, and for oil palm, to highlight companies which are good examples of best practice and expose the logging and plantation companies which are guilty of using fire to clear land.
3. to work with national authorities, local communities and with inter-governmental organizations, as appropriate for early detection and small-scale fire suppression; to increase their concern and capacity to deal with fires and their underlying causes; to provide information, assist in monitoring, undertake programmes and advise on policies.

I believe this may be one of the first occasions that NGOs have addressed the ASEAN Senior Officials for the Environment. We believe that NGOs can contribute to solutions regarding the fires. Following the statement of the ASEAN Ministers in 1998 to welcome NGO contributions, we ask for regular dialogue to be established between NGOs and ASEAN officials. A closer and regular dialogue with ASEAN officials would assist further cooperation and coordination in dealing with the problems of the fires and haze that concerns us all. It would also be a step towards realizing ASEAN´s vision as a community of people.

Simon SC Tay
Chairman, SEC International Policy Dialogue
Thursday, 18 June 1998

*Singapore Environment Council*
*International Policy Dialogue on the Southeast Asian Fires*

**Chairman's Statement**

On 4 and 5 June 1998, the Singapore Environment Council held its first International Policy Dialogue on the Southeast Asian Fires. The Dialogue was organized with support from the Singapore Institute of International Affairs and the Foundation for International Environmental Law and Development (FIELD-UK) and sponsorship from Shangri-La Hotel, Far East Organization and the Hanns Seidel Foundation.

The Dialogue brought together some forty representatives of international, regional and local non-government organizations (NGOs), think-tanks, academic institutions, and the private sector, as well as international and governmental institutions.

These included:

**NGOs:** the Nature Conservancy (USA-Indonesia), the Nature Society of Singapore, NGOs for Integrated Protection Areas (the Philippines), Singapore Environment Council, Worldwide Fund for Nature (WWF-Indonesia and WWF-Regional), World Resources Institute (Regional).

**Think-Tanks and Academic Institutions:** Asia-Pacific Centre for Environmental Law (APCEL-Singapore), Centre for Remote Imaging, Sensing and Processing (CRISP-NUS), Centre for International Forestry Research (Indonesia), Center for Tropical Forest Science, Environment and Economy Programme for South East Asia (EEPSEA-Canada), Foundation for International Environmental Law and Development (FIELD-UK), Institute of Southeast Asian Studies (ISEAS), Institute of Policy Studies (IPS-Singapore), Institute of Strategic and International Studies (ISIS-Malaysia), the Max Planck Institute for Chemistry (Germany), and Singapore Institute of International Affairs.

**Private Sector:** Bombardier Aerospace, Golden Hope Plantations (Malaysia), Singapore International Chamber of Commerce, and Shell-Brunei.

**International and Governmental Organizations:** Asia Development Bank, ASEAN Secretariat, BAPEDAL (Indonesia), United Nations Environment Programme, US State Department, US-Asia Environment Programme and World Conservation Union (IUCN).

The Dialogue called attention to the fires in Southeast Asia, and especially Indonesia, as a matter of regional and global significance. It called on Indonesia and other countries with fires to take appropriate actions to mitigate the present fires and prevent future fires. It called for coordinated action among the regional countries, ASEAN, the international community, international organizations, and non-governmental organizations.
The Dialogue noted that non-governmental organizations (NGOs) can contribute to solutions to the fires and called for greater coordination between NGOs working in Indonesia, the region and at the international level. It also called for regular dialogue to be established between NGOs and ASEAN officials.

Members of the Dialogue noted, with great concern, that the fires in Indonesia:

* were recurrent in nature, mostly of man-made origins, although worsened by El Niño climate conditions;
* related to the use and clearance of forest and other land, mainly by big business, engaged in logging and palm oil;
* could have been foreseen, given climatic forecasts and patterns of forest use;
* burnt up to 4.5 million hectares in 1997 alone, according to satellite monitoring by CRISP;
* caused harm to human life and health, and damage to the environment, nature, and to economic activity, estimated to be worth more than US$4.4 billion by a study by EEPSEA and the WWF; caused damage to Indonesia's neighbouring states, especially Brunei, Malaysia and Singapore, by reason of transboundary air pollution or "haze";
* caused damage to the global commons, by the release of green house gases, estimated to exceed the total greenhouse gases emissions of Western Europe in a single year, and by the loss of biodiversity, especially in mega-diversity areas of Indonesia and East Malaysia; and
* caused enormous harm and damage to the people, environment and economy of Indonesia.

### Members of the Dialogue

**Noted:** ASEAN has promulgated the 1995 Cooperation Plan on Transboundary Pollution and 1997 Action Plan on the Haze, with regular reviews in 1998, promising closer cooperation and joint actions for monitoring, fire-fighting and prevention, establishing sub-regional fire-fighting areas in Kalimantan and Sumatra and considering shared resources for fire-fighting and prevention;

Despite the economic difficulties facing many ASEAN members, ASEAN has shown commitment to regularly review the compliance with and possible improvements to the Action Plan;

And called for ASEAN and its member states:

* to recognize that the norm against intervention in the internal affairs of a state should not prevent effective response to transboundary pollution insofar as the damage is suffered by another state or the global commons;
* to recognize the human, environmental and economic costs of the fires;
* to help mobilise funds to prevent and control fires;
* to further focus plans for the sub-regional fire-fighting areas by prioritizing specific sites for strengthened fire-fighting and prevention, based on factors such as greater biodiversity, ecological value and the potential to release harmful gases if affected by fire;
* to strengthen their existing plans by fully recognizing international principles and laws, including those relating to state responsibility for transboundary pollution, biodiversity and climate change, and to ensure compliance;
* to make satellite monitoring and other information relating to the fires available as widely as possible, especially to NGOs and local communities;
* institutionalize review of actions taken on the fires by all concerned government officials and, further, to invite expert and concerned international organizations, scientists and academics and non-government organizations for dialogue and review;
* to balance economic cooperation with environmental concerns for sustainable development in regional plans, such as the ASEAN Free Trade Agreement and ASEAN Investment Area and sub-regional economic cooperation, especially the SIJORI Growth Triangle, linking Singapore and parts of Indonesia and Malaysia; and
* to strengthen the capacity of the ASEAN Secretariat, especially in matters concerning the environment and sustainable development.

**Noted:** The important role of international law, especially Principle 2 of the Rio Declaration, and that Indonesian authorities had accepted moral responsibility for the effects of the fires and haze;

Indonesia has ratified the international conventions on Climate Change and on Biological Diversity;

Indonesian authorities have sought to address the issue by passing laws to prohibit the use of fire, and increasing fines and penalties for offenders, naming some 180 suspected companies; and

The Indonesian government, experiencing a time of economic hardship, humanitarian emergencies in some regions, and political change, has promised reform, especially to eradicate nepotism, corruption and cronyism;

And called for Indonesia:

* to recognize a duty and obligation to cooperate with other countries and the international community in dealing with the fires;
* to seek sustainable development, balancing economic growth with environmental concerns;
* to enforce its current laws against the use of fire against corporate offenders, effectively, efficiently and equally, without favour or prejudice to any Indonesian or foreign business or investors;
* to coordinate their response both internally, between different agencies and ministries, and externally with countries, institutions and non-governmental organizations that offered technical and other assistance;
* to update its land use plans and to reform its land use policy so as to ensure sustainable use, so as to prioritize any land conversion to better protect forest land, rationally use marginal and degraded land, and exercise extreme caution in any conversion of deep peat swamps; and grant secure and sufficient tenure to users, empowering and recognizing the interests of local communities.

**Noted:** More than 18 different donors from the international community rendered assistance to Indonesia in 1997;

The UN Environment Programme (UNEP) has been welcomed by ASEAN to coordinate international efforts for fire fighting and prevention;

The Asian Development Bank has undertaken to provide technical assistance for ASEAN; and

The International Monetary Fund, World Bank and Asian Development Bank are working with the Indonesian government to deal with the economic crisis in that country by making necessary reforms.

And called for International Organizations and Bilateral Donors

* to support efforts by the UN Environment Programme and Asian Development Bank to coordinate assistance;
* not to over-emphasize fire-fighting, especially by high-technology methods; instead, to develop medium and longer-term responses to the fires and their causes, including education, systems of control, reforestation and agreed principles for the sustainable management of forests;
* to provide new and additional aid and assistance to Indonesia in response to the fires and for the environmental and humanitarian concerns arising;
* to work with the respective convention secretariats to develop appropriate policies and mechanisms to link the prevention of fires in Southeast Asia to the Climate Change Convention, and the Biological Diversity Convention; and
* for the IMF and other assistance programmes and packages not to raise the risk of fires by inappropriate policies and to further sustainable development, especially by addressing inappropriate subsidies and other policies affecting the rational and sustainable use of land.

**Noted:** The efforts of NGOs in Indonesia and the concern of NGOs in the region and internationally; and

The welcome extended by ASEAN Ministers for the Environment in 1998 for contributions by NGOs

And called upon NGOs

* to coordinate among NGOs in Indonesia and at the regional and international levels, for mutual assistance and support; and to avoid wasteful duplication;
* to establish regular dialogue with ASEAN officials;
* to mobilize public concern on the fires;
* to work with national authorities and local communities, as appropriate, for early detection and small-scale fire suppression, to increase their concern and capacity to deal with fires and their underlying causes;
* to work with inter-governmental organizations, where appropriate, to provide information, assist in monitoring, undertake programmes and advise on policies; and
* to advocate and implement the increased use of credible environmental certification for timber and forest products, and for oil palm, to highlight companies which are good examples of best practice and expose the logging and plantation companies which are guilty of using fire to clear land.

**Noted:** Businesses and private sector companies are both involved with and affected by the fires and the resulting "haze" pollution

And called upon Businesses and Private Sector Companies:

* to faithfully comply with Indonesian national laws against the use of fire;
* to transfer appropriate technology to enable zero burn land clearing for palm oil and other plantations, and increasing efficiency in logging and timber processing;
* to review their business practices to lessen environmental damage that results from their economic activity, to establish and uphold best practices in their industry and expose the misdeeds of pollutive producers; and
* to seek appropriate certification for their products to ensure sustainable management of resources under their stewardship.

Simon SC Tay
Chairman, SEC International Policy Dialogue
Friday, 6 June 1998

This statement records the chairman's interpretation of views expressed in the Dialogue. It does not reflect a unanimous or consensus view of the participants of the organizations represented.

The International Monetary Fund, World Bank and Asian Development Bank are working with the Indonesian government to deal with the economic crisis in that country by making necessary reforms.

And called for International Organizations and Bilateral Donors

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* not to over-emphasize fire-fighting, especially by high-technology methods; instead, to develop medium and longer-term responses to the fires and their causes, including education, systems of control, reforestation and agreed principles for the sustainable management of forests;
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* for the IMF and other assistance programmes and packages not to raise the risk of fires by inappropriate policies and to further sustainable development, especially by addressing inappropriate subsidies and other policies affecting the rational and sustainable use of land.

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The welcome extended by ASEAN Ministers for the Environment in 1998 for contributions by NGOs

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ASEAN

***Asian Development Bank (ADB) Support to the Association of Southeast Asian Nations (ASEAN) via a Regional Technical Assistance (RETA) "Strengthening ASEAN's Capacity to Prevent and Mitigate Transboundary Atmospheric Pollution Resulting from Forest Fires (RETA 5778-REG)"***

## Project Background

Land and forest fires have occurred in Southeast Asia since the Pleistocene Age. Long-term climate variability (glacial versus non-glacial climate) and short-term climate oscillations caused by the El Niño-Southern Oscillation (ENSO) event have regularly created conditions that make even rainforests vulnerable to wildfires. Fire is also linked to human interventions, which include: (i) temporary forest conversion by traditional slash-and-burn systems; (ii) permanent forest conversion for establishment of agriculture, including estate crops, food crops, horticulture, and livestock; (iii) conversion of natural forest (mainly exploited or otherwise degraded secondary forest) into industrial timber plantations; (iv) drainage of peat swamps; and (v) wildfires (i.e., land clearing or land preparation fires that escape into surrounding natural forest, peatlands, or plantations).

In response to the fire-and-smoke episodes in Southeast Asia during the periods of 1982-1983, 1987, 1991, 1994, and 1997-1998, several national and international initiatives, especially in Indonesia, were instituted. These included the Bandung Conference (Indonesia) in 1992, a number of regional workshops and meetings on transboundary haze pollution held in Indonesia and Malaysia between 1992 and 1995, and the establishment of the Haze Technical Task Force (HTTF) during the Sixth Meeting of the ASEAN Senior Officials on Environment (ASOEN) in September 1995.

While the objectives of the HTTF were to operationalize and implement the measures recommended in the 1995 ASEAN Cooperation Plan on Transboundary Pollution, which included measures for addressing the problem of fire and smoke, absence of specific operational plans rendered it ineffective. Consequently, the region faced another major episode of transboundary haze pollution in 1997. Because of this, affected ASEAN member countries decided to take more effective and concerted action to prevent and mitigate such disasters. On 11 December 1997, Malaysia and Indonesia signed a bilateral Memorandum of Understanding for collaboration in addressing the haze problem, and for undertaking a joint response to other disasters.

Given the significance of the social, economic and environmental impacts of transboundary atmospheric pollution in the region, especially following the 1997 regional haze episode, the HTTF undertook concerted efforts to finalize a response strategy in the form of a ***Regional Haze Action Plan (RHAP)***. The RHAP was completed in December 1997, and endorsed by the ASEAN Ministerial Meeting on Haze (AMMH) held in Singapore from 22 to 23 December 1997. The primary objectives of the RHAP are to: (i) prevent forest fires through better management policies and enforcement; (ii) establish operational mechanisms for monitoring land and forest fires; and (iii) strengthen regional land and forest firefighting capability, and other mitigation measures.

Following consultation with national, regional, and international agencies and bilateral donors, Asian Development Bank (ADB) formulated a program for addressing the causes of the economic and environmental damage from these fires, and for preventing their recurrence. This program consists of two separate, but inter-related technical assistance projects. The first of these is ADB support to a national initiative via an advisory technical assistance (ADTA) to Indonesia for addressing the problems resulting from forest fires. The second consists of support to the Association of Southeast Asian Nations (ASEAN) via a regional technical assistance (RETA) for strengthening ASEAN's capacity in preventing and mitigating transboundary atmospheric pollution resulting from the forest fires.

On 24 February 1998, ADB approved the RETA to ASEAN in an amount of US$1.0 million. At the request of the Government of Indonesia, ADB also approved the complementary ADTA in an amount of US$1.0 million on 20 March 1998. Operations under the RETA began in mid-April of this year. Operations under the ADTA are scheduled to begin on or about 20 July 198. The remainder of this article discusses the RETA´s objectives, scope of work, its work plan, and the progress that it has made since it began operations.

**RETA Objectives**

The RETA´s main objective is to strengthen ASEAN´s capacity in operationalizing and implementing the RHAP. It therefore leaves to other agencies the issue of suppression of fires that are already burning. Working in parallel with the national-level ADTA for Indonesia referred to above, the RETA will assist ASEAN in setting up a strong regional program for fire and haze prevention, monitoring and mitigation. It is also working to help develop inter-country cooperation arrangements for improving scientific understanding of the causes and consequences of transboundary atmospheric pollution as it affects ASEAN.

Since RETA operations will last only one year, its purpose is to temporarily assist ASEAN in setting up an organization structure for preventing, monitoring, and mitigating fires and haze. Because ASEAN may want, or require, continued assistance from international donor organizations in handling the problem of transboundary haze, another purpose of the RETA is to help coordinate assistance from a large number of international donor organizations. Even though the RETA has been in operation for only three months, it has already developed a large network of communication that includes the following donors. These include:

* UNDP
* UNEP
* UN-FAO/ECE/ILO Team of Specialists on Forest Fire
* South East Asian Fire Monitoring Center
* USAID
* US National Oceanic and Atmospheric Administration,
* US Centers for Disease Control and Prevention
* US Environmental Protection Agency
* US Forest Service
* GTZ (the German Technical Cooperation Agency)
* CIDA
* AusAID
* World Health Organisation
* World Meteorological Organisation
* European Community
* Hans Seidel Foundation
* JICA
* World Bank
* WWF
* IUCN
* Singapore Environment Council, and
* WALHI (an NGO umbrella organization that coordinates work with a large number of NGOs operating out of Indonesia).

**RETA Scope of Work**

There are seven key tasks that the RETA has chosen for itself. All of these help operationalize and implement the RHAP. The seven tasks are:

a) provide direct support to operationalizing and implementing the RHAP and National Haze Action Plans (NHAPs);

b) improve ASEAN Secretariat's fire-and-haze-related information management and dissemination system (which includes establishing an intranet for fire and haze episodes in ASEAN);

c) help improve the ASEAN Specialised Meteorological Centre (ASMC) in Singapore. This centre will serve as a regional hydrometeorological information center, and will collaborate closely with the national meteorological services in all nine of the ASEAN member countries;[2]

d) improve cooperation and collaboration among all types of agencies involved in fire prevention and mitigation;

e) establish fire detection and monitoring systems at the regional level;

f) perform regional-level fire-and-haze-related studies; and

g) hold regional seminars and workshops on fire-and-haze-related topics.

**RETA Activities Thus Far**

The RETA officially began operations on 12 April 1998 with the arrival of the Team Leader. After informal visits with a number of Jakarta-based representatives of international donor organizations and several key Government of Indonesia agencies, the RETA held an Informal Meeting of Donors on 23 April 1998 in Jakarta. This helped familiarize a large number of donor agencies with the RETA.

Some initial commitments to work with the RETA were made at an Open Forum Discussion held on 11 March 1998, again in Jakarta, since the RETA is housed in the ASEAN Secretariat Building in Jakarta. The following day, the RETA held its Inception Workshop, at which its work plan was formally approved. An important conclusion reached at this Workshop was the National Haze Action Plans should be developed for each of the nine ASEAN member countries. After all, if the RETA is to help ASEAN improve its fire suppression capability, most of this type of work must occur at the national level.

Because of the importance of the National Haze Action Plans in building ASEAN's fire suppression capability, the RETA held a Preparatory Meeting on National Haze Action Plans on 8-9 June 1998 in Manila, Philippines. A major conclusion of this meeting was that each country's National Plan should be highly operational rather than descriptive. The RETA assisted this process by presenting a recommended framework for operationalizing the draft National Haze Actions Plans of the ASEAN member countries. The RETA also co-financed the World Meteorological Organization (WMO) Workshop on Transboundary Atmospheric Pollution held in Singapore on 2-5 June 1998.

Upcoming issues of International Forest Fire News will give readers an update on RETA activities to keep them informed of how the RETA fares in achieving its goals.

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[2] The nine ASEAN member countries are: Brunei Darussalam, Indonesia, Malaysia, Myanmar, the Philippines, Singapore, Thailand, and Vietnam. Cambodia is expected to join the ASEAN community later this year.

## SINGAPORE

***Forest Fire Monitoring and Research Activities at the Centre for Remote Imaging, Sensing and Processing (CRISP), National University of Singapore***

### CRISP's Remote Sensing Ground Station

The Centre for Remote Imaging, Sensing and Processing (CRISP), National University of Singapore, operates a remote sensing ground station since September 1995 (Fig.1). It has been receiving data from the SPOT, ERS and RADARSAT satellites. The reception circle of CRISP's ground station for these satellites is as shown in Figure 2. To date, about 155,000 scenes of SPOT, 13,000 scenes of ERS and 6,000 scenes of RADARSAT images have been archived. A World Wide Web catalogue-browse system (http://www.crisp.nus.edu.sg) allows users to search the complete archive, with location maps and quicklook images available online.

### Research Activities at CRISP

CRISP conducts research in three areas: coastal and ocean studies, tropical vegetation studies, and remote sensing data processing techniques. CRISP maintains fruitful collaborative projects with international research organisations, e.g., tropical forest studies with CESBIO, internal wave and other studies with University of Hamburg, paddy field studies with IRRI and University of Can Tho, etc. CRISP is also the principal investigator for two ADEOS projects with partial funding from NASDA.

CRISP has also been actively using the remote sensing facilities for environmental monitoring. In 1996, it captured an ERS image of a ship discharging pollution into the ocean. With the help of this image, the culprits were convicted in court, and this image has become the first ever remote sensing image to have been accepted as court evidence. CRISP is now collaborating with the Maritime and Port Authority of Singapore in an project of oil slick monitoring with synthetic aperture radar remote sensing images. Since last year, CRISP has closely monitored the fires raging across the forests and plantations of the Southeast Asian region. With the high resolution SPOT images, CRISP was able to determine accurately the location of fires and to help determine whether the fires were associated with human activities. In collaboration with Singapore Ministry of the Environment, CRISP has implemented a daily fire monitoring operation. A careful analysis of the fires of 1997 is being carried out using imagery from SPOT, ERS and NOAA satellites. With the SPOT quicklook images, preliminary maps of fire-affected areas have been derived.

### Forest Fire Monitoring and Research

#### 1. Burnt area assessment using SPOT quicklook mosaics

The burnt areas in Sumatra, Kalimantan and Sulawesi have been mapped using mosaics of SPOT quicklook images before (January- June 1997) and during (August-December 1997) the 1997 fire episode, in order to estimate the total area burnt and the types of land cover on fire. Figure 3 shows the map for Sumatra with about 1.5 million hectares affected by the 1997 fires and Figure 4 shows the map for Kalimantan with about 3.0 million hectares affected. In Sumatra, the peat swamp areas stretching from the northern coast of South Sumatra to Jambi Province were observed to be affected by fires. In Kalimantan, the main fire activities occurred mainly on the Southeast and Southwest corners of the Borneo island. Most of the land affected by fires were associated with swamp forests and plantation/agricultural areas.

#### 2. Fire monitoring operation

A daily fire monitoring operation is being implemented at CRISP, in collaboration with the Ministry of Environment, Singapore. SPOT images over hot-spot areas in Southeast Asia are analysed on reception and reports and annotated images of fires are transmitted to the Ministry with minimum delay. The high resolution SPOT images are visually inspected to detect smoke plumes and burnt scars associated with fires, to provide the exact locations of fires and to assess the extent of fires and types of land cover on fires.

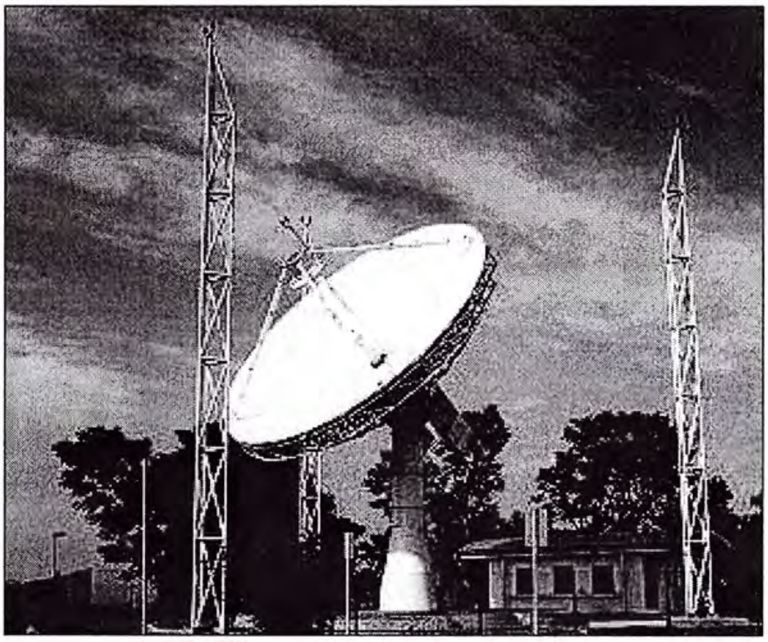



**Fig.1. and 2.** The antenna of the remote sensing ground station of CRISP (upper) receives satellite data within the geographic circle shown on the map (lower).

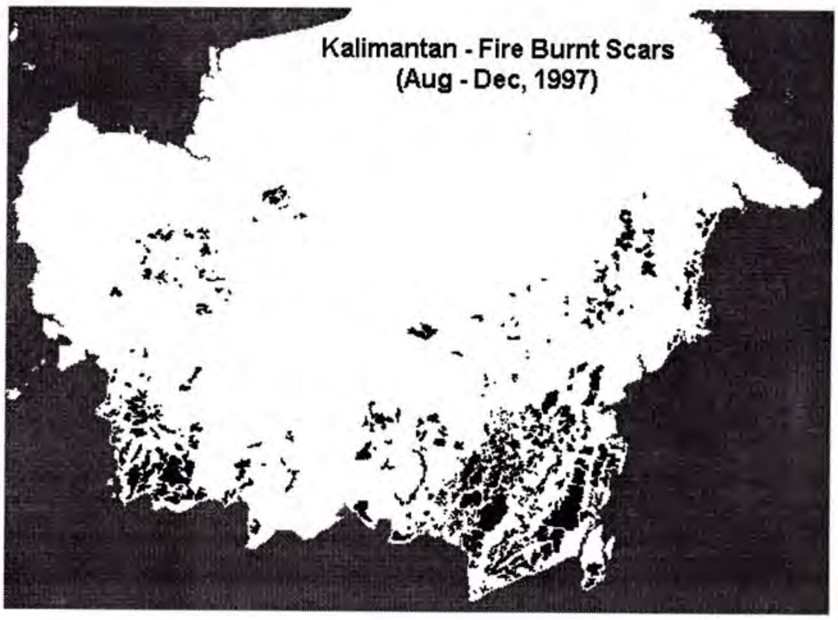
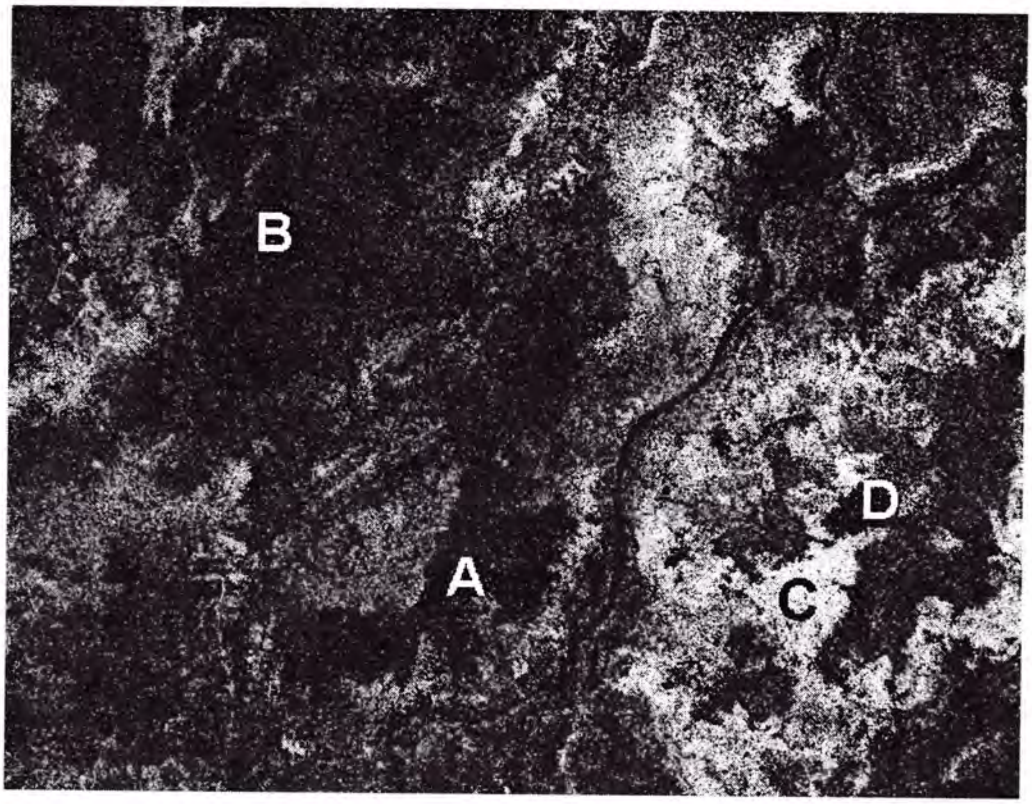




**Fig.3 and 4.** Maps of Sumatra (upper) and Kalimantan (lower) showing the area burned by the 1997 fires of ca. 1.5 million ha and 3.0 million ha respectively.



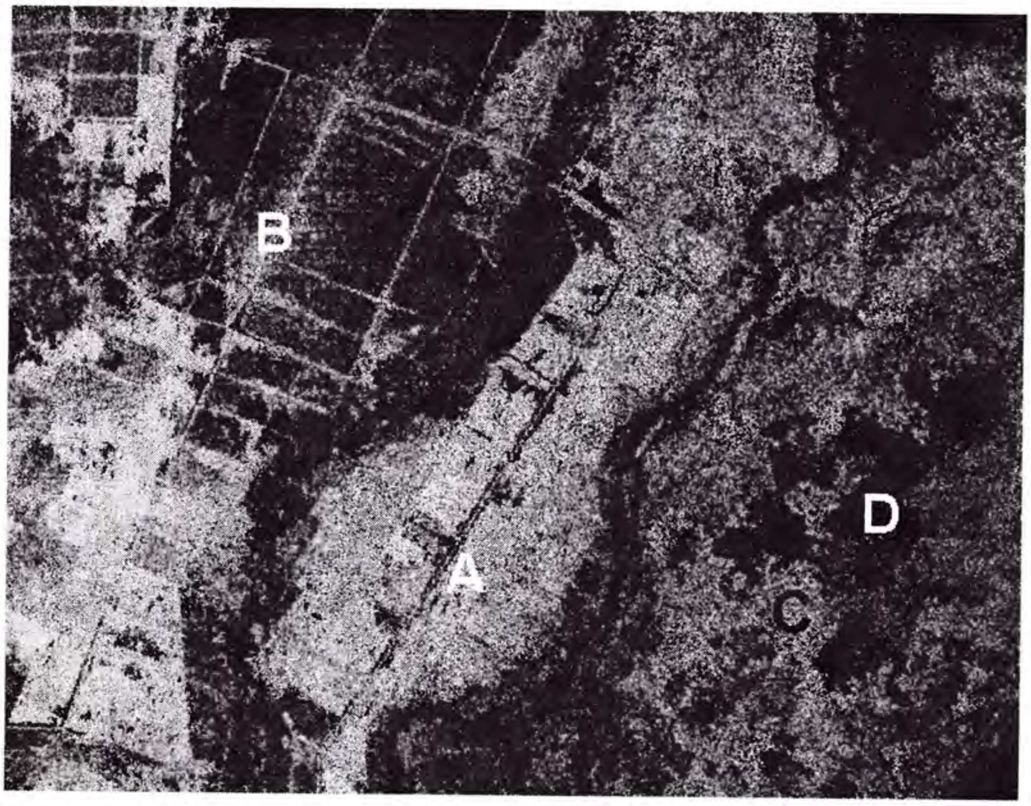




**Fig.5 and 6.** Interferometric coherence image of an area north of Banjarmasin, South Kalimantan, derived from the ERS-1/2 tandem SAR data on 10-11 April 1996 (upper). The lower image shows the same area derived from the SAR data acquired on 22-23 October 1997. In these two images, vegetated areas (low coherence) have dark tones while the bright areas are land clearings. Areas marked A and B were vegetated in April 1996 but were cleared in October 1997 by fires.

## 3. Change detection using ERS interferometric synthetic aperture radar images

Interferometric coherence and radar backscattering amplitude maps of selected fires affected areas in Kalimantan have been processed from ERS synthetic aperture radar (SAR) data acquired during the ERS-1/2 tandem missions in April/May 1996 and October 1997. Burnt areas can be correlated to the areas with low coherence in 1996 but an increased coherence in 1997. Figure 5 is the interferometric coherence image of an area north of Banjarmasin, South Kalimantan, derived from the ERS-1/2 tandem SAR data on 10-11 April 1996. This area is known to be severely affected by fires from observation using AVHRR and SPOT imagery. Figure 6 is the coherence image of the same area derived from the SAR data acquired on 22-23 October 1997. In these two images, vegetated areas (low coherence) have dark tones while the bright areas are land clearings. Areas marked A and B were vegetated in April 1996 but were cleared in October 1997 by fires. The linear features visible in the 1997 image are indicative of plantation/agricultural land use. Area C has already been cleared in 1996 while vegetation in area D has still not been cleared in 1997. Unlike optical imagery, SAR imagery is not affected by clouds or haze. Hence, SAR data can be used to complement optical images in mapping fire affected areas. A project to systematically map out the burnt area using coherence change over the whole southern coast of Kalimantan is in progress.

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## INDONESIA *Daily Forest Fire Observation from Space in East Kalimantan*

The Integrated Forest Fire Management Project (IFFM / GTZ Gesellschaft für Technische Zusammenarbeit) in Samarinda East Kalimantan provides several information on fire and fire occurrences in Kalimantan. Since April 1996, IFFM has received images from NOAA 12 and 14 satellites (**N**ational **O**ceanic and **A**tmospheric **A**dministration) four times daily. The NOAA satellites view a broad swath of the earth from a height of about 860 km and have a picture element resolution of 1x1 $km^2$ (pixel size). The satellites have onboard the AVHRR (**A**dvanced **V**ery **H**igh **R**esolution **R**adiometer) sensor, a five channel scanning radiometer with different spectral characteristics (visible, near infrared, mid infrared and far infrared).

The display and the quantitative analysis of satellite imagery of the AVHRR is provided by Sea Scan STARS (Satellite Analysis and Research System) software. The AVHRR data is provided by the HRPT (High Resolution Picture Transmission) Reception System provided by Sea Scan and built up by Dundee Satellite Systems. The further geographical processing is done with the Geographic Analysis and Display System (GADS) and ArcView (3.0a).

Originally, the AVHRR sensor has been designed for meteorological and oceanographic applications therefore special algorithm have been developed for the fire detection. The most suitable channels for the fire detection are the first two 'thermal' infrared channels, channel 3 and 4. The fire detection process is based on surface temperature measurements by channel 3. A pixel is detected as a **fire pixel** or as a **hotspot** when channel 3 is saturated by a specific temperature much below that of burning vegetation (Malingreau 1990, Kaufmann et al. 1990a, 1990b, Kennedy et al. 1994). Therefore to avoid false alarm detection because of high temperature background (soil), highly reflective clouds or sun reflection from water the satellite processing uses special algorithm. The IFFM receiving station uses several day-time and night-time tests. In particular, it uses the Multiple Threshold Algorithm after Arino & Mellinotte (1995).

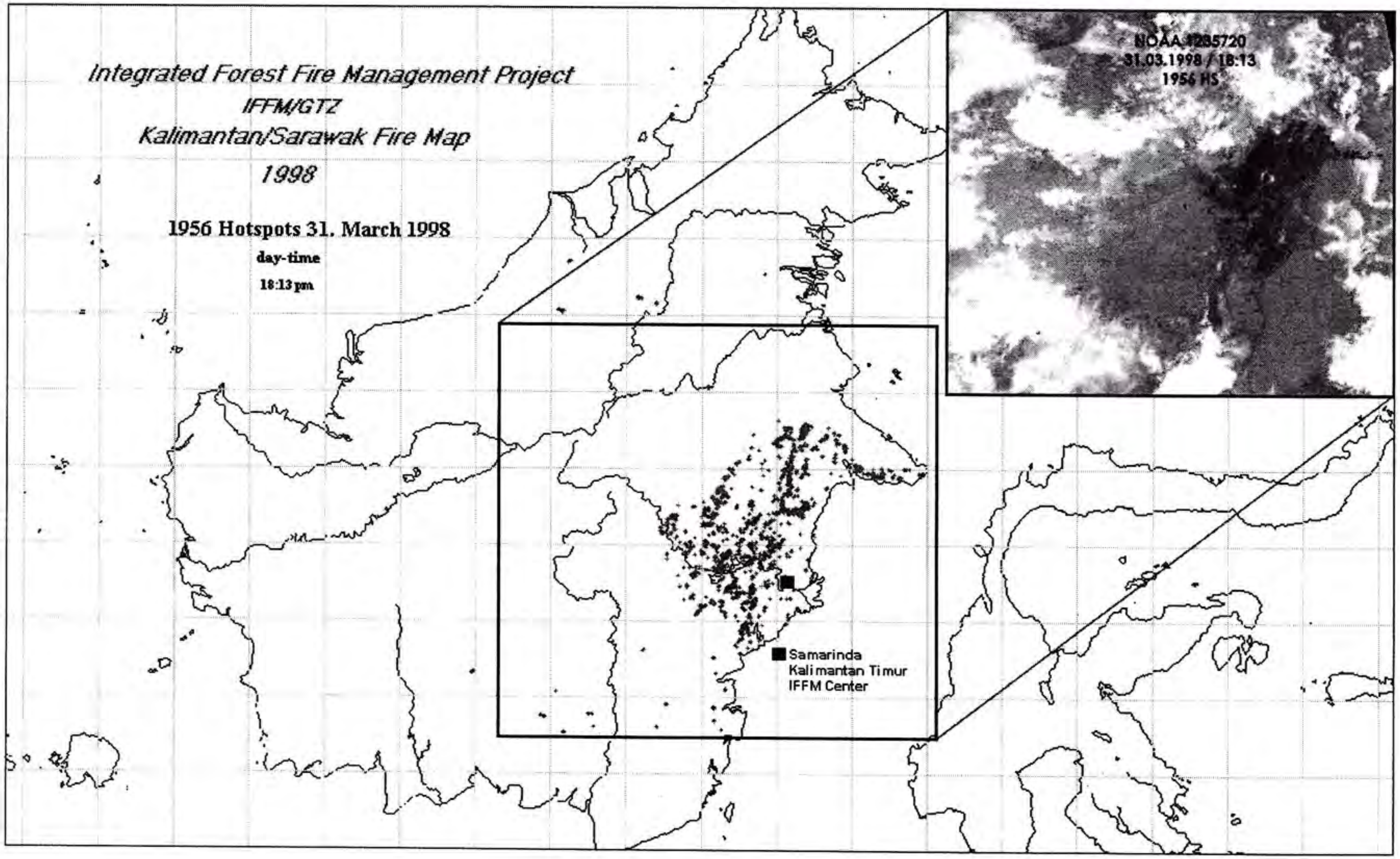


**Fig.1.** Example of a NOAA AVHRR scene with fire spots (upper right corner) which is posted on the daily updated project website (http://smd.mega.net.id or www.kaltimnet.com) (main map). The total number of fires detected on 31 March 1998 was 1956.

During the escalating fire season of 1998 (January to mid-May) in East Kalimantan IFFM delivered the daily hotspots data by facsimile and official letter to several government institutions. These include institutions such as Directorate General for Forest Protection and Natural Conservation, Director of Forest Protection, Governor of East Kalimantan, Control of Environmental Impact Bureau of East Kalimantan, Control of Environmental Impact Bureau Center, Forest Service for East Kalimantan, Department of Forestry East Kalimantan, Military Command East Kalimantan, Department of Plantation East Kalimantan, Department of Agriculture East Kalimantan, Department of Settlement East Kalimantan, Regional Development Planning Bureau East Kalimantan and Regional Military Command. Some government institutions used the hotspots data to monitor the forest fires and to undertake the fire suppression actions. Some analyzed the hotspots locations to warn the concession companies on burning areas. Some made plans for fund allocation for future rehabilitation programs.

In order to respond to outside inquiries especially from concession companies, the IFFM Project made a web sites to provide fire and background information as well the digital values of the hotpot coordinates in mid-February. The website (http://smd.mega.net.id or www.kaltimnet.com) provides the following information i.e. the project's activities, fire prevention activities, current fire situation report for East-Kalimantan, a haze guide or the Fire Danger Rating system based on weather data. The website provides several links to related web sites that puts out information on the current El Niño situation and other related fire information.

The IFFM web site provided the NOAA / AVHRR hotspot data as plotted maps and as digital coordinates in degrees, minutes and seconds and decimal degrees. The hotspot maps also showed information on cloud and thick haze coverage. As far as possible, the hotspot data had been daily updated.

Many other institutions as well as concession companies could take the hotspots daily data directly from the IFFM's web site to monitor concession and large holding areas.

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*Rehabilitation of Fire-affected Forests in East Kalimantan*

## Background

The fires burning in Indonesia during the El-Niño episode of 1997, and particularly in East Kalimantan in 1998, gained sad publicity all over the world and affected millions of people in Southeast Asia. Since the East Kalimantan fires were put out in May 1998 with celestial assistance (rain), the question comes up, what to do with the burnt areas, so that they will again be able to fulfil the economic, ecological and social functions required by their stakeholders. This question becomes a particular challenge, if one considers the present economic strains the country is facing. In the current crisis, various parties put emphasis on producing food to counter the food insufficiencies and to diminish imports of food commodities. A second emphasis is on gaining foreign currency income in the few still promising sectors, amongst others, agricultural plantations like oil palm, cocoa, rubber and coffee and partly timber. All these factors put strong pressure on the burnt forest lands and comprise functions, which the forest lands presently have to provide to the society.

## Purpose and Project History

In January 1998, the project "Promotion of Sustainable Forest Management Systems in East Kalimantan" (SFMP) - a cooperation between the Indonesian Ministry of Forestry and Estate Crops (MoFEC)[3] and GTZ - launched a special component addressing the above mentioned problem. It has a duration of two years.

The purpose of this new component of SFMP is on a pilot basis, to assist forest enterprises (private and state-owned), and local people to implement the necessary steps to rehabilitate fire-affected forests and to integrate them into their management systems. In addition to this, applied technology is being further developed in selected fields as well as with the Forest Research Institute of Samarinda (FRIS) in a demonstration plot for future dissemination.

This demonstration plot was set up as a cooperation project between MoF and ITTO (PD 84/90F) from 1992 to 1994, as a result of another MoF/ITTO cooperation in 1989 (PD 17/87F). In this project an inventory was carried out over the 3.2 mio ha of forests burnt in East Kalimantan in 1982/83. In both MoF/ITTO projects, extremely valuable results about the silvicultural options and technologies in fire-affected forests were developed, from which one can now draw.

Unfortunately, the above mentioned former ITTO demonstration plot for fire-affected forests was destroyed in the recent fires. An impressive result of five years intensive management of dipterocarp plantings was destroyed within a week. Now, not only at this demonstration plot, but almost everywhere in the forestry sector in East Kalimantan, there is a good chance to learn from the present experiences, so that in the future the same shortcomings do not happen again. This chance has to be taken now, while the momentum is still there.

## Short Analysis of the Recent Fires in East Kalimantan

An initial analysis of the damage patterns of fire-affected forests shows in general: *the higher the previous disturbance of the ecosystem, the higher the damage by fire to the forest* (Tab.1).

The main factors leading to the pattern described in Table 1 were dry conditions and degree of opening-up, with exposure to wind and high loads of logging waste (fuel for the fires). They determine to a major extent the degree of damage and spread of fires (fire hazard).

Silvicultural strategies for rehabilitation of the fire-affected areas have therefore to aim at leaving still intact forests as closed as possible. However, since logging cannot be avoided, reduced impact logging, environmentally sound road construction and the wise use of timber to prevent fuel being left in the forest, have to be the overriding principles in forest utilization.

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[3] Before March 1998, the Ministry comprised only Forestry (MoF)

**Tab.1.** Impact of the fires on forest land in East Kalimantan

| *Severely affected forest areas* | *Less affected forest areas* |
|---|---|
| • Fast growing timber estates (HTI) | • Old logged over forest and virgin forest |
| • Plantations using the line planting system | |
| • 200 - 300 m strips along forest roads | • Sites protected from wind |
| • Stands exposed to wind (slopes, wind channels, ridges) | • Protected valleys and wetsites |
| • Newly opened or severely degraded logged over and secondary forests | • Immediate surroundings of settlements (due to intensive fire suppression efforts) |
| • Rattan and other forest gardens | |
| • Alang-alang land (Grass land) | |

Apart from this, there won´t be any meaningful development of silvicultural systems in the future without an assessment of its impact on fire management, as El-Niño related droughts and fires might regularly occur in the lowland Dipterocarp forests in East Kalimantan. Until now, the impact of pre-suppression and suppression measures has been poor. During the 1998 dry season, e.g., there was no effective fire strip system to contain the fires on a large scale. Fire fighting crews were only successful in the closest surroundings of settlements, ranger and research stations and camps.

During the recent dry season fires where lit almost everywhere (fire risk). The reasons for fires are widespread ranging from carelessness of weekend campers to large-scale intentional arson by big companies. Land-clearing for oil palm and timber estates played a role, as well as, shifting cultivation, illegal logging, revenge, land speculation and other reasons which all reflect very dynamic and uncontrolled land occupation and use.

Proper land use planning and democratic and just principles in land use policy become an imperative in order to prevent such disasters in the future. This has to lead, amongst others, to a different approach for dealing with local people. They can effectively destroy forests, if they are treated as enemies, but they can also effectively contribute to fire prevention and suppression, if they are perceived as partners and can gain benefits from these efforts. A constructive cooperation with local people is therefore crucial for fire prevention in the future.

## Project Concept

Rehabilitation measures have to suit the needs and interests of their executors and beneficiaries, if they are to be implemented successfullys. Private and government owned forest enterprises (concessionaires) and local people were identified. As the main target groups for rehabilitation measures. Each require different approaches, but efforts are being taken by the project to bring both parties together.

**Focus Private and Government owned Forest Enterprises:** Although the total burnt area in East Kalimantan is not yet known, it is a fact, that the major part of it lies on forest concession land. Forest concessionaires will therefore carry the main burden of rehabilitation in the future. Until now, some concessionaires have been very eager to get a clear picture about their burnt areas and want to promote rehabilitation efforts in a proactive manner. The biggest, already known, fire-affected area in one concession is about 150.000 ha. Given these huge areas, it is obvious, that priorities for rehabilitation measures have to be set. The focus for rehabilitation will therefore be on severely damaged and accessible areas. Measures will have to start in these areas, where burnt trees can still be used (salvage felling) and planting measures should be carried out with a minimum amount of seedlings. Were suitable, local people should be of benefit of these areas through intercropping or taungya systems and through a participatory buffer zone management.

The sequence for planning and implementing rehabilitation measures can be seen in the following procedure:

Fire prevention and pre-suppression measures have to be part of rehabilitation measures. Besides silvicultural and forest utilization-related techniques as already mentioned above, a fire pre-suppression and fighting infrastructure has to be built up and, standard operation procedures and incentive systems for operational staff have to be adjusted or developed. In this field, the project works closely together with the Integrated Forest Fire Management (IFFM) Project, another MoFEC/GTZ cooperation based in East Kalimantan.

All these efforts have to be integrated into forest management systems aiming at sustainable forest management. This means a lot for companies, which are, until now, often used to timber felling only. If one considers a necessary cutback of the annual allowable cut in the fire-affected concession, one has to think about, what kind of benefits should a concessionaire have from these efforts if the license is lost after 20 years. Therefore, a suitable incentive system for large scale rehabilitation programs also needs to be developed by the project.

In two concessions, these methods are being implemented on a pilot basis. They are the same Forest Management Units (FMU), which are supported by other SFMP units, thus ensuring an integrated, systems-oriented approach concerning sustainable forest management.

**Focus Local People**: Only due to a recent paradigm shift taking place in the Indonesian forest policy, local people can now be given a higher priority in carrying out rehabilitation measures on forest lands in the area surrounding villages. Because of this, new programmes have to be developed and old ones improved, in order to better suit local peoples needs particularly in the present economical crisis.

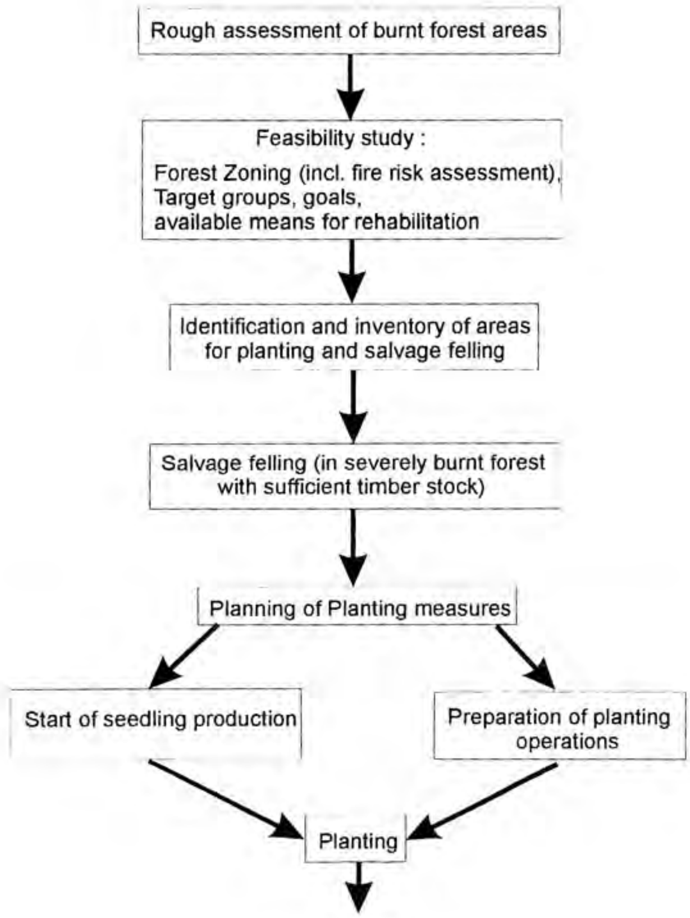


**Fig.1.** Procedure for rehabilitation of burnt forests in forest concessions

Taking all this into account, the project is presently developing a participatory approach, focussing on how to integrate rehabilitation measures into rural household systems. Based on group discussions, household interviews and other methods from the PRA tool box, it is envisaged, that enough consolidated ideas will be are jointly developed with local people to deal with burnt forest land. Based on these findings, short, medium and long-term measures will again be jointly planned, implemented and monitored. Such measures are presently being tried out by the state-owned forest enterprise Inhutani I together with FRIS, NGOs and GTZ experts in the frame of the Inhutani village development program (Bina Desa). The approach will also be implemented in the SFMP pilot FMUs and spread to other interested companies, NGOs and government agencies.

As it can be seen, the project focuses particularly on strengthening partnerships between forest enterprises and local people with mutual benefits. On the one hand, through participatory buffer zone development areas, security for forest management is increased. On the other hand, local people are assisted to improve their livelihood.

**Applied Research**

The long-term experiences of FRIS are used in order to re-establish the 1.099 ha demonstration plot for the rehabilitation of fire affected forests in Samboja. On the one hand, this plot will serve as a field for applied research on rehabilitation of natural forests bearing in mind a certain fire risk. On the other hand the demonstration plot will serve as a communication tool for extension and training purposes.

Research will mainly focus on; fire resistance of local species, development of extensive silvicultural systems, growth & yield studies and site related research. In addition to that, participatory research is carried out to involve local people in rehabilitation measures and particularly in the development of buffer zones in order to protect forest areas from fire.

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**SINGAPORE**

***Germany-Singapore Environmental Technology Agency (GSETA):***
***Asia-Pacific Regional Workshop on Transboundary Atmospheric Pollution***
***27-28 May 1998, Singapore***

The Germany-Singapore Environmental Technology Agency (GSETA) organised the Asia-Pacific Regional Workshop on Transboundary Atmospheric Pollution from 27 to 28 May 1998 at the Pan Pacific Hotel, Singapore. The workshop was opened by Mr. Tan Gee Paw, the Permanent Secretary of the Ministry of the Environment, Singapore and Mr.Hendrik Vygen, Deputy Director-General of the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety, Germany.

The GSETA was established in November 1991 by the Governments of Germany and Singapore. Its main objective is to facilitate the transfer of environmental management know-how and expertise to the Asia-Pacific region. The Asia-Pacific Regional Workshop on Transboundary Atmospheric Pollution was the $12^{th}$ event organised by the GSETA.

About 50 participants from both public and private sector of 11 Asia-Pacific economies, Germany and Singapore participated in the Workshop. Among them were also representatives from international institutions, research institutes and NGOs such as UN-ECE (including the leader of the UN-FAO/ECE/ILO Team of Specialists on Forest Fire), WWF Indonesia, IFFM Indonesia, EEPSEA, APCEL, DNR, the Max Planck Institute for Chemistry, Fire Ecology Research Group, and IIASA.[4]

Officials and experts from Germany, Switzerland, Austria, Malaysia, Indonesia and Singapore presented papers and shared their knowledge and experience on the subject of transboundary atmospheric pollution at the workshop. The workshop served as a forum for the participants to share and exchange information and experience on impacts, strategies, regional agreements as well as the mechanisms and programmes to deal with transboundary atmospheric pollution. Feedback from participants showed that they found the workshop beneficial and that the overall contents of the papers presented at the workshop were relevant and informative. Some of the points made by speakers and participants at the workshop are as follows:

**(a) European Experience**

Participants noted that the European experience in controlling long-range transboundary pollution was useful for countries in the Asia-Pacific Region and that there should be further cooperation and collaboration between the two regions in sharing information; and

Participants noted that while the UN-ECE Convention in the abatement of long range transboundary air pollution cannot be directly applied to South-East Asia, it would be useful in providing indications on the type of appropriate actions that could be taken.

**(b) ASEAN's Approach**

The usual ASEAN co-operative and non-litigious approach could be improved upon in order to deal more effectively with transboundary pollution problem;

Participants recognised that ASEAN countries are unlikely to embrace a strict regime to deal with transboundary pollution straight away. It will be an evolving process over time. Some of the suggestions to improve on the ASEAN approach include setting specific limits and standards to emissions, widen the policy review process to include the participation of NGOs, linking transboundary pollution to existing multi-lateral environmental agreements like Convention on Biological Diversity and the Framework Convention on Climate Change, strengthening the key regional institutions (e.g. ASEAN Secretariat), linking environment to economics and internationalising transboundary pollution concerns; and

Participants noted that atmospheric pollution in the ASEAN region arising from land use is not restricted to Indonesia and that extended fires were also burning regularly in the monsoon forests in other part of continental South Asia.

**(c) Forest Fires in Indonesia**

On the forest fires in Indonesia which contributed to transboundary haze pollution, some expert speakers expressed the view that prevention was the key and that spending massive resources to fight such uncontrollable fires might not be effective; and

The main causes of the fires in Indonesia (99% were human-made) were the forest concession policy (to convert forests to plantations), the land tenure system, lack of enforcement and the lack of control by plantation companies. A review of land use policies might be the key to preventing fires.

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[4] Acronyms: UN-ECE: United Nations-Economic Commission for Europe; WWF Indonesia: World Wide Fund for Nature, Indonesia; IFFM Indonesia: Integrated Forest Fire Management Project (Indonesia-German Technical Cooperation); EEPSEA: Economy-Environmental Programme for Southeast Asia, Singapore
APCEL: Asia-Pacific Centre for Environmental Law, Singapore; DNR: German League for Nature and Environment, Germany; IIASA: International Institute for Applied Systems Analysis, Austria

### (d) Use of Technologies

Participants noted the usefulness of using the various modelling techniques (e.g. RAINS), satellite imagery and high resolution remote sensing techniques in monitoring forest fires and the transboundary haze pollution;

The workshop recognised the need to explore technologies and socio-economically compatible methods to utilise plant biomass for energy production. This would not only reduce uncontrolled wildfire emissions and fossil fuel consumption, but also create employment opportunities for rural populations; and

Participants highlighted the need for exchange of real-time information on monitoring and predicting atmospheric pollution, including information on the sources and protocols to address transboundary pollution problems.

### (e) Economic Cost of Transboundary Atmospheric Pollution

The 1997 haze episode in the region had caused Indonesia, Malaysia and Singapore a staggering US$ 1.4 billion in terms of economic loss;

Economic losses by forest fires and air pollution are much higher than the costs for measures to prevent air pollution; and

Participants noted that the implementation of protocols e.g. to reduce sulphur emissions, also have positive economic benefits.

### (f) Involvement of the Public & NGOs

Public´s involvement in air pollution abatement by providing speedy and accessible information is crucial; and

NGOs also played an important role in the protection of the environment.

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## UNITED NATIONS

***WMO Workshop on Regional Transboundary Smoke and Haze in Southeast Asia***

### Executive Summary

The World Meteorological Organization (WMO) organized a regional workshop on transboundary smoke and haze in Southeast Asia, as part of its continuing response to the 1997 Forrest fire episodes which caused widespread air pollution and environmental problems throughout the region. The Workshop held in Singapore from 2 to 5 June, and hosted by the Meteorological Service Singapore and co-sponsored by the Asian Development Bank, brought together representatives from the National Meteorological and Hydrometeorological Services (NMHSs), the ASEAN Specialized Meteorological Center (ASMC), Regional Specialized

Meteorological Centers (RSMCs), invited experts as well as other agencies that are directly involved with fire-related activities, and other organizations that are helping countries to address the smoke and haze and related transboundary pollution issues.

The workshop focused on the 1997/98 smoke and haze episodes which interfered with civil aviation operations, maritime shipping, agricultural production, and the tourist industry. It also affected the health of populations in the region. The workshop was designed to further foster regional and international cooperation through the review of what has been learned during the latest fire season, and to plan and coordinate implementation activities aimed at improving the NMHS's ability to manage transboundary smoke and haze episodes. This included discussions of regional plans such as the WMO programme to Address ASEAN Regional Transboundary Smoke (PARTS) and the Regional Haze Action Plan (RHAP).

The workshop focused on operational aspects with emphasis on:

* The assessment of the current monitoring and measurement systems and improvements which could be made to enhance regional capability needed to support smoke and haze health and environmental assessments;
* The regional capabilities to provide needed meteorological support during episodes of severe smoke including the performance and improvement of daily smoke trajectory and dispersion forecasts from the Atmospheric Transport Models (ATMs);
* The role of satellite remote sensing in detecting fires, and the aerosols and other pollutants emitted from fires, and in tracking the movement of the resulting smoke and haze envelopes;
* Improvements in the exchange of information and coordination of activities among national authorities, NMHSs and other international and regional agencies concerned with smoke and haze and other transboundary pollution events.

One major lesson learned from the episode was that weather, climate, and smoke and haze do not recognize national boundaries. The fires last year were exacerbated by the El Niño related drought in the region which provided favourable conditions for large scale fire. A second major lesson from this episode was that the Meteorological Services played a critical role in the response and management of the regional and national smoke and haze problem. They contributed in valuable ways through: (1) traditional activities related to meteorological monitoring and forecasting; (2) through monitoring and surveillance functions, including hot spot identification using satellite imageries, haze trajectory modelling, compiling monthly and seasonal climate prediction information, and activities related to air quality monitoring; and (3) through effective and prompt dissemination of information to environmental and other agencies, engaged in fire and smoke and haze response and management, and the general public through Internet activities and press releases.

The fires of 1997/98 were looked at in perspective with earlier events. While the fires of 1997/98 were severe, they were not the first. Records in the region have shown that there have been at least 9 episodes of widespread smoke and haze episodes in the region since the 1970s, and that they occurred most frequently during El Niño periods. Looking at this trend, it is very possible that such fires and widespread smoke and haze episodes will occur again, as present land use plans in the region call for continued large scale land conversion. Thus there is a pressing need for the region to maintain its vigilance, and to further develop and implement haze-related action plans.

A critical importance to the region is the need to further strengthen the capacities of the Meteorological Services to better provide the timely warnings and forecasts needed to anticipate risks of widespread burning and resultant smoke and haze episodes, and assist decision makers in managing smoke and haze episodes. Towards this end a series of recommendations were developed at the Workshop.

**Recommendations**

**A.** *Enhance the regional capabilities to provide needed meteorological support in the form of improved predictions of ENSO and climate variability, and daily smoke trajectory and dispersion forecasts from Atmospheric Transport Models (ATMs),* through:

* Further developing regional climate prediction capabilities to interpret and locally enhance predictions from global forecasts, and provide more frequently global climate predictions and improved climate products.
* Development of flexible, situation-dependent, measurement programs which allow for the provision of enhanced meteorological measurements (expanded frequency and spatial coverage) during periods of severe smoke and haze, and expanded use of satellite-derived meteorological products.
* Installing trajectory / dispersion modelling capabilities at local meteorological services, and utilization of local area modelling (LAM) capabilities in the region.
* Improving model performance through case studies, model evaluation exercises, and by conducting dry run exercises and possible tracer experiments.

B. *Improve the ability to characterize fire activity and track the movement of smoke and haze by strengthening present satellite-usage capabilities by:*

* Improving the operational aspects through provisions for back-up hot spot analysis capabilities, harmonization of fire counts by use of a single detection algorithm, through real time transmission of high resolution data on fires derived from NOAA satellites, and efforts to verify fire counts and burn-area information, through ground-truthing activities.
* Expanded efforts to estimate aerosol and trace gas emissions from fires by combining fire counts with burn-area, along with a better characterization of source characteristics from diverse ecosystems and land-use systems.
* Promotion of the development of the next generation of satellites. This includes the need for a new NOAA channel-3 detector optimized for fire studies, dedicated fire satellites to monitor fires more precisely, and the use of space-borne radar for area burned determination and vegetation dryness assessment, and the use of lidar systems to measure the vertical distribution of trace gases and aerosols.

C. *Strengthen regional monitoring efforts to assess the effects of smoke and haze on human health, to evaluate ecosystem impacts, to help validate atmospheric transport models, and characterize emission sources, by:*

* Enhancement of existing monitoring networks to measure smoke and haze related quantities including aerosol mass (PM2.5, PM10), visibility, optical depth, and meteorological parameters; and at selected sites, targeted chemical quantities including aldehydes, aerosol composition, and UV-B, and other trace pollutants (CO, $O_3$, $NO_x$, $SO_2$, VOCs, $CO_2$). Two levels of observing stations are envisioned, a base level comprising fewer measurement parameters but with a high level of consistency across the network, and a second level with a more comprehensive measurement suite.
* Establishment of additional and population-based monitoring stations at areas not presently covered by existing networks (e.g., Kalimantan)
* Promotion of the scientific exchange of the validated measurement data, and the harmonization and regional coordination of the air pollution indices (API) used in regional smoke and haze alerts, and
* Formulation of uniform protocols for sampling, including temporal resolution and reporting procedures, and expand efforts directed at QA/QC, building upon the WMO/GAW program components.

D. *Improve the management of smoke and haze (and other transboundary) pollution events through enhanced efforts directed at improved information exchange and coordination, including:*

* Enhancement of the current system for dissemination of data, products and other relevant information through the use of GTS for meteorological data and gridded model outputs, and the Intranet and/or Internet systems for non-standard products.
* Efforts to increase the exchange of critical information including meteorological data (especially rainfall), air quality data (including air pollution indices), and trajectory and plume forecasts. A critical element is to promote harmonization of data and output products to support effective real-time decision making.
* Further coordinate emergency response responsibilities and activities between national and regional meteorological services, with primary responsibility for the provision of information and forecasts to reside with ASMC, but with the option of seeking further input from other RSMCs, and with provisions for bi-lateral arrangements.

* Improvements in existing mechanisms to regularly review the operational coordination between the NMHSs and activities related to the Regional Haze Action Plan, and recommend changes and/or improvements to the plans.
* Fostering linkages between the meteorological services and other national, regional, and international organizations and scientific programs, such as (ICBP/IGAC), with common interests.

Follow-up discussions have lead to a tentative implementation plan presented in Table A.

The Workshop further recognized that large-scale forest fires and the associated socio-economic and health-related problems occur frequently in other parts of the world, notably in South and Central America and Africa. It was recommended therefore that the deliberations and recommendations of this workshop be reviewed and evaluated by the organizations and agencies (including NMHSs) concerned in those regions. It was further recommended to organize as soon as possible an expert-level meeting to address the current situation in South and Central America, and the existing and/or required coordination/collaboration mechanisms.

The Workshop concluded with a plenary session which was joined by a delegation from the *Bi-Regional Workshop of Haze-Related Air Pollution*, organized by WHO Regional Offices for South-East Asia and the Western Pacific, held in Kuala Lumpur during 1-4 June 1998. The objectives of that meeting were to: Review haze-related air pollution problems and research findings; Identify further research needs to support haze-related decision-making; and Develop health reduction measures/strategies. That workshop concluded that the haze episodes constituted a substantial health risk to the public as evidenced by the widespread exceedances of health-related air quality standards and guidelines for particulate matter (PM10 & PM2.5) , increased frequency of respiratory-related hospital visits in the most heavily impacted regions; increased frequency of attacks among asthmatic children; and reported persistent decreases in lung function among school children. The risks of long term health from these events is much more difficult to discern.

The WHO workshop stressed that from a health perspective, information on the nature and extent of human exposure to environmental pollutants is essential. Standard monitoring protocols are needed, and data analysis and presentation formats need to be harmonized and easily understood to be useful in health studies. The lack of consistency between the air pollution indices used in the region impedes inter country comparability. From the measurement perspective priority needs to be given to measurements of PM10 and 2.5, and the reporting of actual concentrations. They also concluded that more attention should be directed to filling in gaps in the measurement networks in the region, with emphasis on population-based locations to facilitate the health impact studies. Measurements are also needed to estimate apportionment of sources of particulate air pollution exposure, especially the relative contributions of biomass and motor vehicle-related urban pollution mixture sources.

The representatives at the Workshop recognized that the set of recommendations developed by the two workshops are complimentary, and strongly encouraged closer cooperative activities between the meteorological and health related aspects of transboundary pollution. The delegates pledged to continue to work towards closer collaborations.

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MEXICO

## *A Brief History of Forest Fires in Mexico*

### Introduction

Mexico has a long and interesting history of forest fires. The conditions exist for natural fires, though human settlement has, for millennia, dominated the geography and dynamics of burning. Today, from 2,740 to >12,873 (partial figure, 1998 fire-season) registered forest fires burn between 44,401 ha to 518,265 ha per year. Only 7% of these are due to natural and unknown causes, according to official reports. Mexico's history helps to explain much of its current condition.

### Ancient Anthropogenic Fire

With human colonization, fire risk, fire danger, and fire frequency all gradually increased through millennia, altering both fire regimes and vegetation. From ancient times, for example, native Mexicans used fire on grasslands to assist hunting. Presently, we can see the consequences of these historic practices in the two extremes of Mexico's fire gradient. One extreme is deforestation, although not always fire-related (300,000 ha annually). The other is fire exclusion, which is typical of several commercial pine forests. Natural and anthropogenic fires help to maintain various vegetation types, as in the case of several pine forests (Fig.1.)

### Ancient Civilizations

Many activities of ancient Mexicans started forest fires. For example, they felled trees by cutting a strip around the trunk with a stone or copper axe, then put fuels at the base to start a fire; this eventually toppled the tree (Moncayo 1975). In Teotihuacan, wood charcoal was used to feed ovens to process building and ceramic materials (Vázquez-Yañez 1982), so sites for charcoaling were common, as they still are today in several oak regions. Both these activities increased risk, and forest fires resulted because of accidental or negligent causes. In the absence of metal tools, agriculturalists also used fire extensively to clear woody areas.

In tropical areas, the Olmecs developed an efficient slash-and-burn cultivation some 3,500 years ago, and that agricultural system was used by the Mayas as well. The steps of this system, which is still broadly used in tropical Mexico and which has as its main crop maize, are: select the land, measure and delimit the chosen site, cut the vegetation, clear a fire break, burn, fence, sow, control weeds, and harvest. The present empirical knowledge that peasant descendants of the Mayas have by which they control fire behaviour according to particular needs and site characteristics tells us about the ancient fire lore of the Mayas. Today, however, with an increase in population and a reduction in the land surface available per native owner, the efficient 30 or so year rotation of old has reduced to some three years, with adverse ecological effects and a loss of productivity (Fig.2.)

But the original spirit of the people was conservationist. They knew that wild plants and animals provided them with many goods and services essential to survival, and this was good reason to consider them as gods. So even as human population increased, society stratified, resources became scarce, and droughts and hunger occurred, the care of wildlife was a communal and official task (Aguilera 1985). The Chichimec king Nopaltzin established norms to restrict the burning of grasslands and forests, and his grandson Texcocan king Netzahualcoyotl dictated laws to protect forests (Villaseñor 1980).

The useful and feared fire, moreover, was part of the rich ancient Mexican mythology, as shown by the notion of fire as a renewal element in the Aztec ceremony of the "new fire." This ceremony reflects a preoccupation with the fate of the sun. In the night at the end of a 52-year cycle, every fire in temples and houses was extinguished, and at the same time a group of priests lit a new fire on a hill near the city. Then the people knew that this world would end and a new cycle begin (Vázquez-Soto 1972). Another example is the god of fire Xiuhtecuhtli, also known as Huehueteotl, or old god, represented by an elder with a brazier on his head.

## The Colony

After the conquest of ancient Mexico by Spain, agriculture in forest lands intensified. This fact plus such native practices as charcoaling and those practices introduced by the conquerors such as mining and cattle raising, along with the demand for fuel wood as a source of energy, greatly increased forest exploitation (Gutiérrez-Palacio 1989) and of course forest fires. The *regidores de montes* (a type of forest ranger) had as their responsibilities to care for the forest, including the coordination of rural communities to fight fire (Quevedo 1928). Legislation supported fire prevention and control, as with the Mesta ordinance, which established fines as penalties for those responsible for forest fires (Zuno 1973). But all these good intentions and legislation were not sufficient, and the degradation of the forests continued. An independent Mexico created a Forest Service and a forest ranger corps in 1861 (Verduzco-Gutiérrez 1959).

## The 20th Century

In 1900 Miguel Angel de Quevedo successfully convinced the federal government to establish a forest protection program, over which he subsequently presided. This institution became the primary organ for modern reforestation and the control of forest fires. During the 1920s several reforms accelerated forest fire protection. The first forest law was promulgated, which included provisions for forest fires. Technical trips were conducted to the USA, technical papers on fire were published in the journal *México Forestal*, and the installation of towers for fire detection was begun. The era identified fire as the main destructive factor of forests, considered the prevention of fires crucial, and recognized humans as the major cause of fires. By the 1930s a special Forest Fires Office developed. It had as a strategy, supported by law, the coordination of non-federal human and material resources to fight fire and the creation of volunteer corps. But resources for fire control were scarce.

**Fig.1.** A surface fire burns through the grass layer of an open *Pinus rudis-Alnus jorullensis* forest in central Mexico.

In 1961 President Adolfo López Mateos established a 5-year plan that increased dramatically the financial, human, and material resources to fight fire, primarily in Central Mexico, the critical area. Since then, with highs and lows, the magnitude and efficiency of human, financial, and material resources has increased. Presently, according to Cedeño-Sánchez (unpublished) the federal government has more than 1,800 fire fighters, 133 detection towers, 145 vehicles, while forest owners provide more than 4,000 fire fighters, 96 detection towers, and 313 vehicles, among other resources. A large proportion of the fire fighters have received training courses of middle to high level. In the 1960s the government brought five helicopters for fire detection. By the 1980s helicopters and planes participated in fire control as well. Also in the 1980s computerized systems such as BEHAVE (USA) and EXTINGE (Mexico) were adopted for fire modeling and the development of fire danger and risk maps (Rodríguez-Trejo 1996). Additionally, prescribed burns are applied on larger surfaces, with more diverse objectives.

## Final Words

Historically forest fires have been an important tool for agriculture and cattle ranching in Mexico. Such practices have contributed as fire causes even to the present day, thus assisting deforestation. But it must be recognized also that the frequent surficial fires in several regions have helped maintain pine forests and have reduced the danger of crown fires. The size and efficiency of fire fighting in Mexico continues to progress. For example, during recent years the average size of forest fires has been less than 40 ha/fire. Moreover, the universities and forest research centers are focusing more on several aspects of forest fires for both operational needs and fire ecology.

### *Brief update: The 1998-fire season*

This was the hardest fire season in Mexican history. By 3 June 1998, near to the end of the regular fire-season in the majority of the territory, 12,873 fires affected 439,945 ha. Because of *El Niño*, Mexico experimented the worst drought in 70 years and that complicated severely the fire season. 60 persons died fighting the forest fires, and the smoke produced in central Mexico, Southern Mexico and Central America, reached several USA states, as Texas, Georgia, Arizona and Florida. The smoke produced pollution problems to several cities as Mexico City, Villahermosa, San Cristóbal de las Casas, among others. Several evacuations were done in some periurban areas and villages. By the mentioned date, the president authorized in two occasions an increment in budget to fight the fire, and the USA offered and provided generous technical and financial help to fight the fires. 6,000 fire fighters were active, plus 139,000 elements of the Army, and thousands of volunteers also participated. 57 aircraft from Mexico, the USA and Canada were used in combat activities and the cost of this season it was 290 million Mexican pesos (US$33.3 million), without taking in account the expenses by the governments of each state.

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## BRAZIL / GUAYANAS

### *Fire Activity in the Guyana Shield, the Orinoco and Amazon Basins During March 1998*

### Introduction

The analysis reported here was done in the framework of two projects of the Global Vegetation Monitoring Unit (GVM, ex Monitoring of Tropical Vegetation [MTV] Unit) of the Space Applications Institute (SAI) of the Joint Research Centre (JRC):

* the FIRE project (Fire in Global Resources and Environmental Monitoring) is dedicated to a permanent monitoring of vegetation fires at regional level, but all over the globe, and

* the TREES project (Tropical Ecosystem Environment observation by Satellite) is dedicated to the development of an operational tropical forest monitoring system.

Both projects have to provide the services of the Commission with up-to-date, independent and policy-relevant information on three domains of strategic importance for the European Union:

* the Framework Convention on Climate Change (Kyoto Protocol on source reduction and sink enhancement of green-house gases),
* the implementation of projects which take into account sustainable development, and
* the protection of forests of global importance.

In this context, a team of the GVM Unit was sent to Paramaribo (Suriname) in South America, from 8 to 21 March 1998, in order:

* to map on real time the vegetation fires over Venezuela, Guyana, Suriname, French Guyana and Northern Brazil,
* to assess the type of vegetation affected by the fires,

* to format the information collected in order to support the evaluation of the role of these fires in the deforestation dynamics and of their impacts on the emission of green-house gases, and
* to provide the scientific team of the LBA Project CLAIRE in Mainz (Germany) with in-situ real time information on the fire distribution.

The focus of the CLAIRE (Cooperative LBA Airborne Regional experiment; LBA = Large Scale Biosphere-Atmosphere Experiment) project is to provide the basis of knowledge required to determine the net exchanges of important gases and aerosols between the atmosphere and the Amazon region, and to understand the processes regulating these exchanges.

**Data collection and processing in South America during the campaign of March 1998**

From 9 to 20 March 1998, a total of 36 NOAA-AVHRR-HRPT images (1 km resolution) have been acquired and processed on an area of 2000 km x 2000 km covering Colombia, Venezuela, Guyana, Suriname, French Guyana, Northern Brazil and Northeastern Peru.

The acquisition of the NOAA-AVHRR-HRPT images has been done in-situ, three times a day, with a PC-based portable satellite receiver and a horn antenna. The pre-processing, radiometric calibration and geometric correction were carried out using the PANAIS software package developed by GVM (Janodet et al. 1996). The processing for vegetation fire location and GIS analysis were done using ERDAS IMAGINE 8.3 and ArcView packages, on Unix workstation.

Results were made available by e-mail within 24 hours of the satellite overpass, to the CLAIRE/LBA scientific team in Mainz (Germany) and to the services of the Commission, i.e. the DG JRC in Brussels (Belgium) and the direction of the SAI in Ispra (Italy).

**General considerations on fire distribution in the region during March 1998**

The intense cloud coverage over the region of interest during most of the observation period did not always allow the detection of all individual fires. Therefore, regional sets or groups of fires have been defined and located. Further investigation on individual fires has been conducted locally on specific areas of interest such as conservation areas and "indigenous areas".

The regional groups of fires have been divided into the following categories:

* a fire set is a group of individual fire events observed in a given area of a limited extent and clearly separated from the surrounding, located by the lat/long coordinates of its centre.
* a fire front is a group of individual fire events distributed within an elongated cluster, positioned by the lat-long coordinates of its extremities.
* a fire zone is a group of individual fire events distributed over large area, still clearly separated from the surrounding, and defined by the lat/long coordinates of its corners.

The various groups of fires have been mapped and analyzed in combination with relevant information such as administrative boundaries, river networks, vegetation cover types (D'Souza et al. 1995) and protected areas.

The satellite observations done from 9 to 20 March 1998 have lead to the definition of four main regions affected by fire activity in South America North of the Equator, called Fire Regions (Fig.1).

These four Fire Regions have been characterized in terms of:

* the spatio-temporal distribution of fire and the type of vegetation affected,
* the probable environmental impacts, relevant for the three European Union's key issues.

These environmental impacts include:

* the emission of greenhouse gases and aerosols leading to the degradation of air quality with possible health problems, and to the increase of $CO_2$ emissions with consequences on climate change,
* specific disturbances of the ecosystems, the vegetation cover and the soil, of their function and dynamics, leading to the degradation or even destruction of the natural resources like in the case of soil erosion.

A detailed map of fire patterns in the four Fire Regions during March 1998 will be given in colour as Figure 2 on the Internet version of this issue.

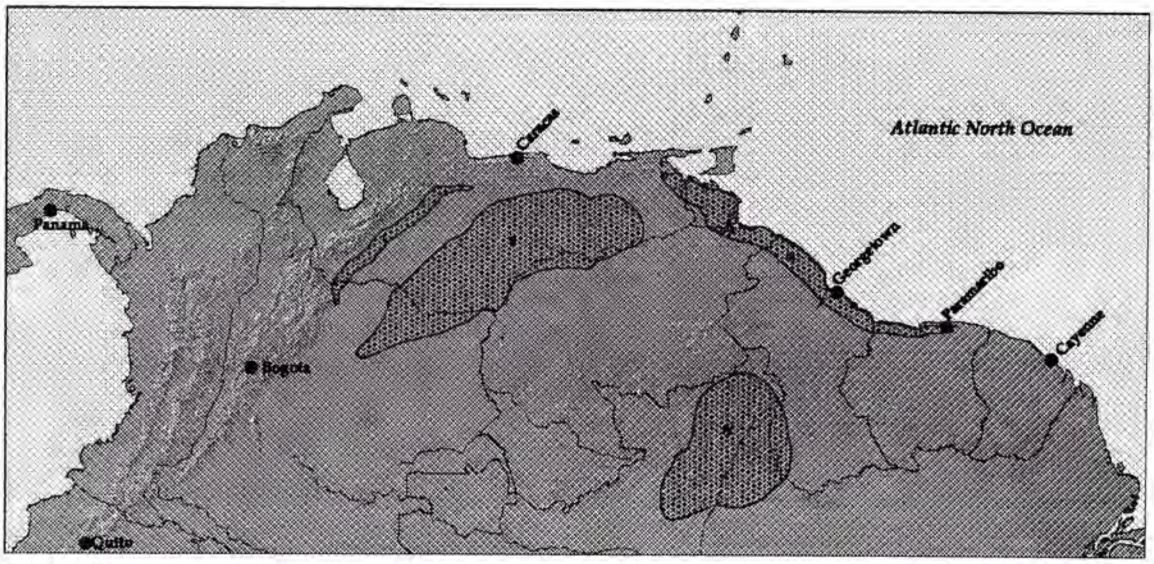


**Fig.1.** The four main fire regions in South America (North of the Equator) as derived from satellite observations between 9 and 20 March 1998.

**Fire Region I: The Northeastern slopes of the Andes (Venezuela and Colombia)**

The activity of the fires, which was previously limited in the Llanos, extended on the 12th and the 13th of March over the slopes of the Cordillera de Merida (Venezuela) and the northern part of the Cordillera Oriental (Colombia). These fires were distributed on a SW-NE transect some 200 km long and created smokes covering about 60,000 km$^2$.

This fire event affected a mixture of "sub-montane forest" and "lowland dense forest". Even if limited in space, it must be considered as having a very high environmental impact with important socio-economic consequences. The sub-montane forest ecosystem is indeed poorly adapted to fire and its disturbance exposes the soil to increased erosion on the slopes.

**Fire Region II: The Llanos of the Orinoco (Venezuela and Colombia)**

Spread over most of the Llanos, the fires in this second region affected more especially two sub-regions: along the Meta river (Colombia) and over the Apure and the Arauca river basins (Venezuela).

At the beginning of the observed period, fires were limited to the central part of the Llanos (Venezuela and Colombia), over most of the Apure and Arauca river basins. A progressive movement of the fire activity was then observed toward East, following the Orinoco river until the end of the reporting period, on 18 March, when the fires were mainly concentrated between Ciudad Bolivar and Ciudad Guyana. The fire activity was intense during the whole period of observation, but with a peak on 13 March.

The main vegetation type affected by the fires in this region was a mosaic of "savannah woodland and xeromorphic forest", with patches of "lowland dense moist forest". Here again the forest ecosystem affected by the fires is far from being adapted to the burning practices and the soil degradation and erosion can be enhanced in region such as south of the Orinoco river.

### Fire Region III: The coastal zones (Venezuela, Guyana, and Suriname)

The third region corresponds to the coastal zone of the Atlantic Ocean, where the fires were distributed according to three sub-regional patterns:

* on the relief along the coast of the Caribbean Sea (Venezuela): the fires were observed mainly within the "dense moist forest" and some of them in the "agricultural mosaic";
* within the Orinoco delta: the fires showed a peak of activity on the 13th and 14th of March, affecting essentially the "coastal swamp forest", and "low land dense moist forest" at the edges of the delta.
* within the 50 km wide belt, parallel to the coast of Suriname and Guyana, liable to flooding from important rivers such as the Essequibo, Berbice or Nickerie: fire activities were particularly dense around Marlborough, Georgetown, New Amsterdam (Guyana), along the Courantyne river and Wageningen (Suriname). A peak of activity was observed from the 15 to 18 March. The vegetation types mostly affected in Guyana were the "lowland dense moist forest" and the "savannah woodland". But in Suriname, the mixed class "coastal swamp forest and mangroves" was affected.

Due to the very high fragility of most of the coastal ecosystems affected here, one can expect very high environmental impacts of this third fire event. This includes the disturbance of the coastal geomorphologic equilibrium and increased erosion, with consequences on the terrestrial resources but also on the fishery capacities of the coastal zone.

### Fire Region IV: The Roraima State (Brazil) and the Kanuku Mountains region (Guyana)

This fourth fire region covers most of the Rio Branco basin, upstream of the confluence with the Catrimani river (Brazil), and the upper basin of the Repununi and the Essequibo rivers (Guyana).

Fires were initially detected within the mosaic of "savannah woodland, xeromorphic forest" and "shrublands". But after 11 March they clearly extended within the "lowland dense moist forest" in Guyana, with a peak of activity on 14 and 15 March. They also penetrated the "fragmented forest" and "dense moist forest" in Brazil after 12 March, with a peak of activity between 15 and 18 March.

Even when they were not in the non-forested domain, the fires were not positioned randomly. They were detected right at the edge of the forested types of vegetation, indicating clearly the purpose of this burning activity.

This fourth fire event has very strong environmental as well as social impact. Further investigations have to be conducted to assess and quantify in which way it affected, directly by burning fronts, or indirectly by dense smokes coverage, many indigenous areas as well as forest reserves and biological reserves.

### Conclusions and Perspectives

From the present analysis of the fire patterns in this South American region during March 1998, and the comparison conducted with historical data from the fire season of 1992-93 (Dwyer et al. 1998; Stroppiana et al. 1998), one can make the following remarks.

The fire event was not totally exceptional and unpredictable. Reasons for burning are known and not new. But the intensity and extension of the fires in the dense moist forest domain (Brazil, Guyana) was effectively unusual. All the fires occurring in the region, and not only the ones affecting the forest, have strong environmental impacts and socio-economical consequences, especially because they affect vegetation on slopes exposed to soil erosion or very fragile coastal ecosystems.

Both of these first aspects were moreover minimized by the media, which focussed on the fires in the forested area of the Roraima State in Brazil.

The evaluation of the ecological and socio-economical consequences of the burning activity in this region requires an almost permanent flow of information on the location and timing of fires, at a scale that fits with the one of the phenomenon. This information must be first collected and then made available in a suitable format to the services of the Commission.

Earth Observation Systems provide here the only practical solution for such information collection. In this context the GVM unit of the SAI is currently developing the World-Fire-Web Network (Pinnock et al. 1998), a system for globally mapping fires in vegetation: a worldwide network of receiving stations will collect and process NOAA-AVHRR images for regional detection of fires. Daily global fire maps will be built up by automatically sharing regional maps over the Internet. This global fire information will then be available on-line and in near real-time. After a 12 months test period of a pilot network with partial global coverage (June 1998), the network will be progressively enlarged to give full global coverage.

As far as the information flow to the services of the Commission is concerned, the Tropical Forest Information System (Wood and Janvier 1995) is a good starting point. It is designed to be a tool for organizing and archiving information related to fire, vegetation and all topographic, geographic, and non-spatial information. It brings together the relevant datasets and allows performing the assessment and analysis of the impacts of fires on the environment. Finally it provide a tool for query, browsing and visualization of the fire products and results.
A prototype version has been installed by the TREES project at DG XI/D4. It is planned to install two others entries to the system in DG VIII and DGI/B.

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**For more information on the FIRE and TREES project's activities:**
**http://www.mtv.sai/jrc.it/**

U.S.A. *A Brief Overview of the Southern United States Fire Situation January - July 1998*

Unusually wet conditions associated with El Niño-Southern Oscillation (ENSO) this past winter had a significant negative impact on prescribed burning operations. In spite of the high rainfall, natural resource managers in Florida still succeeded in treating more than 500,000 acres during the first three months of 1998. (In a typical year about 2,000,000 acres are treated, about 75-80% during this time period.) Many of these burns were, however, more patchy and consumed less fuel than usual because of high dead-fuel moistures. Average ambient temperatures were also higher than normal which resulted in a significantly earlier spring green-up and increased growth of the herbaceous groundcover and woody understorey. Many of these planned dormant-season burns were thus actually conducted during the transition period or early growing-season. This in turn, pushed planned growing-season burns back further into the spring.

Weather patterns switched rather abruptly in late March and by the end of May the deep south was experiencing abnormally high maximum daily temperatures and extended drought. A commonly used measure of relative dryness, the Keetch-Byram Drought Index (also called the Cumulative Severity Index) which ranges from 0 (saturated) to 800 (bone-dry), was already over 600 in some areas. The vast majority of growing-season prescribed burns on the southern coastal plain are conducted between late April and early June. However, many fire managers defer scheduled prescription burns when the KBDI surpasses about 450. The result was a substantial reduction in the number of acres treated during May and June. My guess is that by the end of the year, only about 1 million acres (ca. 400,000 ha) will have been treated, half of the number treated during an average year.

During a typical year, wildfire activity on the southern coastal plain begins to increase in February, and peaks in March as green-up occurs and the winter weather, which is characterized by rain every 5 to 7 days associated with the passage of cold fronts, gives way to our hot steamy summers dominated by afternoon thunderstorms. In Georgia, about 25% of the total number of wildfires occur in March. This year the wet winter resulted in fewer wildfires and dramatically less acreage burned over during this time period in Georgia (Tab.1). The same held true for Florida.

The Central Pacific Ocean was about 4.5°C above average in March when it began to cool. The drop in average sea temperature continued, reaching an unprecedented rate in June before levelling off in July slightly below the norm. As the ENSO effects on synoptic weather patterns weakened, a large area of high pressure formed over the southern US blocking the normal flow of moisture-laden air from the Gulf of Mexico over the southeastern US. Instead hot dry winds from the northwest were the norm. Subsidence, the process that brings dry air aloft down to the surface was also taking place. This resulted in very few convective showers, high temperatures, unseasonably low relative humidities and a concomitant increase in the KBDI with many locations approaching 800. This weather pattern translated into a predictable increase in wildfire activity throughout June and early July. This area of high pressure then shifted west in July resulting in the return of afternoon showers over Florida, but hot, dry, windy weather over Texas and Oklahoma. Texas is experiencing the driest spell in 104 years with temperatures exceeding 100°F (38°C) for the $29^{th}$ consecutive day on 4 August 1998.

Humans cause the vast majority of the 45 to 50,000 wildfires in the 13 southern states each year, with about 40% of the total due to arson. Less than 10% are attributed to lightning although many more are caused by this source but are not included in the database because they are not reported, or go out without human intervention. Lightning generally causes more fires than humans during the summer with most of the acreage burned between late April and early June. Between 500,000 and 600,000 acres (ca. 200,000 to 240,000 ha) are subjected to wildfires in a typical year although about 1 million acres (ca. 400,000 ha) burned over during each of the extremely bad years of 1989 and 1996. As of August first, 28,000 wildfires had already burned over 1,100,000 acres (445,000 ha) including 580,000 (235,000 ha) in Florida and 318,000 (130,000 ha) in Texas. The fall wildfire season is still months away. Not a single southern wildfire burned more than 5,000 acres (2,000 ha) last year. The first of numerous fires to do so this year was discovered 25 May 1998 in a swamp on the Apalachicola National Forest in Florida and reached 7,000 acres (2,800 ha) on 12 June. The largest fire on private lands in Georgia in 40 years burned 16,000 acres (6,500 ha) in June, while a fire on the nearby Okefenokee National Wildlife Refuge reached 7,000 (2,800 ha) acres on 15 July and was finally controlled after more than 4 inches of rain in a 4-day period.

Although major fire activity in the southern US has so far been pretty much confined to Florida and west Texas, brief periods of high activity also occurred in the mountains of western North Carolina and Kentucky, along the Gulf Coast of Alabama, Mississippi, and Louisiana, in Georgia and in Oklahoma. Most of this region is now receiving shower activity but the KBDI is still above 600 in many places. During the first 3 days of August, 200 more fires were reported that burned 19,100 acres (7,700 ha). Toward the end of July, measured live fuel moistures in Texas were 45% in *Juniperus*, 50% in grass, and 80% in the leaves and small branches of *Quercus*. Its no wonder drought-related tree mortality has been reported across the region. Precipitation is 6-25% of average and fine dead fuel moistures are still in the 2-4% range in many areas as of 3 August. Complete consumption of down woody fuels during passage of the flame front was a common occurrence. Firebrands were igniting the grass fuels a mile or more ahead of the main fires. The situation was even worse in Florida because of the large area of urban/wildland interface that was impacted.

Every county in Florida has been subjected to major fire activity since the beginning of June, but the news media have focused on those counties from the centre of the peninsula east to the coast, and north to the Georgia line because of the extensive urban/wildland interface. Evacuation of homes began on 16 June and was a daily occurrence until 11 July. Numerous communities were evacuated in several counties and for the first time to my knowledge, virtually a whole county (approximately 45,000 people) was evacuated and put under a dusk to dawn curfew. Well over 100,000 people were evacuated during this time period in Florida, some more than once as fires were controlled and flared back up, or new ones started. The good news is that less than 100 homes and businesses were destroyed and only about 250 were damaged. Miraculously I am aware of only one firefighter fatality, an Alabama Forestry Commission employee died of a heart attack while constructing fireline in his home state. Three "civilians" in Florida were also claimed by heart attacks attributed to the fires. Resource damage (primarily timber) will likely approach US$100,000,000. Suppression costs are still incomplete, but will be astronomically high. The pulp and paper industry pretty much abandoned the use of prescribed fire over the past decade in favour of herbicides which predisposed their plantations to higher levels of damage because of the increased dead fuel loads that exacerbated fire behaviour.

To help put these fires in perspective, consider the following: 158 aircraft were committed to the Florida fires, 1½ times the number on the Yellowstone fires; virtually every heavy helicopter available was in Florida - the other 3 were fighting fires in Alaska; over 5,200 fire fighters were in Florida; 80 to 100 new fires were occurring each day at the peak; live fuel moistures were in the 70 to 80% range and 10-hour dead fuel moistures were hovering between 3 and 4%; the military airlifted fire engines from California and the Pacific Northwest to Florida (a distance of about 4,000 km); the airports at Ormond Beach and Daytona were closed for several days; wells were dug and a 1-mile hose lay was constructed to get water where it was needed; ground fires were consuming 4-5 feet (1.2-1.5 m) of organic soil; 1, 10, and 100 hour fuels were being completely consumed; a number of fires were plume-dominated; three major fires burned to the Atlantic Ocean; 2-yr roughs were supporting 20 ft (6 m) flame lengths; in some areas the needle cast was heavy enough to obscure the "black" and supported 2-3 ft (60-90 cm) flame lengths during reburns; in some instances the crowns of heat-killed brush were burning and carrying fire into the overstory crowns, and; fires made runs with humidities in the mid sixties.

Fire danger was about the same throughout the southern coastal plain so why did Florida get hammered so much worse than surrounding states? The answer is lightning; Florida has one of the highest concentrations of lightning strikes in the world exceeding 120 strikes per acre per year in some areas. Most of the activity occurred ahead of the daily sea breeze front as it moved inland. The fires were concentrated in peninsular Florida and on at least one occasion, the east and west sea breeze fronts collided over the centre of the state with the increased convective activity causing a large number of lightning fires. Very little rainfall accompanied this lightning. Georgia also had a high number of lightning fires but their initial attack was more successful.

The two suppression organizations are both well organized with state-of-the-art equipment and highly trained personnel so that is not the answer. Both states advocate and facilitate the use of prescribed fire and indeed, many instances were recalled where fires were held only because they happened to run into recent prescribed burns. Downdrafts from thunderstorms, which are more numerous in Florida, result in strong erratic winds that can produce sudden changes in the direction of fire spread. Access to lightning-caused fires can be more of a problem in Florida because growing conditions are better which results in heavier fuels. The difference in initial attack success can be attributed in large part to the extensive urban/wildland interface in Florida meant that initial attack forces often had to protect structures while a fire continued to gain momentum. The large number of daily fire starts in Florida also was a contributing factor, tractor-plow units would put a plow line around one fire and then race off to the next without having time to mop-up.

Can another disaster like this one happen again in the future? The answer is not only that it can happen, but that it almost assuredly will happen. For whatever reason, the loss of life and property was much less than expected but there is no reason to expect it will be so low the next time. Im sure the extensive review and studies that will be conducted over the next few months will address steps that can be taken to decrease the destruction in future wildfire disasters. Pulp and paper companies will undoubtedly reassess their decision to abandon the practice of underburning to control woody competition and for hazard reduction. The only known practical method of reducing wildfire damage is the frequent use of prescribed fire. Yet prescribed underburns will in all likelihood become increasingly difficult to conduct in the future as the urban/wildland interface continues to expand. It remains to be seen whether fire managers will be able to garner and sustain the needed public support to assure the increased use of prescribed fire necessary for ecosystem health and to minimize the threat of catastrophic fire.

**Information supplied by numerous state and federal agency personnel in Florida and Georgia provides the data base for this report.**

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**Tab.1.** Georgia wildfire statistics

| Month | Number of Fires 1998 | Area burned (ha) in 1998 | Number of fires 5-year average (1993-97) | Area burned (ha) 5-year average (1993-97) |
|---|---|---|---|---|
| January | 234 | 207 | 513 | 667 |
| February | 498 | 587 | 1,108 | 1,895 |
| March | 909 | 1,692 | 1,576 | 3,047 |
| April | 426 | 550 | 1,124 | 1,498 |
| May | 492 | 557 | 677 | 779 |
| June | 1,264 | 8,784 | 434 | 646 |

*Influences on Prescribed Burning Activity in the United States National Forest System*

## Introduction

Recent analyses of fire policy have called for increased prescribed burning to prevent future wildfire damage and enhance fire-dependent ecosystems and commercial forests (Mutch 1994, USDA Forest Service 1994, USDI 1995, Bell et al. 1995). The USDA Forest Service has set a goal of burning 1.2 million hectares per year by the year 2010 (Bell et al. 1995). Wise allocation of prescribed fire resources will require a solid baseline assessment of current activity and an understanding of the barriers to implementation of burning programs. Despite its ecological benefits, prescribed burning is being increasingly scrutinized and regulated as a source of air pollution (Sandberg 1978), traffic hazards (Mobley 1990), and escaped wildfire (Mobley 1985, Hoover 1989, Craig 1990, Cleaves and Haines 1997).

This report summarizes the results of a survey conducted to quantify prescribed burning activity on Forest Service lands, and to identify resource objectives and barriers to increased burning. No comprehensive assessment of the area treated by prescribed burning has been made; and Forest Service administrative units only recently have begun to consolidate their estimates of prescribed burning needs. Such information, as well as a characterization of the physical, social, legal, economic, and managerial factors that shape the burning programs on National Forests will be necessary to effectively develop expanded burning programs.

## Methods

Analyses of prescribed burning activity levels, as well as resource objectives and constraints, were based on responses to a questionnaire mailed to Forest Service fuels management officers (FMO's) in December 1995. For the period 1985-1994, the FMO's were asked to provide estimates for the following variables: (1) acres burned annually and number of burns for each of four burn types--slash reduction, management-ignited burns in natural fuels, prescribed natural fires, and brush, range and grassland burns[5]; (2) major intended resource benefits or purpose of burns; (3) historic trends in and expectations for burned acreage by type of burn; (4) barriers to expanding the use of prescribed fire; and (5) annual acreage of prescribed burning needed to achieve resource management goals. The FMO's ranked resource objectives and constraints on a scale of 0 to 5 with 5 being most important.

We received completed surveys from 95 of the 114 FMO's contacted; and those responding units accounted for about 85 percent of the total National Forest System acreage, excluding Alaska. National forest-level estimates were aggregated into regional and national totals.

## Results

### Activity Levels and Resource Objectives

The total prescribed fire area averaged 367,511 hectares per year. The Southern Region reported the highest annual average burned area at 175,686 hectares (Fig.1).

The total acreage treated was not evenly distributed by burn type. Management-ignited prescribed fires accounted for the most at 62.2 percent of the system total; followed by slash reduction (25.3 percent), brush and rangeland (8.3 percent), and prescribed natural fire (4.2 percent). Overall, the national forests conducted an average of 6,763 burns per year, of which 75 percent were for slash reduction and 20 percent were management-ignited burns in natural fuels. Accordingly, regions with significant slash burning acreage reported the most burns.

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[5] Slash reduction includes burns to reduce debris from logging, road construction or natural events. Management-ignited fire is understory burning in an established stand. Prescribed natural fires are those ignited by lightning or spontaneous combustion. Brush, range, and grassland burns do not include fires for cropland management.

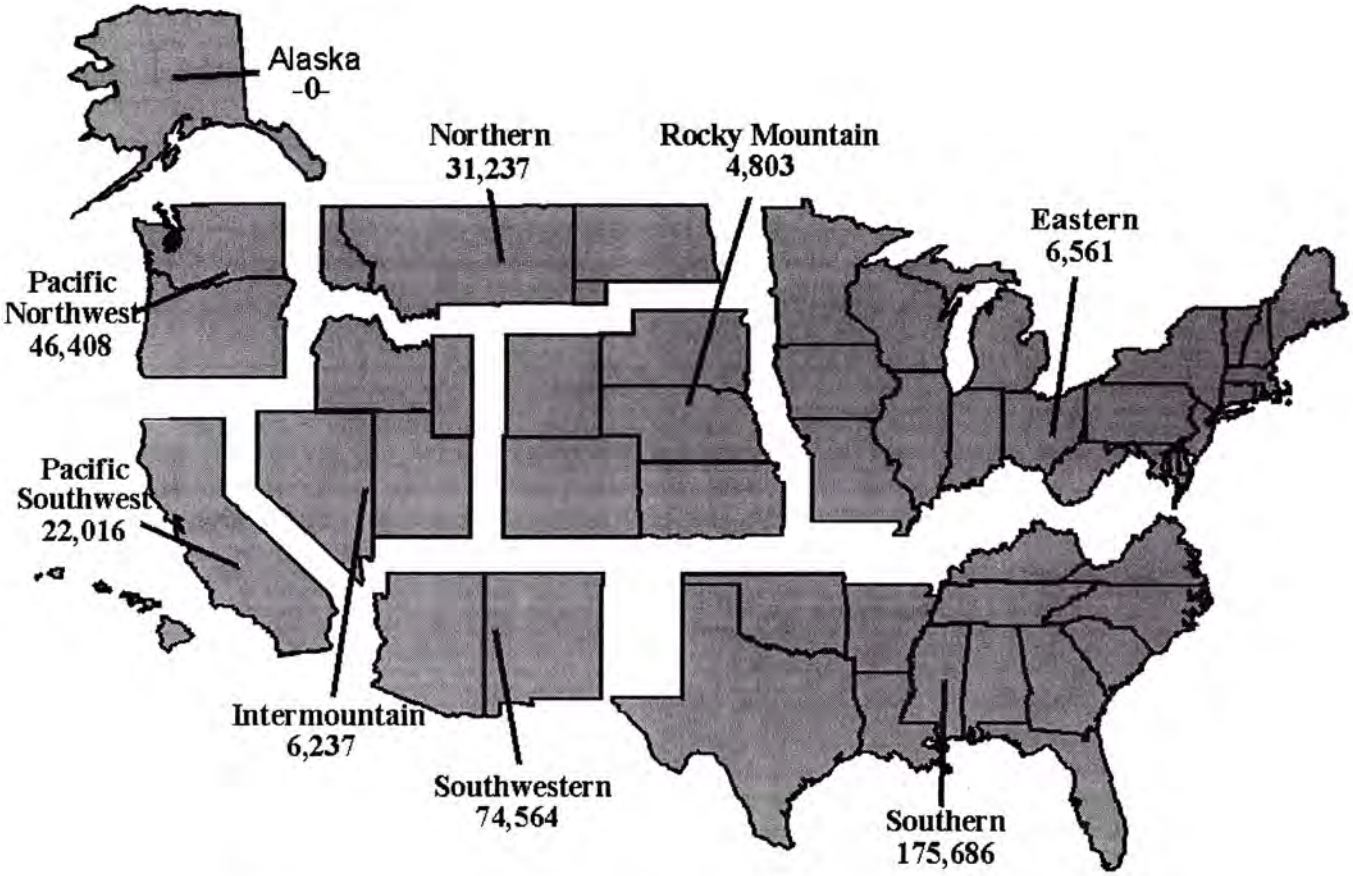


**Fig.1.** Annual prescribed burning area (ha) by U.S. Forest Service Region

The most important resource objective or purpose for burning was wildfire hazard reduction, followed by ecosystem management (using prescribed burning to reestablish natural fire intervals), game habitat enhancement, site preparation for reforestation, nongame habitat enhancement, control of competing vegetation in timber stands, threatened and endangered species habitat enhancement; insect and disease management; and rangeland improvement. The average burn size was 54 hectares. This varied from 17 hectares in the Pacific Southwest Region to 185 hectares in the Southern Region. The largest burns were prescribed natural fires (251 hectares) and smallest were slash burns (18 hectares). Management-ignited burns were the second largest(166 hectares) followed by brush and range burns (124 hectares). This relationship of relative burn size was similar among most regions. Estimates of burning levels needed to achieve management goals totalled 0.82 million hectares per year, more than twice the average achieved during the survey period. Desired acreage, as a percent of the acreage attained, ranged from 145 percent in the Northern Region to 672 percent in the Intermountain Region.

**Trends in Burning Activity**

Because of reductions in timber harvesting between 1985-1994, the slash burn acreage had decreased in more forests (60 percent) than any other burn type. Conversely, increasing fuel treatment budgets and greater emphasis on the use of prescribed fire for silviculture, ecosystem, and wildlife purposes resulted in a 76 percent increase in the number of forests using management-ignited burning. Prescribed natural fire levels remained fairly constant servicewide (62 percent), except in the Southwestern Region where there was a large increase. Brush and rangeland burns either increased (43 percent) or remained stable (44 percent) Servicewide.

Over the next ten years (1995 to 2004), estimated trends for all burn types range from a 57 percent chance of increase to a 15 percent chance of decrease. There is a 28 percent chance it will remain about the same. The likelihood for increasing management-ignited burns, prescribed natural fires, and brush and rangeland burns are

79, 66, and 51 percent, respectively. Conversely, there is only a 31 percent chance that slash burning will increase.

### Barriers to Burning

The FMO's rated 14 factors on a 5-point "scale of importance," representing the degree to which each factor imposed a barrier to expanding the use of prescribed fire. The environmental law factor, which includes laws to protect water quality, endangered species, archaeological sites, and other resource values -- but does not include laws governing smoke management or protecting air quality -- received the highest mean rating (3.82). Environmental laws also include planning and evaluation procedures to be followed when conducting land management activities on Federal lands. Lack of adequate funding was the second most important factor, with a mean of 3.66. Also highly rated were: personnel (shortages of qualified professionals and technicians); narrow window (the prescription window for conducting burns); planning costs; public opinion; liability (for smoke intrusion and escaped fires); and regulations (air quality and smoke management laws). Barriers that received low ratings in all regions included: the use of alternative management practices, uncertainty about burning as an effective fuels management practice (such as effects on soil composition or tree growth), and the availability of insurance.

**Fig.2.** Prescribed burning operation in the Sierra Nevada, California. Photo: J.G.Goldammer

### Discussion and Conclusions

Prescribed burning is an important activity in the National Forest System. At about 364,225 hectares accomplished each year, it may be the most common planned disturbance, a distinction formerly held by timber harvesting. Changes are occurring quickly. For example, Forest Service fuel management budgets have increased substantially, from historic levels of about US$20 million, to US$60 million in 1997. The acreage of natural fuels burned each year has been increasing, for both management-ignited and prescribed natural fire. There is some uncertainty about the prescribed natural fire program; the use of prescribed natural fire is controversial and subject to conflicting political, physical, and managerial objectives.

The FMO's who responded to our survey confirmed the need for an increased use of fire. Less than half of the desired level is being met, although recent increases in appropriated funds has narrowed the gap. Barriers consist chiefly of environmental restrictions, funding shortfalls, and a shortage of available personnel.

The perceived importance of the environmental barrier may be due to a combination of factors: ambiguity in the application of regulatory standards, actual restrictions on burning practices, and reaction to the prospect of increasing regulation. Potential legal actions by interest groups or concerned citizens may also contribute to the importance of this factor. Although appropriated funds have increased since 1995, the availability of personnel for prescribed burning may become critical, especially with increasing competition from the wildfire control burden. Burning helps managers achieve a variety of resource objectives. The Forest Service prescribed burning program is linked to the future of many of its other programs, e.g., wildlife, threatened and endangered species, range, and ecosystem management.

Many respondents identified the shift from slash reduction burns to natural fuels burns as indicative of a trend towards fewer and larger burns. Although such a trend could have positive implications for per-acre costs, it might also could present problems in successfully managing the wildland/urban interface, sensitive species habitat, and other protected areas. The Forest Service officials who responded to our survey were optimistic about achieving resource goals, despite implementation barriers and cost constraints. The shortage of trained personnel and uncertainties about long-term funding are concerns that must be addressed if progress towards these goals is to continue. The burning season's narrow window of opportunity makes it doubly important that managers have a well-trained and available workforce.

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***The 21st Tall Timbers Fire Ecology Conference in Florida: A Focus on Fire and Forest Ecology***

The 21st Tall Timbers Fire Ecology Conference was held in Tallahassee, Florida, U.S.A. on 14-16 April 1998. Titled: "Fire and Forest Ecology: Innovative Silviculture and Vegetation Management", this conference brought together 240 researchers and managers who used 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. The conference goal was to provide a forum to discuss fire ecology, management and effects, both within and outside the context of silvicultural treatments.

The keynote speaker, Dr. Johann-Georg Goldammer, Fire Ecology and Biomass Research Group, Max Planck Institute for Chemistry, set the stage for the conference by speaking to "Silviculture and Vegetation Management By Fire: Global Transitions." His worldview of fire accurately framed the issues of fire's role in natural ecosystem development and the importance of fire as a management tool for progressive natural resource professionals. In the Fire and Forest Ecology session of the conference, moderator Jim Vose, of the Coweeta Lab, U. S. Forest Service, brought us up to date the ecosystem perspectives of using prescribed fire to achieve the manager's objectives. The conference was then treated to a primer on the physiological effects of fire, the long-term effects of prescribed biennial fires on longleaf pine growth, the impact tree harvesting followed by a site preparation burn had upon plant succession and restoration of desired plant communities in the Southern Appalachians (U.S.A.) and a new project where fire behaviour and movement were controlled across artificial corridors of various widths. The second segment of this session had talks on long-term (30 years!) impacts of fire in Montana, old-growth oaks in a fire-dominated system in Florida, the history of disturbance, including fire, in central Alaska, and fuel loads vs. overstory conditions in New Mexico.

Mike Weber, of Forestry Canada, Edmonton, Alberta, introduced the Fire and Soils session by relating how fire impacted ecosystem structure and function in the boreal forests. This talk was followed by others on comparing fire to chemical and mechanical site preparation and the impacts of fire on hardwood forest soils.

In the session titled: "Fire and Ecological Restoration", Wally Covington, of Northern Arizona University, Flagstaff, Arizona, U.S.A. framed the issue of prescribed fire as a specific ecological restoration tool. The speakers who followed documented the use of fire as an ecological restoration tool on federal lands, and dealt with specific management problems, such as snag management or regions, such as Florida sand-scrub or Ohio oak savannas. The "Fire and Herbicides" session was moderated by Shep Zedaker, professor of silviculture at the Virginia Polytechnic Institute and State University, Blacksburg, Virginia, U.S.A. Shep examined the issues, both biological and legal (an increasingly onerous impediment to prescribed burning in the U.S.A.), and the management and research implications. The subsequent papers detailed the use of fire and herbicides to achieve management goals, whether to restore a native wiregrass to fire-excluded sites in the southeastern U.S.A. or to reduce an exotic grass on an island off California, U.S.A., air-quality implications of prescribed fire and the resultant use of herbicides, or enhance game management by periodic herbicides and annual burns.

The "Fire and Wildlife" session, moderated by Dick Williams, CSIRO, Darwin, Australia, started with Dick's talk on fire regimes and biodiversity management in northern Australia landscapes. The following talks dealt with fire's impacts on cavity nesters in Florida and Arizona, U.S.A., and ground dwelling birds and mammals in South Carolina and Arizona, U.S.A. Unlike many scientific conferences, this one explicitly included talks by management professionals outlining their experiences with fire used to achieve their organization's goals. Terry Hingtgen, of the Florida (U.S.A.) Park Service spoke of his efforts to improve wildlife habitat in southern Florida by using fire. Steve Miller, of the St. John's River Water Management District, talked about his organization's efforts to improve the forestland with a fell-and-burn technique. Dave Gerhardt, Westvaco Corporation, South Carolina (U.S.A.) spoke of the constraints and implications that a large industrial landowner faces when using fire as a management tool.

Fire and Policy Issues was introduced by Frank Cole, of the Joseph W. Jones Ecological Research Center, Newton, Georgia, U.S.A. with his outline of policy issues facing prescribed burning. The conference attendees then learned of the extent of the use of prescribed fire in the southeastern U.S.A. and the costs of burning by federal U.S. agencies.

For the banquet speech, Bob Izlar of the University of Georgia, U.S.A. spoke of fire and the impacts on the small landowner in Georgia. He addressed the urbanization of forested land near Atlanta, the capital of Georgia, and the many current and pending regulations which could deleteriously impact the use of prescribed fire as a management tool. The final session, Fire and Silviculture, was also the longest, reflecting the purpose of the conference and the amount of work done in the field. While most of the talks focused on the southeastern U.S.A., there were some interesting talks about research in the Pacific Northwest and the Great Lakes regions of the U.S.A. The moderator, Dave Van Lear, Clemson University, U.S.A., spoke of the latest advances in fire as a silvicultural tool. The audience then heard of specific research on shelterwood-burn techniques in the mountains and foothills of the southern Appalachians, the use of fire in canopy gaps and the impact on deer browse in West Virginia (U.S.A.), the restoration of an endangered forest canopy species, Pinus pungens, using fire, restoring fire to pine systems in the north-central U.S.A. and using fire to maintain old-growth structure in forests in eastern Oregon, U.S.A.

The focus of the conference was on using fire as an active management tool. The subsequent wildfire season in Florida shows what can happen when the use of fire as this tool is restricted, by liability, urbanization or ignorance. As the 1998 fire season in Florida showed, it is not a matter of "if" the forests will burn, but "when."

Federal and state statutes and policy limit the weather conditions under which prescribed burns can be conducted in heavily urbanized regions such as Florida, to minimize the impacts of smoke on visibility and human health. There is a potential danger that a restriction of the burning window would reduce prescribed burning in critical areas. This would create fuel loads, especially in the commercial plantations, that will inevitably result in large conflagrations, with the resulting impact on the economics of suppression, damage to residential and commercial buildings and, perhaps, the loss of life.

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## BLM *Fire Support in the Philippines: BLM provides Experts to Help with threatening Wildfires*

Severe wildfires ravaging the Philippines landscape in recent months prompted government officials there to request help from United States fire experts. A delegation of wildland fire specialists from the Bureau of Land Management and USDA Forest Service, through a request from the USAID / Office of Foreign Disaster Assistance, examined suppression efforts and offered recommendations to the Government of the Philippines.

Roy Johnson, a fire management specialist with the BLM National Office of Fire and Aviation in Boise, Idaho, was selected to lead the team because of his education and experience in wildland fire behaviour and operations.

The area of greatest concern was Palawan Island, which "represents the country's last frontier for natural beauty, is home to significant numbers of endangered species, and contains the Philippines' last remaining virgin rain forest," said Johnson. On Sunday, 5 April 1998, Johnson's team arrived in Manila where they established their headquarters.

Following rain on Sunday that helped slow the spread of fire and clear the smoke, the improved visibility enabled them to assess the situation. They discovered conditions were not as severe as earlier reports described. Johnson said firefighting efforts were successful in keeping the fires out of the virgin rain forest, and praised the Filipino officials for their early detection and response.

By Wednesday, 8 April 1998, the Philippines government determined that foreign assistance was no longer required, and by 9 April Johnson and his team were on their way home.

The team was successful in providing expert advice for handling fire situations and made these recommendations for the future:

* Determine the role of fire in managing the land and it's social, political, and economic impact.

* Develop educational programs that recognize the need for fire in managing fields, define accepted practices, and emphasize under what conditions fire is not acceptable.

* Conduct risk assessment to determine high priority areas and required mitigating measures.

* Cooperate with The Association of South East Asian Nations for support in abnormal conditions.

The BLM and USDA Forest Service routinely respond to international requests for assistance through the Forest Service's International Programs, Disaster Assistance Support Program (DASP). In 1997, federal employees travelled to Indonesia to assist during fires and help develop a drought assessment. The DASP has also provided assistance to Mongolia and Congo-Brazzaville in 1996 and 1997, and helped coordinate the Rwanda refugee relief effort in 1994 to 1997.

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**BLM International Exchanges, Summer 1998**

The U.S. Bureau of Land Management (BLM) continues to develop a comprehensive program that will establish mutual benefits internationally through technical exchanges. There are several projects underway during the summer season of 1998 that will help establish a foundation for development of a long-range program of technological importance and to identify opportunities for natural resource research pertaining to wildland and prescribed fire.

**Canada**

BLM personnel will be in Canada to review their Incident Command structure, examine the air tanker program and evaluate it for possible application in the U.S., evaluate specific aircraft for lead plane applications, examine Canadian methods for management of brush encroachment in prairie regions, review the Canadian Fire Danger Rating System and data utilization, review the fire qualifications system, review their use of satellite technology, and examine their use of the GIS system.

**Mexico**

A proposal is being sent to Mexico officials with a schedule for exchanges beginning in May this year. The exchange would be under the auspices of the national office, and would include a review of the Mexico system by BLM management officials and a corresponding review of the U.S. System by Mexican officials. Later during the fire season, technical fire specialists from Mexico would visit NIFC at Boise, then work with BLM personnel, one group in California and another in Arizona. Also during the fire season, BLM specialists would travel to Mexico to work with fire specialists there and learn of their methods.

**Russia**

Four BLM smokejumper specialists travelled to the Krasnoyarsk region to train and work with the Russian fire programme. In addition to observing and documenting methodologies, they are learning about aspects of fire equipment. Four Russian smokejumpers will spend several weeks in the later part of the active fire season working with BLM from the Boise, Idaho national base. BLM also participated in a demonstration retardant utilization project in Siberia during the season.

**Norway**

BLM will send a technical fire management officer to Norway during this season. A Norwegian fire management officer will travel to the United States later in the season to observe BLM methods and operations.

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## COUNTRY NOTES

**BULGARIA**

***Forest Fires in Bulgaria 1997***

The forest fires in the fire season 1997 of Bulgaria were considerably less in number and affected area than in the preceding fire season 1996, where the burned forest area amounted for over 21,500 ha and the number of fires reached 246. In 1997 the burned forest area reached 860 ha (rounded) with a total number of 167 forest fires. Altogether this is a slight increase compared to the mean surface area of forest fires in the last decade with approximately 500 to 600 ha burned area per year.

The destroyed forest vegetation is distributed in:

| | |
|---|---|
| Conifers | 419 ha |
| Deciduous | 277 ha |
| Non-woody and herbaceous surface | 164 ha |
| **Total surface** | **860 ha** |

The largest forest fire did not exceed an area over 25 ha due to the fact that initial attack and suppression was fast. The fact that the year 1997 was fairly rainy especially in the months of June and August was contributing to the successful operations. The highest amount of fires occurred at the month September (43) and May (36) whereby the smallest occurrence was observed in June (5) and August (4); this proved the influence of the rain on fire occurrence particular in the months of June and August.

The fire causes of the fire season 1997 were mostly classified as unknown (106). The rest of the causes are distributed into negligence (abandoned fires) = 28, natural causes (lightning) = 10, agricultural burning (debris burning) = 14, and intentional fires (arson) = 9, set by individuals which were all caught and punished afterwards.

Most fire incidents (133, covering 555 ha) took place in the South of Bulgaria were the vegetation consists predominantly of conifers.

The fire-fighting organisation in Bulgaria is still not yet very well organized. The fire engines are very seldom utilized - only in regions accessible by car. Airplanes and helicopters are never utilized in the initial attack, although they are used in some incidents for reconnaissance.

Despite all this, the fact is that fires in the forests of Bulgaria are a relative seldom phenomena and the devastated surface area accounts only for 0.025% of the total forested area (3.6 million ha) of Bulgaria. Nevertheless there is no reason to relax since most of the increased number of fires burning the forests are caused by negligence and carelessness.

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## PEOPLE's REPUBLIC OF CHINA

### *The Study and Planning of Firebreaks in China*

As one of projects of the Chinese ninth five years (1996-2000) plan of science and technology, the research project of firebreaks (fuelbreaks) got approved by the Chinese Science and Technology Committee in order to control wildfire better by nature. There are four priority aspects in this research project:

**Selection of fire-preventing tree species**: Fire-preventing tree species need to have the ability to regenerate by shoots after being damaged by fire, to reduce inflammability and fire spread due to high content of moisture, low content of resin and volatile oils, high content of oxide silica and other coarse ash contents. Methods for selection of fire-retarding tree species will be investigated in accordance with biogeographical differences and characteristics of tree species.

**Mechanism of forested firebreak belts (fuelbreaks)**: It includes the mechanism of fuels under forest, trees and forest belt. Several ways to study the mechanism of firebreaks how to prevent wildfire spread include field investigation of vegetation in fire-affected areas, fire experiments and physical and chemical analysis.

**Analysis of the beneficial impacts of firebreaks**: It includes the benefit of preventing fire, the economic benefit of forest belts, the ecological benefit and the social benefit.

**Put forward rules of firebreaks belts built**: In order to guide firebreak construction scientifically and to make the best use of their advantages, technical standards are defined. This includes a classification of firebreaks and the design of size and density of firebreak networks.

Toward the end of 2010, various types of firebreaks will be established in the country. Once properly planted and maintained they will replace traditional fire suppression technologies. Forested firebreaks are advantageous for soil and water conservation and production of timber and non-wood forest products.

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**LATVIA** *Forest and Forest Fire Prevention System in Latvia*

**Latvian Forest Statistics**

Forests in Latvia cover 45 % of the surface of the country, mainly located in the Western regional districts of the country. The forest cover percentages in the different districts are given in Figure 1. Information about the land-use distribution is given in Figure 2. Figures 3 and 4 show the ownership structure and the distribution of forest by site type classes. 52 % of all forests belongs to the state, 44 % - private, 4 % - other. Conifers cover 60,5 % of the total forest area. Prevalent species are Scots pine - 40 %, birch - 28 %, and Norway spruce - 20 %. The age structure is predominantly composed by young and middle-aged stands - 63 %.

**The Fire prevention system in Latvia**

In Latvia the responsibility for forest fire protection is, by low, arraigned to the State Forest Service under the Ministry of Agriculture (SFS). It sets the procedure for fire suppression activities, the organizational set-up and fire safety regulations in the state-owned forests all in coordination with the Fire Control and Rescue Service of the Ministry of Interior. The forest fire control in Latvia is effected by 35 Regional Forest Districts with 262 subordinated Forest Districts. Each Forest District draws up a fire protection plan. The fire protection plans of the Regional Forest Districts are based on these district plans. These plans are continuously reviewed and updated, and they are approved by the local government, exercising control over their implementation. The plan comprises the mobilization of personnel, equipment, and communication. It also provides the mechanisms for the involvement of external assistance in case of an emergency situation.

Other state authorities and fire control and suppression units on the community level get involved in the SFS's set-up as external assistance following the cabinet of Minister's regulations (Fig.7).

At the same time the Law on Forest Management and Utilization declares that the prevention and guarding of forest fires is the duty of the forest owners and forest utilizers; they must fulfil this duty in compliance with the Forest Fire Safety Regulations. The Fire Fighting service within the State Forest Service is organized in a way which allows to locate and extinguish the forest fires as fast as possible. This service has no heavy equipment (bulldozers, excavators, etc.). So in the case of bigger forest fires when the area of the reaches 5-10 ha other state institutions are involved in fire fighting.

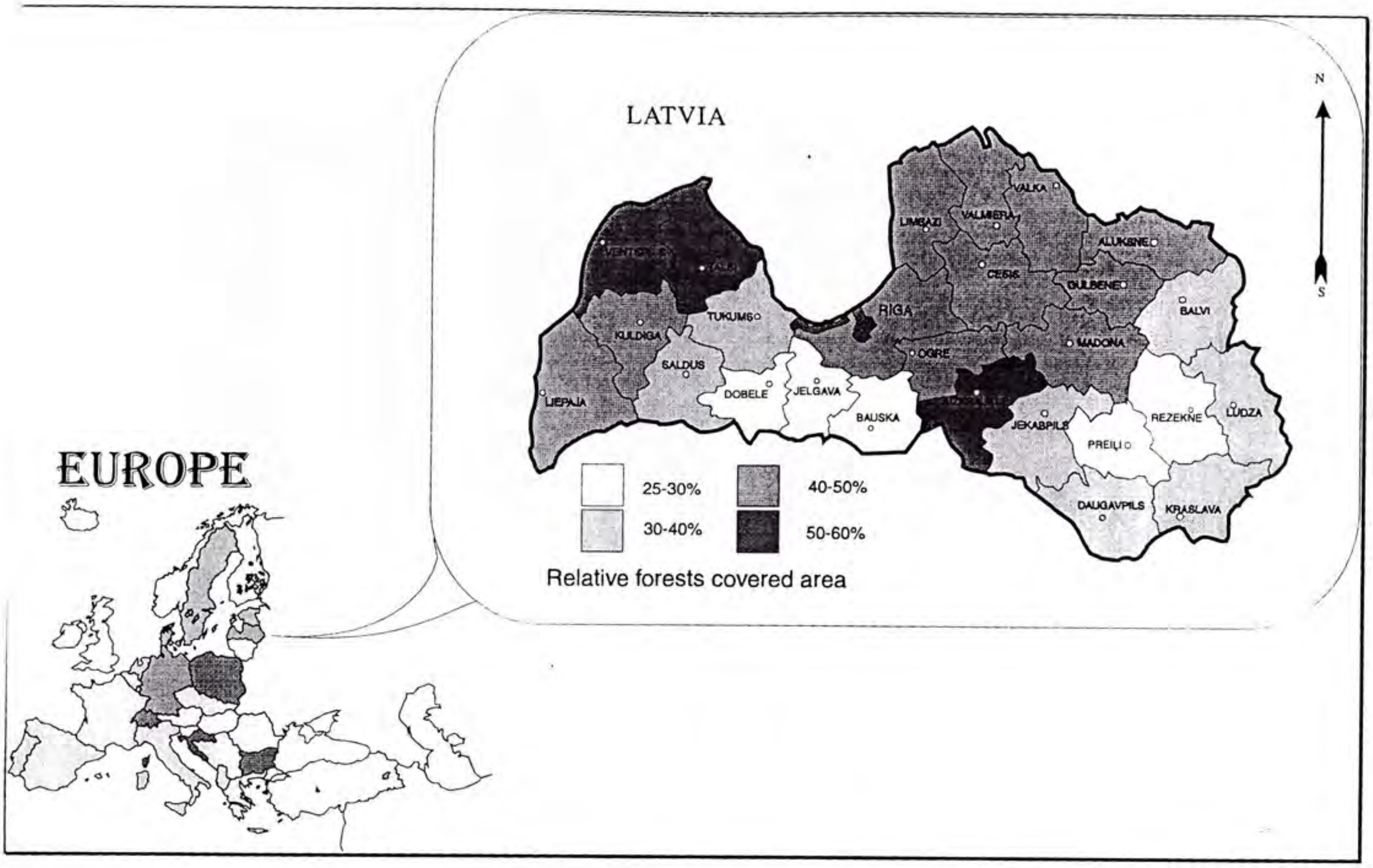
Each Forest District is also responsible for the prevention of forest fires in the area under its supervision: maintenance of bare earth firelines, putting up fire control signs, patrolling, public relations etc.

Forest fire suppression activities are directly supervised by the respective state forest officers - Head Forester of the Regional Forest District or Forester of the Forest District. These officials have undergone a course of instruction and training in forest fire control at the educational establishment they have graduated from (e.g. Forest Faculty of the Latvian Agricultural University).

There is a fire-fighting station at each Forest District (Fig.6). There are heated garage facilities for one or several fire truck-mounted pumper units, operators quarters with radio communications rooms for storing equipment and implements. Each truck has a crew of 3 to 4 men, it is equipped with one or more motor pumps with water capacity 1000 l/min and having attached, jet pipes, also hand tools (buckets, axes, power saws, shovels, etc.).

The crew undergoes training each year before the fire-sensitive season starts. Forest fires are normally detected from fixed lookout towers (Fig.6). There are 200 lookout towers in the country. Most of the forest fires are detected from these towers by informing the respective forest district of the coordinates of fire location. The cases of fire detected in patrolling, from the air or by local people are less frequent. This system allows to start fire fighting operations no later than in a half an hour's time after the detection.

For fire reporting and alarm systems use is made of telephone, radio communications available at every Forest District. They have also pumper units on trucks, other vehicles are used as well. Fire reporting and alarm is as follows: lookout tower - forest district office - fire fighting station.



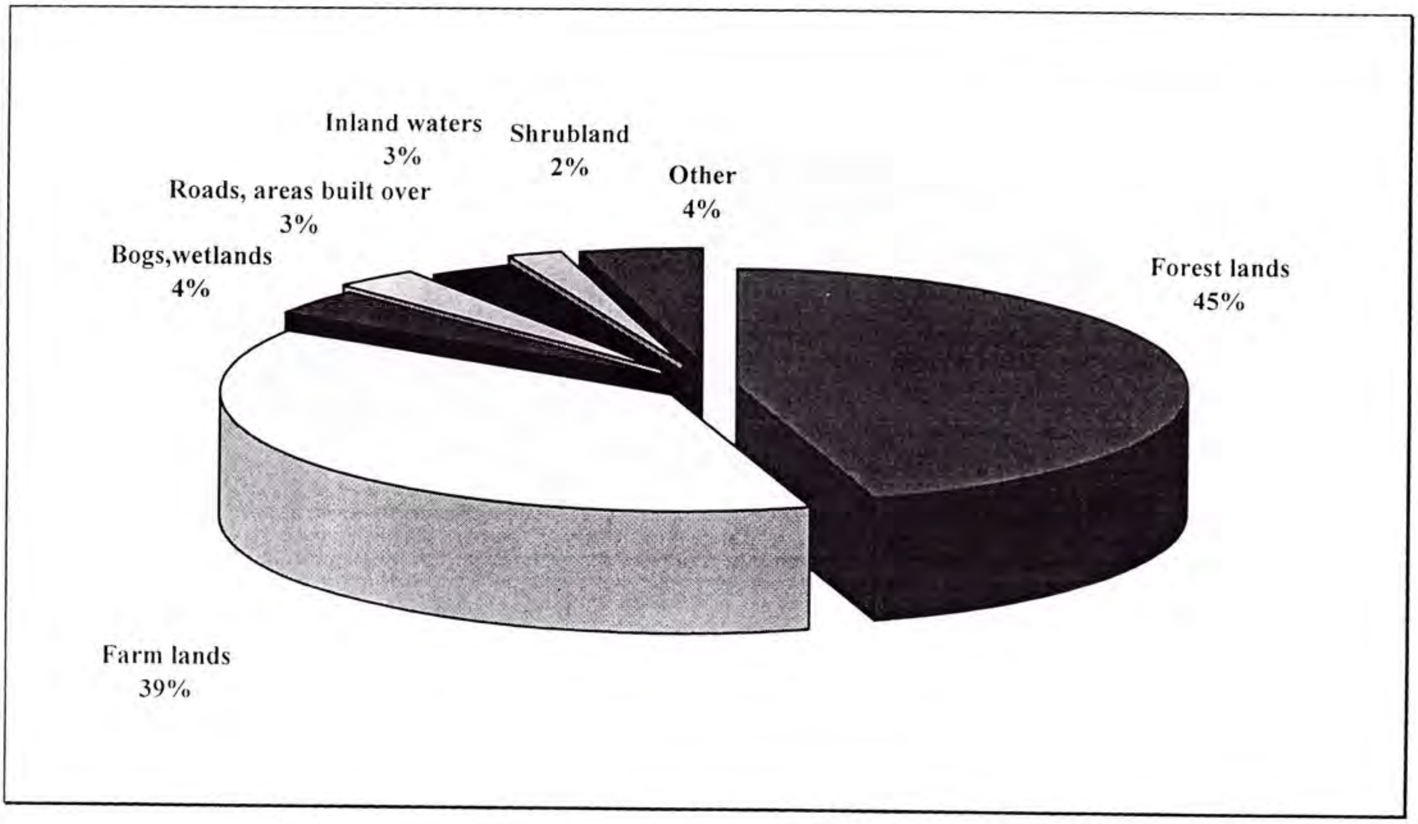




**Fig.1 and 2.** Percentages of forest cover (upper) and land use (lower) in Latvia.

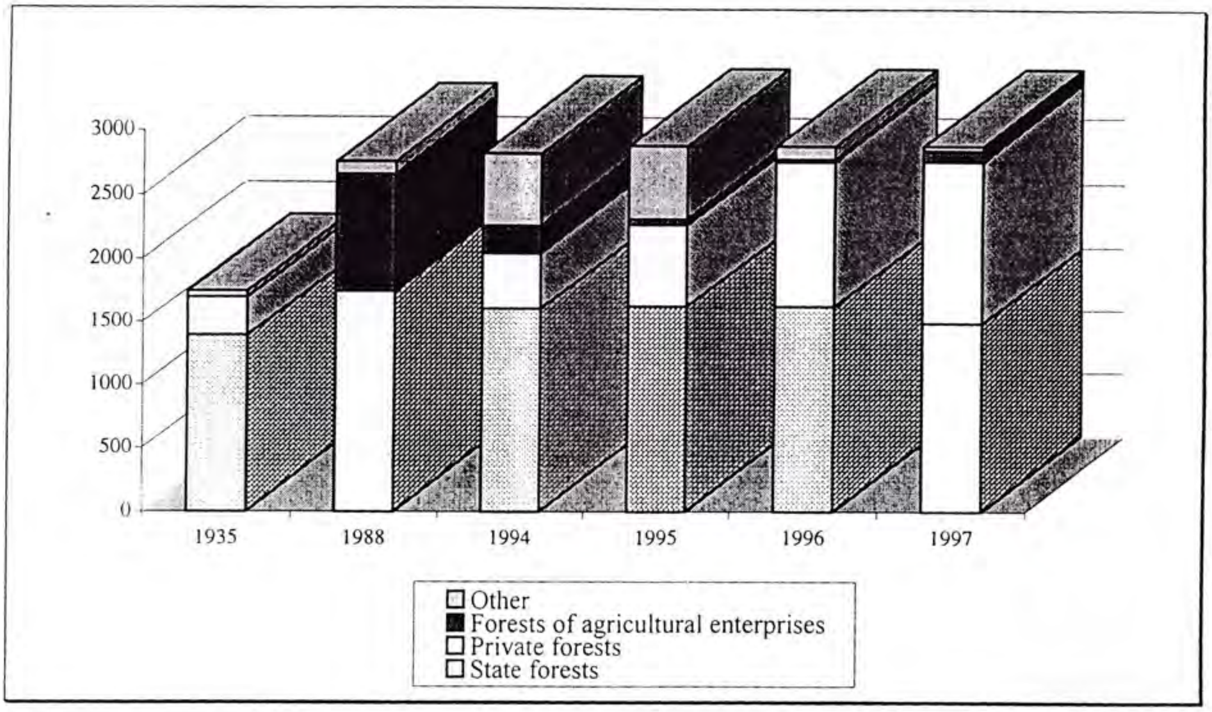



**Fig.3.** Distribution of forest ownership (x 1000 ha)

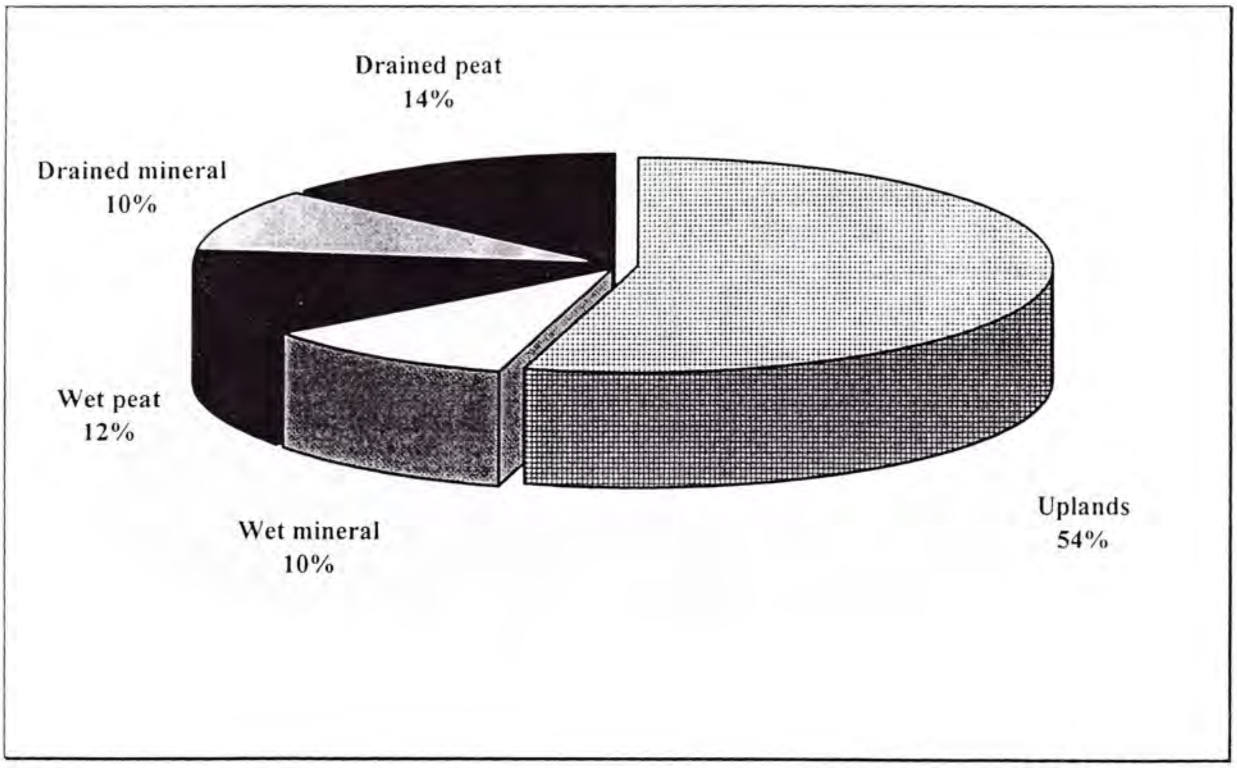
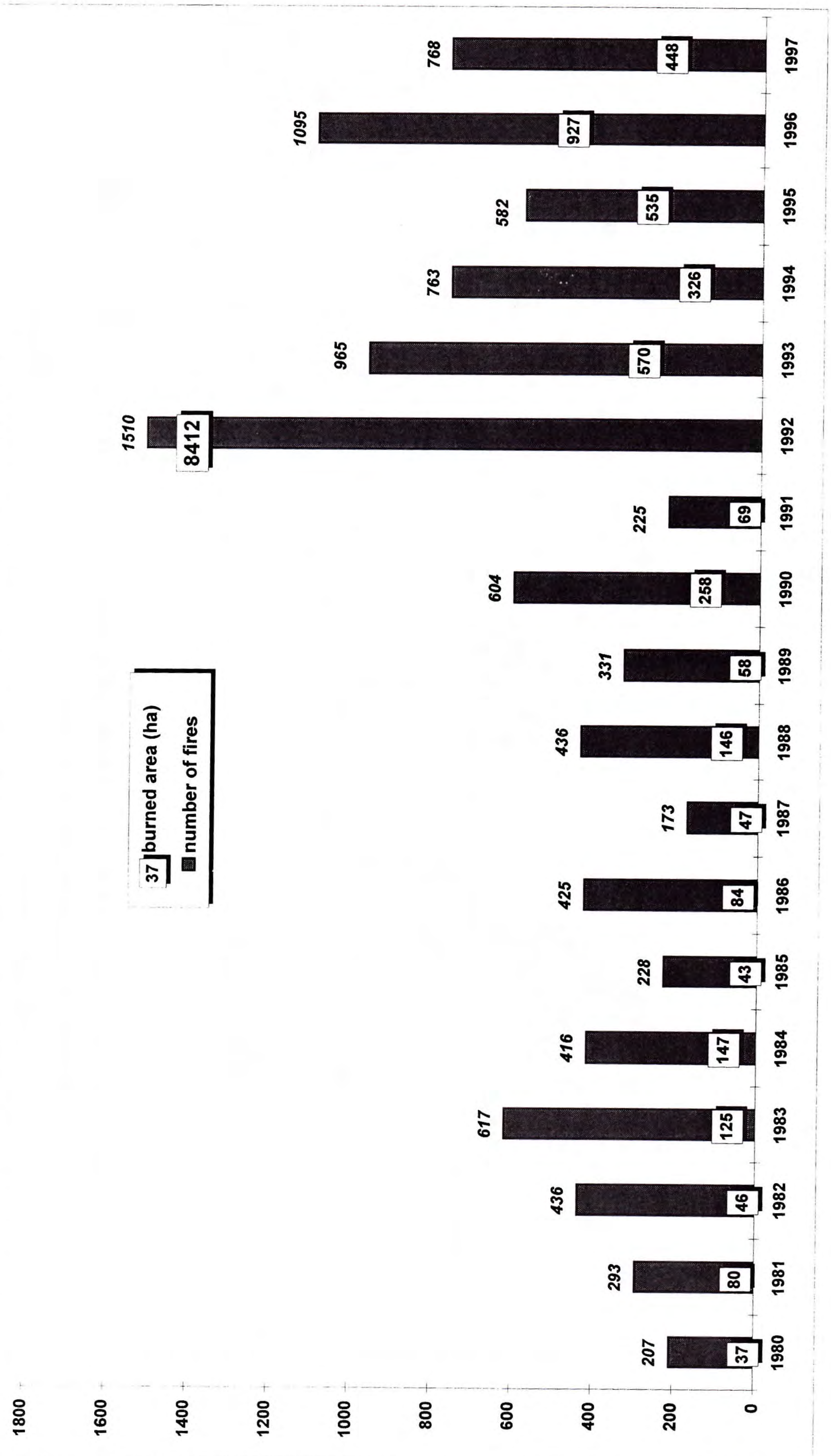



**Fig.4.** Distribution of forest by site types (%)

Fig.5. NUMBER OF FOREST FIRES AND BURNED AREA (ha)



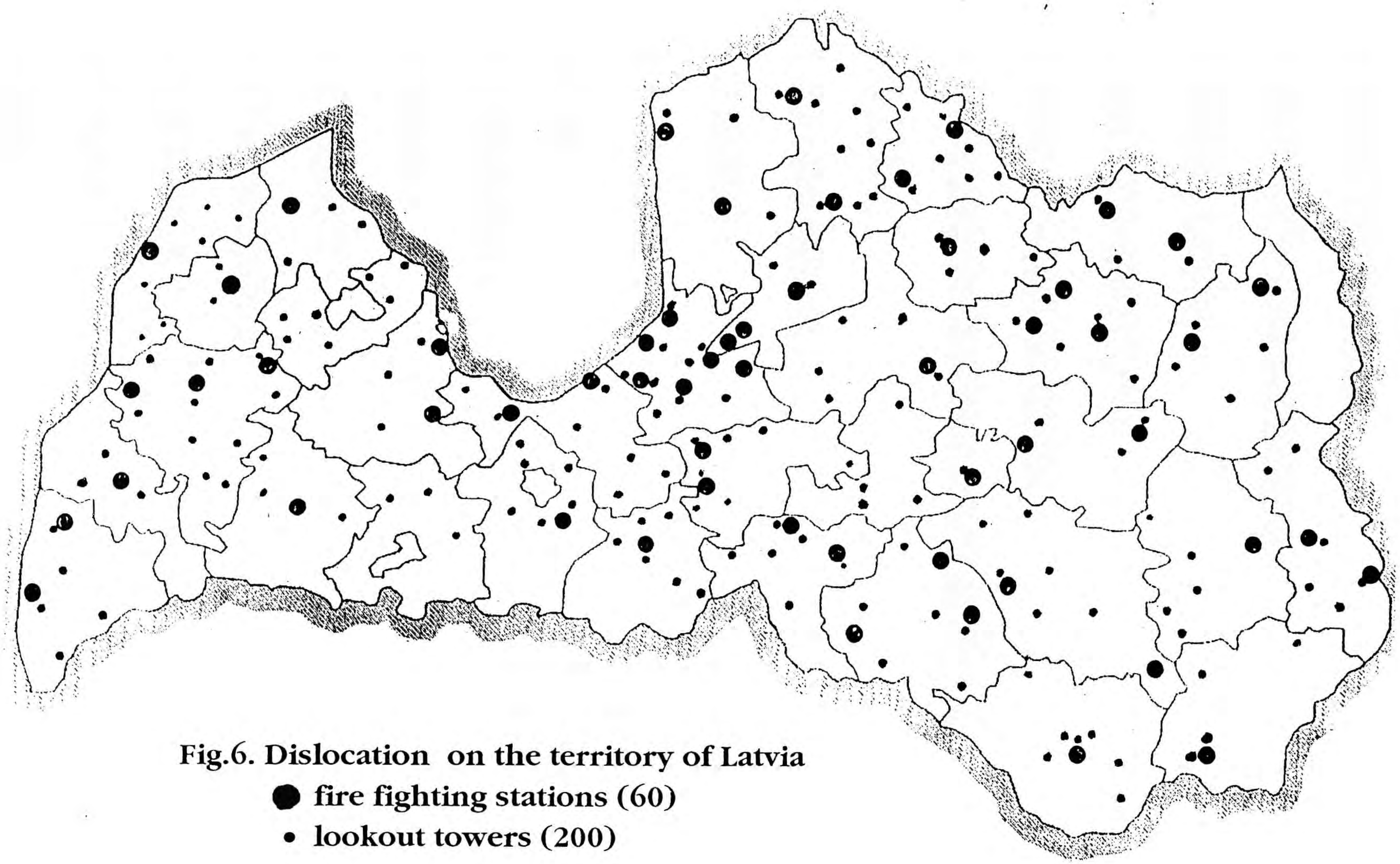


Fig.6. Dislocation on the territory of Latvia
● fire fighting stations (60)
• lookout towers (200)

Fig.7. STATE INSTITUTIONS INVOLVED IN THE FOREST FIRE FIGHTING

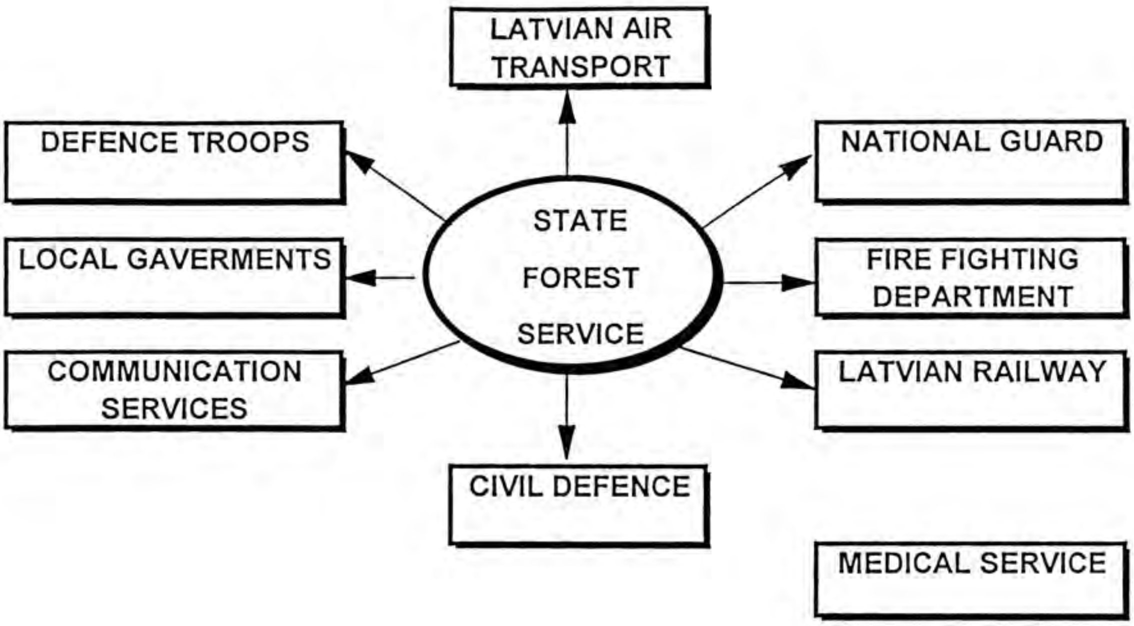



**Fig.7.** State institutions involved in forest fire control

To predict with greater accuracy the development of the forest fire, its speed and direction, the SFS receiver on a daily basis weather forecasts with an evaluation of forest fire danger, wind direction and speed, the temperature for the current day and the period to come.

Each case of forest fire where the area affected exceeds 0.001 ha is recorded by drawing up a statement. The data are summarized by the SFS annually as of 1 November, when the fire-sensitive season is oven.

The cases of forest fires where the area affected exceeds 10 ha are investigated by the officials of the SFS. Latvian forest fires statistics - number of fires and burned area is given in Figure 5.

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**MONGOLIA** *Fire in Forest Ecosystems of Mongolia*

In Mongolia, fire is a major factor which determines spatial and temporal dynamics of forest ecosystems. I also drives the trend of forest formation, varying with altitude. Out of the total of ca. 17 million ha of forest land, 4 million ha are disturbed to different levels either by fire (95%) or by logging (5%). Logged areas have increased drastically for the past 20-25 years. 600,000 ha of cuts have not yet recovered (Korotkov et al. 1990, Gunin et al. 1992). With consideration of the above data, the goal of our study was to investigate spatial and temporal forest fire patterns and conditions of their occurrence, as well as to reconstruct fire history over several centuries by dendrochronological methods.

A number of dendrochronological investigations of a variety of specific site conditions have been conducted in the last decades. Data are now available on annual increment of larch (*Larix sibirica*) and pine (*Pinus sylvestris*) in some regions of the country (Davaazhamz and Lovelius 1974, Bitwinskas et al. 1987). Annual tree increment was established to be strongly dependent on winter and spring air temperatures and on summer precipitation, with the influence of the latter varying with month. 11- and 22-year tree increment fluctuations were identified related with solar and geomagnetic field activity (Lovelius et al. 1992). Although there is quite a number of publications addressing Mongolian forests, there is still a lack of data on the influence of climate on tree increment changes. Also, there is no information available on fire frequency in forest ecosystems of this region.

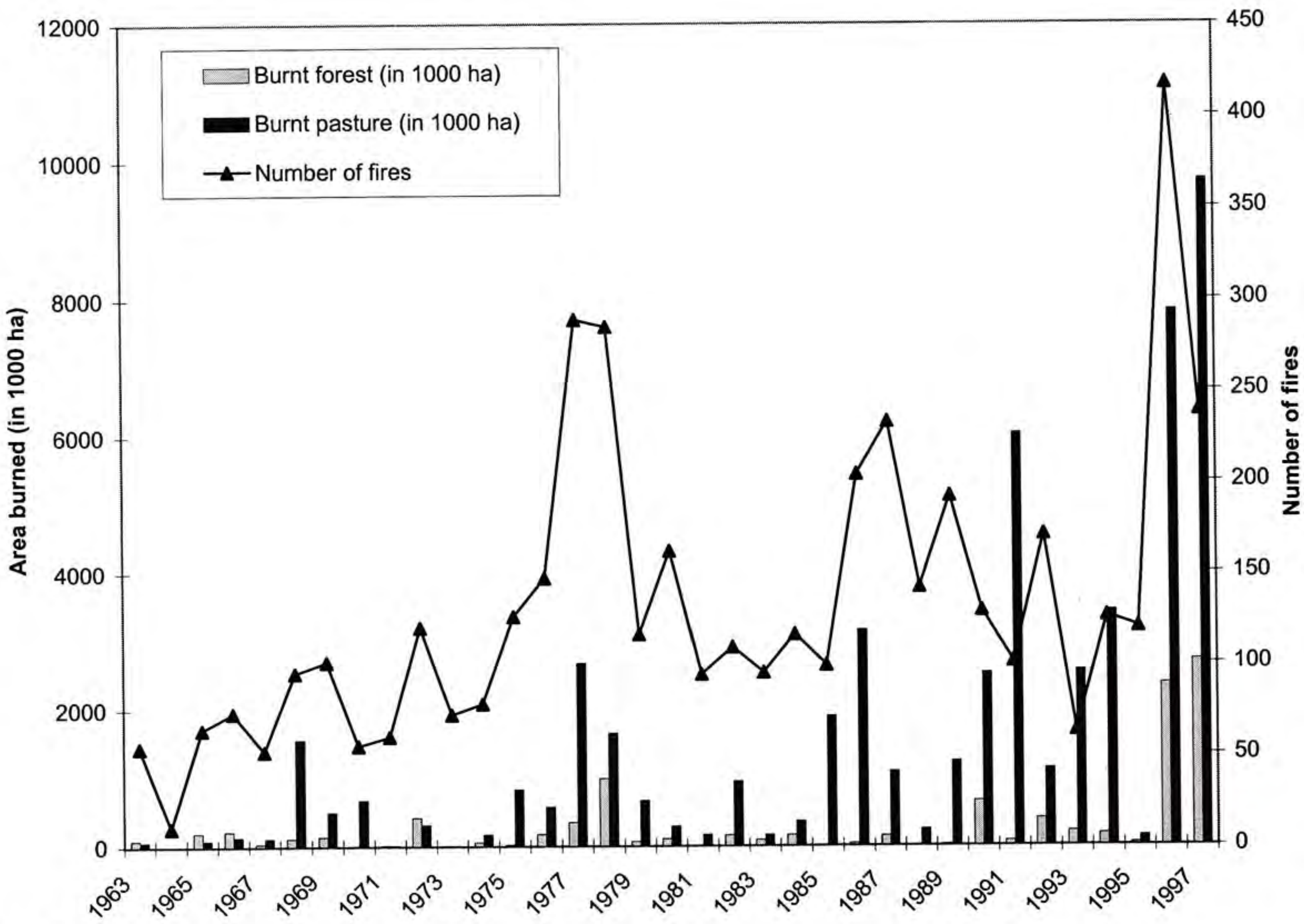
### Fire Frequency and Distribution in Mongolian Forests

Forest land comprises about nine percent of the total area of Mongolia. The highest fire danger is characteristic of low-mountain pine and larch stands growing on seasonally freezing soils. These stands are distributed on Khentey, East Khentey and Khubsugul foothills. Climate here is of an extreme continental type. During a year, air temperature fluctuations can amount to 90°C, with the summer maximum being +40°C. Annual precipitation ranges 250 to 350 mm. In exceptionally dry years, this value does not exceed 200 mm in forest regions. Precipitation is unevenly distributed during a year. Snow cover is not more than 10-15cm deep. Summer is the season of the lowest precipitation that usually occurs as heavy showers (Isaev et al. 1992).

Mongolian forests are characterized by high fire danger. Fire occurrence and extent are controlled by several factors, such as geographic location, climate, vegetation patterns, and human activities. The forest fire statistics for the period 1963 to 1997 are given in Table 1. The majority of fires burned within the central and eastern parts of the forested area. This can be attributed to the predominance of highly fire susceptible (highly flammable) pine and larch stands. Moreover, economic activity is much higher here as compared to other parts of the region. Extreme fire seasons are induced by long droughts. Fires burn from April to July under such conditions. Large fires occur on the background of mass fires. 1992, 1996, and 1997 were extreme fire years. In Mongolian forests, fire seasons are usually discontinuous, i.e. they have two peaks of fire danger. One peak is observed during long dry spring (from March to mid June) and accounts for 80 per cent of all fires. The other fire danger peak falls within a short period in autumn (September-October) and it accounts for 5-8 percent of fires. In summer, fires occur very rarely (only 2-5% of the total) because of heavy rains.

1985-1994 fire distribution data provided by seven forest protection air bases for Khanngai and Trans-Baikal forest zones are shown in Table 2. In these zones, fire activity is the highest in May and April - 48.1% and 33.3% of their total number in a fire season, respectively. Fires start in late March and early April, immediately after snow melt when forest fuels are drying rapidly on southern- and western-facing slopes. Strong winds of a continental-cyclonic character, whose average speed amounts to 5m/s in spring time, also contribute to fast drying of forest fuel.

Intensive solar radiation removes thaw water from the topsoil by evaporation, and the remaining thaw water flows from elevated sites downhill and accumulates in depressions because it cannot penetrate deeply into frozen soils. Spring fires are thus most common in stands on these elevated dry landscape elements and in those where herbs and small shrubs form a loosely compacted living ground cover layer. The number of fires reaches its maximum in May and June which are the hottest and driest months. In summer, abundant green vegetation reduces the fire start risk considerably. In exceptionally dry years, however, fires remain active during summer period.




**Tab.1.** Forest fire statistics of Mongolia 1963-1997. Source: Ministry for Environment and Nature, Mongolia

**Tab.2.** 1985-1992 Forest fire distribution in Mongolia by month

| Local Airbase | Month | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | March | April | May | June | July | Aug. | Sep. | Oct. | Nov. | Total |
| Ar. khalgai | 2 | 18 | 8 | | | | 2 | 4 | | 34 |
| Khovsgol | | 19 | 23 | 11 | | | 2 | 2 | | 57 |
| Bulgan | 11 | 58 | 117 | 5 | | | 3 | 3 | | 197 |
| Selenge | | 27 | 52 | 8 | | | 3 | 9 | 1 | 100 |
| Khentij | 10 | 19 | 23 | 3 | | | | | | 55 |
| Dornod | 1 | 9 | 6 | | | | | 1 | | 17 |
| Ulan-Baatar | | 25 | 24 | 7 | | 2 | | 7 | | 65 |
| Total | 24 | 175 | 253 | 34 | | 2 | 10 | 26 | 1 | 525 |
| Percentage | 4.6 | 33.3 | 48.1 | 6.5 | | 0.4 | 1.9 | 5.0 | 0.2 | 100 |

Numerous fires in the forest-steppe and subtaiga zones are induced mainly by steppe fires that invade forest stands under certain weather conditions. In the mountain forest belt, especially in the high elevations, lightning fires are most common. Lightning storm activity increases considerably at the end of May and in early June. High fire danger is to a big extent due to prevalence of light-needled conifers in stands adjacent to steppe areas. These are mainly pine stands with mixed herb ground cover, which are characterized by high fire danger in spring and autumn. Steppe vegetation and surrounding pine stands attain high flammability practically simultaneously. Fire occurrence depends on forest type, precipitation distribution, and availability of fire sources. Fires are frequent in pine and larch stands of the forest-steppe and subtaiga zones, while they occur much rarer in larch and Siberian pine stands of the mountain taiga.

**Fig.1.** Fire scars at the lower part of standing old growth of pines and larches are common in Mongolia.

**Study Area and Methods**

We analyzed forest fire frequency in Mongolia using dendrochronological data plus official fire records and forest fund information for the period 1985 to 1994. In order to perform dendrochronological analysis and forest fire dating, we collected tree-ring samples in subtaiga pine forests of East Gubsugul highland and Selenga river valley. Sample sites are characterized in Table 3. These are mostly pine stands with mixed herb ground cover growing on rocks. Methods of reconstructing fire histories in forest communities from tree-ring analysis of forest age structures and fire scars (Fig.1) are well known, as are methods for reconstructing past climatic variations from tree-ring measurements (Swetnam 1996). Our fire scar dating project was conducted in the East Gubsugul highland where we collected chronologies on six pine sites (Fig.2). We identified scars of 56 fires which burned during the last two centuries. The biggest number of fires was recorded in pine stands on southern and western slopes (e.g., 16 fires were recorded by fire scars in a pine dry site with Carex/mixed herb ground cover).

In order to build forest fire chronologies, we collected full cross-sections from fire scarred trees, both alive and dead. Fire dates were established on each cross-section from the years when fire scars occurred. As a result, we obtained a general fire chronology, which was based upon to calculate fire intervals and fire frequency for different periods of time (Dieterich and Swetnam 1984, Fritts and Swetnam 1989). For dating fires, we used the method of cross-dating with regional and local tree-ring chronologies (Shiatov 1986). These chronologies were built using cores from old trees which had no fire scars. We used 24 *P.sylvestris* full cross sections.

**Tab.3.** 1985-1994 Dendrochronological sample sites in the East Gubsugul highlands, Mongolia.

| Series | Site | Location | Forest type | Notes |
|---|---|---|---|---|
| 1 | Barum Khairlsteingold river valley<br>940 m a.s.l. - 49°37' N 104°16' E | 25-30°<br>SW slope | Pine-Carex-mixed herbs<br>(dry site) | Exposed rocks |
| 2 | Barum Khairlsteingold river valley<br>940 m a. s.l. - 49°38'N 104°6'E | 20°<br>SE slope | Pine-Carex-mixed herbs | Exposed rocks<br>Burn 1990 |
| 3 | Barum-Khairlsteingold river valley<br>1040 m a.s.l. - 49°33'N 104°02' E | 25°<br>SE slope | Pine-Carex-mixed herbs<br>on stony soil | Exposed rocks<br>Burn 1990 |
| 4 | Barum-Khairlsteingold river valley<br>1100 m a.s.l. - 49°38'N 104°13' E | 15-20°<br>NW slope | Pine-Carex-mixed herbs<br>on stony soil | Exposed rocks |
| 5 | Barum-Khairlsteingold river valley<br>1100 m a.s.l. - 49°38'N 104°13' E | 15°<br>W slope | Pine-mixed herbs | Exposed rocks |
| 6 | Selenga river valley<br>820 m a.s.l. - 49°37' N 104°21' E | Flat site | Pine-mixed herbs<br>(in a valley) | Old Burn |

**Forest Fire Frequency**

Fire frequency varies in pine stands with forest type, slope aspect, and level of recreation. The shortest fire interval (4 years) was found for the pine stand with Carex/mixed herb ground cover in dry sites (Tab.4). Fire activity was the highest in spring, and autumn fires accounted for only 5% of the total number of fires recorded. Mean fire interval was found to range from 13.9 to 18.8 years in mountain subtaiga pine stands and 22.8 years in pine stands located in valleys. High fire frequency in spring is due to dry conditions, frequent lightning storms, and predominantly human activities, especially by cattle herders.

Our fire history reconstruction for the past 250 years showed 31 years with fires in the 19th century, while their number decreased to 22 in the current century. This can be due to a considerable progress in forest fire fighting that has been achieved in Mongolia over the past half century. Forest fire fighting, however, presents a big problem in Mongolia. Fires spread very fast in mountains, and the use of ground technical resources to suppress fires is limited and often ineffective because of long distances, restricted access and steep slopes. This makes fire prevention the key point. The goal should be to prevent steppe fires from invading adjacent forest ecosystems (see also contribution by Wingard and Erdenesaikhan, this volume).

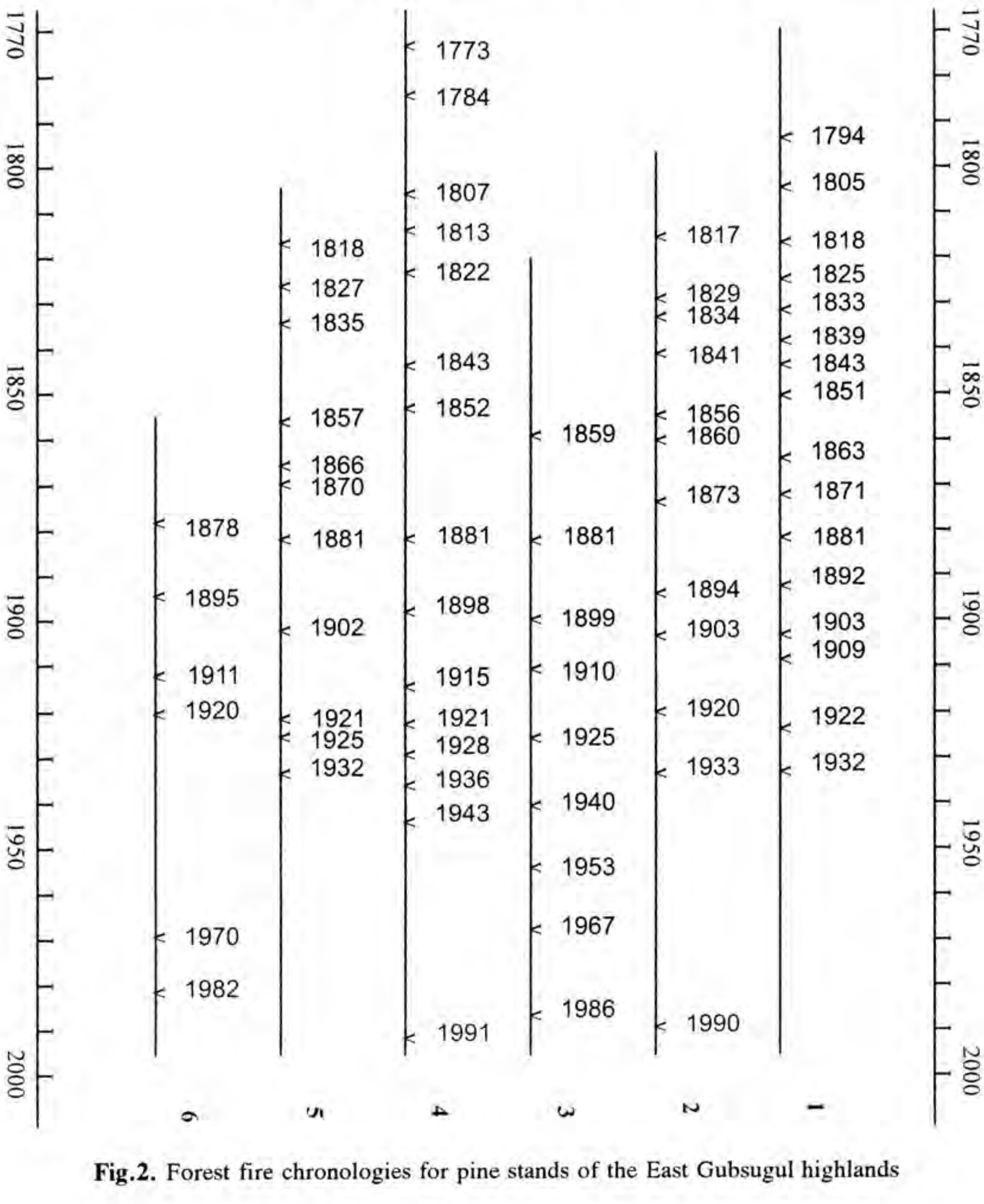



**Fig.2.** Forest fire chronologies for pine stands of the East Gubsugul highlands

### Conclusion

From conducted investigation the following can be concluded: Fire seasons are usually discontinuous in Mongolia, with 80 % of fires occurring in spring and only 5-8 % in autumn. The development of abundant green grass layers together with heavy dragged out rains minimize fire danger in summer. However, fires can be active during summer in exceptionally dry years. Most forest fires are induced by steppe fires invading adjacent forest stands under certain weather conditions. Lightning fires are common in mountain taiga belt because of increasing storm activity in late May and early June. Extreme fire seasons occur every thee years in Mongolia. These seasons account for almost half the number of fires and 1/3 of the total area burned over the past decade. The mean fire interval varies from 9 to 22 years depending on forest type, slope aspect, and human factor.

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*The German - Mongolian Technical Cooperation GTZ Integrated Fire Management Project Khan Khentii Protected Area, Mongolia*

**Background**

Besides first scientific studies on historic fire frequencies the present knowledge about the historic extent of fires in Mongolia is still limited. The first attempts to manage fire did not begin until 1921 and remained limited to local town fire departments until the 1950s. Relatively accurate records exist beginning only in 1981.

It is clear, however, that Mongolia is experiencing a dangerous increase in wildfires. From 1981 to 1995, forest and steppe fires burned an average of 1.74 million hectares (ha) annually.[6] In 1996 and 1997, the area affected by fire was 10.7 and 12.4 million ha respectively - an increase of more than sixfold.[7] The areas hardest hit by these increases have been the forested regions. The typical forest fire season (1981-95) swept through some 140 thousand ha (on average 8% of the total area burned), already a large area. However in 1996 and 1997, this figure radically increased to nearly 18 times the previous average - some 2.5 million ha annually, corresponding to ca. 22% of the total land area affected by fire.[8] In these two years alone more forested areas burned than were harvested over the last 65 years.

**Causes and Consequences**

In one of the most sparsely populated countries in the world, it is difficult to get accurate information on fire causes. It is known, however, that during Mongolia's "main" fire seasons (spring and late fall), no natural fire causes exist.[9] Official statistics cite transportation (trucks, cars, trains, etc.) as one of the primary causes. Anecdotal evidence suggests that most fires can be attributed to carelessness - failure to extinguish campfires, cigarettes, sparks from tractor exhaust, use of tracer bullets, etc. New economic activities and a breakdown in control mechanisms are fuelling the number and severity. One of these activities is the collection of elk antlers for sale to European and Chinese markets. Collection starts in the bitter cold of February where fire is simply a survival tool.

The most obvious consequence of frequent and intense fires is the loss of forested land.[10] The current fire pattern is affecting 14% of this resource annually. The brief growing season and low growth capacity of the trees means that these forests may take 200 years or more to regenerate.

In addition to their commercial value, these forests are a precious ecological resource. They contain the sources of virtually all rivers in the country including the inflow to lake Baikal (Russia), the largest fresh water lake in the world. They protect soil, rangelands, provide habitat for wildlife and serve as windbreaks.

**Political Developments**

Immediately following the 1996 fires, Mongolia received assistance from international organizations to help local people recover from the losses. The German government contributed to these efforts in the form of an Emergency Fire Aid project carried out in the northern and eastern parts of the country (October-December 1996). Since then, the government has been working to find long-term solutions to the problem of fire management. In a first step, the parliament passed of a law designed to organize and improve fire fighting efforts at all levels.

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[6] Report by Erdensaikhan, Basic Data and Information on Forest and Steppe Fires, prepared for the GTZ Integrated Fire Management Project, Ulaanbaatar, Mongolia.

[7] 10,733,257 ha in 1996 (Source data: NOAA-14, 21-24 May 1996) and 12,448,182 ha in 1997 (Source data: NOAA-14, 21-24 May 1997). The area burned was derived from satellite imageries produced by the Information and Computer Center, Ministry for Nature and Environment, Ulaanbaatar, Mongolia.

[8] Fire coverage 1996 - 2,363,600 ha; Fire coverage 1997 - 2,710,000 ha (Report by Erdensaikhan).

[9] Natural fires occur in the summer, but this is also the rainy season and they therefore remain small in number and size.

[10] Approximately 8.1 percent of Mongolia is forested (17.5 million ha) the vast majority of which is inaccessible

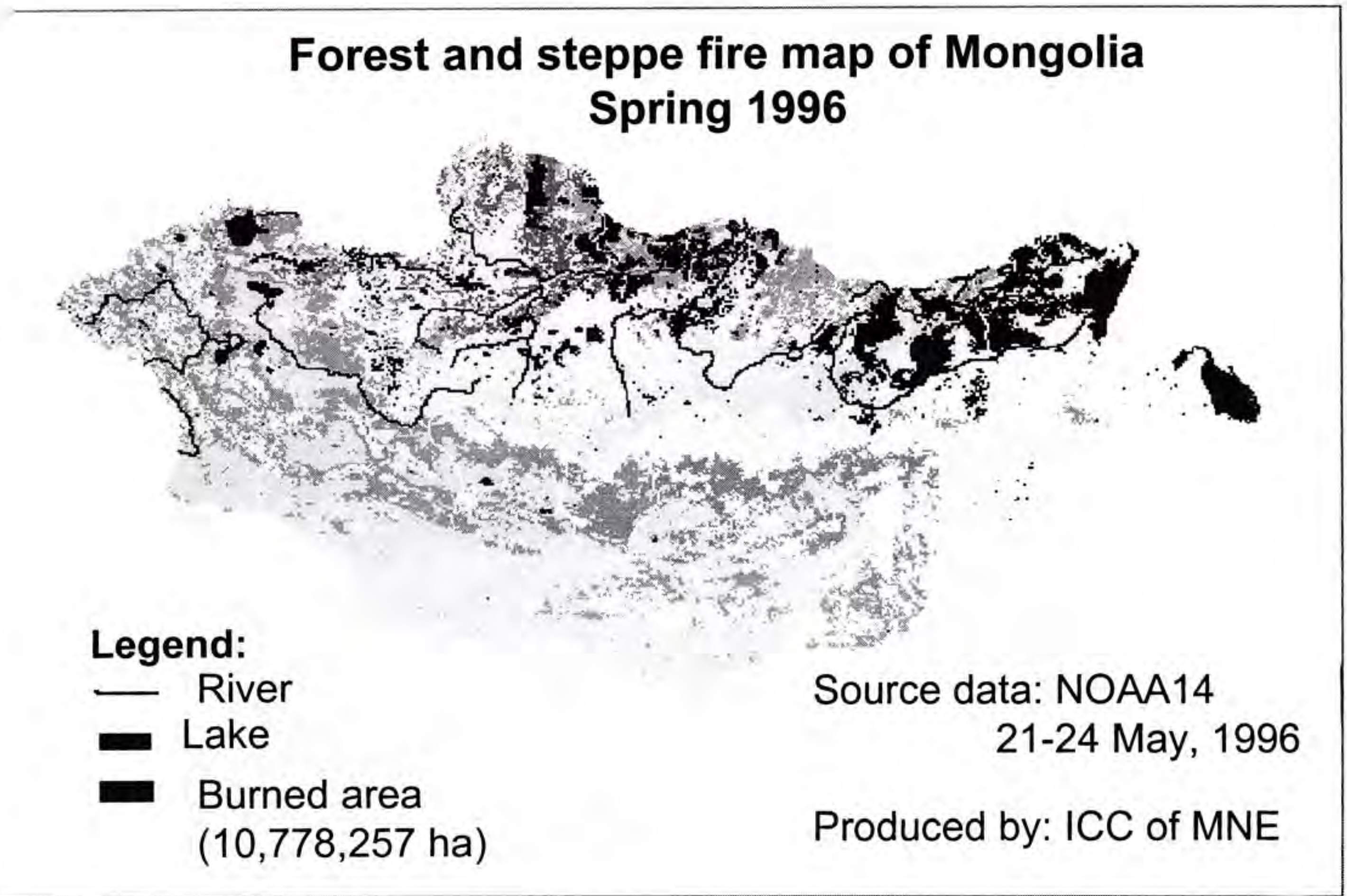


**Fig.1.** Forest and steppe fire map of Mongolia, spring 1996

In February of 1998, the German and Mongolian governments signed an agreement to start an Integrated Fire Management Project to be implemented over the next three years (1997-2000). The GTZ, responsible for the German contribution, will provide long and short-term experts, support staff, training and equipment.

**Project Concept**

The project region selected by the Integrated Fire Management Project is the Khan Khentii Strictly Protected Area and its buffer zones - one of the harder hit areas during the 1996 fires. A primary task will be the establishment of a fire management plan compatible both with the protected area goals and the responsibilities of the local communities. Fire Management Units in the local communities will receive professional training and basic hand tools suitable for the regional conditions. Information and Training Centers will provide the necessary infrastructure for fire prevention activities, management information, training exercises, dispatch and field organization.

**Project Components**

The IFM project supports Mongolia by strengthening local capacities to effectively address the issues of fire prevention, pre-suppression, and suppression. It will do this by helping to organize the cooperation between protected area, local and national administrations responsible for fire management; by establishing the necessary infrastructure, providing training both in-country and abroad; and, by including all stakeholders in the planning and implementation of fire management activities.

**Fig.2.** Forest workers combatting a surface forest fire in Mongolia, spring 1996

**Prospects**

The IFM project in Mongolia is in its infancy. It is, therefore, too early for a prognosis. But the team feels positive about the tremendous response already experienced at all levels. Because of this understanding and support, a number of activities have been possible, i.e., the establishment of fire management units in selected local areas (including initial training); development of a draft fire management plan for the protected area administration; and, the implementation of a pilot fire prevention program. We will be placing a tremendous amount of energy into the prevention aspects of the program.

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**NAMIBIA** *30 % Reduction in Fire Incidents in three Years*

## Background

The Namibia-Finland Forestry Programme (4 years) was initiated in April 1997. This Programme also encompasses Forest Fire Control as one of its components. The Pilot Project on Forest Fire Control for East Caprivi (meanwhile: "Integrated Forest Fire Management") was started in March 1996, more than one year before the new Programme. The aim of this project is to transfer the responsibility of forest protection to the users and beneficiaries of the forests, i.e. local communities.

Traditionally the protection of the environment in the local communities belonged to the community itself. The colonialization of Namibia disrupted however this tradition, and the ownership and management of all forests were reverted to the Government.

In 1996 an effort to remedy this situation was launched and the Directorate of Forestry decided to develop a National Forest Strategy for Namibia. This strategy recommended that the Government should return most of the forests to their original owners i.e. to the local communities. One of the problems foreseen was that while the system to legalize the transfer of ownership was being set-up, the forests were being destroyed. The destruction was going on at an alarming rate, and was mostly done by cutting down and burning the entire forest, thus converting the area to other land uses.

## Pilot area for Forest Fire Control

The pilot area consists of 1.4 million hectares of the best forests of Namibia and it belongs to the sub-tropical region. Despite that the area belongs to the Kalahari zone, the relatively high rainfall (700 mm) keeps the forests growing.

On the one hand, the early burning (April-June) has been tried out in the area in 1960's, and this practice was recommended, because the fires seldom seriously damaged the trees. On the other hand, late burning always damaged the trees, often killing many of them. It was also found, that no regeneration of natural species occurred since 1970's. This was specifically true for the Zambezi Teak (*Baikea plurijuga*) which ones was the predominant species in the area.

**Fig.1.** Open fire-degraded stand of Zambesi Teak in the Caprivi Strip, Namibia. Photo: J.G.Goldammer

**Project Profile**

| | |
|---|---|
| Name: | Namibia-Finland Forestry Programme (April 1997 - May 2001) |
| Component: | Forest Fire Control |
| Duration: | March 1996 - May 1999 |
| Implementing Agencies | |
| Namibia: | Directorate of Forestry, Ministry of Environment & Tourism |
| Finland: | FTP International Ltd. & Enso Forest Development |
| Personnel | |
| Namibia: | 1+1+2 +10 counterparts (14) |
| Finland: | 1 specialist |
| Project site: | East Caprivi Region (1.4 million ha) |
| Project Office: | Forestry District Office, Katima Mulilo |

**Strategy**

The project is embarking on two different approaches to the fire problem:

* To support public relations and extension activities for forest fire prevention within the Government and the training and mobilizing of local communities into fire management units.

* To run a massive Fire Campaign in schools and local organizations in the area, involving all stakeholders. This includes the production of written material, posters, bill boards, theatre plays, radio programmes and videos.

The strategy **does not** include investing in **fire suppression**, it is estimated that the pilot area had more than 10.000 fires in 1996. Thereby, at present moment it is of no use to try to put out 10.000 fires. Instead, the activities are directed towards the source of fire, the local people. The strategy adopted, **will teach people** in local communities in **how to prevent and control fire**.


**Fig.2.** Fire prevention poster designed by the Pilot Project on Integrated Forest Fire Management for East Caprivi. Photo: J.G.Goldammer

27 local communities with 279 villagers joined the fire prevention programme in 1997. The ***Development Brigade Corporation*** (DBC) with 236 ex-combatants (freedom fighters) also joined the fire prevention programme in 1997. A total of 1217 km of fire line were constructed in various strategic areas by the 515 people above.

It is further estimated that the whole northern Namibia or 10-14 million ha or the forested areas are prone to forest fires. In 1996, it was estimated that 4-5 million ha of forest land and more than a million ha of grass savanna burned in the North-Central and North-Eastern part of the country.

**Tab.1.** Achievements of the fire prevention programme

| **East Caprivi** | Percentage of area burned (%) | Area burned (ha) | Area unburned (managed) (ha) |
|---|---|---|---|
| Before 1996 the area burned: | 65% | 780,000 | none |
| In 1996: 7 communities | 60% | 720,000 | 60,000 |
| In 1997: 23 communities | 50% | 578,000 | 202,000 |
| In 1998 (Plan) 25 communities | 40% | 480,000 | 300,000 |
| | | | |
| **West Caprivi** | | | |
| Before 1998 the area burned: | 85% | 510,000 | None |
| In 1998: (Plan) 2 communities | 75% | 450,000 | 30,000 |
| | | | |
| **Fire Campaign** | Students (numbers) | Villagers (numbers) | Wildfires (numbers) |
| 1996 | None | 120 | 10,000+ |
| 1997 | 7,000 | 2,800 | 7,000 |
| 1998 | 15,000 | 5,000 | 5,000 |

## Conclusions

This forest fire control project is the first ever, globally, of its kind, not to have local people being employed by the Government. The 13 Traditional (tribal) Authorities who have signed a Contract to join the annual fire control programme will select a Fire Contractor in each community. This Contractor will them employ people from his/hers village, to work on fire prevention.

The Government will provide the village fire crews with training and with appropriate fire tools. The Government then pays 20 $US/km of fire line produced on the condition that the area is not burned. In case of burn, a percentage will be deducted from the pay. The cost of producing these fire lines is 40-50 $US/km. This means that each community and the DBC is actually paying half the actual cost (20 $US/km) to construct these fire lines. The local communities and the DBC produced 1217 km of fire line in Eastern Caprivi in 1997.

The local population is quite enthusiastic when they see means and ways of protecting their grazing lands and agricultural fields from fire. In addition, very few domestic animals have died in fires in 1996-97, one fatal case of arson excluded, where 100 animals died. Likewise, the communities have seen that no animals have died of starvation in 1996-97, because most grazing areas are still largely unburned, at the end of the fire season.

## Local traditions

The Traditional Authorities have caught 38 people in 1997, for careless burning in various villages, and these people have been tried by these communities. This makes the fire management at community level very efficient. Thereby also, the Police need not get involved in these cases. Thus, also the Forestry personnel, when catching people burning, brings these culprits directly to the Tribal Authorities. The fine at village level is often measured in cattle, one (1) cow is valued at 150 $US in this area. Normally the fine for burning the **grazing areas** is 2 cows.

The Tribal Authorities relate the fine to the loss of weight in their cattle, 200 heads loosing 2 kg/each, makes the loss 400 kg of meat. The buyers of cattle pay 1 $US/kg for the cattle. The above fine is: 400 kg x 1 $US = 400 $US. In case of bigger herds, the fine is proportionately larger. The fine varies slightly between the communities.

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## SOUTH AFRICA

### *A Structured versus a Laissez Faire Approach to Controlled Burning in the Kruger National Park in South Africa*

The Kruger National Park is situated in the north eastern portion of South Africa where it is contiguous to Mozambique in the east and Zimbabwe in the north. It comprises primarily arid savanna (473 mm p.a.) and is 1.9 million hectares in extent. The Park is one of the premier ecotourism centres in southern Africa and is the second oldest national park in Africa tracing its origin back to 1898. It has one of the greatest diversities of animal and plant life in the world and has as one of its management objectives the maintenance of species and structural diversity of the ecosystem. The attainment of this objective is achieved through active managerial involvement but based on the principle of management with minimum interference. One of the most important management practices that has been applied in the Kruger National Park since its establishment is controlled burning. This is because fire is recognised as a natural factor of the environment in the Park where it has occurred since time immemorial and has and still is one of the most important factors influencing the composition and structure of the savanna vegetation. Systematic controlled burning in different forms has been applied since 1954 to provide palatable, nutritious grazing for wildlife and maintain an optimum balance between grass and bush vegetation. A program for monitoring the condition of the rangelands in the Park since 1989 has indicated a steady decline in the forage production potential and a decrease in the diversity of perennial grass species. Excessively frequent burning has been identified as one of the likely causes for these changes and debate has developed on strategies to decrease this rate. One option is a laissez-faire approach which has been adopted in the Park and where fires caused by lightning are permitted to burn (but anthropogenic fires as far as possible are extinguished) believing that this will result in the development of a natural fire regime. Another option is a structured approach where controlled burning is applied following a decision-support system using ecological criteria. In both cases it is believed that this will result in a decrease in the frequency of burning in the Park and lead to sustainable and maximum biodiversity.

Analysis of the records of the fire regime based on the area burnt during the period 1985 to 1992 showed that the most important ignition source in the Park was controlled burning (47 %), which was applied on a rotational basis to remove moribund and/or unpalatable grass material and to maintain an optimum balance between grass and bush vegetation. Fires lit by refugees fleeing from Mozambique via the Park into South Africa accounted for 24 %. These homeless people light fires for protection, cooking and warmth which then spread either by accident or when left unattended. The next most important causes of fires have been grouped under a general heading others (20 %). This includes wildfires caused by poachers, tourists, arsonists, accidents and reasons unknown. Surprisingly lightning (10 %) was not a very significant ignition source and the probable reason for this was that ignition from other sources had a greater probability of causing fires under the form of management in the Park and political conditions in Mozambique.

The frequency of burning in the Kruger National Park is highly variable and is influenced by the annual rainfall and the grazing pressure exerted by the wildlife populations that fluctuate from year to year. The most commonly occurring types of fires in the Kruger National Park are surface fires burning in the grass sward either as head fires with the wind or back fires against the wind. Crown fires do occur when the aerial portions of trees and shrubs occasionally ignite during fierce high intensity head fires but these are the exception rather than the rule. Fire intensities vary primarily according to fuel load consequently the intensity of the fires will be influenced by the rate of accumulation of grass fuel as a product of the annual rainfall. Suffice it to say that fire intensities recorded during experimental burns applied during 1992 in the Park ranged from 8845 to 22 kJ/s/m for head fires and 160 to 20 kJ/s/m for back fires illustrating the wide range of intensities that can occur within and between different types of fires.

**Fig.1.** Experimental prescribed burn in Kruger National Park during the **Southern Africa Fire-Atmosphere Research Initiative** (SAFARI-92). Photo: J.G.Goldammer

As a result of the development of simplified techniques for estimating the standing crop of grass material and assessing the condition of the grass sward in the Kruger National Park a program to monitor the condition of the rangelands was initiated in 1989. This comprises recording the standing crop of grass with a disc pasture meter and the presence and absence of 18 key grass species at 532 sampling sites located in the 35 landscape units. These data are used to monitor annually the grass fuel loads, the potential of the rangeland to produce grass forage and fuel and trends in the grazing intensity of the grass sward. An assessment of the condition of the rangelands in 1989 led to the conclusion that the majority of the rangelands were dominated by Increaser II grass species which indicates that the grass sward was being heavily utilised by grazing animals. Analysis of the data collected during 1994 indicates that Increaser II grass species increased by approximately 40%. This increase between 1989 and 1992 suggests that the rangelands are being overutilized and that the grazing intensity is non-sustainable in the long term. In the absence of any other objective measure of the biodiversity of the grass sward this would indicate that the current management of the rangelands is not achieving one of the primary objectives of biological management in the Kruger National Park viz. the maintenance of species diversity of the grass sward. The condition of this component of the vegetation is of particular importance as it is the primary source of forage for a large proportion of the ungulates and other wildlife species in the Park.

There is evidence to suggest that too frequent burning has also caused an increase in the proportion of Increaser II grass species in the rangelands. This is because an analysis of the grass fuel loads recorded in the Park during the period 1989 to 1992 indicates that the majority of the areas (73%) subjected to controlled burns during this period were in a non-moribund condition (< 4000 kg/ha) and need not have been burnt. These data would suggest that the rangelands were being burnt too frequently during the burning policies that were implemented since 1980.

One of the solutions to the declining condition of the rangelands in the Kruger National Park is to modify the controlled burning program, particularly reducing the frequency of burning.

This was addressed in 1994 when a laissez faire burning policy was introduced to replace the previous subjectively structured burning program. This comprises a "hands off" policy where all fires ignited by lightning in the Park are permitted to burn freely whereas all anthropogenic fires must be extinguished as far as is possible. The basic philosophy of this laissez faire burning policy is that lightning should be regarded as the only natural ignition source and if left alone will result in the development of a natural fire regime as regards types and intensities of fires and the season and frequency of burning. It is reasoned that human interference in the functioning of one component of a natural ecosystem will eventually lead to interference in the other components with unforeseen consequences. The laissez faire burning policy is not based on any practical examples from elsewhere in the savannas of Africa but rather on the basic and sincere belief that if a natural area is large enough, as the Kruger National Park is assumed to be, the ecosystem will function normally in response to natural variations in the environment, for example seasonal variations in the rainfall.

Another option to modifying the burning program in the Kruger National Park in order to achieve the management objectives of the Park is a structured approach where controlled burning is applied following a decision support system using ecological criteria. The basic philosophy of the proposed structured approach to controlled burning is that the use of fire to achieve specific management objectives must be based on the condition of the vegetation and its known reaction to the different components of the fire regime i.e. type and intensity of fire and season and frequency of burning. Based on research results obtained in the Kruger National Park and elsewhere in the savanna areas of southern Africa the following ecological criteria can be used to apply a burning program that will achieve the management objective of maximising species and habitat diversity in the Park. These criteria can be applied using the infrastructure that was in existence up until 1994 and which comprised the Park being divided into 88 burn units and grouped into 23 management units. The burn units should be burnt on a rotational basis that varies according to seasonal rainfall and the condition of the grass sward as described by the botanical composition and the standing crop of grass during the annual monitoring of the condition of the rangeland in the different burn units. The following criteria can be used to identify the burn units that should be considered for burning.

i) If more than 50% (sourveld areas/high rainfall areas) or 33% (sweetveld areas/low rainfall areas) of the management unit has been accidentally burnt by either lightning, poachers or refugees then no burn units should be considered for burning. The 50% and 33% limits are based on field experience that in sourveld the maximum frequency of burning should not be more than biennial and in sweetveld triennial.

ii) If more than 10% of a burn unit has been burnt accidentally then that unit must become a preferred area for a controlled burn provided that it fulfils the other criteria for burning. It is generally undesirable to have a limited area burnt in a large unburnt area because it leads to excessively heavy utilization of the rangeland in the burnt area and a decline in the species diversity as reported on earlier.

iii) If Increaser II grass species are dominant in the burn unit the rangeland must not be burnt in order to allow the grassland to develop towards the Decreaser stage which will have a greater species diversity as reported on earlier.

iv) If the fuel load of grass in the burn unit is less than 4000 kg/ha then the rangeland should not be burnt because it is not in a moribund state and will not generate an intense enough fire to control bush encroachment if necessary.

v) Ideally the size and density of the bush should also be assessed when considering whether a burn unit should be burnt or not. If the bush is becoming too dense then a high intensity fire is necessary whereas if the bush is in optimum condition for habitat requirements, a cool fire is preferable.

vi) Finally all wildfires caused by either lightning, poachers, refugees or other causes should be allowed to burn freely if the affected burn units fulfil the aforementioned ecological criteria otherwise they must be controlled as far as is possible. This is because the effect of fire on rangeland will be similar irrespective of the source of ignition if burnt under the same conditions.

It is proposed that the burn units be ignited around the perimeters as in the past both for security reasons and increasing the range of types of fires burning the rangeland. It is concluded that the burn units are large enough to result in the fire front fragmenting into individual fires and spreading through the burn unit as a mosaic of different types of fires in response to changes in the direction of the wind, air temperature and relative humidity during the extended burning period. This fire mosaic will ensure a range of fire effects which will result in the maximization of habitat diversity both in the grassland and bush components of the vegetation.

It must be acknowledged at the outset that an objective assessment of the proposed structured versus laissez faire burning policy for the Kruger National Park is very difficult as it is fraught with subjectivity from both points of view. For example regarding lightning as being the only natural and therefore permissible source of ignition in the Park, will be logistically difficult to implement. This is because during the period 1985 to 1992 fires caused by lightning burnt only 10% of the Park whereas fires caused by poachers and Mozambique refugees burnt 44% of the Park despite active attempts by the rangers to control such fires. It is therefore highly likely that with the cessation of controlled burning in 1994 the dominant sources of ignition will still be anthropogenic rather than lightning because the probability of fires being caused by poachers and refugees will continue to be much greater than the occurrence of dry lightning storms in view of the enormous human populations surrounding the Park. It is for this reason that it is proposed in the structured approach fires ignited by any form of ignition be permitted to burn provided the condition of the rangeland fulfils the ecological criteria. However in order to ensure the achievement of the management objectives of the Park controlled burns applied according to the proposed ecological criteria should be the dominant ignition source.

One of the assumptions in the laissez faire burning policy is that it will automatically achieve the management objectives of the park because this is the perceived conditions of the rangelands prior to settlement in South Africa when there was no or very limited pro-active management such as controlled burning. It is believed that such an assumption could be valid if the Kruger National Park could be assumed to be a completely natural operating ecosystem. This unfortunately is not because approximately 96% of the Park is sweetveld which disqualifies it as being an ecological unit where major migrations of grazing ungulates between sweetveld and sourveld would naturally occur and provide periods of rest for the rangeland to maintain its condition. The boundary fence around the park also severely limits permanent presence of animals in sweetveld areas which were previously occupied on an intermittent basis depending upon the availability of drinking water. Also the extensive network of roads has created completely unnatural barriers that limit the natural spread of fires that would have occurred prior to settlement. It is therefore believed that proactive management such as controlled burning is unavoidable if the biological management objectives of the Park are to be achieved in a situation where some of the important natural factors of the environment no longer exist.

Finally there are no examples of a laissez faire burning policy based on lightning as the primary ignition being successfully applied in any of the savanna areas of Africa which can be used as a source of reference. Therefore such a policy is an hypothesis at this stage which must be tested over an extended period of time (20-30 years) before any valid conclusions as to its efficacy can be drawn. In contrast the proposed structured burning program for the Kruger National Park is based on research findings from long term fire experiments conducted in the Park and elsewhere in the savanna areas of southern Africa. Furthermore the structured program has been tested in terms of its possible effects on the frequency of burning by applying the ecological criteria retrospectively to the range condition data for the different burn units for the period 1989 to 1992. The results showed that if the ecological criteria had been applied to the burn units that were rotationally burnt during this period the extent of the area burnt would have been reduced by 52%. Interestingly enough on presenting these results to the management staff of the Kruger National Park their reaction from a management perspective to a reduction in the burning frequency was very positive. In conclusion there are examples of successful burning programs based on scientifically tested cause and effect research results in southern Africa which demonstrate that a structured approach is both logistically possible and ecologically acceptable for managing wildlife areas. Examples of these are to be found in the Mpofu and Tsolwana Game Reserves in the Eastern Cape Province and in the game reserves in the Drakensberg administered by the Natal Parks Board where controlled burning is an important management practice.

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## *1998 Southern African Fire Season - An Early Start*

The fire season ended badly in the winter and constant rainfall area of the Cape regions, when the "Bergwind" started early during March/April at the end of a dry summer. The worst fire occurred in the Tsitsikamma region where 60 000 ha of natural fynbos vegetation was burned by a wildfire, which also destroyed 4000 ha of industrial plantations. Six people also lost their lives, while 250 were left homeless. The fuel status of this area has been building up over a number of years, with delayed prescribed burning programmes and a neglected fuel management programme in both the fynbos and adjoining plantation interface. The policy of "natural fire allowance" in some of Tsitsikamma areas also attributed to the steady build-up in fire hazard in the area, and it will happen again unless a concerted effort is made for regional fuel management and fire prevention.

In the summer rainfall area, covering more than 90% of Southern Africa, the fire season also started extremely early, when the summer rainfall season ended as early as during April, compared to June/July during normal years. Last year the region was blessed with good rain as late as during August! The result was devastating, with serious wildfires having been reported as early as during the first week of May in the Mpumalanga forest regions and Swaziland. More serious is the lack of time now left to burn grassland fire belts in the region before the winter and if this fire prevention programme is not making good progress, the area will be even more exposed to wildfires. At the time of writing (end June 1998) no rain has fallen yet, and foresters are desperately trying to complete the fire belt preparation programme, even burning under hazardous conditions. No wonder that several wildfires have in fact originated from "controlled" grassland fires during May/June.

The eastern Free State region - a mixture of nature reserves and agricultural land - was the last three years blessed with higher than normal summer rainfall, and the result was that the dynamic grassland covering most of the area developed abnormally-high available fuel levels. This region is normally not devastated by wildfires to the extent as experienced in the higher rainfall areas of Southern Africa, but this year there are signs that serious wildfires will develop in this region, where fire protection measures are not normally considered on a regional scale. During end May a range of fires were started by arsonists in the Vrede district, destroying 30,000 ha of grazing land, and three weeks later another 20,000 ha of nature reserve land was blackened by another arson fire, forcing the game wardens to transfer their mammals to other game reserves. During May a similar fire burned out most of the Loskop Dam Nature Reserve in the Mpumalanga as well, and urgent questions are now raised about the policy of only allowing natural fire in these reserves, without a prescribed burning programme.

The worst loss of life as a result of fire was experienced during early June in the eastern part of the Gauteng Province, where the smoke of an uncontrolled grassland fire caused a traffic pile up, which caused the lives of 20 people, as car after car plunged into the smashed wrecks at the scene of the accident.

With still a long fire season ahead of us in both the summer and constant (Cape) rainfall in Southern Africa, unprepared fire protection systems and complete absence of rain, the region is embracing itself for another 3 - 4 months of wildfire occurrence, after having experienced such mild fire seasons the previous 2 - 3 years. Local government institutions should take note of the fact that these conditions could have been prevented to a large extent by a concerted fire prevention and fuel management programme, and that urgent attention should in future be given to these issues.

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## SPAIN

### *CIHEAM: International Course on Protection against Forest Fires 4-15 May 1998, Zaragoza, Spain*

#### Objective of the course

Forest fires constitute a chronic problem within the area of the Mediterranean basin, whose environmental consequences have compelled the governments of the Mediterranean coastal countries to make tremendous efforts to prevent and extinguish fires.

The frequency with which these fires occur and the experience we have gained regarding the effects of new fire-fighting techniques and methods, necessitate the organization and systematic analysis of all the available information as an essential element in the planning of protection and fire-control systems. Periodical meetings must also be held between professionals of forestry services with the purpose of exchanging information and technologies with their neighbour countries in the Mediterranean basin.

The CIHEAM, in collaboration with other institutions (FAO and the General Directorate for Nature Conservation in Spain) has been paying special attention to this issue since 1990 and has organized courses and seminars designed for experts with responsibilities at national as well as regional levels. Through these activities, the latest techniques for the appropriate control of forest fires are diffused, and the creation and development of data bases are also encouraged since they are fundamental tools for designing efficient prevention and extinction policies.

In this course the most up-dated techniques for forest fire extinction and fire behaviour prediction have been presented, and discussions held on the planning of fire defence methods using data bases. During the course, three data bases have been seen: the EU decentralized data bank, the data base developed by the CIHEAM/Mediterranean Agronomic Institute Chania (MAICh) for the Mediterranean region and the national data base that has been used in Spain since 1968.

### Organization

The course is jointly organized by the CIHEAM, through the Mediterranean Agronomic Institute of Zaragoza, by FAO, through the ***Silva Mediterranea*** Committee and by the Ministry of Environment (MIMAM), through the General Directorate for Nature Conservation and has taken place at the Mediterranean Agronomic Institute of Zaragoza. The course has been given by well qualified lecturers from research centres, universities, government departments and private companies from different countries. Mr. Ricardo Vélez was the Scientific Director of the Course. Ms. Maite Aguinaco coordinated the organization.

### Participants

25 Candidates from some CIHEAM member countries (Albania, Algeria, Morocco, Spain Tunisia and Turkey) and also from Argentina and Venezuela followed the Course.

### Programme

1. Forest fires in the Mediterranean Basin: Causes and effects

2. Fire behaviour

   2.1. Meteorological and topographic factors
   2.2. Forest fuel: characteristics and models
   2.3. Programmes for the prediction of fire behaviour (BEHAVE, CARDIN)
   2.4. Preventive silviculture

3. Extinction operations

   3.1. Extinction methods
   3.2. Personnel: Selection and safety
   3.3. Vehicles for combating forest fires and hose laying
   3.4. Heavy machinery
   3.5. Air support facilities

4. Data bases on forest fires

   4.1. Data bases: EGIF, PYROSTAT and EU data bases
   4.2. Use of GPS
   4.3. Loss assessment

5. Coordination methods

Some practical activities were performed:

A. Practice with simulators: CARDIN and FARSITE

B. Field visit to Moncayo burned areas: Discussion on fire fighting methods, fire effects and restoration works

C. Visit to Zaragoza air base: CL-215 T; BK-117; Mobile Unit for Communications and Meteorology, including reception of video images by microwaves; use of GPS for burned surface appraisal

D. Visit to Torreferrusa Center for Prevention: Use of GIS for planification; network of automatic weather stations to forecast fire danger; portative GPS equipment for patrolling.

**Future activities**

During the Course the training demands in the Mediterranean countries were analyzed in order to establish a follow up of the cooperation between the CIHEAM, the Spanish Administration and the Committee ***FAO/Silva Mediterranea***. The following activities were listed:

**a) Courses on fire suppression**

With a similar content to the Zaragoza 1998 Course and during two weeks these courses are to he programmed for the fire season in order to include practical activities in the DGCN helibases. The month of September is probably the best time for these courses.

**b) Courses on specific subjects:**

One week courses can be organised on the following subjects:

* Fuel management
* Development of sensibilization Campaigns
* Techniques for investigation of fire causes

**c) Individual stages for personnel with specific responsibilities**

Two to four weeks stages can be considered:

* Uses of GIS for planification and simulation
* Organization and uses of Data Bases
* Management of helicrews (BRIF, CAR)

The Courses are to be organised in Zaragoza because of the facilities in the Mediterranean Agronomic Institute (classes, equipment, simultaneous translation English/French/Spanish, lodgings).

The individual stages can be supported by the Spanish Administration in its own facilities, although candidates need to know the Spanish language.

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## NEWS FROM FIRE RESEARCH

### *The Global Fire Product: Fire Distribution from Satellite Data*

#### Introduction

In 1991, following a workshop on the requirements for terrestrial biospheric data sets and in response to requirements from the International Geosphere Biosphere Programme (IGBP) core projects, IGBP-DIS set up the Fire Working Group (FWG) to develop a consensus algorithm for global fire mapping. From this was born the concept of a Global Fire Product (GFP). This would be based on the use of an active fire detection algorithm and the global daily Advanced Very High Resolution Radiometer (AVHRR) data being collected by the IGBP-DIS 1 km AVHRR Global Land Project (Eidenshink and Faundeen 1994). A consensus algorithm was developed (Flasse and Ceccato 1996) and approved by the FWG in 1996 (Malingreau and Justice 1996). Data processing was initiated at the Joint Research Centre (JRC) in 1996, and completed in November 1997 (Stroppiana et al. 1998).

#### Input data set

The input data set is composed of 5-channel, raw AVHRR scenes at 1.1 km (nadir) resolution for each daily afternoon orbital pass of NOAA-11 over all land and coastal zones. The data were collected over the 21 month period from April 1992 to December 1993. The data set was provided by the USGS-EROS Data Center and ESA-ESRIN; it is fully documented in Eidenshink and Faudeen (1994).

#### Algorithm

Each region of the globe has its own characteristic fire regime, biome, and seasonal pattern of surface temperature and consequently, a different response in each of the NOAA-AVHRR channels as a result of fire disturbance. In order to process a global data set automatically and without adjusting the algorithm for each geographic region a contextual algorithm was chosen since it gives better performance and global consistency compared to a conventional channel-threshold technique (Giglio et al. 1998). The chosen algorithm is essentially that of Flasse and Ceccato (1996), with very minor modifications. For each day processed, the system ingests 2 gigabytes of data from tape, which represents the 5 channels of the raw AVHRR data for the 14 orbits covering all land areas of the globe. Firstly the data is geolocated using an orbit model obtained from the Colorado Center for Astrodynamics Research (CCAR) (Rosborough et al. 1994). The orbit model is typically accurate to $\pm 2$ pixels. Then all ocean and large inland water bodies are masked out. A "no-burn" mask is applied to exclude regions where the surface is of a type which does not support any significant biomass burning. These masks significantly reduce the amount of data to be subsequently processed. A simple cloud detection algorithm based on that of Saunders and Kriebel (1988) is applied before finally testing the remaining pixels for the presence of hot sources using the algorithm mentioned above.

#### Product description

The GFP itself is composed of the following two kinds of data:

***Daily fire position tables***: These consist of daily lists of the latitude and longitude of each fire pixel detected by the system for the period April 1992 - December 1993.

***10-day synthesis raster format data***: These are 10-day composite rasters on latitude-longitude grids of $0.5° \times 0.5°$ cells and contain the following bands:

* Fire Density Map: The number of fire pixels detected in each grid cell (see Fig.1)
* Cloud/No-Data Map: The percentage of cloud or "no-data" obscuring each cell, and
* No-Burn Mask: The percentage of each grid cell masked out by the no-burn mask.

**Global distribution of fire activity**

Twelve months of the global fire product (April 1992 - March 1993) have been studied in detail and the spatial and temporal distribution of fires has been reported elsewhere (Dwyer et al. 1998a,b). A total of 6.5 million fire pixels were detected in the 12 months of 1 km resolution AVHRR data analyzed. However, these are not evenly distributed throughout the year (Fig.2). There is a peak in global fire activity in July and August. It then decreases slowly reaching a minimum in early November when the number detected is only 28% of those detected during the period of peak burning. From November fire activity increases again reaching another lower peak in late December and January after which activity reduces.

While over 70% of fire pixels are located within the tropics, 50% of all fire pixels detected were on the African continent. Most of the fires are set in the savanna regions. The reasons for burning are numerous and vary across the continent, but some of the more common ones are: burning to remove unpalatable stubble and to initiate off-season regrowth of fresh shoots, clearing ground for crops, establishment of fire-breaks around settlements, removal of parasites, to drive game out of hiding and to make pathways accessible. Other regions where very high concentrations of fire activity were seen are in mainland Southeast Asia, the Orissa province in Eastern India, parts of the Cerrado in Brazil and Arnhem land in the Northern Territories of Australia. Although the number of fires occurring in temperate and boreal biomes is much smaller than in the tropics, they can have a big impact on land cover and the global carbon cycle. Fires in boreal biomes can be of extremely large extent, consume very high fuel quantities and are often left to burn out naturally.

**Uses of the product**

The use of the Global Fire Product (GFP) was envisaged for two user communities which can be loosely collected under the subject areas of atmospheric chemistry and ecosystem studies. Biomass burning is responsible for large emissions of gaseous and particulate products into the atmosphere and has a significant role in ecosystem maintenance and change. Use of the data is foreseen in certain IGBP core projects such as the International Global Atmospheric Chemistry project (IGAC), the Land-Use and Land-Cover Change Project (LUCC) and the Global Change and Terrestrial Ecosystems project (GCTE) . Other international initiatives such as the Global Observation of Forest Cover (GOFC) project of CEOS and Forest Resources Assessment (FRA) -2000 (FAO) have expressed interest in utilizing the product. The product is unique in that a single algorithm was used for all the processing therefore guaranteeing an internally consistent data set. The full resolution of 1km is available to all users who may regrid the data for their own requirements. This flexibility allows the use of the product across a wide range of spatial scales.

Atmospheric Chemistry Studies

The highest resolution of the GFP is 1 km. In studies related to atmospheric chemistry, it is probable that a gridded product at a lower resolution is more appropriate. Figure 1 shows fire counts in 0.5° by 0.5° grid cells for a ten day period. Similar products of different grid sizes and over different time durations can easily be constructed from the basic product. The information provided by the GFP which can be of most use to the atmospheric chemistry community is:

* Spatial localisation of fire events
* Spatial variation in the number of fire events
* Seasonality of fire.

With respect to the last point, although the day on which each fire event was detected is recorded, the seasonality i.e. the time period and duration of the burning season is likely to be of more interest. Figure 3 shows an example of such a derived product. The mid fire season month which is defined as the month in which 50% of all fire events were recorded for each grid cell is shown. Other parameters related to the seasonality of burning can be easily derived. Previous studies of emissions due to biomass burning have generally assigned an empirical time distribution of burning events throughout the fire season and across large areas. Hao and Liu (1994) and Kim and Newchurch (1998) used ozone measurements to identify the spatial location and burning period in their studies of gaseous emissions and transport from biomass burning. The GFP can give improved estimates of these parameters from direct observations.

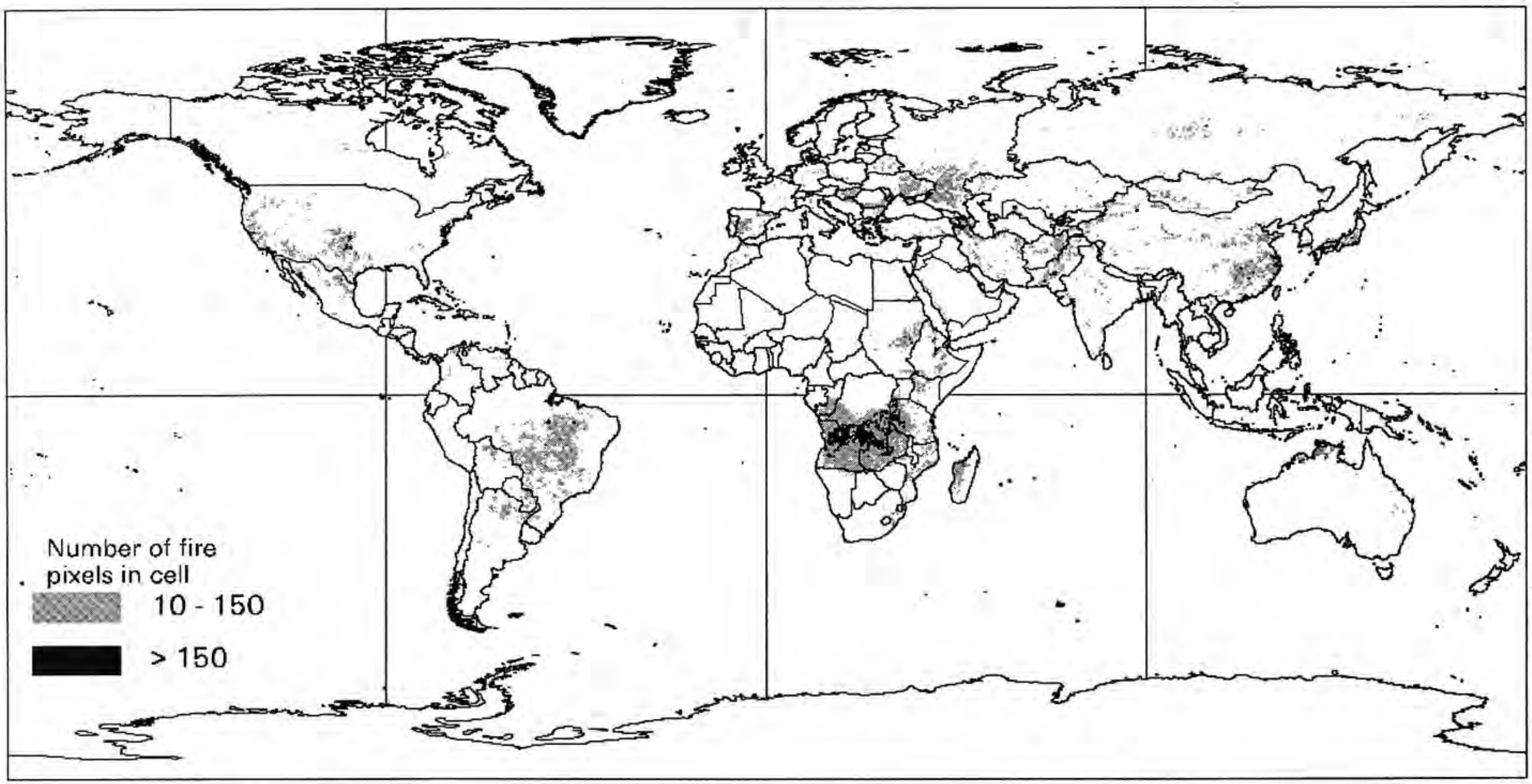


**Fig.1.** An example active fire map. Each 0.5° x 0.5° cell contains the number of fire pixels detected over a period of 10 days, from 30 July 1992.

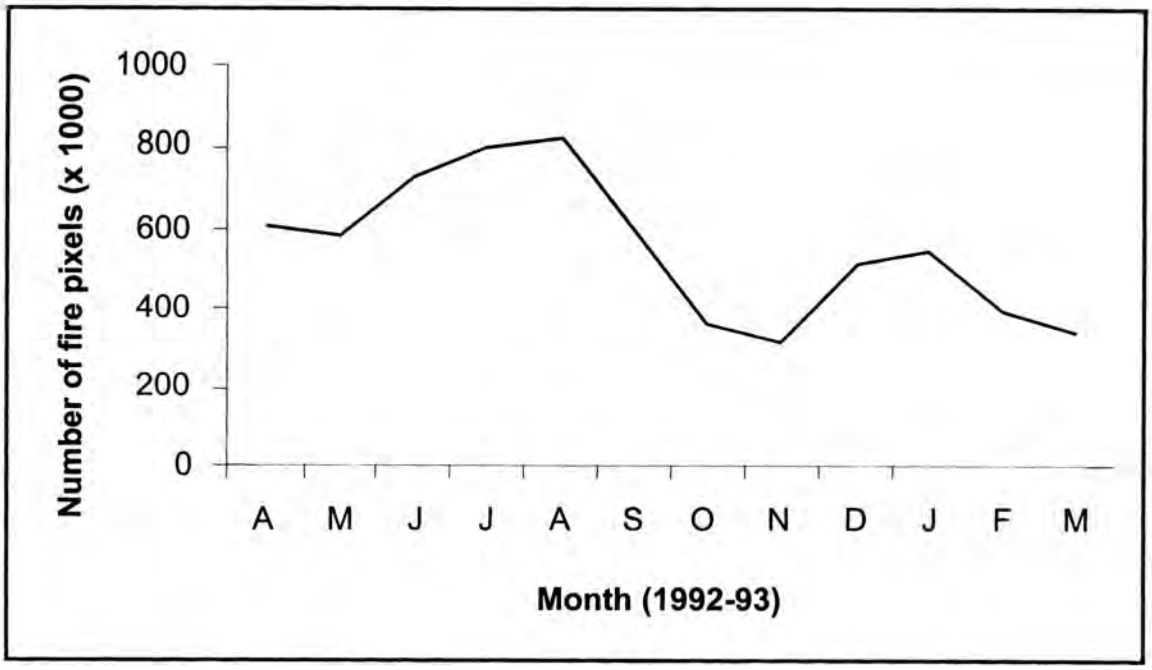


**Fig.2.** The number of fire pixels detected in each of the 12 months of AVHRR data.

It is not advised to use the GFP to estimate area burned as the product indicates only the presence or absence of fire in a pixel. Nor can it be used to count the absolute number of fire events in a given location as it is only a temporal sample. Although a research study using 1 km AVHRR data combined with high resolution LANDSAT data in Southern Africa has shown that it is feasible to estimate burned area from the 1 km data (Justice et al., 1996), its results cannot be universally applied. Extensive research for different vegetation types would need to be carried out if such a scheme were to be adopted. Current research is focused on retrieving burned area directly from low resolution satellite data.

Ecosystem Studies

*Vegetation types affected*: The GFP facilitates the study of fire in relation to landcover and ecosystem dynamics. The relative levels of fire occurrence in different vegetation types and regions can be estimated when the data is used with appropriate land cover maps. Using the 25 class United States Geological Survey (USGS) legend supplied with the IGBP-DIS 1km land cover map, fire distributions were determined for the different vegetation types. Almost 90% of all the fire pixels detected were found in 8 vegetation types. Table 1 shows the percentage of the global land surface covered by each of these vegetation types, the proportion of each type which was affected by fire and the percentage of the earth's land surface this represents. Although over 6% of the earth's surface was affected by fire in the course of the year, this does not mean that this much surface area was burned. As each fire pixel detected covers a 1 $km^2$ surface area it can represent one or more fires of unknown dimensions within that area. The type of vegetation burned is also of interest in atmospheric chemistry studies and in research into carbon cycling.

*Timing* The timing of fire is a very important parameter in relation to the study of fire impact on ecosystems. In tropical regions, late dry season fires are generally more intense and difficult to control than those occurring in the early dry season, when the fuel is more moist. The GFP data combined with data on vegetation conditions or weather data for the year in question can be used to determine how the timing of burning varies spatially and in different vegetation types.

**Tab.1.** Vegetation types affected by fire. The eight vegetation types, as defined in the IGBP-DIS land cover map, which showed the most fire activity account for 66% of the earth's land surface. Varying amounts of each vegetation type were affected by fire, however, savanna burning was the most widespread.

| Vegetation Type | % of global land surface | % of vegetation type affected | % of global land surface affected by fire |
|---|---|---|---|
| Savanna | 11 | 19 | 2.1 |
| Evergreen Broadleaf forest | 10 | 7 | 0.7 |
| Deciduous Broadleaf forest | 5 | 13 | 0.6 |
| Dryland crops and pasture | 9 | 6 | 0.5 |
| Shrubland | 12 | 4 | 0.5 |
| Cropland/Woodland mosaic | 7 | 7 | 0.5 |
| Irrigated Crops and pasture | 3 | 14 | 0.4 |
| Grassland | 9 | 4 | 0.3 |

*Land use and Land Cover Change* Fire is an indicator of land use and land cover conversion. Although the GFP is limited in time to 21 months, because of its global extent which covers all ecosystems it facilitates the study of spatial relationships between fire activity and land cover use and change.

*Diurnal Cycle* The GFP gives a snapshot of fire activity for each location at one instant - early afternoon- during the day. It is not a record of total fire activity. Until further information is available on the diurnal variation in burning in different regions and vegetation types, it is not possible to say what percentage of vegetation fires are captured in the GFP. Night time data from the Defence Meteorological Satellite Program (DMSP), and the Geostationary Operational Environmental Satellite (GOES) combined with the GFP can improve knowledge of the diurnal cycle in burning.

### Limitations of the product

The GFP is the first map of global vegetation fire derived with a single algorithm directly from observations of the fires themselves, and it will undoubtedly prove to be of considerable value both in global and regional scale studies. The contextual algorithm gives better fire detection performance over that obtained with algorithms based on simple threshold tests and it provides the best consistency for global applications (Giglio et al. 1998). However there are a number of limitations to fire detection using the AVHRR sensor alone. The imagery only represents a snapshot of the total number of fires which burn in any 24 hour period, fire counts may be either overestimated or underestimated due to confusion with hot surfaces and sun glint from reflective surfaces such as water and clouds. Although flaming fires with fronts as short as 50 m can be detected, in general no information on the fire characteristics (e.g. size, temperature) is available. However, this single observation system approach will soon be qualitatively and quantitatively improved by combining global datasets of both active fires and burned areas from different Earth observing systems.

**Product availability**

In March 1998 the Fire Working Group (FWG) of the IGBP-DIS recommended an internal evaluation process to be completed by the end of the year before adoption of the GFP as an IGBP-DIS data set. The GFP has been distributed to the FWG and users involved in biomass burning research. During this time, the quality of GFP will be assessed in each of the major biomes. The results of the evaluation will be available with the product. In the meantime, the data set is available for use on application to the authors.

**Acknowledgments**

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Additional colour illustration in the Internet version of IFFN:

**Fig.3.** For each 0.5° by 0.5° cell the month of the mid fire season is shown. This is independent of the number of fire pixels detected in a cell

## News from IGBP/IGAC

### *BIBEX Steering Commiteee Meeting*

Between 19 and 25 August 1998 an International Symposium on Global Atmospheric Chemistry was held in Seattle (USA), jointly organized by the IAMAS Commission on Atmospheric Chemistry and Global Pollution (CACGP) and the International Global Atmospheric Chemistry Project (IGAC), a core project of the International Geosphere-Biosphere Programme (IGBP). One of the activities of the IGAC Focus 2 ("Natural Variability and Anthropgenic Perturbations of the Tropical Atmospheric Chemistry") is Biomass Burnig Experiment (BIBEX) which is co-sponsor of International Forest Fire News.

The Joint Symposium provided the platform for several sessions on "Human Impacts" in which a series of papers and posters were presented on the effect of vegetation burning on the regional and global atmosphere. The symposium provided the opportunity for a BIBEX Steering Committee meeting which was held on 22 August 1998 at the conference site on the campus of the University of Washington, Seattle.

### Minutes of the BIBEX Steering Committee Meeting

After the opening of the meeting by M.O.Andreae, convener of BIBEX, steering committee members and guests reported about the state of fire and fire-related research campaigns:

### The Large Scale Biosphere-Atmosphere Experiment in Amazonia (LBA-CLAIRE)

M.O.Andreae reported the first results of CLAIRE, the 1998 campaign of the Cooperative LBA Airborne Regional Experiment (LBA = Large Scale Biosphere-Atmosphere Experiment in Amazonia; see IFFN August 1996, pp. 53-54 and <http://yabae.cptec.inpe.br/lba/>) which was conducted in March-April 1998. CLAIRE aims to develop an integrated and quantitative understanding of the interactions of biogenic source fluxes, atmospheric transport and vertical exchange, and photochemical processing over the tropical forest. LBA/CLAIRE is a biogenic/biospheric experiment with a fire research component in which the influence of extra-regional fire emissions imported into the study area is investigated. For more details on the fire component: See contribution by Grégoire et al. in this volume. The CLAIRE website is >http://www.mpch-mainz.mpg.de/CLAIRE.htm>.

### The International Crown Fire Modelling Experiment

B.J.Stocks reported about the 1998 field phase of the International Crwon Fire Modeling Experiment which was implemented in June/July 1998 (for an introduction: see IFFN August 1996, pp.54-58; for details See <http://www.nofc.forestry.ca/fire/fmn/nwt>.

### The African Fire-Atmosphere Research Initiative (AFARI-97)

J.G.Goldammer and B.J.Stocks reported about the field implementation of the campaign which aimed to investigate the the ecological and atmospheric chemical impacts of fire in the East African grasslands which - in contrast to the Southern African savannas - are fertile and rich in protein (nitrogen) content. 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 (see IFFN January 1998, pp.91-92). In the BIBEX discussion R.Swap recommended coordination of AFARAI-97 follow-up with the Miombo network.

### The Zambian International Biomass Burning Emissions Experiment (ZIBBEE)

D.Ward reported on the still ongoing (1997-98) research campaign in Zambia. 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-DIS 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 (see IFFN January 1998, pp.92-93). Contact: Darold Ward <pyroward@aol.com>.

**FROSTFIRE**

B.J.Stocks reports about FROSTFIRE. Co-sponsored by the IBFRA Fire Working Group, this experiment will involve conducting a high-intensity 700 hectare prescribed fire on a catchment of the Caribou-Poker Creek Experimental Watershed just north of Fairbanks, Alaska. This catchment consists of steep north-facing slopes dominated by *Picea* underlain by permafrost, and steep south-facing slopes where *Betula* predominates. Hydrological measurements have been conducted at this site for decades, and will be continued after the fire as part of a suite of fire impact studies which will include detailed fire ecology and effects investigations. Thorough fuels and fire behaviour documentation will permit linkages between fire behaviour (fuel consumption/intensity) and postfire impacts. This will be a long-term study, closely linked with the Long Term Ecological Research (LTER) Program in the United States. The burn had been scheduled for summer 1998 but had to be postponed to 1999 due to unfavourable weather conditions. For more information:

<http://www.lter.alaska.edu/cgi-bin/w3-msql/jirons/ffprojects.html>

**SEAFIRE and related expeeriments in SE Asia**

J.G.Goldammer reports about the South East Asian Fire Experiment (SEAFIRE) which has not yet materialized in a larger coordinated fire research campaign. SEAFIRE is rather aiming to provide a networking platform for ground and airborne fire research in the region. SEAFIRE has supported the government of Indonesia in establishing the Indonesian Research Institute for Climate, Environment and Society (INRICES) which was founded during the peak of the SE Asian smoke episode in November 1997. In the context of SEAFIRE a series of projects in remote sensing and ground truthing of fire and fire impacts are being conducted (see various contributions in this issue of IFFN). It is currently envisaged to propose a small research program under the the Asia-Pacific Network (APN) devoted to investigate the emissions of rice field burning and their impacfts on cloud formation processes. The project will be conducted jointly between the US Forest Service, the US National Center for Atmospheric Research (NCAR), the Max Planck Institute for Chemistry, with partner focus in Thailand which may provide a King Air research planes; collaboration with CSIRO is envisaged (I.Galbally).

**The Fire Research Campaign Asia-North (FIRESCAN)**

J.G.Goldammer and B.J.Stocks reported about the recent development of the fire research component in the frame of the IGBP Northern Eurasia Study (IGBP-NES) transects along the Lena and the Yenissei rivers. Current research focus is on post-fire flux studies on sites nearby the FIRESCAN Bor Forest Island Fire Experiment of 1993 (Bor, Krasnoyarsk region).

**SAFARI-2000**

SAFARI 2000 is an international regional science initiative being developed to explore, study and address linkages between land-atmosphere processes and the relationship of biogenic, pyrogenic or anthropogenic emissions and the consequences of their deposition to the functioning of the biogeophysical and biogeochemical systems of southern Africa. This initiative is being built around a number of on-going, already funded activities by NASA, the international community and African nations in the southern African region.

Much like its predecessor SAFARI-92, SAFARI-2000 is more a confederation of affiliated regional and global environmental change research efforts that have secured their own funding and are currently underway or will be underway soon within southern Africa, rather than a specific, funded program. SAFARI 2000 will include the following science components: terrestrial ecosystem and biogeochemical modeling; land cover and land use change mapping; monitoring and modeling; fire disturbance studies; quantification of biomass burning emissions and emissions transport modeling; aerosol characterization and monitoring; atmospheric chemistry; and modeling and atmospheric deposition experiments.

Satellite product validation will be undertaken in the science context of these components providing validated data products as input to the above studies.

SAFARI 2000 will be conducted over a three year period starting in 1999 with field campaigns during 1999 and 2000. A synthesis product of results available in early 2001. SAFARI 2000 will add scientific value by enabling the synthesis, coordination and beginning of budget closure between these different activities within the region that will ultimately provide a contribution to a regional science assessment of global change.

NASA, through its Research and Applications (R and A) Program, EOS instrument teams and EOS Validation activities, is supporting on-going research efforts within the southern African region. In addition to NASA^Rs African scientific collaborators, scientists from South Africa are currently securing funds through their national science foundation to support their involvement. The international regional science networks developed through IGBP and START within the region will participate in the initiative and will be the mechanism for broader African scientific involvement.

The first of SAFARI-2000 science planning workshops was held in Blydepoort, South Africa (11-17 July 1998). Bob Swap reported about the priority research objectives elaborated by the workshop participants, all mainly devoted to understand the linkages between physical, chemical and biological processes. Contact: B.Swap <rjs8g@virginia.edu>.

**Remote sensing programs**

P.M.Barbosa reported about the state of the World Fire Web which is being built at present by the Joint Research Center (JRC). The Web will consist of a network of nodes which receive and interpret fire information derived from the NOAA AVHRR.

The Global Fire Product is another activity of the JRC. In 1991, following a workshop on the requirements for terrestrial biospheric data sets and in response to requirements from the International Geosphere Biosphere Programme (IGBP) core projects, IGBP-DIS set up the Fire Working Group (FWG) to develop a consensus algorithm for global fire mapping. From this was born the concept of a Global Fire Product (GFP). This would be based on the use of an active fire detection algorithm and the global daily Advanced Very High Resolution Radiometer (AVHRR) data being collected by the IGBP-DIS 1 km AVHRR Global Land Project. A consensus algorithm was developed and approved by the FWG in 1996. Data processing was initiated at the JRC in 1996, and completed in November 1997. (For more details: see contribution by Dwyer et al., this volume of IFFN.)

Y.Kaufmann reports on the state of MODIS. J.G.Goldammer reports on the state of progress of the fire sensors development by the DLR: the BIRD satellite and the FOCUS instrument (to be deployed on the International Space Station).

**Fire information systems and inventories**

J.G.Goldammer reports about the **Global Fire Monitoring Center** (GFMC) which is in its establishment phase between June and December 1998. The first phase will be tested at regional base in South East Asia, and it will be expanded gradually to global scale. The GFMC is located at the Fire Ecology and Biomass Burning Research Group of the Max Planck Institute of Chemistry, Germany, at Freiburg University Airport Campus. The GFMC is financed by the government of Germany as a contribution to the UN International Decade for Natural Hazard Reduction (IDNDR). Following the principles which were developed for a scientific Global Vegetation Fire Information System, the Global Fire Monitoring Center will integrate the archived and real-time information related to fire. This will include the interlinking with other national, regional and international information systems. It is expected that the GFMC will be on the Internet by September/October 1998 (see Editorial of this issue of IFFN). Starting with the July-1998 issue International Forest Fire News (which is the official newsletter for the fire research groups of IGAC/BIBEX, IBFRA, IUFRO and the IDNDR) will be posted on the GFMC internet site.

The **Global Vegetation Fire Inventory** (GVFI) will be a focus of the GFMC. GVFI also contributes to the biomass bunrning emission component of the Global Emissions Inventory Activity (GEIA). The Ninth International Workshop of GEIA was held at the University of Washington, Seattle, Washington (USA) 19-20 August 1998, in tandem with the CACGP/IGAC Joint International Symposium on Global Atmospheric Chemistry. B.J.Stocks reported about the state of the Northern Hemisphere fire inventory. The GEIA website is <http://blueskies.sprl.umich.edu/geia/>.

**Partnerships with end-users**

The panel discussion of the joint CACGP/IGAC symposium focused on public policy. While more questions were asked at the panel discussion than answers were given, the BIBEX community could look back to a successful involvement with governments and international organizations. The South East Asian fire and smoke episode of 1997-98 required the inputs by the fire science community into activities of various UN agencies and programmes which responded to the fires, particularly the WMO, WHO, FAO, UNEP, and IDNDR. Details are found in the pages of IFFN starting with the January 1998 issue.

**BIBEX Business: BIBEX Committee membership and chair**

During the closed session of the BIBEX Steering Committee proposed changes to the list of committee members were discussed and agreed upon. Based on a request from the ICAC SSC, the terms of all current BIBEX Committee members were considered to have ended. Some members of the current committee indicated that they would like to terminate their involvement involvement. Four new members were nominated. The proposals for the new composition of the BIBEX Committee will be forwarded to the IGAC SSC for their approval.

M.O.Andreae who served as founding convener of BIBEX since 1990 stepped down. The BIBEX Steering Committee members expressed their gratitude for his engagement over the years.

The committee followed the suggestion of M.O.Andreae to nominate two co-conveners to lead the BIBEX activities into a new direction (nomination to be confirmed by the IGAC SSC). Under the impression that biomass burning emissions chemistry and related atmospheric chemistry processes have been successfully explored during the lifetime of BIBEX, it was agreed that the future emphasis of BIBEX should be in the field of fire inventories (including remote sensing of fires), fire ecology, and global fire modelling.

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**News from ECE/FAO**

***UN FAO/ECE/ILO Team of Specialists on Forest Fire***
***Minutes of the Meeting, Warsaw, Poland, 9 May 1998***

The meeting was held in conjunction with the First Baltic Conference on Forest Fires, Poland, 4-8 May 1998

## Introduction

As agreed by the 13th session of the Steering Committee of the Joint FAO/ECE/ILO Committee on Forest Technology, Management and Training, the Team of Specialists on Forest Fire co-sponsored the First Baltic Conference on Forest Fires, Poland, 4-8 May 1998. The objectives and recommendations of the conference are summarized in ANNEX I. The Team leader took the opportunity to invite the team for a satellite meeting held one day after the conference.

## 1. Report of the Team Leader, Mr. J.G.Goldammer

### 1.1 The 1997-98 fire and smoke episode

The team leader reported about the significant fire and smoke episode of 1997-98 in South East Asia and South America. The January 1998 issue of International Forest Fire News (IFFN) describes in detail the views of parties involved in SE Asia. The July issue will further continue in analyzing the situation in SE Asia and will add contributions from Brazil and Central America.

It was agreed by the team members that in general the international media, public, and politics need to be informed more precisely on the reasons of burning and smoke emissions because most of the international response to the crisis addressed the wrong causative complex.

The issue no. 18 of IFFN was unusually comprehensive due to the events in SE Asia and the preparation of the First Baltic Conference on Forest Fires. Including the two regions with an extended "Special" section in IFFN was on purpose. The editor intended to highlight the fact that fire and smoke are expression of land use and land-use changes. The SE Asian and the Baltic Regions differ from eachother entirely, but have in common a phase of intensive fire utilization - historically in the Baltic Basin, currently in SE Asia.

Regional border-crossing (transboundary) problems (fire, smoke) and mechanisms to jointly overcome these problems by mutual research, development and assistance programmes are also common in the two regions. The mechanisms addressing transboundary pollution in the ECE region and the EU may provide guidance to similar mechanisms to be established the ASEAN region. The team will follow up this development. The next event will be the "Asia-Pacific Regional Workshop on Transboundary Pollution, Singapore, 27-28 May 1998" organized by the Germany-Singapore Environmental Technology Agency in which the ECE experience in transboundary air pollution will be presented by various speakers; the team leader will report about common transboundary issues related to fire and haze in the ECE and the ASEAN region.

### 1.2 International Forest Fire News (IFFN)

IFFN is receiving new sponsorship. Starting in 1998, the US Bureau of Land Management (BLM) has begun to financially sponsor the production of IFFN by granting 4000 US-Dollars per year. The funds go directly to the editorial office (home office of the team leader) and are used for the camera-ready production of IFFN.

On behalf of the Joint Committee, the Team of Specialists and the international readers the team leader and editor once again expressed his gratitude to the representative of the BLM in the team meeting, Mr. Edward Shepard.

IFFN will continue to actively contribute to ECE-wide and global efforts in building strong partnerships in fire-related issues at all levels of research, management, and policy development. The details of the activities of the team, including the results of the FAO/ECE Seminar "Forest, Fire, and Global Change" (Russia, 1996) and the International Fire Conference "Wildland Fire '97" (Canada, 1997), which was supported by the team, are reported in detail in the pages of IFFN. The recommendations of both conferences are attached in ANNEXES II and III.

## 1.3 Link of the Team's work with international organizations and programmes (IDNDR, ITTO, FAO, WMO, WHO, UNEP)

The team leader explained in detail the relationship of the team's activities within and outside the ECE region:

### 1.3.1 International Decade for Natural Disaster Reduction (IDNDR)

Close links were established to the IDNDR Secretariat in Geneva. In July 1997 the team leader was entrusted with the formation of a Working Group "Fire and Related Environmental Hazards" of the IDNDR Early Warning Programme. The recommendations of the report which was submitted to IDNDR in 1997 were incorporated into the Report of the UN Secretary General "Improved effectiveness of early-warning systems with regard to natural and similar disasters"; the full text of the Working Group Report will be released by IDNDR within the next few weeks. The report will be presented at the IDNDR "Early Warning Conference 98" (EWC98) in Potsdam (September 1998) during which the team leader will convene a session on Environmental and Technological hazards.

Team members involved in the preparation of the report were Mr. Goldammer (team leader, Germany), Mr.B.Stocks (Canada), and Mr.M.Fosberg (IGBP-USA/Germany).

The IDNDR activities are also linked to the activities of the Disaster Management Support Project of the Committee on Earth Observation Satellite (CEOS) and the proposed Global Disaster Information Network (GDIN).

The German Ministry of Foreign Affairs through its IDNDR funds confirmed its decision to provide the home institute of the team leader with funds to establish a "Unit for Monitoring Climate Variability, Fire, Smoke and International Response in South East Asia" (tentative designation / tasks of the unit), starting 1 June 1998. This IDNDR contribution may have significant chances to further expand its terms of reference towards a "Global Fire Monitoring Unit" (see topic 4 of team session).

### 1.3.2 International Tropical Timber Organization (ITTO)

In 1997 the ITTO published the "ITTO Guidelines on Fire Management in Tropical Forests" (ITTO Policy Development Series No. 6). The team leader acted as senior author to the basic document which entered the final version of the guidelines prepared by an international panel; and adopted and released by the ITTC. The guidelines for the first time provide a general framework for fire policy and management development. They encourage fine tuning of guidelines at regional and national levels. While the guidelines provide a clear focus on the tropical and subtropical world, they are exemplary for other vegetation zones.

Indonesia was the first country which received assistance by ITTO and other donors to develop national guidelines, a project which is in the final stage at present and was supported by the team. It is expected that Namibia will be the next country which will create a national round table and go into a similar process of developing a national fire programme.

### 1.3.3 Food and Agriculture Organization (FAO)

The cooperation between FAO and the team was discussed the head of the Forestry Department, FAO Assistant Director General M. Hosny El-Lakany, in Geneva during the UNEP Fire Response Coordination meeting (20-21 April 1998; see topic 1.3.6). It was agreed to further strengthen the cooperation in the field of fire. FAO intends to call for an expert meeting on fire in October 1998, and the team is ready to support the meeting if requested. From the point of view of the team it will be most important to come to an agreement on a procedure for collecting global fire data in the frame of the Global Forest Resources Assessment (see topic 3 on Global Fire Statistics).

### 1.3.4 World Meteorological Organization (WMO)

As a consequence of the South East Asian fire episode the WMO is calling for a Workshop on Regional Transboundary Smoke and Haze in South-East Asia (2-5 June 1998, Singapore). The workshop is one element of WMO's efforts to enhance the capacity and capability of National Hydrometeorological and Meteorological Services (NMHSs) in South-East Asia to monitor and model smoke and haze episodes and the long range transport of anthropogenic pollutants, and to improve the NMHS's abilities to advise, alert, and generally manage these pollution events. This will involve review and discussion of regional plans such as the WMO-PARTS (Program to Address ASEAN Regional Transboundary Smoke). Through the participation of the team it is envisaged to contribute the expertise gained from research and development in the fire sector in the SE Asian region and to propose to include the South East Asian Fire Experiment (SEAFIRE) of the International Geosphere-Biosphere Programme (IGBP) as a joint UN-WMO/IGBP activity in exploring the role of fire in regional and global atmospheric processes. The IGBP-SEAFIRE is coordinated by the team leader.

### 1.3.5 World Health Organization (WHO)

The recurrence of transboundary smoke originating from land-use fires and wildfires is cause of acute and long-term respiratory health problems and requires the development of a comprehensive strategy based on broad international consensus. As a consequence of the recent smoke episodes the WHO is convening a small group of high-level experts to develop "Guidelines for Forest Fire Emergencies". The workshop will take place in Lima (Peru), August 1998. The team leader will support the WHO in preparing the guidelines.

### 1.3.6 UNEP

The team also supported the UNEP Meeting "Coordination UN Response to Indonesian Fires", 20-21 April 1998, Geneva. The following team members participated: Mr. E. Davidenko (Russia), Mr.J.G.Goldammer (team leader), Mr. B. Stocks (Canada), and Mr. R. Vélez (Spain). The meeting involved officials from various UN agencies (e.g., OCHA, UNEP, FAO, WMO, WHO), fire management experts, NGO's, and - in the final part - the donor community. One result of the meeting was the design of an internationally supported fire disaster response (fire control campaign) aimed to suppress the wildfires that had started to spread during the second phase of the drought in early 1998, mainly in East Kalimantan.

Before the beginning and after the Geneva planning meeting the team leader communicated with the Executive Director General of UNEP, Dr.K.Töpfer, in order to express their views on the current and long-term fire and smoke issues in the SE Asian region and elsewhere.

The team leader has offered to the UNEP Executive Director General to further support UNEP in the important task of coordinating the UN response.

### 1.3.7 Other

During the "Wildland Fire 1997" conference in Vancouver the team, represented by the team lader and Mr. J. Najera (UN-ECE Trade Division, Timber Section) for the first time officially met with the representatives of the North American Forestry Commission, Fire Management Study Group (NAFC-FMSG).

As a result of the meeting the NAFC-FMSG endorsed the recommendations which came out of the UN FAO/ECE Seminar on Forest, Fire, and Global Change, held in Shushenskoe, Russia 1996. The letter of endorsement was signed by Ms. Mary Jo Lavin (USA, chair of the FMSG) and the representatives of Canada (Mr. A. Simard) and Mexico (Mr. O. Cedeno).

requested. From the point of view of the team it will be most important to come to an agreement on a procedure for collecting global fire data in the frame of the Global Forest Resources Assessment (see topic 3 on Global Fire Statistics).

### 1.3.4 World Meteorological Organization (WMO)

As a consequence of the South East Asian fire episode the WMO is calling for a Workshop on Regional Transboundary Smoke and Haze in South-East Asia (2-5 June 1998, Singapore). The workshop is one element of WMO's efforts to enhance the capacity and capability of National Hydrometeorological and Meteorological Services (NMHSs) in South-East Asia to monitor and model smoke and haze episodes and the long range transport of anthropogenic pollutants, and to improve the NMHS's abilities to advise, alert, and generally manage these pollution events. This will involve review and discussion of regional plans such as the WMO-PARTS (Program to Address ASEAN Regional Transboundary Smoke). Through the participation of the team it is envisaged to contribute the expertise gained from research and development in the fire sector in the SE Asian region and to propose to include the South East Asian Fire Experiment (SEAFIRE) of the International Geosphere-Biosphere Programme (IGBP) as a joint UN-WMO/IGBP activity in exploring the role of fire in regional and global atmospheric processes. The IGBP-SEAFIRE is coordinated by the team leader.

### 1.3.5 World Health Organization (WHO)

The recurrence of transboundary smoke originating from land-use fires and wildfires is cause of acute and long-term respiratory health problems and requires the development of a comprehensive strategy based on broad international consensus. As a consequence of the recent smoke episodes the WHO is convening a small group of high-level experts to develop "Guidelines for Forest Fire Emergencies". The workshop will take place in Lima (Peru), August 1998. The team leader will support the WHO in preparing the guidelines.

### 1.3.6 UNEP

The team also supported the UNEP Meeting "Coordination UN Response to Indonesian Fires", 20-21 April 1998, Geneva. The following team members participated: Mr. E. Davidenko (Russia), Mr.J.G.Goldammer (team leader), Mr. B. Stocks (Canada), and Mr. R. Vélez (Spain). The meeting involved officials from various UN agencies (e.g., OCHA, UNEP, FAO, WMO, WHO), fire management experts, NGO's, and - in the final part - the donor community. One result of the meeting was the design of an internationally supported fire disaster response (fire control campaign) aimed to suppress the wildfires that had started to spread during the second phase of the drought in early 1998, mainly in East Kalimantan.

Before the beginning and after the Geneva planning meeting the team leader communicated with the Executive Director General of UNEP, Dr.K.Töpfer, in order to express their views on the current and long-term fire and smoke issues in the SE Asian region and elsewhere.

The team leader has offered to the UNEP Executive Director General to further support UNEP in the important task of coordinating the UN response.

### 1.3.7 Other

During the "Wildland Fire 1997" conference in Vancouver the team, represented by the team lader and Mr. J. Najera (UN-ECE Trade Division, Timber Section) for the first time officially met with the representatives of the North American Forestry Commission, Fire Management Study Group (NAFC-FMSG).

As a result of the meeting the NAFC-FMSG endorsed the recommendations which came out of the UN FAO/ECE Seminar on Forest, Fire, and Global Change, held in Shushenskoe, Russia 1996. The letter of endorsement was signed by Ms. Mary Jo Lavin (USA, chair of the FMSG) and the representatives of Canada (Mr. A. Simard) and Mexico (Mr. O. Cedeno).

In order to further strengthen the cooperation the team leader invited NAFC-FMSG to join the International Forest Fire News as a co-sponsor. Basically this would allow the Study Group to publish their reports without creating an own newsletter and avoid overlapping publication activities on North America. This invitation was formally transmitted by letter on 11 July 1997, and the NAFC-FMSG was also invited to the team meeting in Poland. So far there was no response on this invitation.

With the help of Mr. Najera, the team also intensified the dialogue with the DG VI of the European Commission (Ms. M. Lemasson, DG VI.F.II.2) on joint issues in collection of forest fire statistical data (see also topic 3).

## 2. Evaluation of the results of the First Baltic Conference on Forest Fires and its relevance to the Baltic 21 Action Programme on Forests

The objectives of the First Baltic Conference on Forest Fires are given in ANNEX I. The team leader took the opportunity to express the gratitude to the government of Poland to host the conference and the organizers of the meeting, the Forest Research Institute, Department of Forest Fire Prevention, Warsaw.

Besides the presentation of papers from the Baltic region the conference focus was the contribution of forest fire management to the Baltic 21 Action Programme. The conference participants agreed to develop a concerted regional Baltic Forest Fire Action Plan. This was reflected in the recommendations of the seminar which are given in ANNEX I.

A follow-up process to the conference was agreed, starting with a pan-Baltic forest fire exercise BALTEX FIRE 2000 (the Baltic Exercise in Forest Fire Information and Resources Exchange) to be held in Finland in 2000 (see new terms of reference of the team [para 5]).

A controversial debate was held on the applicability of prescribed fire in vegetation management. The discussion revealed that there was no common and equal state of knowledge in some Baltic countries on fire ecology and the use of prescribed fire in forest and landscape management and in nature conservation. It was recommended that the team of specialists should organize a seminar on fire ecology and prescribed burning in the countries neighbouring the Baltic Sea.

It must be stated at this point, however, that one of the objectives of the First Baltic Conference on Forest Fires originally intended to elaborate on this topic. The absence of those speakers which had been invited to the conference to present papers on the history and use of fire left a gap which must be filled by a follow-up activity.

## 3. Global Fire Statistics

The UN-FAO/ECE/ILO Seminar "Forest, Fire and Global Change" (Russia, 1996) recommended to introduce an internationally standardized system of collecting and reporting statistical fire data. This recommendation was based on the fact that at present only few countries provide fire statistics which are useful for an international evaluation of the ecological, environmental and economic impacts of fire. Existing fire reporting systems such as the European Decentralized Database on Forest Fires which was created in accordance with the Resolution S3 of the Ministerial Conference at Strasbourg, the ECE/FAO Forest Fire Statistics, or the data collection proposed by the FAO as part of the Global Forest Resources Assessment, are of limited use for evaluating wildland fires at global scale.

While the European Decentralized Database with its "common core" of parameters ("socle minimum") provides very specific information on the performance of fire services, this common core and most other data collection systems are not specifying the forest and other vegetation types affected by fire.

The team recommended to introduce a data collection system which had been developed for the Global Vegetation Fire Inventory (GFVI) some years ago. The required input parameters will raise the awareness of governments concerned about the multitude of fire types involved in land-uses systems, fire-dependent or firetolerant vegetation, and in those forests and other vegetation types in which fire has destructive or destabilizing effects.

In ANNEX II (not enclosed here) a proposed new statistical data reporting form, which was developed from the original GVFI form, is presented. This form should be a base of a consensus agreement, possibly at the FAO fire expert meeting in late 1998.

## 4. Creation of a Global Fire Monitoring Facility

Following the recommendations of the UN-FAO/ECE/ILO Seminar "Forest, Fire and Global Change" (Russia, 1996) and the ITTO "Guidelines on Fire Management in Tropical Forests" and considering the events of 1997-98 in SE Asia and other parts of the world the team strongly underscored the need to establish a Global Fire Monitoring Facility (GFMF). GFMF would process and publicly provide all information on fire and related to fire which would enable governments, international organizations and agreements, scientists and, through the media, the general public to understand fire and to respond appropriately.

As a consequence of these recommendations the government of Germany in May 1998 indicated to establish a Fire Monitoring Center which could serve as precursor to GFMF. This Fire Monitoring Center has been established as an activity of the IDNDR and is based at the Fire Ecology Research Group in Freiburg (Germany). It will become operational in August 1998. In its first phase it will have a focus on SE Asia and offer a test platform for global cooperation fire-related issues.

## 5. Future work contents of the Team

Following new terms of reference were agreed:

### i. Baltic Focus

As a consequence of the First Baltic Conference on Forest Fires it was agreed to establish a Baltic focus activity. The team members which belong to the countries neighbouring the Baltic Sea, hereinafter referred to as Baltic States, will be members of a Baltic Task Force on Forest Fire. At present the following countries are Task Force members: Estonia, Finland, Germany, Latvia, Poland, and Russia. It is still hoped that the remaining Baltic countries (Denmark, Lithuania, Norway and Sweden) will show interest in the work of the Task Force as further activities will develop. It was also agreed that the three following countries will have an observer status because their are either directly connected to the Baltic region or share common problems or developments in fire management:

Belarus, The Netherlands, and the United Kingdom

Task Force leader for the next two years will be Mr. Harry Frelander (Finland) who is exploring currently to host BALTEX FIRE 2000 in Finland. BALTEX FIRE 2000 will be the first pan-Baltic exercise in sharing transboundary information and resources in forest fire management.

### ii. Fire in radioactively contaminated regions

From the reports from Belarus and Russia it was concluded that it will be necessary to create a focus on fire research and management in those radioactively contaminated regions which are bordering the Baltic region. This activity follows the recommendations of the UN-FAO/ECE/ILO Seminar "Forest, Fire and Global Change" (Russia, 1996).

It is recommended that the Joint Committee follows this proposal by supporting a seminar to be conducted jointly by the Team of Specialists on "Forest Fire" and the Team of Specialists on "Problems in the Forestry and Forest Industry Sector Arising from Radiation Contamination, Particularly from the Chernobyl Disaster".

### iii. Global fire statistics

The team will further continue to work with UN organizations, primarily with FAO, to develop an appropriate global fire data collection system.

### iv. Global fire monitoring

Through the Fire Monitoring Center established by German IDNDR funds and based at the research institute of the team leader, the team will continue to develop the concept of a Global Fire Monitoring Facility.

### v. Wildland Fire Management Glossary

The revision, update and publication of the FAO Wildland Fire Management Terminology (FAO Forestry Paper 70, 1986) has been stagnating due to limited funding. Based on the progress of the last two years (entering the contents of the current glossary on diskettes, first reviews of the current glossary by correspondents) the team should continue in updating the glossary.

The previous goal of the update and publication procedure should be revised. It is envisaged now to put the glossary on CD-ROM in addition to printing. This would also ease to gradually add more languages.

The FAO or other donors are kindly requested to provide funding for editorial and technical work to finalize the glossary update.

Johann G. Goldammer — Freiburg, Germany, 22 May 1998
Leader, FAO/ECE/ILO Team of Specialists on Forest Fire

## ANNEX I

*First Baltic Conference on Forest Fire*
*5-8 May 1998, Radom - Katowice, Poland*

### General Recommendation

1. Forest fires constitute one of the main threats for sustainability of forest ecosystems and the continuity of their multifunctional role.
2. Countries neighbouring the Baltic Sea (Denmark, Estonia, Finland, Germany, Lithuania, Latvia, Norway, Poland, Russia and Sweden) hereinafter referred to as Baltic States, are one of the regions in Europe with high fire risk and significant level of environmental contamination. Forests of that region are very valuable for the nature as well as in economic and social terms. Great majority of forest fires break out as a result of direct or indirect human activities. Due to global environmental changes and ever increasing pressure imposed on the forest by the societies we should expect further increase of fire risk in that region.
3. To solve current and future problems regarding forest fire protection it is necessary to constantly enhance and standardise forecasting, detection and extinguishing activities and improve legal regulations.
4. The prerequisite for the effectiveness of those activities is development of comprehensive cooperation in the field of science, technology and organisational aspects with the contribution from the public on international, national and local level.
5. The Conference recognises that forests in the Baltic States should be managed in compliance with biodiversity principles. Considering the above factors, we find it necessary to create an international programme for fire protection in the Baltic states. Protection of woodlands against elemental disasters should be included in cooperation agreements especially in transboundary areas.
6. The Conference recommends that problem of forest fires should be handled in compliance with the Action Plan Baltic 21, regional activities of the International Decade for Natural Disasters Reduction (IDNDR), as well as other programmes.

**Specific Recommendations**

## I. Prevention activities

1. Forest management should encompass to need to strengthen natural resistance of forests to damaging forces, including fires. The tasks to be undertaken in this field are in particular: adaptation of tree stands composition to habitat conditions, protection of biodiversity, improvement of water retaining capacity in woodlands and enhancement of infrastructure.
2. Prevention activities should be particularly intensified in highly contaminated areas, especially with radioactive substances, where, besides economic losses, fires cause reoccurrence of contamination.
3. Fire protection problems should always be considered with regard to drafting spatial management plans which include among others increase of afforestation rate, spacial order in woodlands and development of infrastructure.
4. It is necessary to develop cooperation to enhance training programs for forest and fire control services.
5. It is recommended to further expand informational and promotional activities to raise social awareness, in particular on the local level.

## II. Forecasting, detection and extinguishing activities

1. Fire protection in woodlands should constitute an integral part of national rescue programs.
2. With regard to exchange of information and resources among the Baltic States we recommend to develop Baltic programs and exchange mechanisms which would include scientific research connected with fires, impact of global environmental changes and use prescribed fire (in forestry, nature conservation and landscape management), training on fire protection and mutual assistance.
3. It is necessary to undertake steps to improve legal regulations which refer to the establishment of forest rescue systems and financing methods as well as oblige businesses imposing fire risk for woodlands to protect them and remove damages.
4. We should aim at enhancing transboundary cooperation in the field of early warning, monitoring, detection, fire suppression, exchange of information and undertaking joint initiatives.
5. For the purpose of fire control all forests should receive the same treatment regardless of their ownership structure, in particular in those countries in which forests are reprivatized.
6. We should improve telecommunication systems and ensure their compatibility and reliability, especially in transboundary areas.
7. We should undertake initiatives to remove barriers among Baltic States with custom relieves and subsidies which enable transfer of technical resources used in forest protection.

## III. Post-fire activities

1. Recultivation of burned forests should be treated as a separate problem in science and in forest practice and subject of international exchange in this field.
2. Baltic states should render mutual assistance in the area of availing technical resources and consultancy.
3. It is recommended to develop an advanced system of collecting fire statistic at international level, particularly including damages of forest stands affected by fire.

## IV. Within further development of international cooperation in the field of fire control among the Baltic States we recommend to

1. We find it useful to initiate a tradition to hold biannual working meetings of representatives from Baltic States.
2. It is necessary to unify systematic legal solutions regarding fire prevention in Baltic States.

Participants express their thanks to those who initiated, prepared, summoned the Baltic Conference on forest fire and ensured perfect organisation. Participants are kindly requested to disseminate recommendations form this Conference.

## RECENT PUBLICATIONS

### Transboundary Pollution in South East Asia

A new publication entitled "Transboundary Pollution and the Sustainability of Tropical Forests: Towards Wise Forest Fire Management - The Proceedings of the AIFM International Conference" is now available from the Regional Center for Forest Management, Malaysia. The Regional Center was established in 1998 is the successor of the former ASEAN Institute of Forest Management (AIFM) located until 1997 in Kuala Lumpur, Malaysia. The international conference was organized by AIFM and co-sponsored by the Canadian International Development Agency (CIDA), the Malaysian Timber Council (MTC), the GTZ (Indonesian-German) Integrated Fire Management Project (IFFM), and the Max Planck Institute for Chemistry, Fire Ecology Research Group (Germany).

The book contains very informative and well-written technical papers which were presented at the AIFM Conference on Transboundary Pollution and its Impacts on the Sustainability of Tropical Forests (Kuala Lumpur, Malaysia, 2-4 December 1996). The papers cover a wide range of subjects of interest to foresters, resource managers, forest fire managers, ecologists and specialists, administrators, environmentalists, researchers and other related professionals involved in various disciplines such as training institutions, research agencies, universities, and forest industries interested in the sustainable management of the forests and overcoming transboundary pollution. The book has 29 chapters covering air pollution and its transboundary effects on tropical forests, terrestrial pollution effects on tropical forests, forest fire and smoke management, and research and development in forest fire management.

Copies of the publication are available from the Regional Centre for Forest Management at the following prices: Softcover US$150.00 and Hardcover US$180.00 per copy. Prices do not include postage. For orders and further enquiries, please contact:

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Forest Research Institute of Malaysia (FRIM)
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Tel: ++603-6377633
e-mail: roslan@frim.gov.my

### Dendroecological Studies in Forest and Fire History

The book "Dendroecological Studies in Forest and Fire History" provides a compilation of research papers on the fire and forest history in Sweden authored by Mats Niklasson. In his research with focus on aspects of historical forest use in the Saami region with dendroecological methods, the ecological analysis of important variables of the fire regime on a landscape scale as well as at stand scale, and the quantification of the errors in determining the age of suppressed Norway spruce, the author gives valuable insight in the role of fire over the centuries in Swedish forests. He proves that the used methods of tree ring dating contributes essential data to forest and fire history and gives insight of natural as well as human impacts over the centuries on the Swedish forest resources.

*G.Buchholz*

*Niklasson, M. 1998. Dendroecological Studies in Forest and Fire History. Doctoral thesis Swedish University of Agricultural Sciences, Umeå. Acta Universitatis Agriculturae Sueciae, Silvestria 52 (ISBN 91-576-5336-4)*

## Forest Fire and Environmental Management

As already introduced in the last issue of the IFFN the Norwegian report "Forest Fire and Environmental Management" is now published and available.

This multi-authored report, compiled and edited by Erik Bleken, Ivar and Iver Mysterud, covers extensively the history of forest fires in Norway. Norway with its oceanic climate and the enormous topographic variations is considered a country with relatively minor natural fire occurrence. Nevertheless the human impact caused over the centuries a dramatic shift in the fire frequencies. Because of this important role of human activities, the report focuses primarily on the historic use of fire in Norway considering a variety of geographic and ecological conditions.

Extensive documentation about the geographic factors affecting fire occurrence of whole Scandinavia gives a detailed background knowledge about the forest fire situation in the region. The authors included additional information on modern forest fire management and its implications to the situation in Norway.

The volume provides comprehensive source of information for scientists and resource managers interested in forest fire research in the Nordic countries and able to read Norwegian. An English summary is included in the volume.

*G.Buchholz*

*Bleken, E., I.Mysterud, and I.Mysterud (eds.) 1997. Forest Fire and environmental management. Report. Directorate for Fire Explosion Prevention and Department of Biology, University of Oslo, 266 pp. (ISBN 82-7768-019-8) <in Norwegian>*

The publication (order number: 970 935 444) can be obtained from:

Direktoratet for brann- og eksplosjonsvern (DBE)
Nedre Langgate 20
Postboks 355 Sentrum
N - 3101 Tφnsberg

Fax: ++47-33-310660
Tel: ++47-33-398800
e-mail: postmottak@dbe.dep.telemax.no

## Ecology and Biogeography of *Pinus*

For fire researchers the genus Pinus is one of the most interesting and challenging. The classical work "The Genus Pinus" by Nicholas T.Mirov, published in 1967, for long time was the only comprehensive sourcebook and meanwhile was outdated and hardly available any longer.

David M.Richardson, a senior research officer of the Institute for Plant Conservation, Department of Botany, University of Cape Town at Rondebosch (South Africa) has taken the tremendous task to edit a new, updated monograph of the genus *Pinus*.

Several authors deal with all aspects related to the "success-story" of pines on our globe. From the issues of evolution, phylogeny and systematics, to the biogeography and ecology as well as the topic pines and humans all aspects of this genus are addressed. Especially worth noting is the extensive references for each topic, a treasure box for everybody interested in this genus.

The role of fire takes an important part in the book. With the examples of six species, the different survival strategies of pines under low severity, moderate severity and high severity fire regimes are demonstrated in the chapter **Fire and Pine Ecosystems** authored by James K.Agee. Knowing the fact that the genus *Pinus* possesses the evader strategy, the endurer strategy and the resister strategy as a response to the disturbance by fire, the important role of pine in a fire-prone environment becomes obvious.

The book which comprises 22 chapters divided into six parts stands in the tradition of Nicholas Mirov's classic volume *The Genus Pinus* published 1967. It gives the up-to-date knowledge of scientist all over the world compiled from David M. Richardson and serves as an excellent source of information.

*G.Buchholz*

*Richardson, D.M. (ed.) 1998. Ecology and biogeography of Pinus. Cambridge University Press, Cambridge, United Kingdom, 526 pp. (ISBN 0-521-55176-5)*

## MEETINGS PLANNED FOR 1998-99

**USA** ***The Role of Information Technology in Fire Management***
***16-19 November 1998, San Diego, USA***

This fall the University Extension at Davis, in cooperation with several federal and state agencies is sponsoring a symposium entitled "The Role of Information Technology in Fire Management". This programme will examine the information technology available to support fire management, fire planning, fire ecology, fuels management and fire suppression.

The symposium targets a wide variety of professionals, including scientists, land manager, land owners, fire managers, fire prevention and protection specialists, resource management specialists, consultants, community groups, environmental computing professionals, students interests in fire management and any other interested individuals.

Papers on all technologies including, but not limited to the world wide web, global positioning systems, geographic information systems, remote sensing, image analysis, database management systems and modelling technologies will be accepted for presentation.

The format of the symposium consists of a plenary session of presentations that will examine the emerging role of informational technology in effective fire management, followed by two concurrent tracks, or breakout sessions.

There is no geographic emphasis to the symposium. Papers from any region of the country are welcomed. Papers addressing the following topics are encouraged: the successes and challenges of current technologies, the future advances of these systems and the evolving skills and knowledge required of professionals to utilize these technologies.

The symposium takes place at the Bahia Hotel in San Diego. There are two enrolment options for this event: a US$245 fee which includes conference materials, refreshments and daily lunches and a US$195 fee which includes conference materials and refreshments only.

For more information, please contact:

Ms. Sandra Cooper
Land Use and Natural Resources, University Extensions
University of California, Davis
1333 Research Park Drive
USA - Davis, CA 95616

Fax: ++1-530-757-8634
Tel: ++1-530-757-8948

***Fire Economics, Planning and Policy: Bottom Lines***
***5-6 April 1999, San Diego, California (USA)***

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. vet 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.

**Objectives of the Seminar**

* To provide a forum for the discussion and exchange of ideas regarding the economics of fire management and

* To share the latest in developments and technologies available for optimizing fire management expenditures.

**Format:** General sessions will provide participants the greatest opportunity for dialogue among all the speakers and presenters. Special times will be scheduled for viewing posters and exhibits.

**Other Activities:** An optional harbour dinner cruise will be offered to participants of the symposium. Details will be included in the registration confirmation materials. Other group activities have been minimized to allow participants to take advantage of the many sights in San Diego.

**General Topics:**

* Large wildfire costs: How much and why?
* Alternative approaches to fire planning, in different agencies
* Economics of preparedness
* Fuel treatment, including prescribed fire/wildfire tradeoff,
* 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 resource managers, policy makers. analysts and planners, line officers and participants in wildland fire situation analyses, fire practitioners, consultants, environmental managers, and journalists.

**Sponsorship and Key Organizers:** Primary sponsorship is jointly held by the Western Forest Fire Research Center (WESTFIRE), Colorado State University, and the USDA Forest Service, Pacific Southwest Research Station, The Symposium is also sponsored by the International Association of Wildland Fire and the Society of American Foresters. The Symposium has been approved for 23.0 credit hours, category #1 in SAF's Continuing Forestry Education Program. Other supporters and cooperators will be noted at the Symposium.

**Call for Papers & Posters:** Deadline for submission of abstracts for presentation/poster sessions was 30 May 1998. Coordinator for abstract submission is:

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

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

Proceedings will be published according to USDA Forest Service, Pacific Southwest Research Station guidelines.

**Location, Lodging & other Logistics:**

**Location and Lodging:** The Symposium will he held at the Westin Horton Plaza, San Diego. A block of rooms at the Westin Horton Plaza has been reserved for Symposium participants. Special overnight rates will be available to all participants and are currently S93,00/night Single. $108.00/night Double. Reservations can be made by phone (within the USA: 1-800-693-7846 or from outside the USA: ++1-619-239-2200) and must be made by 1 March 1999, in order to ensure space and special rates. Please identify yourself as a Fire Economics Symposium participant when making reservations.

**Transportation:** The Westin Horton Plaza is 10 minutes from the San Diego International Airport. Cloud 9 Shuttle Service provides transportation to and from the hotel at $5.00 per person one-way. Parking at the hotel is currently available for $12.00/night (self) or $15.00/night (valet). The Metropolitan Transit System (MTS) provides extensive bus and trolley service in the area.

Register for the Symposium electronically

Questions can be directed to:

Philip N, Omi
Director, Western Forest Fire Research Center (WESTFIRE)
Colorado State University
USA - Fort Collins, CO 80523

Fax: ++1-970-491-6754
Tel: ++1-970-491-2626
e-mail: westfire@lamar.colostate.edu

Or consult the Fire Economics Symposium webpage at:

http://www.cnr.colostate.edu/FS/westfire/econ.html

**PORTUGAL**

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

Taking advantage of the 3th 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) will organise a technical meeting on Saturday 21 November 1998, just after the conference.

This short meeting will present an opportunity to review current state of research in remote sensing analysis of forest fires, bringing together active experts on this topic to exchange ideas and promote collaboration. Scientists intending to present papers should send the abstracts to the organisers of the 3th International Conference, since this seminar will be structured in technical discussions. Three key speeches will be given, summing up some controversial issues in the field of fire risk assessment, fire detection and burned land mapping. A draft programme for the RSFF-SIG meeting is as follows:

| | |
|---|---|
| 09:00 | Presentation of participants |
| 09:30 | Current research topics in fire risk assessment.<br>Michael Deshayes, CEMAGREF-ENGREF, France |
| 10:15 | Discussion |
| 11:00 | Coffee break |
| 11:30 | Current research topics in fire detection<br>Cristobal Martín Rico, INSA, Spain |
| 12:15 | Discussion |
| 13:00 | Lunch |
| 14:30 | Current research topics in burned land mapping<br>José Miguel Pereira, Instituto Superior de Agronomia, Portugal |
| 15:15 | Discussion |
| 16:00 | Informal proposals for future projects on remote sensing of forest fires |

The technical coordinator responsible for the EARSeL RSFF-SIG meeting will be Emilio Chuvieco. Although, as mentioned above, 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 of 5,000 Portuguese Escudos to cover meals and room rental will be required. Further information may be obtained from:

Emilio Chuvieco
Department of Geography
University of Alcalá de Henares
Colgios, 2
E - 28801 Alcalá de Henares

e-mail: ggecs@geogra.alcala.es

**ISRAEL** ***MEDPINE International Workshop - First Information***
***January / February 1999, Beit-Oren, Israel***

As a part of our effort to advance the knowledge on Mediterranean pines, we plan an international workshop MEDPINE, to be held in Israel in 1999. The aim of the workshop is to bring together the contributors to the book: "Ecology, Biogeography and Management of *Pinus halepensis* and *P. brutia* Forest Ecosystems in the Mediterranean Basin" (G.NeÆeman and L.Trabaud eds.) and other researchers interested in this subject, in order to present an up to-date state of the art of natural and managed pine forests in the Mediterranean basin. The main topics will be:

* Taxonomy genetics and biogeography
* Autecology
* Pine forest ecosystem
* Pine - animal interactions
* Fire ecology
* Management

The workshop will take place at the guest house in Kibbutz Beit-Oren. The modest guest house is located in Mt. Carmel National Park and Nature reserve. The tentative dates are the last week of January or at the beginning of February 1999.

**Tentative program:**

| | |
|---|---|
| Sunday: | Arrival and opening diner |
| Monday: | Lectures |
| Tuesday: | Lectures & excursion to Mt. Carmel pine forests, dinner in a Druse village. |
| Wednesday: | Lectures |
| Thursday: | Excursion to Nazareth, Sea of Galilee and Mt. Meiorn Nature reserve |
| Friday: | Departure |

The workshop will be organized by us, with the help of the Department of Biology, The University of Haifa at Oranim, with minimal costs and no overhead.

The cost will be only about 550$ per person and will include:

* Transportation from the Ben-Gurion airport
* Two persons per room (additional 110$ for a single room)
* Full board
* Excursions
* Transportation to the Ben-Gurion airport

Optional post-workshop excursion (Friday - Saturday) to the Dead Sea, Judean Desert and Jerusalem, and departure on Sunday (estimated cost 150$).

The cost for Israeli participants will be 75 Shekel for a single day and 100 Shekel for three days (Monday - Thursday), not including meals in the guest house.

Please distribute this circular among other interested contributors or audience. Because of the short time we will appreciate a prompt answer by filling the following form. Depending on your response we will decide whether to continue in organizing the workshop. For more information please contact:

Gidi Neeman and Ido Izhaki
Department of Biology
University of Haifa at Oranim
Tivon 36006
ISRAEL

Fax: ++972-4-9832167
e-mail: gneeman@research.haifa.ac.il

**POLAND**

*IUFRO Conference on Remote Sensing and Forest Monitoring*
*1-3 June, Rogów, Poland*

The IUFRO Conference on Remote Sensing and Forest Monitoring will be held at the Center of Ecological Education of the Warsaw Agricultural University, Rogów, Poland, 1-3 June 1999.

**Conference Objectives:**

* Review the state-of-the-art of remote sensing as a tool of forest monitoring and inventory and forest fire management
* Review the research and application problems of the use of remote sensing in forestry and forest fire management(from countrywide to global scale)
* Review the present and future remote sensing systems in relation to forestry oriented applications
* Discuss the recommendations concerning future activity of IUFRO remote sensing society in relation to IUFRO-2000 Congress.

**Sessions and moderators:**

- * Remote Sensing and Biodiversity
  Barbara Koch
- * Remote Sensing and Regional and Global Forest Monitoring
  Risto Päivinen
- * Remote Sensing and Education Issues
  David L. Evans
- * Remote Sensing and Forest Fires
  Brian Stocks
- * Disaster in Forestry
  Mathias Schardt
- * Remote Sensing and Tropical Forests
  Jusoff Kamaruzaman

**Call for papers and posters:** You are kindly invited to submit a paper/or present a poster. Please send an abstract (approx. 300 words) to the secretariat before 20 September, 1998. The instructions for preparing the final manuscripts and posters will be presented in the second circular.

**Registration fee:** Detailed information about fees and prices will be given in the second circular

**Contact address for the conference organization:**

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**Contact address for the Chair, IUFRO Subject Group 8.05.00 Forest Fire Research, and session moderator "Remote Sensing and Forest Fires":**

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