UNITED NATIONS
ECONOMIC COMMISSION FOR EUROPE

FOOD AND AGRICULTURE ORGANIZATION
OF THE UNITED NATIONS

INTERNATIONAL FOREST FIRE NEWS

No. 14 – January 1996

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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 or on diskettes (WP 5.1)**. Figures and photographs should be submitted by mail.

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

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Focus Impact of Biomass Burning on the Atmosphere and Biosphere
("Biomass Burning Experiment" [BIBEX])

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

The International Association of Wildland Fire

EDITORIAL

The first three fire seminars organized by the UN-ECE/FAO Agriculture and Timber Division (now: Timber Section, UN-ECE Trade Division), supported by the FAO/ECE/ILO Team of Specialists on Forest Fire, were on *Forest Fire Prevention and Control* (Warsaw, Poland, 1981), on *Methods and Equipment for the Prevention of Forest Fires* (Valencia, Spain, 1986), and on *Forest Fire Prevention, Land Use and People* (Athens, Greece, 1991). Following the 5-year interval schedule of previous years, the next seminar will be held this year. Host of the seminar will be the Government of the Russian Federation, through the Federal Forest Service. The seminar is entitled *Forest, Fire and Global Change*. Delegates from ECE member countries and nations from all over the world, representing forest administrations, fire management organizations, and fire research institutions, and international organizations will participate in the seminar.

The objective of the seminar is to present comprehensive state-of-the art knowledge on the present and the possible future role of fire in global ecosystems, with special emphasis on the ECE region. The possible impact of climate change (regional and global warming with consequently changing precipitation patterns) on seasonality, extent and severity of wildfires will be an important focus.

Special emphasis will be put on methodologies to assess the extent and the environmental and economic consequences of wildland fires. One of the desirable outcomes of the seminar will be to elaborate methodologies to improve and standardize fire inventories and fire data banks. Recommendations to develop strategies for the establishment of mechanisms to collect and evaluate fire inventory data on a global scale could be an important result of the meeting. Finally, proposals will be elaborated for international cooperation in fire management on a regular base and in disaster situations.

In furtherance of the UNCED process and the International Decade for Natural Disaster Reduction, a catalogue of proposals will be submitted to the UN Commission for Sustainable Development (CSD).

An exhibition and meeting of fire management specialists and equipment producers will be organized *in tandem* with the FAO/ECE/ILO seminar. The joint convention of both meetings was considered to be advantageous because it would bring together five key groups that are crucial for further joint strategic development in wildland fire research and development, namely producers, users, researchers, policy makers, and funding agencies.

Readers may find details on the seminar in the first section of this issue which is entirely devoted to Russia, the host country of the seminar.

The Editor

Detailed information on the FAO/ECE/ILO seminar
Forest, Fire and Global Change
and a registration form are attached at the end of this issue.

Deadline for registration will be 1 June 1996 !

RUSSIA SPECIAL

The Russian Forest Fund: A Brief Overview

The total area of the Russian Forest Fund covers ca. 1,181 million ha, out of which 886 million ha (= 75,0%) are forested and 763 million ha (= 64%) are stocked. The Federal Forest Service of Russia exercises control over 94% of the total forest fund area and 91% of the total growing stock of Russia. Among other forest owners, the largest are agricultural organizations (collective farms, State farms) with a share of 4% of Russia's forest lands.

Categories of Forests: The forests of the European and Asian parts of Russia are subdivided into three groups in accordance with their ecological and economic importance:

- The first group comprises forests with primary functions in protection of watersheds and other ecologically important functions. This group also includes forests of scientific, historical and socio-cultural values.

- The second group comprises forests in densely populated areas, protection forests and forests of limited exploitation values.

- The third group comprises forests of densely wooded regions with mainly exploitation value. These forests are managed under sustainable forestry management for meeting national economic and export demands.

Species Composition: In the forests under the jurisdiction of the Federal Forest Service of Russia, three groups of main species (coniferous, high and low density broadleaved) cover 638 million ha (90.4% of the total stocked area): 508 million ha (72%) coniferous species, 113 million ha (16%) low density broadleaved and 17 million ha (2.4%) high density broadleaved species.

The predominant coniferous species is Larch (*Larix* spp.). Low density broadleaved tree stand are predominantly composed of Birch (*Betula* spp.; mainly European birch [*B.pendula*] and White birch [*B.pubescens*]). Despite taking the second place among low density broadleaved species, aspen (*Populus tremula*) forests cover an area 4.5 times less compared with the birch area. Oak dominates within group of high density broadleaved species. About 55% of oak stands (composed mainly of Common oak - *Quercus robur*) are concentrated in the European part of Russia, and the rest - in the Far East - almost completely of Mongolian oak (*Q.mongolica*). Stone birch belongs also to high density broadleaved species. Such a collective name involves several species of Birches with dark-coloured bark and very hard wood. They are found in Eastern Siberia and the Far East. As regards areas covered, stands of Stone birch take second place after oak forests within the group of high density broadleaved species. Other high density broadleaved species are Hornbeam (*Carpinus*), Ash (*Fraxinus*), Maple (*Acer*), and Elm (*Ulmus*); these species cover a very small area.

Three main forest species groups contribute 97.9% (= 71.6 billion m^3) of the total standing volume, including 78.9% (57.7 billion m^3) of coniferous, 16.6% (12.1 billion m^3) of low density broadleaved and 2.4% (1.8 billion m^3) of high density broadleaved.

Forest Use: Russian forests produce timber of various specifications and grades, valuable both in the domestic and world markets. In 1993 the volume of merchantable wood harvested amounted to 174 million m^3.

A considerable discrepancy has remained between the European-Urals and Asian parts of Russia with respect to both growing stock and final harvesting. The yield of mature and overmature stands in the European-Urals part amounts to only 19% of that available in the whole country, whereas this part contributes 57% of the harvested wood. Over the last 25 years the share of wood harvested in the Asian part has increased by 10%, but a tendency toward its reduction during recent years has been observed.

The Russian forests are a unique source of wild fruits and berries, nuts and mushrooms, valuable medicinal herbs and raw materials for various sectors of industry.

National Parks: On the forest lands of Russia 24 national parks have been set aside up to now totalling 2,500,000 ha.

Forest Restoration and Protection: Reforestation works are carried out on vast areas of Russian forest lands. Planting, sowing and natural regeneration improvements are carried out on cuts, burns and glades. As a result of these works the area to be reforested in Russia decreased from 3.02 million ha to 2.10 million ha between 1966 and 1993, mainly in the European-Urals part. During this period the total area of artificial stands increased nearly 5 times, their share in the total stocked forest area of Russia amounts to 1.9%, and to 8.2% in the European-Urals regions.

In the steppe and forest-steppe regions of both European-Urals and Asian parts of Russia, large areas are subject to protective afforestation. In 1993 the total area of protective forest stands was 3.0 million ha, including 1.6 million ha of erosion control stands, and 1.2 million ha of field shelterbelts.

Thinning and sanitation cuttings are conducted to obtain productive forest stands of highly valuable trees, to improve the quality of species composition and forest health.

Each year between 12,000 and 34,000 wildfires are recorded in Russian forests. Forest fire survey and control actions are taken by the Aerial Forest Fire Protection Service *Avialesookhrana* on more than half of Russia's forest lands (see reports by N.Andreev and G.Korovin, this issue).

The average forest area affected annually by insects and diseases ranges from 1.5 to 2.5 million ha. In 1993 more than 40,000 ha of forests were killed by these causes. Control of pests and diseases is carried out annually on an area exceeding 500,000 ha. Biological management methods (application of bacteriological and virus preparations) are used on 85% of this area.

Forest Inventory: All the forest lands are now explored. The area studied and inventoried with ground-based methods increased nearly three times between 1966 and 1993, and it comprises now about two-thirds of the total Russian forest area. Other forests (situated mainly in the mountainous and the less accessible regions of Siberia and the Far East) have been studied and included into the forest account by means of other survey methods. Forest planning and inventory works are carried out by 13 enterprises employing 3,300 people.

Research: The scientific potential of the Federal Forest Service of Russia is presented now by 10 research institutes and 18 forest research stations in which 1867 people are involved in research. In addition, more than 1,000 scientists work in the forest institutes of the Russian Academy of Sciences and in the national higher educational institutions (universities).

This information was taken from the brochure ЛЕСА РОССИИ ("Russian Forests") published by the Federal Forest Service of Russia (ISBN 5-88305-004-2).

The 1994 Forest Fire Season

Considering the influence on the structure and dynamics of the Russian forest fund, forest fires have a dominating role among all the natural and anthropogenic disturbances. According to the forest inventory data of the Russian Forest Fund (state: 1 January 1993) the area of totally fire-damaged (non-regenerated) forest comprised 28.4 million ha. This area of severely burned forests (dead stands) was 3.3 times higher than the area of non-regenerated cuttings.

Regular forest fire observation is carried out only in the zone of active forest protection, corresponding to 2/3 of the Forest Fund area. This zone includes almost all the European part of Russia, the southern and central regions of Siberia and the Far East. In the northern regions of the Asian part of Russia, covering 1/3 of the Forest Fund territory, forest fire fighting is not carried out or is carried out only episodically. Thus, regular acquisition of fire data in this zone is almost lacking.

The number of forest fires registered annually in the protected forest zone ranges between 10,000 to 30,000, affecting between 0.5 to 2.1 million ha. Taking into account the correlation between the area of burned out forests and dead stands in actively protected, non-protected and episodically protected territory, the area of the Russian Forest Fund annually affected by fire is estimated to range between 0.9 and 3.7 million ha. Taking into account the lack of instrumental methods to sufficiently monitor burned areas and the earlier practice to reduce the number of reported damages, we must consider these estimations as being at the lower limits of its possible ranges.

About 20,287 forest fires affecting a total area of 723,100 ha were registered in 1994 on actively protected forest lands. The number of fires in the 1994 season was near its average annual value for the previous five-year period (20,355), and the area burned was only a half of the average area burned annually (1,437,200 ha). A peculiarity of this forest fire season is that almost a half of all forest fires (9,875) arose on the territory of the European part of Russia with well developed infrastructure and relatively high levels of forest protection. These forest fires were promptly controlled, and the area burned was only 26,700 hectares, corresponding to less than 5.0% of the whole burned area of the Forest Fund. The other 1,412 fires occurred in the regions of Siberia and the Far East, covering 510,100 ha of forests. The average area of a single fire in these regions was 18 times higher than that in the European part of Russia.

Detailed information about forest fires is available for the Forest Fund area that is under aerial protection and is included in a Geographic Information System. Aerial forest fire protection is carried out on an area of 731.3 million ha and includes almost the whole protected territory of the Forest Fund of Siberia and the Far East and also the relatively forest-rich regions of the European part of Russia (Fig.1). In 1994 active aerial fire fighting was carried out on an area of 551 million ha; this area includes 122.5 million ha of deer pasture lands. A total of 14,796 forest fires burned 644,700 ha of the protected Forest Fund territory. About 147 fires burned a total area of 172,600 ha of deer pastures.

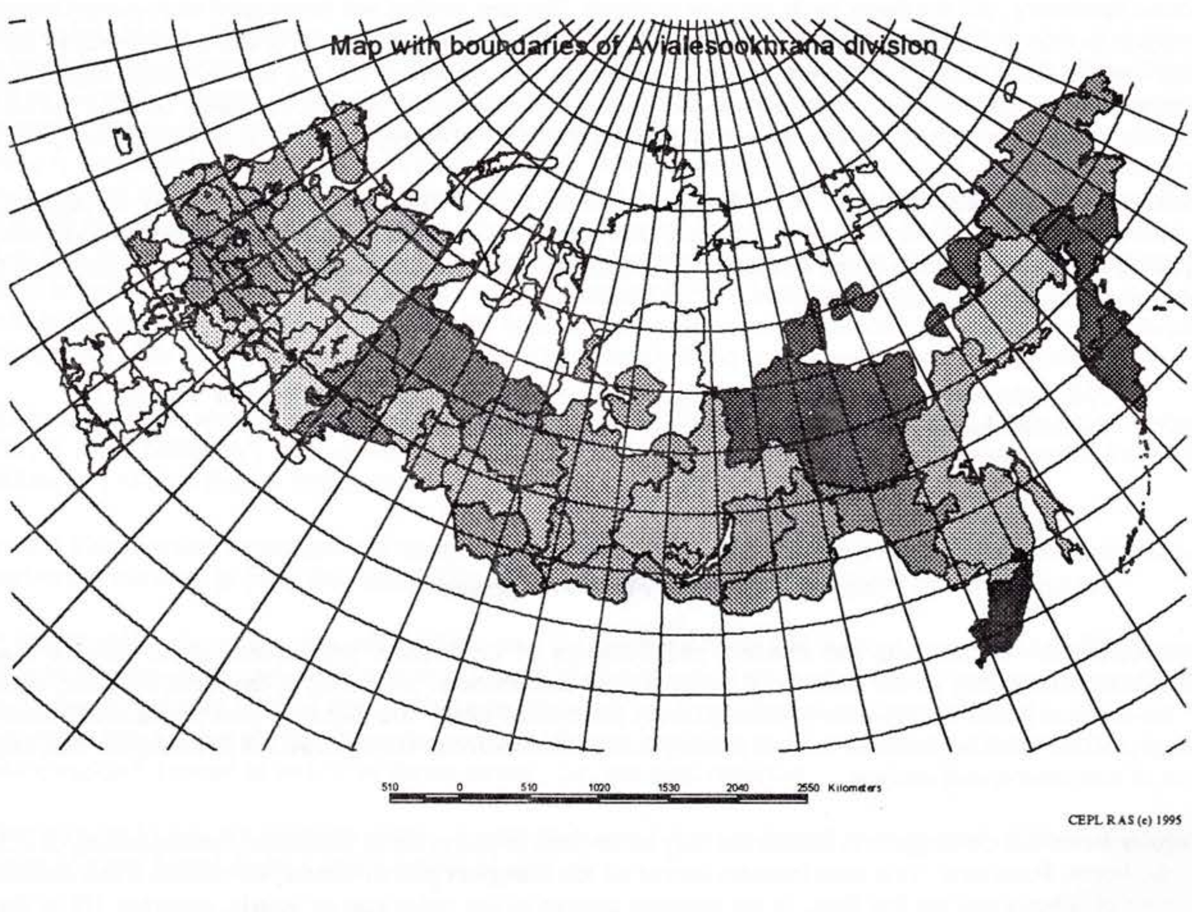

Fig.1. Map of Russia showing boundaries of *Avialesookhrana* divisions. The unprotected zone is in the northern regions of the Asian part of Russia, covering 1/3 of the Forest Fund territory.

More than 75.5% of the number of fires, and 90% of the area burned in the lands protected by aerial means were in taiga forest (Fig.2). In the zone of mixed and deciduous forests and in the forest steppe 20% of the number of fires burned 6% of the area. The low number of fires reported in the tundra and tundra-taiga transition zone can be explained by the fact that there is no or only episodic systematic fire observation and control. Only 5.0% of the area of deer pastures affected by fire was in the category of forest lands.

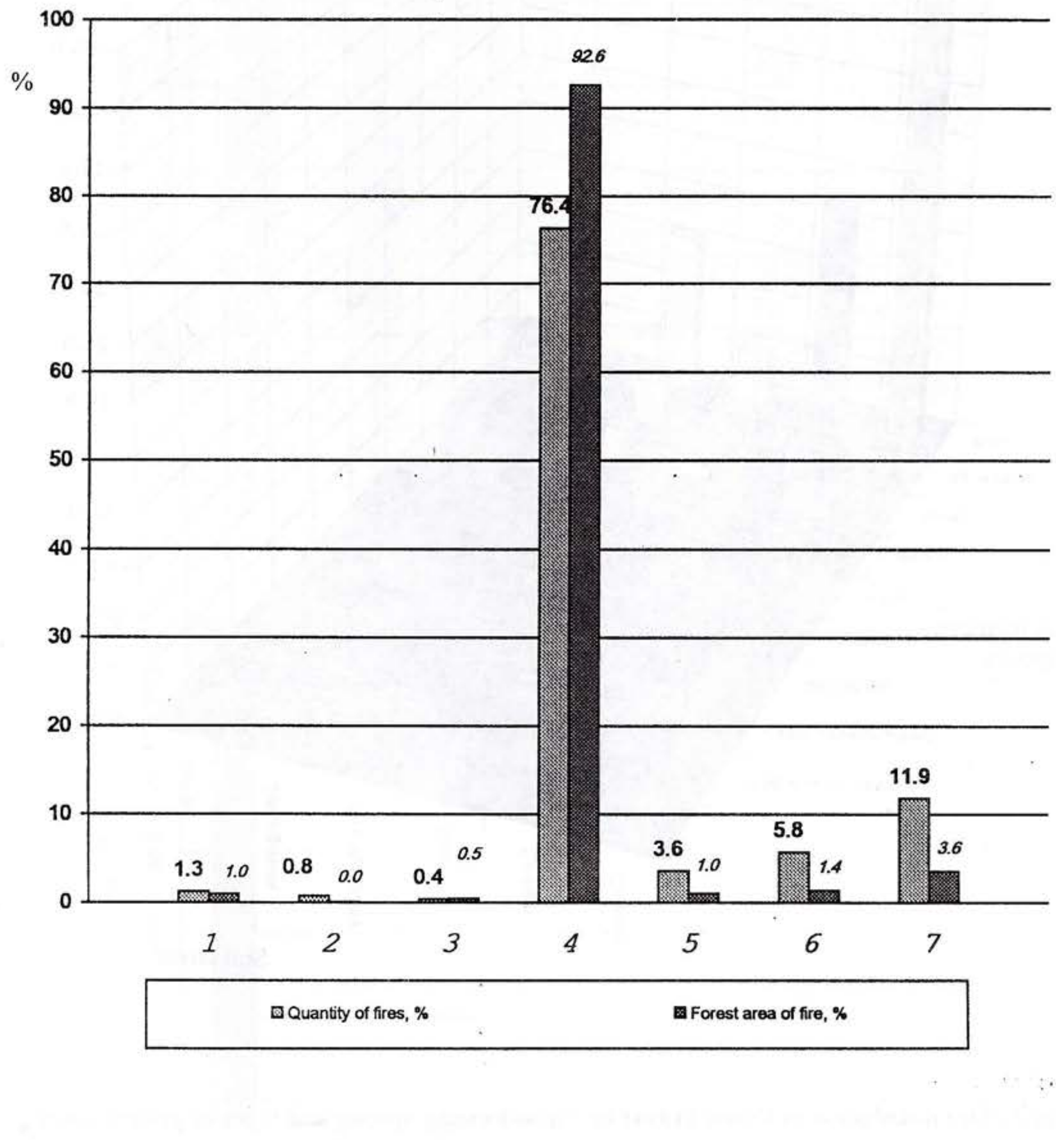

Fig.2. Fire distribution in Russia (1994) by forest vegetation zones
1 - Tundra
2 - Forest tundra
3 - Grasslands and open woodlands
4 - Taiga
5 - Mixed forests
6 - Deciduous forests
7 - Forest steppe

The majority of forest fires arose in light coniferous species (pine, larch) and softwood forests (birch, aspen) in which surface fuels consist of highly inflammable materials (grass, shrubs, lichen, green moss [Fig.3]).

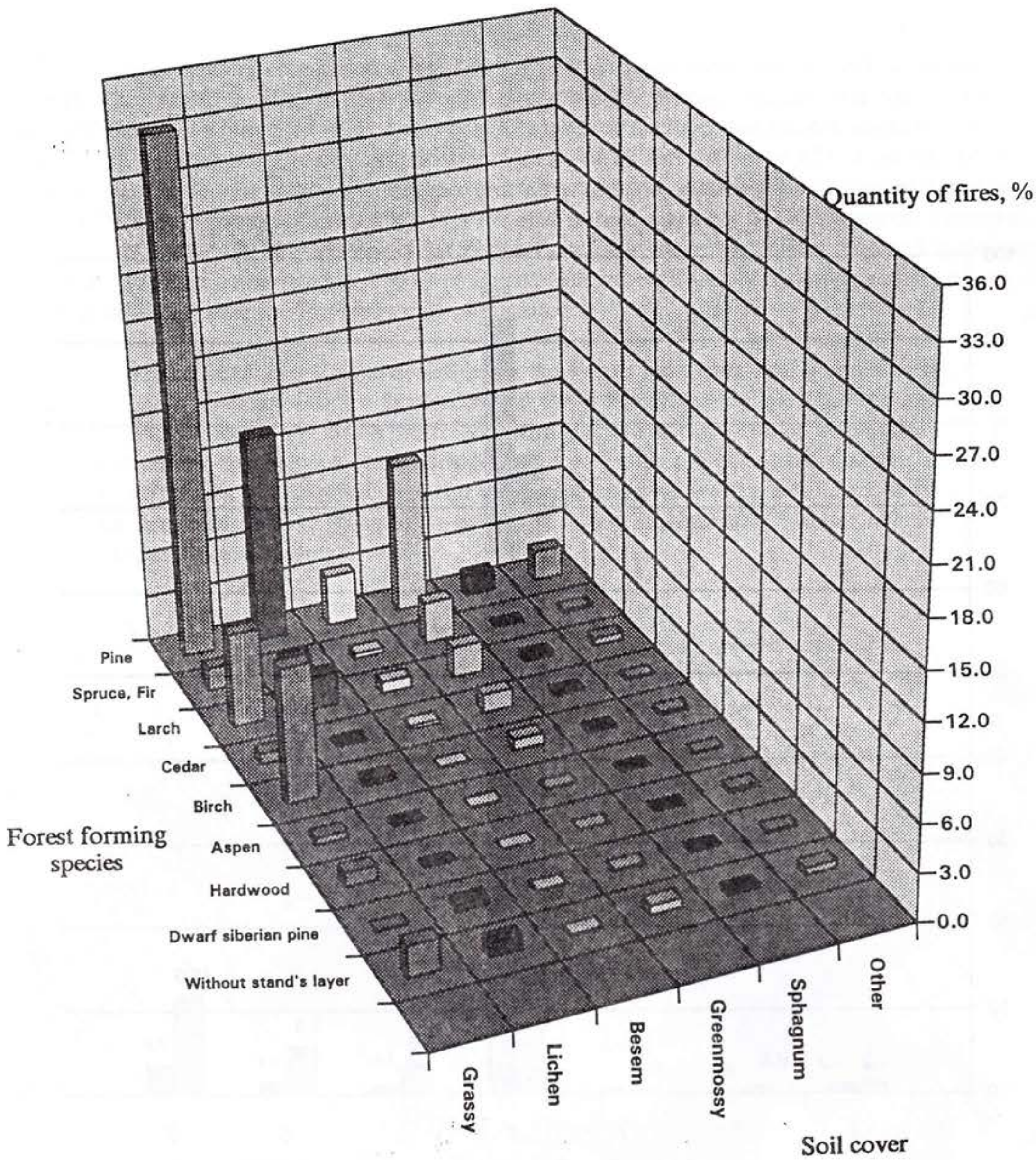

Fig.3. Fire distribution in Russia (1994) by forest-forming species and types of ground cover.

The distribution of forest fire causes show the dominating role of anthropogenic sources (ca. 90% of all forest fires registered in Russia). On the Forest Fund territory covered by aerial forest fire protection the share of anthropogenic sources of fire was 70.0%, natural factors (lightning) 12.7%, and unknown causes 12.3% (Fig.4). Although the number of lightning-caused fires was relatively small, these fires burned 37% of the total area burned. This can be explained by the group character of these fires and the long distance from transport roads and populated points.

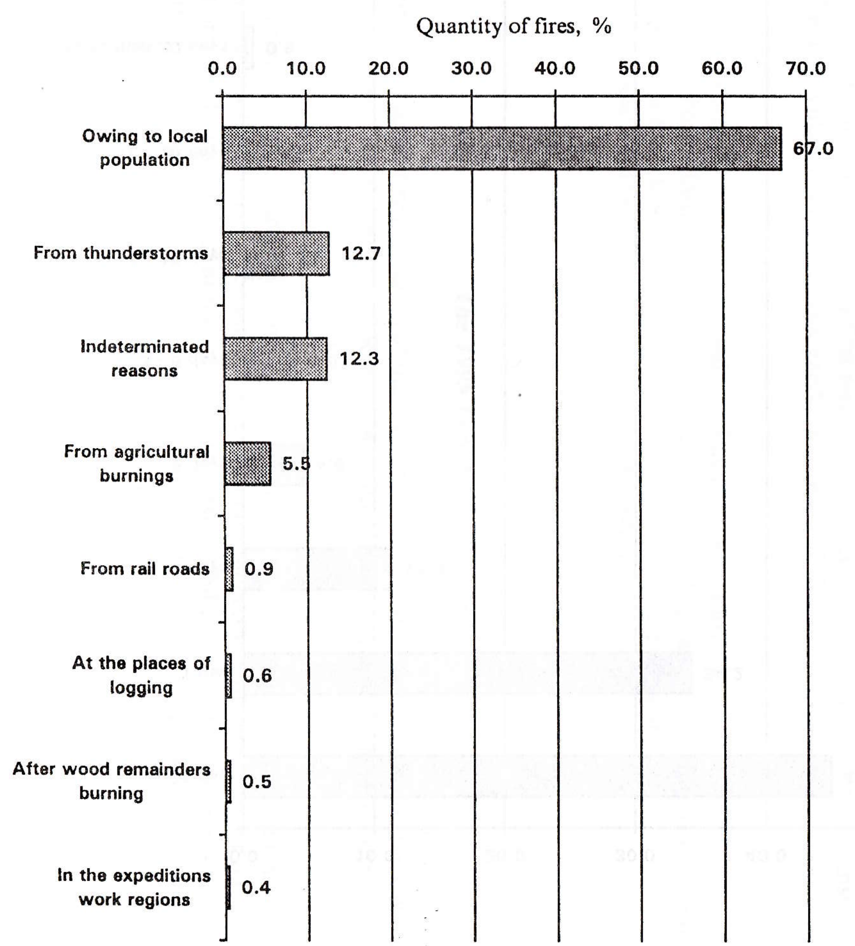

Fig.4. Causes of forest fires in Russia (1994)

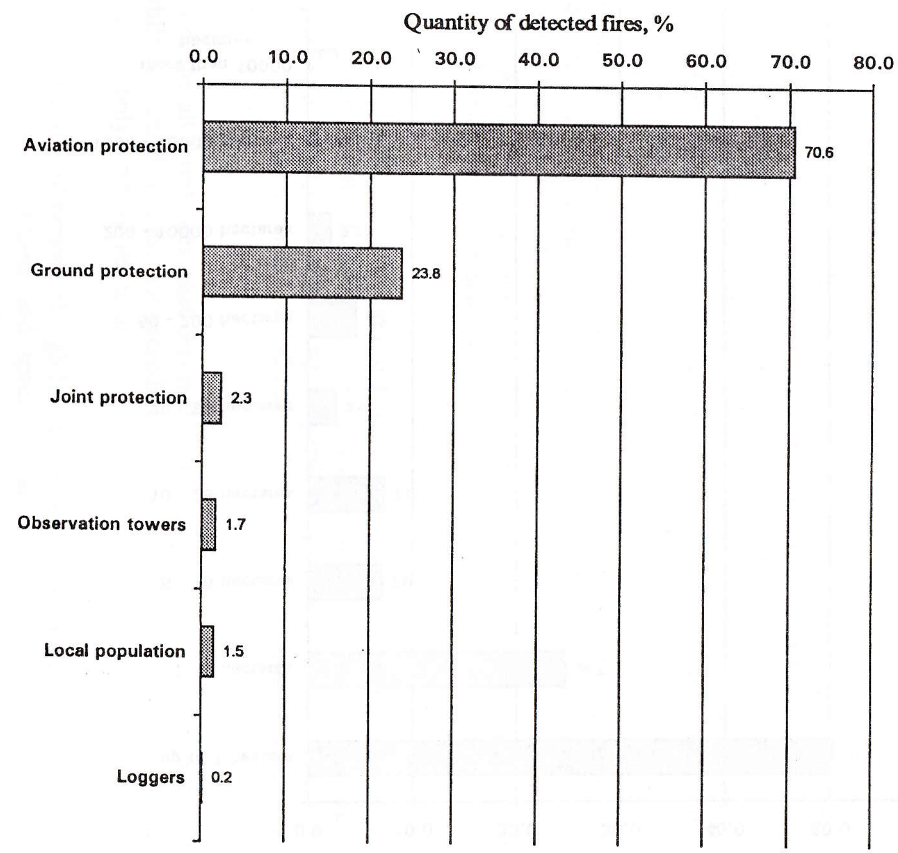

Fig.5. Means of detection of forest fires in Russia (1994)

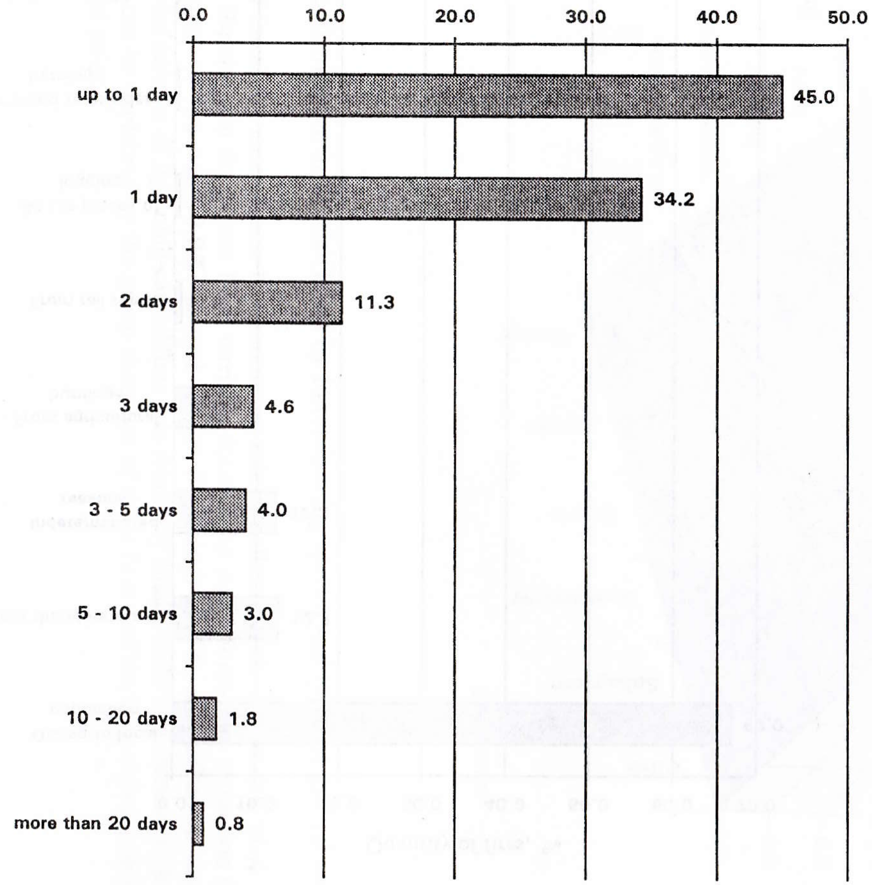

Fig.6. Duration of forest fires in Russia (1994)

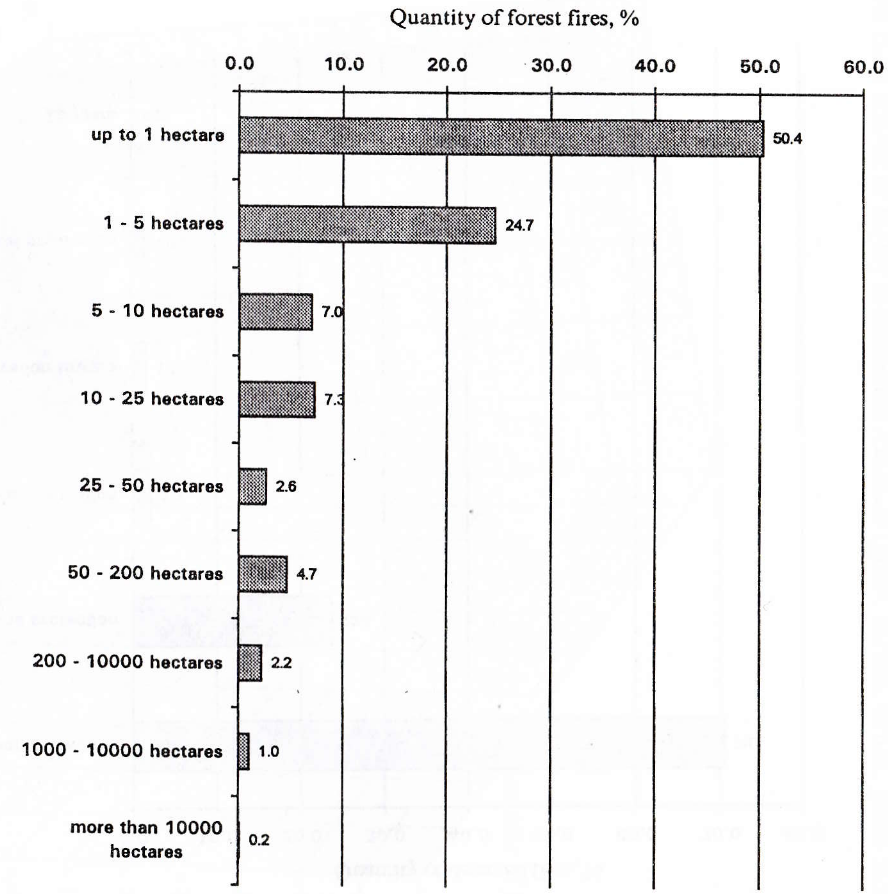

Fig.7. Size distribution of forest fires in Russia (1994)

About half of all forest fires (9,725) were detected by aerial reconnaissance. On the territory covered with aerial forest fire protection the share of fires detected by aerial observation was 70% (Fig.5), 25% of the forest fires were detected by ground services, and 5.0% were detected by the local population, expeditions, loggers, etc.

About 5,034 forest fires (ca. 1/4th of all fires in the Forest Fund) which burned 526,900 ha (3/4 of the total area burned) were controlled by aerial means (including 132 fires which finally affected 163,800 ha of deer pastures). On the total territory covered by aerial protection the share of forest fires put out with aerial means was 34,0%. The role of aviation forest fire protection in forest fire detection and fighting was lower than in the previous fire seasons. This was due to the fact that because of insufficient finances the frequency of aerial forest patrolling and the number of aviation forest protection staff were reduced.

The majority of forest fires were put out in the day following its detection. On the territory covered with aerial fire protection 45.0% of the forest fires were suppressed on the day of detection, and 35.5% forest fires were put out the day after detection (Fig.6). The share of these fires in the total area burned of the Forest Fund did not exceeded 5,0%. At the same time more than a half of this area was burned due to lightning fires, which were put out 10 and more days after starting; the number of these fires did not exceed 2.0% of the total number.

As in previous years, the main part of the Forest Fund area affected by fire is concentrated in several regions of highest wildfire risk within Russia and represent the limited number of large forest fires which went out of control. The hotspots were in Irkutsk region, Krasnoyarsk territory and Republic Sakha (Yakutya). The total area burned in these three regions was 464,700 ha, or 72.1% of the burned surface on the area covered by aerial forest fire protection.

No less than 3/4 of the all forest fires, that occurred on the Forest Fund territory protected by aerial means, were put out while still small in area, not exceeding 5 ha (Fig.7). The number of large forest fires burning more than 200 ha was only 3.5% of the total.

Because of the high variability of periods of high fire danger and fire occurrence, the analysis of forest fire risk must be based on long-term datasets and specific mathematical processing methods. Sufficiently full understanding of the influence of fire on forest ecosystems can be formulated only when we can organize regular fire monitoring on episodically protected and unprotected Forest Fund territory. Under conditions of inadequate ground-based and aerial infrastructures, fire monitoring in these regions can be provided only by spaceborne remote sensing methods. As a first step in this direction we are considering the installation of the NOAA AVHRR receiving stations in Krasnoyarsk, Yakutsk and Khabarovsk.

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The 1995 Forest Fire Season

The special service for aerial fire protection of the forest resources against fires headed by the Central Aviation Base for Aerial Forest Fire Protection of Russia (*Avialesookhrana*) was integrated into the system of the Federal Forestry Service of Russia (*Rosleshoz*).

Aerial forest fire protection is carried out by 329 sub-divisions incorporated into 23 regional aviation bases. Active forest fire control is conducted on an area over 700 million hectares of forests under the jurisdiction of *Rosleshoz* and on over 110 million ha of forests under the responsibility and management of other agencies. 26 mechanized crews for combating forest fires are operating in the regional aviation bases. All activities of Avialesookhrana concentrate exclusively on forest fire protection.

More than 5,000 smoke jumpers and helirappellers are engaged in fighting forest fires (Fig.1). In 1995 more than 22,000 fires were recorded in the forests of *Rosleshoz*, affecting 321,000 ha (Fig.3). The fire season started 1-2 weeks earlier than in previous years. In April about 3000 forest fires occurred (2.2 times more than in April 1994). Despite the growing number of forest fires, the burned area was reduced by 112,000 ha or 25% in comparison with 1994. The most complicated situation arose in the Khabarovsk and Krasnoyarsk territories, Irkutsk and the Amur regions as well as in the Sakha (Yakut) Republics. 270 large forest fires burned 220,500 ha or 68.8% of all burned wildlands. In the regions with extreme fire danger large numbers of fire fighting personnel and equipment were transferred within the regional fire centres and from bases to bases. It should be mentioned that the mobilization of local labour power and necessary equipment is becoming more and more difficult due to the movement of our society to the market economy and the fact that agencies and the local industry have gained independence.

During the 1995 fire season 600 aircraft were rented, including 50% helicopters, flying more than 60,000 hours on fire operations. The smoke jumpers performed 34,000 jumps and the rappellers made 50,000 interventions from helicopters.

Fig.1. Smoke jumper landing near a fire site in Siberia during the 1995 fire season.

Significant attention has been paid to the use of airtankers in the lake Baikal basin. In 1995 air tankers operated on 19,200 ha in the subdivisions of the Baikal, Irkutsk and Chita aviation bases. According to the records for many years, on average 600 forest fires started annually in the above mentioned territories, burning 25,500 ha. In 1995 a total of 802 fires burned 4328 ha. The individual fire size was reduced from 9.8 ha (in 1994) to 5.4 ha (in 1995). A total of 29 airplanes was involved in forest fire suppression. Additionally three heavy amphibious BE-12P water bombers, each carrying 6000 litres of water, were used since they were under testing in that area.

The three-year experience of testing the BE-12P proved its high efficiency, provided that the distance to reservoirs for scooping water should be located within the operating radius of 70-80 km. These operations completed the initial step for introducing amphibious planes into the general technological scheme carried out by the aviation subdivisions of Irkutsk region.

Fig.2. The use of explosives for fire line construction represents an efficient fire control method applied by Russian smokejumpers and helirappellers.

In the course of the last three years 1161 aerial water drops were performed, delivering 6966 tons of water (1995: 698 drops and 4188 tons of water). A total of 341 hours were flown by the three amphibious planes.

Under the "State Programme for Forest Protection for 1995-1997" the introduction of the AN-2P plane modified for extinguishing forest fires was continued. Five AN-2P were used in Karelia, two in Bashkiria and two in the Briansk Region.

The Central Aviation Base for Aerial Forest Fire Protection *Avialesookhrana* took the necessary measures for the establishment of its own aviation company. At present one such type aviation subdivision is attached to the Northeast regional base (Magadan). This subdivision has received 12 AN-2P, two AN-26 and six helicopters MI-8. In addition the Vladimir State Aviation Company, which provides 30 AN-2 and two AN-24, has been incorporated into the structure of *Avialesookhrana* in 1995. Twelve AN-2 are planned to be converted into AN-2P for aerial fire suppression. For more details on aircraft technologies see the **International Forest Fire News** issues of July 1994 and July 1995.

The causes of fires in 1994 are distributed to as follows:

Human origin - 63%
Dry lightning - 10.9%
Agricultural burning - 4.6%
Forest logging operations - 1.4%
Unknown causes - 20.1%

Lightning-caused fires burned 49% of the total area affected by fire.

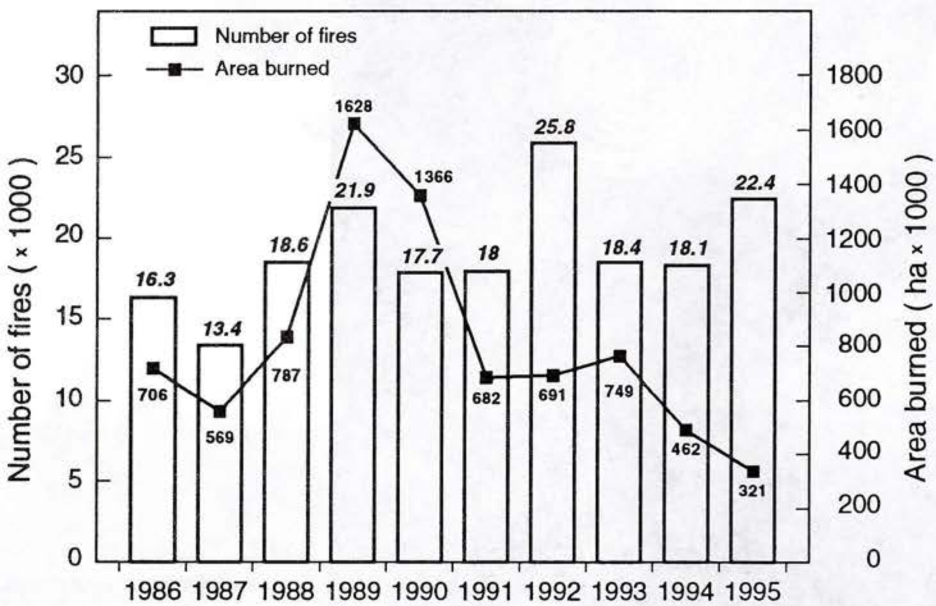

Fig.3. Number of fires and area burned in the USSR/Russia between 1986 and 1995.

In order to implement the "State Programme for Forest Protection" the system of remote sensing for forecasting and detecting fires caused by lightning was established in 1994 in Khabarorsk territory. The results of its use are encouraging. In 1994, 26 forest fire hot spots were detected by that system. The deployment of such systems is foreseen in the Primorsk and Kranoyrsk territories as well as in the Amur, Irkutsk and Tiumen regions.

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COUNTRY NOTES

BRAZIL

Fires Heat up After a Four-Years Decrease

After four years of decreases on the burnings index, Brazil had to deal again with high levels of fire activities during the 1995 dry season. According to the information obtained from the NOAA AVHRR satellite sensor the average total number of fires detected between 1991 and 1994 had dropped by 23% each year. During the five dry months of 1995 the total number of detected fires reached 367,000. That means a 70% increase, if compared with 1994's numbers.

The distribution of the main fire concentrations also changed. During the last four years the fires had followed almost the same pattern throughout the dry season, in a high correlation with the dislocation of the Intertropical Convergence Zone (ITCZ) and the occurrence of rainfall. The regions where the rainfall stops first, burning activities also start first. Whenever out of season rainfalls occur, there are no burnings. From 1991 to 1994, June and July were the months of medium fire concentrations in Southern Brazil, predominating in Paraná, Santa Catarina and Sao Paulo. From August on, the burnings rapidly progressed into Central Brazil, spreading smoke over Mato Grosso do Sul, Mato Grosso, Goiás, Tocantins and West Bahia. Then the major fire concentrations moved North, towards the Amazon region (Pará, Amazonia, Acre, Rondônia), and to the East (Maranhao, Piauí), ending October with the first burnings in Northeastern Brazil, at the semi desert region called ***The Drought Polygon*** (Bahía, Pernambuco, Rio Grande do Norte, Paraíba, Ceará).

This year, June and July started with the highest concentrations of fire points ever registered, and many of them were localized in the Amazon Region. These months' indexes almost doubled, if compared with the average of previous records. In August there was a 34% increase above the average of previous years. But in September and October the fire numbers kept the same level of previous years.

The main reason for this change of patterns and standards was economic. Since 1991, less investment money was available for farmers, cattle ranchers and agriculturists. They have reduced, therefore, their planted areas and did not open new farming lands. In 1995, the situation changed, with the success of the ***Plano Reál***. Its economic measures drastically reduced inflation and stabilized the Brazilian economy. Farmers, cattle ranchers and agriculturists reinvested in plantations and pasture renovations. The abandoned areas were again prepared and fire was again used as the cheapest and easiest tool to control weeds and accelerate grass sprouting. New areas were also opened, on a smaller scale.

The climate also favoured the fires, especially in the Amazon Basin. This year, the dry season started first and lasted longer in the Amazon states. Consequently, agriculturists had more time to prepare their lands and set fire. At Rondônia State, for example, the satellites detected concentrations of fire from early June until late November! Usually, the burnings detected in that state last only from August to September/early October.

It is important to bear in mind that Brazilian fires are very different from those in the natural vegetation of the Mediterranean basin, from wildfires in California's chaparral, and forest and tundra fires in Alaska. The untouched rainforests - either at the Amazon Basin and at the Brazilian Atlantic Coast - do not burn by accident, nor even if someone sets fire to them. They are too humid to burn by themselves. They only catch fire after a severe and long drought and if disturbed or cut down. Therefore, almost all fires detected on forested areas are associated with either deforestation or post-deforestation burning. When converting forest into other land-use systems, trees are first cut down. After several months of drying, trunks and branches are burned. It takes an average of eight years until all the wood is burned. So, fire is used as a tool to clean up the land, and the hotspots are not representing wildfires. Fire is also used to eliminate weeds, plagues and leftovers of plantations, to accelerate the pastures sprouting and even to make harvesting easier, as well as a fast fertilization process. And those are the causing that high number of fires detected each winter in Brazil. That's why burnings cannot necessarily be used as a deforestation indicator: if it is true that the fire is commonly set on deforested areas, it is also true that deforested areas are not always burned and it is specially true that fires are also set on a lot of other areas, not necessarily deforested, like ***Cerrados***, grasslands, and traditional agricultural lands. More reliable deforestation indicators were developed in studies by the National Space Research Institute (INPE), with Landsat TM and Spot data (called PRODES). At the end of December 1995, INPE will release the new deforestation numbers, based on 1992 and 1994 satellite images. The 1995 numbers shall be available by June 1996.

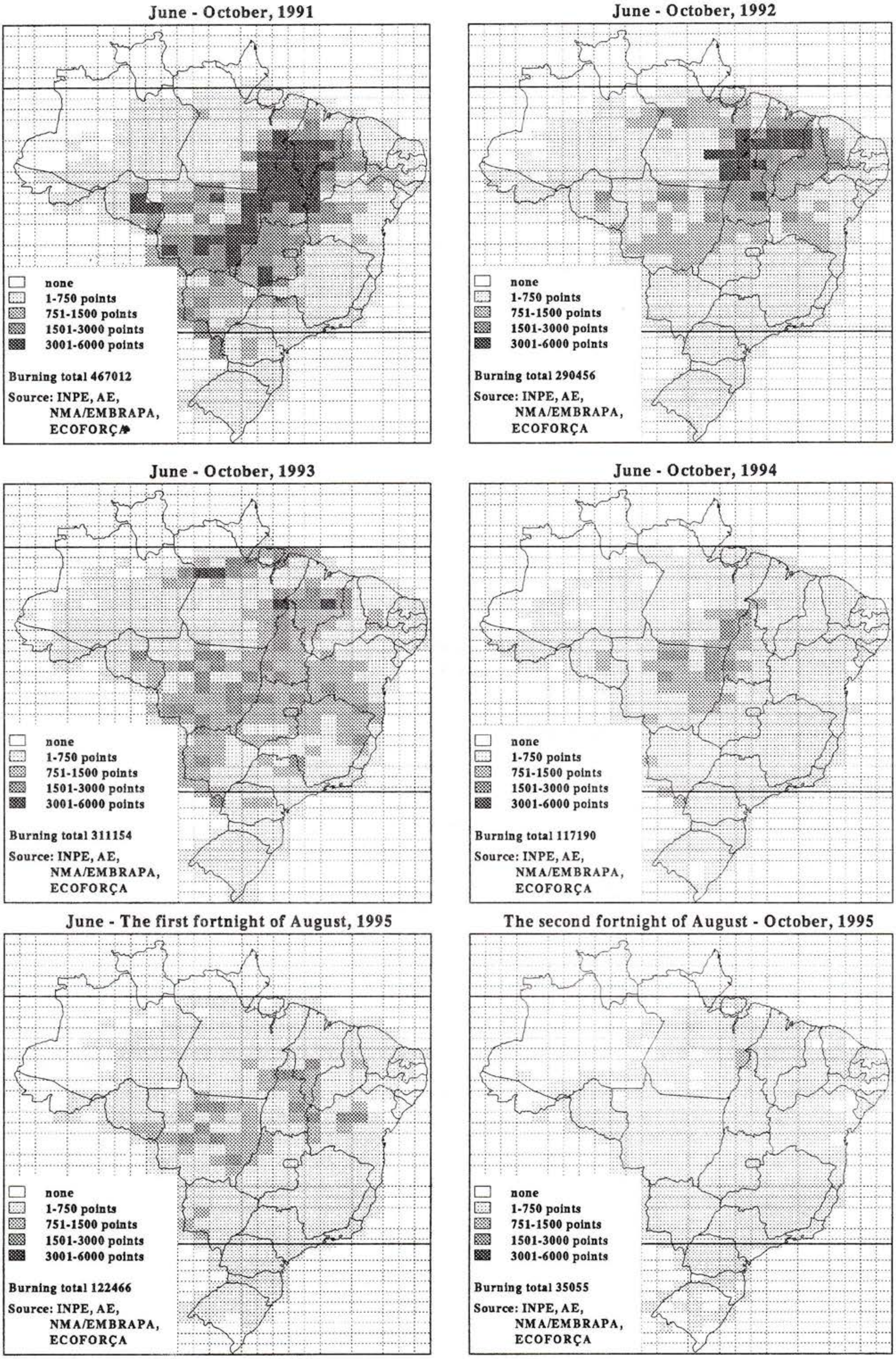

Fig.1. Spaceborne (NOAA AVHRR) observations of fire activities in Brazil in the period 1991-1995.

Spaceborne Fire Monitoring

The first NOAA images used to detect fire points were treated at INPE, back in 1987. The fires detected by the satellite sensor were georeferenced by a computer software (determination of geographical coordinates). Since then, lists with fire coordinates were sent daily to the Brazilian Environmental Agency (IBAMA), to be checked/verified in the field. The federal agency was never able to truly use the monitoring data, due to alleged lack of financial support. But one of the state environmental agencies, the SMA of Sao Paulo, actually investigated the main fires pointed by INPE, and established a programme, called ***Mata Fogo***, to control burnings.

In 1991, the Environmental Monitoring Center (NMA) and the non-governmental organization ***Ecoforça*** joined INPE, in an effort to make the system more operational. They developed a software to translate the NOAA data, processed by INPE, into maps. The maps use the standard 1:250,000 grid over the Brazilian territory, in order to better classify and localize the fire concentrations. There are also numerical maps, which identify the number of fire points in each square. Those maps have been released to the press, through the ***Agencia Estado News Wire Service***, together with an analysis of what kind of vegetation is probably burning, where are the worst fire concentrations, fire spots that should be investigated by authorities, etc. Those features and maps have been published on a weekly basis, throughout the dry season. The maps are available at Internet, on Ecoforce's site (see URL at bottom).

At the end of 1994, there were some interruptions, due to the NOAA-11 failure. In 1995, the NOAA-14 was picked as the substitute, because it passes over Brazil twice in the afternoon, when the major part of the fires are still going on. Unfortunately, the NOAA-14 is almost 2 hours earlier than the NOAA-11. This led to a solar reflection problem: in mid-August the open cerrados (savanna-like vegetation) were so bright that they saturated the pixels. INPE was forced to adopt the NOAA-12 images, with a big loss of data. NMA and Ecoforce decided to publicize two different maps for 1995 fires: one from June to 15 August, and the other from 15 August to October. The first based on NOAA-14 and the second on NOAA-12. Up to now, they are not comparable. The NOAA-12 passes over Brazil at night, when only illegal, accidental and roadside fires are still lighted or continuing. There are 4 to 5 times less fires at night, as can be seen by NOAA-12 and NOAA-14.

The total of fire points from 15 August until October was then estimated (and not measured). These preliminary estimates were based on the burnings tendency and on the differences observed between those two satellites. Other evaluations are on their way. INPE has recorded all NOAA-14 images not used on the operational monitoring system and is trying to solve the problem with a new software. Ecoforce got some images of other satellites (DMSP and GOES) and will compare them with NOAA data. The burnings are a complex and dynamic problem, but Brazil will find better technology to fully re-establish its monitoring system.

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CANADA ***The 1995 Fire Season***

The 1995 fire season in Canada was truly national in scope with all agencies involved in either mobilization or suppression activities.

The period from 28 May until 7 July saw the largest mobilization of resources on record. Over 1000 fire management personnel had moved, including 520 personnel from the United States. In excess of 500 pumps

with 8000 lengths of hose, complete communication systems, large amounts of fireline handtools and camping equipment were mobilized during that short period of time. This massive mobilization of resources put Canada's cooperative system of resource sharing to the test.

Once again the Canadian forest fire season began with low over-winter precipitation bringing the northern portions of British Columbia (BC), Alberta (AB), Saskatchewan (SK), Manitoba (MB), northwestern Ontario and the southern half of the Northwest (NT) and Yukon (YT) Territories into the fire season, with extremely high drought codes (DC). Above normal temperatures and below normal precipitation across the northern portions of the western provinces and territories further increased the fire occurrence and fire severity potential. The above-normal temperatures slowly spread across northern Canada from Saskatchewan right through to the Atlantic leaving behind a trail of multiple fire occurrence and large fire activity.

28 May ushered in the fire season with a vengeance. Extensive lightning activity spread across Alberta, Saskatchewan and Manitoba producing multiple fire starts.

Saskatchewan was hit the hardest with numerous starts being recorded daily over the next five days. Severe fire behaviour resulted in many fires escaping initial attack, growing quickly to project fire status and soaking up resources. Competition for available air tankers and helicopters was increasing rapidly and large quantities of fireline equipment was being moved into Saskatchewan. By 3 June problem fires were being reported in BC, AB, SK, MB, ON and Quebec (QC). Evacuations and road closures had occurred, open fire bans were in effect in all four western provinces and the first reported forest fire related fatality had occurred in Alberta. The Northwest Territories joined in later that week with two problem fires, one causing the evacuation of a northern community. Extreme fire conditions in other agencies restricted the availability of resources. The Canadian Interagency Forest Fire Centre (CIFFC) began to look to the National Incident Command Center (NICC) in the United States (US) for communication equipment and large numbers of sustained action crews.

Slightly moderating weather conditions helped some western agencies during the next two weeks, but the heat and extreme conditions continued their progression east. By mid-June the fire intensity resumed with multiple fire starts occurring once again in AB, SK, MB and now Ontario (ON). Agencies that had loaned airtanker were beginning to recall then due to conditions at home. Requests for skimmer type airtankers could not be filled with none becoming available in the foreseeable future.

To help alleviate the problem land based tankers and portable retardant mixing systems were mobilized into MB and ON. To help integrate the land based systems air attack officers familiar with both land based and skimmer operations were mobilized. During the 10 day period from 16 to 25 June ON experienced in excess of 600 new starts with many escaping initial attack and growing to project status. With the situation modifying somewhat in BC and AB, they were able to supply much needed initial attack and sustained action crews along with the US to ON. Fireline resources were moving in from all available sources across the country. With this continued escalation of fire activity came the next fire tragedy. Three fire related fatalities occurred in a helicopter crash in northern Manitoba. Problem fires were now being listed in YT, NT, SK, MB, ON with resources being drawn down daily.

The heat and resulting fire activity continued its trek east across ON and into QC. From 29 June to 2 July QC received 200 fires and once again a number of fires escaped initial attack. Requests for resources again poured in, and again agencies responded within their capabilities. Throughout the first week of July, QC continued to draw in resources to assist in suppressing its fires. QC instituted the emergency signing of the Canada/United States Forest Fire Fighting Reciprocal Arrangement to access US resources through CIFFC. Full-scale suppression activity was now occurring in NT, YT, SK, MB, ON and QC with BC beginning to recall their resources in anticipation of escalating fire activity back home.

By this time CIFFC had responded to over 100 resource requests resulting in the largest mobilization of manpower and equipment in Canadian history. The United States through the NICC was relied on heavily for the supply of professional forest fire fighters, communications equipment and high level infrared photography. Agencies such as YT, ON and QC activated their border agreements with individual US State fire organizations to acquire additional resources. Helicopters had been imported from US based companies and initial reviews were being looked at for off-shore resources. Although resources were stretched to the limit and with the exception of CL-215 aircraft all requests received at CIFFC were responded to.

The period from the third week of July through to the second week of August, which is historically the most active, was comparatively quiet. This allowed the agencies to gain control of many of their project fires and begin to return some of the resources that have been mobilized. Although the weather had moderated somewhat, many areas still reported high to extreme drought codes with potential head fire intensity predictions capable of producing crown fire activity. Activity again began to escalate in the east with Quebec and Ontario receiving double digit fire starts almost daily.

Prolonged drought and severe burning conditions again resulted in escaped fires. Air tankers, fire suppression equipment, initial attack and sustained action crews were once again mobilized into Ontario and Quebec. At the height of this renewed fire activity all the CL-215's in Canada except for 2 NF air tankers, in excess of 1,200 initial attack and sustain action forces which included over 400 personnel from the US had been mobilized for either ON or QC. Availability of personnel was good due to moderating fire conditions from Manitoba west and through NICC in the US. The only thing that slowed mobilization was the availability of large Canadian transport aircraft.

Even with extensive use of the NICC large transport jets some personnel movements had to be delayed one or two days.

Tab.1. Canada forest fire statistics for January to October 1995

	Number of Fires			Area Burned (ha)		
Province	Full Response	Modified Response	Total	Full Response	Modified Response	Total
BC	1,475		1,475		53,254	53,254
YT	105	42	147	57,371	202,377	259,748
AB	773		773	339,369		339,369
NT	142	65	207	1,108,680	1,618,178	2,726,858
SK	538	110	648	926,710	678,299	1,605,009
MB	505	137	642	119,887	689,979	809,886
ON	1,904	154	2,058	172,507	445,297	617,804
QC	1,117	120	1,237	179,168	530,932	710,100
NF	96	7	103	390	404	794
NB	529		529	403		403
NS	400		400	399		399
PE	27		27	36		36
PC	43	13	56	603	8,127	8,730
TOT	7,654	648	8,302	2,958,777	4,173,593	7,132,370

A fire originating in the US Superior National Forest crossed the border into Canada between Atikokan and Thunder Bay. The fire was actioned initially through a Canada/US cooperative effort and then due to the extreme fire load in ON the fire was turned over to the US to manage until control was obtained, then reverted back to ON.

The season concluded with CIFFC responding to 185 resource requests which resulted in 2,618 personnel including over 900 from the United States, 26 air tankers groups for a total 67 air tankers, 1,088 pump kits, 22,134 lengths of hose, 1,644 sprinkler heads, 27 complete communication systems from the US, 5,213 assorted hand tools plus camping gear and other items. Due to the abnormally quiet fire season in the United States, CIFFC was able to make extensive use of their suppression crews, large transport jets, high level infrared aircraft and other resources. Once again CIFFC broke all previous records for mobilization in all resource categories. This year tested the operational procedures, agreements and exchange standards that have been developed and are in place for many of the agencies including CIFFC. The continued development and acceptance of national standards for all resources and operational procedures will continue to raise the level of forest fire management in Canada.

Throughout the fire season CIFFC utilized the series of daily Fire Severity maps from the Canadian Forest Service, Northern Forestry Centre. These maps confirmed that the actual areas of fire occurrence, matched with the maps that forecasted the spread of fire potential across Canada and also the potential for large fire occurrence. These maps proved invaluable to CIFFC by providing a general national overview of the hazards, and gave CIFFC a good forewarning of potential fire areas.

Canada as a whole experienced a slightly below average fire year. Up to October 8,302 fires were recorded compared to an ten year average of 9,621. On the down side fire consumed 7,132,370 ha of forested land in Canada compared to a 10-year average of 2,321,146 ha.

The following statistics (up to October) show that out of a total of 8,302 fires burning 7,132,370 ha, 648 were actioned under a *Modified Response*, consuming 4,173,593 ha. A Modified Response fire is one that is allowed to burn within set policy and management guidelines or may be actioned in a limited manner to bring the fire back into those guidelines. The fires that received a Modified Response account for only 7.7% of the total fires to date, but 58.5% of the total area consumed.

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CÔTE d'IVOIRE ***Wildfires: Situation and Actions***

During the meeting of the ITTO Panel on the Protection of Tropical Forests against Forest Fires in Jakarta (6-10 March 1995) the General Secretary of the National Committee of Forest Protection and Bush Fire Control presented the existing situation in Côte d'Ivoire and actions that are taken currently.

In 1950 the total forest cover of Côte d'Ivoire was 15 million ha. Ten years later total forest cover had decreased to 10.68 million ha, and in 1992 only 3.5 million ha remained. The annual rate of deforestation is estimated to be approximately 320,000 ha.

Shifting agriculture, stimulated by increasing amounts of immigrants from neighbouring countries, forest opened by exploitation roads, inefficient land management practices associated with fallow systems, and bush and forest fires are the most important causes of forest and bush degradation.

Every year the national press reports on disastrous wildfires. The "Ivoire Soir" No.1941 of 16 February 1995 gives a good example of the type of problem encountered. Under the headline "Bondoukou - 4 villages ravaged by fire" the report demonstrated that villages continue to be decimated by bushfires caused by carelessness. The journal reported that 4,000 people living in these four villages were affected by the wildfire. All plantations in the vicinity of the villages were burnt. According to the official information the fire may have spread from a nearby field where a cooking fire was not extinguished.

Since the drought in 1983 the government is regarding bushfires and forest fires as a serious natural disaster. In that year wildfires destroyed more than 60,000 of forests and 108,000 ha coffee and cacao plantations. Between 1983 and 1994 wildfires destroyed homes of more than 70,000 people and killed 77 people.

Summarising the situation in Côte d'Ivoire at the begin of 1995 the General Secretary stated that during the period of 1 January to 20 February 1995 wildland fires caused 12 deaths, affecting 25 villages, eight of which were destroyed completely. A total of 218 ha plantations (coffee, cacao, cotton) were burnt as well as large numbers of household and farming goods. These numbers illustrate only the provisional figure during the first half of the dry season of 1995.

In the years after 1983 forest and bush fire control became an important priority of environmental protection policy of the government. In 1986 a National Committee of Forest Protection and Bush Fire Control was founded. The positions of the General Secretariat and the Presidency of the National Committee are filled by personnel of the Forest Service. These bodies coordinate the participation of 14 ministries involved in national programs.

The task of this committee is to raise awareness of the population of the damage caused by fires, the need for fire prevention and techniques for extinguishing them.

On the administration level 1,500 village committees, 57 local committees and 32 regional committees were created to decentralize the task of fire control during the last 10 years. These committees consist of elected members, a secretary and a president. The committees work to raise consciousness of the threats and inform the public about fire prevention. They are supported by the office of the Secretary General and the regional divisions in an advisory role. The office of the Secretary General and the regional divisions also play an important role in monitoring the current forest fire situation at national level.

The public is educated in the subject of forest fires using various media to reach the maximum number of people possible. The media used include roadside advertising, radio and TV advertising in a wide range of ethnic languages and the emission of educational films at the village level. Fire control and suppression techniques are demonstrated. A National Fire Prevention Day is being organized every year since 1991 in order to maintain public awareness. On these occasions fire control equipment is donated to village committees.

However, in spite of all these efforts uncontrolled fires still remain a problem because farmers, hunters or other groups utilizing fire are careless and forget to extinguish their fires. Surely there also exist always some pyromaniacs or travellers who simply cause fires by throwing away cigarette butts.

The main difficulties in fire control policy mentioned by the Secretary General are first of all inadequate financial support and a lack of exchange of experience.

Environmental protection in general and forest fire control in particular remain the preoccupation of the national government. But the mentioned structures and strategies come up against the financial problems. A better equipment, e.g. 4x4 cars, tools, medias etc., of the decentralized structures is necessary for efficient work.

The implementation of a five-year project elaborated by the national government would cost 1,600,000,000 FCFA (ca. 3.2 million US-$). Without the support of NGOs or other sources these finances can not be acquired. Exchange of experience with other countries in form of conferences, workshops etc. is considered to be very important for the problems of tropical forest protection and fire control.

The materials for this report were provided by the General Secretary of the National Committee of Forest Protection and Bush Fire Control, Côte d'Ivoire, at the ITTO Expert Panel for Preparation of Guidelines for the Protection of Tropical Forests Against Fire (Jakarta, Indonesia, 6-10 March 1995 [see IFFN July 1995]). The materials were translated and summarized by Nicolo Kannenberg (IFFN Editor's Office).

CYPRUS *The 1995 Forest Fire Season*

In the last 15 years good results have been achieved in reducing damage caused by wildfires. This is best demonstrated by the statistics presented in Table 1. Fortunately the same holds true for the 1995 forest fire season. Up to the 15 September 1995 there have been 16 fires, and the burned area was 36 ha - exempt the large wildfire described below.

Wildfire of the Pentadaktylos Range: In 1995 the island of Cyprus experienced the second worst wildfire since 1886. The worst fire occurred in July 1974 burning an area of 21,600 ha but the anomalous political conditions at that year could have been a good explanation.

The fire broke out on Tuesday, 27 June 1995, around noon at Palaiosofo village of the Pentadaktylos range (Fig.1).The area is inaccessible to Cyprus government. In other words, the Cyprus government was unable to undertake the fighting task which has been undertaken by the Turkish Cypriot side and troops from the mainland of Turkey.

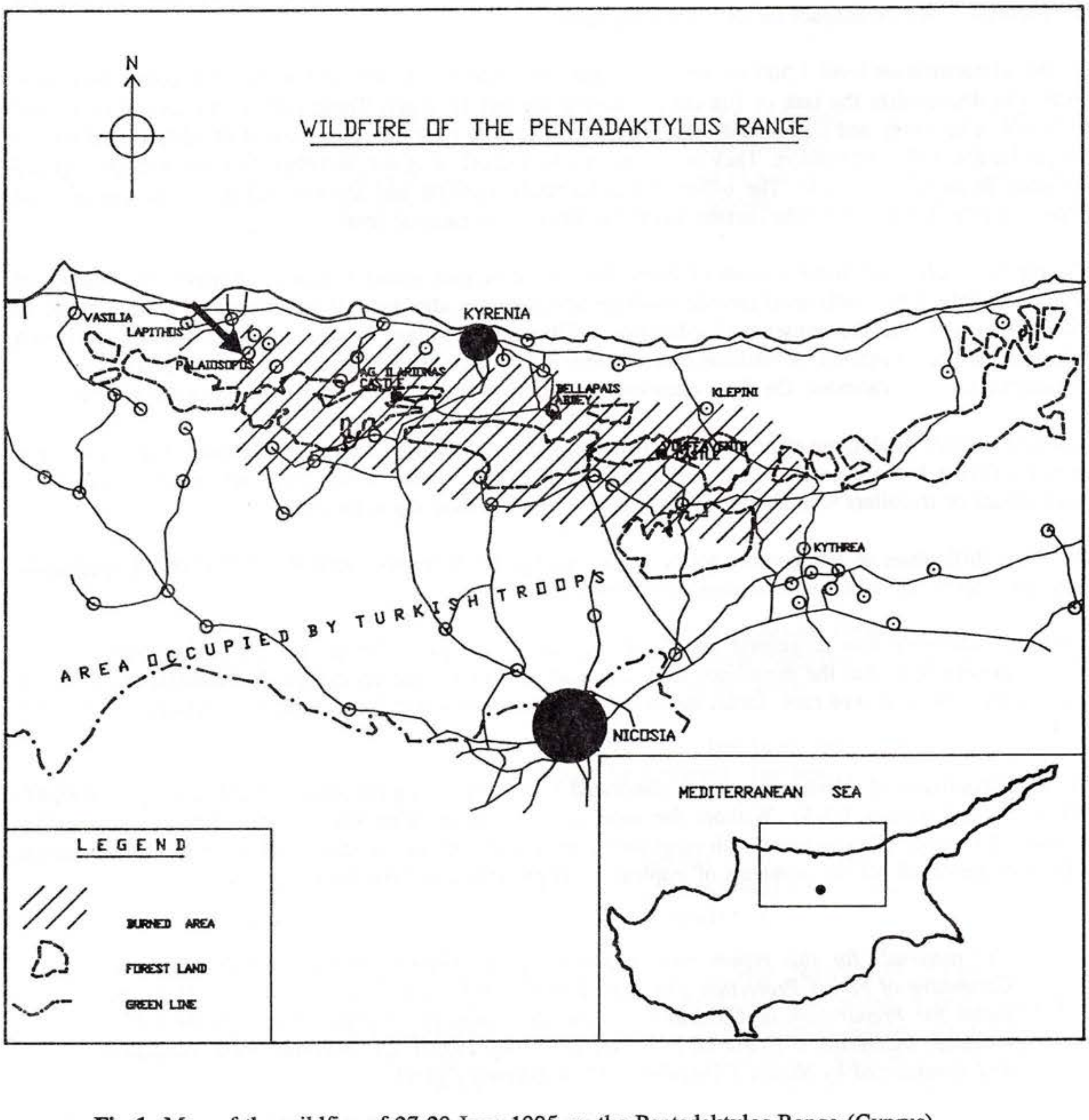

Fig.1. Map of the wildfire of 27-29 June 1995 on the Pentadaktylos Range (Cyprus)

The adverse meteorological conditions on that day (strong winds up to 15 m/s) and the mountainous terrain coupled with the limited resources available to tackle the fire made the fire fighting task extremely difficult. The strong winds were responsible for developing serious spotting ahead of the main fire front resulting in a quick spread over a large area.

On Wednesday morning forces from the British sovereign bases in Cyprus (forty fire fighters, five fire engines and two helicopters) joined the efforts to fight the fire. Most importantly, however, their support included provision of technical assistance and coordination. The fire was under control on Thursday, 29 June 1995, around 14:00. Unfortunately figures concerning personnel and equipment mobilized are not known. The cause of fire is not known either.

The fire spread over the area of 12 villages burning approximately an area of 8-9,000 ha (figure below) including both forest and agricultural land. The resulting damage included 25 burned and 21 damaged houses. It was fortunate that there was not any life loss or severe injury.

The environmental impact of the fire and its impact on the standard of living for Cypriots are pretty obvious. A beautiful Mediterranean landscape has been transformed into a desert-like one, valuable forest resources have disappeared, the habitats of indigenous species have been affected, and there was extensive damage to archaeological sites and monuments, just to mention a few. But in such cases it is even possible that there must be inconceivable ecological impacts that can not be tackled. The major forest vegetation types included: Pine stands (*Pinus brutia*), Cypress stands (*Cupressus sempervirens*), Maquis (*Pistacia* spp., *Arbutus* spp., *Genista* spp.); and Garrique (*Sarcopoterium* spp., *Thymus* spp.).

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Tab.1. Decadal fire data of Cyprus between 1960 and 1994

	Decade 1960-69	Decade 1970-79	Decade 1980-89	Period 1990-94
Mean annual number of fires	40	31	21	19
Mean burned area per fire (ha)	14	10	8	3

FRANCE ***The 1995 Fire Summer: Summary and Lessons Learned***

Between 1 January and 15 September 1995 a total of 19,000 ha of forests, wildlands, *maquis* and *garrigue* on French territory were affected by fire. The Mediterranean Departments (provinces) suffered the most: 2,300 fires destroyed 10,330 ha of forest vegetation. This last number remains lower than the mean area burned annually during the last 15 years (31,000 ha) despite the fact that the summer of 1995 experienced days of extremely high fire risk in the portions of the country west of the Rhône river (Bas-Rhône and Languedoc-Rouissillon). In Corsica, however, the year was particularly favourable with only 815 fire starts burning a total of 2,430 ha.

Tab.1. Forest fire data for 1995 (up to 15 September) for the Mediterranean zone of France

Départements and Regions	Number of Fires	Area Burned (ha)
Alpes-de-Haute-Provence	44	
Hautes-Alpes	12	206
Alpes-Maritimes	238	27
Bouches-du-Rhône	171	739
Var	264	1794
Vaucluse	66	495
Total Provence-Alpes-Côte-d'Azur	**795**	49
		3,310
Aude	75	
Gard	100	527
Hérault	84	463
Lozère	79	343
Pyrénées-Orientales	84	350
Total Languedoc-Roussillon	**422**	1,814
		3,497
Ardèche	218	
Drôme	25	1,051
Total Rhône-Alpes	**243**	44
		1,095
TOTAL CONTINENT	**1460**	**7,902**
Corse-du-Sud	303	
Haute Corse	515	167
		2268
TOTAL CORSICA	**818**	**2,435**
GRAND TOTAL	**2,278**	**10,337**

Tab.2. Forest fires in the non-Mediterranean zone of France in 1995 (provisional data of 30 September 1995). Source: Ministry of Agriculture and Sécurité Civile.

Region	Number of Fires	Area Burned (ha)	Number of Fires > 100 ha
Eastern Zone (Alsace, Bourgogne, Champagne-Ardennes, Franche-Comté, Lorraine)	625	645	0
Central regions and Ile-de-France	238	1004	1
Western Zone (Basse-Normandie, Bretagne, Pays-de-la-Loire)	366	118	0
Southeastern Zone (Auvergne and Rhône-Alpes without Ardèche and Drôme)	539	303	0
Southwestern Zone (Aquitaine, Limousin, Midi-Pyrénées, Poitou-Charentes)	2,930	6377	7
TOTAL (without the Mediterranean zone and the North)	**4,698**	**8447**	**8**

A detailed analysis of fires in the Mediterranean zone shows that:

- the total number of fires is still very high: 2,300 fires correspond to the 15-years average;

- the surface burned was restricted to 10,330 ha out of which only half burned during the summer;

- 95% of the fires were under control before reaching 5 ha size;

- 27 large fires (> 100 ha) were recorded.

Thus, France is gaining the benefits from a policy which has been followed with remarkable continuity for years as much by the Ministry of Agriculture, Fisheries and Food as by the Ministry of the Interior, and always in partnership with the territorial administrations. In particular the strategy of fire surveillance and rapid intervention which builds on equipment available in the forest areas and the mobilization of ground-based and aerial means of fire prevention, shows its efficiency.

The creation and maintenance of agricultural clearings and forms of agroforestry hold an essential place among the management activities for areas at risk. Within the framework of the agri-environmental decree no. 207/92, the State is providing a total budget of 14.25 million francs (FF) a year over a period of 5 years, which is supplemented by the European Union, for promoting improvements to some 50,000 ha of land by farmers, based on an appropriate scales of charges. The farmers are thereby required, through compensatory payments of from 200 FF/ha/year (according to how rigorous are the obligations called for in the local agreements), to carry out work using traditional methods on cultivated land (olive groves, vineyards) or modern grazing techniques (clearings, chestnut and cork oak stands). These basic operations may be supported by suitable types of more intense intervention, such as brush clearance or grazing. One required result is the clearance of the parcel of land of its combustible vegetation by the middle of June, the date that coincides with the period of high fire risk.

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GREECE — *The 1995 Forest Fire Season*

1995 was a better than average year, with respect to forest fires, for Greece. At the end of October, with the fire season practically over due to heavy rains, a total of 1572 forest fires had been reported. The area burned was 25,186 hectares which is approximately half the area burned for each of the three previous years (Fig.1 and 2).

In spite of the good overall results, one large fire at the mountain of Penteli, in Attica, a distance of a few kilometres NE of Athens, burned 6,500 hectares in three days (21-24 July 1995) and created, both nationally and internationally, the impression of a catastrophic fire season. A short description of the evolution of this fire follows.

The Fire on Penteli Mountain

The fire started around 08:00 on 21 July, in a thick Aleppo Pine (*Pinus halepensis*) forest, under an unusually strong northerly wind with gusts reaching 75 km/hr. This wind had started blowing on the previous day and continued at this strength throughout the first two days of the fire. An extreme fire danger warning had been

issued on 19 July for the next four days. Three other fires, at short distances from Penteli mountain, that erupted in the sixteen hours preceding the Penteli fire, were controlled successfully in spite of the adverse conditions. However, they drained resources from Penteli for their suppression and mop-up. These efforts were still in progress at the time the large fire started.

The fire on Penteli mountain started next to a road with quite heavy traffic and was reported immediately, through mobile phone, by drivers who stopped and tried unsuccessfully to extinguish it. It accelerated quickly and in a very short time developed into a crown fire exhibiting extreme fire behaviour including medium and long range spotting. The ground forces dispatched to the fire were unable to control it. The aerial means (amphibian Canadair CL-215 airtankers and CHINOOK CH-47D helicopters with bambi-buckets [7 m^3]) that were already operating on two of the other fires in the area were diverted immediately to this fire but were unable to perform efficiently due to extreme wind-caused turbulences.

The fire soon reached an extensive urban-wildland interface area where a number of villages and individual homes were close to or even within the thick Aleppo pine forest. A gigantic effort started at that time to save people and homes while trying to control the fire at the same time. The main fire front was controlled by the evening of 21 July. More than 2000 ha had burned by that time. Subsequent runs on the flanks, as the wind shifted direction and efforts concentrated on saving homes and lives, gradually increased the burned area to its final size.

More than ninety fire trucks of the Forest Service and the Municipal Fire Service were dispatched to this fire. Some of them were sent from areas at distances exceeding 500 km from Athens. Approximately forty tanker-trucks belonging to the municipalities were used for the supply of the fire trucks with water. More than 1150 fire fighters and 1400 soldiers were also involved. They were supported by a large number of volunteers.

Nearly all the heavy aerial fire fighting means of the country were involved in the suppression efforts. Nine CL-215 amphibian water bombers, one MAFFS equipped C-130 air tanker and two CHINOOK CH-47D helicopters were used for class A foam, fire retardant and water drops respectively, while two BELL UH-1H "Huey" helicopters were used for reconnaissance and coordination. This fleet was augmented, after the first day, by two Canadair CL-415 water bombers that were sent by the Italian government and one FOKKER-27 airtanker plus one BE-20 lead-plane sent by the French government in a highly appreciated move of international cooperation in disaster management. A fleet of six helicopters sent by the government of Germany arrived on the third day of the fire and was dispatched to support fire fighting efforts in another significant fire close to Patras, in Peloponese, which finally burned approximately 1000 ha.

The fire of Penteli, burned a total of 105 buildings. Few of them were high quality houses built with reinforced concrete frame, clay-tile roofs etc. Most of the structures that were destroyed were out-houses, mobile homes, small temporary buildings, farm-barns etc. made of flammable materials. In spite of the extreme conditions, no lives were lost which should be credited to the effective coordination of the fire fighting forces and the police.

The ecological destruction was heavy, given the significance of the mountain of Penteli for the environment of Athens. A series of actions was started immediately by the Forest Service in an effort to prevent further degradation and erosion problems. Grazing is not allowed to protect natural regeneration. 800 ha that had recently burned again and are not expected to regenerate naturally are being planted with a variety of mainly broadleaf species adapted to the environmental conditions, in an effort to avoid establishment of a new Aleppo pine monoculture that will lead to similar problems in the future. On steep slopes where the possibility of extreme erosion in case of heavy rain causes a fear of serious flooding, the trunks of burned pines are cut and laid on the ground parallel to the contours, tied with wire to the tall stumps left on the site. They are expected to function as dams reducing the eroding force of water. Many kilometres of rows of such "dams" have already been constructed.

An overview of the fire season

As mentioned above, the 1995 fire season was a better than average one. The effectiveness of the fire suppression mechanism, as judged by the mean burned area per fire, was the best since 1976 (Fig.3). This can

be attributed to some extent to not-so-severe overall weather conditions. However, the quick suppression of many potentially disastrous fires is evidence of the improvements that took place in the fire fighting organization. The most important changes were:

a. Improvements in the selection of the dispatchers at the Fire Fighting Coordination Centre and in the cooperation between them.
b. Improvements in the communications network of the fire fighting forces including preparation of two command vehicles with sophisticated communications capabilities.
c. Improvements in maintenance and performance of the country's fleet of 11 CL-215 amphibian water bombers, as well as addition of foam capability.
d. Improvements in the distribution of the bases of the fleet of aerial fire fighting means which included:
   Airplanes: 11 CL-215, 21 PZL-M18, 3 C-130/MAFFS.
   Helicopters: 4 CHINOOK CH-47D, 7 BELL UH-1H "HUEY"
e. Increase in the number of well-trained airborne fire fighters who are carried to the fire by helicopters, to a number of 500 for the whole country.
f. Training of 25 foresters on fire cause investigation through a specially designed course offered by specialists from the United States Forest Service.

It should also be mentioned that in 1995 there was no loss of life due to wildfires in sharp contrast with the previous few years. In the future, it is expected to improve on the results of 1995 through improvements in the organization of the forest fire suppression mechanism, stronger prevention efforts, better personnel training and increase in the available ground and aerial fire fighting means.

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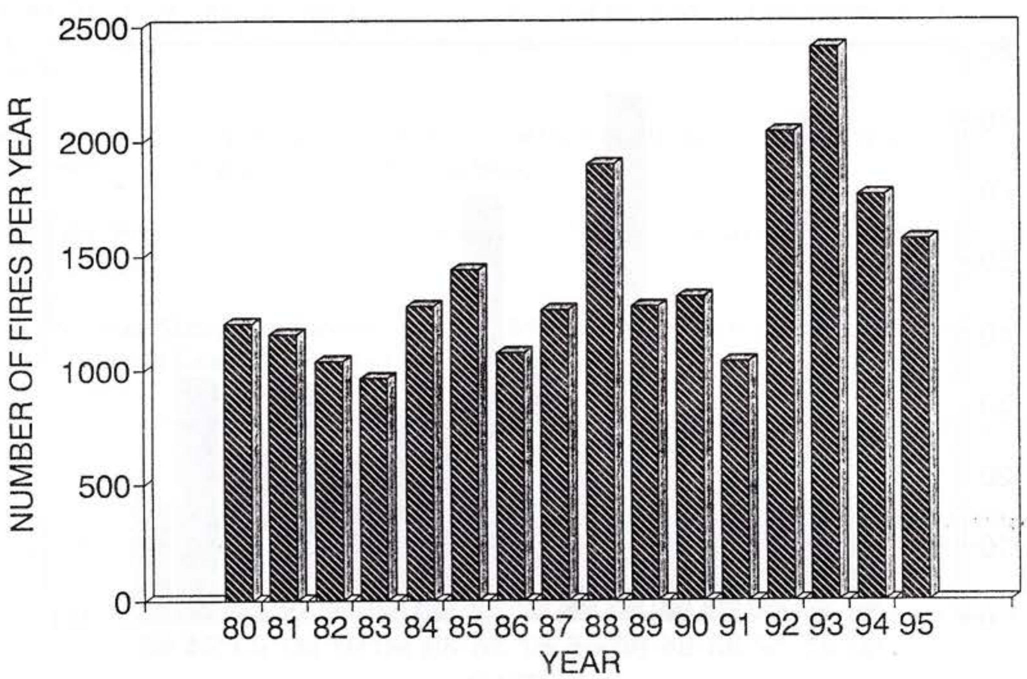

Fig.1. Number of forest fires in Greece in the period 1980-1995

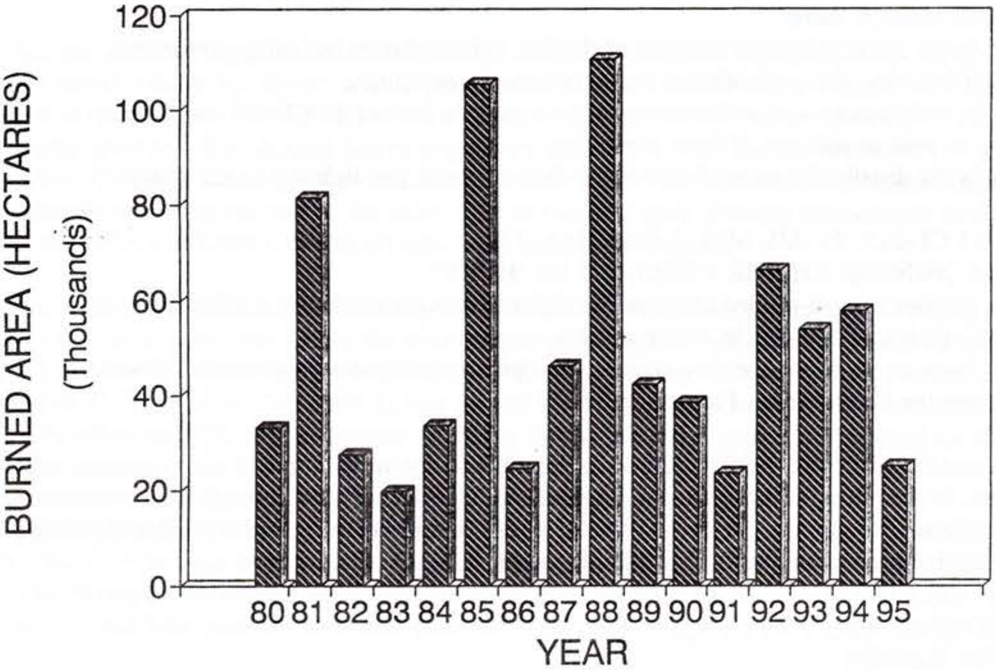

Fig.2. Burned area per year in Greece in the period 1980-1995

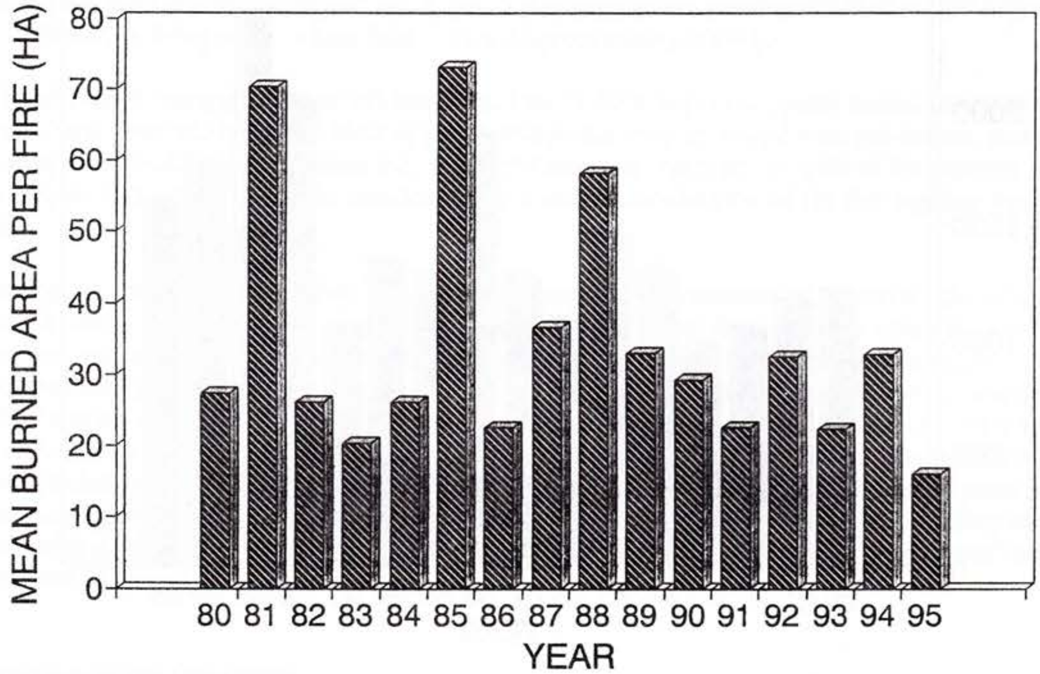

Fig.3. Mean burned area per fire in Greece in the period 1980-1995

INDONESIA

National Coordination Team on Land and Forest Fire Management

Background: Forest fires in Indonesia are increasing in frequency and area. The main factors responsible for this development are human activities, particularly in land clearing, and the recent changes in climate pattern. The main sources of forest and other wildland fires are:

- Land clearing by shifting cultivators and other local communities, categorised as non-institutional sources.

- Land clearing for timber estate plantations, transmigration sites and animal ranching, categorised as institutional sources. To cite an example, some 1,375,000 ha of lands are required for transmigration during the Sixth Five Year Plan (PELITA VI) for the period 1993-1998.

- Spontaneous causes spreading from burning coal seams, which are long-lasting sources of fire, by lightning and volcanic eruptions.

The occurrence of forest fires is closely related to the severity and duration of the dry season. This condition is closely correlated with the El Niño Phenomenon acting in the South Pacific.

Forest fires result in ecological and economic losses. At the ecological level, reduction in biological diversity and increase in erosion are two common impacts. Economic damage includes the loss of valuable timber and property. In 1991, damage in forest lands due to fire was estimated at Rp. 232,3 billion (US$ 103 million). This estimate does not include damage in estate plantation and timber estate areas and the products of community agricultural land in the surroundings of the forests.

Another important impact is the haze caused by the fire which in 1994 affected the regional economies of Kalimantan and Sumatra since it disrupted land, sea and air transportation. Several airports had to be temporarily closed down at that time, while the impact of the haze was felt also by several neighbouring countries.

Institutional Arrangements: Management and control of land and forest fire has become a concern for various related technical agencies. At the policy level, this concern is manifested in the issuance of decrees, which are, among others:

- Decree of the Minister of Forestry No. 260/Kep-II/1995 on Guidelines for Prevention and Control of Forest Fire, supplemented with the implementation guidelines;

- Decree of the Minister of Forestry No. 188/kpts-11/1995 on the Establishment of National Forest Fire Management Centre;

- Decree of the State Minister of Environment No. 18/MENLH/3/1995 on the Establishment of the National Coordination Team on Land Fire Management;

- Decree of the Direcor General of Estate Crops. No. 38/KB.110/DJ.BUN/05.95 on Technical Guidelines for Land Clearance Without Burning to Develop Plantations;

- Circular Letter of the Directorate General of the Environment and Settlement No. SE 256/PL/1995 on Land Preparation in fiscal year 1995/1996.

To develop and strengthen the existing coordination, a Presidential Decree is being prepared to establish the "National Coordinating Body" on Management of Land and Forest Fire.

Programmes: To prevent and manage fire that may occur during the dry season of 1995 and the coming years, the following programmes have been undertaken or are being developed:

- Prevention of fire in alang-alang grasslands; management and utilization of these through tree planting.

- Increasing awareness and alertness of forest-dwelling communities and farmers on the dangers of using fire for land clearing in agriculture, through printed and electronic media.

- Guidance for traditional communities in permanent agriculture systems through extension services and mass media.

- Fire control management by sectors involved in land clearing, through:
    - Minimising haze during burning to be contained in the EIA document.
    - Provision of fire control activities in the work contract.
    - Providing incentives for utilisation of waste wood, particularly for chip and pulp mills.

- Establishment of information and communication satellite network among agencies with responsibilities in fire management at the national level (Ministry of Forestry, BAPEDAL, and other related institutions) and at the regional level, to be supplemented with interpreter sources from the Meteorological and Geophysics Agency. In addition a reporting system from the field, using radio, will be continued and developed.

The following measures, among others, have been implemented or are being prepared in the field of fire management:

- International Workshop on Long-Term Integrated Forest Fire Management (17-18 June 1992, Bandung), attended by all related agencies and several donor countries and international organizations (see report in IFFN, January 1993 issue).
- National Alert Assembly held on 1 June 1995 at Subanjariji, South Sumatera.

- Training for core fire control team and development of training centres. In 1994, 57 instructors and 314 specialists were trained and then sent to fire-prone areas to train other personnel.

- Establishment of monitoring tower network in forests vulnerable to fire and formation of fire control team with equipment adapted to the field situation in all forest concession and timber estate areas.

- Development of training centres.

- Procurement of communications equipment that can cover all areas of Indonesia so that an early fire warning can be sent from the site to the Central Forest Fire Control Commanding. The code name of this service is Manggala 100, Jakarta.

- Since 1995, land clearing for transmigration settlement is done without employing fire.

Responsible agencies are:

Secretariat, National Coordination Team
on Land and Forest Fire Management
Deputy II BAPEDAL
Arthaloka Bld, 6th floor
Jl. Sudirman No. 2
Jakarta

Director of Forest Protection
Ministry of Forestry
Jl. Ir. Juanda 100
Bogor

The Orangutan is one of the species endangered by fire - and therefore the national Indonesian logo for fire prevention

Integrated Forest Fire Management Project in East Kalimantan

The "**Integrated Forest Fire Management Project**" is a bilateral technical cooperation project between the governments of Indonesia and Germany. The project is administered by the Ministry of Forestry (MoF) of Indonesia through the forest authorities in the Province of East Kalimantan (Kanwil and Dinas Kehutanan) and assisted by the German Agency for Technical Cooperation (GTZ). It is scheduled for a period of six years. The first three-year pilot-phase began in April 1994. The second three-year phase as well as a financial grant will be negotiated in 1996 and executed in 1997.

The Forest Fire Problem in Borneo: For more than two decades the island of Borneo has had a serious forest fire problem. In 1982/83 the largest forest fire of the century burned for several months through Kalimantan and Malaysia, affecting more than 5 million ha of forests. In 1987, 1991 and 1994 forest fires covered Indonesia and the neighbouring countries of Malaysia and Singapore with smoky haze. Most fires are caused by or related to human activities:

- The removal of primary forest and the dryer residual secondary vegetation make the forest area more prone to fire.

- Fire ignited by farmers using traditional slash and burn agriculture methods escape control due to lack of knowledge of fire control methods.

- Agricultural use and forestry plantations have left the forest areas more susceptible to fires.

- Increase of Alang-Alang grass (*Imperata cylindrica*) in disturbed areas raises fire susceptibility.

Some natural factors have a strong influence on fire risk:

- Normally, Kalimantan has a low-precipitation period from July to October. Every five to six years, drought periods occur as a result of an El Niño Southern Oscillation (ENSO) event.

- East Kalimantan has coal seams, that reach the surface in the forest regions. They are concentrated in the area of **Bukit Soeharto** National Park. Some of the coal seams have been burning for many years, and others since the last major fires. Many of the coal seam fires cannot be extinguished using practical methods but will require continued monitoring to prevent them from igniting the surrounding forest.

Consequences of Forest Fires: Apart from the ecological damage which is very significant but difficult to quantify, the economic loss is considerable. It is estimated that damage of more than US$ 50 million a year occur to the forest plus a loss of 2 million m^3 of timber. Additionally, the smoke adversely affects health and impedes aircraft movement and shipping throughout Southeast Asia.

History of the IFFM Project: Following the 1991 forest fires and an extended smog situation all over SE Asia, the Federal Republic of Germany responded to a request for assistance by the Indonesian government. In June 1992 the National Planning Agency of Indonesia (Bappenas), assisted by the Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ), held an **International Workshop on Long-Term Integrated Forest Fire Management** in Bandung (more details about the Bandung Workshop: see January 1993 issue of IFFN). At this workshop, the core problem identified was that no sufficiently developed fire management system existed in Indonesia. A national Long-term Integrated Forest Fire Management System (IFFM) was proposed. The IFFM project, based on this workshop, began in 1994. It is a pilot project situated in the Bukit Soeharto area of East Kalimantan.

Integrated Fire Management is based on prevention, detection/pre-suppression, suppression, and application of prescribed or controlled burning. Uncontrolled wildfires are reduced by launching prevention campaigns for the public, rural villages and logging areas. Fire prevention also includes incentives and enforceable laws. In the project area fires are not only detected by observation towers manned during the high risk seasons and by mobile fire patrols. Additionally, a satellite receiving station will be established in Samarinda in 1996; it will show "hot spots" on a map covering all of the East Kalimantan Province.

Pre-suppression measures embrace infrastructure, logistics and preparedness in the event of a fire incident (e.g. maps, water supply stations, trained fire fighting units, etc.). Suppression is all of the activities used to extinguish or limit unwanted fire. Training will be furnished for government personnel as well as village volunteers. Controlled burning techniques will be introduced to reduce the escape of agricultural fires. Rural people frequently use fire in their agricultural activities. When uncontrolled, these fires can spread into and damage vast areas of lands. Controlled burning techniques include firebreak establishment, prescribed fires, and trained fire fighters who can control the spread of fires.

IFFM Objectives and Results: The main objective is to establish an operational Integrated Fire Management System in the pilot region. The expected results are:

- The necessary infrastructure for the IFFM system is operative.
- An operative organization for the implementation of the IFFM system is implemented with participation by local government and PUSDAL (Provincial emergency committee).
- The fire management centre personnel, the advisory services and the mobile fire management teams are in a position to carry out their task.
- Within and around the Bukit-Soeharto region, the local populations, companies, and contractors cooperate with the IFFM system
- Post-phase I IFFM activities in East-Kalimantan are prepared.
- The internal project management is operational.
- The mechanisms of dialogue among participating organisations are established.

Implementation of IFFM: IFFM is an Indonesian project with outside assistance. IFFM will be integrated into the Indonesian administrative system, aimed at developing a sustainable fire management organisation in cooperation with Kanwil and Dinas Kehutanan in East Kalimantan. The executing agency (field level) is Dinas, and the lead counterpart agency for GTZ is the Ministry of Forestry, Directorate of Forest Protection and Nature Conservation, represented by Kanwil Kehutanan at the Provincial level. The people living in and around the park will be integrated into the IFFM system. The project also seeks close cooperation with other related projects (ITTO, FAO, GTZ and EU).

The Provincial Fire Management Center is located in Samarinda, with a district fire management office in the Bukit-Soeharto area. Four additional district fire management centres will be set up in Phase II (1997-2000). They will serve as an example for all of East Kalimantan as well as other forest fire prone areas throughout Indonesia.

Integrated Forest Fire Management Project (IFFM/GTZ)
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SENEGAL *Bushfire Monitoring and Management*

Background: Senegal is a coastal country lying on the westernmost point of Africa. The country has a surface area of approximately 197,000 km^2 and is covered by vegetation of variable density increasing from North to South from arid steppe to forest with transitional savannas in between. Every year, much of Senegal is affected by bush fires, which have a considerable impact on the development of the vegetation. The burning season starts in November at the end of the rains and extends until May. The timing of fires coincides with the ***Harmattan*** winds, which carry hot, dry continental air from the Sahara desert and which dry out the herbaceous vegetation layer, thereby supplying a ready source of fuel.

The monitoring of fires by remote sensing has been carried out by the **Centre de Suivi Ecologique (CSE)** since 1990. The principal aim of this activity is to assist the Direction des Eaux, Forêts, Chasse et Conservation (DEFCCS) of the Senegalese government with the identification and management of bush fires.

Methodology

Data: CSE carries out satellite monitoring of bush fires using NOAA-AVHRR imagery. This is received on average twice daily by the CSE's receiving station, installed in 1992. Prior to 1992, images were obtained from the AVHRR receiving station at Maspalomas (Canary Islands) with an average delay of two weeks from acquisition to delivery at CSE. This delay made CSE's job of real time fire monitoring virtually impossible, and thus until recently CSE was unable to alert government authorities concerned with controlling and extinguishing active fires.

The raw images received at CSE are geometrically corrected and mapped to a UTM projection. The correction modules, which apply orbital parameters obtained from the satellite, are integrated in the mapping routines of CHIPS, an image processing software package developed by the University of Copenhagen in collaboration with CSE.

Classification: Classification is undertaken by applying a threshold to channel 3 (thermal infrared) on night images to identify active fires. The threshold capitalizes on the thermal contrast between active fires and unburned or recently burned surfaces. In general, the greatly decreased incidence of solar radiation at night time minimizes the risk of confusing grey body surfaces (that is, surfaces which behave almost like black body emitters) with burned areas having spectral characteristics similar to that of laterites.

Daytime images are then utilised to estimate the burned surface area. These images are converted to false colour composites with channels 1 (visible), 2 (near infrared), and 3 (thermal infrared) assigned to the red, blue and green image plans respectively. These false colour images allow on-screen identification of burned areas, which are then sampled for their radiometric characteristics. The image samples, or training sites, are used in a supervised classification employing the Box class method and the surface area is subsequently calculated by counting pixels classified as burned in the resultant images.

Verification: CSE regularly carries out field verifications of these classifications. This is necessary because of the difficulties inherent in mapping burn scars in areas where tree cover often prohibits direct view of burned surfaces from space. Verification is done with the assistance of Global Positioning System (GPS) receivers, which permit the exact location of burned areas to be identified and related to the satellite images mapped in UTM. In addition aerial statistics are derived after a correction factor of 0.8 has been applied to the original estimates. This correction factor takes account of the coarse resolution (1.1 km at nadir view angles) of the AVHRR sensor and the fact that the AVHRR tends to over estimate (by about 20%) the amount of burned area.

Operational Monitoring: Bush fire classifications are done almost daily during the burning season. This results in the production of daily maps in A4 format, with exact positions of fires given by administrative units (arrondissements), which are then transmitted directly to DEFCCS. In addition, monthly and annual maps are produced that reveal the full extent of burning over these longer time periods. These images are incorporated into Geographic Information System (GIS) software (usually either Idrisi or Arc/INFO) to facilitate further cartographic enhancements and analysis of results.

Summary of Results in 1993/94

The results of the analysis of 1993/94 images reveal that approximately 750,000 ha were burned and 1,677 fires were identified among all the arrondissements of Senegal. Bush fires were most extensive in terms of burned area during the three month period of December-February, with a pronounced peak during February. During the next trimester (March-May) the number and the extent of fires diminished probably due to the low herbaceous cover at the end of the dry season. However, these late dry season statistics may include certain extreme fire events which can result from ignition of highly inflammable herbaceous material.

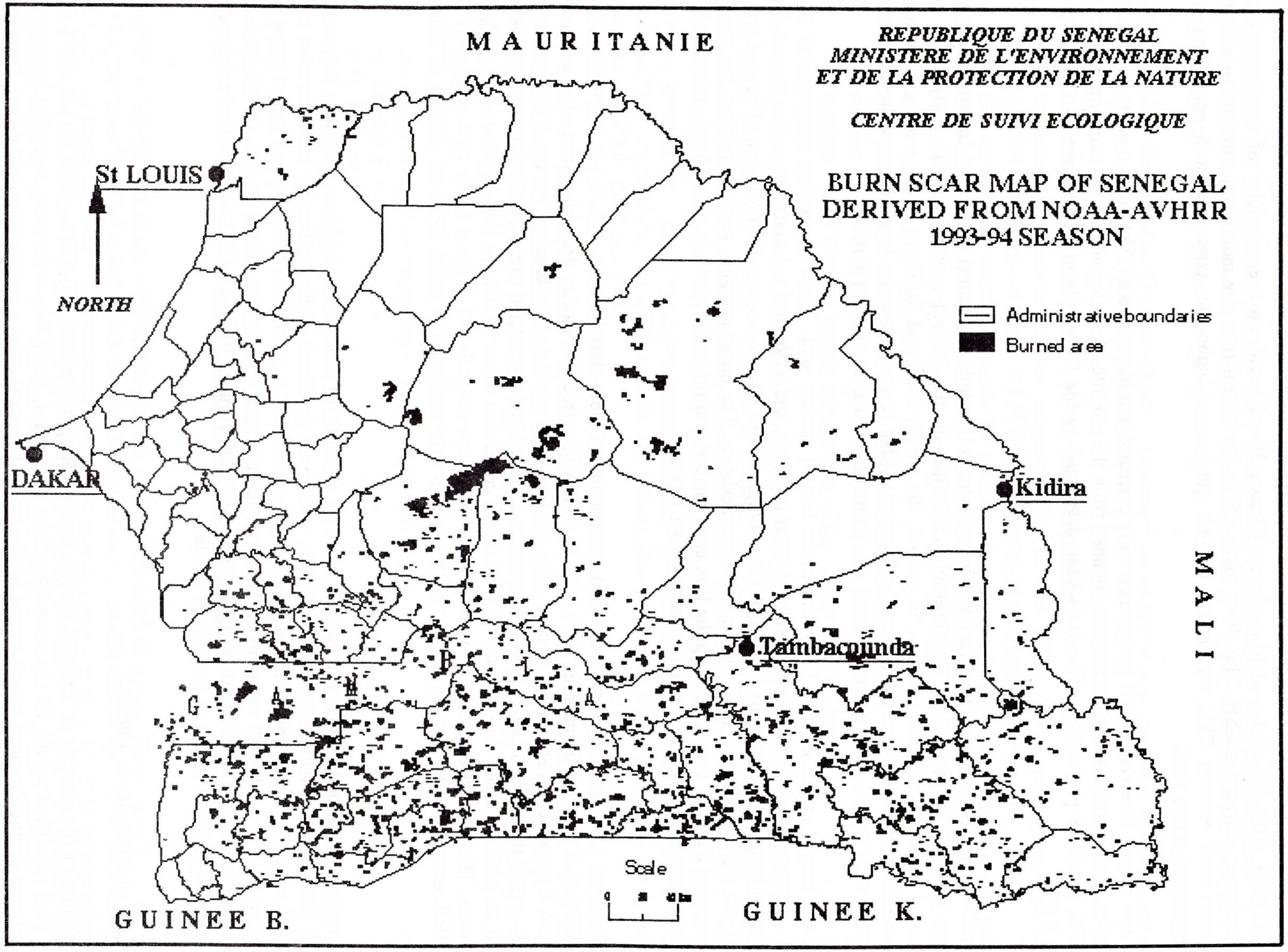

Fig.1. Burn scar map of Senegal for the 1993-94 fire season derived from NOAA AVHRR imageries.

The annual fire map on the previous page shows the predominance of bush fires in the southern part of the country, where fires were highly dispersed yet prevalent. In this zone, vegetation production, as measured by CSE's vegetation monitoring unit, reaches an annual rate of approximately 4,000 kg of dry matter per hectare. These areas tend to be dominated by *Combretum* spp., which are less extensive toward the south-west, where the more humid sub-Guinean climate regime along with well-conserved dense forests probably retard fire development.

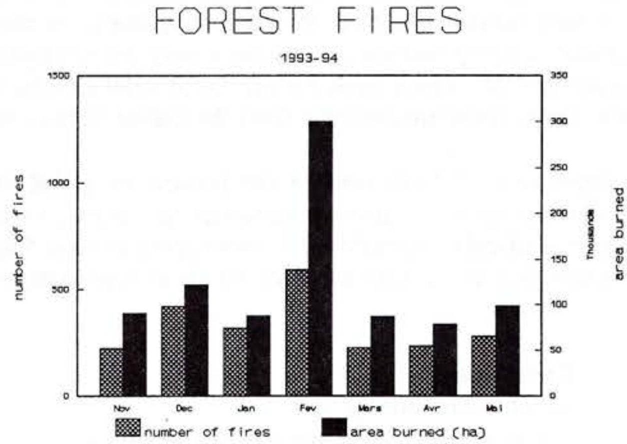

Fig.1. Wildfire statistics 1993-94

The northern portion of the country had fewer instances of bush fires, although the areas burned tended to be more continuous. This region is part of the Sahelo-Sudanian zone, characterised by high production of grasses such as *Eragrostis tremulata* and *Schoenefeldia gracilis* during wet years. In these areas, fires spread extensively across the continuous herbaceous layer, where there are generally few fire breaks. In such zones, the surface area of burns sometimes exceeded 50,000 hectares. Moreover, the passage of fire is considered an adverse impact on the so-called "sylvo-pastoral" zones, where grazing is the primary occupation and land use. In particular, fire lessens the pasturage and subsequently leads to longer distance movements of herds and humans in search of forage, a system which is known widely as transhumance.

The cluster of isolated fires at the extreme north of the map corresponds to the burning of sugar cane fields, conducted by the Senegalese Sugar Company to stimulate further production. These are the so-called "feux de la canne".

Application of the Results

Intervention Strategies: The bush fire monitoring is carried out by CSE as a service to the DEFCCS to help them to better manage bush fires. Products are supplied in accordance with protocols agreed between CSE and DEFCCS, which ensure timely delivery and certain standards of cartographic products and statistical indicators. However the means for dealing with fires on the ground after information has been transmitted by CSE are still somewhat limited. This serious handicap has led in the past few years to a change in strategy concerning the fighting of bush fires, which now emphasizes raising the awareness of local populations. Numerous village fire committees have been created across Senegal and have been given light equipment to limit and stop the spread of bush fires.

In this context, the cartographic information remains extremely important given its role in planning interventions and impact assessment in affected zones. Overall, it serves as a means for taking decisions towards better coordinated actions at national level. Moreover, the use of remote sensing for bush fire detection has reversed traditional monitoring schemes by enabling information to flow from CSE to the field.

Sub-regional Cooperation: The Republic of Guinea contains within its territory the upper basins of the Senegal and Gambia Rivers as well as a portion of the Niger River. To the extent that fire threatens the ecological balance of the basin areas, these basins and the role of fire in them are important in the regional context.

With the support of the Swiss development cooperation agency (Cooperation Suisse), CSE is currently leading a trial programme with the Direction des Forêts et Faune of Guinea aimed at raising awareness of the problems posed by bush fires. Information on fire dynamics gathered by CSE's AVHRR fire monitoring activity is transmitted by radio in rural areas in order to alert local populations to the urgency of the problem and the need to control it. It is expected that the impact of these radio campaigns in certain test areas will determine whether the approach is feasible elsewhere.

Global Change: The results of the satellite monitoring of bush fires in Senegal and Gambia during the 1991/92 season have served as a base for calculating the contribution of bush fires to the greenhouse effect. The determination of burned biomass has been made by overlaying fire maps with those of the biomass production produced by CSE, which totals the amount of vegetation biomass available from the previous growing season. Copies of this study are available from the United Nations Environment Programme [1].

The importance of bush fires in the process of global change merits the establishment of sub-regional cooperative programmes involving institutions that monitor and measure the phenomenon of bush fires. CSE already has extensive experience in monitoring of bush fires and vegetation production and could bring its expertise to bear on such an initiative, which will ultimately reinforce programmes directed at the global level.

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SOUTH AFRICA ***Bushfire Causes Chemical Fire Inferno***

The African Explosives and Chemical Industries (AECI) factory, one of South Africa's major chemical companies, is located just SW of Somerset West, and about 40 minutes driving from Cape Town. West of this factory the community of Macassar is situated, one of a string of settlements, scattered all over the Cape flats on the way to the centre of Cape Town city, but most important, directly in the path of the dominant SE winds that normally prevail in this area during the summer months.

Saturday 17 December 1995 was no exception, and a strong SE wind came howling from the Hottentot Hollands' Mountains, over the AECI factory. The landscape is mainly covered by **fynbos** (a macchia-type vegetation), with a strong *Acacia longifolia* component.

There is no evidence how the bushfire started, but the fire had been raging in the area close to AECI for a number of days; and there may even have been a number of fires, as this time of the year arson is common on the Cape flats. However, with no direct evidence regarding the cause of the fire at this stage, the fire actually jumped over the fence between the open bushland and a heap of sulphur of 15,000 tons. At ca. 19:30 hrs the sulphur heap caught fire. A large smoke plume containing toxic sulphur compounds was driven by the SE wind to the area in the northeast of the sulphur storage compound.

The fire raged over an area of half a football field, and bulldozers, fire trucks and two Oryx helicopters from the South African Air Force were rushed to the site, attempting to contain the fire which was finally extinguished the next day.

Chaos erupted that Saturday night when inhabitants of neighbouring communities, particularly Deepfreeze and Brandwag which are located only 1 km away from the fire site, were overwhelmed by the fumes. At that time of night many people were already in bed. Approximately 2500 people had to be evacuated from the area in a hurry, in all sorts of possible means of transport, and by 03:30 hrs the next morning there were still 500 patients in the trauma unit of the closest hospital while two persons had died due to sever respiratory problems. Police teams equipped with gas masks had to transport hundreds of people to hospital for treatment, and even inhabitants of communities as far as Stellenbosch, Somerset West and Kuils River had burning throats and eyes.

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[1] *Inventaire des sources d'émission des gaz à effet de serre au Sénégal.* Ministère de l'Environnement et de la Protection de la Nature. 1994.

There is a possibility that agricultural crops might be affected seriously as well, as crumbling of leaves has been noted immediately after the fire. Obviously this could give rise to all sorts of aftermath complications, although life had basically returned to normal by late Sunday.

The two Oryx helicopters did an excellent job with their buckets, delivering 447,000 litres of water during seven hours of flying, contributing significantly to the success of containing the fire and eventually putting it out; by 13:00 hrs on Sunday 18 December the fire was completely under control.

AECI has admitted that fire protection was inadequate, and an independent court of enquiry has been requested to investigate the unfortunate happening. The company has already promised to handle any claims in connection with fire losses favourably.

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du Toit Street 16
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SOUTH AFRICA
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SPAIN *Forest Fires in 1995*

Two main facts made the year 1995 a relaxing time for us after the awful 1994 fire season.

- First: The burned surface decreased from the 1.4% of the national forest surface in 1994 to only 0.4% in 1995. Table 1 shows the figures up to the end of September in comparison with the previous five years.

- Second: Forest fires (and the people concerned like us) were no news for the media. Only 13 fires burned over 500 ha, the largest being the Sierra Cardó Fire (Tarragona) with 4,638 ha, mostly brushland. Remaining out of the field of interest of the media was really comfortable.

Weather in 1995 supported all predictions of high fire risk. The long-lasting drought went on over two thirds of the country, creating huge difficulties for agricultural crops, for the water supply in urban areas and for forest plantations. All planting activities were nearly discontinued because of the lack of water in the soil. Then most resources were transferred to preventive silviculture. However, in many places it was not possible to burn forest debris for reducing the fire hazard.

The lack of rainfall had a positive influence to decrease that hazard, because of reduced growth of new grass in the grazing lands. Thus, the shepherds were not interested in grass burning, and the livestock contributed to decrease the hazard by intense browsing of bushes and trees.

Although there was no rainfall, another source of humidity kept the fine dead fuels at a high moisture level. Winds were blowing mainly from the Mediterranean Sea (the opposite direction as compared to 1994). Consequently the Eastern regions suffered less lightning storms than in 1994, and the fuels were not ready to burn. These Eastern winds shifted the risk to the Western regions of the Iberian Peninsula. In Galicia (Northwest) 14,381 fires burned 41,799 ha in April and August. At the same time Portugal (also in the West of the Peninsula) registered 30,175 fires and 125,328 ha burned. During the April fire season three crew men got trapped by a sudden rekindling of a brush fire in the province of Leon, quite close to Galicia. This fire, like most in the Northwest, started like a brush clearing, gathering momentum in the large fuel accumulations that cover many abandoned rural areas.

The activities against forest fires in 1995 had one main objective, to improve coordination among the different administrations concerned. A Coordinating Committee was established with the Ministry of Agriculture and the 17 Autonomous Regions in order to jointly develop and coordinate fire policies and fire management resources.

A plan for the whole country was approved by the Government establishing guidelines for the support with State resources for the suppression operations conducted by the Regions and for evacuations in the urban-forest interfaces. The Senate produced a first revision of its 1993 Report on Forest Fire Policies emphasizing coordination, training and prevention activities. A permanent course on Coordination for the Fire Directors was initiated. Another course on investigation of fire causes has been continued to train forest rangers and the police.

Three prevention campaigns started in June. A general purpose campaign by TV reached the whole population with dramatic pictures of the 1994 fires, showing at the same time the responsibilities of everyone. A campaign for rural people visited 100 villages performing a theatre play showing the tragic consequences of fires in the rural areas. More than 150,000 people watched the play in the main squares of their villages during the summer. Another fire prevention campaign in the schools is on the way, e.g. a National Contest, using table games, computer games, movies etc.

The main difficulties come from the earlier mentioned abandonment of rural areas, covered by huge fuel accumulations. In the next Action Plan (1996-1999) forest owners are demanding enough funding for preventive silviculture operations.

This year the State fleet of 13 Canadair CL-215 Turbo got again a level of availability of over 85% over the whole fire season. Two more aircraft are being transformed with the turboprop engines in a Spanish company. Five of the older CL-215 were given a major overhaul and worked together with the turbos. The CL-215 No. 1 which arrived in Spain in 1971 and is still in good condition for operation was given to the Museum of the Air (Madrid) because it is a historical piece of aeronautics and forest protection in Spain.

In 1995 we reached two anniversaries:

- 40 years (1956-95) since the establishment of the Forest Fire Service in the Ministry of Agriculture, and

- 25 years (1971-95) since the Forest Fire Service/Air Force Agreement for the CL-215 operation.

In this time we reached a main conclusion: forest fire is a permanent phenomenon. Strategies to control it have to consider the socio-economic constraints with the weather and vegetation conditions, integrating all silviculture techniques with other measures based on social sciences and advanced technology sciences and engineering.

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Tab.1. Area burned (ha) by wildfire in Spain between 1 January and 30 September 1995

	1991	1992	1993	1994	Average 1990-94	1995
No. of Fires <1 ha	5,256	8,337	8,947	10,007	8,143	14,877
No. of Fires >1 ha	6,907	7,022	4,735	7,567	6,558	8,413
Forested area burned	114,930	37,964	33,011	250,231	109,034	41,556
Brushland burned	137,115	59,691	54,861	182,766	108,608	80,835
Total area burned	252,045	97,655	87,872	432,997	217,642	122,391
No. of Fires >500 ha	79	16	26	92	53	13

NEWS FROM FIRE RESEARCH

IGBP Northern Eurasia Study
Prospectus for Integrated Global Change Research

Interest within the global change research community in Northern Eurasia (European Russia, Siberia, and the Far East of Russia) has grown dramatically in the last few years. It is a vast area about which very little is known. It is a region where temperature rise due to anthropogenic climate forcing is predicted to be the greatest, and where the consequent feedbacks to the atmosphere are potentially large. In addition, it is poised to undergo rapid economic development, which may lead to large and significant changes to its land cover. Much of this interest in Northern Eurasia, as in the high latitude regions in general, is centred on its role in the global carbon cycle, which is likely to change significantly under global change.

During two planning meetings in Sweden (Stockholm, 1994) and Japan (Tsukuba, 1995) a prospectus was developed for an integrated hydrological, atmospheric chemical, biogeochemical, and ecological global change study in the tundra/boreal region of Northern Eurasia. The preparation of the report on the **IGBP Northern Eurasia Study** is a joint effort of scientists representing several IGBP Core Projects, the Biospheric Aspects of the Hydrological Cycle (BAHC), International Global Atmospheric Chemistry (IGAC) and Global Change and Terrestrial Ecosystems (GCTE) projects.

The unifying theme of the IGBP Northern Eurasia Study is the terrestrial carbon cycle and its controlling factors, and the study's most important overall objective is to determine how these will change under the rapidly changing environmental conditions projected under global change. Two aspects of the study's overall objective are particularly important. First, understanding the interaction between ecosystem composition and ecosystem process is critical. Second, the overall objective demands a projection not just of net primary productivity or net ecosystem productivity but of "biome productivity", that is, net ecosystem productivity integrated over large spatial and temporal scales to account for such processes as successional dynamics and major disturbances such as fire, timber harvesting and insect outbreaks.

The IGBP Northern Eurasia study will consist of an integrated set of experimental and observational studies at a number of scales, modelling and aggregation activities, and supporting databases and GIS systems. The major elements are:

- North-south transect(s) in eastern Siberia (East Siberia/Far East) including sites in tundra, tundra-forest transition and in larch forest. This is a critical region for study; it has a marked continental climate, it contains a vast expanse of larch forest about which more needs to be known, and the potential for land-use change over the coming decades is high. The transect(s) will join others in Alaska, Canada and Scandinavia/northern Europe as part of the high latitude set of IGBP terrestrial transects.

- A network of sites throughout Northern Eurasia focusing on trace gas emissions and their controlling factors. The network will be concentrated on the extensive wetland in western Siberia but should include at least two or three other sites in wetland in the northern areas of European Russia and in eastern Siberia (including the area of continuous permafrost), one site in the coniferous evergreen forests, and one site in the tundra. Of particular importance is an apparent "hot spot" for gas emissions in the wetland at the southern edge of western Siberia.

- A water, energy and carbon flux study, integrated with the transect and network components. The design of this component requires further background research and modelling sensitivity studies before it is finalised, but its linkage, so far as possible, to the trace gas and ecological components will provide a powerful mechanism for integrating much of the work in the IGBP Northern Eurasia Study.

- Studies of disturbance regimes. The studies should include work on all major disturbances of Northern Eurasian ecosystems, such as timber harvesting and insect infestations, but particular emphasis will be placed on fire. They should include work on both gas emissions from fires, and on the ecological role of fire in influencing the successional dynamics of the boreal forests. An essential component is the development of a fire database which includes extent, frequency and controlling factors so that fire regimes under a changing environment can be predicted.

- Scaling up, modelling, integration. A wide variety of models will be used to help design the experimental and observational studies, interpret the data, and project the impacts of global change on high latitude systems into the future. These include ecosystem physiology and dynamics models at various scales, trace gas flux models, SVATS, landscape hydrological models, atmospheric transport models, biome-scale simulations of the carbon and hydrological cycles, and comparisons to paleo-climate and -vegetation studies. Scaling methodologies such as nested watershed studies and the boundary-layer averaging technique will be used, as appropriate, to scale up results of the process studies carried out at individual sites. Remote sensing, data assimilation and management and GIS technology are important methods that will be used in the study.

- Associated studies. The IGBP Northern Eurasia Study provides a framework for related global change research. Examples include global change impacts on managed forests, observational and modelling studies of land-use/cover change in the region, and research on global change and ecological complexity (biodiversity). The land use-cover change study, in particular, is crucial to long-term projections of change in the carbon cycle in the Northern Eurasian region, and should become a central element of the IGBP study in future. Taken together, the IGBP Northern Eurasia Study and associated studies will provide valuable information to assist the development of sustainable management strategies for Northern Eurasia, in addition to elucidating its role in the Earth system.

The IGBP Northern Eurasia Study will be implemented in a phased approach. Where there is already general agreement that research is required in a particular area, such as a north-south transect(s) in eastern Siberia, appropriate sites can be selected and long-term observational studies can be initiated as soon as practicable. Care should be taken, however, that sites selected are compatible with the requirements of more intensive studies that will be phased in later. This is a critical consideration, as the "whole system" approach recommended for this study requires that the various individual studies be carried out at the same sites, if at all possible.

Other components of the Study, such as the intensive measurements of water, energy, carbon and trace gas fluxes by eddy correlation or similar techniques, require preparatory (sensitivity) analyses before an experimental design can be finalised and work begun. Given the overall requirement for a general understanding of the composition/structure and physiology/productivity of Northern Eurasian ecosystems at a large scale, an early task is to survey the existing research that is being carried out in the region, analyse past work, and, where appropriate, retrieve and standardise data from this existing and past work.

There are already a large number of groups interested in various aspects of global change research in Northern Eurasia. As it does in other regions of the world, IGBP aims to collaborate so far as possible with these other groups to avoid unnecessary duplication, to enhance the scientific value of the work, and to maximise the efficiency of the use of resources. Of particular importance to the IGBP Northern Eurasia Study are GAME (GEWEX Asian Monsoon Experiment), which is planning observational and modelling studies of the hydrological cycle in the eastern Siberia, and two IIASA studies, one a comprehensive study of Siberian forests and the other a project on modelling land-use and land-cover changes in Europe and Northern Asia.

The production of this prospectus is the first step in the implementation of the IGBP Northern Eurasia Study. The next steps include: (i) an awareness campaign, to introduce the Study to global change scientists around the world, and particularly in Russia; (ii) sensitivity studies to refine the design of the study; (iii) a review of existing research and data in the Northern Eurasian region; (iv) the selection of sites for the transect(s) and the initiation of the long-term ecological studies, and (v) the establishment of a project office to coordinate the study. The latter is particularly important, as dedicated, professional staff are essential to coordinate such a large, multidisciplinary study.

The Fire component in the IGBP Northern Eurasia Study

Disturbances, most notably fire, insect outbreaks and direct human conversion or modification of land cover, play a critical role in the hydrology, atmospheric chemistry, biogeochemistry and ecology of the circumpolar boreal biomes. Fires in forests and peat lands impact the hydrological cycle through changes in rates of evaporation and run-off and represent a significant global source of active trace gases and aerosol to the

atmosphere. Fires in boreal Eurasia have a significant impact on the structure and composition of forests at stand and landscape levels, on formation and nutrient status of soils, on the formation of peat lands and permafrost, and on insect population dynamics. Dendrochronological and lake sediment analyses suggest that taiga forests have been influenced by fire since the mid-Holocene and therefore must be considered as an important natural phenomenon.

Assessments of present pyrogenic carbon and trace gas fluxes from Northern Eurasian ecosystems are based on fire data systematically collected on protected lands of the former USSR and today's Russian Forest Fund. First systematic evaluation of remotely sensed fire data indicate that the information collected by conventional means (ground and aerial fire and fire effects assessments) highly underestimate the total fire activity and consequently the quantity of pyrogenic emissions. The emissions data collected during the 1993 phase of the Fire Research Campaign Asia-North (FIRESCAN) reveal that boreal forest fires produce higher amounts of active trace gases (e.g. CO, CH_4) and ozone-depleting components like methyl bromide than fires in other vegetation types. The magnitude of pyrogenic formation of black carbon (chemically inert elemental carbon) in boreal fire ecosystems and its role as atmospheric carbon sink is largely unknown and must be explored with priority.

Scenarios of future fire regimes, developed on the base of Global Circulation Models (GCM), indicate that the successional state of the forests in much of Northern Eurasia may be determined by increasing fire frequencies and fire severity, and will therefore strongly influence the regional carbon cycle in the longer term. Thus, there is an urgent need to understand fire behaviour in the high latitudes. Fires in tundra, forest, and peat land biomes, especially production of trace gases and aerosol, are much less understood than burning processes in the tropics.

Design of the Fire Component

Fire-induced successional dynamics are a critical element in determining the productivity and carrying capacity of phytomass. Succession studies and measurements of plant biomass, carbon storage and fluxes made at point locations during relatively short time steps, must be scaled up over decades and over large regions containing ecosystems in various stages of succession. It is essential that the extent and frequency of fires under changing environmental conditions and management scenarios be predicted, based on data of present-day fire regimes and their relationship to climate and biomass.

The fire component of the IGBP Northern Eurasia Study will have four parts: (i) fire manipulations at individual forest sites; (ii) a series of campaigns based on air- and spaceborne research platforms; (iii) the construction of a fire database, relating the extent, frequency and intensity of fires to vegetation and climatic conditions for present-day and historic conditions; and (iv) development of aggregated models of forest fire frequency and extent, responsive to global change variables.

First, fire will be used as a treatment in the manipulative experiments at some of the intensive study sites in the transect and in the network. The experiments will measure the effects of fire on the successional dynamics of the vegetation, particularly on the composition of the regrowth forest, and will determine the effects on the nutrient dynamics of the soil and the vegetation. Special attention will be given to the consequences of fire on permafrost sites and to emission characteristics and black carbon formation of peat fires and other less explored fuel types.

Second, more research campaigns in the frame FIRESCAN are required to couple air- and spaceborne measurements of biogenic trace gas and aerosol emissions with pyrogenic sources. The newly established NOAA AVHRR receiving stations in Krasnoyarsk, Yakutsk and Khabarovsk will play an important role in identifying fires in real-time or in post-campaign reconstruction.

Third, given the importance of fire in terms of long-term and large scale ecosystem dynamics, a comprehensive ecologically-oriented fire database for Northern Eurasia is essential. The database will build on the National Resources Geographic Information System developed by the Russian International Forestry Institute and should include, in a geographically explicit format, the timing, areal extent, frequency, and intensity (in terms of effects on vegetation as well as gas emissions) of fires as well as the state of the vegetation and the climatic

conditions at the place and time of the fires. A strong component of paleo-fire and historic fire research will link information from tree ring fire chronologies and densitometric analyses with palynological and charcoal data in peat layers and lake sediment cores. This component will be a major inter-core project link and provide the base for the reconstruction of past fire regimes.

Fourth, the ultimate aim is to develop a model of change in fire frequencies and patterns under global change, based on an environmental response surface for fire. Such a model must also be responsive to natural disturbances such as lightning and to fire patterns caused by socioeconomically driven land-use changes.

The prospectus of the study will be available soon as a IGBP publication.

W.L. Steffen and A.Z. Shvidenko (eds.) 1996. The IGBP Northern Eurasia Study. Prospectus for Integrated Global Change Research. The International Geosphere-Biosphere Programme: A Study of Global Change (IGBP) of the International Council of Scientific Unions (ICSU), IGBP Stockholm (in press).

Coordinator of the fire component will be the BIBEX Secretariat:

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The South East Asian Fire Experiment (SEAFIRE)

The South East Asian Fire Experiment (SEAFIRE) intends to explore the role of fires in forests, wildlands and land-use systems of SE Asia and adjoining regions and the impact of pyrogenic, biogenic and marine exchange processes on the regional and global atmosphere. SEAFIRE is a regional fire research campaign in the frame of the International Global Atmospheric Chemistry (IGAC) core project of IGBP and is in its early planning stage.

The first SEAFIRE planning meeting was held in Samarinda (East Kalimantan, Indonesia) between 13 and 15 September 1995 in the premises of the University of Mulawarman. The meeting was hosted by the Indonesian-German Integrated Forest Fire Management (IFFM) Project (see page 29 of this issue of IFFN). The meeting was attended by scientists and administrators from various Indonesian institutions (the Federal and Provincial Forest Services, the Bureau of Meteorology, the Faculties of Forestry Samarinda and Bogor) and by scientists from Australia, Germany, and Japan.

The participants prepared a draft outline for the research prospectus. The draft prospectus is being prepared at present and shall be reviewed in discussed in the sequence of the following open meetings. These meetings are in an early planning stage:

- IGBP Workshop on **SE Asian Land-Use Change Study**, May 1996. The exact date of the meeting which will be held at the SEACOM Regional Research Centre, Bangkok, Thailand, was not yet determined at the stage of printing IFFN). SEAFIRE will be one of many sub-components of that regional study. Convener of the IGBP workshop is:

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The next two opportunities to review and discuss the prospectus will be in late 1996. In order to allow interested scientists to attend two meetings in the Australasian region, it is intended to call for two subsequent planning workshops:

- ASEAN regional SEAFIRE planning workshop, hosted by the SE Asian GCTE Regional Impact Center (Bogor, Indonesia), 23-25 October 1996. This meeting intends to bring together government institutions from ASEAN countries. Programme head of the host facility is:

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- The 13th Conference on Fire and Forest Meteorology (27-31 October 1996, Lorne, Australia) will provide the opportunity for fire scientists to review the prospectus. Details on that conference are found on page xx of this issue of IFFN.

The BIBEX Secretariat is convener of the SEAFIRE planning sessions:

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Nobel Prize Awarded to Ozone Scientists

On 11 October, the Royal Swedish Academy of Sciences (Stockholm) awarded the Nobel Prize in Chemistry to three atmospheric scientists for their role in determining the chemical processes responsible for stratospheric ozone formation and destruction. Paul Crutzen of the Max Planck Institute for Chemistry (Mainz, Germany), Mario Molina of the Massachusetts Institute of Technology (Cambridge), and F. Sherwood Rowland of the University of California (Irvine) will share the prize.

"By explaining the chemical mechanisms that affect the thickness of the ozone layer, the three researchers have contributed to our salvation from a global environmental problem that could have catastrophic consequences," the Academy noted in its announcement of the award. In 1970, Crutzen showed that nitrogen oxides catalyze ozone destruction reactions. Five years later, Molina and Rowland published a ground breaking article in *Nature* that outlined the threat to the ozone layer from CFCs and other chlorinated hydrocarbons.

Although their hypothesis was initially controversial, the theory gained support with the discovery of an ozone hole over Antarctica in 1985. Crutzen and colleagues later showed that the severe depletion over Antarctica was due to the presence of polar stratospheric clouds, whose particles serve as a site for ozone-depleting chemical reactions to take place.

The fire research community knows Paul Crutzen's scientific engagement in exploring the role of emissions from vegetation fires on the global atmosphere. His earliest publications on this topic date back to 1979 in

which he described the complexity and atmospheric chemical consequences of biomass burning in different ecosystems, fuel types and fire regimes, influenced by cultural, demographic and economic factors.

This is only the second Nobel Prize to be awarded in the field of atmospheric research - the first was a physics award in 1947. Paul Crutzen has received numerous congratulations from fire scientists all over the world.

The Editor

Robert Kirsch Award for Fire Historian

On 1 December 1995 the 1995 Robert Kirsch Award was presented in Los Angeles to the fire historian Stephen J. Pyne (American Studies Program, Arizona State University West, Phoenix). This prize is part of the Los Angeles Times Book Prizes presented to a living author who either resides in the West of the U.S.A. or whose work focuses on the region and whose contribution to American letters deserves recognition. The Kirsch Award is named after The Times' late book critic, who died in 1980 following a 25-year career as a novelist, editor and teacher as well as one of the nation's foremost reviewers. Past winners include, for example, the Nobel laureate Czeslaw Milosz. The prize has been given to Stephen Pyne's lifetime literary achievement. Pyne is the author of a series of fire history books, such as the latest World Fire, Fire in America - A cultural history of wildland and rural fire, Burning bush - A fire history of Australia. Other books published by Pyne are on fire management and on a topic less related to fire - on Antarctica.

The Editor

RECENT PUBLICATIONS

World Fire

World Fire is the latest major publication by Stephen J. Pyne. The analysis of global fire, written by an environmental historian, provides a provoking opportunity to the international fire science community to make use of the historical interpretation of fire and put it into the larger context of contemporary fire research, particularly global fire modelling. The fire history reviews of Europe (Russia, Sweden, Greece, Iberia), Australia, the Americas (Brazil, USA), Africa (South Africa), and Asia (India) describe the highlights of global fire cultures. *World Fire* explains that the historic dimension of burning vegetation for all kinds of cultural purposes was much more important and widespread than the contemporary use of fire in ecosystems - with the exception of tropical forest conversion. In my opinion the book helps to overcome the still prevailing and too much generalized views on fire, which clearly has been stigmatized by today's escalating use of fire in tropical forests, as a symbol for destruction, or by the tragic role of wildfires in the mediterranean-type landscapes all over the world.

World Fire is one within a series of fire history books published by the author. It is no wonder that Stephen J. Pyne recently received the Egon Kirsch Award (see previous page).

The Editor

Pyne, S.J. 1995. World fire. Henry Holt, New York, 379 pp. (ISBN 0-8050-3247-9)

The Ecology of Fire

Wildfires kill many animals, but are populations of animals affected? How do animals survive the passage of fire? Why do some tree species survive and others die in a fire? Do frequent fires cause changes in plant community composition? How important is long-distance seed dispersal in vegetation recovery after fire? How does fire affect plant-herbivore interactions and predator-prey interactions? What are the effects of frequently applied, out of season fires for land management?

Answering questions such as these requires an understanding of the ecological effects of fire. Aimed at senior undergraduate students, researchers, foresters and other land managers, Robert Whelan's book examines the changes wrought by fires with reference to general ecological theory. The impact of fires on individual organisms, populations and communities are examined separately, and emphasis is placed on the importance of fire regimes. Each chapter includes a listing of 'outstanding questions' that identify gaps in current knowledge. The book finishes by summarizing the major aspects of ecology that are of particular relevance to the management of fires - both protection against wildfires and deliberate use of fire.

The Editor

Robert J. Whelan 1995. The ecology of fire. Cambridge Studies in Ecology. Cambridge University Press, Cambridge (UK), 346 pp. (ISBN 0-521-32872-1 hardback; 0-521-33814-X paperback).

Forest and Shrubland Wildfires on the Western Canary Islands

Between 1983 and 1990 ca. 16,500 hectares of forest and shrubland were affected by wildfires on La Palma, Tenerife, La Gomera, and El Hierro by only five wildfires. That is 4.8% of the total area of the western Canary Islands, which have a Mediterranean-type climate. These wildfires have been declared repeatedly as environmental catastrophes.

A study has been recently published by Peter Höllermann, in which in which he approaches the burnt ecosystem in a holistic way, particularly from a landscape ecological perspective. Höllermann relates the pattern of vegetation fires on the western Canary Islands to the altitudinal zonation of vegetation (type and structure): Many wildfires have their origin in the zone of subsistence agriculture at 400-1200 m a.s.l. Arson and negligence start most fires, and the land use patterns favour an irregular, patchy spread. Especially in the late summer season, when dry winds from North Africa promote the spread of uncontrollable wildfires, the zone of optimal biological productivity and biomass concentration (800-1400 m a.s.l.) is affected by extensive damaging fires. Steep slopes and the inaccessibility of the region restrict fire-fighting activities, and so large areas have been burnt in this zone, which corresponds with the lower part of the Canary pine forest belt and the transition zone to the **Monte Verde** belt.

The natural vegetation on the western Canary Islands - with its most important endemic elements *Pinus canariensis*, *Erica arborea*, and *Myrica faya* - has developed strategies to survive and even to make use of wildfires. Post-fire recovery in general needs 7-8 years in **Monte Verde** shrublands and 8-10 years (Canarian pine forest), except for sites affected by high-intensity fires, sites reforested with exotic species (*Pinus radiata, Eucalyptus globulus*), and sites with unfavourable ecological conditions (i.e. aspect, inclination, elevation, substrate). Fire-induced changes of habitats have negative effects on wildlife and other fauna (loss of shelter and food) as well as positive effects (increase of landscape diversity), both of only short duration and less extreme than one would expect.

Ca. 90% of the area burned on the western Canary Islands have been affected by low-intensity surface fires which have little effects on structure and chemistry, and the microbiological activity of the upper soil layer. The ash supplies nutrients, and the pH is raised for a short time by mineralization of biomass. Since most wildfires on the Canary Islands are not intense enough to burn the organic soil matter completely, infiltration capacity does not decrease, and re-establishment of the ground cover is fast. Accelerated runoff, soil erosion, and gradual depletion of nutrients cannot be observed, although the altitudinal zone of extensive wildfires corresponds with the zone of maximum precipitation. Although the loss of vegetation cover affects the microclimate, no long-lasting disturbances of the water balance were observed.

As a conclusion Höllermann states that the long-term geoecological consequences of wildfires on the western Canary Islands are not disastrous as long as fires are not too frequent and too intense. In order to preserve the ecological diversity and productivity he even suggests prescribed burning as a possible tool in landscape management. In accordance with the ecological disposition of each particular landscape an optimum perturbation cycle should be defined and practised - a challenge for future fire ecological research. In the last

chapter of his monograph Höllermann forms a qualitative geoecological model, where balances of energy and substances of a wildfire are visualized. He states that the concept of this model, which is based on the principles of processes and their correlations, may not be suited for application in fire ecology because it describes the ecosystem in a steady state. Fire, however, changes all system components abruptly and its effects are chaotic and unpredictable.

Kai Schrader

Höllermann, P. 1995. Wald- und Buschbrände auf den westlichen Kanarischen Inseln - Ihre geoökologischen und geomorphologischen Auswirkungen. (Forest and Shrubland Wildfires on the western Canary Islands - Geoecological and Geomorphological Consequences). Abhandlungen der Akademie der Wissenschaften in Göttingen, Mathematisch-Physikalische Klasse, dritte Folge, Nr.46, Vandenhoeck & Ruprecht in Göttingen, 184 pp. <in German, with English and Spanish summaries).

Natural Forest Fires and Controlled Burning - a Study of the Literature
<Brand och bränning - en literaturstudie>

The recent revival of interest on the influence of forest fires in the Nordic forest ecosystems was the main reason for a literature review. In this literature study, published by the Forestry Research Institute of Sweden, the authors first summarize the results of research projects on the role of natural fires in ecosystem dynamics in the Nordic countries. Under natural conditions forest fires occur every 40 to 160 years, depending on the type of site and climatic conditions. Today natural fires are of less importance due to of efficient fire fighting methods and the reduction of forest fuels due to modern forest practice.

Swedish agriculture has a long tradition in Sweden. In former times fire was mainly used in agroforestry systems to prepare the ground for crop and potato plantations (***svedjebruk***). At the beginning of this century the Swedish began to use fire increasingly in forest management for preparing the site for natural regeneration after clear felling (prescribed burning = ***hyggesbränning***). The peak of the prescribed burning practices was between 1950 and 1965, when in Sweden a total area of ca. 40,000 ha was burned annually. This number rapidly declined to prescribed fire application on ca. 800 ha/year today.

The study includes a description of various burning techniques and the effects of the fire on growth dynamics of the regenerating forest on different site types. The authors also compare the Swedish burning methods with techniques from Finland, USA, Canada and Australia.

Today there is a comeback of prescribed burning both in forest management and for nature conservation purposes. The study evaluates a questionnaire which was circulated within forestry enterprises. Among questions concerning objectives and techniques of burning, the result of the enquiry also reveals the costs of prescribed burning. At present the costs of post-clearcut prescribed burning are usually in the range of SKr 1000-3000 per ha (equivalent to $US 135-410/ha). Mechanized scarification, which is a common alternative to burning, costs SKr 1200-1400/ha ($US 165-190/ha).

Hans Page

L.Hörnström, E.Nohlgren, and Y.Aldentun 1995. Brand och bränning - en literaturstudie. Redogörelse nr.9. Skog Forsk - The Forestry Research Institute of Sweden. Uppsala, 36p. Text in Swedish with an extended abstract in English (ISSN 1103-4580).

MEETINGS HELD IN 1995

AUSTRALIA ***6th Fire Weather Workshop***
18-22 June, Hahndorf, South Australia

This workshop was the sixth in the series of workshops and conferences run by the Bureau of Meteorology to provide directions for the Bureau's fire weather services. The first Conference was in Melbourne 1958, the second in Adelaide 1985 and as workshop every two years since. On this occasion the emphasis of the workshop was on the application of meso-meteorological models as research and forecasting tools for fire weather.

From an operational view point there were presentations of the Bureau's new meso-model soon to be available as a fire weather forecasting tool. The Bureau's meso-model will be operating at the coarser end of meso-models at a resolution of around 25 kilometres. This promises to be most useful for fire weather warnings. CSIRO also have a meso-modelling capability and have taken a particular interest in sea breeze problems. All fire managers will agree that the sea breeze is a particularly important phenomenon for both fire control and prescribed burning. Other meso modelling interests centre around using models to assist in forecasting strong wind conditions that are of a small and often local scale and the ever important issue of smoke dispersion.

The workshop looked at the major activities in the various States and at automatic weather station problems and opportunities. Some interesting fires were examined including the recent Victorian "Enfield" fire and the NSW and the Queensland fires of 1994. The basis for imposition of fire bans and their effectiveness was also considered. Satellite techniques (Vegetation index and fire detection), lightning detection and the Haines index were also presented and briefly discussed.

The abstracts for the presentations are included in a proceedings report. At the end of the workshop small groups were formed and each was asked to produce four important issues for the workshop to present as recommendations for further work, study or implementation as appropriate. These major recommendations are included in the report. Readers interested in this report should contact:

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FINLAND ***20th IUFRO World Congress, 7-12 August 1995, Tampere***

The 20th IUFRO World Congress took place in Tampere (Finland) from 7-12 August 1995. Four two-hour sessions were devoted to presenting and discussing the results of the Bor Forest Island Fire Experiment in the Russian Federation, an activity of the first phase of the ***Fire Research Campaign Asia-North*** (FIRESCAN), a component of the ***International Global Atmospheric Chemistry*** (IGAC) project and the ***International Boreal Forest Research Association*** (IBFRA), Stand Replacement Fire Working Group. The abstracts of the single papers are contained in the abstract volume. The final synthesis paper on the experiment jointly written by 19 authors will be published as follows:

FIRESCAN Science Team. 1995. Fire in ecosystems of boreal Eurasia: The Bor Forest Island Fire Experiment, Fire Research Campaign Asia-North (FIRESCAN). In: J.S.Levine (ed.), Biomass burning and global change, The MIT Press, Cambridge, MA (in press).

SPAIN ***Remote Sensing and GIS Applications in Forest Fire Management***
7-9 September 1995, Alcalá de Henares

This international EARSeL (European Association of Remote Sensing Laboratories) workshop was held at the University of Alcalá de Henares (Spain). Although the organizers had planned to have a small meeting, the interest of the topics discussed resulted in participation of 93 scientists from 15 countries (Belgium, Brazil, Bulgaria, Canada, Denmark, Germany, Greece, Israel, Italy, Portugal, Senegal, Spain, Switzerland, UK, USA).

The workshop focused on four themes: fire detection, fire danger estimation, fire mapping and remote sensing-GIS integration. Five lectures were presented: "New sensors for Fire Research", by J.P. Malingreau (Institute for Remote Sensing Applications, Italy), who provided a general overview of current remote sensing programmes for fire monitoring, stressing the importance of global and local effects of tropical fires; "Fire Detection from Remote Sensing Systems" by A.W. Setzer (Space Research Center [INPE], Brazil), who offered a review of the operational fire detection programme carried out in Brazil using NOAA-AVHRR images; "Burned Land Mapping and Fire Effects on Vegetation Recovery" by M. Karteris (University of Thessaloniki, Greece), who emphasized the importance of quick burned land assessment to take reforestation measures and to avoid soil erosion; "Use of Remotely Sensed Data for Fire Danger Estimation", by R. Burgan (U.S. Forest Service) who presented the efforts of the U.S. Forest Service to include satellite information in improving the National Fire Danger Rating System, through the use of absolute and relative NDVI temporal dynamics generated from NOAA-AVHRR data; and "Remote Sensing and GIS Integration for Fire Risk Management", by M.J. Vasconcelos, (National Geographic Information Centre, Portugal) who showed the main problems for the integration of satellite data and GIS in fire prevention and modelling.

Thirty five contributing papers were presented in the poster section. Many innovative works were presented. Among them the fire detection and vegetation monitoring programmes carried out for large areas in tropical countries by the Institute for Remote Sensing Applications (Italy) and the Natural Resources Institute (UK); the estimation of fire danger from the Normalized Difference Vegetation Index (NDVI) and surface temperature, developed by the CEMAGREF and University of Marseille (France) and the Universities of Valladolid and Alcalá de Henares (Spain); the methods for mapping and assessing fire effects on soil erosion and the hydrological cycle by research institutes from France, Italy, Portugal, Spain and Switzerland.

The general discussions offered an excellent opportunity to share ideas about the application of remote sensing techniques to improve fire management and assessment of fire effects. In the fire detection section, operational difficulties in using AVHRR images for the Mediterranean countries of Europe was stressed, since channel 3 data present a great signal to noise ratio and inconvenient spatial and temporal resolution for European conditions. A brief discussion about the convenience of proposing a dedicated satellite for fire detection in the Mediterranean basin was held. In spite of the great possibilities offered by such a system, a clear agreement about its convenience was not expressed. The requirements of a fire dedicated sensor would be the following: saturation at 1,000 K, multi-spectral capabilities in the thermal region, IFOV between 50 and 250 meters, global coverage, 3-4 times per day frequency, and accessibility for local reception.

The fire mapping and fire effects assessment section brought up some techniques to reduce the confusion of burned areas with non-vegetated surfaces, such as using spectral mixture analysis and multitemporal techniques within the framework of GIS. Local and global scale projects were reviewed, emphasizing the importance of integrated approaches for generating a clearer picture of environmental effects of fire upon desertification and soil degradation processes.

Within the fire danger estimation section, potential interest of collaboration among different European countries to establish common methods of fire danger rating was observed. To do so, current indices, based on meteorological data, should be improved by taking into account the temporal dynamics of vegetation vigour, as measured by satellite information. The concept of fire risk was also discussed, pointing out the importance of considering not only economic but also human and cultural values associated with specific forested areas, which would deserve special protection against fire.

Finally, within the integration of GIS and remote sensing techniques section, several difficulties in modelling fire risk were discussed. Special attention was paid to the human component, which is the main risk factor in

all Mediterranean countries. The importance of promoting social studies about human attitudes towards fire was highlighted. Some time was also dedicated to discussion about the current techniques for modelling the spatial distribution of meteorological variables, especially to wind flows over complex terrain. The participants agreed on the difficulty of obtaining accurate models but also on the importance of improving present methods to obtain better fire behaviour programmes.

As general conclusions of the workshop, the participants agreed on the convenience of fostering collaboration among remote sensing scientists dealing with forest fire applications. The specific channels to spread knowledge and experience were not agreed on, but a general consensus about creating a network of scientists related to fire applications was underlined. Such a network might be organized as a Special Interest Group, within the EARSeL, a network of the European Space Agency (ESA) or a thematic group for the Centre for Earth Observation (CEO). There was also agreement about the utility of organizing a similar workshop in two years time. This potential collaboration among fire related scientist should be strengthen by extending the use in fire research of European satellite and GIS data generated for other applications, such as the AVHRR mosaic derived for the MARS project or the CORINE data base. Considerable frustration was expressed concerning the difficulty of accessing these data. The importance of easing the access to these data for the European researchers (specially to those involved in EU-funded projects) was stressed. Additional efforts should be made to solve this problem.

The full-length proceedings of the workshop will be published in 1996. At present copies of the abstract volume (cost: 3,000 Pesetas) are available from the Workshop Chairman:

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MEETINGS PLANNED FOR 1996-97

THE NETHERLANDS ***European Geophysical Society, XXI General Assembly***
6-10 May 1996, The Hague

Fire researchers are invited to participate in the Biomass Burning Symposium to be held during the forthcoming XXI General Assembly of the European Geophysical Society in The Hague. This symposium will present results from the various IGAC/BIBEX (International Global Atmospheric Chemistry/Biomass Burning Experiment) projects and other contributions related to biomass burning. Topics will include:

(1) the effects of biomass burning on the atmospheric environment
(2) the ecological role of vegetation fires
(3) biomass burning and remote sensing
(4) climatic consequences of biomass burning

BIBEX-Steering Committee members please remember: This will be our next official meeting.

Meinrat O. Andreae
Biogeochemistry Department
Max Planck Institute for Chemistry
P.O. Box 3060
D-55020 Mainz
e:Mail: moa@diane.mpch-mainz.mpg.de

Johann G. Goldammer

(address on p. ii)

U.S.A. ***20^th^ Tall Timbers Fire Ecology Conference***

Fire in Ecosystem Management: Shifting the Paradigm from Suppression to Prescription

7-10 May 1996, Boise, Idaho

Purpose of the Conference:

Land managers, research scientists and natural resource agency administrators realize that fire is an integral component of many ecosystems. They also understand that effective implementation of ecosystem management will often involve the application of prescribed fire. Furthermore within the past ten years, people have started to consider the long-term ecological consequences of fire regimes. Historic management paradigms of fire suppression at all costs are being challenged for reasons that range from simple economics to the view that frequent fire is essential for forest health.

The purpose of the conference will be to explore this emerging shift in the fire-management paradigm. As we move from suppression to the use of specific prescriptions for application of fire, it will be useful to make a state-of-art assessment of our current knowledge. To effectively use fire in the contemporary, and often highly fragmented landscape, we must develop and refine specific prescribed fire regimes that target predetermined goals for the ecosystems in which it is applied.

Questions to be Addressed:

- What are the ecological consequences, both beneficial and detrimental, of prescribing fire as opposed to suppressing it? For example, it is relatively easy to prescribe fire to reduce fuel, but is the use of fire in such a context being contemplated with any regard for the ecological outcome?

- What are the consequences of not pairing a fuel reduction regime with local or regional vegetation? That is, would a desired future condition of less fuel, and presumably less frequent catastrophic fire, be compatible with desired ecological conditions?

- What can we learn from areas of the country (world) where fire has been part of the landscape for a number of years? For instance, what are the ecological results of the historical use of fire in the southeastern U.S. or the Australian bush?

Our goal is to provide a forum for people to discuss the use of specific prescribed fire regimes in the context of modern natural resource policy and management. We seek papers from scientists, managers and administrators that describe successful (or unsuccessful) use of alternate fire regimes and describe linkages between use of prescribed fire and long-term management objectives to achieve specific desired future conditions of forests, shrub or grassland ecosystems. We encourage a case history approach from state, provincial, regional and international perspectives.

If you are interested in participating in this conference, please contact:

Leonard A. Brennan
Director of Research
Tall Timbers Research Station
Route 1, Box 678
USA - Tallahassee, Florida 32312

Fax: ++1-904-668-7781

AUSTRALIA ***13th Conference on Fire and Forest Meteorology***
27-31 October 1996, Lorne

The Fire and Forest Meteorology Conferences have been open, research meetings organized by the American Meteorology Society and the Society of American Foresters. The 13th Conference will be the first one to be held outside North America. It will take place in Lorne, Australia. Conference chairs are Rodney Weber and David Packham.

Theme: The theme for the 13th Conference on Fire and Forest Meteorology will be "International Perspectives on Landscape Fires." While papers on all aspects of fire and weather topics be accepted for presentation, this year's organizing committee would like to encourage authors to make the most of the opportunity afforded by this conference for international information sharing. Topic areas will include, but are not limited to: fire ecology; fire management; fire disaster planning; media issues; smoke; meteorology/climatology; fire physics; modelling, and urban interface issues. Papers may be presented orally or by interactive poster. All papers will be printed in a conference proceedings book. A booklet of abstracts will be available to registrants at the beginning of the conference.

Pre- and Post-Conference Tours: Several options for pre- and post-conference tours are being explored. A two or three day tour of Victorian sights and tastes; a tour of New Zealand rural fire protection organisations and tourist sights, and a tour of Western Australia with Lachlan McCaw as host are all possibilities if enough interest is expressed.

SEAFIRE Planning Meeting: The South East Asian Fire Experiment (SEAFIRE) will hold planning meetings on Monday and Wednesday nights. Anyone interested is invited to attend. SEAFIRE intends to explore the role of fires in forests, wildlands and land-use systems of SE Asia and adjoining regions and the impact of pyrogenic, biogenic and marine exchange processes on the regional and global atmosphere. SEAFIRE is a regional fire research campaign in the frame of the International Global Atmospheric Chemistry (IGAC) core project of IGBP. In the SEAFIRE planning meetings the prospectus and research plan will be discussed (see pages 40/41 of this issue of IFFN).

Registration Cost: The registration fee for the entire conference will be AUS$ 250 or US$ 180.

Student Assistance: Any full-time student who presents a paper or poster will be eligible for up to AUS$ 250 in travel assistance. Also, all full-time students will be able to register for the reduced rate of AUS$ 150 or US$ 110. For more information contact:

International Association of Wildland Fire
P.O.Box 328
USA - Fairfield, Washington 99012

Fax: ++1-509-283-2264
Phone: ++1-509-283-2397

CANADA ***2nd International Wildland Fire Conference***
25-30 May 1997, Vancouver, British Columbia

The North American Forestry Commission's Fire Management Study Group is the principle sponsor of the Second Wildland Fire Conference, a follow-up conference after the First International Wildland Fire Conference, which was held in Boston, 1989. The conference is co-sponsored in part and hosted by the Province of British Columbia's Ministry of Forests' Protection Programme.

The second international wildland fire conference will appeal to participants from around the globe as guest speakers and participants tackle the growing issue of wildland fire. Aimed at fostering international co-operation and information sharing, the conference will bring together leading public and private agency specialists and speakers to discuss issues, programmes and strategies surrounding wildland fire and sustainable development.

During two days of plenary sessions, panel discussions, poster sessions and hand-on demonstrations, conference delegates will address these and other key wildland fires topics. A third day has been planned that will focus delegate's attention on the global scene. Invited speakers and dignitaries from around the globe will inform delegates about programmes, initiatives and opportunities in their specific regions.

The conference facilities will also host an information exhibit which will run concurrently with the conference sessions. This technical display of posters, services, educational and scientific developments will provide an opportunity for delegates to see first hand the new and innovative technologies and scientific advancements. During the five conference sessions, speakers will explore fire and sustainable development from the environmental, economic, social, regional, and organizational perspective.

In addition, a special operative trade show is being planned to showcase international exhibits and supplies of everything from specialized fire fighting aircraft to equipment and systems. The first two days of the three-day session will be dedicated entirely to conference delegates.

This conference is a forum of wildland fire policy makers, leaders and decision makers, fire and land managers, international coordinators, scientists and technical specialists as well as anyone interested in the role of fire within the evolving concept of sustainable development. For more information contact:

Conference Secretariat
Events by Design
601-325 Howe Street
CDN - Vancouver, B.C. V6C 1Z7

Fax: ++1-604-669-7083
Phone: ++1-604-669-7175

FROM THE PRESS

Fighting the Flames in a Spanish Garden

Andrew Hill has a brush with fire too close to home

We enjoy playing with fire. Anyone who has stood as a child in front of a bonfire, nudging the dry leaves with a Wellington boot to encourage the flames to take hold, or spent just a little longer than necessary putting a match to the firelighters, has shared the fascination which moves pyromaniacs.

And we have all been engrossed by television images of forest and brush fires, in the Mediterranean or North American countryside - a combination of environmental disaster, human drama and spectacular visual footage.

Such is our apparent familiarity with forest and brush fire that I had always thought the real thing could be an anticlimax. It is not.

From the lawn of my parents-in-law's house in the hills near Marbella in southern Spain, we spotted the smoke almost as soon as the blaze began, at about three o'clock on a Sunday afternoon.

We should have been well protected, or at least on our guard. After a devastating fire six years ago, which destroyed some local apartments, three-metre-wide dirt firebreaks had been cut into the scrub in the valley behind the small development of villas and apartments.

Elsewhere in Andalucia, large fires were already burning up tracts of the sierra. Firewatchers from the local authority were supposed to be on duty.

But the omens for this fire were bad from the start. It was set off by a car crash on the road behind the neighbouring villas - an accident odd enough for locals to begin speculating about the possibility of arson. People reminded each other with knowing looks that the 18-hole golf course in the next valley was built after the last fire.

Conditions were ideal for the blaze to spread quickly out of control. The weather was hot and gusty; the scrub, mimosas and young pines in the valley surrounding our house were drought-dry. Two local fire tenders - called immediately to tackle the car crash - soon found themselves powerless to contain a large brush fire.

I took a couple of photographs as the fire came into view behind the neighbouring row of apartments. But within minutes, as we packed the car with a few belongings and tried to seal the house from potential smoke damage, we could feel the heat of the flames moving erratically across the valley towards us. We were the last house of the development, the most difficult to get to, and therefore probably the most vulnerable.

Suddenly this was no longer a mere Sunday diversion.

My brother-in-law, who had spent the last six summers rebuilding a garden turned to charcoal in the previous fire, insisted on defending his handwork with a small garden hose, although it seemed a feeble weapon against a biblical scourge. By spraying the foliage, he reasoned, the scorching effect of the fire - which kills mature trees as surely as if they had been burnt to the ground - would at least be delayed.

In fact, there is no certain way to put out such a fire. Fire fighters talk about "attacking" a blaze, but in reality once a fire is set, it is more a case of desperate defence. Much of the skill of the trained fire fighters combating our fire seemed to consist in waiting for it to run out of "fuel", or predicting when the wind would drop or change direction so that the fire turned back on itself. As for the firebreaks, the strong wind rendered them useless.

Wildfire makes a sinister crackle-and-swish noise as it approaches, like a column of murderous pygmies on the march through the undergrowth. It is at the same time faster, hotter, louder and more fascinating than that childhood bonfire experience would lead you to expect. And it varies its tactics: while you are trying to smother the smouldering underbrush, it can throw 10-metre flames at the topmost branches of mature pines.

The flames now threatened to engulf our garden. The water had been cut and for two or three minutes, as we slapped desperately at the burning brush with shovels it looked as though the fire would leap the drive and ignite the old pines in front of the house.

In the end it was probably the wind more than our feeble heroics which spared us, blowing the main force of the blaze past the house and condemning other villas, squarely in the path of the fire.

By the time fire fighters had negotiated the difficult track to our villa and turned their hoses on to the smoking undergrowth, the main danger had passed. Only 45 minutes had elapsed since we first spotted the fire and the main front of the blaze was already two valleys away.

From the garden it was now possible to assess the extent of the damage. The nearest foothills of the sierra, dotted with trees, had been turned into a cemetery of smoking stumps. A dozen white circles on the ground halfway up the hill showed where the fire had destroyed a local apiarist's beloved bee-hives.

Helicopters, Canadair fire fighting aircraft and biplanes were churning overhead towards the next valley to drop seawater into the towering smoke clouds.

As night fell, the same smoking stumps revealed themselves as small fires burning in the dusk, like the braziers of an army encamped ahead of the next day's battle. A team of the region's fire fighters was posted near the house overnight, mustachioed and professional-looking in their green and yellow overalls. They were keeping an eye on smouldering patches in the valley below which could reignite if the wind changed direction.

We searched the papers next day for news of our apocalyptic Sunday. But the fire only made it on to the local front pages, and not even a paragraph in the national news. Fiercer fires were burning elsewhere in Andalucia, north of Madrid, and in the Algarve. Near Athens, forests were burning across a 20km front, while in Siberia and central Russia it was reported that 14,000 fires were raging out of control.

Ours was a mere bonfire by comparison, and by the time we had read the morning papers the bluff young fire fighters from the regional authority had already moved on to the next blaze. They had obviously kept themselves awake by smoking; we found the cigarette ends meticulously stubbed out in the dirt, a small nod to the enemy.

Forest and brush fires are a phenomenon which seem to be on the increase. Careless picnickers or an innocent lightning strike can do equal damage, but in Mediterranean countries, the majority of forest fires now have deliberate human causes.

According to the United Nations' Economic Commission for Europe, based in Geneva, arson was the cause of more than 8,000 of the 14,200 fires reported in Spain in 1993, and more than 7,600 of Italy's 12,000 forest fires in the same year.

Add in fires with unknown causes - many of which "may be due to arson", according to the UN-ECE - and nearly three-quarters of the fires in Italy and Spain may have been set off deliberately. It looks as though the infant pyromaniacs have come of age.

This article was published in the Financial Times of 2-3 September 1995

FAO/ECE/ILO Seminar on *Forest, Fire, and Global Change* Shushenskoye (Russian Federation), 4-10 August 1996

Provisional agenda and information on the seminar

The seminar on forest, fire and global change will be held in Shushenskoye, Krasnoyarsk Region, (Russian Federation) from Monday, 4 August to Saturday 10 August 1996 under the auspices of the Joint FAO/ECE/ILO Committee on Forest Technology, Management and Training, in collaboration with the Federal Forest Service of Russia. It is being arranged in cooperation with the International Boreal Forest Research Association (IBFRA) and the International Global Atmospheric Chemistry (IGAC) Project. The seminar will be held in conjunction with the First International Boreal Fire Management Technology Meeting and Exhibition.

The programme will include five days of presentation of papers intermixed with the exhibition on fire management technology equipment, field demonstration of fire suppression hardware, and local and regional study tours.

Objectives and scope of the seminar: The seminar will provide a forum for the international exchange of information on the role of natural and accidental fire in global ecosystems, with special emphasis on the ECE region. The expected outputs of the conference will be, in accordance with the objectives of the UNCED process and the International Decade for Natural Disaster Reduction, to prepare proposals for:

- developing a standardized fire inventory system;

- establishing mechanisms to collect and evaluate fire inventory data at a global scale;

- developing an internationally accepted statement on fire management policy; and

- establishing mechanisms for international cooperation in fire management on a regular basis and in disaster management assistance.

Basic papers will be prepared by selected experts at the invitation of the secretariat and in accordance with the suggestions of the host country. They will be issued in one of the three official languages (English, French or Russian) with a summary in the other two official languages, and will be distributed to registered participants before the seminar, provided they are received by the secretariat not later than 1 May 1996. A limited supply of basic papers will be available at the seminar, but participants are requested to bring with them the copies they have received beforehand.

In addition, participants are welcome to table voluntary papers in one of the official languages on any topic of their choice falling within the scope of the agenda. The amount of voluntary oral presentations will be restricted in order to avoid an overloaded programme and to ensure that sufficient time is reserved for discussion amongst participants under each item of the agenda. Voluntary contributors are encouraged to prepare posters instead of oral presentations. Participants wishing to submit voluntary contributions should indicate their intention in the registration form (including the title of the contribution). Authors of voluntary papers should bring 100 copies to the seminar. One copy should be sent in advance to each of the three addresses given on the registration form.

Simultaneous interpretation into the official languages of ECE (English, French and Russian) will be provided during the seminar.

First *International Boreal Fire Management Technology Meeting and Exhibition*

The seminar will be held in conjunction with the First International Boreal Fire Management Technology Meeting and Exhibition. Producers are invited to present/demonstrate systems, technologies, procedures, hard- and software on the following topics:

- Fire suppression equipment (aerial, ground): fixed-wing aircraft, helicopters, foam, retardants, explosives, parachutes, helirappelling, ground tankers, pumps, hand tools, etc.;

- Fire intelligence and decision-support technologies: communication systems, GPS, satellite downlinks (NOAA AVHRR, NOMOS/MIR etc.), IR equipment, etc., expert systems, etc.

Exhibition and demonstration of large equipment will take place on Shushenskoye airport during the whole week of the seminar (see draft program). Small hard- and software exhibition will take place in the meeting facility.

Vendors are kindly requested to seek contact to exhibition coordinators in the USA and Canada. Detailed information can be obtained from the International Association of Wildland Fire or the Federal Forest Service of Russia (address list: see further below)

Study visits: Study visits to forest and cultural sites will be organized during the conference and exhibition week. Field trips will be devoted to demonstrate forests and forest fire problems. A cultural study tour will cover an open-air museum village showing traditional, well preserved structures of a rural community dating back to the turn of the century.

FAO/ECE/ILO Seminar on
Forest, Fire, and Global Change
Shushenskoye (Russian Federation), 4-10 August 1996

Provisional Agenda

1. Adoption of the agenda

2. Election of officers

3. Opening speeches, keynote address and basic papers (introduction to the seminar)

4. Assessments on the extent of land areas affected by fire (forest and other land)

5. Assessments of damage caused by wildfires (boreal, temperate, mediterranean, tropics)

6. Methodologies to improve and standardize assessments of fire inventories and fire impacts

7. Clarification of the role of forest fires in

   7.1 Land-use and land-cover changes
   7.2 Maintaining biodiversity
   7.3 Global carbon, nutrient and water cycles
   7.4 Forests affected by industrial and radionuclid pollution
   7.5 Ecosystems affected by climate change

8. Discussion/Working Groups on

   - Development of a standardized fire inventory system;
   - Establishment of mechanisms to collect and evaluate fire inventory data at a global scale;
   - Development of an internationally accepted statement on fire management policy; and
   - Establishment of mechanisms for international cooperation in fire management on a regular basis and in disaster management assistance.

9. Conclusions and recommendations

10. Any other business

11. Adoption of the report of the seminar

Location: The seminar will take place in Shushenskoye, a small rural community in the South of Krasnoyarsk Region, in midst of Southern Siberian taiga forests and close to steppe landscapes and mountains. The location has been selected in order to provide insights in forested and agricultural landscapes of Siberia and to provide opportunities to demonstrate airborne and ground fire management technologies.

Non-Russian participants of the seminar cannot travel to the meeting place on an individual base. All travel arrangements will be organized through the Federal Forest Service of Russia.

Travel: For non-Russian participants a charter flight will be organized either between Frankfurt (Germany) or Moscow directly to Abakan, the closest international airport to Shushenskoye. The organizers will arrange for bus transport from Abakan to Shushenskoye (60 km, approximately an 1 hour drive). Details about charter flight arrangements and costs will be provided to registered seminar and exhibition participants in due time. The costs for the charter flight will be in the frame of usual air fares.

Tentative dates for travel and meeting are:

3 August 1996 (Saturday)	Leaving Frankfurt or Moscow for Abakan
4 August 1996 (Sunday)	Arrival Abakan, Transit to Shushenkoye, transfer to hotel, welcome dinner
5-10 August 1996	Seminar, exhibition and field trips
11 August 1996 (Sunday)	Return flight from Abakan to Frankfurt or Moscow

Accommodation, food and clothing: All participants will be fully accommodated in the "Tourist Hotel", five minutes walking distance from the meeting place. The weather in August is usually warm and dry in southern Krasnoyarsk Region. However, it is recommended that participants bring a raincoat, mosquito and tick protection, and field boots.

Registration procedures and costs: The registration fee is 100 US-$ (200 US-$ at late registration between 1 June and 1 July 1996, in exceptional cases only). A package for accommodation, full board meals and transport during the whole week will cost 500 US-$ (obligatory for every non-Russian participant). Participation fees for vendors/exhibitors will be explained in a leaflet issued by the International Association of Wildland Fire.

The payment instructions for the charter flight will be made available to registered parties as soon as the details on costs will be available.

For practical and logistical reasons non-Russian participants will be limited to 70.

Final registration will be confirmed only after (1) transmission of the registration form to the two addresses indicated, and (2) payment of registration fee, the accommodation/food/transport package and the charter flight costs.

Visa: An official invitation to the seminar will be required to obtain a visa for entering Russia. The invitation will be transmitted by fax to every registered participant. A fax number must be indicated on the registration form in order to avoid time-consuming mailing procedures.

Cancellation of registration: Refunding after cancellation of registration is not possible due to charter flight constraints. Registered participants will not receive refund of any paid fees after cancellation.

Banking instructions for transferring the participation fees

Registration fee and accommodation/food/transport package costs must be transferred to a special conference account which has been opened in Germany. This procedure has been selected in order to avoid high banking fees, lengthy and complicated money transfer procedures when dealing with the Russian Federation. The Federal Forest Service of Russia has authorized Mr.J.G.Goldammer, leader of the FAO/ECE/ILO Team of Specialists on Forest Fire, to act as the responsible person in charge of the administration of the fees.

The total payment for seminar participants of US-$ 600 (US-$ 700 between 1 June and 1 July 1996) and should be transferred to the credit of the following account:

Beneficiary:	Mr.Johann G.Goldammer, Fire Ecology Research Group c/o Freiburg University, P.O.Box, D-79085 Freiburg, Germany
Bank:	Deutsche Bank, D-79098 Freiburg, SWIFT Code: DEUT DE 6F, German BLZ Code: 680 700 30
Account No.:	0520361

Non-German participants: are urged to instruct your bank to use the SWIFT Code. This will facilitate the payment procedure.

Contact addresses for vendors interested to participate in the First *International Boreal Fire Management Technology Meeting and Exhibition*

International Association of Wildland Fire
103 E. Main, P.O.Box 328
USA - Fairfield, WA 99012
Fax: ++1-509-283-2264
e:Mail: jgreenlee@igc.apc.org

Richard L. Stauber
preliminary contact for the USA
Fax: ++1-208-336-8220
Phone: ++1-208-389-2604
e:Mail: DStauber@aol.com

C.Allan Jeffrey and Tom Johnston
Canadian Interagency Forest Fire Centre
210-301 Weston Street
CDN - Winnipeg, Manitoba R3E 3H4
Fax: ++1-204-956-2398
Phone: ++1-204-784-2030
e:Mail: ciffc@merlin.magic.mb.ca

Mr. Dimitriy Odintsov
Deputy Chief, Federal Forest Service of Russia
59/19 Pyatnitskaya str.
RUS - Moscow 113184
Fax: ++7-095-233-09-50

Appendix I: Draft timetable of the FAO/ECE/ILO Seminar on Forest, Fire and Global Change, Shushenskoye, Krasnoyarsk Region

	Sunday	Monday	Tuesday	Wednesday	Thursday		Friday	Saturday
Morning	Transit to Con- ference Site	Plenary Opening Ceremony Keynote address Basic Papers	Joint Technical Session I	Joint Technical Session II	Separate Technical Sessions		Cultural Trip all Day Working Groups: Preparation of final report and resolution	Plenary Close Out
					FAO/ECE Seminar	Fire Management - Ground - Aerial - Intelligence - Communi- cation,GPS		
After- noon	Regist- ration	Demo: Aerial delivery of extinguishants, and personnel	Demo: Intelligence and Decision- Support, Equipment, Communication Systems, GPS Half of Afternoon: Plenary	Cultural Study Tour	Demo: Ground Equipment Explosives	Poster Sessions		Leave for Post- Con- ference Field Trip
Evening	Ice- breaker	Opening Dinner			Poster Sessions (continued) Working groups (report, resolution)			Closing Party

Registration form for the ECE/FAO/ILO Seminar on *Forest, Fire, and Global Change*
Shushenskoye (Russian Federation), 4-10 August 1996

To be completed (please use typewriter or block letters) and sent not later than 1 June 1995 (preferably before 1 May 1995) to:

Federal Forest Service of Russia
59/19 Pyatnitskaya str.
RUS - Moscow 113184
Fax: + + 7-095-233-09-50

with one copy for information to:

Fire Ecology Research Group
c/o Freiburg University
P.O.Box
D-79085 Freiburg
Fax: + + 49-761-808012

and

Timber Section
UN-ECE Trade Division
Palais des Nations
CH-1211 Geneva 10
Fax: + + 41-22-917-0041.

Family name: . . . .

First name(s): . . . .

Functional title: . . . .

Office/Mailing address: . . . .

. . . .

. . . .

. . . .

. . . .

Fax number:. . . . . **Phone number:** . . . .

Representative of (country/organization): . . . .

Accompanied by: . . . .

Preferred language (please circle): - English - French - Russian

I intend to prepare a voluntary paper/poster on the theme of: . . . .

I intend to exhibit the following equipment/technology/hardware/software: . . . .

I have paid the amount of US-$ 600 (US-$ 700 between 1 and 30 June 1996) on the Deutsche Bank Account (Deutsche Bank, D-79098 Freiburg, SWIFT Code: DEUT DE 6F, German BLZ Code: 680 700 30) Account No.0520361)
on .... 1996 (please indicate date of payment).

Date: . . . . **Signature:** . . . .

Registration form for the ECE/FAO/ILO Seminar on *Forest, Fire, and Global Change*
Shushenskoye (Russian Federation), 4-10 August 1996

To be completed (please use typewriter or block letters) and sent not later than 1 June 1995 (preferably before 1 May 1995) to:

Federal Forest Service of Russia
59/19 Pyatnitskaya str.
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with one copy for information to:

Fire Ecology Research Group
c/o Freiburg University
P.O.Box
D-79085 Freiburg
Fax: + +49-761-808012

and

Timber Section
UN-ECE Trade Division
Palais des Nations
CH-1211 Geneva 10
Fax: + +41-22-917-0041.

Family name: . . . .

First name(s): . . . .

Functional title: . . . .

Office/Mailing address: . . . .

. . . .

. . . .

. . . .

. . . .

Fax number: . . . . **Phone number:** . . . .

Representative of (country/organization): . . . .

Accompanied by: . . . .

Preferred language (please circle): - English - French - Russian

I intend to prepare a voluntary paper/poster on the theme of: . . . .

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on .... 1996 (please indicate date of payment).

Date: . . . . **Signature:** . . . .

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