UNITED NATIONS
ECONOMIC COMMISSION FOR EUROPE

FOOD AND AGRICULTURE ORGANIZATION
OF THE UNITED NATIONS

INTERNATIONAL FOREST FIRE NEWS

No. 13 – July 1995

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CONTENTS

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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 mailed separately.

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

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

The International Association of Wildland Fire

EDITORIAL

After the World Climate Summit: Global Change or Business as Usual ?

Global Circulation Models (GCM) are used by climatologists for modelling global climate under certain assumptions of present and predicted human-caused emissions of greenhouse gases from fossil-fuel burning and land-use systems. The term "***Global Change***" is generally used for the anticipated global development as affected by global climate change and other human impacts. The concept of "***Business as Usual***" describes a scenario of unlimited growth of fossil energy consumption, i.e. no reduction of emission of "greenhouse gases", either through enforcement of international conventions or voluntarily.

The UN World Climate Summit is over, and there is no global change in energy consumption and emission policies. No, the world is back to business as usual. Politicians and representatives of member states of the United Nations had been occupied by debating political procedures. When the summit delegates left Berlin little or nothing had been discussed about the state of and the threat to the world's forests, not to speak about fire, one of the burning problems on the globe.

The initiative came from the Non-Government Organizations (NGO's). The NGO scientific and policy-oriented conferences and workshops at and around the summit attempted to remind the public and the science community that forests and global change must receive attention. ***Endless Taiga? Threat to and Protection of the Boreal Forests*** was the title of an international conference in Berlin organized by the German Nature Protection League and Taiga Rescue Network, parallel to the UN summit. West European, Eurasian and North American scientists presented their views on climate change, boreal forests and the need for protecting them against destructive utilization practices, pollution and fires.

A couple of weeks later the World Wildlife Fund (WWF/USA) called tropical forest ecologists to the ***WWF Conference on the Potential Impacts of Climate Change on Tropical Ecosystems***. In this conference scientists presented their views and models of tropical forest development in a globally changed climate. Fire was one of the hot topics in this conference, and it became clear that fire will be a major factor determining the fate of vegetation under multiple stress of changed climate and increasing human population pressure. The results of this conference will be published soon.

The International Tropical Timber Organization (ITTO), a body formed under the UN International Tropical Timber Agreement (ITTA), realized a first and very important step towards international cooperation in fire management. In the week following the UN summit an international expert panel consisting of fire specialists from ITTO member countries met in Jakarta (Indonesia) and drafted the ***ITTO Guidelines for the Protection of Tropical Forests Against Fire***. Although the guidelines have not yet passed the ITTO Council (in which ITTO members must agree before releasing such a document), it is expected that they will have an influence on national and international projects and agreements on fire protection in the tropics.

The fire science community was not silent. In the same month the participants of the 1995 Chapman Conference "Biomass Burning and Global Change" released a declaration expressing the need to conduct global vegetation and fire inventories in order to better assess the role of vegetation fires in a changing environment.

One week later, the ECE/FAO Agriculture and Timber Division (since 1 July 1995: Timber Section, UN-ECE Trade Division) with its FAO/ECE/ILO Team of Specialists on Forest Fire, FAO and the European Communities met in Geneva and discussed a common strategy for collecting global fire data; the results of this meeting are printed in this issue.

All these activities are important steps toward the upcoming global fire summits, the **ECE/FAO Seminar on *Forest, Fire and Global Change*** (Russian Federation, August 1996; **see p.41**) and the ***Global Wildfire Conference II*** (Canada, May 1997).

In the fire community there is no business as usual. There will be global change - in spirit, cooperation, and policies.

Freiburg, July 1995 Johann G. Goldammer

COUNTRY NOTES

ARGENTINA

Assessment of Economic Losses in Livestock Lands and Use of Fire by Ranchers

Background: It is not easy to assess the amount of burned vegetation (forests, pastures) per year in Argentina. According to official statistics recorded by the **Dirección de Producción Forestal** more than one million hectares are burnt annually. But this figure underestimates the real occurrence of fires. Only a few provinces have an efficient system of collecting information. In most cases the data are incomplete or do not contain useful information. Therefore a very conservative figure of the real annual area burned is at least 1.5 million hectares.

Considering the fact that more than 70% of the area affected by fires are grazing lands, we thought that an enquiry would be an appropriate way to establish contacts with a large number of ranchers.

The objective of the enquiry was to evaluate types of vegetation affected by fire, economic losses, cause of the fires, extent and reasons for use of prescribed fire, and measures of precaution, including cooperation with the authorities, and to determine if an anonymous enquiry is a right approach to obtain feasible information.

Another main goal of the enquiry was to obtain information from ranchers about their views/perceptions of fire. Such information is an important base for development of a fire management plan.

At this stage of the enquiry 680 questionnaires were mailed to ranchers in ten provinces. Most answers came from four provinces: Mendoza, La Pampa, Santa Fe and Corrientes. Out of the 680 letters delivered to these provinces 97 replies were received.

Details of the results of the enquiry are published elsewhere (see below). In this short report we provide some of the most interesting findings.

Results and Conclusions: Although only 14% of the questionnaires were returned, the ranchers had a strong inclination to answer the enquiry. Within this group, 58% considered the fire problem as a high priority matter in their region.

Of course the limited amount of replies does not permit to extrapolate the results to a whole region or province. The information obtained on fire causes show some differences in various provinces, e.g. most apparent in the case of lightning (Fig.1).

According to the answers of the ranchers, almost a half of them practice prescribed burning. The main purpose of this is to stimulate the growth of grass, the grazing resource for cattle. As a simple consequence of this, the principal vegetation type affected by fire was pure grassland, followed by grassland with isolated trees.

On account of the subjects considered when they do a prescribed fire, the items most chosen were: wind speed, to burn with or against the wind, and hour of the day. All ranchers that answered this question considered at least two items before to starting a prescribed fire (they could chose among the following items: hour of the day, wind speed, temperature, relative humidity, fuel moisture, weather forecast, to burn with or against the wind, and "nothing").

The answers to one of the questions ("In the case of a wildfire whom do you ask for help?") reflect the poor trust of ranchers in counties and/or provincial agencies (Fig.2). When they cannot control the fire themselves, most of ranchers (44%) go to their neighbours for help, although only one in four of the ranchers are organized in any way, e.g. in consortia.

The average of total economic losses per ranch is 1.21 $/ha (Tab.1). Greatest economic losses were recorded in Mendoza (1.55 $/ha), where only 12.5% of ranchers practice prescribed burning. Smallest losses were recorded in La Pampa, where a little more than a half of the ranchers are practising prescribed burning.

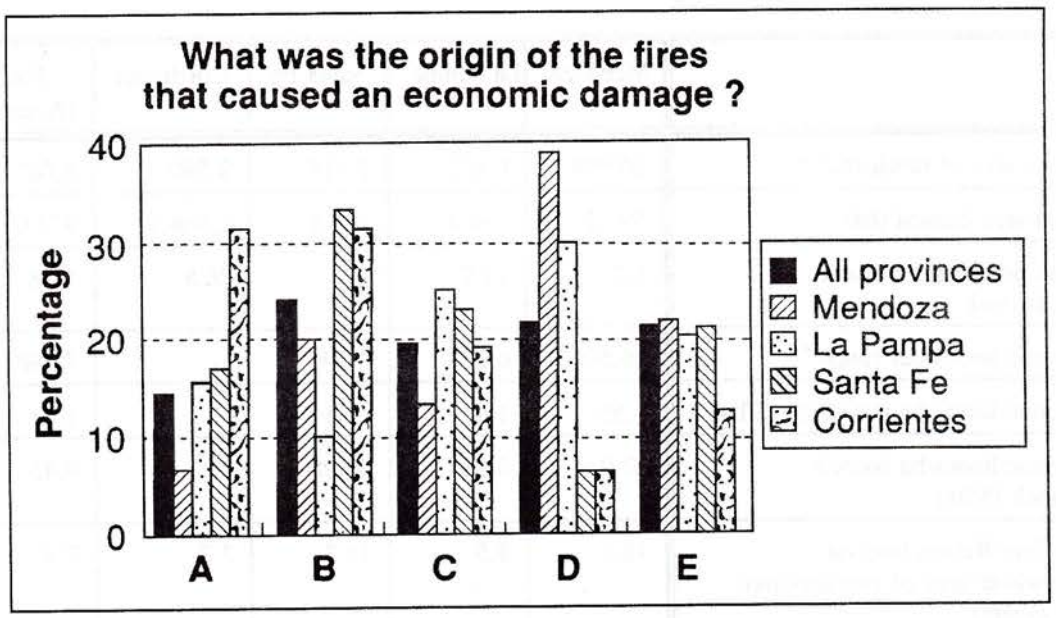

Fig.1. Sources of wildfires causing economic damages

A: escaped management fires; B: arson; C: accidents, negligence; D: lightning; E: unknown

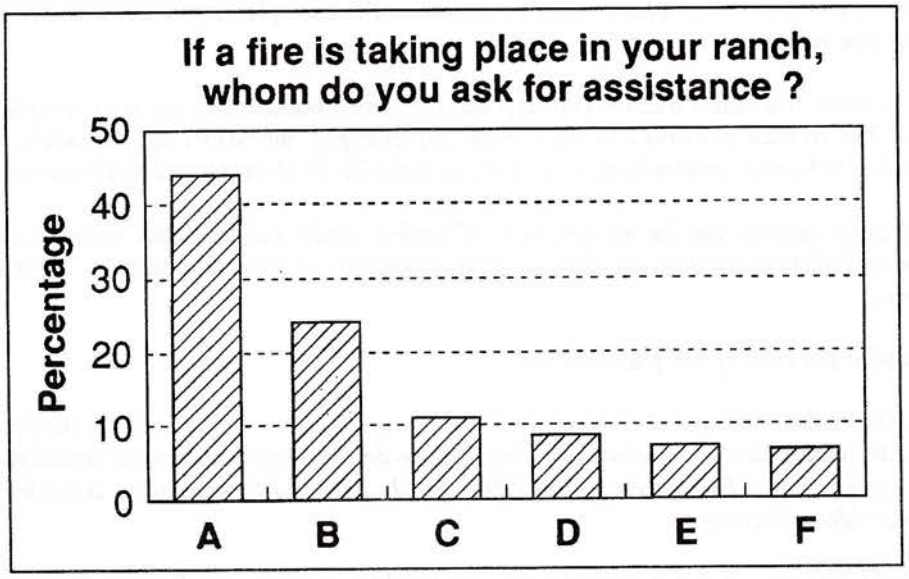

Fig.2. Actions taken by ranchers if a wildfire occurs on their land and fire-fighting support is needed

A: call neighbours; B: call the fire brigade; C: organized system available of reciprocal help with neighbours; D: call the county authorities; E: call the police; F: call the civil defense

Tab.1. Average data on ranch sizes, fires and economic losses in the four Argentinean provinces Mendoza, La Pampa, Santa Fe, and Corrientes

	Mendoza	La Pampa	Santa Fe	Corrientes	Total (Average)
Average size of ranch (ha)	10,598	6,671	3,118	9,590	6,007
Annual area burned (ha)	590.2	780.3	218.8	2,568.8	772.0
Annual percentage of each ranch burned	5.5	11.7	7.0	26.8	12.8
Economic losses per ranch *	16,500	6,833	4,394	-	7,298
Economic losses/ha per ranch ($/ha)	1.55	1.02	1.41	-	1.21
Economic losses/ha burned per ranch ($/ha)	27.9	8.75	20.08	-	9.45
Mean Fire Return Interval of the whole area of average-sized ranch (years)	18.0	8.5	14.3	3.7	7.8

* 1 Argentina $ = 1 US $

In the same way, in Mendoza, the economic losses per burned hectare reach the highest values (27.9 $/ha), and in La Pampa, the lowest (8,75 $/ha burned). The value mentioned for Mendoza is three times the average for all the provinces considered (9.45 $/ha burned). It is important to point out that both economic losses per hectare and economic losses per burned hectare are direct losses. For example they do not consider the reduced income in the post-fire years.

Fire recurrence (= mean fire return interval [MFRI]) and the annual burned area can also provide an idea of the importance of fire in each province. In La Pampa, for example, the MFRI for the whole area of an average-sized ranch is 8.5 years, in Mendoza 17.9 years, in Santa Fe 14.25 years, and in Corrientes 3.7 years.

Finally, an anonymous enquiry can be an easy way of getting quick and abundant information from the ranchers. But this kind of approach does not allow detailed information of many practises or a better assessment of economic losses.

The detailed results of the enquiry are published in:

Tesolin, O., H.Zucchini, y J.G.Goldammer 1994. Encuesta piloto: Evaluación de pérdidas económicas ocasionadas por incendios de campos y uso del fuego por productores ganaderos. Revista Agropecuaria, Forestación, Julio 1994, 34-51. Editorial Agropecuaria Hemisferio Sur, Montevideo, Uruguay.

The research project was carried out in cooperation with the Fire Ecology and Biomass Burning Research Group, Max Planck Institute for Chemistry, Biogeochemistry Department, Germany.

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PEOPLE'S REPUBLIC OF CHINA

Carbon Dioxide Emissions from Forest Fires in China

With the increasing concern about the rise of atmospheric CO_2 content that will incur climate change, the role of forest fires in the global carbon cycle has received increasing interest. However, the frequency and areal extent of forest fires in China, and their implication for CO_2 emission to the atmosphere, have not been assessed yet.

The objectives of this paper are to assess the frequency and areal extent of forest fires in China from 1950 to 1992, and to estimate the carbon emission from these forest fires. Two sources of statistical data were compiled: (1) annual forest statistics of China, which identify the frequency and areal extent of forest fires for each province since 1950; and (2) forest growing stock volumes available on a provincial basis as a result of the third countrywide forest survey of 1984-1988.

Here, two forest components have been taken into consideration: the aboveground biomass and litter mass because they are more sensitive to fires than the underground component. For the aboveground tree component, its carbon density was estimated as a product of volume density, wood density, the ratio of total to merchantable biomass, the ratio of aboveground to total biomass and the conversion factor of biomass to carbon. Wood density is in the range of 0.3 to 0.7 t/m^3. An average value of 0.5 t/m^3 was adopted because the softwood and hardwood areas are approximately equal both on a national and provincial basis. We assumed the ratio of total to merchantable biomass to be 2.7, while the ratio of aboveground to total biomass is assumed to be 0.75. The generally accepted conversion factor of biomass to CO_2-C was 0.45. For litter mass, the carbon storage in litter per unit of area (t/ha) was calculated from the litter mass on the forest floor (10 t/ha) and the conversion factor of biomass to carbon, which was taken again to be 0.45 as mentioned above.

The annual carbon emission M from forest fires in a statistical unit is related to the burned area A by the following equation:

$$M = A \times \Sigma(B_i \times E_i) \qquad (1)$$

where B_i is the average organic carbon per unit area or carbon density (t/ha) of the i^{th} forest component in a statistical unit, and E_i is the burning efficiency of the i^{th} forest biomass. Here we adopted E_i to be 0.4 for the aboveground component. The reason is that the burned area A herein is defined as the forest area in which more than 30% of the trees have been combusted and recurring fire on the same forest was excluded. According to the chronicle of forest fires, the forest area burned was about of half of the forest area influenced by fires. A similar E_i value of 0.4 was used for secondary forest and 0.3 for primary forest by other authors. The E_i for litter mass was assumed to be 0.8, because litter, comprising fallen leaves, small twigs and branches, is easily ignited.

The cumulative occurrence of forest fires in the period of 1950-1992 in China amounted to 632,994, with an annual average of 16,212 (Tab.1). The variations in number of forest fires in all provinces are significant and nearly 60% of provinces have variation coefficients larger than 1. The cumulative burned forest area amounted to 36.31 million ha in the period of 1950-1992, consisting about 29% of the total forest area in China, with an annual average of 946,000 ha (Tab.2). The variation in burned forest area for all provinces is also significant. About 76% of provinces have variation coefficients larger than 1. The cumulative direct carbon emission from forest fires amounted to 343.29 million t in the period of 1950-1992, with an annual average of 20 million t per year, of which 12.4 million t per year (62%) from aboveground biomass combustion (Tab.3). The carbon release from Neimenggu, Helongjiang and Yunnan Provinces accounts for 75.9% of the total release (Tab.3).

The direct carbon release from forest fire is 0.30 million t in 1992 and 20 million t/year over 1950-1992, which are about 0.04% and 2.94% of the carbon emission from fossil fuel combustion and cement production in 1992 (678 million t/year), respectively, and about 1.76% and 117% of the carbon emission from forest due to change in land use (17 million t/year), respectively.

As compared with the temperate and boreal forests in other countries, forest fire in China is significant. According to the annual occurrence of forest fires (number of fires), China ranks second in the world after Russia. Regarding to burned area, China lies the third, following Canada and Russia.

On a global scale, the carbon release from biomass burning was estimated to be 3.0-6.2 billion t/year, which accounted for 40-60% of the net carbon flux from terrestrial ecosystems. The carbon emission from temperate and boreal forest have been estimated at 130 million t/year, accounting for 3% of the carbon release from biomass burning. If we take the carbon emission from forest fires in China into account, the global carbon release from temperate and boreal forests increases by 15.4%.

A more detailed version of this article, with bibliographic references, can be obtained from the authors:

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Tab.1. Occurrence of forest fires by province in China from 1950-1992

Province	Number of Records	Cumulative Number	Annual Number of Fires			
			Average	Max.	Min.	Coefficient of Variation
Bejing	23	659	29	108	1	1.13
Tianjing	2	8	4	6	2	0.50
Hebei	36	3 471	96	355	2	1.17
Shanxi	40	4 328	108	440	7	0.85
Neimengu	32	2 684	84	211	1	0.83
Liaoning	41	7 299	178	783	10	1.21
Jilin	43	8 238	192	617	1	1.04
Helongjiang	42	11 040	263	904	1	0.93
Shanghai	3	3	1	1	1	0.00
Jiangsu	29	1 714	59	201	6	0.87
Zhejiang	34	29 548	869	3 976	69	1.10
Anhui	43	13 979	325	2 100	21	1.24
Fujiang	40	62 436	1 561	6 134	307	0.84
Jiangxi	42	35 728	851	4 143	13	1.05
Shandong	29	3 757	130	760	6	1.23
Henan	38	5 756	151	846	10	1.29
Hubei	38	21 898	576	2 465	65	1.06
Hunan	40	58 921	1 473	11 809	44	1.31
Guangdong	43	50 192	1 167	8 514	167	1.28
Guangxi	42	65 553	1 561	5 701	149	0.83
Sichuan	40	39 746	994	6 888	42	1.39
Guizhou	40	61 784	1 545	4 493	80	0.73
Yunnan	37	122 653	3 315	12 948	324	0.74
Xizang	12	568	47	301	4	1.69
Shaanxi	43	14 688	342	3 585	5	1.76
Gansu	43	4 150	97	969	1	1.66
Qinghai	31	381	12	58	1	1.14
Ningxia	23	108	5	14	1	0.88
Xingjiang	36	941	26	127	3	1.07
Hainan	5	763	153	454	33	1.00
Daxinanli	3	8	3	4	1	0.47
Total		632 994	16 212			

Tab.2. Forest area affected by fires for each province of China from 1950 to 1992

Province	Number of Records	Cumulative Number (10^3 ha)	Annual Forest Area Affected by Fires (10^3 ha)			
			Average	Max.	Min.	Coefficient of Variation
Bejing	14	2.18	0.16	0.40	0.01	0.83
Tianjing	2	0.05	0.02	0.05	0.00	0.89
Hebei	35	86.79	2.48	14.91	0.01	1.68
Shanxi	37	79.82	2.16	18.60	0.01	1.75
Neimengu	30	6 055.14	201.84	1 458.87	0.25	1.43
Liaoning	41	94.16	2.30	11.33	0.02	1.49
Jilin	40	532.86	13.32	94.13	0.01	1.69
Helongjiang	42	13 540.10	322.38	1 947.93	0.04	1.36
Shanghai	1	0.33	0.33	0.33	0.33	0.00
Jiangsu	24	21.36	0.89	5.87	0.02	1.56
Zhejiang	39	254.53	6.53	36.00	0.66	1.18
Anhui	41	387.72	9.46	119.73	0.07	2.23
Fujiang	40	1 212.22	30.31	305.20	1.23	1.66
Jiangxi	43	846.12	20.10	129.00	0.43	1.19
Shandong	29	26.68	0.92	5.73	0.05	1.59
Henan	39	292.94	7.51	54.87	0.02	1.81
Hubei	37	815.37	22.04	142.33	0.47	1.68
Hunan	40	892.97	22.32	193.20	1,27	1.51
Guangdong	42	1 859.16	44.27	307.20	1.04	1.34
Guangxi	41	2 259.66	55.11	237.53	1.47	1.03
Sichuan	42	710.72	16.92	82.53	0.15	1.16
Guizhou	38	1 067.90	28.10	113.33	0.51	0.96
Yunnan	39	4 892.92	125.46	468.67	0.14	0.97
Xizang	12	25.16	2.10	6.00	0.00	0.81
Shaanxi	43	239.73	5.58	67.53	0.08	2.48
Gansu	42	35.62	0.85	8.93	0.00	1.69
Qinghai	20	16.76	0.84	8.53	0.01	2.18
Ningxia	6	0.40	0.07	0.13	0.00	0.81
Xingjiang	29	39.97	1.38	7.53	0.05	1.60
Hainan	5	2.16	0.43	1.55	0.14	1.29
Daxinanli	3	0.18	0.06	0.11	0.01	0.69
		36 309.69	946.22			

Tab.3. Direct carbon emission from forest fires by province in China

Province	Direct Carbon Emission (10^3 C t/ha/year)		
	Aboveground	Litter	Total
Bejing	0.50	1.25	1.74
Tianjing	0.08	0.20	0.28
Hebei	9.73	19.84	29.57
Shanxi	15.00	17.26	32.26
Neimengu	2 300.00	1 614.70	3 941.71
Liaoning	12.86	18.37	31.24
Jilin	276.77	106.57	383.34
Helongjiang	4 954.92	2 579.07	7 533.98
Shanghai	0.48	2.67	3.15
Jiangsu	2.89	7.12	10.01
Zhejiang	25.96	52.21	78.17
Anhui	54.50	75.65	130.15
Fujiang	291.23	242.44	533.67
Jiangxi	102.99	160.77	263.75
Shandong	1.11	7.36	8.47
Henan	35.23	60.09	95.32
Hubei	111.60	176.30	287.89
Hunan	84.74	178.59	263.33
Guangdong	211.63	354.13	565.75
Guangxi	392.15	440.91	833.06
Sichuan	361.10	135.37	496.48
Guizhou	249.12	224.82	473.94
Yunnan	2 688.11	1 003.68	3 691.78
Xizang	84.69	16.78	101.46
Shaanxi	55.86	44.60	100.46
Gansu	13.11	6.78	19.89
Qinghai	16.96	6.70	23.66
Ningxia	0.56	0.53	1.09
Xingjiang	30.76	11.03	41.79
Hainan	5.29	3.46	8.75
Daxinanli	0.93	0.48	1.41
Total	12 390.84	7 569.73	19 960.58

ECUADOR ***Setting a World Heritage Ablaze - the 1994 Fire in the Galápagos***

What comes more natural to a volcano than destruction? Well, the fire on the slope of one of Isabela islands' volcanoes in the Galápagos National Park during spring 1994 was not a natural event. It was human-caused and it reflects the deep turmoil that currently affects this world heritage archipelago.

When the fire was first detected on 11 April 1994, the potential threat to the endemic tortoise populations made world news. Ecuador, to which the islands legally belong, declared a state of emergency and asked for international assistance. However, even before the fire started, several dozen tortoises had been killed by locals

(probably fishermen), often without using their meat as food, reaching a total death toll of 81 in 1994. Despite the international public's perception, the fire never even came close to the threatened tortoise populations.

I will argue that both the killing of the tortoises and the arson were used as political threats against conservationists, and that both are linked to the exploitation of the marine national park.

Facts on Fire

Between 3500 and 5500 ha of national park land were affected by the 1994 fire, the fourth wild fire on Isabela island this century (Fig.1). This fire was small in comparison with the 1985 fire, which had affected an area of approximately 20,000 ha in the same locality. All areas burnt in 1994 had already been burnt in 1985 (Fig.2). The fire was mainly nurtured by Guayaba trees and dried ferns. The ferns formed a dense cape of inflammables which helped spread the fire. Wind, mostly from southerly directions, pushed the fire spread rapidly, sometimes up to 3 kilometres per hour. Furthermore, burning Guayaba leaves were carried off by the wind for distances of up to half a kilometre, where they sometimes started secondary fires.

Topography : The affected area was situated approximately 6 km to the southwest of volcano Sierra Negra in the highlands of the island and consisted of a slightly inclined surface. The slope of the terrain was usually less than 15%. Because the entire archipelago is of volcanic origin, the lava surfaces are highly rugged and underground tunnels abound. This makes all kind of movements and work extremely difficult.

Climate: Being situated near the equator (at less than 1°S), the effective temperature often exceeds 50°C, implying a shaded daytime air temperature of 30 to 38°C. The climate in the Galápagos is characterized by two seasons, the cold or ***garua*** season from June to December and the warm and sometimes wet season from January to May. During the ***garua*** season a constant slight drizzle prevails, whereas during the warm season (as in April) there are mostly clear skies with occasional cumulonimbus clouds and rain. The humidity during the warm season, when the fire burnt, fluctuated between 65 and 85%.

Fire activity: The flames usually reached a height of about half a metre, but with 5 to 10 knots wind speeds could increase to about one and a half metres. The fire also continued below ground and in cracks, where vegetation had accumulated. This made rapid efforts to extinguish the fire impossible, thus one could only hope for the rains of the warm season or the drizzle of the ***garua*** season to come. In the course of the day, fire activity fluctuated: below a humidity of 70 %, in the morning before about 11 a.m. and the evening after about 5 p.m., fire activity decreased. Around midday, humidity was reduced and the fire increased again. Due to the rugged topography and dense vegetation the fire burnt for a period of about 9 weeks. The last fires were extinguished by 7 June, after the cold season had started.

Fire fighting: More than 100 fire fighters from 7 institutions worked on the spot (the Galápagos National Park Service, the National Institute of Galápagos, the Ecuadorian Forestry Institute of Natural Areas and Wildlife, the Municipality of Isabela, the Ecuadorian army, the Charles Darwin Research Station and the Civil Defence). Two helicopters supported the fire fighters. Three to six tractors were used to construct a total of about 20 km of fire breaks in two months. The heavy equipment did better than manual work as the latter was extremely exhausting and at times ineffective due to the rapid progress of the fire. Furthermore, hand tools like backpack pumps were largely unavailable in the Galápagos; later the Canadian government (through the Canadian Interagency Forest Fire Centre, Winnipeg, Manitoba) provided tools.

A major problem turned out to be logistics. Supplies could only be brought in from the continent by air to Baltra or San Cristóbal island, where the two airports of the archipelago are located which are suited for large planes (a new airstrip will soon be finished in Puerto Villamil, Isabela). Supplies by cargo vessels were brought to Puerto Villamil directly either from the continent or from the two major islands of Santa Cruz or San Cristóbal. However, unloading was sometimes very difficult in the small natural harbour of Puerto Villamil due to the heavy swell.

All material had to be transported to the fire fighters from the small town of Puerto Villamil located at the southeastern coast of Isabela island. There are no other villages on Isabela, which is home to about a thousand people. The distance from Puerto Villamil to the fire was about 40 to 50 km on land or 20 km by air. On

several occasions both fuel and water became scarce for the fire fighters, causing the machinery to halt. Similarly, communications between fire fighter camps were difficult because fuel to run generators for the recharging of radio batteries was scarce. Nevertheless, the entire operation turned out to be well coordinated between the two principal agencies, the INEFAN (Ecuadorian Forestry Institute of Natural Areas and Wildlife) and the army. The local heads of both institutions handled the situation with caution and circumspection. Despite the prolonged period of burning and the extent of the destruction, the local population of Isabela, living far from the fire, generally showed little interest in the fire fighting operation or the fire itself.

Ecological effects: The vegetation was not completely destroyed by the fire; patches of vegetation remained to create a mosaic of burnt and intact areas. After four months, sprouts of ferns and other plants started to appear in the burnt areas. It is likely that the burnt area will be covered with lush vegetation within half a decade or so, as judged from the aftermath of the 1985 fire, when there was little sign of destruction four years after the fire. There was never a threat to the tortoise populations, not even the one of Cerro Paloma, which was closest to the fire and numbers approximately 30 individuals. Ten tortoises were, however, moved by helicopter or on the backs of donkeys to an enclosure close to Puerto Villamil to protect them from slaughter.

Political aspects: As already stated, there was never a real threat to any of the tortoise populations from the fire. The real threat to the tortoises originated from killing, as 81 tortoises were slaughtered in Isabela during 1994. Previously tortoises had sometimes been killed for meat; this was not the case in 1994. This demonstrated both the inability to protect wildlife without the collaboration of local fishermen and the determination of locals to break national park legal rules.

In searching for explanations for the killing and the forest fire, one first has to look into the history of immigration into the Galápagos. Many people, including fishermen and peasants, left continental Ecuador during the last decade to earn a better living in the "Enchanted Islands". Most of these people had no relation to the conservation of natural areas and behaved accordingly. Thus animals were killed thoughtlessly and fires probably started the same way. Recently, however, both ways of destruction have also been used as threats in political debates.

Because groupers and lobsters had both been overfished for years and had became scarce, fishermen searched for a new source of revenue. The exploitation of sea-cucumbers, although previously prohibited, turned out to be a gold mine. In addition to "local" fishermen from the Galápagos, hundreds of fishermen from the continent rushed to the archipelago to get their share. When the Ecuadorian government, through the Galápagos National Park Service (GNPS), tried to stop the illegal exploitation inside the marine national park, both the GNPS and the Charles-Darwin Research Station (CDRS) were threatened and taken hostage for several days (in the first week of 1995). Proposed threats included the introduction of cats and dogs to untouched islands, the killing of "Lonely George" - the last tortoise of its species -, the killing of tortoises on other islands and the burning of entire islands such as Santa Fe or the Plazas.

Thus the destruction caused by the fire and the slaughter of tortoises were evidently used to threaten the authorities whose job is to protect the national park. A fire like the one in 1994 on Isabela island efficiently tied up resources and personnel necessary to control the national park and also distracted attention from the massive exploitation of the marine national park. If the "gold-rush" mentality of destructive exploitation really spreads in the Galápagos world heritage, then this is the end to one of the worlds most famous and most fabulous laboratories of evolution.

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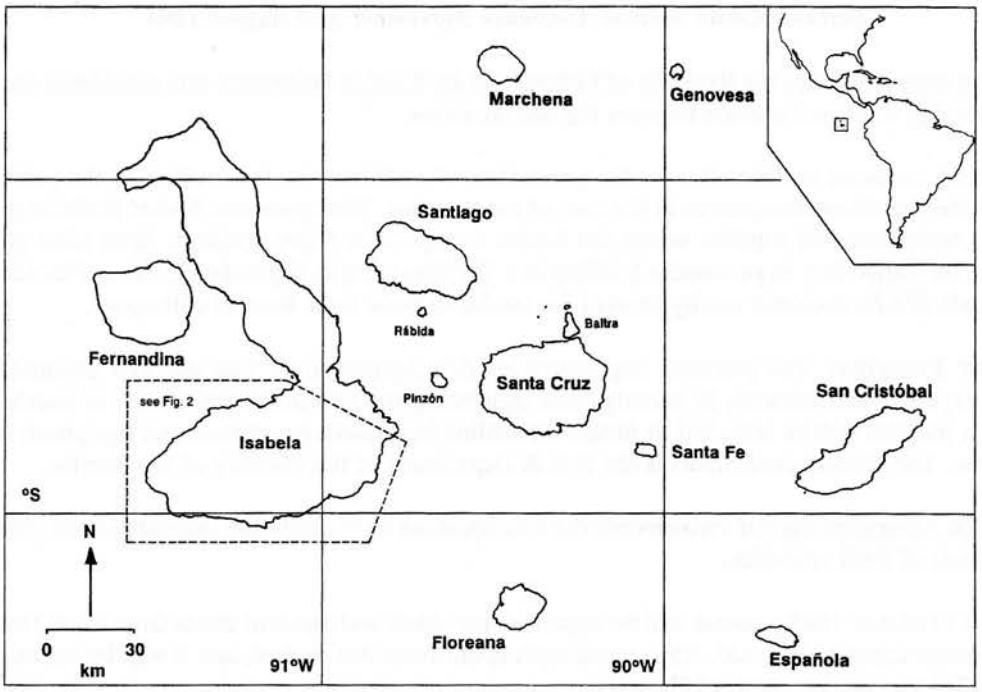

Fig.1. Map of the Galápagos showing the major central islands of the archipelago. The small map in the right upper corner shows the location of the archipelago in the Pacific ocean, ca. 1000 km in the west of Ecuador, South America. The 1994 fire burnt on Isabela, the largest island of the archipelago. Only the south-eastern areas of Isabela island are settled by approximately 1000 people.

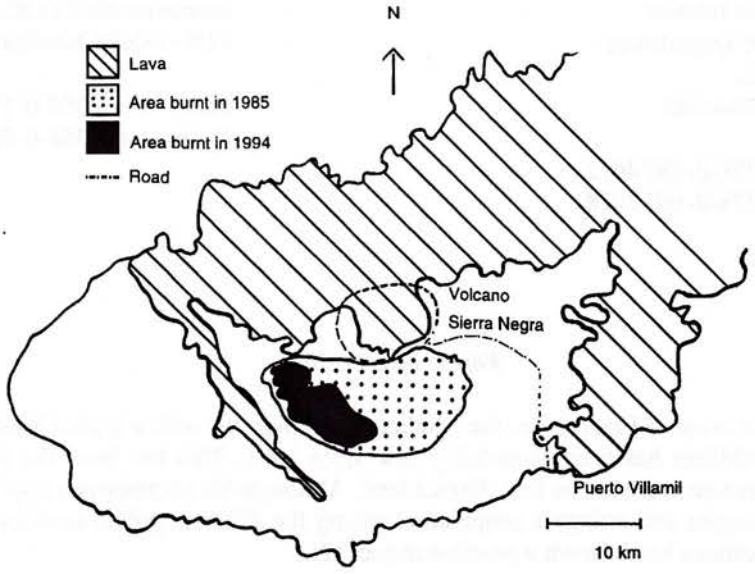

Fig.2. Detailed map of southern Isabela island showing the areas burnt in 1985 and 1994, the surface structure and the major village Puerto Villamil.

FINLAND

Finland/Russia Mutual Assistance Agreement of 9 August 1994

An agreement signed between the Republic of Finland and the Russian Federation was considered necessary in view of increasing trade and tourism between the two countries.

This agreement concerns collaboration in the prevention of accidents, in information to the public and in reduction of the negative consequences in the case of emergencies. The agreement further includes procedures for bringing equipment and supplies across the border in case of a major accident. Soon after signing the agreement a fire started in a large wooden building in a Carelian town in September 1994. A Finnish Fire and Rescue Brigade (F&R) stationed nearby crossed the border to assist their Russian colleagues.

Exchange of Expertise: The practical implication of this Agreement is that the two countries will be exchanging expertise and assisting in investigations concerning the prevention and causes of accidents. Also joint research projects will be launched to further streamline legislation, procedures and equipment in case of large disasters. The Finnish counterpart is the F & R Department of the Ministry of the Interior.

Training: The Agreement further recommends the two countries to intensify the organization of joint training in various fields of F&R activities.

Between 10-13 October 1995 a course will be organized for chiefs and assistant chiefs from F&R Departments in the metropolitan area of Helsinki. The course topic is on forest fire control, and it will be organized at the Evo Forest College (140 km north of Helsinki).

These F&R Departments have formed a special emergency unit in the case of needs outside Finland. This Unit is called FINN-RESCUE-FORCES (FRF).

The participating countries are: Estonia, Finland, Latvia, Russia and Ukraine.

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FRANCE ***Forest Fire Profile***

For the most fire-prone areas of France, i.e. the Southern *Départements* with a typical Mediterranean climate, the area burned by wildfires has been remarkably low since 1991. This has been the longest period ever registered since data became available on fire-affected land. Although this phenomenon may be partly explained by fire prevention strategies and stringent cooperation among the different public services, it is obvious that moderate weather conditions have shown a positive impact (2).

In the 1994 fire season in France the number of fires and the area burned were distinctly reduced with 2,538 fires affecting 21,400 ha forest (0.5%), *maquis* and *garrigue*, compared with the decennial average (1980-90) of 30,600 ha caused by 3,000 fires. This result is even more satisfying when compared with the all-Mediterranean situation. In 1994 a total of 652,000 ha burned in southern Europe. The annual average for this area is 504,000 ha (1980/93). Italy and Spain both experienced severe fire seasons with 100,000 ha (1.2%) and 300,000 ha (1.1%) burned respectively. The generally satisfying French result has been overshadowed by the wildfires on the island of Corsica where 930 fires burned 16,800 ha in 1994 (6).

Fire prevention measures have been made more efficient by improved meterological prediction and risk assessment. These actions were combined with supply of heavy equipment efforts in different forest regions with the help of the *Conservatoire de la Forêt Méditerranéenne* C.F.M.) in southern France and the European Union (E.U.) in other parts of France. The result: 80% of the fires were smaller than one hectare, and 95% of the fires were smaller than five hectares.

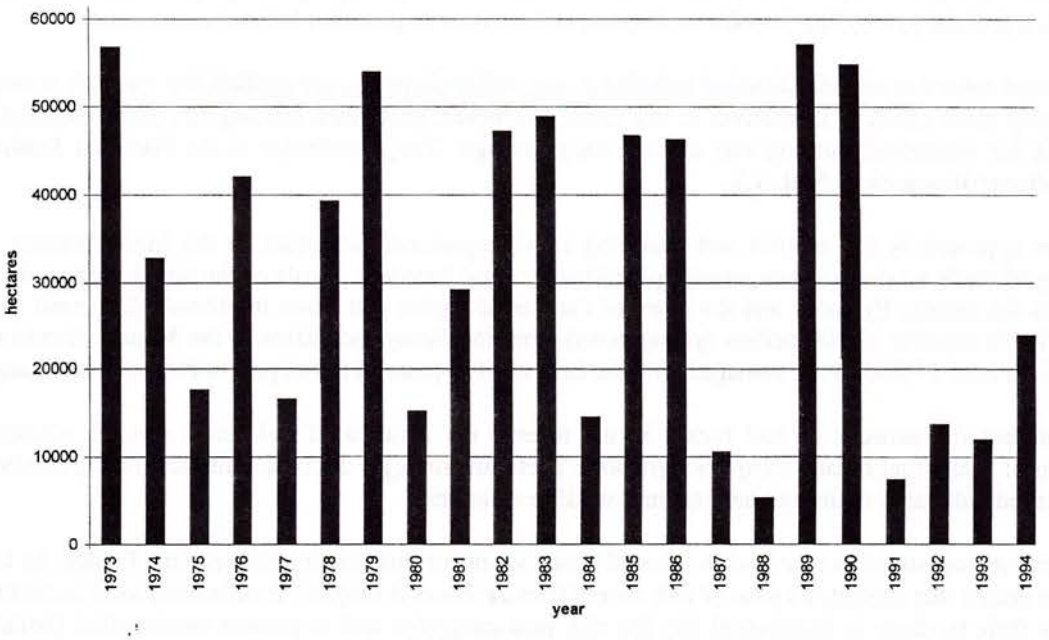

Fig.1. French Mediterranean forest area burned by wildfires during the period 1973-1994

Fire protection

In fire protection the French state services take three types of actions: (a) fire prevention education for the public, (b) surveillance of forested areas for early fire detection, and (c) vegetation management to reduce fuels (5).

(a) In the Mediterranean basin fire is traditionally used as a management tool by farmers or forest workers. Negligence (42%), accidents (27%) especially during forest utilization and agricultural activities, and arson (11%) are the main fire causes in France (1). Therefore information campaigns are organized each year in order to remind the public of the risk associated with the use of fire and the different obligations, e.g. house owners in forested areas are obliged by law to create fuel breaks with a radius of 50 m around houses.

(b) For the surveillance of forest land all state services are mobilized (*gendarmerie*, national police, forest service, the administration for agriculture and forestry, fire brigades, private forest owners and hunting associations). By law active fire fighting is the task of the fire brigades. In addition, a specially trained forester was created in the sixties for the Mediterranean region: the fire fighting foresters (*sapeur-forestier*).

In the Mediterranean climate, defined as a "red" zone of high fire risk, fire detection is primarily based on a system of fire towers throughout the region. In addition, fire spotting planes and mobile ground units of the fighters and *sapeur-forestiers*, equipped with water carrying four-wheel drive utility vehicles for rapid initial attack, patrol the Mediterranean forests and enforce the law. In the temperate areas of France ("orange" zone of average fire risk) fire detection is more extensive and primarily based on fire towers. To improve the surveillance and the prevention, the E.U. finances 70% of the measures in the "orange zone".

For all actions in which the state is not directly involved a public association (*Entente interdépartementale en vue de la protection de la forêt contre l'incendie*) was established in 1963. This association regroups the fifteen French *Départements* with a Mediterranean climate. Its objectives are to inform the public, test new fire fighting equipment, train specialists, maintain special services (e.g. a water bomber air base) or fire fighting equipment (e.g. retardants).

(c) The third pillar of fire prevention is land management. Fire prevention measures, e.g. fuel breaks are planned at the scale of an entire forested area (*massif forestier*) without differentiating between ownerships. The private owners have to be convinced of the necessity and utility of proposed projects. In the rare case of refusal, a judicial proceeding in order to dispossess the owner is possible, but not recommended.

For hazard reduction not only classical techniques, e.g. roller-chopping, are applied, but research is carried out to develop more efficient alternatives at low costs. Moreover, prescribed burning has been introduced and a network for prescribed burning was created six years ago. The coordinator is the **National Institute for Agricultural Research (I.N.R.A.)**.

Another approach is the support and financing of silvo-pastoral techniques in the Mediterranean forests. Grazing of cattle or sheep is temporarily permitted for local breeders. Herds of the Ariège region descend to graze in the eastern Pyrenées and the cows of the Cantal region will graze in Hérault. The most important action is the transfer of 500 heifers (young cows) from the Savoy mountains to the Maures forests near St. Tropez. In total 17,000 ha are managed with the help of silvo-pastoral techniques in Provence and Languedoc.

To complete the network of fuel breaks in the forests, the agricultural and forest services encourage the creation of green fuel breaks (*coupure agricole*). These are strategic discontinuities separating forested areas by interlaid cultivated fields and help to limit wildfire disasters.

The scattered construction near and in forested areas is a major problem in south-eastern France. In 1992 this led to a decree that instituted a plan of risk zones (*Plan de Zones à Risque*). It authorizes local communities to classify their territory in function of the fire risk into categories and to prevent construction (buildings) in wildfire prone areas or to apply restrictive measures. The communities also have to manage their domestic waste dumps in a way that prevents spontaneous combustion.

Actual Problems and Research Needs

In the last thirty years France has developed a well performing and highly competitive industry. It has a surplus of agricultural production within the European Union. In the Mediterranean area a low return on investment, high exploitation costs, low timber quality and a loosely organized wood processing industry, have created new problems for forest fire protection. Farming land is often abandoned and naturally and artificially regenerated forests cover the former agrarian countryside. Conifers, as typical pioneer species and fast growing, were favoured by this development. Since 1900 the French Mediterranean forest surface gained 220,000 ha (174,000 ha conifers) without counting the bush vegetation (6).

The question is to what extent the decreased areas burned by fires have been directly the result of better fire prevention and suppression techniques and not just of weather conditions. It is certain that wildfires of more than 500 ha are causing an increasing part of the burned area (32% in 1976, 57% during the last four years). The more effective fire protection measures seem to lead to an accumulation of fuel in the French Mediterranean forests. The policy of rapid initial attack is very effective, but does not seem to be adapted to large fires (6). Parallel to these phenomena the biodiversity of the Mediterranean ecosystems is rapidly decreasing. The traditional mosaic-shaped forests and landscapes, rich in edge-effects, provide niches for rare and endangered flora and fauna. Here, prescribed fire for hazard reduction and silvo-pastoralism for conserving the traditional landscape might offer an appropriate solutions.[1]

[1] For more details on the use of prescribed fire in France: See last issue of "Informations D.F.C.I.", the fire newsletter of CEMAGREF (Address: CEMAGREF, Le Tholonet, B.P.31, F-13612 Aix-en-Provence).
The Editor.

Forest Fire Research

Mediterranean forests are characterized by complexity and fragility. Their management with the objectives of protection, production and biodiversity necessitates the mastering of especially adapted techniques. The actual French research programmes aim to define the different vulnerable zones of the Mediterranean forest corresponding to soil characteristics, vegetation and relief. Different research projects funded by the European Union and international contracts show that scientific cooperation is considered as essential.

At the moment the knowledge about "traditional" preventive measures, (e.g. surveillance, fuel breaks) and modern fire fighting techniques, are relatively advanced in France. The introduction of Geographical Information Systems (GIS) in combination with more sophisticated satellite data have fostered fuel mapping and forest fire modelling projects and expert systems. While the basic characteristics of fire physics are known under controlled conditions, little research has been achieved to document fire behaviour and effects. Additional research is needed to better predict the behaviour and effects of prescribed burning and wildfires.

The Mediterranean forest research division at I.N.R.A. with its forest fire prevention unit (*prévention des incendies de forêt*) in Avignon concentrates its research on (a) modelling of flammability and fire propagation, (b) traditional and new hazard reduction methods for fuel breaks, including modelling of vegetation dynamics on fuel breaks, and (c) effect on trees of surface fires and convective activities in prescribed fires.

The École Nationale des Mines is investigating digitized cartography of fire prone zones. The National Centre for Scientific Research (C.N.R.S.) and various universities are working on the different aspects of fire ecology, e.g. plant succession after fire. Remote sensing of savanna fires and determination of gaseous and aerosol emissions is one of the major research activities conducted under the umbrella of IGBP/IGAC.

The National Centre for Agricultural Machines, Rural Engineering, Water and Forestry (*Centre National du Machinisme Agricole, du Génie Rural, des Eaux et des Forêt*) provides access to an important documentation on forestry and forest fires in the Mediterranean basin.

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Sources

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ISRAEL

Worst Forest Fire in Israel's History

Around noon on Sunday 2 July 1995, a fire started in the foothills some 15 km west of Jerusalem near the Tel Aviv - Jerusalem highway. The cause appears to have been negligence. Foehn conditions with very low relative humidity, high surface temperatures and strong winds, as well as steep terrain, caused high rates of spread and heavy spotting across roads and other fire breaks. Within a short time the fire was out of control and threatening buildings. In the next few hours some six kibbutzim and moshavim (rural settlements) had to be evacuated. By evening (19:00) the fire was under control. Some 30 houses were partly or completely destroyed, but luckily there were no deaths, and only 29 people were injured by smoke inhalation. First unofficial estimates of burnt area (2000 ha) make it the largest and most destructive forest fire in the history of the state. The forest area destroyed included both natural (Mediterranean oak maquis) and planted (conifer) forests. A significant fraction of the latter were planted through donations from both Israel and abroad.

Israel's Forest Department has set as a goal the reforestation of the burnt area within a time period of four years. The area includes both sides of a drainage area, through which runs the major intercity highway leading to Israel's capital and as such is of great scenic and historic value. For this reason, a GIS Forest Mapping project, already in progress, will be enlisted to aid in the planning process.

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REPUBLIC OF KOREA

Forest Fires: Background, Statistics, Management and Research

The Republic of Korea is located on a peninsular between 124-131°E and 33-43°N, between the Yellow Sea and the Sea of Japan. Of the four distinct seasons spring and fall are relatively short, while summer and winter are long, with annual mean temperature ranging from 3-16°C and annual precipitation ranging between 600 and 1,600 mm. According to the 1993 forestry statistics forests cover 6.46 million ha, occupying 65% of the total land area. Coniferous forests account for 45%, hardwood forests 25%, mixed forest 27%, and unstocked areas 3%. The growing stock of the Korean forest was estimated to be 272 million m^3 in 1992. Forest land ownership is as follows: national forest 21%, public forest 8%, and private forest 71%.

The Forest fire situation: A turning point in the history of Korean forest policy was witnessed in 1973 by the initiation of two of the successive 10-year forest development plans. As a result, 2 million ha were reforested, which is approximately 34% of total forest land. Thereafter, as the forests grew, wood fuel and ground litter increased. The forests have been exposed to the risk of forest fire by the increases in ground fuel and number of visitors. Therefore, Korean foresters are facing a new task of protecting forest land from fire disasters.

Based on to the official statistics collected since 1987, there is no record of fire from natural causes. All fires have been caused by humans, especially by careless burning by local people. Major causes of forest fire were careless weed burning in the spring season, activities of people visiting ancestors' graves, etc. The majority of forest fires (>80%) occur in the spring and fall. Detailed forest fire statistics are given in Table 1.

Because most cases of forest fire were caused by careless human activities, it seems to be important to reinforce fire prevention activities based on anthropogenic causes. A headquarters for forest fire control has been established in the Forestry Administration, and local fire control centres are in operation with national forest stations distributed in provincial, city and county levels.

Tab.1. Forest fire statistics of the Republic of Korea for the period 1987 to 1991

Year	Number of Fires	Area Burned (ha)	Timber Damaged (m^3)
1987	87	191	243
1988	270	878	3,383
1989	294	1,652	3,024
1990	71	175	323
1991	139	429	1,740

The forest fire prevention period is designated as follows: Spring (1 March to 31 May) and fall (15 November to 15 December). Major activities during those periods are to strengthen campaign, patrol and other prevention measures (Tab.2).

For a long time fire fighting was done with green branches, rakes, shovels, hand saws, hatchets and hoes. However, in recent years, aerial fire fighting with helicopters, chainsaws, and motor pumps have come into use.

Tab.2. Fire danger levels estimated by weather conditions

Danger level	Weather Conditions	Defensive Measures
High	. E.R.H.*: < 40% . Wind speed: > 5 m/sec	. Working alert with 1/2 of staff on stand-by at the office . Hiking routes closed
Medium	. E.R.H.: 41-60% . Wind speed: < 3 m/sec	. Working alert with 1/3 of staff on stand-by at the office . Hiking routes partly closed
Low	. E.R.H.: > 60% . Wind speed: < 3 m/sec	. Normal working routine . Hiking routes open

* E.R.H.: Effective Relative Humidity

Forest Fire Research

The Forestry Research Institute of Korea has carried out the following research activities:

- Development of a fire management system with the following subcomponents:
  - Computer-supported forest fire danger rating model
  - Forest fire detection system
  - Forest fire suppression model
- Fire suppression technology using helicopters and ground personnel
- Aerial application of foam and other chemical fire retardants
- Fire ecology research.

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LITHUANIA — Forest Fire Statistics Update

Lithuania, a Baltic country with a land area of 65,200 km^2 and 3.7 million inhabitants, has approximately 1.8 million ha of forest cover. These forests occupy roughly 30% of the country's land area. Some 1.5 million ha of forest are in state ownership. The remainder are parts of agricultural communes. State owned forests are subdivided into 44 forest enterprises and 4 national parks. Approximately 40% of the forest area consists of pine (*Pinus silvestris*). Spruce (*Picea abies*) comprises 20% of the forest area, birch 10%, alder 10%, oak 2%, and ash 2%. Lithuania typically has a spring fire season which occurs immediately prior to bud burst of deciduous species (April). Most fires are human-caused with burning of pastures, carelessness and arson being the major causes of fire.

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Tab.1. Forest fire statistics for Lithuania, 1984-94

Year	Number of Fires	Area Burned (ha)	Area of Largest Fire (ha)
1984	132	26	10
1985	63	13	3
1986	339	239	19
1987	60	40	14
1988	131	29	2
1989	115	59	11
1990	236	122	12
1991	147	54	4
1992	1180	971	78
1993	634	304	20
1994	715	280	29

THE PHILIPPINES

Creation of a new Forest Protection and Rehabilitation Division

The Department of Environment and Natural Resources (DENR) has approved the proposal to upgrade the present Section for Forest Protection within the Forest Management Bureau (FMB) to a full Division. The new Division will be designated **Forest Protection and Rehabilitation Division**, and will be established during 1996. Previously, forest protection in the Philippines has primarily been dealing with problems related to illegal wood harvesting.

Fire reporting: The basic fire problem in many tropical countries is to be able to distinguish between agricultural fires, slash and burn fires and wildfires inside the forest. In the Philippines traditionally very few if any agricultural or shifting cultivation (*kaingin*) fires have been reported. The reported fires have been related to man-made or plantation forest; in the Philippines some of the plantation species grown are local or indigenous species like Bagras (*Eucalyptus deglupta*).

The Forestry Master Plan of the Philippines estimates that 9 million people are living in the uplands, i.e. within the remaining forests of the country. These 2 million families are burning from 0.5 to 1.0 hectare of forest and bushland/cogon (alang-alang: *Imperata cylindrica*) land every year for their subsistence.

A newly launched program: A new program called the "Oplan Sagip Gubat" or Oplan Save the Forest, has been striving very hard to persuade the field personnel of DENR, namely the PENRO's (Provincial) and CENRO's (Community) to provide data from burned areas of non-plantation forests as well as from "Alienable and Disposable" (A&D) lands.

Only realistic fire data will in the long run attract sufficient attention from politicians to support and to enforce forest fire prevention, detection and suppression programmes country-wide.

Conclusions: The DENR aims at the strengthening of the existing Multi-Sectoral Forest Protection Committees (MFPC). The Government Organization (GO) and Non-Government Organizations (NGO's) sectors represent the network of members in the MFPC which consists of DENR, Department of National Defence (DND), police, church, youth, education, environmental groups, Local Government Units (LGU's), People's Organizations (PO's) and the Air Transport Office (ATO).

The FMB will then collect and evaluate the acquired fire data and prepare annual fire statistics for the decision makers and international institutions collecting global fire datasets (e.g. GVFI).

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RUSSIAN FEDERATION

The 1994 Forest Fire Season in Russia

The 1994 forest fire season in the Russian Federation can be marked as an extremely high fire load in the East Siberia region. The burnt area in Krasnoyarsk, Irkutsk and Jakutsk districts comprised together 362,000 ha, corresponding to more than 70% of the total area burnt on the territory under permanent aerial control in Russia. 327 forest fires went out of control, and they were recorded as large fires (>200 ha). The stable midsummer drought and shortage of resources for firefighting favoured the recurrence and spreading of large fires. The economic crisis in Russia has had a negative influence on the organization of forest fire protection on the whole. In 41 cases the decisions to stop firefighting operations were taken due to lack of resources. For instance it happened with 29 fires in the Irkutsk region, 3 in the Krasnoyarsk area, 3 in Yakutia, 3 in the

Magadan region and 1 fire in the Khabarovsk region. Nevertheless, in spite of lot of negative points ***Avialesookhrana*** (Aerial Forest Fire Service) has so far managed to maintain the readiness for action and professionalism of its specialists at a sufficient level.

Without any assistance from other agencies smokejumpers and helirappelers from ***Avialesookhrana*** independently put out 3056 forest fires, mostly in remote inaccessible areas of boreal ***taiga***.

There is also progress in the technology of supporting the ground forces by dropping retardants from airtankers. During the last season 8 airtankers out of 570 planned aircraft rendered assistance in fighting 51 fires. A total of 20 water bombing tanks (capacity: 1200 l) for the AN-2 plane (our "work horse") are planned to be produced by the fire season of 1995. ***Avialesookhrana*** is considering the further expansion of the use of specially equipped aircraft combatting forest fires and expanding initial attacks as the priority in its technical development.

It is appropriate to say some words about international cooperation in forest fire protection. It is quite natural that any state or nation which has forest and other fire-threatened vegetation formations (steppes, savannas etc.) creates appropriate infrastructure for wildfire protection. As a rule expenses for the establishment of such full-scale operational structures are very high and they are beyond the capability of many nations.

In addition, wildfires are seasonal phenomena and do not occur regularly. This is why maintaining large amounts of fire equipment and specialists is often economically very questionable. It is much more appropriate to have mobile, well trained and equipped crews under the auspices of UN, which, depending on the situation, could monitor the international fire situation and intervene with the most up-to-date equipment, including aircraft and helicopters. International forest fire brigades could act by moving from the Northern to the Southern Hemisphere and vice-versa, taking into account that hemispheric fire seasons are opposite. These ideas are well presented in the proposals of the FAO/ECE/ILO Team of Specialists on Forest Fire in International Forest Fire News No. 11 (p. 36). It is desirable to know the opinions of managers, specialists and scientists of other countries, so you are invited to write to:

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TECHNOLOGY NEWS

Switzerland: Demonstration of Hardware for Fire Detection, Monitoring and Suppression

At the 1995 meeting of the ***International Technical Committee for the Prevention and Extinction of Fire (Comité Technique International de Prévention et d'Extinction du Feu - CTIF)*** in Interlaken, Switzerland, one of the main foci was "Aerial Support for Fire Brigades".

Fire detection, monitoring and initial attack: Fast fire detection and real-time monitoring of a fire (fire spread, location of hot spots) are crucial for the success of the initial attack on and containment of a wildfire.

One of the instruments used for observing the fire scene is the ***Forward Looking Infra Red*** scanner (FLIR-2000). Mounted on a helicopter this system can be airborne within half an hour after reporting the fire. From a screen the fire spotter obtains all necessary information on hot spots (including non-visible smouldering fires or flames obscured by smoke), wind direction, results of aerial extinguishant delivery. This information is transmitted by radio to the fire command vehicle, and the information of the fire location is transformed into coordinates and relayed to the ground and helicopter crews. In this first stage of the fire fast information support helps to contain a fire before it becomes large.

Reconnaissance of large fire situations: For large fire monitoring and control the use of the ADS-95 drone ***Ranger***, an unmanned small air vehicle equipped with optoelectronic sensors, was demonstrated (Fig.1). The vehicle is constructed by Oerlikon-Contraves and has been tested by the Swiss Air Force for its use in forest fire detection and monitoring.

The infrared sensor of the ADS-95 is able to distinguish temperature differences of ca. 0.1°C (Fig.1). In addition a video camera with zoom lens is available on board. The information of both optical camera systems is converted into a video signal and transmitted to the command vehicle on the ground (ground control station). With an endurance of up to 5 hours and a deployment distance of up to 100 km the drone is able to deliver a real-time situation analysis which facilitates the deployment of fire suppression forces, both from the air and on the ground. Operating with a cruise speed of up to 190 km/h at a service ceiling of 4500 m, the drone does not interfere with aerial extinguishant delivery (maximum operating altitude of fire bombing helicopters: 100 m above ground). With continuous transmission of data this system provides decision support for the fire command centre.

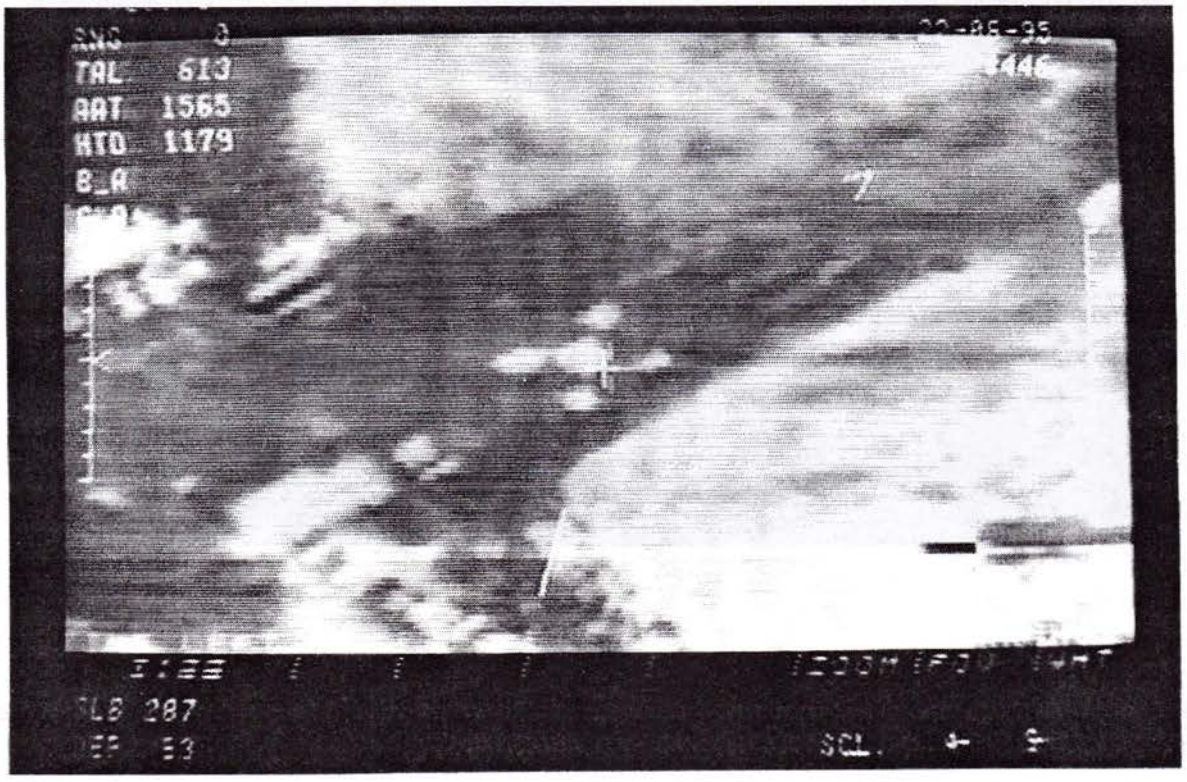

Fig.1. Aerial view of five ground fire spots (five dots in the centre of IR imagery) as transmitted from the ADS-95 drone to the mobile receiving unit on the ground. The subsurface fires (size: ca. 40 x 40 cm) produced a soil surface heat of 60°c and were detected by the scanner from an altitude of 1500 m above ground.

Suppression of high-intensity fires: Aerial extinguishant delivery was one of the main attractions at the Interlaken meeting. Two systems were demonstrated: the Ilyushin IL-76 and the Canadair CL-415. Both systems have been described in International Forest Fire News No.11 (July 1994). Detailed technical data are now available on the largest water bomber globally available - the Ilyushin IL-76 (Fig.2):

Total tank capacity:	42 tons
Number of water tanks:	2
Wing span:	50.5 m
Maximum take-off weight:	190 t
Cruising speed:	800 km/h
Speed during discharge:	278 km/h
Area covered by water	550 x 100 m
Water concentration in centre of drop:	5.2 l/m^2

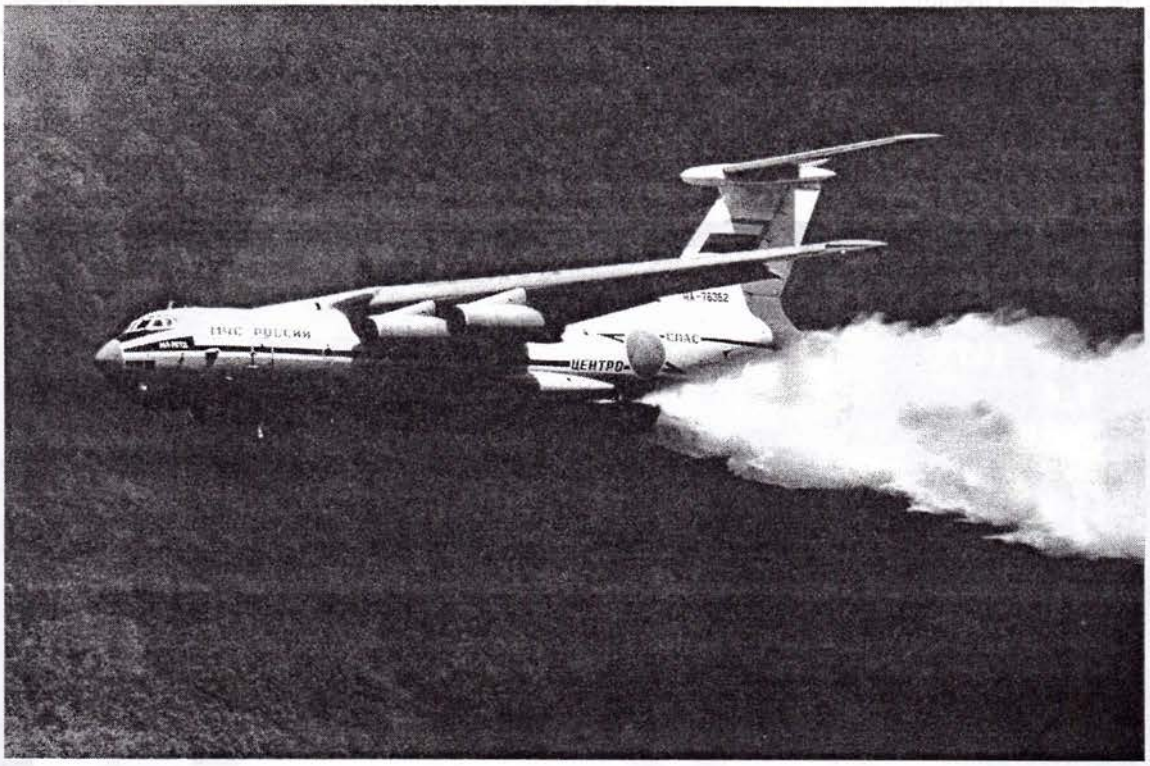

Fig.2. Test drop of the Ilyushin IL-76 at the CTIF-1995 meeting in Interlaken: Releasing 42 tons of water (photo courtesy Keystone Press).

Report by:

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NEWS FROM FIRE RESEARCH

The Smoke, Clouds And Radiation (SCAR) Experiments

The overall goal of the Smoke, Clouds And Radiation (SCAR) experiments is to obtain simultaneous measurements and to characterize many of the physical and chemical components of the Earth's surface, the atmospheric aerosol, trace gases, clouds as well as the radiation field and the properties of fires in the biomass burning environment. The purpose is to narrow the uncertainties in the estimates of the impact of biomass burning on the atmosphere and therefore on climate. Additionally the data obtained in these experiments are vital for the development and evaluation of remote sensing algorithms which will be used to detect and characterize fires and smoke from space with the MODerate Resolution Imaging Spectroradiometer (MODIS) sensor as part of NASA's Earth Observing System (EOS) set to be launched in 1998.

The SCAR experiments are a series of three related experiments. SCAR-Atlantic (SCAR-A) conducted in 1993 on the Atlantic coast of the United States concentrated on urban/industrial aerosol consisting of primarily sulphate particles, not smoke. SCAR-California (SCAR-C), took place in 1994 in the western United States and measured the properties and radiative effects of smoke aerosol and trace gases emitted by wild and prescribed fires. The main experiment, SCAR-Brazil (SCAR-B), is being planned for the period 15 August - 14 September 1995. SCAR-B will attempt to measure smoke aerosol and trace gases emitted from fires in both the Cerrado and deforestation regions of Brazil. In addition, SCAR-B will attempt to measure smoke/cloud interaction. Measurements will be made across Brazil and may yield information on the transport of the smoke aerosol, its lifetime and outflow to the ocean. The data set will be used to study the process of biomass burning, its effect on atmospheric composition, clouds, the Earth's radiation budget, climate and the capability of remote sensing of these processes from present and future spaceborne platforms.

The SCAR experiments are coordinated by NASA but involve an international collaborative effort with participants from Brazil's INPE, the Brazilian University of Sao Paulo, American universities (University of Washington, University of Wisconsin, University of Arizona) and the United States Forest Service. The principal base of operations for SCAR-B will be Brasilia, Brazil. The experiment will include:

- The NASA ER-2 aircraft flying the MODIS Airborne Simulator (MAS) in its 50 channel configuration, ranging from the visible to the thermal. In this configuration the MAS has sufficient dynamic range and resolution to measure fire temperature alongside background surface at terrestrial temperatures. The MAS scans perpendicularly to the aircraft flight track with a scan angle of +/- 43 degrees about nadir, thereby providing images with a spatial resolution of 45 m at nadir and a 35 km swath width. The ER-2 will also carry A Visible/InfraRed Imaging Spectrometer (AVIRIS). AVIRIS covers the entire solar spectrum in 10 nm channels and provides a 12 km swath with 20 m spatial resolution.

- The University of Washington C-131A research aircraft will be the principal platform from which in situ measurements will be obtained on the aerosol and gas emissions from biomass burning in Brazil. Measurements will include the direct radiative properties of the aerosols and the indirect effects of the emissions on cloud microphysics and radiative properties. The aircraft also carries the Cloud Absorption Radiometer (CAR) and solar and infrared flux radiometers for remote sensing.

- The INPE Bandeirante aircraft is outfitted with U.S. Forest Service in situ sampling instruments for trace gases and aerosols, as well as some remote sensing instrumentation.

- The NASA AERONET network of up to 13 automatic sun/sky spectroradiometers has been measuring spectral optical thickness and downwelling sky radiance at several locations in Brazil since 1993. This network will continue to monitor the smoke aerosol optical properties during SCAR-B. The AERONET network sites are located in regions of high fire activities in both the Cerrado and forested areas and also in agricultural lands to the south and east of the Amazon region. This allows characterization of the source regions as well as the southerly transport of aerosols out of the Amazon basin. Augmenting the primary spectroradiometers at specific sites will be several other PAR and broadband radiometers measuring downwelling radiation.

- Ground-based measurements in areas of intense interest will contribute to the data base with measurements of aerosol size distribution and composition. Several of these stations have been integrated with the AERONET

stations. These stations will make simultaneous measurements of soot carbon and sulphates, and electron microprobe analysis will provide size distributions as a function of particle composition.

- Satellite data from the NOAA-12 and -14 polar orbiting satellites, GOES-7, -8 and -9 geostationary satellites and Landsat TM will enhance the remote sensing capabilities of the experiment. The GOES-8 3.9 micron channel proved to be especially valuable in locating fires during the SCAR-C experiment and we anticipate that during SCAR-B this channel will give us much information about the diurnal characteristics of the biomass burning. In addition, the geostationary data are useful in determining the large-scale transport of the smoke out of the Amazon basin.

- Ground-based in situ measurements of the vegetation properties and fire temperature distribution. The purpose will be to characterize the fuel type and provide ground truth before and after a fire event, in clear and smoky conditions for the remote sensing analysis.

The experiment strategy is to take advantage of whatever conditions are present and to make flight plan decisions a day in advance based on meteorological and fire conditions as determined from daily GOES-8 images. On smoky cloudless days, measuring the smoke angular properties becomes a priority for the ER-2 which will be directed to fly a star-shape pattern (Fig.1) while the in situ aircraft makes multi-level measurements over AERONET sites (Figs.2 a,b). On smoky cloudy days, the smoke-cloud interaction becomes a priority. The planes will be directed to fly a "cloud mapping" pattern (Fig.2 c) in which the ER-2 makes remote sensing measurements of the clouds and smoke, while the in situ planes cross the ER-2's flight lines at a much lower altitude, measuring cloud and aerosol properties within and alongside the clouds.

Measurements will be taken in different regions including over the ocean in order to characterize the aerosol as it is transported and ages. If the opportunity presents itself to carefully monitor a prescribed or well-characterized fire the planes will be directed to make many passes over the same fire and follow the individual smoke plume from this fire as it is advected downwind. This strategy was used successfully during SCAR-C in order to relate fire temperature/size to smoke amount/characteristics. It may be possible to find a similar situation in Brazil.

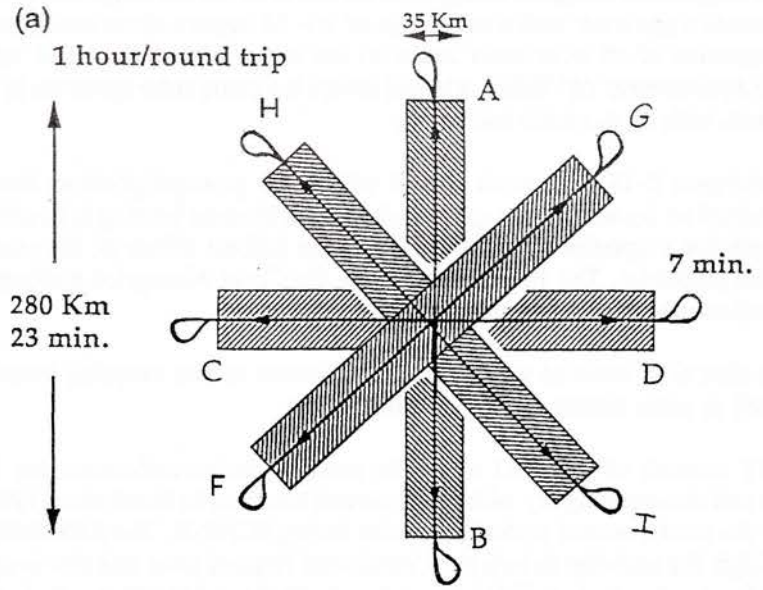

Fig.1. Star-shape flight pattern of the ER-2 (smoky, cloudless days, for measuring the smoke angular properties).

These simultaneous measurements from both in situ and remote sensing instruments on the ground, in the air and from space, will be integrated to give a better view of the biomass burning environment and its effect on the earth's radiation budget and climate.

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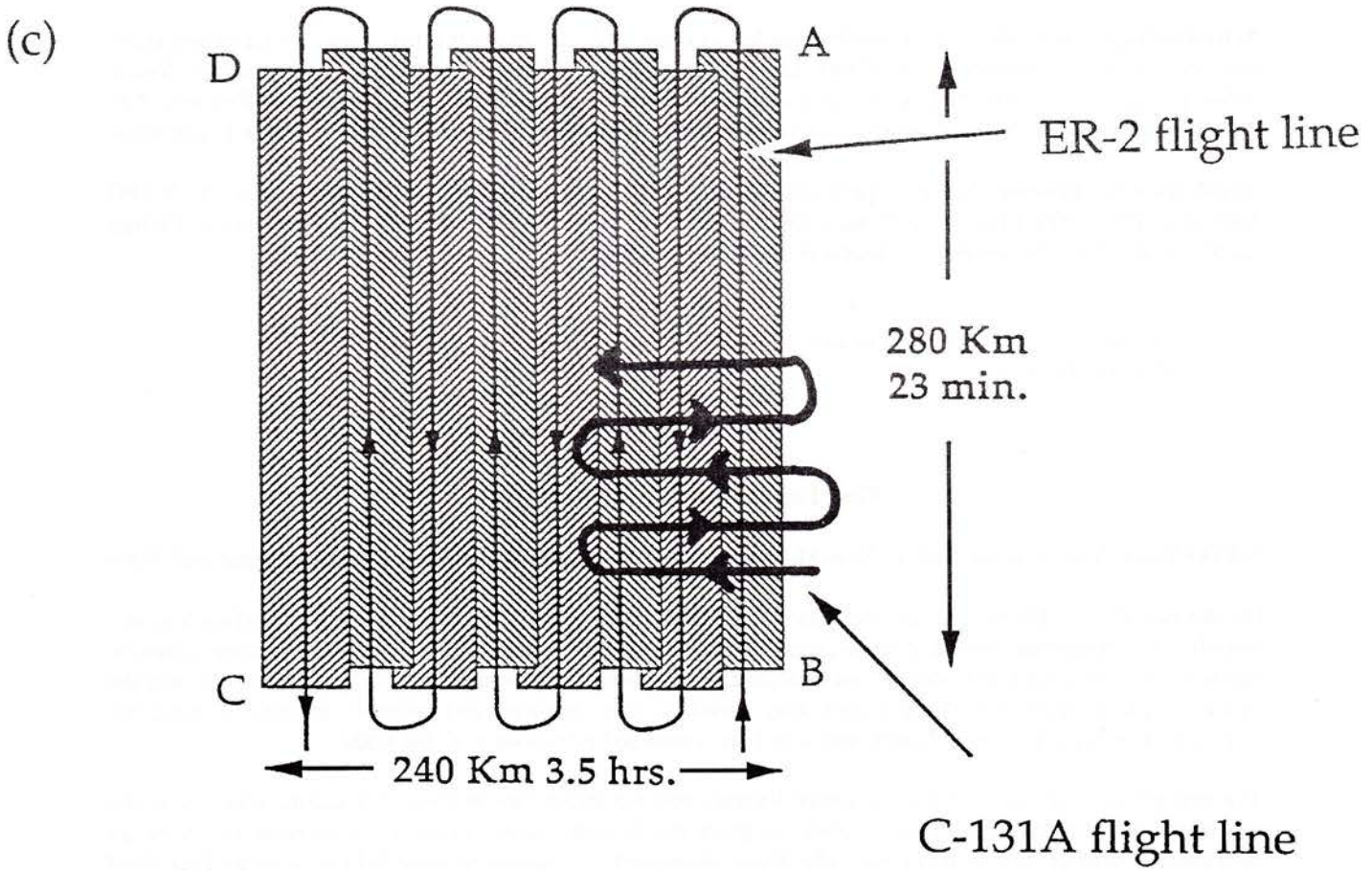

Fig.2. Multi-level measurements over AERONET sites (a,b). On smoky cloudy days, the smoke-cloud interaction becomes a priority and the planes will be directed to fly a "cloud mapping" pattern (c) in which the ER-2 makes remote sensing measurements of the clouds and smoke, while the in situ planes cross the ER-2's flight lines at a much lower altitude, measuring cloud and aerosol properties within and alongside the clouds.

NATO *NATO's Support in Fire Research*

In addition to its well known political and military dimensions, the North Atlantic Treaty Organization (NATO) has a "Third Dimension" which seeks to encourage interaction between people, to consider some of the challenges facing our modern society, and to foster development of science and technology. The NATO Science Programme is a major component of this third dimension.

The activities of the NATO Science Committee enhance science and technology by facilitating international scientific cooperation. The transatlantic link has been and remains a major feature of this cooperation. Recently, links with the CIS and Central and Eastern Europe, NATO's Cooperation Partners, have also become an important aspect of the NATO Science Programme. Following consultation with representatives of the Cooperation Partner countries, a number of priority areas were selected for support. In the following the possibilities of funding for collaborative projects between scientists of NATO countries and Cooperation Partner (CP) countries are described. Funding possibilities are in the priority areas only. Scientific problems related to the environment, regional environmental problems and natural and human-caused disasters are considered as priority areas.

Activities Supported: The support mechanism for tackling problems in the priority areas are Advanced Study Institutes, Advanced Research Workshops, Collaborative Research Grants, Linkage Grants and Expert Visits. Although applications for these activities may be submitted by either NATO or Cooperative Partners (CP) scientists, applications in the Priority Areas must involve cooperation between both NATO and CP scientists.

Application for funding: Specific application forms and Notes for Applicants are available from the NATO Scientific Affairs Division for all these activities. Scientists from NATO countries and Cooperation Partner countries can apply for support for topics in the Priority Areas.

NATO Scientific Affairs Division
B-1110 Brussels

First Fire-Related NATO Activities

NATO Workshop: Science Policy: New Mechanisms for Scientific Collaboration between East and West

On the eve of the 21st century our civilisation is colliding with the next global problem, demanding a global solution. It is becoming more and more clear that the future of the world will be impossible without scientific support, analysis, prediction, and the use of scientific achievements. The immensity of these problems, and the limited financial resources which society may spend on their research and solution, urgently demand the selection of priority areas of research and scientists' combined efforts on a global scale.

The new geopolitical situation has uncovered Russia's and the former Soviet Union's scientific potential to the rest of the world community. This situation has given rise to wider opportunities for involvement in work on international projects and programmes. The above mentioned considerations impelled the Siberian Branch of the Russian Academy of Sciences to organize a workshop, under NATO (Scientific and Environmental Affairs Division) sponsorship, "Science Policy: New Mechanisms for Scientific Collaboration Between East and West". This Workshop was held in Novosibirsk in 22-25 November 1993.

The Workshop participants, from 17 countries, represented research institutes, universities, as well as NATO's scientific bodies, UNESCO, the Council of Europe, and other international organizations. The range of discussed problems included current problems, as well as prospects of international collaboration of scientists from both the East and the West. The scope of discussion also included interdisciplinary priority programmes demanding the combined efforts of scientists from many countries, the experience in organizing the work of international research centres in Siberia as a new and promising form of international collaboration, some of their scientific results, and a suggestion of the direction in which collaboration should move.

One of the first priority areas among joint East/West research programmes is the rational use of natural resources and sustainable development of regions. The global boreal forest is one of the most productive ecosystems, but highly vulnerable to wrong forestry practices, industrial pollution and fire. Because of its size and ecological functions boreal fires play an important role in ecosystem processes at global scale. New research initiatives between Western and Eastern countries were designed to address the field of wildland fire science. Cooperative research agreements under the International Geosphere-Biosphere Programme (IGBP), in conjunction with the International Boreal Forest Research Association (IBFRA), have been used as research instruments to initiate a joint research campaign. The first phase of the Fire Research Campaign Asia-North (FIRESCAN) was implemented under these agreements. More details on this East-West fire research programme is published in the NATO workshop proceedings:

Goldammer, J.G. and V.V.Furiaev 1995. Global change, the boreal forest, and fire: Search for new strategies in science policies and research mechanisms. Science Policy: New Mechanisms for Scientific Collaboration between East and West (V.A.Koptyug and J.Klerkx, eds.), 45-61. NATO ASI Series 4, Science and Technology Policy Vol.1. Kluwer Academic Publishers, Dordrecht-Boston-London, 256 p.

NATO Workshop: Sediment Records of Biomass Burning and Global Change

Fifty scientists from North America, Eurasia, and Australia gathered in Algarve, Portugal, 11-14 October 1994, for an assessment of the role of biomass burning during past changes in climate, vegetation, and land use. This interdisciplinary group of paleoecologists, fire ecologists and managers, atmospheric scientists, and organic chemists presented and debated three of the principle challenges to interpretation of long-term burning from sediments. These challenges are i) characterization of combustion products embedded in organic sediment matrices, ii) description of production and transport of emissions, and iii) synthesis of existing sediment records. Problems characterizing combustion emissions in sediments have not only made it difficult to document past burning, but also to estimate the amount of carbon that is sequestered in recalcitrant elemental forms. The relative merits of microscopy, chemical, and thermal assays were compared. Atmospheric scientists used recent developments in mesoscale transport and empirical evidence from controlled burns to argue that even relatively "large" particles might frequently be transported long distances. Paleoecologists presented evidence to suggest that these particles represent principally local sources and therefore can be used to interpret local fires. Numerous examples were presented where known fires are well-documented by sediment combustion records at local scales. Regional syntheses showed a high degree of geographic coherency in accumulation of combustion products. The results are being synthesized in an edited volume anticipated in 1996 from Springer Verlag. Convener of the NATO Workshop and lead editor of the volume is:

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International Global Atmospheric Chemistry (IGAC) Project: The Biomass Burning Experiment (BIBEX)

Minutes of the BIBEX Coordinating Committee Meeting

On 12 and 14 March 1995 two meetings of the Coordinating Committee of the IGAC Biomass Burning Experiment (BIBEX) took place in conjunction with the AGU Chapman Conference *Biomass Burning and Global Change*, Williamsburg, Virginia (USA). Ten committee members and other interested scientists attended the meeting. The topics discussed and some other update information on BIBEX activities are given below. For more detailed information on the fire research campaigns, the reader is kindly asked to refer to previous issues of IFFN.

1. Organizational

Two important atmospheric chemistry programmes with fire-related research components have merged: The *International Atmospheric Aerosol Project* (IGAP) is now integrated into the International Global Atmospheric Chemistry (IGAC) project. As a consequence of this, members of the BATIR Steering Committee (*BATIR: Biomass Burning Aerosols in the Tropics: Impacts on Radiation Budget and Climate*) are now members of the BIBEX Steering Committee (Paulo Artaxo, Joyce Penner, Didier Tanre).

2. SA(F)ARI Research Programme 1995-1997

Publication of SAFARI-92 Results: The special issue of the Journal of Geophysical Research (guest editor: Janette Lindesay, South Africa/Australia) is in press. The book **Fire in Southern African Savannas: Ecological and Atmospheric Perspectives** (editors: Meinrat O.Andreae, Johann G.Goldammer, Janette Lindesay, Brian van Wilgen) is in preparation and will be published at University of Witwatersrand Press (early 1996).

SA'ARI 1995: SA'ARI, the non-fire season component of the *Southern African Fire-Atmosphere Research Initiative* (SAFARI), conducted its flight campaigns in early 1994 and 1995 (mission lead: Günter Helas, Max Planck Institute for Chemistry, Germany). The 1995 campaign was weakened by delays due to aircraft damage. First results of the SA'ARI-94 campaign are in press (South African Journal of Science).

East Africa: The East African fire research component in Tanzania and Kenya is planned to be operational in 1997. New counterparts in Kenya were found through the Kenyan Academy of Sciences. Research will focus on *Miombo* woodlands of Tanzania and various grassland types in Kenya (African coordinator: Winston S.W. Trollope, University of Fort Hare, South Africa).

3. Boreal Fire Research: IBFRA/FIRESCAN

The high-intensity crown fire experiment in the North West Territories (Canada) is now postponed to June/July 1996. Preparations for the experiment were conducted in June 1995 (Coordinator: Brian J. Stocks, Canadian Forest Service). The Bor Forest Island Experiment is continuing in 1995. The site has been re-visited in July 1995 by a science team consisting of Russian, US and German participants.

The Conference on Mathematical Modelling of Forest Fires was held in Tomsk, last week of July 1995 (Convener: Anatoly Grishin, Tomsk State University).

4. South East Asian Fire Experiment (SEAFIRE)

A planning workshop will be held in Samarinda, Indonesia, 13-15 September 1995 (convener: Johann G. Goldammer, Max Planck Institute for Chemistry, Germany).

5. Global Vegetation Fire Inventory (GVFI)

The state of GVFI was reported at the BIBEX Steering Committee meeting. GVFI is still in its very early stages, lacking support from many countries. The Chapman Conference participants accepted a proposal made by the BIBEX Steering Committee to release a declaration on the need for systematically conducting global vegetation and fire inventories. The text of the declaration and the results of a subsequent meeting of the FAO/ECE Team of Specialists on Forest Fire (UN) is printed in this issue (under News from the UN).

This report was prepared by the editor of IFFN who will forward any request on a specific project to the project coordinator/convener.

NEWS FROM THE UNITED NATIONS

FAO/ECE *Forest Fire Statistics*

A consultative meeting was held in Geneva on 24 March 1995 of agencies active in collecting statistics on forest fires, to exchange information on activities and coordinate them, in order to use available resources in an optimum manner and avoid unnecessary duplication. The report of the meeting was submitted to the **Joint FAO/ECE Working Party on Forest Economics and Statistics**, a subsidiary body of the European Forestry Commission (EFC) and the UN-ECE Timber Committee, and approved at its 20th session (20-22 June 1995). The report (TIM/EFC/WP.2/R.146) provides an updated summary on collection of international fire data and is therefore printed in full below.

Background

1. For over 15 years, FAO/ECE has been collecting information, at the national level, on the number of forest fires and the area burnt, as well as information on causes and on value of losses. FAO/ECE now has a data base with national information for practically all member countries from 1982 onwards, which is now published annually.

2. Resolution S3 of the Ministerial Conference at Strasbourg committed the signatories (including the EU) to creating a decentralised data base on forest fires, under the coordination of Portugal. Since then a data base, with fire-by-fire information, has been built up, in those countries/regions of the European Union with a particularly severe forest fire problem. In this system, for each fire, information is collected on first alert and extinction times, location, area, cause etc. according to a "common core" of parameters ("socle minimum"). In answer to a questionnaire by Portugal in 1993, 19 of the 27 signatories of Resolution S3 expressed their willingness to adhere to a data base network based on the common core system adopted by EU members, considering it a good, feasible starting point for collecting data on a common base at the pan-European level.

3. Silva Mediterranea, like the Working Party a subsidiary body of the European Forestry Commission (EFC), covers a region where forest fires are one the most serious dangers to sustainable forest management, and is also moving towards a fire-by-fire information system, based on the EU system. Two meetings have been held, at Chania (1991) and Montpellier (1993), to coordinate this work.

4. At the global level, FAO has collected data on forest fires, using the FAO/ECE conceptual framework and definitions, and would like to repeat the exercise regularly as part of its monitoring of the state of the world's forests.

5. International Forest Fire News (IFFN), prepared by Mr. Goldammer, leader of the FAO/ECE/ILO Team of Specialists on Forest Fires, contains both technical and statistical information on forest fires worldwide. Mr. Goldammer is also developing a Global Vegetation Fire Inventory (GVFI), collecting information by a network

of correspondents. GVFI is an activity of the International Global Atmospheric Chemistry (IGAC) project, a core project of the International Geosphere-Biosphere Programme (IGBP).

6. The Timber Committee and the EFC assigned "low priority" to the activity of collecting forest fire information, although they recognised the importance of regular collection of statistics on forest fires, because they considered this work was being carried out, with more resources, by other organisations, notably the EU.

7. In recent years the scientific community has shown renewed interest in forest (vegetation) fires, notably because of their significant role in climate change, and has developed new methods of collecting information, using remote sensing techniques. The scientific research conference on "Biomass Burning and Global Change" (Williamsburg, Virginia USA, April 1995) recommended that: "the United Nations System support the establishment of an improved relational data system for the interdisciplinary assessment of the effects of fire in the global environment, and that an appropriate scientific organization be involved in designing and evaluating the data system."

Consultative Meeting

8. A meeting was held in Geneva on 24 March of agencies active in collecting statistics on forest fires, to exchange information on activities and coordinate them, in order to use available resources in an optimum manner and avoid any unnecessary duplication.

9. The meeting was attended by Mr. W. Ciesla (FAO), Mr. J. Goldammer, leader of the FAO/ECE/ILO Team, Ms. M. Lemasson and Mr. Chevassus (European Commission DGVI), Mr. R. Velez, Silva Mediterranea coordinator for forest fires, and Mr. J. Najera and Mr. C. Prins (FAO/ECE). Mr. Ciesla chaired the meeting.

Proposals of the Meeting

10. There is a strong need for a comprehensive international set of comparable data on forest fires and other wildland fires, as a tool for policy makers, and for operational planning (for both prevention and suppression), as an essential part of improving understanding of climate change and the factors influencing it, and as a part of an effort to monitor the state of the world's forests.

11. The approach pioneered in the EU is very valuable and should be extended within the framework of Resolution S3 to other countries, chiefly in Europe and around the Mediterranean, but also in other regions where institutions and resources made it possible to collect fire-by-fire data. Countries starting to collect this information should use the "common core" ("socle minimum") already developed in the EU as a starting point, in order to promote comparability between data for different regions. The Commission of the European Communities offered to provide technical support to this work and to process data for new countries (including non-EU countries and non-signatories of Resolution S3) in its existing structure. The Silva Mediterranea forest fire network would also contribute to establishing contacts, encouraging the setting up of such systems and ensuring international comparability. It was pointed out that the research community needed geo-referenced data (although not at a very fine degree of resolution). If possible the coordinates of the starting fire location (or those of the commune) should be collected, in addition to the parameters already collected, which included information on the commune of the fire.

12. However, it would be many years before all countries, even in Europe, were able to supply the type of detailed information required by the fire-by-fire approach. In order to avoid a short term reduction in the coverage of forest fire information, the meeting considered it was essential to maintain the existing (FAO/ECE) system of data collection at the national level, until a more comprehensive and detailed system, with at least as wide a geographic coverage, was operational. Indeed the terms and definition, and the questionnaire itself, could be used as the basis for data collection in other regions.

13. The meeting was informed that almost all countries in the ECE region were able to provide reasonably good information on number of fires, area burnt and causes of fires, but few countries provided information on value of losses and costs of suppression and prevention. Furthermore the latter information was not really comparable between countries, and collating it accounted for a significant part of the secretariat time devoted

to producing forest fire statistics. The meeting suggested therefore that forest fire statistics continue to be collected and published annually by FAO/ECE, but concentrate only on the "core" data (number of fires, area burnt and causes of fires). The European Commission offered to provide this information for the 15 member countries, and to process the data collected, including from non-EU countries. The feasibility of a joint publication FAO/ECE-EU will be considered. Together these measures would reduce the FAO/ECE secretariat resources necessary to produce the information very significantly.

14. At the global level, for the time being, all those involved should share information acquired, notably through IFFN, in order to build up over time a more accurate picture of the situation. Countries outside Europe and the Mediterranean area might consider adopting an approach along the lines of the one at present in place for the EU.

15. FAO and the Global Vegetation Fire Inventory will closely cooperate and share information of a fire data base covering countries not members of ECE or Silva Mediterranea.

Declaration on Global Vegetation and Fire Inventories

The declaration, as released by the participants of the 1995 Chapman Conference on "Biomass Burning and Global Change", had been submitted to the consultative meeting on fire statistics and is printed below.

Declaration of the 1995 Chapman Conference

"**Biomass Burning and Global Change**"

13-17 March 1995, Williamsburg, Virginia (USA)

on

Global Vegetation and Fire Inventories

Recalling the Rio Declaration on Environment and Development, the Agenda 21 as adopted by the United Nations Conference on Environment and Development (UNCED), the United Nations Framework Convention on Climate Change, the Convention on Biological Diversity, and the objectives of the work of the UN International Decade for Natural Disaster Reduction (IDNDR) and the UN Commission for Sustainable Development (CSD), and

Noting that these Conventions and Initiatives require an assessment of natural and anthropogenic sources and sinks of radiatively active gases and aerosols, including the contribution of vegetation fires, and the role of fire in the ecological and economic sustainability of ecosystems, and

Noting further that monitoring, understanding and predicting environmental impacts of fire require coupling of fire data with vegetation data,

The participants in the 1995 Chapman Conference on Biomass Burning and Global Change, representing scientific investigators of biomass burning from many nations, recommend that the United Nations system support the establishment of an improved relational data system for the interdisciplinary assessment of the effects of fire on the global environment, and an appropriate scientific organization be involved in designing and evaluating the data system.

This declaration was unanimously adopted by the conference on 16 March 1995.

FAO/ECE FOREST FIRE STATISTICS 1991-1993

The results of the latest enquiry on forest fire statistics, carried out in 1994 by the Joint FAO/ECE Working Party on Forest Economics and Statistics, have been issued. The publication provides information on the number, area, causes and losses of fire in Europe, Belarus, the Russian Federation, Ukraine and North America. Copies are available free of charge from the secretariat:

Timber Section
UN-ECE Trade Division
Palais des Nations
CH - 1211 Geneva 10

Fax: ++41-22-917-0041

SUMMARY TABLE SHOWING TOTAL AREA AFFECTED BY FIRES (x 1000 ha)

	1990	1991	1992	1993	1990-1993 average
Europe	702	580	438	471	548
-of which: southern Europe *	687	573	386	459	526
Russian Federation	1670	1126	1143	1200	1285
North America	3138	2681	2152	3799	2943

* Bulgaria, France, Greece, Israel, Italy, Portugal, Spain, Turkey, and former Yugoslavia

Tab.1. Summary of available data on area affected by wildfires in the ECE region (Europe, Belarus, the Russian Federation, Ukraine and North America) for the period 1990-1993.

ITTO *Guidelines for the Protection of Tropical Forests Against Fire*

Pursuant to a decision of the Council of the International Tropical Timber Organization (ITTO), an Expert Panel was established to develop ***Guidelines for the Protection of Tropical Forests Against Fire***. The Expert Panel met in Jakarta from 6-10 March 1995 and prepared a Draft of the guidelines which was submitted to the ITTO Council. It is planned to finalize discussions and changes proposed by ITTO member countries at the next ITTO Council meeting in Yokohama (Headquarters of ITTO). Detailed information on the final version of guidelines, including distribution, will be given in the next issue of IFFN.

The Editor

RECENT PUBLICATIONS

Landscape Fires '93: Proceedings

The proceedings of the Australian Bushfire Conference, Perth, Western Australia, 27-29 September 1993, are now available. The Landscape Fires '93 Conference was the fourth in a series of Australian bushfire conferences and attracted more than one hundred delegates from Australia, New Zealand and the United States. The purpose of the conference was to provide a forum for members of the Australian fire community, both researchers and managers, to review the latest concepts and developments in bushfire science. Invited speakers presented papers addressing the six key themes of the conference:

- fire danger rating and fire behaviour prediction
- fire measurements for fire ecology studies
- bushfire and the urban-rural interface
- bushfire emissions
- fire-plant-animal interactions
- fire-induced landscape mosaics

The proceedings of the conference have been published as Supplement Four to CALMScience (June 1995), the scientific journal of the Western Australian Department of Conservation and Land Management. This 225 page proceedings, edited by W.C. McCaw, N.D. Burrows, G.R. Friend, and A. M. Gill, contains 25 peer-reviewed papers, together with abstracts of posters displayed at the conference. It will be an important reference document for all those interested in current developments in Australian bushfire science.

To order your copy of CALMScience Supplement Four - Proceedings of the Landscape Fires '93 Conference send an order with payment of AUS-$30 plus postage and handling (for postage please add: within Australia $6.00, surface mail $20.00, economy airmail $30.00; all in Australian currency) to:

CALM Publications
P.O. Box 104
AUS - Como 6152 Western Australia

Proceedings: International Workshop on Satellite Technology, GIS and Fire Management

Between 4 and 6 November 1993 the Department of Forestry and Natural Environment, Aristotelian University, Thessaloniki, in cooperation with the Joint Research Centre, Ispra, Italy, and the EARSeL (European Association of Remote Sensing Laboratories), Paris, France, organized an International Workshop entitled "Satellite Technology and GIS for Mediterranean Forest Mapping and Fire Management", held in Thessaloniki, Macedonia, Northern Greece (see IFFN No.9). The proceedings of this workshop have been published by the European Commission and contain 42 scientific papers on the subject. The bibliographic information is:

European Commission EUR 15861 - Satellite Technology and GIS for Mediterranean Forest Mapping and Fire Management (P.J.Kennedy and M.Karteris, eds.). Luxembourg: Office for Official Publications of the European Communities. 1994-XII, 516 pp. (Catalogue Number: CL-NA-15861-EN-C).

MEETINGS AND COURSES HELD IN 1995

NEPAL *Training Course on Forest Fire Control*
Hetauda, 5-10 March 1995

This national training event was organized by the Enso Forest Development Ltd. (EFD) and by the National Forest Division, Nepal. The target group was Assistant Forest Officers, forest rangers and village representatives from forest districts near Hetauda, totalling 19 persons.

Background: Forest management plans have been prepared for some of the forest districts in the Terai-area where natural forest of Sal (*Shorea robusta*) is prevailing. All these forest areas are very fire prone from mid-March onwards, and most of them are gutted by fires during every fire season. These fires repeatedly destroy the regeneration of Sal and other species, resulting in a slow but inevitable disappearance of the existing forests.

Reasons for Fires: Almost all fires in this area of Nepal are human-caused, thus fire prevention and education was given first priority during the fire course.

Research: In the fire research it was also found out that 65 % of all standing trees are having centre-rot, most likely due to early fire scars. It is now hoped that the reason for this high percentage of damage in the standing trees will be clarified. This could be done in connection with the planned South East Asia Fire Experiment (SEAFIRE) (see IFFN Nos. 10 and 12).

Recent research findings reveal that if a Sal stand is harvested, it regenerates vigorously, and further, that more than 100,000 seedlings per hectare of natural regeneration are recorded after clear felling of trial plots.

Conclusions

If these new areas of Sal regeneration can be protected from fire, a new Sal forest will develop naturally. To make this possible, the local forestry personnel will have to develop additional skills in fire control and in prescribing "early" burning practices.

At the same time the National Forest Division will have to start a large scale national fire education campaign at all primary schools throughout the entire country.

This was the first ever fire course in Nepal directed to the district personnel and to village representatives. Previously all fire control training in Nepal had been organized in relation to reforestation projects, and biased towards fire suppression rather than tackling the reasons for fire. Using the Thai forest fire control graph, Nepal is now going to concentrate on the reduction of causes of fire (prevention) rather than on buying lots of equipment for suppressing fire.

The Fire Course in Nepal was financed by FINNIDA

Mike Jurvélius
Suonotkontie 3.G.85
FIN - 00630 Helsinki

GERMANY ***Endless Taiga? Threat to and Protection of the Boreal Forests***
27-28 March 1995, Berlin

This international conference was organized by the German Nature Protection League (Naturschutzbund Deutschland - NABU) and Taiga Rescue Network (TRN), sponsored by the Deutsche Bundesstiftung Umwelt (Federal German Foundation for the Environment), the Senate of Berlin and the Friedrich Ebert Foundation. In the same week that the UN summit was held, Western European, Russian and North American scientists

presented their views on climate change, boreal forests and the need of protecting them against destructive utilization practices, pollution and fires. NABU/TRN will produce proceedings of this conference (in German and English, to be published in late 1995). For more information contact:

NABU-Ostkoordination
attn. Ms. Karin Eder or Stefanie von Ow
Klimaforum '95
P.O.Box 65
D - 10001 Berlin

PORTUGAL ***International Seminar on Forest Fires***
7-8 April 1995, Loulé, Algarve

This International Seminar was organized by the National Association of Portuguese Communities (ANMP) in collaboration with the sister associations in Greece, France, Finland, Italy, Spain and the EU. The seminar was attended by more than 250 people.

Objectives: The main objective was to outline possible areas for improving the forest fire control situation in the Mediterranean area.

The seminar topics included

Fire prevention:

- legislation and planning
- the effects of wind in the spread of fire (research)
- causes of fires, means and organization available, risk reduction
- the use and practice of controlled fire (research)

Fire suppression:

- effectiveness, a problem of command or regional/local policy
- organizations, main difficulties, voluntary or professional fire fighters
- the role of local authorities and local communities
- structure of forest fire fighting in Albacete, Spain

Consequences of forest fires:

- ecological effects
- other effects of fires

Future of Mediterranean forests:

- community actions for the protection of forests against fires (EU-DG VI.-Agriculture)
- intermunicipal European cooperation for the protection of forests
- Community framing of forest fires; possibility/necessity to form a specific body to carry out research into the improvement of legislation, organization, fire prevention, fire detection and fire suppression (European Agency for the Environment)

Conclusions: One main conclusion was that the efforts on forest fire prevention need to be reorganized and target groups for the programme carefully studied.

Mike Jurvélius
Suonotkontie 3.G.85
FIN - 00630 Helsinki

PUERTO RICO

WWF Conference on the Potential Impacts of Climate Change on Tropical Ecosystems
24-28 April 1995, San Juan, Puerto Rico

World Wildlife Fund (WWF-USA), affiliated with World Wide Fund for Nature (WWF), called tropical forest ecologists to the ***WWF Conference on the Potential Impacts of Climate Change on Tropical Ecosystems***. The conference was held in San Juan, Puerto Rico, 24-28 April 1995. In this conference scientists presented their views and models of tropical forest development under various climate change scenarios. The papers provided the latest update on trends in tropical deforestation and the consequences of climate change on extreme events, e.g. droughts, floods, hurricanes and fire. The fire group presented the state-of-the-art knowledge on tropical fire scenarios. The materials of the conference will be published in a special issue of the scientific journal ***Climate Change***. Convener and editor of the papers of the seminar is:

Adam Markham
Director, WWF Energy and Climate Program
1250 Twenty Fourth St., NW
USA-Washington, D.C. 20037-1175

Fax: ++1-202-293-9211

MEETINGS PLANNED FOR 1995-96

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

Remote sensing and geographic information systems are an important contribution to fire detection and risk assessment. The objective of the workshop is to discuss different applications of satellite remote sensing in forest fire research, with special emphasis on remote sensing and GIS integration. Emphasis of the workshop will be on the discussion of current approaches to the use of remote sensing and GIS techniques in different fields of fire management. Topics of the conference will cover:

- Mapping of burned land
- Spatial modelling of fire risk
- Fire information systems
- Estimation of fire danger
- Fire detection
- Assessment of vegetation recovery

Working language of the workshop is English. Deadline for submitting abstracts was 30 March 1995. For more details on the timetable, costs of participation, workshop logistics, etc., contact the European Association of Remote Sensing Laboratories (EARSeL):

EARSeL Secretariat
Attn.: Ms. M. Godefroy B-418
2, Avenue Rapp
F - 75340 Paris Cedex 07

Fax: ++33-1-45567361
Phone: ++33-1-45567360

CANADA ***Biomass Burning, Climate Change, and the Carbon Cycle***
11-14 September 1995, Fairbanks, Alaska

The Office of Research and Development of the Environmental Protection Agency will sponsor a workshop in Fairbanks, Alaska from 11 to 14 September 1995 entitled "Biomass Burning, Climate Change, and the Carbon Cycle in the North American Boreal Forest Region - Scientific, Management and Policy Implications." The goals of the workshop include:

1. Determine the current status of our capability to quantify greenhouse gas emissions (sources and sinks) from fires in boreal forests.
2. Identify additional information and research required to reduce the uncertainties in estimating greenhouse gas emissions from fires, as well as other sources and sinks of carbon in boreal forests.
3. Review the current understanding of how climate change will affect the fire regime and carbon cycling in boreal forests.
4. Identify major areas of uncertainty in terms of understanding how climate change will affect fire and carbon cycling in boreal forests.
5. Review the sources of information currently available to monitor fires in boreal forests and to estimate the levels of greenhouse gas emissions from boreal forests.
6. Identify the additional types and sources of information required to quantify greenhouse gas emissions (both short-term and long-term) resulting from fires in North American boreal forests.
7. Review the fire management policies and approaches of the various resource agencies in Alaska and Northern Canada.
8. Determine how the fire management policies and approaches will be affected by climate-induced changes in the fire cycle.
9. Identify management options for decreasing greenhouse gases from fires in North American boreal forests.

Workshop Organization

The workshop itself will be divided into three separate, but inter-related activities: Plenary sessions, plenary discussions, and working groups. The major thrusts to be covered can be divided into four categories:

I Fire and Carbon Cycling in Boreal Forests

II The Effects of Climate Change on the Fire Regime and Carbon Cycling in Boreal Forests

III Fire and Natural Resource Management and Policy in Boreal Forest Regions

IV Data Bases and Systems for Monitoring Fires and Carbon Cycling in Boreal Forest Regions

The plenary sessions and plenary discussions will be held during the first three days of the workshop, with the working groups being convened on the fourth day. The plenary sessions will consist of ~25 invited papers which will address a sub-set of the workshop goals. On the final day of the workshop, the participants will be divided into four working groups. The working groups will be charged with summarizing the findings of workshop with respect to the goals defined for each group. The outcome of these working groups will be an outline of a paper to be prepared by the working group co-chairs during the months after the meeting.

For more information contact the convener of the workshop:

Eric Kasischke
School of the Environment
Duke University
USA-Durham, NC 27708-0328

Fax: ++1-919-684-8741
Phone: ++1-919-613-8002

AUSTRALIA ***Australian Bushfire Conference***
27-30 September 1995, Hobart, Tasmania

Bushfire '95 continues the biennial Australian Bushfire Conference series initiated by the University of New South Wales in Canberra. The purpose of these conferences is to provide a forum for members of the Australian fire community, both researchers and managers, to present the latest advances and concepts in bushfire science.

Conference Theme: *Forging links between practitioners and researchers* is the theme of Bushfire '95. A wide variety of fire-related issues will be discussed during the six conference sessions and the Organising Committee expect the Conference to attract delegates from throughout Australia.

Programme: Conference sessions will be held over three days from 27-29 September 1995, at the University of Tasmania, Sandy Bay. The conference will be divided into six half-day sessions. The sessions on Wednesday 27 September will be on fire ecology and run jointly with the Ecological Society of Australia Inc. Topics will include:

Fire / plant / animal interactions
Fire hazard / risk / threat analysis
Smoke management
Bushfires and the urban interface
Developments in fire behaviour modelling

An optional post-conference field trip will be available on 30 September 1995. The field trip will be a full-day excursion to Tasmania's tall southern forests to look at planning for high intensity regeneration burning of heavy wet sclerophyll fuels in one of the most sensitive areas of the State.

Call for Papers and Posters: Space will be available to display posters during each session. People wishing to present a poster should provide a title and brief description. Papers presented at the conference will be published in the conference proceedings. All delegates will receive a copy of the conference proceedings.

Bushfire '95 is being sponsored by the Tasmanian Parks & Wildlife Service of the Department of Environment & Land Management, Tasmania Fire Service, and Forestry Tasmania. Registration for the three days of conference sessions costs AU$100, which includes morning and afternoon teas, lunch and a copy of the published proceedings. The optional field trip includes lunch; the cost is to be advised. Enquiries about conference registration should be mailed to

Bushfire '95
Dept. Geography & Environmental Studies
University of Tasmania
GPO Box 252C
Hobart, Tasmania 7001
AUSTRALIA

Quick enquiries by fax or phone should be directed to

Ms.K.Green (Fax: ++61-2-202989, Phone: ++61-2-202463)

U.S.A. ***Fire and Rare and Endangered Species and Habitats***
13-15 November 1995, Coeur d'Alene, Idaho

Conservationists and natural resource managers today are challenged to maintain entire ecological systems and the processes that make them work. Awareness of the important role of wildland fire (both as a natural disturbance and as a management tool) in the maintenance or destruction of threatened and endangered species and habitats is emerging. However, there are serious gaps in the knowledge and documentation of the specific

interactions, and hence in the knowledge of specific management actions that can be implemented, to maintain critical habitats. Unfortunately, wildland fire is seen as a rather odd and obscure interest, until there are major fires, which burst on the public scene and attract media attention.

The goal of this conference is to bring together policy makers, managers of public lands, and conservation groups to promote dialogue and information sharing about the possible interactions between fire and threatened and endangered species and habitats.

Suggested topics include, but are not limited to: specific species and habitats studies; identifying challenges for the future; economic implications; political implications; habitat restoration; effects of fire suppression activities; planning implications; public education, and working together.

Deadline for abstracts of papers was 1 February 1995. Late registration is possible, and the fee will be $145.00. Fee includes conference materials, refreshment breaks, lunches, banquet and proceedings. Accommodation is available at the Coeur d'Alene Hotel at a special conference rate of $59.00 per night (standard room). For abstract submission and registration, contact:

Jason Greenlee
International Association of Wildland Fire
103 E. Main, P.O.Box 328
USA-Fairfield, WA 99012

Fax: ++1-509-283-2264
Phone: ++1-509-283-2397
e-mail: jgreenlee@igc.apc.org

U.S.A. ***61st North American Wildlife and Natural Resources Conference***
22-27 March 1996, Tulsa, Oklahoma

At this conference a 3.5 hour session will be held on "Prescribed Fire Effects on Wildlife Habitats and Populations". Each speaker will be allotted 15-20 minutes for presentation plus another 5 minutes for discussion. Submitted papers should either (1) give research findings that contribute significantly to knowledge on prescribed fire relationships to wildlife use and needs; (2) contain timely information that is useful in guiding or calling for action; (3) present positive case histories that illustrate success in using prescribed fire to achieve a wildlife-related objective(s); (4) highlight prescribed fire and wildlife programmes, interrelationships and approaches in the region where the conference is held, or (5) have wide appeal, or help give broad geographical coverage to the subject of prescribed fire as a wildlife habitat and population management tool.

Authors have the primary responsibility to obtain colleague review of their manuscripts before submitting them in final form. Two copies of each abstract must be forwarded to the session chair not later than 15 September 1995. If a proposed paper is accepted, a completed manuscript from the presenter must be submitted no later than 15 February 1996. Volunteer or invited speakers must register for the conference and pay the registration fee.

For further information or submission of an abstract for this session, contact:

Champe Green, Session Cochair (e-mail: cgreen@okway.okstate.edu, Phone: ++1-405-744-5445)
Ron Masters, Session Cochair (e-mail: rmaster@okway.okstate.edu, Phone: ++1-405-744-8065)
Extension Wildlife & Forestry
008C Ag Hall
Oklahoma State University
USA-Stillwater, Oklahoma 74078-0491
Fax: ++1-405-744-9693

U.S.A.

20th 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 of 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

RUSSIAN FEDERATION

FAO/ECE/ILO Seminar on Forest, Fire, and Global Change
4-10 August 1996, Shushenskoye, Krasnoyarsk Region

FAO/ECE Fire Seminar on *Forest, Fire, and Global Change*

The first three fire seminars organized by the ECE/FAO Agriculture and Timber 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 fire Prevention* (Valencia, Spain, 1986), and on *Forest Fire Prevention, Land Use and People* (Athens, Greece, 1991). Following the 5-years interval schedule of the previous years, the next seminar will be held in 1996. Host of the seminar will be the Government of the Russian Federation, through the Minister of Forestry. The seminar is entitled *Forest, Fire and Global Change*. The objectives and expected outputs of the seminar are given in the agenda (see box below).

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 the following five key groups that are crucial for further joint strategic development in wildland fire research and development:

- Producers
- Users
- Researchers
- Policy makers
- Funding agencies

Equipment producers are invited to exhibit and demonstrate ground equipment, explosives, aerial delivery of extinguishants and personnel, intelligence and decision-support equipment, communication systems, global positioning/navigation systems, etc.

Important Note !

Parties and individuals being interested in presenting a voluntary paper on the topic given in the agenda, or to exhibit scientific and/or commercial materials on forest fire research, fire intelligence, or fire suppression techniques, are invited to use the reply form at the end of this newsletter and to fax it as soon as possible to the organizers of the seminar.

In the next issue of International Forest Fire News (which will be printed and distributed earlier than usual -- before the end of 1995) detailed information will be given on

- Registration procedures
- Travel advice
- Deadlines for voluntary papers and posters

FAO/ECE/ILO Seminar on Forest, Fire, and Global Change
4-10 August 1996, Shushenskoye, Krasnoyarsk Region

Objective:

The objective of the seminar is for participants to better understand the role of natural vs. accidental fire in global ecosystems, with special emphasis on the ECE region. This objective will be achieved through the following activities:

(a) to develop

1) Assessments on the extent of land areas affected by fire (forest and other land);

2) Assessments of damage caused by wildfires;

3) Methodologies to improve and standardize assessments of fire inventories and fire impacts; and

(b) to clarify the role of forest fires in:

4) Land-use and land-cover changes;

5) Maintaining biodiversity;

6) Global carbon, nutrient and water cycles; and

7) Forests affected by industrial and radionuclide pollution.

The expected outputs of the conference will be to prepare, in fulfilment of the UNCED process and the International Decade for Natural Disaster Reduction, international agreements to:

8) Develop a standardized fire inventory system;

9) Establish mechanisms to collect and evaluate fire inventory data on a global scale;

10) Develop an internationally accepted statement on fire management policy; and

11) Establish mechanisms for international cooperation in fire management on a regular base and in disaster management assistance.

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 of 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.

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.

A second announcement will be distributed in mid-1995 to all respondents to this expression of interest, including a call for papers and a registration form. A final announcement will be distributed in early 1996 to remind all intending participants and to finalise accommodation requirements. 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

MEXICO

Fire and Sustainable Natural Resource Development in Latin America and the Caribbean
4-8 November 1996, Mexico

First Announcement

The objective of this workshop is to provide information and analyze the state-of-the-art in fire disciplines and rural development. The workshop will be broad in scope and provide information for fire professionals, scientists, economists, administrators, community leaders, and land-use planners. The focus will be on

- Fire science and applications, technology transfer
- Conservation strategy, education and implementation planning
- Founding multi-lateral, eco-industrial working teams

The workshop will provide proceedings - a reference manual for professionals, and a "Who's Who" of professionals leading tropical studies on the American continents and the Caribbean islands.

For further information, contact:

Andrea Koonce or Timothy Paysen
Riverside Fire Laboratory
4955 Canyon Crest Drive
USA-Riverside, CA 92507

Fax: ++1-909-276-6426
Phone: ++1-909-276-6570 or 6552

CANADA ***2nd International Wildland Fire Conference***
25-29 May 1997, Vancouver, British Columbia

The conference theme of "**Wildland Fire Management and Sustainable Development**" will study and inform delegates over two and one-half days of plenaries, panels, posters and hands on demonstrations at the Hotel Vancouver. As a follow-up to the **1989 International Wildland Fire Conference** (Boston, Massachusetts, USA), the Vancouver conference will bring together leaders of public and private organizations from around the world to discuss issues, programs and strategies to promote international cooperation in wildland fire management.

The conference facilities will also host an "Information Exhibit" running concurrently with the conference sessions. This technical exhibit of products, services, scientific and educational developments will provide an opportunity for conference delegates to familiarize themselves with new and innovative technologies while reviewing the latest in scientific achievements.

An added bonus allied with the Wildland Fire Conference will be a dedicated one day "Operative Trade Show" for all delegates. Situated just outside of Vancouver, the Abbotsford International Airport (host to the World Famous Abbotsford International Air Show"), will stage a working trade show that will spotlight international exhibitors and suppliers. Everything from fire fighting aircraft to specialized suppression equipment and systems will be on display. This three day equipment trade show, open on the first day to conference attendees only, will feature "live" demonstrations and will encourage delegate participation. Delegates will be invited back for days two and three of the "operative trade show", and as well, Abbotsford will open its doors to the fire community at large and to a general public viewing. This is a must attend international event.

Key dates: 2nd announcement, call for abstracts, and registration: July 1996
Abstract submission deadline: February 1997
Early-bird registration deadline: March 1997.

Key contacts of the conference are:

Rick Clevette
Chair, 2nd International Wildland Fire Conference
Steering Committee
c/o British Columbia Ministry of Forests, Protection Branch
31 Bastion Square
CDN - Victoria, British Columbia V8W 3E7

Fax: ++1-604-356-9327
Phone: ++1-604-387-8716

Dr. A. J. (Al) Simard
Program Chair
c/o Canadian Forest Service
Place Vincent Massey
351 St. Joseph Blvd.
CDN - Hull, Quebec K1A 1G5

Fax: ++1-819-994-3389
Phone: ++1-819-997-1107

In Memory of Ed Komarek

Edwin "Ed" V. Komarek, Sr., nestor and grand old man of fire ecology, passed away on 6 May 1995. Most readers of International Forest Fire News probably know the numerous publications and proceedings of the Tall Timbers Fire Ecology Conferences, inspired by Ed Komarek.

Ed Komarek was born in Chicago on 4 June 1909 and received collegiate training in zoology and worked as museum mammalogist until he became Herbert L. Stoddard's assistant in the Cooperative Quail Study Association in Thomasville, Georgia. Influenced by Stoddard's vision of the need to study the long-term effects of fire and his new experiences in southern pine forests, Ed Komarek began to realize the full breadth of fire as a natural process.

In 1958 Ed Komarek became the driving force in the creation of Tall Timbers Research Station. To stimulate the interest in the use of fire in land and forest management, he organized the Tall Timbers Fire Ecology Conference series, which began in 1962. Between the first and the 19th conference, discussions were concerned primarily with the ecological effects of fire on flora and fauna in most of the United States and Canada. However, international representation included 23 countries from Asia, 13 from South America, 30 from Africa, 11 from Central America, and 11 from Europe and Mediterranean countries. The scientific work contained in the proceedings are one of the most valuable compendia in fire ecology.

Ed Komarek authored more than 80 papers on a wide variety of subjects. Among his many awards for scientific achievements was an Honourary Degree of Doctor of Science from Florida State University in 1971.

Personally, I met Ed Komarek on several occasions. He was my teacher as he was of many others, especially from Europe. Tall Timbers Research Station in the 1970's was the first school for fire ecologists. Ed told me how to set fire, not how to extinguish it. He critically analyzed and commented on the aftermath of the catastrophic fires in Germany of 1975-76, a result of the European fire suppression paradigm. He was an important personality in encouraging the post-war science community in Germany to wake up and to leave this paradigm. In 1976 we attended the Atlanta meeting "Fire by Prescription", convened by the US Forest Service. It was the time of the big change from fire control to fire management. When Ed had finished his talk, critically looking back to the years of his battle as advocate of fire and nature, there was silence. This silence was a high recognition for a pioneer in fire ecology.

In 1996, at the 20th Tall Timbers Fire Ecology Conference, the Ed Komarek Fire Ecology Lecture will be given by our fire historian Steve J. Pyne. He will talk about it, the *Strange Fire: the European Encounter with Fire*.

The Editor

FROM THE PRESS

Fighting Fire with Fire

If we are to stop the planet turning into a giant tinderbox, we have to learn how to use fire at least as well as our ancestors, says Larry O'Hanlon

As flames roared up the ridge, through trees and brush near the town of Verdi in the Sierra Nevada, firefighters from the US Forest Service were not unduly worried. The fire would reach the far side of the ridge, they thought, then slow down or stop. That is the way a typical fire would behave. But little about this blaze and others last summer on the US West Coast was typical. In a matter of minutes, the flames had crested the ridge and were charging unabated into the next canyon and beyond, leaving the firefighters scrambling.

"It was a life-changing experience," recalls John Swanson, the fire and timber chief for the US Forest Service at nearby Lake Tahoe and a veteran of numerous fires. Like many others, Swanson came back from Verdi and similar wild blazes in the western US last year suspecting that the fires which sweep through these landscapes had begun to change.

Researchers who study the geography and ecology of brush and forest fires have exactly the same fears - and not just about Californian fires. They believe that across the globe, from California to Australia and from the Mediterranean to South Africa, such wildfires are becoming hotter, more devastating and more frequent. Indeed, the pessimists among them talk about the planet being on the brink of a "global pandemic" of wildfires as a vast tinderbox of flammable shrubs and dead vegetation accumulates in forests, brush and grassland.

Nobody is suggesting that wildfires are anything new. It's just that in centuries and millennia past, the "surface fuels" that feed them would have been regularly ploughed under or burnt off by farmers and other land managers, or by hunter-gatherers who used controlled doses of fire to flush out prey or to protect hunting grounds from lightning strikes. But such practices have mostly fallen by the wayside. The result, the argument goes, is tracts of land at the mercy of carelessly discarded cigarettes, arsonists and lightning. The infernos that swept past Sydney at the beginning of last year and Los Angeles last summer could be a taste of things to come.

If this pessimistic assessment right - and no one can yet be certain that it is - what should governments do about the problem? Encourage controlled burning, or invest in better technologies for suppressing and fighting fires? Curb the expansion of suburbs into fire-prone countryside or attempt to build fireproof houses? Then there is global climate change to consider. Will it make wildfires more prevalent? For that matter, what will more prevalent fires do to the climate? Ecologists, fire researchers and land managers have only just begun to tackle such questions in earnest.

Though the scope for debate is still huge, one thing seems certain. Flames, heat and even smoke are among the forces that have shaped and sustained natural environments for millennia. The idea that you can somehow exclude fire from natural environments in places like Australia and South Africa is a nonsense. European colonists and their descendants have discovered the hard way that the only real choice is between landscapes shaped by frequent, human-controlled fires and landscapes shaped by infrequent and unpredictable firestorms.

The fear is that we are about to get the latter by default, and anecdotal evidence seems to support this view. Last year's wind-whipped blazes near Los Angeles reached temperatures of around 1400 °C - hot enough to ignite the asphalt of the Pacific Coast Highway, according to one firefighter at the scene. Decades of growth and fire suppression had left abundant fuel, which in the favourable dry winds fed firestorms that resisted all human attempts of containment, and only fizzled out when they reached the Pacific Ocean. The extended suburbs added a new kind of fuel to the fire: people's homes.

Such disasters could hardly be more dramatic. But finding out whether they are part of a global trend is proving difficult, because reliable data are hard to come by. "The statistics for fire stink," says Stephen Pyne

of the University of Arizona, whose book *World Fire: The Culture of Fire on Earth* analyses the histories of wildfires in Sweden, South Africa, North America, Siberia and many other parts of the globe. Wildfires have gone largely unmonitored by governments and scientists, and even where figures exist the picture is often blurred by the lack of clear definitions for classifying fires. For example, a lot of what was once agricultural burning is now considered to be wildfire, Pyne says. Even the word "forest" can lead to confusion. Europe is struggling with definitions of "forest fire" because legal definitions of what counts as forest often do not make biological sense.

Among the people trying to straighten out the statistical jumble is Johann Goldammer of the Fire Ecology Research Group at the Max Planck Institute for Chemistry in Freiburg, Germany. Goldammer is developing an information clearing house that will centralise and standardise statistics on fires. As the leader of a UN team of forest fire specialists, Goldammer is also managing an ambitious project to set up a **Global Fire Management Facility** that would monitor fires worldwide, organise and share fire specialists and firefighting equipment, coordinate fire-related research, and develop policies for controlling fires and managing vegetation.

Pyne believes the need for such measures has never been greater. Over the past 20 years, many policy makers have come to accept the idea that controlled burning is desirable, yet the amount of controlled burning in places such as California has actually plummeted. The same is true, says Pyne, for the forests of Sweden and Finland and also around the Mediterranean, where 90 per cent of Europe's fires occur. Globally, he argues, "there is a whole lot less [controlled] burning than in centuries past". He reckons that the area being burnt in this way today is a mere 20 per cent of what it was when Columbus sailed.

The result is that flammable debris keeps piling up in forests, grasslands and farms, like so many bundles of dynamite - and this in a world where the political environment is more hazardous than ever. To demonstrate what a dangerous combination this is, researchers point to the recent history of Greece. "During the 1980s it is generally believed that rightists tried to burn the country," says Goldammer. In fact, the areas burnt in the election years of the 1980s nearly trebled, from less than 40 000 hectares per year to nearly 120 000. The worst single year was 1993, when 2417 fires burnt 47 000 hectares, reducing to ash an area more than half that of New York City.

Russia could be next. According to Pyne's analysis, nearly 10 million square kilometres of Russian forest - about a quarter of all the world's forests - are now at the mercy of the country's social unrest and political confusion. The emerging market economy will not necessarily help matters, either. Timber is a highly profitable commodity, and logging companies understandably look on fire as a threat to their livelihood. Yet suppressing all fires and cutting for quick profits may eventually lead to thickly overgrown forests and calamitous infernos.

But even if it is agreed that the planet needs more regular, controlled burning of its forest floors and grasslands, taking action will not be easy. Yes, national park managers in Australia, South Africa, California and other parts of the western US are doing whatever they can to bring "prescribed burning" back to conservation areas. But their resources are limited and the job requires detailed (and costly) monitoring of winds, humidity, the moisture content of forest floor debris and a host of other variables.

Other obstacles may prove even harder to overcome. In the resort area of Lake Tahoe in the Sierra Nevada, tourists and residents don't want smoke obscuring the alpine views. Never mind that clear, pristine air may be just another cultural construct we are imposing on the land. Before it was settled in the last century, around 1000 acres of Tahoe's forests burnt each year, Swanson estimates. Less than 20 hectares burnt there last summer - and that was considered a bad fire year.

Then there is the problem of spreading suburbs and the fears of rural home owners. Burning undergrowth is dangerous. Burns that are supposed to be limited and controlled may break free, levelling homes and threatening entire towns, as happened in the tiny mountain town of Woodfords, California, in 1987. There the US Forest Service was held accountable for homes which burnt to the ground when a prescribed burn ran out of control. Fire ecologists and foresters involved in controlled burns would face similar liability if things went wrong.

Even if Californians accepted this risk, and were prepared to put up with the smoke, there are legal problems.

California has some of the strictest air pollution standards in the world and a limited amount of "airshed" in which to dilute carbon dioxide, ozone and other pollutants. Prescribed burning and the burning of agricultural waste have to take their turn after high-priority polluters like cars and power stations.

Such restrictions are becoming increasingly contentious. Certainly, there are atmospheric chemists and air-quality specialists who argue against controlled burning. Too much vegetation, they say, already goes up in flames each year for one reason or another, pumping out CO_2, methane and toxic pollutants in the process. But ecologists and researchers who study the impact of vegetation burning on the atmosphere see things differently. According to them, curbing controlled burning to avoid pollution and greenhouse emissions is at best a waste of time and at worst a false economy. The real problem lies elsewhere - with burning vegetation for land clearance.

The distinction, though easily lost, is crucial. Controlled burning of landscapes to reduce surface fuels has been on the wane for decades. The paradox is that the total amount of vegetation being burnt each year across the globe seems to be climbing, due mainly to the clearance of forest, bush and savanna for agriculture and development in the tropics. A few years ago, Richard Houghton, a researcher at the Woods Hole Oceanographic Institution in Massachusetts, suggested that the amount of carbon released to the atmosphere each year due to land clearing, especially deforestation, may have increased by about 50 per cent since the middle of the last century. But this was, by Houghton's own admission, just a crude estimate, and the race is now on to collect hard data.

At NASA's Atmospheric Sciences Division at the Langley Research Center in Hampton, Virginia, Joel Levine and his colleagues are studying a range of indicators of global "biomass burning", including deforestation rates and chemical analyses of air sampled on the ground and from planes. The main string to the researchers' bow, however, is satellite imaging. "We're using satellite datasets developed to study other things, like cloud formation and weather patterns, to find out the extent and frequency of burning," says Levine.

Since this has never before been done at a global level, the researchers are having to write new computer algorithms that can extract detailed information about fires and land clearance from the satellite data. It will be some time before Houghton's estimate of 50 per cent can be validated. But Levine is convinced which way the trend in burning for land clearance is pointed. "We're destroying biomass each year, each day," he says - and not only that, but this relentless destruction has contributed as much as 40 per cent of the CO_2 in the atmosphere today.

But when it comes to controlled burning, fears about atmospheric pollution and CO_2 emissions are largely misplaced. "Prescribed and controlled fires are negligible in terms of the amount of biomass converted into CO_2, methane and other gases," says Levine. "In our calculations, we don't even have a category for how much material is released by prescribed burning."

It's not just a question of scale; controlled burning is environmentally benign in a deeper sense. Fire-prone landscapes will eventually burn with or without human intervention, so sooner or later the carbon locked in the vegetation will be released into the atmosphere as CO_2. The key point is that after a controlled fire, vegetation regrows, absorbing CO_2 in the process. Indeed, by encouraging germination and new plant growth, certain types of fire - even wild blazes - may actually help the growth of vegetation. As long as the land is allowed to regenerate, the CO_2 absorbed should roughly balance that released during the burning.

Goldammer concludes: "Recurrent savanna and dry forest fires do not contribute to a net release of carbon dioxide to the atmosphere. Although the annual release of carbon from such fires is, of course, very high." The same is not true of fires designed to change the use of the land. Hectare for hectare, for example, a tropical rainforest contains about 100 times more carbon than pasture.

But even if everyone agreed that prescribed burning is not going to affect the production of greenhouse gases, other problems would remain. Many of the old "fire ecologies" have long been abandoned by the people who used to manage them, or worse, so irresponsibly corrupted that it would be unwise or impossible to bring back the firestick.

Recent events around Chernobyl shows how badly things can go wrong. After the reactor melted down in 1986

and released lethal concentrations of radioactive material into the air, the countryside for miles around the plant was evacuated. A landscape which for centuries had been intensively managed was suddenly left to go its own way. As fields fell fallow, flammable debris built up. In May 1992, 136 fires erupted in the region around Chernobyl, which stirred up radioactive material and spread it on the wind. The US has had similar problems with fires at the contaminated Hanford nuclear site in Washington state.

An equally insidious complication arises from the worldwide problem of introduced weeds and other exotic invaders. The human habit of deliberately or inadvertently moving species around the globe has left many of the old fire ecologies at the mercy of aggressive introduced species such as grasses and pines, which exploit the openings created by fires to crowd out native plants. One such area is Florida's Everglades where for tens of thousands of years regular fires shaped and sustained the ecology. Now fires have become a destructive force. According to Goldammer, "Exotic invaders march in hand in hand with fire", accelerating changes of fauna and flora. When imperata grasses invade rainforests after disturbances by humans, for instance, a largely non-flammable natural ecosystem is replaced by a species-poor, vegetation that goes up in flames on average once or twice every two years.

The story is similar in Australia. Before the Europeans arrived with their cats and foxes, burning off forest-floor vegetation probably created only short-term problems for native mammals. That may no longer be true in some areas. Without ground cover, native mammals can make easy prey for alien predators (see "How to burn a wilderness", *New Scientist", 29 October 1994*). So if you don't burn, the bush is subjected to intense and destructive fires; but if you do, you risk losing native mammals to cats and foxes. It looks like a no-win situation.

The same could be said elsewhere in the world. The good news is that American foresters and ecologists have lost their revulsion for land fires. The bad news, says Pyne, is that they may have swung too far in the opposite direction, striving for the impossible ideal of presettlement days, when American Indians and lightning regularly burnt the land. Now the land is heavily populated and developed, so the widespread, frequent, low-intensity burning of old is out of the question.

The story is similar in the South African veld, Siberian taiga and various types of Australian bush. We can neither keep fires eternally at bay, nor go back to "nature's fire". Our better understanding of fire ecologies may have come too late for many landscapes. In many places fuel loads are so high that fires burn hot and explosively, sterilising the land instead of rejuvenating it. If researchers like Pyne and Goldammer are right about global fire trends, we could be locked into a cycle which could make the 21st century the most flammable ever known.

Further Reading: *World Fire: The Culture of Fire on Earth*, by Stephen J. Pyne, Henry Holt & Co., New York, 1995. - *Global Biomass Burning: Atmospheric, climatic and biospheric implication*, ed. J.S. Levine, MIT Press, Cambridge Massachussetts, 1991. - *Fire in the Environment: the Ecological, Atmospheric and Climatic Importance of Vegetation Fires*. eds. P.J. Crutzen and J.G. Goldammer, John Wiley and Sons, Chichester, 1993.

This article by Larry O'Hanlon was first published in **New Scientist** (David Concar, Life Sciences Editor) on 15 July 1995 (copyright by IPC Magazines). Reprinted with permission of **New Scientist**. Larry O'Hanlon is a freelance writer from Nevada.

Indonesia to crack down on firms burning forests to clear land

Jakarta - Indonesia, trying to prevent a repeat of last year's huge forest fires, has vowed to get tough with companies which burn forests to clear land, the official Antara news agency reported yesterday. Environment Minister Sarawono Kusumaatmadja, quoted by the agency, said timber companies which cleared land through burning would have their forest concessions revoked. Speaking after launching a forest-fire prevention drive in south Sumatra on Thursday, he said the warning also applied to firms granted permits to open land for transmigration, a programme which moves people off crowded Java to less-populated outer islands.

The move follows a promise by Jakarta late last year to prevent a repeat of the blazes which ravaged part of its territory and blanketed neighbouring Malaysia and Singapore in thick haze during August and September. The fires razed more than five million hectares of bushes, plantations and forests in Sumatra and Kalimantan, Indonesia's half of Borneo island. Damage was estimated at more than US$100 million (Singapore$ 140 million).

President Suharto, in a speech read by Mr. Sarwono at the launching ceremony, said it was time to stop burning forests for any purpose across the archipelago. "The haze from the fires flies off and has led to complaints by neighbouring countries," Mr. Suharto said. Mr. Sarwono said a team of officials had been meeting since February to work towards stopping a recurrence of the fires. Environmentalists and officials have blamed the fires on factors including extensive logging and the age-old practice of tribal sash-and-burn farming. Mr. Sarwono added earlier in the month that the government would set up a body to monitor forest fires ahead of the forthcoming dry season.

"We will set up the permanent body comprising several senior officials from other ministries to monitor forest fires," he told reporters after meeting Mr. Suharto.

A Reuter report, reprinted from ***The Straits Times*** (Singapore) of 3 June 1995

THE LAST PAGE: RARE FIRE EVENTS

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