UNITED NATIONS
ECONOMIC COMMISSION FOR EUROPE

FOOD AND AGRICULTURE ORGANIZATION
OF THE UNITED NATIONS

INTERNATIONAL FOREST FIRE NEWS

No. 12 – January 1995

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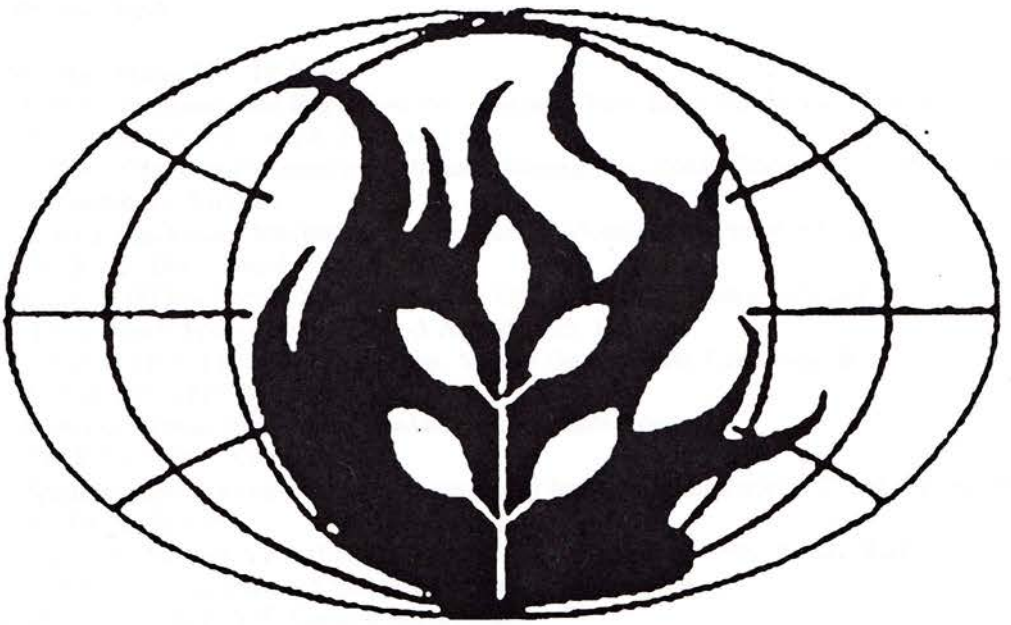

INTERNATIONAL FOREST FIRE NEWS

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. Finland: IBFRA Annual Meeting 1995 on Climate Change, Biodiversity and Boreal Forest Ecosystems, 30 July-5 August 1995, Joensuu
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The publication is edited and prepared by Johann Georg Goldammer, Leader of the FAO/ECE/ILO Team of Specialists on Forest Fire, at the Max Planck Institute for Chemistry, Germany (address: see next page).

Mailing address, telephone and fax numbers of the editor:

Johann Georg Goldammer
Fire Ecology Research Group
c/o Freiburg University
P.O.Box
D - 79085 FREIBURG

Fax: ++49-761-80 80 12
Phone: ++49-761-80 80 11
Telex: 41 87 674 mpch d
E-mail: jggold@sun1.ruf.uni-freiburg.de

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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("Biomass Burning Experiment" [BIBEX])

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

The International Association of Wildland Fire

EDITORIAL

1994 - A Year of International Fires

International cooperation in wildland fire research and management is a permanent ongoing, increasing and in no way new process. 1994 was a year of international fires. International fires, however, are rather rare events: wildfires crossing national frontiers or smoke arising from one country and causing health and safety problems in neighbouring nations.

In September-October 1994 the multinational astronaut and cosmonaut crews on duty on the Space Shuttle missions or stationed on the orbiting space station MIR spotted extensive smoke layers over South East Asia. Forest conversion in the Indonesian archipelago, together with traditional dry land farming activities, were the principal causes of these fires, which created enormous regional smog problems in South East Asia and were the most spectacular events observed from space. Singapore was one of the neighbours most affected by smoke. The Health Ministry of Singapore repeatedly had to issue warnings to protect people with respiratory problems. Flight cancellations were another problem related to the haze from Singapore's neighbour country. And the headlines of the *Strait Times*, a major daily newspaper of Singapore, expressed on 28 September 1994 what many Singaporeans had been hoping and urging for weeks: "*Give us back our day*".

The extent of the area affected by the smoke-producing fires is not yet clear. First numbers released by the Ministry of Forestry reveal that a total land area of ca. 5.1 million ha had been affected by fire, whereof

traditional dry land farming	2.8 million ha
shifting cultivation	1.5 million ha
transmigrant farming	260,000 ha
plantations	221,000 ha
transmigrant settlements	39,500 ha
reforestation areas	20,500 ha
timber estates	17,000 ha
natural forests	8,000 ha

The reaction of ASEAN countries was immediate. It was decided to set up jointly an early warning system and emergency response procedures to cope with the fire and smoke problems. Indonesia declared new measures for preventing future smoke pollution in the regional environment. A detailed report about Indonesia's fire situation and the fire management programmes in progress will be given in the next issue of IFFN.

The reports from space on North African fires were rather different. The astronauts of Space Shuttle mission STS-66, in orbit between 28 October and 14 November 1994, were advised to watch the consequences of the most spectacular events of the Mediterranean fire season of 1994, the border-crossing fires in North Africa.

Tunisia in 1994 suffered its most extreme fire season for many years. More than 5,600 ha were burned, destroying 0.8 % of Tunisia's natural and planted forest lands. Major fires swept from Algeria into Tunisia. The border-crossing fires are an expression of regional instability which has lead to a decrease in operational capability to control fires raging over the two nations.

North Africa has so far shown a development of the forest fire scene that is quite different from its Mediterranean neighbour countries of southern Europe. Unlike in southern Europe, North Africa's forests are still utilized intensively. Tunisia's population living in the forest, concentrated in the northwest of the country, is still dependent on the utilization of plant biomass for energy supply and food production, thus reducing the dangerous loads of fuels and wildfire hazard. The rural population is extremely supportive in preventing wildfires in order to protect their own interests and benefits from income in the forest sector. However, the recent developments are alarming precursor signals that fires in North Africa will go a way similar to southern Europe. The country report of Spain (this issue) reveals that forest fires are getting out of control despite the excellent efforts the country has taken to prevent and combat wildfires. Where are the solutions?

Freiburg, January 1995 Johann G. Goldammer

COUNTRY NOTES

ALBANIA

Wildfires in Albania

Introduction

Albania, despite its very small territory, is one of the European countries with a rich vegetation which originated during the Tertiary era. Today's vegetation of Albania is composed of endemic relic vegetation and of species that have invaded from neighbouring regions through migration, having phytogenetic similarities with floristic elements of neighbouring countries.

Albania is a mountainous country with high topographic and climatic variety: 52% of its surface is on elevations between 600 and 700 m above sea level with prevailing steep slopes (ca. 30%). Thus, ca. 90% of its surface is subject to severe erosion.

About 65% of Albania's population is living in rural areas, and mainly depend on extensive agricultural and stock-breeding activities. The northern, north-eastern, southeastern and central areas are characterized by hilly-mountainous terrain, whereas the north-southern/coastal area along the Adriatic and Ionian coast is a lowland. Climate extremes range from extreme cold winters in the northern, north-eastern and south-eastern areas to very hot and dry summers along the coast. Rainfall regimes vary from north to south and from Coast to Inland. There are fewer rainy days in the south than in the north, but months without rainfall can occur at any time of the year, as it is typical for the Mediterranean climate. Local precipitation differences lead to diverse vegetation patterns.

The forests

Forests occupy 1.045 million ha with a standing volume of about 82 million m^3 and an average annual growth of 1.4 m^3 per ha. This is very low compared with many countries of Central Europe. Most of the forested land (77%) consists of degraded forests with low productivity, e.g. oak forests (31.8%) and shrubland (25.6%).

The forest area is divided in two basic categories according to function: production forests (ca. 900,000 ha = ca. 86% of the area) and protection and recreation forests (ca. 140,000 ha = ca. 14%). The highland ecosystems are characterized by laurel, chestnut and alpine pastoral belts at various altitudes. In the south and near the Mediterranean coast, these belts grow at a higher altitude than in the northern inland areas. The major forest tree species are:

Beech (*Fagus silvatica*), on 160 000 ha (= 17%)
Pine (*Pinus* spp.), on 142 000 ha (= 15%)
Fir (*Abies* spp.), on 13 000 ha (= 2%)
Oak (*Quercus* spp.), on 300 000 ha (= 32%)
other broadleaved species, on 510 000 ha (= 34%)

The National Forest Inventory is carried out every ten years, and 40% of the area is treated on the basis of 5-year management plans.

Forest fire prevention and control

Human misuse of fire (accompanied with deforestation during the past years) and grazing practices were no doubt largely responsible for most of the forest destruction. Unfortunately unrestricted grazing and uncontrolled fires, caused accidentally and often due to agricultural burnings, still occur throughout the Albania.

A well-organized fire prevention programme is still absent in Albania. A permanent observation-signalization system/net (with several fire towers per district) is available in fire-endangered forests of the whole country and operated by the Forest Service during the fire season. The availability of fire suppression infrastructure and equipment, however, is still very insufficient.

The legislative frame of forest fire control is incorporated into the law "On Forests and Forest Service Police", being accompanied by the by-law "On Forest Fire and Pest Control" and a special Regulation "Forest Fires".

Forest Fire Statistics

Forest fire statistics are collected by the Forest Districts and evaluated by the General Forest Directorate. Most of the forest fires in Albania occur at the end of spring and in summer. The main causes of fires are human negligence, and to a lesser extent due to arson or caused by lightning. Fire data for the period 1981-1993 are given in Table 1.

Fire programme needs

Humans are responsible for almost all wildfires in Albania, due to people's careless and destructive behaviour. The use of slogans for public awareness-raising, e.g. forest animals with fire-prevention slogans as used in other countries, is not applied in Albania. An improved fire-prevention programme is needed which must go along with technical fire-management measures. For instance, lookout towers for fire detection are available, but they are not accompanied by other necessary means such as a fire danger rating system or the involvement of the media. There is modest equipment available for forest fire suppression, but it is far from being sufficient.

Albania urgently needs technical assistance from other countries to build up forest fire management capabilities and basics in fire research. For this purpose the General Directorate of Forestry & Pastures, the Forest & Pastures Research Institute and the Forestry Faculty need to exchange information with other countries and the expertise of national/international institutions. The training of specialists in this field is indispensable, and provision of equipment is urgently needed.

Mehmet Meta
Specialist, Forest Protection
General Directorate of Forestry & Pastures
Tirana

Call for Support

In Spring 1994 the Editor of International Forest Fire News visited Albania. An agreement was made that the Fire Ecology Research Group will support Albania to build up fire management and research capabilities. A new research unit has been established at the Forest Research Institute in Tirana. This unit is lacking basic literature on forest fires. The readers of International Forest Fire News are kindly requested to support the new research facility and the governmental fire protection unit by providing reprints, brochures, books, training and demonstration materials on fire research and fire management, on a cost-free base. Please mail the materials to:

Basic Fire Research Materials:

Ms. Silva Janço
Instituti i Kerkimeve
Pyjore Kullotave
Rr: Niko Avrami
Tirana, ALBANIA

Fire Management Materials:

Mehmet Meta
Specialist, Forest Protection
General Directorate of Forestry & Pastures
Tirana
ALBANIA

JGG

Tab.1. Forest fire statistics of Albania for the period 1989-1993

District	Number of Forest Fires between 1989 and 1993					Total Number of Fires	Area Burned (ha)
	1989	1990	1991	1992	1993		
Berat	-	4	-	15	18	37	11
Diber	10	18	12	20	58	118	64
Durres	-	19	-	3	10	32	23
Elbasan	7	3	4	38	32	84	56
Fier	4	-	2	19	16	41	47
Gramsh	-	2	-	11	22	35	25
Gjirokaster	-	4	25	48	31	144	88
Kolonje	3	9	3	33	38	86	118
Korce	9	16	1	49	52	127	170
Kruje	1	6	1	16	10	34	42
Kukes	16	20	14	25	15	90	55
Lezhe	10	12	16	22	20	80	99
Librazhd	8	4	8	15	14	49	64
Lushnje	-	3	-	1	5	9	40
Mat	2	18	1	22	70	113	117
Mirdite	5	28	35	59	44	216	171
Permet	-	5	-	-	2	7	5
Pogradec	1	-	1	2	1	5	4
Puka	17	31	26	80	88	242	208
Sarande	1	15	-	5	12	33	125
Skrapar	-	2	-	5	17	23	76
Shkodar	-	9	3	7	25	44	103
Tepelene	-	3	-	8	12	23	39
Tirane	5	14	4	37	48	109	123
Tropoje	2	4	2	38	9	55	52
Vlore	1	24	26	35	7	93	145
Total	**102**	**273**	**184**	**613**	**676**	**1,929**	**2,070**

Preliminary fire data of 1994: 509 forest fires on 400 ha

Introduction

In the countries of the Mediterranean Basin, including Cyprus, fires are considered one of the major agents which contribute to the degradation and reduction of forests. Today, however, the protection of forests against fires has been given a top priority. The sustainable management practised in Cyprus is concerned primarily with protection and conservation.

Forests in Cyprus

Forests (and other forest land) in Cyprus cover an area of 175,398 ha which is 19% of the total land area. State forests (and other forest land) cover an area of 161,820 ha which is 92% of the total forest area (Fig.1). It should be noted, however, that only half of the area can be classified as high forest.

State forests are classified into the following vegetation types: *Pinus brutia*, *Pinus nigra*, *Cedrus brevifolia*, reforestation, garrigue or bare land, shrubs (*Quercus ainifolia*, etc.), maquis, and *Eucalyptus* spp. Table 1 shows the indicative area of each vegetation type.

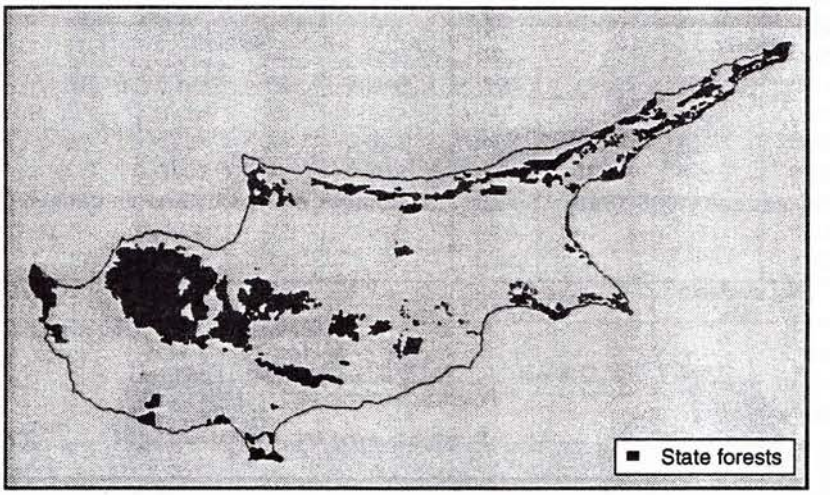

Fig.1. State forest map of Cyprus

Tab.1. State forest land vegetation types in Cyprus

VEGETATION TYPE	Area (%)	Cum Area	Area (Ha)
PINUS BRUTIA	45,0	45,0	72 434
PINUS NIGRA	3,0	48,0	4 827
CEDRUS BREVIFOLIA	0,5	48,5	814
REFORESTATION	21,0	69,5	33 823
GARIQUE OR BARE LAND	6,0	75,5	10 239
SHRUBS (QUERCUS ALNIFOLIA, etc.)	5,0	80,5	7 920
MAQUIS	16,5	97,0	26 976
EUCALYPTUS	1,0	98,0	1 453
OTHER USE	2,0	100,0	3 334
Total	100,0	100,0	161 820

Forest Fire Statistics

The term forest fire includes:

- all fires which break out in State forests;
- forest fires which break out on other land:
  - the fires that are up to 1 km away from the forest delimitation line.
  - certain other cases e.g. fires which break out in private forests.

Data are retained on all three cases. The statistics reported, however, are limited to the forest fires which break out on state forest and from fires which break out in other land and only to those which include forest land in the burned area. Statistics are compiled in Tables 2, 3, and 4 and in Figures 2,3, and 4. Figure 2 presents a basic analysis of the causes. Table 2 and Figure 3 present the number of fires and burned area per year since 1886. Table 3 presents the number of fires by burned area per month for years 1985-1993. Table 4 does the same, but per day of the week instead of month. Figure 4 presents the number of fires by attack time (1985-93).

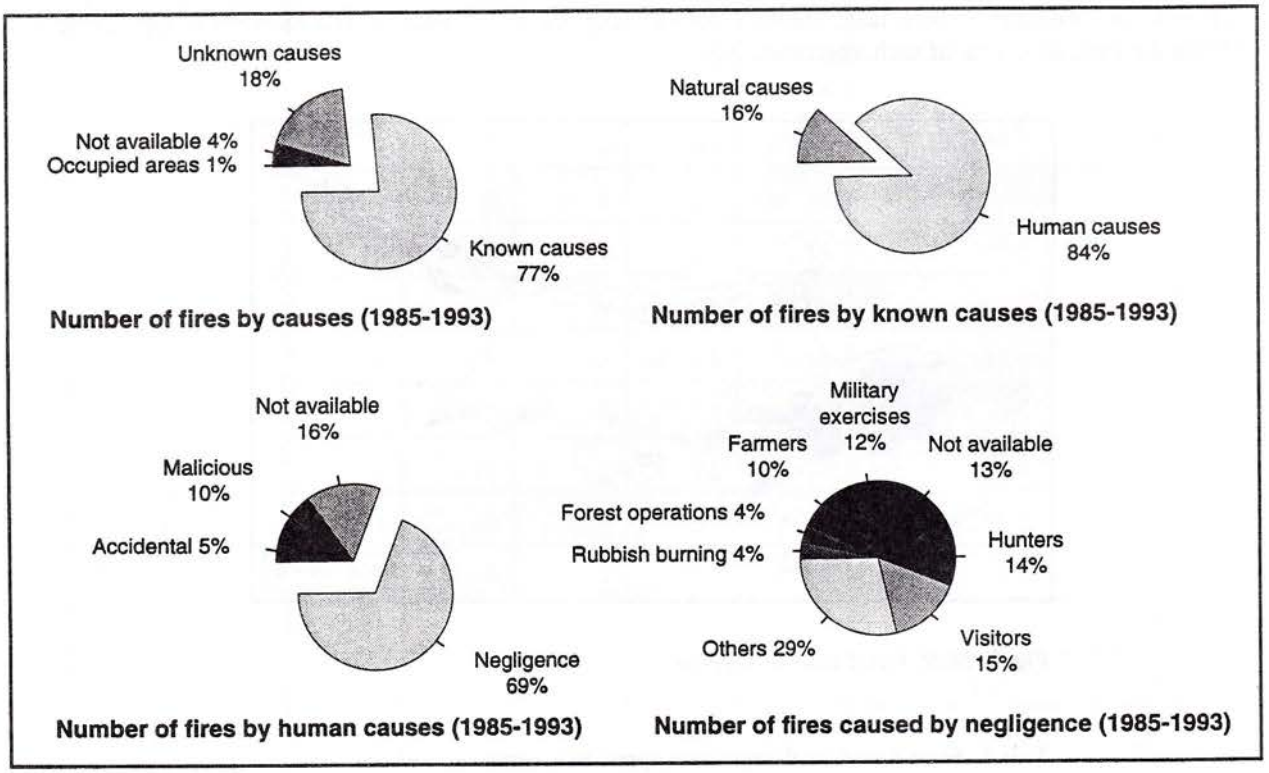

Fig.2. Basic analysis of the causes of forest fires in Cyprus

Facts and conclusions

From these statistics a number of inferences and conclusions can be drawn. We point out the following ones:

- Statistics clearly demonstrate that forest fires are caused by human activities. Considering the number of fires, the percentage for human causes is 84%. Considering the burned area, however, this percentage is as high as 99,5%. Now, among human activities negligence is ranked first (69%).

- Although there is a relationship between the number of fires and the burned area, this relationship is not strong. The political situation is one of the main reasons which makes this relationship weaker. Let us take 1974 as a key example of a year with political instability. Though there were only 42 fires in that year, the burned area was 25,900 ha which is the largest figure the island has ever experienced.

Tab.2. Number of fires and burned area per year in Cyprus (1886-1993)

YEAR	NO. OF FIRES	BURNED AREA(Ha)	YEAR	NO. OF FIRES	BURNED AREA(Ha)	YEAR	NO. OF FIRES	BURNED AREA (Ha)	YEAR	NO. OF FIRES	BURNED AREA (Ha)
1886	10	67	1913	70	87	1940	49	223	1967	48	138
1887	23	562	1914	77	615	1941	72	228	1968	43	249
1888	24	94	1915	88	321	1942	61	171	1969	47	104
1889	36	161	1916	110	629	1943	76	334	1970	51	432
1890	40	4414	1917	43	268	1944	93	256	1971	58	182
1891	30	829	1918	46	936	1945	60	888	1972	61	99
1892	46	1338	1919	102	1338	1946	60	122	1973	57	164
1893	44	428	1920	60	67	1947	43	148	1974	42	25897
1894	32	3344	1921	71	181	1948	55	115	1975	26	470
1895	66	134	1922	65	401	1949	50	166	1976	20	41
1896	71	80	1923	62	803	1950	35	25	1977	22	582
1897	82	161	1924	63	5618	1951	57	100	1978	26	127
1898	63	161	1925	117	542	1952	41	27	1979	54	371
1899	45	47	1926	110	522	1953	39	552	1980	23	97
1900	60	281	1927	128	268	1954	41	128	1981	23	15
1901	70	107	1928	130	1084	1955	61	524	1982	32	30
1902	79	883	1929	118	468	1956	126	7582	1983	22	16
1903	80	54	1930	74	277	1957	63	652	1984	13	160
1904	40	134	1931	157	951	1958	128	2289	1985	15	46
1905	42	27	1932	140	1314	1959	77	138	1986	21	467
1906	42	294	1933	89	346	1960	70	599	1987	18	96
1907	78	241	1934	85	669	1961	55	238	1988	26	750
1908	87	87	1935	56	109	1962	57	470	1989	19	14
1909	56	187	1936	72	342	1963	67	420	1990	11	9
1910	93	401	1937	50	734	1964	65	2706	1991	14	27
1911	58	54	1938	37	68	1965	40	38	1992	18	9
1912	73	27	1939	38	49	1966	53	1168	1993	16	69

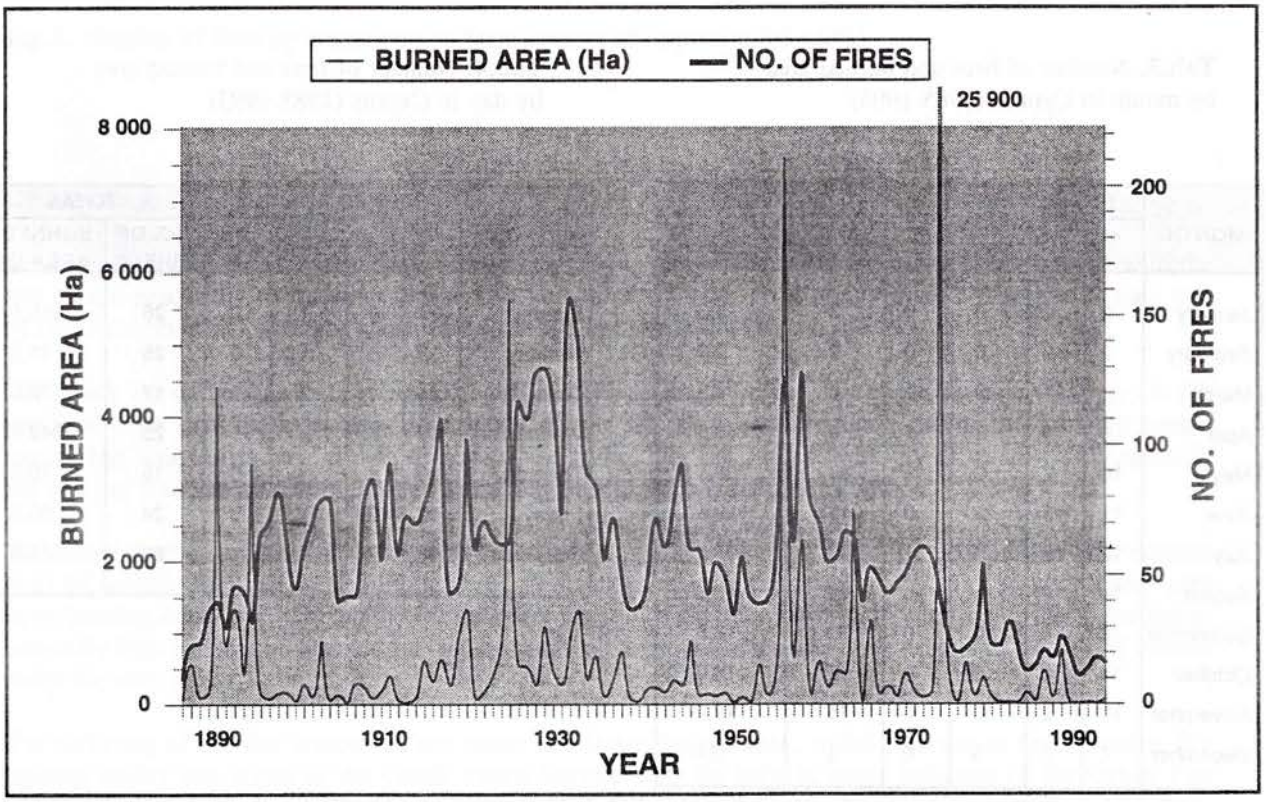

Fig.3. Number of fires and burned area per year in Cyprus (1886-1993)

- If we take 1960 as a reference year, that is since independence, there is a trend for the number of forest fires to decrease.

- In 1990 and 1992, the burned area was only 9 ha which is the lowest recorded figure.

- The forest fire season is eight (8) months long extending from April to November. May is the worst month in both the number of fires and in the burned area. The presence of easily flammable material like grass in May explains the large number of fires, while the occurrence of strong winds during this month accounts for the large burned area.

- Although the number of fires seems to be evenly distributed during the week the same is not true for the burned area which appears to have two peaks; the first peak is on Sunday and is higher than the second one on Wednesday.

- Figure 4 clearly demonstrates the capability of the Department of Forests to attack forest fires in their early stages. The attack time for 93% of the fires was less than 30 minutes.

Charalambos Chr. Alexandrou
Ministry of Agriculture and Natural Resources
Forestry Department
Loukis Akritas Avenue
CY - Nicosia

Tab.3. Number of fires and burned area by month in Cyprus (1985-1993)

MONTH	BURNED AREA(Ha)				TOTAL	
	<1	1-10	10-100	>100	NO. OF FIRES	BURNED AREA (Ha)
January	2	1	0	0	3	1,3
February	2	0	0	0	2	0,0
March	3	1	0	0	4	4,3
April	6	1	0	1	8	168,8
May	18	7	2	1	28	700,1
June	11	5	2	0	18	119,6
July	12	5	5	1	23	407,6
August	14	4	1	0	19	47,3
September	16	4	0	0	20	13,5
October	14	3	0	0	17	14,0
November	13	2	0	0	15	11,4
December	1	0	0	0	1	0,1

Tab.4. Number of fires and burned area by day in Cyprus (1985-1993)

DAY	BURNED AREA(Ha)				TOTAL	
	<1	1-10	10-100	>100	NO. OF FIRES	BURNED AREA (Ha)
Sunday	17	6	1	2	26	915,1
Monday	19	5	1	0	25	44,6
Tuesday	14	1	2	0	17	73,0
Wednesday	15	7	2	1	25	249,9
Thursday	10	4	1	0	15	70,5
Friday	19	3	2	0	24	63,3
Suturday	18	7	1	0	26	71,6

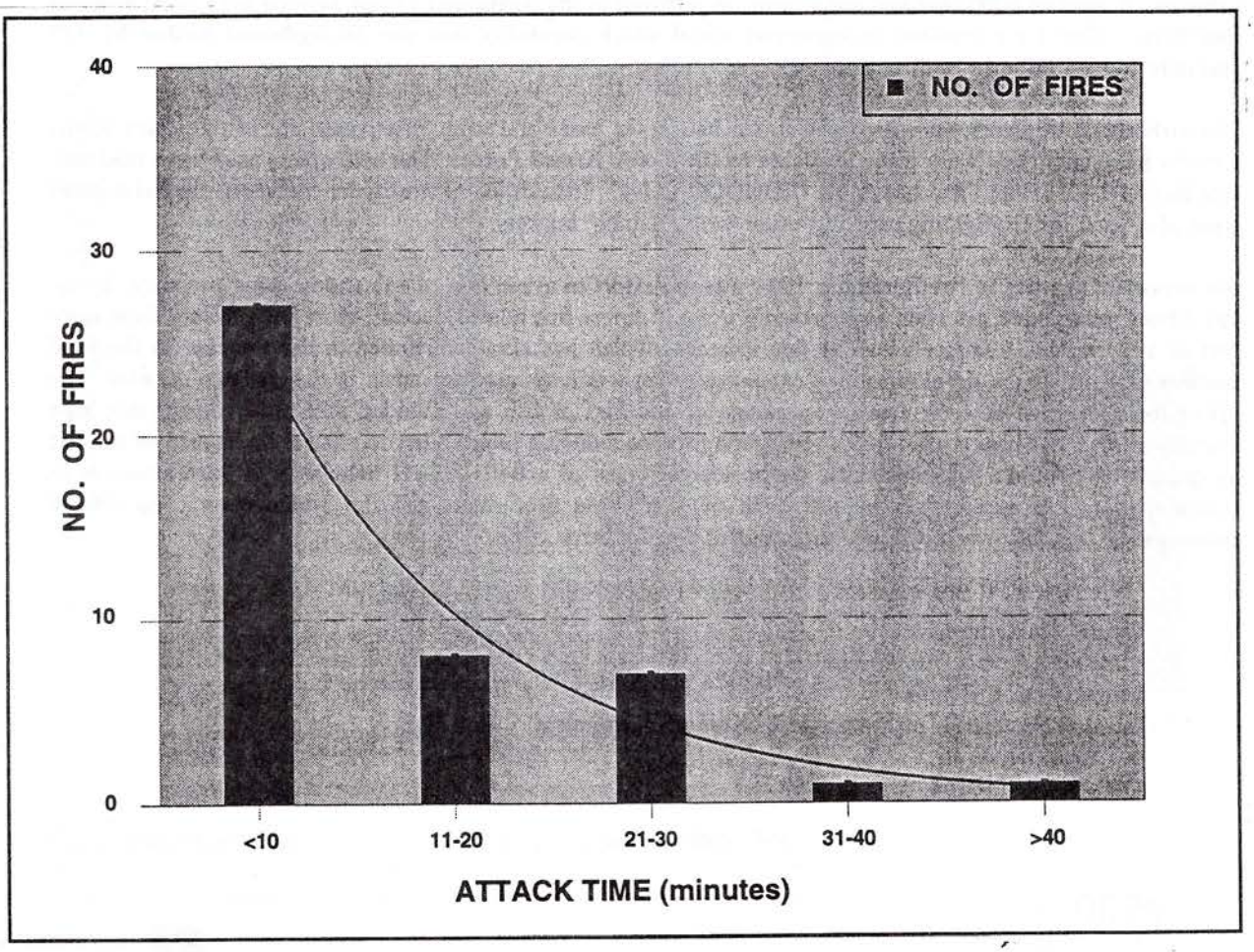

Fig.4. Number of fires by attack time in State Forests of Cyprus (1985-1993)

GREECE *The 1994 Forest Fire Season*

Greece had slightly fewer forest fires in 1994 than during the previous year. At the end of October, with the fire season practically over due to heavy rains, a total of 2074 fires had been reported. The area burned was 54.000 hectares which is at the same level as in the last two years (Fig. 1 and 2).

The Greek Forest Service had anticipated a difficult fire season from the start of the summer. Contrary to the previous years that had been very dry, plenty of rain fell all over the country during the growing season resulting in unusually heavy growth of grasses and forbs. July and August were dry as usual with unnaturally hot and dry weather extending through all of September, prolonging the fire season.

The heavy load of grasses, once cured in the summer months, favoured quick fire acceleration and extreme rates of spread. As usual, a small number of fires that escaped initial attack under high winds became very large burning between 2,000 and 4,000 hectares. Most of these fires burned, in addition to the forest lands, unusually high acreage of agricultural lands, mainly olive groves. This was due to the high loading of grasses under the crop trees.

The difficulty of the fire season did not result in a larger burned area, which was due to the increased fire fighting ability and effort of the Greek Forest Service with the help in many instances of the Urban Fire fighting Service. The fleet of forest fire fighting vehicles, with the recent addition of two hundred 4X4 semi-trucks equipped with slip-on fire fighting units and 40 new UNIMOG 2150, exceeded a total of 600 vehicles.

vehicles. A total of 6000 seasonal employees, in addition to the permanent Forest Service personnel, manned this fleet. This force resulted in improved initial attack capability that was strengthened further by 375 specially trained airborne firefighters.

The airborne firefighters were deployed in ten helicopter bases and were transported for initial attack to the fires by helicopters that were made available by the Greek Armed Forces. The helicopters used were medium-size Bell UH-1H (Huey) and heavy lift CHINOOK CH-47. In addition to firefighter transport, the helicopters were also used for firefighting carrying water with "Bambi" buckets.

An important priority in firefighting in 1994 was the effort to avoid loss of life and housing property. In the last fifteen years there has been an increasing trend in forest fire related deaths. More than twenty lives were lost in 1993 alone. A major cause of this increase, which has also contributed to the increase in the total number of fires, is the development of extensive urban-wildland interface areas in the last two decades. The effort for protection of such areas was successful and loss of life was avoided there. Of course, this high priority effort put a heavy load on the firefighting forces reducing their ability to control the spread of the fire as quickly as possible. Unfortunately, the accidental crash of a Bell UH-1H helicopter in September on its return trip from a mission caused the death of 7 airborne firefighters and the 3-man crew. The official investigation that followed attributed the accident to pilot error.

Gavriil Xanthopoulos
Forester - Forest Fire Specialist
Ministry of Agriculture
General Secretariat of Forests and Natural Environment
3-5 Ippokratous str.
GR - Athens 10164

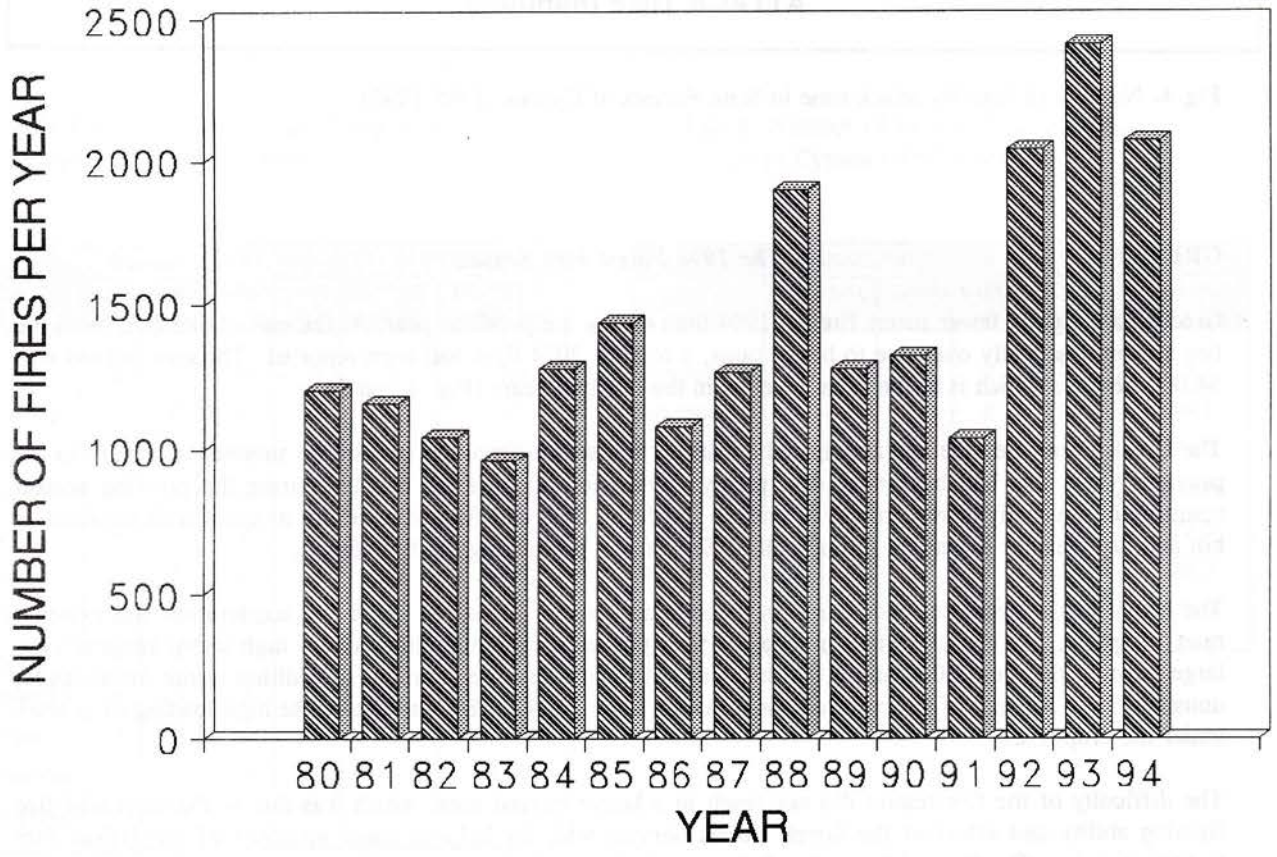

Fig.1. Number of forest fires in Greece during the period 1980-1994

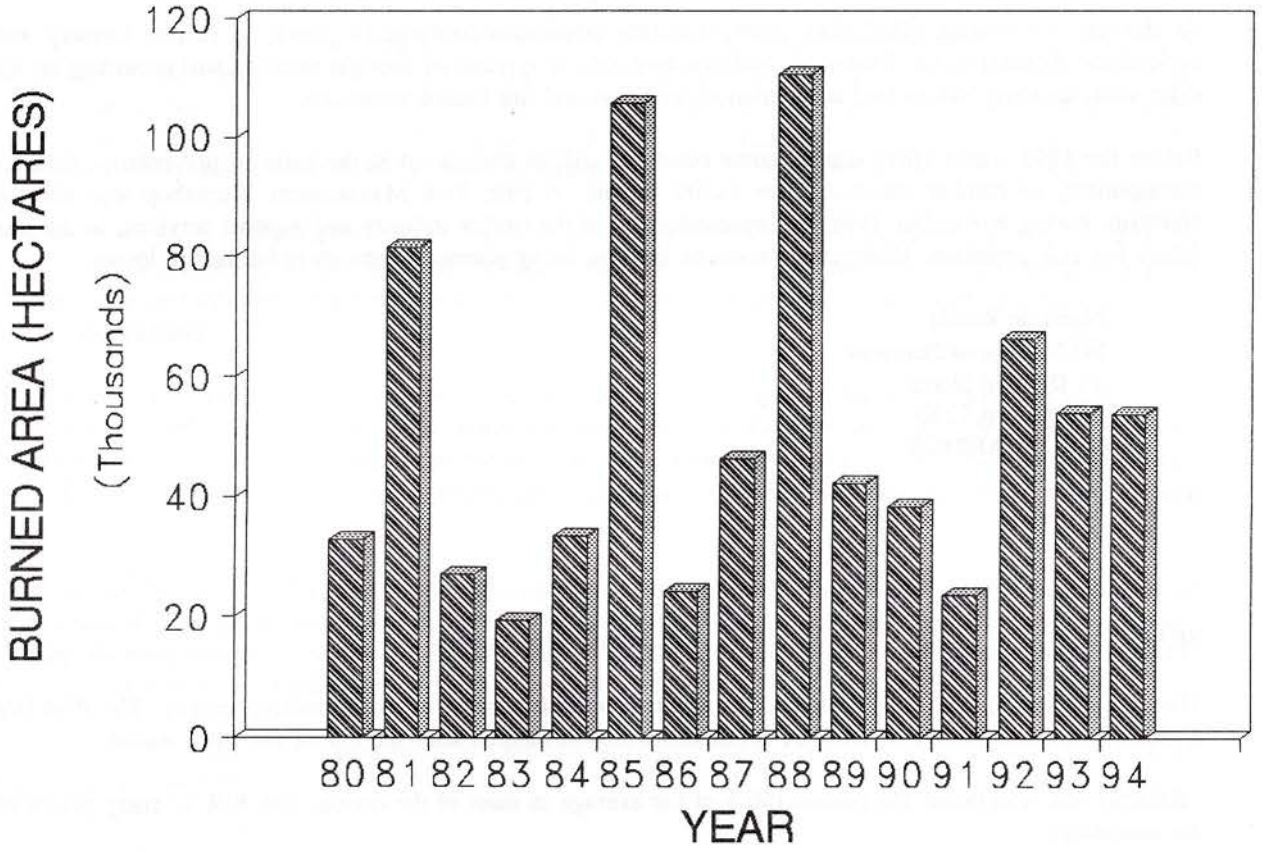

Fig.2. Burned area per year in Greece during the period 1980-1994

SOUTH AFRICA ***A Disastrous Wildfire Experience***

On 28 September 1994, towards the end the worst fire season recorded in South African Industrial Plantations to date, the industry also experienced its most serious loss of lives during a wildfire, since its existence. Ten fire fighters lost their lives during a runaway fire in the Eastern Transvaal forest region, while eleven others had to be hospitalised for serious burns.

The investigation is still in progress, but the fire was probably started by honey hunters inside a SAFCOL plantation, near the village of Sabie, under extremely dangerous conditions (*Red* grading, fire danger index 77). Various institutions rendered immediate assistance to local fire fighting teams who had by now already started to attempt to contain the fire. The Forest Fire Association (FFA) also arrived at the scene within minutes, with spotter planes, water bombers and a MI-8 helicopter (details on the FFA organization in IFFN, July 1994).

By the time the fire fighters arrived at the scene the fire was already sweeping through *Pinus* and *Eucalyptus* stands, with the latter very soon developing serious spotting ahead of the main fire front. The unfortunate team of fire fighters that lost their lives or were seriously burned, found themselves suddenly encircled by spotting fires which developed into a high intensity head fire within seconds. Other detail cannot be provided at this stage as the case is still being investigated by a specially-appointed commission of enquiry. What can be mentioned is that the sequence of spotting fire development, around the site where the accident occurred, was photographed from the air from the spotter plane. This evidence will provide the commission with a unique opportunity to assist them in their investigation, and to avoid any re-occurrence of this tragic event.

Two vehicles and other equipment where also burned out during the fire, and direct losses (excluding plantations lost) will probably exceed R 1,000,000. The fire swept through about 1,270 ha of plantations, but some mature stands appear to have survived the fire.

At the time of writing (December 1994) droughty conditions continue to persist in certain forestry and agricultural districts in the Transvaal, and tree mortality as a result of drought stress is still occurring on the drier sites, creating further fuel accumulation problems and fire hazard situations.

Before the 1995 winter (fire) season, some measures will be considered in the form of preventative disaster management, to combat continued fire hazard threats. A Fire Risk Management Workshop was held at Nelspruit during November 1994, by representatives of the timber industry and support services, to address future fire risk problems. Emergency measures are now being planned to minimise future fire losses.

Neels de Ronde
SILVA Forest Services
16 Du Toit Street
Bredasdorp 7280
SOUTH AFRICA

SPAIN **The 1994 Forest Fire Season**

The year 1994 in Spain can be designated as *Annus Horribilis* because of its fire season severity. The 1994 fire weather was characterized by extreme conditions which developed after the end of the 1993 season:

- Rainfall was well below the normal (50% of the average in most of the region, and 30% in many places of the southeast);

- Strong winds from inland (*Poniente* at Valencia, *Tramontana* at Cataluña, *Terral* at Andalusia);

- Frequent lightning storms in the mountains of Aragón, Cataluña, Valencia;

- Daytime temperatures of up to 46-47°C in the coastal regions and up to 30°C at 1500 m a.s.l., bringing the relative humidity down to 15%.

By the end of the month of June there were 48,000 ha burned with eleven fires larger than 500 ha. A week later, on 8 July, those figures had increased up to 200,000 ha burned and 30 fires larger than 500 ha. At the end of the fire season (30 September) 17,156 fires had affected a total of 405,082 ha, thereof 224,199 ha forest and 180,883 ha woodland and grazing land. Those figures of burned surface correspond to 1.43% of the forest and woodland area of Spain, a percentage well beyond of 0.4% in 1992 and the 0.3% in 1993.

The majority of fires (61%) burned less than 1 ha each. The major losses were due to only 67 fires (= 0.39% of the total number of fires) which burned 299,043 ha (= 73.9% of the total burned surface). Ten fires larger than 10,000 ha were the most outstanding: Villarluengo: 26,402 ha (Aragón-Valencia); Moratalla: 25,919 ha (Murcia); Requena-Buñol: 26,695 ha (Valencia); Millares: 23,574 ha (Valencia); San Martin de Boniches: 17,932 ha (Cuenca); Yeste: 11,580 ha (Albacete); Montmajor: 12,180 ha (Cataluña).

The year 1994 was also unique because of the number of casualties: 22 among the fire-fighters and 9 among country people. The wildfires spread into the fields, burning farms and vacation houses and making necessary the evacuation of thousands of people, a situation very seldom occurring in Spain.

The above-mentioned weather conditions were combined with the continuous increase of fine fuel accumulations in the forest and woodland because of the steady process of depopulation and land abandonment of the rural areas.

The Central and Regional Administrations had mobilized more than 20,000 fire fighters (forest brigades and firemen) and 201 aircraft for water and retardant delivery and transport of fire crews. The performance of the modernized State-owned aerial fleet has been remarkable. The 13 amphibious aircraft (CL-215 Turboprop) flew

3,019 hours on fire missions, offering an availability of 90%, always at its maximum load capacity. Other fixed wing aircraft have been operated, the C-130, DC 6, Canso PBY, Firecat, Dromader, Air Tractor, Grumman Agcat, and helicopters of different capacities (Bell 205, 212, 412; Sokol, Kamov [5000 l], Mi 8, Mi 2). During the first week of July several Army Chinook helicopters were mobilized to carry personnel. The total number of flight hours by the ICONA (Central Administration) fleet was 11,918 (65% more than in 1993).

The intervention of big brigades (BRIF), specially trained, according to the programme started in 1992, has confirmed the efficiency of the use of well prepared personnel, trained to apply techniques of indirect attack which is required when extreme fire intensity with flame lengths of more than 20 m dwarf the efficiency of fire trucks and airtankers.

The use of video cameras, airborne or combined with IR on outlook towers, has confirmed their usefulness to support the coordination decisions. Also a tool for coordination is the software CARDIN of fire simulation. New versions of this software, which can run on commercial GIS (ARC/INFO, TERRASOFT) are now being used. Experiences to use NOAA images to calculate vegetation indexes and help fire danger forecasting are also advancing.

To conclude this summary the prevention campaigns must be mentioned. They are focusing more and more on public education by personal contacts in the villages (rural people), in the schools (children and young people). A play showing the consequences of forest fires has been performed in many villages in southern Spain, creating new attitudes towards prevention among country people.

A new plan to promote fuel management and preventive silviculture is being prepared to deal with the earlier mentioned abandonment of the land.

Ricardo Vélez
Chief, National Forest Fire Service
ICONA
Gran Via San Francisco, n° 4
E - 28005 Madrid

TURKEY *Status of Forest Fires and Fire Management in Turkey*

At present 20.2 million ha of forested land cover 26% of the territory of Turkey, thereof 8.9 million ha (44%) are productive forest. The remaining forest land of 11.3 million hectares (56%) is forest land either with low yield or no yield at all, consisting of degraded coppice, maquis and shrubs. About 99% of the forests in Turkey are State forests. According to the constitution all forests are supervised by the government. As a result of this all forest fire prevention and control activities are under the responsibility of the Forest Service.

Forest fires are considered to be the main destructive factor of Turkish forests. Between 1937, the year in which the first forestry law entered into force, and the end of 1994, 55,485 forest fires occurred, and about 1,432,585 hectares of forest land were burned. 41% of forest fires are occurring in the Aegean, 24% in the Mediterranean, 22% in the Marmara Region and 13% in other regions. Statistical data for the period 1937-1994 are given in Figure 1. Detailed data for the period 1989-1994 are given in Table 1.

Causes of Forest Fires

Approximately 1/4 of the Turkish population is living either within the forest, on the edge of the forest, or at a distance of less than 10 km from the forest. The socio-economic level of the people living in or near the forest is below the average living standard. This is why people would like to use the forest without any limitation for their survival, regardless of laws and regulations being violated. Fires are started for various reasons like acquiring new grazing land, clearing for new farmland, etc.

Tab.1. Forest fire statistics of Turkey for the period 1989-1994

Year	Forest Fires in Turkey 1989-1994	
	Number of Fires	Area Burned (ha)
1989	1,633	12,610
1990	1,725	13,000
1991	1,448	7,590
1992	2,110	12,312
1993	2,547	13,734
1994	3,218	20,981
Total	12,681	80,217

This is the reason why 99% of the forest fires in Turkey are caused by humans; only ca. 1% of the recorded forest fires are started by lightning. The origin of about half the human-caused fires is known: 25% are due to negligence, and 26% intentionally set fires. It is assumed that most of the fires with unknown origins are intentionally set fires, including arson.

Environmental conditions influencing the fire danger

The summers of the Mediterranean, Aegean and Marmara regions, characterized by high air temperature and low relative humidity, lead to the reduction of the moisture content of all forest fuels to extremely low levels, thus creating a high wildfire hazard.

In different parts of Turkey two characteristic types of fire season are recognizable:

(1) Short fire season: This is very typical in regions Karadeniz and Marmara. In the Karadeniz region July-August, and in the Marmara region June-August are the peak fire seasons.

(2) Long fire season: The Mediterranean and Aegean regions are typical examples. The fire season lasts about 5-8 months, but some parts of these regions have an all-year long fire season.

Ecological effects of forest fires

According to the research carried out in the various forest fires regions, fire did much damage especially in the Mediterranean and Aegean regions over the centuries. The effect of fires on the soil, microclimate and fauna are other factors that should be regarded in addition to the overall destruction of forests.

In the Mediterranean and also the Aegean regions, there are very few areas that have not been burned between sea level and an altitude of 500 metres. Almost all of the old Calabrian Cluster Pines (*Pinus brutia*) in these areas have a clear indication of fire on the lower part of their stems close to the roots. As one goes higher in

this region, the density of fires decrease, and one can rarely come across burned areas above 1100 meters.

Once destroyed by fire, the natural regeneration of these forests is very sparse. Most burned areas are now covered by brushland. It is for this reason that the burned areas in the Mediterranean and Aegean regions should be afforested instead of allowing further degradation. Otherwise, this would lead to soil erosion caused by heavy rainfall, especially on steep terrain, and thus these areas would turn into calcareous formations.

Forest species threatened by fire

The natural distribution of *Pinus brutia* forests is along the coastal slopes of the Mediterranean, Aegean and Marmara regions, between sea level and 1250 m altitude. Especially in the higher altitudes of the Mediterranean region *Pinus nigra* and *Cedrus libani* accompany the *Pinus brutia* stands. The maquis formations are also distributed all over the areas. The broadleaved species, especially oak, chestnut and beech, are also present in pure or in mixed stands in these areas. *Pinus brutia* stands are the most susceptible to fire damage throughout all their lifetime, followed by *Pinus nigra* and *Cedrus libani*. Among the broadleaved species oak is the first, and chestnut and beech are the second species influenced by fires in Turkey.

National forest organization and present activities against fires

The Forest Service Turkey is under the jurisdiction of the Ministry of Forest and is responsible for all measures in forest protection, including forest fire prevention and control.

A network of 780 fire detection towers is operating throughout the country, some of them being equipped with solar energy systems. A total of 640 "First Intervention Teams" consisting of 12 to 15 specially trained fire fighters are available for deployment for initial attack. For reinforcement 148 "Ready Force Teams" consisting of 40-50 fire fighters are on standby. Altogether 17,000 fire fighters are organized in these teams.

Until 1985 forest fire suppression was exclusively based on ground-based technologies. Beginning in 1985 aerial fire observation and fire fighting has been introduced. Fixed-wing airplanes (4 Dromader, 1 Cessna) with a capability to drop 800 to 1000 l of water were first used in the most fire-endangered Regional Forest Directorates Izmir and Canakkale, and in a second stage the system was expanded to the Mugla region. Three aerial fire fighting groups consist each of three fire extinguishing planes and one reconnaissance plane (Cessna). The planes are rented from the Turkish Aviation Associations.

Helicopters (3 Ecurel, 3 Dauphin) are currently being used for fire detection and transport of fire fighting personnel at Mugla, Antalya, Izmir, and Canakkale Regional Directorates where close to half (48%) of the forest fires occur in Turkey. An Aviation Group was formed that is attached to the Forest Protection and Fire Fighting Department. Fourteen pilots and seven maintenance personnel are employed under contract for the helicopters.

Mehmet Serez
Department of Forest Entomology and Forest Protection
Faculty of Forestry
Karadeniz Technical University
TR - 61080 Trabzon

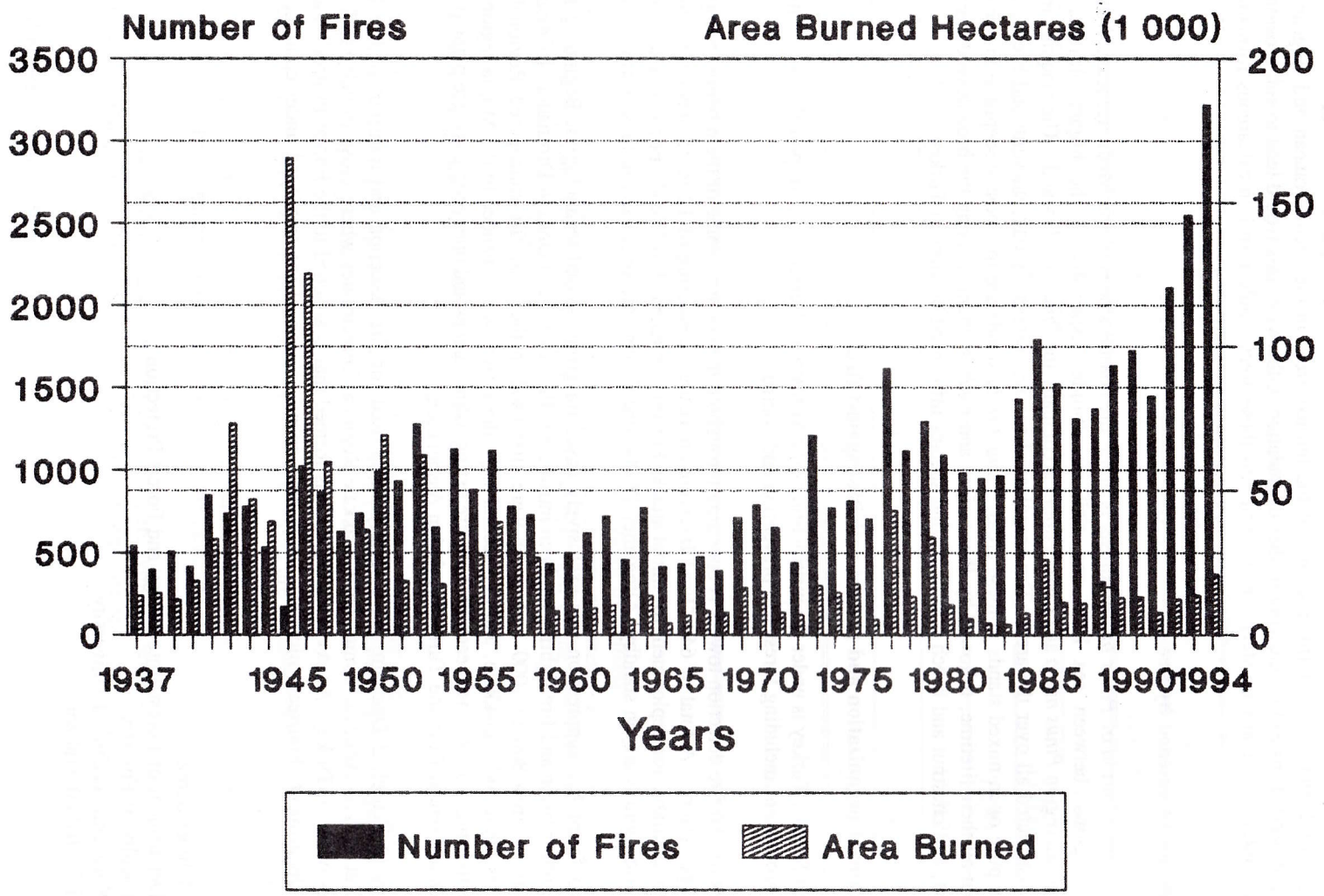

Fig.1. Forest fire statistics of Turkey for the period 1937-1994

U.S.A. **The 1994 Calendar Year Fire Report**

The winter of 1993-1994 was another mild winter with below normal precipitation and snowpacks over much of the western United States. A persistent deep trough over the East Coast brought bitterly cold weather to much of the East. Several locations suffered record cold temperatures and snowfall. Out West, a strong high pressure ridge blocked most Pacific storms from moving inland. By 1 March, the snowpack for the West was: California, 65% of normal; Arizona, 88%; New Mexico, 93%; Nevada, 66%; Utah, 77%; Colorado, 88%; Oregon, 76%; Washington, 85%; Idaho, 67%; Montana, 76%; and Wyoming, 81%. High pressure prevailed in the West during March with an upper trough over the Great Lakes area. Even though a number of storms tracked across the country, only the Great Lakes and northeast areas reported a colder and wetter than average March. Areas of severe and extreme drought (Palmer Drought Index) increased significantly in the northern Rockies, Great Basin, California, and the Northwest. The wildland fire protection agencies began preparations for another busy year.

January-April

The southeastern United States experienced their fourth consecutive below average spring fire season. While there was some fire activity, most large fires were contained by the following day. A Type II Incident Management Team[1] was mobilized on 8 April for the *Sunset Fire* on the Wichita Mountain NWR in Oklahoma which burned 960 ha (2,370 acres) before being controlled. The Fifth Army was requested to provide a transportation unit to transport fire fighters to and from the fireline.

A Type I Incident Management Team was mobilized on 18 January for the Northridge Earthquake in southern California. The team was assigned to manage a receiving and distribution centre. Another Type I Team was mobilized on 24 January to assist the Federal Emergency Management Agency (FEMA) with disaster response and recovery assessments. Both teams were released by the end of January.

Areas in the northern Rockies and the Southwest experienced very active fire conditions for March and early April. In addition, a great deal of prescribed burning was accomplished much earlier than normal.

A Type I Incident Management Team was mobilized for the *County Line Fire* on the Huron-Manistee National Forest on 24 April. This fire threatened the community of Baldwin, Michigan, and burned eight mobile homes before being controlled at 330 ha (820 acres).

By 1 May, the western mountain snowpacks were well below average with the worst conditions in California, Nevada, and Oregon where snowpacks were less than half of normal. By the end of April, the southern area's spring fire season was winding down except for areas in Texas and southern Florida that were still experiencing significant fire activity.

May

Just as the southern area's spring fire season was coming to a close, significant fire activity occurred in Florida and North Carolina. On 5 May, lightning started the *Basshole Fire* on Florida State lands near Miami. The fire origin was in a remote, swampy area. A 16,000 ha (40,000 acres) backfire operation was completed on 7 May and the fire was controlled after burning ca. 32,00 ha (80,000 acres). All wildland fire protection units in Florida were busy during the month with initial attack and extended attack fires because of a persistent drought condition.

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[1] *Type I Incident Management Team*: A team made up of 33 people that are trained in specific areas of expertise in the command, logistics, operations, and finance functions to manage a complex incident: high value resources and/or life and property at risk and generally more than 1,000 people working in the incident.

Type II Incident Management Team: The same as Type I Team but the incident is not as large or complex and the number of people working on the incident is between 200 to 1,000.

Areas in North Carolina were also very busy because of drought conditions. The *Angola Bay Fire*, North Carolina State, which was started by lightning on 18 May, burned 3,500 ha (8,647 acres). A Type II Incident Management Team, 27 tractors, and 170 people were mobilized for this fire. On 25 May, the State mobilized their two National Guard MAFFS air tankers for this fire. [2]

During the last week of the month, fire conditions continued to worsen in North Carolina. The *Fish Day Fire*, National Forests of North Carolina, burned 10,000 ha (24,600 acres) before being contained on 2 June. A Type I Incident Management Team, five air tankers, seven Type II helicopters[3], one infrared aircraft, 27 tractors, 43 engines/tenders, and 560 people were mobilized. This fire exhibited very erratic behaviour and because of its remote location was very difficult to control.

The two MAFFS air tankers that were mobilized for the Angola Bay Fire were only used on the Fish Day Fire. They flew 95 missions, flying 31.4 hours and dropped 1.13 million litres of retardant.

Fire activity in the southwest was well below normal for the month. A series of low pressure systems dominated the weather for much of the month which kept temperatures and precipitation in the near normal range. On 8 May, the *Mother's Day Fire*, Saguaro National Monument, burned 458 ha (1,157 acres) before being controlled. During mid-month, the Arizona Strip and Las Cruces Districts, Bureau of Land Management (BLM); Buenos Aires National Wildlife Refuge, Fish and Wildlife Service (FWS); Gila National Forest, US Forest Service (USFS); Salt River and San Carlos Agencies, Bureau of Indian Affairs (BIA); and Arizona and New Mexico State all responded to extended attack fires. At the close of the month, the Southwest Area had sent three airtankers to the southern Area and four air tankers to California to support large fire activity in those areas.

On 21 May, the National Interagency Coordination Center (NICC) sent five crews to the Eastern Area which was experiencing critical fire conditions and a lot of initial attack activity. No large fires were reported during this period.

On 27 May, the Brown Fire, California Desert District, burned 410 ha (1,012 acres) before being contained the next day. Four air tankers and 400 people were mobilized for this fire.

The remainder of the West experienced cool, moist conditions for much of the month with no significant fire activity being reported. Areas of extreme and severe drought as depicted by the Palmer Drought Index continued to expand in the West. As the summer months approached, the potential for a busy fire season became more probable.

June

Major fire activity occurred in many areas in the West during June. The southwest experienced a very active month. Large fires occurred on a daily basis. On 1 June, the *Mackenzie Fire*, Phoenix District BLM, burned 507 ha (1,252 acres) before being controlled. A Type II Incident Management Team and 350 people were mobilized for this fire. Three people deployed shelters on this incident but they were not injured.

On 7 June, the Silver City Smokejumper base was activated. By the end of June, 108 smokejumpers had been assigned to the Southwest Area.

Between 4 and 16 June, Type I Incident Management Teams were mobilized for the *Miller Fire*, Coronado National Forest, 1,200 ha (2,970 acres); *Bridge Fire*, Lincoln National Forest, 2,180 ha (5,380 acres); Ryan Complex, Cibola National Forest, 10,000 ha (24,800 acres); *Pigeon Fire*, Gila National Forest, 2,500 ha (6,250 acres). A Type II Incident Management Team was mobilized for the *Marcus Fire*, Guadalupe National

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[2] MAFFS=Modular Airborne Fire Fighting System: A 3,000 gallon pressurized tank that is fitted into a C-130 aircraft, used to deliver fire retardant to a fire.

[3] Type II helicopter: a medium lift helicopter. Types include: Bell 204, 205, 212, for up to 14 people (including pilot) and up to 2,500 pounds payload.

Park, which burned 2,500 ha (6,250) acres before being controlled. Type II Incident Management Teams were also mobilized for several other fires.

The Rocky Mountain and Great Basin Areas also had large fire activity. Type II Incident Management Teams were assigned to the:

Boy Scout Fire	Wasatch-Cache National Forest	172 ha (425 acres)
Coalbed Fire	Moab District, BLM	243 ha (600 acres)
Buniger Fire	Grand Junction, BLM	648 ha (1,600 acres)
Bitter Creek	Moab District, BLM	1,546 ha (3,820 acres)

The Garlick Fire, Sierra National Forest, was reported on 18 June which burned 253 ha (625 acres) before being contained. A Type I Incident Management Team was assigned to the *White Fire*, Sequoia National Forest. Forty-eight crews and over 1,500 people were mobilized for this fire before it was contained at 1,014 ha (2,505 acres). Type II Incident Management Teams were mobilized for the *Scout* and *Shooting* Fires, Angles National Forest, which burned 1,140 ha (2,820 acres) and 1,416 ha (3,500 acres) respectively.

The eight military airtankers (MAFFS) were mobilized on 27 June for the Shooting Fire on the Angeles National Forest. They performed 26 missions (45.1 flight hours) and dropped 340,000 l of retardant in support of several fires before being re-assigned to Phoenix, Arizona on 1 July.

On 29 June, Type I Incident Management Teams were mobilized for the Lucas Complex, Sequoia National Forest, and the *Second Fire*, Cleveland National Forest. These fires burned 4,031 ha (9,960 acres) and 2,072 ha (5,120 acres) before being contained on 1 July.

On 27 June, an escaped prescribed fire burned 80 ha (200 acres) on the Modoc National Forest. On 28 June, an arsonist started five fires on the Winema National Forest and Oregon State lands which burned 600 ha (1,500 acres) before being contained on 1 July.

By mid-month, fire danger increased in Alaska because of very warm temperatures. Lightning started several fires and 25 smokejumpers and several overhead personnel were mobilized from the *Lower 48*. [4] Type II Incident Management Teams were committed to fires on lands protected by the State of Alaska. By 20 June, fire activity moderated in Alaska because of cool, unsettled weather which dominated their weather picture for the remainder of June. By the end of the month, all overhead personnel and smokejumpers had been returned to the Lower 48.

Due to widespread fire activity in the Southwest, California, and the Rocky Mountain Areas the National Interagency Coordination Center raised the National Fire Preparedness Level to III on 27 June.

July-September

The fire situation in the Southwest and the Rocky Mountain Areas had reached a critical level by 1 July. Dry lightning and strong winds caused many fires to spread rapidly. The *Hour Glass Fire*, Roosevelt National Forest, which was fanned by strong thunderstorm winds on 1 July, travelled more than three miles in one afternoon. Several structures on the Colorado State University Forestry Campus at Pingree Park were burned. A Type I Incident Management Team and over 600 people were mobilized for this fire before it was controlled at 500 ha (1,200 acres). There were five shelter deployments on this fire but there were no injuries.

The West Slope of Colorado also had major fire problems from several dry lightning storms. Type II Incident Management Teams were committed to:

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[4] "Lower 48": A slang term from Alaska. the 48 states that make up the contiguous continental United States. Alaska and Hawaii are separated by Canadian territory and/or water.

Squaw Mountain Fire	1 July	Casper District BLM	1,469 ha (3,630 acres)
Sheep Mountain Fire	3 July	Big Horn National Forest	98 ha (242 acres)
Wake Fire	5 July	Montrose District, BLM	1,400 ha (3,460 acres)
Mitchell Lake Fire	6 July	San Juan National Forest	109 ha (270 acres)
North Fork Fire	12 July	Uncompahgre N. F.	219 ha (540 acres)
2-Road Fire	13 July	Grand Junction Dist. BLM	1,467 ha (3,625 acres)
Larimer Complex	13 July	Roosevelt National Forest	191 ha (473 acres)
Wray Fire	14 July	Montrose District BLM	623 ha (1,540 acres)
Black Ridge Fire	15 July	Southern Ute Agency BIA	4,856 ha (12,000 acres)

A ***Red Flag Warning*** [5] was issued 6 July for Colorado for strong winds associated with a frontal passage. At about 5:00 p.m., strong winds fanned the South Canyon Fire, Grand Junction District, BLM, which was then about 50 ha (130 acres) in size. The fire spread rapidly and overran the fire fighters on the lines, resulting in 14 fatalities. A Type I Incident Management Team and 650 people were mobilized for this fire which was contained at 751 ha (1,856 acres). On 14 July, a Type I Incident Management Team was mobilized for the *Ute Creek Fire*, White River National Forest. This fire burned 1,200 ha (3,000 acres) before being contained on 23 July. By late June, extreme fire danger was being reported throughout the Southwest because of record breaking temperatures. Dry lightning storms ignited several hundred fires. By 1 July, over 20 project fires were being battled by about 150 crews, 20 airtankers, and 18 helicopters. A Type I Incident Management Team was assigned to the *Rattlesnake Fire*, Coronado National Forest on 1 July. This fire burned 10,330 ha (25,525 acres) before being contained on 24 July. Type II Incident Management Teams were assigned to several large fires in New Mexico and Arizona. These included the Catclaw Complex, Prescott National Forest, 3,882 ha (9,592 acres); Big Rock Complex, Lincoln National Forest, 2,839 ha (7,015 acres); Redington Complex, (Arizona State, Coronado National Forest, Saguaro National Monument) 8,387 ha (20,725 acres); and the Tower Complex, Truxton Canyon Agency, BIA, 4,229 ha (10,450 acres).

The military airtankers (MAFFS) that were assigned to Phoenix, Arizona on 1 July flew 420 missions (538.9 flight hours) and dropped 4.8 million l of retardant. 220,000 l were dropped on the *Black Ridge Fire* in Colorado with the remainder of the retardant dropped on fires in Arizona.

On 12 July, a helicopter en route to a new fire crashed on the Gila National Forest. This crash resulted in fatalities to the pilot and two Gila National Forest employees. Two other employees escaped with minor injuries. On 15 July, the *Hallelujeh Fire*, Carson District BLM, was reported. This fire spread rapidly and threatened several rural sub-divisions. A Type I Incident Management Team and more than 800 people were mobilized for this fire before it was controlled on 17 July.

Finally, on 17 July, the monsoons arrived in the southwest. While fire conditions moderated in the southwest and Rocky Mountain Areas, sub-tropical moisture triggered a series of dry lightning storms beginning on 21 July and ending on 11 September. The Northwest, California, northern Rockies, and Great Basin Geographic Areas were all heavily impacted. During this period 102 major fires occurred in the West. Within each Geographic Area these fires were widespread, further complicating the logistical support and suppression efforts. Type I Incident Management Teams were mobilized for 35 fires during this period.

On 28 July, NICC raised the National Fire Preparedness Level to IV and on 29 July to Level V. By 1 August, a major fire campaign had begun. All available agency and private sector resources were committed. Demand for resources continued. Multi-Agency Coordinating Groups at the Geographic Area and National levels were busy prioritizing incidents, allocating and re-allocating scarce national resources. Fire activity continued at a relentless pace during August. Weary fire fighters were rested and re-deployed. Unprecedented demands on the logistical support system occurred, as fire activity continued at record levels for three months. At the peak of activity in August, more than 25,000 fire fighters, 900 engines, 155 helicopters, 54 airtankers, 31 mobile kitchens, and 42 shower units were assigned to fires.

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[5] *"Red Flag Warning"*: A term used by the National Weather Service Fire Weather Forecasters to bring attention to a weather component expected in the forecast period that could cause severe fire danger or activity on fires that already exist. Examples: low relative humidity, strong gusty winds, dry lightning or a combination of any of these components.

Several fires received national attention. Many towns and communities were threatened including Leavenworth and Chelan, Washington; McCall and Idaho City, Idaho; and Libby and Jardine, Montana. Military assistance was first requested on 18 July for one Battalion (approximately 600 people) of fire fighters. By 25 August, seven battalions of fire fighters, eight military Chinook helicopters, and 10 military Black Hawk helicopters had been mobilized for fires in the Northwest, northern Rockies, and Great Basin Areas. NICC requested an eighth battalion 1 September, but cancelled the request on 4 September after many areas in the Northwest and northern Rockies began receiving precipitation.

Four military airtankers (MAFFS) were activated again on 25 July for Boise, Idaho. On 26 July, four MAFFS were mobilized for Spokane, Washington, and then re-assigned to Helena, Montana on 3 September. The Boise MAFFS delivered 11 million l and the Spokane/Helena MAFFS, 5 million l respectively.

On 29 July, a P2V airtanker (04) crashed on the Butler Fire near Missoula, Montana, resulting in fatalities to the pilot and co-pilot. On 13 August, a C-130 airtanker (82) was dispatched on an initial attack mission in southern California and crashed before arriving at the fire, resulting in fatalities to the three-person flight crew.

On 25 August, a bulldozer operator was killed as he was overrun by fire on the Hull Mountain Fire in southwestern Oregon on Oregon Department of Forestry lands. Canada also provided assistance. One hundred Mark III Pumps, five DC-6 airtankers, and five "bird dog" aircraft were used on fires during August.

Finally, between 10 and 13 September, light rain showers occurred over much of the Northwest, northern Rockies, northern California, and the central mountains of Idaho, which provided some relief from the long, hot summer. The military Black Hawk helicopters were released on 12 September and the last battalion of military fire fighters returned to their home base on 14 September. The eight MAFFS airtankers also returned to their home bases on 14 September.

On 13 September, the National Fire Preparedness Level was lowered to IV and to III on 16 September. A Type I Incident Management Team was mobilized on 13 September to assist with flood relief efforts in the villages of Hughes, Allakaket, and Alatna, Alaska.

An emergency fire fighter employed by the Great Basin Fire Cache located in Boise, Idaho, died from injuries sustained in a vehicle accident on 16 September. The employee was delivering equipment and supplies to the Payette National Forest at the time of the accident.

Just as fire conditions were beginning to moderate, another series of dry lightning storms occurred in northern California and Oregon. Large fires occurred on the Klamath, Shasta-Trinity, and Lassen National Forests in California and on the Malheur and Wallowa-Whitman National Forest in Oregon. Hot, dry weather during the last two weeks of September caused many of the contained fires in Idaho and Montana to become active again. During the last week of September, the NICC mobilized about 90 crews for fires in the Great Basin, northern Rockies, Northwest, and North Zone Geographic Areas.

Lightning storms on 28 September started over 400 fires in northern California and southern Oregon. There was some precipitation with these storms and all fires were controlled at less than 4 ha in size.

October-November

In early October, a significant weather change occurred. Cool, unsettled weather with some precipitation moderated fire conditions throughout the West. By 15 October, demobilization of the large fires was nearly complete. By late October, wetting rains had occurred over much of the western United States. The fire risk continued to increase in November until the third week when new fires occurred in Kentucky, Tennessee, and Georgia. These fires resulted in the mobilization of a Type I and Type II Incident Management Team, Type II helicopters, an airtanker, and miscellaneous overhead and crews from across the country. On November 20, a fatality occurred on the Cedar Mountain fire on the Chattahoochee NF during a fire shelter deployment. After Thanksgiving, more typically-seasonal weather conditions resumed and the fire season wound down.

Summary

In terms of length and scope, the 1994 fire season has been the most demanding on record. Major fire activity involving all the Western Geographic Areas occurred from the end of May through October. Demand for resources of all types often exceeded the supply. Listed below is some data about resources mobilized through the National Interagency Coordination Center and comparisons with previous years (Tab.1). Number of wildland fires and area burned in the U.S.A. by agency for the 1994 fire season are given in Table 2. Number of wildland fires and area burned in the U.S.A. by geographic areas for 1994 are given in Table 3. For comparison with previous years the number of wildland fires and area burned in the U.S.A. for all agencies for the decade 1985-1994 are given in Table 5.

Without question, this season ranks as one of the worst in terms of loss of life among those involved in suppression efforts. From initial and extended attack fire fighters, to retardant flight crews, to support personnel, it crossed agency and private sector lines and their sacrifices were high.

Woody Williams
National Mobilization Officer
USDA, Forest Service
National Interagency Fire Center
3905 Vista Avenue
USA - Boise, Idaho 83705

NATIONAL INTERAGENCY FIRE CENTER (NIFC)

NIFC is the nation's logistical and technical support center for wildfire suppression. Through planning and interagency management, the five major federal land and resource management agencies, along with the National Weather Service, work together to provide cost-effective response to wildfire and other national emergencies. At NIFC are the Nationals Interagency Coordination Center, the National Incident Radio Support Cache, Fire and Aviation Training, Great Basin Smokejumpers and Equipment and Supply Cache, Technical Support, Equipment Development, Infrared Mapping, Initial Attack Management System, and Fire and Aviation Contracting.

NATIONAL INTERAGENCY COORDINATION CENTER (NICC)

An interagency operation at NIFC that provides logistical support and intelligence reporting to all wildland management agencies. As local and regional resources are exhausted during fire emergencies and other disasters, geographic coordination centers throughout the U.S. order additional resources through NICC. Based on the "closest forces" concept, the closest qualified resources, regardless of agency affiliation, will be sent. NICC dispatches crews, overhead personnel, aircraft, equipment and supplies across the U.S. and Canada and to other foreign countries based upon requests.

Tab.1. Resources mobilized through the National Interagency Coordination Center in 1994 and comparisons to previous years

Resource Mobilized	1994	1993	1988	5-year Average
Type I Incident Management Team	69	9	60	24
Overhead	10,379	814	7,740	3,200
Crews	1,636	275	1,336	654
Type I Helicopters	142	26	31	42

Tab.2. Number of wildland fires and area burned in the U.S.A. by agency for the 1994 fire season

Number of Wildland Fires and Area Burned in the U.S.A. by Agency for the 1994 Fire Season		
Agency	Number of Fires	Area Burned (ha)
Bureau of Indian Affairs	3,870	107,432
Bureau of Land Management	3,479	309,671
U.S.Fish and Wildlife Service	132	68,204
National Park Service	998	34,536
States	51,604	521,633
U.S.Forest Service	14,396	598,761
Totals	74,479	1,640,237

Tab.3. Number of wildland fires and area burned in the U.S.A. by geographic areas, for all agencies for 1994

Number of Wildland Fires and Area Burned in the U.S.A. by Geographic Areas for 1994 (for all Agencies)		
Geographic Area	Number of Fires	Area Burned (ha)
Alaska	606	103,533
Northwest Area	5,878	235,051
California North Zone	1,566	64,858
California South Zone	8,841	100,990
Northern Rockies Area	4,875	122,476
Eastern Great Basin Area	3,175	375,310
Western Great Basin Area	909	82,422
Southwest Area	6,974	227,772
Rocky Mountain Area	3,203	43,451
Eastern Area	11,020	59,171
Southern Area	27,442	225,204
USA Total	74,479	1,640,238

Tab.4. Number of wildland fires and area burned in the U.S.A. for all agencies for the decade 1985-1994

Number of Wildland Fires and Area Burned in the U.S.A. for all Agencies for the Decade 1985-1994		
Year	Number of Fires	Area Burned (ha)
1994	74,479	1,640,238
1993	58,810	727,457
1992	87,394	837,688
1991	75,754	1,195,297
1990	66,481	1,870,344
1989	48,949	739,502
1988	72,750	2,027,232
1987	71,300	990,407
1986	85,907	1,100,430
1985	82,591	1,172,055
1985-1994 Average	72,442	1,230,065

TECHNOLOGY NEWS

Russian Experiment *NOMOS* - First Results and Plans for 1995

In the previous issue of "International Forest Fires News" (July 1994), we described the Russian experiment *NOMOS* which is designed to determine the potential of spaceborne and airborne sensors for detection of small forest fires spots ($\leq 100 m^2$) and evaluation of pre-fire conditions in forests. The research includes use of the scientific module ***PRIRODA*** to be launched in September 1995 and docked to the orbiting station ***MIR***. In September 1994 the first stage of NOMOS experiments took place involving a fixed-wing airplane platform (forest-fire-patrol airplane AN-2). The experimental area was a forested region east of Moscow. The aim was to observe fires of small size (2-2.5m ∅) by optical infrared and microwave instruments. The results were very informative. Small experimental fires were detected from flight altitudes of 200-1,500 m above ground (Fig.1), while in the visible range human eyes or TV-cameras were often unable to distinguish small fires against the background. Computer-processed infrared fire imageries gave the precise temperature resolution ($\leq 1°C$), both of surface fires and of ground (turf) fires. The detection capabilities of the infrared sensor (thermo vision sensor ***AGEMA*** with 3-5 μm and 8-14 μm channels) were very high and did not depend on the absence of smoke and mist obscuring the terrain. Attenuation of fire radiation by tree branches and foliage was also very low.

The results of airborne experimental measurements of signals from fires and from the background helped to calculate exactly the minimally detectable sizes of forest fire front length or diameters (l_f) in the infrared (3-5 μm) range (Fig.2). This fire front length l_f is about 10-15 metres both from *PRIRODA* instruments (height of orbit H_o=400 km, curve 1) and from the future fire-monitoring satellites *NOMOS* (H_o=900 km, curve 2).

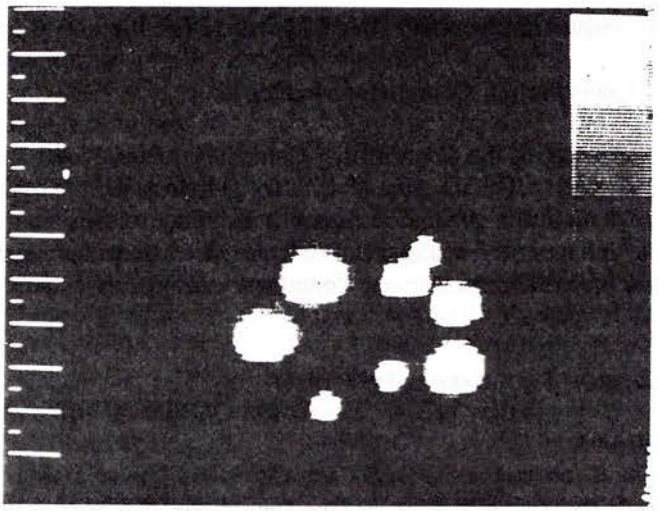

Fig.1. Set of experimental fires as depicted by the NOMOS infrared sensor during the test flights in September 1994, Moscow Region

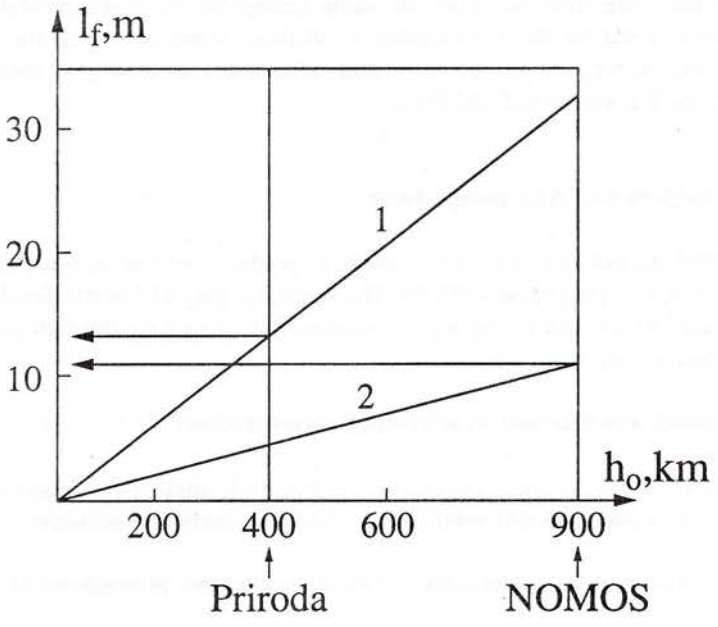

Fig.2. Minimal detectable sizes of forest fire front length or diameters (l_f) in the infrared (3-5 μm) range. H_o = height of orbit (see text).

In May 1995 and autumn 1995 a second stage of flying experiments (near to Nizhny Novgorod) and a space experiment with *PRIRODA* are planned. Scientists and laboratories interested in joint research are invited to take part in these experiments and to share results. For more information contact Saliut or the editor of IFFN (supporting unit of *NOMOS* and *PRIRODA* tests).

Yu.G. Burlakov and V.M. Vishniakov
Saliut Design Bureau
Khruchinev State Research and Production Space Center
Novozavodskaja st., 18
RU - 121309 Moscow
Fax: + +7-095-142-5921 Phone: + +7-095-145-9307

NEWS FROM FIRE RESEARCH

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

Minutes of the BIBEX Coordinating Committee Meeting

On 9 September 1994 a meeting of the Coordinating Committee of the IGAC Biomass Burning Experiment (BIBEX) took place in conjunction with the Joint 8th CACGP Symposium/2nd IGAC Conference, Fuji-Yoshida, Japan, 5-9 September 1994. Eighteen committee members and other scientists attended the meeting. Some of the results that may be of interest for a broader audience are taken from the minutes. Additional information on developments that took place after the Steering Committee meeting are included in the following summary.

1. SA(F)ARI RESEARCH PROGRAMME 1994-1996

1.1 SA'ARI 1994-95

One of the components of the *Southern African Fire-Atmosphere Research Initiative* (SAFARI) intends to investigate the background atmosphere of Southern Africa outside of the burning season (SA'ARI = SAFARI without Fire). In May 1994 a first survey was conducted using a Learjet 24 operated by the Max Planck Institute for Chemistry (MPIC) Germany) in cooperation with Cloudquest. It turned out that the month of May did not provide a fire-free atmosphere because burning was already observed at that stage of the season. The investigations will therefore continue, using the same Learjet 24, in February/March 1995. The meteorology component will be covered by the Universities of Witwatersrand and Virginia, remote sensing by NASA Goddard Space Flight Center, and ground-based and radiosonde meteorological measurements will be provided by the Universities of Witwatersrand and Natal.

1.2 The 1995-96 SAFARI perspectives

In July/August 1994 discussions were held amongst parties involved in STARE/SAFARI on the priority objectives of SA(F)ARI for the period 1995-96. The fire geography of Central/Southern Africa shows main fire activities in Southern Africa and in the humid savanna belt stretching through Angola, Zaire, Zambia, and Tanzania. The following priorities were defined:

1.2.1 Ground, satellite and near-ground aerial studies

- Characterize emissions from important but less well studied fire ecosystems (e.g. humid infertile savannas and woodlands, Miombo forests, Dambos; early fire seasons).

- Characterize airmass characteristics, regional distribution, photochemical processing and transport.

Desired activities are:

- Quantification of fires in this region by remote sensing

- Ground and small aircraft (fixed wing and helicopter) studies of fires (DECAFE/SAFARI-92-type studies)

Potential parties to participate: Goddard Space Flight Centre (GSFC, NASA), Max Planck Institute for Chemistry (Germany), US Forest Service, Langley Research Centre (NASA), local/regional parties (particularly Tanzania and Kenya), Forestek (South Africa), Forestry Canada, University of Fort Hare.

In early October 1994 an exploratory mission investigated research opportunities in Kenya (East African *Themeda triandra* grasslands) and Tanzania (Miombo woodlands). Both countries have offered support. In Kenya two sites are of major interest. The Hopcraft Ranch, located close to Nairobi, offers well investigated research plots available for ground and airborne fire experiment components. North of Mt.Kenya the Lewa

Downs sanctuary offers additional terrain for ecological and aerial fire-related experiments. Fire research groups interested to join the East African component of SAFARI are asked to contact W.S.W.Trollope University of Fort Hare), Bob Scholes (Forestek, South Africa), B.J.Stocks (Forestry Canada), and J.G.Goldammer (Germany)(central address for contacts: see end of report).

1.2.2 Long-range aerial sampling

Long-range aerial mid- to high altitude sampling transects chasing CO, CO_2, NO_x, HC's, and particles in the same and adjacent areas mentioned under paragraph 1.2, with the necessary backup of regional meteorology/climatology inputs are scheduled for the fire season (June-September). Aircraft platforms involved are: Lear 24, Aero Commander, C-131, ER-2. Potential participants are MPIC, Universities of Wits, Virginia, Natal and Potchefstroom; Scripps Institute for Oceanography; GSFC. Contact point for aerial component: M.O.Andreae.

1.2.3 Possible links with EXPRESSO and SCAR

The links with the research programmes EXPRESSO and SCAR are envisaged. Both programmes are briefly described below. A more detailed SCAR report will be given in the next issue of IFFN.

2. EXPERIMENT FOR REGIONAL SOURCES AND SINKS OF OXIDANTS (EXPRESSO)

Tropical biomes are the most dynamic, yet most poorly understood on Earth. Tropical forests are being cleared at a rate of ~1% per year. Biomass burning, ubiquitous in African savanna, exerts a dominant influence on ecology and atmospheric chemistry. Biogenic fluxes of reactive or relatively active trace gases are concentrated in tropical land areas and are strongly influenced by land use change and biomass burning. Future human population increase is projected to be higher in tropical areas than in any other region and will accelerate changes in land use. The interplay of global change, climate change, biogeochemical processes, population increases and resource limitations are likely to affect more people in the tropics than anywhere else.

Plans are being developed for an international experiment, EXPRESSO (Experiment for Regional Sources and Sinks of Oxidants), to investigate tropical biogeochemistry. EXPRESSO will take place in the Central African Republic (CAR) and the Congo with some aircraft missions extending over South Africa. The goals of EXPRESSO are:

- to better quantify the exchange fluxes of reactive trace gases and aerosols between the biosphere and the atmosphere in the tropics;

- to analyze chemical interactions between the savanna and the tropical forest;

- to isolate the roles of photochemical and meteorological processes;

- to characterize the effects of ecological processes on trace gas fluxes;

- to assess the impact of these tropical processes and land use changes on the global atmosphere.

Two field initiatives are planned for a 1996-1997 time frame. One is planned for the wet season of the CAR savanna, and one for the dry, biomass burning season. Preparations to allow the future field campaigns to occur have already begun. These preparations include:

- instrument development efforts;

- laboratory studies to elucidate biological processes which control trace gas emissions from soils and vegetation; and,

- chemical, mechanistic and kinetic studies to determine the fates of atmospheric constituents.

The field campaign will include:

- the determination of fluxes of important carbon and nitrogen containing trace gases utilizing tower-based micro meteorological techniques and ground based field studies located at sites along a moisture and latitudinal gradient from the dry savanna in the northern CAR to the tropical rain forest in the Congo;

- aircraft studies to define the chemical and meteorological climatology of the study region;

- remote sensing studies to define the location and extent of biomass burning and to aid in vegetation characterization; and,

- modelling efforts for a hierarchy of models which operate on scales ranging from micro-scale processes which occur in soil and leaves, to coupled regional/global models of atmospheric chemistry and dynamics. International participation in the project is developing. Scientists that have participated in planning for EXPRESSO represent research groups from the US, France, Canada, Germany, the United Kingdom, the Central African Republic, and the Congo.

EXPRESSO has been endorsed by IGAC and is approved as a project of BIBEX. EXPRESSO is being coordinated by Robert Delmas (Université Paul Sabatier) and Patrick Zimmerman (NCAR).

Two international planning meetings have been held. The first was in Boulder, Colorado in May 1994. The most recent planning meeting was held in Paris in November of 1994. Plans are under way for preliminary trips to the Congo in January and May of 1995. The research proposal and copies of the planning meeting summaries are available on request. Please contact

Trinh Dean, ML 582
National Center for Atmospheric Research
USA - Boulder, colorado 80307-3000

Fax: ++1-303-497-1477
e-mail: tdean@ncar.ucar.edu

For more information regarding EXPRESSO, please contact

Pat Zimmerman
National Center for Atmospheric Research
USA - Boulder, Colorado 80307-3000
e-mail: zimmer@ncar.ucar.edu; or,

or

Robert Delmas
Laboratoire d'Aérologie
Université Paul Sabatier
118 route de Narbonne
F - 31062, Toulouse, Cedex
e-mail: delr@aero.ups-tlse.fr.

3. THE SMOKE CLOUDS AEROSOLS AND RADIATION (SCAR) PROJECT

SCAR is an experiment coordinated by NASA, with the participation of several American and Brazilian universities. The experiment is aimed to study the effects of biomass burning emissions on the direct and indirect effect on the radiation balance of the atmosphere. Three major campaigns were planned. Last year (1993) an intensive study at the North America Atlantic coast was carried out to study first the sulphate aerosol radiative effects. That experiment was named SCAR-A (Sulphate Clouds Aerosols and Radiation--Atlantic). The airborne platforms used were the NASA ER-2, the University of Washington C-131, and other smaller planes. The ER-2 carried the MODIS-simulator on board. The C-131 had several aerosol and radiation instruments.

In 1994 an experiment will be conducted in the West Coast region of the United States. In September and October the ER-2 and the C-131 will operate over several prescribed and wildfires in California, Oregon and Washington States. In 1995 a large experiment is being planned in the Brazilian Amazonian Region. By next November the final plans for the 1995 activities will be ready. The MODIS simulator and the AVIRIS instruments are scheduled to fly in the ER-2 plane in SCAR-B (SCAR--Brazil) experiment.

A more detailed report on SCAR and the MODIS simulator will be given in the next issue of IFFN (July 1995).

4. BOREAL FIRE RESEARCH: FIRESCAN AND THE CANADIAN FIRE EXPERIMENT

The objectives and activities of the Fire Research Campaign Asia--North (FIRESCAN), an effort of institutions and individual scientists jointly working under the umbrella of IGAC-BIBEX and the International Boreal Forest Research Association (IBFRA), Stand Replacement Fire Working Group, were described in IFFN No. 10 (January 1994). Joint international research on behaviour of high-intensity stand replacement fires and emission studies will be continued in June/July in an experimental fire in the North West Territories, Canada. The experiment is coordinated by B.J.Stock (Canadian Forest Service). Besides large Canadian and US participation, it is expected that scientists from the Russian Federation and Germany will contribute to the experiment. In 1996/97 it is planned to continue the research in Siberia. Remote sensing of fire activities and fire effects will be linked with a trans-siberian aerial emission sampling transect. Collaborative plans are being developed with scientists from Russia, Germany, Japan, USA, and Canada.

5. THE SOUTH EAST ASIA FIRE EXPERIMENT (SEAFIRE)

Some basic outlines of the planned *South East Asia Fire Experiment* (SEAFIRE) were described in IFFN No. 10 (January 1994). The need for regional research on environmental impacts of forest fires and other vegetation burning has been underscored by the events of September-October 1994. During that period much of the Indonesian archipelago and the Malayan peninsula had been covered by thick smoke, leading to health problems and closing down of airports. The smoke came mainly from fires burning in Indonesia (see editorial, p.1). SEAFIRE is now at the stage of preparing the research programme. Before and during the BIBEX Steering Committee meeting the following parties indicated interest and possible contributions:

Indonesia: Indonesia will be one research focus, e.g. on forest conversion fires, shifting cultivation and on *Imperata* grassland fires. A major operation base for SEAFIRE will be the German-funded technical cooperation project **Integrated Forest Fire Management**, based at Samarinda, the capital of the Province East Kalimantan. The primary objective of the project is to build up provincial fire management capabilities. One of the reasons and concerns is the smoke management problem. The project aims to support SEAFIRE by assisting as a logistical base for fire experiments in the region, e.g. by providing office space with communication facilities, trained fire management personnel, fire management equipment, NOAA AVHRR local receiver, access to Weather data. Indonesian authorities will support the research. The Indonesian National Institute for Research and Space (Bandung) is interested in joining SEAFIRE with its near ground and tropospheric ozone monitoring programme.

Australia: Strong contacts are being developed with Monash University which is acting as liaison to research contributions through various Australian institutions, e.g. CSIRO, ANU, etc. The CSIRO Bushfire Research Unit and other research groups provide excellent expertise in fire research. Climatology, meteorology and atmospheric chemistry groups seem to be interested in collaboration.

The following current activities of the Monash Environmental Climatology Group are relevant to SEAFIRE:

a. Satellite observations of fire activity

August 1994 began real-time monitoring of fire activity (active fires/development of fire scars) in Borneo/northern Australia using NOAA-AVHRR satellite imagery obtained through the new Bureau of Meteorology receiving station in Darwin. The entire island of Borneo (Sabah, Sarawak, Brunei and Kalimantan)

is being monitored. Subject to funding/manpower we plan to keep up this monitoring throughout SEAFIRE by using analytical techniques developed during earlier studies in northern Australia. It involves the collaboration of the Bureau of Meteorology Research Centre BMRC).

b. Trajectory-dispersion modelling

This is establishing contemporary transport patterns, and year-to-year variability in the region using BMRC trajectory model and the Bureau´s tropical analysis scheme (TAPS). It covers 40°N-40°S, but will concentrate on the SE Asia, N Australian region. There will probably be 10 day trajectories from 5°x 5° grid points. It will illustrate preferred modes of transport, source and sink areas, etc.

In related work the NOAA HYSPLIT trajectory-dispersion model will be utilised to investigate dispersion from large scale forest fires that contribute to local air quality degradation as well as the regional ASEAN haze problem. This will be done by using both historical data (e.g. 1990-91 fires) and contemporary situations as they arise, and will tie together the satellite monitoring and the air quality monitoring (see below). These investigations of modern circulation/dispersion patterns will also provide a basis for detailed palaeo environmental interpretation.

c. Air quality investigations

Current work on air quality and aerosol chemistry in a number of Asian and near-Asian cities (Hong Kong, Seoul, Bangkok, Jakarta and Darwin) will be focused more clearly on the north Australian/South East Asian region, and sampling sites expanded to include rural locations in the region (two sites in Brunei are planned and one in Jabiru, NT - to be operating by early 1995). A range of organic and inorganic elements are being investigated as markers of natural and anthropogenic sources, along with mechanisms of production, transportation and destruction.

Rural sources of aerosols will get more attention in future, in particular we will be looking for elemental carbon from biomass burning. We anticipate collection of substantial pollen in our samples; this should be of considerable interest to the palynologist in our group looking to reconstruct past environments. Analysis of samples will therefore include both SEM and chemical analyses.

d. Circum-Australian Aerosol Research Project (CAAP)

In a related area, the University of Virginia and Monash University are currently developing a proposal to investigate sources, transport and deposition of natural aerosols (especially dust) in the Australasian region. There is strong evidence that aerosols of continental Australian origin travel as far as Indonesia in the northwest and New Zealand in the southeast. A preliminary trajectory climatology for the Australian region has already been developed, and offshore dust sampling, especially to the northwest, will begin during 1995.

Japan: An interested candidate contributor to SEAFIRE is the National Institute of Agro-Environmental Sciences (NIAES) which is preparing a project on "The effects of land use changes on the emission of trace gases in tropical Asia" (feasibility study 1994, 3-years project 1995-97 to follow).

The Philippines: Good contacts are existing with the Government, Ministry of the Environment, Bureau of Forest Management. The Ministry is willing to support SEAFIRE. The SEAFIRE coordinating unit will provide basic experience in fire research in the Philippines.

Thailand: Thailand has expressed its firm intention to cooperate. The fire control organization provides excellent information on the fire environment. Thailand is the most developed SE Asian country in respect to fire management. Research in fire ecology of monsoon forests is in progress.

Vietnam/France: The connection to Vietnam is ensured through the pathways of fire ecology (through scientists of the University and the National Research Council of Ho Chi Minh City), and atmospheric chemistry; the latter is coordinated by the Centre des Faibles Radioactivités, Laboratoire Mixte CNRS-CEA, Centre d'Études Nucléaires de Saclay, France.

People's Republic of China: The Academy of Sciences, Laboratory of Remote Sensing Applications, Beijing, has expressed interest in involving their high-altitude aircraft equipped with various scanners, to be used for remote sensing of fires in Yunnan, and possibly the northern parts of Vietnam. Connections are with the Institute for Remote Sensing Application (Ispra).

Germany: The Max Planck Institute for Chemistry will provide the coordinating capabilities, fire ecology, fire history, and the aerial component for the main gaseous and aerosol measurements. Logistics for experimental fires and investigation of wildfires will be provided.

Remote sensing components in East Kalimantan (state of forest, shifting cultivation, GIS, etc.) may be covered by DLR and Kayser-Threde. The Nuclear Research Center Kernforschungszentrum Karlsruhe has indicated interest in participating.

European Union: The Institute for Remote Sensing Applications (Ispra, J.P.Malingreau) is working on fire calendars of northern Vietnam and southern China. Their activities within the FIRE project are identical with SEAFIRE objectives. Previous experience on 1982-83 fire evaluation by NOAA AVHRR.

Canada/USA: Candidate partner institutions for remote sensing research are the Canadian Forest Service, Ontario Region, and NASA Langley. The US Forest Service, Missoula Fire Laboratory, are actively interested in contributing with experience in near-ground emission characterization and are already working on setting up connections with Indonesia.

The Center for Atmospheric Chemistry Studies, Graduate School of Oceanography, University of Rhode Island has experience in airborne peroxide/formaldehyde sampling as biomass burning indicators in the Atlantic and Pacific regions (NASA/GTE/TRACE-A and PEM/WEST-A)

6. INITIAL FIRESCHEME MEETING

Fire Information Systems Research in the Socio-Culture, History and Ecology of the Mediterranean Environment (FIRESCHEME) is the suggested working title of a proposed Pan-Mediterranean research project. A first basic discussion among fire scientists was held on 24 November 1994, in conjunction with the 2nd International Conference on Forest Fire Research, in Coimbra (Portugal). Initial thoughts on the proposed project were given in IFFN No.10 (January 1994).

Scientists from all over the Mediterranean region and the adjoining countries, a representative of the Commission of the European Communities (EU), the Managing Director of the International Association of Wildland Fire (IAWF), and representatives of the IGBP/IGAC/BIBEX Steering Committee attended the meeting.

In a lively discussion it became obvious that there is a demand for a pan-Mediterranean research vehicle in which the historic, cultural, ecological and atmospheric chemical aspects of vegetation fires would be investigated in an international and interdisciplinary approach as had been demonstrated in other regions of the world. However, it was underscored by most of the participating groups that a main obstacle will be the restricted availability of budgets for the Mediterranean fire research community.

Although the EU, the IAWF and IGAC/BIBEX offered their support - within the capabilities and restrictions of their organizations - to set up a FIRESCHEME-type project approach, it became clear at the end of the meeting that groups need to be formed to develop a conceptual outline of the project and to investigate the funding mechanisms. Concrete decisions were not made at this stage.

Contacts: The editor of IFFN compiled this report. Parties interested in joining one of the research groups should direct a letter to the editor. This letter will be forwarded to the responsible project coordinator.

SWITZERLAND

Forest Fire Research in Switzerland

In Switzerland most of the forest fires occur in the southern part, a small region of 397,000 ha with 44% forest cover (176,000 ha). During the period 1973-1992, 60 % (1,840) of all wildfires recorded in Switzerland occurred in this region, covering 88% (16,375 ha) of the total burnt surface. The highest frequency of fires in the southern Alps is recorded in winter and spring along the colline-submontaneous belt between 200 and 1000 m a.s.l. (chestnut forest belt). During the dormant period, high loads of highly flammable downed woody fuels and meteorological conditions (low precipitation, north wind, low relative humidity) favour the start and spread of forest fires. The causes of these fires are all anthropogenic. Natural fires are less important and are caused by lightning in summer (July, August).

The external station of the Swiss Federal Institute for Forest, Snow and Landscape Research (FSL), the Sottostazione Sud delle Alpi (FNP-SdA), collaborating with other Swiss institutes, has started a broad research programme on forest fires. The main topics of this research in southern Switzerland are:

- Wildfire database
- Historical aspects
- Socio-cultural aspects
- Economic aspects
- Ecology and landscape
- Forecasting models for forest fires (fire weather index)
- Fire behaviour and fire planning
- Future evolution

A first major project on wildfires, entitled *Climate Changes and Natural Disasters*, financed by the Swiss National Science Foundation and included in the National Research Programme 31 (NRP31), is now in progress. The first goal of this project is the collection and organisation of information about wildfires to the south of the Alps in a wildfire database.

The aims of this database are to help users compile the data, to give an easy method for obtaining results for different standard and ad hoc queries and to guarantee data integrity and correctness. The only system which fits these conditions in an optimal manner is a relational database system. For this reason the wildfire database is built up on the database system ORACLE.

The wildfire database of the FNP-SdA contains six tables (Fig.1). The three most important tables describe the information about the communities of the research region (table COMUNE), all the data about fires provided by the forest service (table SERVIZIO FORESTALE) and the fire data recorded by the fire-brigades (table DIPARTIMENTO FINANZE). Connected with the table COMUNE is a fourth table (METEO) containing meteo data from 1980 to now. Each community belongs to one of three climatic regions into which the research region has been divided. Two smaller tables (GIORNO FESTIVO and ORA LEGALE) contain information about holidays (including common and region-specific holidays) and the periods of daylight saving time.

The records of the important tables can be described as follows: **COMUNE**: The name of the community, the climatic region, the affiliation to the forest district and several types of areas. Every record is identified by a four-digit code according to the official Swiss community code. **SERVIZIO FORESTALE**: Temporal and spatial data about the fire in more than 40 parameters describing the event. In relation to the table GIORNO FESTIVO each outbreak of a fire is assigned to the week-day and to the possible coincidence to a special holiday. The key of a record consists of a unique ten-digit number which is built up from the actual data and a consecutive number within the day. At the moment this table contains information about 5000 fires between 1900 and 1993. **DIPARTIMENTO FINANZE**: Data about the activities of fire-fighting such as the alert time, the number of assigned firemen, applied technical means (fire engines, helicopters, planes) and the duration and costs of the operation. The records are identified by a similar unique key to that of the table SERVIZIO FORESTALE. **METEO**: The conventional daily parameters of the three climate regions such as temperature, moisture, wind, radiation and precipitation. Except for precipitation the meteo data come from one climatological station per region. For topographical reasons the precipitation has to be computed from the values of four or five stations of the same region. It is planned to complete this table with earlier data but

because a sufficient number of stations has only been established since 1980 in southern Switzerland, the problem of inaccurate data has to be solved.

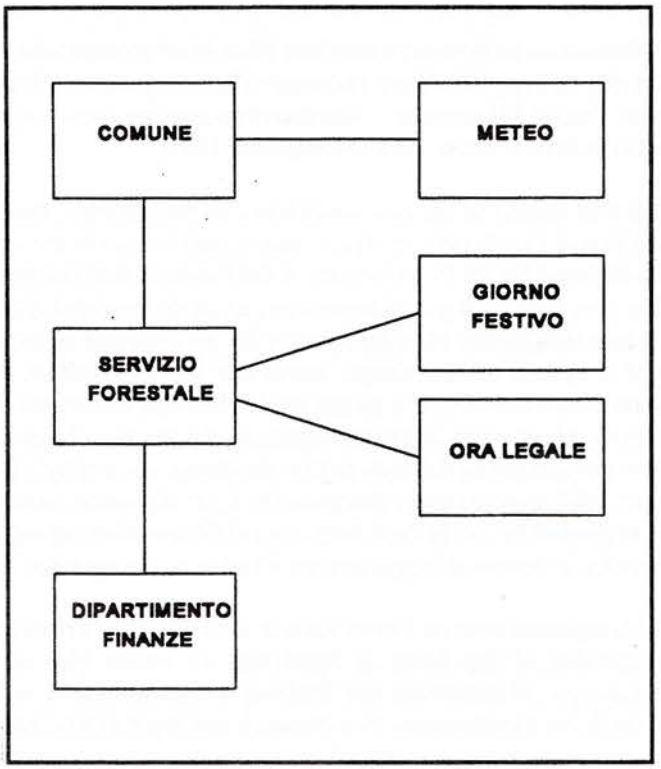

Fig.1. Structure of the wildfire database

The relational structure of the database guarantees that, as an integrity constraint, an owner-member relationship exists between two tables. This means that no record can be entered in the lower level of hierarchy unless the relevant key is already present in the higher level. Conversely, no key can be deleted from the higher level as long as any records registered under this key are still present in the lower level. In the wildfire database the most important relationships of that kind are that every record of the table SERVIZIO FORESTALE, e.g., every fire, refers to an existing community in the table COMUNE and, in the same way, every record in the table DIPARTIMENTO FINANZE, e.g., a fire with information of the fire-brigades, must be assigned to an existing fire in the table SERVIZIO FORESTALE. However it is possible that there are communities with no reference to a fire or that there are fires with data from the forest service but none from the fire-brigades.

At the moment the wildfire database is built up on the database system ORACLE running on a local personal computer with MS-DOS 486 at the FNP-SdA. Next year it will be transferred to a special database host server at the institute in Birmensdorf. This will have only minor effects for the users because the user does not have to take care of the operating system of the computer. The normal way to communicate with the database is with a menu system and a group of screen forms, which look as similar as possible to the paper forms used by the forest service and the fire-brigades gathering the data. Starting with a main menu, the user may select the different tables for querying, modifying or entering new data. In addition to that, one of the submenus gives the possibility of selection from a couple of predefined standard reports. And of course there is always the possibility of access to the database through the standard SQL interface of ORACLE.

Marco Marcozzi
Marco Conedera
FNP Sottostazione Sud delle Alpi
Casella postale 2014
CH - 6501 Bellinzona

and

Beat Jud

Swiss Federal Institute for Forest,
Snow and Landscape Research
CH - 8903 Birmensdorf

NEWS FROM FAO AND FAO/ECE

FAO / *Silva Mediterranea*

The FAO Committee on Mediterranean Forestry Questions *Silva Mediterranea* held its latest session at Larnaca (Cyprus) in June 1994. At that meeting Mr.Pierre Delabraze (France) presented his resignation as coordinator of the Forest Fire Network. One of P.Delabraze's last activities was the recent organization of workshops on the use data of bases on forest fires (Chania 1991, Montpellier 1993).

Mr. Ricardo Vélez (Spain) was elected as the new coordinator of the network. Since 1986 Ricardo Vélez has been Chief of the National Forest Fire Service of Spain, and is well known to the readers of IFFN through his frequent contributions. He obtained his Ph.D. in forestry at the Polytechnical University of Madrid in 1963 and his doctorate in 1967. The next year he was appointed forester in the National Forest Fire Service, Ministry of Agriculture of Spain. Since then he has been involved in the development of the Forest Fire Data Base for his country, the design of a system of fire danger alarm and the introduction and further spread of fire suppression aircraft in Spain. Since the early 80s he has established and further developed a system of training courses for the different levels of activities in fire management. He has been teaching on forest fire protection in many international courses organized by CIHEAM (Chania, Zaragoza) and by USAID (Arizona 1984, Chile 1985, Mexico 1988). Since 1989 these courses, designed for Latin American experts, are held every year in Spain under his direction, supported by the Spanish International Cooperation Agency. He has published several books and a number of articles in technical magazines on forest fire management.

Ricardo Vélez is the Spanish representative on Forest Fires at the Permanent Forest Committee of the European Union. Through his membership of the Team of Specialists on Forest Fire of the Joint FAO/ECE/ILO Committee on Forest Technology, Management and Training he has expressed to strengthen communication and cooperation between the Silva Mediterranea Fire Network and the FAO/ECE/ILO activities.

Johann G. Goldammer

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

In 1994 the FAO/ECE/ILO Team of Specialists on Forest Fire was reactivated, and the first meeting took place in Geneva, April 1994 (see IFFN No. 11, p.31). One of the tasks of the team is to prepare a seminar with a topic related to the activities of the team. The previous three seminars 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, it is now planned to prepare a seminar entitled *Forest, Fire and Global Change*. With a letter of 1 September 1994, directed to the Executive Secretary of the ECE, the Government of the Russian Federation, through the Minister of Forestry, offered to host the seminar in 1996. This offer has been accepted.

In addition to the ECE/FAO seminar it is planned to organize an additional exhibition/meeting of fire management specialists and equipment producers, *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

The draft agenda of the FAO/ECE/ILO Seminar *Forest, Fire and Global Change*, as prepared in Geneva, Moscow and during the team meeting in Freiburg (Germany) is given below. The draft agenda of the equipment meeting is not yet finalized. It is envisaged to invite producers 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.

More information on both meetings will be given in the next issue of IFFN (July 1995).

Johann G. Goldammer

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

RECENT PUBLICATIONS

Soil Erosion and Degradation as a Consequence of Forest Fires

Two and a half year after the organization of an international Conference on Soil Erosion and Degradation as a Consequence of Forest Fires in Valencia and Barcelona, Spain, by the European Society for Soil Conservation (ESSC), the selected papers have been published by María Sala and José Luis Rubio. 48 authors from several European countries present in 21 articles results from investigations in soil, vegetation, and hydrological responses to fire. The major part of the papers refer to field measurements on burnt areas - burnt under natural or controlled conditions - all situated in a Mediterranean climate (Spain 11, Portugal 2, Southern France 2, and Italy 1). Laboratory experiments (2), a proposal for a soil heating model (1), and general consideration about soil erosion on burnt areas (1) and fire prevention (1) complete these field studies.

The papers make the complexity of the scope obvious. Fire ecology is already a broad research theme and it becomes even more complex when approaching soil erosion on burnt slopes. The temperatures of a wildfire in a study area, especially the intensities affecting the soil, are mostly unknown. The rate of regrowing vegetation - a key factor in soil erosion - is dependent on various ecological factors, such as soil type and depth, fire intensity, seed banks, water budget. Soil erosion itself is highly connected to other parameters such as rainfall intensities, geomorphology, soil type, infiltration capacity, resprouting. The synergetic effects make it almost impossible to choose sampling areas and install test plots where comparable environmental conditions can be found. This is why results of field studies published in the volume remain hardly interpretable and sometimes contradictory to other investigations. Moreover most of the studies presented are of a short period (some months) and results range widely according to the meteorological conditions after the fire.

Some articles lack transparency about the methods and instruments used in the field and of basic information about the sampling areas and test plots. Conclusions are often very general and the question about the impact of forest fires on landscape degradation remains largely unanswered. *K.Schrader*

Sala, M. and J.L.Rubio (eds.) 1994. Soil Erosion and Degradation as a Consequence of Forest Fires. Selection of papers from the International Conference on Soil Erosion and Degradation as a Consequence of Forest Fires. Geoforma Ediciones, Logroño, 275 p. (in English with Spanish summaries).

The Role of Fire in Mediterranean-Type Ecosystems

Volume 107 of the Ecological Studies Series from Springer-Verlag gives an interesting sectional view of fire ecology research in the Mediterranean Subtropics. By looking at wildfires from very differing points of view, by analyzing one or several factors in different time-scales and dimensions, by using various methods, and by touching almost all important parameters, the authors facilitate an impressive sketch of the state of the art in these regions. Unfortunately the atmospheric and the socio-economic aspects of the wildfire problem remain untreated.

In the first article L.Trabaud shows that in France studies on post fire vegetation dynamics have a history of almost 130 years and briefly presents some recent investigations within this topic from Spain, France, Italy, and Greece.

E.R.Fuentes, A.M.Segura & M.Holmgren ask the very interesting question of whether fire responses of matorral shrubs with a long, natural fire history (such as Californian shrublands) differ from such shrublands with short, mostly human-made fire history (such as Chilean landscapes), and leave answering this question to future long-term research.

J.M.Moreno & W.C.Oechel prove a two-year-study of Californian chaparral, where they monitored four test-plots of not given size and ecological disposition. That of *Ceanothus greggii*, an obligate fire seeder, is more resistant to elevated fire intensities than *Adenostoma fasciculatum*, a facultative one.

A broad and global evaluation of literature combined with his own observations by R.D.Quinn gives an overview of the effects of fire on invertebrates, reptiles, birds, and mammals and their influence on post fire succession and vegetation composition through herbi- and granivory.

N.L.Christensen summarizes studies from Mediterranean-type ecosystems in all five continents of the impact of fire on physical and chemical soil properties - above all on nutrients - and tries a generalization, being conscious of the stochastic nature of ecological parameters influencing fire regimes, soil types and their responses to wildfire.

S.Rambal discusses the role of fire on the annual water yield, using various accepted models mainly based on climatic processes and post fire vegetation recovery, and dares to make a (pessimistic) outlook of the possible effects of "Global Change" on the water balance of a French *Quercus coccifera* garrigue by running simulations of five scenarios.

Through introducing empirically gained data (among others from charcoal records, historical narratives, archival photography, and satellite imagery) into a Regional Fire Regime Simulation model - which they hope to become an applicable tool for managers and planners - F.W.Davis & D.A.Burrows try to create a 500-years-perspective of the fire history of a landscape in southern California.

P.J.Riggan, S.E.Franklin, J.A.Brass & F.E.Brooks show from research carried out in California that fire frequencies, savoir, and impacts are highly related to biomass accumulation and chaparral dieback which in turn are often affected by hardly predictable extreme climatic events. They conclude that fire management should aim at maintaining a shifting mosaic of plant age classes through prescribed burning in order to reduce catastrophic wildfires.

The importance of wildfires in conserving ecological diversity and the possibility of using prescribed burning as a tool for keeping in balance the homeorhetic (="preserving the flow") human perturbation-dependent Mediterranean ecosystems is highlighted by Z.Naveh. Giving a holistic view of recent decades of fire ecology research he calls for a new understanding of fire impact, both from the research community and the practitioners and, in order to determine optimum land management strategies, he calls for systematic, long-term studies on landscape scales. *K.Schrader*

Moreno, J.M. and W.C.Oechel (eds.) 1994. The Role of Fire in Mediterranean-Type Ecosystems. Ecological Studies 107, Springer-Verlag, New York, 201 p. (in English).

Forest Resources in Europe

An independent and non-governmental research body, the European Forest Institute (EFI) conducts problem-oriented and multidisciplinary forest research at the European level in order to serve the needs of policy-making and decision-making bodies in Europe. The first research report of EFI provides a detailed country-by-country account of the increase in forest resources in Europe over the past forty years. This expansion, in standing volume and to a lesser extent in area, is a continuation of a trend that began during the nineteenth century. After presenting the historical developments, the author discusses the implications, should this trend be allowed to continue, for the future health and vitality of the forests, for forest policy management and silviculture, and for the economic viability and environmental sustainability of the resource. An increase in thinnings and regeneration cuttings is advocated, replacing currently unstable tree species by true climatic climax species, as is a shortening of the currently over-long rotation ages. The author concludes that preserving the sustainability and biodiversity of Europe's forests ecosystems can be achieved by maintaining the genetic diversity, density, age and health stability of forests, protecting habitats of endangered species and establishing cultural biotopes and strictly protected natural reserves. While the role of fires in European forests is analyzed only marginally, this volume provides an excellent source for those investigating and protecting Europe's forest resources.

J.G.Goldammer

K. Kuusela 1994. Forest resources in Europe. European Forest Institute Research Report 1. Cambridge University Press, Cambridge (UK)-New York-Melbourne, 154 p.

MEETINGS HELD IN 1994

FINLAND *Expert Consultation on Forest Fire Control*
25 July - 5 August 1994, Kotka and Lappeenranta, Finland

This international event was jointly organized by Finnish Training Partners International (FTP) of the National Board of Education, the Finnish National Committee of the International Decade for Natural Disaster Reduction of the Ministry of Interior, the Rescue Departments of Kotka and Lappeenranta Municipalities, Finland, in collaboration with *International Forest Fire News*.

Other cooperating organizations were the Technical Research Centre (VTT) of Finland, the Area de Defensa Contra Incendios Forestales (ICONA), Spain, Zimbabwe Forest Fire Research, the Fire Ecology Research Group of the University of Freiburg, Germany, and the Finnish Forest Research Institute.

The consultation addressed the ever increasing concern about the global degradation of our environment, in particular through wildfires and the indiscriminate use of fire. The objectives of the consultation were the following:

- to give the participants a better understanding of fire ecology;
- to provide the participants with new knowledge as to how other countries are addressing the ecological challenge of fire;
- to recall the knowledge as to how satellite imageries may be used in fire monitoring and how this can be applied to field conditions;
- to develop a broader and deeper knowledge of how to plan, organize and implement forest fire prevention activities using eg. the Korean, Spanish or Thai models;
- to be better able to examine the limitations and advantages in the use of manual and light motorized forest fire equipment;
- to be able to compare the legislative limitations in forest fire control in the respective home countries of the participants.

The programme included the following topics: Fire ecology and biomass burning, multi-temporal satellite data in forest fire monitoring; long term-ecological research in savannah forests of Zimbabwe; organization of fire and rescue services; the basis for preparation of a national fire plan; the approach taken by Thailand; training of rural villagers in Indonesia; leadership in fire suppression; the use of methods and tactics in fire suppression; tools and equipment; slash-and-burn practices, and presentation of country reports.

The Consultation was attended by 32 participants and delegates from the following 18 countries: Ethiopia, Finland, Germany, Ghana, Indonesia, Malaysia, Namibia, Nepal, the Philippines, the Seychelles, South Korea, Spain, Sri Lanka, Sudan, Tanzania, Thailand, Vietnam and Zimbabwe.

The theme of the Consultation started from outer space and the ozone layers working its way towards the surface, ending in a 3-hectare slash burning practice on a clear felling area with a fuel accumulation of 110 years. All participants also observed a fire experiment conducted by the Max Planck Institute for Chemistry (Germany) during which smoke emissions were collected for trace gas analysis.

The proceedings will only consist of the Consultation Programme with the addresses of all delegates. The basis of the background information for the Consultation (FTP Trainers Guide: Handbook on Forest Fire Control, 239 p., in English) may be obtained from the FTP.

The Consultation was sponsored by FINNIDA (The Finnish International Development Agency).

Mike Jurvélius
FTP International
P.O. Box 484
FIN - 00101 Helsinki

MEETINGS PLANNED FOR 1995-96

U.S.A.

Environmental Regulation and Prescribed Fire: Legal and Social Challenges. 15-17 March 1995, Tampa, Florida

A national conference, Environmental Regulation and Prescribed Fire: Legal and Social Challenges, will be held from 15-17 March 1995 in Tampa, Florida. The conference will provide a forum for prescribed fire practitioners and environmental regulators to discuss their respective roles in maintaining ecosystem health, preserving endangered species, reducing hazardous fuels, and protecting air and water quality. Conference organizers include air and water quality regulatory agencies, federal, state, and local land management agencies, conservation organizations, and forest product industries. For more information, contact

Diane Ots
Environmental Regulation and Prescribed Fire Conference
Florida State University
Center for Professional Development & Public Service
USA - Tallahassee, FL 32306-2027

Fax: ++1-904-644-2589
Phone: ++1-904-644-7543

Chapman Conference on Biomass Burning and Global Change Williamsburg, Virginia, 13-17 March 1995

The aim of the conference is to assess the role and importance of biomass burning as a process for global change. The conference will consider the impact of gaseous and particulate emissions from biomass burning on atmospheric chemistry, on the biogeochemical cycling of elements, and on climate. The conference will be held in Williamsburg, Virginia. Convenor of the conference is Joel S. Levine, Atmospheric Sciences Division, NASA Langley Research Center, Hampton, Virginia.

Conference Purpose: The conference will consist of 10 half-day oral sessions featuring tutorials, review talks, and contributed talks. Public lectures are also planned. Topics to be discussed are:

- Measurements of biomass burning from space
- The global geographical and temporal distribution of biomass burning
- The burning and combustion characteristics of diverse ecosystems: tropical, temperate, and boreal forests, grasslands and agricultural lands
- Gaseous and particulate emissions from biomass burning
- Impact of biomass burning on atmospheric chemistry and climate
- Biomass burning as a source of chlorine and bromine in the stratosphere
- The impact of biomass burning on the biogeochemical cycling of gases
- Modelling the impacts of biomass burning
- History and future of biomass burning
- Social, economic and political implications of biomass burning
- Future biomass burning experiments

Publication of conference papers will be in a dedicated volume and/or in a special issue of an American Geophysical Union (AGU) journal. The deadline for abstracts was 23 November 1994, and the program has been finalized and distributed. However, those interested to attend the meeting without giving a presentation should contact:

AGU Meetings Department
Biomass Burning and Global Change
2000 Florida Avenue
USA - Washington, D.C. 20009 Fax: ++1-202-328-0566

Fire and Rare and Endangered Species and Habitats
13-15 November 1995, Coeur d'Alene, Idaho

Fire is a natural disturbance which plays a major role in ecosystems, as became dramatically apparent during the Yellowstone fires of 1988. However, our understanding of fire's role in the maintenance or destruction of habitats is limited. The goal of this conference, convened by the International Association of Wildland Fire (IAWF) 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 rare and endangered species and habitats.

Abstracts of papers should be submitted by 1 February 1995. Early registration fee is $120.00 (until 1 February 1995). Late registration 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

PORTUGAL

Erosion and Land Degradation in the Mediterranean:
The Impact of Agriculture, Forestry, and Tourism
14-18 June 1995, Aveiro

Throughout the Mediterranean region, natural landscapes have suffered from intensive human impact since historical times. Nowadays new threats from tourism, forestry and agriculture result in accelerated erosion processes. What are the causes of these problems? What solutions are being applied? How effective are they?

Researchers are attempting to quantify processes from different points of view. The variety of approaches and contributions will lead to a better understanding of current knowledge of erosion processes, and the solutions to be implemented to control them.

Papers are invited related to the following topics:

- study and detailed analyses and quantification of erosion processes;
- analyses of human impact and recent evolution of social, economic and political factors generating land degradation;
- solutions to soil erosion and land degradation.

The conference is organized under the auspices of The International Geographical Union, Study Group on Erosion and Desertification in Regions of Mediterranean Climate, and will be hosted by the University of Aveiro. Deadline for abstracts will be 15 February 1995. For more information and registration forms, contact the Organization Committee:

Celeste Coelho
Departamento de Ambiente e Ordenamento
Universidade de Aveiro
P - 3800 Aveiro

Fax: ++351-34-29290
Phone: ++351-34-370200

RUSSIAN FEDERATION

International Scientific Research Conference on Mathematical and Physical Modelling of Forest Fire and Ecology Problems
24-28 July 1995, Tomsk, Russian Federation

The International Conference on Modelling of Forest Fires will be organized by the Tomsk State University and the Tomsk Society of Scientists on Mechanics. The scientific programme comprises: General mathematical model of heat-mass transfer processes in forest phytocenoses; interaction of forest phytocenoses with the atmospheric surface layer; analyses of natural and technogenic catastrophes; general mathematical forest fire models; mathematical and physical simulation of forest fires; forest fire prediction; ignition and propagation of surface, crown, and large-scale forest fires; new fire fighting methods; post-fire ecological effects; influence of fires on the global carbon cycle.

The conference programme comprises two plenary sessions, scientific presentations and poster sessions, an exposition and sale of printed products and software; demonstration of fire fighting techniques; cultural program with excursions and museum visits. Conference languages are Russian and English.

Because of a series of international fire experiments and conferences in summer 1995 it may be possible that the conference will be postponed into August 1995 (possibly immediately after the IUFRO World Congress). Those interested in participating and presenting a paper should contact the convener, A.M.Grishin before the deadline of submission of abstracts and registration forms (1 May 1995).

A.M.Grishin
Head, Department of Physical Mechanics
Tomsk State University
Lenin Avenue 36
RU - 634050 Tomsk

Phone: ++7-3822-232791
Fax: ++7-3822-445089
e-mail: sneg@sneg.tomsk.su

FINLAND ***Climate Change, Biodiversity and Boreal Ecosystems***
30 July - 5 August 1995, Joensuu

The annual meeting of the International Boreal Forest Research Association (IBFRA) will be held in Joensuu, Finland, 30 July - 5 August 1995.

Background to the Conference: The world's forested ecosystems are a vital link in the exchange of carbon dioxide and other greenhouse gases between the atmosphere and the biosphere. In this context, the boreal forests of Eurasia and North America have a special role in controlling the global carbon cycle, since the boreal zone in the form of forested ecosystems and peat lands account for more than one-third of the carbon accumulated in the biosphere. At the same time, the boreal forests provide timber and other benefits thus making the northern regions habitable throughout the boreal zone.

The predicted global climate change is among the major factors affecting the future economic and social development of the boreal zone. Research and international collaboration are needed to create a solid knowledge base for the assessment on the ability of boreal forests to control the effects on global climate and on the growth and development of boreal forests under the changing climate conditions, with implications for economic and social development in the boreal zone.

Biodiversity and its conservation have become major issues of public concern. Population pressure on forests in the boreal zone is less than elsewhere due to low population density, but on the other hand, forests in the boreal zone are an important source of well-being. The concept of biodiversity as well as measuring and applying it in management are still under discussion and require research.

Aims of the Conference:

- To assess the current understanding of the role of the boreal forests in controlling the global cycles of greenhouse gases and global climate;
- To assess the current understanding of the dynamics of boreal forest ecosystems (unmanaged and managed) in relation to the global climate change.
- To discuss the possibilities to predict the impacts of the global climate change on boreal forests, and the costs and benefits and forest policy implications of mitigating the impacts of climate change through appropriate management and land-use practices under sustainable forestry.
- To discuss the recent understanding of biodiversity issues in boreal forests.

The session of the ***Stand Replacement Fire Working Group***, one of the working groups of IBFRA, will organize its meeting one week later, during the 20th IUFRO World Congress, 7-12 August 1995, in Tampere, Finland (see announcement below). Both conferences are held *in tandem* in order to benefit from each other and to economize time and travel expenditures. For more information on the IBFRA Annual Meeting, please contact:

European Forest Institute (EFI)
Torikatu 34
FIN - 80100 Joensuu
Fax: ++358-73-124393
e-mail: efisec@joyl.joensuu.fi

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

The 20th IUFRO World Congress will take place in Tampere (Finland) from 7-12 August 1995. During which there will be four two-hour sessions "Objectives and Design of Experimental Fires in Boreal Forest Ecosystems". Convenor of the session is Johann G. Goldammer, Coordinator of IUFRO Subject Group S1.09-00 Forest Fire Research (address on page iv). These sessions will provide the occasion for presentation of the results of the Bor Forest Island Fire Experiment, an activity of the first phase of the ***Fire Research Campaign Asia-North*** (FIRESCAN), a component of the ***International Global Atmospheric Chemistry*** (IGAC) project and the ***International Boreal Forest Research Association*** (IBFRA), Stand Replacement Fire Working Group. Several additional papers will give introductions on selected boreal fire topics and on the first results of the international stand replacement fire experiment in Canada, June/July 1995. The session will include the presentation of a 1-hour film "The Fire Experiment" (English commentary). The draft programme with the locations are given below.

General information about the IUFRO XX World Congress "Caring for the Forest: Research in a Changing World"

IUFRO News 1/1994 is devoted to the preparation of the 20th World Congress. For those interested in more information, please contact:

IUFRO-95 Congress Secretariat
Finnish Forest Research Institute
Unioninkatu 40 A
FIN - 00170 Helsinki

Fax: ++358-0-625 308
Phone: ++358-0-857 051
Telex: 121286 metla sf
E-mail: iufro@metla.fi

20th IUFRO World Congress: Draft Programme of Subject Group S1.09-00

Monday, 7 August, 16:30-18:30 Session Chair: J.G. Goldammer

J.G. Goldammer (Germany): Introduction to the objectives and design of the Bor Forest Island Fire Experiment (July 1993). Presentation the film "The Fire Experiment" (extracts).

B.J. Stocks (Canada), G. Korovin (Russian Federation), A. Sukhinin (Russian Federation), D. Cahoon (USA), and J.G. Goldammer (Germany): Forest fire occurrence in the Russian Federation: Data from ground and aerial observations and satellite remote sensing

B.J. Stocks (Canada): Fire weather climatology: Comparison between boreal North America and Eurasia

Tuesday, 8 August, 16:30-18:30 Session Chairs: A. Granström and G. Ivanova

G. Ivanova, V.V. Furiaev (Russian Federation), and P. Angelstam (Sweden): Landscape ecology of the Central Taiga forest in the Dubches Plain, Western Siberia

T. Swetnam (USA): Fire and climate history of Bor Forest Island and the Dubches Plain derived from dendrochronology

J. Clark (USA): The prehistoric record of ancient forest fires in the Bor Forest Lake sediments

G. Ivanova (Russian Federation) and E. Mälkönen (Finland): Pre-fire vegetation, forest stand and site characteristics of Bor Forest Island

Thursday, 10 August, 09:30-11:30 Session Chairs: V.V. Furiaev and E. Mälkönen

B.J. Stocks (Canada), B. Lawson (Canada), and E. Valendik (Russian Federation): Fuels and fire behaviour of the Bor Forest Island Fire

W. Cofer (USA), N. Bufetov (Russian Federation), and J.G. Goldammer (Germany): Emissions from the Bor Forest Island Fire

S. Conard (USA), G. Ivanova (Russian Federation) and V.V. Furiaev (Russian Federation): Mortality, post-fire vegetational and insect infestation development in *Pinus silvestris* on Bor Forest Island and other sites in the Angara River region

Thursday, 10 August, 16:30-18:30 Session Chairs: J.G. Goldammer, R.E. Martin, and B.J. Stocks

A. Granström (Sweden): Boreal fire research in Scandinavia: Present state and opportunities for the future

B.J. Stocks (Canada), J.G. Goldammer (Germany) and W. Cofer (USA): Report on the Stand Replacement Fire Experiment, Canada, July 1995: First results of fire behaviour and emission studies

Business meeting: Discussion of future research programmes in the frame of the International Geosphere-Biosphere Programme (IGBP: IGAC/BIBEX/GEIA), the International Boreal Forest Research Association (IBFRA), Stand Replacement Fire Working Group, and the activities of the FAO/ECE/ILO Team of Specialists on Forest Fire. Discussion and decision about the future of IUFRO Subject Group S1.09-00 Forest Fire Research.

FRANCE ***TIEMEC'95: International Issues Concerning Research And Application***
9-12 May 1995, Nice

The International Emergency Management and Engineering Society (TIEMES) presents TIEMEC'95, an interdisciplinary conference which aims to bring together users, planners, researchers, managers, technicians, response personnel, and other interested parties to learn, teach, present, share and exchange ideas about how, when, where, and why mitigation management tools can be used to avoid, mitigate, and recover from disasters and other emergencies. Forest fires will be one of the conference topics. The conference will be held in the École des Mines de Paris, Sophia Antipolis, located on the French Riviera, between Nice and Cannes. Those interested to attend a workshop dedicated to forest fires should contact as soon as possible:

Jean Luc Wybo
Ecole des Mines de Paris
B.P. 207
F - 06904 Sophia Antipolis

Fax: ++33-9365-4304
Phone: ++33-9395-7429
e-mail: wybo@cemef.cma.fr

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. Topis 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 is 30 March 1995. For more details on the time table, 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

or the Organizing Committee

Mr. Emilio Chuvieco or Ms. Pilar Martín
Departamento de Geografía
Universidad de Alcalá
Colegios 2
E - 28801 Alcalá de Henares

Fax: ++34-1-8854439
Phone: ++34-1-8854438 or 8855013
e-mail: ggmpmi@alcala.es

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.

Program: 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 Saturday 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 on the attached registration form. 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)

RUSSIAN FEDERATION

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

A first announcement and preliminary information on the planned FAO/ECE/ILO Seminar is given under *News from FAO and FAO/ECE* (p.34).

FIRE MANAGEMENT COURSES

Spain

Four fire management training courses are scheduled by ICONA in 1995. The table below gives an overview on titles of the courses, participants, dates and locations. For more information, contact:

Mr. Ricardo Vélez
Chief, National Forest Fire Service
ICONA
Gran Via San Francisco, n° 4
E-28005 Madrid

Fax: ++34-1-347-6302

1995 ICONA Fire Management Training Courses

Course Title	Participants (No. of Participants)	Duration (Weeks)	Date	Place
Investigation of Fire Causes	Forest Guards, Rural Police (3 x 30)	1	3 Courses: 23-31 March 3-7 April 17-21 April	CENEAN, Valsain (Segovia)
Suppression and Fire Safety	Forest Guards, Crew Bosses (30)	1	24-28 April	CENEAN, Valsain (Segovia)
Advanced Course on Coordination of Forest Fire Fighting	Directors of Fire Suppression (25)	4	6-10 March 3-7 April 16-20 October 13-17 November	Madrid Torrejon Air Base Madrid Madrid
Advanced Course on Fire Management (with Agency for International Cooperation)	Latin American Experts	2	1-15 October	Puerto Ordaz, Venezuela Alternative: CENEAN, Valsain

FIRE STATISTICS

Global Summary of Causes of Forest Fires

Fig.1. The third most common cause of forest fires *

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