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→ Due of the timelag between editing and print/distribution of IFFN, readers interested in meeting announcements are kindly requested to visit the Internet version of this issue for update and short-term announcement of meetings (continuously updated) on <http://www.uni-freiburg.de/fireglobe/>

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All current issues of IFFN are posted on the homepage of the Global Fire Monitoring Center (GFMC) and can be accessed @

http://www.uni-freiburg.de/fireglobe/

All IFFN contributions published between 1990 and this current issue are accessible through 61 country files and other special files on the GFMC website.

Call for contributions

Readers of the International Forest Fire News are warmly invited to send written contributions to the editor at the above address. These may be in the form of concise reports on activities in wildland fire management, research, public relations campaigns, recent national legislation related to wildfire, reports from national organizations involved in fire management, publications, personal opinions (letters to the editor). Photographs (black and white) and graphs, figures and drawings (originals, not photocopies, also black and white) are also welcome. Contributions are preferably received by e-mail (text as non-encoded ASCII file, Word Perfect 5.1 or Word 6.0, Word97/8; graphic files saved as *.JPG, *.GIF or similar) or on diskettes. Hard copies of figures and photographs should be submitted by mail (please do not submit by fax).

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

EDITORIAL

The Expert Consultation on Global Forest Resources Assessment 2000 held in Kotka, Finland (June 1996) recommended that the Food and Agriculture Organization of the United Nations (FAO) provide annual statistics/estimates for the *Forest Resources Assessment 2000* for each country on the number of forest fires and the area burned over the period 1990-2000. Although FAO has provided forest fire management assistance for years, including data collection and dissemination, the organization recognized that current data on fires are still incomplete. Thus, it remains difficult to assess the annual degradation of forests caused by wildfires.

The Forest Resources Assessment process 2000 provided an opportunity for FAO to define the global effects of fires on forests as a part of the forest assessment that is undertaken every ten years. The report "Global Forest Fire Assessment: 1990-2000" was prepared by the *Global Fire Monitoring Center* and *Fire Management Applications* (USA). The report summarizes the results of questionnaires and contacts with countries to obtain wildfire data and narrative information regarding the fire situation. The report is organized according to FAO's six geographical regions: Africa, Asia, Europe, Oceania, North and Central America and South America. In-depth fire situation profiles are presented for 48 countries, with shorter reports highlighting fire conditions in several additional countries. Much of the information was either prepared by the correspondents of International Forest Fire News (IFFN) and the GFMC or taken from the IFFN archive. Although the submission of wildfire data on fire numbers, area burned and causes fell short of expectations, the importance of regularly recording and evaluating such information has been established with Member countries. This assessment of the global forest fire situation revealed strengths and weaknesses associated with sustaining the health and productivity of the world's forests when threatened by drought, wildfires and an increasing demand for natural resources.

The full global fire report of more than 500 printed pages is on file at FAO and will possibly be published in the near future (hard copy or CD ROM). However, in any case FAO and GFMC will successively put standard country profiles on the forest fire situation on the FAO website (http://www.fao.org/forestry/fo/country/nav_world.jsp). Since a large number of country profiles has been collected as IFFN contributions, e.g. the country reports of the Baltic Region in this issue, in conjunction with the *Baltic Exercise on Fire Information and Resources Exchange* (BALTEX FIRE 2000), most of the full reports will be published in the IFFN issues 23 to 26. The readers of IFFN are kindly reminded that all 72 IFFN forest fire country notes that have been collected between 1990 and 2000 are accessible in the GFMC archive on the Internet (http://www.ruf.uni-freiburg.de/fireglobe/iffn/country/country.htm).

This IFFN issue provides a Baltic Fire Special, including the BALTEX FIRE 2000 report. In addition we present the fill report of the *FAO/ITTO International Expert Meeting on Forest Fire Management* (Rome, Italy, 7-9 March 2001). At the time of printing this issue the first meeting of the *Working Group Wildland Fire* of the *Interagency Task Force on Disaster Reduction* (*International Strategy for Disaster Reduction - ISDR*), will take place in Geneva (3-4 May 2001). The Editor of IFFN provides a full report on the precursor work of the ECE/FAO/ILO Team of Specialists on Forest Fire and the Global Fire Monitoring Center towards the establishment of this first global and intersectoral platform for wildland fires.

The 2001 Fire Season

At the time of writing this Editorial there are an increasing number of precursor signals that indicate another “hot” wildland fire season. Rainfall and snow layers well below long-term averages have been recorded in some parts of the world, including the Mediterranean region and North America. All nations that had been affected by extreme wildfire situations in 2000 have been active to be prepared for another extreme year in which all national resources will be needed to prevent and reduce damages caused by wildfires. Other regions, such as Southeast Asia, will continue to have a fire break. The year 2001 will not be affected by an El Niño. Thus, burning activities and wildfires escaping from land-use fires will be rather limited.

The year 2000 has seen an increasing international interest to collaborate in large forest fire emergencies, e.g. by providing assistance to countries that are short in personnel and equipment. After the 2001 fire season we will evaluate if the visions of the international fire community have been realized.

Freiburg, April 2001 Johann G. Goldammer

BALTIC FIRE SPECIAL

BALTEX FIRE 2000
(Baltic Exercise for Fire Information and Resources Exchange)

Conference Report

1. Preface

Between 5 and 9 June 2000 the Baltic Exercise for Fire Information and Resources Exchange (BALTEX FIRE 2000) was held in Kuopio, Finland. BALTEX FIRE 2000 is part of an initiative devoted to strengthen cooperation in forest fire management and transboundary cooperation in large fire disasters between all countries bordering the Baltic Sea. The conference and exercise was organised and hosted by the Finnish Ministry of Interior and the Emergency Services College in Kuopio. BALTEX FIRE 2000 was arranged and co-sponsored by the several national institutions (the Finnish Forest Research Institute; the Forest and Park Service; the University of Helsinki; the Meteorological Institute and the Technical Research Center [VTT] of Finland).

The common Baltic forest fire initiative has been initiated in the mid 1990s by the *UN-ECE/FAO/ILO Team of Specialists on Forest Fire* which operates on behalf of the *Joint UN-ECE/FAO/ILO Committee on Forest Technology, Management and Training* and coordinates its work through the Global Fire Monitoring Center (GFMC).

2. Rationale

2.1 Fire in the Central-Northern European Environment

Forest fires in the region of the Baltic Basin are closely linked to modern human activities, e.g. industrialization, socio-economics (land-use change), military installations and activities (currently becoming less significant), problems arising at the forest/residential interface, and tourism. The wildfires severely threaten the valuable forest resources of the region. Some fire events cause secondary problems, such as fires in industrially polluted forests or in radioactively contaminated vegetation.

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

The Baltic initiative includes all countries bordering the Baltic Sea and several observer countries. The Russian Federation is part of the Baltic Fire Initiative because it shares a long borderline with other Baltic States and owns a hinterland which represents the largest and most fire-prone forest of the world that is ecologically and socio-economically connected to the Baltic Sea region. The majority of problems concerning the expected increase of the regional fire problem due to climate change is primarily in the Russian Federation.

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

2.2 The International Nexus

The UN-ECE/FAO/ILO Team of Specialists on Forest Fire is promoting a cooperative approach of the nations bordering the Baltic Basin to share fire management expertise and resources. At the *ECE/FAO/ILO Conference on Forest, Fire and Global Change* (Russia 1996) and the *First International Baltic Conference on Forest Fire* (Poland 1998) the Team has proposed to set up pan-Baltic programs and exchange mechanisms encompassing fire research, fire management training, the use of prescribed fire (in forestry, nature conservation, and landscape management), and mutual fire emergency assistance.

As a consequence, the UN Fire Team established a Baltic Forest Fire Task Force which is chaired by Finland. Finland therefore was host of BALTEX FIRE 2000.

BALTEX FIRE 2000 is considered as a contribution to the *Baltic 21 Action Programme* which is an initiative for the application of the Agenda 21 in the Baltic Sea Region and includes the Baltic 21 Action Programme on Forests. This programme is in line with:

- The UN Conference on Environment and Development UNCED (Rio 1992): Forest Principles and the Agenda 21, Chapter 11 on "Combating Deforestation and other";
- The Intergovernmental Panel on Forest (IPF, 1995-1997); and
- The Ministerial Conferences on the Protection of Forests in Europe (Strasbourg 1990, Helsinki 1993, Lisbon 1998).

BALTEX FIRE 2000 was organized in line with the objectives of the UN *International Strategy for Disaster Reduction* (ISDR) which constitutes the follow-up arrangement of the UN *International Decade for Natural Disaster Reduction* (IDNDR). The meeting and exercise included the participation of an international group of wildland fire and industrial fire specialists which prepares the formation of an advisory group under the *UN International Search and Rescue Advisory Group* (INSARAG) scheme. This group will support the United Nations in coordinating and implementing international response to forest and other wildland fire emergencies worldwide.

3. Conference Programme

3.1 Participants

A total of 85 participants of BALTEX FIRE 2000 consisted of five invited groups:

- Nations bordering the Baltic Sea (Estonia, Finland, Germany, Latvia, Lithuania, Norway, Poland, Russia, Sweden)
- Observer countries (Belarus, United Kingdom)
- Country members of the ECE/FAO/ILO Team of Specialists on Forest Fire (in addition to the representatives of the Baltic countries: Canada, Portugal, U.S.A.)
- UN International Search and Rescue Advisory Group (INSARAG) Europe-Africa Region (Austria, Germany)
- Country associated with a bilateral technical development programme of a Baltic country: Namibia

3.2 Papers Presented

Following papers were presented in thematic sessions:

- Host country Finland: Opening remarks and technical reports on programmes and projects in the country (Forest fire risk assessment; fire detection by satellite; aerial fire suppression; fire behaviour)
- ECE/FAO/ILO Team of Specialists on Forest Fire: Introduction, retrospective on the 1st Baltic Conference on Forest Fires
- Baltic and observer countries: Official national reports (Estonia, Finland, Germany, Latvia, Lithuania, Norway, Poland, Russia, Sweden)
- Prescribed burning focus: Finland, Germany, Norway
- Other:
- Peat fire problems (Finland)
- North America (country report U.S.A.)
- Fire research (Canada: The International Crownfire Modelling Experiment (ICFME); forest fires and global climate change)
- Developing countries (Namibia: Integrated Forest Fire Management [IFFM])

3.3 Working Groups

Two working group sessions were organized on 8 and 9 June 2000. The aim of the working groups was to address priority areas of action concerning forest and other wildland fire issues in the Baltic region and internationally. Three groups were formed:

- Forest fire risk assessment, detection and monitoring of forest fires
- Forest fires and environment
- Transboundary operational cooperation in fire management, training and technical development

The results of the Working Groups are presented under (4).

3.4 Demonstration Exercises

Two demonstration exercises were conducted during the conference. On 7 June a prescribed burning and forest fire suppression exercise was jointly conducted in Hyövynniemi, Heinävesi. The site consisted of an area (size: 12 ha) which was prepared for a prescribed nature conservation fire by the local Finnish Forest and Park Service. Despite the cold weather and lasting precipitation during the week preceding the exercise, favourable weather conditions on 7 June allowed a partial execution of the burn.

The second part of the field demonstration consisted of a demonstration of aerial and ground-based forest fire suppression capabilities. Aerial fire fighting was conducted by fixed-wing airplanes from Poland and Finnish helicopters using helibuckets. Fire brigades of Heinävesi and nearby municipalities as well as Russian fire brigades, supported by the Heinävesi District Police demonstrated their organizational and technical fire suppression skills at a highly professional level.

On 8 June a peat fire exercise was held in Kurkisuo, Suonenjoki, and demonstrated the fire hazards of peat production and related risk assessment, fire-fighting equipment and fire suppression. Due to heavy rains during the demonstration day the state-owned peat production company Vapo Oy, the Suonenjoki Fire Department and the Emergency Services College used smoke flares to demonstrate active fires and simulated their suppression.

4. Conference Results Recommendations of BALTEX FIRE 2000

In the following the recommendations of the three Working Groups are provided.

4.1 Group I: Forest Fire Risk Assessment; Detection and Monitoring of Forest Fires

Group I prepared a list of recommendations in the form of keywords in the field of regional Baltic forest fire risk assessment, detection and monitoring of fire. The recommendations include:

a There is a need for common understanding and sharing of fire management information in the Baltic region. All Baltic countries should therefore summarize and circulate information on their national fire danger, prevention, detection and suppression systems. This could also be achieved through development of standardized country report forms (templates).

b In order to develop a general understanding of variation in fire danger/risk that exists across the Region, which would facilitate better transboundary (border-crossing) cooperation in terms of both operational fire management and fire research the fire danger/risk throughout Baltic Region should be evaluated using a common fire danger system (likely the Canadian FFDRS), and post daily fire danger maps of the GFMC website. Current country systems could still be used, but a common, over-arching system should be developed, perhaps with the European Forestry Institute taking the lead, with the help of meteorological institutions and country representatives.

c The development of a Baltic Region-wide land cover, vegetation, fuel classification system (or approach) would assist in converting fire danger calculations into prediction of fire behaviour for specific fuel types.

d While current satellites provide valuable research information (e.g. land cover), there is a strong need to develop fire-specific satellite technology (e.g., BIRD and FOCUS of the German Center of Aeronautical and Space Research - DLR) in support of aerial and tower-based detection systems.

4.2 Forest Fires and Environment

The group prepared a list of recommendations in the form of keywords to be further explored and developed. A few explanatory remarks have been added to the list that was finally presented at the meeting.

I. The concept of "Forest and Forest Fire"

The use of the concept "forest" in the topic for the work was debated. (Forest) fire and environmental management will certainly involve important vegetation characteristics and fuel regimes that due to their successional stages cannot be precisely defined as forests, for instance different types of heathlands and other sub-climax communities. The use of different broad concepts such as "ecosystem" and "landscape type" might be evaluated in cases were more precise definitions of "forest" is difficult.

The following list of recommended fields and keywords must be further developed:

a. Scales

Any dataset, plan and management action on forest fires and the environment must be specific regarding definition of scale. Scale therefore need to be specified throughout most of the list of key words also given below. Examples:

- Time
- Space
- Boreal
- Local / regional / national
- Habitat network
- Population viability data.

b. Agreement on common standards

- Fire regime
- Fuel characteristics
- Fire monitoring (incl. prescribed burning or wildfire)
- Pre-planning
- Fire weather
- Fire effects, post-fire monitoring
- Habitat types
- Skills/techniques

c. Country fire history/regime

- Habitat maps (EU-standards)
- Fire weather/climate maps
- Identification of affected and non-affected species and habitats
- Current resource use
- Fire frequency.

d. Identification of information gaps

It is essential to explore the process at any stage to identify where information might be lacking.

e. Country vision statement

Each country is recommended to write down their visions for the theme of forest fire and environment to create overall objectives for the planning and implementation process.

f. Country fire management strategy

To create detailed objectives to support the development of country fire policies, and action plans, including:

* Biodiversity plans
* Smoke management
* Regulation and laws

g. Education/ Information

Several basic questions need to be addressed, e.g., the clarification of

* Responsibilities
* Methodologies and procedures
* Format of a supportive network.
* Methods of conflict resolution, e.g., National, regional, and local Round Tables on Fire Management in which all stakeholders will be involved

h. Training

Training is a key aspect of any future regional fire programme. Training will encompass formal training of researchers in

* Fire ecology
* Wildfire management
* Application of prescribed fire
* Multidiscipline activity
* Fire research

i. Evaluation

The many research data set, plans and management actions needed will require a competent group that can evaluate efficiency and outputs from the process.

II. Country "Action Plans"

Due to the broad range of issues and multi-faceted nature of (forest) fire and the environment each country is recommended first to develop a specific *Action Plan* which contain a list of elements or objectives. For each of the objectives an action plan (descriptive) and an implementation time scale must be given. The elements of the action plan should be priority ranked.

4.3 Transboundary Operational Cooperation in Fire Management, Training and Technical Development

This group discussion was driven by the previous activities of the UN-ECE/FAO/ILO Team of Specialists on Forest Fire and the initiative to establish a Wildland Fire Subgroup within the UN International Search and Rescue Advisory Group (INSARAG) Europe-Africa Region. The aim of the discussion was to further develop the efficiency and mechanisms of international cooperation in fire management, training and technical development.

Until recently the mandate of the International Search and Rescue Advisory Group (INSARAG) of the United Nations had been restricted to the "classical" SAR cases such as saving lives after earthquakes. However, experience has shown that secondary effects of natural and technogenic disasters require additional specialist advice in conjunction with SAR response and other humanitarian aid missions. The INSARAG family offers an appropriate structure. At the regional INSARAG Europe-Africa meeting in December 1999 (Germany) a first proposal was elaborated to establish an INSARAG Fire Group consisting of three elements:

* Wildland Fire
* Hazardous Materials (Hazmat)
* Industrial Fire

At a meeting at the UN Office for the Coordination of Humanitarian Affairs (UN-OCHA) in January 2000 it was agreed that the original mandate of INSARAG which in addition to search and rescue would also cover wider aspects of disaster/emergency response. This could include a variety of natural and human-made disasters, including wildland fires. INSARAG would assist in strengthening UN-OCHA's role by:

* governmental experts advisory support in case of a major emergency
* advisory experts to be provided out of the INSARAG family covering many fields of disaster relief

At the foundation meeting of INSARAG Fire it was recommended:

* INSARAG-Fire is a global network of specialists in dealing with industrial fire, wildland fire and HAZMAT incidents affecting populations and the environment
* INSARAG-Fire is organized in regional nodes
* INSARAG-Fire has been initiated by a Starting Core Group of INSARAG Europe-Africa and will seek the establishment of Fire groups in the INSARAG Americas and Asia-Pacific regions.
* Activation of involvement of existing international structures by calling on wildland fire expertise of international organizations and individuals already in place will be coordinated through the Global Fire Monitoring Center (GFMC) network
* Encourage a continuous exchange of information through the Internet, initially utilizing the GFMC network

At BALTEX FIRE 2000 the meeting of the FAO/ECE/ILO Fire Team further elaborated on the formation of the INSARAG Fire Group and particularly on the Subgroup Wildland Fire. The final format of INSARAG Wildland Fire will be submitted to the next INSARAG Europe Africa Regional Meeting (Tunisia, November 2000).

The BALTEX FIRE 2000 recommendations for INSARAG Europe-Africa include:

a. Establishment of a Database

For the Europe-Africa Region a database should be developed on the base of circulated questionnaires which include information on:

* Human resources for
    - Assessment of fire situations
    - Technical assistance
    - Fire fighting

It was stressed that fire specialists to be selected for deployment to international wildland fire emergency situations should be experienced or at least trained to work in national to local conditions of the recipient country (see recommendation [b]).

* Equipment
    - Hardware and software for use in international emergency assistance operations (including national to regional fire equipment warehouses)
    - Availability and mobility of equipment (time, space)

The need was underscored to observe and improve technical compatibility of equipment.

* Information sources
    - Provider of data (real-time, near-real time) for fire situations, e.g. fire reconnaissance (from air and space), fire-weather or -danger forecasts, environmental and socio-economic conditions, etc.

b. International Fire Management Training Courses

The need is recognized to train fire management specialists to be used in international response groups. Training programmes still need to be defined but should certainly include elements which would prepare these specialists to foreign situations such as the specific conditions of a target nation or region, e.g.

- natural fire environment (fuels, fire characteristics, fire behaviour);
- geographic conditions (topography, water sources)
- climate and weather (typical fire weather, local particularities such as wind patterns)
- socio-cultural conditions (land-use systems, fire use, involvement of land users or the public in fire management activities, public response to foreign intervention, limitations of use of advanced technologies)
- infrastructures and technical facilities (fire fighting resources)
- policies and administrative settings and policies in place (legal framework, law enforcement, responsibilities of agencies, role and capabilities of NGOs)
- information sources (provider of national to local real-time or near-real time data needed for fire situations assessments, e.g. fire aerial and spaceborne fire reconnaissance, fire-weather or -danger forecasts)

The training programme should include a link to the UN-OCHA / UNDAC system through which wildland fire specialists would be prepared to become candidate members for UNDAC missions in wildland fire emergencies.

International certificates should be issued in order to guarantee the competence and quality of fire management specialists deployed to international tasks.

Figure 1. The BALTEX FIRE 2000 forest fire management exercise began with a prescribed burning experiment conducted by the Forest of Finland, the Park Service and the Forest Research Institute. The objectives of the prescribed fire included improvement of forest site conditions, biodiversity enhancement and an exercise for certification burning.

Figure 2. In the second part of the forest fire management exercise several municipal fire departments, the police, the National Border Guard, and fire-fighting forces of neighbour countries Poland an Russia showed their high spirit of cooperation by sending ground and aerial fire fighting forces.

Figure 3. The Finnish coordinator of BALTEX FIRE 2000 and head of the Regional Baltic Focus of the UN-ECE/FAO/ILO Team of Specialists on Forest Fire, Mr. Harry Frelander, in a TV interview at the edge of the fire exercise. Photos: Global Fire Monitoring Center (GFMC).

c. Utilization of the Existing GFMC Network for Building the Coordination Process

The existing forest fire network organized under the ECE/FAO/ILO Team of Specialists on Forest Fire and the Global Fire Monitoring Center should be used for further strengthening the regional Baltic to global collaborative process and coordinative efforts.

The establishment of a link to UN-OCHA and the INSARAG Secretariat must be secured. The role of the GFMC as facilitating and supporting instrument for UN-OCHA and the INSARAG Secretariat in wildland fire questions must be clarified.

5. Immediate Actions to be Taken in the Baltic Region

The final discussion of the BALTEX FIRE 2000 plenary and the subsequent meeting of the ECE/FAO/ILO Team of Specialists on Forest Fire and the INSARAG Fire Group fully supported the recommendations of the three Working Groups.

The following short- to medium-term steps will be taken:

I. Establishment of a special Website on the Baltic Region on the Homepage of the GFMC

II. Design of a comprehensive and standardized format of a country profile in which the Baltic Region countries fully describe the basics on the fire situation in the country and the available fire-fighting resources for national, transboundary and international forest fire fighting, including contact numbers

III. Distribution of the country profile questionnaire to the governments; subsequent placement of country profiles on the website

IV. Establishment of links and extraction of existing open internet and intranet websites which are currently constructed, e.g. in Finland (fire danger rating system, automatic regional fire detection system), Russia (fire information system), and Germany (GIS-based Fire Information System for the State of Brandenburg: integration of data and information from an automatic ground-based fire detection system, fire danger rating, and fire behaviour modeling)

V. Publication of the national reports presented at BALTEX FIRE 2000 in the pages of UN-ECE/FAO International Forest Fire News (IFFN)

VI. Exploration of host countries and conveners for working group activities and the next BALTEX FIRE (possibly 2002)

VII. Conduct a first INSARAG Wildland Fire short introductory course in 2001; Finland has offered to investigate the possibility to host such a seminar.

6. Related Activities

The FAO/ECE/ILO Team of Specialists on Forest Fire recommended to follow up its activities in other countries of the ECE region. A meeting in the Southeast of the ECE region would be a logic continuation of a series of activities that had been initiated by topic- or region-focussed seminars, such as the meetings:

* Fire Suppression Technologies (Poland 1981)
* Fire Prevention (Spain 1986)
* The Socio-Economic Environment of Fire (Greece 1991)
* Forest, Fire, and Global Change (Russian Federation 1996)
* The First Baltic Conference on Forest Fires (Poland 1998)
* The Baltic Exercise on Fire Information and Resources Exchange - BALTEX FIRE 2000 (Finland 2000)

At BALTEX FIRE 2000 it was discussed to direct the attention of the next seminar on the Eastern part of the Mediterranean Basin and its adjoining regions which have not yet been addressed by the FAO/ECE/ILO Team of Specialists on Forest Fire. The target region will include countries East of the Balkans, Turkey, the Near East and the

central Asian ECE member states and those countries not being member of the ECE but bordering them in Central Asia, e.g. Mongolia and China.

Several reasons support this idea. First, the post-war situation in the Balkan countries as well as the South Eastern European countries which are still in transition, have not participated in recent activities of the Team and other international projects and programmes. This also refers to the neighbours of Turkey, such as the Kaukasus states, Iran, and furthermore Turkmenistan, Usbekistan, and Kazakhstan.

From the point of view of the Fire Team and the Global Fire Monitoring Center (GFMC) which coordinates the work of the team, these countries deserve full attention and support to bring them into the family of international community of forest fire scientists, managers and policy makers.

Turkey is situated in a strategically important place in the region. It was recommended that Turkey could be an excellent place in the Eastern Mediterranean region where the ecological and cultural influences of the countries mentioned above are meeting anyway. This makes Turkey ideal for convening a meeting of the mentioned forest fire community.

Thus, a possible conference to be organized in 2002 could be entitled tentatively:

"Forest Fire in the Eastern Mediterranean, Balkans and adjoining Regions of the Near East and Central Asia".

It was recommended to approach the Forest Service of Turkey and suggest Turkey to host this conference.

7. Acknowledgements

On behalf of the participants of BALTEX FIRE 2000, the Joint UN-ECE/FAO/ILO Committee on Forest Technology, Management and Training, and the new INSARAG initiative the leader of the UN-ECE/FAO/ILO Team of Specialists on Forest Fire congratulated and thanked the government of Finland for hosting and generously financing the conference and exercise. Particular thanks were given to the staff of the Ministry of Interior and the Emergency Services College in Kuopio which proved high organizational skills, excellent conference facilities and well prepared field demonstrations. The engaged coordination with several municipal fire departments, the police, the National Border Guard, the Finnish Forest Research Institute and the Forest and Park Service in the field exercise activities were well visible. The neighbour countries Poland an Russia showed their high spirit of cooperation by sending ground and aerial fire fighting forces.

In his final statements he elaborated on the good spirit of the regional Baltic discussion and the willingness to come to a consensus concerning future collaboration in forest fire research, development and transboundary support in emergencies.

He also underscored the importance of the first joint meeting of the ECE/FAO/ILO Team of Specialists on Forest Fire and the INSARAG Fire Group and envisaged a strong common future action programme.

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BELARUS

Forest Fire Situation in Belarus

As of January 1997 the forest resources of Belarus comprised 9 088 700 ha and cover 36 percent of the territory. With a share of 74.2 percent the Ministry of Forestry is the main holder of forests. The remaining 25.8 percent belong to the Department of Defence, the National Academy of Sciences, the Ministry of Education, national parks and forest reserves, and the administration of the office of the president of Belarus.

The forests under jurisdiction of the Ministry of Forestry consist of coniferous forests (67.1 percent), hard leaf forests (4.2 percent), and soft leaf forests (28.7 percent). The main trees species are pine (56.4 percent), birch (17.9 percent), fir (10.7 percent), black alder (7.3 percent), oak (3.6 percent), and aspen (1.8 percent). High wildfire hazard is prevailing in coniferous forests with understory fuels (25.2 percent), and middle-aged coniferous forests (27.7 percent). (Note: the percentage numbers refer to forested lands.)

Five Fire Hazard Classes are distinguished. Class 1 represents the highest fire hazard, Class 5 the lowest (Tab.1). The mean fire hazard level of all of Belarus is 2.3.

Table 1. Distribution of forest resources of Belarus by Fire Hazard Class

Fire Hazard Class	1	2	3	4	5
Percentage of forest land	29 %	28.2 %	30.2 %	12 %	0.6 %

Wildfire occurrence

Between 1988 and 1997 a total of 27 612 forest fires burned an area of 34 808.7 ha of forest land (0.6 percent of all forest land). The average size of a fire was 1.26 ha. This average area burned by fire is 2.14 times greater than during the period 1978 – 1987 (0.59 ha). Some forest fires spread over several hundreds of hectares. Between 1978 and 1997 years with highest fire occurrence were 1979, 1983, 1984, 1992, and 1995. The most critical fire year was 1992 when 7 444 forest fires burned 1 9701.7 ha. The highest number of wildfires occurred in May (27.2 percent), and the largest area was burned in August (39.6 percent). Between 1988 and 1997, surface fires were most frequent (92.1 percent of all fires) and burned most of the total area affected by fire (64.9 percent).

The presence of large areas of coniferous forests with understory vegetation provides conditions favourable for the transformation of surface fires to crowning fires (26.2 percent of the total area burned). Ground fires occurred only during extremely dry years and had a share of 3.5 percent of all fire incidents that burned 8.9 percent of the total area affected by fire.

Forest fire protection organisation

Fire prevention in the forests under the jurisdiction of the Ministry of Forestry are is implemented by the State forestry departments, nine aerial fire protection groups and three air bases of the State enterprise *Bellesavia*. There is no private forest sector in Belarus.

The main responsibility for fire prevention is with the Regional Executive Committees and the Executive Committees of the Districts. Their tasks are:

* Planning of annual fire protection measures
* Organisation of preparedness of fire protection personnel, technical equipment, and responsibilities for fire suppression
* Establishment and maintenance of access roads and aerodromes
* Organisation of public awareness and education campaigns for fire prevention

There are 188 fire-chemical stations in forest districts and in areas of high fire hazard in order to allow timely response to wildfires. As of 1996 there were 636 caches of fire suppression equipment located in those forest districts where fire-chemical stations are absent. Fire brigades are set up during the fire season which consist of

forest workers. In addition local people and personnel as well as engineering capabilities of local enterprises and organisations are mobilised and integrated.

The Ministry of Forestry is responsible for the overall coordination, analysis, and financing for new technologies and methods for forest fire control. Fire detection is executed by executed by the forest service by means of ground patrol, tower observation and aerial patrol. A total of 26 lookout towers are equipped with TV and remote infrared fire detection and environmental monitoring systems. The local population plays an important role in early forest fire detection. The Department of Science of the Ministry of Forestry coordinates the work of scientific institutions in the field of fire control through government programs and contracts.

Table 2. Wildfire database of Belarus, 1990-2000

Year	Total No. of Fires on Forest, Other Wooded Land, & Other Land No.	Total Area Burned on Forest, Other Wooded Land, & Other Land ha	Area of Forest Burned ha	Area of Other Wooded Land and Other Land Burned ha	Human Causes No.	Natural Causes No.	Unknown Causes No.
1990	2 471	1 039.1					
1991	1 517	319					
1992	7 743	23 822	1 8551	5271	5 458	14	49
1993	1 887	1618	1 253	365	997	2	890
1994	3 716	8 586					
1995	3 257	5645.1					
1996	3 872	5745					
1997	1 466	964.8					
1998	876	567.7	552.3	15.4	645	1	230
1999	3 959	6 260.8	4 214.5	2 046.3	2871	5	1 083
2000	2 569	1 931	1 760.1	170.9	1 700	5	864

Use of prescribed fire

The use of prescribed fire is banned by law in Belarus.

Sustainable land-use practices employed in the country to reduce wildfire hazards

For the decrease a forest fire hazard levels in the various forest types of Belarus the following actions receive priority:

- Silvicultural measures for reducing wildfire hazard in coniferous forests, particularly the introduction of less flammable and economically valuable broadleaved tree species intermixed in pure coniferous stands
- Thinning operations and sanitary cuts
- Construction of anti-fire barriers consisting of :
  - Fire breaks and internal fuel breaks
  - Fire resistant forest edges
  - Shaded mineralised shelter belts.

Public policies affecting wildfire impacts

The Forestry Code of the Republic of Belarus was enacted on 14 July 2000. According to this legislation the main fire protection tasks include fire detection, fire containment and fire suppression.

It will be necessary to create a multilevel system of fire suppression and extinguishing on the basis of streamlined land and aerial forest fire prevention services supported by spaceborne remote sensing information. It will be necessary to use systems of early forest fire detection, and to improve fire fighting capabilities by introducing new and expanding established fire fighting technologies.

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ESTONIA

Forest Fire Situation in Estonia

Introduction: Forest fire statistics for 1990-1999

The total area of Estonian forests is 2.011 million ha. Forests cover 48 percent of the land area of the country. Altogether, 2 058 forest fires have been registered in Estonia in the years 1990–1999, affecting a total area of 6 211 ha. The average size of a forest fire was three hectares (Tab. 1).

The number and area of fires differs from year to year. Table 1 shows that there were large fires in 1992, 1997 and 1999, their total area exceeding 1 000 hectares. The major fires occurred in Vihterpalu, Harju County, in 1992 and 1997, with almost 800 ha of forest burned in both cases. Due to a rainy summer, only 61 forest fires with the total area of 53.8 ha were registered in 1998. The average fire area was 0.88 ha, which is the lowest average area burned in the last ten years. The next year, the average area of a forest fire was 8.48 ha, which is almost ten times more than the year before and the second highest in the last 40 years. The largest forest fires took place in 1963, with the average area per fire being 13.9 ha. Statistical data for an extended time period indicate that 40 percent of all fires

take place in Harju County and the major fires have also occurred there. But in 1999 forest fires occurred in other counties as well. Ida-Viru County suffered the most damage in 1999, with the biggest fire of the year also occurring there (near Narva). Major fires also occurred in Harju County (Männiku) and Lääne County (Nõva). A number of major fires occurred under extraordinary circumstances that complicated their suppression. Several examples are given below.

The most extensive forest fire in 1999 took place in the vicinity of Narva (Ida-Viru County), where 400 ha of forest and peat bog that were to be turned into open-cast oil-shale pits caught on fire. Fire brigades from a number of counties participated in the suppression of this fire. Suppression was carried out sector by sector. Both portable motor pumps and truck-mounted pumps were used and a helicopter proved to be most useful. Suppression was complicated by the fact that heavy fighting had taken place at this spot during World War II. Old bombs and warheads exploded in the fire in a number of cases, making fire suppression extremely dangerous. A special mine clearing unit was called on to prepare zones where fire brigades could act in comparative safety. Due to this complicated situation, it took four weeks to suppress the fire. None of the firefighters were hurt, as adequate safety measures were taken.

Table 1. Forest fire database for Estonia, 1990 to 1999

Year	Number	Area burned (ha)	Average area burned (ha)
1990	164	194.0	1.07
1991	39	58.0	1.49
1992	348	1 787.0	5.13
1993	207	647.1	3.13
1994	289	456.4	1,58
1995	188	185.9	0.99
1996	273	579.0	2.12
1997	359	1 146.5	3.19
1998	61	53.8	0.88
1999	130	1 103.0	8.48
Total	**2 058**	**6 210.7**	**3.02**

An 80 ha forest fire occurred near Männiku (Harju County) with fire brigades from various counties involved. Water was transferred with the help of portable motor-pumps and pumping stations from an open cast pit (a distance of 1.5 km) and a mire pond (a distance of 1 km). A helicopter was also used to suppress the fire. This was a dangerous fire as it was very close to the city. The fire brigades managed to stop it from spreading when it was only 300 m from the dwellings. The fire was caused by arson. Suppression lasted for 16 days, a period that could have been shorter, considering the area of the fire. But arsonists (who could not be caught) twice again ignited the forest after the fire had been brought under control.

Returning to the forest fire statistics for the last ten years, it should be noted that only approximately one percent of all the fires are caused by natural factors (lightning, etc.). The remaining 99 percent are generally related to human activities (Fig.1).

Framework of forest fire protection

As a result of institutional rearrangements, forest fire protection in Estonia has been structured as follows:

- A general emergency phone-number (112) has been established and county emergency centres have started functioning. All notices of forest fires are now received on one phone-number.
- Suppression of forest fires is now the responsibility of the Rescue Board under the jurisdiction of the Ministry of Internal Affairs, as provided by the Rescue Act.
- Monitoring of forest fire protection and measures to prevent widespread and especially dangerous fires are the responsibility of the Ministry of Environment, as provided by the Forest Act. For this purpose, the dissolved Forestry Board has been formed into the Forest Department of the Ministry.

Management of state forests and detection of forest fires from observation towers is the responsibility of the State Forest Management Centre, a state for-profit institution under the jurisdiction of the Ministry of Environment, as provided by the Forest Act.

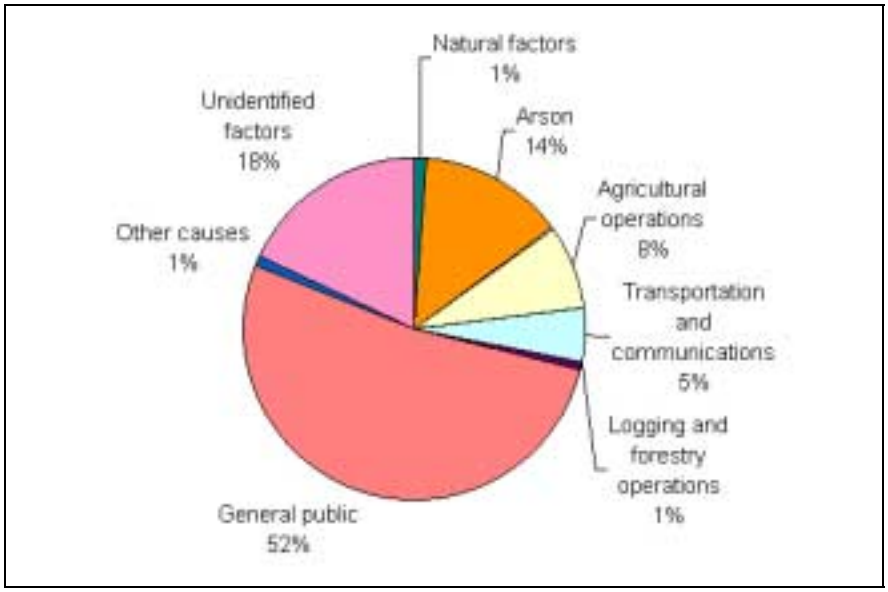

Figure 1. Causes of forest fires in Estonia during the 1990s

Research and development projects

Consistent with the recommendations of the First Baltic Conference on Forest Fires and the corresponding Polish experience, an applied research project aimed at increasing the fire-resistance of forests in the Vihterpalu region, Harju County, was launched and financed by the Forestry Board. The project report contains practical guidelines for forest owners (including the state) on developing fire breaks in fire-prone forested areas, building artificial water bodies and fire protection roads and tending roadsides. Studies on improving the fire-resistance of forests will continue in 2000.

As the process of integrating Estonia into the European Union continues, attention will be paid to the enforcement of Council Regulation (EEC) No 2158/92 and a number of development projects have been planned in this context. These projects will address methodologies for determining the degree of fire hazard and the planning of fire protection measures. Studies on the causes of forest fires are under way. The Ministry of Environment ordered these studies and research projects.

The Estonian Rescue Board has been upgrading its equipment for the suppression of forest fires. Its primary goal has been the creation of a mobile, quickly deployed water-transferring system that takes advantage of the number and distribution of Estonia's lakes and rivers. Fire-pumps of different capacities and hose lines of varying diameters have been and will be acquired for this purpose. The development of these systems is region-specific.

Cooperation in the Baltic Sea Region

Estonia thinks that it is very important to carry out coordinated fire management activities with the other countries of the Baltic Sea region. The country is interested in participating in conferences and practical training sessions. There has been good cooperation with Finland in detecting forest fires in their early phases with the help of satellites. It is intended that this project will be developed further. A cooperative agreement concerning rescue services has been concluded with the Republic of Finland and a similar agreement is presently being prepared with the Kingdom of Sweden. These agreements give Estonia the opportunity to receive prompt technical assistance and support using previously agreed-upon procedures. So far, Estonia has not used these services and hopefully no such need will arise.

However, the existence of these agreements gives a positive impetus to bilateral cooperation in the field of rescue services. In the case of extensive and long-lasting forest fires, it would undoubtedly be useful to invite specialists from other countries to observe conditions. Exchange of experiences on the basis of real-life situations would be beneficial.

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FINLAND

Fire Situation in Finland

Introduction

The total area of Finland is 338 145 km^2, of which the land area is 304 529 km^2. Forests cover 68 percent of the total area, i.e. 26 million ha. Finland's forests are in the boreal coniferous forest zone. The most common species are spruce (*Picea abies*) and pine (*Pinus sylvestris*) as well as birch (*Betula* spp.). About 54 percent of the forests are privately owned, 33 percent are owned by the state, 8 percent by forestry enterprises, and 5 percent by others.

The forest fire season in Finland is relatively short, usually starting at the beginning of May and ending in September, i.e. 5-6 months. Finnish summers are cool and relatively wet. In addition, Finland is not too complicated in terms of geography for fire control purposes. There are no mountains and the forest road network is quite extensive. There are also a lot of natural obstacles, including 188 000 lakes, that help keep forest fires quite small. This helps the Finnish forest fire management system to keep the fire problem relatively small in scale as compared to southern Europe.

The Fire Management System

The Finnish fire management system consists of prevention, early warning and suppression as presented in the flow chart (Fig.1).

As shown in the flow chart, educational, legislative and technical means are used in fire prevention. People need to be educated to behave in a safe way in the forests. This has been reinforced by legislation. For instance, when a forest fire warning is issued it is against the law to set an open fire inside or near a forest. A forest fire warning is issued when the forest fire index reaches a high level. The Finnish Meteorological Institute publishes a daily fire danger map of Finland. The map is based on the *Forest Fire Index Calculation System* (Heikinheimo 1998; see also http://metsapalo.fmi.fi/).

To provide early warning and information on forest fires the general public is educated to react when they see that something is wrong. In practice this means that they don't ignore the situation and that they also report by telephone using the emergency number 112. By law, everyone is obligated to inform the authorities about an incident. Airborne surveys and an operational satellite system are examples of technical applications, e.g. an automated fire detection system based on the NOAA AVHRR satellite sensor (Kelhä 1998).

The third part of the system is a fast response. According the law, people are obliged to do their best to reduce the damage in an incident. What can be done depends on the type of the incident and the person. However, the goal is to educate people to do some simple preliminary actions before the fire brigade comes to the incident site. As mentioned before, risk assessment is based on law. Municipalities have to assess the risk of forest fire and have in place suitable personnel and equipment to handle the situation. Forest fire suppression is assisted by technology such as aeroplanes, helicopters and the equipment of the fire brigades.

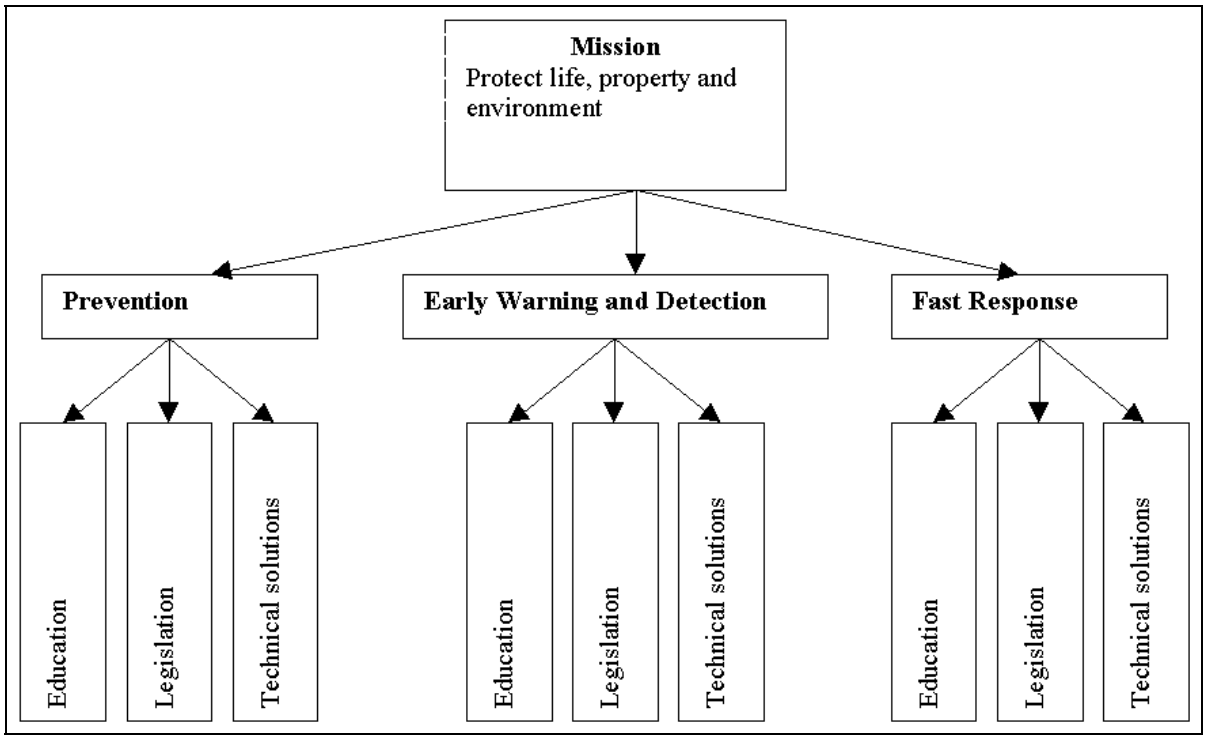

Figure 1. The Finnish forest fire management system

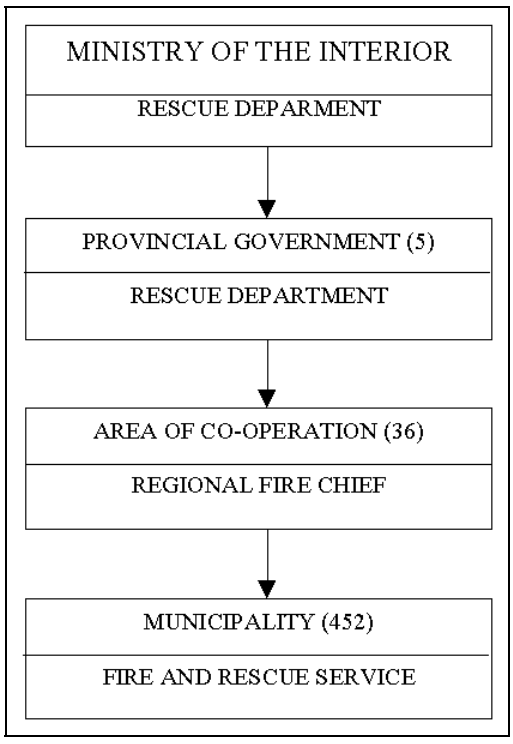

Figure 2. The organisation of fire and rescue services in Finland

The Municipal fire brigades do the actual operational response. The local municipal fire officer is responsible for leading the operation inside the local municipal area. Finland is divided into 36 alarm areas. Each alarm area has several municipal fire brigades. If a situation exceeds the local capability, other municipal fire brigades can be called upon for help. In each alarm area there is also a regional fire chief. He has the responsibility to take the lead if he thinks it is necessary. The fire officer in charge is responsible for every strategic decision.

The role of the Ministry of the Interior is to insure that all the necessary resources are functional and that in every area there are also enough resources to handle bigger situations. In the case of a large or national catastrophe the Ministry of the Interior takes the lead.

In an operational sense, the governmental and provincial levels don't have much to do as far as daily incidents are concerned. In the case of a national catastrophe, where there are hundreds of thousands of people in danger, these organisations start to function at the operational level.

Forest officials are urged to use more prescribed burning for ecological reasons (see below). This, in fact, would not interfere with fire prevention if the prescribed burns can be properly controlled.

Impact of wildfires in Finland

Forest fire is one of many incident types in Finland. We can get a general picture of this when we study the incident statistics. Forest fires form only approximately two percent of all the incidents where the fire brigades respond.

The last reported casualty in a forest fires was at the beginning of the 1980s when a firefighter got lost in a peat fire and died. There was another similar incident in the 1970s.

Property and the environment are mainly at risk from forest fires in Finland. All in all, forest fire damage in Finland has been very low indeed, i.e. less than 10 million Finnish Marks per year. There is no significant damage to ecology or public health.

Forest fire database

The forest fire database in Finland is in an electronic format from 1993 on. However, a new database has been recently introduced in which information from 1995 on is being processed.

The total area burned has been very small over the last two decades as shown in Figure 3 and the statistical table (Tab.1).

Use of prescribed burning

Fire is an important natural factor in forest ecosystem maintenance and dynamics. The use of prescribed fire has decreased since the 1950s. The lack of forest fires has caused an impoverishment of biodiversity. In addition, the forests have become denser than before. It is envisaged that in the future prescribed burning programmes will be expanded in order to restore biodiversity. A "let burn" policy is currently being discussed. However, more research on burning behaviour in Finnish forests needs to be done before this could be implemented.

The use of prescribed fire is rare for agricultural maintenance or other vegetation management purposes.

Reducing wildfire hazards

As it was mentioned above, the combination of climatic and biogeographic conditions in Finland does not favour the spread of large, catastrophic wildfires. Therefore, special measures for wildfire hazard reduction are not required.

Public policies concerning fire

Finnish forest officials have urged an increase in the use of prescribed fire. The forest certification procedure also requires a certain amount of prescribed burning. The Finnish Ministry of the Interior accepts prescribed fires if they are properly managed so that they do not cause damage to a third party. Together with the University of Helsinki the Finnish Ministry of the Interior is conducting a research programme on forest fire behaviour (Frelander 2000, Kuuluvainen 2000).

The role of the Finnish Ministry of the Interior is to protect life, property and the environment. With regard to forest fires the aim is to keep the damage as low as it is today. Prescribed fires are acceptable if they are properly managed and confined within prescription.

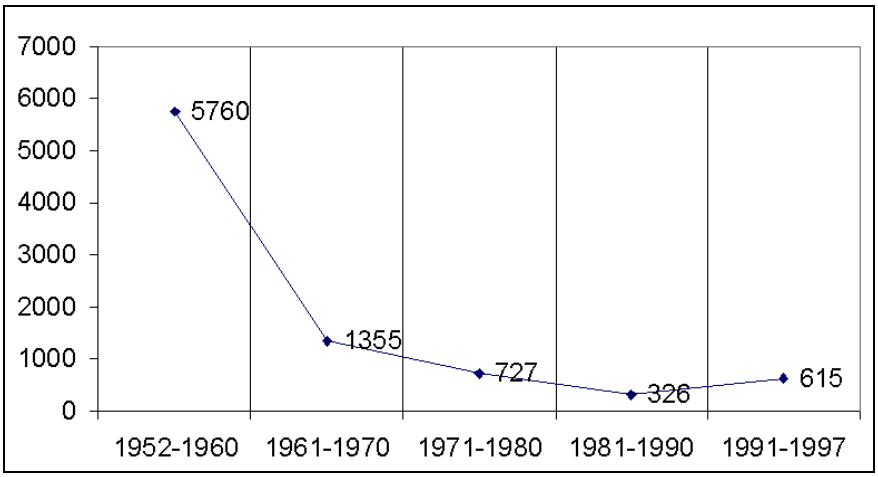

Figure 3. Average forest area burned annually in Finland by decades since 1952 (in hectares)

Table 1. Wildland fire statistics for Finland, 1990-1999

Year	Total No. of Fires on Forest, Other Wooded Land, & Other Land No.	Total Area Burned on Forest, Other Wooded Land, & Other Land ha	Area of Forest Burned ha	Area of Other Wooded Land and Other Land Burned ha	Human Causes No.	Natural Causes No.	Unknown Causes No.
1990	4 000		434				
1991	3 400		226				
1992	3 800		1 081				
1993	2 000						
1994	2 500		1 583				
1995	2 867	1 438	774	664	1 409	178	577
1996	3 181	901	446	455	1 815	80	502
1997	3 574	1 827	1 333	494	1 731	450	579
1998	1 196	323	121	202	835	38	159
1999	2 769	1 050	550	500	996	337	1 436

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Figure 4 – From the Archive of IFFN/GFMC. Slash-and-burn agriculture in Finland in the 19th Century. Source: Eero Järnefelt 1873, Raatajat rahanalaiset, Ateneum, Helsinki

GERMANY

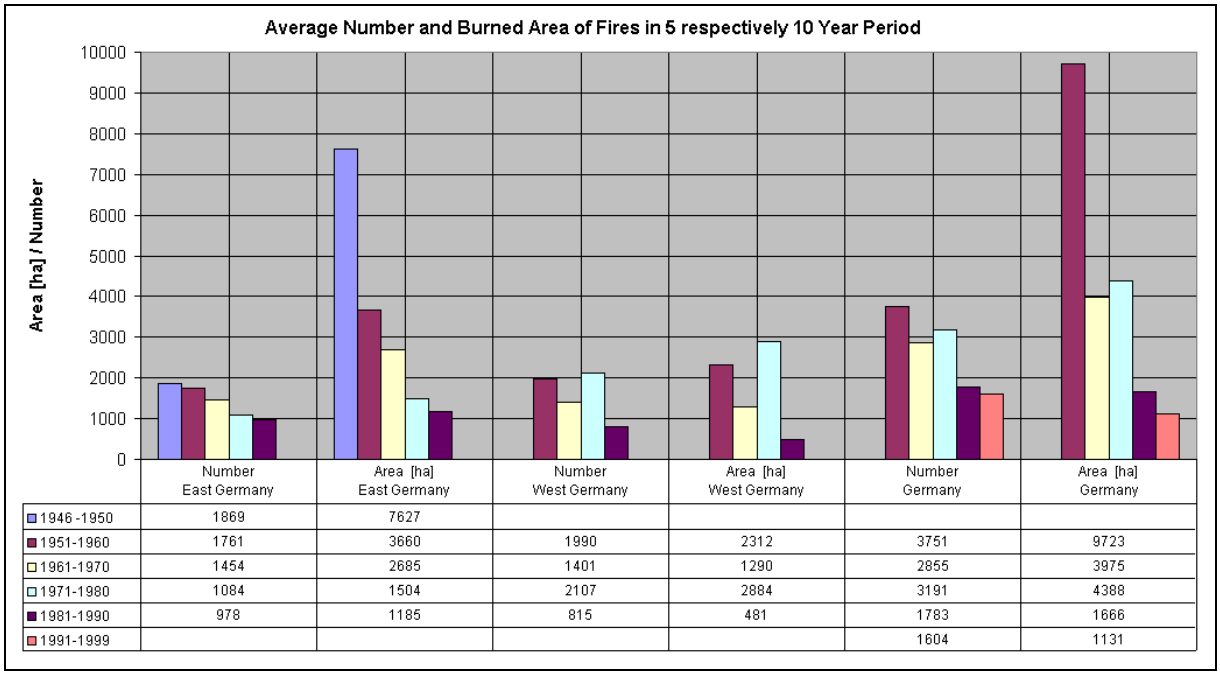
Fire Situation in Germany

Introduction

In Germany the main fire problem areas are located in the northern portion of the country where predominantly poor soils are associated with continental climate features. The forests in this region between Lower Saxony in the West and Brandenburg in the East (bordering Poland) are dominated by pine (*Pinus sylvestris*) stands characterised by a relatively high fire hazard.

The Statistical Database on Forest Fires

In 1991, the first uniform forest fire statistics were introduced in the Federal Republic of Germany. Between the end of the Second World War and the unification of the two separate German republics each system operated its own statistical database (Fig. 1 a). The compilation of forest fire statistics of the former German Democratic Republic (GDR – East Germany) started in 1946. Data for the Federal Republic of Germany (West Germany) were not available before 1957. With the reunification in October 1990, a common fire statistics system was introduced in Germany that met the standards of the ECE/FAO.



	Number East Germany	Area [ha] East Germany	Number West Germany	Area [ha] West Germany	Number Germany	Area [ha] Germany
1946 -1950	1869	7627				
1951-1960	1761	3660	1990	2312	3751	9723
1961-1970	1454	2685	1401	1290	2855	3975
1971-1980	1084	1504	2107	2884	3191	4388
1981-1990	978	1185	815	481	1783	1666
1991-1999					1604	1131

Figure 1 a. Average number of forest fires and area burned in Germany in 5- and 10-year periods, 1946-1999

The majority of fire damages occurred after the war in the East German territory. Although the number of fires was sometimes smaller than in West Germany, the burned area, except from 1971 to 1980, was larger than in West Germany (Fig. 1 b). Between 1951 and 1960 the highest post-war fire damage occurred in the GDR (Fig. 1 c). In this period the average number of 1 761 fires per year was registered with an average burned area of 3 660 hectares per year. In this context, it is important to note that forest land comprises only 28 percent of East Germany.

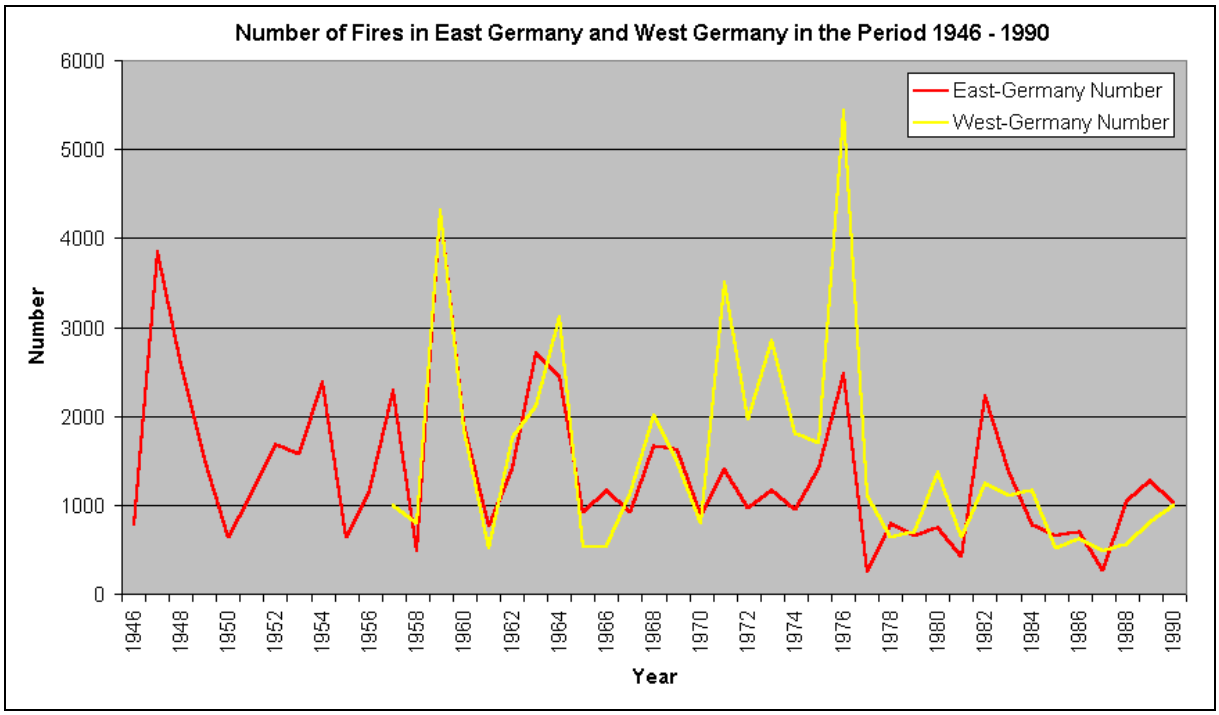


Figure 1 b. Number of forest fires in Germany, 1946-1999

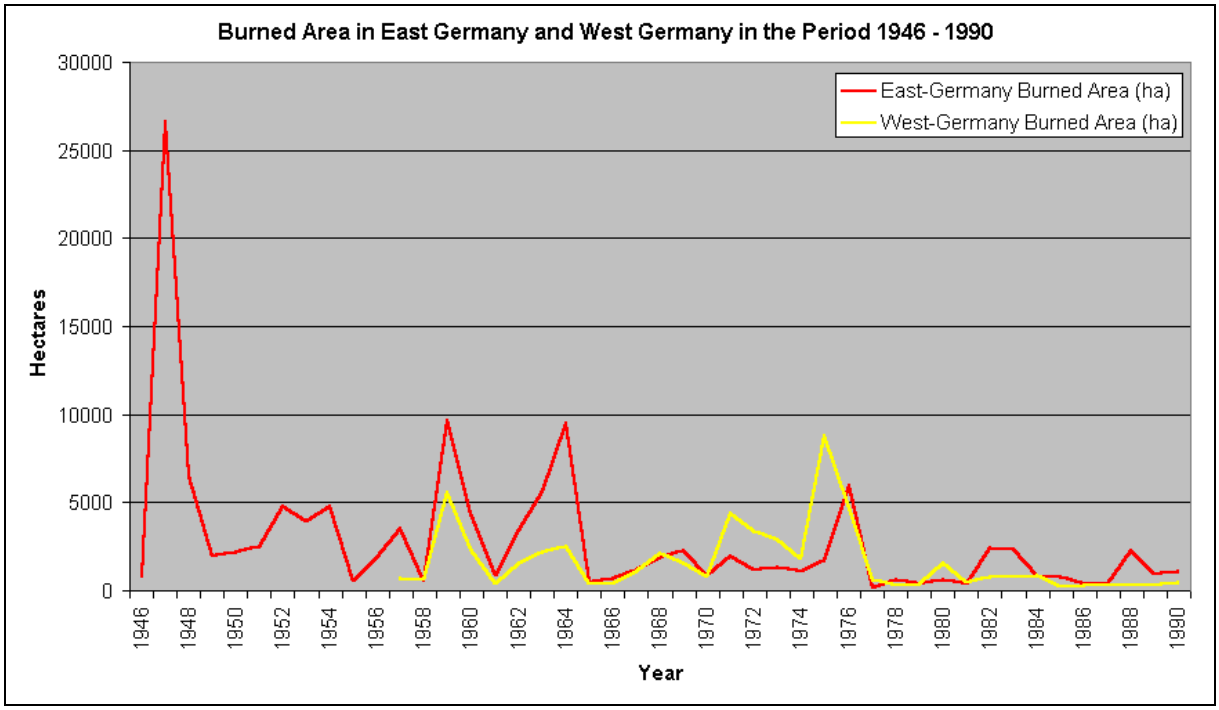


Figure 1 c. Area burned in Germany, 1946-1999

In 1990, the real causes of fires in the GDR were published for the first time (Missbach 1990). For political reasons the issue was treated secretly. During the period 1951 to 1970 fires caused by negligence mounted 46 percent and, in the subsequent years, up to 60 percent. Railway traffic caused 28 percent of the ignitions by sparks from locomotives which were driven with brown coal. During the period from 1971 to 1988 the percentage of fires caused by military training and exercises increased to 29 percent. These fires were located outside the borders of the military exercise areas; they had been hidden in the statistics before 1990.

In West Germany, the conflagrations of the years 1975 and 1976 in Lower Saxony had a strong impact on the statistics for the period 1971 to 1980. The average number of fires rose to 2 107 with an average burned area of 2 884 ha per year. In 1975 the average size of the burned area per fire increased to 5.15 ha. The number of fires and the area burned depend on inter-annual climate variability and ranged from 242 ha in the wet year 1985 to a maximum of 8 768 ha in the hot and dry year 1975. Therefore, the West German statistical figures show that the burned area of 1975 was 36 times larger than in 1985. The importance of the climate is also represented in the average size of the burned area. In East Germany the amounts ranged from 0.52 up to 6.93 ha between 1946 and 1990; whereas West German data show areas from 0.35 to 5.15 ha (Fig 2 a).

The average burned area per fire in the period 1977 to 1999 is shown in Figure 2 b. After reunification 1992 shows a peak of burned area with 4 908 ha (Fig. 3). More than 80 percent of these fires happened in East Germany and a considerable number started on military training areas. This phenomenon can be explained by the political circumstances. In the former GDR the fire brigades were managed by fire bosses who were members of the police force. As a result of the reunification they had quit their jobs. The democratically elected new fire bosses lacked the experience in fighting large forest fires. The inadequate technical equipment of the rural voluntary fire brigades worsened the situation.

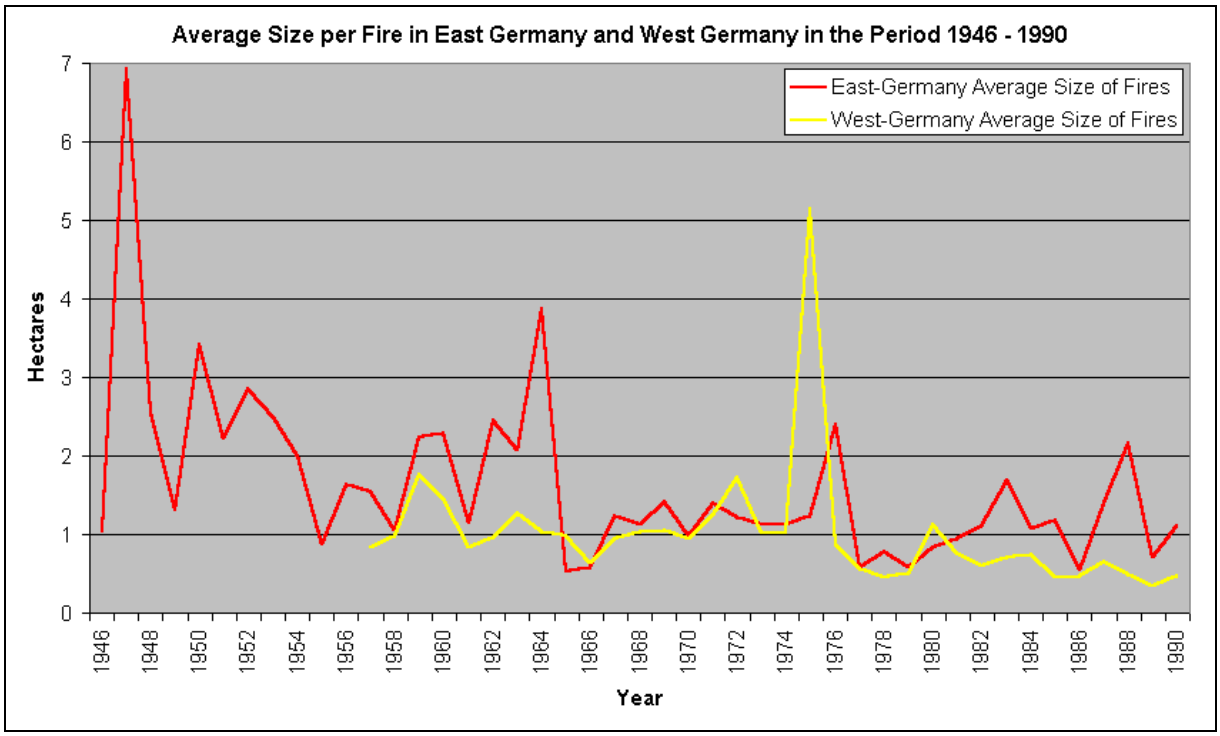


Figure 2 a. Average size per forest fire in Germany, 1946-1999

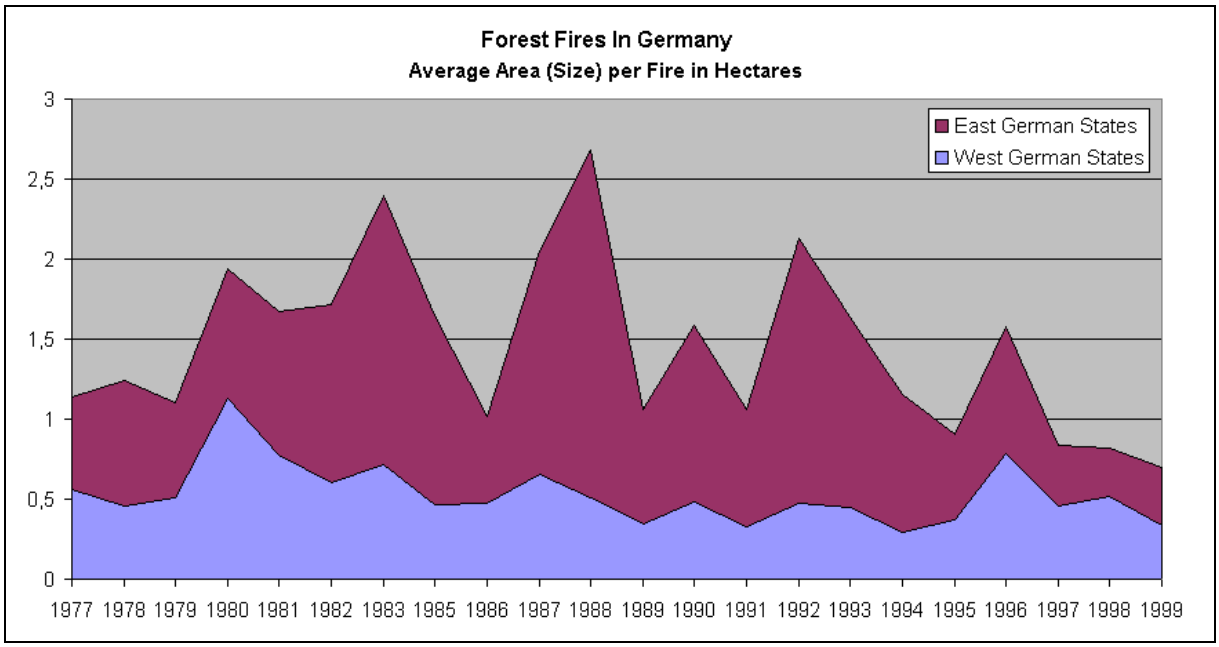


Figure 2 b. Average size per forest fire in Germany, 1977-1999

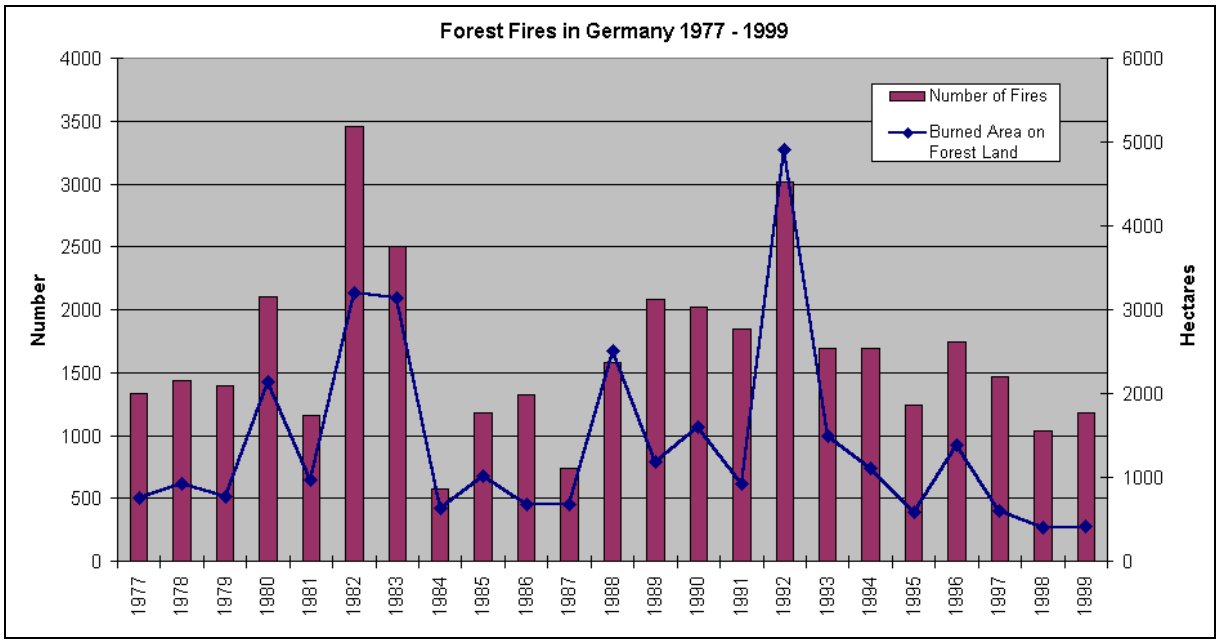


Figure 3. Number of forest fires and area burned in Germany, 1977-1999

Fire causes

Only two percent of all fires are caused by lightning. The identification of fire causes is unsatisfactory because the average percentage of unknown causes is 39 percent from 1991 to 1999 (Fig. 4 a, b). Negligence holds second place with 25 percent in the period 1991–1999. Negligence had a higher percentage in West Germany, decreasing from 50 percent to 30 percent between 1961 to 1990. There is a steady increase of arson in West Germany since 1961, with an average percentage of 22 percent in the period 1991–1999 in the whole of reunified Germany. The reduction of military training and the electrification of railways, especially in East Germany, explain the decrease of the "other causes" to ten percent. The four most important "other causes" are the railway, public ways, agriculture and forestry. Figures 5 a and 5 b show the monthly distribution of fires between 1995 and 1999 in Germany. The average number

and the average burned area in this period indicates two peaks in April and August. This supports the earlier theses of Geiger (1948), Weck (1950), and Missbach (1982) that most fires occur in spring and in high summer.

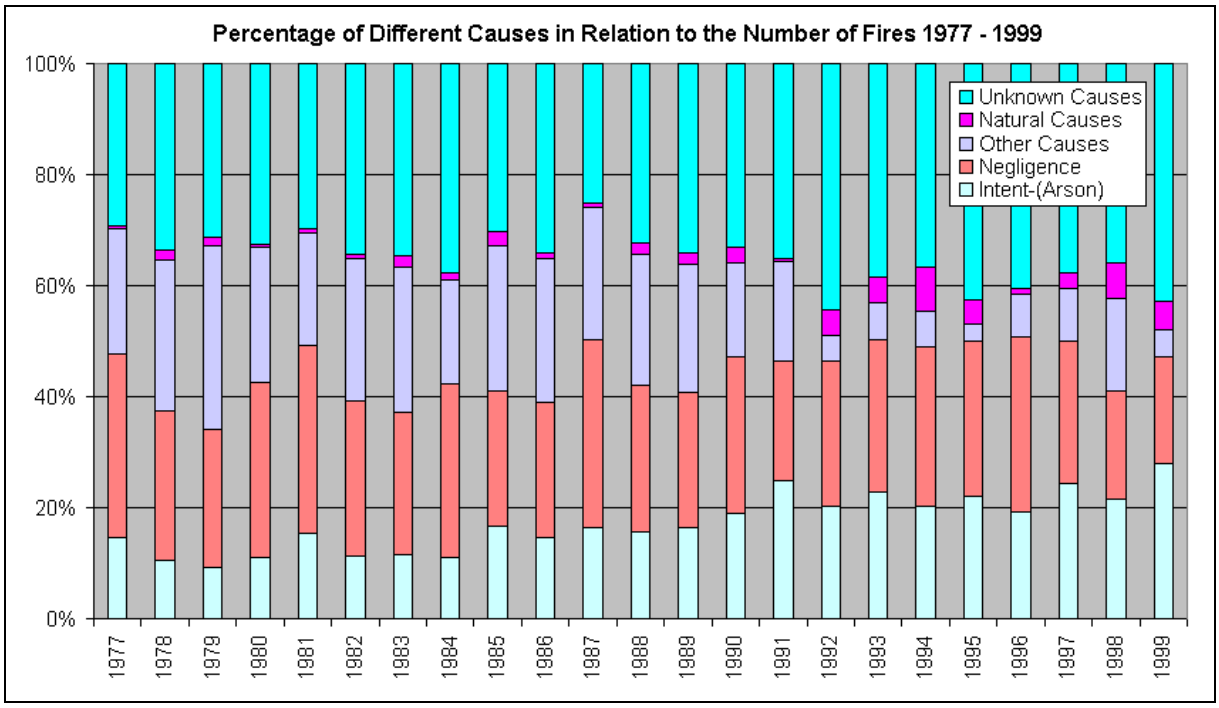


Figure 4a. Causes of fire in relation the number of fires in Germany, 1977-1999

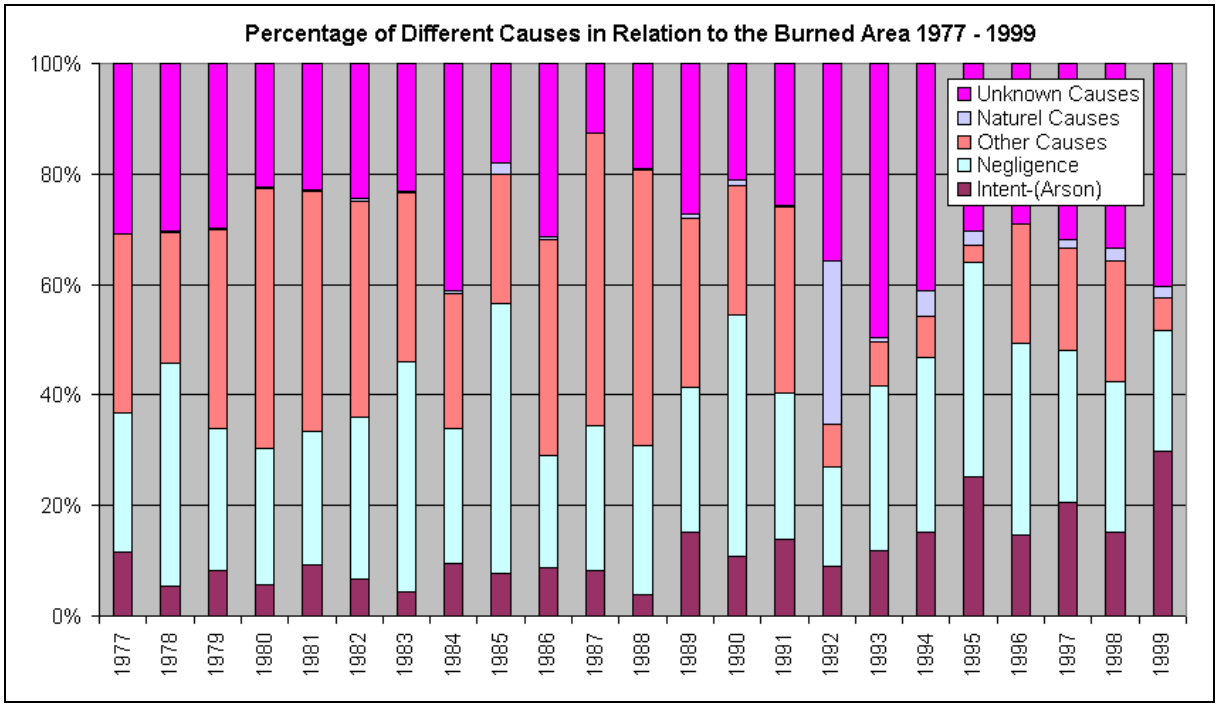
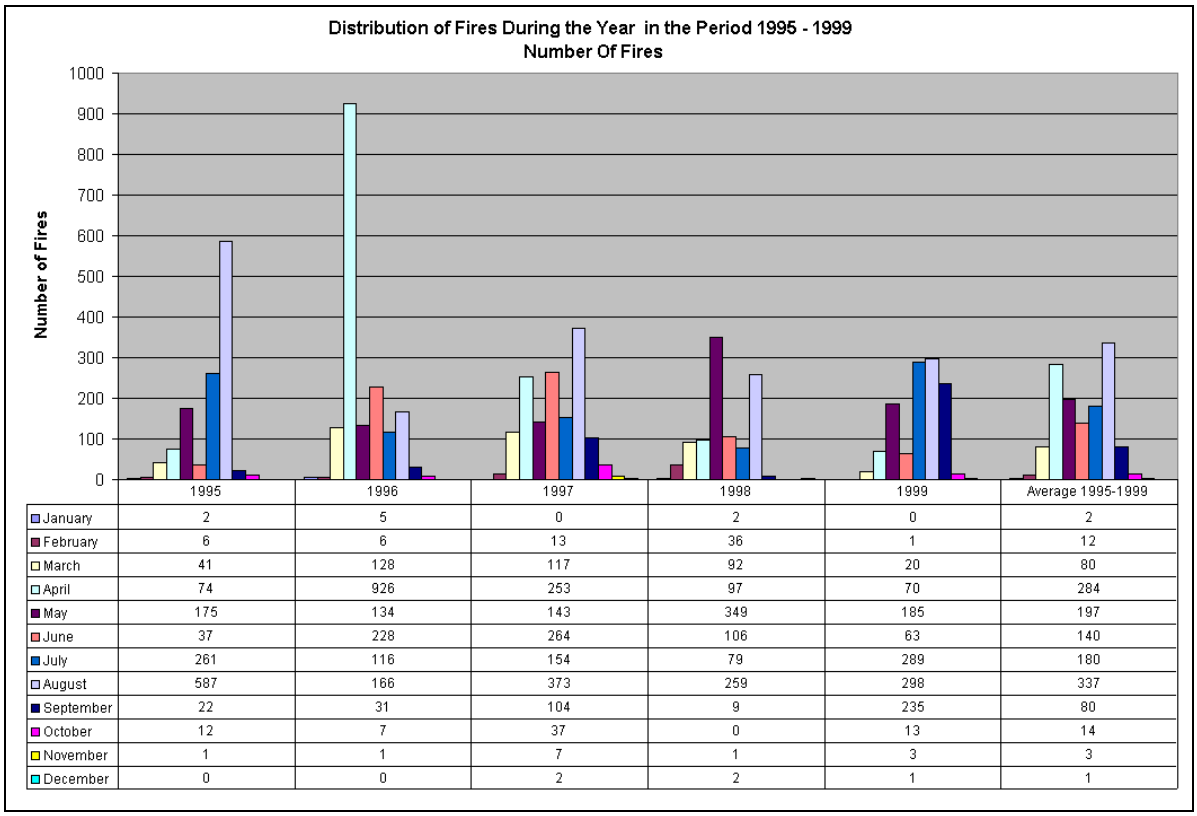
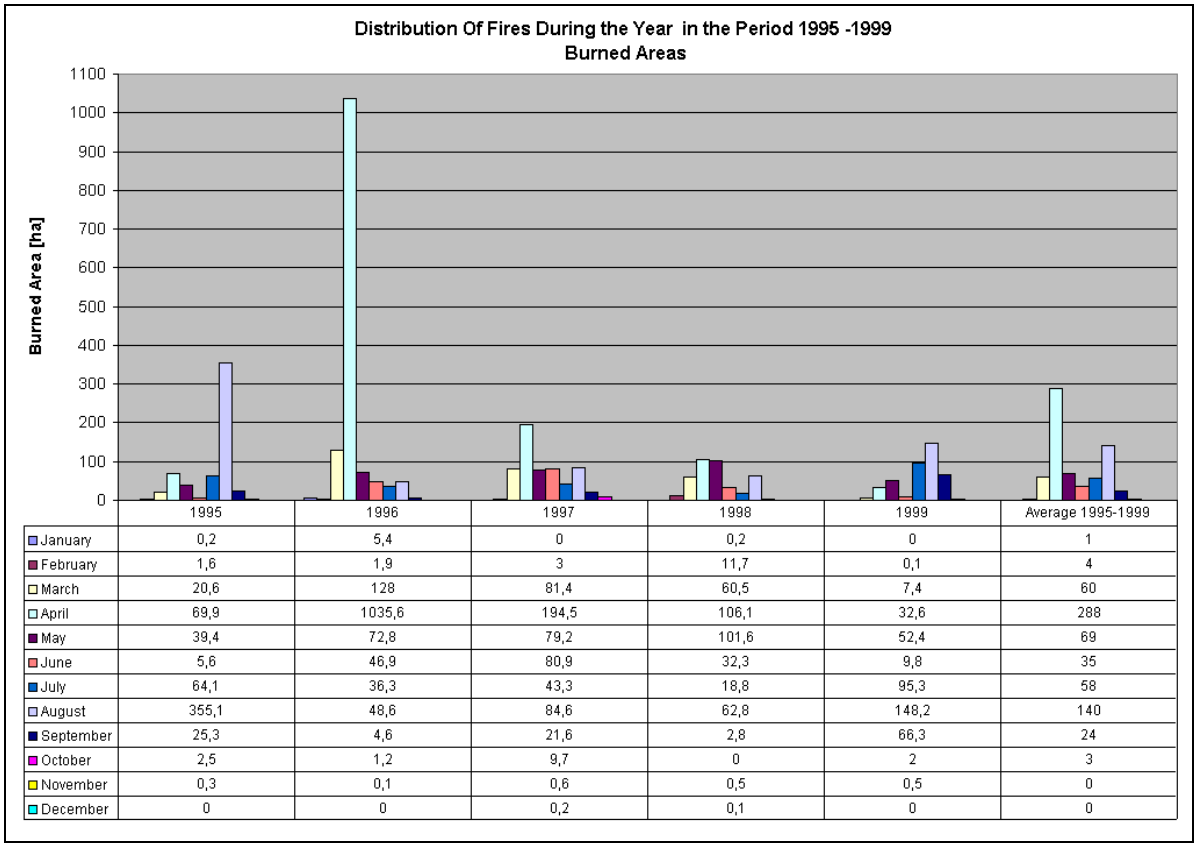


Figure 4b. Causes of fire in relation the area burned in Germany, 1977-1999



	1995	1996	1997	1998	1999	Average 1995-1999
January	2	5	0	2	0	2
February	6	6	13	36	1	12
March	41	128	117	92	20	80
April	74	926	253	97	70	284
May	175	134	143	349	185	197
June	37	228	264	106	63	140
July	261	116	154	79	289	180
August	587	166	373	259	298	337
September	22	31	104	9	235	80
October	12	7	37	0	13	14
November	1	1	7	1	3	3
December	0	0	2	2	1	1

Figure 5a. Distribution of number of fires by month in Germany, 1995-1999



	1995	1996	1997	1998	1999	Average 1995-1999
January	0,2	5,4	0	0,2	0	1
February	1,6	1,9	3	11,7	0,1	4
March	20,6	128	81,4	60,5	7,4	60
April	69,9	1035,6	194,5	106,1	32,6	288
May	39,4	72,8	79,2	101,6	52,4	69
June	5,6	46,9	80,9	32,3	9,8	35
July	64,1	36,3	43,3	18,8	95,3	58
August	355,1	48,6	84,6	62,8	148,2	140
September	25,3	4,6	21,6	2,8	66,3	24
October	2,5	1,2	9,7	0	2	3
November	0,3	0,1	0,6	0,5	0,5	0
December	0	0	0,2	0,1	0	0

Figure 5b. Distribution of area burned by month in Germany, 1995-1999

Prescribed burning

Since forest fire management in Germany is not faced with exceptional fire problems, the use of prescribed fire in forest stands for wildfire hazard reduction has not been seriously considered. Prescribed fire has been proposed and tested in pilot experiments during the 1970s (Goldammer 1979).

However, changing paradigms regarding the role of fire in nature conservation have been observed the past few years. At present new initiatives are demanding the restoration of fire as a dynamic and vital element to maintain biodiversity and the cultural and ecological characteristics of landscapes. Changes in many vegetation types have occurred as a consequence of abandoned traditional land-use practices. Ecologically important disturbances by land-use practices include grazing, mowing, bio-fuel utilization and burning. Traditionally fire was used to keep vegetation open and at early successional stages to regenerate grass, heath and brush, and to clear land of weeds and harvest residues. Since 1975, a vegetation burning ban has been imposed in all German states.

Targets of these initiatives are those ecosystems and landscapes that had been treated with fire historically and where prescribed fire could be used to prevent the reforestation process.

In 1997, the first large prescribed burning research programme began in the State of Baden-Württemberg. It aims to investigate the use of prescribed burning in the management of hedge and slope terrain in the viticulture region of Southwest Germany. The objective of this programme is to use fire to maintain or restore grass cover that provides habitats for endangered flora and fauna. The project was requested by the State Ministry for Rural Space of Baden-Württemberg because of the dramatically increasing subsidies necessary to mow and mulch those sites where biodiversity is lost due to succession towards bush and forest cover (Page and Goldammer.2000). Detailed references on the historic role of fire in European land-use systems and strategic concepts on the use of fire in modern nature conservation and landscape management are provided by Goldammer et al. (1997 a, b, c).

Fire research

Fire science in Germany has a traditional focus on fire ecology, fire management and fire policies at Freiburg University. The Fire Ecology Research Group (FREG) concentrated its efforts on the tropics and the boreal zone, and on the role of fire in the global environment. In 1990, the FREG was integrated into the Max Planck Institute for Chemistry. Since then the institute conducts interdisciplinary fire research in support of biogeochemistry and atmospheric chemistry studies. Since 1998, the FREG has hosted the Global Fire Monitoring Center (GFMC 2000).

Advanced sensor technologies and operational systems of dedicated fire satellites are required to improve the spatial-temporal coverage and information content for research and disaster management purposes. A prototype improved high temperature event (HTE) sensor, the Bi-spectral IR Detection (BIRD) small satellite mission, is being developed by the German Aerospace Center (Deutsches Zentrum für Luft- und Raumfahrt - DLR) in cooperation with the GFMC. A launch date has been set for June 2001. The development of the Innovative Infrared Sensor System FOCUS, to be flown as an early external payload of the International Space Station (ISS), is another project developed by DLR (Oertel et al. 2000).

The DLR has also developed the Autonomous Early Warning System for Forest Fires in Brandenburg State (Kührt et al. 2000).

A *German Research Network for Natural Disasters* was established in 1999. The *Forest Fire Cluster* is focusing on the development of an operational fire modelling, information and decision-support system for the State of Brandenburg (DFNK 2001).

The German fire science community is actively involved in the work of the *German Committee on Disaster Reduction* (within the ISDR) and its Scientific and Operational Advisory Boards (http://www.dkkv.org).

During the 1990's, the research conducted under the scientific framework of the *Biomass Burning Experiment* (BIBEX) of the *International Geosphere-Biosphere Programme* (IGBP), *International Global Atmospheric Chemistry* (IGAC) Project and an increasing number of other projects has provided a sound base for understanding the implications of wildland fires on ecosystems, planetary-scale processes (biogeochemistry, atmospheric chemistry, climatology) and humanity. Some elements of the international fire research programmes have been initiated, planned and implemented by German research institutions (BIBEX 2000).

A number of fire management projects or fire management project components within forestry development projects have been implemented or are underway at the international level. Most advanced are Integrated [Forest] Fire

Management (I[F]FM), or Community-Based Fire Management projects. The projects were supported by the German Ministry for Economic Cooperation (GTZ 2001).

Figure 6. After a four-years pilot project on the use of prescribed burning for maintaining open landscape structures in the Kaiserstuhl viticulture region (Southwest Germany), the government of Baden-Württemberg State is now preparing a six-years operational programme. Between 2001 and 2006 prescribed fire will be applied by land owners on the basis of a comprehensive fire management plan, training of viticulturists and public information campaigns. According the Federal and State Nature Conservation laws of the mid-1970s the use of open vegetation burning is still prohibited in Germany. Photo: Fire Ecology Research group / Global Fire Monitoring Center (GFMC)

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LATVIA

Forest Fire Situation in Latvia

Introduction

Forests account for 44 percent (2 870 000 ha) of Latvia's total land area (64 589 km^2). From region to region of the country the forest cover varies between 30 and 60 percent. The most wooded regions are in the west, the most sparsely forested in the south and southeast.

Of the total forest area, 1 493 000 ha (51.8 percent) are owned by the state, 1 276 000 ha (44.2 percent) by 250 000 private owners and 2.8 percent by agricultural enterprises. Other ownership categories (municipalities, church, etc.) make up 1.2 percent. Private holdings are small – on the average 10 ha. Only 0.05 percent of the private owners have forests larger than 100 ha.

The dominant tree species (in percent of the forested area) are as follows:

Pine	40%
Spruce	20%
Birch	28%
Grey alder	5%
Other broadleaved	5%

About 20 percent of the coniferous forests (accounting for 60 percent of the total forest stock) are subject to high fire-hazard, especially young stands. Also, medium-age and near-mature stands of pine and spruce on dry mineral soils, making up 44 percent of the total forest area, have high fire hazard levels. In dry summers, fire may also become a problem in the bogs, which account for 3.8 percent of the country's land area.

Organization of the forest fire conservancy

The State Forest Service (SFS), a state civil administration institution under the Ministry of Agriculture, is responsible for enforcing a unified forest policy and supervising compliance with the forest management and utilization laws and regulations. The forest fire conservancy is one of the functions vested in the SFS by act of law. The fire safety regulations set forth the basic rules for fire conservancy and the preventive actions to be taken. These regulations are mandatory for forest owners, holders and persons visiting the forest.

The SFS effects its functions via its territorial units in 26 regions. Their area of jurisdiction is identical to the administrative-territorial regions of the country. These regional entities are comprised of 197 Forest Districts. The work of forest fire control is organized following the Instructions on Forest Fire Conservancy.

To deal with cases of fire, each Regional Forest District, depending on the fire hazard level, has one or several forest fire stations equipped with a fire truck (or trucks) and a crew of three to four members for each truck.

Before the fire season, which normally starts in mid-April, each crew takes a short refresher course of instruction. In hot and dry summers, when the SFS cannot cope with the situation on its own, other state institutions are also involved in forest fire control. Mutual cooperation agreements have been made with the State Fire Safety and Rescue Service of the Ministry of the Interior, the State Joint Stock Company *Latvijas valsts mezi*, which manages the state forests and the Forestry Board of the Riga City Municipality, which owns over 50 000 ha of forest. The closest cooperation is with the State Safety and Rescue Service, which deals with all cases of fire in the municipal and local government forests.

Moreover, each year each Regional Forest District draws up an operational plan of fire safety identifying the manpower and hardware resources needed for forest fire control. The plan is approved and its execution supervised by the local authorities.

The forest fire conservancy is financed from the state budget. The SFS fights forest fires in all forests, irrespective of ownership.

A network of fire lookout towers is intended to detect and follow up on the development of forest fires (Fig.1). The fire observer on the tower informs the person on duty at the forest district office and the fire station about the

situation by telephone or via radio communications. The location of the fire is identified on a map and an initial attack fire crew is dispatched.

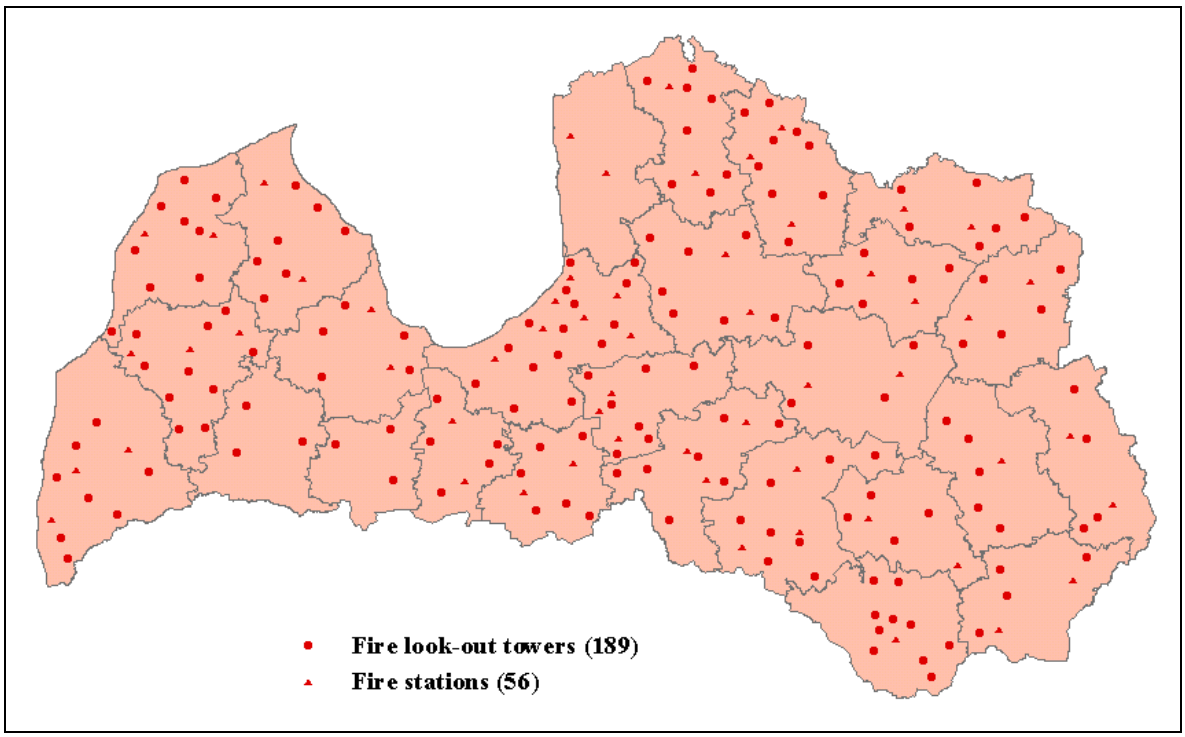

Figure 1. Map of fire lookout towers and fire stations in Latvia

Forest fire occurrence: fire statistics

As can be seen from the statistics for the period 1980 to 1999, some fire seasons are quite serious. An overall tendency toward a more frequent occurrence of fires and more area burned can be noted (Fig. 2).

Differences between the regions of the country are also apparent (Fig. 3). The frequency of forest fires is higher in the vicinity of settlements and the biggest cities – Riga, Daugavpils and Ventspils.

The average area burned by a fire event only exceeds 1.0 ha in some years (Fig 4). Occasionally, large forest fires break out. The year 1992 was especially disastrous in this respect – two conflagrations at the same time that burned 3 300 ha in each case. Large areas of peat bogs were affected, too. The most recent disaster was in 1999 in Kemeri National Park where the burned area was 377 ha. In dry summers close to the autumn season, bog fires are especially devastating because of difficult access and the shortage of water supply in the vicinity of bogs.

An analysis of fires shows negligence to be the main cause (Fig. 5). A lot of fires are started by people visiting the forest and by the burning of agricultural residues (straw, last year's grass, etc.).

To predict the fire situation, the SFS, under an agreement with the State Hydro-meteorological Board, receives weather forecasts and a map showing the level of forest fire hazard on a daily basis.

Great attention is paid to the improvement of radio communications and the compatibility between communication systems. Thus, outdated radio stations are being replaced by Motorola products. The SFS also expects to procure a specially equipped MI-8-MTV-1 helicopter this year.

In working out a new approach in forest fire conservancy, the SFS places great emphasis on a professional, well-trained and technically equipped unit within the State Fire Safety and Rescue Service.

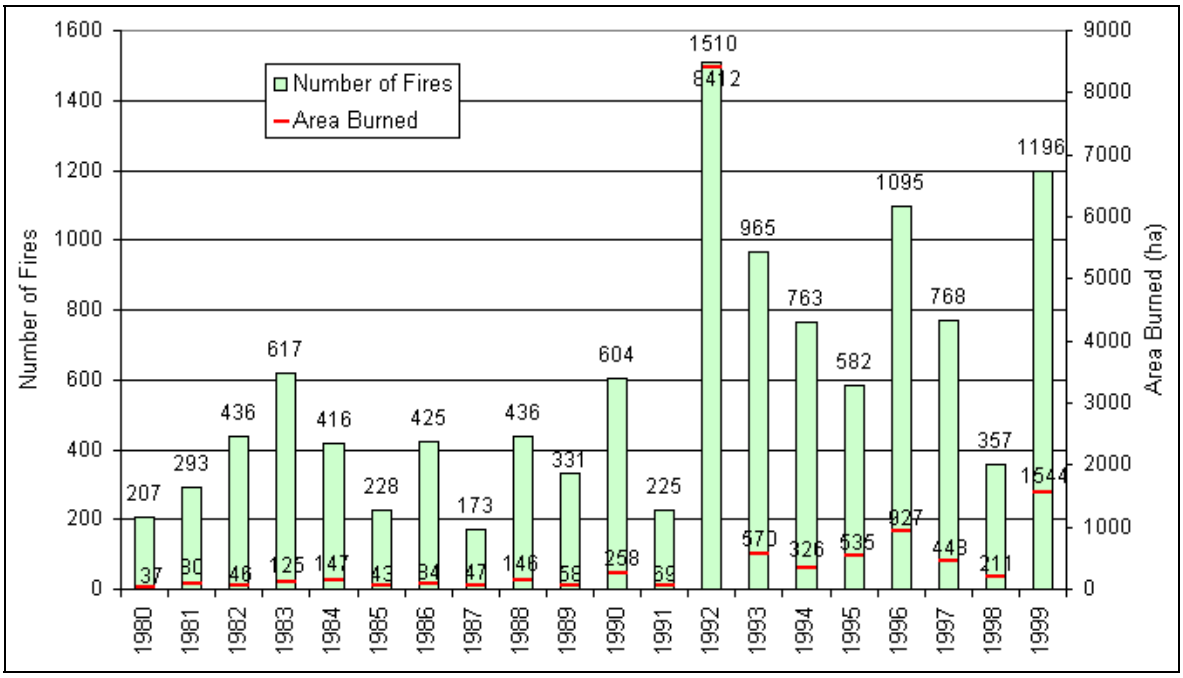

Figure 2. Forest fire statistics of Latvia, 1980-1999 (Average number of fires: 549; average area burned:661 ha)

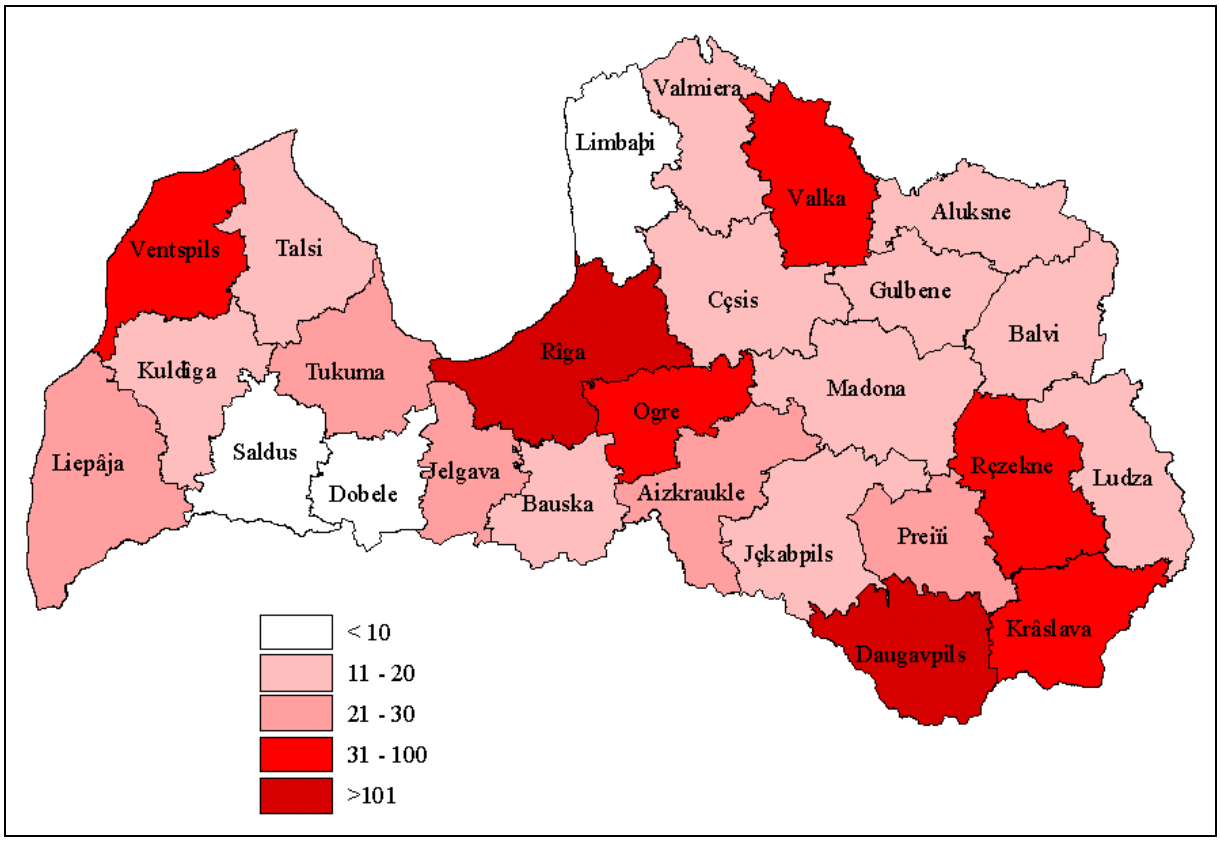

Figure 3. Distribution of forest fire occurrences in Latvia by region, 1980-1999

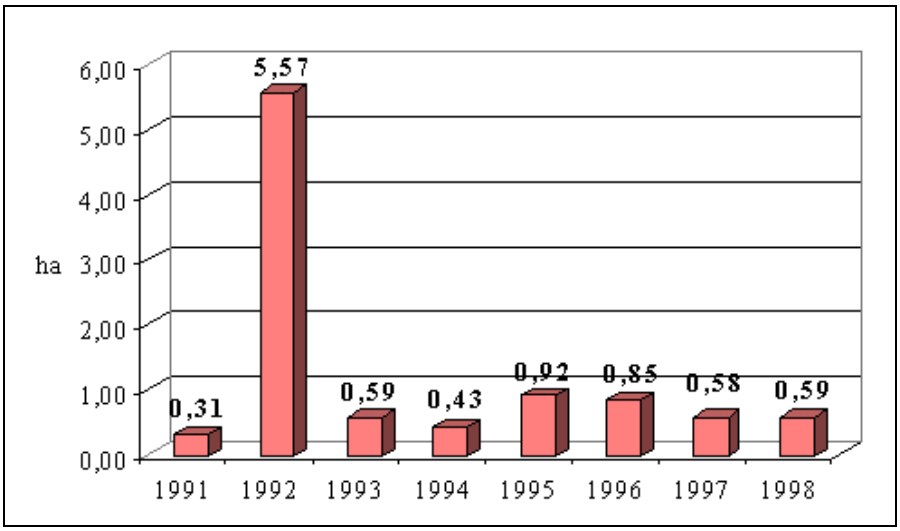

Figure 4. Average area affected by a forest fire event in Latvia, 1991-1998

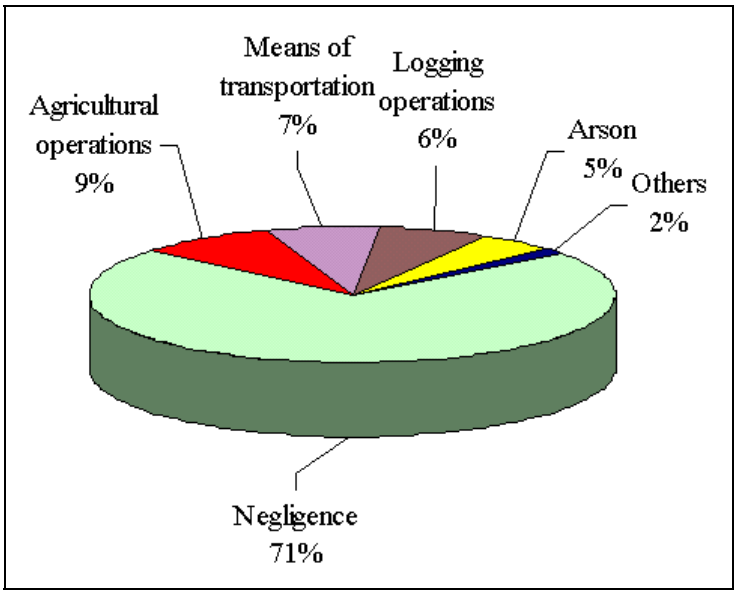

Figure 5. Distribution forest fire causes in Latvia, 1980-1999

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LITHUANIA

Forest Fires in Lithuania

Introduction

Forests cover an area of 1 978 000 ha or 30.3 percent of the territory of Lithuania. The forest area *per capita* is 0.53 ha.

As of 1 January 2000 the ownership distribution of forests is the following: State-owned forests - 53.8 percent; private-owned - 18.9 percent; the remainder of 27.3 percent are in the transition state to be privatised. Currently 150 800 forest owners who have the proprietary right to manage forests have been registered (Fig. 1).

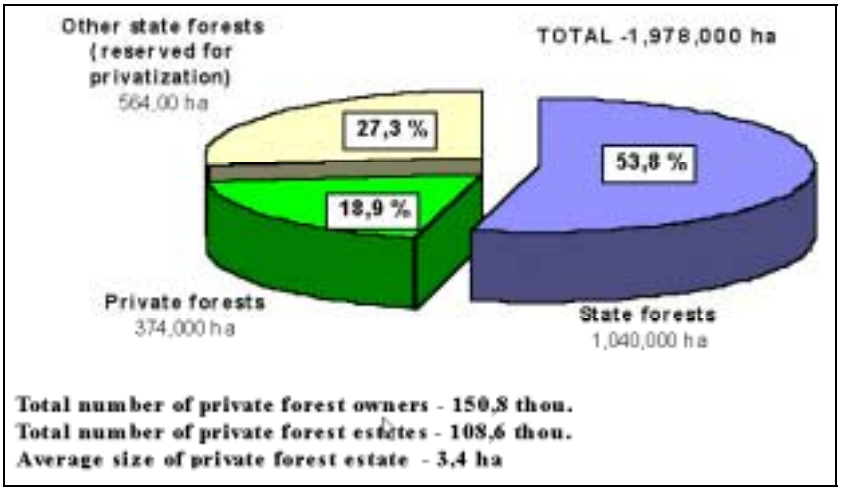

Figure 1. Distribution of forest ownership in Lithuania (1 January 2000)

Pine forests make up 42 percent, spruce stands 26 percent, and hardwood deciduous trees 4 percent of the state-owned forests. Private forests comprise 32 percent of pines, 20 percent of spruce and 5 percent of hardwood deciduous trees (Fig. 2).

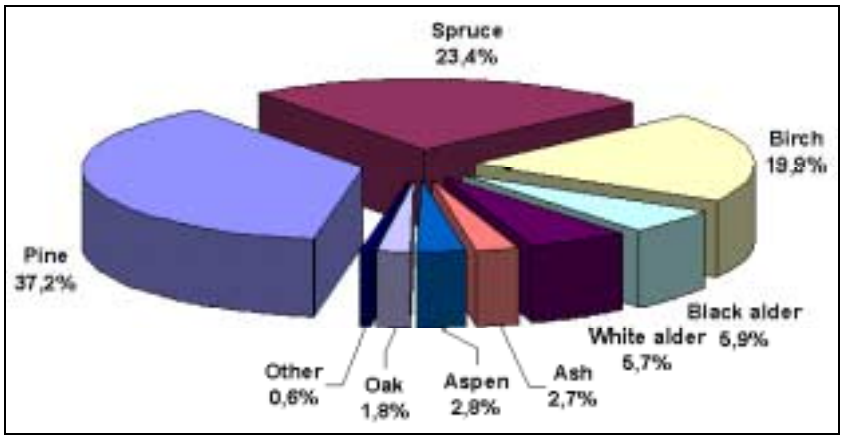

Figure 2. Species composition of forests in Lithuania

Forest Fire Hazard

In accordance with the Forest Fire Prevention regulations the Lithuanian forests fall into three natural fire hazard classes (high, medium and low) which are defined by the relation between the total habitat area and the coniferous undergrowth of up to the age of 40 years.

The distribution of fire hazard classes is as follows: high – 40 percent, medium – 23 percent, and low – 37 percent (Fig. 3). Forests of heterogeneous (mixed) natural fire hazard are distributed unevenly. They fall under the class of high fire hazard, thus contribute to the overall large area of this category.

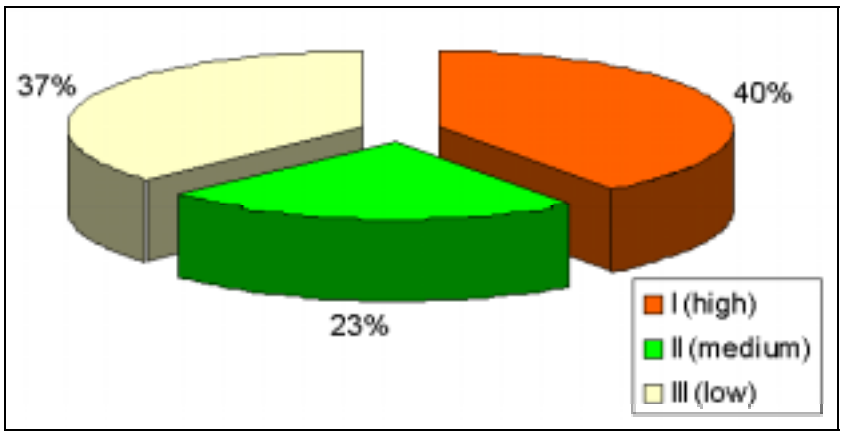

Figure 3. Distribution of forest stands in Lithuania classified by fire hazard

In terms of fire hazard nine forest massifs are at highest risk, including Varėna (51 400 ha), Labanoras (35 800 ha), Kazlų Rūda (45 000 ha), Rudninkai (11 100 ha), Viešvilė-Smalininkai (16 400 ha), Kapčiamietis (29 800 ha), Lavoriškės (15 600 ha), Šimonys (9 700 ha) and Kuršių Nerija (9 800 ha) (Fig. 4).

Figure 4. Map of large forest and bog complexes in Lithuania

The Kuršių Nerija massif is rated in the highest natural fire hazard class on nearly 100 percent of the forest cover within its territory. The entire peninsular area of Kuršių Nerija including its settlements is surrounded by water with the Baltic Sea in the West and the Kuršiai lagoon in the East. An additional factor of high fire danger in the pine forests of Kuršių Nerija is the frequent occurrence of strong winds. Recent fire events confirm this classification: 60 ha were burned in 1995 and 9 ha in 1999.

Peat fires cause a lot of problems in the country. However, in the course of privatisation a lot of peat bogs have lost their owners and become unattended. In future these peat bogs may be at high risk during the fire season.

In terms of the fire hazard nine peat bogs are the most endangered, including Tyruliai (3 000 ha), Laukėsa (2 000 ha), Traksėdžiai (1 800 ha), Palios (1 500 ha), Ežerėlis (1 300 ha), Šepeta (700 ha), Šiluvos Tyrelis (600 ha), Sulinkai (600 ha) and Baltoji Vokė (500 ha). Between 1994 and 1999 a total of 288 fires occurred in the peat bogs.

Challenges for Fire Management

State forest-enterprises are faced with the complicated task to extinguish peat fires due to the lack of special fire equipment. The fire and rescue brigades, which are subordinate to the Fire and Rescue Department, carry out the basic work of putting out peat fires. The fire brigades often enjoy assistance in receiving fire equipment from other institutions involved through the municipality level.

Pursuant to the Law on Forestry of the Republic of Lithuania the integral state system of fire prevention measures is applied within the forest territories of the Republic. Measures include forest fire surveillance, prevention and fire protection. The main objectives of the system are to reduce forest fire hazard, improve fire prevention; increase resistance of forests to wildfires, and to forecast, detect and extinguish fires.

Forest managers, owners and users are responsible for the fire protection status within their forest territories; however, they tend not to allot funds to the forest fire control.

The state forest-enterprises, state park organisations and municipalities should allot financial resources in order to implement the integral state system for fire surveillance and extinguishing in accordance with the Law on Forestry of the Republic of Lithuania. Yet, all these activities are financed only from the funds of the state forest-enterprises and state park organisations.

Issues of fire control in privately owned forests have not yet been resolved up till now. They do not pay any taxes either.

Prevention Measures

Officials from the State Fire Prevention Service in cooperation with the officers of the State Forest Service are in charge of supervising forest fire prevention in the forests throughout Lithuania. The State Fire Prevention Inspectorate and the State Forest Service are responsible for planning and implementation of an annual package of fire prevention measures within their area of responsibilities. Fire prevention measures include the following:

* information of the public about fire danger and fire risk through the mass media;
* state forest managers and private forest owners as well as enterprises in charge of peat-bogs and railway routes are required to renew (maintenance) or establish firebreaks, to put up fire places that meet fire safety requirements in the rest areas, to repair fire watch towers and fire equipment before the beginning of the fire season, and to put up warning signs and billboards;
* enforcement of strict control measures of forests and peat-bogs during the critical fire season; to pay regular inspection visits to the areas mentioned;
* information of county or city municipalities about the deficiencies discovered on site;
* the State Fire Prevention Inspectorate and the State Forest Service officials shall inflict administrative penalties on the violators of the fire safety regulations.

The awareness campaigns through the mass media are functioning and the system to control the fire-prevention obligations of forest owners and managers are implemented as well.

Forest enterprises undertake measures of fire-prevention and forest management. In forests of high fire danger class the special measures are designed and implemented: Forests are divided into blocks and separated by firebreaks

(mineral strips) and fuelbreaks (belts of broadleaved trees); forest roads are cleaned. In Lithuanian forests a network of 28 500 km of roads provides approximately 14.4 km of roads per1 000 ha of forests. With this network of forest roads and the coverage of fire lookout towers it is possible to detect and suppress fires adequately.

Legislation and Law Enforcement

The main legislative documents regulating the requirements of forest fire safety include the Law on Forestry, the regulations on forest fire safety, the Code for the Violation of the Administrative Law and appropriate decisions of the Government of the Republic of Lithuania on issues of fire safety as well as legal acts of the Department of Forests and Protected Areas and the General State Forest Enterprise (GSFE).

The General State Forest Enterprise is in charge of implementing the integral state system of fire prevention measures that include measures for surveillance, prevention and fire protection. The GSFE in cooperation with the state forest managers and regional administrations as well as the city and county municipalities take responsibility in organising the implementation of this system and the forecast of forest fires as well as prevention and the announcement of the possible danger to the Lithuanian citizens through mass media.

The amendments to the Administrative Code of Law Violations were introduced in 2000 and regulate the penalties for violations of fire-prevention and environment protection rules. Private forest owners have to take full responsibility for fire-prevention measures.

Fire Management Organisation

Forest fire protection in Lithuania is under the responsibility of 42 state forest enterprises and four state park organisations. For forest fire surveillance 124 fire watch-towers equipped with surveillance and communication devices have been built in the country.

During the highly critical fire season the state forest enterprises and national park organisations keep an elevated watch in accordance with the standard operating procedures.

The fire brigades of the state forest enterprises and the state park organisations are responsible for extinguishing all forest fires that occur in Lithuania. Only in the case of failure to put out a forest fire the city and county fire and rescue units are called up for assistance.

In the event of an emergency caused by a large fire situation and when the fire and rescue services of the city (county) forces, the state forest enterprises, state park organisations and other forest-peat bog managers as well as private owners fail to control the fire, the Regional (County) or the Government Emergency Management Centres take over the control of the situation through the regional and state levels concerned.

The fire and rescue services subordinate to the Fire and Rescue Department respond to emergencies in coordination with the fire teams of the state forest enterprises and state park organisations.

Criteria for Declaration of an Emergency

On 24 February 2000 the Lithuanian Government approved the Criteria for Emergencies in the Republic of Lithuania. Natural forest and peat bog fires make up one of their fields that are described in Table 1.

In case of emergencies the Lithuanian armed forces and units of the National Guards also render assistance in extinguishing forest fires.

For extinguishing forest fires the state forest enterprises handle fire teams equipped with fire trucks and communication devices that include 50 fire vehicles as well as about 600 radio stations and mobile telephones.

The forest fire guard or lookout of a fire team must inform the nearest fire and rescue service of the Fire and Rescue Department about each fire. The state forest functionaries and directors of the state forest organisations are responsible for establishing such fire teams and providing them with means of fire extinguishing, transport and communications.

Table 1. Criteria for declaration of a forest fire emergency in Lithuania

Criteria for an Emergency		
Emergency type	**Criteria**	
	Description (including Units of measurement)	**Assessment (value, size)**
Forest Fires		
Extremely high fire hazard – predictable fire danger		
Favourable conditions for fire break out	Probability (%)	30 ÷ 60
	Fire danger class	IV
	Fire danger index	4 000 ÷ 10 000
Extreme conditions for fire break out	Probability (%)	61 ÷ 100
	Fire danger class	V
	Fire danger index	≥ 10 000
Fire size	Ha	≥ 3
Danger for settlements or individual households	Yes / no	yes
Distance to gas pipeline network	Distance (m)	≤ 350
In a coniferous forest	Forest fire hazard class	1 or 2
Severe injuries or fatalities	Persons	≥ 1
In forests of high fire hazard	Fire / no fire	fire
In the most hazardous forests & forests massifs in terms of fire risk	Fire / no fire	fire
Peat–bog fires		
Fire and smoke		
A nearly burnt (or completely burnt down) farmstead household or a farm building	Unit	≥ 1
In the most hazardous peat–bogs in terms of fire risk	Fire / no fire	fire
Residential areas affected by smoke		
In case of forest or peat–bog fire: densely populated residential areas downwind		
Lithuanian cities, towns, settlements	Yes / no	Yes
Towns, small towns, settlements: inhabitants need to take precautionary measures or to be evacuated	Total number of inhabitants residing in that area (%)	≥ 25

A forest safety engineer or other specialist is appointed as a forest fire safety leader to be charge of the fire teams. The leader is responsible for the training and control of the team members. The main and reserve fire teams are set up in the state forest enterprises. Fire teams on duty are set up in the case when forest areas of high fire danger are located more than 20 kilometres from the headquarters serviced by one fire team. The reserve fire teams consist of 15-20 firemen who are ready to quickly respond. They consist of a group of people at their work places employed in timber processing and repair shops, timber warehouses etc.. These teams are accommodated with an assembly location where they usually keep their necessary stock of fire extinguishing equipment and outfit.

The organisational questions of forest fire control (fire extinguishing, the mobilisation and deployment of technical and human resources) are being decided on the municipality, regional and city levels with the assistance of organisations and companies from the territory of municipalities. Operational fire control plans provide special measures for reciprocity and the coordination of actions among the fire control parties involved. Access to forests in some Lithuanian regions could be restricted or other measures could be taken if required. The General Forest Enterprises control and coordinate fire detection, fire control and the implementation of fire prevention measures.

Forest Fire Statistics

During the period 1991 to 1999 the total of 5 856 forest fires occurred in Lithuania, affecting a total area of 3 100 ha. Thus, an annual average approximately 600 forest fire destroy 300 ha of forest stands and cause losses in the magnitude of 0.5 million LTL (Litas), equivalent to $US 2 million. The average size of a forest fire is about 0.5 ha. The number of forest fires has extremely increased during the favourable meteorological conditions, e.g., in 1992

and 1999 (Fig. 5). Most forest fires are caused by negligent behaviour of tourists and forest visitors (70 percent), careless grass burning in spring 14 percent), and arson (16 percent).

The process of forest ownership restitution is still going on and many private forest owners are taking back their property. Nevertheless, the number of forest fires in private forests is increasing as well. (1997 - 14.6 percent, 1998 - 25.1 percent, 1999 - 24 percent out of total number of forest fires). Many private forest owners are living in the cities and cannot take care of their property – a major reason why the number of forest fires in private forests is increasing.

A big problem in Lithuania is the burning of dry grass in spring. This tradition is very old. However, it is often not understood that grass burning can cause a forest fire; about 40 ha of forests are ignited and damaged by grass burning every year. The State Environment Protection Inspection, its regional authorities, together with the officers of the Fire Prevention Department, make efforts to eliminate this tradition.

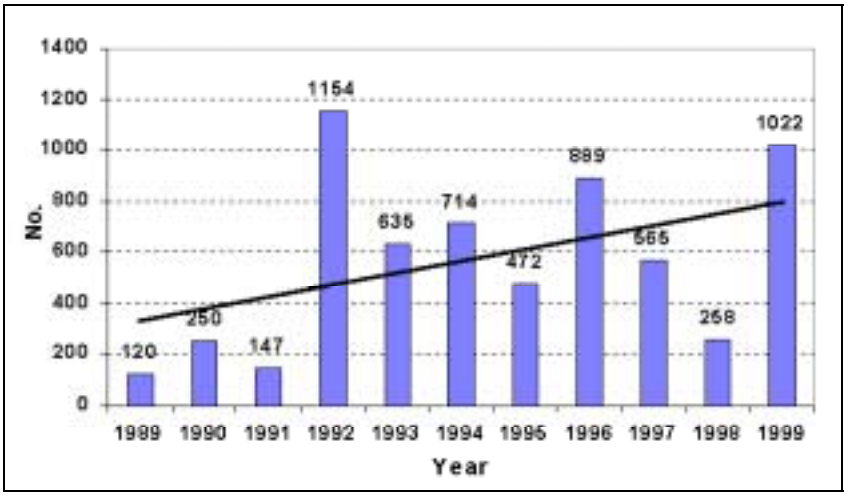

Figure 5. Number of forest fires in Lithuania, 1989-1999

Problems Ahead

The main reasons why it is so difficult to organise forest fire suppression and undertake fire-prevention are:

1. There is no unified program for forest and peat-bog fire prevention and suppression.
2. The financing mechanism of fire prevention measures in state and private forests is not defined yet.
3. The technical base in state forest enterprises and national parks is too old and inefficient; the possibility to renew it is limited due to poor funding.
4. The legislative system and the damage recovery mechanisms are not efficient enough.

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RUSSIAN FEDERATION

Fire Situation in Russia

Introduction - terminology and classification

Russian forest inventory manuals and basic forest legislative acts (e.g., the Forest Code of the Russian Federation, 1997) characterise forest land into two categories, Forest Fund and Forest Lands, with the latter divided into Forested Areas, or closed forests, and Unforested Areas, or lands that are temporarily not covered by forests but are intended for forests (e.g., burnt areas, dead stands, natural sparse forests, grassy glades and barrens). Official definitions of these categories are given in the Appendix.

We use Forested Areas, together with natural sparse forests and non-stocked forest plantations as equivalent to the FAO category "forest", and the other categories of Unforested Areas as "other wooded land". Some analysis is given for "other land", which is mostly represented by non-forest land of the Forest Fund and northern unused territories of State Land Reserve.

As of 1 January 1998, Russian forests (FFSRF 1999) were comprised of 1.178 billion hectares (ha) of Forest Fund, 881.97 million ha of Forest Lands, 296.58 million ha of Non-forest Lands [NFL], 774.25 million ha of Forested Areas and 107.72 million ha of Unforested Areas, of which 24 percent were burnt areas and dead stands, 68 percent were sparse forests, 5 percent were unregenerated harvested areas (clearcuts), and about 3 percent were represented by grassy glades and barrens. The total growing stock volume (i.e. total volume of stem wood of all growing trees) was estimated to be 81.86 billion m^3. Russian closed forests (Forested Areas) contain 41.05 billion tons of vegetative carbon, including 32.86 billion tons of carbon in living biomass (phytomass), 3.79 billion tons in dead roots and 4.40 billion tons in coarse woody debris (Shvidenko et al. 2000). In addition, the top one metre layer of soil of forest ecosystems contains 130.4 billion tons of carbon, of which the litter layer contains 11.4 billion tons.

Fire environment, fire regimes, ecological role of fire

A tremendous diversity of climate, soil and vegetation, together with a wide variety of anthropogenic impacts, is inherent in the vast territories of Russia. Russian forests stretch through eleven time zones and ten bio-climatic zones and subzones-from tundra in the north to deserts in the south. The major factors that influence the distribution, species composition, structure and productivity of forests, as well as the fire regimes of Russian terrestrial vegetation in general and in forests particular are temperature, precipitation, continentality and aridity of climate and land-use. Table 1 shows the distribution of Russian terrestrial biota by bio-climatic zone with a special emphasis on forests.

There are several reasons why fire is a major natural disturbance in Russian forests:

1. About 95 percent of the forests are boreal forests, and a major part of them is dominated by coniferous stands of high fire hazard;
2. A significant part of the forested territory is practically unmanaged and unprotected – large fires (>200 ha) play an important role in this region;
3. Due to slow decomposition of plant material, the forests contain large amounts of accumulated organic matter;
4. A major part of the boreal forest is situated in regions with limited amounts of precipitation and/or frequent occurrences of long drought periods during the fire season.

Forest fire in the boreal zone of Eurasia is both a geographical and historical phenomenon, and its impact on the environment has local, regional and global dimensions (Goldammer and Furyaev 1996). The diversity of forest types, growing conditions, landscape peculiarities, structure and productivity of forests, types of anthropogenic impacts, etc., define different types of fires, their distribution, intensity, ecological impact on terrestrial ecosystems and landscapes as a whole, and even alters the general estimates of the environmental role of wild forest fire.

The double-faceted role of forest fires – destructive and dynamic – is evident in the boreal zone. In the southern and central parts of the zone, forest fires are one of the most dangerous environmental phenomena, causing significant economic losses with a strong negative ecological impact on forest ecosystems and biodiversity. On the contrary, in unmanaged and unused forests of the northern and sparsely stocked taiga and forest tundra, particularly on permafrost sites, surface fires occurring at long-return intervals of 80 to100 years represent a natural mechanism that

prevents the transformation of forests to shrubland or grassland: Exclusion of fire induces the build-up of organic layers that prevents melting of the upper soil and rise of the permafrost layer, resulting in impoverishment of forests, decreasing productivity, and paludification. Nevertheless, frequent recurrent fires can significantly decrease the productivity and stability of forests (up to 40-50 percent), even in the extreme north. Under severe climatic conditions, fire is often responsible for forest decline and extension of the tundra to the south. Fire is the major reason for the "human-induced" treeless belt along the boundary between the taiga and tundra in northern Eurasia. It presently is 100-250 km wide and its area increases by 0.3 million ha per year.

Table 1. Distribution of Russian terrestrial vegetation by land class and bio-climatic zone

Bio-climatic zones	Vegetated areas by major land classes (million ha)				Species composition of closed forests[c]	Amount of potential fuel in forests (kg C/m^2)		
	Total	including				AGB[b]	CWD[b]	Litter
		Wetland	G&ShL[a]	Forest				
Arctic desert and semi-desert	0.7	0.0	0.7	0.0	-	-	-	-
Tundra	266.9	62.3	199.0	3.8	10L[d]	0.93	0.17	0.35
Forest tundra, sparse taiga	233.0	64.7	15.5	141.2	7L1S1P1B	1.78	0.52	1.58
Middle taiga	683.6	62.0	152.0	455.0	4L2P2S1C1B	3.54	0.70	1.58
Southern taiga	211.5	30.1	19.5	126.5	3P3S2L1F1C	4.32	0.66	1.41
Temperate forests	60.3	1.8	2.6	26.4	3P2S2B1O2D	4.76	0.42	0.65
Steppe	148.4	0.7	26.7	9.3	5O1P1E2B1A	2.95	0.17	0.13
Desert and semi-desert	25.4	0.3	6.4	1.3	6O1P2E1B	1.23	0.15	0.17
Non-vegetated land	79.6							
Total	1 709.5	222.0	432.4	763.5	8.2Cn0.3HD1.5SD	3.36	0.58	1.50

Note: *Abbreviations used in Table 1 are:*
a – (land classes) G&ShL - grassland and shrubs.
b – (fractions of vegetation organic matter) AGB - above ground live biomass (phytomass), CWD-coarse woody debris (on-ground and above-ground dead wood with the diameter at the small end >1cm).
*c – (dominant tree species) L-larch, S-spruce, P-pine, B-birch, F-fir, C-Russian "cedar" (*Pinus sibirica *and* P. koraiensis*), O-oak, A-aspen, D-other deciduous, Cn-coniferous species, HD-hard deciduous species, SD - soft deciduous species.*
d – Coefficients of the species composition formulas indicate 0.1xPercent of a species in the total growing stock volume by a zone.

Forest fire is a significant force in the transformation of vegetation cover in the boreal zone. It initiates long-term changes in all the components of a landscape. The micro-climate conditions of the atmosphere's surface layer (light, humidity, wind), the temperature and humidity of upper soil layers, soil water regimes, soil chemical properties as well as many other site characteristics, are significantly changed for long periods by fire. The soil formation processes can be changed, in particular on humid and wet sites. The partial or complete change of species, age, stand structure, reforestation peculiarities, level of productivity, etc., are common components of post-fire succession. Generally, fire generates the specific features of ecological regimes at the landscape scale. The duration of post-fire recovery of forest ecosystems depends on the type and severity of fire as well as climatic conditions and usually ranges from 5-7 to 100-150 years.

Fire is a major driving force in the succession of northern Eurasian forests. Among five classes of a comprehensive forest succession classification developed for Siberia and the Russian Far East, different phases and stages of pyrogenic succession cover 40 to 96% of the total forested area of most ecological regions. For instance, for a typical taiga landscape of 165 000 ha in the Kos-Yenisey plain of eastern Siberia, the total area affected by fire (including recurrent fires) for the period 1700-1956 was estimated at 5.38 times the size of the total area (Furyaev 1996). The expansion or decrease in area of different forest associations, as well as changes in dominant species and species composition, are mainly dictated by fire in the major boreal areas of Russia.

Fire hazard and fire risk depends on forest ecosystem characteristics, weather and ignition sources. Forest inventory identifies all Russian forests by five classes of fire hazard based on landscape/ecosystem indicators from Class I [highest fire danger], where fire is possible during the entire fire season (young coniferous forests, dry sites of slashed harvested areas, pine forests with lichens and mosses, etc.) to Class 5, where fires occur only under extremely unfavourable conditions, e.g. long-period drought (e.g., spruce forests with *Sphagnum*).

Russian forests (Forested Areas) are 72 percent dominated by conifers, including larch (about 37 percent), pine (16 percent), spruce and fir (13 percent) and cedar (*Pinus sibirica* and *P. koraiensis*) – (about 6 percent). The distribution of Forest Fund area in 1998 by fire danger classes was: first class, 17.4 percent second class, 15.3 percent; third class, 30.3 percent; forth class, 26.3 percent; and fifth class, 10.7 percent, i.e., about two-thirds of all the Forest Fund area belongs to the first three fire danger classes.

The duration of the fire season is geographically dependent and ranges from 90-100 to 200-250 days per year. There is a clear zonal gradient in the seasonal distribution of fire (Korovin, 1996). On the average, for the zone protected by aviation, the distribution of fire occurrence (percentage of fires by month) is as follows: May 23 percent, June 28 percent, July 31 percent, August 13 percent and September 5 percent (Chervonny 1979).

Fire in the boreal zone is a significant source of greenhouse gases. Due to different approaches, estimates of annual carbon emissions to the atmosphere caused by fires in the early 1990s (for relatively "normal" by fire danger years) ranged from 35 to 93 million tons of carbon (Isaev and Korovin 1999) to 125±21 million tons (Shvidenko and Nilsson 2000), of which post-fire biogenic flux comprised about 50%. Fire generates from 30 to 40 % of the total carbon flux emitted to the atmosphere by all human-induced and natural disturbances in the northern Eurasian boreal forests.

There is no doubt that fires also have had a significant negative impact on biodiversity, in particular in the southern part of the boreal zone. Fires and other anthropogenic impacts impoverish biodiversity at both the ecosystem and landscape levels. Southern species that are at the northern edge of their distribution are particularly vulnerable. For example, in Primorsky Kray the richness of 60 species of vascular plants, 10 fungi, 8 lichens and 6 species of mosses changed for the worse during the previous decades, mostly due to human-induced fires and fragmentation of forests. Significant fragmentation of forests inhabited by the far eastern tiger has been reported. The number of tigers, wild pigs, sable and deer *(Cervus elaphus)* on large areas burned in 1976 in the Amur River basin decreased from 1972 to 1997 by 20-50 times (Kulikov 1998). The number and species composition of wild animals has dramatically declined in territories impacted by large severe fires.

Such indicators as the extent, frequency and severity of fire determine the duration of post-fire regeneration, etc., and define the major features of disturbance regimes and their impact on the environment and the ecological functions of forests.

Extent of fire occurrence

Official data on the number and extent of fires have only been reported for protected areas of the Forest Fund, which, for last 40 years, have comprised about 60 % of the Forest Fund area (e.g., official data for 1985-1990 were 62.5 percent of the Forest Fund). Areas not protected against fires are mostly located in the forested tundra and the northern and part of the middle sparse taiga of western Siberia (43 million ha in 1989), eastern Siberia (119 million ha), and the Far East (249 million ha). During recent years the area actually protected has significantly decreased. Even for the protected area, data are often not complete and, as a rule, are underestimated, in particular for fires on Unforested Areas and Non-forest Land. In addition, official statistical data on forest fires before 1988 were deliberately falsified for political reasons.

Annual forest fire statistics for fire-protected areas during 1950-1999 are presented in Table 3. During this period, the number of forest fires detected annually was between 18 000 and 37 000. After a decade with rather high fire activity (1950-1959) the burned area was reported as stabilized for the next three decades, and again increased during the last 10 years (the average area of Forest Lands burnt annually for the decades 1950-1959, 1960-1969, 1970-1979, 1980-1989, 1990-1999 was 1.54, 0.68, 0,48, 0.54 and 1.2 million ha, respectively). The major ignition causes (as a percentage of the total number of fires) were local population 64.8 percent, lightning 16.0 percent, agricultural prescribed burning 7.3 percent, forest harvest activity 2.9 percent, expeditions 0.9 percent, activities of other enterprises 5.0 percent and unknown reasons 3.1 percent (Shetinsky 1994). The data do not include prescribed controlled burns on Forest Fund areas (which were negligible) and on “other lands” (for which no statistics exist; some expert estimates are given in Shvidenko et al., 1995).

Evidence of areas of stand-replacing fires is given by forest inventory data on areas of burnt and dead stands. These data are available for the entire country for the period from 1961 to 2000, and are of good reliability. According to the State Forest Account data, areas of burns, dead stands and grassy glades were estimated for the last 40 years for forests managed by state forest authorities, i.e., for about 95% of all Russian forests as of 1961, 70.6 million hectares; 1966, 68.4 million hectares; 1973, 53.6 million hectares; 1978, 43.9 million hectares; 1983, 36.8 million hectares; 1988, 34.9 million hectares; 1993, 35.0 million hectares and 1998, 28.0 million hectares (SNKh SSSR 1962; Goskomles SSSR, 1968, 1976, 1986, 1990, 1991; FSFMRF 1999). These data show significant progress in forest fire suppression during the last 40 years, but they also illustrate the incompleteness and significant bias of the official statistics.

The extent, timing and geographical distribution of fires varies greatly. The annual area burnt can vary about ten-fold. About 60 to 90 percent of the area burned annually is usually concentrated in three to six regions. In one or more of these, fires could be of catastrophic character. In Siberia, on average, about 1 percent of the fires are large (with an area of more than 200 ha) but in dry years this may rise to 10 percent. However, large fires make up 50 to 80 percent of the burned area and cause up to 90 percent of the total damage (Valendik 1990). In extremely dry years, a similar picture can be observed even in densely populated regions with intensive ground-based fire protection, e.g., during the twentieth century about 25 percent of all forests have burned twice in the Mary-El Republic (the basin of the Middle Volga) – in 1921 and 1972. In extremely dry years fire behaviour is extreme, including the occurrence of fires in wetlands. High-intensity fires are difficult to control. The consumption of large amounts of phytomass results in high fire severity with consequent long-lasting impact on ecosystem composition and function.

The areas burned annually in unprotected territories can only be indirectly estimated. Several modelling and expert approaches have reported rather consistent results. For instance, Shvidenko and Nilsson (2000), using a specially developed expert system, directly and indirectly available regional fire statistics and other information, data on the dynamics of major forest formations as well as distribution of Forested Area by age classes and types of stand age structure, estimated the average area burned annually for the period 1988-1992 in Forest Fund areas at 3.0 million ha (of which fires on Forested Areas are estimated to be about 1.2 million ha) and, in addition, 0.5 million ha on territories of the State Land Reserve in the extreme north. Official data reported for this period for the protected territories of the Forest Fund were about half of this figure. Using the modified model described in Shvidenko and Nilsson (2000) we estimated the long-term average burned area (1970s to the end of the 1990s) at 5.1 million ha, of which 4.1 million ha were on Forest Fund lands. The model results aggregated by bio-climatic vegetation zones are presented in Table 2.

The official fire statistics account for three types of fire on forested areas; surface, crown, and ground. The average ratio (percent of forested area burned) of the above three types of fire for the protected forested area was 83:17:0.3 in 1989-1992; 82:18.0:0.3 for the period 1986-1995 and 73.6:25.4:1.0 for the period 1971-1985. In a "normal" year, 1962, the ratio was 87:11:2. In the extremely dry year of 1972 it was 56:44 percent (no data for ground fire) and in 1978, 76:24:0.1 percent (Chervonny 1979). Shetinsky (1994) presented the ratio 81.4:18.6:0.02 based on official statistics for recent decades. Taking into account the nature of forest fire regimes in unprotected areas, our long period ratio of crown to surface fires on Forested Areas is about 15:85 percent. Taking into account a significant amount of peat burning in the carbon budget evaluation we separated peat fires (which are defined as fire on sites with an organic layer more than 15 cm deep and the depth of the consumed organic matter more than 10 cm, usually 15-20 cm) and kept the category of ground fires (which are defined as basically peat, but there are other types of underground fire) with the consumed organic layer more than 0.7 m.

There are some satellite data estimating the total extent of fire for all of Russia or its major parts. Cahoon et al. (1994), based on AVHRR data, determined the area burned in the Russian Far East and eastern Siberia in 1987 to be 14.4 million ha. VNIIZlesresurs, using Soviet satellite data for 1987 for central Siberia and a major part of the Far East, estimated about six million ha. Such huge areas of fire are possible in extremely warm and dry years. In the year 1915, with catastrophic weather conditions, forest fires were observed on 1.6 million km^2 and the total area of burnt closed forest was estimated to about 14 million ha. There are also years with rather low fire risk – for example, 1994 and 1995. Cahoon et al. (1995), using AVHRR data, estimated the burnt vegetated areas in the total Russian territory in 1992 to be about 1.5 million ha (officially reported burned areas for protected Forest Fund territories were 1.14 million ha). Based on satellite data, Shvidenko et al. (unpublished data) estimated the area of vegetation burned in 1998 for Forest Fund in the Asian part of Russia at 9.4 million ha (for details, see below).

Table 2. Model estimates of annual average forest fire area during the last three decades by bio-climatic zone and type of fire for the total Forest Fund and lands of the State Land Reserve.

Bio-climatic zone	Estimates of annual areas burned by types of fires, 1970-1999 (million ha)						
	Crown fire	Surface fire			Peat fire	Incl. GF[1]	Total
		FA[1]	UFA[1]	NFL[1]			
Arctic desert and semi-desert[2]	-	-	-	0.04	-	-	0.04
Sub-arctic and tundra[2]	-	-	-	0.89	0.07	-	0.96
Forest tundra and northern taiga	0.04	0.30	0.17	0.44	0.07	0.001	1.02
Middle taiga	0.19	0.98	0.25	0.63	0.10	0.007	2.15
Southern taiga	0.08	0.40	0.10	0.16	0.03	0.004	0.77
Temperate forests	0.01	0.07	0.02	0.01	0.01	-	0.12
Steppe	-	0.02	0.01	-	-	-	0.03
Semi-desert and desert	-	0.01	-	-	-	-	0.01
Total	0.32	1.78	0.55	2.17	0.28	0.0012	5.10

[1] *Surface fires in forested areas (FA), on unforested areas (UFA), and on non-forest lands (NFL); ground fire (GF).*
[2] *Basically, territories of State Land Reserve areas.*

Fire frequency

Frequency of fire depends on many factors: the spatial structure of landscapes, their ecological regimes, the fuel characteristics of forests and adjoining vegetation, typical fire weather during the burning period, inter-annual climate variability (recurrence of extreme drought), population density, accessibility, level of forest fire protection, etc.

As a rule, for basic upland forest types and geographical localities, the fire-return interval, including all types of fire, is 25 to 70 years. However, the variation is very large with an upper limit of 250 to 300 years for wet sites and a lower limit of 7 to 15 years or even less. An interval of 3 to 4 years was observed in dry pine and larch forests in densely populated areas. From a historical perspective, areas in which no fires occurred during a single life cycle of a coniferous forest (200-300 years) are negligibly small in the taiga zone (Furyaev 1996). There have been many attempts to identify temporal regularity of fires occurrence (specifically, years with extremely dangerous fires) based on climatic cycles, but the best conclusion is that available statistics and historical records do not present enough reliable data to permit any sort of prediction (Melekhov, 1979). For instance, from 1972-1982 there were extremely high fire risks in the Far East (Autumn 1976 in Khabarovsk Kray, autumn 1977 in Primorsky Kray, summer 1979 in Amur Oblast, summer 1980 and 1982 in the southern part of Khabarovsk Kray). In 1987 and 1998, extended fire episodes affected large areas of the Russian Far East and eastern Siberia.

A large amount of research on fire regimes (e.g. Furyaev 1996) has shown that: 1) wildfires have an explicit landscape nature; 2) quantitative indicators of frequency are scale-dependent; 3) the impact of forest type on the frequency of fires is more evident than impact of relief (mountain, plateau, plain, etc.); 4) high-frequency fires (e.g., in pine and larch forests on well-drained sites), as a rule, do not cause significant damage to the main canopy layers and do not lead to a change of species, but significantly impact the process of natural regeneration and the structure of stands; 5) fires in wet sites are very rare (up to 200-300 or more years), but damage is very severe; 6) the accessibility of forests to people, proximity to populated areas and the presence or absence of roads are crucial factors of fire frequency in taiga zone.

Post-fire dieback

The immediate reaction of stands to fire is expressed by post-fire mortality (dieback). The intensity and duration of post-fire dieback depends on many factors. The average period for dieback is roughly estimated to be five years, varying from two to seven years and sometimes more. The indirect consequences of fires can be seen over a longer period. For many forest formations, in particular those in the southern part of the boreal zone, other types of

disturbance often accelerate the consequences of fire, e.g. by intensive outbreaks of secondary insects (likewise, fires in forests destroyed by insects are often extremely severe due to a large amount of dead, dry wood).

Post-fire tree mortality varies greatly and greatly depends on the type and intensity of the fire, relief, presence of permafrost, weather conditions, species composition, age and diameter of trees, and many other factors. The following are average estimates of post-fire mortality for growing stock in the taiga zone: for low-severity (superficial) surface fire, 6 to 12 percent; surface fire of medium-severity, 15 to 20 percent; litter fire, 30 to 50 percent; turf fire, 60 percent; peat fire, 70 percent; and crown fire, 75 percent. The variations are, however, very large, e.g., 5 to 90 percent for litter fires and 35 to 85 percent for turf fires. In many Siberian forest types, peat and crown fires cause total tree mortality (stand-replacement fires) (Telizin 1988, Sheshukov et al. 1992). Many publications report the complete destruction of stands after only medium-intensity surface fires. Post-fire mortality on continuous permafrost with a thin melting layer is very high, and stands of all species (including larch) usually die almost completely after surface fires of medium intensity due to the large amount of dead organic matter consumed and the superficial root systems of the trees. The average annual area of forests killed due to mortality over time is approximately equal to the area killed in stand-replacement fires (i.e., the area of forests dying annually as a result of fires of current and previous years is estimated to be 0.6 million ha). For all types of fires other than stand-replacement fires, partial dieback is estimated to average 15 to 40 percent of the growing stock.

Post-fire regeneration

Post-fire natural reforestation relies on a great number of factors: geographical distribution and climate; structure of the landscape and the location of a burned area in a landscape; type and peculiarities of relief; site characteristics (parent material, soil, drainage, moisture regime, etc.); biological and ecological properties of tree species; specifics of forest types and succession stages; type and severity of the fire; size of the burnt area; availability and quality of seed; etc. The process of post-fire regeneration strongly depends on the bio-climatic zone and geographic and site conditions. As general and rough conclusions: 1) the ability of boreal forests to restore themselves is very high – the area of burnt and dead stands in Russia has decreased by 50 percent (from 70 million ha in 1961 to 28 million ha in 1998) during the last 50 years; 2) post-fire reforestation in the extreme north (forest tundra, northern and sparse taiga) is, as a rule, slow and requires a rather long time, up to 30-35 years, due to the insufficient availability and quality of seed; 3) productivity of the first post-fire forest on permafrost is 2-3-fold higher than in undisturbed areas; 4) in practically all bio-climatic zones, excluding larch stands in the extreme north, stand-replacement fire basically causes succession with a change of the dominant species; e.g., an usual scheme is: dark coniferous (spruce, fir, cedar) to soft deciduous (birch, aspen) to mixed dark coniferous-deciduous forests; 5) recurrent fires often lead to impoverishment of forests and generation of grassy glades, development of paludification processes, and finally to indefinite long periods of deforestation and "green desertification" – there are studies showing that a significant area of burns (up to 30-50 percent), if recurrent fires occur, are not restored for many years; and 6) regeneration under the canopy layer of mother stands after other than stand-replacing fires is dependent on the frequency of recurrent fires, and this is the major reason for the development of uneven-aged forests of different types.

Fire impacts in the period 1990-1999

The strong negative impact of forest fires is particularly evident during the years when catastrophic forest fires are driven by extremely unfavourable weather conditions during the fire season. During the last 15 years, Russia faced such years in 1987 and 1998.

During the summer of 1998, extremely dry weather prevailed on huge areas of Asian Russia. For instance, in Khabarovsk Kray rapid melting of snow when the soil was still frozen and subsequent lack of precipitation significantly decreased the moisture content of forest fuels by the beginning of the fire season. Precipitation in June was only 15 to 20 percent of the long-term average, in July 0 to 20 percent and in August 20 to 50 percent (Efremov et al. 2000). Hundreds of fires, a significant number of which escaped control and covered large areas, began simultaneously from May to October. Estimated burned area for the Asian part of Russia using satellite data (Shvidenko et al. 2000, unpubl. manuscript), was 9.4 million ha of vegetated land, of which Forest Land was 7.2 million ha. The area affected by crown fires was estimated to be 1.0 million ha. The severity of the fires and amount of organic matter consumed was very high. Estimated direct emissions of carbon during the fire season totalled 172.8 million tons, of which forest fires emitted 133.8 million tons.

The total area impacted by the fires was more than 100 million ha. Dense smoke significantly decreased photosynthetic activity and reduced visibility to 100 m and less. Based on preliminary estimates, average fire and post-fire dieback is estimated to be about 80 m^3/ha of Forested Area. This means that expected losses of wood might

reach 400-500 million m^3, about 4 times the current level of harvest in all of Russia. Some regions have lost a major part of their potential for industrial harvest. Due to the extreme severity of the fires, more than 2 million ha of forests have lost their major ecological functions for a period of 50 to 100 years and about 0.5 million ha of formerly forested areas, due to deep burning of the soil, were irreversibly transformed, at least for more than 200-300 years. Outbreaks of forest pests and diseases are expected during the next few years, as well as a significant increase in fire hazard due to the accumulation of large amounts of dead wood.

The impact on wild animals and fisheries will be revealed during the coming decades. Initial estimates lead to the conclusion that the total number of birds and wild animals in the regions most affected by fire decreased by a factor of ten or more. Mortality of squirrels and weasels reached 70-80 percent, boar 15-25 percent and mice and rodents about 90 percent. There were observed mass deaths of fish. Fires greatly influenced the spawning of salmon due to increased water temperatures and possibly due to high carbon dioxide levels in the air and water (Kulikov 1998). A significant increase in respiratory ailments was observed in many settlements in the Far East. There were indications that this may have contributed to several deaths during the period.

Extremely large fires have long-term and partially irreversible consequences. One of the most severe fire years in northern Eurasia was in 1915 when about 14 million ha of closed forests were completely burned within a forest area of 160 million ha in Siberia, and about 600 million ha was affected by smoke. Deep (up to several meters) peat fires continued until winter. Only 65 % of normal solar radiation was registered in parts of the country in August, and crops matured 15-20 days later than usual. Corn and fodder for livestock were of very low quality and contributed to the poor health of the population and the loss of cattle. Large numbers of wild animals died, and a dramatic migration of animals for thousands of kilometres was observed (Shostakovich 1924, 1925).

Catastrophic forest fires in northern Eurasia should be a topic of national and international interest. The most dramatic predictions of climate change indicate an increase in annual average temperature of 4-6^{o} C, together with a significant increase in aridity and greater frequency of extreme drought during the fire season for this region (Stocks 1993, Fosberg et al. 1996). If these predictions are correct, Russia must increase its preparedness to cope with the situation. A long-term fire prevention and management strategy must be put in place with the utmost priority. If the results of these models come to pass, they indicate a high probability that during the next century major areas of Russian coniferous forests could be burnt if the current level of fire protection is not significantly improved.

Forest fire databases

Table 3 contains data on forest fire in the protected territory of the Russian Forest Fund during the previous decades. These data were basically derived from official data of the Russian Federal Forest Service. It should be noted that different sources, including official publications, are often not consistent and sometimes contradictory. The major historical records and databases on forest fire are at the Forestry Department of the Ministry of Natural Resources. The Central Base of Aerial Forest Fire Protection (Avialesookhrana) also maintains a multi-year database in which the geographical co-ordinates and major fire characteristics are provided for each registered fire. IIASA also has a database on disturbances in Russian forests that contains aggregated regional data on the number of fires and burned areas by type of fire for the last decades.

Operational fire management systems

Under the Forest Code (1997), practically all Russian forests are federal property. There are some inconsistencies between the Russian Constitution and the Forest Code and the Russian Government is currently investigating the possibility of privatising some lands and forests.

Russia has a hierarchical system of state forest fire protection that includes two major responsible players; the state forest management authority and the aircraft forest protection system (Avialesookhrana) (Fig.1). In severe fire situations, the Ministry of Extraordinary Situations is also significantly involved.

Table 3. Number of wildfires and forest area burned on protected territories of the Forest Fund, 1950-1995.

Year	Number of fires	Area burned (1 000 ha)							
		Total FF [b]	of which FA [b]				incl. UFA [b]	FL [b]	incl. NFL [b]
			CF [c]	SF [c]	GF [c]	Total			
1950-1959[a]	12 662	na	na	na	Na	na	na	1535	na
1960-1969 [a]	18 684	na	na	na	na	na	na	675	na
1970-1979 [a]	18 906	771	125	301	2	428	50	478	293
1980-1989 [a]	16 244	1 134	99	413	5	517	26	543	591
1980	15 384	234	15	140	1	156	11	167	67
1981	19 876	511	26	223	1	250	5	255	257
1982	16 092	519	38	256	33	326	24	351	168
1983	11 831	260	49	101	<0.5	151	17	167	93
1984	14 977	502	53	257	<0.5	310	5	315	187
1985	11 719	694	91	395	<0.5	486	3	489	205
1986	16 353	1 159	207	487	1	695	10	705	454
1987	13 439	4 414	123	413	1	537	32	569	3 845
1988	18 573	1 011	144	613	1	758	29	787	224
1989	21 934	2 040	247	1 249	8	1 504	124	1 628	412
1990-1999 [a]	25 481	1 602	174	927	5	1 106	94	1 200	402
1990	17 672	1 670	274	1 043	1	1 318	48	1 366	304
1991	17 965	1 126	116	411	4	531	151	682	444
1992	25 777	1 142	56	544	3	603	88	691	451
1993	18 428	1 201	104	619	1	724	25	749	452
1994	20 287	723	61	465	2	528	9	537	186
1995	25 951	463	23	326	3	352	8	360	103
1996	32 833	2 312	205	1 523	9	1 737	131	1 854	458
1997	31 300	984	127	566	4	697	30	727	257
1998	27 970	5 340	607	3 234	2	3 843	426	4 269	1 071
1999	36 629	1 048	164	543	20	727	25	752	296

Based on data from the Russian Federal Forest Service.

Notes:

a Average annual data by decades.

b The abbreviations of forest land-cover categories: FF - Forest Fund area, FA - Forested Area, UFA - Unforested Area, NFL - Non-Forest land.

c Types of fires: CF - crown fire, SF - surface fire, GF - ground fire.

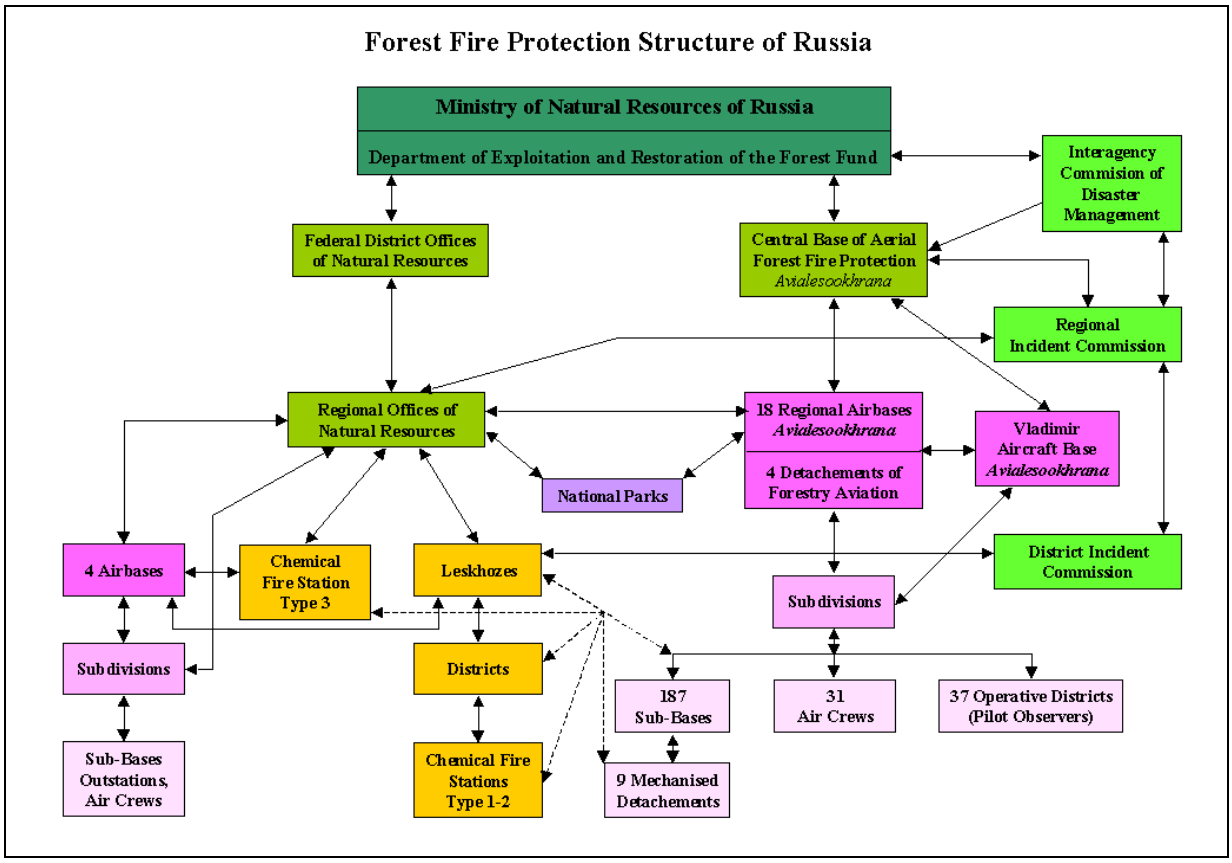

Figure 1. Organization of forest fire protection in Russia after the reorganization in 2000.

The distribution of protected territories by the type of forest fire protection is as follows (percentage to the total area of the Russian Forest Fund; official data for 1985-1990):

Regions covered by aerial forest protection,		62.5 %
including sub-regions:		
- extinguishing of fire by aviation means alone	50.9 %	
- detection of fire by aviation,		
- extinguished by ground methods[1]	11.6 %	
Area covered by ground protection		49.1%
including sub-regions		
- forest guards, fire-chemical stations, and mechanized detachments	11.0 %	
- other organizations	2.3 %	
- sub-regional reserved unprotected forests	35.8 %	

[1] *Also included in the area covered by ground protection*

The state forest authority divides Forest Fund areas into aerial and ground protection regions and the regional and subregional boundaries are indicated on maps. There are two types of aerial forest fire protection. One uses aviation as a major tool for all operations while the second provides only detection of fires by aircraft. In the latter case local ground forces of the forest management authorities provide fire suppression. The reserved unprotected forests are formally included in the area of ground protection, but practically no protection is provided. There were some attempts to divide the Russian Forest Fund and its large regions into homogeneous pyrological regions based on the

different characteristics of the forests, indicators of fire risk and historical level of fires, but this has not been implemented in practice.

The State Forest Guard (SFG, currently the State Forest Service of the Ministry of Natural Resources) and managers of Avialesookhrana are the major responsible authorities for forest fire protection. The Forest Code (Article 77) and a special *Statute on State Forest Guard of the Russian Federation*, approved by the Decision of the Government of the Russian Federation in 1998, defines the rights and duties of the State Forest Guard. The most important duties of the SFG are prevention, detection, warning and extinguishing forest fires and mitigation of the consequences. Rangers are the lowest level in the hierarchical structure of the SFG. They are responsible for a forest territory of several hundred to several thousand hectares. As of 1 January 1998 there were 69 963 units managed by rangers with an average area of 15 900 ha. Masters are managers of 3-5 rangers. Foresters are managers of forest districts, which include 2-5 territories managed by masters. Currently Russia has about 8 000 forest districts (7 875 in 1998). An individual forest district has jurisdiction over several thousand to over a million hectares (the average area was 141 000 ha in 1998). Three to ten forest districts are combined into forest management enterprises. As of 1998 there were 1 826 forest enterprises with an average area of 608 200 ha (FSFMRF 1998). At the forest enterprise level, the Director, Main Forester and Engineer of Forest Protection are responsible for all aspects of forest protection. Simultaneously, a main forester of the forest enterprise acts as Main State Inspector on Forest Protection in a district. Correspondingly, the forester acts as Senior State Inspector. In addition there are special fire protection subdivisions (Fire Chemical Stations) strategically located in forest management enterprises. Their technical capacity depends on the regional economic and social conditions and the level of fire hazard. There are also regional and federal levels of the SFG.

Avialesookhrana provides forest fire monitoring and all types of forest fire protection using aircraft as its major technical tool. It has its own hierarchical structure (Fig. 1). Managers and forest professionals of Avialesookhrana are also members of the SFG. Avialesookhrana includes special detachments of parachute jumpers (smokejumpers). During the last few decades, about 80-85 % of all fires have been detected by aviation and about 50 % of all detected fires are extinguished during the first day. Fires that are not extinguished during the first day often become very large and difficult to extinguish.

Operational regimes of the forest fire protection services are based on the weather and forest fire danger, which is usually measured by the Nesterov fire index (for a definition see Shetinsky, 1994) or some regional improvement or modification of it. Five different fire danger classes are used depending on the value of the index: 1) no fire risk, $B<300$; 2) small risk, $301<B<1\,000$; 3) medium risk, $1\,001<B<4\,000$; 4) high risk, $4\,001<B<10\,000$; and 4) extremely high risk, $B>10000$. For example, aircraft patrols are usually not provided under the first fire danger class , once every one or two days at noon under Class 2 conditions, one to two times per day from 10 a.m. to 5 p.m. under Class 3 conditions and not less than two times per day for each route under Class 4. Under Class 5 conditions the Forest Guard must devote all its time to fire protection and aircraft patrols should be provided not less than three times per day over each routine.

The State Forest Guard and Avialesookhrana operate in close coordination with the local and regional authorities of state forest management. Under severe fire situations, the local population, military detachments, etc., can be involved in fire fighting. In spite of intensive preventive work with the population, wide use of mass media before and during each fire season, special lessons in schools, organization of special voluntary fire brigades and school forest districts, etc., not all social groups and members of society are educated and conscientious enough about fire prevention and humans continue to be a major source of forest fires. Nevertheless, the awareness of the population, participation in voluntary fire brigades, etc., has been constantly increasing, although this process is slow and different in different regions. The role of non-governmental organizations (Greens and other ecological movements) has also increased during the last decade.

The large fire situation in Khabarovsk Kray in 1998 illustrates how forest fire protection operates in Russia. From the middle of May to 15 July, when 30-40 active forest fires occurred daily, fire suppression was mostly provided by the fire protection sub-units of forest enterprises, the Far Eastern Aviabase and forest industry enterprises (44 chemical fire stations with about 350 fire fighters, 290 members of the aerial protection service, and brigades of the forest logging enterprises). In addition, 18 caterpillar cross-country vehicles were bought, re-equipped and delivered to forest enterprises. During these two months, 480 forest fires with an area of 80 000 ha were extinguished. Sixty-five percent of the fires were extinguished during the first two days.

Due to an increased fire threat, an extraordinary situation was implemented in the Kray on 17 July. Free access of vehicles and the population to forests was prohibited. All available reserves were called up. A month's reserve of food for 1 000 persons and 33 million roubles were allocated for fire fighting. In addition, 120 people and 25

mechanized units (all-terrain vehicles, caterpillars, tankers, etc.) from the Ministry of Extraordinary Situations situated in the Kray, 360 persons and 96 mechanized units from the Ministry of Defence, and 220 fire brigade members and 25 mechanised units from the Ministry of Interior were allocated. Other regions of the country provided 140 people from the aerial protection service. Two BE-12P amphibian aircraft worked in the Kray. All the above prevented burnt settlements and industrial enterprises and the loss of human life. During the most dangerous days about 2 000 people and 500 mechanized units were involved in fire fighting.

Although results were more or less satisfactory, many fires, particularly in remote regions, escaped. Many of these covered areas of 25 000 to30 000 ha per fire. The regional estimate of ecological and forestry losses due to fire was 4.56 billion roubles. It probably would be difficult to organise effective forest fire protection in the Kray under these conditions due to the catastrophic character of fires. Nevertheless, the situation highlighted serious shortcomings in forest fire protection. A major problem is the shortage of funds and the lack of centralised financing. In 1997, only 9.3 percent of the total finances for forest management were allocated for forest protection, and only 24 percent of that was paid from the state budget. In 1988 and 1998, only US$0.25 and US$0.06 per ha of protected area was allocated for forest protection, respectively. The number of the State Forest Guard Staff (lower levels) in the Kray decreased by ca. 75 percent during the period 1988-1998, and Avialesookhrana's staff decreased by 30 percent.

During recent years there has been some practical implementation of remote sensing for early warning. NOAA-AVHRR receiving stations are functioning in some Siberian cities (Tomsk, Krasnoyarsk, Irkutsk, etc.). Nevertheless, in general, there are serious shortcomings in the functional and operational activities of the different forest fire protection organizations. Following are some of the most important:

* Lack of both up-to-date financing of aviation for fire prevention and control and sufficient use of it as an operational tool for fire suppression. At the end of the 1980s, Avialesookhrana used about 700-800 aircraft during the fire season. Currently, the number of aircraft and patrol time has decreased by more than 50 percent.
* The number of State Forest Guard staff has significantly decreased in many regions, particularly at the lower levels.
* Due to significantly decreased activities in sustainable land-use management of forests, huge areas still remain without any protection.
* Lack of advanced equipment; in particular, a unified system of radio communications.
* Insufficient use of satellite information.
* Lack of special autonomous mobile detachments equipped with transport and trained in relevant techniques.
* Lack of real integration between the ground and aerial fire protection services.

However, some projects that are currently being implemented are encouraging and point toward the right direction:

TACIS Project "Improvement in Forest Fire Response"

A project for the "Improvement in Forest Fire Response", funded by European Commission Directorate DG1a as Technical Assistance to the Commonwealth of Independent States (TACIS) Project ENVRUS-9701, is operational between 1998 and 2001. TACIS partners are the Federal Forest Service of Russia (currently the Department of Exploitation and Restoration of Forest Fund of the Ministry of Natural Resources) and its Central Base for Aerial Forest Fire Protection, Avialesookhrana (TACIS 1999, 2000). The goal of the project is to improve the response to forest fires, pests and diseases. Project activities include:

* Adaptation of existing satellite data acquisition;
* Tests of fire detection algorithms based on existing NOAA capability;
* Development and implementation of a federal and regional GIS;
* Development of a forest fire information network.

Applied fire management research

The Fire Laboratory of the Sukachev Institute of Forest, Russian Academy of Sciences, Krasnoyarsk, provides new fire information products to the State Forest Service. These products include fire location maps generated daily that

are also displayed on the homepage of the Global Fire Monitoring Center (GFMC). The Institute for Solar Terrestrial Physics, Irkutsk, provides daily maps with fire locations depicted by NOAA-AVHRR and also a summary of the last ten days of fire occurrences as well as a map for the whole fire season. These maps are also displayed daily on the GFMC homepage (Fig. 2 and 3). An example of a regional burned area map for a whole fire season is provided in Figure 4 (Amur Oblast).

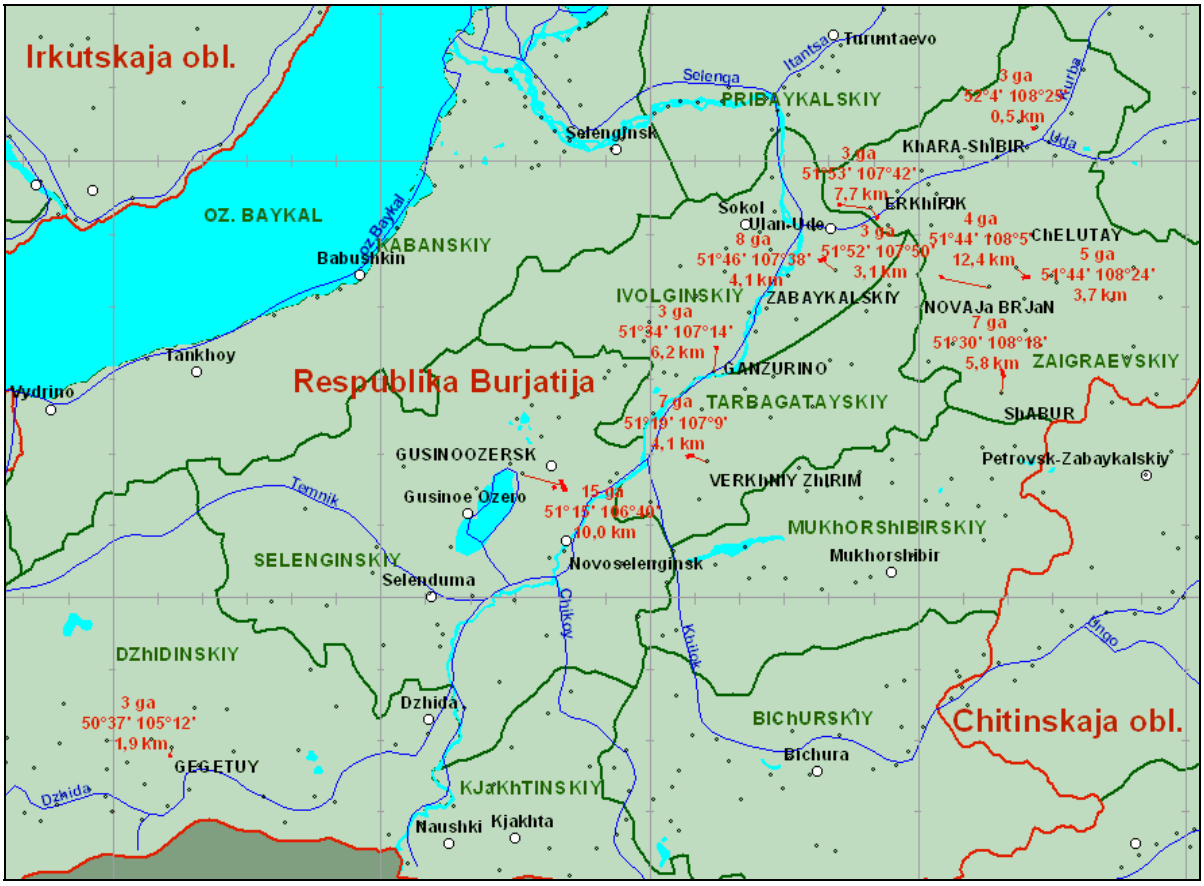

Figure 2. Example of a daily fire monitoring map (date: 29 May 2000) generated by the Fire Laboratory (A. Sukhinin) of the Sukachev Institute of Forest, Krasnoyarsk, in collaboration with the Emergency Situation Monitoring and Forecasting Agency, Krasnoyarsk branch. The maps are produced on the basis of satellite data (classification by NOAA-AVHRR). They show fire locations (by latitude and longitude) and the area affected by fire (red signature, size in ha). The red arrow at each fire location points to the nearest populated place. The fire maps are provided to the GFMC.

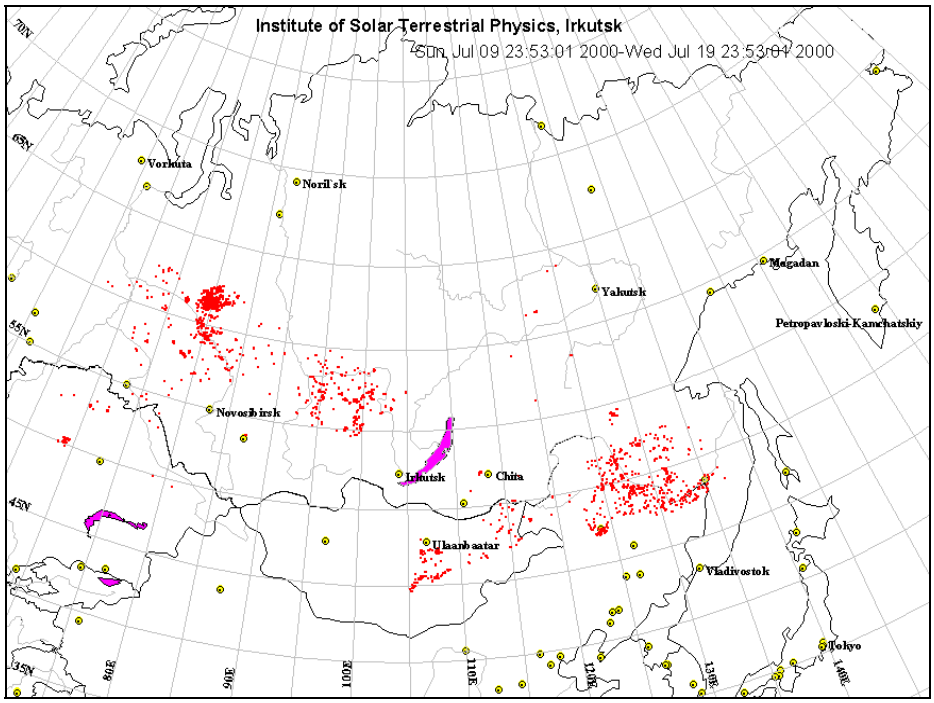

Figure 3. The Institute for Solar Terrestrial Physics, Irkutsk, generates daily fire observations (high-temperature events depicted by the NOAA-AVHRR sensor) in the territory of the Russian Federation and the neighbouring territories of China and Mongolia (within the range of the receiving station). The Institute provides daily fire occurrence summaries, 10-day fire summaries (accumulated fires during the last ten days) and a total fire season summary. The map products are displayed daily on the GFMC homepage. This map shows a 10-day product (9-19 July 2000).

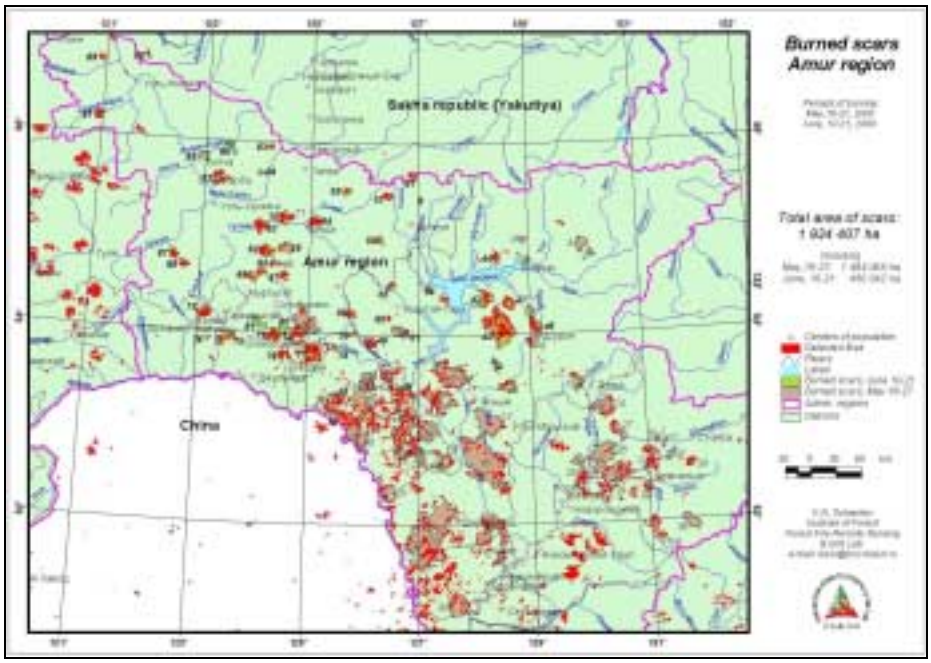

Figure 4. Burned area map of Amurskaia Oblast for the period 16-27 May 2000 and 10 to 21 June 2000. The area burned is 1 934 407 ha. Source: Fire Laboratory, Sukachev Institute of Forest, Russian Academy of Sciences, Krasnoyarsk.

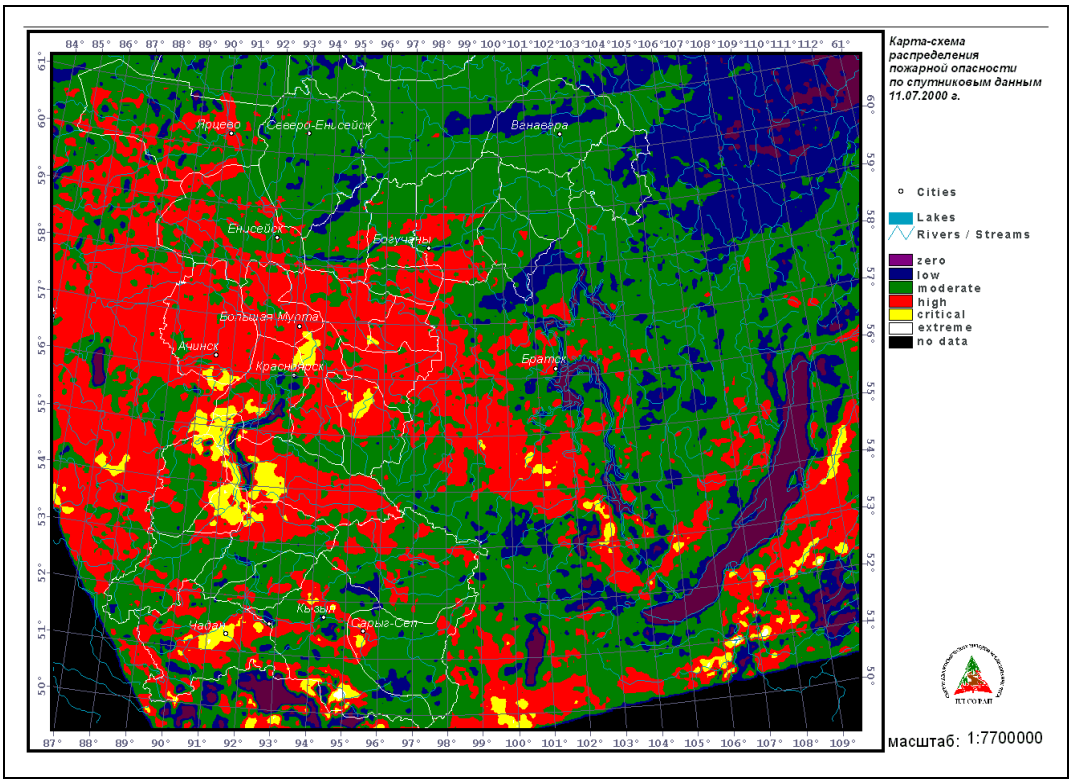

Figure 5. Fire weather forecast map for 11 July 2000 for the Krasnoyarsk and Irkutsk regions.

Prescribed fires

Agricultural prescribed burning in Russia is estimated to total 30 million ha annually, of which about 5 million ha is stubble burning and 25 million ha are pastures and hayfields (Shvidenko et al. 1995). These burns often escape and cause forest wildfires. In forest management activities, fire is used for disposal of debris on harvested areas, preparation of land for planting, reduction of fuel along railways, etc. Other types of prescribed burning, particularly as a direct fire protection tool, are not used in Russia. There is concern about the threat of large fires if prescribed fires escape control. The high cost and organizational and technological difficulties of safely conducting large-scale prescribed burning in the vast taiga with poor infrastructure are also important impediments. For these reasons prescribed burning is not currently part of the official forest fire protection policy of the country.

However, it has been repeatedly urged that high priority be given to formulating and introducing a new fire policy that would allow the integration of prescribed natural fires and the use of prescribed burning to restore the ecological balance of forest ecosystems in which fires have been suppressed over many decades. A number of experiments in Siberia and the Russian Far East support the concept of using prescribed burning as an important fire management tool. Recent publications have suggested the development of adequate prescriptions, manuals and technical requirements (Goldammer and Furyaev 1996, Sedykh 1997).

Sustainable land-use practices

There are two types of documents that regulate the practice of sustainable land-use as a tool to reduce wildfire hazard and risk. The first is a Perspective Plan of Fire Protection Arrangement of Forests that is prepared by a special institution (usually by the so-called All-Russian Designing and Prospecting Institute of Forest Management, Roshiproleshoz) for administrative regions of the Russian Federation with high fire danger. Regional Forest Inventory and Planning Enterprises prepare the second, a Plan of Fire Protection Arrangement, simultaneously with a forest inventory (lesoustroistvo) of each forest enterprise.

The Perspective Plan defines the forest fire protection strategy in a region, the distribution of areas by type of forest fire protection (ground, ground with aerial patrol, aerial), the area of responsibility of chemical fire stations, regional coordination of fire protection efforts, etc. The Plan of Fire Protection Arrangement is based on the fire hazard of

individual forest stands, potential sources of fire (fire risk), peculiarities of climate and weather during the fire season and recent fire history (for the last 8 to 15 years). It also includes fire prevention activities, early detection and monitoring of fires and initial attack. Furthermore, the plan includes technical measures to reduce ignition, flammability, intensity and spread of forest fires through construction of roads, firebreaks, and fuelbreaks consisting of planted deciduous forest belts. However, a common shortcoming of these plans is insufficient funding for them to be effectively implemented (forest fire protection is still basically financed from the state budget).

More effective is a third document, an Operative Plan of Fire Protection Activities, that is developed on an annual basis (and is partially drawn from the two above-described plans) as part of the planning of forest management activities for each forest enterprise based on available financing. Briefly, this plan includes all relevant activities that support a core integrated fire management system, with special emphases on all types of fire prevention work with the local population, children, etc. Unfortunately, these plans are fully realized and relatively effective only in areas of intensive forest management, e.g., in the centre of European Russia.

By 1998 Russia had 8 822 artificial water reservoirs and specially equipped areas to provide water for fire suppression, of which 7 138 were in European Russia and 1 684 in the Asian part. The total length of fire prevention barriers (fire breaks) is 211 161 km (of which about 60 percent are in European Russia). The total length of forest roads is 997 400 km (57 percent are in the European part). Large territories of the European North, Siberia and the Far East are insufficiently covered by forest protection activities.

Public policies concerning fire

Russia has a well-developed legal basis for forest fire protection. It includes:

* The Forest Code of the Russian Federation (special Chapter 12, Articles 92-102, directly devoted to fire protection problems);
* Regulations on Fire Safety in Forests of the Russian Federation, approved by the Russian Government on 9 September 1993;
* Article 261 of the Criminal Code of the Russian Federation ["Destruction and damage of forests"];
* A number of Instructions/Regulations/Manuals that are obligatory for all bodies of state forest management, i.e., Instruction on fire prevention prophylactic in forests and regulation of activities of forest protection services, approved by the Federal Forest Service [1993], Instruction on detecting and extinguishing of forest fire, approved by the Federal Forest Service [1985], Instruction on forest fire protection by aviation [1993], Statute of Chemical-Fire Stations [1993], etc. (Shetinsky and Sergeienko 1996).

These laws cover all relevant aspects of forest fire protection and are obligatory for people, state and private organizations, all forest stakeholders, etc. However, implementation of the legal requirements is poor. In many regions, forest authorities do not have enough human and financial resources to provide effective forest management and control. Russia is still undergoing a period of transition from a centrally planned to a decentralized market economy and is suffering severe economic, social and moral stress. Unfortunately, the country has not yet developed a clear long-term national forest policy addressing problems of forest protection and conservation. The major current problems of the forest sector are of an institutional nature. Many unsolved forest problems are dramatically reinforced by ineffective legislation and unresolved state economic and social policies. The country has no long-term forest strategy. The elimination of the State Forest Committee and the Federal Forest Service in mid 2000 and the new administration under the Ministry of Natural Resources (see Fig. 1) will lead to decentralization of tasks to the regional and local forest management levels but positive results of this reorganization are yet to be seen. However, an increased interest in the fate of Russia's forests by the public and various stakeholders has been evident during the last two to three years. This process has been facilitated by a number of international institutions such as the World Bank, the International Institute for Applied Systems Analysis (IAASA), the World Conservation Union (IUCN), the Russian office of the Worldwide Fund of Nature (WWF) and the Global Fire Monitoring Center (GFMC).

Forest fire science, including fire ecology, protection, etc., is well developed in Russia. Nevertheless, a rather modest part of this knowledge is really used. The Russian experience is clear evidence that during catastrophic fire years such a big country with a huge boreal zone is not able to adequately protect its forests against fire. Taking into account expected climate change, the need to develop and, of crucial importance, implement a new forest fire protection paradigm for Russia is evident. This paradigm should be part of a philosophy of sustainable forest

management and include an anticipatory strategy with a solid background of relevant long-term activities supported by appropriate human and financial resources in the following areas:

* zoning of Forest Fund territories by relevant fire protection regimes based on estimates of current and future fire danger and the ecological role of fire;
* development and implementation of a forest fire monitoring system using a combination of multi-sensor remote sensing observations along with a comprehensive characterisation of the landscape, e.g., an integrated land information system;
* consistent implementation of sustainable land-use practices and fire protection arrangements, e.g. regulation of species composition, development of appropriate infrastructure, regulation of the amount of on-ground fuel, etc., in particularly in territories of taiga zone;
* introduction of forest fire protection services that correspond to the basic philosophy and criteria of sustainable forest management;
* involvement of the population and all forest stakeholders as a very important part of forest fire protection;
* increasing international cooperation in all aspects of forest protection.

Conclusions and Recommendations

It is quite obvious that forest fire management in Russia has a large potential – a potential for both opportunity and failure. More than seventy percent of the global boreal forest cover is in Asia, mainly in the Russian Federation, and this economically and ecologically important area represents the largest undeveloped forested area of the globe. The carbon stored in boreal ecosystems corresponds to ca. 37 percent of the total terrestrial global carbon pool (plant biomass and soil carbon). Thus, the magnitude of the boreal forest area suggests that it may play a critical role in the global climate system, e.g. as a potential sink or source of atmospheric carbon. Vice versa, climate change models indicate potentially dramatic changes in the continental climate of the country. Prolonged vegetation growth and an increasing occurrence of extreme summer droughts, with consequent extreme wildfire danger, are elements of climate change scenarios.

As a consequence of the increasing occurrence of wildfires under extreme drought conditions, as was experienced in 1987 in the Trans-Baikal Region and in 1998 in the Far East, it is expected that natural recovery cycles will be disturbed as well. Fires affecting forest ecosystems on permafrost sites could lead to the degradation or disappearance of eastern Siberian larch forests. Melting permafrost could lead to the decay of presently frozen organic matter and the release of radiatively active (greenhouse) gases. In addition, fires penetrating into desiccated organic terrain (swamps) could release large amounts of terrestrial carbon into the atmosphere. That the boreal ecosystems of Eurasia represent such a potential threat, recently called the “carbon bomb”, requires significant national and international attention.

This brings the authors of this report to the conclusion that the proper management of the Russian forests and associated vegetation resources and ecosystems needs to receive high priority. The responsibility of managing and protecting these resources should not be given solely to the private sector, and there are limitations on delegating resource protection to the regional and local levels. The establishment and strengthening of a central institution to protect forests and other ecosystems is not only in the best interest of the country but must also be supported by the international community.

International responsibility is two-sided and includes "taking" and "giving". Russia must receive continuing international assistance to protect its vegetation resources. During times when they are not needed, however, Russia can pay back other countries by making available human resources and equipment to address fire problems in other parts of the world.

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Appendix

Translations of major forest land-use/land-cover definitions from the "Manual on Forest Inventory and Planning in Forest Fund [sometimes designated Forest Reserve] of Russia". Volume 1. Organization of Forest Inventory and Planning. Field observations. Approved by the Federal Forest Service of the Russian Federation on December 15, 1994, N 265. Published by VNIIZlesresurs, Moscow, 1995, 175 pp [in Russian]

Comment: Forest Fund is not defined in the Manual cited above. Forest Fund, Forest Lands and Non-Forest Lands are defined by the Russian Forest Code (Articles 7 and 8), but not in a quantitative way. For instance, page 6:

Article 7. The Forest Fund

All forests except of those located on defence lands and the lands of settlements, as well as lands of the Forest Fund not covered with forest vegetation (forest lands and non-forest lands) make up the Forest Fund…

Article 8. Lands of the Forest Fund

The lands of Forest Fund include forest lands and non-forest lands. Forest lands include lands covered by forest vegetation or those not covered by it but intended for its restoration (cutovers, slashes, perished forest stands, open stands [comment: better-s*parse forests*], wastelands, glades [comment: better-*grassy glades and barrens*], areas occupied by nurseries, free-growing forest cultures [comment; i.e., forest plantations], and others. Non-forest lands include lands that are part of the forestry system (land occupied by cutlines between forest compartments or blocks, roads, arable lands, and other lands), as well as other lands located within the borders of the Forest Fund (lands occupied by bogs, rocky places, or other lands unsuitable for use.

Manual on Forest Inventory, Page 53, Paragraph 5.1.2.

… All lands of Forest Fund are divided in two major categories: Forest Lands and Non-Forest Lands. Non-Forest Lands include lands that are not designated, or which are not suitable for forest or shrub growth without preliminary melioration or recultivation. All the rest of the lands are inventoried as Forest Lands, i.e., suitable and designated for forest growth. Forest Lands are divided into following categories:

- Forested Areas;
- Non-Stocked Planted Forests [comment: i.e., planted stocked forests, not plantations in the tropical sense];
- Forest Plantations and Nurseries;
- Natural Sparse Forests;
- Unforested Areas.

5.1.2.1. Forested Areas include:

- lands covered by young stands with a relative stocking of 0.4 and more and stands of other age groups with a relative stocking of 0.3 and more;

* cutovers, burns and other territories of naturally reforesting Forest Lands, on which the amount and quality of natural regeneration, or young trees, protected under harvest, are corresponding to requirements, developed for conversion of these categories into Forested Areas; areas covered by shrubs in regions where tree species cannot grow due to severe natural and geographical conditions, or where special shrub management is provided. [comment: the definition of closed forests (i.e. Forested Areas) has not been changed after 1961; see, for instance, cl. 152, page 66 of the *Manual on Inventory and Survey of Forests of State Meaning of the USSR*, Moscow, 1952; approved by the Minister of Forest Management of the USSR on June 29, 1951]

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… Planted forests of which indicators are not corresponding to the requirements for the conversion of them into Forested Areas, are identified and inventoried as non-stocked planted forests.

5.1.2.2. Natural sparse forests include:

* stands with a relative stocking of 0.1-0.2 that grow under extreme climatic conditions, where forming stands with higher relative stocking is impossible. …

5.1.2.3. Unforested areas are:

* presented by areas of Forest Lands on which at the time of the tree and shrub vegetation is absent, which by their relative stocking, canopy closure or amount of regenerated young trees cannot by identified as Forested Areas.

Primary inventory units of Unforested Areas include the following categories:

* burned areas (burns) - areas on which woody vegetation has been killed by fire;
* dead stands - areas of dead stands as a result of the damage caused by insects or diseases, natural calamity (blowdown, windfall, snowbreak), atmospheric pollution and other natural or anthropogenic impacts.

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Cutovers (unregenerated harvested areas) - areas on which stands have been clear cut due to final felling or entire sanitary cuts and natural regeneration on those either is absent or its amount and quality do not correspond to requirements on conversion into Forested Areas.…

Grassy glades and barrens; grassy glades are presented by small unregenerated areas caused by windfall or harvest of a stand due to any negative impact of the local character; barrens include significant by area old harvested areas, burns and others territories with destroyed forest vegetation which was not restored during the period after the previous forest inventory" [comment: the period between two inventories is usually from 10 to 15 (20) years].

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COUNTRY NOTES

KAZAKHSTAN

Forest Fire Situation in Kazakhstan

Introduction: Fire environment, fire regimes, ecological role of fire

Kazakhstan is a large country covering a total surface of 2.7 million km^2 The climate of Kazakhstan is extremely continental. The North of the country is characterized by cold and long winters and dry, short summers. Conversely, the South experiences short and low-snow winters and long, dry and hot summers. Summer droughts accompanied by dusty storms and dry winds are very common (Gvozdetski and Nikolaev 1971). During such drought periods, the fire danger increases sharply and the number of wildfires occurring on wooded land is extremely high. An overall trend of increasing aridity of the climate of Kazakhstan has been observed for about half a century. Consequently, a destabilisation of forests and woodlands and an increase of wildfire danger have been observed.

The large size of the territory of Kazakhstan has produced a great diversity in natural landscapes. Five major natural zones and wildland fire characteristics have been identified (Arkhipov et al. 2000):

- **High-mountainous landscape zone** consisting of three sub-zones: nival with eternal snow, alpine meadows, and high-mountainous coniferous forests. Fires occurring in the coniferous forests spread uphill and develop as crown fires.
- **Forest steppe landscape zone** consisting of two sub-zones: southern forest steppe and typical forest steppe. The forests in the typical forest steppe are frequently ignited by steppe fires.
- **Temperate steppe landscape zone** consisting of two sub-zones: northern grassland-cereal steppes and southern dry *tipchak-kovyl* steppes. The fire regimes of timber islands, embedded in the steppe, depend on the fire conditions in the steppe.
- **Semi-desert landscape zone** consisting of two sub-zones: lowhill-foothill semi-desert and flat semi-desert.
- **Desert landscape zone** consisting of two sub-zones: *wormwood-saltworty* (*Artemisia-Salsola rigida*) deserts and *ephemerial-wormwood* deserts.

Saksaoul (*Haloxylon* spp.) is the main element of woody vegetation in the two last zones. Saksaoul stands are usually not affected by wildfires if understory vegetation and the herb-shrub layer are intensively grazed and browsed by livestock. If understory fuels are present, these forests can be damaged severely by wildfires. Tougai, the flood-plains forest of Central Asia, represent a separate class of woodlands and a microclimatic zone with its own particular fire regimes.

The Forest Fund of Kazakhstan is divided into natural fire danger classes (Tab. 1). Figure 1 shows the types and pyrological classification of forests in Kazakhstan.

The forest-steppe zone is located at the limits of the West-Siberian Lowland and occupies the northern part of Kazakhstan (territory of North-Kazakhstan, Aqmola and Pavlodar administrative provinces) with a total share of more than ten percent of the territory of the country. This is occupied by intensive agriculture (grain, pastures and grasslands for hay production) and large areas of wooded lands. Fires occurring in these territories cause high losses in the agriculture and forest sectors. Systematic wildland fire protection is therefore required by state forest and agricultural enterprises. The fires usually occur in the early spring and in autumn, especially in dry years. The basic causes of wildfires are agricultural burning and violation of the requirements of fire safety.

The steppe landscape zone comprises up to 20 percent of the total territory of the republic. All steppe vegetation and the grain crops quite often suffer from human-caused fires, mainly from agricultural burning. The steppe phytomass after drying, becomes a dangerous fuel. The fires occurring in kovyl (*Stipa capillata* L. - “feather grass”) and tipchak (*Festuca sulcata* Hack) grassy steppe usually last for long time and spread over large areas. The fuel load of dry herb material on such sites ranges from 0.22 up to 0.38 t/ha. The fires start due to the negligence of shepherds, fishers and hunters, machines, members of expeditions, agricultural burnings and dry thunder-storms, and cause considerable damage to the national economy. The crops of agricultural cultures, pastures, hay production and groves are damaged and destroyed by fires. The rate of spread of a steppe fire is directly dependent on wind velocity. Flame heights usually reach 0.9-1.0 m in grass fuelbeds of 30 to 40 cm height. In the kovyl steppe, fire can spread against

the wind with a rate of 5 to 10 times below the wind-driven spread rate. During such a wind-driven headfire, a convective movement is formed, and the fire quite often "runs" along the tops of grass stands. When it reaches either a natural barrier or a mineralised strip (firebreak) it stops, and the fuel on the whole area burned over by the headfire gradually burns out.

Table 1. Fire danger classes in Kazakhstan (after V. Arkhipov)

Danger Class	Groups of Forest Types, Planted and Deforested Territories	Characteristic Fire Types and phases of their origin
1 Very High	Coniferous saplings. Logged sites of dry and fresh pines, larch, fir and grassy cedar forests, bushy broad grassy silver fir forests. Dry and rocky pine forests. Damaged and dying tree stands (dead dry stands, sites of storm debris and wind falls, unfinished harvest sites, slash, insect-damaged stands).	Surface fires during the whole fire season. Crown fires occur on sites with high fuel loads.
2 High	Young pine forests, especially with pine undergrowth. Periodically dry larch forests. Cedar forests on country rocks of southern slopes. Dry growing conditions of flood-plain forests.	Surface fires are possible during the whole fire season. Crown fires occur during the phase of highest fire intensity.
3 Medium	Continuous harvest areas of coniferous forests in moist and wet sites. Dry fir forests, fresh larch and fir forests, wet pine forests. Mountainous-valley silver fir and fir forests. Cedar forests of remaining types of forest. Fresh growing conditions of flood-plain forests. Radical and derivative fresh birch and aspen groves and their cut sites.	Surface and crown fires are possible during the peak of the summer fire season. In mountains, forests fires occur during spring and autumn dry spells.
4 Low	Wet pine forests. Wet dark-coniferous taiga forests. Wet larch forests. Mossy-grassy silver fir forests, wet fir forests. Mossy fir forests. Bushy, dog-rose and aspen fir forests. Apple, birch and aspen groves. Wet growing parts of flood-plain forests. Black saksaoul.	The occurrence of fires is possible during dry spells in spring and autumn. During the summer, fire occurrence is possible in pine forests
5 Very Low	Sub-alpine coniferous forests. Cedar forests on bare rocks. Wet birch and aspen groves. Damp poplar groves. Willow groves of all types. All types of saksaoul (except black saksaoul).	The start of a fire is possible only under extraordinarily unfavourable conditions.

The Central Kazakhstan Low Hill Land is located in a woody zone of the northwest part of Sary-Arka (Aqmola province, Baian-Aoul of the Pavlodar province, Karkaraly of the Karagandy province). Wood and steppe vegetation, climate and relief of the region promote the origin, distribution and development of wildfires, especially in hot, dry and windy weather. The control of fires is hampered here due to inaccessibility of the woody sites. At the same time, rocky ledges and the stony material act as natural obstacle to further fire spread.

Fires in the pine forests of Sary-Arka represent a major factor influencing plantings and causing considerable damage to the forest economy. Afforested wood species here are pine (*Pinus sylvestris*) and birch (*Betula verrucosa* Ehrh.). Fire hazard and flammability are highest in the following forest types: very dry stony-rocky pine forests, dry stony lichen-pine forests and dry cereals-berry pine forest. The average annual number of fires here is about 100; and the average area of a fire is 5.4 ha during an average fire season. The basic cause of forest fires here is the violation of the fire prevention rules by many people in sanatoriums, boarding houses, camping sites, motels and tourist bases; and by the local population. Lightning represents only a minor fraction of all fire starts. Coniferous trees occur as undergrowth and plantations. Their flammability is determined by the high fire hazard of coniferous stands, dryness of the climate and availability of a large area of combustible materials, from 9 to 30 t/ha. Special attention in the forests of this region should be devoted to fire prevention and the regulation of recreational activities.

The Band (Strip) Pine Forests (Lentochnyie Groves) of Western Siberia and Kazakhstan are located in a steppe between the Irtysh and Ob Rivers. The forests are important for the protection of water resources, soils and the

agricultural sector. They are also of high aesthetic importance and represent an important basic source of wood in the region. The main afforestation species is Scotch pine (*Pinus sylvestris*). Fire hazard and flammability are highest in the following pine forest types: dry forest of high dunes, dry forests of sloping hillocks, topographic depressions and lowlands. In the indicated forest types, fires are even common in wet years. In the very dry 1997 extremely large, catastrophic fires occurred in the timber enterprises of Semey (Semipalatinsk) Forest Management Department, totalling 511 fires affecting an area of 58 893 ha. In timber enterprises of Band Pine Forests of the Pavlodar province, 316 forest fires burned 17 672 ha in the same year. The basic reason for forest fires is violation of the fire prevention rules. In regard to the high fire danger and flammability of Band Pine Forests, the basic fire protection strategy should be one of prevention and development of a detection and suppression system for fire-prone areas.

Figure 1. A forest fire map of Kazakhstan. The legend at the left side of the map shows forest types and fire danger classes.

The island pine forests of Kostanai province are located as green islands among extensive unforested areas on flat terrain. The climate is extremely arid with annual precipitation varying from 240 to 350 mm. The duration of an average fire season exceeds 180 days. These forests are exposed to frequent fires. For instance, the large fires in the territory of Naurzum Reserve have essentially reduced the total size of forests. There is no natural regeneration on burned sites. Regeneration is found only occasionally in “saucer”-shaped depressions where pine, aspen and birch are regenerating.

The remaining pine forests of the region also experience frequent fires. The fire history of these stands has been reconstructed by fire scars in tree rings. Despite the damages, pine forests represent favourite recreational places for people from the cities Kostanai, Rudnyj, Lissakovsk; and tourists from other regions also visit the area. During the summer season numerous youth camps, recreation houses and tourist bases are functioning here.

The semi-desert that covers the central part of the country (22 percent of the territory) represents the transitional zone between steppe and desert. Typical landscapes are hillock-sandy plains with wormwood-grassy and bushy vegetation. Under these conditions, wormwood-salsola (*Artemisia* / *Salsola regida*) vegetation is characteristic and does not form closed grass stands. In valleys of the drying rivers and in crevices of hills there are small meadows. The climate is rather droughty: cold and low-snow winters and dry and hot summers. Fires occur frequently. Steadfast attention is required to protect the area from fires, especially in pastures and haymaking grasslands. The zone of deserts reaches to the central and southwest parts of Kazakhstan, between 48°N and 41°N. The deserts of

Kyzyl-Kum and Kara-Kum (drainage-basin of Syr-Darya river) and the southern Balqash region (drainage-basin of Ile river) are sand deserts (Aral sands) and cover about 47 percent of the territory of the country. The continental climate is characterised by high insolation and aridity. The large rivers (Ural, Syr-Darya, Ile, Lepsy) and other rivers originate outside the desert zone. Landscapes are characterised by black saksaoul (*Haloxylon aphyllum*), white saksaoul (*Haloxylon persicum*), zhuzgun (*Calligonum arborescens*), tamarisk (*Tamarix ramosissima* Ldb.*, Tamarix gallica*), chingil (*Halimodendron halodendron* (L) Voss.), sandy acacia (*Ammodendron* Fish. ex. DC) and zhantaq (*Alhagi pseudalhagi*).

Narrative summary of major wildfire impacts on people, property, and natural resources during the 1990s

The largest number of wildfires of the 20th Century occurred in the 1990's. A recent analysis reveals that the number of wildfires and the area burned in Kazakhstan grew exponentially during the last 50 years (Arkhipov et al. 2000). Extreme fire years were 1963, 1974 and 1997. The most extreme fire season occurred in 1997 when a total of 2 257 wildfires affected 216 950 ha. Forests were affected in all landscape zones, e.g. in the Band Groves (Lentochnye Groves) along the Irtysh River, spruce groves on the slopes of the Ile Alatau mountains, the insular coniferous groves in Kostanai province and the forests of North of Kazakhstan and Altai. The large crown fire in Altai in 1997 (Markakol ranger station) generated a fire storm in which 17 firefighters were killed. The causes of the forest fires during the 1997 fire season are summarized in Table 2. The wood losses from wildfires in Kazakhstan for the period 1991 to 2000 were ca. 92 million $US in domestic wood prices (Tab. 3). The costs of these losses in world prices exceeded 400 million $US. Considering the need for increasing the import of wood, job losses in the wood industry, expenses for reforestation, rehabilitation of fire-affected land and other expenditures, the amount of damage caused by this fire episode is much higher.

Table 2. Number and causes of forest fires during the 1997 fire season

Forest Management Associations and Reserves	Total Number of Fires	Violation of the Fire Prevention Rules (%)	Lightning (%)
Aqmola	204	99.5	0.5
Almaty	22	100.0	0.0
Aqtobe	0	0.0	0.0
Taldy-Qorgan	18	100.0	0.0
East Kazakhstan	141	65 *	35 **
Semey	511	67 *	33 **
Zhambyl	5	100.0	0.0
West-Kazakhstan	5	100.0	0.0
Karagandy	143	99.3	0.7
Kyzyl-Orda	3	100.0	0.0
Kokshetau	353	99.2	0.8
Kostanai	127	97.0	3.0
Pavlodar	316	64 *	36 **
North-Kazakhstan	152	?	?
South-Kazakhstan	4	?	?
Baian-Aoul GNPP	107	97.2	2.8
Ile-Alatau GNPP	19	100.0	0.0
Kokshetau GNPP	114	100.0	0.0
Almaty State Reserve	2	100.0	0.0
Naurzum Reserve	12	100.0	0.0
Total	**2 258**		

* *data are probably underestimated*

***data are probably overestimated*

Fire database: Wildfire statistics of fire numbers, area burned and fire causes for the period of 1990-1999

In addition to the information on the fires in 1997, the statistical data for the period 1980-2000 are given in Table 3.

Table 3. Forest fire statistics of Kazakhstan for the period 1980-2000.

Year	Number of fires	Area burned (ha)	Damages from wood losses (x 1000 US$)
1981	892	5 853	1 697.4
1982	1 004	2 086	604.9
1983	722	992	287.7
1984	685	2 082	603.8
1985	421	692	200.7
1986	605	2 467	715.4
1987	601	652	189.1
1988	641	1 112	322.5
1989	917	4 891	1 418.4
1990	605	1 277	370.3
Total 1981-1990	**7 093**	**22 104**	**6 410**
1991	1 194	4 942	1 433.2
1992	518	1 175	340.8
1993	354	731	212.0
1994	881	5 046	1 463.3
1995	1 320	22 540	6 536.6
1996	1 002	10 305	2 988.5
1997	2 257	216 950	62 915.8
1998	1 053	16 322	4 733.4
1999	948	20 691	6 000.4
2000	943	12 930	5 559.5
Total 1991-2000	**10 470**	**311 632**	**92 183.5**

Operational fire management system and organizations present in Kazakhstan

All forest land in Kazakhstan is the property of the state. Thus, the task of forest protection, including fire protection, is exclusively the responsibility of government agencies. An organizational diagram is given in Figure 2.

Fire management practices

The traditional system of wildfire protection used in Kazakhstan includes the establishment and maintenance of firebreaks around forest stands. There are also restrictions for agricultural and other activities in buffer zones (defence bands) around forests. Prescribed fires are not used in Kazakhstan, since they are officially forbidden.

Public policies concerning fire

Because humans are the main cause of forest fires, the public policy regarding wildfires comprises public awareness and educational campaigns. The government is gradually transforming hunting and forest facilities to nature reserves and national parks. In 1998, Karkaraly National Nature Park was established, and in 2000 Borovoye Timber Enterprise was transformed to National Park called "Bourabai". In the same year Markakol Ranger Station (in East Kazakhstan) was transformed to Markakol Nature Reserve.

In 2000, the government established a moratorium for the industrial harvest of wood in all forests and groves of Kazakhstan. Wood harvest is permitted only on damaged sites for sanitary reasons. This regulation has generated two problems: deficit of wood fuel in the rural regions of the country and, as a consequence, a sharp increase in

illegal cutting. Significant funding was made available for 2001 to rehabilitate the Band Groves along Irtysh River and insular groves of Kostanai Province which had been extremely damaged by wildfires in recent last years.

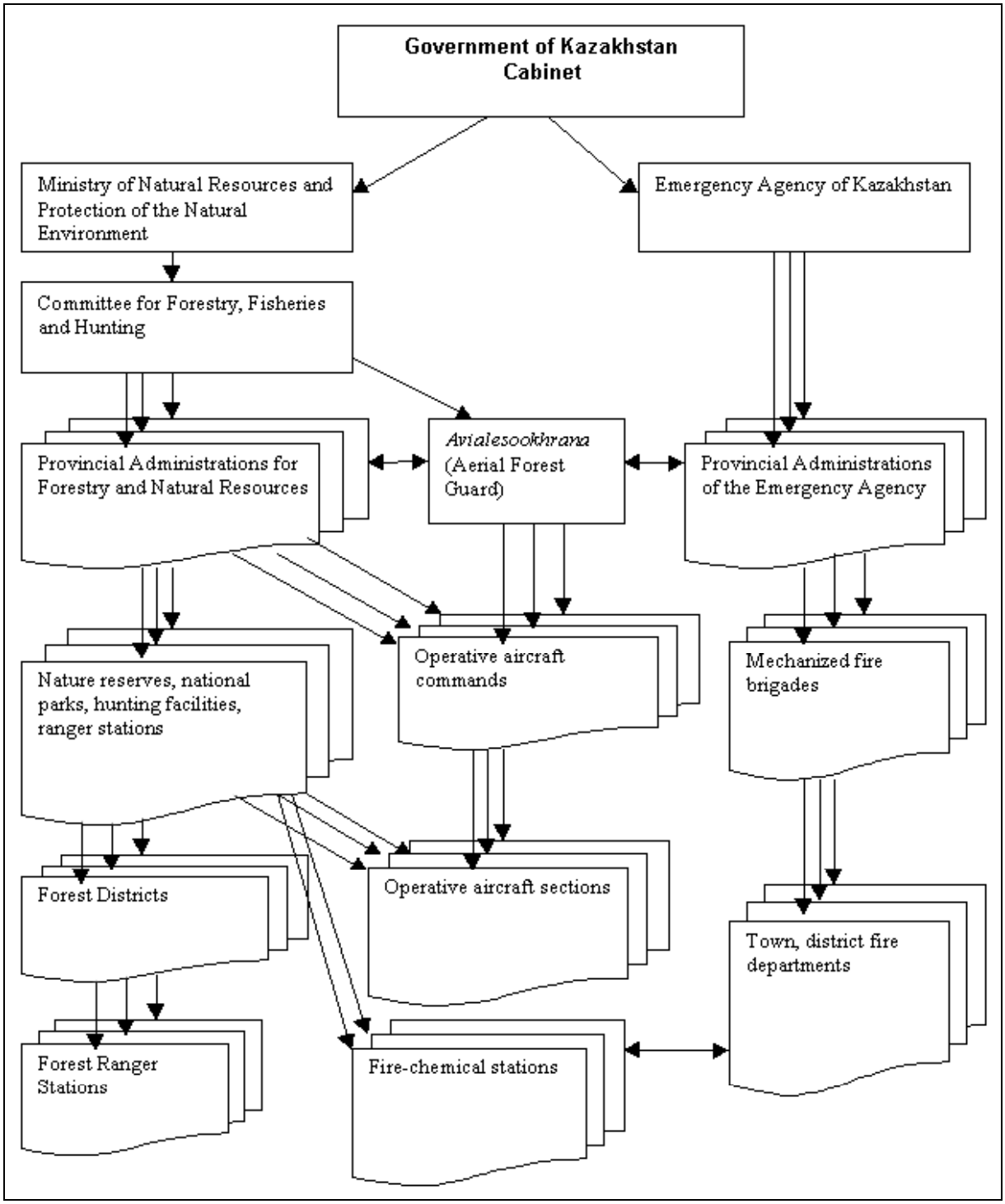

Figure 2. Organization of forest fire protection responsibilities in Kazakhstan

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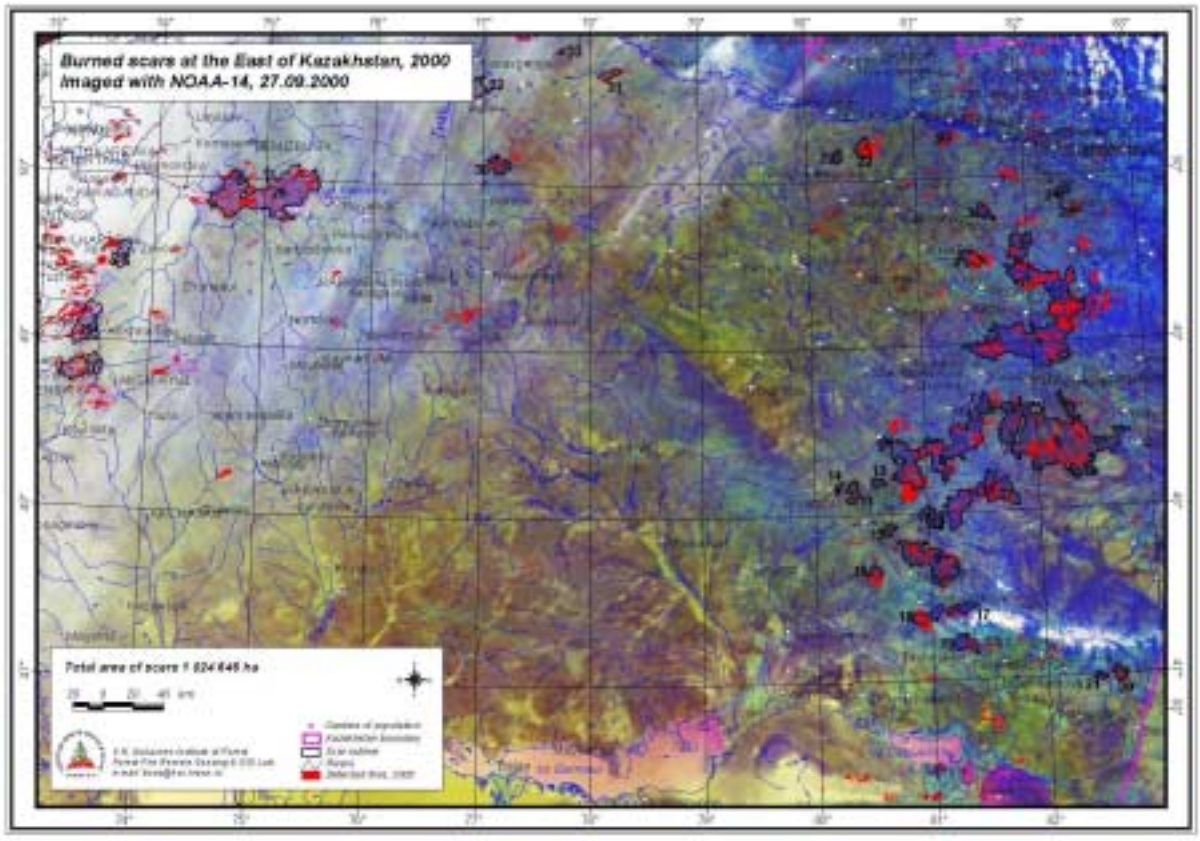

Additional Information from the GFMC. Forest and steppe area burned in Kazakhstan during the fire season 2000 (date of satellite image: 29 September 2000). The total area burned was 1.024 million ha. Source: A. Sukhinin, Sukachev Institute for Forest, Fire Laboratory, Krasnoyarsk, Russian Federation.

NEWS FROM THE UNITED NATIONS

At the third meeting of the Inter-Agency Task Force on Disaster Reduction (Geneva, 3-4 May 2001) the newly established Working Group 4 *Wildland Fire* will become operational (see Editorial of IFFN No. 23, December 2000). The final terms of reference and the work programme of the Working Group which will be coordinated by the Global Fire Monitoring Center will be published in the next issue of IFFN.

The following paper was prepared for the Interagency Task Force meeting and for the FAO/ITTO International Expert Meeting on Forest Fire Management Rome, Italy, 7-9 March 2001 (report on pages 78-98 of this issue). The report is a narrative of the involvement and precursor activities of the ECE/FAO/ILO Team of Specialists on Forest Fire and the Global Fire Monitoring Center (GFMC) towards the establishment of the Inter-Agency Task Force Working Group on Wildland Fire within the UN International Strategy for Disaster Reduction (ISDR). It highlights the contribution of numerous UN and non-UN international organizations in the process of building an international coalition to address global wildland fire (or vegetation fire) issues.

INTERNATIONAL STRATEGY FOR DISASTER REDUCTION (ISDR)

The precursor work of the ECE/FAO/ILO Team of Specialists on Forest Fire and the Global Fire Monitoring Center (GFMC) towards the establishment of the Inter-Agency Task Force Working Group on Wildland Fire within the UN International Strategy for Disaster Reduction (ISDR)

1. Abstract

On 11 October 2000 the first UN inter-agency platform for wildland fires has been created under the *International Strategy for Disaster Reduction* (ISDR). This decision was made at the second meeting of the *Inter-Agency Task Force for Disaster Reduction* (IATF). The IATF is a constituent element of the ISDR and serves, among other, as the main forum within the UN system for devising strategies and policies for the reduction of natural hazards in accordance with the framework laid down in resolutions of *Economic and Social Council* (ECOSOC) and of the UN General Assembly. The *Working Group on Wildland Fire* is one of four working Groups of the IATF and is coordinated by the Global Fire Monitoring Center (GFMC).

This report highlights the activities of the GFMC and the ECE/FAO/ILO *Team of Specialists on Forest Fire* which have preceded this initiative during the last decade and in particular during the period 1998-2000.

The report contains a list of major events. In order to keep this document reasonably short some of these events are not explained in detail because they are self-explaining steps (milestones) on the way towards the formation of a global consortium of UN agencies and non-UN groups working on regional to global projects and programmes to address vegetation fires. International cooperation in mutual assistance during extreme fire emergencies at regional to global levels is underway.

2. Introduction: Precursor activities during the IDNDR

In response to the problems arising from forest fires in the region of the Economic Commission for Europe (ECE) the Joint ECE/FAO/ILO Committee on Forest Technology, Management and Training established the Team of Specialists on Forest Fire in the early 1980s. The team's main task is to provide a link in communication and cooperation between fire scientists, managers and policy makers. The main activities embrace (1) the production of International Forest Fire News (IFFN); (2) organization of international seminars; and (3) promotion of synergistic collaboration between governments, international institutions, non-government institutions, and individuals, especially in science and technology transfer, and policy development.

Recognizing that there is no similar regional activity elsewhere within the UN system the Team of Specialists on Forest Fire from the very beginning envisaged and implemented global information exchange by producing IFFN with a global scope and distribution (since 1988).

In response to the global escalation of wildfires and the problems related to the application of fire in land-use systems and land-use change, especially during the El Niño episode 1997-98, the Global Fire Monitoring Center (GFMC) was established as a contribution of the German government to the UN International Decade of Natural Disaster Reduction (IDNDR). The GFMC is hosted by the Fire Ecology Research Group (Max Planck Institute for Chemistry, c/o Freiburg University, Germany). The GFMC head is also in charge of coordination (leader) of the ECE/FAO/ILO Team of Specialists on Forest Fire (since 1993). Consequently the work of the Team merged with the activity of the GFMC.

Since 1998 the GFMC has extended its activities with the overall objective to create regional to global synergies in developing policies, programmes and projects to address fire in the different sectors of the UN system and the civil society. In the following an overview is given on the major projects which were initiated, coordinated or supported by the GFMC

3. Establishment of operations of the Global Fire Monitoring Center (GFMC)

Following the recommendations of the UN-ECE/FAO/ILO Seminar Forest, Fire and Global Change (Russia 1996) [1] and the ITTO Guidelines on Fire Management in Tropical Forests [2] and considering the events of 1997-98 in SE Asia and other parts of the world the team strongly underscored the need to establish an institution which at that time was preliminarily designated as a Global Fire Monitoring Facility. It was envisaged that this facility would process and publicly provide all fire and fire-related information which would assist governments, international organizations, the science community, and the management levels concerned to understand fire and to respond appropriately.

On the base of these recommendations the Government of Germany through the Ministry of Foreign Affairs, Office for the Coordination of Humanitarian Assistance, in June 1998 provided initial funding for the establishment of the *Global Fire Monitoring Center* (GFMC). In the foundation stage it was envisaged that the GFMC may facilitate the formation of a mechanism that would support the UN in assisting countries in wildland fire emergency situations, particularly through collaboration with the UN Office for the Coordination of Humanitarian Affairs (UN-UNEP/OCHA). The GFMC was inaugurated at the FAO Meeting on *Public Policies Affecting Forest Fires* (Rome, October 1998).

The GFMC fire documentation, information and monitoring system is accessible through the Internet [3]. The daily to periodically updated national to global products of the GFMC are generated by numerous institutions worldwide. The information and data are systematically collected, interpreted and finally displayed on the internet.

The GFMC supports the international community of decision makers and scientists by providing global coverage of

* Early warning of fire danger and near-real time monitoring of wildland fires
* Interpretation, synthesis and archive of wildland fire data through a global network of information providers
* Support of government or projects in developing national fire management programmes, with emphasis on fire prevention and community-based (integrated) fire management
* Consultative support of international organizations and the United Nations through the coordination of Inter-Agency Task Force Working Group on Wildland Fire within the UN International Strategy for Disaster Reduction (ISDR)
* Emergency hotline and liaison capabilities for providing assistance for rapid assessment of wildland fire emergencies in collaboration with the United Nations Office for the Coordination of Humanitarian Affairs (OCHA) and the Joint UNEP Environment Unit, Emergency Services Branch.

The GFMC is acting as affiliated partner of the

* World Conservation Union (IUCN)
* International Strategy for Disaster Reduction (ISDR)
* United Nations Educational and Scientific Organization (UNESCO)
* World Bank, Disaster Management Facility (DMF) and the ProVention Consortium on Natural and Technological Disasters

- International Disaster Risk Management Institute (DRM)
- German Agency for Technical Cooperation (GTZ)

Furthermore the GFMC serves as coordinating or facilitating unit of the

- Biomass Burning Experiment (BIBEX) of the International Geosphere-Biosphere Programme (IGBP), International Global Atmospheric Chemistry (IGAC) Project, and
- the Forest Fire Research Groups of the International Union of Forestry Research Organizations (IUFRO) and the International Boreal Forest Research Association (IBFRA).

4. Partnership with IDNDR-ISDR

From the beginning of the UN International Decade of Natural Disaster Reduction (IDNDR) and particularly at and after the World Conference on Natural Disaster Reduction (Yokohama, Japan, 1994) and the closing event of the IDNDR, the Geneva Forum (1999), the GFMC formulated programmatic visions to cope with disaster fires at national, regional and international scales.

After the formation of the Working Group Fire and Related Environmental Hazards within the IDNDR Early Warning Programme the GFMC contributed to the IDNDR Early Warning Conference 98 (EWC98, Potsdam, Germany). The report of the IDNDR fire group [4] was published at the occasion of the Potsdam conference. The GFMC was also represented at the IDNDR Scientific and Technical Council (STC) meeting in Washington (1998). At the closing event of the IDNDR, the Programme Forum convened in Geneva, 5-9 July 1999, the Team contributed jointly with the IUCN to the thematic session "Disaster Reduction and Preparedness through Protection of Natural Resources" [5].

Following a proposal of the World Conservation Union (IUCN) and the Global Fire Monitoring Center (GFMC) the ISDR Inter-Agency Task Force for Disaster Reduction (IATF) at its second meeting on 11 October 2000 agreed to establish the Working Group Wildland Fire.

The GFMC is coordinator of the Working Group. Details of the working mode and the terms of reference of the Working Group are prepared in early 2001.

5. Support of other sectoral UN activities and other international consortia

Food and Agriculture Organization (FAO)

Several members of the GFMC and the ECE/FAO Fire Team (Finland, Germany, Spain, Turkey) participated at the FAO Expert Meeting "Public Policies Affecting Forest Fire" (FAO, Rome, October 1998) [21]. The GFMC contributed the forest fire analysis of the temperate-boreal zone of Europe-Asia [6]. The expert meeting was followed by the FAO meeting of the ministers of forestry which released the "Rome Declaration on Forestry" (March 1999).

After the FAO ministerial meeting the GFMC was tasked by the FAO to update/revise the multilingual FAO "Wildland Fire Management Terminology"; the base document (English) has been finalized in 2000. Jointly with an FAO consultant the GFMC is currently finalizing the FAO *Special Report on Forest Fires* within the Forest Resources Assessment (FRA 2000). The report attempts to provide a global analysis on the state of forest fires and the measures taken by the governments (draft is due in December 2000). Starting in December 2000 the GFMC has been entrusted by the FAO to establish and maintain the national reports and statistics on forest fires in the FRA 2000 homepage of the FAO. The GFMC also coordinates the preparation of the *FAO Guidelines for Fire Management in Boreal, Northern Temperate and Southern Temperate Forests*. The guidelines will follows the approach taken by the ITTO in developing the *ITTO Guidelines for Fire Management in Tropical Forests*.

An International Expert Meeting on Forest Fire Management, organised by FAO in cooperation with the International Tropical Timber Organisation (ITTO), was held at FAO Headquarters in Rome from 7 to 9 March 2001. The main objective of the meeting was to examine the need and capacity of concerned member countries in predicting, preventing, managing and fighting forest fires and propose an action plan to enhance international cooperation in fire management, including mutual assistance in fire emergencies. The GFMC represented the WGWF and called for cooperation with the ISDR/WGWF. The Expert Meeting requested FAO, ITTO and

collaborating agencies, to *"Participate in the existing initiatives and mechanisms such as the Interagency Task Force Working Group on Wildland Fire of the International Strategy for Disaster Reduction (ISDR); the United Nations International Search and Rescue Advisory Group (INSARAG); the Joint United Nations OCHA/UNEP Environment Unit, the Global Fire Monitoring Centre (GFMC), and actively support the development of their programmes, and facilitate linkages within the Collaborative Partnership on Forests (CPF)"* [22].

United Nations Forum on Forests (UNFF)

The UNFF has been established in accordance with ECOSOC resolution E/2000/L.32* (18 October 2000) as a subsidiary body of ECOSOC. The objective of the international arrangement on forests is "to promote the management, conservation and sustainable development of all types of forests and to strengthen long-term political commitment to this end." The arrangement should "provide a coherent, transparent and participatory global framework for policy implementation, coordination and development" and promote the implementation of forest-related decisions of the international forest regime. In carrying out principal functions of the arrangement, the work should be based on the Rio Declaration, the Forest Principles, Chapter 11 of Agenda 21. An Eight-Country Initiative called for an International Expert Consultation, held in Bonn, Germany from 27 November to 1 December 2000. The expert consultation was an informal forum at the expert level to exchange views and information among participants in their personal capacity. On behalf of the ISDR/WGWF the GFMC presented the views and highlighted the needs for cooperation between UNFF and the Collaborative Partnership on Forests (CPF) in the field of forest fire protection. The report of the expert consultation recommended areas of priorities to be identified by UNFF in which forest fires were included. Discussions were held with various partners to establish close links between UNFF / CPF and the Working Group on Wildland Fire (Appendix: Fig.1).

World Health Organization (WHO)

Recognizing that smoke originating from land-use fires and wildfires is cause of acute and long-term respiratory health problems and requires the development of a comprehensive strategy based on broad international consensus, the GFMC in 1998 began to cooperate with the World Health Organization (WHO). In November 1998 the WHO convened a meeting in Peru aimed to prepare the *Health Guidelines for Vegetation Fire Events* The GFMC chaired the meeting and co-edited and co-authored the Health Guideline Document and a comprehensive set of background documents on behalf of UNEP, WHO, and WMO [7, 8, 9]. The guidelines are designed to support decision makers in preparedness and management of health problems arising from wildland fire smoke pollution.

United Nations Educational and Scientific Organization (UNESCO)

The work of the United Nations Educational and Scientific Organization (UNESCO) was supported by participation at the UNESCO International Scientific Conference on Fires in the Mediterranean Forests [10]. One of the two declarations released by the conference explicitly recommended to cooperate with the GFMC by stating [11]:

> *The Global Fire Monitoring Center (GFMC) was established in 1998 and is currently co-sponsored, among others, by UNESCO, the IDNDR and several international fire research programmes, and cooperates with UN-ECE/FAO and FAO Silva Mediterranea. The overall goal of the GFMC is to facilitate information exchange and decision support at an international level by providing near real-time fire monitoring, archive data and other relevant information. Mediterranean countries are urged to actively contribute to continuously improve the information and data flow to the GFMC in order to create a most complete fire information system, to share expertise and to contribute to common international action programmes in fire management and policy development.*

In December 1998 the Director General of UNESCO had formally declared the partnership with the GFMC.

United Nations Environment Programme (UNEP)

In 1998 the GFMC contributed the UNEP meeting "Coordination UN Response to Indonesian Fires". In 1999-2000 the GFMC jointly with the IUCN cooperated with UNEP to prepare a request for funding from the Global Environment Facility (GEF) for a multinational network of Integrated Forest Fire Management (Community-Based Fire Management) projects. It is envisaged to establish partnerships between regions, such as the Baltic Region, the Mediterranean Region, ASEAN, the Southern African Development Community (SADC), or the Organization of American States (OAS). The project proposal is currently on hold.

The joint UNEP/OCHA Environment Unit, Emergency Services Branch, is the key link to the emergency management assistance to countries affected by extreme wildland fire situations (cf. para 7).

United Nations University Research and Training Center (UNU-RTC)

The GFMC has supported a feasibility study on the establishment of the *UNU Research and Training Center on Environment and Human Security*. The study recommends the establishment of this facility in Bonn, Germany. Among the environmental hazards to be addressed by the UNU-RTC, the theme vegetation fires has been prioritized. The GFMC is available to further support this UNU concept as the academic and training element in the UN family concerned with fire.

Other International Consortia outside the UN System

The GFMC furthermore supported the establishment and is affiliated member of the *ProVention Consortium on Natural and Technological Disasters* at the *World Bank Disaster Management Facility* (DMF); the GFMC participated at the foundation meetings in Paris (June 1999) and Washington (February 2000).

The GFMC is an affiliated institution and covers the wildland fire disaster component of the *World Institute for Disaster Risk Management* (DRM), a consortium of the Swiss Federal Institutes for Technology, Virginia Polytech, Swiss Reinsurance, and the World Bank.

6. Regional activities in fire management cooperation

UN-ECE Region

Within the ECE region the ECE/FAO/ILO Team of Specialists on Forest Fire and the GFMC regularly organizes regional seminars and conferences on forest fire issues. The last three conferences focused on the northern (temperate-boreal) forests:

* Forest, Fire, and Global Change (Russian Federation 1996)
* The First Baltic Conference on Forest Fires (Poland 1998)
* The Baltic Exercise on Fire Information and Resources Exchange - BALTEX FIRE 2000 (Finland 2000)

The next conference will be focusing on:

* Forest Fire in the Eastern Mediterranean, Balkans and adjoining Regions of the Near East and Central Asia (2002)

It is planned to organize this conference under co-sponsorship of the ISDR Interagency Task Force for Disaster and its Working Group Wildland Fire.

The BALTEX FIRE 2000 meeting for the first time provided a forum for fire scientists, managers and policy makers in which a multilateral prescribed burning and fire suppression exercise allowed to exchange information, personnel and material. BALTEX FIRE 2000 recommended a follow-up regional fire management programme aimed to contributed to the Baltic 21 Action Programme on Forests. This programme is in line with:

* The UN Conference on Environment and Development UNCED (Rio 1992): Forest Principles and the Agenda 21, Chapter 11 on "Combating Deforestation and other"
* The Intergovernmental Panel on Forest (IPF, 1995-1997); and
* The Ministerial Conferences on the Protection of Forests in Europe (Strasbourg 1990, Helsinki 1993, Lisbon 1998)

TACIS Cooperation

The Technical Assistance to the Commonwealth of Independent States (TACIS) Project ENVRUS-9701 "Improvement in Forest Fire Response System, Russia" is an example for technology transfer between EU member states and the Russian Federation. The overall goal of the project is to support the establishment of a fire

management information system that will enable conservation aims to be achieved in the implementation of sustainable forest management objectives. The project is technically and scientifically supported by a European consortium of three consulting companies which have included a number of European scientists. The GFMC has a project backstopping function and publishes the TACIS Project Newsletter on the GFMC Website [12].

NATO and Partners

After initial talks between the North Atlantic Treaty Organization (NATO) and Russia about new mechanisms in East-West cooperation in science in 1993 [13] a new initiative has been established within the NATO Science Programme. The NATO-Russia Joint Scientific and Technological Cooperation Committee under the auspices of the Scientific and Environmental Affairs Division of the NATO has organized a targeted program of cooperative research. The cooperative activity was be initiated with three seminars one of which was entitled *Forecasting and Prevention of Catastrophes, Safety in Natural and Industrial Aspects*. The seminar took place on 30-31 October 2000 in Moscow at the Russian Academy of Sciences and agreed on a scope statement defining the research area and outlining the range of potential collaborative research activities. The scope statement will be forwarded to the NATO-Russia Advisory Panel to provide the basis for solicitation of research proposals to be funded by NATO and member country government agencies. The concept paper *Implications of Global Change on Forest Fires* was introduced by the GFMC as an invited partner. Both sides, the representatives of the science community of NATO member states and Russia, agreed that priority must be given to address the problems proposed by the GFMC. The GFMC envisages to call for a *NATO Workshop on Advanced Fire Management Strategies in the Boreal Forest* to be convened in Russia in the near future (2001 or 2002).

Africa

Currently the GFMC prepares a regional Subsaharan Africa fire management initiative which builds on previous activities within the Southern African Development Community (SADC) region. A comprehensive survey of the countries South of the Sahara is underway and will be included in a *Handbook for Forest Fire Management in Subsahara Africa* in early 2001 [14]. The project is funded by the German Foreign Office, Office for the Coordination of Humanitarian Assistance.

ASEAN Region

The Association of South East Asian Nations (ASEAN) forms a political and geographic entity which seeks intra-regional and international cooperation in solving transboundary fire and fire-generated smoke pollution problems. ASEAN has appreciated inputs by ECE member countries to overcome the past and future environmental and humanitarian crises caused by indiscriminate burning of forests and other vegetation.

The GFMC contributed to the "Asia-Pacific Regional Workshop on Transboundary Pollution" (Singapore, May 1998) which was organized by the *Germany-Singapore Environmental Technology Agency* (GSETA). The ECE experience in transboundary air pollution was presented by various speakers. The team leader reported about common transboundary issues related to fire and haze in the ECE and the ASEAN region [15].

As a consequence of the South East Asian fire and smoke-haze pollution episode of 1997-98 the *World Meteorological Organization* (WMO) also called for a Workshop on Regional Transboundary Smoke and Haze in South-East Asia which followed the GSETA meeting on 2-5 June 1998, Singapore. The workshop was one element of WMO's efforts to enhance the capacity and capability of National Hydrometeorological and Meteorological Services (NMHSs) in South-East Asia to monitor and model smoke and haze episodes and the long range transport of anthropogenic pollutants, and to improve the NMHS's abilities to advise, alert, and generally manage these pollution events. It involved a review and discussion of regional plans such as the WMO *Program to Address ASEAN Regional Transboundary Smoke* (WMO-PARTS). Through the participation of the GFMC the expertise gained from research and development in the fire sector in the SE Asian region was contributed [16]. At a later stage of the SE Asian fire crisis the GFMC reviewed fire management guidelines at *the International Cross-Sectoral Forum on Forest Fire Management in South East Asia*, Jakarta, Indonesia, 7-8 December 1998 [17].

Furthermore the GFMC assisted the Asian Development Bank (ADB) to design a regional cooperation project "Strengthening ASEAN´s Capacity to Prevent and Mitigate Transboundary Atmospheric Pollution Resulting from Forest Fires" (RETA 5778-REG).

7. National fire management programs

During the report period the GFMC continued to support a broad range of bi- and multilateral scientific, technical fire management and fire policy development programmes in all continents. Most of the projects are long-term oriented, thus some of them go back to the early 1990s or even the 1980s. With the begin of the technical cooperation with Indonesia the GFMC developed the concept of Integrated Forest Fire Management (IFFM) which, among other, is based on a Community-Based Fire Management (CBFM) element. The IFFM Indonesia project is sponsored by the German Agency for Technical Cooperation (Deutsche Gesellschaft für Technische Zusammenarbeit – GTZ) with a lifetime of nine years (1994-2003) and a total funding of ca. DM 20 million.

A special focus has been developed by the GFMC to assist nations in developing long-term fire management strategies. So far the GFMC has initiated *National Round Tables on Fire* and facilitated long-term programmes in Indonesia (1992), Namibia (1999) and Ethiopia (2000).

8. Science and technology transfer

Fundamental research in fire ecology and atmospheric chemistry

During the 1990s the research conducted under the scientific framework of the *Biomass Burning Experiment* (BIBEX) of the *International Geosphere-Biosphere Programme* (IGBP), *International Global Atmospheric Chemistry* (IGAC) Project, and an increasing number of other projects have provided a sound base for understanding the implications of wildland fires on ecosystems, planetary-scale processes (biogeochemistry, atmospheric chemistry, climatology) and humanity. It is felt, however, that only a marginally small amount of fundamental knowledge has found its way to the level of application, especially in the disadvantaged countries of the developing world. A major objective of the work of the GFMC therefore is the science and technology transfer (see para. 6).

Remote sensing of wildland fires

Advanced sensor technologies and operational systems of dedicated fire satellites are required to improve the spatio-temporal coverage and information content for research and disaster management purposes. A prototype improved high temperature event (HTE) sensor, the Bi-spectral IR Detection (BIRD) small satellite mission is currently developed by the German Aerospace Center (Deutsches Zentrum für Luft- und Raumfahrt - DLR) in co-operation with the GFMC. The development of the Innovative Infrared Sensor System FOCUS, to be flown as an early external payload of the International Space Station (ISS) is another joint DLR-GFMC project.

Most significant is the cooperation of the GFMC with the work of the *Committee of Earth Observation Satellites* (CEOS). The GFMC provides inputs into the *Disaster Management Support Group* (DMSG) and the *Global Observation of the Forest Cover* (GOFC) Fire Implementation Team. A major synthesis publication on the state of the art and the future requirements of satellite remote sensing of vegetation fires and fire effects is currently prepared by GOFC and the GFMC [18].

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The GFMC is currently investigating to test the application of the *Charter on Cooperation to Achieve the Coordinated Use of Space Facilities in the Event of Natural or Technological Disasters* in cooperation with the European Space Agency (ESA), the French Centre National d'Études Spatiales (CNES) and the Canadian Space Agency (CSA).

9. International wildland fire emergency assistance

Until recently the mandate of the International Search and Rescue Advisory Group (INSARAG) of the United Nations has focussed to the "classical" SAR cases such as saving lives after earthquakes. However, experience has shown that secondary effects of natural and technogenic disasters require additional specialist advice in conjunction with SAR response and other humanitarian aid missions. The INSARAG family offers an appropriate structure.

At a regional INSARAG Europe-Africa meeting in December 1999 (Germany) a first proposal was elaborated to establish an INSARAG Fire Group consisting of three elements:

* Wildland Fire
* Hazardous Materials (Hazmat)
* Industrial Fire

At a meeting at the UN Office for the Coordination of Humanitarian Affairs (UN-OCHA) in January 2000 it was agreed that the original mandate of INSARAG which in addition to search and rescue would also covers wider aspects of disaster/emergency response. This could include a variety of natural and human-made disasters, including wildland fires. INSARAG would assist in strengthening OCHA's role by:

* Governmental experts advisory support in case of a major emergency
* Advisory experts to be provided out of the INSARAG family covering many fields of disaster relief

At the 5th INSARAG Regional Europe-Africa Conference (Hammamet, Tunisia, November 2000) the establishment of the Working Group Fire was formally decided. The terms of reference of the group include:

* Implementation of fire and HAZMAT topics into the INSARAG Guidelines as required
* Establishment of a database of human resources, equipment, information sources, evaluation of missions
* Facilitation of continuous exchange of information through the Internet, initially utilizing the OCHA Relief Web and other homepages and networks such as GFMC
* Support the Joint UNEP/OCHA Environment Unit, Emergency Services Branch, by providing expertise and knowledge of its members

Between December 1999 and the Hammamet Regional INSARAG Conference the GFMC facilitated the work of the provisional Fire Group, including its participation at BALTEX FIRE 2000. The GFMC favours the establishment of an international INSARAG Working Group on Wildland Fire for all INSARAG regions.

In view of recent experiences, in particular the large forest fires in Indonesia (1997-98), the Russian Federation (1998) and Ethiopia (2000), the Joint UNEP/OCHA Environment Unit, Emergency Services Branch, and the Global Fire Monitoring Center (GFMC) recognized the need for improved cooperation in early warning, information dissemination and response to wildland fire emergencies. In February 2001 it was agreed between the Joint UNEP/OCHA Environment Unit, Emergency Services Branch, and the GFMC to elaborate details for a cooperative agreement. In April 2001 both institutions signed Interface Procedures that regulate of communication flows and information sharing between both institutions.

This new development represents an initiative which would support Decision 21/17 o the 21st Session of the UNEP Governing Council (UNEP/GC21/L.6) in which it was recommended to enhance long-term strategic cooperation between ISDR and the Joint UNEP/OCHA Environment Unit.

10. Disaster management networks and use of advanced Information and Communication Technology (ICT)

The GFMC is in close contact with numerous providers of data and information which is needed to compile and analyze the wildland fire situation at national to global scales. Various information networks are linked with the GFMC. The GFMC has also been used in providing near-real time situation reports during fire crises, most prominently during its involvement in assessing of and responding to the large fire emergency in Ethiopia, February to April 2000 [19].

The GFMC is observing the development of upcoming networks such as the Global Disaster Information Network (GDIN international). GDIN international is a concept for reducing the impact of natural and technological disasters through better application of information technology to disaster management.

The Workshop on Natural and Technological Hazards Research in the European Union: Contribution to a Mediterranean Disaster Information Network (MEDIN), held at the European Commission in Brussels in November 2000, elaborated a regional initiative which is carefully being observed by the GFMC. MEDIN is an initiative to

promote the sharing of disaster related information, data, research results, knowledge and expertise with the GDIN-International partners and shareholders.

The GFMC is available to share its expertise with GDIN international and MEDIN.

11. Organizational and scientific setting of the GFMC in Germany

The GFMC is established at the Fire Ecology Research Group, a subdivision of the Max Planck Institute of Chemistry, Biogeochemistry Department. The location of the GFMC is the University of Freiburg where a basic course on fire ecology and fire management is offered at the Faculty of Forest Science [20]. The GFMC supervises and acts as examiner (referee) for doctoral dissertations in a number of universities worldwide.

In Germany the head of the GFMC serves as a member in the Board of Directors of the German Committee on Disaster Reduction (within the ISDR) and its Scientific and Operational Advisory Boards (http://www.dkkv.org/). The GFMC is also member of the German Research Network for Natural Disasters and coordinates the Forest Fire Cluster (http://dfnk.gfz-potsdam.de/).

The GFMC through its head is full member of the Scientific Council of the Siberian Centre for Ecological Research of Boreal Forests and the International Laboratory of Forest Fire Ecology (Krasnoyarsk, Russian Federation).

The GFMC and its precursor host facility, the Fire Ecology Research Group, convened a number of international conferences on wildland fire ecology, strategic science planning and policy development.

12. Conclusions and outlook

The El Niño of 1997-98, its resulting circum-global climate extremes, and the associated fire and smoke episode have revealed the need to address vegetation fires at international or truly global scale. Much of the work of the Fire Ecology Research Group, jointly with the partners of the ECE/FAO Fire Team and the GFMC network, during the recent years has been devoted to create interdisciplinary and international synergies to achieve this goal.

One of the strategies of the GFMC was the systematic cooperation with international agencies, programmes and consortia by establishing links to focal points within these different groups. It seems that in the year 2000, right at the beginning of the work of the ISDR, this community, jointly with the civil society including the academia, is ready to collaborate.

Through the ISDR Interagency Working Group on Wildland Fire it is envisaged to establish interagency and intersectoral forum of UN agencies and programmes, mechanisms of information and task sharing in the field of reducing the negative impacts of fire on the environment and humanity. The Working group will be supported by a Consultative Group consisting of representatives of the civil society, including the academia, non-government organizations, and the industry active in relevant fields or potentially to be involved.

The terms of reference of the Working Group yet has to be determined at its constituting meeting. However, taking into consideration earlier international conference resolutions there is a strong feeling that the Working Group will give priority to:

* Establishment of internationally agreeable criteria for fire damage assessment and procedures for a Global Vegetation Fire Inventory i.a.w. with the requirements of the Conventions on Climate and Biodiversity as well as the overall scope of work of the UN agencies and programmes; and
* Development of a scheme for the establishment and operational procedures of a global network of regional to national focal points for wildland fire early warning, monitoring and impact assessment, with the objective to enhance the capabilities of the existing Global Fire Monitoring system.

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Appendix I

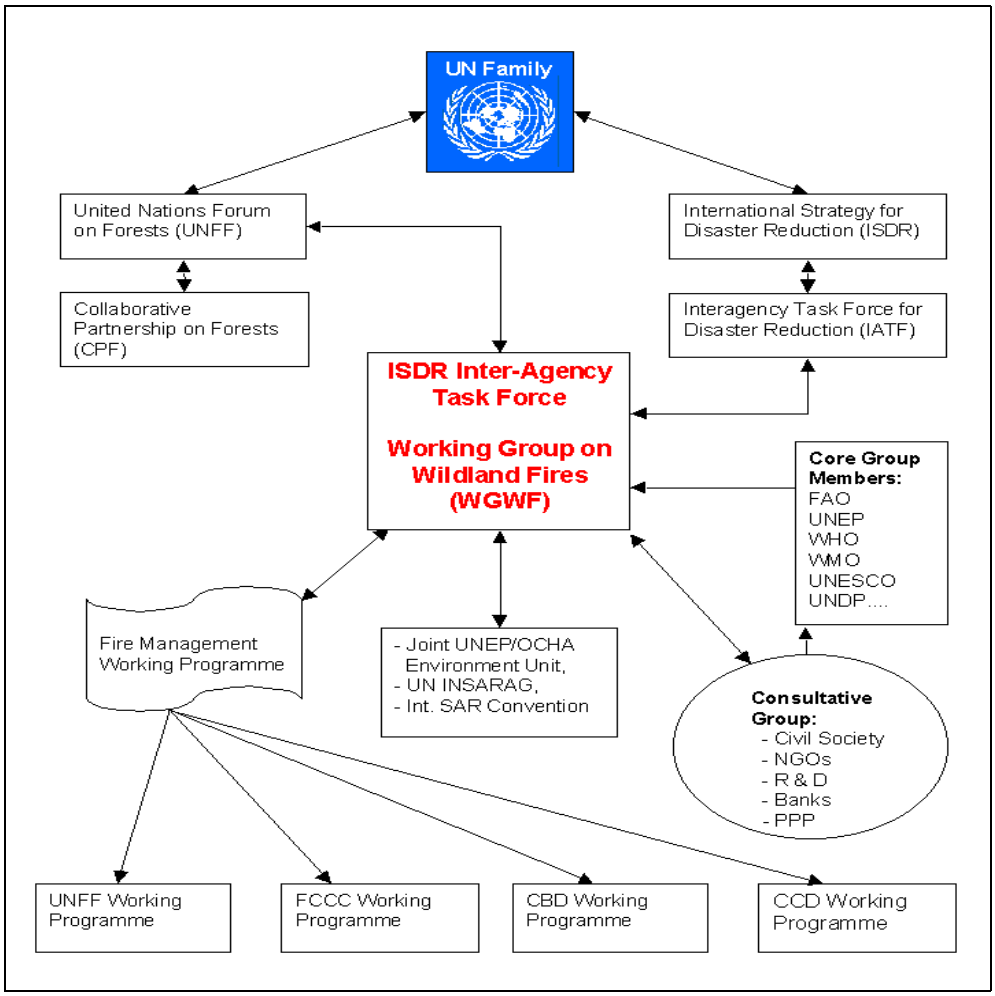

Fig.1. Draft structure of international fire management working programme between the ISDR and United Nations Forum on Forests (UNFF) and the Collaborative Partnership on Forests (CPF) in conjunction with other UN and non-UN programmes.

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS (FAO)

Report on the FAO/ITTO International Expert Meeting on Forest Fire Management[1] Rome, Italy, 7-9 March 2001

I INTRODUCTION

1. The International Expert Meeting on Forest Fire Management, organised by FAO in cooperation with the International Tropical Timber Organisation (ITTO), was held at FAO Headquarters in Rome from 7 to 9 March 2001.

2. The meeting was held in follow-up to the FAO meeting on Public Policies Affecting Forest Fires, held in Rome in October 1998, which identified the need for support to the development of regional and bilateral Agreements for collaboration in forest fire management, including identification of technical and financial inputs; improved sharing of information and knowledge, and support to strengthened technical cooperation among developing countries i.a. through networking and twinning; and identification of the roles which FAO and other international organisations could play in this regard, including technical assistance, institutional support and capacity-building.

3. Organization of an international expert meeting on forest fires was, further, recommended in the consultancy report, "Proposals for Strengthening FAO's Role Regarding Forest Fire Management" (FAO 2000)[2].

4. The specific objectives of the meeting were to:

   (i) Examine the need and capacity of concerned member countries in predicting, preventing, managing and fighting forest fires;

   (ii) Identify countries that have such capacity, and the period of the year when they could put know-how and equipment at the disposal of others who might need it;

   (iii) Identify countries that could potentially utilise the capacity available with others during a relevant period of the year; and

   (iv) Explore the possibility of organizing the necessary logistics and compensation in inter-country arrangements of this kind.

On the basis of findings in (i) to (iv) above, the experts were to recommend action related to:

   (v) Development of human resources and mechanisms needed to support cooperation in forest fire management and control, mainly at bilateral, regional and, eventually, international levels; and

   (vi) Mechanisms for the establishment of inter-country Agreements among groups of two or more countries, aimed at coordinating efforts to establish norms and to share resources, personnel and equipment in situations of emergency. This would include review of the feasibility to share heavy land and aerial equipment, and on prospects for developments on a wider geographic basis.

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[1] The designations employed and the presentation of material in this publication do not imply the expression of any opinion whatsoever on the part of the Food and Agriculture Organization of the United Nations concerning the legal status of an country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries.

The printed report is available in five languages (English, French, Spanish, Arabic, Chinese). A list of acronyms is given at the end of this report.

[2] Available from Forest Resources Division, Forestry Department, FAO, Rome (Italy).

The Experts would, further:

(vii) Help identify the role of international organizations in promoting the work in points (i) to (vi).

5. The Agenda of the meeting is given in Annex 1.

6. The attendance in the Expert Meeting is detailed in Annex 2. The eighteen experts, from 14 countries, invited by the Director-General of FAO, were selected on the basis of their specialised knowledge and their familiarity with policies, practices, databases, monitoring procedures and dialogue in international, regional and national forest fire management. The experts served in their personal capacity and not as representatives of their governments or organizations.

7. Participants in the meeting included resource persons from each of FAO and ITTO as the two co-sponsoring agencies and international NGOs including IUCN/WWF and GFMC. Regrets were received from UNESCO, the World Bank, UN/ECE and the UN University. UNEP, WHO and CIFOR were unable to attend.

8. A number of FAO staff members from other units of the Forestry, Legal, Agriculture and the Sustainable Development Departments, attended the Opening and some of the sessions of the meeting.

II OPENING OF THE MEETING

(Agenda Item 1)

9. Mr. M. Hosny El-Lakany, Assistant Director-General, Forestry Department, welcomed the participants to the International Expert Meeting on Forest Fire Management on behalf of the Director-General of FAO, Mr. Jaques Diouf.

10. Mr. El-Lakany noted that the meeting was organized by FAO in collaboration with the International Tropical Timber Organization (ITTO). He expressed the appreciation of FAO for the continuing, constructive collaboration with ITTO as a long-standing partner in the forestry field.

11. Mr. El-Lakany noted that the recent occurrence of extensive forest fires in different parts of the world had deepened the concern of policy makers, technicians and scientists, the general public, and the mass media alike.

12. He mentioned that causes, extent and effects of forest fires were related not only to climatic and environmental conditions, but also to national policies, laws and institutions.

13. He stressed that people used fire because they expected to obtain benefits from its use. The problem was not so much in its use as in its management. The overall goal of a policy on fire had to be focused on reducing adverse effects. Fires constituted a serious threat not only to the environment and human livelihoods, but also to human life. Conversely, fire was an important phenomenon in the dynamics of most ecosystems, and an essential tool in human management of such systems.

14. Mr. El-Lakany referred to the meeting on Public Policies Affecting Forest Fires mentioned above, in which several of the participants attended. He re-iterated the findings of the Public Policies meeting that emergency responses only to suppress forest fires were not adequate by themselves; and that the key lay in forging links between sustainable land use policies and practices on the one hand and emergency preparedness on the other. He noted that, ultimately, private owners and local people must be intimately involved in the development and implementation of strategies and methodologies; involvement of all stakeholders was essential for success in forest fire prevention, prediction, suppression and monitoring.

15. Co-operation between sectors at national level and between countries at international level was becoming increasingly important. Recent large-scale fires throughout the world had resulted in instances of countries assisting neighbouring countries on an *ad hoc* basis. Such cooperation could be significant also in establishing shared databases, strengthening policy-making capabilities, and developing institutional and legislative frameworks.

16. Mr. El-Lakany noted that FAO had over the past years been active in the field of forest fire management, through support to member countries in policy level dialogue, the collection, analysis, interpretation and dissemination of information and know-how, the updating of forest fire terminology, and the development of methodologies and strategies related to early warning, prevention, management, control and remedial action following forest fires- *i.e.* rehabilitation. In this work, FAO had closely collaborated with national institutes in member countries, and with a number of international partners.

17. In line with its mandate, FAO planned to strengthen its work in the field of forest fire management in the coming years. In this regard, FAO will continue to support countries to strengthen national capacities and capabilities, and, in collaboration with international partners, support the sharing of information and know-how among countries.

18. Mr. El-Lakany stressed that in line with the objectives, the meeting should help review and support the development of mechanisms for the establishment of inter-country Agreements aimed at cooperation and collaboration between countries and, where feasible, the development of bilateral arrangements by which countries might share resources, personnel and equipment in situations of emergency. Requests from countries for this kind of support clearly indicated that as forest fire management issues were of utmost importance in achieving sustainable forest management, FAO and other agencies had to support countries to respond to these challenges.

19. In closing, Mr. El-Lakany noted that the conclusions, recommendations and action plans to be developed by the present expert meeting would be made available to the 15th Session of the Committee on Forestry to be held in Rome during 12-16 March, 2001. Recommendations of COFO would, subsequently, be incorporated into the FAO work programme, including forthcoming initiatives related to forest fire management.

20. The representative of ITTO, Mr. Efransjah, joined Mr. El-Lakany in welcoming the forest fire experts and participants to the meeting and acknowledged the close working relationship with FAO in key issues relating to sustainable forest management. He concurred with the statements of Mr. El-Lakany on the major constraints and inadequacies in forest fire management.

21. Mr. Efransjah emphasized the challenge to synergize the work of all international institutions in order to better respond to the needs of member countries in forest fire management, including prevention. He mentioned the ITTO Guidelines on Fire Management in Tropical Forests as one of the key references under preparation by FAO, of guidelines for temperate and boreal forests. Mr. Efransjah noted that ITTO had redefined its role in forest fire management in light of the recent major fires in Indonesia and SE Asia. ITTO had a policy of collaborating and participating in inter-agency initiatives on forest fire management; he suggested that the expert meeting prepare a concrete plan of action to prioritize the support needed to serve countries and strengthen capacity and response to forest fire management. He looked forward to collaboration with FAO and other international agencies in supporting achievable initiatives that would make immediate and major impacts in forest fire management.

III. ELECTION OF CHAIR AND VICE-CHAIRS

(Agenda Item 2)

22. The meeting elected Mr. Ricardo Vélez Muñoz Chair; and Mr. Johann G. Goldammer and Mr. Samsudin Musa Vice-Chairs. Mr. Jan Troensegaard acted as Rapporteur. Ms. Christel Palmberg-Lerche, Mr. J.B. Carle, Mr. M. Paveri and Ms. G. Allard served in the Secretariat of the meeting.

IV. ADOPTION OF AGENDA

(Agenda Item 3)

23. The Provisional Agenda as proposed by the Secretariat was adopted (see Annex 1).

24. Mr El Hadji Sène, Director, Forest Resources Division, Forestry Department, FAO, re-iterated that there had been a dramatic increase in the incidence and impacts of fire in recent years, however, the responses for suppression had been inadequate and often ad hoc. He outlined the objectives, outputs, format and content of the present expert meeting. Background documentation for the meeting were highlighted with special reference to the consultancy report "Proposals for Strengthening FAO's Role Regarding Forest Fire Management", mentioned above; technical papers by FAO, ITTO and other organisations made available; case studies prepared in advance by experts; Agreements and operational plans used by collaborating countries, and submissions by international agencies in line with the objectives of the meeting. Mr Sène concluded by stressing the need for cooperative and collaborative approaches in preparation of components of an action plan, with particular reference to capacity building and mechanisms in forest fire management and legal instruments for emergency responses. He emphasized that FAO was seeking expert advice on the key issues and recommendations for both immediate and longer term implementation and working groups were designed to facilitate these outputs (see Annex 3 and Annex 4).

V. CONCLUSIONS AND RECOMMENDATIONS

Preamble

25. The experts noted that many previous consultations and meetings on forest fire management had consistently developed a number of recommendations which still awaited effective implementation. What was urgently needed today was an action plan specifying responsibilities and time frames for completion of the tasks at hand.

26. Stressing that forest fire management was an integral component of sustainable forest and land management, the experts noted the following:

(i) The FAO Meeting on Public Policies Affecting Forest Fires, 1998, recommended that countries adopt sustainable forest and land use policies and practices to manage the flammability of forests;

(ii) The vital existing roles and potential for the participation of communities in forest and vegetation fire management was a critical consideration for sustainability;

(iii) If sustainable forest management practices were not established, then emergency responses of any kind would ultimately fail;

(iv) On-going international criteria and indicators processes for sustainable forest management included indicators related to forest fires and the FAO coordinated Global Forest Resources Assessment database was being expanded to incorporate sustainability indicators;

(v) Widespread emergencies in recent years in all regions of the world underscored the importance of having fire management cooperation and international Agreements on mutual assistance and emergency response established in advance of fires;

(vi) Prevention implied the actions in the fields of public awareness, equipment and infrastructure, enforcement and fire fuel management;

(vii) There was an urgent necessity for countries to activate strong and effective fire prevention measures. It was better to prevent a wildfire than fight one; and

(viii) Member countries needed to develop effective emergency response procedures internally, so that they could more effectively receive and efficiently use outside assistance.

Key Issues to be Addressed

27. The experts noted that unmanaged and unplanned forest and other vegetation fires had negative impacts on human health and livelihoods, availability of forest products and services, biological diversity, and possibly climate change. In spite of allocation of increased resources, the number, scale and impact of forest and vegetation fires had increased in many countries in recent times.

28. The experts further noted that existing national organisations and international agencies and mechanisms, some of them with long-standing and significant experience, had struggled to address the complexities and problems of forest fire management. In spite of this, much of the work and efforts of reviews, missions, studies and development of new international structures had not translated effectively into meaningful and sustained improvement in the management of forest fires around the world.

Major Constraints and Challenges

29. The experts stressed that the main reasons identified for the above situation were:

(i) Lack of national land-use and fire policies and their implementation, and lack of recognition and compliance with related international processes and conventions;

(ii) Low level of awareness among policy makers, decision makers and the public, which led to institutions lacking adequate resources, focus and capacity;

(iii) Insufficient human resource capability in most aspects of forest fire management due to inadequate education and training;

(iv) Inadequate awareness, dissemination and understanding of existing information and experiences, lack of socialisation of information and know-how (e.g. early warning systems, use of prescribed fire);

(v) Lack of basic quantitative and qualitative information and data, which provided a relevant, useful and often necessary basis for the interpretation and meaningful analysis and use of forest fire statistics;

(vi) Lack of appropriate bilateral and multi-lateral Agreements for mutual assistance prior to fire emergency events.

Recommendations

30. The experts recognized the fundamental requirement for effective sustainable forest and land management policies and practices. To achieve this objective, an overriding priority was the establishment of Agreements, protocols and institutional capacity to better share international fire management resources, knowledge and understanding.

31. The Expert Meeting requested FAO, ITTO and collaborating agencies, to support action as set out in recommendations below:

32. Policy

(i) Identify relevant existing policy instruments, mechanisms and networks which could support and strengthen commitment and action on forest fire management; and

(ii) Support activities that bring local people, professionals and policy makers together and build awareness and capacity.

33. Technical Support

(i) Facilitate networking and collaboration between countries through identifying or creating national focal points;

(ii) Exchange experiences through institutional collaboration;

(iii) Provide technical support to enhance management of forest resources that include fire prevention measures as an integral part of such action;

(iv) Improve capacity and capability to prepare for forest fires, particularly in countries that have existing gaps in attributes such as laws, policy, planning, practices and monitoring;

(v) Catalyze action in providing technical support to member countries in development of Agreements[3] at bilateral and regional levels (see Annex 5. and Annex 6.);

(vi) Strengthen in-house human and non-staff resources to respond to increasing issues and actions in forest fire management.

34. Information and Data Bases

(i) Make information available on techniques, networks, resources, collaboration and approaches to forest fire management;

(ii) Develop a data standard within the Forest Resource Assessment framework to address the requirements of national and international fire management reporting needs;

(iii) Review on-going activities in forest fire management by international and regional organisations to clarify linkages, facilitate collaboration and identify gaps. Key factors are land use policies and practices, community based fire management, knowledge, training, public awareness, institutional arrangements;

(iv) Synthesize and support the preparation of country profiles which provide international collaborators and donors an insight into institutional set-up and operational responsibilities at national level, as well as basic information without which outside assistance will not be effective or even possible. Aspects in such country profiles to include reference to: political will, governance, security, socio-economic, climate, vegetation, demography, resources (personnel, equipment, funds, information and infrastructure);

(v) Establish an international forest fire information centre to facilitate the sharing of world-wide information among all partners regarding such issues as: Agreements, resource availability, contacts at regional, eco-regional, global levels, etc. This centre should provide real-time situation reports and conditions. In addition, the centre should be institutionalised in order to play an advisory role in assisting countries to develop Agreements and respond to emergencies.

35. Emergency Response Agreements

(i) Develop emergency response Agreements bilaterally and multilaterally (at regional or global levels, as appropriate); details will vary depending on considerations that may vary from region to region;

(ii) Encourage forest fire management cooperation, and catalyze and support the development of new emergency response Agreements, making full use of already existing regional and other mechanisms, such as those in the CILSS, SADC, Mediterranean, Baltic, South-East Asia, Central America, Caribbean, South America and other regions, as yet to be identified;

(iii) Compile an inventory of existing emergency response Agreements to serve as models for others. Guidelines or models should be prepared for developing such Agreements and related operating plans and protocols. FAO could distribute a questionnaire soliciting opportunities for new Agreements;

(iv) Activate a task force to track and monitor progress in the development of Agreements and collaboration and develop a detailed action plan that defines time frames, responsibilities and costs to implement the recommendations of the International Expert Meeting[4];

(v) Develop funding mechanisms to encourage vigorous action that leads to the development of emergency response Agreements;

(vi) Establish compatible incident management organisation systems in countries to facilitate the integration of international resources; such mechanisms need to be compatible between them, but do not need to be identical;

(vii) Review and expand a "Fire Season Table", for all countries to show complementing and overlapping fire seasons; the purpose of this information would be to determine availability of resources from other countries, in cases of emergency (example given in Annex 7.);

[3] Agreements for mutual assistance in preparation for, and emergency response to, fire events.
[4] See Annex 8 for a preliminary draft action plan and timeframe.

(viii) Continue and strengthen the update and dissemination of forest fire management related information in collaboration with organizations to be determined;

(ix) Develop training and briefing programmes for emergency response teams, based upon on-going experiences; and

(x) Catalyze and support the development of emergency simulation response exercises among countries prior to emergency situations arising.

36. Collaborating Agencies

(i) Participate in the existing initiatives and mechanisms such as the Interagency Task Force Working Group on Wildland Fire of the International Strategy for Disaster Reduction (ISDR)[5]; the United Nations International Search and Rescue Advisory Group (INSARAG)[6]; the Joint United Nations OCHA/UNEP Environmen Unit[7], the Global Fire Monitoring Centre (GFMC), and actively support the development of their programmes, and facilitate linkages within the Collaborative Partnership on Forests (CPF) [8]; and

(ii) Prepare a preliminary action plan and time schedule (initially without prioritization) for implementing the above recommendations (see Annex 8.).

[5] Mandate to prevent and reduce natural disasters, including wildland fires.

[6] Mandate to coordinate on-site response to emergencies, including wildland fires. An International Search and Rescue Convention is currently being prepared to explicitly include a wildland fire emergency component.

[7] Mandate to coordinate international response to natural disasters, including wildland fire.

[8] Mandate to advance implementation and monitor progress in agreed actions for sustainable forest management and to enhance international cooperation on forest-related issues, including wildland fires.

ANNEX 1

Annex I of the original report contains the agenda of the meeting. In this version of the report the editor of IFFN has included a group photograph showing most of the participants listed in Annex 2.

Fig.1. Participants of the FAO/ITTO International Expert Meeting on Forest Fire Management. First row (from left to right): Ricardo Velez (Spain), Johann G. Goldammer (Germany), Christel Palmberg-Lerche (FAO), Oscar Cedeño S. (Mexico), Johan P. Heine (South Africa). Second (middle) row: Mustafa Kizmaz (Turkey), Panagiotis K. Balatsos (Greece), Patricio I. Sanhueza (Chile), Ronaldo V. Soares (Brazil), Efransjah (ITTO), Gillian Allard (FAO), Brian J. Stocks (Canada). Third row: Manuel Paveri (FAO), Samsudin Musa (Malaysia), E.H. Sène(FAO), Jan Troensegaard (FAO/Denmark), Gavriil Xanthopoulos (Greece), Robert W. Mutch (USA), Davide Pontani (Italy), Peter F. Moore (IUCN-WWF), Million Bekele (Ethiopia), Richard Sneeuwjagt (Australia).

ANNEX 2

FAO/ITTO International Expert Meeting on Forest Fire Management

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[10] A number of other colleagues from the Forestry Department attended the Opening and part of the sessions of the meeting.

ANNEX 3

Report of Working Group 1:

Human Resources Development, Strengthening Institutional Capacity and Mechanisms for International Cooperation in Forest Fire Management

The working group addressed issues, constraints and recommended actions to strengthen existing mechanisms, networks and institutional capacity (including human resource development) to enhance cooperation and collaboration in forest fire management at bilateral, regional and international levels. The role of national, regional and international agencies were taken into consideration.

Working Group 1 - Members

Goldammer, J.G. (Germany)
Moore, P.F. (IUCN/WWF)
Musa, S. (Malaysia)
Pontani, D. (Italy)
Stocks, B. J. (Canada)
Troensegaard, J. (Denmark)
Viana Soares, R. (Brazil)
Xanthopoulos, G. (Greece)
Efransjah (ITTO)
Sène, E. H. (FAO, Director, FOR)
Palmberg-Lerche, C. (FAO, Chief, FORM)
Carle, J. B. (FAO, FORM)

Observer (part time)

Mr. Dario Morini (see Footnote 8)

Key Issues Addressed – What?

- The number, scale and impact of forest and vegetation fires had increased in recent times. With negative impacts on livelihoods, human health, biodiversity, forest services and possibly climate change;
- The existing national organisations and international mechanisms, some of them with significant experience, had struggled to address the problems and complexities of forest fire management; and
- Much of the work and effort of reviews, missions, studies and international structures had not translated effectively into meaningful and sustained improvement in the management of forest fire around the world.

Major Constraints and Challenges – Why?

Some of the main reasons identified for the above situation were:

- Lack of national fire policy and its implementation, and lack of recognition and compliance with related international processes and conventions;
- Low level of awareness among policy makers, decision makers and the public, which led to inadequately resourced institutions lacking adequate focus and capacity;
- Insufficient human resource capability in most aspects of forest fire management due to inadequate education and training;
- Existing information and experience was not well known, effectively distributed, understood or socialised (*e.g*: early warning systems, use of prescribed fire);
- Fire statistics had not always supported meaningful analysis. Both quantitative and qualitative information and data, which was relevant and useful was required.

Recommended Actions – How to overcome?

FAO/ITTO were requested to support the work with relevant agencies as set out in the following points:

- Information be made available on techniques, networks, resources, collaboration and approaches to fire management;

- Develop a data standard that addresses the requirements of national and international fire management reporting needs within the Forest Resources Assessment framework;
- Facilitate networking and collaboration between countries through identifying or creating national focal points;
- Exchange experience through institutional twinning;
- Review ongoing activities in forest fire management by international and regional organisations to clarify linkages, facilitate collaboration and to identify gaps. Key factors being land use policies and practices, knowledge, training, public awareness, institutional arrangements;
- Identify relevant existing policy level Agreements, mechanisms and networks which could support and strengthen commitment and action on forest fire management;
- Support activities that bring local people, professionals and policy makers together and build awareness and capacity;
- Synthesise and support the preparation of country profiles that provide international collaborators and donors and insight into institutional set up, operational responsibilities, and provide basic information without which outside assistance will not be effective or even possible. Aspects to include: political will, governance, security, socio-economic, climate, vegetation, demography, resources (personnel, equipment, funds, information and infrastructure);
- Improve capacity and capability to prepare for forest fires, particularly for countries that have existing gaps in these attributes such as laws, policy, plans, practices and monitoring; and
- FAO strengthen its regular programme activities in the field of forest fires through appointment of a full time Forest Fire Officer at FAO Headquarters.

Collaborating agencies (co-ordinating with existing initiatives and mechanisms) – Who?

Noting that a large number of institutes, agencies and mechanisms were active in the field of forest fires, operating at various levels and with different foci, scope, and level of resources, FAO and ITTO, together with partners should discuss and review forest fire-related initiatives, activities and arrangements. These included, among others;

International agencies and organizations, such as:

- UNESCO
- WHO
- UNEP
- UN University
- UN/ECE Trade Division
- World Bank
- IUCN
- WWF
- GFMC

International mechanisms, such as:

- UNFF and the Collaborative Partnership on Forests
- Interagency Task Force for Disaster Reduction (ISDR), Working Group on Wildland Fire
- INSARAG
- OCHA

Regional mechanisms or policy frameworks, such as:

- Regional Forestry Commissions coordinated by FAO

* Silva Mediterranea
* CIHEAM
* ECE/FAO/ILO Team of Specialists on Forest Fire
* Baltic Fire
* SADC, CILSS, IGAD, ASEAN, CCAD

Scheduling and Cost Estimates

The Group recognised the need to develop a time scale for recommended priority action, and to develop corresponding cost estimates or approximations, the Group requested that FAO, in collaboration with ITTO and other international partners, develop a provisional framework plan for further discussion and elaboration.

ANNEX 4

Report of Working Group 2:

Inter-Country Agreements to Share Resources in Emergencies

The working group addressed issues, constraints and recommend actions relating to inter-country Agreements to establish operational procedures and share resources, information, personnel and equipment in situations of emergency. This would include review of the feasibility to share heavy land and aerial equipment and prospects for development on a wider geographic basis.

Working Group 2 (Legal Instruments)

Balatsos, P. (Greece)
Bekele, M. (Ethiopia)
Cedeño Sánchez, O. (Mexico)
Heine, J. (South Africa)
Kizmaz, M. (Turkey)
Mutch, R. (USA)
Sanhueza, P. (Chile)
Sneeuwjagt, R. (Australia)
Vélez Muñoz, R. (Spain)
Paveri, M. (FAO, Chief, FONP)
Mekouar, A. (FAO, LEGN)
Allard, G. (FAO, FORM)
Malagnoux, M. (FAO, FORC)

Forest Fire Emergency Cooperation Agreements

The Group identified the existence of a number of Forest Fire Emergency Co-operation Agreements at various levels, including:-

* in-country Agreements
  - central level
  - local level
* bilateral Agreements; and
* multilateral Agreements

A list of Agreements known to exist and referred to by the experts in given in Annex 5.

It will be necessary to use the comprehensive and proven instruments as base documents for other countries seeking or providing assistance to derive their own Agreements suited to their unique circumstances.

Key contents to be considered by countries as a base for preparation of their Agreements are listed in Annex 6.

RECOMMENDATIONS

Considering that:

Forest fire management was closely linked to sustainable forest management practices;

Member countries were strongly encouraged to establish sustainable forest management policies and practices to reduce the flammability of forests. If sustainable practices were not established, then emergency responses of any kind would ultimately fail;

Member countries were encouraged to activate strong and effective fire prevention campaigns. It was better to prevent a wildfire than fight one. Prevention implies public awareness, equipment and infrastructure preparation, enforcement and fire fuel management;

Member countries were encouraged to develop effective emergency response procedures internally, so that they would be able to more effectively receive outside assistance;

Widespread emergencies in recent years in all regions of the world had underscored the importance of having International Agreements established in advance of fires;

Efficient emergency assistance required prior planning among all parties due to the nature of forest fires to prepare personnel, organisation, equipment, procedures, etc.

It was recommended that FAO and ITTO and other relevant partners:

* Develop Agreements bilaterally and multilaterally (at regional or global levels, as appropriate), with due consideration to conditions which may vary region by region;
* Encourage the development of new Agreements through existing regional and other mechanisms. taking into consideration experiences to date;
* Provide technical support to member countries in development of Agreements at national and regional levels;
* Compile an inventory of existing Agreements to serve as models for others. In this regard, FAO may consider distributing a questionnaire soliciting opportunities for new Agreements;
* Activate a task force to track and monitor progress in the development of Agreements and develop an action plan that defines objectives, outputs, activities, inputs, costs, timeframes and responsibilities to implement the recommendations of the International Expert Meeting;
* Review possibilities for developing appropriate funding mechanisms to encourage action leading to the development of Agreements;
* Assist countries to describe and establish mutually compatible incident management organisation systems to facilitate the integration of international resources;
* Review and apply regional or eco-regional, or global, “Fire Season Tables”, showing coincidence of overlapping fire seasons in determining availability of international resources (example given in Annex 7.);
* Review the possibilities to coordinate the tasks of information updates and sharing;
* Review recommendations and identify appropriate organizations and agencies to take action;
* Develop training, technical exchanges and briefing programmes between countries in non-crisis situations in preparation for emergency response;
* Develop emergency simulation response exercises among countries;
* Assist to establish an international forest fire information centre to facilitiate the sharing of world-wide information among all partners regarding such items as: Agreements, resources availability, contact points, etc. This centre would provide real time situation reports and conditions. In addition, the centre would be institutionalized to provide an advisory role in assisting countries to develop Agreements and respond to emergencies;
* Disseminate information on issues and experiences in the use of volunteers, local communities and other resources in prevention and remedial action in forest fire management;.
* Disseminate information and support training in the application of airborne and remote sensing technologies as tools in integrated fire management.

ANNEX 5

Tabel 1. Some Existing Agreements for Mutual Assistance and Emergency Response[11]

Agreement Type	Country	Agreement Partner Descriptions
In-country	USA	National, with individual States (National Wildfire Coordinating Group National with Military
	Mexico	Federal Government with individual States
		Federal (SEMARNAP) with Military
	Chile	National Government with Regions
		National Government with Private Sector
		Bilateral Agreements between Regions
		Bilateral Agreements between Regions and Private Sector
		Private to Private Sector Agreements
		Other Agreements with Armed Forces, Fire Brigades etc
	Australia	Federal Government with individual States (large emergencies)
		State to State agreements
	South Africa	Agreements with Military
		Agreements between Provinces and National Government (under formulation)
	France	Prevention done within Forestry Sector
		Fire Suppression under Civil Society (Military Corps)
		Centralized authority decides how, without formal Agreements
		Local Authorities have local mechanisms to share resources
	Ethiopia	Individual Regions responsible
		Federal level have funds for Emergency Plans to share resources
	Spain	National Coordinating Committee establishes rules for Sharing Central Government resources to fight fire when Autonomous Region resources need
		Bilateral Agreements between Regions (principle of single command, each agency covers costs of services provided)
		Agreements with Armed Forces
	Greece	Resources centrally allocated in cooperation with Districts for fire suppression
		Prevention: National leadership with funding to Regions
		Involvement of Local Authorities through personnel, volunteers
		Regions have Emergency Plans communicated to National Government
Bilateral Agreements	Spain	Portugal, France and Morocco (Aircraft and equipment), West Mediterranean Specific Coordinating Centre in each Country, Cost paid by receiving countries
	USA	USA with Mexico
		USA with Canada
		USA and Canada with Australia and New Zealand (under preparation)
	Chile	Chile with Argentina
	Turkey	Central Government, Memo of Understanding with Other Countries for Fire Resources, allocated centrally and distributed at the local level

[11] Agreements list derived by Expert Consultative Working Group 2.

ANNEX 6

Provisional[12] Legal and Operational Checklists for Developing Forest Fire Emergency Agreements (Bilateral or Multi-lateral)

I National Legislation promoting International Agreements and establishing the framework for such Agreements (This requirement may vary by country in terms of process)

A. An example exists between Canada and USA
B An example exists between USA and Mexico

II Annual Operating Plan specifying details of how to accomplish emergency assistance.

III Protocols to promote technical exchanges of personnel between countries (a non-emergency assistance)

I National Legislation or Other Enabling Protocols for Establishing Contents (Elements) for Agreements:

1. Establish Agreements between Governments for emergency assistance if they do not exist. Determine appropriate channels for establishing Agreements. This will differ by country as how this is to be done.
2. Identify the Central Agency or Contact Point to coordinate the exchange of resources.
3. Specify Sending Party and Receiving Party.
4. Specify type of resources that may be sent or received.
5. Specify how costs will be allocated. Usually Receiving Party pays.
6. Specify time for reimbursements.
7. Specify who controls resources.
8. Specify how to cover losses and damages.
9. Specify the process for recalling resources to return them to sending party.
10. Specify Liability arrangements for damages (both ways). Fatal accidents, insurance, etc.
11. Specify qualifications of people.
12. Specify how to mediate disputes.

Note: Principle for success: Good will and practical solutions are essential in developing Agreements

II Checklist for Annual Operating Plan to Provide Emergency Fire Assistance (Bilaterally or Multi-laterally)

1. State purpose of assistance.
2. Cite authorities.
3. Detail general procedures
   (i) Who requests (how?)
   (ii) Reimbursements
   (iii) Identify types of resources

[12] Provisional Checklist Derived by Expert Consultative Working Group 2.

(iv) Personnel

(a) Daily rate and pay
(b) Lodging
(c) Meals and travel
(d) Medical costs, insurance coverage
(e) Safety, health and welfare
(f) Safety equipment
(g) Who provides liaison?
(h) Compensation claims for death and injury
(i) Specify indemnity procedures

4. Equipment and supplies.
5. Billing and payment procedures and currencies.
6. Situation reporting daily.
7. Authorization, signatures.
8. Process for re-call of resources.
9. Customs considerations.
10. Resolution of logistical limitations and constraints.

Note 1: Successful emergency assistance requires careful prior planning and review.

Note 2**:** Elements may need to be adapted to suit the conditions existing in different countries

III Protocols for Technical Exchanges of Personnel Among Countries

1. Authority
2. Qualifications and Objectives
3. Requests
4. Procedures and Payment (loss, damage, injury)
5. Documentation report that evaluates the exchange
6. Signatures for Approval

Additional Notes:

Agreements, Operational Plans and Protocols could be to:

1. Provide for exchanges of technical information, not people, on a recurring basis.
2. Share information regarding individual serious fires to other partners.
3. Exchange information regarding technical support in fighting fires from private vendors who supply equipment.
4. Consider contract requirements for aircraft.
5. Determine responsibilities and opportunities for providing technical assistance to developing countries. Identify countries or organizations to provide such assistance.

ANNEX 7

Sample of fire seasons on different continents[13]

Country	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Europe												
Spain						■	■	■	■			
Italy						■	■	■	■			
Greece						■	■	■	■			
Turkey						■	■	■	■	■		
Baltic States						■	■	■				
Russia						■	■					
N. America												
USA						■	■	■	■			
Canada					■	■	■	■				
C/S America												
Mexico			■	■	■							
Brazil							■	■	■	■		
Chile	■	■	■	■						■	■	■
Asia												
Indonesia					■	■	■	■				
Thailand	■	■	■									
Pacific												
Australia	■	■	■									
NZ	■	■										
Africa												
Ethiopia		■	■									
E. Africa								■	■	■		
Sth Africa	■										■	■

■ Difficult fire season - help may be needed from other countries
Generally lesser danger
Low danger - help may be offered to other countries

This table represents the recording of fire seasons by experts attending the meeting and is reproduced as an example only. The experts recommended that a schedule on these lines be prepared to evaluate the high, medium and low danger periods in all countries and regions as a first step to gauge potential for giving and/or receiving international assistance, to be requested and organizationally prepared in advance of high risk periods.

[13] Selection of "Fire Seasons" derived by participants at the Expert Consultative Group Meeting.

ANNEX 8

Provisional action plan and schedule for implementation of recommendations (In accordance with expert meeting recommendation, no attempt was made to prioritize actions)

Recommended Actions		Provisional Time Schedule of Actions by Month - starting April 2001																							
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Policy	(i)																								
	(ii)																								
Technical Support	(i)																								
	(ii)																								
	(iii)																								
	(iv)																								
	(v)																								
	(vi)																								
Information & Data Base	(i)																								
	(ii)																								
	(iii)																								
	(iv)																								
	(v)																								
Emergency Response	(i)																								
	(ii)																								
	(iii)																								
	(iv)																								
	(v)																								
	(vi)																								
	(vii)																								
	(viii)																								
	(ix)																								
	(x)																								
Collaborating Agencies	(i)																								
	(ii)																								

Legend ☐ **Approximate Duration of Activity** ☐ **Continuous Activity**

APPENDIX 1 to the Report on the FAO/ITTO International Expert Meeting on Forest Fire Management

List of Acronyms

ASEAN	Association of Southeast Asian Nations
BALTEX	Baltic Exercise on Fire Information and Resources Exchange
CCAD	Central American Commission on Environment and Development
CIHEAM	International Centre for Advanced Mediterranean Agronomic Studies
CILSS	Permanent Interstate Committee for Drought Control in the Sahel
COFO	FAO Committee on Forestry
CPF	Collaborative Partnership on Forests
ECE	Economic Commission for Europe
FAO	Food and Agriculture Organization of the United Nations
FRA	Forest Resources Assessment (coordinated by FAO)
GFMC	Global Fire Monitoring Center
IGAD	Inter-Governmental Authority for Development
ILO	International Labour Organization of the United Nations
INSARAG	UN International Search and Rescue Advisory Group
ISDR	International Strategy for Disaster Reduction
ITTO	International Tropical Timber Organization
IUCN	World Conservation Union
OCHA	Office for the Coordination of Humanitarian Affairs
SADC	Southern Africa Development Community
UNCED	United Nations Conference on Environment and Development
UNECE	United Nations Economic Commission for Europe
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFF	United Nations Forum on Forests
UNU	United Nations University
WB	World Bank
WHO	World Health Organization
WWF	World Wide Fund for Nature

Final Remarks by the Editor

A summary of this report of the expert meeting was submitted to the 15th Session of the Committee on Forestry (COFO), which met at the FAO, Rome 12-16 March 2001. The draft report of the COFO meeting includes the follwoings statements (extracts):

In relation to FAO Programmes in the Forestry Sector:

"The Committee felt that the FAO should facilitate the exchange of information within and amongst countries about successful approaches to forest management, given that this flow of information is essential to serve the cause of sustainable forest management. It also took note of the serious threat that amongst others, forest fires and forest diseases are posing to forests. It therefore requested FAO to provide better support to National Forestry Programmes in this regard."

In relation to FAO's Medium Term Plan:

"The Committee emphasized other important areas of work; including support to countries with low forest cover and efforts to combat desertification; management of wild fauna; forest fire management; combating of illegal activities in the forest sector; forests and water management; and development of non-wood forest products. "

In relation to sustainable forest management:

"In relation to sustainable forest management, the Committee was informed of the results of the International Expert Consultation on the Management of Forest Fires. The Committee took note of the important conclusions and recommendations of the meeting, and urged that FAO take follow-up action to support efforts in fire management."

IN MEMORIAM

Michael "Mike" A. Fosberg

Michael A. Fosberg, 63, a well-known former USDA Forest Service scientist, born on 11 January 1938, died 2 February 2001 in Onancock, Virginia, USA. A graduate in Atmospheric Sciences and Oceanography of Oregon State University, Mike Fosberg joined the USDA Forest Service in Riverside (California) and Fort Collins (Colorado), in 1962, and served as a Project Leader between 1987 and 1987. Between 1987 and 1995 Mike worked as a staff specialist for Forest Fire and Atmospheric Sciences Research at the USDA Forest Service Headquarters in Washington, D.C. After his retirement from the Forest Service in 1966 Mike Fosberg accepted the offer of the *International Geosphere-Biosphere Programme* (IGBP) to serve as Executive Director for the Core Project *Biospheric Aspects of the Hydrological Cycle* (BAHC), based at the *Potsdam Institute for Climate Impact Research*, Germany. After his assignment which ended in 1998, Mike Fosberg continued to work at the Potsdam facility as an independent contractor until 2000.

The international wildland fire community lost a bright scientist who was active in a broad range of international consortia and programmes. Mike Fosberg was an important ambassador of the fire community in international processes such as the *Intergovernmental Panel on Climate Change* (IPCC), the FAO Specialists Panels on *Climate Change* and *Global Forest Inventory* and the *World Meteorological Organization*. Mike Fosberg contributed significantly to several national and international programmes of the United States in the field of fire, e.g. the *National Wildfire Coordinating Group* (National Advisory Group on Fire Danger Rating), the President's *Climate Change Mitigation Group* (Rio Earth Summit), the Interagency Analysis Team to develop the international *Open Skies Treaty* for monitoring of the environment.

The involvement of Mike Fosberg in the UN fire focus included his membership in the ECE/FAO/ILO *Team of Specialists on Forest Fire* in which he represented the U.S.A. between 1990 and 2000. Within the frame of the International Boreal Forest Research Organization (IBFRA) Mike Fosberg was an active member of the Fire Working Group and supported the cooperation between North American and Russian fire scientists, especially through the *Stand Replacement Fire Working Group* which was initiated at an Association meeting in Krasnoyarsk, Russia, May 1992 (see IFFN No. 7, August 1992, pp. 6-8 and 32, with a photograph showing the signatory parties including Mike Fosberg).

Mike Fosberg was a true international fire person who loved to work on both sides of the Atlantic Ocean. He contributed to major scientific brainstorming events such as the conference *Fire in the Tropical Biota* (Freiburg 1989), the first global fire analysis at the Dahlem Konferenz *Fire in the Environment: The Ecological, Atmospheric, and Climatic Importance of Vegetation Fires* (Berlin 1992), and the conference *Fire in Ecosystems of Boreal Eurasia* (Krasnoyarsk 1993).

His very emotional and positive feelings towards the Eurasian fire community was very well received by his numerous friends and their families in Germany, Eastern Europe and Russia. Mike and his wife Barbara enjoyed living in Werder near Potsdam where they made many good friends. They often visited Freiburg, and Mike was a frequent guest in Russia.

The ECE/FAO/ILO *Team of Specialists on Forest Fire* has lost a good friend, loyal comrade and constructive collaborator.

Johann G. Goldammer
Global Fire Monitoring Center
Freiburg / Germany
April 2001