

Fire Management Needs in Russia's Boreal Forest Zone

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Abstract

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. 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 Eurasian boreal zone. In the southern and central parts of the zone, forest fires during prolonged dry periods in the high fire season represent 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, fires occurring outside of the high-fire danger season and fires affecting unmanaged and unused forests of the northern and sparsely stocked taiga and forest tundra, particularly on permafrost sites, represent a natural mechanism that stabilizes forest stands or prevent the transformation of forests to shrubland or grassland.

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. At the same time, 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, 1998 in the Far East, and 2002 in the central regions of Asian Russia 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 to the conclusion that the proper management of the Russian forests and associated vegetation resources and ecosystems needs to receive high priority. Most important is the development of a clearly formulated new fire policy that recognizes the beneficial functions of fire, aiming at replacing the fire control policy by a policy that allows the integration of low-intensity fires for fuel reduction, silvicultural purposes and economics.

The responsibility of managing and protecting must be given to a new generation of forest fire management specialists who have been trained in fire ecology and fire management. There are clear limitations to delegate all responsibilities in the protection of forest resources to the regional and local levels. 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.

Introduction

The world's total boreal forests and other wooded land within the boreal zone cover 1.2 billion ha of which 920 million ha are closed forest. The latter number corresponds to ca. 29% of the world's total forest area and to 73% of its coniferous forest area (ECE/FAO 1985). About 800 million ha of boreal forests with a total growing stock (over bark) of ca. 95 billion m³ are exploitable (41% and 45% respectively of the world total). The export value of forest products from boreal forests is ca. 47% of the world total (Kuusela 1992).

The vast majority of the boreal forest lands (taiga) of Eurasia are included in the Russian Forest Fund, covering ca. 900 million ha. Depending on the criteria used to define "boreal forest", the area of closed boreal forest in the Russian Federation varies from 400 to 600 million ha. These numbers correspond to a 43-65% share of the world's closed boreal forest.

Wildfires from natural causes (lightning) constitute a very important ecological factor of the formation of boreal forests. Together with the climate and local growing conditions fire control age structure, interrelation of species and formation, landscape diversity and mosaic of vegetation, as well as influence on currents of energy and biochemical cycles, especially global carbon cycles. In boreal forests of Eurasia the fires were considered as the means of land clearing and solution of problems and meeting tasks of silviculture, agriculture, hunting and pasturage of live-stock and that old cultural practice in addition to the natural fires put in occurrence a great number of anthropogenic fires inside the Boreal landscapes of Eurasia.

In the beginning of the 20th century the intensity of making use of fire in the agricultural sector began to decrease. However, in spite of the reduction of traditional burning practices humans are still the most important source of wild fires; on the average only 15 % fires in Russia are caused by lightning.

The reduction of number of natural fires in Western Eurasia (Norway, Sweden, Finland) in the last century was followed with the increase of fire load on the Eurasian part of Russia and other countries of the Commonwealth of Independent States (CIS).

The official statistics show that in Russia between 20,000 to 40,000 fires occur annually affecting an area of 2 to 3 million ha of forest and other lands (Figure 1). Hitherto they are detected and controlled only in the so-called "protected forests" and on the protected pasturelands. As a result of estimation, the real fire load on the boreal vegetation of Eurasia is

much higher than mentioned above and reaches more than 10 million ha during the extreme fire years.

However, the use of the spaceborne sensors such as the NOAA-AVHRR allowed to improve considerably the evaluation of fire consequences and to determine the location of active fires and areas burned by vegetation fires with the precision that is suits practical purposes.

For example, before the 1980s it was considered that in the boreal forests on the territory of the former Soviet Union fires burned annually, on the average, 1.5 million ha. Investigations based on satellite imageries revealed that the magnitude of fires had been underestimated. The instrumental survey ascertained that in the boreal zone fires burned annually on the average about 8 million ha with considerable fluctuation for different years. For instance, in 1987 in the boreal forests of East-Asia the fires burnt about 14 million ha (Cahoon et al. 1994).

Fire – a Historical and Ecological Factor

The boreal forests have been formed as a result of a long evolutionary process which in the recent history becomes increasingly influenced by humans. An important factor taking part in the formation of forests is natural and human-caused fire. Fire is a recurrent event that under natural conditions is important to determine species selection, stand development and dynamics, thus the overall functioning of a forest ecosystem. Wildfires occurring in forests that are managed or protected for timber production and conservation purposes, however, may have detrimental effects on the economy, environment and human security. Large, high-intensity and high-severity fires eliminate, as a rule, all vegetation, including all trees and therefore lead to a renewal of the vegetation association (stand-replacement fires). Large high-severity forest fires caused by lightning are occurring, on the average, once during 50-100 years on dry sand soils and 100-200 years on moist moraine soils.

The latter phenomena have strongly influenced the forest fire protection policy on the state level which is based on the indispensable condition to suppress absolutely all fires occurring on the protected territory, not to permit any fire spreading, irrespectively of country conditions, composition of forest stands, forest types, economical and ecological value of the territory. However, the scheme of keeping under total observation all the protected territory and to suppress all detected fires is feasible only in the conditions of adequate financing of the forest fire protection service. Under inadequate financing the scheme does not work and leads to a considerable increase of the damage from forest fires. Thus, it is required to search more versatile approaches to forest fire management, in which by all means the factor fire must be integrated. This factor should be taken into account during making decision on use of fire in the form of prescribed wildfires and prescribed burning for fuel reduction.

The different views of ecologists and practitioners must be harmonized. Scientists from Russia, the Nordic countries and North America have proven the necessity of fire occurrence in forests as an important factor, determining the whole lifecycle of a forest ecosystem. But if one imagines that a fire burned the large tract of forest which is connected a part of one's life, especially the childhood, and where one picked up berries, mushrooms and where one was used to go fishing and hunting, one's philosophy is automatically changed and fire is considered as a disaster. That is why the greater part of population having the lack of deep ecological knowledge, considers the fire in forest as undesirable phenomenon independently of the former state of burnt forests.

Thus, it is very important to acquaint the public as well as the forest managers with the basics of fire ecology – and this will constitute an important part of forest fire management in Russia in the future.

Fire Management Capabilities

The Aerial Forest Fire Control Center of Russia *Avialesookhrana* operates through 24 regional airbases across Russian Federation (Figure 2) and a fleet of 102 aircraft. The total area under aerial fire protection is 690 million hectares including 12.9 million ha of reserved forests. There are about 270 subdivisions in the structure of Avialesookhrana that are responsible for organization of reconnaissance, combat and monitoring wildland fires. Before the begin of the fire season contracts to lease 257 airplanes and helicopters are signed from which 120 are small planes (with a capacity of carrying six smokejumpers), four planes able to carry a payload of 5000 kg of cargo or 20 firefighters, 40 light helicopters and 93 helicopters Mi-8 to carry up to 4000 kg of cargo or operating helibuckets with retardants. This number of aircraft has been calculated to meets the needs at low fire danger level. More than 3800 firefighters (smokejumpers and helirappellers) have been trained to suppress wildland fires.

The Fire Season of 2002 and early 2003

The 2002 fire season in Russia was extremely severe. According to the statistics published by the government during the period of April to October 35,000 fires were registered that burned of 1,222,000 ha. (For comparison: The record of number of 36,600 fires was recorded in 1999). The main causes of fires in 2002 were

- Local population – 58 %
- Lightning – 12 %
- Other – 30 % (power lines, railways, unknowns)

Long-term fire-cause statistics for the period 1992-2002 reveal a share of lightning of 13%, human causes 72% and unknown ignitions 15%.

From the board of aircraft were detected 44.1 % of total fires in forests under the jurisdiction of the Ministry of Natural Resources. In the 1980s the percentage was about 80%. In the past season 995 fires spread on large areas and were classified as large fires.

Severe fires started on the territory of the Far East region in April - May embracing Republic of Yakutia, Khabarovsk and Chita regions. On several days the fire authorities of Khabarovsk alone had to respond to 255 fires per day. Special attention was paid to protection of towns and villages to prevent homes and population from fires. Hundreds of firefighters from different airbases from throughout the Federation were sent to assist fire battles in Yakutia, Chita and Khabarovsk. As example, about 600 smokejumpers and helirappellers were delivered to Yakutia's hotspots. Two amphibian planes (scoopers) Beriev-12 (6000 litres capacity) were deployed to help them to attack fires from the air. Nearly 350 drops of water (2100 tons) helped to stop 21 km of fire edges. Weather conditions in Yakutia were extremely unfavourable to get fires under control, that is why 151 fires were transfer into category of large ones. The main reason of flames were agriculture burns in spring (May) and lightning in summer (July, August). According to satellite data fires in Yakutia (protected and

non protected zones altogether) have passed nearly 5 million ha (Sukhinin 2003, Goldammer 2003; Figures 3 and 4).

At the same time dry and hot weather conditions provided big amount of forest fires in Tuva Republic. The main reason of fires were also local people that made prescribed burning up on the mountain slopes to collect wild deer antlers for selling them to China and prepare pastures. The number of fires totalled 481 out of which 129 large ones burnt about 1 million ha.

In the second part of the summer (July, August) and beginning of fall (September) high fire danger arisen in the European area of Russian Federation, such as Sankt Peterburg, Novgorod, Vologda, Tver, Moscow etc. Fires were caused by forest visitors to pick up berries, mushrooms and hunting of wild game. In August only 11,300 of fires (31 % of total) were registered. Moscow region suffered of 1900 fires in forests and in bogs (Bannikov et al. 2003, Goldammer 2003). The smoke of peat fires disturbed millions of people. Many of them were taken to the hospitals.

Besides fire management tasks the regional airbases performed pest and disease control. Over 500 million ha of forests were covered by aerial monitoring during the 2002 fire season for this reason. That helped to discover serious insect infestation spots in the beginning of their activity and to provide required operations in time. Over 50 special expeditions including specialists of Avialesookhrana and Forestry Departments sent by aircraft to explore experimental spots. Many regions have extreme pest and disease problems that required special attention of the Forest Service and other government institutions.

Total 32,300 flight hours have been made during the season by own and leased aircraft for fire management and pest and disease control, that is just 30 % compared to the early 1990s. Thanks to own aviation over 1500 firefighters were sent from base to base to assist on fire fighting. But there still were undue financing problems of aerial operations that resulted in delayed fire detection and response. As a consequence these wildfires affected much larger areas and more financial resources were needed to suppress these fires as compared to early detection and rapid response.

New types of pumps, drip torches, fire engines and the foam injection system (SPS-1) into VSU-5 helibucket were tested and involved into practice during the fire season by aerial fire fighters. Two hotshot crews, trained by U.S. Forest Service instructors, worked across Siberian fires. A new type of parachute “Lesnik-3” (Arbalet) was tested and approved for future development and use in aerial operations under joint interagency program with the Ministry of Emergency Situations EMERCOM.

The fire season of 2003 started very early and very heavy. Up to July 2003 – the time of writing this manuscript – official statistics show that 18,926 fires affected 1,601,507 ha forested and 318,703 ha non-forested land under the responsibility of the Ministry of Natural Resources (Figure 5). Satellite-derived information show a total area burned of more than 20 million ha. The regions with highest satellite-detected burned areas are Chitinskaya Oblast (6.5 million ha), Buryatiya Republic (4.1 million ha) and Amurskaya Oblast (2.8 million ha). It is aimed to verify the extent of damage in protected forests during a research campaign in late 2003.

International Cooperation

International exchange programs with the U.S.A. (U.S. Forest Service and BLM), the Forest Services of Canada and China and the Global Fire Monitoring Center (GFMC) helped to share information and modern technology to address the global problem of wildland fires. Avialesookhrana continued to actively contribute to the FAO/ECE Team of Specialists on Forest Fire and the UN International Strategy for Disaster Reduction (ISDR), Working Group on Wildland Fire.

Conclusions

For the future effective fire management in Russia and modern function of an aerial forest fire service it is needed:

- Sharing all the protecting territory into priority zones;
- Providing in time financing of Avialesookhrana needs before fire season starts (training, maintenance, and other preparations);
- Fire management agreements with other landowners, that have wildland fire problems;
- Creating of the special programme for the management of large fires;
- Creation of a National Wildland Fire Training Center.

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Appendix

Table 1. Fire statistics and operational data in aerial fire protection zone of Russia for 1981-2002.

	Annual average		- decreasing + increasing 1980s to 1990s	2000	2001	2002
	1981-1990	1991-2000				
Total protected area (x million ha)	701.1	685.9	-1.02	638.3	690.8	692.8
Number of fires in the aerial zone	13699	17131	+1.25	13447	14561	19071
Forested area burnt (x 1000 ha)	617.2	896.8	+1.45	898.9	792.4	1204.8
Number of fires on 1 million ha	19.5	25.0	+1.28	21.1	21.1	27.5
Flight hours on fire protection duties	116350	52801	-2.20	27477	27899	29961
Flight hours on fire fighting missions	50469	24224	-2.08	22650	23205	24777
Number of fires detected by aircraft	12233	9606	-1.27	6865	6817	8390
-% from total number of fires on the aerial protection zone	89	56		51	47	44
Number of large fires	324	750	+2.31	1005	583	940
Are burnt by large fires (x 1000 ha)	423.0	751.0	+1.77	760.3	703.4	818.2
Number of smokejumpers and hellirappellers	7878	4920	-1.60	3741	3796	3802
Number of fires suppressed by aviation	7510	5708	-1.32	5197	5287	6317
Number of fires put out by smokejumpers and hellirappellers (just by themselves)	5415	3058	-1.77	2316	2107	2134
Number of inter-regional transfers of smokejumpers and rappellers	89	39	-2.28	29	24	58
Number of transferred personnel	2532	1036	-2.44	829	559	1388

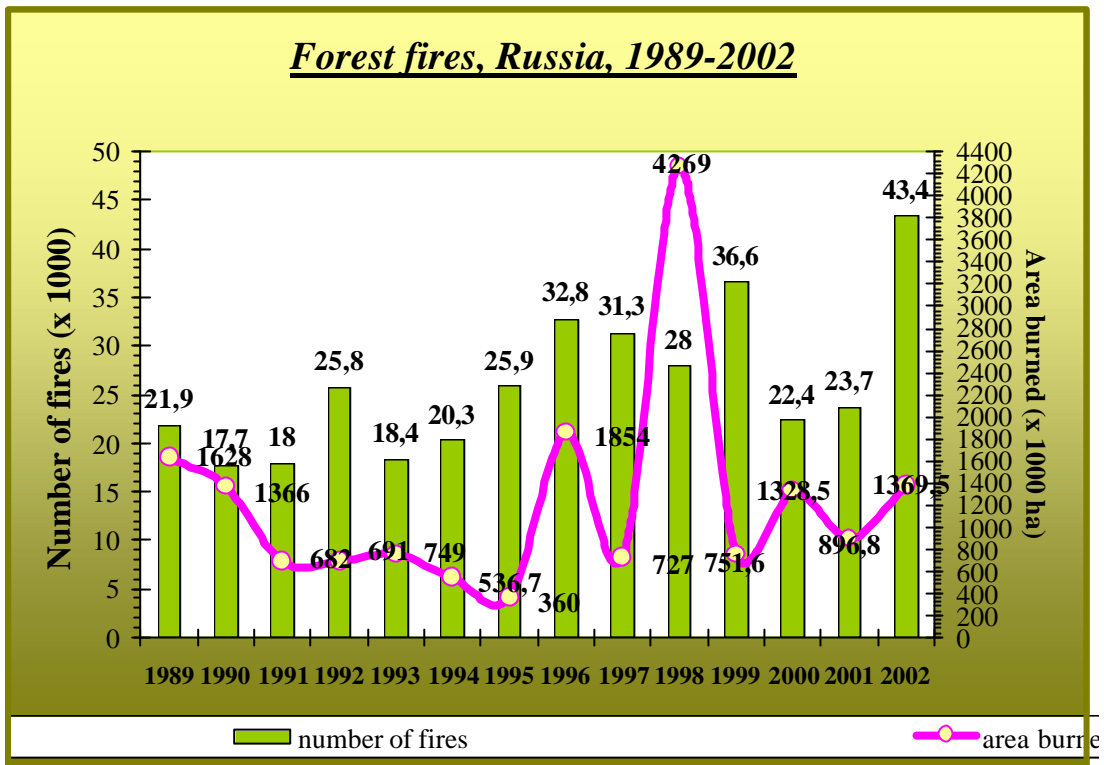


Figure 1. Official statistics of the number of fires and burnt area for aerial protection zone for 1989-2002.

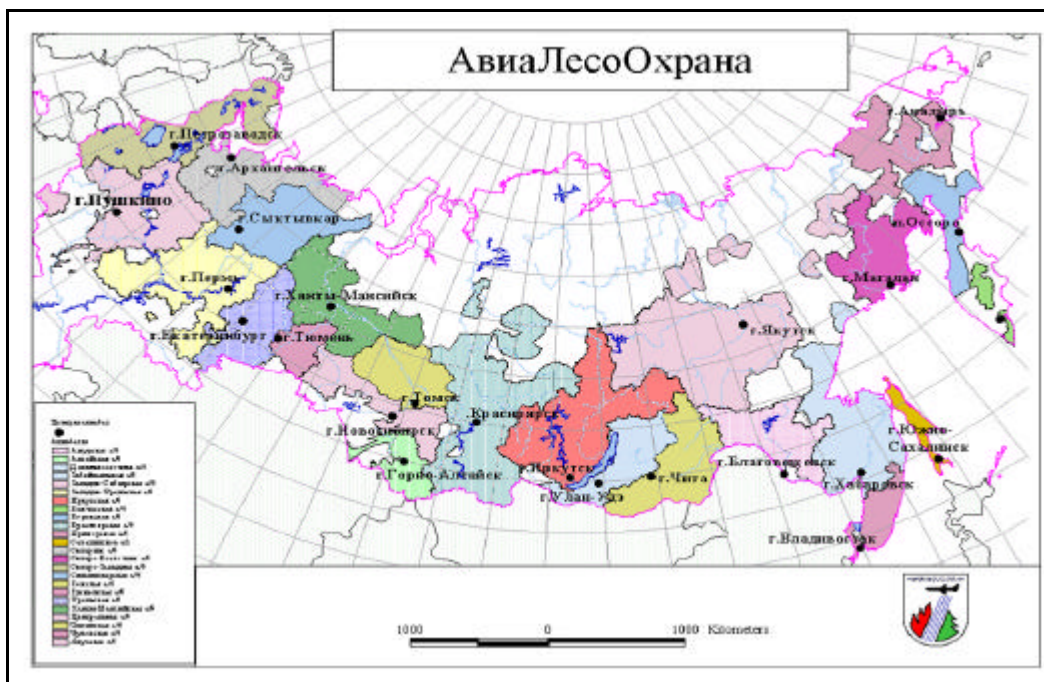


Figure 2. Aerial fire control responsibility zone

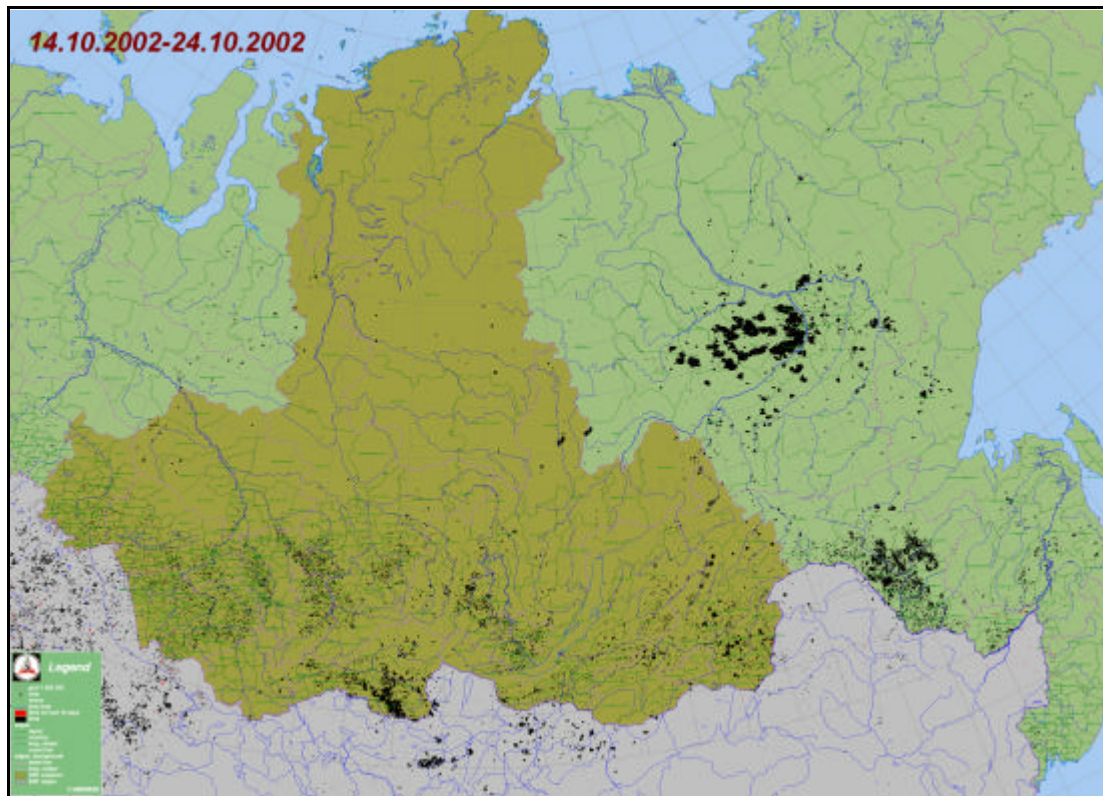


Figure 3. Example of a map showing 10-days active fires and total up-to-date burned area. These maps are produced by the Fire Laboratory, Sukachev Institute for Forest (Russian Academy of Sciences, Krasnoyarsk) and published three times per week by the GFMC (<http://www.fire.uni-freiburg.de>). This example shows the distribution of fires at the end of the fire season 2002.

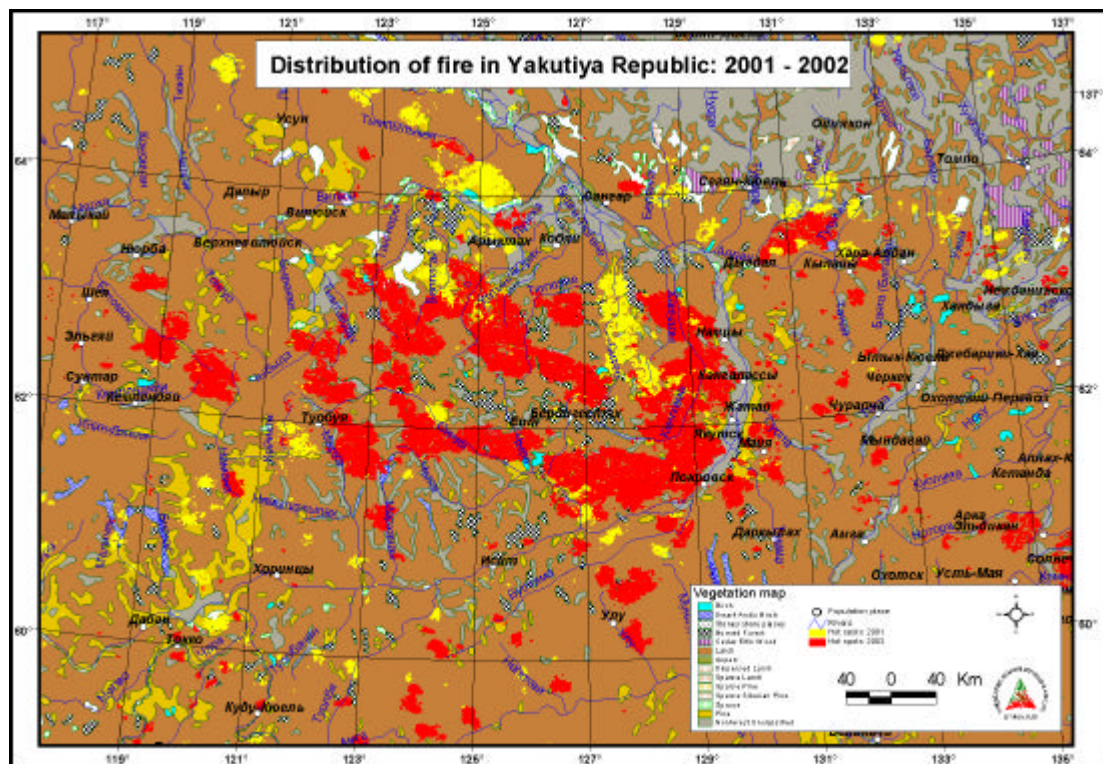


Figure 4. Vegetation type affected by wildfires in Yakutia Republic during the fire seasons 2001 (yellow) and 2002 (red). The forest cover predominantly affected by fire in this part of Yakutia is Siberian larch forest (brown colour). Source: A. Sukhinin, Fire Laboratory, Sukachev Institute for Forest, Russian Academy of Sciences, Krasnoyarsk.



Figure 5. Location of large fires in Russia during the first part of the fire season 2003 (up to 1 July 2003).