This volume consists of 5 parts covering:
- Use of prescribed fire in forestry in Russia,
- Description of the first phase of a long-term fire experiment in Siberia
- Fire history and research in Mongolia
- Use of prescribed fire in forestry, conservation and landscape managemet in Eurasia
- The Krasnoyarsk 10-Point Programme on the Future of Fire Management in Russia

Besides the table of contents of the volume, some sample pages of the five parts are provided.

Prescribed Burning in Russia and Neighbouring Temperate-Boreal Eurasia

A Publication of the Global Fire Monitoring Center (GFMC)
Edited by
Johann Georg Goldammer

Contributing Authors:
E. N. Valendik, J. G. Goldammer, Ye. K. Kisilyakhov, G. A. Ivanova,
S. V. Verkhovets, A. V. Bryukhanov, I. V. Kosov, Oyunsanaa Byambasuren, and the
FIRESCAN Science Team

www.forestrybooks.com

Supported by:

Federal Ministry of
Food, Agriculture
and Consumer Protection

based on a decision of the Parliament
of the Federal Republic of Germany

Eifelweg 37
53424 Remagen-Oberwinter
Germany

Tel.: 0049 - 2228 - 493
Fax: 0049 - 3212 - 1024877
email: webmaster@forstbuch.de

Internet:
www.forestrybooks.com
www.forstbuch.de

Printed in Germany
www.business-copy.com

ISBN: 978-3-941300-71-2

Preface

In the landscapes of temperate-boreal Europe – the western part of the Euro-Siberian region of the Holarctic Floral Kingdom – the prevailing fire regimes are shaped by human-ignited fires. Direct fire application in land-use systems – agricultural burning and burning of pastures – and human-caused wildfires, ignited accidentally, by negligence or otherwise deliberately set, have influenced cultural and natural landscapes since the beginning of land cultivation.

However, in the Central Euro-Siberian region there are large tracts of forest ecosystems that have been shaped by natural fire, e.g. the forests dominated by pine (*Pinus* spp.) and larch (*Larix* spp.) that constitute the "light taiga" in Siberia and adjacent regions.

Starting with the first East-West international conference "Fire in Ecosystems of Boreal Eurasia" and the Fire Research Campaign Asia-North (FIRESCAN) and its "Bor Forest Island Fire Experiment", organized in Krasnoyarsk, Russian Federation, in 1993, the dialogue between scientists and forestry authorities from Europe, North America and the Russian Federation revealed the rich knowledge of the fire ecology of temperate-boreal Eurasia (Goldammer and Furyaev 1996)[1]. The results of the following two decades of joint scientific research, mirrored by numerous publications by the international wildland fire science community, encouraged forest authorities to participate in the dialogue, devise new concepts in fire management and replace fire exclusion policies by integrated fire management approaches, which would include the use of natural fire and prescribed burning (prescribed management fires).

In Part I of this volume fire scientists of the Sukachev Institute for Forest, Russian Academy of Sciences, Siberian Branch, Krasnoyarsk, and the Fire Ecology Research Group at the Global Fire Monitoring Center (GFMC), Freiburg University / United Nations University, Germany, have now summarized experience and provide targeted advice in the application of prescribed fire in advanced fire management.

Part II constitutes a summary of results of the first 19 years of the "Bor Forest Island Fire Experiment" of 1993, a long-term, 200-years experiment designed for the period 1993 to 2192. The participating scientists are large in number, and more will join in future when this project will be handed over to the next generation of fire scientists.

1 Goldammer, J.G., and V.V. Furyaev (eds.). 1996. Fire in ecosystems of boreal Eurasia. Kluwer Academic Publishers, Dordrecht, 528 pp.

Part III summarizes the knowledge of the history and ecology of forest and steppe fires in Mongolia, as well as the first experiences of prescribed burning research and practices in pine forest ecosystems initiated in 2008.

The results of the work published in the first three parts of this volume had considerable impact on the objectives and formulation of the "White Paper on Use of Prescribed Fire in Land Management, Nature Conservation and Forestry in Temperate-Boreal Eurasia", which was developed by scientists who work together within the Eurasian Fire in Nature Conservation Network (EFNCN), and released in 2010. The White Paper provides rationale and recommendations for the future use of prescribed fire and is published as Part IV of this volume.

Finally, steps are required to convincing forestry and land-use policy makers to consider the scientific evidence and the first achievements in application of prescribed natural and management fires, and to inform the public accordingly. The First International Fire Management Week", held in Krasnoyarsk, Russia, in September 2012, came up with a number recommendations that point into the direction for integrating the recommendations of the fire science community in policy and practice, including capacity building.

These efforts of advancing fire science and policies have received substantial financial and institutional support by the Max Planck Institute for Chemistry, Germany, the Sukachev Institute for Forest, Krasnoyarsk, the Federal Forest Agency of Russia *Rosleskhoz*, the Aerial Forest Fire Center of Russia *Avialesookhrana*, the German Agency for International Cooperation *Deutsche Gesellschaft für Internationale Zusammenarbeit* (GIZ) and the Federal Ministry for Food, Agriculture and Consumer Protection of the Federal Republic of Germany in the frame of the work of the bilateral Russian-German Cooperation in Sustainable Forest Management. Furthermore the contribution of members of the UNECE Team of Specialists of Forest Fire is acknowledged. The continuing scientific and technical support of Yegor K. Kisilyakhov, Sukachev Institute for Forest, in a number of wildland fire expeditions and field experiments in the Russian Federation and Mongolia, including the preparation of this book volume, has been crucial for the success of international cooperation in wildland fire research.

Most important for the success of the research and the policy dialogue was the contribution of Eduard Pavlovich Davidenko, former Chief of the Science and Technology Department of *Avialesookhrana*. At the stage of finalizing the edition of this book he passed away on 2 April 2013. In recognition of his professional and personal contribution to build a culture of cooperation between fire scientists and fire managers from Russia and other countries this book volume is dedicated to his memory.

Freiburg, Krasnoyarsk, Ulaanbaatar

6 May 2013

Contents

Part II: The Bor Forest Island Fire Experiment ... 149

FIRESCAN Science Team

Part III: Forest and Steppe Fires in Mongolia 233

Oyunsanaa Byambasuren and Johann Georg Goldammer

Part I: Prescribed Burning in Russia

E.N. Valendik, J.G. Goldammer, Ye.K. Kisilyakhov,
G.A. Ivanova, S.V. Verkhovets, A.V. Bryukhanov, I.V. Kosov

Introduction

The term "prescribed burning" refers to the use of fire in natural environments for different objectives, such as forest and logging site fire hazard reduction, forest regeneration enhancement and elimination of undesired vegetation species and forest pests. Prescribed fires are conducted under environmental conditions that allow to meet fire intensity and rate of spread. As prescribed burning has not been permitted in Russia until recently, there are very little prescribed fire data in the Russian scientific literature. The USA, Canada, and Australia, where prescribed burning has been a common practice since as far back as the early 20th century, provide most scientific insight and experience in prescribed burning. There is an increasing use of prescribed fire in Western Eurasia, notably in nature conservation and management of cultural landscapes (GFMC 2010).

At present, opponents of use of fire in the forest still outnumber its supporters in Russia due to a long-term prescribed forest fire ban and perception of fire as a "disaster" by common people. However, "controlled fire" was recognized as an effective forest management tool by well-known Russian forestry specialists Tkachenko (1931) and Melekhov (1983). A number of foresters share their opinion nowadays. Studying negative and positive fire influences on forest ecosystem components and developing guidelines for the use of prescribed forest fire are the two major fire science priorities (Artsybashev 1984).

Prescribed fire was first used in Russia in 1952 through 1957, in western Siberian dark conifer forests killed by Siberian moth, in an effort to enhance forest regeneration.

Today, prescribed fire is permitted to be used for burning piled logging slash and creating fuel breaks by burning cured grass in treeless sites of the Russian forest fund in non-fire-season time (Anonymous 2007).

The V.N. Sukachev Institute of Forest, in cooperation with the Federal Forestry Committee of Krasnoyarsk Region, tested controlled broadcast burning of logging sites and forest sites damaged by insects or situated close to settlements to reduce fire hazard and stimulate forest regeneration. These fires were conducted in several forest districts as a part of a joint Russian-American project on forest management improvement in Siberia. These experimental prescribed burnings have grown to become a practical forest treatment since 1999. Mobile prescribed fire crews established in five Forest Management Areas (FMA) of Krasnoyarsk Region began to conduct prescribed burning.

The authors of this book tried to analyze the experience gained in prescribed burning so far and they are sure forest research scientists and forestry practitioners will find it useful.

1. Prescribed Burning Background in Russia: A Historical Overview

Cured grass burning was practiced for increasing grazing land productivity in forest-steppe and steppe landscapes of southern Urals, Kazakhstan, Trans-Baikal region, Yakutia, Khakassia, and Tuva as early as in the 5th and 6th Century. Cattle breeders noted that spring burning of cured grass resulted in proliferation of new grass, extended its growing season, and, hence, improved grazing conditions. As uncontrolled grass burning grew in scale and increasingly resulted in forest fires, this practice countrywide became a big problem in the 17th century. To cope with this situation, legal fines were imposed for arsons in the forest and the so-called "agricultural fires". In the 18th century, Peter the Great promulgated a law that prohibited cured grass burning near forest and in forest glades. People conducting grass burns in areas adjacent to forests and disregarding fire safety rules were fined by penalties (Gaikovsky 1885; Shilov 1889).

Although the agricultural fire ban was extended to cover the entire snow-free period in the early 20th century (Nazarov and Sabinin 1913), agricultural burning still is practiced large scale.

Forest fires drastically grew in extent in Siberia and the Russian Far East in the early 18th century, as peasants from the European Russia began to move to these parts of the country, where they were given free non-forest and forest plots. Peasants burned forest to clear land for building settlements, sowing crops, and grazing cattle. Residents of settlements situated in taiga forest conducted burns in Scots pine (*Pinus sylvestris* L.) stands to increase productivity of red whortleberry (*Vaccinium vitis-idaea* L.) sites and in deciduous stands to improve conditions for bee keeping. Importantly, burning was done under control of peasant communities. This was actually when prescribed fire was started to be used for agricultural purposes.

In Russia, use of prescribed fire has always raised contradictory attitudes, from its full support to absolute aversion. Positive forest fire influence, namely, fire-caused increase in Scots pine stand regeneration rate, was noted as long ago as the beginning of the last century (Tkachenko 1911; Turin 1925). Therefore, it was concluded that fire could be used as a forest management tool (Tkachenko 1931) and first steps were taken in using fire as a tool to enhance forest regeneration (Kazansky 1931).

Clearing logging site from slash by fire was first approached scientifically in Karelia, European Russia, with burning methodologies and effective use manpower being the two priorities. As a result, logging slash was burned on logging sites accounting 8% of the total Karelia's logging area. Prescribed fire tests showed that logging site clearance methods, such as post-logging burning of piled logging slash, piling logging slash and leaving the piles stay without burning, and burning of logging slash in the course of forest harvesting, failed to meet forest management requirements. Broadcast burning of logging slash and its burning on plots where logging slash occurs were introduced later. With broadcast burning, logging sites and remaining in-site seed tree pockets were recommended to be surrounded by 30-meter wide fire lines prior to burning. With the later method, firelines were established around logging sites and the plots were earthed up (Davydov 1934).

Pobedinsky (1955) reported that mineral soil can account for up to 40% of the total logging site area as a result of logging slash burning as compared to 5-10% resulting from logging itself. Mineral soil surface stimulates both natural forest regeneration and planted woody species growth. Logging slash burning should be conducted in summer, on calm days, at high slash moisture content on clearcuts having no healthy regrowth.

Belov (1973) proposed controlled burning in mature Scots pine and larch stands, as well as in those approaching maturity (5-10 years before logging) in order to ensure pre-logging forest regeneration. Also, he believed that burning of deep forest floor organic layer and feather moss layer can result in decreasing forest fire hazard for as long as 20-30 years, which decrease is beneficial for future forest generations. Burning of natural vegetation on permafrost increases soil thaw depth. Fires of moderate intensity were found to favor Scots pine stand development, provided that the mean fire interval (MFI) is 40-50 years (Belov 1973).

Melekhov (1983) considered prescribed fire as an important tool to achieve forestry objectives. He recommended to conduct fire-hazard-reduction controlled fires in Scots pine and larch stands aging 40-50 and older, when trees become fire resistant.

In Siberia, particularly in Krasnoyarsk Region, controlled fire was used by Prozorov (1956) to eliminate pine looper (*Bupalus piniaria* L.) pupae from the forest floor and reduce thereby the population of this forest pest. In this effort, litter and forest floor organic matter were broadcast burned or piled and then burned.

About four million hectares of dark conifer forests were damaged by Siberian moth (*Dendrolimus superans sibiricus* Tschetw.) in western Siberia in 1952-1957; thereof 40,000 hectares were completely killed forest (Furyaev 1966). This area was annually subjected to large forest fires that disturbed economical activities. Not one of all the costly efforts made to suppress these fires ever succeeded. Furyaev proposed to treat the Siberian moth-damaged conifer forest area with controlled fire in attempt to enhance forest regeneration. The USSR Ministry of Forestry approved the recommendation of Sukachev Institute of Forest not to suppress but contain wildfires in this area in order to prevent their spread into adjacent forest stands for 20 years. These activities led to forest regeneration resumption through woody species conversion only 18 year following the Siberian moth outbreak. This damaged area was colonized by deciduous species, such as birch and aspen, with fir, spruce, and Siberian pine seedlings occurring under their canopy.

Prohibition of prescribed burning on logging sites had negative consequences for forest protection and hampered forest regeneration drastically. As a result, thousands of hectares of treeless logging sites have high loads of logging slash and are covered by tall grasses. Windfall and infestation by Siberian moth and over-stocked light coniferous stands are commonly found. Fires occurring on these types of sites are particularly destructive, and post-fire forest regeneration is hampered for decades due to extreme severities.

Up to 70% of all wildfires begin on logging sites from where they are spreading to adjacent forests. In this situation, any forest restoration efforts are often jeopardized. Logging sites remain highly flammable during 3-4 months due to fuel overloading. Even prolific new green grass and shrubs fail to reduce high fire hazard on logging sites (Valendik et al. 2000).

Experience gained by other countries show that prescribed burning can be effective in reforesting logging sites and reducing their fire hazard levels. Fire burns logging slash and, hence, adds nutrients to soil that are available for plant growth. As a result, woody seedling vigor and competitive ability increases. Additionally, logging slash burning reduces the risk of invasion of xylophagous insects to neighboring stands.

It should be noted that wildfire suppression is very expensive, whereas controlled vegetation residue burning is nowadays the only effective and economical method to clear logging sites, stimulate forest regeneration, and prevent high-intensity fires.

The V.N. Sukachev Institute of Forest has conducted test underburning and prescribed fires on logging sites (Valendik et al. 1997; Valendik 1998; Valendik et al. 2000, 2001) and sites defoliated by Siberian moth (Valendik et al. 2006, 2007) in cooperation with Krasnoyarsk Regional Forest Committee since 1996.

These prescribed burning tests should be replicated in a range of natural environments to gain experience sufficient for developing prescribed fire use legislation.

Part II: The Bor Forest Island Fire Experiment

FIRESCAN Science Team

Fire Research Campaign Asia-North (FIRESCAN)

Preface of the 2013 Publication

The initiation of East-West cooperation in wildland fire science and management goes back to the first visit of two wildland fire scientists from the U.S.A. and Germany in the Soviet Union in 1991 (Pyne 1992) and follow-up exchange arrangements under the frame of the International Boreal Forest Research Association (IBFRA) (Fosberg 1992). Subsequently in 1993 the first East-West conference on „Fire in Ecosystems of Boreal Eurasia“ and the Fire Research Campaign Asia-North (FIRESCAN) with its core activity, the „Bor Forest Island Fire Experiment“ were organized, *in tandem,* in Krasnoyarsk Region, Central Siberia.

While the aim of the conference was to compile, discuss and publish the state of knowledge on fire in boreal ecosystems, particularly in Eurasia (Goldammer and Furyaev 1996), the research campaign was designed to investigate hypotheses developed by the International Boreal Forest Research Association (IBFRA), Stand Replacement Fire Working Group. These hypotheses are related to quantitatively understanding boreal ecosystems, the role of fire in boreal ecosystems, and modeling and predicting forest dynamics. The involvement of atmospheric scientists through the structures of the International Global Atmospheric Chemistry (IGAC) Project, a core project of the International Geosphere-Biosphere Program (IGBP) gave additional insights into aspects of fire emissions and atmospheric chemistry. On 6 July 1993 a large forest fire experiment was conducted on Bor Forest Island, Krasnoyarsk Region, Russia. In this paper the results of the first phase of the experiment are given and the medium- to long-term objectives of follow-up research are described.

Abstract

Fire is an important natural and anthropogenic factor in the dynamics of the boreal forest system. The ecological and environmental impacts of boreal fires depend on fire weather, fuel availability, fire behavior, and the history of stand development (frequency and size of fires and other biotic and abiotic disturbances, influence of surrounding landscape on successional developments). About 70% of the global boreal forest is in Eurasia, almost all of it in the Russian Federation. It is estimated that in years with high fire danger up to ca. 10 million hectares (ha) of forest and other land in the Russian Federation are affected by fire. The demand for reliable information on the role of natural and anthropogenic fire, and the necessity of developing adequate fire management systems, is basically due to globally increasing concerns about (1) impacts of boreal wildfires on atmosphere and climate, (2) changing utilization and ecologically destructive practices in boreal forestry, and (3) possible consequences of global climate change on the boreal forest system (Crutzen and Goldammer 1993).

In 1993 a conference on Fire in Ecosystems of Boreal Eurasia, and a subsequent Fire Research Campaign Asia-North (FIRESCAN) were organized, *in tandem,* in the Krasnoyarsk Region, Central Siberia. The aim of the conference was to compile, discuss and publish the state of knowledge on fire in boreal ecosystems, particularly in Eurasia (Goldammer and Furyaev 1996).

The research campaign was designed to investigate hypotheses developed by the International Boreal Forest Research Association (IBFRA), Stand Replacement Fire Working Group. These hypotheses are related to quantitatively understanding boreal ecosystems, the role of fire in boreal ecosystems, and modeling and predicting forest dynamics. The involvement of atmospheric scientists through the structures of the International Global Atmospheric Chemistry (IGAC) Project, a core project of the International Geosphere-Biosphere Program (IGBP) gave additional insights into aspects of fire emissions and atmospheric chemistry. On 6 July 1993 a large forest fire experiment was conducted on Bor Forest Island, Krasnoyarsk Region, Russia. In this paper the results of the first phase of the experiment are given and the medium- to long-term objectives of follow-up research are described.

1. Fire in Ecosystems of Boreal Eurasia

The worlds total boreal forests and other wooded land within the boreal zone cover 1.2×10^9 ha of which 920×10^6 ha are closed forest. The latter number corresponds to ca. 29% of the worlds total forest area and to 73% of its coniferous forest area (ECE/FAO 1985). About 800×10^6 ha of boreal forests with a total growing stock (over bark) of ca. 95 billion m^3 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 1990, 1992).

The vast majority of the boreal forest lands (*taiga*) of Eurasia are included in the Russian Forest Fund, covering ca. 900×10^6 ha. Depending on the criteria used to define "boreal forest", the area of closed boreal forest in the Russian Federation varies from 400 to 600×10^6 ha (Pisarenko and Strakhov 1993). These numbers correspond to a 43-65% share of the worlds closed boreal forest.

1.1. Disturbances in Transition: Natural to Anthropogenic

Among natural disturbances fire (lightning fire) is the most important factor controlling forest age structure, species composition and physiognomy, shaping landscape diversity, and influencing energy flows and biogeochemical cycles, particularly the global carbon cycle, since prehistoric times (cf. monographs and synopses e.g. by Sofronov 1967; Slaughter et al. 1971; Zackrisson 1977; Sherbakov 1979; Viereck and Schandelmeier 1980; Alexander and Euler 1981; Heinselman 1981; Wein and MacLean 1983; Kurbatsky 1985; Johnson 1992; Sannikov 1992; Furyaev 1994; Shugart et al. 1992; Goldammer and Furyaev 1996). Small and large fires of varying intensity have different effects on the ecosystem. High-intensity fires lead to the replacement of forest stands by new successional sequences. Low-intensity surface fires favor the selection of fire-tolerant trees such as pines (*Pinus* spp.) and larches (*Larix* spp.) and may repeatedly occur within the lifespan of a forest stand without eliminating it.

Large-scale forest disturbances connected with drought and fires are familiar from recent history. The Tunguska Meteorite Fall near Vanavara (Krasnoyarsk Region, Russia) (ca. 60°54'N - 101°57'E) on 30 June 1908 a cometary nucleus explosion at ca. 5 km altitude, was one of the more exceptional events which caused large-scale forest fires in the region of impact.[1]

Several years later, from June to August 1915, the largest fires ever recorded occurred as a consequence of an extended drought in Central and East Siberia (Tobolsk, Tomsk, Yeniseisk, NE Irkutsk, S Yakutsk regions). Shostakovich (1925) estimated that the fires were burning ca. 50 days in the region between 52-70°N and 69-112°E. The main center of fires was between Angara River and Nijnya Tunguska, and the total area burned was estimated at $14.2x10^6$ ha. However, the smoke of these fires covered the region between 64-72°N and 61-133°E, corresponding to ca. $680x10^6$ ha. Shostakovich estimated continuous smoke (visibility ca. 100 m) on $284x10^6$ ha, heavy smoke (visibility 25-100 m) on $215x10^6$ ha and thick smoke (visibility 5-20 m) on ca. $181x10^6$ ha.

It is not clear, however, whether lightning, humans or a combination of the two were the primary cause of the extended fires of 1915. In Eurasia fire has been for a long time an important tool for land clearing (conversion of boreal forest), silviculture (site preparation and improvement, species selection), and in maintaining agricultural systems, e.g. hunting societies, swidden agriculture, and pastoralism (Viro 1969; Pyne 1996). In addition to the natural fires, these old cultural practices brought a tremendous amount of fire into the boreal landscapes of Eurasia. In the early 20th century, the intensity of fire use in the agricultural sector began to decrease because most of the deforestation had been accomplished for agriculture, and traditional small-sized fire systems (treatment of vegetation by free burning) was replaced by mechanized systems (use of fossil-fuel driven mechanical equipment). Despite the loss of traditional burning practices, however, humans are still the major source of wildland fires; only 15% of the recorded fires in the Russian Federation are caused by lightning (Korovin 1996).

In recent years wildfires were more or less eliminated in Western Eurasia. The average annual area affected by fire in Norway, Sweden and Finland is less than 4,000 ha. Thus, the major occurrence of Eurasian fires is in the territory of the Russian Federation and other countries of the Commonwealth of Independent States. Statistics compiled by the Russian Aerial Fire Protection Service *Avialesookhrana* show that between 10,000 and more than 30,000 forest fires occur each year, affecting up to $2\text{-}3x10^6$ ha of forest and other land (Korovin 1996). Since fires are monitored (and controlled) only on protected forest and pasture lands, it is estimated that the real area affected by fire in Eurasia's boreal vegetation is much higher. For instance, satellite-derived observations by Cahoon et al. (1994) indicate that during the 1987 fire season approximately $14.5x10^6$ ha were burned. In the same fire season ca. $1.3x10^6$ ha of forests were affected by fire in the montane-boreal forests of Northeast China, south of the Amur (Heilongjiang) River (Goldammer and Di 1990; Cahoon et al. 1991). Fires in boreal North America in the past decade affected, on average, $1\text{-}5 \times 10^6$ ha per year. An exceptional year was 1987 in which 7.4×10^6 of forests were burned in Canada (FIRESCAN Science Team 1994).

1 For more details see http://en.wikipedia.org/wiki/Tunguska_event

1.2. Concerns: Global Change and Fire

Expected global warming over the next 30-50 years, as predicted by Global Circulation Models, will be most evident in the northern circumpolar regions (Bolin et al. 1986; Maxwell 1992; Shugart and Smith 1992; Shugart et al. 1992). As Wein and de Groot (1996), Fosberg (1996), Stocks (1993), and Stocks and Lynham (1996) underscore, fire may be the most important (widespread) driving force in changing the taiga under climatic warming conditions. The prediction of increasing occurrence of extreme droughts in a $2xCO_2$ climate indicates that fire regimes will undergo considerable changes. Increasing length of the fire season will lead to a higher occurrence of large, high-intensity wildfires. Such fire scenarios may be restricted to a transition period until a new climate-vegetation-fire equilibrium is established.

Regional warming may also lead to the shift of vegetation zones, e.g. the boreal forest shifting north ca. 500-1000 km (Kauppi and Posch 1988). The shift of ecosystems will have considerable impacts on the distribution of phytomass. Estimates of carbon stored in above- and below-ground live and dead plant biomass (without soil organic matter) in the global boreal forest area range between 66 and 98 Gt (66-98x10^{15} g) (US Department of Energy 1983; Apps et al. 1993). Additional large amounts of carbon are stored in boreal forest soils (ca. 200x10^{15} g) and boreal peatlands (ca. 420x10^{15} g) (Apps et al. 1993). There is concern that changing fire regimes due to climate change will affect the balance of the boreal carbon pool and lead to additional release of carbon into the atmosphere, thus acting as temporary positive feedback loop to global warming.

Changing forestry practices in boreal Eurasia, stimulated by increasing national and international demands for boreal forest products, have resulted in the widespread use of heavy machinery, large-scale clearcuts, and, with this, in the alteration of fuel complexes. The opening of formerly closed remote forests by roads, and subsequent human interferences bring new ignition risks. Additional fire hazards with little predictable environmental consequences, are created on forest lands heavily damaged by industrial emissions (severe damages in the Russian Federation affect ca. 9x10^6 ha). Radioactive contamination on an area of ca. 7x10^6 ha creates considerable problems because it redistributes radionuclides through forest fires (Dusha-Gudym 1992). These direct effects on the ecosystem are added to the indirect effects of climate change, and both will almost certainly lead to an unprecedented era of fire.

1.3. Objectives of Cooperative Fire Research in Boreal Eurasia

Jointly with the first East-West conference entitled “Fire in Ecosystems of Boreal Eurasia” (Goldammer and Furyaev 1996), the Fire Research Campaign Asia-North (FIRESCAN) was prepared under the co-sponsorship of the International Boreal Forest Research Association (IBFRA) and the IGBP/IGAC subprogram “Impact of Biomass Burning on the World

Atmosphere" (Biomass Burning Experiment [BIBEX]; for details cf. FIRESCAN Science Team [1994] and Goldammer and Furyaev [1996]).

In accordance with the hypotheses of the IBFRA Stand Replacement Fire Working Group (Fosberg 1992), the objectives of the experiment were:

- set a high-intensity stand replacement fire under controlled conditions, under conditions and with characteristics of an uncontrolled wildfire;
- investigate all pre- and post-fire characteristics of the site;
- describe fire behavior and relate the findings to ecological and meteorological conditions before and during the fire;
- analyze emissions of aerosols (characteristics and transport), the most important radiatively active trace gases, and trace gases with stratospheric ozone-depleting effects;
- relate the fire experiment to the fire history of the site and the surrounding landscape;
- set up an investigation area for long-term follow up research on ecosystem response (e.g. collection of data on mortality and recovery, succession, biological diversity nutrient cycling, soil respiration, and carbon accretion);
- demonstrate and compare methodologies in fire research developed in the East and West.

To meet these objectives, the FIRESCAN Science Team, an international multidisciplinary research team, assembled in the summer of 1993 to investigate site characteristics, fire effects, fire emissions, and fire behavior on a 50 ha experimental stand-replacement fire in a typical boreal pine forest.

The experimental site is in the central part of the Krasnoyarsk Region of Siberia, about 28 km west of the Yenisei River and 28 km south of the Dubches River (60°45'N, 89°25'E) at an elevation of approximately 150 m above sea level (Figure 1). The study site is a nearly level, slightly elevated, sandy island, about 50 ha in size, which is surrounded by bogs dominated by mixed-grass, sphagnum and tall sedge (Figure 2). The site was referred to as Bor Forest Island, after the town of Bor, 90 km to the North, which served as the transportation base for research activities. The Bor Forest Island study site is on the Sym Plain, in the Western Siberian Lowland - a large block of the earth's crust characterized by past tectonic depression. The Sym Plain is an area of low relief, with sandy surface materials of glacial outwash and alluvial origin. Very deep, unconsolidated deposits are present, and there are numerous lakes and oligotrophic and mesotrophic bogs. Forests are dominated by pure pine stands of the *Pinus sylvestris-Ledum-Vaccinium vitis idaea-Pleurozium schreberi, P.sylvestris-P.schreberi-Cladonia sylvatica* (40%), and *Pinus sylvestris-Polytrichum commune*-dwarf shrub-Sphagnum (20%) forest types. Oligotrophic bog ridges with pools covered by *P.sylvestris*-dwarf shrub-Sphagnum forest cover 40% of the landscape. The forest on the experimental fire site is a typical middle taiga pine forest of the Sym Plain.

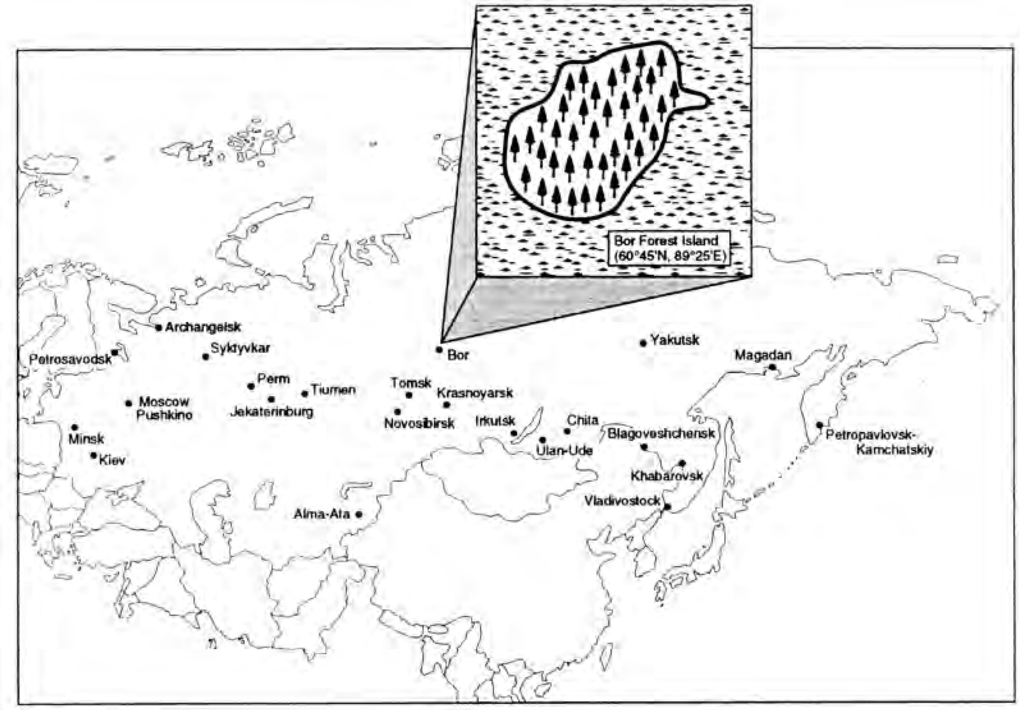

Figure 1. Location of Bor Forest Island near Bor, Krasnoyarsk Region, Russian Federation. All other names of locations are regional headquarters of the Russian Aerial Fire Protection Service Avialesookhrana or relevant services in other countries of the Commonwealth of Independent States.

Because Atlantic air masses are transformed to continental over the Western Siberian Lowland, zones and subzones are clearly discernible across the landscape. The climate is cool and moist. Average annual air temperature ranges from 3.2 to 5.7°C. Total annual precipitation is 450-500 mm, with wide year-to-year variations. Although most precipitation occurs in the summer, frequent dry periods are caused by dry cyclonic air masses coming from the south. In the past century, 26 droughts have occurred in the area (an average of 2-3 times per decade).

The fire season lasts from May to September, with most fires in June-July. In the *Pinus sylvestris*-lichen forest types, about 20% of the area is in even-aged stands that have regenerated from stand-replacement fires. Fire periodicity varies from 40-50 years in the north to 25-29 years in the central part of Krasnoyarsk Region. For the *P.sylvestris-V.vitis idaea*-Sphagnum forest type characteristic of the central part of the area, forest fire periodicity is 10 to 80 years. As in the rest of Siberia, periodic extreme fire seasons are common. Those seasons are remarkable for long rainless periods (up to 38 days), with relative humidities down to

30%, and air temperatures up to 30-35°C. Until the end of the 19th century, extreme fire seasons in the central Krasnoyarsk Region occurred from 3-4 to 7 times a century. This has increased up to 20-25 events in the 20th century. Most of these fires are human caused, as a result of intense forest exploitation in the area. For the past 50 years, extreme fire seasons associated with mass forest fires have occurred at least twice a decade, sometimes two years in succession (for more details on geology, climate and ecology of the region cf. Goldammer and Furyaev (1996).

Figure 2. Aerial view of Bor Forest Island immediately prior to the experimental fire

Results of the first two years of investigation from the Bor Forest Island Fire Experiment, including pre- and post-fire studies, are given in the following two sections. Part II reports characteristics of the study site and its vegetation, and presents preliminary results on short-term fire effects. Part III describes fuel characteristics, fire behaviour, and emissions.

2. Fire History, Ecology, and Short-term Fire Effects

2.1. Fire Ecology of *Pinus sylvestris* Forests of the Sym Plain

The Bor Forest Island experimental site is typical of pine-lichen forests of Western Siberia that have been described in the literature (Tkachenko 1952; Korchagin 1954; Shanin 1965; Komin 1967; Popov 1982; Furyaev and Zlobina 1985, and others). Generally, in the taiga zone, dominant pine stand age is dependent on the time period since the last intense fire. Pine stands on sands are represented primarily by pine-lichen forest types. Species composition of post-fire woody plant regeneration is typically similar to pre-fire composition. The time it takes for a young stand canopy to become closed after fire depends on burned area size, seed sources available, and seed production in the years following the fire. Because of insufficient surface fuel loads, fires typically are patchy and cover relatively small areas. As a result, seed sources are generally available nearby. Only young and pole stands, and sometimes middle-aged stands, tend to burn out completely.

Popov (1982) described the regeneration processes in pine stands of the southern taiga zone in the Angara region of Central Siberia. These stands occurred on sandy and podzolic soils on high terraces and in river valleys, and experienced periodic fires. They were the same forest type as the Bor Forest Island experimental site. Popov found that grass cover following burns in pine-lichen forests was usually extremely low and poorly developed; soil often remained bare in considerable parts of burned areas. Pine, either in pure stands or with a very small admixture of birch, typically began to regenerate in high densities (usually several hundred thousand pine seedlings per hectare) after the first year of good seed crop. Popov described the following developmental stages for these stands:

- young pine stands with red whortleberry (*Vaccinium vitis idaea*)-lichen surface cover, and birch as a minor component
- pole pine stands with litter and lichen surface cover;

a)

b)

c)

Figure 5. View from photo point 5 of typical stand condition on the Island. **a.** Before the fire, **b.** Immediately after the fire, **c.** July 1994, one year after fire. For the years up to 2012: See Annex II.

by 1994. In July 1994 we established five additional plots. Plot centers were again randomly located, but sampling was restricted to areas of low to moderate fire severity to ensure an adequate sample of surviving trees for modeling purposes. In both years, all trees in the plots were tagged and numbered. Measurements included maximum and minimum scorch height on the bole, tree diameter, tree height, height to bottom of crown, and depth of residual forest floor organic matter at the base of the tree (as a possible indication of impacts of fire on shallow roots). In 1993, we also did visual estimates of percent crown scorch. This was not possible in 1994 because dead needles resulting from post-fire insect damage and decreases in tree vigor could not be distinguished from scorch, and many needles had already been shed. In 1994 we also noted whether trees had visible evidence of insect infestation on the boles (as indicated by exit holes in the bark and by visible insect frass).

Data were analyzed following procedures described in Regelbrugge and Conard (1993). Logistic regression analysis (Walker and Duncan 1967) was used to model the probability of post-fire tree mortality as a function of tree size and fire damage variables. The model used is of the form:

$$P(m) = 1/(1 + e^{-(\beta_0 + \beta_1 X_1 + \ldots + \beta_k X_k)})$$

where $\boldsymbol{P(m)}$ is the probability of post-fire mortality, $\boldsymbol{X_1}$ through $\boldsymbol{X_k}$ are independent variables and $\boldsymbol{\beta_1}$ through $\boldsymbol{\beta_k}$ are model coefficients estimated from the data. We used DBH, maximum and average ((maximum - minimum)/2) stem bark char height, relative char height (height of bark char/tree height), depth of forest floor organic matter, and percent of canopy volume scorched as independent variables to predict fire-induced mortality. The SAS LOGISTIC procedure was used to obtain maximum likelihood estimates of the model coefficients and model fit was evaluated using the Homer and Lemeshow goodness of fit statistic (SAS Institute 1989; Saveland and Neuenschwander 1990).

Of the 201 trees sampled for development of mortality models, 57 percent were dead by a year after the fire. Ninety-nine percent of dead trees sampled, as well as 85 percent of the living trees, were infested with bark beetles. Although infestation levels tended to be low in living trees, at least another year will be required to ensure that all mortality has occurred before developing final models. Only 14 of 100 trees were intermediate in canopy scorch estimates. Forty-three percent had no crown scorch and 43 percent had 90 to 100% crown scorch. Of those with no crown scorch, 56% were dead a year after the fire. Of those with 90 to 100% scorch, 97.6% had died.

General population characteristics for trees used to develop mortality models are in Table 7. These trees were selected to provide a well-distributed set of characteristics for model development, and not to describe the stand in general. Diameters were slightly larger than those measured in the 30 by 30 m plot and in the vegetation transect, primarily because sampling focused on areas of incomplete mortality along the fringes of the island, where average tree size tended to be larger that in the interior.

Annex II

The FIRESCAN Science Team (1993)

The Bor Forest Island Fire Experiment was a joint effort of the science team of the first phase of the Fire Research Campaign Asia-North (FIRESCAN). Coordinators of the experiment were Johann G. Goldammer, Brian J. Stocks, Valentin V. Furyaev, and Erik N. Valendik. The introductory part of this manuscript was compiled by Johann G. Goldammer. Lead author of Part II of the manuscript was Susan G. Conard (with James S. Clark, Valentin V. Furyaev, Johann G. Goldammer, Galina A. Ivanova, E. Mälkönen, and T.W. Swetnam), while lead author of Part III was B.J. Stocks (with J.S. Clark, Wesley R. Cofer, Bruce D. Lawson, and Johann G. Goldammer). Addresses and affiliations of participants actively involved in preparing, conducting and evaluating the field research are given in the list below. Affiliations are given without details. At the time of the update of this report (July 2012) several FIRESCAN Team members have moved to new assignments or are retired.

FIRESCAN Team Members (in alphabetic order)

Christopher H. Baisan
Laboratory of Tree Ring Research
The University of Arizona
USA

James S. Clark
Duke University
Department of Botany
USA

Wesley R. Cofer III
Atmospheric Sciences Division
NASA Langley Research Center
USA

Susan G. Conard
Riverside Forest Fire Laboratory
USDA Forest Service
USA

Valentin V. Furyaev
Sukachev Institute of Forest
Russian Academy of Sciences
Russia

Johann G. Goldammer
Global Fire Monitoring Center (GFMC)
Max Planck Institute for Chemistry
Germany

Hartmut Gossow
University of Agricultural Sciences
Vienna
Austria

Gary Hartley
Canadian Forest Service
Canada

Galina A. Ivanova
Sukachev Institute of Forest
Russian Academy of Sciences
Russia

Yegor K. Kisilyakov
Sukachev Institute of Forest
Russian Academy of Sciences
Russia

Bruce D. Lawson
Canadian Forest Service
Canada

Eino Mälkönen
The Finnish Forest Research Institute
Finland

Loyd W. Overbay
Atmospheric Sciences Division
NASA Langley Research Center
USA

Jon C. Regelbrugge
Riverside Forest Fire Laboratory
USDA Forest Service
USA

Brian J. Stocks
Canadian Forest Service
Natural Resources Canada
Canada

Thomas W. Swetnam
Laboratory of Tree Ring Research
The University of Arizona
USA

Erik Valendik
Sukachev Institute of Forest
Russian Academy of Sciences
Russia

Ross W. Wein
Forest Science and Canadian Circumpolar Institute
University of Alberta
Canada

Edward L. Winstead
Science Application International Corporation
USA

Annex III

The Expeditions 2008 and 2012

In 2008 routine field work on the Bor Forest Island took place 18-21 September. With the following participants:

- Leonid G. Kondrashov UNISDR Regional Northeast Asia Wildland Fire Network / Pacific Forest Forum, Khabarovsk, Russia
- Yegor Kisilyakov, Sukachev Institute of Forest, Siberian Branch, Russian Academy of Sciences, Krasnoyarsk
- Alexander Selin, Krasnoyarsk Aviabase, Russia
- Johann G. Goldammer, Global Fire Monitoring Center (GFMC), Freiburg, Germany

The opportunity should be taken to acknowledge the work of Dr. Leonid Grigorievich Kondrashov, who over many years served as the leader of the UNISDR Regional Northeast Asia Wildland Fire Network and the Pacific Forest Forum. His main work was to bring the state-of-the-art knowledge in wildland fire science to the fire management community and to policy makers. Three years after the expedition Leonid Kondrashov passed away on 29 April 2010.

In memory of Leonid G. Kondrashov (left)

Toast to the escape from bear attack
From left: Goldammer, Selin, Kisilyakov

In memory of Leonid G. Kondrashov (left)

Farewell at Yartsevo air field

Group photo of the 2012 expedition

The last expedition before the publication of this book volume was realized in the frame of the "International Fire Management Week" in Krasnoyarsk Krai, Russian Federation, 1-10 September 2012 (see Part V of this volume). The field work took place on 5 September 2012 and involved a larger group of participants, including two film teams from *Avialesookhrana* and the public Russian TV channel Vesti. A full documentation produced by these film teams is available on the Vesti.ru and GFMC on-line repositories:

- TV report produced by Vesti.ru: http://www.vesti.ru/videos?vid=446529&cid=1320 and http://www.fire.uni-freiburg.de/intro/Krasnoyarsk-Int-FM-Week-Vesti-ru-15-Sep-2012-short.mp4 (mp4, 56 MB)
- Film produced by *Avialesookhrana*: http://www.fire.uni-freiburg.de/intro/Krasnoyarsk-International-Fire-Management-Week-2012.mp4 (mp4, 0.7 GB)

From left to right (back row, standing): Alexey Narishkin (Head, Department of Fire Prevention and International Cooperation, Aerial Forest Fire Center *Avialesookhrana*), Yulia Gavrikova (Reporter, Newspaper Forestry News), Antonina Kramskih (Reporter, Newspaper Forestry News), Johann Georg Goldammer (Director, Global Fire Monitoring Center), Andrey Eritsov (Deputy Chief, Aerial Forest Fire Center *Avialesookhrana*), Sergiy Zibtsev (Head, International Programs, Institute of Forestry and Landscape Park Management, National University of Life and Environmental Sciences of Ukraine), Alexey Kolegov (Helirapeller, Krasnoyarsk Aerial Forest Fire Center, Yartsevo outstation), Aleksandr Selin (Director, Krasnoyarsk Aerial Forest Fire Center), Elena (Reporter, TV Rossia-2), Fedor Zebzeev (Instructor, Team of Helirapellers of Krasnoyarsk Aerial Forest Fire Center, Yartsevo outstation)

From left to right (first row, sitting): Aleksandr Stepchenko (Deputy Director, St. Petersburg Forestry Research Institute), Battugs Gendenjav (National Emergency Management Agency, Mongolia), Oleg Arban (smokejumper, *Avialesookhrana* Yoshkar-Ola outstation, and camera operator).

This group photo of the 2012 expedition does not include all participants. Photographs of Yegor Kisilyakov (Sukachev Institute of Forest, Siberian Branch, Russian Academy of Sciences, Krasnoyarsk) and Oyunsanaa Byambasuren (GFMC) are found on the following page.

The international participants (from left): Oyunsanaa Byambasuren, Johann G. Goldammer, Sergiy Zibtsev, Battugs Gendenjav

Unloading the MI-8 helicopter

Helicopter rotor downwash

On-site briefing

Yegor Kisilyakov

Alexey Narishkin and Alexey Kolegov setting up an inventory plot

Part III: Forest and Steppe Fires in Mongolia

Oyunsanaa Byambasuren and Johann Georg Goldammer

1. Introduction

The Central Asian region including Mongolia for the last two decades is experiencing an increase in occurrence, area burned and environmental impacts caused by wildland fires. In Mongolia the damages from wildland fires, as well as their influence on human health and wellbeing, are increasing. The scale of wildland fire sometimes has transboundary effects (e.g. fires and fire-smoke pollution crossing the borders with Russia and China), demanding regional / international and cooperative efforts to address the problem.

Reasons for the escalation of destructive wildfires are, among other, result of the rapidly changing socio-economic conditions, a limited public budget for forest and fire management, and side effects of illegal logging. Projected trends of climate change impacts on vegetation cover and fire regimes, as well as observed demographic and socio-economic trends suggest that wildland fire may continue to play a major role in the destruction of vegetation cover in Mongolia, resulting, among other, in accelerating steppization, permafrost thawing and desiccation of peatlands / wetlands.

Every landscape has a specific fire regime, and the adaptation methods of vegetation types are diverse. In the Taiga- und Sub-taiga forests, fire is a natural ecological factor which, in conjunction with climatic and edaphic factors, influences species composition and the spatial distribution of forest ecosystems (Goldammer 2002; Mühlenberg et al. 2000). The main natural cause of forest fires in the Taiga ecosystems during the summer months is lightning (Chuluunbaatar 2001). Since the transition to a market economy at the beginning of the 1990s, the duration, frequency and intensity of forest fires have increased significantly. The seasonal outbreak of fires correlates with socio-economic activities resulting in a main fire season from March to June (80% of forest fires), and a smaller fire season during the autumn months (5 to 8% of forest fires) from September to October (Goldammer 2002). Forest fires are one of the main causes of the drastic degradation of Mongolian forest resources over the past two decades. Fire regimes may vary in space and time at both regional and local scale (Johnson and Van Wagner 1985). At the regional scale, latitudinal and longitudinal gradients in fire regime have been observed (Heinselman 1981; Payette et al. 1989) and the response of fire regimes to short and long-term climate change has been reported (Clark 1988, 1990). At the local scale, different topography and vegetation types may be characterized by specific fire behavior (Romme and Knight 1981; Fowler and Asleson 1982; Engelmark 1987) and fire regimes may vary from one landscape to another in relation to the specific proportion and arrangement of their topographical units and forest cover (Heinselman 1981; Knight 1987). Thus, understanding of ecology and dynamics of different forest ecosystems is essential to implement sustainable forestry and forest fire management planning.

In this chapter we present the socio-economic changes, which influences on forest resources and wildland fire situations in Mongolia. Also, general characteristics of Mongolian forest ecosystems, historical fire conditions in different forest ecosystems and results the First Central Asian Forest Fire Experiments were presented.

2. Physical and geographical characteristics of Mongolia impacting the fire risk

The Mongolian environment is hosting a range of diverse landscapes that include forested mountain ranges in the north, and desert, desert-steppe and steppe areas with low mountains and sparse vegetation in the south. High mountains and glaciers are concentrated in the west while the east of the country is characterized by vast plains and wild heathlands. The average elevation of the country is 1580 meters above sea level (Tsedendash 1995).

Natsagdorj et al. (1998) estimate that during the last five decades sandy areas have increased by 47,500 ha due to the progression of the Gobi Desert and the northern part of the country. The observed and the predicted changes in annual precipitation across Mongolia have been variable. Recent global climate model simulations have predicted declining precipitation in all parts of Mongolia, which would cause decreased soil moisture and increased drought duration (Batima et al. 2005). Mongolia has 3811 rivers and streams stretching for 67,000 km, over 3000 lakes containing 500 km^3 of water, about 6900 springs with steady flows, over 190 glaciers taking about 540 km^2 and over 250 mineral water springs. However, less than 43% of people have access to a safe water supply. 18% of the annual water reserves available for use in Mongolia are groundwater resources. Surface water is located in northern and central regions, but for the Gobi Desert and steppe areas in the southern parts of Mongolia the only source is groundwater (MNE 2006).

The principal soil type is dry-steppe chestnut soil that covers some 40% of Mongolia. Other major soil types are brown desert-steppe and grey brown desert soils. Arable soils are generally dark chestnut and chestnut soils, which are typically light, fine-silty, around 20-30 cm deep with an organic matter content of 3-4% and pH of 6-7. Due to above mentioned climatic factors the soil ecosystems are comparatively vulnerable, highly susceptible to degradation by human activities.

The rates of humus production and vegetative regeneration and growth are very low throughout the country and agricultural productivity is not high comparing to other countries of the same latitude. Land degradation and desertification are the problems of great significance in Mongolia since, according to the Land Administration Authority, approximately 11 million ha or 7% of the total land area is degraded to some extent. The principal factors leading to degradation and desertification are considered to be: climate change

Annex I: Photographic documentation and satellite images of the experimental site

Figure 21. Instruction of freshly equipped and trained firefighters

Figure 22. Distribution of hand tools to local communities attending the prescribed burn

Figure 23. Starting the prescribed fire by local firefighters

Figure 24. Demonstration of hand tools by local community members

Figure 25. Low-intensity fire burning downhill controlled by the firefighters

Figure 26. Local community members are attending and exercising

Figure 27. Patrolling the fire edge

Figure 28. Demonstration of multiple ignition lines

Figure 29. Merging of downhill and uphill fire lines, creating fire whirls and higher fire intensities

Figure 30. Exercising the use of air blowers for fire suppression

Part IV: White Paper on Use of Prescribed Fire in Land Management, Nature Conservation and Forestry in Temperate-Boreal Eurasia

Johann G. Goldammer (ed.)

White Paper on Use of Prescribed Fire in Land Management, Nature Conservation and Forestry in Temperate-Boreal Eurasia

Edited and published on behalf of the participants of the Symposium on Fire Management in Cultural and Natural Landscapes, Nature Conservation and Forestry in Temperate-Boreal Eurasia and members of the Eurasian Fire in Nature Conservation Network (EFNCN) [1]

by the Global Fire Monitoring Center / Fire Ecology Research Group, Freiburg, Germany

In the landscapes of temperate-boreal Europe – the western part of the Euro-Siberian region of the Holarctic Floral Kingdom2 – the prevailing fire regimes are shaped by human-ignited fires. Direct fire application in land-use systems and human-caused wildfires – ignited accidentally, by negligence or otherwise deliberately set – have influenced cultural and natural landscape since the beginning of land cultivation. Only in Northern Europe and the adjoining Western and Central Asian region natural fires constitute a significant factor, which is influencing the natural composition and dynamics of ecosystems. Thus, the targeted use of fire in ecosystem management in Europe is predominantly in those vegetation types that either have been shaped by human-ignited fires over historic time scales or where the application of prescribed fire reduces the vulnerability to and damages of uncontrolled fires. Fire is also used as a tool to substitute abandoned cultivation practices and for the control of wildfires.

In the following broad classification of fire regimes and burning practices a number of examples of fire use in ecosystem management are provided which reflect a highly diverse range of applications.

1 Note: A printed version of the White Paper is also available online: http://www.fire.uni-freiburg.de/programmes/natcon/EFNCN-White-Paper-2010.pdf

2 This White Paper follows the definition of "landscape" in accordance with the European Landscape Convention (Council of Europe, 2000): "Landscape means an area, as perceived by people, whose character is the result of action and interaction of natural and / or human factors". The geographic region is the Euro-Siberian region of the Holarctic Floral Kingdom.

1. Natural Fire Regimes

The integration of naturally ignited fires (by lightning) in vegetation management aims at maintaining the natural dynamics of fire-dependent or at least fire-adapted or fire-tolerant ecosystems. In North America, a continent hosting a broad range of fire-adapted ecosystems, the use or "integration" of natural fire under controlled conditions in the overall management of the ecosystems dates back to the 1960s and was referred to as "Let Burn", "Prescribed Natural Fire", and more recently "Wildland Fire Use" (van Wagtendonk, 2007). In the greater European / Eurasian space the use or the management of naturally ignited wildland fire to accomplish resource management objectives is not yet developed. In Western Europe (including the Euro-Mediterranean region and the Nordic countries) the functional role of natural fire had limited impact on the evolution of ecosystem properties and thus to their future maintenance – despite the presence of remarkable adaptations to fire, e.g. in some Mediterranean ecosystems (Naveh, 1975). Thus, there is a limited acceptance of allowing a naturally ignited fire to burn – even if the wildfire would burn within the "prescriptions" set by the ecosystem management plan.

However, in the Western and Central Asian region there are large tracts of forest ecosystems that have been shaped by natural fire, e.g. the pine (*Pinus* spp.) and larch (*Larix* spp.) forests that constitute the "light taiga" in Siberia and adjacent regions. In this rather extended biome there is a strong need to introduce the concept of allowing natural fires to burn, mainly in order to maintain open, fire-resilient stand structures and to reduce the risk of stand-replacement fires. Starting with the first East-West international conference "Fire in Ecosystems of Boreal Eurasia" (Goldammer and Furyaev, 1996) and the Fire Research Campaign Asia-North (FIRESCAN) (FIRESCAN Science Team, 1996) a dialogue with the forestry authorities of Russia (and the predecessor administration in the former Soviet Union, the State Forest Committee) has been initiated to replace the fire exclusion policy in the protected zone of Russia by an integrated fire management approach, which would include the use of natural fire and prescribed burning. While this approach has not yet been introduced in practice, there is a progress in the scientific and the policy acceptance of the concept. Given the magnitude and importance of wildfires in Central Eurasia there is need to prioritize the implementation of such a concept in the region, particularly in the Russian Federation.

7. Conclusions and Recommendations

In evaluating the presentations discussed during the symposium[4] the participants concluded hat recent research and the revival of prescribed burning practices in some regions of Europe have revealed the role and importance of fire in the maintenance and restoration of biodiversity in the cultural and natural landscapes of Europe.

The current trend of rural exodus and abandonment of land cultivation in some regions of Europe and the loss of traditional land use is leading to an alarmingly increasing rate of loss of open land habitats with its inherent biodiversity.

The maintenance and in many cases also the restoration of open land habitats by grazing, mechanical treatment and fire use is imperative if threatened biodiversity and landscape features are to be preserved.

Prescribed fire may be used in those ecosystems which historically were shaped by cultural fire, or in which prescribed fire may substitute other historic land-use techniques.

A sound understanding of the "pros and cons" of prescribed fire application is necessary as well as the consideration of side effects of fire use. Large areas threatened by land abandonment are embedded in industrialized regions in which society is becoming increasingly unreceptive to smoke emissions. Legal restrictions for open burning must be understood in the context of clean-air rules and overall goal of reducing gaseous and particle emissions that are threatening human health. This perception is reinforced by hysteria of some who consider prescribed fire emissions to increase the anthropogenic "greenhouse effect" and thus global warming.

On the other side it is noted that nature conservation agencies, non-government actors and the general public meanwhile turn out to have a rather sound understanding of the natural role of fire in various ecosystems. Thus the general perception of the "nature of fire" nowadays is better as compared to the situation two to three decades ago.

Based on the facts and recent trends presented in the Symposium on "Fire Management in Cultural and Natural Landscapes, Nature Conservation and Forestry in Temperate-Boreal Eurasia" the following recommendations are given:

Prescribed Fire Research

The symposium revealed that there is a need in:

4 See symposium report available at: http://www.fire.uni-freiburg.de/programmes/natcon/EFNCN-meetings-1-2008.html

- Continued support for prescribed burning research
- Clear analysis of the pro's and con's of prescribed burning in a European context, e.g., via meta analysis and expert knowledge regarding, environmental, economic and societal issues
- Studies of additional, not yet identified areas / ecosystems that require prescribed fire treatment
- Identification of possible vulnerabilities of systems subjected to prescribed fire
- Setting up a European group of scientists, managers and policy makers who are involved in management of temperate grazing systems and have adopted (or not yet) fire as an additional management tool. Besides the Eurasian Fire in Nature Conservation Network supporting groups/ organizations could include the European Heathland Network, the Husbandry Animal Group, the European Grassland Group, Aquatic Warbler Conservation Team, the UK Heather Trust and Moorland Forum
- Special emphasis on the use of fire in open fen mire habitats, e.g. in Eastern Germany, Belarus, and Poland

Prescribed Fire Management and Capacity Building

Since prescribed fire in ecosystem management is not yet largely applied, despite its recent revival, tools and systems must be developed to develop and support fire management capability. Action is needed to:

- Adjust the Canadian Fire Behavior Prediction System to European conditions with fuel types from every country
- Develop expert systems to assist burners to understand whether they should burn and to guide them to burn safely
- Enhance closer cooperation on the issue of prescribed burning for nature conservancy and landscape management between Temperate-Boreal Eurasia and the Mediterranean Region
- Develop prescribed specific regional fire guidelines which consider the biophysical and social settings, for the use of agencies, land owners and other stakeholders involved
- Limit bureaucracy and develop easier rules for permitting the application of traditional burning as well as advanced prescribed burning practices
- Develop specific prescribed burning training systems
- Develop a scheme for the certification of Burn Boss and Ignition Specialist on a European level and with national modifications
- Assist in capacity building of fire specialists in countries in transition
- Establishment of regional Training / Education Centers for Fire Management for the Balkans and for East European and adjoining Central Asian / Far East countries

Modified Fire Policies

The legislative framework in most European and neighboring Eurasian countries does not provide regulations for the use of prescribed fire. In contrary, in general the use of fire is banned by law – although law enforcement in some countries is nil. Besides national legal instruments a regional European framework directive would be needed to create an enabling environment for the sound use of prescribed fire in nature conservation, landscape management and forestry. Thus it is needed to:

- Emphasize at national level on the importance of prescribed burning and the consequences of not burning
- Using model projects (examples of "good practices") to demonstrate to local to national authorities in the need of the application of prescribed fire in combination with other complementing means of vegetations treatment
- Create an appendix with list of reference books / publications explaining core methods and showing the examples of "good practices" (aimed at informing influencing decision / policy makers)
- Cooperate with the EU *Fire Paradox* project[5] and its follow-up arrangement to support the development of a European Fire Framework Directive, which would create an enabling policy supporting the use of fire[6]

Public Relations and Education

Most important is to inform society on the dual role of fire on ecosystems, to allow the general public to understand the use of prescribed fire in some land-use system vs. the need to prevent and combat fires in others. Collectively we need to:

- Show the policy makers that there is a strong alliance and cooperation in promoting the use of fire at European level
- Show the public and policy makers that the severity and impacts of wildfires are increasing as a consequence of land-use change (increase of wildfire hazard resulting from rural exodus, land abandonment and fallow)
- Prove that prescribed burning is cost-efficient to restore and regenerate important and threatened habitats
- Prove that prescribed burning will contribute to stabilizing some forest ecosystems by making them less vulnerable to destructive wildfires, thus reduce the threat of land degradation and a decrease of net carbon emission to the atmosphere

---

5 http://www.fireparadox.org/

6 see Agudo and Montiel (2009)

General Remarks on Fire and livelihood of some Rural Populations

There are also some very pragmatic aspects for fire use that are crucial for livelihoods of people all over Eurasia. For instance, in the coastal heathlands of Norway it is important to maintain the traditional vegetation mosaic between heath-dominated and grass-dominated vegetation. The grassland represents the main fodder for the animals during the summer season, while evergreen heath species provide the main fodder during the winter. Heath burning is an important tool to maintain the mosaic, which does not only shape the highest possible biological diversity within the heath ecosystem but also the highest fodder value over the year. Similarly, many shepherds and their families throughout Southern and South-eastern Europe and the Balkans are dependent for their livelihood on the productivity of grazing lands regularly maintained by fire.

The International Context

In 2007 the 4th International Wildland Fire Conference was held in Sevilla, Spain. Participants from 88 countries, representing government organizations and civil society from all regions of the world, the United Nations and other international organizations, recommended in particular[7]:

- Regional strategies for fire management be developed and designed to the specific needs of regions;
- An international framework for fire management standards be developed and regional wildland fire training be supported, especially to meet the needs for capacity building in developing countries;

This White Paper – a call of the Eurasian Fire in Nature Conservation Network (EFNCN) through the conclusions of the Freiburg Symposium on “Fire Management in Cultural and Natural Landscapes, Nature Conservation and Forestry in Temperate-Boreal Eurasia” – is in line with these recommendations and also the outcomes of the “Fire Paradox” project (Sande Silva et al., 2010).

7 http://www.fire.uni-freiburg.de/sevilla-2007/Conference-Statement-en.pdf

8. References

Agudo, J., and C. Montiel. 2009. Basis to start the process for a proposal of a new legislation at EU level. Deliverable D7.1-1-3 of the Integrated Project "Fire Paradox", Project No. FP6-08505. European Commission, 66 p.

Ascoli, D., R. Beghin, R. Ceccato, A. Gorlier, G. Lombardi, M. Lonati, R. Marzano, G. Bovio, and A. Cavallero. 2009. Developing an Adaptive Management approach to prescribed burning: a long-term heathland conservation experiment in north-west Italy. International Journal of Wildland Fire 18, 727-735.

Bobbink, R., M. Weijters, M. Nijssen, J. Vogels, R. Haveman, and L. Kuiters. 2009. Branden als EGM-maatregel. Ede: Directie Kennis, Ministerie LNV (Rapport / DK 2009/dk117-O).

Bonn, S. 2004. Research and development project "Sustainable development of xerothermic slopes of the Middle Rhine Valley, Germany". Int. Forest Fire News No. 30, 59-62.

Bonn, S., J. Albrech, K. Bylebyl, N. Driessen, P. Poschlod, U. Sander, and M. Veith. 2009. Offenlandmanagement mit Panzerketten. Naturschutz und Biologische Vielfalt 73, 189-205.

Bruce, M., and G. Servant. 2004. Prescribed Fire in a Scottish Pinewood: A Summary of Recent Research at Glen Tanar Estate, Aberdeenshire. Int. Forest Fire News No. 30, 84-93.

Brunn, E. 2009. Feuermanagement auf Truppenübungsplätzen in Brandenburg. Naturschutz und Biologische Vielfalt 73, 165-178.

Davies, M.G., A. Gray, A. Hamilton, and C.J. Legg. 2008. The future of fire management in the British uplands. International Journal of Biodiversity Science and Management 4 (3), 127-147.

Delabraze, P., and J.Ch. Valette. 1983. The fire, a tool for clearing the French Mediterranean forest associations. In: DFG-Symposion Feuerökologie. Symposionsbeiträge (J.G. Goldammer, ed.), 27-38. Freiburger Waldschutz-Abh. 4, Institute of Forest Zoology, Freiburg University, 301 p.

Driessen, N., J. Albrech, S. Bonn, K. Bylebyl, P. Poschlod, U. Sander, P. Sound, and M. Veith. 2006. Nachhaltige Entwicklung xerothermer Hanglagen am Beispiel des Mittelrheintals (Sustainable development of xerothermic hillsides in the Middle Rhine valley). Natur und Landschaft 81, 130-137.

Faerber, J. 2009. Prescribed range burning in the Pyrenees: From a traditional practice to a modern management tool. Int. Forest Fire News No. 38, 12-22.

FAO-GFMC. 1999. Wildland Fire Management Terminology. Update of the FAO Wildland Fire Management Terminology of 1986 (Food and Agriculture Organization of the United Nations, FAO Forestry Paper 70, 257 p.), published online at GFMC: http://www.fire.uni-freiburg.de/literature/glossary.htm

Fernandes, P., and H. Botelho. 2004. Analysis of the prescribed burning practice in the pine forest of northwestern Portugal. Journal of Environmental Management 70, 15-26.

FIRESCAN Science Team. 1996. Fire in ecosystems of boreal Eurasia: The Bor Forest Island Fire Experiment, Fire Research Campaign Asia-North (FIRESCAN). In: Biomass burning and global change. Vol.II (J.S.Levine, ed.), 848-873. The MIT Press, Cambridge, MA.

Forstzoologisches Institut. 1978. VW-Symposium Feuerökologie. Symposionsbeiträge. Freiburger Waldschutz-Abh. 1 (1), 1-159. Institute for Forest Zoology, Freiburg University, Freiburg, Germany.

GFMC Team. 2009. The LIFE Rohrhardsberg project: The use of Prescribed Fire in Maintaining Endangered Habitats and Landscape Feature in the Foothills of the Black Forest. Int. Forest Fire News No. 38, 84-87.

Goldammer, J.G. 1978. Feuerökologie und Feuer-Management. Freiburger Waldschutz Abh. 1 (2), 1-50. Institute for Forest Zoology, Freiburg University, Freiburg, Germany.

Goldammer, J.G. 1979. Der Einsatz von kontrolliertem Feuer im Forstschutz. Allg. Forst- u. J. Ztg. 150, 41-44.

Goldammer, J.G. (ed.). 1983. DFG-Symposion Feuerökologie. Symposionsbeiträge. Freiburger Waldschutz-Abh. 4, 301 p.

Goldammer, J.G. 2009. The use of Prescribed Fire on Nature Conservation Areas in Germany contaminated by Unexploded Ordnance (UXO). In: Advanced Seminar "Wildfires and Human Security: Fire Management on Terrain Contaminated by Radioactivity, Unexploded Ordnance (UXO) and Land Mines", Kyiv / Chornobyl, Ukraine, 6-8 October 2009, Abstract Volume (J.G. Goldammer, ed.), 21-22. – http://www.fire.uni-freiburg.de/GlobalNetworks/SEEurope/GFMC-CoE-OSCE-Seminar-Ukraine-Brochure-Final-06-Oct-2009.pdf

Goldammer, J.G., and V.V. Furyaev (eds.). 1996. Fire in ecosystems of boreal Eurasia. Kluwer Academic Publ., Dordrecht, 528 pp.

Goldammer, J.G., S. Montag, and H. Page. 1997a. Nutzung des Feuers in mittel- und nordeuropäischen Landschaften. Geschichte, Methoden, Probleme, Perspektiven. Alfred Toepfer Akademie für Naturschutz, Schneverdingen, NNA-Berichte 10, Heft 5, 18-38.

Goldammer, J.G., J. Prüter, and H. Page. 1997b. Feuereinsatz im Naturschutz in Mitteleuropa. Ein Positionspapier. Alfred Toepfer Akademie für Naturschutz, Schneverdingen, NNA-Berichte 10, Heft 5, 2-17.

Goldammer, J.G., E. Brunn, G. Hoffmann, T. Keienburg, R. Mause, H. Page, J. Prüter, E. Remke, and M. Spielmann. 2009. Einsatz des Kontrollierten Feuers in Naturschutz, Landschaftspflege und Forstwirtschaft – Erfahrungen und Perspektiven für Deutschland. Naturschutz und Biologische Vielfalt 73, 137-164.

Goldammer, J.G., and S. Zibtsev (eds.) 2009. Advanced Seminar "Wildfires and Human Security: Fire Management on Terrain Contaminated by Radioactivity, Unexploded Ordnance (UXO) and Land Mines", Kyiv / Chornobyl, Ukraine, 6-8 October 2009, Abstract Volume, 41p. http://www.fire.uni-freiburg.de/GlobalNetworks/SEEurope/GFMC-CoE-OSCE-Seminar-Ukraine-Brochure-Final-06-Oct-2009.pdf

INRA. 1988. Proceedings, International Prescribed Burning Workshop, Avignon, 14-18 March 1988. Institut National de la Recherche Agronomique (INRA), Station de Sylviculture Méditerranéenne.

Jensen, H.S. 2004. Restoration of dune habitats along the Danish west coast. Int. Forest Fire News No. 30, 14-15.

Keienburg, T., and J. Prüter. 2006. Naturschutzgebiet Lüneburger Heide – Erhaltung und Entwicklung einer alten Kulturlandschaft. Mitteilungen aus der NNA 17 (1), 68 p.

Korontzi, S., J. McCarty, T. Loboda, S. Kumar, and C. Justice. 2006. Global distribution of agricultural fires in croplands from 3 years of Moderate Resolution Imaging Spectroradiometer (MODIS) data. Global Biogeochem. Cycles 20, GB2021, doi: 10.1029/2005GB002529.

Kvamme, M., and P.E. Kaland. 2009. Prescribed burning of coastal heathlands in Western Norway: History and present day experiences. Int. Forest Fire News No. 38, 35-50.

Lambert, B. 2008. Bilan et perspectives du réseau brûlage dirigé. Réseau des équipes de brûlage dirigé, SUAMME, Conservatoire de la Forêt Méditerranéenne. 32p.+CDRom.

Lázaro, A. 2009. Collection and mapping of prescribed burning practices in Europe: A first approach. Int. Forest Fire News No. 38, 110-119.

Lovén, L., and P. Äänismaa. 2004. Planning of the Sustainable Slash-and-Burn Cultivation Programme in Koli National Park, Finland. Int. Forest Fire News No. 30, 16-21.

Lutz, P. 2008. Traditional slash-and-burn agriculture in the Black Forest: Reconstruction of burning and agricultural techniques. Paper presented at the Symposium on Fire Management in Cultural and Natural Landscapes, Nature Conservation and Forestry in Temperate-Boreal Eurasia, Freiburg, Germany, 25-27 January 2008.

http://www.fire.uni-freiburg.de/programmes/natcon/ppt/23-EFNCN-2008-1-Germany-Swidden-Lutz.pdf

Mälkönen, E., and T. Levula. 1996. Impacts of Prescribed Burning on Soil Fertility and Regeneration of Scots Pine (*Pinus sylvestris* L.). In: Fire in ecosystems of boreal Eurasia (J.G. Goldammer and V.V. Furyaev, eds.), 453-464. Kluwer Academic Publ., Dordrecht, 528 pp.

Mause, R. 2009. The Use of Prescribed Fire for Maintaining open Calluna Heathlands in North Rhine-Westphalia, Germany. Int. Forest Fire News No. 38, 75-80.

Montiel, C., P. Costa, and M. Galán. 2010. Overview of suppression fire policies and practices in Europe. In: Towards Integrated Fire Management – Outcomes of the European Project Fire Paradox (J. Sande Silva, F. Rego, P. Fernandes, and E. Rigolot, eds. European Forest Institute Research Report 23.

Naveh, Z. 1975. The Evolutionary significance of fire in the Mediterranean Region. Vegetatio 29, 199-208.

Niemeyer, F. 2004. Prescribed Burning of Moorlands in the Diepholzer Moorniederung, Lower Saxony State, Germany. Int. Forest Fire News No. 30, 43-44.

Page, H., and J.G. Goldammer. 2004. Prescribed Burning in Landscape Management and Nature Conservation: The First Long-Term Pilot Project in Germany in the Kaiserstuhl Viticulture Area, Baden-Württemberg, Germany Int. Forest Fire News No. 30, 49-58.

Pyne, S.J. 1997. Vestal Fire. An environmental history, told through fire, of Europe and Europe's encounter with the World. University of Washington Press, 680 p.

Rego, F.G., J.M. da Silva, and M.T. Cabral. 1983. The use of prescribed burning in the Northwest of Portugal. In: DFG-Symposion Feuerökologie. Symposionsbeiträge (J.G. Goldammer, ed.), 88-104. Freiburger Waldschutz-Abh. 4, Institute of Forest Zoology, Freiburg University, 301 p.

Rietze, J. 2008. Ecological monitoring of the management of slope-vegetation by prescribed burning in the Kaiserstuhl-Region, Germany. Int. Forest Fire News No. 38, 63-66.

Rigolot, E., 2000. Le brûlage dirigé en France: outil de gestion et recherches associées. In: Vega, J.A., Vélez, R. (Eds.), Actas de la Reunión sobre Quemas Prescritas, Cuadernos de la Sociedade Española de Ciencias Forestales 9, 165-178.

Rösch, M., O. Ehrmann, L. Herrmann, E. Schulz. A. Bogenrieder, J.G. Goldammer, M. Hall, H. Page, and W. Schier. 2002. An experimental approach to Neolithic shifting cultivation. Vegetation History and Archaeobotany 11, 143-154.

Rösch, M., O. Ehrmann, L. Herrmann, E. Schulz, A. Bogenrieder, J.G. Goldammer, H. Page, M. Hall, and W. Schier. 2004. Slash-and-burn experiments to reconstruct late Neolithic shifting cultivation. Int. Forest Fire News No. 30, 70-74.

Rydkvist, T. 2009. Prescribed fire as a restoration tool and its past, present and future use in the County of Västernorrland, Sweden. Int. Forest Fire News No. 38, 63-66.

Sande Silva, J., F. Rego, P. Fernandes, and E. Rigolot (eds.). 2010. Towards Integrated Fire Management – Outcomes of the European Project Fire Paradox. European Forest Institute Research Report 23.

Schreiber, K.-F. 2004. Germany: Use of Prescribed Fire in Maintaining Open Cultural Landscapes in Baden-Württemberg State. Int. Forest Fire News No. 30, 45-48.

Scotland Government. 2008. The Muirburn Code. Guidance on safe burning of heather (principal legislation constraints that apply for the wise use of fire in moorland management of Scotland). ISBN 978-0-7559-1004-5. http://www.scotland.gov.uk/Publications/2008/04/08154231/0

Tanneberger, F., J. Krogulec, and A. Kozulin. 2009. Feuermanagement im Niedermoor - Beispiele aus Polen und Weißrussland. Naturschutz und Biologische Vielfalt 73, 179-188.

Valendik, E.N., V.N. Vekshin, S.V. Verkhovets, A.I. Zabelin, G.A. Ivanova, and Ye.K. Kisilyakhov. 2000. Prescribed burning of logged sites in dark coniferous forests. Siberian Branch Russ. Acad. Sci. Publishing, Novosibirsk. 209 pp <in Russian>.

Valendik, E.N., V.N. Vekshin, G.A. Ivanova, Ye. K. Kisilyakhov, V.D. Perevoznikova, A.V. Bryukhanov, V.A. Bychkov, and S.V. Verkhovets. 2001. Prescribed burning of logged mountain forest sites. Siberian Brunch Russ. Acad. Sci. Publishing, Novosibirsk, 172 pp. <in Russian>.

Valendik, E.N., J.C. Brissette, Ye.K. Kisilyakhov, R.J. Lasko, S.V. Verkhovets, S.T. Eubanks, I.V. Kosov, and A.Yu. Lantukh. 2006. An experimental burn to restore a moth killed boreal conifer forest, Krasnoyarsk Region, Russia. Mitigation and Adaptation Strategies for Global Change 11 (4), 883-896.

Valette, J.Ch., E. Rigolot, and M. Etienne. 1993. Intégration des techniques de débroussaillement dans l'aménagement de défense de la forêt contre les incendies. Forêt Méditerranéenne XIV(2), 141-154.

van Wagtendonk, J.W. 2007. History and evolution of wildland fire use. Fire Ecology Special Issue Vol. 3 (2), 3-17.

Vega, J.A., S. Bará, and C. Gil. 1983. Prescribed burning in pine stands for fire prevention in the Northwest of Spain: Some results and effects. In: DFG-Symposion Feuerökologie. Symposionsbeiträge (J.G. Goldammer, ed.), 49-74. Freiburger Waldschutz-Abh. 4, Institute of Forest Zoology, Freiburg University, 301 p.

Vélez Muñoz, R. 2007. Experiences in Spain of Community Based Fire Management. Paper presented at the 4th International Wildland Fire Conference, Sevilla, Spain 13-17 May 2007.

http://www.fire.uni-freiburg.de/sevilla-2007/contributions/doc/cd/SESIONES_TEMATICAS/ST2/Velez_SPAIN_DGB_ExpeEnglish.pdf

Viro, P.J. 1974. Effects of forest fire on soil. In: Fire and ecosystems (T.T. Kozlowski and C.E. Ahlgren, eds.), 7-45. Academic Press, New York.

Vogels, J. 2009. Fire as a restoration tool in the Netherlands – first results from Dutch dune areas indicate potential pitfalls and possibilities. Int. Forest Fire News No. 38, 23-35.

Part V: The Krasnoyarsk 10-Point Programme on the Future of Fire Management in Russia

PART V

Recommendations of the "International Fire Management Week"

Krasnoyarsk Krai, 2-8 September 2012

The Krasnoyarsk 10-Point Programme on the Future of Fire Management in Russia

Rationale

Sustainable management and protection of forest resources are key elements of the forest policy of the Russian Federation. For more than a century the prevention and control of all forest fires has been primary task of agencies responsible for forest management and fire protection. However, scientific evidence reveals that some forest types in the different ecoregions of Russia's territory have co-evolved with natural fires (lightning fires) and even human-set fires. The effects of fire disturbances include removal of dead and live accumulated biomass, recycling of nutrients, stand thinning and regeneration of forest stands. Fire disturbances are creating valuable wildlife habitats. Recurrent surface fires of low intensity remove combustible materials and result in an overall reduction of the risk of severe and large destructive fires, which are considered threat to sustainable forest management and utilization, and may lead to large, uncontrollable outbreaks of pests and diseases.

With the presence of natural fires over millennia some forest types can be classified as fire-tolerant, fire-adapted or even fire dependent. Thus, a complete exclusion of fire from some forest ecosystems is neither ecologically desirable, nor economically feasible. Considering the increasing importance of managing long-term stable forest cover, forest productivity and carbon sequestration, a future forest and fire management policy of Russia shall include the integration of planned and prescribed natural and accidental wildfires, as well as prescribed management fires.

Wildfire prescriptions need to be determined for each forest type, allowing wildfires to burn if their effects are expected to be beneficial to the forest ecosystem short- to long-term.

The application of prescribed management fires (prescribed burning) shall reduce hazardous combustible materials within forest stands (under canopy burning); burning residuals (slash) of forests destroyed by pests, diseases and wind; or induce forest regeneration and secure ecological dynamics of natural protected forests. Currently there are no regulations on prescribed natural and prescribed fire management operations under canopy of forests in Russia.

The International Fire Management Week

Between 2 and 8 September 2012 the „International Fire Management Week“ was organized under the joint umbrella of the Federal Forestry Agency ROSLEZKHOZ of Russia and the Global Fire Monitoring Center (GFMC), both cooperating partners under the bilateral Russian-German Agreement on Cooperation in Sustainable Forest Management, and under the framework of the UN International Strategy for Disaster Reduction (UNISDR) and the UN Economic Commission for Europe (UNECE).

During this event the latest and up-to-date state of the art of fire ecology and advanced fire management methods on the use of prescribed fire for wildfire hazard reduction in temperate-boreal Eurasia were presented and discussed between scientists, practitioners and policy makers at national level of the Russian Federation, and with representatives of the administrations of Krasnoyarsk Krai.

Participating and consulted institutions included:

- Federal Forestry Agency (Roslezkhoz)
- Global Fire Monitoring Center (GFMC)
- Aerial Forest Fire Center (Avialesookhrana)
- Forest Inventory and Planning Enterprise “Roslesinforg”
- All Russian Institute of Continuous Education in Forestry (VIPKLH)
- Vice Governor of Krasnoyarsk Krai
- Minister of Natural Resources and Forest Complex of Krasnoyarsk Krai
- Sukachev Institute of Forest SB RAS
- Krasnoyarsk Krai Forestry Agency
- Krasnoyarsk Forest Fire Center
- National University of Life and Environmental Sciences of Ukraine
- National University of Mongolia
- National Emergency Agency of Mongolia
- Sankt Peterburg Forestry Research Institute (SPbNIILH)
- Krasnoyarsk Forest Health Center (Regional office of Roslesozaschita)
- Krasnoyarsk Center of EMERCOM of Russia

In a seminar basic statements and papers were presented on the role of fire in ecosystems and the implications on fire management.

At a field demonstration on prescribed burning under canopy of a pine stand nearby Krasnoyarsk media representatives were briefed about the objectives of prescribed sub-canopy burning in pine forests. Attendees of this demonstration witnessed for the first time that a prescribed low-intensity surface fire can be set in a forest to safely reduce surface fuels without damaging the stand.

An expedition to the site of Bor Forest Island Fire Experiment of 1993, located between the settlements Yartsevo and Bor, demonstrated the concept of a long-term research project of the consequences of a severe, high-intensity fire. The experiment, scheduled for the

200-years research period 1992-2192, investigates the consequences of a high-intensity forest fire, followed by secondary pests, on the regeneration of a natural forest.

A Round Table on the 4th day of the International Fire Management Week evaluated the seminar, the prescribed burning experiment and the visit of the Bor Forest Island Fire Experiment.

The Krasnoyarsk 10-Point Programme on the Future of Fire Management in Russia

The Round Table concluded that there is an urgent need to revise the policy and practice of fire management in the Russian Federation, and agreed upon the following recommendations:

1. Legal and other normative documents that are regulating forest management and forest fire protection need to be complemented concerning the use of prescribed fires and prophylactic burning under forest canopy.
2. Methodological guidelines for prescribed burning under forest canopy need to be developed at federal level.
3. Educational programs for the training of forest firefighters and fire management specialists at different educational levels need to be developed and approved at Federal level.
4. Programs of advanced continuous professional education for foresters on prescribed burning need to be developed and approved.
5. Create the occupation categories "Forest Fire Fighter" and Fire Crew Leader in the tariff-classification reference book.
6. Further scientific research concerning prescribed fires needs to be supported at Federal level.
7. The Order of the Federal Forestry Agency № 174 of 27 April 2012 "Approval of the normative for forest fire management plans" need to be changed in the section on planning the prophylactic burnings at forest district unit level and to determine the normatives for fire prevention operation plans in the 1-km zone around settlements.
8. Concepts for the use of fire on agricultural and other non-forested lands of the Russian Federation need to be developed.
9. A new system of statistical accounting and classification of types of forest and other vegetation fires and their consequences needs to be developed, and appropriate changes to be made in the GOST № 17.6.1.01-83 (approved by Decree of the State Committee on Standards, 19 December 1983).
10. International expertise in the field of fire management needs to be used, including the system of statistical accounting and classification of vegetation fires proposed by GFMC.

Международная неделя пожароуправления
Красноярский край, 2-8 сентября 2012 г.

Рекомендации

Красноярская Программа из 10-ти пунктов по вопросу о будущем пожароуправления в России

Обоснование

Устойчивое управление и охрана лесных ресурсов являются ключевыми элементами лесной политики Российской Федерации. В течении более чем столетнего периода профилактика и борьба с лесными пожарами были основными задачами государственных органов управления, ответственных за ведение лесного хозяйства, в том числе за охрану лесов. В то же время, результаты научных исследований показывают, что природные пожары (возникшие от молний), а в некоторых случаях и пожары антропогенного происхождения, были неотъемлемой частью динамики отдельных типов леса различных экорегионов на территории России. Воздействие огня на лесную экосистему заключается в удалении отмершей и живой накопленной биомассы, стимулировании круговорота питательных элементов, прореживании древостоя и содействии природному восстановлению лесов. Нарушения, произведенные огнем, содействуют формированию ценных местообитаний диких животных. Периодические низовые лесные пожары низкой интенсивности удаляют лесные горючие материалы и, таким образом, способствуют снижению риска развития катастрофических разрушительных пожаров, которые являются угрозой для устойчивого управления лесами, лесопользования, и могут привести к большим, неконтролируемым вспышкам вредителей и болезней леса.

Природные пожары были одним из факторов, который наравне с другими экологическими факторами, на протяжении тысячелетий влиял на формирование некоторых типов леса. В этой связи данные леса могут классифицироваться как устойчивые к пожарам, адаптированные к пожарам или даже зависимые от пожаров. Таким образом, полное исключение пожаров из некоторых типов лесных экосистем является нежелательным с экологической точки зрения и нецелесообразным экономически. Учитывая возрастающее значение управления долгосрочным и стабильным лесным покровом, продуктивностью лесов и депонированием углерода, будущая лесная политика и политика в области охраны лесов от пожаров России должна включать интеграцию предписанных запланированных природных пожаров и пожаров антропогенного происхождения, а также профилактических выжиганий.

Предписания, касающиеся природных пожаров (возникших от гроз или по антропогенным факторам), должны быть определены для каждого типа леса, что будет предусматривать возможность развития пожара, если ожидается, что его влияние будет позитивным для лесных экосистем, как в кратко- так и в долгосрочной перспективе.

Применение профилактических выжиганий должно включать снижение накопления пожароопасных горючих материалов в лесных насаждениях (выжигание под пологом леса); сжигание растительных остатков (валежа) в лесах, поврежденных вредителями и болезнями леса, ветровалами; или стимулировать природное возобновление леса и обеспечивать природную динамику коренных лесов на охраняемых территориях. В настоящее время в России не существует утвержденных инструкций о проведении предписанных природных пожаров и профилактических выжиганий под пологом леса.

Международная неделя пожароуправления

«Международная неделя пожароуправления» была организована с 2 по 8 сентября 2012 г. совместно Федеральным агентством лесного хозяйства и Центром по глобальному мониторингу пожаров (GFMC) в рамках двустороннего Российско-Германского Соглашения о сотрудничестве в области устойчивого лесопользования и под эгидой Международной стратегии ООН по уменьшению опасности стихийных бедствий (UNISDR) и Европейской Экономической Комиссии ООН (UNECE).

Во время этого события, было представлено и обсуждено современное состояние знаний в области экологии пожаров и передовых методов пожароуправления, в частности, использование предписанных пожаров для снижения природной пожарной опасности в лесах умеренно-бореальной Евразии учеными, практиками и политиками на национальном уровне России, а также представителями администрации Красноярского края.

В обсуждении и консультациях принимали участие следующие организации и их представители:

- Федеральное агентство лесного хозяйства (Рослесхоз)

- Центр по глобальному мониторингу пожаров (GFMC, Германия)
- Федеральное Бюджетное Учреждение «Авиалесоохрана»
- Восточно-Сибирский филиал Рослесинфорг «Востсиблеспроект»
- Всероссийский институт повышения квалификации руководящих работников и специалистов лесного хозяйства (ВИПКЛХ)
- Заместитель губернатора Красноярского края
- Министр природных ресурсов и лесного комплекса Красноярского края
- Институт леса им. В.Н.Сукачева СО РАН
- Агентство лесной отрасли Красноярского края
- Краевое государственное автономное учреждение «Красноярская база авиационной и наземной охраны лесов» (КГАУ «Лесопожарный центр»)
- Национальный университет биоресурсов и природопользования Украины
- Национальный университет Монголии
- Национальное агентство по чрезвычайным ситуациям Монголии
- Федеральное Бюджетное Учреждение «СПбНИИЛХ»
- Филиал ФБУ Рослесозащита «Центр защиты леса Красноярского края»
- Главное управление МЧС по Красноярскому краю

В рамках «Международной недели пожароуправления» был проведен семинар, на котором были представлены сообщения и научные доклады, посвященные роли огня в экосистемах и перспективам использования огня в системе охраны лесов от пожаров.

Во время демонстрации контролируемого пала под пологом соснового насаждения, расположенного в окрестностях г. Красноярска, представители СМИ были проинформированы о целях предписанных выжиганий под пологом сосновых лесов. Участники данной демонстрации в первый раз в регионе были свидетелями того, что предписанный низовой пал низкой интенсивности может проводиться в лесу с целью безопасного уменьшения количества напочвенных лесных горючих материалов без ущерба для древостоя.

Экспедиция к месту лесопирологического полевого эксперимента «Лесной остров Бор» 1993 года, расположенного между поселками Ярцево и Бор, продемонстрировала концепцию долговременного исследовательского проекта, посвященного изучению экологических аспектов лесного пожара высокой интенсивности. Эксперимент, который запланирован на 200-летний период исследований (1992-2192), позволит установить закономерности динамики растительности после лесного пожара высокой интенсивности, динамики популяций вторичных вредителей и восстановления естественного насаждения.

Круглый Стол, который был организован на 4-й день «Международной недели пожароуправления», был посвящен оценке семинара, демонстрационного эксперимента по проведению предписанного пала и результатам экспедиции на «Лесной остров Бор» спустя 19 лет после начала долговременного лесопирологического эксперимента.

Красноярская Программа из 10-ти пунктов по вопросу о будущем пожароуправления в России

Участники дискуссии на заседании Круглого Стола пришли к выводу, что существует настоятельная необходимость в пересмотре политики и практики пожароуправления в Российской Федерации и пришли к согласию относительно следующих рекомендаций:

1. Ввести в нормативные правовые документы изменения и дополнения в области использования предписанных пожаров и профилактических выжиганий под пологом леса.
2. Разработать методические указания по проведению профилактических выжиганий под пологом леса на федеральном уровне.
3. Разработать и утвердить единые программы подготовки специалистов по пожароуправлению и лесных пожарных различного уровня.
4. Разработать и утвердить программы повышения квалификации работников лесного хозяйства по проведению предписанных (контролируемых, профилактических) выжиганий.
5. Создать категории профессий «Лесной пожарный» и «Бригадир пожарной группы» в отраслевом тарифно-квалификационном справочнике.
6. Инициировать дальнейшие научные исследования по предписанным выжиганиям и их поддержку на федеральном уровне.
7. Внести изменения в приказ Рослесхоза № 174 от 27 апреля 2012 г «Об утверждении нормативов противопожарного обустройства лесов» в части планирования работ по предписанным (профилактическим) выжиганиям в разрезе лесничеств и определить нормативы

противопожарного обустройства в 1-километровых припоселковых зонах.

8. Учитывая большое количество лесных пожаров от сельхозпалов, разработать единую концепцию использования огня на землях различного назначения Российской Федерации.
9. Разработать новую систему статистического учета и классификации видов пожаров и их последствий, внести соответствующие изменения в ГОСТ № 17.6.1.01-83 (Постановление Госкомитета СССР по стандартам от 19.12.1983).
10. Использовать международный опыт пожароуправления, включая систему учета растительных пожаров, используемый Центром глобального мониторинга пожаров (ЦГМП).