



**Symposium on Fire Management in Cultural and Natural Landscapes, Nature Conservation and Forestry in Temperate-Boreal Eurasia
Freiburg, Germany, 25-27 January 2008**

Programme

Background and Rationale

In large parts of Eurasia the use of fire and other disturbances have contributed to shape landscape patterns of high ecological and cultural diversity and value, e.g. heathlands, open grasslands, meadows, and swidden (shifting) agriculture sites, as well as open and stress-resilient forest ecosystems. The rapid socio-economic changes in the past four decades and the recently increasing trend of rural exodus all over Eurasia, however, have resulted in abandonment of traditional land-use methods. With the elimination of these disturbances by cultivation, including traditional burning practices, large areas of Europe are converting to fallow lands, a process that is associated with ecological succession towards brush cover and forest, and an overall loss of open habitats. Besides the loss of valuable biodiversity the abandoned lands constitute an increase of wildfire hazard – a trend that is revealed by a growing number of extremely severe fire disasters. Similarly, the exclusion of fire in natural ecosystems such as northern boreal and sub-boreal coniferous forests in Eurasia has resulted in changing vegetation composition and an increase of wildfire hazard, notably in Central-Eastern Eurasia. Changing paradigms in ecology and nature conservation currently have led to reconsideration of fire-exclusion policies in certain sectors of land / landscape management, nature conservation and forestry.

Auspices and Partners

The symposium is an activity of the Eurasian Fire in Nature Conservation Network (EFNCN), which has been founded in 2000. EFNCN is facilitated by the Fire Ecology Research Group / Global Fire Monitoring Center (GFMC), Max Planck Institute for Chemistry, c/o Freiburg University / United Nations University, Freiburg, Germany.¹ The Symposium will be organized in close association with the EU FIRE PARADOX project, the EU LIFE Project “Rohrhardsberg, Obere Elz und Wilde Gutach”, the EU Leonardo da Vinci EuroFire project, the UNECE Team of Specialists on Forest Fire, the UNISDR Regional Baltic Wildland Fire Network and the United Nations University (UNU). The symposium is also linked to the PhD course „Hot Topics and Burning Issues: Fire as a Driver of System Processes – Past, Present, and Future (30 March – 5 April 2008, C.T. de Wit Graduate School for Production Ecology and Resource Conservation, Wageningen University, Global Fire Monitoring Centre / Max Planck Institute for Chemistry, and the United Nations University).²

Objectives of the Symposium

The symposium will provide a platform for the exchange of data, expertise, and views of institutions and individuals who are actively applying or conducting research in prescribed burning for the purpose of nature conservation (biodiversity management, habitat management), land and landscape management, and forestry, notably in forest fire management. As the EFNCN is operating at the science-management and science-policy interface, representatives of institutions representing land managers and owners, public services, e.g. fire services, are invited to attend to discuss and share views on professional capacity building in the use of prescribed fire.

¹ <http://www.fire.uni-freiburg.de/programmes/natcon/natcon.htm>

² <http://www.dpw.wageningen-ur.nl/peenrc/index.php?item=Fire%20as%20a%20Driver%20of%20System%20Processes>

Overall, the symposium will support the advancement of the use of prescribed fire in Eurasia; particularly by considering the involvement of local communities in land and fire management.

The region of interest covered by the symposium is temperate-boreal Eurasia with a focus on Europe North of the Alps and the adjoining countries of East / Southeast Europe, Caucasus, Central and Northeast Asia.

Outputs of the Symposium

The symposium will include plenary sessions with presentations of project reports and analyses of policies and management strategies, as well as dedicated side events for major projects and other groups.

All attendees of the Core Group (the symposium participation is by invitation only) are actively working in the use of prescribed fire, either in research or in management application. The participants will receive a template for reporting basic information on prescribed burning sites, aimed at updating the EFNCN database. This database will be shared with the Fire Paradox database.

The desired outputs of the symposium include:

- Collate and publish the state-of-the art and expertise in the use of prescribed fire (project reports)
- Update the EFNCN database
- Prepare a short White Paper on the Use of Prescribed Fire in Land Management, Nature Conservation and Forestry in temperate-boreal Eurasia

Venue, Date and Logistics

The symposium is following the tradition and scope of the series of Eurasian fire ecology symposia and conferences initiated and held in Freiburg (1977, 1981, 1989) and as satellite conferences in Russia 1993, Finland 2000 and 2004, and a number of regional consultations and meetings in the frame of the UNISDR Global Wildland Fire Network.

The symposium will be held at the Fire Ecology Research Group / Global Fire Monitoring Center (GFMC), Lecture Hall 101 of Freiburg University Airport Campus, Freiburg, Germany, on the weekend 25-27 January 2008. The opening session will be on 25 January 2008 at 14:15 hrs.

For information on hotel location, transport from and to Frankfurt and Basel airports, please see:

- <http://www.fire.uni-freiburg.de/intro/about3.html>

Draft Programme

Note: The final programme on Saturday 26 January 2008 will be determined by weather conditions. It is envisaged to observe prescribed winter burning in the Kaiserstuhl vineyard region. After the field presentations of Kaiserstuhl prescribed burning programme, the LIFE Rohrhardsberg Project and other local projects will be given and discussed in the meeting of the Oberbergen Wine Growers Association (Winzergenossenschaft Oberbergen). In case of unfavourable weather conditions the Saturday afternoon programme will focus on the presentations. The plenary sessions on Friday afternoon and Saturday morning are open to the students of Forest and Environmental Sciences, Freiburg University.

Friday 25 January 2008

14:15-14:30 Opening address by Mr. Johann G. Goldammer, Symposium Convener
Welcome address by Mr. Hanno Hurth, Commissioner of Emmendingen County
Welcome remarks by Mr. Bernd Seitz, Regional Council of Südbaden, Nature and Landscape Protection Division

14:30-16:00 Plenary presentations I

Goldammer, Johann Georg
Opening and Introduction to the Symposium

Rigolot, Eric
Fire Paradox: An Innovative and Integrated Approach to Wildland Fire Management

Rigolot, Eric
Prescribed Burning for Fuel Reduction Purposes in a Conservation Context

Bruce, Michael
Developments in Prescribed Fire and Wildfire Management in the United Kingdom

Rydkvist, Tomas
The use of Fire in Boreal Sweden

Kuivaniemi, Jukka
Organisation and Education for Prescribed Burning by the Swedish Forest Agency

16:00-16:30 Coffee Break

16:30-18:30 Plenary presentations II

Faerber, Johanna
Prescribed Range Burning in the French Pyrenees

Vogels, Joost
Relight the Fire: Burning as Restoration Tool in the Netherlands

Kaland, Peter Emil and Mons Kvamme
History and Present Experiences with Heathland Burning in Western Norway

Nagy, Daniel and Nikola Nikolov
Increasing Wildfire and Land Management Problems in Middle East and South East Europe: Needs and Opportunities to Introduce the Concept of Prescribed Burning

van de Vijver, Claudius
Fire as a Tool to Manage Temperate Grazing Systems: Lessons to be Learnt from Africa

19:30 Icebreaker for foreign guests at Hotel Minerva

Saturday 26 January 2008 (Morning)

09:00-10:30 Plenary presentations III

Bilgili, Ertugrul
Prescribed Burning for Successful Regeneration of Calabrian Pine Stands in Turkey

Kisilyakhov, Yegor K.
Prescribed Fire Experiments in Krasnoyarsk Region

McRae, Douglas J.
The Russian FIRE BEAR Project: An Experimental Fire Study to Enhance Forest Sustainability in Central Siberia

Kondrashov, Leonid
Prescribed Burning in the Russian Far East: Present and Future

Oyunsanaa, Byambasuren
Forest Fire Dating in Northern Mongolian Forests

10:30-11:00 Coffee Break

11:00-12:30 Plenary Presentations IV

Krogulec, Jaroslaw
Fire Management of open Landscapes in Poland: Conservation Needs and Legal Status

Kozulin, Alexander
Use of Prescribed Fire in the Maintenance and Restoration of Wetland Bird Habitats in Belarus

Zibtsev, Sergiy
Forest fires in Ukraine: Management and Policy (including a brief on the "Experimental Study of Radio-ecological Impacts of Wildland Fires in the Chernobyl Zone (by Vasyl Yoschenko)

12:30-13:30 Lunch

Saturday 26 January 2008 (Afternoon - Kaiserstuhl)

13:30-14:00 Transit to Kaiserstuhl area (by bus)

14:00-15:30 Observations of prescribed burning by local farmers. Transit to Oberbergen.

15:30-18:00 Core Group Presentations I: Kaiserstuhl, LIFE and other German projects

Welcome remarks by Mr. Gabriel Schweitzer, Mayor of Vogtsburg

Special guest of honour: Mrs. Gerdi Staiblin, Minister for Rural Space of Baden Württemberg State (1996-2001)

Page, Hans
Prescribed Burning integrated in Ecological Landscape Management in the Kaiserstuhl Viticulture Area, Baden-Württemberg, Germany

Rietze, Jörg
Ecological Monitoring of the Management of Slope Vegetation by Controlled Burning in the Kaiserstuhl-Region, Germany

Lutz, Peter
Traditional Slash-and-Burn Agriculture in the Black Forest: Reconstruction of Burning and Agricultural Techniques

Goldammer, Johann Georg and Hans Page
The LIFE Rohrhardsberg project: The use of Prescribed Fire in Maintaining Endangered Habitats and Landscape Features in the Foothills of the Black Forest

Rietze, Jörg
Ecological Monitoring in the Rohrhardsberg Region, Germany

Brunn, Egbert
Re-establishment of Traditional Heathland Management Tools in the Federal Forest Service District Lausitz, Brandenburg State, Germany

Mause, Rene and Alex Held
First Experiences in the Use of Prescribed Fire for Maintaining open Calluna Heathlands in North Rhine-Westphalia, Germany

18:00-19:00 Wine tasting (local wines from Kaiserstuhl)

19:00-20:30 Supper (local Kaiserstuhl specialties)

Sunday 27 January 2008

10:00-11:00 Core Group Presentations II:

Spielmann, Michaela and Daniel Kraus
Methodology of Prescribed Burning Demonstration Plot Description and Inventory for the Eurasian Fire in Nature Conservation Network and the Fire Paradox Russia and Mongolia Programme

Valese, Eva
Pianacci Prescribed Burning Project: Fire Risk Reduction and Fuel Load Management for Private Land Owners, Florence, Tuscany, Italy

Lázaro, Andrea
Collection and Mapping of Prescribed Burning Practices in Europe: A First Approach

11:00-11:30 Coffee Break

11:30-12:30 Core Group Presentations III: Fire management training

Bruce, Michael
EuroFire: Developing a Basic Level Competency-Based Training System for Vegetation Fire Management in Europe

Castellnou, Marc
Training for Fire Managers in the Use of Prescribed Fire for Wildfire Hazard Reduction and Nature Conservation in Europe

12:30-13:30 Lunch

13:30-15:30 Core Group Discussions within participating groups

Presentation of a draft concept for a "White Paper on the Use of Prescribed Fire in Nature Conservation, Forestry and Land Management in temperate-boreal Eurasia"

Breakout Groups: Development of related statements / recommendations for the use and policies of prescribed fire use in temperate-boreal Eurasia (internal group discussions)

15:30 ++ Final Core Group Discussion

Evening
Departure of some participants
Informal gathering of those participants who will leave 28 January (downtown Freiburg)

Annex I - Abstracts of Presentations

Opening and Introduction to the Symposium

Johann Georg Goldammer

Global Fire Monitoring Center (GFMC) / Fire Ecology Research Group, Freiburg, Germany

In large parts of Eurasia the use of fire and other disturbances have contributed to shape landscape patterns of high ecological and cultural diversity and value, e.g. heathlands, open grasslands, meadows, and swidden (shifting) agriculture sites, as well as open and stress-resilient forest ecosystems. The rapid socio-economic changes in the past four decades and the recently increasing trend of rural exodus all over Eurasia, however, have resulted in abandonment of traditional land-use methods. With the elimination of these disturbances by cultivation, including traditional burning practices, large areas of Europe are converting to fallow lands, a process that is associated with ecological succession towards brush cover and forest, and an overall loss of open habitats. Besides the loss of valuable biodiversity the abandoned lands constitute an increase of wildfire hazard – a trend that is revealed by a growing number of extremely severe fire disasters. Similarly, the exclusion of fire in natural ecosystems such as northern boreal and sub-boreal coniferous forests in Eurasia has resulted in changing vegetation composition and an increase of wildfire hazard, notably in Central-Eastern Eurasia. Changing paradigms in ecology and nature conservation currently have led to reconsideration of fire-exclusion policies in certain sectors of land / landscape management, nature conservation and forestry.

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FIRE PARADOX: An Innovative and Integrated Approach to Wildland Fire Management

Eric Rigolot

INRA National Institute for Agronomic Research (INRA), Mediterranean Forest Ecology Research Unit (UR629), Fire Physics and Ecology Team, Avignon, France

The social, economical and environmental consequences of the current wildfire regime in southern Europe are severe, and are likely to aggravate and geographically expand in the near future. FIRE PARADOX seeks to contribute to the mitigation of fire impacts by creating the scientific and technical foundation for practices and policies consistent with the concept of integrated wildland fire management, i.e. allowing an adequate balance between the management of natural resources and the management of unwanted fires. For the sake of integration, coherence and completeness, FIRE PARADOX approaches fire from four complementary sides, respectively prescribed burning (a powerful tool in proactive risk management), wildfire initiation, wildfire propagation, and suppression

fire (the use of fire in fire fighting). FIRE PARADOX is an European integrated project and therefore the work programme comprises thirteen interrelated modules evenly distributed by the Research, Development, and Dissemination domains.

"Fire is a bad master but a good servant": this Finnish proverb, often cited by J. Moreira da Silva who instigated prescribed burning in Portugal in the 1980s, sums up well the focus of this project. Stated otherwise: in several places in Europe, fire managers have committed themselves to developing a policy of wise use of fire which they justify because they are convinced that, as they become more efficient in putting out wildfires, those fires that do get out of control are going to be that much more ferocious and damaging. Fuel build up in the natural woodland areas around southern Europe's Mediterranean Rim is a structural fact which can be counterbalanced by a vigorous policy of fuel management.

FIRE PARADOX is a joint European initiative including 36 partners from 17 different countries from member states of the European Community and from third countries, including developing countries. Partnership includes various types of entities necessary to ensure integration like universities and forestry schools, research institutes, fire management agencies, international networks, associations or SMEs.

FIRE PARADOX expected benefits include the increased cooperation between European researchers, enhanced exchanges and increased integration for the forest and fire professionals using fire wisely, and a better awareness and preparation and safer behaviour of citizens. Finally, the FIRE PARADOX project will have an impact on policy making and initiative in regards to integrated wildland fire management.

Prescribed Burning for Fuel Reduction Purposes in a Conservation Context

Eric Rigolot

INRA National Institute for Agronomic Research (INRA), Mediterranean Forest Ecology Research Unit (UR629), Fire Physics and Ecology Team, Avignon, France

Fuel build up in the natural woodland areas around southern Europe's Mediterranean Region is a structural fact which can be counterbalanced by a vigorous policy of fuel management. Prescribed burning is one of the techniques available. Its advantages and limits need to be well understood but this technique can be combined judiciously with others used for intervention in natural areas around the Mediterranean, in particular with grazing. As a method, it has range and flexibility that suit it for application well beyond the fuel management in wildlands.

First of all, the traditional use of fire in mountain ecosystems around the Mediterranean should be acknowledged, assisted and fostered when necessary, because such ecosystems have been shaped by the sequence of agro-pastoral techniques in which fire has had the major role. The role played by rural communities in land management and protecting the environment is increasingly recognised.

Then specialized team in prescribed burning organized within the various forest and fire management agencies can offer an additive contribution. French case showed that the organisation through a national network of the different partners involved in prescribed burning activities, could further contributed to the acceptance and development of the technique. In this country, the training sessions for prescribed burning bosses and crews was one of the key actions collectively achieved in the frame of this network. The interface between research teams and prescribed burning teams was another important outcome of this network. Nowadays, 27 teams are officially operating, more than 100 prescribed burning bosses are accredited and 65 000 ha have been treated over the past 20 years.

While recourse to prescribed burning in France is nowadays backed by the recent legislation contained in the Forest Orientation Act, this institutional consolidation is limited to fire management purposes, whereas prescribed burning is more and more used for landscape management and conservation purposes. Prescribed burning is increasingly considered in conservation documents like Natura 2000, Life programs, and management plans with conservation objectives, along with increasing efforts for scientific monitoring of several groups: pray birds like Bonelli eagle, passerines

birds, red-legged and rock partridges, mammals like *Ovis gmelini musimon*, reptiles like *Vipera ursinii* or insects from the orthopters group.

A suitable fire regime should be defined for each conservation area with prescribed burning and grazing as the main management techniques. In that respect, there is still a need to assess, through research on fire ecology, the impact of the technique on specific environments in order to better define the conditions and specifications for a wise use of fire in conservation.

Developments in Prescribed Fire and Wildfire Management in the United Kingdom

Michael Bruce
Glen Tanar Estate, Aboyne, Aberdeenshire, United Kingdom

The United Kingdom has a mild oceanic climate with regular rainfall. However there are also periods of high temperatures and drought. In recent years there has been an increase in the number of wildfires and the fire behaviour experienced has become more severe.

In the United Kingdom there are large areas of native shrubs, dominated by heather (*Calluna vulgaris*) moorland, a cultural landscape, much of which has been designated as conservation sites both at national and EU levels. The soils underneath the shrub layer are largely peat, a significant carbon store.

The traditional land management of heather moorland is by prescribed burning during the winter months. There is now a debate about what the acceptable intensity and severity of prescribed burning is and what the fire return interval should be.

In areas of high fire risk, usually in areas with significant moorland and forestry interests, public/private sector partnerships between land managers and fire services have become established to address common problems. Similar multi-stakeholder partnerships addressing strategic issues have also become established at national levels in Scotland and England.

The Use of Fire in Boreal Sweden

Tomas Rydkvist
County Administrative Board of Västernorrland, Nature Conservation Office, Härnösand, Sweden

In Sweden most of the prescribed burned is done by certified forest companies, which burn about 2000-3000 hectares annually. Most of that area are of low quality and consists of logged areas with few retention trees.

There are only a few counties in Sweden that is using fire as a management tool in protected areas. About 50-200 hectares is burned in nature reserves annually but of high quality. Until now there is only a total of 729 hectares burned in the boreal forest reserves. If we want to see some radical changes we must boost up the area burned annually.

One of the problems is that most of the reserves have management plans that say "free development". They often say that a natural fire should be put out and they banned prescribed fire, often with no regards to past fire history. During the last few years we are re writing those management plans so we can use fire as a management tool. Another problem is that it has been more than 100 years since the latest forest fire, due to effective fire suppression. During that time there has been a huge increase in the number of trees per hectare, mostly spruce. Those spruces sometimes cause problems during burning, because of high risk of torching and by then inducing high temperature that might kill the pine trees. In some cases we have logged some of the surplus trees, mostly spruce trees, prior to burning. Combined with logging we should remove branches and tops and then reducing the risk of high intensity.

Another important issue is to preserve important structure and substrate, as snags and old pine trees. We need to find an easy and cheap way to secure these structures during prescribed burning.

This year we did conduct a small test on fire fighting additive as foam, gel and wet water. The result was satisfying and we find that some products were really good as a method to preserve snags and old pines. We have started a joint venture with the Swedish Forest Service when it comes to increase our own knowledge about forest fire behaviour, how to use prescribed fire to meet our objectives. And as a raw model we have looked at British Columbia, Canada, how they are organized and what demands they have on a Burn Boss and other crew members.

We have just finished our first round of education of new Burn Bosses. We have also looked at Canada in how to write a Prescribed Burn Plan and how to communicate with the local Fire department, politicians, public and so on. There has been a tremendous change during the last few years in the way people look upon a prescribed burning.

One great thing is that people see that the forest is still there, just slightly different and hopefully changed to the better.

Organisation and Education for Prescribed Burning by the Swedish Forest Agency

Jukka Kuivaniemi
Swedish Forest Agency, Ånge, Sweden

In the Forest District Södra Västernorrland (ca. 870 000 ha) annual plans are prepared for prescribed burning operations on a total area of 200-300 ha. The largest prescribed burns are approximately 100 ha. In Södra Västernorrland we have built up an organisation based on the functions of a Burn Boss and an Ignition Boss. The Burn Boss is always the person in charge. He/she has the overall responsibility of a burning operation. He is supervising the Ignition Boss who is responsible for igniting and securing the fire. Depending on the size of the fire we are using different amount of fire fighters. All personal that works with burning must have an education in prescribed burning.

In the year of 2007 started to train additional Burn Bosses in our region (Region Mitt). Our goal is to have three burning crews in our region. To increase the efficiency we are also training people from the county administration. It is important that all people involved in burning operations have the same level of knowledge. This makes it easier to prepare the plans and to carry out the burns.

Recently we have just started to build up an organisation for the northern part of Sweden. Our goal is to have one well-functioning burning team in each of the three regions in Sweden.

Prescribed Range Burning in the French Pyrenees

Johanna Faerber
Département de Géographie, Université de Perpignan, France

Fire is one of the oldest and most efficient tools of land management. In the Pyrenees, the use of fire has contributed to shape landscapes of high ecological and cultural diversity, e.g. heathlands and open grasslands. Clearing and rangeland management by periodical setting of fire was for centuries an indispensable technique to control shrub progression. In the Pyrenees, the use of fire never stopped: a more restrictive regulation since the end of the 19th century made the legal use of fire difficult, but burning continued in an illegal -and uncontrolled- way.

In the 1980th, the damages linked to illegal burnings and a slight revival of stockbreeding made necessary to reconsider the official fire policy. The regional authorities tried to develop a strategy allowing both, to reduce fire hazards and to restore rangelands that had turned to shrub. As a result, different policies of prescribed burning have been implemented in the Pyrenees. In the Eastern, Mediterranean Pyrenees, in a fire-sensitive environment, prescribed burning is executed since 1985

by a group of specialists assisted by fire brigades. In the central and Western part of the Pyrenees, the local population does most of the burnings, but the traditional know-how has been lost during the decades of illegality. The regional authorities try since the 1990th to make local stakeholders sensitive to the problem of uncontrolled fire and propose technical help. A more appropriate regulation wants to bring burning back to legality.

The efficiency of the new policy is variable from one département to another. Illegal burning generally decreased, but a significant reduction has been obtained only if a low-cost and easy-to-practice alternative is proposed, or if the new policy is based on a strong implication of the local stakeholders. However, in the Pyrenees, prescribed burning seems definitively installed and accepted as an appropriate management technique.

The impact of the burnings on vegetation dynamics and pastoral value has been studied by quantitative recording on permanent transects. The results show that, at the scale of plots, burning does not affect the species richness of rangelands. The heathlands proved to be of high resiliency: generally there is no appearing or disappearing of species. Soil erosion was not significantly higher on burnt plots. In all cases studied, the pastoral value increased after burning, linked to the different regeneration capacity of herbaceous and ligneous plants. The degree and persistence of this positive impact depend mostly on the floristic composition and on the age of the stands, but also on the conditions of burning and on subsequent grazing. Additionally, controlled burning maintains open rangelands by blocking afforestation, and may create a patchwork of grassland, heathland, shrub and forests, thus increasing landscape diversity at the scale of slopes.

Relight the Fire: Burning as Restoration Tool in the Netherlands

Hans Esselink, Joost Vogels and Marijn Nijssen
Bargerveen Foundation, Department of Animal Ecology and Ecophysiology, Radboud University,
Nijmegen, The Netherlands

Nutrient poor ecosystems in the Netherlands are suffering from increased anthropogenic pressure. Increased levels of atmospheric Nitrogen-deposition lead to eutrophication as well as acidification of these ecosystems. This in turn results in the dominance of a few well-adapted plant species such as tall grasses (grass encroachment). These changes also affect vegetation-structure and associated microclimatic characteristics, thereby negatively influencing the composition of characteristic faunal communities. For the last two decades, much effort has been made to counteract the negative effects of nitrogen deposition by means of the development of restoration measures. Early research aimed at the effectiveness of restoration measures in terms of nutrient removal revealed that burning was less effective in nutrient removal than other practices such as sod cutting. Moreover, negative effects of fire on fauna populations were reported. As a result, burning has been widely ignored as a possible restoration measure in the Netherlands.

Nowadays, managers report positive experience with small-scale burning experiments. At the same time, it became clear that the nowadays commonly used restoration measures, aimed at removal of nutrients, are not always producing the desired effects. Nutrient removal alone proved to be insufficient in restoring the system as a whole. As a result, renewed attention is given to alternative types of measures, including the potential of burning management in the Netherlands as restoration measure.

At the moment, a literature study is being prepared to get more insight in the mechanisms and viability of fire management in the Netherlands. Questions that need to be answered include: (1) effects on physio-chemical soil properties; (2) effects on nutrient-state and -availability; (3) differential effects on biota (including flora, fungi and fauna) in comparison with other measures; (4) environmental parameters (type of vegetation; weather conditions, etc) that determine the outcome of burning-management; (5) effect of the type of burning technique used on the outcome of the measure. In addition, a pilot study has been carried out on the effects of prescribed burning, in comparison to wildfires, in Dutch dry dune ecosystems. Biomass-removal proved only significant in the investigated wildfires. The conditions in which the prescribed fires were carried out was probably an important factor explaining this difference, suggesting that lack of practical knowledge and experience on the

technique of burning in the Netherlands is a factor of importance on the success of the measure. One year after the occurrence of a wildfire on Terschelling, rapid regrowth of tall-grasses took place on formerly grass-encroached sites, suggesting that successive management such as grazing is needed for successful restoration. The effect of burning on carabid assemblages proved to be of less importance than the effect of the type of the formerly present vegetation. Vegetation with low species richness did not result in higher species richness after occurrence of fire. Species assemblages of burnt areas resembled nearby unburned controls. In a dune area where the carabid community was found to be species-rich and highly characteristic, mobile species were more abundant after fire, suggesting that the carabid community re-established by means of recolonisation, instead of local survival. This implies that restoration of carabid communities will only occur when (1) source populations are present in the neighbourhood, and (2) at least parts of these populations are excluded from fire management.

History and Present Experiences with Heathland Burning in Western Norway

Peter Emil Kaland and Mons Kvamme
University of Bergen, Department of Biology, Norway

The coastal heaths of Norway are human-made cultural landscapes. They developed gradually through more than 4000 years with a start during the early Neolithic period. The mild oceanic climate allowed all year round grazing of sheep and goats up to the Polar Circle, and *Calluna vulgaris* and sea weed constituted the main winter fodder for the animals. The coastal population had a stable food source by combining fishing and farming.

The farmers managed the heathland in the same way as the farmers further south in Europe by burning the old heather during the winter and early spring. The frequency of burning was dependent on grazing pressure. Because of the shorter growing season in the northernmost part of Norway the burning frequency was lower here than further south.

Today the traditional management of the heathlands has come to an end along most of the coast, and the heathlands are therefore rapidly overgrown by shrubs and trees. In a few places, e.g. The Heathland Centre outside Bergen, the traditional management has been continued in cooperation with the local farmers in order to preserve the open heathlands and the culture connected to it. Regular burning has been an important part of this work. The knowledge of this technique we have learnt from the last farmers who were still doing it as an authentic part of their farm work.

During the last years the old Norse breed of sheep has got a new market because of its meat quality. This has increased the interest of the coastal population to resume the traditional management of the heathlands. However, the knowledge of how to perform a safety burning has almost died out. Because of the good reputation of 20 years authentic management of The Heathland Centre we receive many enquiries about heath burning. We have therefore a busy time every spring to organize courses in the art of proper heath burning for farmers in small communities along the entire coast.

Increasing Wildfire and Land Management Problems in Middle East and South East Europe: Needs and Opportunities to Introduce the Concept of Prescribed Burning

Daniel Nagy¹, Nikola Nikolov², and Johann Georg Goldammer³

¹ Ministry of Agriculture and Rural Development & University of West Hungary, Budapest / Sopron, Hungary; ² Faculty of Forestry, Skopje, Republic of Macedonia; ³ Global Fire Monitoring Center (GFMC), Freiburg, Germany

An increase fire hazard has been noted in the Middle East and South East European region in the last decade as a consequence of an increasing extent of abandonment of land use and management of private agricultural lands and forests. The main reason of abandonment was the decreasing of economic viability of smallholder farming. In these areas, which are often under natural protection, the fuel loads have increased rapidly in the last decades. Hand or mechanized land-care tools, such as

scything or crushing of vegetation succession are expensive or even impossible due to the steep slopes prevailing in the abandoned areas. The increasing fuel loads in these areas do not only lead to an increased wildfire hazard due to fuel accumulation, but also to a loss of open land ecosystems, often involving a loss of biodiversity, including protected species.

Well-planned, timed and performed prescribed burning could be a close-to-nature and cost-effective management method for these areas. The application of advanced and ecologically sound methods of prescribed burning in the countries of the regions requires a paradigm change among foresters, park managers and firefighters. To find the decision, in which stand types prescribed fire is needed to prevent high-severity wildfires and site degradation we urgently need to develop dedicated research and technology transfer. The use of prescribed fire will not only reduce the costs for landscape and nature reserve management, but will also reduce fire hazard in stands at wildfire risk.

Because the prescribed burning is a forgotten and therefore not any longer a „common“ method in Middle-East and South East Europe, a pilot project was designed to demonstrate its applicability and viability. An interdisciplinary analysis of the fire effects is needed to determine adequate firing methods for different stand types.

Under the EU-sponsored Southeast-European European Research Area (SEE-ERANET) programme the University of West Hungary, the Faculty of Forestry, Republic of Macedonia and the Global Fire Monitoring Center (GFMC) are conducting a research and demonstration programme in Southeast Europe on 2008, associated with the Eurasian Fire in Nature Conservation Network (EFNCN) and in cooperation with EU Fire Paradox and EuroFire. The collected experience of each partners based on their former research activities is contributing with special measuring, analysis and operational knowledge to the success of the joint project.

The main aim of the collaboration is to collect missing data on the influence of the fire on the specific forest, environment, landscape, soil etc. conditions in the region and to develop most proper methodologies to use fire to protect abandoned agricultural areas, grasslands, shrub lands and managed forests.

Fire as a Tool to Manage Temperate Grazing Systems: Lessons to be Learnt from Africa

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In many areas in Europe increased restrictions of intensified agricultural practices and the selling of agricultural land for (biodiversity) conservation and natural recreational purposes is leading to an increase in (semi)natural lands. These areas are often stocked with domesticated or natural grazing animals to maintain or increase heterogeneity, to increase the natural, recreational value of the landscape and when applicable to provide for an increasing demand of meat from organic farming practices. One of the issues that farmers and managers of these areas are confronted with is bush-encroachment, which refers to an increase of bushy, scrub vegetation at the expense of the natural, desired vegetation such as heathland, grasslands or wooded meadows. Bush encroachment does not only affect the biodiversity and natural value, but also the availability of forage for the grazing animals. The encroachment can even reach such a level that reversal to the original vegetation would require costly (mechanical or chemical) intervention. Accordingly the question is how to challenge bush encroachment in an optimal way being: maintaining/increasing the natural value and biodiversity of the land and when applicable maximizing organic livestock outputs) but at the same time keeping management interference (costly mechanical methods) low. In this paper we discuss the use of fire to tackle bush encroachment in a grazing system through fire and refer to the savannas of Sub-Saharan Africa.

Savannas are characterized by the co-occurrence of trees and grasses and fire and herbivory are seen as two major driving factors of these systems. In these systems bush encroachment has increasingly become a serious issue in the past decades. The question accordingly rises why this is the case since these systems have occurred for millennia. Using a simple model that investigates the interactive effects of fire, grazing and browsing on the tree–grass balance in savannas, we argue that

the balance between trees and grasses largely is determined by the indirect interactive effects of herbivory and fire. These effects are based on the positive feedback between fuel load (grass biomass) and fire intensity. An increase in the level of grazing leads to reduced fuel load, which makes fire less intense and, thus, less damaging to trees and, consequently, results in an increase in woody vegetation. The system then switches from a state with trees and grasses to a state with solely trees. Similarly, browsers may enhance the effect of fire on trees because they reduce woody biomass, thus indirectly stimulating grass growth. This consequent increase in fuel load results in more intense fire and increased decline of biomass. The system then switches from a state with solely trees to a state with trees and grasses. We maintain that the interaction between fire and herbivory provides a mechanistic explanation for observed discontinuous changes in woody and grass biomass i.e. bush encroachment.

The given information on grazer-fire interactions may provide insight for European management practices in areas where bush encroachment is an issue or in other areas where grazers may provide a means to counter fire threats.

Prescribed Burning for Successful Regeneration of Calabrian Pine Stands in Turkey

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Many ecosystems around the globe have evolved in the presence of fire over thousands of years. They require fire at certain intervals, seasons and scales for their maintenance. In this regard, prescribed burning is one of the more valuable tools available to fire and land managers. Prescribed burning is the deliberate use of fire under exacting fuel and weather conditions to achieve defined management objectives. In many forest ecosystems, the application of prescribed burning is usually done for three primary purposes: *i*) for fuel load (hazard) reduction to reduce the impact and difficulty of suppression of wildfires, *ii*) for the protection and conservation of biodiversity and other environmental values, and *iii*) for the re-establishment of plant communities. Here, the use of prescribed burning will be discussed and explained as a management tool in the successful regeneration of Calabrian pine (*Pinus brutia*) stands in Turkey. Site preparation, burning technique and burning conditions will be discussed, and some recommendations will be made.

Prescribed Fire Experiments in Krasnoyarsk Region

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In Russia understory burning and prescribed burning on logged areas are prohibited. All forest fires starting on forested areas and logged sites obligatory should be suppressed immediately. However, many scientists had been noted the positive effects of surface fires and suggested their integrated use in silviculture. Starting from 1996 experimental prescribed fires in slash fuels in Siberia have been conducted under the auspices of the Russian-American Central Siberian Sustainable Forest Management Project. High load of slash fuels is the main cause of logged areas high fire danger. Often wildfires start on logged areas and then move to surrounding forests. Mechanical removal of slash fuels is practically impossible due to the labour-consuming character and the lack of suitable mechanized equipment. Removal of natural forest and slash fuels using broadcast burning on logged areas was implemented between 1996 and 2001 on a total of more than 900 ha in Krasnoyarsk Region (Central Siberia). The burning experiments addressed three main issues. First, the fire hazard on logged areas is eliminated for the first 2 to 3 years and is very low during 5-10 years after prescribed burning. Second, prescribed burning creates conditions for natural and artificial regeneration (planting of seedlings, sowing). Third, prescribed fire reduced soil erosion, which is often observed as a consequence of mechanical treatment; prescribed fire is also strengthen fireweed growth, which is favouring the development of coniferous seedlings. Along with fires starting from logged sites wildfires in forests damaged by pests represent big problems for foresters and forest fire

fighters. Mechanical treatment and prescribed fire were used to restore a mixed conifer stand (*Picea-Abies-Pinus*) following mortality from an outbreak of Siberian moth (*Dendrolimus superans sibiricus*). Moth-killed stands often become dominated by *Calamagrostis*, a sod-forming grass. The large amount of woody debris and the sod hinder coniferous seedling establishment and development as well as creating conditions favourable for the ignition and spread of wildfires. Fire has been demonstrated to be an effective method of reducing woody debris and eliminating sod, but the random nature and timing of wildfires often do not create conditions favourable for the regeneration of conifers. Following treatment, the potential for wildfire was reduced and the area was suitable for either natural conifer regeneration or planting without further mechanical site preparation. Also fires in wildland-urban interface have great potential to be catastrophic due to high forest fuels loads after many years of intensive suppression policy. Experimental prescribed understory burns were carried out to decrease surface fuel loads and to remove regeneration thickets having high potential for crown fires. It was established that creation of park like forest stand without regrowth and understory with minimal surface fuel load near populated areas will help to exclude catastrophic forest fires. Thus, in Central Siberia experimental prescribed fires have been conducted to demonstrate possibilities of their use in restoration of dark and light coniferous forests after logging, Siberian Moth outbreak areas and for the prevention of catastrophic fires in the wildland-urban interface.

The Russian FIRE BEAR Project: An Experimental Fire Study to Enhance Forest Sustainability in Central Siberia

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The Russian boreal forest contains about 25% of the global terrestrial biomass, yet data on the extent and impacts of fire in these forests are scarce and often contradictory. In typical years, wildfires affect about 10 to 15 million ha annually in Russia. Several recent studies indicate that the impacts on terrestrial carbon storage of fires in boreal forest regions have been vastly underestimated. Furthermore, changes in land management and land-use practices, regional climate, and fire-suppression capability will affect fire risk and ecosystem damage from fires in ways that are currently poorly understood. In changing environments, fire can be a key agent to accelerate changes toward new ecosystem conditions. Improved understanding of the landscape extent and severity of fires and of factors affecting fire behaviour, and the effects of fire on carbon storage, air chemistry, vegetation dynamics and structure, and forest health and productivity is needed before such considerations can be adequately addressed in regional planning.

The Russian FIRE BEAR (Fire Effects in the Boreal Eurasia Region) Project is a research study designed to provide answers to basic questions in central Siberia on the management of fuels, fire, and fire regimes to enhance carbon storage and forest sustainability in ways that minimize the negative impacts of fire on the global environment, wood production, and ecosystem health. The project uses 4-ha experimental fires, a form of prescribed fire, to mimic the fire behaviour and the fire impact of what would normally occur on actual wildfires. Plots are ignited through a range of burning conditions to create low- to very high-intensity fires to provide data to model fire behaviour (e.g., rate of spread, fireline intensity, fuel consumption) and the effects of fire severity on combustion, emissions, and ecosystem impacts for estimating the effects of fire regimes on carbon balance, greenhouse gas releases, and forest health and productivity.

Fire in two important forest fuel types in Siberia has been documented: dry Scots pine (*Pinus sylvestris*) and larch (*Larix* spp.) dark conifer (mixed wood) forests. A total of 20 experimental fires have been conducted. While both the Russian and Canadian Forest Fire Weather Index (FWI) Systems can predict fuel consumption well, the absence of fire behaviour indices in the Russian System makes the FWI System superior in understanding the expected fire behaviour necessary for making fire management decisions on fire prevention and in suppression efforts. In addition, we are combining the processed data and models developed through our experimental fires with remote-sensing data to produce regional estimates of fire areas, fire severity, and the impact of fire on carbon balance, emissions, and forest health. Ground validation sampling of wildfires is being conducted in this analysis to better understand the ability of remote sensing to accomplish this.

Prescribed Burning in the Russian Far East: Present and Future

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In the Far East of the Russian Federation agricultural burnings for many centuries were and still continue to be a means to clean lands, a practice which frequently involved wildfires escaping to surrounding boreal forests. In spite of strict punishments and legal liability introduced by the Rules on Fire Safety and in other instructions and directions agricultural burnings are still a major cause of forest fires. According to various sources, up to 1/3 of all forest fires in the Far East are caused by agricultural burnings.

The Far East has a little experience of prescribed burning under the canopy of the forest stands though today this method is recognized and used in many countries to reduce wildfire hazard and to favour / conserve valuable species that are dependent or adapted to natural or management prescribed fires. There are only some specialists in the Far East (M.A. Sheshukov, V.V. Peshkov, H.P. Telitsyn, and V.V. Ostroshenko) who tried to introduce this approach in the regional forestry.

In Russia in connection with the ban of fire use in the forestry with the lack of experience and the psychological attitude (fire is a disaster) there are many opponents of prescribed burning though the leaders of domestic forest science M.E. Tkachenko, V.Z. Gulisashvili, I.S. Melekhov paid a great attention to the use of fire in the forestry. In the frames of the Eurasian Fire in Nature Conservation Network (EFNCN) and the Fire Paradox project network of sites will be set up, which will serve to demonstrate prescribed burning as an effective tool to reduce wildfire hazard and to conserve the most valuable stands in the Russian Far East, in Central Siberia and in the Transbaikalian Region as well as in montane-boreal Mongolia. Prescribed burning demonstration experiments will be conducted with a training course for the local fire specialists, a cooperative effort between the Global Fire Monitoring Center (GFMC) and the Pacific Forest Forum (PFF).

Forest Fire Dating in Northern Mongolian Forests

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Tree-ring studies can provide information on long-term growth and on historical fire regimes. We hypothesized that different growth rates of trees are influenced by natural or human-caused disasters, such as fire events. In this study we tested the hypothesis by determining growth rate and fire events in the eastern shore of Lake Hovsgol forest, Bogd Mountain and Bugant region of Selenge province, Mongolia. The long-term fire history and seasonality over the past 440 years (AD 1559-2005) is inferred from the mixed-aged Siberian larch (*Larix sibirica*) and Scotch pine forest (*Pinus sylvestris*) in selected sites in Central Mongolia. The largest reductions in tree growth occurred over most of the investigated forests during the 1720s to 1770s, 1860s to 1890s and 1940s to 1970s. Recruitment increased overall tree density in the sampling area during this period, which suggests a period of increased tree-to-tree competition might have led to these reductions in growth. In the last 15 to 30 years growth indices had increased throughout the Hovsgol forest. Tree-ring analysis shows that fire frequency varies in larch stands and pine stands. The earliest fire recorded in the scars was in 1596, while the most recent scars were dated 1997 in the eastern shore of Lake Hovsgol forests. Major information of analysis in the Bogd Mountain forest includes the following:

- 14 fire-scarred cross sections analyzed
- 41 total fire scars
- No lightning scars seen
- 8 total fire years
- 5 major fires (> 3 trees scarred)
- First fire 1632; Last fire 1766
- Nearly all dormant season scars
- MFI = 15; range = 2 – 45
- > 2 with scars = 30, range = 6 – 55

In Bugant region forests due to difference of forest structure, species composition, slope aspect, climate condition, therefore in our study area not many fires occurred last hundred years. However, in the end of last century, in Bugant area many fires were monitored in 1996, 1997, 2000, 2002, 2004 and 2007.

From this fire study, we conclude that early wood fires (spring) were dominating in our study area. More studies are necessary to characterize the fire severity pattern, and more importantly, to understand the cause of this pattern and its effect on post-fire vegetation response. Since there is no other long-term historical fire study in the country we cannot compare this study site with other regions. However, this study produced valuable tree growth and fire chronologies for the period 1534-2007 in northern Mongolia.

Fire Management of Open Landscapes in Poland: Conservation Needs and Legal Status

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Controlled burning of vegetation offers a cheap way of fen mire and xerothermic grassland management, which could considerably increase the possibilities of establishing a sustainable management regime without large amounts of external finances. However, the method cannot yet be used at most sites as there is only limited experience in Poland that would prove that the method is suitable. Thus well-investigated experiments have to be conducted. Such experiments will be carried out within Life project "Aquatic Warbler Conservation in Poland and Germany". Should it prove suitable, the legal situation that currently forbids burning for conservation purposes in Poland needs to be overcome. According to Polish Nature Conservation Act burning of vegetation is strictly forbidden. Legal tools for using of fire for conservation purposes should be developed in Poland.

Use of Prescribed Fire in the Maintenance and Restoration of Wetland Bird Habitats in Belarus

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As a result of drainage reclamation operations between the 1960s and 1980s, the area of open sedge fens in Belarus was reduced from 300,000 to 40,000 hectares. Nowadays, there are only 4 large and about 10 small fens in their natural condition. The state of sedge fens is indicated by the global threatened species of aquatic warbler (*Acrocephalus paludicola*), whose numbers have reduced by 90% as a result of reclamation. In recent years, aquatic warbler numbers have been continuing to dwindle. The main reason for this and for the decrease in the number of unique sedge fens is gradual overgrowing of fens with shrubs and reeds. Previously, the local population used to mow almost all sedge fens by hand, which prevented shrubs and brushes to invade. However, when agriculture in Belarus was mechanized, hand mowing almost disappeared. As a result, the area of open fens in the Zvanets Natural Reserve has been reduced down to 10% of its original size, and in the Sporovsky Natural Reserve to 20%.

Another point is that the accumulation of old vegetation hinders natural growth of sedge and leads to general decrease in the productivity of fens. This causes general reduction in insect biomass and in the density of the aquatic warbler. The same consequences arise from the density of reeds during several years. One of the feasible means of conservation of warbler habitats / fen ecosystems is the burning of old grass, a practice, which is now used in Zvanets Natural Reserve.

In the past almost every year local people used to burn the dead grass in order to increase herbage productivity, usually in early spring. However, due to lack of water before spring floods, the fire caused substantial damage to the fen ecosystem. Because of very low water level, the fire destroyed the higher peat level and tussocks, which resulted in deaths of insects, rodents and shrews. After such fires, an ecosystem took 2-3 years to restore. Nevertheless, the use of guided burning also helps to

increase the productivity of the site and to prevent open fens from overgrowing with shrubs. The best opportunities for guided burning are when the surface of the fen is covered with ice or snow and the dry vegetation remains over the frozen peat. In this case, only the upper part of sedge and reeds burns away and the fire does not spread on surrounding territories. When the thick vegetation layer is burnt down, increasing insolation increases the productivity of green vegetation and of the whole fen ecosystem. In addition to this, during the burning osiers, exposed to high temperature, are also destroyed.

Previously, burning of vegetation was legally forbidden. However, the Law on Wildlife has recently been amended to permit guided burning for improving habitat conditions of rare species and also for conservation of unique ecosystems. Finally, for the preservation of open fen ecosystems, it is necessary to combine guided burning with measures for water level management and removal of shrubs and reeds.

Forest Fires in Ukraine: Management and Policy

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Number and area of forest fires in Ukraine is characterized by steady tendency to increase during last 25 years. In particular, during the 1980s the number of fires varied from 792 up to 2377 cases per year, in the 1990s this parameter has increased twice and more - from 1818 up to 6743, and remained at a level of 3205 to 6383 fires per year during the period 2000 – 2007. The area burned in these periods increased even with higher rates: 286 to 2887 hectares (ha) annually in the 1980s, 579 to 10,982 in the 1990s, and 621 to 10,000 between 2000 and 2007. Considering this more or less proportional growth of area burned and numbers of fires during this period, the average area annually burned was relatively stable and did not exceed 1 ha during the most of the years. Nationwide average indices of the number and areas of fires do not display an acuteness of the problem in the crisis regions of the country. In the majority, fires happen most often in Scotch pine (*Pinus sylvestris*) forests and much less often - in spruce, fir or larch forests. Scotch pine semi-natural forests (of artificial origin) are widespread, practically, across all Ukraine: as a massive forest region in the North of the country (the Ukrainian Polissia), and as a belt of forests along the biggest rivers stretches from the north to the south. Considerable part of those Scotch pine forests grows out of borders of its natural habitats. More than half of pine forests in Ukraine, which are created artificially and presented by young and middle-aged monocultures, are characterized by the high fire danger.

Due to low percentage of forest lands in the Ukraine (15.6 % in average and near 3-5 % in the South-East region), high density of population and lack of forest resources in general prescribe burning is restricted. According to the current legislation the use of fire is permitted only after harvesting during the winter (snow) season to burn slash piles. A tendency is noted that the national fire policy may change towards implementation of prescribed burning. The main challenges are: decreasing of labour force in the Public Forestry Enterprises; requirements of forest certification (FSC) to increase biodiversity and attempts to implement nature-oriented silviculture; changes of fire management in some forest reserves with low natural values; increasing of recreation and State Forestry Committee efforts to provide proper services for visitors and as a result reducing fire numbers; increased interest of carbon investors in efforts for wildfire reduction as a carbon sequestration tool; increasing private property on forests.

Weak points of wildfire control in Ukraine are lack of research and analysis; lack of effective fire-prevention measures; not enough attention to long-term measures on fire risk reduction and short- and middle- term fire forecasting; lack of PR of the problem in mass-media.

In the near future next steps could be recommended for improvement situation in fire management in Ukraine: A national fire policy should be developed, taking into consideration a proposed regional strategy; in crisis regions, like Chernobyl area or the South-East region, development of bilateral/multilateral cooperation in framework of UNISDR Regional South East Europe / Caucasus Wildland Fire Network is desirable. In the Chernobyl crisis region - with Russia and Byelorussia, as well as in South-East region (Crimea, Kherson) - with Turkey and Balkan countries, a Governmental

Programme for long-term fire management measures needs to be developed to reduce wildfire risks. Seminars and conference as a tool to bring more information to foresters and to other stakeholders about modern views on wildland fire policies in the world; modern decision support tool like GIS, modelling and remote sensing should be implemented for fire risk forecasting and monitoring of wildfires; training on fire suppressions and prescribed burning for professionals in crisis regions, with involvement of all stakeholders.

Experimental Study of the Radioecological Impact of Wildland Fires in the Chernobyl Zone

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In 2001-2004 UIAR carried out the researches for evaluation of the radio-ecological impact of the forest and grassland fires in the Chernobyl Exclusion zone. For these researches, three sites (two in the grasslands and one in the forest) were selected and their full radio-ecological description was performed before the controlled burning. Methodology of the active experiments involved the measurements of the controlled parameters at the spatial grid and detail record of the meteorological parameters during the experiments. High contamination of the experimental sites enabled the reliable measurements of ¹³⁷Cs, ⁹⁰Sr and Pu isotopes airborne concentrations and fallout intensities at various distances from the source of release along the radioactive plume trace, as well as an assessment of the radioactive aerosol dispersal composition.

The resuspension factors of ¹³⁷Cs and ⁹⁰Sr during the grassland fires were 10^{-6} - 10^{-5} m⁻¹ (if calculated for the activity located in the fuel material at the sites), and approximately one order of magnitude lower for Pu isotopes. During the forest fire the resuspension factors of all radionuclides were 10^{-7} - 10^{-6} m⁻¹.

The process of the radioactive plume initial rise was described using the specially developed model. In our approach, the plume trajectory and parameters are calculated using the physically based equations instead of the empirical dependencies. The further transport and deposition of the plume was modelled using the standard Gauss model. Because of the stochastic nature of some input parameters, the Monte-Carlo modelling was performed. The model predictions were realistic and fitted well the experimental data. Model calculations were used to estimate the radionuclides relative release from the contaminated areas during the grassland and forest fires. The maximum radionuclide releases were observed during the forest fire: up to 4 % of the ¹³⁷Cs and ⁹⁰Sr activities and up to 1 % of the Pu activity in the fuel material at the burned site.

Evaluation of the radio-ecological impact of the fires in the radioactive contaminated territories included two main points. First, we estimated the fires contribution into radioactivity redistribution inside and outside the Exclusion zone. This contribution was found negligible for the small-scale (limited) fires. Second, the potential doses to the firefighters were derived from the experimental data on the radioactive aerosol airborne concentrations and dispersal compositions. For this purpose, we applied the dosimetric model of the human respiratory system recommended by the International Commission on Radiological Protection (ICRP) (Publication 66). It is shown that the inhalation doses, due to transuranium elements in the radioactive plume, can be commensurable to the doses of external γ -irradiation, which demonstrates the significance of the problem.

Prescribed Burning Integrated in Ecological Landscape Management in the Kaiserstuhl Viticulture Area, Baden-Württemberg, Germany

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The majority of high ecological value areas in Central Europe is not of pristine nature. They are embedded in landscapes that have been shaped by land-use systems over centuries.

The same concerns the Kaiserstuhl area, where over centuries the farmers grow wine on terraces built into the loss-layer on the hilly terrain. The traditional vegetation cover on the slopes between the terraces was of a meadow-like grassland developed and maintained by mowing and occasional burning. In 1975, following the Federal German nature conservation law, the State of Baden Württemberg imposed a ban of the free burning (broadcast burning) of vegetation.

The consequence in the next two decades was the ever increasing expansion of bush and trees and a strong decrease of the meadow like vegetation on the slopes due to secondary succession and the lack of any vegetation management. But from an ecological point of view as well as for the wine production an open vegetation cover is favoured.

To built up an acceptable and harmonised management strategy which could be accepted by the farmers as well as for the nature conservancy agencies a "Round Table on Slope Management in the Kaiserstuhl Area" was created. Here the local actors succeeded in developing a general management strategy, which also includes prescribed burning as one accepted management tool under the following general framework states:

- Prescribed burning will be restricted to the winter season under specifically defined weather conditions.
- The maximum lateral extension of one burned part is 40m and it must be surrounded by unburned parts with a similar extension. With this prescription a mosaic of burned and unburned plots is guaranteed which is a vital prerequisite for recolonising of damaged fauna.
- The owner of the slope is responsible for the management. Everybody is eligible to obtain a permission for the use of prescribed burning under the condition that he/she has participated in an information and training programme.

Aside with the development of the above mentioned rules on prescribed burning the "Round Table" worked out that vegetation management on slopes must also include other means like mowing, mulching, selective wood clearing or grazing of goats.

Therefore a comprehensive concept on slope management for the Kaiserstuhl area was established which included prescribed burning as well as the other means of vegetation management. The concept focuses on the ecological benefits and therefore serves as basis for receiving state grants for slope management activities within the given state regulations.

A management programme has been established to coordinate the slope management activities over the whole area according to the concept and to gain access to the state grants for the private slope owners as well as for the municipalities. Having been sponsored for the first two years by the state of Baden-Württemberg, this programme will further on be financed by the towns and cities in the area all by themselves.

Ecological Monitoring of the Management of Slope Vegetation by Controlled Burning in the Kaiserstuhl Region, Germany

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Goals, subjects and approach of the study

The impacts of controlled burning on the vegetation, flora and fauna of the characteristic slopes in vineyards were investigated in five study areas of the Kaiserstuhl-Region (state of Baden-Württemberg, Germany) in the period from 2002 to 2005. The main goal of monitoring was to analyse if the process of burning leads to considerable and permanent negative effects on threatened species. On the other hand, the positive effects of burning on the primary targets of nature conservation in this region were investigated. A focus of the use of controlled fires was to prevent the succession of shrubs and groves as well as the control of dominance stocks (e.g., *Solidago gigantea*) by controlled burning. The prevention of succession with shrubs and groves is the explicit overall concept for the maintenance and development of the characteristically open slopes within vineyards in the Kaiserstuhl Region.

Apart from the vegetation types, the main subjects of study were selected target species of several groups of species: flora, reptiles, butterflies and burnet moths, mantids and grasshoppers, ground beetles, spiders and terrestrial snails. The selection of target species comprised a broad range of indicator species for strategies of hibernation, feeding, mobility and sensitivity.

Results

- In general, for the majority of the considered target species, a threat for the populations caused by the burning within the frame of the analysis could not be observed. However, for a small number of extremely sensitive species, a decline of the population size has to be expected, although they will not disappear completely from the slope complexes. An example is the butterfly species *Minois dryas*. For this species a negative correlation between the annual burned area and the population size of the following year could be found.
- Direct positive effects on populations of threatened species or their habitats could not be found.
- The overall efficiency of burning to prevent the succession of shrubs and groves has to be considered as low.
- Suppressing the dominance stocks of *Solidago gigantea* cannot be achieved exclusively by burning.
- Burning can only be effective if combined with other treatments like mowing, grazing, clearance of shrubs, or removal of topsoil.

Conclusions

Essential conclusions for the management of the characteristic slopes of vineyards from the perspective of nature conservation are presented. A differentiated consideration is necessary before applying the recommendations on other habitat-types or in other landscape units. The most obvious transfer of the results might be the application in the neighbouring Tuniberg and the foothills ("Vorbergzone") of the Black Forest.

Traditional Slash-and-Burn Agriculture in the Black Forest: Reconstruction of Burning and Agricultural Techniques

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The Schwarzwaldverein ("Black Forest Association") is a traditional association providing a forum for the protection of nature and cultural heritage in the Black Forest region, as well as hikers and trekkers enjoying and exploring the Black Forest region. Since a couple of years the Association is conducting demonstration of traditional slash-and-burn agriculture (swidden agriculture) locally called "Rüttibrennen" ("Reutbergwirtschaft"). This swidden system was common in the Black Forest region

until the early 20th Century. It involved a cycle of cutting of coppice forest (for fuelwood, bark for tannin production), followed by burning of residuals and agricultural use. After a couple of years the agricultural use had to be terminated and the coppices grew up to form a new forest. The activities followed the following scheme (with local to regional variations):

Year 1: The coppices forest (mainly consisting of Hazel [*Corylus avellana*], oaks [*Quercus* spp.] and other deciduous tree species) are cut in spring. Larger stem volumes are used for firewood. The bark of the still moist and resprouting (coppicing) oak trees is peeled with a special tool („Rindenlöffel“ = ”bark spoon”) and used for tanning of leather. The remaining woody material is left on site and subject of drying. During the following summer, preferably at high daytime temperatures, the burning of the dried slash (“Rüttibrennen”) is carried out, using the technique of downhill rolling of the slash by using long hooks. In autumn the soils is prepared and rye is seeded.

Years 2 to 4: Cultivation of rye, potatoes and oat. The amounts, density and vigour of sprouts are increasing.

Years 4/5 and beyond: Grazing by cattle. Succession of broom (*Sarothamnus scoparius*) and sprouting of other coppicing tree species. After termination of grazing: Development of the coppice forest

Years 20 to 25: The next cycle of slash-and-burn and subsequent agricultural and pastoral use is initiated.

The LIFE Rohrhardsberg Project: The Use of Prescribed Fire in Maintaining Endangered Habitats and Landscape Features in the Foothills of the Black Forest

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The Rohrhardsberg with its peak at 1,155 m a.s.l. is one of the highest mountains in the Central Black Forest Region. The LIFE Nature Project „Rohrhardsberg, Obere Elz und Wilde Gutach“ is including the Natura 2000 sites around the Rohrhardsberg covering an area of around 6,350 hectares (ha). The landscape around Rohrhardsberg is a highly diverse mosaic of different forest types, moors, and grasslands that provide habitats of rare and endangered flora and fauna. About 75 percent of the total area is covered by forest. The remainder is dominated by grasslands, first of all (150 ha) the priority habitat of species-rich *Nardus* grasslands (FFH-Code 6230*). Other priority habitat types are active raised bogs (7110*), bog woodland (91D0*), alluvial forests (91E0*) and Tilio-Acerion forests of slopes, scree and ravines (9180*). The vast woodlands are of (national) importance as an important home range of grouse species (Tetraonidae), the capercaillie (*Tetrao urogallus*) and hazel grouse (*Bonasa bonasia*). Most of all the hazel grouse suffered a massive decline in the last ten years, making immediate measures very urgent.

As a consequence of land-use change due to rural exodus and the forest management practices in the past decades the extent of habitats of these grouse species have been decreasing, resulting in a decrease of grouse populations, most of all the hazel grouse. The project objectives include, among other, the development, improvement and connecting of habitats in order to ensure sustainable survival of populations. Other actions and means include:

- Development of habitat connexion between *Nardus* grasslands (reactivation of fallow land, expanding of pastures)
- Reduction of spruce in bog areas
- Renaturation of water courses/alluvial forests

The use of prescribed fire for maintaining open grasslands and / or restoring habitat prerequisites for these species within forest complexes is one of the key activities in the project. First experimental prescribed fires were conducted in 2007 on formerly hurricane-disturbed forest sites (Hurricane Lothar of 1999) to maintain and mimic disturbances and to create the necessary open space for the grouse

species. Further burning experiments are planned for 2008 on fallow grasslands. The participation of local communities in the overall land management in the project region, as well as in the prescribed burning operations is a key for a participatory approach in the LIFE project, sponsored by the European Commission.

Ecological Monitoring in the Rohrhardsberg Region, Germany

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Ecological monitoring to conserve grazing fields with few cattle by controlled burning is a component of the LIFE project "Rohrhardsberg" (Mountains of Black Forest-Region, state of Baden-Wuerttemberg, Germany). The investigation started in 2007, the first fire treatment will be carried out during the winter 2007-2008, the impact to vegetation and parts of the fauna will be studied over the next four years.

In four zones within the project region (characterized by different histories of grazing intensity, status of succession, exposition, supplementary treatment and altitude above sea-level) we initiated the investigation of comparable (neighbouring) sites for planned fire treatment (controlled burning), sites characterized by low grazing intensity, target areas (e.g. Nardetum) and sites with long-term succession. The main subjects of study include vegetation composition, soil parameters, ground beetles and target species of butterflies and grasshoppers.

Re-establishment of Traditional Heathland Management Tools in the Federal Forest Service District Lausitz, Brandenburg State, Germany

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Historical land management tools to preserve more than 100 ha of *Calluna vulgaris* heathlands are currently reintroduced in Brandenburg State, Germany. The Federal Forest Service (FFS), in collaboration with the Fire Ecology Research Group / Global Fire Monitoring Center (GFMC), restored the traditional technique of prescribed burning as a landscape and habitat management tool.

The heathlands are located in a former Air Force bombing range of the German Democratic Republic. Training activities over more than two decades caused fires, which had a positive effect on the establishment of *Calluna* heathland. The termination of military activities in 1989 required the development of new management tools to maintain this unique ecosystem. The FFS up to date had successfully applied mowing for short-term regeneration of heather. However, in the long run mowing as sole management tool proved insufficient to encourage *Calluna vulgaris* to propagate. For this reason the FFS decided in 2002 to employ prescribed burning as an additional management technique.

In February and late August 2002 the FFS District Lausitz, technically implemented by the GFMC and in collaboration with the local fire brigade, conducted several burns, each not larger than one hectare. Focus of the FFS was the development of a cost-effective management tool for the maintenance and improvement of heathland ecosystems and habitat for Black Grouse (*Tetrao tetrix*). The aim of the GFMC was to promote the use of prescribed burning in land management in the Baltic Region. The project was also part of the development of a decision-support system for catastrophic wildland fire events, conducted by the GFMC in the frame of the German Research Network for Natural Disasters between 2000 and 2003.

Subsequent burns were conducted by FFS and GFMC in winter 2003, and also 2005. The burning programme in 2005 was financed as a project sponsored by the foundation „Nature-Protection-Fund-Brandenburg“ (NaturSchutzFonds Brandenburg).

The Project revealed:

- It is possible both in operational and in ecological terms to use prescribed burning, including the use of high-intensity fires, to modify the Calluna structure, to suppress succession and improve Black Grouse habitat.
- Best conditions for a intensive regeneration of heather and a powerful suppression of birch succession are provided by weather situations with eastern air current [air temperatures far below zero, without snow and a air humidity around 40 percent and less]

All fires successfully simulated natural and manmade disturbance events. The fires burned within the prescriptions. Especially the flora and also partly the fauna composition for all burnt areas are monitored carefully.

First Experiences in the Use of Prescribed Fire for Maintaining Open Calluna Heathlands in North Rhine-Westphalia, Germany

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The „Drover Heide“ (680 ha) is one of the most remarkable nature reserves in Nordrhein-Westfalen (North Rhine-Westphalia) State. At least 150 ha open heathland is characteristic for the former military training area. The reserve provides habitats for many endangered plants and animals, especially birds. To protect the area it is necessary to cultivate and maintain the open landscape. One of the biggest problems are shrubs and trees encroaching the heathland. The succession towards in some cases was controlled by grazing. However, since March 2007 prescribed burning has been introduced to reduce old heathland and trees and shrubs. So far a total of nearly 6 ha heathland were successfully burned by Working on Fire (WoF) and the Global Fire Monitoring Center (GFMC).

The first results are really impressing. The heathland has regenerated and most of the young trees and shrubs have been killed by fire. After the fire at first new coppice shoots came out of the trunks, but they disappeared after one year. It is not possible to prove if this result is only an effect of the fire, because the area is used as paddock for highlands and goats. Especially the young branches are very interesting for the grazers. Beneath the grazers rabbits are seen often to feed in the burned area. The heath in the „Drover Heide“ grows on clay and not on sand, so it rising to a height of up to 1.5 m and is representing an high fuel load, which causes a high-intensity fires with high temperature.

In future it would be interesting to create a sample to proof the effect of fire and grazing separately.

Methodology of Prescribed Burning Demonstration Plot Description and Inventory for the Eurasian Fire in Nature Conservation Network and the Fire Paradox Russia and Mongolia Programme

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In large parts of Eurasia there is a lack of well-documented prescribed burning demonstration sites that help to understand the effects of fire on forest stands, open habitats and other vegetation types treated by fire. In most regions it is still not clear how and when to implement best prescribed burning techniques, although it is often recognised that the use of fire is required in forestry, land management and nature conservation.

A methodology for the description and documentation of demonstration sites is being developed as a research component of the Eurasian Fire in Nature Conservation Network (EFNCN) and the EU Fire Paradox Programme. One of the objectives to establish plots on closed to open forest ecosystems, which will be burned at different times of the year, is to determine the differences of fire effects on fuel

consumption, burn patterns, resulting heterogeneity etc. under early vs. late season burning conditions.

A standard design for demonstration plots and plot documentation will be presented. This includes implementation of prescribed burning and control units on the area. A detailed site description, vegetation composition and topography will be documented for their influence on fuel heterogeneity. Fuels will be sampled with the Line-Intersect-Method in order to determine fuel consumption. Stand characteristics such as canopy cover, which may influence the fuel moisture content is acquired with hemispherical photographs.

Scorch height and percentage of burned surface fuel area will be determined as an indicator for fire severity. This will provide first indicators on the effects of burning in different seasons: emission reduction potential, heterogeneity and patchiness, fuel reduction potential, risk reduction potential.

Pianacci Prescribed Burning Project: Fire Risk Reduction and Fuel Load Management for Private Land owners, Florence, Tuscany

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The Pianacci project is presenting prescribed fire as a land and risk management tool for European landowners. The project was initiated when a concerned landowner in Tuscany had a fire risk analysis conducted on her property. Taking the fire history, the current state of vegetation (fuel), local risk factors and the landowner's responsibility into account, a fire management plan has been developed. The severe fires that burned in Italy during the 2007 fire season triggered this initiative.

The use of low- to medium-intensity controlled fire for environmental friendly fire break construction as well as fuel load management is playing a key role within the fire management plan, together with mechanical and social-economic measures.

Although the regional forest law does provide for the use of prescribed fire, it is widely seen as "impossible" to implement the fire management plan. It appears the paragraph about the preventive use of fire had to be re-discovered.

The project is demonstrating firstly the responsible and concerned private landowner that wants to act proactive and secondly the bureaucratic and legal process of the application of an official burn permit in Tuscany. Further, the project is demonstrating the potential cooperation of all relevant stakeholders, which is not always the rule in Italy or elsewhere in Europe.

One has to note that Pianacci originated through private initiative, this could well serve as a role model for other land owners throughout Europe, where the (private) land owner could play a vital role in supporting Forest and Fire Services in their annual fire suppression efforts, as well as acting proactive to minimise own and insurance losses.

Partners of the project include: Land owner and neighbours, WoF International, Universities of Padua and Florence, GFMC, Local Volunteer Fire Service, Corpo Forestale, Civil Protection and Volunteers.

Collection and Mapping of Prescribed Burning Practices in Europe: A First Approach

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In the history of land use in Europe, fire has been an important element in forestry, agriculture and pastoralism, and an important process in shaping landscape patterns of high ecological and cultural diversity. However, crisis taken part over rural areas during the second half of the 20th century caused the loss of the notion of fire as a useful tool and changed its perception from tool to threat, resulting in the complete elimination of traditional burning practices in some areas. At present new opportunities and challenges are underway for the development of the use of fire for management purposes in Europe. The aim of this paper is to present a first approximation of the development of prescribed burning (PB) in Europe, in order to show the existing diversity of fire use practices within the continent as well as to infer possible temporal and spatial patterns for its development in space and time. For this purpose, a review of fire use practices at the national and regional for different EU member-states was developed taking into an original approach, based not only in the objectives for the use of fire, but adding the importance of the degree of standardization. Results obtained have been developed within FIRE PARADOX, a European Integrated Project, which is part of the 6th Framework Programme (2006-2010).

EuroFire: Developing a Basic Level Competency Based Training System for Vegetation Fire Management in Europe

Michael Bruce

EuroFire Project, Global Fire Monitoring Center

A learning outcomes approach to training and qualifications is being developed in Europe through the European Qualifications Framework (EQF). EuroFire is an EU Leonardo project which runs for 24 months from October 2006 to September 2008. The purpose of the project is to develop, evaluate, produce and distribute a new EU wide, multi-lingual on-line training resource for basic vegetation fire management. The areas that will be covered are: basic fire management, prevention and suppression. The target end-user groups for the EuroFire project are: firefighters, the rural and land-based sector, sectoral organisations and education and training institutions. The project partners are the Global Fire Monitoring Center, CTIF (The International Association of Fire and Rescue Services), Rural Development Initiatives Ltd. (RDI). The EuroFire project is currently researching and reviewing competency-based wildfire training systems to identify best practice examples from Europe and around the world. This research is informing the production of competency-based basic training materials specifically for use in European countries. A key aspect of the system will be the drafting and consultation on competency standards at Level 2, the basic level. These will form the learning outcomes for other training resources.

Training for Fire Managers in the Use of Prescribed Fire for Wildfire Hazard Reduction and Nature Conservation in Europe

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In the last decades, the recognition of a natural fire regimes and the role of the use of prescribed management fires is spreading in Europe. Thus prescribed burning is increasingly used and recommended as a management tool, with different and coexisting objectives: Reducing the negative impacts of catastrophic wildfires; supporting the maintenance of sustainable land use and resource management; protecting sustainable ecosystems; and reducing negative impacts of fire on the environment, the public and fire-fighter safety.

However, its positive effects depend on correct planning, prescription, execution and control of the intensity, seasonality, recurrence and size of these burnings. Thus, an specific training in fire behaviour and fire ecology is needed for the different roles in a prescribed burning operations: planner, burn boss, and executer.

In many temperate and boreal areas, climatic change threatens to change temperatures and precipitations, and subsequently fire behaviour of the prescribed burnings. Exchanges between fire managers are specially needed in boreal and temperate ecosystems, to face this change of prescribed fire regimes.

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