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Study of the Contemporary and Expected Future Wildland Fire Problems in the UNECE Region

Supporting Materials

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Introduction

This report contains supporting materials to Report 1 “Study of the Contemporary and Expected Future Wildland Fire Problems in the UNECE Region”.

Part i The first two parts have been published preceding the UNECE/FAO Forum on Cross-boundary Fire Management as chapters 22 and 23 of the volume “Vegetation Fires and Global Change. Challenges for Concerted International Action. A White Paper directed to the United Nations and International Organizations”.

This Global White Paper provides the nexus between regional and global approaches in fire management. The introduction of the “Global White Paper” provides the rationale for this global analysis:

Today, fire interacts with human environmental concerns in terms of catastrophes, carbon and climate. Future fire management will not only require implementing fire where it belongs and restricting it where it does not, but also must address the increasing vulnerability of flora, fauna, ecosystems and our society – all already affected by global environmental changes, notably changes of climate and land. This is an increasingly challenging undertaking given increasing social, economic and environmental pressures at a global scale.

At the present time only a few countries have implemented policies addressing the role, consequences and management of vegetation fires comprehensively and across sectors. It seems that information generated and synthesized to support the development of informed policies is scant.

The Global Wildland Fire Network, which is operating under the United Nations International Strategy for Disaster Reduction (UNISDR) and partnering with a large number of national and international agencies and organizations, through its Wildland Fire Advisory Group, provides advisory support to the United Nations. The Global Fire Monitoring Center (GFMC), acting as Secretariat of the UNISDR Wildland Fire Advisory Group in conjunction with the United Nations University – the think tank of the UN system – felt obliged to take the initiative for developing a White Paper on Vegetation Fires and Global Change that would close this gap.

This White Paper has a strong focus on analyzing the historic, current and expected / projected trends of future fire regimes in the main vegetation zones. In other words: It is not the intent of the White Paper to develop a comprehensive and all-embracing analysis of the multi-faceted aspects of global fire ecology. The chapters rather provide an insight to the state-of-science at the end of the first decade of the 21st century that may be considered useful for medium- and long-term fire management planning at national and international levels.

Several international (global) conventions, such as the three “Rio Conventions” (Convention on Biological Diversity [CBD], United Nations Convention to Combat Desertification [CCD], and the United Nations Framework Convention on Climate Change [FCCC]) and the Ramsar Convention on Wetlands are examples of international legal agreements that provide rationale and a catalogue of environmental protection obligations for signatory countries. However, none of these or any other legally binding conventions or informal or voluntary international instruments, such as the Hyogo Framework for Action 2005-2015: Building the Resilience of Nations and Communities to Disasters, are explicitly addressing wildland fires as a driver of environmental...
degradation. Nor do they address the need for integrating natural and prescribed management fires in those ecosystems and land-use systems that require fire for maintaining their function, sustainability and productivity. There are also not yet protocols in place that provide internationally accepted standard methods and procedures for countries that provide and receive assistance in wildland fire emergencies that would ensure inter-operability, efficiency and safety of cooperating parties.

The contributions of this White Paper reveal that globally, fire regimes are altering in parallel with and under the influence of socio-economic developments, land-use change and climate change. Increasing vulnerability of society to the direct and secondary effects of wildland fires, as well as the transboundary nature and consequences of wildland fires are prompting countries and international organizations to define their common interests in enhancing sustainable and integrated fire management capacity. The requirement for systematic and efficient sharing of scientific and technical expertise, solutions and resources, including transboundary cooperation, means that the transition from informal information exchange and networking to a more systematic and formalized cooperation is more necessary than ever.”

The Third Part is the “White Paper on Use of Prescribed Fire in Land Management, Nature Conservation and Forestry in Temperate-Boreal Eurasia” Edited and published by the Global Fire Monitoring Center / Fire Ecology Research Group, Freiburg, Germany, on behalf of the participants of the “Symposium on Fire Management in Cultural and Natural Landscapes, Nature Conservation and Forestry in Temperate-Boreal Eurasia” (January 2008) and members of the Eurasian Fire in Nature Conservation Network (EFNCN).²
Part I – Global White Paper Chapter 22

Beyond Climate Change: Wildfires and Human Security in Cultural Landscapes in Transition – Examples from Temperate-Boreal Eurasia

Abstract

In many regions of Eurasia cultural landscapes that were formed by traditional agrarian societies over centuries are changing rapidly. The process of rural exodus and the rapidly accelerating trend of urbanization is associated with abandonment of land cultivation and thus directly or indirectly affecting cultural and wildland fire regimes. This chapter looks at the specific issues linked with wildland fire, land use and land-use change in Eurasia, and to wildfires and threats emerging from the heritages of civilization. While the temperate-boreal zone of Eurasia is in the focus of this chapter, some views to the cultural landscapes of North America reveal comparability and similarities between continents. An increasing awareness of newly arising or newly perceived fire-related problems by the general public and by policy makers is apparent. However, development of fire management solutions such as the adjustments to public policies affecting land management and operational fire management to the changing land use conditions and society’s vulnerability are lagging behind. Changing paradigms in ecology and nature conservation have recently led to reconsidering fire-exclusion policies in certain sectors of land / landscape management, nature conservation and forestry. However, the use of prescribed fire in ecosystem management in Europe may not exclusively target those vegetation types that have been shaped by fire over historic time scales, but rather to introduce fire as a tool to substitute abandoned cultivation practices. However, use of fire in agriculture is being questioned where new insights into the side effects of burning are revealed by recent research. For example, there are indications that deposition of black carbon emitted from agricultural spring fires in Northern Eurasia are impacting the albedo of the Arctic environment, leading to acceleration of warming and melting of snow and ice cover. As a symptom of these developments the terms “necessary” and “unnecessary” burning in the agricultural sector in temperate-boreal northern Eurasia are entering the wildland fire terminology.

Keywords: Cultural landscape fire, rural exodus, land cultivation abandonment, radioactive pollutants, prescribed burning

Introduction

In many regions of Eurasia cultural landscapes that were formed by traditional agrarian societies over centuries are changing rapidly. The process of rural exodus and the rapidly accelerating trend of urbanization is associated with abandonment of land cultivation and is thus directly or indirectly affecting cultural and wildland fire regimes. This chapter identifies the specific issues linked with wildland fire, land use and land-use change in Eurasia, and the wildfire threats emerging from the heritages of civilization. While the temperate-boreal zone of Eurasia is the focus of this chapter, some analyses of the cultural landscapes of North America reveal comparability and similarities between continents.

Socio-economic Changes, Industrial Heritages and Emerging Fire Threats in Eurasia

Temperate-boreal Eurasia extends from Western Europe to Asia’s Far East and spans more than 200 degrees of longitude. While the region contains a large variety of ecosystems and land-use systems,
there exist commonalities of determinants of wildland fire between these countries and subregions that share similar historic and contemporary natural, cultural and social conditions.

Some hazards and risks associated with wildland fires have been perceived as threats only recently due to a better scientific understanding of conditions influencing wildland fire. The public perception of wildland fire throughout the region has been stirred significantly by the discussion of the anticipated consequences of climate change on forest fire occurrence and impacts. However, some recent wildfire episodes also revealed the vulnerability of society to direct and secondary effects of fire such as the impacts of fire smoke pollution on human health and security.

Wildland fires burning at the interface of, or even inside residential, urban and industrial areas, and fires burning on terrain contaminated by industrial deposits and heritages of armed conflicts are perceived as new, unprecedented threats – although they have existed before, albeit unnoticed publicly and politically. It is also becoming evident that the alteration of fire regimes in the cultural landscapes of Eurasia is driven fundamentally by land-use change.

Recent wildfire episodes in temperate-boreal Eurasia have resulted in severe environmental damages, high economic losses and considerable humanitarian problems. After the Mediterranean fire crisis in 2007, followed by the fire and smoke episode in Western Russia in 2010, several key issues affecting wildland fire in the cultural landscapes of temperate-boreal Eurasia have been identified:

- Increasing rural exodus and urbanization, resulting in abandonment of traditional land cultivation (agriculture, pastoralism, forestry) resulting in an increasing wildfire hazard;
- Urbanization resulting in a reduced rural work force, including availability of rural firefighters;
- Re-privatization of formerly nationalized forests resulting in the absence of forest and fire management in smallholder forest estates;
- Weakened governance over forestry and decreased fire management capabilities in many Eastern European and Central Asian countries as a consequence of the transition of national economies, often associated with the uncontrolled or illegal forest use and increase in related wildfires;
- Increasing occurrence of wildfires affecting the perimeters of metropolitan areas, settlements and developments dispersed throughout wildlands;
- Secondary problems associated with wildfires, e.g., those burning in territories contaminated by radioactivity and remnants from armed conflicts (e.g., unexploded ordnance, land mines, uranium-depleted ammunition); or wildfires affecting agricultural lands treated with pesticides; landfills, other industrial waste and structures containing hazardous materials, especially at the urban / residential perimeters;
- Consequences of climate change on cultural fire regimes and ecosystem vulnerability (e.g., climate-driven transformation of former fire-free or fire-protected natural ecosystems and land-use systems such as peat bogs and high-altitude mountain ecosystems to ecosystems becoming vulnerable to and increasingly affected by wildfires).

The assessment of changing fire regimes and the increasing vulnerability of society and subsequent public policy responses are influenced by new scientific insights into the composition of fire emissions and their impacts on the environment and human health and must address the following considerations:

- Effects of gas and particle emissions from open burning vegetation fires on human health;
- Vulnerability of industrial and rural societies to air pollution generated by vegetation fires;
- Impacts of radiatively active trace gases and particle emissions from vegetation fires affecting the functioning of the atmosphere and contributing to climate change;
- Impacts of fire emissions on ecosystems, e.g. the consequences of deposition of fire-emitted black carbon in the arctic environment;
- Resulting conflicts in fire management, e.g., controversial views on the acceptance of prescribed burning.
While a growing acknowledgment of these issues by the public and by policy makers can be noted, there is a lack of review, adjustment or development of appropriate fire management policies.

The recently published *White Paper on Use of Prescribed Fire in Land Management, Nature Conservation and Forestry in Temperate-Boreal Eurasia* (Goldammer, 2010a) is an example for changing perceptions of the role of fire in cultural landscapes. The white paper reveals that the use of fire – including disturbance related to swidden (shifting) agriculture and other land cultivation practices – have contributed to shaping landscape patterns of high ecological and cultural value and diversity across temperate-boreal Eurasia in areas such as heathlands, open grasslands and meadows. In the eastern Euro-Siberian biota, e.g. in the light taiga, natural fires have shaped open and stress-resilient forest ecosystems (Sannikov and Goldammer, 1993).

Changing paradigms in ecology and nature conservation have recently led to reconsidering fire-exclusion policies in certain sectors of land / landscape management, nature conservation and forestry. However, the use of prescribed fire in ecosystem management in Europe may not exclusively target those vegetation types that have been shaped by fire over historic time scales, but rather may introduce fire as a tool to replace abandoned cultivation practices (Goldammer, 2010a).

A sound understanding of the "pros and cons" of prescribed fire application is as necessary as consideration of the side effects of fire use. Large areas threatened by land abandonment are embedded in industrialized regions in which society is becoming increasingly intolerant of fire emissions. The fire and smoke episode in Western Russia in 2010 is a striking example of both increased perception and vulnerability (Goldammer, 2010b). Legal restrictions for open burning are included in clean-air rules and the obvious general necessity to reduce those gas and particle emissions that are threatening human health (cf. chapter 18 of this volume). Concerns of those parties that consider prescribed fire emissions a contribution to the increase of the anthropogenic greenhouse effect and thus global warming complicate the debate. The traditional use of fire in agriculture is being questioned due to new insights into the side effects of burning emerging from recent research. For example, there are indications that deposition of black carbon emitted from agricultural spring fires in Northern Eurasia are impacting the albedo of the Arctic environment, leading to acceleration of warming and melting of snow and ice cover (Clean Air Task Force, 2009; Doherty et al., 2010; Hegg et al., 2010; McCarty et al., 2012). As a symptom of these developments the terms "necessary" and "unnecessary" burning in the agricultural sector in temperate-boreal northern Eurasia are entering the wildland fire terminology.5

On the other hand it is noted that nature conservation agencies, non-government actors and the general public have developed a rather sound understanding and perception of the "nature of fire" compared to the situation two to three decades ago. International (regional) dedicated networks and research projects such as the *Eurasian Fire in Nature Conservation Network* (EFNCN)6, within which the *White Paper on Use of Prescribed Fire* was developed, and particularly the European Integrated Project *Fire Paradox*, have significantly contributed to the acceptance of fire use in wildfire hazard reduction and fire suppression (Sande Silva et al., 2010; see also Birot, 2009).

**Pressing Issues**

Some of the newly arising or recently perceived wildland fire problems in the Eurasian region are strongly related to cultural and industrial heritages and recent changes in the cultural landscapes. The examples given in the following reveal that the most immediate impacts of wildland fires on society are determined by human activities, rather than by nature or climate change. Some of the examples highlight events that have been influenced or generated by policies and politics. While some cases may uncover some unspoken problems, there is no intent to blame or accuse any party, nation or country.

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5 The *International Conference on Open Burning and the Arctic* (Russia, November 2010), which explored the impacts of emissions from open fires on Arctic climate, particularly black carbon emissions from set fires in Northern Eurasia, provide a critical view of the escalating fire use in the agricultural sector (Clean Air Task Force, 2009; Clean Air Task Force / Bellona, 2011).

6 [http://www.fire.uni-freiburg.de/programmes/natcon/natcon.htm](http://www.fire.uni-freiburg.de/programmes/natcon/natcon.htm)
Rural Exodus

The interest and insight into cultural landscape ecology has been driven by the increasingly visible socio-economic changes in the past four decades – notably the rural exodus all over Eurasia, which has resulted in abandonment of traditional land-use methods over wide areas (Dimitrakopoulos and Mitsopoulos, 2005). With the elimination of land cultivation, including traditional burning practices, large areas of Europe are reverting 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 fire regimes of abandoned lands are transitioning from fuel-limited to water-limited (Pausas and Fernández-Muñoz, 2011), resulting in an increased wildfire hazard (Goldammer, 2010b). 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.

The country with the highest rate of abandoned villages and agriculture is Russia (Ioffe, 2005; Ioffe et al., 2006, 2011). Between 1939 and 1989 the rural population of the USSR declined from 130.2 to 97.7 million. Within the Russian Soviet Federative Socialist Republic (RSFSR) alone the decline averaged 100,000 people per year between 1979 and 1988. In 2010 alone more than 3,000 villages in Russia became deserted, a development obviously supported by government policy aimed at relocating people from rural areas and impoverished towns to larger metropolitan areas in order to improve living conditions.

The consequences of rural exodus in Russia and its neighboring countries of temperate-boreal Eurasia on changing fire regimes have not yet been subject to dedicated research. After the collapse of the former Soviet Union the decreasing support of the agricultural sector by the Russian government resulted in abandonment and fallow of 27 million ha of agricultural lands between 1990 and 2009 (Schierhorn and Müller, 2011). Empirical observations suggest that abandonment of agricultural lands, coupled with uncontrolled succession towards bush encroachment and natural reforestation constitute an increasing wildfire hazard – at least during the transition phase to forest formation. At the same time it seems that intentionally set fire is increasing - to keep agricultural lands open or to dispose of crop residue – with the consequence of uncontrolled wildfires spreading to surrounding vegetation, including forest and peat swamps. Recent studies of agricultural burnings at the global scale (e.g., Korontzi et al., 2006) are revealing the magnitude of occurrence but cannot yet prove long-term changes of agricultural fire regimes in temperate-boreal Eurasia related to the historical and current trend of rural exodus.

Increasing vulnerability of urban and peri-urban populations

The weakening or depletion of the rural work force is another factor aggravating the newly arising fire problems in these cultural landscapes in transition. Abandoned villages, along with those with aging populations are increasingly unprotected. As witnessed in 2010, the risk of wildfires spreading uncontrolled into villages and the resultant damage appears to be becoming a serious problem.

The problems and vulnerabilities of infrastructures and populations neighbouring or interspersed with wildlands have received increasing interest by the Western European research community and led to some policy response. Many countries have created guidelines and legal instruments obliging

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7 Recently the consequences of rural exodus on increasing wildfire hazard and occurrence has been investigated and proven for the Western Amazon region (Peru) (Uriarte et al., 2012)
8 Data provided by ‘Seventeen Moments in Soviet History’: http://www.soviethistory.org/index.php
11 For comprehensive literature on the wildland-urban fire research, including modeling, see: http://www2.bfrl.nist.gov/userpages/wmell/public.html#sec_publications.
owners of properties at risk of wildfire to take precautionary and preventive measures for wildfire hazard reduction, and jurisdictions to enforce these policies (Xanthopoulos, 2004).

Secondary effects of wildland fire, however, have been largely neglected in the past, notably vegetation fire smoke pollution impacts on human health and security. The episode of drought, wildfires and smoke pollution in Western Russia in July-August 2010 revealed the humanitarian problems arising in metropolitan areas from smoke emitted by burning of natural vegetation in the rural landscape as well as through long-distance smoke transport (Goldammer, 2010b).

Other threats have also been largely ignored. Wildfires burning houses, industrial infrastructure, agricultural lands treated with pesticides, fungicides, and fertilizers and fires affecting landfills (residual waste) and other waste (e.g. batteries, radioactive materials) generate substantial amounts of hazardous pollutants (Statheropoulos and Goldammer, 2007; Goldammer et al., 2009). The Frio Fire in the Pinal Mountains near in Arizona, which burned between August and October 2011 and assumedly affected an area treated with Agent Orange in 1965, fuelled public concerns about the consequences of smoke pollution containing dioxins on human health.12

Vegetation fires have the potential to release and transport toxic industrial and agricultural substances that have been previously deposited in ecosystems (Genualdi, 2008).13 In the case of pesticides and polychlorinated biphenyls (PCBs) these persistent organic pollutants can land in regions where the compounds are now banned – or even in the Arctic, where they were never applied. One of the studies uses satellite imaging of smoke plumes and modeling of air mass trajectories to track the source of pollutants emitted by Siberian wildl and fires in 2003 and transported to the Pacific Northwest of the U.S., including dieldrin and alpha-hexachlorocyclohexane (alpha-HCH) (Genualdi, 2008).

Recent research reveals that as a consequence of climate change, mercury deposits previously protected in cold northern forests and wetlands will increasingly become exposed to burning. Mercury is readily released into the atmosphere with fire smoke. Turetsky et al. (2006) quantified organic soil mercury stocks and burned areas across western boreal Canada. It was assumed, that based on ongoing and projected increases in boreal wildfire activity due to climate change, atmospheric mercury emissions will increase and contribute to the anthropogenic alteration of the global mercury cycle and to the exacerbation of mercury toxicity in northern food chains.

**Fires Burning on Radioactively Contaminated Terrain**

In some countries forests and other lands are contaminated by a variety of hazardous chemical and radioactive pollutants. Wildfires occurring in such contaminated terrain may result in hazardous secondary air pollution. The territories most affected by radioactive pollution are those contaminated with radionuclides released during the failure of the Reactor Number Four of the Chernobyl Nuclear Power Plant in 1986. Among the total 6 million ha of radioactively contaminated terrain in Ukraine, Belarus and Russia, the most polluted forest area covers over 2 million ha in the Gomel and Mogilev regions of Belarus, the Kiev region of Ukraine, and the Bryansk region of the Russian Federation. The main contaminant is reported as caesium-137 (137Cs) but in the core zones of contamination strontium-90 (90Sr) and plutonium-239 (239Pu) were also found in high concentrations. Under average dry conditions the contaminated surface fuels – the grass layer and the surface layer of peatlands – are consumed by fire. Most critical is the situation in peat layers, where radionuclides are deposited. The long-range transport of radionuclides lifted in the smoke plumes of wildfires and their fallout on large areas were investigated in detail in 1992 (c.f. review by Goldammer et al., 2009b). A recent study presented at the conference “Twenty-Five Years after Chernobyl Accident: Safety for the Future” (Kiev, Ukraine, 20-22 April 2011) concluded that radioactive fallout from a large forest fire


occurring in the Chernobyl Exclusion Zone could affect the food chain and thus be considered threat to human health and security (Hohl et al., 2012; see also chapter 18 of this White Paper).

Wildfires Collateral Damages during Armed Conflicts

Fires occurring during or after armed conflicts or during political unrest constitute a major humanitarian and security issue. The history of fire use as a weapon during wars is as long as the history of armed conflicts of humankind (Pyne, 1995). In World War I the Turkish Army burned extended areas in the Rhodopi mountains of Bulgaria to clear the vegetation cover and the hideouts of the Bulgarian resistance fighters (Müller, 1929); in 1922 Greece suffered large wildfires due to similar reasons (Xanthopoulos, 2010). Most prominent examples of fire use in the 20th Century were the attempts by conflicting parties during World War II to ignite the enemy’s hinterland forests in order to distract its military operations. More than 9,000 balloon-carried incendiary devices were launched by the Imperial Japanese Army in 1944 and 1945 (operation Fusen Bakudan) to be carried by the high-altitude jet stream to North America, with several hundreds reaching U.S. airspace and soil (Webber, 1975). The Allied Forces on the other hand sent more than 53,000 balloon-carried incendiary devices to ignite forests in Germany at the late stage of the war (Peebles, 1991). In Greece German military forces ignited forests in Central Greece (Pertuli, Thessaly) to drive out members of the resistance movement (Xanthopoulos, 2010). The war in Viet Nam in the 1960s did not only involve large-scale chemical spraying to defoliate forests to destroy the cover of the Viet Cong ("Operation Ranch Hand"), but the Military Assistance Command-Vietnam (MACV) also ordered "Operation Pink Rose", which attempted (in vain) to burn herbicide-treated forests and the hideouts of the enemy forces (Shapley, 1972; Westing, 1975; Lewis, 2005).14

Most recent occurrences of wildfire during armed conflicts cannot clearly be assigned to intentional tactical or strategic intentions. Most of the fires highlighted in the following are rather collateral damages during conflicts, or fires that were otherwise started at times of armed conflict. Warring parties often used wildfires as an opportunity and reason for mutual accusations. The most recent conflict-related wildfires occurred mainly in the South Caucasus, Near East and the Central Asian Hindu Kush regions.

South Caucasus: The Nagorno-Karabakh conflict (2006): During the period of June to September 2006, extended wildfires affected territories situated close to the Line of Contact (LoC) in and around the Nagorno-Karabakh region. Countries involved in the unresolved conflict around Nagorno-Karabakh accused each other of having ignited the fires intentionally. The fires affected large areas of abandoned lands around the LoC as well as adjoining agricultural and forest lands. Impediments to controlling the fires included the threat of landmines and unexploded ordnance, as well as ongoing tensions between armed forces along the LoC. Concerns over the fires in the affected territories resulted in the UN General Assembly Resolution A/RES/60/285 “The Situation in the Occupied Territories of Azerbaijan” (15 September 2006).15 A joint mission of the Organization for Security and Cooperation in Europe (OSCE), the United Nations Environment Programme (UNEP) and the Global Fire Monitoring Center (GFMC), assessed the short- and long-term impacts of the fires on the environment. In his report to the UNGA the OSCE Chairman-in-Office recommended a number of short- to long-term measures aimed at improving fire management capability in the countries concerned and to contribute to peace building in the region (UN General Assembly, 2007).16 Between 2007 and 2012 the recommendations were implemented by the GFMC with funding from the Environment and Security (ENVSEC) Initiative17 and the Secretariat of the Euro-Mediterranean Major Hazards Agreement (EUR-OPA) of the Council of Europe.18

14 See a review of the emerging field of warfare ecology by Machlis et al. (2011).
16 61st UN General Assembly Session, Agenda item 17 „The situation in the occupied territories of Azerbaijan“, Letter dated 20 December 2006 from the Permanent Representative of Belgium to the United Nations addressed to the Secretary-General: http://www.fire.uni-freiburg.de/GlobalNetworks/SEEurope/N0720860-OSCE-UNGA-ENG.pdf
17 The Environment and Security (ENVSEC) Initiative transforms environment and security risks into regional cooperation. ENVSEC comprises the Organization for Security and Co-operation in Europe (OSCE), Regional Environmental Centre for Central and Eastern Europe (REC), United Nations Development Programme (UNDP),
Afghanistan / Pakistan (2006): In 2006 the armed conflict in the border region between Afghanistan and Pakistan escalated. Afghanistan-based NATO forces entered Pakistan's airspace from the neighboring Nooristan province. The air raids on two border villages Daroshot and Azo (Arandu) involved dropping of bombs, which ignited wildfires in the surrounding forests.19

Israel-Lebanon (2006): During the armed conflict shelling, air raids and rocket attacks started numerous fires on the territories of Israel and Lebanon at a time of drought and extreme wildfire risk (Achiron-Frumkin and Frumkin, 2006). In Israel 800 forest fires were induced by rockets (400 of which required response) affecting 1,200 ha of forests (mainly coniferous). In addition about 6,600 ha of nature reserves, national parks and landscapes proposed as nature reserves, as well as ca. 7,000 ha pasture lands were burned. In Lebanon the total area of burned forests was 712 ha and that of burned productive trees was 308 ha.20 The use of white phosphorous as marker bombs or smoke screens in the Gaza War of 2008-2009 carried a high risk of igniting structural and wildland fires.21

Georgia (2008): During the armed conflict in Georgia in August 2008 a number of forest fires occurred as a consequence of military activities and caused collateral damages in several sites in the country. According to reports by government authorities and non-government organizations the fires burned between 13 August and the end of August 2008. Starting on 13 August 2008 two forest fires in the Ateni Gorge (Ateni and Ormotsi compartments of the Inner Kartli Regional Forest District) affected around 60 ha of forests. Fires affected approximately 950 ha in the Borjomi Gorge in Samtskhe-Javakheti Region, of which approximately 150 ha of the Borjomi area burned in the buffer zone of the Nedzvi Nature Sanctuary. Several fires also affected two national parks and one nature reserve. Three fires burned within the Borjomi-Kharagauli National Park. A joint mission of OSCE and UNEP to assess the environmental impacts of the conflict in Georgia confirmed the damages caused by fires in Borjomi Gorge and noted that additional areas had burned along the main corridors of combat activities (roads between South Ossetia and Gori Region).22 Starting in 2009 the ENVSEC programme included Georgia in the above-mentioned regional fire management project.

Asymmetric Conflicts: The Forest Fire Jihad

In November 2008 a website carried the first known posting calling for Forest Jihad. According to a U.S. intelligence report published in January 2009 the statement, in Arabic, said that “summer has begun so do not forget the Forest Jihad.” The writer called on all Muslims in the United States, Europe, Russia and Australia to “start forest fires.”23 The posting quoted an imprisoned Al Qaida member:

- “Jihad is an art just like poetry, music, and the fine arts. There are people that draw and there are others that are jihadists. They both act upon inspiration”.
- “The idea of forest fires is attributed to him, may God set him free, as is in this short clip”.
- The posting said that setting forest fires was legal under extremist Islamic law as part of “an eye for an eye” and can produce “amazing results”.

United Nations Environment Programme (UNEP), and the North Atlantic Treaty Organization (NATO) as associate partners.
18 The ENVSEC project „Enhancing National Capacity on Fire Management and Wildfire Disaster Risk Reduction in the South Caucasus“ is operational since 2008 and includes Armenia, Azerbaijan and Georgia, as well as a regional component on cooperative capacity building in fire management.
19 http://www.fire.uni-freiburg.de/media/2006/10/news_20061019_pak.htm
20 Report of Association for Forests, Development and Conservation (AFDC) is archived in the GFMC repository.
- The writer stated that it was permissible to burn trees in carrying out jihad. “Scholars have justified chopping down and burning the infidels' forests when they do the same to our lands,” the writer said.
- The writer stated that “targeted forests” are in the nations that “are at war with Muslims,” including the United States, Europe, Russia, and Australia.
- “Smoke caused by the fires will create pollution and military forces could be tied up fighting fires”. The report noted that U.S. military forces in Iraq or Afghanistan “could even be recalled” as occurred following hurricane Katrina, which, in fact did not occur.
- The report urges terrorists to use sulphuric acid to start a forest fire, as well as gasoline.

While Australian authorities have revealed no evidence linking any recent wildfires to extremists, terrorism experts say “the large death toll, the huge swath of destruction and the massive financial blow to the country are proving to Islamic terrorists that arson can be a highly effective – and simple – tool of holy war.”

In December 2010 Israel's police, fire brigades and press intentionally covered up an Arab arson offensive that took place while fires raged on Carmel Mountain on the first week of December 2010, an Israeli media report claimed. Police and the Fire Commission decided not to spread the information about the arson "so as not to wake into action more potential terrorists". The press report listed the locations of about 25 arson attacks that the fire brigades fought in the early days of the month. In November 2010 eighteen acts of arson were recorded in the Forest of Peace, the press report noted.

The tensions are reflected by recent events that are not yet finally evaluated. In February 2011 the leader of a major Muslim movement in Israel was arrested for allegedly damaging and setting fire to a eucalypt forest in Southern Israel. The attack was allegedly in protest of a Jewish National Fund project in the area. The Jewish National Fund is working to plant forest on parts of the Negev, a plan opposed by some Bedouin residents of the region. Residents of the town of El-Araqib in particular had condemned the project out of concern that it will use land that they hope to use in the future to house Arabs “returning” to Israel from the rest of the Arab world.

In May 2012 Al Qaida called upon its followers to unleash massive forest fires upon the United States and published graphic instructions for the creation and ignition of “ember bombs”. Detailed in the memorably titled, “It is of your Freedom to Ignite a Firebomb” the call targeted Montana because of its rapid population growth in the wooded areas.

Later in 2012 the Russian Secret Service FSB claimed to possess information that terrorism tactics of Al Qaida included setting fire to European forests, an allegation which could not be proved.

The U.S. Department for Homeland Security (DHS, 2012) released an internal note (unclassified but for official use only) “Terrorist Interest in Using Fire as a Weapon” aimed at “providing awareness of terrorist interest in the tactic of intentionally setting fires to cause casualties, economic damage, and resource depletion”.

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24 “Australian wildfires could fuel 'Forest Jihad' terrorists, experts say”, published on 09 February 2009 by [http://www.foxnews.com/story/0,2933,490306,00.html](http://www.foxnews.com/story/0,2933,490306,00.html)
29 For more information on the concept of „pyro terrorism” see Baird (2006) and Deshpande (2009)
Wildfire outbreaks have also occasionally been attributed to domestic civil unrest in some countries. Kailidis (1992) intended to prove that wildfires in Greece were started purposely during times of elections and political crises between the 1920s and 1980s. Xanthopoulos (2010) rejected this direct link of high-fire occurrence years with political unrest and attributed the underlying causes to poor performance of government agencies. In this regard he also rejected the hypotheses developed by Christodoulakis and Skouras (2009), who developed theories suggesting that around elections, wildfires and tax evasion increase significantly in Greece, with important economic implications. However, Xanthopoulos (2010) confirmed the use of fire during the civil war between the nationalistic and communist movements.

Political motivations and accusations for arson can hardly be proven, for example blaming the ETA in Spain or the Mafia in Italy for political arson (Xanthopoulos, 2010). However, there is occasional evidence indicating such motivations such as the series of arson fires in and around Athens (Greece) in 1981. In August 1981 the right-wing movement Galazios Toxotis (“Blue Archer”) was accused having lit fires in the residential area Nova Politeia of Athens – home to many political leaders, as well as trying to blackmail the government into releasing political prisoners (members of the former military junta).30 A case of collateral damages of civil protest involving wildfires has been noted during demonstrations in Israel in May 2010 when brush fires started by tear gas canisters were fanned by the wind and engulfed the land in a massive brushfire.31 In June 2011 Jewish settlers were accused of setting fire to fields belonging to Palestinian inhabitants of the West Bank village of Burin.32

It is alleged that in December 2011 former Turkish Prime Minister Mesut Yilmaz officially admitted that Turkish secret agents intentionally started forest fires in Greece in the 1990s as part of state-sponsored sabotage. This followed earlier claims that the blazes were a retaliation for Greece’s alleged hosting of training camps for Kurdish rebels of the Kurdistan Workers’ Party (PKK) and urban underground leftist group Devrimci Sol and even a retaliation for forest fires in Turkey’s tourism areas during the 1990s allegedly set by Greek secret service agents.33

Wildfires and other Remnants of Armed Conflicts: Land Mines and Unexploded Ordnance (UXO)

The countries in the region most affected by land mines are Bosnia and Herzegovina, Croatia, Serbia, Macedonia, Georgia, Ukraine, and Armenia. The origin of the land mines and unexploded ordnance (UXO) in Bosnia and Herzegovina, Croatia and Serbia is from the civil war from the last decade of 20th century. It is estimated that about 300,000 ha are contaminated by land mines and UXO (mostly along to the line of conflict during the civil war). According to a report from Bosnia and Herzegovina about 127,000 ha of forests, or 10% of the total forest lands, are contaminated by UXO and land mines (Pešković, 2008). Croatia reports 95,000 ha of mined forests and other lands with a total of ca. 100,000 land mines left (Jungwirth, 2009). This is a significant problem and challenge for forest fire management since wildfires burning on mined lands cannot be fought on the ground using conventional equipment. Wildfires triggering explosions of land mines have caused casualties in several cases and resulted also in reluctance to attack wildfires, or in orders for firefighters to stay out of the “red zones”. In Vietnam UXO stemming from the war in the 1960s and 1970s continue to trigger wildfires and posing threats to firefighters more than 35 years after the termination of the armed conflict.34

31 „An Nabi Saleh demonstrates against violence in the midst of extensive brushfires“, published on 16 May 2010 by www.palsolidarity.org and http://www.fire.uni-freiburg.de/media/2010/05/news_20100516_ps.htm
33 At the time of finalizing this chapter the debate on false quotations and accusations are ongoing, see GFMC Media repository of December 2011 (http://www.fire.uni-freiburg.de/media/2011/12/news_december11.htm), notably see: http://www.fire.uni-freiburg.de/media/2011/12/news_20111228_gr.htm
Similar reports from the Line of Contact (LoC) between India-Pakistan in Jammu and Kashmir reveal that landmines are the main hindrance in controlling forest fires. There are reports of incidences in July and December 2009 and May 2011 of land mines laid along the LoC exploding during wildfire. In Israel, wildfires in minefields on the Golan Heights threatened a UN peacekeeping battalion in August 2009. In Turkey about one million land mines have been laid between the 1950s and the early 1990s. In the border region between Syria and the Turkish province Sanliurfa about 14,000 ha of productive agricultural land have been mined as a strip along the border. These areas with land mines pose a great danger in fire suppression (Bilgili, 2009).

Ironically land mines may also protect forests from destruction by non-sustainable or illegal use. The Global Fire Monitoring Center (GFMC) assessed the wildfire threats inside and around Quadisha Valley, Lebanon, which has been UNESCO World Heritage listed since 1998. The Joubbeh-Bcharri community forest at the edge of Quadisha Valley contributes to the few large forest tracts in Lebanon which have not yet been subjected to illegal cutting, occupation by constructions or other degradation. The reason for this lies in the contamination of the forest by land mines, which had been laid by Syrian and Lebanese troops during the civil war (1975-1990). These mine fields have not yet been cleared, thus people are not entering the forest. Grazing by goats is common around the edge of the forest complex and contributes to reduced fuel loads and thus decreased risk of wildfire spreading into the forest. The technical report to UNESCO concludes that land mines and goats so far have protected the forest from degradation (Global Fire Monitoring Center, 2010).

Unexploded Ordnance (UXO) is found on several hundred thousand hectares of forests and other lands throughout Western, Eastern and Southeastern Europe. Remnants of World War I battles along the frontlines of 1917 in the South of today’s Former Yugoslav Republic of Macedonia have repeatedly created problems, e.g. during the fire season of 2007 when more than 70 incidents of explosions of ammunition triggered by forest fires were noted (Goldammer and Nikolov, 2007). In Germany, the battlegrounds of the final phase of World War II in Brandenburg State around Berlin are still highly contaminated by approximately one hundred thousand tons of unexploded artillery, grenades and bombs. In addition, former and active military exercise areas and shooting ranges dating from the early 1900s to post-World War II, pose a high risk to civilian populations, especially firefighters (Goldammer, 2010; Goldammer et al., 2009). A recent estimate reveals that ca. 250,000 ha of former and active military training and shooting ranges in Germany are contaminated by UXO.

Besides the above-mentioned land mine contamination in the Balkans and the South Caucasus the combat grounds in and around the Nagorno-Karabakh territory represent one of the major UXO-polluted terrains worldwide. In the Near East the aftermath of the Israel-Lebanon War of 2006 revealed numerous problems associated with unexploded cluster bombs. The National Demining Office of Lebanon reported 22 fatalities and 166 injuries due to post-conflict explosions of cluster bombs; two incidents occurred during wildfire suppression.

Similar risks are found in other continents. For example in Australia, where large tracts of lands are contaminated by World War II explosives, nearly 40,000 blocks of land across Brisbane and Ipswich on which UXO had reportedly exploded during bushfires.

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36 „Feueralarm: Grasbrände in der Zone“, published on 3 August 2009 by the Austrian Army http://www.bundesheer.at/ausle/undof/artikel.php?id=2893
37 This assessment of January 2011 has been extracted from the databank „Nature Conservation and Military“, David Foundation, Germany (unpublished data on file at GFMC). See also Goldammer et al. (2012).
Threats arising from Wildfires Affecting Military Assets

Wildfires have the potential to affect other military assets, including ammunition depots, nuclear and conventional research and storage facilities, and active military shooting and exercise ranges. Forest fires have entered ammunition storage facilities in the territories of the former Soviet Union in recent years. In 2008 artillery shells and other ammunition at a storage facility in Ukraine exploded when a forest fire swept into the depot.\(^39\) Details of the causes of other reported incidents remain unclear; a fire and subsequent explosions at a munitions depot in southern Ukraine in 2004 killed five people; a fire at a Soviet-era military base in Kagan, Uzbekistan spread to an ammunition depot in July 2008, also igniting a series of explosions that killed three people and injured 21 others; and a fire that burnt an arsenal near Ulyanovsk (720 kilometers east of Moscow) in November 2009.\(^40\) The latest incident of this kind resulted in a large ammunition depot fire in Russia, which was attributed by some to be caused by a wildfire and which burned in May 2011 nearby the village of Urman (Bashkortostan).\(^41\)

During the fire and smoke pollution episode in Western Russia in July/August 2010 several military depots and nuclear facilities were threatened by fire. In the first week of August wildfires overran a weapons storage facility near Moscow (the Central Air and Technical Naval Base 2512), with an estimated loss of 200 airplanes and half of the buildings destroyed. At the same time the Russian military garrison Naro-Fominsk near Moscow moved all its artillery ammunition and rockets to a safer location as wildfires advanced in the region. In the same week wildfires threatened a factory in Kolomna that produces guided missiles, the Novovoronez nuclear power station near Voronez and the Tryokhgorny nuclear closed city in the Urals (Soviet code name: Zlatoust-36) where nuclear warheads are assembled and dismantled.\(^42\) A critical situation developed in the closed “nuclear city” of Sarov (Arzamas-16) as wildfires advanced towards nuclear arms-producing facilities.\(^43\)

Similar incidences have affected other continents - for example in the U.S.A, where the Los Alamos nuclear weapons laboratory - located 70 miles north of Albuquerque (New Mexico) and employing 7,000 people - was threatened by wildfires in May 2000. The fires burned within 300 yards of a plutonium storage facility and forced the evacuation of more than 20,000 people from the main and an adjoining the facility.\(^44\) A similar situation arose during the Las Conchas Fire in June / July 2011. This fire once again threatened the Los Alamos nuclear facility and spread fears of radioactive contamination (O’Brien and Goldammer, 2011).

In South Europe the most recent severe accident on a military site was caused by a wildfire in Cyprus, which occurred on an ammunition storage site and became the most disastrous recorded event in that region. On 11 July 2011 a brush fire triggered the explosion of the Iranian explosives that had been confiscated in 2009 and stored at the munitions dump of Evangelos Florakis naval base in Zygì. Two containers caught fire and a series of explosions followed. The blast killed six base personnel and six fire fighters who were battling the bush fire that preceded the explosion. More than 60 people were injured. Severe damage to the island's biggest power station – Vasiliko, which supplied about 60% of the island's electricity – resulted in severe power supply shortages (O’Brien and Goldammer, 2011).

Military Training and Wildfires

Military activities on training and shooting ranges are common in Europe. In 2009 and 2010 extensive fires burned near the suburbs of Marseille (France) as a consequence of exercise shelling by the Foreign Legion. In July 2009 more than 300 people were evacuated from their homes when fires

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\(^{39}\) „Blaze sweeps Ukraine military base“, published on 29 August 2008 by [http://english.aljazeera.net](http://english.aljazeera.net) and [http://www.fire.uni-freiburg.de/media/2008/08/news_20080830_ukn.htm](http://www.fire.uni-freiburg.de/media/2008/08/news_20080830_ukn.htm)

\(^{40}\) „Blasts rock Russian ammunition depot, 2 killed“, published on 15 November 2009 by Associated Press and [http://www.google.com/hostednews/ap/article/ALeqM5hw4_DV-6Y-ikKH HogsqUKg vh92XIRAD9BUSIVG0](http://www.google.com/hostednews/ap/article/ALeqM5hw4_DV-6Y-ikKH HogsqUKg vh92XIRAD9BUSIVG0)

\(^{41}\) „Unknown cause for Russian arms depot fire“, published on 27 May 2011 by Euronews, see [http://www.euronews.net/2011/05/27/unknown-cause-for-russian-arms-depot-fire](http://www.euronews.net/2011/05/27/unknown-cause-for-russian-arms-depot-fire)

\(^{42}\) [http://www.fire.uni-freiburg.de/GFMCnew/2010/08/07/20100807_ru.htm](http://www.fire.uni-freiburg.de/GFMCnew/2010/08/07/20100807_ru.htm)

\(^{43}\) For a detailed situation description and a map of Sarov and surroundings, with active fires, depicted by WorldView-2 satellite sensor (2-m resolution), on 6 August 2010, see: [http://www.fire.uni-freiburg.de/GFMCnew/2010/08/07/20100806_ru.htm](http://www.fire.uni-freiburg.de/GFMCnew/2010/08/07/20100806_ru.htm). See also [http://www.fire.uni-freiburg.de/media/2003/news_05122000_1.htm](http://www.fire.uni-freiburg.de/media/2003/news_05122000_1.htm)
caused by shelling became uncontrolled. Similar experiences have been shared by countries in other continents. In the U.S.A. the “Machine Gun Fire” of September 2010 burned through the training range of Camp Williams, Utah. It was caused by automatic weapons training and affected the artillery impact area with UXO contamination, consuming 4,326 acres and three houses and forcing the evacuation of 1,652 houses and nearly 5,000 people. In the extremely dry spring months of 2011 extensive fires caused by military shooting exercises in the training grounds of Fort Lee, White Sands Missile Range, Fort Bliss and Camp Pendleton were recorded.

The presence of UXO constitutes a considerable threat to land management authorities, ground firefighters and aerial fire suppression. Within this broad category of UXO, the threat of residual exercise ammunition is less than the risk of residual combat ammunition. In Germany fire services are not allowed to fight wildfires on demarcated terrain contaminated by UXO (“red zones”). Thus, as wildfires cannot be attacked swiftly and with conventional means there is high threat of fires becoming out of control and spreading to adjacent terrain.

Opportunities and Challenges of maintaining Military Training Ranges of high Conservation Value

In Europe active and former military training areas and shooting ranges have been shaped by wildfires in such a way that open land ecosystems of high biodiversity value have been created or maintained by recurrent fires. The Atlantic and continental *Calluna vulgaris* heathlands of Germany are a classic example of sub-climax ecosystems that historically had been maintained by intensive cultivation (grazing, mowing, biomass export) and intentionally or accidentally lit fires on military training grounds. In the wake of demilitarization at the end of the Cold War and the unification of Germany the 1990s and into the first decade of the 21st Century, the use of former military ranges was largely abandoned, and subsidized maintenance of open land habitats has reached critical limitations due to lack of appropriate policies and funding prioritization (Goldammer et al., 2009). The recent introduction of prescribed fire in Germany to maintain open heathland habitats is based on traditional burning practices and coincides with new ecological insights of applied fire research that are receiving increased acceptance from nature conservation groups and the public. The above mentioned *White Paper on Use of Prescribed Fire in Land Management, Nature Conservation and Forestry in Temperate-Boreal Eurasia* (Goldammer, 2010a) is indeed calling for a widespread application of prescribed fire to maintain the conservation value of former military training sites.

The presence of UXO, however, is a limiting factor for the application of prescribed fire on approximately 250,000 ha of high conservation value terrain (Fig. 1). A pilot project is currently underway in the Heidehof-Golmberg Nature Reserve in the State of Brandenburg, Germany, to test safe application methods of using armored vehicles (demilitarized tanks) for prescribed fire ignition and control. Monitoring and control of the fire operations by an unmanned aerial system (helicopter drone with real-time video downlink to the control center) allows navigation and safe and efficient ignition and control of the armored vehicles (Goldammer et al., 2012).

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45 'Imbeciles': Hundreds evacuated from their homes as bushfire caused by French military threatens Marseille”, published on 23 July 2009 by www.dailymail.co.uk and http://www.fire.uni-freiburg.de/media/2009/07/news_20090723_fr.htm

**Figure 1.** Germany has about 700,000 ha active or former military exercise and shooting ranges with high conservation value. About 250,000 ha of these lands are contaminated with Unexploded Ordnance (UXO). Source of map and contamination assessment: *Naturstiftung David*, Germany (Goldammer et al., 2012). Legend: green – active military areas; ochre – abandoned military areas.

**Overall Global Wildland Fire Fatalities**

Reliable global statistics on wildland fire fatalities (deaths and injuries) are not available. A major share of wildfire fatalities are occurring in developing countries and are not entering the electronic media or insurance statistics, and thus are not available for international evaluation. Injuries caused by indirect effects of fire are common but not systematically evaluated, e.g. short- to long-term effects of fire smoke pollution on human health, including premature mortality. Fire and smoke episodes in Southeast Asia and the Amazon lowlands caused by conversion burnings since the 1980s have sparked numerous media reports on such massive near-ground smoke pollution and the resulting...
threats and observations of people adversely affected by smoke inhalation, but only very few scientific investigations have been conducted (for details cf. chapter 18 of this volume).

Since 2008 annual global wildland fire fatalities reports are published by GFMC.47 The reports reveal that 345, 374, 279 and 130 people were killed directly by wildfires in 2008, 2009, 2010 and 2011 respectively. The 2010 report does not include fatalities that could be possibly attributed to the consequences of the extreme heat wave and extended fire smoke pollution in Western Russia (cf. final remarks in chapter 18 of this volume).

The reports also include persons injured and – starting in 2011 – the extent of structural damages caused by wildfires and evacuations due to wildfire threat.48 As stated by GFMC, the numbers of fatalities and damages include only those reported in the media and GFMC correspondents. Thus, due to the lack of a comprehensive national / international reporting system the statistical dataset is likely to be incomplete, especially considering the numerous unreported fatalities in remote regions of the developing world.

Addressing Politics and Policies

The chapters of this volume – the White Paper – have reflected on the natural and human-influenced history of vegetation fires globally. The individual chapters address a complexity of situations in which fire regimes are changing. Thus, conclusions point various directions, depending on the specific nature of local and regional environmental and socio-economic changes. In the final chapter some considerations about options of how to cope with changing fire regimes and fire management in future will be given. In the context of the questions addressed in this chapter two examples are selected to highlight the need for action: Wildfires as means or consequences of armed conflicts or strained political relations, and the prevention of dangerous wildfires on contaminated terrain.

Opportunities: Confidence Building for Human Security and Peace

Since wildfires and vegetation fire smoke can easily spread over boundaries, thus making fire management become an additional source of contention to already strained relations between neighbouring countries. Hence, because of the transboundary nature of wildfires and their potential impact, co-operating on fire management across borders is in the interest of all sides involved. Thus, like water management, fire-management has great potential to be a source of co-operation and an avenue for confidence-building.

The most recent events during a state of high tension between countries, or state of war, were the above-mentioned situations around the Nagorno-Karabakh conflict in 2006 and the armed conflict in Georgia in August 2008. Mandated by the UN Security Council in 2006 and by the Organization for Security and Cooperation in Europe (OSCE) the Global Fire Monitoring Center (GFMC) was entrusted with the technical lead to develop confidence building measures between countries directly and indirectly affected. The proposed measures of building national and transboundary fire management capacity are aimed at managing and preserving natural assets and protecting populations from adverse impacts of fires. They were implemented starting in 2007 (ongoing) within the framework of the OSCE Mission and the Project “Enhancing National Capacity on Fire Management and Wildfire Disaster Risk Reduction in the South Caucasus”, which comes under the umbrella of the ENVSEC Initiative.49 Following the OSCE report to the UN General Assembly on the Nagorno-Karabakh

47 http://www.fire.uni-freiburg.de/media/bulletin_news.htm. Starting with the 2011 report data will be provided on structures and other economic assets burned and damaged, as well as numbers of evacuations and evacuees.
48 According to the 2011 report a total of 125 evacuations in 15 countries involved the temporary displacement of 85,723 persons. The loss of private homes destroyed by wildfires in 2011 in 15 countries amounted a total of 7193. The number of homes damaged by wildfires in three countries amounted 269. Farmers lost more than 9800 livestock in six countries, more than 700,000 ha of valuable agricultural lands were affected by wildfires and were considered destroyed. Estimated agricultural loss in South Africa was $US 7.16. Only in Texas, U.S.A., wildfires during April have caused an estimated $20.4 million in agricultural losses, destroying fences, buildings, grazing pastures and resulting in livestock deaths.
49 See section “Pressing Issues” above.
mission in 2006, in which was stated “The Mission’s hope is that, further to its recommendations, fires might be transformed from an additional source of conflict into an opportunity for regional cooperation, confidence building and ultimately reconciliation” (UN General Assembly, 2007) the OSCE considers the ongoing project as one of the successful non-military confidence building measures in the region.50

In December 2010 a wildfire affected the Mount Carmel massive near Haifa, Israel, resulting in a relatively short, but intense and dangerous inferno of planted, partially exotic tree stands and natural vegetation on the slopes of the mountain. Given the scarcity of forests in Israel, the high emotional value of the fire, and the tragic loss of 42 human lives entrapped by the fire, the country received a widespread response of assistance to combat the fire, including the provision of aerial firefighting resources from as far as the U.S.A. and Russia.51 Most significant, however, was the assistance of Palestinian authorities by sending fire trucks and crews for support of fire suppression, despite fierce political tensions between the parties. On 7 December 2010 the President and the Prime Minister of Israel signed a letter of recognition, in which “The State of Israel expresses its gratitude and deep appreciation to the Special Delegation of the Palestinian Authority for the invaluable contribution and exemplary courage in battling the blaze of Mt. Carmel”.52

During the Mt. Carmel fires in December 2010 Turkey assisted with massive firefighting support, despite the tensions between the countries that had earlier arisen from the incident on a Turkish ship bound for Gaza and seized by Israeli military, which resulted in the deaths of nine Turkish citizens in May 2010.53

In July 2011 a wildfire threatening the Yad Vashem holocaust memorial in Jerusalem was controlled with the assistance of Arab staff from East Jerusalem, who significantly contributed to save the archives.54

In October 2011 rabbis from the United States of America thanked envoys from countries that helped Israel douse forest fires, “including some that now have difficult relations with the Jewish state”, including a Palestine Liberation Organization envoy.55

Starting an international dialogue on Dangerous Fires on Contaminated Terrain

In 2009 an international seminar made history by addressing the problem of “Wildfires and Human Security: Fire Management on Terrain Contaminated by Radioactivity, Unexploded Ordnance (UXO) and Land Mines”. The seminar was held in Kyiv and Chernobyl, Ukraine, and provided new insights into phenomena and problems arising from fires burning in radioactively contaminated terrain in the Eurasia biota. Most severe problems are in the territories of Ukraine, Russia, and Belarus, which were highly contaminated by the failure of Reactor 4 of the Chernobyl Nuclear Power Plant back in 1986. Traces of radioactivity are found in emissions from wildfires burning in Central Asia and are transported long-range and intercontinental. Wildfire incidents in the U.S.A. have threatened nuclear test facilities but so far have not resulted in severe contamination.

Reports from Germany, the Southern Caucasus countries Armenia and Azerbaijan, the Near East countries Lebanon and Israel and the Balkan countries Bosnia and Herzegovina, Croatia and FYROM Macedonia reveal the magnitude of unexploded ammunition and land mine contamination in forested and other lands and the problems associated with remnants from armed conflicts dating back as far as the

51 For a real-time log on the Mt. Carmel fires see GFMC daily updates archives at: http://www.fire.uni-freiburg.de/current/archive/archive.htm#ISRAEL.
52 Copy of letter available at GFMC repository.
53 http://en.wikipedia.org/wiki/Gaza_flotilla_raid
as World War I. Reports on fires burning in former military exercise and shooting ranges reveal that unexploded ordnance are potentially very dangerous and have repeatedly resulted in firefighter casualties.

The seminar called on its host – the government of Ukraine – and the auspices of the seminar, the Global Fire Monitoring Center (GFMC), the Council of Europe (CoE), OSCE / ENVSEC, the UNISDR Regional Southeast Europe / Caucasus and Central Asia Wildland Fire Networks, and the UNECE / FAO Team of Specialists on Forest Fire to address the problems. The “Chernobyl Resolution on Wildfires and Human Security: Challenges and Priorities for Action to address Problems of Wildfires burning on Terrain Contaminated by Radioactivity, Unexploded Ordnance (UXO) and Land Mines” recommends to develop policies and practices related to fire management on contaminated terrain. 56

Conclusions

Without intending to repeat the historic role of fire use in the evolution and maintenance of the cultural landscapes and land-use systems of temperate-boreal Eurasia (e.g., Goudsblom, 1993; Pyne, 1997; Goldammer et al., 1997), and the subsequent changes due to the takeover of using fossil-fuel driven technologies replacing traditional cultivation systems including fire use, it seems that the cultural landscapes of the region are on the brink of an era of transition.

While the rural exodus may offer opportunities for natural revegetation – a process welcomed by those supporting the transformation of former cultivated or otherwise intensively used lands to natural vegetation or “wilderness” areas - large tracts of cultivated landscapes are transitioning to a state of high wildfire hazard and wildfire risk as a consequence of vegetation succession and buildup of combustible materials readily susceptible to ignition and spread of wildfires.

This coincides with an obviously increasing vulnerability of society to fire and fire effects – a trend that is observed in other cultural landscapes around the world. New approaches in integrated land management are needed, ranging from small-scale approaches aimed at preserving or managing habitats of endangered species to landscape-scale approaches that take into account the overarching aspects of landscape functioning, environmental protection and climatic changes.

With increasing knowledge on the adverse effects of fire smoke emissions on human health, biogeochemical cycles and direct and indirect effects on climate, it may be expected that conflicts between the need for natural and cultural fires and the need to protect an increasingly vulnerable human society will become apparent.

References

Note: Media reports quoted in footnotes and mirrored in the GFMC global wildland fire data repository can be accessed using a User ID and a Password, which will be made available on request by GFMC. Enquiries to be address to: fire@fire.uni-freiburg.de

Achiron-Frumkin, T, Frumkin, R. (2006) Preliminary assessment of environmental damages induced by the fighting in northern Israel-Lebanon, summer 2006. Based on preliminary reports issued by the Israel Nature and Parks Authority (INPA), the Jewish National Fund (JNF) - Forest Department, the Ministry of Environmental Defence (MOE) and the Ministry of Agriculture (MOA) and prepared for Israel’s National Committee of the World Conservation Union (IUCN).


Abstract

The contributions of the White Paper „Vegetation Fire and Global Change“ reveal that globally, fire regimes are altering in parallel with and under the influence of socio-economic developments, land-use change and climate change. Increasing vulnerability of society to the direct and secondary effects of wildland fires, as well as the trans-boundary nature and consequences of wildland fires are prompting countries and international organizations to define their common interests in enhancing sustainable and integrated fire management capacity. The requirement for systematic and efficient sharing of scientific and technical expertise, solutions and resources, including transboundary cooperation, means that the transition from informal information exchange and networking to a more systematic and formalized cooperation is more necessary than ever. Several international (global) and regional conventions are examples of international legal agreements that provide rationale and a catalogue of environmental protection obligations for signatory countries. However, none of these legally binding conventions or any informal or voluntary international instruments explicitly address wildland fires as either a driver of environmental degradation, or the need for integrating natural and prescribed management fires in those ecosystems and land-use systems that require fire for maintaining their function, sustainability and productivity. Currently there are also no protocols in place that provide internationally accepted standard methods and procedures for countries that provide and receive assistance in wildland fire emergencies that would ensure interoperability, efficiency and safety of cooperating parties. The Global Wildland Fire Network (GWFN) is a voluntary network which evolved in the late 1990s as an initiative of the Global Fire Monitoring Center (GFMC) and the UNECE/FAO Team of Specialists on Forest Fire. The GWFN operates through the GFMC as a “Thematic Platform” under the United Nations International Strategy for Disaster Reduction (UNISDR), and promotes international cooperation in wildland fire management – notably through capacity building in wildfire prevention, preparedness and suppression, and the development of standardized procedures for use in international wildfire incident response.

Keywords: Fire management, international cooperation, transboundary fire effects, international legal agreements, voluntary agreements

Introduction

The contributions of this White Paper „Vegetation Fire and Global Change“ reveal that, globally, fire regimes are altering in parallel with and under the influence of socio-economic developments, land-use change and climate change. Increasing vulnerability of society to the direct and secondary effects of wildland fires, as well as the trans-boundary nature and consequences of wildland fires are prompting countries and international organizations to define their common interests in enhancing sustainable and integrated fire management capacity. The requirement for systematic and efficient sharing of scientific and technical expertise, solutions and resources, including transboundary cooperation, means that the transition from informal information exchange and networking to a more systematic and formalized cooperation is more necessary than ever.

Several international (global) conventions, such as the three “Rio Conventions” (CBD, CCD and FCCC) and the Ramsar Convention on Wetlands are examples of international legal agreements that


58 Johann Georg Goldammer, Global Fire Monitoring Center (GFMC), Max Planck Institute for Chemistry, c/o Freiburg University / United Nations University (UNU), Freiburg, Germany. Address for correspondence: fire@fire.uni-freiburg.de
provide rationale and a catalogue of environmental protection obligations for signatory countries. However, none of these or any other legally binding conventions or informal or voluntary international instruments, such as the *Hyogo Framework for Action 2005-2015: Building the Resilience of Nations and Communities to Disasters*, are explicitly addressing wildland fires as a driver of environmental degradation. Nor do they address the need for integrating natural and prescribed management fires in those ecosystems and land-use systems that require fire for maintaining their function, sustainability and productivity. There are also no protocols in place that provide internationally accepted standard methods and procedures for countries that provide and receive assistance in wildland fire emergencies that would ensure inter-operability, efficiency and safety of cooperating parties.

In preparation for and following the International Wildland Fire Summit of 2003\(^{59}\) the international wildland fire community has taken steps to develop preliminary concepts, templates and guidelines with widely agreed-upon principles and best practices in fire management and incident command. Detailed operational standards are now needed to facilitate the exchange of fire fighting resources, including aviation, management personnel, and equipment. The UN Disaster Assessment and Coordination (UNDAC) and the International Search and Rescue Advisory Group (INSARAG) Guidelines\(^{60}\) and the principles laid down in the “Rosersberg Initiative – Improving the international environmental emergency response system” may serve as examples for developing interoperable standards, protocols, Standard Operating Procedures (SOPs) and rules of engagement.

At the level of multilateral bodies, such as the Association of South East Asian Nations (ASEAN), the UN Economic Commission for Europe (UNECE), the Asia-Pacific Economic Cooperation (APEC), the Council of Europe (European Open Partial Agreement on the Prevention, Protection Against and Organization of Relief in Major Natural and Technological Disasters – EUR-OPA), the European Union (EU), or the Southern African Development Community (SADC), recent developments have revealed an interest of countries to enhance the capabilities of regional, transboundary cooperation in fire management. Experience gained in bilateral (reciprocal) agreements include common usage of the Incident Command System (ICS) - as practiced under agreements between North American countries (U.S.A., Canada and Mexico) and between the U.S.A. and Canada on the one side, and Australia and New Zealand on the other side. These experiences may serve as examples for developing other regional agreements or protocols.\(^{61}\)

The Global Wildland Fire Network (GWFN)\(^ {62}\) is a voluntary network which evolved in the late 1990s as an initiative of the Global Fire Monitoring Center (GFMC)\(^ {63}\) and the UNECE/FAO Team of Specialists on Forest Fire\(^ {64}\). The GWFN operates through the GFMC as a “Thematic Platform” under the United Nations International Strategy for Disaster Reduction (UNISDR), and promotes international cooperation in wildland fire management – notably through capacity building in wildfire prevention, preparedness and suppression, and the development of standardized procedures for use in international wildfire incident response. Lead institutions serve as coordinators of Regional Wildland Fire Networks and work with representatives of international organizations mandated or otherwise active in the wildland fire arena. These lead institutions are represented by the UNISDR Wildland Fire Advisory Group (WFAG), which provides advisory services to the UN system.

The application of fire management guidelines developed under the auspices of international organizations such as the International Tropical Timber Organization (ITTO) and the Food and Agriculture Organization (FAO) of the United Nations, and with major inputs of the members of the regional networks, provide a voluntary basis of common understanding of best practices and solutions in fire management.

In the long-term the GWFN is also aiming at developing an International Wildland Fire Accord (voluntary or binding under international law), which would be based on the rationale that there is a

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\(^{59}\) [http://www.fire.uni-freiburg.de/summit-2003/introduction.htm](http://www.fire.uni-freiburg.de/summit-2003/introduction.htm)


\(^{61}\) See special issue of UNECE/FAO International Forest Fire News (IFFN) No. 29, with examples of agreements and Annual Operating Plans: [http://www.fire.uni-freiburg.de/ffn/ffn_29/content29.htm](http://www.fire.uni-freiburg.de/ffn/ffn_29/content29.htm)

\(^{62}\) [http://www.fire.uni-freiburg.de/GlobalNetworks/globalNet.html](http://www.fire.uni-freiburg.de/GlobalNetworks/globalNet.html)

\(^{63}\) [http://www.fire.uni-freiburg.de/](http://www.fire.uni-freiburg.de/)

\(^{64}\) [http://www.fire.uni-freiburg.de/intro/team.html](http://www.fire.uni-freiburg.de/intro/team.html), see section 2.6 of this chapter
common international interest in protection of global vegetation cover against degradation or
destruction and that common endeavors in fire management will contribute to disaster risk reduction.
For example, reduction of the risks associated with direct fire damages to human assets and
ecosystems, fire-generated smoke pollution affecting human health and security, release of
greenhouse gases, secondary disasters such as landslides, erosion, floods and threats to
biodiversity.

In the following sections examples are given of achievements and ongoing activities which reflect
some progress in the dialogue to enhance international cooperation in wildland fire management.65

Progress in regional cooperation in fire management

Association of South East Asian Nations (ASEAN)

As a consequence of extended fire and smoke episodes since the early 1980s and especially in the
1990s ten member states of the Association of Southeast Asian Nations (ASEAN) commenced
negotiations for a ASEAN agreement addressing regional air pollution resulting from land-use fires
and wildfires. In June 2002 the Agreement on Transboundary Haze Pollution was adopted and came
into force on 25 November 2003, with nine states currently participating (Brunei Darussalam,
Cambodia, Lao PDR, Malaysia, Myanmar, Philippines, Singapore, Thailand, and Viet Nam).

This Agreement marks a world-first, as the first regional arrangement binding a group of contiguous
states aimed at tackling transboundary haze pollution resulting from land and forest fires.66 The
Agreement requires the Parties to:

- cooperate in the development and implementation of measures to prevent, monitor, and
mitigate transboundary haze pollution by controlling sources of land and/or forest fires,
developing monitoring, assessment and early warning systems, exchanging information and
technology, and allowing the provision of mutual assistance;
- respond promptly to a request for relevant information sought by a State or States that are or
may be affected by such transboundary haze pollution, with a view to minimizing the
consequence of the transboundary haze pollution; and
- take legal, administrative and/or other measures to implement their obligations under the
Agreement.

The Agreement establishes an ASEAN Coordination Centre for Transboundary Haze Pollution
Control to facilitate cooperation and coordination in managing the impact of land and forest fires – in
particular haze pollution arising from such fires. Pending the establishment of the Coordination
Centre, ASEAN Secretariat and ASEAN Specialized Meteorological Centre (ASMC) are co-
performing its interim functions. Despite the fact that Indonesia is by far the largest source of the fires
and haze the ratification of the ASEAN Agreements is still outstanding (Khee-Jin Tan, 2005;
Nguitragool, 2011). In 2012 Indonesia indicated its willingness to move toward ratification.67

European Union (EU)

In the 1980s and 1990s there was some exchange of firefighting expertise within the EU but little
formal cooperation. The European Union Civil Protection Mechanism was established in 2001 and
further strengthened in 2007. It provided a new capacity for coordination for Europe and now plays a
central role in the EU forest fire risk prevention and forest firefighting coordination at EU level. There
are currently 32 countries participating in the Mechanism („Participating States“): The 27 Member
States of the European Union (EU) together with Iceland, Liechtenstein, Norway, Croatia and the
Former Yugoslav Republic of Macedonia. The Mechanism, which is managed by the European

65 Note: Materials of this paper have been presented at the 5th International Wildland Fire Conference, South
66 See ASEAN website „Haze Online“: http://haze.asean.org/hazeagreement/, and the full text of the agreement
at: http://haze.asean.org/docs/1128506236/ASEANAgreementonTransboundaryHazePollution.pdf/view
67 http://www.fire.uni-freiburg.de/media/2011/01/news_20110122_id.htm
Commission, has tools to cope with wildfires in three phases of the disaster management cycle. The main responsibilities and the tools allocated to the European Commission are outlined as follows.68

Monitoring and prevention: The core operating body of the European Union Civil Protection Mechanism is the Monitoring and Information Centre (MIC). The MIC’s three major roles are:

- to provide a coordination platform for exchanging requests for assistance and offers of resources among Participating States;
- to be an agent for information exchange and dissemination regarding natural and man-made disasters worldwide and the regarding Mechanism interventions;
- to act as a coordinator in identifying gaps and developing solutions on the basis of the information it receives, facilitating the pooling of common resources where possible and supplying expert teams to the disaster location to tackle the problems more effectively.

The Common Emergency Communication and Information System (CECIS) facilitates coordination between the MIC and national authorities. The main tasks of CECIS include hosting a secure and reliable database on potentially available assets for assistance; handling requests for assistance on the basis of this data; facilitating the exchange of information and documenting all action and message traffic.

The MIC receives fire risk assessment information from the European Forest Fire Information System (EFFIS). This web-based platform, which consists of a scientific and technical infrastructure, was developed jointly by the European Commission Joint Research Centre and Directorate General Environment (European Commission).

Preparedness: The EU Civil Protection Mechanism intermediates information dissemination activities and exchange of best practice knowledge between Participating States. It also provides training programmes and exercises to intervention teams and organizes informative activities, seminars, conferences and pilot projects on the main aspects of interventions. During a test phase this Mechanism provided access to the assets in the European Union Forest Fire Tactical Reserve (EUFFTR) – a pilot project designed to enhance cooperation between Member States for combating forest fires during high risk seasons. The project, to which two Canadair CL-215 aircraft were allocated during the summers of 2009 and 2010, was activated in the cases where Member States were not in a position to provide assistance to a requesting country due to their aerial resources being needed in their own territory or because they could not reach the fire site quickly enough. The Mechanism develops implementing rules for module development and administers the CECIS module database.

Response: Through the EU Civil Protection Mechanism, the European Commission is able to:

- Mobilize small teams of experts to the site of an emergency;
- Provide and distribute information during an emergency/intervention;
- Play a facilitating role in the coordination of assistance requests and offers from Participating States;
- Coordinate with other actors at the international level and with other EU services; and
- Provide co-financing for the transport of assistance to the affected areas, on the request of the offering Participating States.

The EU Civil Protection Mechanism is well-accepted and is being increasingly used by Participating States. Twenty-eight requests for assistance were received by the MIC in 2009-2010 from within the EU and 18 requests from non-EU states. For comparison: In 2002 only three requests had been

68 Note: Parts of this general description of the EU Mechanisms has been taken from the introduction to the report „Study on wild fire fighting resources sharing models“, prepared by GHK Consultants to DG ECHO, European Commission (October 2010), in which the author participated. See executive summary at: http://ec.europa.eu/echo/civil_protection/civilprote/pdfdocs/future/Wildfire_Exec_Summary.pdf
received. The Mechanism coordinates and facilitates voluntary efforts, with each Participating State free to decide its contribution on case-by-case basis.

Asia-Pacific Economic Cooperation (APEC)

In October 2010 the first “International Conference on Forest Fires: Management and International Cooperation in Preventing Forest Fires in APEC Region” was convened at the initiative of the Russian Federation. The aim of this conference was to strengthen cooperation between the emergency services of the APEC member economies in order to emphasize the readiness of the region to reduce the risks of disasters. Following a deep and comprehensive analysis of the problem of forest fires in the APEC region and other regions, the conference identified the urgent necessity for joint efforts, mutual help and cross-border cooperation in forest fire risk reduction. The conference released the “Khabarovsk Recommendations on Management and International Cooperation in Preventing Forest Fires in the APEC Region”. The following priority directions of international cooperation under APEC were among those proposed:

- Development of an international mechanism to monitor and enhance responsibility of APEC member economies to ensure forest fire protection on their territories and coordinate action under APEC using existing institutions of international cooperation, such as UNISDR Global Wildland Fire Network, ASEAN, UNECE and others.
- Promotion of economic cooperation in projects that aim to reduce the degree of fire risk and restoration of forests on lands degraded by fire and non-sustainable forest management;
- Development of bilateral agreements on cooperation in fire management, particularly between APEC economies sharing common borders, and a voluntary regional agreement on cooperation in fire management, aiming at harmonizing cooperation with neighboring regional entities such as the UNECE and ASEAN, particularly in the light of overlapping membership of some economies.
- Development of long-term fire management strategies in each economy that allow for mitigation of the consequences of climate change.
- Improvement of strategic and operational early warning mechanisms in the APEC region as a regional activity to be coordinated with the Global Wildland Fire Early Warning system.
- Conduct regular consultations to exchange knowledge and best practice.
- Reconvene and contribute to the 5th International Wildland Fire Conference scheduled for 2011 (South Africa), and the following conference scheduled for 2015 (South Korea).

A priority follow-up activity has already included a joint fire management study course offered to APEC countries in 2011, hosted by the Russian Federation.

Southern African Development Community (SADC)

In the last two decades, vegetation fires have become a major concern in the region of the Southern African Development Community (SADC) with regard to the negative impacts they have on the welfare of the environment and humans. Uncontrolled wildfires cause forest and vegetation degradation as well as biodiversity loss. This can result in immediate and long-term impacts on the livelihoods of local communities and upstream impacts on national and regional economies. Fires in the tropical environment are a major contributor to tropical forest degradation and over time frequent fires lead to savannization in these areas. However, fires are also needed to maintain healthy ecosystems and biodiversity of natural savannah and grassland vegetation types - many being adapted to regular fire occurrence. Prescribed or controlled burning is used to meet objectives often essential to sustaining livelihoods. Fire is also used for conservation reasons, removal of old growth,

71 The information provided in the chapter are taken from the SADC Regional Fire Management Programme Document, draft proposal (June 2010). Web source: http://www.fire.uni-freiburg.de/GlobalNetworks/Africa/SADC%20Regional%20Fire%20Management%20Programme%20Document-Final-6.pdf
suppression of bush encroachment and stimulation of the growth of grazing grass as well as the removal of fuel with the aim of pre-empting dangerous wildfires at the peak of the fire season.

The SADC region of 14 Member States is home to 238 million people, of which approximately 75% are rural based. The perceived rise in the number of wildfires negatively affects these rural communities which are often situated near the forests that provide them with their basic needs. The on-going process of climate change has the potential to exacerbate this situation by altering the frequency, intensity, severity and seasonality of fires in the SADC region.

A SADC regional fire management programme was proposed in 2010. It provides a framework for cooperation on fire management issues across national boundaries. Fire management is a technical, socio-cultural and political challenge that requires an effective network of willing partners that include governments, the private sector, local communities and international partners to find the appropriate balance between developing and conserving natural resources and managing unwanted fires while at the same time promoting the safe and beneficial use of fire. The programme intends to foster cooperation and collaboration in fire management on a regional basis to move towards integrated environmental policies and fire management practices. The programme pursues a multiple stakeholder approach working closely with regional and international organizations to support five areas of fire management. These are; legal and regulatory aspects of fires; community based fire management; institutional strengthening and establishment of a fire management coordination centre; generation and dissemination of relevant fire information for detection and early warning and; associated capacity building in the respective areas.

The envisaged programme is based on the SADC Protocol on Forestry of 2002, which forms the policy framework for sustainable forest management in the SADC member states. Its objectives include the goal to achieve effective protection of the environment and to safeguard the interests of both the present and future generations.

The SADC Forestry Strategy of 2010 is based on the vision to develop and maintain a forest sector that contributes to rural development, poverty reduction and industrial progress, meanwhile continuing to retain vital ecosystem services such as water supply, climate change mitigation and biodiversity protection. The Strategy thereby provides motivation for countries to cooperate for the protection, management, and sustainable use of their forests. The primary purpose of the strategy is to provide a framework for both regional cooperation and international engagement on forest issues by paying special attention to issues that transcend national boundaries The Strategy's mission is to facilitate cooperation among member states to ‘promote the active protection, management and sustainable use of forest resources through sound policy guidance and the application of requisite skills and the best available technology, in order to enjoy the multiple benefits of forests in perpetuity’.

There is increased willingness by SADC member states to cooperate on fire management on a regional and international basis. There is also recognition that a regional framework based on cross border cooperation is required to address issues of national, regional and transboundary fire management. Member states have expressed the need for a regional agency or centre to foster and coordinate such cooperation and information exchange in fire management. Establishing an agency responsible for collecting and analyzing fire related data and formulating standardized rules, guidelines and procedures will ensure coordinated dissemination of relevant information and guide policy development. Furthermore it would spearhead the promotion of integration of Community-Based Fire Management (CBFIM) into national policies and fire management strategies.

The expected activities and outcomes of the SADC Regional Fire Management Programme include the establishment of a Regional Fire Management Coordination Center. This center will also facilitate and coordinate international and regional cooperation in fire management by providing a mechanism through which one country may request and receive wildfire suppression resources from another country. This mechanism should also encourage cooperation and exchange on other fire management activities such as training and lessons learnt. A SADC fire management programme will allow the development of a SADC Memorandum of Understanding (MoU) which will prescribe the conditions of cross border cooperation to combat transboundary fires and include operational guidelines for the regional coordination centre.
The programme intends to foster regional level interaction by developing guiding policy frameworks and procedures for several aspects of fire management. During the Consultative Workshop on the Development of a SADC Regional Fire Management Programme (January 2010, Maputo) participants from all SADC member states compiled capacity development measures that must be carried out by all SADC member states to ensure success of a regional fire management program. The project includes the following components:

- Establishment of a Regional Fire Management Coordination Center. Objective: To promote the establishment of a regional fire management coordination centre for improved stakeholder cooperation and collaboration
- Reform and Harmonize Policies and Procedures. Objective: To secure essential policy harmonization at national and regional level to provide the basis for controlling harmful fires and promoting the safe use of beneficial fires within SADC
- Community-based fire management. Objective: To promote integration of CBFiM into Member States’ fire and natural resources management systems/programmes
- Fire information. Objective: To improve production, access, dissemination and application of fire information within the region
- Capacity development. Objective: To increase awareness of and proficiency in balanced and integrated fire management and its elements

Between 2010 and 2013 the Trilateral Cooperation Fund (TRI-CO Fund) project between South Africa, Tanzania and Germany (Trilateral Cooperation Fund – TRI-CO Fund) “Tanzania - South Africa Fire Management Coordination Project” was implemented to demonstrate the utility of coordination and exchange of techniques, resources, science and capacity building in fire management amongst contributing parties and SADC member states. The GIZ project “Transfrontier Conservation and Use of Natural Resources in the SADC Region” (2013-2015) is also addressing the cooperation of border-crossing processes in conservation, including transboundary fire management.

**Latin America**

**Mesoamerica**

Several developments during the last decade indicate the political willingness of nations in Mesoamerica to share information and resources in fire management. An important regional initiative has been launched by the First Central Mesoamerican Meeting on Forest Fire Protection (Primera Reunión Mesoamericana de Cooperación en Materia de Protección contra Incendios Forestales) held in Guatemala City in 2002. This regional meeting was organized within the framework of the project “Prevención y Combate de Incendios Forestales en Mesoamerica” of the “Programa Mesoamericano de Cooperación 2001-2002”, launched at the 4th Tuxtla regional dialogue. Delegates of Belize, Costa Rica, El Salvador, Guatemala, Honduras, México, Nicaragua and Panamá formally agreed to launch a programme of cooperation which includes the sharing of information and resources in fire management as well as in capacity building. 72

A number of follow-up conferences and workshops have consolidated these dialogues and strategic visions for cooperation in fire management. The Mesoamerica Meeting was followed by a meeting in Honduras (Taller para el Desarrollo de un Plan Estratégico Regional para el Manejo del Gorgojo del Pino y los Incendios Forestales en Centroamérica, 26-30 August 2002) in which the representatives from Central America developed a strategic plan for fire and bark beetle management in Central America. The momentum created by the Mesoamerican Meeting and the Honduras Strategy is currently maintained and coordinated by the Comisión Centroamericana de Ambiente y Desarrollo

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72 In June 2003 consultations were held with the Government of Guatemala concerning cooperation between the Mesoamerican Cooperation Regarding Protection against Forest Fires and the GFMC. A Memorandum of Understanding was signed by the Mesoamerican Permanent Technical Group on Forest Fires (Grupo Técnico Mesoamericano Permanente sobre Incendios Forestales), represented by the President of the Coordinating Council of the Sistema Nacional de Prevención y Control de Incendios Forestales (SIPECIF), Guatemala, and Executive Coordinator of the Presidency of Guatemala, and the Global Fire Monitoring Center (GFMC), operating under the auspices of the UN International Strategy for Disaster Reduction (ISDR), concerning Cooperation in the Global Wildland Fire Network through active participation of the Regional Mesoamerica Wildland Fire Network.
A Technical Commission on Forest Fires and Pests has been established under the CCAB/AP. In 2004 the Technical Commission requested the Consejo Centroamericano de Bosques y Áreas Protegidas (CCAB/AP) to officially create the Regional Central America and Mexico Forest Fire and Pest Network (Red Regional de Centro América y México de Incendios y Plagas Forestales) operating under the CCAD. The recommendations of the network were presented at the Pan-American Wildland Fire Conference on 23 October 2004, San José, Costa Rica. The Central American Strategy on Fire Management 2005-2015 (Estrategia Centroamericana para el Manejo del Fuego) was published in 2005 and implemented in a number of regional activities in the following years.

South America

In 2004 the Regional South America Wildland Fire Network was founded in Curitiba, Brazil. In 2005 the South America Subregional Technical Workshop, sponsored by the FAO Latin American and Caribbean Forestry Commission (COFLAC) developed the first draft of the South American Strategy on Fire Management 2006-2010 (Estrategia de Cooperación de América del Sur para el Manejo del Fuego). In the frame of this Strategy it was decided to establish the Fire Management Working Group of South America. The network is co-chaired by PREVFOGO / IBAMA (Brasilia, Brazil), the Federal University of Paraná (Curitiba, Brazil) and the National Forestry Corporation (CONAF), Chile.

Together with the representatives from Central America and the Caribbean the “Regional Strategy on Cooperation in Wildland Fire Management in Latin America and the Caribbean” was finalized in a regional meeting in Santiago de Chile in 2005 and presented and at the 24 COFLAC Session in 2006. In 2007 IBAMA and COFLAC signed an MoU on technical cooperation and development of the South American Strategy on Fire Management (Memorando De Entendimiento Para la Cooperación Tecnica y el Desarrollo de la Estrategia de Cooperación de América del Sur Para el Manejo del Fuego) and agreed on an operational bi-annual plan for the Secretariat of the network (Plan Operativo Bimanual de la Secretaria Ejecutiva del Grupo de Trabajo de América del Sur de Manejo del Fuego). Effective inter-governmental cooperation in fire management has been proven during mutual assistance in wildfire emergencies in 2012 by the cooperation between the authorities of Argentina, Brazil and Chile. Progress can also be noted in development and use of common regional assets in wildland fire early warning and satellite monitoring, led by Brasil and Red Latinoamericana de Teledetección e Incendios Forestales (RedLaTIF).

UN Economic Commission for Europe (UNECE)

Within the last decade the region of the United Nations Economic Commission for Europe (UNECE) has experienced a number of wildfire episodes that have resulted in severe environmental damages, high economic losses and considerable humanitarian problems. Reasons and underlying causes of changing fire regimes have been elaborated in detail in Chapter 22 of this White Paper. There is a high interest of governments, national agencies, international organizations and civil society in the UNECE region to address the increasing threats and imminent problems by fire management solutions that could be developed collectively, thus economically, allowing inter-operability in fire management between nations and regions.

73 http://www.fire.uni-freiburg.de/GlobalNetworks/Panamerica/Panamerican-Conference.htm
74 http://www.fire.uni-freiburg.de/GlobalNetworks/MesoAmerica/CCAD-FINAL-Estrategia-Manejo-Fuego-con-logos.pdf
75 http://www.fire.uni-freiburg.de/GlobalNetworks/MesoAmerica/MesoAmerica.html
76 http://www.fire.uni-freiburg.de/course/meeting/meet2003_14.htm
77 http://www.fire.uni-freiburg.de/current/archive/br/2001/10/br_10082001.htm
78 http://www.redlatif.org/
79 This section refers to the planning document for the UNECE/FAO Regional Forum on Cross-boundary Fire Management, to be organized by the UNECE/FAO Teams of Specialists on Forest Fire through its Coordinator – the Global Fire Monitoring Center (GFMC), Germany, and supported by the Council of Europe. For details and updates: see website of the UNECE/FAO Teams of Specialists on Forest Fire: http://www.fire.uni-freiburg.de/intro/team.html
At the time of publishing this White Paper the preparation of the “UNECE / FAO Forum on Cross-boundary Fire Management” in November 2013 at the United Nations in Geneva is underway. The Forum will be organized by the Global Fire Monitoring Center (GFMC) and the Secretariat of the UNECE/FAO Forestry and Timber Section, and co-sponsored by the Secretariat of the Euro-Mediterranean Major Hazards Agreement (EUR-OPA), Council of Europe.

The conference will elaborate on recommendations to UNECE and CoE member states to take advantage of recent insights and solutions of contemporary and expected future wildfire problems. The central focus of the conference will be to address the situation in countries in which progress of enhancing fire management capabilities is limited, for example as a consequence of political and administrative transition, difficult economic conditions, or countries experiencing extraordinary fire situations, and hence would benefit from the experience of their neighbor countries.

The outcome of the conference will build on existing and already proposed initiatives, such as

- New approaches in integrated vegetation management regarding renewable energy concepts and carbon storage. Some of these initiatives fall within the context of the UNFCCC endeavor to reduce deforestation and forest degradation by identifying opportunities to incorporate wildfire hazard reduction and fire management;
- Wider application of prescribed fire in nature conservation, forestry and landscape management, with encouraging progress of countries cooperating under the “Eurasian Fire in Nature Conservation Network” and similar initiatives;
- Exploitation of the results of successful international fire research projects with the aim to develop adequate public policies affecting fire management, e.g. the most recently accomplished multinational “Fire Paradox” project, or the ongoing development of the multinational Alpine Forest Fire Warning System (ALPF FIRS);
- Introduction and further development of competency-based fire management training standards offering qualifications to fire fighters, foresters and land managers, e.g. the “EuroFire Competency Standards”;
- Strengthening dedicated networks of wildland fire specialists, agencies and other representatives from civil society, e.g. the six Regional Wildland Fire Networks of the Global Wildland Fire Network that are covering the UNECE region;
- Application and further strengthening of existing as well as development of new bilateral agreements on reciprocal transboundary assistance in wildfire emergencies across the ECE region;
- Endeavor to enhance governance of UNECE member states in order to provide and receive assistance in wildfire (and other environmental) emergency situations by setting up standards, protocols and agreements. This should happen in cooperation with procedures evolving under the lead of the UNEP/OCHA Joint Environment Unit and the UN Advisory Group on Environmental Emergencies, e.g., the proposed creation of an Environmental Emergencies Center (EEC);
- Follow up of the recommendations of regional groups, projects, programmes and earlier regional conferences aimed at enhancing international cooperation in fire management in the UNECE region and adjoining regions. Examples of such recommendations include
  - the development of a “Regional Strategy for Cooperation in Fire Management in Southeast Europe” proposed in 2006;
  - the outcomes of expert meetings such as the workshop “Assessment of Forest Fire Risks and Innovative Strategies for Fire Prevention” – an activity of the Ministerial Conference for the Protection of Forests in Europe (MCPFE) of 2010;
  - the European Commission study entitled “Study on wild firefighting resources sharing models”.

80 http://www.fire.uni-freiburg.de/programmes/natcon/natcon.htm
81 http://www.fire.uni-freiburg.de/programmes/other/intr.html
82 http://www.alpfire.eu/
83 http://www.euro-fire.eu/
86 http://ec.europa.eu/echo/civil_protection/civil/prote/perspectives_en.htm
- the recommendations from projects supported by the Environment and Security (ENVSEC) Initiative addressing wildland fire, human security and peace in the EECCA region;\(^{87}\) and
- the outcomes of the International Conference on Cross-Boundary Fire Management (Irkutsk, Russia, 2010)\(^{88}\) and the APEC Conference on Forest Fire Management and International Cooperation in Fire Emergencies of the Asia Pacific (Khabarovsk, Russia, 2010).\(^{89}\)

The outcomes of the Forum shall be regarded as complementary to existing agreements and mechanisms. The conference will further the objectives of the international forest and climate regimes and shall contribute to the evolving of an "international wildland fire regime" as envisaged by the UNISDR Global Wildland Fire Network.

A large number of countries of the UNECE region are members of the Council of Europe, member states of the European Union and signatory states of the MCPFE, and are all concerned about the impact of climate change on forests and forest destruction by fire. There is also a collective demand for robust forest policies. However, wildland fires are not only impacting on the protection and function of forest ecosystems. Fire use and wildfire occurrence in the cultural landscapes of the region are shaped by agriculture, pastoralism and forestry and have considerable impacts, both positive and negative, on landscape patterns, land productivity, biodiversity and the atmosphere – with considerable implications for air quality, human health and security, and climate change.

The UNECE Convention on Long-Range Transboundary Air Pollution\(^{90}\), the European Landscape Convention\(^{91}\) and the Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention)\(^{92}\) are examples of conventions that address the pressing regional issues and relevant to – although not yet explicitly referring to – a potential regional "wildland fire regime".

Thus, the overall aim of the Forum will be a first step towards the development of an agreement on international cooperation to enhance fire management dialogue and capacity in the UNECE region. The political consultation and technical planning process in preparation of the Forum refers to the outcomes and the follow-up of the 4\(^{th}\) and 5\(^{th}\) International Wildland Fire Conferences (see section 3.4. and Annexes I and II).

**Bilateral reciprocal agreements with multilateral character: Examples**

Looking back a decade, the United States wildland fire season of 2000 at that time was the worst fire season in more than 50 years. Almost 100,000 fires burned more than 2.8 million hectares of forest and range lands. This was approximately twice the U.S. ten-year average. The season was long and difficult and firefighters faced dangerous burning conditions throughout the western U.S.A.

Faced with this unprecedented situation, and with a forecast for continuing hot and dry weather patterns, fire managers realized they would need to reach beyond U.S. borders for assistance. During the remainder of the 2000 fire season, the U.S. received assistance from more than 1200 Canadian firefighters, 96 fire specialists from Australia and New Zealand and 20 Mexican firefighters. These additional resources performed important roles in the U.S. fire fighting efforts. Some international fire fighters provided much needed support to fire crews on the fireline while others performed as middle managers on incident management teams. International agreements with Canada and Mexico were in place prior to the 2000 fire season but none existed with Australia and New Zealand.

Throughout 2001 and up to August of 2002 fire managers, risk managers and solicitors from the U.S., Australia and New Zealand proposed and reviewed options to solve the liability concerns raised after the 2000 fire season. One alternative that was explored was the purchase of sufficient liability

\(^{87}\) http://www.fire.uni-freiburg.de/GlobalNetworks/SEEurope/SEEurope_1.html
\(^{88}\) http://www.fire.uni-freiburg.de/GlobalNetworks/CentralAsia/CentralAsia_6.html
\(^{89}\) http://lesscentr.ru/en/en/index0.htm
\(^{90}\) http://www.unece.org/env/lrtap/
\(^{91}\) http://www.coe.int/t/dg4/cultureheritage/heritage/Landscape/default_en.asp
\(^{92}\) http://www.plantaeuropa.org/pe-wider_context-Bern.htm
insurance to meet risk managers requirements. However, the cost was prohibitive and the policies would have become unwieldy and complex. The best possible solution was to change U.S. law that would give any international firefighter brought to the U.S. under the “Wildfire Suppression Assistance Act,” tort liability coverage equivalent to that provided to U.S. Government fire fighters. In early August the bill was passed and signed by the President of the U.S. The language in the bill provided the assurance required by Australian and New Zealand with the result that U.S. fire managers were once again allowed to request assistance from these countries. Signatures of the Secretaries of Agriculture and the Interior were quickly inked on the official Arrangement papers and posted overnight to Australia and New Zealand. The Australian States of Victoria, New South Wales, Tasmania, Western Australia, and South Australia and New Zealand signed these documents and within a week of the passage of legislation, 50 Australian and New Zealand fires specialists were again on U.S. fire lines filling critical mid-level management fire positions in operations and aviation.

Through mobilizations of firefighters and numerous exchange activities, these arrangements have repeatedly proven the value of having effective, flexible, cooperative and formal relationships. These Arrangements are not static but must be periodically reviewed, adjusted, and re-approved by the signatories. The U.S. will continue to work with its partners in Australia and New Zealand to improve and expand on these valuable relationships in order to cooperatively address the common global challenges of wildland fire management.93

Progress in developing guidelines, protocols and standards for increasing efficiency and effectiveness of transnational cooperation

In addition to bi- and multilateral agreements the international community has, in recent years, developed a number of proposals, templates and models for improving governance, efficiency and effectiveness of international cooperation in wildfire disaster risk reduction, management and response. The “tools” include common international wildland fire terminology, methods for wildland fire risk identification at national, regional, and global levels and non-binding guidelines for fire management and smoke management - including dedicated eco-zonal fire management guidelines. The use of a standardized, commonly accepted wildland fire incident management system for international cooperation in a disaster situation has been proposed. The Global Wildland Fire Network has also developed a template for international cooperative agreements for countries interested in entering formal relationships on reciprocal assistance with others facing similar issues. Training in fire disaster management through development of internationally compatible standards and competency, as well as certification of international fire responders, are important elements of improving international cooperation in wildland fire management. In the following some key activities are described.

International Wildland Fire Terminology

The fundamental prerequisite for international cooperation in fire management is a commonly agreed upon terminology – a language that is understood by all partners intending to develop cooperation in fire management. In a number of countries very useful terminologies have been developed. This includes English-speaking countries in which fire terminologies are becoming increasingly compatible at an international level. However, terminologies show some differences in the use and meaning of terms. In some countries specific terms have been developed that are unknown elsewhere. As the English language is becoming the major language used for international cooperation in fire management it has proven useful to develop a basic English glossary with English explanations of the terms, which would then be translated directly. The “Global Wildland Fire Management Terminology”, first published by FAO (1986) was updated by the Global Fire Monitoring Center (GFMC) on behalf of FAO in 1999. The glossary has not been printed as it is considered a dynamic document, open for ongoing changes considered necessary. The glossary is available as an interactive search engine on the web.94 In the 1999 version, the only non-English language updated was German. The FAO also added French and Spanish in the FAO web-based terminology.95 In 2010 the GFMC published the

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93 For details see USDA Forest Service (2003).
94 http://www.fire.uni-freiburg.de/literature/glossary.htm
Russian and Mongolian version (together with English and German). In 2013-2014 Chinese and Korean will be added.

**International Statistical Wildland Fire Data Collection**

Internationally agreed methodologies and procedures for establishing fire databases and formatting national fire reports are not in place. Such databases and national fire reports (assessments) are important decision support tools at national, regional and international levels and for targeted cooperation in fire management.

The FAO “Global Forest Fire Assessment 1990-2000” (a special report of the Global Forest Resources Assessment 2000 [FRA-2000]) and reports from 12 Regional Wildland Fire Networks were summarized and evaluated in the “Fire Management Global Assessment 2006.” This exercise revealed the lack of compatible and up-to-date statistical data sets at the global scale. The concept proposed in the “Global Wildland Fire Assessment 2004” – an initiative of the GFMC – was used for a number of national reports submitted to the Regional Wildland Fire Networks. However, the assessment covered only a small number of countries.

The effective flow of information from national and regional levels to a central repository for receiving, processing and disseminating fire data must be ensured. This central organization should also feed fire information back to countries and other users that are connected through a network of national fire management agencies. The validity of an earlier recommendation by the UNECE/FAO/ILO in 1996 advising the establishment of a Task Force to produce a proposal for harmonized and coordinated data collection and reporting systems that will meet the demands of various user communities is therefore underscored and considered priority.

The next step to overcoming uncertainties and inconsistencies of fire inventories is the development of a global satellite-based vegetation fire inventory. The Global Observations of Forest and Land Cover Dynamics (GOFC/GOLD) project, an element of the Global Terrestrial Observing System (GTOS), sponsored by the Integrated Global Observing Strategy (IGOS), provides a forum for international information exchange, observation and data coordination (including calibration and validation of sensors and algorithms) and a framework for establishing the necessary long-term monitoring systems. The GOFC/GOLD Fire Mapping and Monitoring Theme aims to refine and articulate common observation requirements and make the best possible use of fire products from the available satellite observation systems – for fire management, policy decision-making and global change research.

**Template for International Wildland Fire Management Cooperation**

The International Wildland Fire Summit of 8 October 2003 provided an important forum for discussions of how to manage the future of international wildland fire management and share solutions to global problems. One of the outcomes of the Summit was a paper that offered a template and other information on cooperation in wildland fire management to countries interested in entering formal relationships and agreements with others facing similar issues. The paper is intended to enhance current international coordination and cooperation by providing information on the following:

- A template outlining areas to consider when developing international cooperative agreements;
- Listing of the types of cooperation and assistance that may occur between countries;

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96 [http://www.fire.uni-freiburg.de/literature/glossary.htm](http://www.fire.uni-freiburg.de/literature/glossary.htm)
100 Initial proposal for a global fire dataset by the ECE/FAO International Conference "Forest, Fire, and Global Change": [http://www.fire.uni-freiburg.de/iffn/org/eco/eca_ece_3.html#Appendix%20D](http://www.fire.uni-freiburg.de/iffn/org/eco/eca_ece_3.html#Appendix%20D)
101 [GOFC/GOLD Fire Implementation Team: http://gofc-fire.umd.edu/](http://gofc-fire.umd.edu/)
102 See section 3.4 of this chapter
103 Published in International Forest Fire News (IFFN) No. 29, p. 10-14: [http://www.fire.uni-freiburg.de/iffn/iffn_29/content29.htm](http://www.fire.uni-freiburg.de/iffn/iffn_29/content29.htm)


Page 34 of 64
- The responsibilities of countries sending assistance and of those receiving assistance;
- Websites containing information and examples of existing cooperative agreements and arrangements.

The role of the International Wildland Fire Conferences

With the first International Wildland Fire Conference, hosted by the North American Fire Management Working Group (FMWG) in the United States (Boston, Massachusetts) in 1989, a forum was initiated which aimed to share knowledge and expertise in wildland fire management, research and operational techniques in North America. The second conference was held in Canada (Vancouver) in 1996 and saw already increased international interest and participation. The third conference, held in Australia (Sydney) in 2003, became the first truly global conference of its type, as it included the inaugural “International Wildland Fire Summit”. Since the time planning the Sydney conference and summit the “International Liaison Committee” (ILC) of the conference series has consciously involved international experts and leading organizations. This is in large part thanks to the support offered by the U.S. Forest Service and the fact that they operate under the FMWG. The outcomes of the 2003 International Wildland Fire Summit and the following conferences in Spain (Sevilla) in 2007 and South Africa (Sun City / Pilanesberg National Park) in 2011 reveal that the IWFC have become the premier international forum on wildland fire policy, management, and transfer of science and technology applications.

The outcomes of the International Wildland Fire Summit included a Summit Communiqué and five strategic papers released by the Summit participants:104

- **Guiding Principles for Wildland Fire Management**: Guiding principles are suggested for consideration by international collaboration on fire management projects.
- **International Wildland Fire Management Agreements Template**: The paper identified issues and provided a template to encourage countries to cooperate in dealing with wildland fire.
- **Incident Command System (ICS)**: A globally implemented ICS will improve firefighter safety, efficiency and effectiveness in management response.
- **A Strategy for Future Development of International Cooperation in Wildland Fire Management**: The Summit participants recommended a series of strategies that will build on the work of many groups, conferences and regional summits and produce a series of actions building towards enhanced international cooperation in wildland fire management.
- **Community-Based Fire Management**: The paper addressed the role of local communities to become involved in fire management, and examples of and suggestions for implementation.

The conclusions of the 4th and the 5th International Wildland Fire Conferences identified priority issues concerning wildland fires globally and recommended to systematically strengthen fire management at national, regional (multinational) and global levels. The calls for enhancing international cooperation in fire management are reflected by the outcomes of the regional sessions and the conference statements.105 The 6th International Wildland Fire Conference will be held in the Republic of Korea in 2015 and evaluate the achievements of the previous conferences.106

Internationally Compatible Training, Standards and Competency; Certification of International Fire Responders

Capacity building of human resources is a key prerequisite for efficient planning and implementation of sustainable fire management. Many countries that are in need of developing or reviewing fire policies or upgrading existing fire management methods and / or technologies do not have the

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necessary resources or expertise in capacity building in fire management. International cooperation in fire management is critical to do so. Priority for international cooperation should focus on capacity building targeted at those groups responsible for developing fire policies, fire management planning and the subsequent implementation. Multi-stakeholder, inter-sectoral and inter-agency approaches will be a key consideration. It is also important to look beyond the responsible government agency to non-government organizations and the private sector to develop these capacities. Capacity building of instructors (training for trainers) is also a key prerequisite for the success of building capacities at local to national levels. Several fire management handbooks are available that are tailored for use in countries that need to build fire management capacity. They strive to guide the application of advanced knowledge in fire ecology and fire management, including participatory approaches to fire management (Community-Based Fire Management).107

Advanced international training courses for fire management specialists working in high-level positions in their country’s public or private sector will support the development of a culture of trans-national cooperation. Experience has been gained by several UN interagency training courses conducted by the United Nation University (UNU) and GFMC in Africa and in the South Caucasus countries. Progress has also been made in developing unified approaches for capacity building in fire management in Latin America through the joint efforts of the U.S. Forest Service, U.S. Aid and its Office of U.S. Foreign Disaster Assistance (OFDA). The most recent example is the joint firefighter mobilization exercise in 2010 in Ecuador, which for the first time has been held at pan-Latin American level (Quarto Ejercicio Nacional y Primer Latinoamericano de Movilización para Brigadas de Control de Incendios Forestales).108

All of this progress has been made while keeping the vision in mind to establish a decentralized worldwide network of training institutions in which donor organizations can collaborate. The development of training materials for international use is desirable.

The “Partnership for Environment and Disaster Risk Reduction” (PEDRR) is currently developing training materials on “Ecosystem-based Disaster Risk Reduction for Sustainable Development”, in which a module “Integrated Fire Management” has been included.109

In the case of fire suppression, the first steps have been taken to develop competency standards that will ensure the smooth cooperation between firefighting units of different nations, i.e. their interoperability in international missions. The EuroFire project is an initiative that has been financed by the EU Leonardo da Vinci programme and implemented jointly by the Global Fire Monitoring Center (GFMC) and partners between 2006 and 2008.110 EuroFire reviewed competency-based wildfire training systems to identify best practice examples from Europe and around the world. This research was the basis for the production of competency-based basic training materials specifically for use in European countries. The key target end-user groups for the EuroFire project included: firefighters; the rural and land-based sector; sectoral organizations and; education and training institutions.111 Meanwhile, EuroFire competency standards and training materials have been translated to Armenian, Azerbaijani, French, Georgian, German and Russian, and tested in Europe and neighboring countries in East Europe / Caucasus in the frame of the Environment and Security (ENVSEC) Initiative.

In future competency-based standards could serve for certification of firefighters to be deployed on international fire response missions. In 2011 The "International Fire Aviation Working Group" (IFAWG) started to draft a set of voluntary guidelines for improving the safety, efficiency and effectiveness of international aerial firefighting missions (cf. section 7 of this paper).

107 http://www.fire.uni-freiburg.de/Manag/CBFiM.htm and FAO (2011)
108 http://www.fire.uni-freiburg.de/GlobalNetworks/MesoAmerica/MesoAmerica_6.html
109 www.pedrr.net
110 EuroFire partners included the International Association of Fire and Rescue Services (CTIF) and Rural Development Initiatives Ltd.
111 EuroFire project website with competency standards and training materials for download: http://www.euro-fire.eu/
Fire Management Guidelines

Fire Management Guidelines are needed for the various user levels – ranging from practical guidelines for local fire managers to guidelines for land-use planning and policy development. Guidelines must consider the specific natural (ecological) conditions of vegetation fire, as well as the social, cultural, economic and political environment. Valuable examples of such guidelines already exist for local to global use. However, in many countries these guidelines are not known or not applied, are in need of adaptation for the specific conditions or simply need to be translated. Fire management guidelines for international use that have been developed by international organizations since the 1990s and are available on the Internet:\(^\text{112}\)

- The WHO/UNEP/WMO Health Guidelines for Vegetation Fire Events (1999)
- The UN Fire Management Voluntary Guidelines (2006)\(^\text{113}\), with its implementation group, the Fire Management Actions Alliance (2007)\(^\text{114}\)

While guidelines have been developed primarily to assist countries in developing sound, sustainable fire management capacities – including fire management policies and implementation strategies – they also provide guidance on standard approaches or standards in fire management that have been proven internationally and which will facilitate international cooperation in fire management.

International Systems to be Shared: Global Wildland Fire Monitoring and Early Warning

There are a number of fire management support tools that are based on international Earth Observation Systems (EOS). These systems include spaceborne sensors for fire detection and monitoring, and terrestrial networks of hydrometeorological services for recording and forecasting of fire weather (cf. Chapters 20 and 21 of this White Paper; Ahern et al., 2001).


A number of public providers of near-real time satellite-based observations of active fires and burned area allow free access to public domain data and free open source software (Alexandris, 2011), such as the Rapid Response system - part of NASA’s Land Atmosphere Near Real-time Capability for EOS (LANCE). Rapid Response provides daily MODIS images in near real time.\(^\text{115}\) Monthly MODIS Burned Area images have been available in the Web Fire Mapper since 2010.\(^\text{116}\) The Fire Information for Resource Management System (FIRMS) – a part of LANCE since 2011 – integrates remote sensing and GIS technologies to deliver global MODIS fire locations and burned area information to natural resource managers and other stakeholders around the World.\(^\text{117}\) The operational transition of the FIRMS system to FAO in 2011 is now complete. Operational users are advised to use the services of the Global Fire Information Management System (GFIMS) hosted by the FAO.\(^\text{118}\)

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\(^\text{112}\) Overview / portal: http://www.fire.uni-freiburg.de/literature/Fire-Management.htm
\(^\text{113}\) http://www.fao.org/docrep/009/i9255e/i9255e00.htm
\(^\text{114}\) http://www.fao.org/forestry/firealliance/en/
\(^\text{115}\) http://lance.nasa.gov/imager/rapid-response/
\(^\text{117}\) http://maps.geog.umd.edu/firms/
\(^\text{118}\) http://www.fao.org/nr/gfims/en/
Monitoring and modeling global emissions from vegetation fires is a component of Monitoring Atmospheric Composition and Climate (MACC), which is the current pre-operational atmospheric service of the European Global Monitoring for Environment and Security (GMES) programme. Its D-FIRE sub-project provides estimations of global emissions from biomass burning to the other MACC services and to the general public. The emissions are calculated in real time and retrospectively from satellite-based observations of open fires (Kaiser et al., 2011).\(^{119}\)

In 2005 a global multi-hazard early warning system was proposed in the Hyogo Framework for Action. Subsequently a concept for the development for a Global Early Warning System for Wildland Fires was endorsed by the United Nations and presented at the Third International Conference on Early Warning (EWC-III) in March 2006.\(^{120}\) The Global Early Warning System for Wildland Fires is an activity of GOFC-GOLD implemented by the Canadian Forest Service (CFS) and the Global Fire Monitoring Center (GFMC)\(^{121}\) and is linked to the Group on Earth Observations (GEO)\(^{122}\). Its central aims are to develop:

- Early warning of fire danger on a global basis that will provide international agencies, governments and local communities with an opportunity to mitigate fire damage by assessing threat, likelihood and possibility of extreme behavior. This should enable implementation of appropriate fire prevention, detection, preparedness, and response plans before wildfires arise.
- A robust global operational early warning framework with an applied system that will provide the foundation upon which to build resource-sharing agreements between nations during times of extreme fire danger.
- Local expertise and capacity building in fire management for system sustainability through technology transfer and training.

**International Wildfire Incident Management System: A Proposal**

As a result of severe fires over a number of years, national leaders have demanded a more coordinated approach to the management of wildfires, including receiving or sending firefighting assistance to other countries. However, the ability to effectively cooperate is still limited by organizational and communication barriers. In the USA, State and Federal legislators that are concerned at the lack of uniform emergency management protocols have directed federal, state, and local government to develop common incident management systems. The purpose is to provide a framework that enables wildland fire protection agencies to effectively facilitate clear response authority, acquire and mobilize resources, coordinate interagency actions and provide effective management during incident response. A fundamental element of incident management was the creation of the “Incident Command System” (ICS), which provides consistent terminology and established organizational structures to enable effective, efficient incident management. Australia and New Zealand, faced with similar emergency response issues, have evaluated incident management systems around the world and elected to adopt the ICS and modify it to meet their specific needs.

The complexity of incident management, coupled with the growing need for multi-agency and multi-functional involvement at incidents has increased the need for standard inter-agency incident management systems within countries and states as well as internationally. Many countries have chosen to adopt similar or common systems of addressing emergencies. In addition a number have developed firefighting agreements based on a common system designed to enable interoperability when lending support to other countries. In the past this has usually been to support adjoining States or Countries within the same geographical region. Since 2000 we have seen examples of this being broadened by the provision of support occurring from different hemispheres. In 2000 and 2002, Australia and New Zealand sent critically needed incident managers to the USA. Similarly, early in 2003 the USA reciprocated by sending fire specialists to Australia. Canada and the USA frequently

\(^{119}\) [http://www.gmes-atmosphere.eu/about/project_structure/input_data/d_fire/](http://www.gmes-atmosphere.eu/about/project_structure/input_data/d_fire/)

\(^{120}\) [Website of the Global Early Warning System for Wildland Fires: http://www.fire.uni-freiburg.de/fwf/EWS.htm](http://www.fire.uni-freiburg.de/fwf/EWS.htm)

\(^{121}\) See chapter 21 of this White Paper

\(^{122}\) [GEO Task DI-09-03B “Implementation of a Fire Warning System at Global Level”](http://www.earthobservations.org/geoss_imp.php)
exchange firefighting forces, especially along their borders and New Zealand sent firefighting forces to Australia in 2002 and 2003. ICS was also used commonly by all firefighting forces during the wildland fire emergency in Ethiopia in 2000.

The Incident Command System may need to be adapted to suit a particular country’s existing political, administrative or cultural systems, customs and values. Where the primary purpose is to enhance emergency management within a country, such adaptations are not only beneficial, but may be essential to have the ICS system adopted. If the purpose of adopting ICS is to enhance cooperation between countries, through the sharing of resources such as fire management teams, it is highly recommended that the sending country and the receiving country both use the same emergency management system.

One of the strategic papers produced by the International Wildland Fire Summit in 2003 suggests that the ICS is the most suitable tool available to fill this role on the international scene (see section 3.4 of this chapter). Given that ICS is a proven model in many countries and given that training materials for ICS are freely available, there is considerable benefit to be gained by a country adopting this system over any other.

It is hereby proposed that there be broad-scale introduction of a single International Wildfire Incident Management System (IWFMS) based on the incident management components discussed previously, including the principles of the ICS. This system would not necessarily require that specific components, such as ICS, be used as the incident management system of the country receiving or providing firefighting assistance. However, IWFMS components would need to be previously agreed upon, ideally in a formal arrangement, and utilized by all countries at the time of cooperation in wildfire emergencies.

IWFMS should also be considered as a candidate to be introduced in the UN-driven process to strengthen the international potential to respond to environmental emergencies. The UNEP and OCHA have established the Advisory Group on Environmental Emergencies (AGEE) as their most important cooperation and support mechanism for the response to environmental disasters. The AGEE is an international forum that brings together environmental experts from around the world to share information, expertise and lessons learned in order to improve response to environmental emergencies worldwide – particularly in developing countries. In 2007 AGEE founded the “Rosersberg Initiative”, which aims at strengthening the global regime that governs environmental emergency response and preparedness and initiated the establishment of the online Environmental Emergencies Center (EEC) in 2012.

In this context the application of the principles of developing High Reliability Organizations (HRO) may be of interest (Weick et al., 1999). A cooperation project between the U.S.A. and France reveals the utility of mutual exchanges of expertise and “lessons learned” by HRO may contribute improving incident management (Vidal et al., 2011).

The international firefighting assistance offered during the wildfire emergencies in Greece (2007), the Russian Federation (2010) and Israel (2010) reveal the need for introducing a unified incident management system – especially for the international deployment of aerial firefighting assets. Following the International Wildland Fire Summit (2003) an interest group was formed at the 4th International Aerial Firefighting Conference and returned recommendations for concerted international action. In a series of International Aerial Firefighting Conferences (2008-2010) this idea became

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123 See: International Arrangements on the Sharing of Wildland Fire Suppression Resources between the United States of America and Australia and New Zealand: [http://www.fire.uni-freiburg.de/iffn/iffn_29/USA-Australia-NZ-Intl-Arrangements.pdf](http://www.fire.uni-freiburg.de/iffn/iffn_29/USA-Australia-NZ-Intl-Arrangements.pdf)

124 See: The Ethiopia Fire Emergency between February and April 2000: [http://www.fire.uni-freiburg.de/iffn/country/et/et_1.htm](http://www.fire.uni-freiburg.de/iffn/country/et/et_1.htm)


In 2010 the International Fire Aviation Working Group (IFAWG) was founded and officially launched at the meeting of the UNISDR Global Wildland Fire Network / Wildland Fire Advisory Group at GFMC. The terms of reference have been laid down in the IFAWG Charter:

The "International Fire Aviation Working Group" (IFAWG) is working under the framework of the UNISDR Wildland Fire Advisory Group (WFAG) / UNISDR Global Wildland Fire Network (GWFN) as an advisory committee with the following principal objectives:

- Sharing of relevant information, especially information that will support the promotion and improvement of safety in the sector;
- Providing a conduit or facilitation mechanism for the sharing of resources between jurisdictions;
- Identification of opportunities for international harmonization of operating practices and establishment of consistent standards; and recommend or initiate suitable harmonization action, including the development of voluntary guidelines;
- Providing advice and guidance to individual states and the United Nations regarding fire aviation through the UNISDR Wildland Fire Advisory Group / Global Wildland Fire Network.

Sharing of resources in fire emergency situations that exceed the capacities of the fire-affected country are addressed by the study "Wildfire fighting resources sharing models" commissioned by the European Commission.

Conclusions

The United Nations International Strategy for Disaster Reduction (UNISDR) and its Wildland Fire Advisory Group are working to strengthen the efforts of United Nations agencies, other international organizations, non-governmental organizations, and a large number of national agencies responsible for fire managements with the aim to reduce the negative impacts of wildland fires and to promote a safe and ecologically benign model of fire use in ecosystem management. Similarly, the Global Wildland Fire Network (GWFN), the Global Fire Monitoring Center (GFMC) and the FAO are working systematically to increase the intra- and inter-regional cooperation in wildland fire management around the world. The outcomes of the International Wildland Fire Summit of 2003 and the 4th and 5th International Wildland Fire Conferences in 2007 and 2011 reveal that the majority of countries worldwide are ready to establish and strengthen regional and international dialogues on cooperation and exchange of information, research and wildland fire management, including through formalized agreements.

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128 See website of the last AFF Conference in Spain (December 2010), which includes the reports of all AFF conferences between 2008 and 2010: http://www.fire.uni-freiburg.de/course/meeting/2010/meet2010_19.htm
130 IFAWG website: http://www.ifawg.org/
131 http://ec.europa.eu/echo/civil_protection/civil/prote/pdfdocs/future/Wildfire_Exec_Summary.pdf
132 See Annexes I and II
133 The 6th International Wildland Fire Conference "Fire of the Past, Fire in Future" will be hosted by the Republic of Korea in 2015 (http://www.wildfire2015.kr/)
References

Note: Numerous references have been provided as footnotes or embedded in the text of this paper in order to facilitate online reading. Further search for documents on international cooperation in wildland fire management is facilitated by the search engine on the GFMC homepage (http://www.fire.uni-freiburg.de/). For searching documents only a relevant term (without adding “fire” etc.) needs to be entered.

Other references cited in the text:


Annex I

At the 4th International Wildland Fire Conference (Sevilla, Spain, May 2007) the representatives of the Regional Wildland Fire Networks and the participants of the joint regional sessions agreed on the need to develop synergies through coordinated and collective action to address the most pressing problems related to fire management globally.134 Furthermore, the conference participants recommended that:

- The international wildland fire community pursue the development of a global-scale international resource sharing strategy to assist countries with fire management planning activities (including prescribed fire for ecological purposes and fuels management), and active support during periods of wildland fire;
- The FAO promote the global adoption of Incident Command System (ICS) including the publishing of an annual list of countries which have implemented ICS;
- 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;
- Scientific research programmes addressing the consequences of changes of climate, land use and land cover, and socio-economic changes on fire regimes, environment and society must be supported at all levels;
- The Strategy to Enhance International Cooperation in Wildland Fire Management and the implementation of the Fire Management Voluntary Guidelines be encouraged and endorsed;
- Agencies and groups be encouraged to participate in the Fire Management Actions Alliance in support of their adoption of the Voluntary Guidelines;
- The UNISDR Global Wildland Fire Network, the Regional Wildland Fire Networks and the Secretariat of the global network, the Global Fire Monitoring Center (GFMC), be supported by national agencies and international donors aimed at fostering international cooperation in fire management, including collecting and disseminating fire information, arranging and enhancing international policy dialogue, and supporting projects;
- A series of Regional Consultations tentatively addressing “Global Change and Wildland Fire: Regional Solutions for Fire Management” – be held globally, within the next 1-2 years, to progress the global issues that are impacting people, resources and livelihoods;
- The 2nd International Wildland Fire Summit – tentatively addressing “Global Change and Wildland Fire: Fire Management Solutions for Mitigation and Adaptation” – be held within the next 2 to 4 years under the auspices of the United Nations and partners.

134 The results of the 4th International Wildland Fire Conference are documented at:
http://www.fire.uni-freiburg.de/sevilla-2007.html
Annex II

Four years after the Sevilla Conference the 5th International Wildland Fire was held in 2011, hosted by South Africa. The conference was held under the auspices of the United Nations International Strategy for Disaster Reduction (UNISDR) and the Food and Agriculture Organization of the United Nations (FAO) in conjunction with the Third Session of the Global Platform for Disaster Risk Reduction in Geneva. The Secretary General of the United Nations, Mr. Ban Ki-moon, conveyed an opening statement to the 500 delegates from 61 countries. He welcomed the efforts of fire specialists from around the world to develop a spirit of global cooperation in addressing the role of fire in the global environment and its impacts on society. The conference participants elaborated on both the need for the wise use of fire in sustainable management of natural and cultural ecosystems, and on the adverse effects of wildfires at local to global scales. They expressed strong concern at the escalation of wildfires across the globe - many unprecedented in the modern era regarding their severe impact on communities, the environment and the world economy. The conference participants acknowledged the benefits derived through collaboration in sharing information and researching new ways to tackle emerging issues. The conference participants, including the representatives of Regional Wildland Fire Networks and international thematic networks concluded that efforts be strengthened in capacity building in wildland fire science and management, and that this can be fostered by international cooperation and sharing of expertise and resources. The post-conference website includes all regional session reports as well as the global conference report.135

135 The results of the 5th International Wildland Fire Conference are documented at: http://www.fire.uni-freiburg.de/southafrica-2011.html


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) 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 Kingdom – 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. 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.

136 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

137 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.
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.

Dendrochronological analyses provide historic evidence of recurrence of natural surface fires in the “light taiga” of Siberia and thus the influence of fire in shaping the composition and dynamics of pine (Pinus spp.) and larch (Larix spp.) forest ecosystems. Photos: GFMC.

2. Cultural Fire Regimes

Pollen and charcoal records in Western Europe reveal the advent of slash-and-burn agriculture in the late Neolithic between 4300 and 2300 BC. (Rösch et al., 2004). Since then the historic use of fire has been manifested in the development and shaping of a variety of land-use systems in the region (Goldammer et al., 1997a,b; Pyne, 1997). Mechanical treatment, intensive utilization of biomass for domestic purposes, the impact of domestic livestock grazing and the application of fire modified formerly forested lands to open lands and shaped distinct landscape mosaics. These open land ecosystems provided habitat requirements for a flora and fauna that otherwise is not occurring in forest ecosystems. Modern agricultural practices and the reduction of fire use due to legal restrictions or prohibitions in most European countries on the one side, and the rural exodus associated with the abandonment of traditional land management practices, including fire use, on the other side are dramatically altering these ecosystems. The rural depopulation and the rapid increase of fallow is resulting in a loss of open land ecosystems and habitats and is even resulting in an alteration of whole landscape patterns. At the same time the increasing availability of phytomass – a consequence of the decrease of its use – has resulted in an increase of fuel loads at landscape level and thus in increasing wildfire hazard.
There are a number of reasons and approaches in Europe to maintain or to restore the traditional use of fire in some ecosystems or land-use systems.

2.1 Restoration of traditional practices of swidden agriculture

There are a few cases in Europe where a reconstruction or restoration of abandoned slash-and-burn agriculture practices is demonstrated. These attempts have primarily a “museum” character and are serving educational purposes with a touch of landscape pattern restoration. Until the middle of the 20th Century slash-and-burn agriculture with a spatio-temporal land-use pattern similar to the “shifting cultivation” system was widely practiced in Europe and has left landscape features that are still visible today, e.g. the still visible small-sized burning plots with their distinct successional patterns (Goldammer et al., 1997). There are two regions where this kind of fire treatment is practiced for demonstration purpose:

- Koli National Park in Finland is the only national park in the world that has a fire symbol in its logo. In Koli the traditional slash-and-burn practice is demonstrated regularly and reveals the importance of this traditional land use on the composition of Finland’s boreal coniferous forest that has been shaped by this cultivation over centuries (Lovén and Äänismaa, 2004).
- Historic slash-and-burn practice in the Black Forest of Germany: There are two sites near Freiburg (Yach, Vorderlehengericht) where the procedure of rotational cutting and use of coppice trees, the burning of residuals, followed by seeding and harvest of wheat, with subsequent fallow and forest regrowth period, are demonstrated (Lutz, 2008).

There is also a scientific interest to reconstruct earlier slash-and-burn practices, e.g. those that evolved in the late Neolithic. The most recent experiment to reconstruct Neolithic fire cultivation was conducted in 1999 in Forchtenberg, Germany (Rösch et al., 2002).

Swidden agriculture in the Black Forest, Germany, around the late 19th Century. Source: Historic copperplate print, archive of GFMC.
Demonstration traditional slash-and-burn practice in Koli National Park, Finland. Photo: Koli National Park.

Demonstration of traditional fire cultivation practices in the Black Forest, Germany (Vorderlehengericht, June 2007). Photo: GFMC.
2.2 Maintenance of grazing lands

The use of fire in maintaining openness and species composition on grazing lands is the most common practice that has survived its early application throughout Eurasia. Pastures that are threatened by succession are traditionally burned in a region stretching from the Western Mediterranean via the Balkans to East Europe. Although banned by law in most countries, the burnings are still practiced in many places. Together with burning of agricultural residuals (c.f. section 2.4) pasture burnings are a major cause of wildfires that are also affecting forests and even the wildland-residential interface. The illegality of burning is often resulting in “hit-and-run” practices, i.e. pastoralists setting fires and disappear from the site in order not to be sued. This is often resulting in uncontrolled fires with a high likelihood of developing and spread of devastating wildfires to adjoining terrain. While many countries did not yet attempt to introduce a solution to this problem, Spain has made significant progress by developing a government-supported permit and support system for the use of prescribed fire for grazing improvement and fire social prevention (Velez, 2007). Similarly, prescribed burning for rangeland improvement is practiced by several French prescribed burning teams, including the Department Pyrénées-Orientales (Faerber, 2009). For a European survey on prescribed burning practices, including grazing land management, see Lázaro (2009).


2.3 Nature conservation and biodiversity management

The major focus and activities in the use of prescribed fire in Western Europe is for the conservation and restoration of the biodiversity heritage of former cultivated lands or lands otherwise affected by human-ignited fires (habitat and biodiversity management). The range of application is rather wide, as reflected by the activities conducted in the frame of the Eurasian Network for Fire in Nature
Conservation (ENFNC). The following examples represent the main target systems for the application of prescribed fire:

- **Heathlands**: The composition and extent of Atlantic and continental heathlands (mainly dominated by *Calluna vulgaris*) has been shaped by grazing, cutting of heath, sod and turf layers and by burning throughout centuries. Burning is conducted in the United Kingdom (Davies et al., 2008; Scotland Government, 2008), to a lesser extent in Southern European countries such as Portugal and Italy (Ascoli et al., 2009), and predominantly in Central and Northern Europe, e.g. in Denmark (Jensen, 2004), the Netherlands (Vogels, 2009; Bobbink et al., 2009), Norway (Kvamme and Kaland, 2009) and Germany (e.g., Brunn, 2009; Mause, 2009; Goldammer et al., 2009). Endangered target species for habitat conservation burning include e.g. the Black Grouse (*Tetrao tetrix*) or game species such as Red Grouse (*Lagopus scoticus*).

- **Wetlands**: Maintenance of peat bogs, open fen mires, e.g. in Poland and Belarus, is practiced to maintain the habitat requirements of endangered plant and animal species, e.g. birds such as the Aquatic Warbler (*Acrocephalus paludicola*) or the Spotted Eagle (*Aquila clanga*) (Tanneberger et al., 2009). Moorlands in Germany that are threatened by succession are treated with prescribed fire in addition to other means such as waterlogging, tree cutting, mowing and mulching (Niemeyer, 2004).

- **Grasslands**: Similarly to the wetlands, xerothermic grasslands or *Molinia* meadows are hosting birdlife or plant species threatened by extinction, e.g. orchids, steppe grasslands plants or calcareous grasslands plants. Prescribed burning the Münsingen range in Southern Germany, a former military exercise and shooting range in which fires caused by the military had created and maintained openness for a century, is used for preserving the open habitats for endangered birds such as the Northern Wheatear (*Oenanthe oenanthe*) and the Woodlark (*Lullula arborea*).

- **Forests**: The use of prescribed fire in the restoration and maintenance of habitats of species dwelling in forests is pioneered by management in Finland and Sweden. Traditionally fire has been used in the boreal forests of the Nordic countries in order to improve growth and productivity of tree stands by removing the temperature-isolating raw humus layers or to facilitate natural forest regeneration (Viro, 1974; Mäkäräinen and Levula, 1996). Since the 1990s there are first experiments and currently extended application underway to use fire for creating forest stands under the pre-industrial conditions, i.e. more open stand structures, and to create habitats of endangered insect species (e.g. *Stephanopachys linearis* and *S. substratus; Aradus* spp.) and wood-decaying fungi as well as habitats for vascular plants (Rydkvist, 2009).

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138 [http://www.fire.uni-freiburg.de/programmes/natcon/natcon.htm](http://www.fire.uni-freiburg.de/programmes/natcon/natcon.htm). See also the special issue of UNECE/FAO International Forest Fire News at [http://www.fire.uni-freiburg.de/iffn/iffn_30/content30.htm](http://www.fire.uni-freiburg.de/iffn/iffn_30/content30.htm)
Danish postcard showing a fire set in Randbøl Hede – today Randbøl Hede Nature Reserve – in the early 20th Century. Source: GFMC archive.


Control of birch and pine succession (left) in Zschornoer Heide Nature Reserve (Brandenburg State, Germany) is controlled by prescribed fire (middle and right: prescribed burning in 2002). Photos: GFMC.

Post-fire views of prescribed burns in Zschornoer Heide Nature Reserve immediately after the burn (left) and two years after the fire. Photos: GFMC / E. Brunn.
3. Substitutional Fire Use

The use of fire as a tool to substitute or replace another form of vegetation treatment is referred to as substitutional fire use. In Central Europe there are abundant open vegetation types that were shaped by agriculture, grazing or other land use (e.g., extraction of biomass for harvesting domestic fuels, stable litter, thatching material, etc.). Some of these open land habitats have a high biodiversity or landscape conservation value. In the late 20th Century many sites threatened by succession have been maintained by mechanical (mowing, mulching, etc.) or prescribed grazing measures that were financed by public subsidies. However, increasing costs and financial constraints of public budgets on the one side, and a rapid increase of fallow on the other side during the last three decades, have prompted scientists and conservationists to replace costly mechanical and grazing measures by prescribed fire.

3.1 Fallow management on small-scale and extreme habitats

The problem of increasing fallow is not only restricted to former grazing lands. The abandonment of traditional land use is also affecting sites that have been utilized for hay production by mowing. In regions where the open grasslands have a high value for landscape aesthetics and tourism, major public subsidies have been used in the past to keep these lands open by mechanical means. However, besides the limitations due to increasing costs there are also limitations to use machinery on small-sized private property plots, on open lands on steep slopes or on sites intermixed with trees, e.g., high-conservation value xerothermic grasslands with interspersed trees. Long-term investigations in using fire to maintain openness on small-scale fallow plots in Southwest Germany were initiated and monitored since the mid-1970s (Schreiber, 2004).

Another example of using fire as a substitutional tool is practiced in the viticulture region of Southwest Germany. Traditionally the xerothermic slopes between vineyard terraces in Southwest Germany (Kaiserstuhl) were mowed by the landowners and the hay used to feed cattle. The mowing of the grass strata on the slopes was very labor intensive and could not be mechanized. Thus, with the socio-economic changes in the viticulture sector beginning in the 1950s the winegrowers abandoned the treatment of slope vegetation, which very rapidly responded by bush encroachment and succession towards tree stands – a development detrimental to the microclimate for wine growing and also not well perceived for landscape-aesthetic reasons by the local populations. Excessive use of fire to maintain openness during the 1960s did not observe the rules necessary to protect vulnerable flora and fauna, especially when burning was conducted large scale and at progressed development stages in springtime. A complete fire ban imposed by law in the 1970s resulted in progressing succession as a consequence of neglected maintenance of the xerothermic sites. Since the late 1990s a scientific research project elaborated a framework of a prescribed fire regime (Page and Goldammer, 2004) which is now replacing mechanical treatment and is practiced by ecologically sound small-sized burnings during the winter period in two counties of Southwest Germany (Rietze, 2008; Goldammer et al., 2009).
Prescribed fire is used to maintain openness of fallow slopes in the Kaiserstuhl viticulture region. Fire is now replacing traditional mowing (Southwest Germany). Photos: GFMC.

The targeted application of small-sized fires for creating mosaic- or edge-rich habitat structures is common in the management endangered bird species, e.g. Black Grouse (*Tetrao tetrix*) (cf. 2.2.3), capercaillie (*Tetrao urogallus*) and Hazel Grouse (*Tetrastes bonasia*). While capercaillie habitat management by fire has been proven successful in Scottish pine-heath forests (Bruce and Servant, 2004), similar approaches elsewhere in Europe were less successful. For instance, capercaillie populations increased in some sites of the Black Forest (Germany) that were disturbed by hurricane “Lothar” in 1999. Wind throws and wind falls, partially salvage-logged but with snags remaining, resulted in the formation of edge-rich habitat structures preferred by capercaillie. The populations began to disappear with the onset of regeneration of spruce (*Picea abies*) and the development of succession towards dense forest. Small-scale, mosaic-rich prescribed burning application was intended to

- control abundant regeneration of spruce (*Picea abies*) to maintain general openness
- create vegetation-free areas (mineral soil exposed) for food search / scratching
- maintain refuge areas (small groups of young stands and thickets)
- foster berry/shrub cover, particularly black berry (*Vaccinium myrtillus*), as a key source of nutrition
- foster softwoods
- foster structural diversity through a detention of the development of closed high forests in parts of the stands
- maintain tree stumps and snags as sitting places
- maintain appropriate trees as sleeping and singing places

However, in the long run these burnings could not be implemented on a regular basis because of the prevailing moist conditions on altitudes of around 1000 m a.s.l. of the Black Forest.
3.2 Landscape management

The Middle Rhine Valley (Germany) represents a typical example of the widespread conflict between a high nature conservation value of the cultural landscape on the one hand and the abandonment of traditional land use on the other hand. The Valley constitutes one of the largest coherent xerothermic areas of Germany with habitats and vegetation types that are classified as endangered at European level. The necessity for the development of management concepts to protect this landscape was emphasized by the inscription of the Upper Middle Rhine Valley in the UNESCO World Heritage List as a protected cultural landscape in 2002 (Bonn, 2004). In order to prevent further loss of the characteristic open habitats as a consequence of dramatic reduction of vine cultivation and other land use, a research and development project investigated the more or less uncontrolled (“semi-wild”), extensive grazing by horses and goats on the steep slopes, clearing the shrub-dominated shallow slopes with tank-tracks, and prescribed burning (Bonn et al., 2009). Prescribed burning was applied successfully during the experimental phase of the project, especially in the grass stage and earlier succession dominated by *Rubus* spp., but turned out to be limited as a tool for restoring overgrown xerothermic habitats on sites in progressed development stages dominated by *Prunus mahaleb* and *Cornus sanguinea* (Driessen et al., 2006).

The Middle Rhine cultural landscape with small-scale viticulture terraces is rapidly changing under fallow and succession. Combined grazing, mechanical and fire treatments are possible solutions for maintaining the aesthetic impressions of this unique cultural asset. Photos: S. Bonn and S. Bonn / GFMC Archive.

There are areas where the objectives of both nature conservation and landscape management are matching and prescribed fire is used for biodiversity management and maintenance of landscape aesthetics, mainly for recreational purpose. Nature conservation sites and nature parks (national parks) hosting *Calluna* heathlands are the most prominent examples of this dual use of fire, especially in Central Europe where these protected areas are important spots for national and regional tourism. The aesthetic impression of the old cultural landscape dominated by the colorful flowering of heath is a high attraction for visitors. A prominent example of such an area is the Lunenburg heath (Germany) with the Lunenburg Heath Nature Park (area: 1,130 square kilometres) and at its center the Lunenburg Heath Nature Reserve. As mentioned above, the composition and extent of Atlantic and continental heathlands (mainly dominated by *Calluna vulgaris*) historically has been shaped by grazing, cutting of heath, sod and turf layers and by burning throughout centuries. The use of fire for regeneration of over-aged heath, however, played a role as one of many disturbance agents and has now been restored successfully in Lunenburg heath (Keienburg and Prüter, 2006).
4. Waste Disposal

The use of fire in biomass waste disposal merits to be regarded separately. While all burning objectives mentioned previously are targeting for a removal or suppression of unwanted, competitive dead or live vegetation elements – either by combustion or by the impact of heat – the removal of unused dead biomass by burning in agriculture (e.g., stubble burning after harvest) and forestry (slash / harvest residual burning after timber harvest, notably on clearcuts) aims at facilitating the growing of the next crops or the regeneration or reforestation of forest stands.

Burning of stubble fields and other agricultural crop residuals in Europe has a long tradition, similar to other regions and continents, but is now largely banned by law since these burnings are a major source of wildfires and air pollution. In Eastern Europe and Central Asia, however, agricultural burning – despite its legal ban – is very widespread and constitutes one of the major areas worldwide that are burned annually (Korontzi et al., 2006).

Burning of forest slash – the unused materials left on site after timber harvest – is still practiced in Europe, although to a decreasing extent. In the Nordic countries the main aim is site preparation for regeneration, i.e. to improve accessibility of the site for planting, including the use of machinery. Two techniques are practiced: burning on piles and broadcast burning over a larger area, usually on clearcuts with or without seed trees (particularly in the Nordic countries). At the same time slash burning is also serving to improve site conditions by reducing the raw humus layers and, as a silvicultural tool, to facilitate the germination of natural regeneration. In Russia the use of broadcast slash burning is now practiced to decrease fire hazard on logged sites and promote natural regeneration (Valendik et al., 2000, 2001). Also prescribed burning was used to restore forests killed at large scale by insects (Valendik et al., 2006). In the Mediterranean countries, burning on piles is used for eliminating tree branches and other residues after tree clearing and thinning on fuel breaks.

The recent move towards more intensive use of renewable energy is calling for the use of forest slash for bioenergy production. At medium- to long-term perspective this may result in a reduction of open forest residual burning.

5. Wildfire Hazard Reduction Burning

In Europe the concept of using prescribed fire as a management tool to reduce the combustible materials on the surface inside of forest stands, and thus the energy potential and the risk of high-intensity and -severity wildfires, has a relatively short history. It was only after the pioneering work of U.S. scientists in the 1970s and the official recognition of the use of “fire by prescription” by the U.S. Forest Service in 1976 when Europeans formulated the first ideas to consider prescribed burning as a tool for wildfire hazard reduction and presented the first research. The Fire Ecology Symposia held at Freiburg University in 1977 and 1983 (Forstzoologisches Institut, 1978; Goldammer 1978, 1983) and a dedicated workshop in Avignon in 1988 (INRA, 1988) brought together a community that intended to investigate prescribed fire as a forest and fire management tool. First practical applications and increasingly sophisticated approaches in fundamental prescribed fire research were conducted in Southern and Central Europe starting in the late 1970s (e.g., Goldammer, 1979; Delabraze and Valette, 1983; Rego et al., 1983; Trabaud, 1983; Vega et al., 1983). The use of fire to reduce wildfire hazard in open lands, including brush lands, namely for the creation and maintenance of fuelbreaks, then entered practice in the Southern European countries Spain, France and Portugal (Valette et al., 1993). In the Mediterranean part of France, prescribed burning for hazard reduction has continuously been developed and consolidated along years (Rigolot, 2000; Lambert, 2008). Prescribed burning for fuel reduction inside forests was practiced first in Portugal in the 1980s (Rego et al., 1983; Fernandes and Botelho, 2004). Subsequently, in this country, its application became dormant until its recent revival in the frame of the EU Fire Paradox project.

None of the forest ecosystems in Southern and Central Europe, including the natural pine forests, are natural fire ecosystems. Thus, the introduction of prescribed fire for wildfire hazard reduction can be considered as an innovative tool, applicable only in forests with target species resilient or tolerant to low-severity surface fires, such as Pinus spp. or Quercus spp.. In some cases prescribed fire can be regarded as a substitution tool for replacing historic fuel reduction methods, e.g. the intensive use of biomass for domestic use, or silvopastoral forest use.
In the overall context of landscape ecology the use of prescribed fire on open (non-forest) lands may serve several objectives. On the one hand well-maintained open landscape fragments – either a heritage of the cultural history or strategically planned to reduce “fuel bridges” between fire-vulnerable forests or other ecosystem – allow better access, ease the control of wildfires and enhance safety for firefighting operations. On the other hand the open lands may serve as pasture or for conservation purposes.

Use of prescribed broadcast burning in a coniferous forest clearcut in Siberia (“dark taiga” – with main species *Abies sibirica*, *Picea obovata*, *Pinus sibirica*, *Betula pendula*, *Populus tremula*) east of Yenisey river (Yenisey Ridge), Bolshaya Murta leskhoz, in June 1997, for slash removal and stimulation of forest regeneration. Photo: Y. Kisilyakhov.

Prescribed burning inside of standing coniferous forests for wildfire hazard reduction is not yet practiced systematically in the region, although demonstrated occasionally such as here in a pine stand (*Pinus sylvestris*) in Southwest Germany in 2008. Its future application in the Western part of the Euro-Siberian region is probably less likely, whereas its application is strongly recommended in natural coniferous forests of the Central Asian region. Photos: GFMC.
The main objective of prescribed fire application in the Stormyran-Lommyran nature reserve (Sweden) is to restore open stand structures and provide habitats for fire-dependent and fire-adapted species, e.g. the insect species *Stephanopachys linearis* and *S. substriatu*, *Aradus* spp. Photo: T. Rydkvist.

Joint training of professionals and local villagers in the use of prescribed fire for wildfire hazard reduction in native mountain pine forests (*Pinus sylvestris*) in northern Mongolia. The hand-over of prescribed fire by scientists to the practitioners is a high priority issue aimed at reducing destructive wildfires. Photos: GFMC.
6. Limitations for Prescribed Burning: Contaminated Terrains

In some Eurasian countries high-value nature conservation sites are located on former military training areas or shooting ranges. In Germany many of these areas have been used by the military since more than 100 years, others were newly created and especially used during the Cold War. The total extent of sites in Germany contaminated by Unexploded Ordnance (UXO) is close to ca. 700,000 ha on active and former military training and combat theater sites, i.e. 2% of Germany’s land cover. Many of these military exercise areas were located on the territory of the former German Democratic Republic, used by the Soviet Army and the Warsaw Pact allies. The disturbances caused by military activities (e.g., mechanical impacts of direct shooting, fires started by shooting, mechanical impacts by tanks and other vehicles) have resulted in the creation and maintenance of valuable open ecosystems. With the closing of the exercise areas many vegetation types, notably the Calluna vulgaris heathlands, are becoming subjected to succession and development towards forests – a trend that is rather undesirable from the point of view of landscape and biodiversity conservation.

On these former military sites there are some obstacles for using prescribed fire as they are densely contaminated with UXO, which may explode during prescribed burning operations and also during wildfires. A new approach in the use of prescribed fire to maintain openness of UXO-contaminated terrain has been launched in 2009 in Brandenburg State in the nature conservation site „Heidehof-Golmberg“ in Teltow-Flaeming County, South of Berlin. This site is classified according to the “Fauna-Flora-Habitat Directive” (FFH) of the European Commission and belong to an overall area of ca. 70,000 ha of FFH lands in Brandenburg State that are endangered by succession and loss of open habitats. The new approach is going to use armored vehicles (former combat tanks converted to fire extinguishing vehicles) to secure personnel during ignition, control of the prescribed fire and mop-up). In future it is envisaged to use aerial incendiary ignition systems to start the prescribed fires from safe distance and over large areas simultaneously, and use Unmanned Aerial Vehicles (UAV) to monitor progress and safety (Goldammer, 2009; Goldammer et al., 2009). This first project of its kind reveals that prescribed burning operations under such circumstances are rather complex and costly.

Similarly there are problems on lands contaminated with UXO and land mines inherited from recent conflicts, e.g. the extended areas covered by land mines on the Balkans, notably in Croatia, Bosnia and Herzegovina and Serbia, totaling ca. 300,000 ha. Not all of these territories may be candidates for prescribed burning. In the context of wildfire prevention and control, however, the connectedness between contamination by explosives, must be kept in mind.
This refers also particularly to the terrains contaminated by radioactivity, notably in the impact zone of the fallout from the Chernobyl nuclear power plant failure in 1986. Territories most affected and contaminated by long-resident radionuclides of $^{238}\text{Pu}$, $^{239,240}\text{Pu}$, $^{137}\text{Cs}$ and $^{90}\text{Sr}$ are posing a potential threat to human health and security if lifted, redistributed and newly deposited after lifted by an extremely intense wildfire and dispersed by smoke. In the most affected territories of Ukraine, Belarus and Russia the application of low-intensity prescribed fire for wildfire reduction and biodiversity conservation may be feasible but is not yet acceptable under the current psycho-social settings (Goldammer and Zibtsev, 2009).

7. Conclusions and Recommendations

In evaluating the presentations discussed during the symposium the participants concluded that 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:

- 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 Polices

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 vegetation 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 project140 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 fire141

140 http://www.fireparadox.org/
141 see Agudo and Montiel (2009)
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

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 Southeastern 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:\footnote{http://www.fire.uni-freiburg.de/sevilla-2007/Conference-Statement-en.pdf}

- 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).
8. References


