Timo V. Heikkilä
Roy Grönqvist
Mike Jurvélius

Wildland Fire Management

Handbook for Trainers

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MINISTRY FOR FOREIGN AFFAIRS OF FINLAND
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Wildland Fire Management Handbook for Trainers

TIMO V. HEIKKILÄ, ROY GRÖNQVIST,
MIKE JURVÉLIUS

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Mike Jurvélius

Photographs
Mike Jurvélius
Roy Grönqvist
Timo V. Heikkilä

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FOREWORD

Fire is an important land management tool, but careless or criminal use of fire may have catastrophic impacts. Wildfire can be a major cause of ecosystem degradation and may result in loss of human life, economic devastation, social disruption and environmental deterioration. Each year, fires destroy millions of hectares of valuable timber, other forest products, and environmental services provided by forest ecosystems. However, in fire adapted ecosystems, managed fire plays a positive role in ecosystem health and vitality whilst in fire sensitive ecosystems, damage is incurred. In many ecosystems, good management practices help to reduce the extent and severity of unplanned fire. Countries benefit if they develop the capability to manage fire as an integral part of their approach to ecosystem management.

Globally more than 350 million ha were burned in 2000 of which 95 percent were caused by people. The continued expansion of agriculture and other forms of land conversion activities in developing countries; the increased use of wildlands for recreational purposes and tourism in both developed and developing countries; are among the factors that are contributing to the increasing incidence and impacts of wildland fire. In 2005 an estimated 230 million hectares of forest, savannah and grasslands were burned south of the equator in Africa. Many fires were intentionally set to clear land for agriculture, and many of these fires burnt much larger areas than were originally intended.

It is not possible to state conclusively that there is a long-term upward trend in fire at the global level, since historical data are available for only a small minority of countries, however, an increasing number of national and local governments are elevating fire as a priority, requiring increased policy attention and increased allocation of resources.

The FTP-21 Handbook on Forest Fire Control, A guide for Trainers was first produced by the Finnish National Board of Education in 1993 to train people in the developing countries in fire detection and suppression; as was the global priority at the time. Since then, the Voluntary Guidelines for Fire Management highlights that the risk, frequency, intensity and impacts from wildfire can be reduced through more holistic approaches to fire management that include monitoring, early warning, fire prevention, fire preparedness, fire suppression and restoration following fire events. Sound policy, legal, regulatory and planning frameworks need to be supported by mechanisms to ensure compliance, including law enforcement. However, equally as important is the adoption of community based fire management approaches and public awareness raising programmes that improve knowledge of fire impacts (positive and negative) on food security and rural livelihoods, including linkages and conflicts between uses of fire in the forestry-agriculture and wildland-urban interfaces.

Many countries are adopting fire strategies that address the root causes, prevention and preparedness for fire that are proving more cost effective than investments in fire suppression technologies and resources, which are often only used during a few months each year.

The majority of todayís wild fires stems from fire uses outside the forest ecosystems. The sustainable management of forest ecosystems requires the participation of the local population in landscape level management of wildland fire, adjacent to these areas. Where people have a direct interest in protecting their natural resources, haphazard or unplanned wildfire started by people is significantly reduced. Successful fire management produces direct benefits to local communities. Only when local communities understand that they will benefit from protecting their natural resources will they be mobilized to prevent fires.

Fire management requires that trainers and instructors, including at community level, be trained to facilitate the new holistic approaches in fire management, including ecology and local communities. Also land-use authorities and managers around the world, need to be educated in principles of ecological fire management.

The Finnish Ministry of Foreign Affairs (MFA) have supported implementation of the Voluntary Guidelines for Fire Management by financing review of the Handbook on Forest Fire Control, A Guide for Trainers, to incorporate the more holistic approaches. This new *Handbook on Wildland Fire Management, for Trainers,* will target field trainers/instructors, and thus complement the other recent Wildland Fire Management Handbooks; for Sub-Sahara Africa (2004), for North-East Asia (2006) in Russian, produced by the UNISDR and the Global Fire Monitoring Center (GFMC).

Since 2002 the UNISDR Regional Wildland Fire Networks facilitates regional and global dialogue and facilitates transfer of knowledge and technology. It is proposed that each country will analyze its fire situation, develop a strategy for preventing and managing wildland fire and assess the risks and impact on forest ecosystems. As many countries lack the capacity and capability to implement an effective programme, the Voluntary Guidelines for Fire Management, supported by this Wildland Fire Management Handbook for Trainers, will form the bases for a programme of institution strengthening and capacity building in fire management, particularly in developing countries. It is hoped that Governments and other stakeholders will embrace the approaches outlined in this handbook and the fire management code and commit the resources to implementation of the principles and practices necessary for effective fire management.

Helsinki, January 2007

Mike Jurvélius

THE SAN DIEGO DECLARATION ON CLIMATE CHANGE AND FIRE MANAGEMENT

WAS PRESENTED AT THE THIRD INTERNATIONAL FIRE ECOLOGY AND MANAGEMENT CONGRESS 1. BY THE ASSOCIATION FOR FIRE ECOLOGY, NOVEMBER, 2006[1].

PREAMBLE

As scientists and land managers who focus on fire and its effects on natural ecosystems, we recognize that climate plays a central role in shaping fire regimes over long time scales and in generating short-term weather that drives fire events. The science surrounding human-caused climate change continues to strengthen and the weather patterns that shape the ecosystems where we live and work may be altered dramatically over the coming decades. In anticipation of such changes it is important to consider how fire management strategies may enable us to respond to a changing global climate and thereby reduce potential disruptions to plant communities, fire regimes and, ultimately, ecosystem processes and services.

Currently, we are observing serious wildland fire conditions, such as increasing numbers of large and severe wildfires, lengthened wildfire seasons, increased area burned, and increasing numbers of large wildfires in fire-sensitive ecosystems (*e.g.* tropical rain forests and arid deserts). Recent research suggests that these trends are, in part, related to shifts in climate.

As temperatures increase, fire will become the primary agent of vegetation change and habitat conversion in many natural ecosystems. For example, temperate dry forests could be converted to grasslands or moist tropical forests could be converted to dry woodlands. Following uncharacteristic high-severity fires, seedling reestablishment could be hindered by new and unsuitable climates. Plant and animal species already vulnerable due to human activities may be put at greater risk of extinction as their traditional habitats become irreversibly modified by severe fire. Streams and fisheries could be impacted by changing climates and fire regimes with earlier peak flows, lower summer flows, and warmer water even if ecosystems don't burn. Finally, extreme wildfire events and a lengthened fire season may greatly increase the risk to human lives and infrastructures, particularly within the wildland urban interface.

We acknowledge that there are uncertainties in projecting local impacts of climate change, however, without taking action to manage fire-dependent ecosystems today and in the absence of thoughtful preparation and planning for the future, wildland fires are likely to become increasingly difficult to manage.

We, the members of the Association for Fire Ecology that endorsed this document at the Third International Fire Ecology and Management Congress, support the following considerations for planning and management to enhance ecosystem resiliency to wildland fire in a changing global climate.

[1] This declaration represents the position of the Association for Fire Ecology and other signatories and may not represent the position of other organisations or agencies sponsoring the Congres.

Background

1. Both fire and climate regimes interact with other natural processes to direct the formation of vegetation in ecosystems. Given that climate and fire regimes are linked through vegetation, changes in climate can lead to large or small changes in fire regimes. Climate and fire regimes are also directly connected through the climate drivers of ignitions and fire weather. Climate influences both where and how vegetation grows and thereby creates the fuel conditions that drive fire frequency, intensity, severity, and seasonality. Precipitation and temperature patterns regulate the accumulation of fuels. In some ecosystems, wet years may promote ”boom” vegetative (fuels) conditions, while drought years promote ”bust” and the burning of the ”boom” vegetation. Further, we know that the inevitable dry years, particularly when warm, are associated with larger fires, both in size and number, especially where fuel is abundant. Fire can also contribute to the problem of increasing green house gas emissions because it is a source of CO2 and particulate emissions, which may affect local and regional air quality and worldwide climate.

2. Historical fire regimes have been disrupted in many ecosystems. Factors such as human activities and land development, loss of indigenous burning practices, and fire suppression have all led to changes in some plant communities historically shaped by particular fire regimes. Human activities have significantly increased the number of ignitions in many temperate, boreal, and tropical regions. Fuel loads have increased in some temperate forests where low intensity fires were historically the norm. In some rangelands, shrubs have been replaced by annual grasses or colonizing trees. Human caused burning has increased fire frequency in some tropical regions where fire-sensitive ecosystems dominate.

It should be noted that not all vegetation types in have been significantly altered by fire suppression. Many shrubland ecosystems, such as California chaparral, burn with high severity under extreme weather conditions and fire management in the 20th and 21st centuries has not appreciably changed their burning patterns. Coastal, mesic coniferous forests in the Northwestern US have not been modified to a great extent by fire suppression policies because fire rotations in this area are much longer than the period of fire suppression. In other forests such as Rocky Mountain lodgepole pine, high severity fires every 100-300 years are ecologically appropriate and fire suppression has probably not affected these ecosystems to a great extent. The ecosystems most impacted by fire suppression are forests that once experienced regimes of frequent, low-moderate intensity fires; these ecosystems are probably the most vulnerable to altered fire regimes from changing climates.

Approaches to restore fire-adapted ecosystems often require treatment or removal of excess fuels (*e.g.* through mechanical thinning, prescribed fire, or mechanical - fire combinations), reducing tree densities in uncharacteristically crowded forests, and application of fire to promote the growth of native plants and reestablish desired vegetation and fuel conditions. Excess fuels are those that support higher intensity and severity fires than those under which the particular ecosystem evolved or are desired to meet management objectives. For example, in dry western US forests that once burned frequently, a high density of trees and a large surface fuel load often promotes crown fires that burn over very large areas. Some of these same forests once flourished under a fire regime where frequent, non-lethal low-intensity surface fires were the norm, and large-scale crown fires were rare. Managers should determine if forests can be restored to what they once were or if another desired

condition is more appropriate. If it is not appropriate to restore ecosystems to a previous condition because of expected novel climate conditions, then managers should develop new conservation and management strategies and tactics aimed at mitigating and minimizing uncharacteristic fire behavior and effects.

3. Climate change may interact with other human activities to further change fire regimes. For example, in much of the western US, since the 1980s, large fires have become more common than they were earlier in the century. This has often been attributed to increased fuel loads as a result of fire exclusion. However, a number of research studies suggest that climate change is also playing a significant role in some regions, elevations, and ecosystem types. In the western US, researchers recently identified an increase in fire season duration in mid-elevational forests. These changes were correlated with earlier spring snowmelt dates. With global temperatures projected to rise throughout this century, increases in fire season length and fire size can be expected to continue.

4. Climate change can lead to rapid and continuous changes that disrupt natural processes and plant communities. Are managers safe in assuming that tomorrow's climate will mimic that of the last several decades? Increased temperatures are projected to lead to broad-scale alteration of storm tracks, thereby changing precipitation patterns. Historical data show that such changes in past millennia were often accompanied by disruption of fire regimes with major migration and reorganization of vegetation at regional and continental scales. Exercises in modeling of possible ecological responses have illustrated the potential complex responses of fire regimes and vegetative communities. These exercises indicate that dramatic changes in fire regimes and other natural disturbance processes are likely. Indeed, some believe that the impacts of climate change may already be emerging as documented in widespread insect infestations and tree die-offs across some areas in the western US and British Columbia, and more rapid and earlier melting of snow packs. Developing both short- and long-term fire and fuels management responses that improve the resilience of appropriate ecosystems while reducing undesired impacts to society will be critical.

5. Changes in climate may limit the ability to manage wildland fire and apply prescribed fire across the landscape. Under future drought and high temperature scenarios, fires may become larger more quickly and could be more difficult to manage. Fire suppression costs may continue to increase, with decreasing effectiveness under extreme fire weather and fuel conditions. In some temperate and boreal regions, it is expected that more acres will burn and at higher severities than historically observed. In humid tropical regions exposed to severe droughts, vast forests could burn making it difficult for forest managers to prevent farmers from entering destroyed forests and establishing new farms. Globally, new fire regimes would be associated with shifts in ecosystem structure and function and likely, changes in biodiversity.

6. Approaches to fire management that recognize the potential for greater variability and directional change in future climates may help to reduce ecological and societal vulnerability to changing fire regimes. Such approaches are likely to improve fire management and ecosystem health. A goal could be to reduce the vulnerability, both ecologically and socially, to the uncertainties that accompany a changing climate. For example, if managers restore some forests as a means to increase ecosystem resiliency to climate change, they will also be improving biodiversity and protecting important forest resources. In the humid tropics, if managers make a concerted effort to prevent fire from entering rain forests during drought years, then they would be reducing the risk of future fires and illegal logging, even if droughts did not become more frequent and severe with a changing climate.

Considerations for Management, Research, and Education

Recent changes in climate and fire patterns have been observed in many areas of the world, and current projections are that ongoing and long-term changes are likely. We believe that the actions outlined below could help managers to be better prepared to anticipate and mitigate potential negative effects of variable and changing future environments.

Fire and Ecosystem Management

- Incorporate the likelihood of more severe fire weather, lengthened wildfire seasons, and larger-sized fires in some ecosystems when planning and allocating budgets, which traditionally are based on historical fire occurrence.
- Make use of both short-term fire weather products AND season-to-season and year-to-year climate and fire outlooks that are increasingly available from ”predictive services” groups in federal agencies, and particularly the sub-regional variations in anticipated fire hazards that enable strategic allocation of fire fighting and fire use resources nationally.
- Continually assess current land management assumptions against the changing reality of future climates and local weather events.
- Develop site-specific scenarios for potential weather events linked to climate change and redesign fire management strategies to make room for rapid response to these events.
- Consider climate change and variability when developing long-range wildland fire and land management plans and strategies across all ownerships.
- Consider probable alternate climate scenarios when planning post-fire vegetation management, particularly when reseeding and planting.

Fuels Management

- Prepare for extreme fire events by restoring some ecosystems and reducing uncharacteristic fuel levels through expanded programs of prescribed burning, mechanical treatments, and wildland fire use to meet resource objectives. Burning under the relatively mild weather conditions of a prescribed fire produces lower intensity burns and, generally, less carbon emissions than would a fire burning under wildfire conditions. Burning and thinning treatments should be strategically placed on the landscape in locations where they are more likely to influence fire spread. Some ecosystems will continue to burn in high severity stand replacement fires and this is appropriate for their sustainability.
- Incorporate emerging scientific information on the impact of changing temperature and precipitation on plant communities into fuels management project design and implementation at the local level.
- Expand wildland fire use at the landscape scale in fire-adapted ecosystems to restore fire regimes and reduce fuel loads. Be more aggressive in promoting fire use during lower hazard fire seasons, and fire use in landscapes that offer particular opportunities for relatively low-risk, large-scale burning. This will allow more acres to be burned under less extreme fire weather conditions than fires that might occur in the future under extreme heat or drought conditions.
- Control highly flammable non-native plant species and develop management options to address their increased spread and persistence. In some ecosystems appropriately timed prescribed fires can be used to reduce non-native species, while in others, continued fire exclusion may be the best management strategy. In some areas, reseeding and active restoration may be the best option.
- In some cases the removal and use of small diameter forest products (engineered lumber, pulp and paper, biofuels) and chipped fuels (for electrical energy generation) could be used to reduce fire hazards in appropriate vegetation types. Burning excess fuels in a co-generation plant has the additional advantage of producing lower emissions when compared to prescribed fires.

Research, Education, and Outreach

- Implement long-term biodiversity and fuels monitoring programs in the fire-adapted ecosystems that are expected to undergo the widest range of change and variability linked to climate change, such as those that once experienced frequent, low-moderate intensity fire regimes.
- Expand inter-disciplinary research to forecast potential fire season severity and improve seasonal weather forecasts under future climate change scenarios.
- Integrate the subject of climate change and its influence on ecosystem disturbance into curricula within natural resource management programs at the university and continuing education levels, and in science programs within primary schools.
- Disseminate information to the general public and government agencies regarding the potential impacts of changing climate on local natural resources and disturbance regimes, particularly those that interact with fire.

- Hold conferences or symposia to enhance communication among researchers and managers and to engage the general public in discussion on how best to adapt public land management to cope with fire in a changing environment.
- Form inter-disciplinary teams of researchers that include fire ecologists and climate scientists to identify and pursue emerging areas of climate and fire research.

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Development Policy Information Unit

Street address: Kanavakatu 4 a, 00160 Helsinki
Postal address: Box 176, 00161 Helsinki
Telephone: + 358 9 1605 6370
Telefax: + 358 9 1605 6375
Exchange: + 358 9 16005
E-mail:keoinfo@formin.fi
Internet: http://global.finland.fi

MINISTRY FOR FOREIGN
AFFAIRS OF FINLAND