SURE

SUstaining and Enhancing REsilience of European Forests

Pro-active wildfire management workshop

Background document

Date: 31/07/2019

Version: 1.0 - Draft

EFI

Federal Ministry of Food and Agriculture

This following document is an output from the SURE project, which is managed by the European Forest Institute (EFI) Resilience Programme in Bonn and supported and funded by the German Federal Ministry for Food and Agriculture (BMEL).

In a Nutshell:
Integrated Fire Management for Europe

Status Quo

- Current focus on fire suppression not enough to safeguard our ecosystems and societies
- Poor forest and vegetation management creates fire-prone landscapes
- Lack of awareness and action-taking by authorities and public → no adequate resources, no adapted communities, no resilient landscapes

So What?

- Uncontrollable fires pose a huge threat to ecosystems, economy and human lives
- Wildfires can contribute to climate change by 1) changing the ecosystem and releasing massive amounts of carbon to the atmosphere 2) limiting the potential for bioeconomy
- Climate change scenarios predict an increase in fire weather→ causing more fires in the future in more countries

Solutions

- Create landscape-level fire strategies by involving all actors (authorities, fire service, landowners), provide positive attitude, leadership and budget
- Evaluate legislation to remove implementation obstacles
- Raising awareness through campaigns for the general public, authorities, fire services and landowners
- Building capacity for fire services and landowners through training and exchanges

Benefits

- Fire resilient landscapes and communities
- Pro-active and preventive measures increase response efficiency
- Better informed society
- Increased fire-fighters safety
- Sustainable forestry and related ecosystem services available for circular bioeconomy

European forests and wildfires –the Pro-active Wildfire Management Workshop

The occurrence of wildfire has become a common sight in the Mediterranean region. These new fire regimes have led not only to the loss of millions of hectares of forests and billions of euros but to the tragic losses of hundreds of human lives. Further, the intensity and number of fires in the "traditional" fire countries have continued to increase. A new development is the occurrence of wildfires also in countries that were so far either not or only affected to a minor extent. Examples are Sweden, Ireland and Germany. These countries are often overwhelmed by these events.

However, the focus in addressing wildfires is mainly on fire suppression. That, however, will not be enough to safeguard our forest ecosystems and societies. We need to move towards more integrated fire management approaches at European level. Many experts agree on that and promote to more pro-active fire management, where fuel loads are actively managed and fire strategies planned across landscapes. The benefits of such pro-active wildfire management are numerous: more controlled fires, improved human health, and the decrease of economic loss, to name a few.

A variety of solutions have also been proposed and proved useful in wildfire management, e.g. prescribed burning or well-timed forest management. Practical implementation of these approaches is, however, facing hardships. There is no, or only little, communication and cooperation between different authorities participating in landscape planning and fire management, public opposition, a lack of funds and leadership and sometimes even legal restrictions that prevent some pro-active fire management methods. Under such conditions it is at the least very challenging if not downright impossible.

In SURE, we believe in working together with the practitioners, scientists and policy makers to identify barriers and gaps on the implementation of a more pro-active wildfire management. Bringing all three groups together will enable a constructive dialogue and understanding on how to move towards more pro-active fire management. This upcoming workshop is regarded as one step to support this process.

This document provides an overview of the current scientific knowledge on wildfire management and on tools that are already available to practitioners. It serves as background material and input to the forthcoming workshop in Cardiff and aims to focus on the existing obstacles and hindrances in applying existing fire management tools and to assess what are the needs in order to achieve empowerment (i.e. permits for transcribed burning programmes).

The reality of European fires

Wildfires have been a critical topic in Europe during the past decades and especially in recent years. Not only due to their increased occurrence across the continent but also due to their high magnitude. Large, uncontrollable fires are becoming the normality, and from Portugal in 2017 to Sweden and Greece in 2018, many countries suffer yearly from wildfire events that cost millions of euros in natural, social and infrastructural damages.

During the time between 2000-2017, the impact of forest fires in the European Union has been assessed in terms of environmental, human and economic losses. According to the European Forest Fire Information System (EFFIS), approximately 480 000 ha have burned per year, accounting to a total of 8.5 million ha of forested land. 611 firefighters and civilians have tragically lost their lives during those 17 years, while the economic impact amounted to more than EUR 54 billion or an estimated EUR 3 billion per year. Following the current pace of economic growth and environmental degradation, the European Commission PESETA II project indicated that the economic impact of forest fires for Greece, Spain, France, Italy and Portugal may increase to over EUR 5 billion per year by 2070-2100.

In fact, as of April 2019, the burned area in ha over Europe had already reached a total of 2018 (EFFIS). By the 26th of August 2019 nearly 290,000ha have been burned in Europe (EFFIS 2019). This figure is still under-representing the total burned area, as fires smaller than 30 ha are not mapped by EFFIS. 1746 fires were registered by the EFFIS of a magnitude of 30ha or more.

As we observe an increasing number of fires during last years' fire seasons, fire prevention is more often referred to as a top priority in local and international agendas (Forest Europe, 2010; European Commission, 2018). Due to these emerging insights discussions on effective preventive measures (forest management schemes), improved preparedness and corresponding action plans are imperative.

What do we know about wildfires?

Fire regimes have changed in Europe over the last decades. The magnitude of fires has been increasing, and the occurrence of big "megafires" is more common, especially in the Mediterranean region. However, wildfires are also spreading from south to north across the continent to regions, where the culture of fire is less known, e.g. Germany, Poland and Sweden. There are several reasons that contribute to these changes and patterns in the European fire regime:

- **Climate change** is creating unpredictable weather events that might alter the fire regime of a given ecosystem. Hotter and drier weather causes the vegetation to be more susceptible to fire and ignitions due to high flammability levels. Fire disturbances might also serve as vegetation renovation processes in non-fire prone areas – leading the path to new species.
- **Fire-history of the landscape** explains how prepared the society is and how much fuel there is to burn if these systems were stable. However, we cannot assume to manage landscape like in the last century.
- **Rural abandonment** causes forest expansion due to lack of land use and management.
- **Poorly adapted forest management** towards wildfires can lead to an increase in fuel loads and fuel continuity. This situation may impact the number and size of fires as it will be difficult to prevent human-caused ignitions. This can only be reached by better education and awareness of societies.Together these factors explain to some degree the changes in the European fire regimes and are entry points to tackle the wildfire management problems.

Wildfire characterization

Any fire will need fuel, oxygen and an ignition source. Wildfires occur when there is suitable fire weather (dry and hot), an ignition source and enough of flammable fuel available (see e.g. this online course from the National Fire Prevention Association).

Once the wildfire is burning, its intensity is affected by wind, slope, aspect and the amount of available fuel. When these three factors are aligned, the fire has its maximum intensity. However, the factors are not aligned uniformly across the burning area. For example, if the head of the fire is aligned with wind, the flanks and heel of the fire will not be aligned. This variation creates a fire signature, from where the fire behavior can be seen. The signatures can also be used to predict future fire behavior. Finally, a trigger point is a place on the terrain where a change in the alignment of forces will change the fire behaviour, creating either opportunity or danger. Trigger points are a time and/or place where the tactic or placement of resources needs to be changed to assure firefighter safety. (Campbell and Schubert, 2009)

On a landscape scale, nothing can be done in fire management to influence fire weather or to remove the available oxygen or the shape of the terrain. And while it is possible to reduce the human-caused ignitions via awareness-raising and education, it is unlikely that they can be eliminated. Furthermore, there will always be natural ignitions e.g. by lightning. The only factor that can efficiently be modified is the type and amount of fuel in the landscapes. The magnitude of fires is directly related to the amount of available fuel.

Considerations for wildfire management

In the case of wildfires, prevention is usually much more cost-effective than suppression (Forest Europe, 2010). The focus should thus shift away from focusing too much on suppression to more integrated fire management (EC, 2018), which gives more attention to preventive measures e.g. through fire-adapted forest management and takes applies effective approaches to prepare for future wildfires.

There are several approaches to wildfire prevention. A ground rule for successful prevention is clearly defined roles and responsibilities of local communities (Forest Europe, 2010).
On a rather technical level there are numerous options of which a few are listed:

- constructing fire- and fuel breaks by either removing the entire vegetation or significantly reducing the fuel load
- performing fuel treatments along the roadsides to reduce fire spread but also to reduce ignitions from the roadside
- performing prescribed burning to reduce fuel amounts on landscape level
- use of grazing in the landscape are efficient ways to prevent high-intensity fires (Xanthopoulos et al., 2006).

Fuel types also affect fire behavior as not all fuel will burn in the same way. By creating a mosaic of different fuel types and loads, fire behavior and spread can be influenced. This will result in heterogeneous fire effects and more fire-resilient landscapes (Fernandes et al. 2013). In the long term, efficient fire prevention needs further research and on-site experiences, a profitable forest product supply chain, and coherent policies on a landscape level (see e.g. this video by the European Forest Institute)

Fire research themes – Research into practice?

There are several project lines focusing on fire research at the European level. The European Commission (EC) identified five major research themes in its 2018 report on "*Forest Fires: Sparking fire-smart policies in the EU"* (Figure 1). the majority of research-driven projects give attention to **fuel management** (prevention) and **technological tools** (suppression). However, research does not necessarily set out their project aims to result in practice applications fuel management measures are still seen as one central point in wildfire management agendas. Nevertheless, funding continues to go mainly to fire suppression (Forest Europe, 2010).

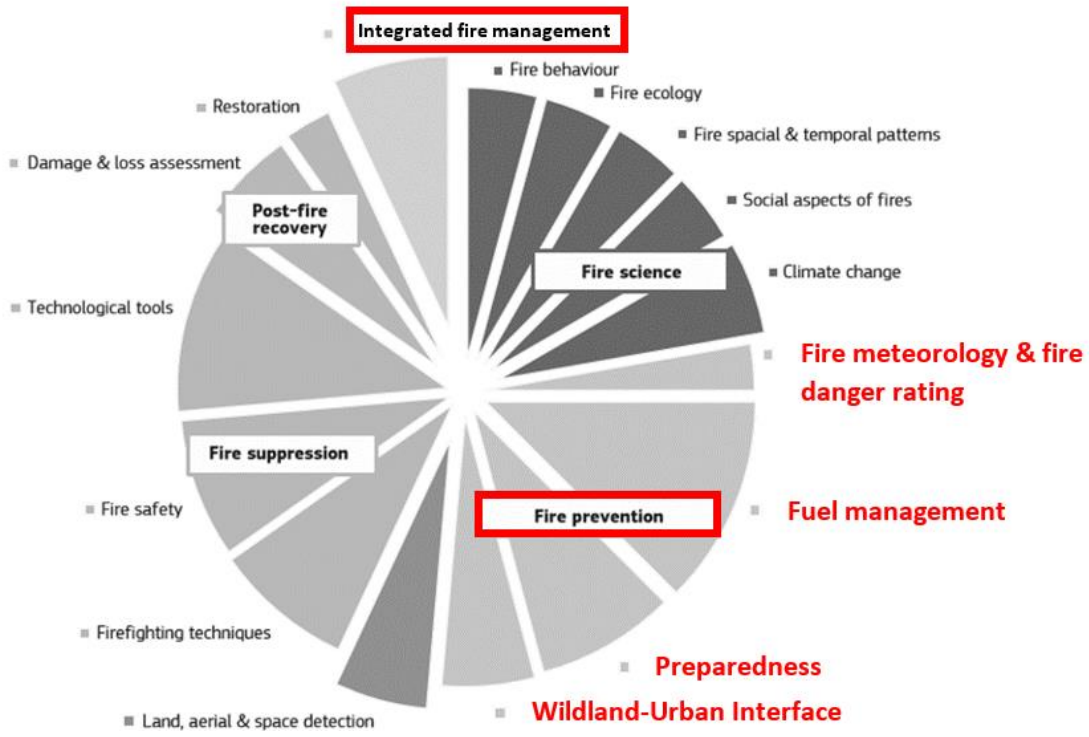

Figure 1*. Relative occurrence of forest fire research themes covered by EU-funded projects under review by the European Commission. Fire prevention and integrated fire management programmes still need to gain momentum at the wildfire management agendas. Modified from European Commission 2018.*

A more detailed overview of the different projects identified in the EC report can be found in the report "*Forest Fires: Sparking fire-smart policies in the EU".* Many of those projects were financed by Horizon 2020 or LIFE programmes. The *Pro-active wildfire management workshop* aims at creating an open space as a first step to foster knowledge transfer among practitioners and experts. Thus, the EC report is highly relevant. It is now imperative to move such knowledge to the implementation process while identifying good practice examples. Thus, sharing of any a-priori ideas is both encouraged and welcomed. Also, ideas on which financial tools could also be used to propose projects that coherently compile information on the different wildfire management schemes and actions at the European level is a target of the workshop.

One of the upcoming EU projects on fire research is the so-called Pyrolife Innovative Training Network funded by the Marie-Curie Action within the Horizon2020 programme. It is a pan-European education project based on an integrated PhD programme for 15 future fire experts, involving a consortium of

10 European universities and institutes and a total of 21 international partners that include governments, fire services, business and non-profit agencies. Pyrolife will act as a knowledge transfer across different countries and disciplines and hopefully also between science and practice.

How can we pro-actively manage fire?

Pro-active wildfire management requires practices, tools and programmes **readily available and effectively functioning** at the different phases of crisis management: prevention, preparedness, response and recovery. This involves a coordinated and harmonized planning at the landscape level, including education programmes on Pan-European level, assessment of fire risk and the development of an action plan for wildfire management. An integrated fire management approach will look like:

First and foremost, a clear and shared Vision and Strategy of all affected and mandated stakeholders is needed:

resilient landscapes – adapted communities –adequate response

This vision is providing overall direction and defines specific objectives:

- Avoid Catastrophic Fires
- Reduce Unwanted Fires and their negative effects
- Use Positive Fire Effects
- Increase Fire-Fighter Safety (!) and fire-fighting efficiency

Then, to implement this vision and objectives, there is need for respective fire management plans with elements, like:

- Early Warning and Rapid Detection
- Good Access
- Well trained and equipped fire services
- Community awareness
- **Leadership**
- **Reduction of Fuel Load and Fuel Availability**
- **Forest Conversion towards resilient structures, i.e. “Continuous Cover Forestry”**

European examples

Currently, there are several programmes in Europe providing valuable information and support to wildfire professionals. However, the focus is mainly on theoretical/scientific knowledge exchange and suppression efforts rather than on preventive and practical measures that tackle the core of wildfires in new regions as well as the more frequently occurring fire disasters. Transferring knowledge into

action often requires jumping over obstacles that block the ultimate goal of successful **landscape management for disaster risk reduction** (e.g. policies, budget allocation, permits, social discomfort). Thus, a **holistic approach** is further encouraged.

Overseas examples

The US National Cohesive Wildland Fire Management Strategy is a collaborative effort among different stakeholders and landscapes to work towards resilient landscapes, fire-adapted communities and safe and effective wildfire response in the US. It fosters interagency cooperation and tackles four main challenges: (1) managing vegetation and fuels; (2) protecting homes, communities, and other values at stake; (3) managing human-caused ignitions; and (4) effectively and efficiently responding to wildfire. The strategy is backed up by the National Action Plan to support its implementation.

Where can I learn more?

Terminology and further reading

Vegetation fires / wildfires constitute a serious and increasing threat throughout Europe, particularly in Greece, Spain, France, Italy and Portugal. Despite a decreasing trend in the number of fires and areas burned, observed in some countries since the 1980s, larger and more damaging fires are challenging the suppression capacities of many wildfire protection programmes across Europe. This trend is the result of unbalanced policies that can be effective in fire suppression in normal weather conditions but are insufficient to prevent extreme events. More and more countries outside the Mediterranean region are facing a wildfire challenge. Countries like the UK, Germany, the Netherlands, Sweden, Norway, etc. have to adapt to the “new normal”.

The analysis of the knowledge, methodologies and technologies produced in the last two decades opens up new perspectives for enhanced fire risk management in the face of climate and environmental changes, social and cultural trends and growth dynamics. Based on the findings of the research and innovation projects and the conclusions of multi-stakeholder workshops and consultations, key recommendations have emerged intending to adapt policies and management to face the new challenges:

https://resilience-blog.com/2019/02/28/sparking-firesmart-policies-in-the-eu-lets-train-together/

Integrated fire management - A concept for planning and operational systems that include social, economic, cultural and ecological evaluations with the objective of minimizing the damage and maximizing the benefits of fire. These systems include a combination of prevention and suppression strategies and techniques that integrate the use of technical fires and regulate traditional burning. Forest fire is a natural hazard that becomes semi-natural as far as most fire incidences are caused by human activities, in Europe and elsewhere. Forest fires are complex phenomena involving land use and related policies such as the EU CAP, urban planning in the vicinity of forests, climate and weather conditions, and human activities, cultural traditions. Therefore, the problem has multiple interacting drivers and aspects, beyond just considering ignitions and firefighting issues. The social and economic changes that result in increased fuel build-up and the increased frequency of extreme weather

conditions require a full understanding of the problem and the use of integrated solutions. Wildfires have become a structural problem in the EUMed countries and would probably expand to other EU regions in the near future. To live with fire in the long-term requires mastering fire hazard within safe boundary conditions, addressing the multiple involved factors in a proactive way. Management of forest in risky areas demands a multipurpose strategy that weights appropriately the competing demands of forest uses with the consequent risks they imply. These holistic solutions have to be found using experiences and knowledge from various partners and they may include many diverse components as the use of fire in reducing fuel loads or the use of biomass for energy. The search of these more efficient and integrated solutions therefore requires more cooperation, coordination and integration of research.

Fire Ecology Challenges - In fire driven areas, ecosystems possess structural and functional characteristics that were selected over time, and that allow them to cope with fires. Understanding how ecosystems respond to fire is important for managing them in a context where fires are prevalent. However, fire regimes are not stable nowadays in southern Europe, due to changes in land-use, human pressures and climate, among other drivers. Understanding how ecosystems will respond to changes in fire regime (e.g., increased fire frequency, severity, timing) and climate (e.g., increased temperature and decreased rainfall), or past land-use history and management is critical for assessing their vulnerability and capacity to provide their services.

In the short term, changes in fire drivers and regime can elicit variations in species composition, structure and functioning, which may further interact with fire drivers to further affect fire regimes. Understanding ecosystem's vulnerability and potential to adapt to such changes can help developing proactive prevention and post-fire regeneration strategies.

Effective forest **fire management and decision-making** requires science-based information:

- New wildfire context calls for better prevention and preparedness
- Firefighting and rescue services need better coordination and competence
- Learning how to live in fire-prone areas requires adequate governance
- Landscapes and communities need to become more resilient to forest fires

Reinforce the **disaster response** capacity by:

- Improve coordination and coherence between EU and national policies
- Support proactive prevention operations
- Integrate fire management with sustainable forest management
- Improve fire preparedness through participative, multilevel governance

Fire behaviour - The way a fire reacts to the variables of fuel, weather, and topography, including variables as rate of spread and intensity.

Fire regime - The pattern of fire occurrence, fire frequency, fire seasons, fire size, fire intensity, and fire type that is characteristic of a particular geographical area and/or vegetation type. Forest fires vary in their occurrence throughout the year, and from year to year. A number of parameters characterize fires in a region; these include fire frequency, fire size distribution, fire seasonality, fire type and fire severity, among other. Trends over time in any of these can occur due to several drivers that may also change with time. Having good fire statistics is essential to analyse trends over time and determine the underlying causes. Additionally, fires do not affect equally all areas in a landscape while new areas are becoming fire-prone. Precise fire mapping is necessary to understand the role of driving factors like climate or other land-based features. Moreover, the dynamic nature of the landscape, owing among other to the effect of disturbances such as fire or land management, can affect both spatial and temporal fire patterns. Management actions and deployment of resources to deter fires are based on where and how fires occur. Understanding how fires vary in space and time is important for assessing the risk of fire and for evaluating the effects of past policies and management decisions on fire activity. Understanding what makes an area to be particularly prone to burn or not only important for conserving its values and resources but also for preventing that future management actions, particularly in areas were fires accumulate, do not result in increased vulnerability to wildfires.

Fuel management - The practice of controlling the accumulation and flammability of forest fuels through mechanical, chemical, biological or other means (e.g. prescribed fire) in support of land management objectives. Fuel management is critical to reduce the probability of ignitions and fire propagation. The increasing trend in fuel load and continuity in southern Europe over the last century can be attributed to land abandonment, inadequate landscape and forest management, and fire exclusion policies. Current prevention programmes suffer limited budget allocation and often lack an adaptive legislative framework able to regulate fuel management activities. There is also a lack of guidance for fuel management protocols at the national levels, including the use of prescribed burning. The projected increase in drought severity and associated increase in fuel flammability due to climate change will further intensify forest fire risk beyond existing fire prone areas. However, there is currently a limited uptake of scientific knowledge by policy and management actors to address fuel management under future climate and land-use scenarios.

Tactical Fire Use - Intentional application of fire to speed up or strengthen fire suppression action on wildfires. The suppression fire is usually set by firefighters to consume fuels in advance of the main fire, stopping its spread by breaking the fire triangle. Types of suppression firing include backfire, burning out, and counter firing. The increasing intensity of wildfires, together with the increased concern about fire safety and costs, requires better strategies and tactics for firefighting. There is a strong need for professional development in firefighting and the promotion of safety practices for firefighters

Wildland-urban interface (WUI) - The zones of transition between urban areas and wildlands or lands occupied by forests or shrublands. These zones are generally at risk of wildfires. Wildland–urban and rural–urban interfaces are the spatial manifestation of the coupling of fire and people, and the most proximate scale of exposure and risk mitigation The abandonment of rural lands and the expansion of urban areas led to the creation of important interfaces between built infrastructures and vegetation with high fuel load that, when burning, create very significant threats to people and make firefighting

and other civil protection operations much more difficult to coordinate. Limiting the sprawling of WUIs and mitigating the impact of wildfire in these interface areas elicits many social and scientific challenges, such as establishing construction and development standards, defining asset - protection zones with proper fuel management and predicting fire spread and behaviour in interface areas and making this information available to the public for a better response in case of emergency.

Fire Danger Rating / Early Warning - Meteorological conditions that affect fire ignition, behavior and suppression Fire danger - The sum of constant (fuels, topography) and variable (weather) factors that affect the initiation, spread and difficulty of control, and subsequent fire damage of wildfires on an area. It is often expressed as an index. Meteorological conditions largely determine the suitable conditions for fire spread at the local level and are therefore widely used to predict fire danger. Fire activity across countries varies considerably from year to year, suggesting a strong dependence on both meteorological and climate conditions, since no other factors can change in such magnitude. A better understanding of fire risk, and its sensitivity to changes in meteorological and climate conditions across spatial scales is needed to better forecast fire danger and improve the response capacity, i.e. stand-by procedures, initial attack levels, etc.

Interesting links:

https://lessonsonfire.eu/

http://www.paucostafoundation.org/

European Forest Institute EFI

https://resilience-blog.com/?s=fire

https://effis.jrc.ec.europa.eu/

https://www.nfpa.org/Public-Education/Fire-causes-and-risks/Wildfire/Firewise-USA

https://www.aidr.org.au/programs/centre-of-excellence-for-prescribed-burning/

https://www.fws.gov/fire/pftc/

http://landworksnpc.com/firewise/

https://www.fs.usda.gov/treesearch/pubs/38646

The Campbell Prediction System

https://drmkc.jrc.ec.europa.eu/knowledge/Gaps-Explorer/forest-Fires#Challanges

https://www.iawfonline.org/

https://www.daff.gov.za/doaDev/sideMenu/ForestryWeb/webapp/Documents/ForestFire/192.168.10.11/nvffa.nsf/037495e53fc3007e42256dde0043eebd/b48c1816614658da42256dcc004afbcb02ec.html?OpenDocument

http://www.fao.org/3/a-i1363e.pdf

FAO Voluntary Fire Management Guidelines

http://gfmc.online/

https://www.forestsandrangelands.gov/strategy/

https://fireadaptednetwork.org/

And remember: Keep your house well prepared and keep the bush well burnt!