



European Forest Fire Network (EUFOFINET) Project

INTERREG IVC PROGRAMME

SUPPRESSION TACTICS

Synthesis of good practices

Partner No. 13



Northumberland Fire and Rescue Service, United Kingdom



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1. INTRODUCTION

This report provides a synthesis on the topic of *Wildfire Suppression Tactics*, which was one of five themes of the European Forest Fire Networks Project. This thematic was led by Northumberland Fire and Rescue Service (NFRS) in the UK.

The remainder of this chapter provides a summary overview of the EUFOFINET Project and the suppression tactics thematic. The remainder of the document is subsequently separated into three key chapters. The following chapter provides a brief description of Workshop 5 of the EUFOFINET Project which was hosted by NFRS in Northumberland (UK) on 19th-24th March 2012. The Northumberland Workshop focused on the wildfire suppression thematic and was one of eight technical workshops held during the EUFOFINET Project. The subsequent chapter then presents a synopsis of the presentations that were delivered by donor partners and external experts during the Northumberland Workshop. These presentations outlined a number of different suppression strategies and tactics that have been developed and implemented around Europe. The final chapter provides some general conclusions to this synthesis and includes some brief recommendations from the EUFOFINET partnership with regards to the development of important foundations for the implementation of safe and effective wildfire and forest fire suppression activities.

1.1 The EUFOFINET Project

The European Forest Fire Networks Project (EUFOFINET) began in November 2012 and will culminate on 31st December 2012. The principal aim of the Project was to improve and enhance regional and local approaches to wildfire prevention and suppression through European cooperation, collaboration and the exchange of good practice.

The project has been delivered by a partnership of 13 organizations from 9 EU countries. The partnership included:

- The Association of Municipalities of Attica (PEDA) (Greece)
- The Region of Tuscany (Italy)
- Office National des Forêts (France)
- ENTENTE pour la Forêt Méditerranéenne (France)
- The National Forest Center (Slovakia)
- The Centre for Servicing Woods and Forests of Castilla y León (CESAFOR) (Spain)
- The Region of the North Aegean (Greece)
- The Region of Epirus (Greece)
- The Region of Thessaly (Greece)
- The Galician Academy of Public Security (Spain)
- Frederikssund-Halsnæs Fire and Rescue Service (Denmark)
- The Forest Research Institute (Poland)
- Northumberland Fire and Rescue Service (United Kingdom)

The involvement of a number of northern European partners reflects the growing concerns about wildfire across the continent as a whole, and the accepted need for practitioners working in all regions of Europe to share good practice and collaborate across national borders.



In order to achieve the principal aim of the EUFOFINET Project, the partnership structured the project around five key thematic areas:

- ❖ **Intervention strategies**
 - GP1 - Wildfire suppression tactics

- ❖ **Technological innovation**
 - GP2 - Training using simulation tools
 - GP3 - Territorial surveillance, detection and prevention strategies
 - GP4 - Mapping hazards and fire risks

- ❖ **Restoring fire-damaged terrain**
 - GP5-Techniques and procedures

Each of the key themes listed above was addressed during at least one of eight technical workshops held during the project. The dates and locations of the eight workshops were:

- “Restoration of land burned by wildfires” in Valabre (France), 16th-20th May 2011
- “Prevention of wildfires” in Frederikssund-Halsnæs (Denmark), 19th-23rd September 2011
- “Training and simulation” in Valabre (France), 1st-5th November 2011
- “Action planning” in Athens (Greece), 17th-19th January 2012
- “Cartography of risks and hazards” in Leon (Spain), 20th-24th February 2012
- “Wildfire suppression tactics” in Northumberland (UK), 19th – 23rd March 2012
- “Detection of wildfires” in Zvolen (Slovak Republic), 20th-25th May 2012
- “Action planning” in Firenze (Italy), 1st-5th October 2012.

During these workshops, partners and external experts presented examples of good practice from their regions and discussed the potential for transferring good practices in part or in full to their own regions. The information exchanged during the workshops formed the basis for the development of Operational Action Plans (APs) by all of the partners. The thirteen APs document how the partners plan to transfer and implement within their region one or more of the good practices exchanged during the project.

In addition to the organisation of the technical workshops, the EUFOFINET partners have produced a number of other key deliverables, including:

- Publication of 5 technical synthesis guides (one per project theme) documenting best practice exchanged during the project.
- Compilation and publication of the “European Glossary for Wildfires and Forest Fires”.
- Organisation of a final project conference for wildfire stakeholders in Europe – titled: “Cooperation to face wildfire challenges in Europe”. This event will be held at the Committee of the Regions in Brussels (Belgium) on 12th November 2012.
- Production of an Operational Action Plan by each partner documenting the planned implementation or one or more good practices exchanged during the project.



1.2 Good Practice Thematic 1: Wildfire Suppression Tactics

The first thematic of the EUFOFINET Project (abbreviated as GP1) was designed to address the issue of wildfire suppression tactics and, more specifically:

“Good practice in the development and implementation of safe and effective tactics for wildfire and forest fire suppression”.

All wildfires and forest fires are initially uncontrolled events. An important challenge for suppression agencies is the decision-making process that informs the selection and utilisation of appropriate suppression strategies, tactics and techniques. This decision-making process is always underpinned by the central premise of maintaining safety of suppression personnel and members of the public while also suppressing the fire both effectively and efficiently.

The EUFOFINET partners are aware of a substantial range of potential tactics that could be selected by an Incident Commander in order to suppress a wildfire/forest fire or part of a wildfire/forest fire. Each tactic and strategy has its benefits and limitations and will be safer and/or more effective within particular contexts. The majority of potential suppression options are commonly grouped into one of three broad categories:

- **Direct attack** – “An offensive fire suppression tactic which involves an attack being made at or near the fire edge. This technique normally relies on the use of hand tools and or water”¹.
- **Indirect attack** – “Any suppression methods implemented away from the fire edge”².
- **Aerial attack** – “Fire suppression operations involving the use of aircraft to release water or retardant on or near a wildfire”³.

Incident Commanders need to be able to make an informed assessment of a wildfire incident to ascertain which suppression tactics will be most safely and effectively deployed at particular times and particular locations. This decision-making process may be complex and may depend upon an assessment of a significant number of factors. Commonly, Incident Commanders will need to identify when and where it is safe to deploy suppression crews to fight the fire.

NFRS decided to divide GP 1 into two different phases of work. The first phase of GP1 was:

- **GP Phase 1:** To create a summary description of the different good practice suppression tactics that have been developed and implemented by the EUFOFINET partners and a selection of external experts.

The EUFOFINET partners acknowledged during the project development phase that it is not sufficient to simply provide a summary of the different types of suppression tactics that might be suitable for deployment at a wildfire or forest fire incident. Consequently, the partners decided to complete a second phase of work for GP1 which was divided into two key areas of work:

¹ EUFOFINET (2012) *European Glossary for Wildfires and Forest Fires*.

² EUFOFINET (2012) *European Glossary for Wildfires and Forest Fires*.

³ EUFOFINET (2012) *European Glossary for Wildfires and Forest Fires*.



- **GP1 Phase 2 a):** To produce general recommendations regarding good practice in wildfire suppression tactics.
- **GP1 Phase 2 b):** To produce a European glossary of terminology for wildfires and forest fires to establish a common language among practitioners working in Europe to improve and enhance cross-border communication at wildfire/forest fire incidents and during multinational exchanges and meetings. The document will be designed for use as both a training and reference resource.

For reasons of brevity, this report presents a synopsis of the results and recommendations developed as part of Phases 1 and 2a) of GP1. Further information about the glossary that has been produced as part of GP1 Phase 2b) is not included here, but a full copy of glossary can be obtained by contacting the author of this report or by contacting any of the EUFOFINET partners. Please see the end of this report for contact details of the author.

2. SUMMARY INFORMATION CONCERNING THE NORTHUMBERLAND WORKSHOP OF THE EUFOFINET PROJECT

GP1: Wildfire Suppression Tactics was the topic of the fifth workshop of the EUFOFINET Project. This workshop was hosted by NFRS in Northumberland (UK) between 19th and 24th March 2012. Fifty five wildfire and forest fire experts from 11 countries attended and contributed to the event. Summary information about the workshop donors and participants is included overleaf.

The Northumberland Workshop involved a number of different sessions which were designed to facilitate the exchange of good practice, knowledge, experience and opinions. Seven donor partners and three external experts presented and discussed their good practices during presentation sessions and these good practices were then later discussed during open discussion sessions.

Another key element of the Northumberland workshop was the arrangement of three field visits by NFRS. These field visits were designed to give delegates a practical demonstration of some of the suppression tactics that have been developed and used within Northumberland and the UK. A summary of the three field visits is now provided below.



Figure 1 – Live Burn Exercise held during the Northumberland Workshop of EUFOFINET



Figure 2 – Summary Information concerning The Northumberland Workshop of the EUFOFINET Project

Thematic Leader: Northumberland Fire and Rescue Service (NFRS), United Kingdom

Number of delegates: 55

Donor Partners:

- Academia Galega (Spain)
- CESAFOR Castilla-y-León (Spain)
- ENTENTE pour la forêt Méditerranéene (France)
- Forest Research Institute (Poland)
- Northumberland Fire and Rescue Service (UK)
- Office National des Forêts (France)
- Regione Toscana (Italy)

Recipient Partners:

- Academia Galega (Spain)
- CESAFOR Castilla-y-León (Spain)
- ENTENTE pour la forêt Méditerranéene (France)
- Forest Research Institute (Poland)
- Frederikssund-Halsnæs Fire and Rescue Service (Denmark)
- National Forest Center (Slovakia)
- Office National des Forêts (France)
- PEDA (Greece)
- Region of Epirus (Greece)
- Region of the North Aegean (Greece)
- Region of Thessaly (Greece)

External Participants:

- National Fire Protection Association (USA)
- Gestão Integrada de Fogos Florestais (GIFF) (Portugal)
- Slovak Fire Brigade (Slovakia)
- Veiligheidsregio Noord- en Oost-Gelderland (Netherlands)
- Veiligheidsregio Gelderland-Midden (Netherlands)
- Cheviot Futures Programme (UK)
- Northumberland National Park Authority (UK)
- Northumbria University (UK)
- Cumbria Fire and Rescue Service (UK)
- Derbyshire Fire and Rescue Service (UK)
- Dorset Fire and Rescue Service (UK)
- Durham and Darlington Fire and Rescue Service (UK)
- North Yorkshire Fire and Rescue Service (UK)
- Staffordshire Fire and Rescue Service (UK)
- University of Manchester (UK)



Figure 2 – Summaries of the Field Visits of the Northumberland Workshop

Field visit 1 – Tuesday 20th March 2012 – Wildfire Suppression Equipment Demonstrations

During a visit to NFRS HQ at West Hartford near Cramlington, participants were given the opportunity to meet with a number of suppliers of wildfire specific equipment. Participants also attended a session on wildfire equipment innovation.

Field Visit 2 – Wednesday 21st March 2012 – Live Burn Exercise

NFRS arranged for a live burn exercise to be held at New Moor near Longframlington. NFRS uses the site to deliver specialist training in the use of fire as a suppression tool. A number of fires were lit and subsequently extinguished by specially trained Wildfire Support Officers from NFRS. The WSOs demonstrated a range of different ways that fire can be used to remove fuel in front of an advancing fire as a suppression tactic. In particular, NFRS WSOs demonstrated the use of defensive and offensive burns. In addition to observing the burn and the subsequent extinction of the fires, participants also observed WSOs strengthening a control line prior to the burns and the delivery of an exemplary briefing by the burn supervisor to the burn team.

Field Visit 3 – Thursday 22nd March 2012 – Multi-Agency Wildfire Simulation Exercise

NFRS arranged a multi-agency wildfire simulation exercise near the village of Linhope within the Northumberland National Park. This exercise was delivered in partnership with the Cheviot Futures Programme, Northumberland National Park Authority, Linhope Estates, Northumberland National Park Mountain Rescue Team and the North of Tyne Mountain Rescue Team. During the exercise, NFRS demonstrated the deployment of a high volume pumping unit to create a water curtain during a wildfire incident. In addition, a representative from Linhope Estate discussed the management of heather moorland for grouse and the recent construction of a fire pond on the estate for the National Park. The two volunteer mountain rescue teams within Northumberland also demonstrated the specialist communication systems that they provide to assist the fire and rescue service during wildfire incidents in more remote rural locations.



3. SYNOPSIS OF PRESENTATIONS DELIVERED AT THE NORTHUMBERLAND WORKSHOP

This chapter provides a synopsis of the good practices presented and discussed in Northumberland in March 2012. The following sub-sections address each presentation in turn.⁴

3.1 Strategies for Suppression of Simultaneous Wildfires in Galicia, Spain

Presentation delivered by: Academia Galega

Galicia is a region in northwest Spain that is divided into four provinces. The provinces are subdivided into 315 municipalities which are in turn subdivided into approximately 3,800 parishes. Galicia covers an area of approximately 3 million hectares, of which approximately 2 million hectares are classified as rural or natural areas. The most abundant vegetation are thickets of "toxo" (*Ulex spp*), "brezo" (*Erica spp*), "carqueixa" (*Chamaespartium tridentatum*) and "Escoba" (*Cistus spp*), and forests of pine (*Pinus pinaster, radiata* and *sylvestris*), eucalyptus (*Eucalyptus globulus*) and oak (*Quercus robur, pyrenaica* and *petraea*). The forest is generally very productive (more than 10 m³/ha/year are sold in public forests and more in private forests of eucalyptus), but the economic value of wood is relatively low. Near the coast, the region is densely populated and urbanized, with high numbers of tourist visiting every year. As with many countries in Europe, the dominant trend in the last few decades has been the expansion of the wildland-urban interface and an increase in the general population's exposure of risk to wildfires.

On average, 8,000 wildfires and forest fires are recorded in Galicia each year (for the period 2000 to 2011). This significant number of wildfires on an annual basis creates significant difficulties for management of suppression activities and emergency management. The situation is even more difficult due to the fact that multiple simultaneous wildfires and forest fires are a common occurrence. In 2011 the *Plan for Prevention and Protection against Forest Fires in Galicia* (PLADIGA) was developed in order to address the significant wildfire and forest fire problem. The PLADIGA details how wildfire and forest fire incidents will be managed and establishes the procedures for requesting and deploying resources and services that are owned by the Autonomous Community of Galicia and the Spanish Central Government. The overall objective of PLADIGA is to minimize potential ecological, economic and social damage of forest fires in the region through the effective use of available resources. In order to achieve this, the PLADIGA currently includes a number of general objectives:

- Maintain the number of fires over 25 hectares below 2% of the total fires per year.
- Maintain the percentage of fires of less than 1 hectare above 70% of the total fires per year.
- Reduce the number of fires to the average of the last 10 years.
- Decrease the response time for attending wildfires/forest fires from the 10 year average which is set at 21 minutes.
- Decrease the average time taken to control wildfires/forest fires below the 10 year average of 1 hour and 39 minutes.
- Decrease the average duration of fires below the 10 year average of 2 hours and 52 minutes.
- Decrease the number of re-ignitions.

⁴ An additional presentation on the topic of "Fire Adapted Communities: The US approach to Wildfire Mitigation" was very kindly delivered by Molly Mowery of the National Fire Protection Association (NFPA) in the USA. The topic of this presentation was more closely aligned to another thematic of the project and is therefore not summarised within this document.



The PLADIGA also stipulates that the following actions are carried out to improve the speed and effectiveness of suppression activities:

- Preparation and review of management protocols.
- Locating resources based upon risk assessment.
- Automatic dispatch of aircraft during times of high forest fire risk.
- Application of restrictions on use of areas classified at high risk of forest fire.
- Activation of heavy machinery equipment.
- Strengthening of surveillance during periods of high forest fire risk: by the police, army and volunteers.
- Using fire as a suppression tool when conditions are suitable and favourable.

An important piece of software is used in Galicia to collect, analyse and evaluate data about previous wildfires and forest fires. This software stores a range of important data about wildfires and forest fires, including; numbers and locations of fires; surface area burned; resources deployed; and, response and extinction times. The software also includes an assessment of the effectiveness of the suppression tactics that were implemented at the fires.

In summary, the PLADIGA provides a framework in Galicia to:

- Rapidly detect and locate wildfires and forest fires and to coordinate resources provided by various administrations;
- Notify local authorities and civil defence and emergencies about the detection of a wildfire in real-time;
- Improve the distribution of information to the population and therefore increase public safety;
- Reduce response times for extended attacks;
- Optimise the distribution of resources for single and simultaneous wildfires and forest fires.

3.2 Use of Dozers, Backfire and Support Convoys in Castilla-y-León (Spain)

Presentation delivered by: Defence Against Fire Centre (CDF), Junta de Castilla-y-León

The Region of Castilla-y-Leon in central Spain covers a land area of 9,42,265 hectares (approximately 94,223 square kilometres). 52% of the land area is classified as woodland-scrubland-grassland. This predominantly rural region also has a very low population density of 26.6 inhabitants per square kilometre. The region records an average 2,000 wildfires/forest fires per year which burn on average a land area of 27,500 hectares (275 square kilometres).

The resources available for suppression of wildfires/forest fires in Castilla-y-Leon include:

- 4,390 personnel
- 204 trucks
- 186 brigades
- 29 aircraft
- 23 dozers (also commonly referred to as “bulldozers”)

Two key suppression tactics utilised in Castilla-y-Leon are the use of dozers and the use of fire as a suppression tool (referred to as backfire in Spain). Indeed, during the previous 10 years the largest wildfires and forest fires in the region have been controlled by using either or both of these tactics.



The remainder of this section provides an overview of the 1 to 3 dozer squads that have been created within each province of Castilla-y-Leon. These squads are ready 24 hours of the day and consist of an articulated lorry, a dozer, a warning car, one lorry driver and one dozer driver. The cost per squad is 900 Euros per day. The provinces commonly have a second dozer which is deployed to assist in prevention activities, such as the maintenance of firebreaks. At wildfire/forest fire incidents, dozers are used for both direct and indirect attack. Direct attack using a dozer involves driving the dozer along the fire line and turning earth onto the fire. Indirect attack using a dozer involves using a dozer to remove fuel away from the fire edge to create a control line. Both forms of attack using dozers require support of ground personnel to ensure safety and provide support. Both tactics can also be very effective for extinguishing wildfires/forest fires with a large perimeter. The use of dozers for fire suppression is extremely efficient when compared to using personnel with hand tools for suppression activities. In addition, the dozers are equipped with lights and can be safely and effectively deployed for fire suppression at night.

While the dozer squads are based within their particular provinces, they remain a resource that can be deployed throughout the entire region. For example, it is common for 10 dozer squads to be deployed at wildfires/forest fires that are 1,000 hectares in size. Dozer convoys have been designed to be entirely self-sufficient with their own command staff. They work as a unique squad and can be rapidly deployed through a well-managed convoy support system.



Figure 4 – Use of a Dozer for Fire Suppression

3.3 Interventions and Strategies for Forest Fire Suppression in Tuscany, Italy

Presentation delivered by: Regione Toscana

The Region of Tuscany experiences approximately 1,200 forest fires every year. The Regional Administration is responsible for organising and managing forest fire suppression activities within Tuscany and has:

- 4,000 suppression personnel (inclusive of Fire Bosses and Fire Fighters)
- More than 1,000 vehicles (including off-road vehicles with water reserves of various sizes)
- The ability to deploy up to 150 fire crews each day.

Several other agencies are also involved in forest fire prevention and suppression, according to guidelines established by the Region of Tuscany and described in the “Regional Operational Plan for Forest Fire Prevention and Suppression” and an “Operational Procedures” document. The specific stakeholders involved in forest fire suppression are:

- The Region of Tuscany
- Provincial administrations



- Municipalities and other unions
- Regional Park Institutions
- Volunteer fire fighter Associations
- National Forest Service (Corpo Forestale dello Stato)
- National Fire and Rescue Service (Corpo Nazionale dei Vigili del Fuoco)

Overall responsibility for fire suppression rests with different organisations, depending upon the circumstances of the fire. For example:

- The National Fire and Rescue Service is responsible for suppressing fall fires that do not involve vegetation (for instance, vehicle fires, building fires etc)
- The National Fire and Rescue Service is also responsible for suppressing all vegetation fires that do not involve forested areas.
- The Region of Tuscany is responsible for suppressing all forest fires in the region and will deploy a Fire Boss to all incidents.

Suppression tactics and activities are organised through close cooperation between the various agencies/organisations involved in forest fire suppression. The development of guidelines and an organisational model with three different levels of coordination has improved the organisation of suppression activities.

A Regional Coordination Centre, called the SOUP, is open 24/7 every day of the year and coordinates prevention and suppression activities for the whole of Tuscany. The coordination centre is managed by the Region of Tuscany in collaboration with personnel from the National Forest Service, National Fire and Rescue Service and Volunteer Fire Fighter Organisation. Provincial Operating Centres (COP AIB) then occupy the second level of coordination and operate during the summer period between the hours of 8:00hrs and 20:00hrs. The COPs manage suppression of forest fires at the provincial level and provide support to the SOUP. The final level in the coordination hierarchy is the Fire Boss (DO AIB). The Fire Boss represents the connection between the coordination and operational structure. He/she has overall responsibility for organising suppression operations at the incident. The SOUP and COP support the Fire Boss in managing suppression resources at the regional and provincial level respectively.

The latest Regional Operational Plan created new positions within the chain of command. These new positions are:

- *Fire Boss Assistant* – a person designated to assist the Fire Boss during suppression operations.
- *Fire Logistics Manager* – a person who assists the Fire Boss by organizing water supplies, crew rotation, food and beverage supplies and by collaborating with regards to management of communications.
- *Vehicle Column Coordinator* – a fire fighter specifically trained to supervise and organize the activity of two or more fire crews at an incident.

Suppression strategies and tactics are defined by the Operational Plan and change in relation to the calculated risk level. During the highest risk period of the year (15th June to 15 September), the following resources are mobilized to enable rapid detection and suppression:



- *Detection* – infrared cameras and fire lookouts are activated across the whole region.
- *Patrolling* – fire fighter crews carry out patrol activities in agreement with the COP or SOUP.
- *Suppression resources* – Fire crews are classified according to their activation time:
 - *Readiness* – crews ready to be deployed in a maximum of 5 minutes.
 - *Availability* – crews ready to be deployed in a maximum of 20 minutes.
 - *Usability* – personnel of public agencies or institutions that are permitted to be requested by the COP or SOUP for firefighting during their normal work time.
- *Other suppression resources* – For example, mobile water tanks, heavy machinery etc. may be activated and moved to another location.
- *Helicopters* – 10 helicopters are available during this period and following a request by the SOUP must be airborne in a maximum of 10 minutes.

During the normal operational period (from 16th September to 14th June), risk is much lower and so suppression resources are scaled back. During this period the following resources are available:

- *Suppression resources* – Fire crews are classified on the basis of a different activation time:
 - *Availability* – crews are not present at their base but will be ready to be deployed in a maximum of 20 minutes.
 - *Inter-municipal availability* – crews ready to be deployed in a maximum of 20 minutes.
 - *Usability* – the activation time is defined according to the COP or SOUP.
- *Helicopters* – 2 or more helicopters are available during this period following a request by the SOUP must be airborne in a maximum of 10 minutes.

Fire suppression actions in Tuscany tend to focus on direct attack. When fire intensity is too high for ground crews to complete a direct attack then helicopters are used from the regional fleet. During larger fires, the Fire Boss will sometimes request heavy machinery to create control lines as part of an indirect attack.

3.4 The French doctrine for fighting forest fires

Presentation delivered by: ENTENTE pour la forêt Méditerranéenne (France)

In 1986, a harmonized national doctrine for wildfire and forest fire suppression was developed. The doctrine incorporates activities of all key stakeholders concerning forest fire risk and ensures that the forest services and fire fighting services work together to prevent and suppress wildfires/forest fires.

The doctrine is based on 2 fundamental principles:

1. The need for a global or holistic approach to wildfires/forest fires - including an appreciation of the fact that prevention and suppression are inseparable.
2. The importance of anticipation and planning to improve management of the wildfire/forest fire problem.

The doctrine also outlines four key objectives, which are:

1. To prevent fires
2. To develop and master techniques for suppressing wildfires/forest fires in their early stages



3. To avoid catastrophic fires and their resulting consequences
4. To rehabilitate areas burned by wildfires

Like in other countries, a Fire Weather Index is calculated in France which determines the risk of wildfires/forest fires within different areas. This index influences decisions regarding the deployment of detection patrols (as discussed in ONF's presentation later in this document) and preparations for potential suppression operations.

The success of suppression operations is dependent upon the speed and composition of the strike force. Safety of people and the protection of property is always the key concern for suppression operations and suppression tactics will be implemented to achieve this aim above any other. In order to avoid catastrophic fires that pose the greatest risk to life and property, the doctrine prioritises the coordination of a massive attack against ignited wildfires/forest fires. This massive attack will usually involve the coordination of substantial aerial and ground resources to intervene quickly to rapidly extinguish fires before they develop into larger catastrophic fires. If there are a number of simultaneous fires within an area, resources may actually be diverted from a larger fire to assist in suppressing a recently ignited smaller fire.

In addition to light vehicle intervention patrols (see ONF's presentation), another tactic adopted to rapidly detect wildfires and to rapidly commence initial suppression attack is the deployment of armed surveillance aircraft during the wildfire season. These aircraft have an automatic authority to drop their load of water or retardant onto wildfires/forest fires that they detect from the air.

While it is difficult to precisely evaluate the impact of the doctrine, there is evidence that there have been improvements to suppression tactics since its introduction in 1986. Statistics show that 95% of fires burn less than 5 hectares, among which 83% of fires burn less than 1 hectare. In addition, less than 1% of fires during the summer season exceed a threshold of 100 hectares.

ENTENTE concludes that the factors contributing to the success of the strategy are numerous and include:

- Thoughtful and joint (multi-agency) prevention measures
- Development of a close relationship between stakeholders (for instance, the foresters and fire and rescue service)
- A precise daily evaluation of risk through the use of the Fire Weather Index
- Early detection of fires
- Preventive mobilization of suppression resources
- Rapid deployment of suppression units
- A priority for massive attack against recently ignited fires
- An aggressive and flexible attack of fires

3.5 Rapid intervention using light vehicles in France

Presentation delivered by: Office National des Forêts (ONF)

Statistical studies conducted in France have shown that during the days with the highest calculated risk of wildfires/forest fires, an intervention within 10 minutes after ignition and/or when the fire is still less than one hectare in size will give a much better chance of avoiding a large fire that develops beyond the threshold of control of suppression resources.

Within the framework of the French National Strategy for prioritising massive attack for newly emerging wildfires/forest fires (as presented by ENTENTE), there is a national target of confining 80%



of wildfires/forest fires to an area of less than 1 hectare. One measure that has been implemented to assist in achieving this target is the use of surveillance patrols to facilitate rapid detection and, subsequently, rapid intervention.

The State is responsible for the patrol network and provides the majority of the finance required, although some provinces and municipalities also finance patrols. The majority of patrols are performed by foresters from ONF and the provinces, although some patrols are carried out by local volunteers integrated within various prevention mechanisms and by fire fighters. During the periods with the highest calculated risk of wildfires/forest fires, up to 300 patrols are performed each day within the Mediterranean region of France, 90 of which can be implemented by ONF. The time of day of patrols is set by the individual departments, but will generally be from 11:00 to 19:00hrs or 12:00 to 20:00hrs to cover the highest risk of the day. On the days with the highest risk, patrols may be extended until sunset (between 21:00 and 22:00hrs) by order of ONFs headquarters.

Some patrols are performed to detect wildfires and engage in other prevention work with the public while other patrols, called "armed patrols", are also equipped to commence initial suppression actions should a wildfire/forest fire be detected. The armed patrols consist of a team of two personnel with a 4x4 pickup truck which can be used to drive on forest tracks and off-road. Armed patrols are typically assigned to patrol an area from 1,000 to 5,000 hectares in size. Each patrol should theoretically be able to reach any point within their area in 10 minutes or less. Patrols must always remain within their patrol area but beyond this restriction their movements can be flexible as there are no fixed patrol routes. Each armed patrol carries a water reserve (600 to 800 litres), pump, hose and nozzle. The pumps have a maximum flow rate of 200 to 300 litres per minute, which limits the duration of attack to less than 10 minutes at most. The vehicles also carry other basic fire suppression tools such as beaters. This equipment enables the patrols to intervene quickly if they identify a wildfire/forest fire during their patrol. All patrols have a direct radio link to the static lookout towers and coordination centre in order to relay information about detected wildfires and to receive orders to commence suppression actions.

When attacking a recently ignited wildfire/forest fire, the armed patrols choose to use one of two suppression techniques:

- *Watering the red* – Spraying water in the first third of the burning vegetation to reduce the spread of the fire by reducing fire intensity. This attack technique typically uses between 8 and 40 litres of water every 30 seconds.
- *Watering the green* – Spraying water onto vegetation in front of the fire to reduce combustibility and the spread of the fire into unburned fuel. This attack technique typically uses 2-29 litres of water every 30 seconds.

All personnel performing patrols attend an initial 3 day training course. In addition, all patrol personnel receive refresher training of between 1 and 2 days before each summer wildfire/forest fire season. The content of the training focuses on: the mission; use of the equipment; use of the radio; map reading; fire behaviour; and, safety (the largest component).

In order to maintain the safety of personnel, all personnel working on armed patrols are equipped with appropriate Personal Protective Equipment (PPE), which is identical to the PPE worn by fire fighters. Other key safety measures that are implemented include:

- Instructions are given for personnel to park their vehicle in the direction of escape and to leave the engine running when suppressing a fire. These measures facilitate an easy escape if fire behaviour changes etc.



- Instructions are also given to ensure a clear division of labour when performing suppression operations. While one person attacks a fire, the other person remains near the vehicle and radio and is responsible for monitoring safety of both members of personnel.



Figure 5 - Light Vehicles for Rapid Intervention in the South of France

3.6 Organisation, tactics and techniques for forest fire suppression in Poland

Presentation delivered by: Forest Research Institute

Suppression of wildfires and forest fires in Poland is the responsibility of several organisations: the National Fire and Rescue Service, Voluntary Fire Brigade Units and the State Forest Service. Ground resources are used as the main form of attack, although aerial resources are used in a limited capacity for detection and suppression.

A number of suppression methods are used in Poland, including:

- Beaters
- The use of soil
- Creation of control lines and fire breaks
- Controlled burning
- Water
- Water with wetting agents (particularly for ground fires or fires within deeper layers of litter and debris)
- Foam (usually to create a control line)
- Application of hydrogel (to prevent objects and buildings etc. from igniting)

A number of standard suppression tactics have been developed for different types of wildfire/forest fire. These different tactics are summarised below:

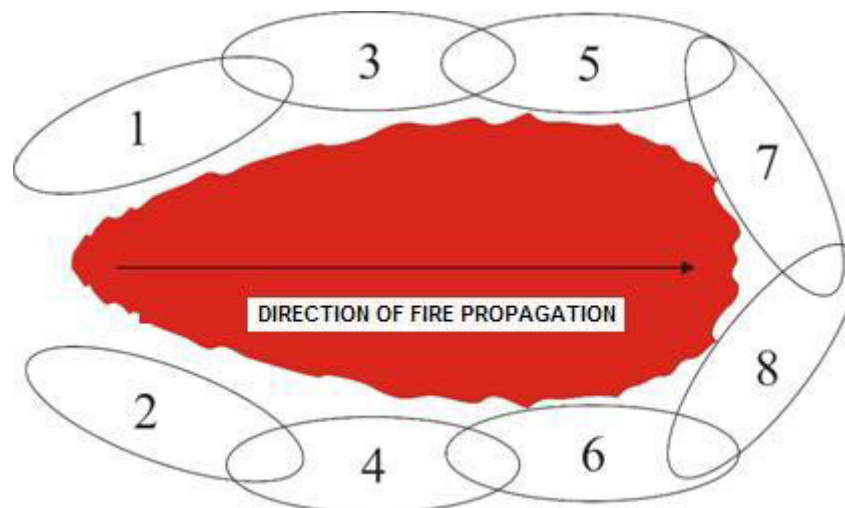
- *Ground fires* – The first step is to identify the location of the fire below the surface. Once the location is identified, ground crews apply water with wetting agents which penetrates deeper into the soil than water alone. A greater coverage of water and wetting agent is applied to the fire perimeter to prevent fire spread. Thermal cameras are used throughout suppression operations to monitor the temperature within the soil layers. The final step taken is to create a control line around the entire fire using a plough, bulldozer etc.
- *Surface fire* – The attack is usually focused on the head of the fire or on the flanks if the responding forces do not have the capacity to perform a head attack. Different tactics are

used in the following order of application: foam, water with wetting agents, water. Aerial resources are very often used to suppress surface fires, especially on parts of fires which are difficult for ground crews to access.

- *Total fire* – The head fires of total fires are characterised by very fast rates of spread, high temperatures, high levels of fire intensity and significant volumes of smoke. Suppression actions are therefore usually limited to the tail and flanks, because suppression at the head is too dangerous. Following a prediction of fire spread and development, control lines will usually be created using machinery such as bulldozers and ploughs. Where possible, these control lines are created to utilise existing natural firebreaks. Aerial resources are often used for total fires and they will tend to focus drops of foam on the left and right flank of the fire. Another tactic that is sometimes used by ground crews to suppress total fires is to ignite a counter fire to remove fuel in front of an advancing wildfire/forest fire.
- *Single tree fire* – Generally speaking, water is used to suppress this type of fire. Sometimes it will be necessary to use a wetting agent to penetrate deeper into the wood and/or roots. As with ground fires, thermal cameras are used to monitor these fires.

There are general guidelines regarding the deployment and use of aircraft. These guidelines aim to maximise the effectiveness of aerial resources used at wildfires/forest fires. Generally speaking, at least 3 fire fighting planes are used to deliver successive drops. It is recommended that the interval between each drop does not exceed 5 minutes. The guidelines also provide a suggested sequence for aerial drops. This sequence follows a general pattern of commencing drops at the tail of the fire and then making progressive drops along the flanks to culminate at the head (as shown in Figure 6 below).

Figure 6 - Recommended sequence of aerial drops for very intensive fires in Poland



3.7 The Slovak Fire Brigade's Ground Module for Forest Fires

Presentation delivered by: Slovak Fire Brigade

In October 2000, a forest fire in the Slovak Paradis National Park in Slovakia killed 6 people. In order to suppress the fire, the Slovak government had to request international assistance in the form of helicopters from Poland and Hungary. The incident demonstrated that Slovakia was adequately prepared for large-scale wildfire incidents in difficult terrain. The incident prompted action in Slovakia and the development of a new concept for fighting forest fires: the formation of the Slovak Ground Module for Fighting Forest Fires.



The Slovak Ground Module for Forest Fires (GMFF) team is able to intervene in “any” terrain and elevation and is trained to coordinate helicopter support, ground support, evacuate persons endangered by a wildfire, create control lines and protect buildings near the fire front. The Team is led by a Team Leader and consists of three groups assigned to three different regions of Slovakia and a number of individuals who provide specialist support. The GIS specialist plays a particularly important role in support of the GMFF because he/she provides information to support decision-making by the team leader (for instance, in the provision of detailed information about the predicted spread of a fire using fire simulation models).

Each of the groups within the GMFF has specialist vehicles, including: off-road tankers, four wheel drive vehicles and an off-road tracked vehicle. These vehicles are designed to enable the GMFF to access remote areas that are difficult for standard Fire Brigade units to access. The vehicles also allow the GMFF to transport personnel and equipment over the rough terrain.

The GMFF are trained to use and coordinate range of different suppression tactics, including:

- Aerial attack
- Ground attack
- Combination of aerial and ground attack

In particular, the GMFF are specially trained to be dropped from the air into remote areas to commence a ground attack with limited equipment. They are also specially trained to create water transport systems over steep terrain using ponds, hoses and pumps (see Figure 7 for an illustration).



Figure 7 – The Slovak Ground Module for Forest Fires Transporting Water Up Slope to a Wildfire Incident

3.8 Use of fire as a suppression tool in Portugal

Presentation delivered by: Gestão Integrada de Fogos Florestais (GIFF)

GIFF began the presentation by providing a basic overview of wildfire/forest fire suppression in Portugal. These arrangements include:

- the provision of a daily fire risk forecast using an index system that is based on but adapted from the Canadian Forest Fire Weather Index System.
- The maintenance of a network of lookout towers throughout the country to enable rapid detection of wildfires.



- The provision of a minimum number of crews to be available for suppression actions, based upon the daily fire risk.
- Deployment of suppression crews in strategic places, dependent upon daily fire risk.

Wildfire suppression teams are composed of volunteer fire fighters and professional teams from various organisations, including the military and GAUF (see later for further information on the GAUF).

When the first report of a wildfire/forest fire is received, the priority in Portugal is for a massive attack using both aerial and ground resources. This can be challenging during some busy periods when some crews may respond to between 20 and 30 ignitions per day and when there may be a number of simultaneous ignitions.

One suppression tactic that has been used in Portugal with very positive results is the use of fire as a suppression tool (also called “backfire”). The first use of this technique in Portugal was recorded in 1976 in the Parque Nacional do Gerês. Between 1977 and 2007, training programmes in the use of fire as a suppression tool were delivered to a number of personnel who were certified to use the technique at wildfire incidents and to complete preventative prescribed burning at a landscape scale to reduce fuel loading and risk of wildfires/forest fires. In 2009, new legislation was produced to provide a legal framework for the use of a fire as a suppression tool and for prescribed burning. The legislation requires a certification process to ensure that those who use fire have the necessary training and competencies to do so safely and effectively.

The finding from Portugal is that the use of fire as a suppression tool can improve and enhance the safety and effectiveness of wildfire suppression operations, if those burning have the necessary technical knowledge and appropriate training.

Specific teams with special training in the use of fire were deployed within Portugal between 2006 and 2010. These teams, called the GAUF (Group of Analysis and Use of Fire), were responsible for planning and executing prescribed burning (to reduce fuel loading and wildfire risk) and to use fire as a suppression tool at wildfire incidents. The GAUF also delivered training to other suppression personnel and agencies. During their period of operation, there were 8 GAUF teams across the country with 3 vehicles, 1 aerial monitoring airplane and 9 MAF airplanes. The GAUF vehicles were equipped with hand tools, drip torches, GPS equipment and a computer. When deployed to a wildfire incident, the GAUF teams would: evaluate the fire perimeter and predict likely fire behaviour and fire spread; identify critical points and windows of opportunity⁵; and, assist Incident Commanders in developing a safe and effective suppression plan.

The deployment of the GIFF and the GAUF for fire suppression duties during the wildfire season and for prescribed burning outside of the wildfire season was an extremely efficient approach for developing and maintaining skills and experience of using fire. The GIFF conclude that the deployment of teams to execute prescribed burning can assist in developing knowledge, experience and skills for wildfire suppression and vice versa.

⁵ Defined by the *European Glossary for Wildfires and Forest Fires* as “A period of time or location on the landscape when/where it will be particularly advantageous to adopt particular suppression tactics or actions”.



3.9 Northumberland Fire and Rescue Service's Wildfire Prediction System

Presentation delivered by: Northumberland Fire and Rescue Service(UK)

Delegates were presented with the Wildfire Prediction System (WPS) which has been developed for use at wildfire incidents by Northumberland Fire and Rescue Service (NFRS). The WPS is based on the Campbell Prediction System and has been adopted by other Fire and Rescue Services around the UK and Republic of Ireland.

In summary, the NFRS WPS can be used as an effective management tool to:

- Predict fire behaviour
- Predict rate of spread
- Predict fire intensity
- Identify windows of opportunity⁶

The WPS is flexible and relatively easy to understand and implement. This enables both Incident Commanders and fire fighters to use WPS to quickly and accurately predict the likely behaviour of a wildfire. Predicting development of a wildfire is extremely important for ensuring the safety of fire fighters and other individuals working within the Incident Command Structure (ICS) and for the effective and efficient allocation of resources and selection of suppression tactics.

Following some development research in the 2000s, NFRS decided that existing prediction systems were too complex for use as practical tools at wildfire incidents. This research did, however, suggest that three key factors have perhaps the most significant influence on wildfire behaviour: wind, slope, and aspect⁷. NFRS decided to collectively call these three key factors “the forces of alignment”. According to NFRS WPS, the severity of a fire in a given fuel is dependent upon the number of alignment forces acting in favour of the fire. Each force of alignment acting in favour of the fire will increase the severity of the fire by a factor of one. This principal gives an alignment value which refers to the number of forces working in favour of the fire. For instance:

- F0 = no forces of alignment acting in favour of the fire
- F1 = one force of alignment acting in favour of the fire
- F2 = two forces of alignment acting in favour of the fire
- F3 = three forces of alignment acting in favour of the fire

Incident Commanders (or nominated officers) should plot alignment factors on a map of the wildfire incident area to predict fire behaviour and fire spread over time and space (see Figure 8 overleaf for an example). The WPS tool is extremely useful for assisting Incident Commanders to plan the safe and effective deployment of resources and the identification of “windows of opportunity”.

By understanding how and when changes will take place an understanding will be reached on where, when and how a fire should be fought. Fire fighters and Incident Commanders alike are taught to appreciate that change is often for the worse and to understand when suppression plans are likely to/will fail. Students are taught that wildfire is dynamic and that they should interpret the behaviour of the whole fire and not just the head of the fire. On many occasions, the real danger to fire fighters and other personnel on the ground comes not from the head of the fire but other areas of the fire that are currently factor 0 or 1 that change alignment into factor 2 or 3. Fire fighters and officers on

⁶ Defined by the *European Glossary for Wildfires and Forest Fires* as “A period of time or location on the landscape when/where it will be particularly advantageous to adopt particular suppression tactics or actions”.

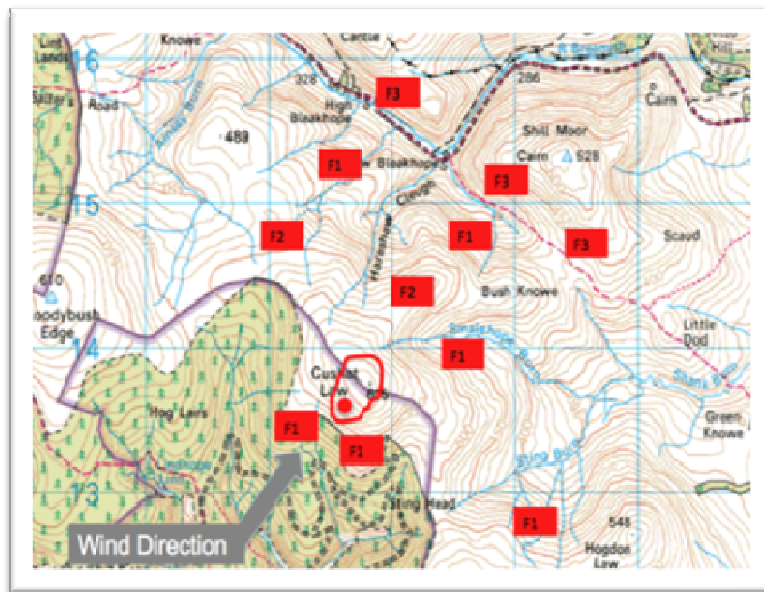
⁷ Defined by the *European Glossary for Wildfires and Forest Fires* as “The direction a slope faces in relation to the sun”.



the ground can easily see the danger presented by the head of the fire but, without using an adequate prediction system, they may not see the potential danger represented by other areas of the fire.

Training by NFRS currently emphasises to UK fire fighters and officers the importance of utilising and maximising windows of opportunity that are identified and predicted through the WPS system. There are some places when fire fighters will not be able to suppress a wildfire, but there will be others where the fire can be safely and effectively suppressed. Consequently, the WPS system can be used to assist in understanding when and where to commit resources safely and effectively.

Figure 8 – Plotting Alignment Factors on a Map



3.10 United Kingdom Incident Command System for Wildfire

Presentation delivered by: Wildfire Advisory Services in collaboration with Northumberland Fire and Rescue Service (UK)

The UK Incident Command System (ICS) is the doctrine that all Fire and Rescue Services use to manage and coordinate all operational incidents from fires to flooding to road traffic collisions. The ICS outlines how to organise resources on the incident ground. It also stipulates that risks should be assessed and control measures should be implemented to protect suppression personnel and members of the public and that fire officers should be trained and competent for their role.

The UK ICS has proven to be a very effective system for coordinating a range of fire and rescue incidents and for managing safety. However, the first National Operational Guidance (NOG) Manual for Wildfire, which is currently being developed by the Scottish Government, has identified that while the UK ICS works well at structural or static incident types, it lacks functionality when applied to large spatial incidents such as flooding or wildfires. Put simply, the ICS is a good management system but there has been a failure to develop specific supporting systems to improve the application of the ICS at large spatial incidents. There has also been a lack of wildfire guidance, training and expertise within the UK FRS. FRS personnel are largely structural/urban fire fighters who have few skills for working within the wildfire operational environment. In summary, this situation has led to a lack of



effectiveness and efficiency at wildfire incidents and safety has not always been maintained to sufficient levels.

The new NOG for Wildfire has made recommendations for improving the UK ICS in order to improve incident management, safety and effectiveness at wildfire incidents. These recommendations are to:

- **Provide fire fighters and fire officers with a better understanding of the wildfire environment** - specifically by developing their skills in using maps for navigation, safety and as planning tools.
- **Implementation of a Wildfire Specific Safety System** - More specifically, the NOG recommends the use of the LACES⁸ safety protocol to improve supervision and monitoring of all personnel deployed at a wildfire incident.
- **Implementation of a Wildfire Prediction System (WPS)** – the NOG recommends the use of a practical prediction system which has been developed by Northumberland Fire and Rescue Service for use at wildfire incidents. The adoption of a UK WPS will allow FRS to take a more proactive rather than reactive approach to fire management. A UK WPS can be applied as both a useful planning and risk assessment tool.
- **Changes to Sectorisation of Wildfire Incidents** – the NOG recommends that the landscape of a wildfire incident should be sectorised according to the area that the fire has the potential to burn rather than just over the fire itself at a particular point in time. This new approach allows Incident Commanders to take into account the likely expansion of the fire.
- **Improved resource management** – the NOG recommends that Teams/Crews of fire fighters should be deployed in larger more resilient groupings. At most incidents, FRS crews are deployed in small teams of 5 or 6, which corresponds to the number of fire fighters arriving at an incident in one standard fire appliance. The NOG suggests that it is more effective at wildfire incidents to amalgamate arriving teams/crews into larger teams of approximately 10 people.

4. CONCLUSIONS AND RECOMMENDATIONS OF THE NORTHUMBERLAND WORKSHOP AND GOOD PRACTICE THEMATIC 1

The Northumberland Workshop provide an opportunity for the EUFOFINET partners to compare the processes, strategies and tactics that have been developed and implemented to ensure safe and effective suppression operations within the EUFOFINET countries and those of a small number of external experts. The workshop revealed a number of similarities and contrasts in the approaches that are adopted and revealed there is no perfect single approach. Rather than develop a single common framework, an approach the partnership concluded would not be compatible within the multitude of political and administrative areas of Europe and its countries, it was decided that the partners would develop some generic guidelines concerning key good practice foundations for organising suppression operations. The partners deemed these good practices to be an important basis for enabling a safe and effective approach to wildfire/forest fire suppression.

The recommendations of the EUFOFINET partners are now presented and described briefly below:

1. **Incident Command System that is appropriate for Wildfire/Forest Fire Incidents** – Some suppression organisations have an excellent Incident Command System (ICS), however, these ICS are sometimes designed for structural incidents. It is recommended that an ICS implemented at a wildfire incident should include appropriate support systems that are

⁸ LACES is an acronym for: L = Lookouts; A = Awareness; C = Communication; E = Escape Route; and S = Safety Zone.



specific to wildfire, such as: wildfire prediction systems; wildfire specific training for personnel; and, wildfire specific safety systems (all of which are described in more detail below and overleaf).

2. **Fire Weather Indexes/Fire Severity Indexes** – All of the partner organisations and external experts utilise some sort of fire weather or fire severity index to support suppression operations. These indexes provide a quantitative calculation of the risk of wildfire/forest fires igniting on a particular day and within a particular area and/or the potential severity of wildfires/forest fires that might occur. These indexes enable suppression organisations to be proactive and plan their approach prior to wildfires/forest fires actually igniting. They also enable suppression organisations and other partner organisations to structure their detection procedures most effectively.
3. **The importance of rapid detection and intervention** –There are a multitude of ways to increase the rate of detection, all of which are outlined in more detail in a separate technical guide produced for EUFOFINET, but it is important to note here that rapid detection can enable a more rapid response which can dramatically limit the size and impact of wildfires and forest fires. Detection must therefore be viewed as an important element of suppression (and vice versa).
4. **Wildfire/Forest Fire Prediction Systems for Suppression Personnel at Incidents** - Prediction of the intensity and rate and direction of spread of a wildfire/forest fire as it moves across a landscape is crucial for determining which tactics to use and when and where to deploy ground and aerial resources. Incident Commanders and fire fighters all need a basic Wildfire Prediction System (WPS), like the NFRS WPS, to enable them to be proactive. The ability to be proactive is essential for maintaining the safety of personnel. Incident Commanders must also be proactive in order to identify windows of opportunity, trigger points and critical points, all of which are essential to any suppression plan.
5. **Wildfire specific training for suppression personnel** – Suppression organisations that respond to both structural fires and wildfires, need to provide their personnel with basic wildfire specific training. This training should include instruction on: fire behaviour; map reading and navigation; suppression tactics; wildfire prediction; safety.
6. **Wildfire/Forest Fire Specific Safety System** – In connection with the previous recommendation, it is extremely important that suppression organisations implement a wildfire specific safety system, such as the LACES protocol. The LACES protocol enables suppression agencies to monitor and manage safety of ground personnel and ensures safety measures are put in place and communicated to suppression crews prior to their deployment to complete suppression actions.
7. **Effective systems for the management and coordination of aerial resources** – The experience from a number of the partners that routinely deploy aerial resources at wildfire/forest fire incidents is the fact that it is essential for suppression organisations to establish effective management and coordination systems for aerial resources. It is also advisable that pilots of aerial resources are provided with some training to improve their knowledge and understanding of fire behaviour and fire suppression. In addition, management and communications systems must be established to enable effective interaction and joined-up working between aerial and ground resources.
8. **Consideration to the use of a variety of different tactics and a reappraisal of alternative suppression tactics** – A number of EU countries rely very heavily upon aerial resources for



wildfire/forest fire suppression, but as the Northumberland Workshop demonstrated, other tactics may be more cost-effective in certain circumstances. The use of dozer squads in Castilla-y-Leon is a specific example of the utilisation of a more cost-effective alternative to aerial resources. Also, while a number of EUFOFINET partners and external experts use fire as a suppression tool, a number of countries have banned the use of this tactic due to accidents that have happened in the past. The experience from Portugal, Spain and the UK is that the use of a fire as a suppression tool can be a very safe, efficient and effective tactic, as long as the fires are ignited by trained teams with appropriate knowledge, understanding and training. The creation of control lines using fire is often safer and much more effective than deploying large numbers of personnel using hand tools. It is recommended that countries that do not use fire as a tool should revisit the possibility for using this tactic in future.

9. **Estimation of the size of area saved by suppression actions** – The partners agree that there is a tendency for suppression organisations to record and publicly communicate the size of the area burned by a wildfire, but there is rarely an attempt to estimated size of the area protected as a result of suppression actions. This change in approach would assist suppression organisations to continually evaluate the effectiveness of suppression actions and, therefore, improve training and tactics in the future.

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