

# **Forest Fire Fighting**

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## **Types and Strategies of Forest Fire Fighting**

**The objective of fighting a forest fire is the prevention of damage to people, property and assets. In addition it significantly contributes to environmental protection. Fundamentally, the protection and safety of the operational fire fighting force is of prime importance. Necessary fire fighting measures, which could put the rescue personnel in danger, should be limited as much as possible.**

If a forest fire is first reported to fire service headquarters, they notify the rescue services and inform the forest authorities as well as forest owners.

By means of the modern sensory equipment used in forest fire early warning systems, forest fires can be quickly and accurately located. This head start can be decisive in the resulting size of a forest fire. For about 75% of forest fires in Brandenburg, 20 minutes elapses between detecting the fire and starting to put it out.

Local fire brigades extinguish most forest fires at their first attempt. Weak points in the alarm system or a breakdown in cooperation between the fire service and the forest authorities can have an impact on the size of the blaze and the amount of damage caused. Therefore regular forest fire drills, in which all the actors get to know each other and practise working together, are an essential part of forest fire fighting and prevention.



Fig. 1: Forest fire. Photo: State of Brandenburg

## **Operational Headquarters**

If a fire can not be extinguished at the first attempt then additional personnel and resources must be notified and brought to the site of the fire. If the extent of the fire makes it necessary to split the fire fighting forces into divisions, then an operational headquarters is established. The operational manager is the fire chief who is the first to arrive at the scene.

Fire fighting is coordinated through the operational headquarters (emergency services centre or operations centre) from a central location (command vehicle or previously determined space), which is not directly located at the endangered site. The manager directs all actions to combat threats, in particular the effective deployment of fire fighters at often unknown locations. Hence, the manager must quickly ascertain and evaluate the situation. S/He has to be able to rely on information and recommendations from the operational headquarters. The

relevant local forest official must also be part of the operational headquarters team, as s/he has precise knowledge of the forest area.

The operational headquarters has the following duties:

- Estimate, control and evaluate the state of the fire, fire development and fire fighting measures as well as present recommendations on how to proceed to the operational manager
- Position fire fighters and resources according to the operational manager's commands
- Install necessary means of communications
- Ensure the provision of operational forces, the timely relief of personnel, medical supplies
- Prepare site plans and document issued commands, notifications etc.
- Set up barricades
- Detain at risk people

### Strategies to fight forest fires

In contrast to building fires, the priority in forest and wild fires is to prevent the fire from spreading. In the rarest of cases, sites can be completely extinguished. The fire fighting strategy predominantly aims to contain the fire.



Fig. 2: A fire on a hillside has particular pitfalls.  
Photo: M. Conedera (Sottostazione WSL)

### Type of forest fire

Forest and wildfires typically form roughly in the shape of an ellipse. Burning only occurs in the area of the perimeter of the ellipse. The fire flanks found to the right and left of the wind direction spread noticeably slower than those in the direction of the wind – the so called fire front or hot spot. If the wind changes direction, the flanks can quickly become the fire front.



Fig. 3: Ground fire. Photo: S. Kaulfuß

It is important to assess fires on terrains such as mountainous areas. Along with the danger that fire personnel could fall, fire fighting on slopes and in valleys demand particular expertise. Generally a forest fire in a mountainous terrain spreads uphill very rapidly. This is caused by the upward flowing hot air and warm thermals. Higher growing, stunted vegetation is readily desiccated by the approaching fire. Furthermore, fires can be rekindled again and again by rolling and burning forest material.

The most important objective is to prevent the fire jumping from the ground into the tree canopy and hence starting a crown fire. It is possible to fight flame lengths up to 1m above the ground with fire beaters. Fire perimeters with flames the height of a person (1-2m) are fought with water jets along with backpack sprayers and shovels. Putting out flames higher than 2-3m is not possible using hand held equipment. With flames greater than 3m there is a danger of an aerial fire and therefore an increased risk of fire islands caused by firebrands. Due to the rising hot air, sparks of pinecones, moss, charcoal or birch bark tar can be lifted up and carried to ignite new fires up to 400m ahead of the fire front. In this manner flying sparks allow even wide strips of deciduous forest to be jumped.

## **Reconnaissance**

In order to fight a forest fire successfully, a thorough survey of the site is a must. The key focus areas are determined according to the following tactical priorities:

1. Protection of people
2. Protection of animals
3. Protection of structures (buildings, streets, utility lines)
4. Protection of endangered or fast burning vegetation

When investigating the type of fire (crown, ground or surface fire), geographic and topographic particulars (main direction of spread of blaze, terrain specifics, entry and escape points for water tenders, wind direction and any expected changes) also play an important role. Conclusions can also be drawn about the fire by observing the column of smoke (already when driving to the site). The colour and form of the column of smoke provides information about the fire's behaviour.

Based on all this information a decision is made during the operational planning about how the fire will be fought. A defensive or offensive method of fire fighting is possible.

## **Offensive forest fire fighting**

Common fire fighting practice in Germany is a direct offensive attack on a fire front by means of fire fighting crews, fire engines and/or air tankers. An approach against the wind at the fire front is the most effective, but because of the difficulty in predicting the speed at which the fire is spreading, is not without risks. This method can only be applied at low flame heights. The danger to people is high if the speed of the fire and flame lengths has been falsely estimated. Increasing wind speeds and hard to manage topographical conditions can lead to fire services being enclosed by fire. Furthermore fire crews are exposed to the heat of the fire and smoke.

## **Defensive forest fire fighting**

If a direct attack is not possible, because the flames are too high to tackle or the surface is contaminated with ammunition, then these blazes are fought defensively. By creating fire breaks (fire lines) or using existing fire resistant barriers (streets, paths) the fire should be able to be halted. Fire breaks can even be laid in advance allowing straight fire lines to be created. Along with the positive benefit of working without heat or smoke stresses, this method also has disadvantages. They include the increased workload and the danger posed to the fire crews by working without visual contact with the fire perimeter. Furthermore fires are able to jump these fire breaks and surveillance of the land lying behind them is required. It is important while fire fighting (defensive as with offensive) to monitor the surrounds and immediately put out any fire islands caused by sparks or firebrands.

## **Establishing and Safeguarding Firebreaks**

Establishing firebreaks is generally only sensible when intensive aerial fires are to be stopped. In most cases the immense personnel and material effort required (clearing tools, staff etc.) can be more effectively used in an offensive procedure. However, their establishment can always be seen as a Plan B in order to safeguard the operational success of an offensive approach. Coordination with the relevant forest officials and forest owners must occur before their construction. Creating firebreaks usually requires using large equipment. Forestry and agricultural machinery as well as bulldozers or military armoured recovery vehicles can be used to undertake the scarification (exposing the mineral soil layer). Firebreaks are always created in two pieces with a vegetation free scarified strip and an observation area lying behind it. The scarified strips should be so created that they are twice as wide as the expected flame length.

## **Ammunition contaminated lands**

Special rules must be adhered to when extinguishing fires on military training areas (current or former) and on former battlefields (e.g. WWII). Fire accelerants and explosions increase a fire's intensity. Close cooperation between the fire service and local and expert advisers like the army and forest personnel is important. Fire fighting on ammunition contaminated takes place at a safe distance or at strategically important points. In most cases these fires are fought indirectly or from the air. One waits until the fire reaches "non-dangerous" areas and then it is extinguished there. Areas contaminated with ammunition which are ablaze can not be driven over with conventional fire engines. Hence, specially protected fire engines are used in such fire fighting. Active military exercise areas have their own fire service and/or some armoured vehicles which can be deployed.

## Forest fire fighting crews and equipment

A large part of fighting forest fires is hard physical labour. Heavy equipment and helicopters are also used. Seamless cooperation between the individual actors is ultimately decisive in rapidly combating a fire. Therefore annual forest fire trainings take place in forest fire danger areas. Carrying out such exercises is also sensible in areas with lower forest fire risks.

### Fire fighting crews

A fire fighting crew's duty is to put out surface fires (offensive approaches) and create firebreaks and scarification strips (defensive approaches). In addition, they ensure that a fire is completely extinguished and prevent the fire spreading by sparks, also without the support of fire tenders. A fire fighting crew is made up of at least a group of 9 people and a vehicle if required.

### Equipment for manual fire fighting crews

Forest fires can be successful fought using simple work tools. What needs to be considered is the flame length (FL), which is the distance from the tip of the flame to the ground. The choice of tool is dependent on this length.

Fire fighting crews are equipped with the following equipment depending on the fire's intensity:

- Hoes and fire rakes,
- Shovel (the "Bavarian Sand Shovel" is particularly suitable),
- Forest fire beaters,
- Chain saws with personal protective equipment and accessories,
- Backpack sprayers,
- Hoses, distributors, basic nozzles,
- Carrier for the equipment and supplies
- Lights (torch, flashlight, headlight)

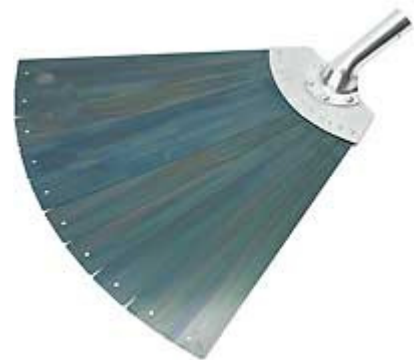


Fig. 4: Forest fire beater

Branches can be felled using carried axes and used as fire-fighting tools (to swat out flames).

### Personal protective equipment

When deploying fire fighting crews, personal protective equipment is indispensable. A balance must be made here between the optimal protective effect from short term contact

with flames and flying sparks and the greatest possible level of wearer comfort. In warm weather conditions multilayered outerwear can cause stress for the wearer. However, work should not be undertaken without outerwear as even small sparks can cause injury. Wearing long underclothes and a single layer fire fighting uniform is optimal.

To ease working in slightly smoky areas simple particle filters with an additional cotton cloth in combination with closely fitting, non-fogging, protective glasses can be worn. The glasses protect fire fighters from sparks, smoke and heat radiation. Free skin (face, throat, neck) is protected with a flame proof hood or neck protector or during longer deployments with a light helmet and headscarf. Breathing apparatuses should only be worn in extreme circumstances in heavily smoky areas. In cases when fleeing from a fire zone, a breathing mask with filter is to be worn.

In addition, protective gloves and a whistle to warn of sudden dangers belong to the personal protective equipment. Sunscreen or insect repellent should also be available to the fire service staff.

Wearing robust lace-up boots is recommended as suitable protective footwear for the uneven terrain of forests. The risk of spraining a foot or of being injured is reduced as the foot is well supported. As burning areas and embers are walked on when fighting fires, soles of shoes must be heat resistant and sufficiently stable.

### **Drinks and provisions**

There is a threat of heat exhaustion from hard physical labour near a fire. For this reason adequate amounts of liquid should be drunk as a precautionary measure. Approximately one litre of water per hour, spread over time, should be consumed. Fruit juice spritzers or still water are the most suitable liquids. Similarly, a sufficient energy supply during the mission is also important. Fruit, bread and sausage are found on the menu.

The operational personnel must be regularly replaced. Effectively battling a blaze is only possible if there are sufficient fire crews available to be deployed as reinforcements.

### **Fire fighting with fire engines**

Ground based fire crews are usually supported by fire engines. In particular fire risk areas special forest fire tenders are used. In principle only all terrain vehicles should be used.

The most important features when operating in rough terrain are four-wheel drive, a shortest possible vehicle, ground clearance, low total weight and low ground pressure as well as appropriate tyres (with variable air pressure if needed). Additional equipment features are antiskid chains (when used on slopes) as well as dust masks, protective glasses and breathing apparatuses for the crew. When fighting forest fires extra pieces of equipment are

to be carried as a minimum. This includes additional hoses, pipes and distributors, a planting mattock, a fire beater, two backpack sprayers/rucksack extinguishers as well as a set each of dust masks or protective eyewear.

In the best case, fire tenders have a “Pump & Roll-Function” which makes discharging water while driving possible. In the early phases of a forest or wildfire one must be extremely efficient with the amount of available water. Particularly when using mobile water tankers, which only have a limited storage capacity, the optimal output quantity has to be determined. The addition of wetting agents can increase efficacy and counteract the general scarcity of water. Air foam, pressurized air foam and gelling agents are appropriate for safeguarding objects and firebreaks.

As most forest fires deal with surface fires, water canons with jet sprayers are of prime importance. On difficult terrain good manoeuvrability is especially advantageous. In locations where open flames and burning matter endanger the use of conventional hoses, steel pipes are used.

Only once the outer perimeter of the fire has been extinguished can one begin with extinguishing the entire area of the fire by means of fire engines. Before the fire engines can be positioned, it must be ensured that the planned parking spot is completely extinguished. In doing so damage to the control and supply lines is prevented.

During the operation vehicles are so positioned that an escape is possible if the fire changes direction. That means driving backwards into the site so that a quick escape can be realised if danger arises. Furthermore care must be taken that parked vehicles do not impede the access for following units. Oncoming traffic on access and exit areas to supply stations, water extraction and operation sites are to be avoided.

### **Fire fighting from the air**

In principle, fighting forest fires from the air can only be seen as a supporting measure to a ground based campaign. However, it is indispensable for large scale fires and is not seldom the only combative option. Water bombs released from aircraft are primarily used to fight



Fig. 5: Keep the way clear!  
All Photos: Birgit Ahrendt, Oder-Spree County Press Office



Fig. 6: Driving backwards into the site.

rapidly spreading fires. Areas contaminated with ammunitions or which are difficult to access e.g. alpine regions, can be reached using air support. Precise water bombs are used as targeted extinguishers.

In Germany helicopters with special external containers belonging to the police, military or private service providers are usually used. In Austria the fire service is supported in fighting forest fires by the Federal Ministry of the Interior and Federal Armed Forces. Along with the transport of water by helicopter, in alpine regions the transport of crews and equipment is also an important role.

Before using a helicopter a clear deployment strategy is developed. It must be determined at which location the helicopter can fill its external tanks and where the sources of fire can be attacked. The plan must show where vehicles can be refuelled and parked during breaks.

In order not to put the ground crews at risk it must be clearly defined in advance in which areas water can be dropped from the air. During an air attack the target area must be cleared of fire fighting crews. If fire fighting crews remain in the target area these should not be doused if possible. Similarly, the danger of falling branches or rolling stones on hillsides is increased by helicopters.

Coloured agents are usually added to fire fighting water when fighting fires from the air to indicate which areas have been treated.

### **Water extraction points**

When fighting a forest fire, apart from a supply of provisions, a large amount of water must be obtained. The maintenance, expansion and technical improvement of a network of fire fighting water extraction points is therefore especially necessary in fire endangered areas. The density and output capacity of the network is determined by site specific needs. Water extraction points must be permanently marked and mapped and accesses maintained and signposted. Water for fire fighting can be taken from: natural watercourses accessible by fire engines, artificial ponds and/or shallow and deep wells with a powerful underground pump if possible.



Fig. 7: Extracting water for fire fighting.



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