# Wildfire Prevention in the Alpine region

## Fire- Resilient Forest Management in Switzerland

FACT SHEET

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FoRISK

### 1. WHY: Context and the growing necessity

**Increasing risk in mountain regions**

Climate change is altering the traditional distribution of risks in Switzerland.

**Not a paradigm shift, but an aspect in the on-going forest adaptation to climate change:**

Switzerland already practices close-to-nature forest management oriented toward climate adaptation. Wildfire prevention is therefore not a completely new strategy, but an integral part of on-going adaptation processes. The focus lies **on strengthening stand resilience** and reducing human ignition sources (the main cause of fires).

#### 1.1 The New Normal: Climate change as a risk driver

Climate change is fundamentally altering the traditional distribution of risk:

- **More frequent extreme events**: Climatic conditions that currently lead to wildfires only once every 60 years are expected to occur **on average every 10 years** by 2090. In areas with favourable geomorphological (i.e. steep slopes) and forestry conditions (i.e. large, continuous forest areas), this may result in correspondingly more frequent large-scale events.
- **Measured latent risk:** Between 2000 and 2023, the absolute number of wildfire events on the northern side of the Alps was already comparable to the southern side, indicating high vulnerability under worsening climatic conditions.
- **There is no future without fire disturbance**. The goal, therefore, cannot be the (unrealistic) total prevention of fire, but rather prevention must aim at avoiding large fires and limiting post-fire gravitative hazards, that is r: controllable fires in resilient landscapes - "living with fire."

#### 1.2 The necessity

Protecting the forest as a critical protected asset (protective forest, climate mitigation, ecosystem services) implies a departure from reactive fire management. Wildfires in mountain regions follow their own dynamics and have severe direct and indirect consequences for infrastructure safety. Often, the long-term damage in mountain regions is even more dramatic:

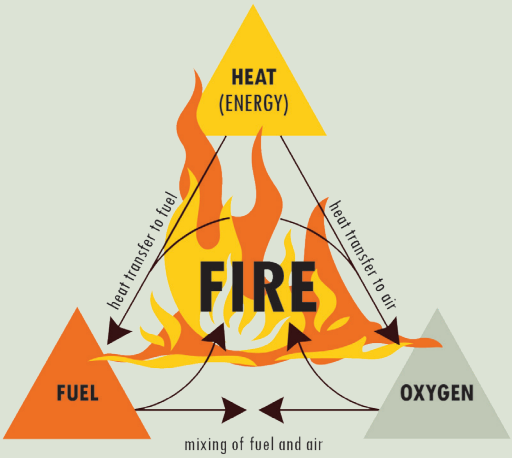
- **Extreme fire dynamics:** Steep slopes and continuous forest stands promote strong upward thermal currents. Rapidly spreading fires in conifer stands can lead to **crown fires** and the phenomenon of **"spottings"** (embers travelling up to 500 m), often making direct fire suppression by fire brigades impossible.
- **Secondary gravitative hazards after fire:** A major fire can compromise the forest's protective function. The result is **erosion, and debris flows**, since soil structure without vegetation becomes unstable during heavy rainfall (example: debris flow in Visp in 2018 following the 2011 fire).
- **Conflicting objectives in protective forests**:
  * *Deadwood:* Important for biodiversity, but in exposed areas it can critically increase fuel loads.
    - *Gap size management:* Regeneration cuts must be dimensioned so that they do not weaken the protective functions (avalanches/ rockfall), do not disturb the forest microclimate, and do not accumulate too much fine deadwood.
- **An important leverage point:** Forest management can actively steer and influence **fuel characteristics**, one of the three components of the "fire triangle" (oxygen, ignition energy, fuel – -load, -type, -structure, -continuity, -moisture).
- **Structural prevention as a core strategy**: Instead of a disaster response strategy, **forest resilience should be proactively fostered.** Forest services assume a central role in natural

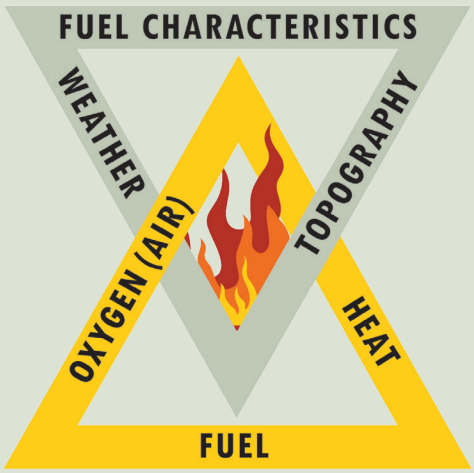
hazard management, as they possess the expertise for long-term stand resilience. Close cross-sector cooperation between forestry and fire brigades is essential.

## 2. HOW: Principles of fire-resilient Forest Management

The fire behaviour triangle describes the interaction between fuel, weather, and topography, and thus how a fire spreads. The underlying fire triangle – consisting of oxygen, ignition energy, and fuel – describes the general conditions necessary for combustion. The common denominator of both triangles is fuel, i.e. biomass.

While factors such as topography and weather can neither be influenced preventively nor reactively, biomass and its fuel properties can be managed extensively. Forest managers can influence fuel -quantity, -type, -structure, -continuity, and -moisture content. In this way, fire resilience can be increased preventively, both through short-term technical measures and long-term strategic approaches.
See also: https://www.waldbrand-klima-resilienz.com/feuerresiilienz-waldumbau




### 2.1 Silviculture as the central driver of fire behaviour

Forest management indirectly controls fire behaviour through the design of forest stands. Wildfire prevention is a joint responsibility of forest services, fire brigades, and civil protection.

Since most fires are anthropogenic (human-caused), managing recreational use and informing the public are effective immediate measures.

**Image**: *Deciduous forest with highly flammable herbaceous vegetation*

**Image**: *Structurally diverse stand with internal forest microclimate*

**The role of Forest Management:** Silvicultural concepts form the scientifically grounded basis for prevention. They aim to promote:

- **Species and structural diversity:** Diverse, multi-layered mixed forests (as opposed to homogeneous conifer age-class forests). A single-layered stand with easily flammable understory increases wildfire risk. A well-structured stand promotes a stabilizing microclimate.
- **Soil fertility and water storage:** Healthy, humus-rich soils act as natural barriers against fire spread. Where possible, runoff velocity should be reduced ("Slow Water").

- **Core measure – increasing the proportion of broadleaf species:** Transitioning from flammable conifer monocultures to mixed stands rich in broadleaf trees significantly reduces wildfire risk, as broadleaf species are generally moister, less flammable, and often capable of resprouting.
- **Forest-wildlife aspect**: Effective wildlife populations are important for the regeneration of fire-resilient mixed forests.

Forests managed close to nature show higher vitality, faster regeneration, and are inherently more resistant to disturbance events (drought, fire), thereby fulfilling their protective function more sustainably.

**Note:** Depending on the site, silvicultural concepts must be adapted. The spectrum may range from dark, cool, wind-sheltered, humid continuous-cover forests (forest microclimate) to open, grazed agroforestry systems (fuel availability).

## 3. WHAT: Concrete measures (and implementation)

### 3.1 Detailed silvicultural measures in areas with elevated fire risk

Prevention requires a combination of long-term forest conversion and complementary short-term technical measures strategically applied in the terrain (Table A).

### 3.2 Strategic and operational recommendations

Successful implementation is based on a multi-layered approach (Table B).

Table A

| Measure | Alpine Application / Protective Forest Focus | Objective |
|---|---|---|
| **Promotion of broadleaf species** | Site-adapted mixtures where ecologically appropriate | Reduce flammability and increase regenerative capacity |
| **Strategic protection strips** | Focus on risk points (settlements/roads). Pruning lower branches in coniferous forests to interrupt fire ladders. Avoid fine fuel accumulation | Prevent transition from surface to crown fire. Create operational areas with reduced fuel loads for fire brigades |
| **Cool microclimate** | Maintain continuous stand cover in shaded areas | Reduce desiccation of the topsoil |
| **Prioritization** | Focus on forests with steep slopes and high fuel loads above settlements | Protect human life and infrastructure from secondary hazards |

Table B

| Level | Recommendation |
|---|---|
| **Strategic Level (Federal/ Cantonal)** | 1. Integrated concepts: Establish binding cross-agency wildfire strategies (forestry, fire brigades, wildlife management). |
| | 2. Intercantonal and international cooperation: Systematic exchange of knowledge and experience between cantons and with the southern Alps, as well as cross-border exchange with international actors. |
| | 3. Financial incentives: Continuation of attractive lump-sum compensation schemes (Motion Fässler) to accelerate forest conversion (age-class forests → fire-resilient mixed forests). |
| **Operational Level (Forest Services/Forest Owners)** | 1. Targeted forest conversion: Consistent implementation of measures (structural adaptation, promotion of broadleaf species, establishment of protection strips where appropriate) considering site-specific conditions. |
| | 2. Effective wildlife management: Close cooperation with hunting authorities to reduce wildlife populations and enable natural regeneration of climate-resilient tree species. |
| | 3. Public outreach: Active public information and awareness-raising regarding behavioural guidelines and increasing wildfire danger. |

# Summary

- Aligned with the on-going climate adaptation strategy, broadleaved species shouhd be promoted;
- Support the forest microclimate through closed forest edges, permanent soil cover, and targeted natural regeneration using adapted tree species;
- Allow the accumulation of large deadwood (where appropriate and within the framework of a spatial-temporal deadwood concept) in order to increase water storage capacity, improve soil quality, and reduce temperatures through evaporation; reduce fuel loads (and fine deadwood) in protection and buffer zones;
- Promote, where appropriate, agroforestry and mixed grazing systems to achieve multiple objectives;
- Reduce the number of skid trails where appropriate; adapt or establish forest roads for emergency access in higher-risk areas;
- Integrate predefined protection and buffer zones (reducing vegetation density, structure, and type) as well as other protective measures, especially near settlements, critical infrastructure, and other assets at risk;
- Enable cooperation, communication, and capacity building in climate-adapted sustainable forest management and Integrated Fire Management (IFM) across sectors, supporting diversity and dialogue.

**Note:** Even the best-managed forest will burn under extreme weather conditions. However, sustainable fire-resilient forest management provides a broad range of mitigation measures before, during, and after a fire.

The creation of a fire-resilient forest landscape on the northern side of the Alps is achievable. Forest conversion must understand its role as the central prevention strategy. Wildfire management in mountain regions means securing the protective function of forests in the long term. This is achieved through **active regeneration of climate-resilient stands and close coordination between stakeholders**.

**Image:** *Grazed larch forest as a traditional agroforestry system in Switzerland.*

## Further information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