2.4. Forest fires

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Forest fires occur more frequently to the south of the Alps than to the north. They are mostly caused by human activity. Humans will continue in future to influence trends in extreme forest fires both by starting them and through measures to prevent them. Natural factors such as drought and heavy winds, which could increase to the south of the Alps as a result of climate change, would also lead to an increase in the risk of fire.

Introduction

Fire occurs when combustible material, oxygen and ignition energy are all present at the same time and place. With forest fires, vegetable material – particularly dead material – supplies the fuel. Depending on its density, chemical composition and humidity, vegetable material varies in flammability.

The effects of forest fires depend, among other things, on the vulnerability of the ecosystem to fire, on the tree species involved, on the previous fire history and from other natural hazards arising subsequently in the area. Till now, the influence of fire on the environment has been little studied.[1] It is, however, clear that fire adversely affects the protection capability of the forest. As a result of the high temperatures and the ash arising in fires, the pores in the ground are sealed and the ground displays higher repellency to water.[2] During heavy rainfall, surface runoff and erosion are thereby increased.[3] In areas that have not suffered fire for more than 10 years, this effect is particularly marked, since none of the vegetation there is adapted to fire.[4] For example, in a fire which occurred in the area of Ronco near Ascona (Canton of Ticino) in 1997, 80% of the catchment area of the River Buffaga was affected. In the following period (in August), heavy rainfall of an intensity occurring only once a decade caused a flash flood – a century-wide record. A mud slide carrying some 4000 m^3 of material descended on inhabited areas causing losses to property of several million Swiss francs. By chance, there were no casualties. The costs of fire fighting, which may in extreme cases top half-a-million CHF, appear quite low in comparison to the material losses.

In this chapter, an extreme event is defined as one or more forest fires that occur during dry weather, and are therefore very intensive, that affect an area of over 100 ha and/or entire catchment areas, and occur in areas that have not been affected by forest fires for over 10 years.

Causes

Of the forest fires occurring to the south of the Alps between 1981 and 2000, 8.6% were caused naturally by lightening (Tab. 3). With lightening, ground fires occur that spread only slowly. However, the frequency of the fires and of the circumstances causing them fluctuate heavily from year to year. For about 40% of all fires, the cause is unknown. Among fires of known cause, on average over 90% may be traced to premeditated or negligent human actions. Between 1981 and 2000, almost 97% of the areas burnt down resulted from these causes.

In addition to lightening – a direct cause of forest fires – natural factors exist in certain areas that increase the fire risk (Tab. 3). Frequently, lack of precipitation, high windspeeds, and low relative humidity are decisive. Solar radiation, humidity deficit and wind frequency also exert an influence. Failing precipitation and low humidity may exert an influence enduring for many years.

Humans cause forest fires mostly through negligence or arson. In rare cases, fires are caused by sparks from the railway or from an electrical short circuit, and through the impact of projectiles from military exercises. Human activity can alter the fire risk in an area. Today, legislative measures are the dominating influence. Also important are socio-economic influences (e.g. retreat of traditional agriculture and depopulation of remote valleys), landscape maintenance and measures to enhance environmental awareness. The effects of these are mostly long-term.

Table 3 Summary of the main factors influencing forest fires in Switzerland.[5]

			Frequency/ weighting	Time frame
Predisposing factors	natural	Precipitation	++	one day to several years
		Wind frequency	+	one to several days
		Wind speed	++	one day
		Relative humidity	++	one day
		Solar radiation	+	one day
		Humidity deficit	+	one day to several years
	human	Socio-economic developments	+	several months to several years
		Landscape maintenance	+	several months to several years
		Legislative framework	++	several months to several years
		Measures to enhance environmental awareness	+	several months to several years
Direct causation	natural	Lightening	8.6%	
	human	Negligence	26.1%	
		Arson	15.2%	
		Railway	3.6%	
		Military	1.7%	52.5%
		El. connections (short circuit)	1.7%	
		Cross-frontier	1.7%	
		Others	2.4%	
	Cause unclear or unknown		38.9%	

++ = frequent / decisive; + = repeated / substantial influence
The figures in percent apply to the period 1981-2000

What trends are already visible?

Deposits of carbon particles in Lake Origlio (Canton of Ticino) suggest that the area south of the Alps has always been naturally vulnerable to fire (Fig. 27). Also, humans have continued to exert an influence on the frequency of forest fires, firstly by fire clearing (in the iron and bronze ages), and secondly by exerting a control function (from Roman times onwards). Data from Lake Lobsigen (Canton of Bern) show that in all probability the general level of forest fires to the north of the Alps is a factor of 2-5 lower than to the south of the Alps. Here too, the influence of human activity through fire clearing in the iron age may be seen.[6]

In the 20th century, the annual number of fires to the south of the Alps increased in the 1960s from the previous average of 30 to 80 (Fig. 28a). Since the early 1980s, the number of forest fires has declined. The areas burnt down have decreased since the early 1960s, and most sharply since the early 1980s. One exception to this is the extreme year of 1973. Extreme events in which forest fires affected areas of over 100 ha were most frequent between 1941 and 1980 (Fig. 28b). Between 1981 and 2000, the number of fires declined to the level pertaining between 1921 and 1940.

No figures are available covering the whole area north of the Alps. In the (Alpine) area to the north of the Canton of Valais, the number of fires and the extent of the areas affected by fire have in general increased since the 1990s by a factor of 3-4 in comparison to previous decades (namely from 5.2 to almost 20 per year[7]). From 1978 onwards, a natural cause, namely lightening, was recorded in 12% of cases. In 34% of cases, the cause remains unknown.[7] In the Canton of Grisons, systematic recording of forest fires did not begin until the early 1980s. In most cases,

smaller areas are involved (1-10 ha), but some larger areas were affected (Calanda near Choir in 1943, approx. 477 ha; Münstertal in 1983, approx. 60 ha; St. Luzisteig in 1985, approx. 110 ha; Misox in 1997, approx. 405 ha). Contrary to areas south of the Alps, the evaluation of these fires pointed to significant differences in time and extent between fires caused by human activity and those of natural origin. Fires arising predominantly from human activity (74% since 1980, incl. those of unknown origin) were identified mainly in the Grisons Oberland, Rhine Valley and Central Grisons. Fires of natural origin (26% since 1980, which were caused by lightening was) are concentrated in the regions of lower Engadine, Münstertal and the southern Grisons valleys.[10]

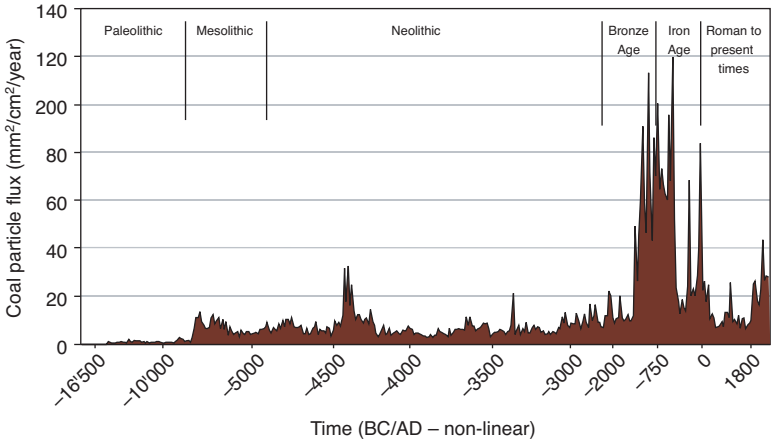

Fig. 27 Human activity also influenced the frequency of forest fires in earlier times. Deposits of carbon particles in the post-ice age, as identified in the sediment of Lake Origlio, are directly related to the frequency of forest fires.[8] The period 5000-7200 BC shows the level of natural forest fires under climatic conditions similar to today's. The very high frequency of forest fires in the bronze and iron ages is attributable to fire clearing by humans. However, fire clearing ceased when the Romans introduced the sweet chestnut around the year 1 AD.[9]

Trends in the frequency of forest fires mirror the influence of human activity. To the south of the Alps, the expansion of forest areas and the increasing quantities of combustible material left lying on the ground since the early 1960s have led to a larger number of fires. However, thanks to the proficient organisation of the fire services, the average area affected and the number of extreme events has declined. The reorganisation of the fire brigades in Ticino has been in progress since 1980. The Ordinance on Complete Prohibition of Outdoor Fires was introduced in 1987 (and partially relaxed in 1996). Furthermore, reports in the media have proved to be very effective, and the public is now more aware of environmental issues in general. In the Canton of Valais, this effect is less pronounced, environmental awareness there lagging behind by about 20 years. In the Canton of Grisons, the general prohibition applying to outdoor fires was repealed when the new cantonal forest law was introduced in 1996. However, the Grisons Forest Agency is authorised to issue temporary regional fire prohibitions when necessary via the Incendi forest fire forecasting system (www.wald.gr.ch).[11] Further forecasting methods are now being developed to cover the whole of the southern side of the Alps.[12]

Through landscape maintenance, legislation and measures to prevent fire, humans are modifying the conditions under which fires occur. By applying measures to combat fire, they are also exerting a controlling influence. Humans, however, are still responsible for most of the fires, both through negligence and arson.

Influence of climate change

Extreme events will continue to occur in the future, particularly where exceptionally unfavourable weather conditions arise. Following an extended dry period in early 1997 – and despite the generally declining tendency (Fig. 28b) – several larger forest fires occurred to the south of the Alps on days with heavy föhn gusts.[13]

In an analysis of dry periods in Ticino, although somewhat longer periods of low precipitation were found towards the end of the 20th century[14], no connection was found between these and the forest fires shown in Fig. 28. It was mentioned in Chapter 2.3 that in future, particularly to the south of the Alps in summer, reduced discharge, more acute low water and drier soils must be expected as a result of reduced precipitation and higher temperatures. This could increase the probability of several critical fire conditions arising at the same time.

The occurrence of extreme forest fires will continue to be influenced on the one hand by human action such as landscape maintenance, fire

protection and fire fighting, and on the other by the frequency of extreme weather conditions such as longer periods of drought in conjunction with heavy winds. In predicting trends in forest fires, research must take both these factors into account.

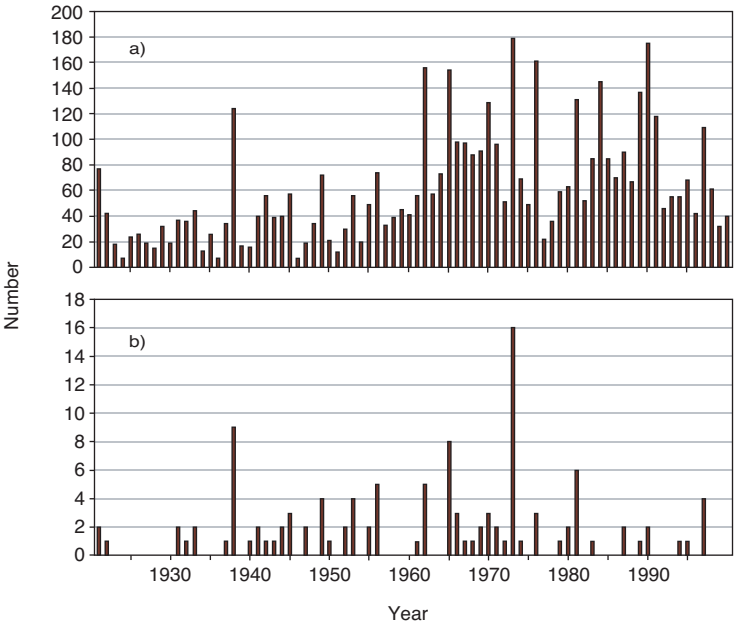

Fig. 28 Trends (a) of the number of fires per year and (b) the number of extreme events involving an area >100 ha. Reference time period 1900-2000. Database on forest fires to the south of the Alps.[5]

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