8 FOREST FIRES

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8.1 INTRODUCTION

Forests vary significantly with the location. The following refers particularly to Alpine forests with a typical elevation of 500 to 2000 m a.s.l. in the moderate climate zone. In Switzerland most forest fires occur in the Southern **part,** a small **region** of 4'000 km^2 (10% of the total national area) with a forest cover of **44%** (176'000 **ha).** Other minor fire-sensitive regions are the Northern part of the canton of Grison and the canton of Wallis.

8.2 FOREST FIRE DATA BASES

In 1992 a forest fire research project was started within the Swiss National Research Program 31 **(NRP** 31) *Climate Change arid Natural Disasters* by the. branch station south of the Alps of the Swiss Federal Institute €or Forest, Snow and Landscape Research (FNP Sottostazione Sud delle Alpi). The NRP 31 project enabled to reconstruct fire data concerning date, time, duration, cause of ignition, area burnt, fire type, forest habitat, and other variables from more than 5500 fire events since 1900 (Conedera et al. 1993). This information has been organised in **a** relational database. **A** similar data base is now in progress for the canton of Wallis (Bochatay and Moulin 1998). The spatial and temporal analysis of wildfire Occurrence has been studied for the canton of Grison through a case study (Langhart et al. 1998).

8.3 FIRE HISTROY

Based on the corresponding fire data base the fire history for southern Switzerland in this century has been recreated (Conedera et al. 1996). The significance of these factors was then verified by comparing the results with charcoal concentrations in recent sediments from the lake of Origlio (Tinner et al. 1998). The most notable aspect of fire regime development in this century is the general increase in the occurrence of fires since the sixties with a **marked** rise of summer fires since the seventies (Conedera et al. 1996, Fig. 8.1).

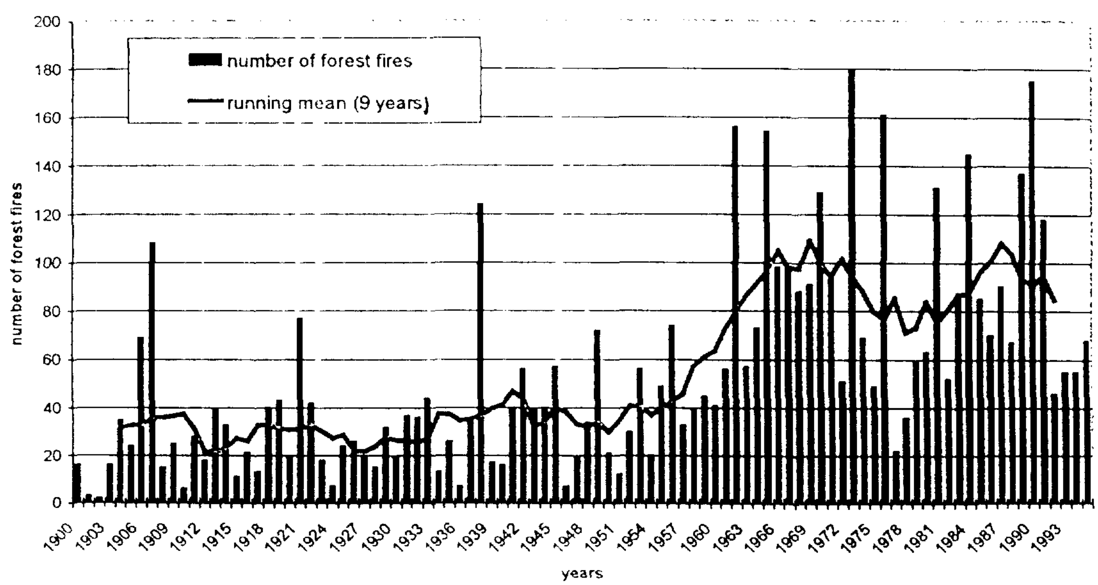

Fig. 8.1 Development of number of fires and running mean (9 Years) in Southern Switzerland.

Paleoecological methods were used in order to reconstruct prehistoric forest fires and their possible effects on vegetation (Tinner and Conedera **1995,** Tinner et al. **1998,** Tinner et al. **1999,** Berli et al. **1994).** In southern Switzerland the highest fire frequency occurred in the Holocene during the Bronze and Iron ages due to anthropogenically induced fire (slash and bum practices, Tinner et al. **1999). All** marked peaks in the charcoal curve since the Neolithic correlate with decreases of tree pollen (Tinner and Conedera **1995,** Tinner et al. **1999).**

8.4 EFFECTS OF FOREST FIRES

Different fire ecology studies on the effects of forest fires are being carried out. The main issues are:

- Post-fire vegetation reaction (tree, shrub and grass layer),
- Effects on invertebrate diversity,
- Post-fire runoff and soil erosion (splash and sheet erosion),
- Effects on soil water content,
- Effects on soil microorganisms.

Tab. 8.1:

Institute	Unit	**Group leader(s)**	**Field of activity**	**Participation EU-Projects**
Swiss Federal Institute for Forest, Snow and Landscape Research	FNP Sottostazione Sud delle Alpi	Marco Conedera Peter Marxer Marco Moretti	Fire ecology, **Fire** management	Minerve **II;** Prometheus s.v.
	ecological processes	Peter Blaser	Effects on soil	
	Biodiversity	Peter Duelli	Effects on invertebrates	
	landscape dynamics and management	F. Schweingruber	Dendroecology	
	avalanche dynamics	Perry Bartelt	Modelling	Inflame
ETH Zurich	D-WAHO	Daniel Mandallaz	**Risk** prediction	Minerve II
University of Berne	Geobotanic Institute	Brigitta Ammann Willy Tinner	Paiaeohistory	
	Department of Geography	Helmut Elsenbeer	Effects on soil	
University of Zurich	Department of Geography	Britta Allgöwer Andreas Bachmann	Modelling **Fire** Management	Minerve **II;** Inflame
University of Lausanne	Institute of Botany	Pierre Hainard	Effects on vegetation	
University of Basel	Department of Geography	Helmut Leser C. Wüthrich	Effects on soil	

Although these studies are going on, first results for the chestnut forests in southern Switzerland are available:

- Repetition of fires leads to an impoverishment of the vegetation towards fire-tolerant species (Delarze et al. 1992, Hofmann et al. 1998, Berli 1996),
- This development is not only dependent on the original floristic composition, but also on the survival strategies of the different species (Hofmann et al. 1998),
- Long-term repeated fires lead to a reduction of the nutrient level (Marxer et **al.** 1998, Delarze et al. 1992, Hofmann et al. 1998),
- Forest fires increase soil erosion, runoff and **risk** of debris flow. The magnitude of this effect seems to be a function of fire severity (Marxer et al. 1998),
- In burned areas the richness of species of many faunistic groups (spiders, carabids, ants) is higher than in unburned areas (Moretti et al. 1998),
- Distribution of the species' abundance of the burned areas reflect typically an unstable (disturbed) and dynamic ecosystem (Moretti et al. 1998),
- Different fire regimes (fire frequency and time elapsed since the last fire) have clear effects on faunistic diversity (Moretti et al. 1998).

8.5 FIRE RISK PREDICTION

The general increase in the occurrence of forest fires since the sixties (Conedera et al. *1996)* makes it increasingly necessary to improve the *forest fire risk prediction methods.* Different fire **risk** prediction approaches are operational or in development in Switzerland:

- Statistical model based on the Poisson distribution (Mandallaz and Ye 1997),
- Hybrid expert system for the spatial prediction of wildfire danger (Bolognesi 1996),
- GIS-based framework for wildfire risk asiessment (Schoning et al. 1997).

Due to the anthropogenic origin of most fires, factors describing human activities (i. e. weekends or holidays) had to be integrated in fire **risk** forecasts (Mandallaz and Ye 1997).

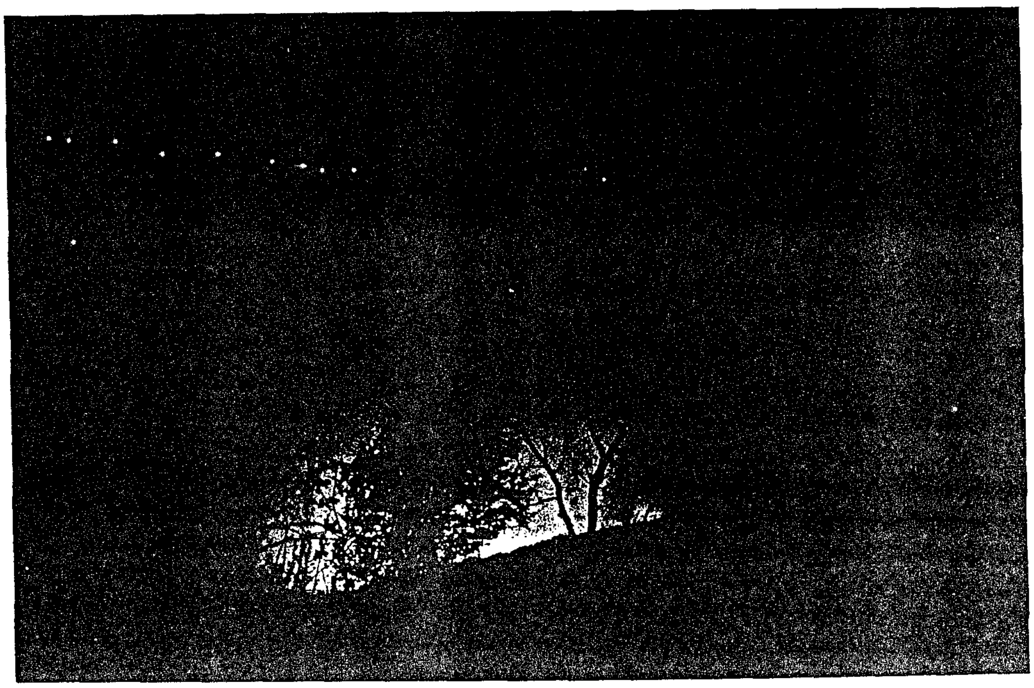

Fig.8.2 Forest lire in Sta. Maria (Misox) in **April** 1997.

8.6 FIRE BEHAVIOUR MODELLING

Fire behaviour modelling may be approached with two different scales: Landscape scale (Schoning et al. 1997) and Fuel bed scale (burn table, Bartelt 1997). The basis for the fire behaviour modelling on the *landscape level* is the Rothermel model for the behaviour of surface fires. For any given point it calculates local intensity and spread parameters for the head of a surface fire. The fire spread model is implemented in **SPARKS,** a prototype fire behaviour modelling application. It is fully integrated in a commercial Geographical Information System (ARC/INFO), built on its raster modelling and applications development functionalities (Schoning et al. 1997). In order to provide input data for the fire behaviour modelling, fuel models were built for different forest types in Switzerland (Allgower et al. 1998).

The *small scale approach* proposes to investigate the thermodynamical properties of the forest fuel bed as well as the mechanics of forest fire spread by field observations, laboratory experiments and numerical modelling in combination. Fire intensity and fire spread velocity are studied in laboratory experiments (burn table) and numerical modelling (Bartelt 1997).

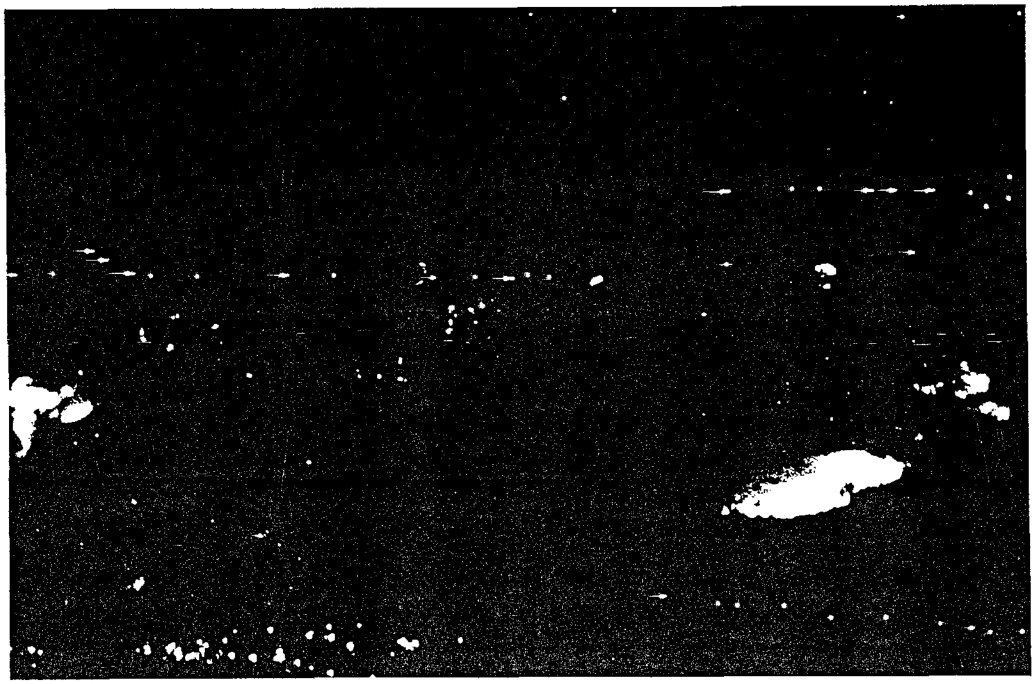

Fig.8.3 Night view of the burning slope above Mezzivico (Tessin) in April 1997.

8.7 FIRE MANAGEMENT

Although forest fires in the Alps seldom became a threat to life and property of local residents and tourists, some problems originate from forest fires in connection with the protection function of the forest, soil conservation or economical aspects of the timber industry. Therefore it is important to implement the acquired knowledge on forest fires in *decision support systems* and computer based management tools.

Different studies were already carried out on this topic: GIS-analysis for wildfire management planning in the Swiss National Park, Internet applications in the context of wildfire management, a GIS-based framework for wildfire risk assessment (Bachmann et al.

1997, Bärtsch et al. 1998) and a study on the integration of fire effects on vegetation in fire management strategies (Fürst and Conedera 1996).

Fig.8.4 Fire line of the 1998 organized fire experiment by the FNP Sottostazione Sud delle Alpi in St. Antonino (Ticino).

8.8 CONCLUSIONS

With these activities the Swiss research groups participated in European projects like MINERVE 2, INFLAME and PROMETHEUS s.v. since 1994 (Tab.8.1). The ongoing studies on prediction, modelling, ecology and effects of forest fires allow to obtain decisive instruments for supporting the responsible fire management authorities and fire brigades in order to aim at a more differentiated fire management strategy for Switzerland.

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