Windthrow research after the 1990 storm Vivian in Switzerland: objectives, study sites, and projects

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Abstract

In this special issue we publish a series of articles which summarise the results of ten years research on four study sites in mountain forests in the Swiss Alps. The study sites were set up after the 1990 blow-down caused by the storm Vivian. Each site was divided into the following three treatments: (1) uncleared with natural regeneration, (2) cleared with natural regeneration, and (3) planted (cleared with natural and planted regeneration). Special projects studied and compared the soils, the dynamics of the ground vegetation, the natural and artificial forest regeneration, the mycorrhiza, the impact of ungulates, the diversity of insects, the spread of bark beetles, the formation of avalanches, the surface erosion, and the timber decay in the different treatments. This paper summarises the common objectives of the projects and the characteristics of the four study sites.

Keywords: disturbance, blow-down, vegetation succession, forest regeneration, natural hazards, insects, mountain forest, Switzerland

1 Introduction

The majority of the contributions to this special issue on windthrow research summarise the results of ten years research on four windthrow areas carried out by the Swiss Federal Institute for Forest Snow and Landscape Research. This interdisciplinary research project was set up after the storm Vivian on February 26 to 28, 1990 to find answers to some of the questions raised in the editorial, and to support future decision-making after storms. The objectives of the research project were: (1) to document and compare the initial situations and to monitor the changes in flora, vegetation, soil and natural hazards in cleared and uncleared treatments, (2) to compare the reforestation processes in two regeneration treatments (natural regeneration and planting), (3) to compile a comprehensive decision-support tool for future management of windthrow areas after blowdown, and finally (4) to set up the study sites as exemplary teaching and demonstration sites.

Twelve of the Swiss research projects on windthrow after Vivian used four main study sites. These sites are characterised in detail in this introductory paper.

2 Study sites and experimental treatments

Four windthrow study sites (Disentis, Pfäfers, Schwanden, and Zweisimmen) in different parts of the Swiss Alps were preserved, via contract, for research. All sites were located in the oceanic northern Prealps (Fig. 1), an area that receives high precipitation. Each study site (except Zweisimmen) was divided into three experimental units which received one of three treatments: (1) uncleared: site untouched, only natural regeneration, (2) cleared: timber harvested using a cable crane, coarse woody debris removed, only natural regeneration, and
(3) planted: timber harvested, site cleared (like 2) and replanted with a variety of broadleaved and conifer species (details in SCHÖNENBERGER this issue, Table 1). In Zweisimmen the area was left uncleared, i.e. uncleared treatment only. The main characteristics of the study sites are as follows:

**Disentis** (Fig. 2): 1400–1550 m above sea level; NW-aspect; total area including all treatments about 6 ha; all treatments adjacent; pre-storm stand of pure 110- to 150-year-old Norway spruce (*Picea abies*) on a low subalpine spruce-fir (*Abies alba*) site; dystric cambisols and podsols on gneiss and granite; very steep slope of 30–45°; zone of potential release or transit of snow avalanches, sliding rocks, logs or trunks; study site in the middle of a windthrow of about 100 ha; no seed trees available, next seed trees 250–500 m distant.

![Fig. 1. Location of the four windthrow research areas in the Swiss Alps established after Vivian 1990.](image1)

![Disentis June 30, 1992. The uncleared treatment is located in the middle, the cleared adjacent on the left and the planted on the right. Photo Documenta Natura.](image2)
Pfäfers (Fig. 3 and 4): 1430–1500 m a.s.l.; WNW-aspect; treatments separated by intact forest; total area 3 ha; pre-storm stand of 70- to 120-year-old spruce-larch (*Larix decidua*)-fir on a high montane spruce-fir-beech (*Fagus sylvatica*) site; highly erodible eutric cambisols on limestone schists; very steep slope of 30–45°; landslides, avalanches and log- or trunk-sliding possible; some maple (*Acer pseudoplatanus*) in the cleared treatment, and seed trees of other species closer than 50 m; the planted treatment fenced against ungulate browsing, and furnished with temporary timber barriers to prevent the release of avalanches.

Fig. 3. Study site Pfäfers June 30, 1993. The photo shows the planted treatment with completed avalanche barriers. Photo Documenta Natura.

Fig. 4. Study site Pfäfers June 30, 1993. The uncleared treatment 1993. Photo Documenta Natura.
Schwanden (Fig. 5 and 6): 900–1100 m a.s.l.; W-aspect; total area 7 ha; treatments located in an altitudinal gradient; pre-storm stand of spruce with some beech and maple on a montane fir-beech-ash (*Fraxinus excelsior*) site; cambisols and regosols on verrucano; slope of 20–35°; few natural hazards expected except some surface erosion; forest edge at medium distance 0–150 m, some broadleaved seed trees survived on the site.

![Study site Schwanden May 20, 1992.](image)

**Fig. 5.** Study site Schwanden May 20, 1992. The uncleared treatment is located at the top; below adjacent are the cleared and the planted treatments. Photo Documenta Natura.

![Study site Schwanden June 27, 2000.](image)

**Fig. 6.** Study site Schwanden June 27, 2000. Photo Documenta Natura.
Zweisimmen (Fig. 7): 1440–1560 m a.s.l.; NW-aspect; total area 4 ha; only the uncleared treatment realised; pre-storm stand of 120- to 130-year-old spruce on high montane spruce-fir site; rendzic leptosols on limestone-breccia; gentle slope of 15–30°; no natural hazards; no seed trees on the site, but surrounded by spruce stands at a distance of 0–70 m.
3 Research projects

A linking project provided the basic information for a number of specific projects dealing with fauna, ground-vegetation, reforestation, and natural hazards. This information was extracted from historical records, sporadic aerial photographs, from yearly terrestrial photographs (Fig. 8–9), and from image analysis with GIS. The project provided an extensive site description, maps (Fig. 10), and the maintenance of the infrastructure for the benefit of all researchers.

Fig. 8–9. Vegetation dynamics documented in photographs annually repeated in the uncleared treatment Schwanden, May 26, 1992 and June 27, 2000. Photo Documenta Natura.
The projects on fauna dealt with the abundance and diversity of insects and small mammals (DUELLI et al. this issue) and the spread of bark beetles (WERMELINGER et al. this issue). The project on ground-vegetation studied the succession of plant communities (WOHLGEMUTH et al. this issue). With regard to reforestation the natural establishment of seedlings (WOHLGEMUTH et al. this issue) and the performance of planted and natural saplings (SCHÖNENBERGER this issue), the impact of browsing ungulates on the forest regeneration (SENN et al. this issue), and the role of mycorrhiza for the establishment and performance of seedlings (EGLI et al. this issue) were investigated. Natural hazards were looked at in projects on changes in soil properties (LÜSCHER this issue), on snow avalanches (FREY and THEE this issue), on rockfall, landslides, and surface erosion (GERBER et al. this issue), on the preventive effects of downed logs against natural hazards, and on the decomposition process of timber (FREY and THEE this issue). These contributions are all based on data obtained in the four study sites. 

Fig. 10. Map of treatments and installations for the different research projects, example of the study site Disentis.
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4 References


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