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Monitoring approach for forest reserves in Switzerland

Peter Brang, Lukas Rohrer, Brigitte Commarmot, Raphaela Tinner Harald Bugmann

Summary

The monitoring in Swiss forest reserves has recently been relaunched based on a Swiss-wide consistent concept. It is intended to provide federal authorities with the basis for controlling in the field of the Swiss forest reserve policy and to enhance the scientific understanding of forest succession without human intervention. The monitoring encompasses forest structure, including dead wood, and tree characteristics that are important as habitat for organisms such as stem cavities with a mulm body, stem cracks and root plates. It should enable a characterization of natural forests in widespread phyto-sociological communities, e.g. those dominated by *Picea abies or Fagus sylvatica*. It combines surveys on 100 ha of permanent plots, which are 0.1 to 3.3 ha large, with an inventory on about 1400 sampling plots, similar to those used in the Swiss and other national forest inventories. In small reserves, a full callipering at the compartment level replaces the sampling inventory. Terrestrial repeat photography is used for documentation purposes. A monitoring of species richness of birds, fungi and insects was originally envisaged, but not implemented due to financial constraints. The monitoring takes place in 15 forest reserves with an intensive and in 29 reserves with an extensive observation program. 33 reserves that have been studied for 20 to 50 years play an important role in the reserve network, as they already enable an analysis of long-term trends in forest succession.

Keywords:

Forest reserves, Switzerland, permanent plot, stand structure, habitat structures, monitoring

Introduction

In Switzerland, systematic monitoring of natural forest dynamics started with Hans Leibundgut, professor for silviculture at ETH Zurich from 1941 to 1979, who created many strict forest reserves for scientific purposes. Since a revision of the federal forest law in 1991, the Swiss Confederation supports the establishment of forest reserves in the context of its forest biodiversity strategy. The federal goal is that 10% of the forest area is declared as nature reserve before 2030, half of it being strict forest reserves which are not subject to any form of human intervention. The effectiveness of this policy shall be evaluated by monitoring. In 2006, WSL was tasked by the Federal Office for the Environment with the elaboration of a monitoring concept for Swiss natural forest reserves in collaboration with ETH Zurich.

Monitoring approach

The main objectives of the monitoring in strict forest reserves are to follow the development from managed to natural forest and to quantify differences in forest dynamics and biodiversity-related structures between forest reserves and managed forests (Brang et al 2008). The monitoring should also increase the scientific understanding of natural forest succession and contribute to environmental education. It focuses on the processes regeneration, competition, ageing, mortality and decomposition, and on habitat structures such as stem cracks and cavities.

The monitoring concept should meet the following requirements: It should be scientifically sound and compatible to similar monitoring programs in Switzerland and abroad, in particular to the Swiss National Forest Inventory and to the existing reserve research by ETH. It should be non-destructive, feasible (payable and workable) in the long term and applicable by different teams and other institutions. Moreover, it should provide results for the most important forest types (vegetation belts) in Switzerland.

The concept elaborated by WSL and ETH is modularly organized. The basic modules include

- a documentation of basic information (maps, ownership, contracts, site conditions, history, information on flora and fauna etc.)

an inventory of forest and habitat structures

a comparison with managed forests

time series photographs and

an event register, in which disturbances or special observations are noted.

A direct monitoring of biodiversity components such as fungi, xylobiontic insects or birds is impossible with the financial means available. Therefore only the assessment of biodiversity-related structures on trees is included in the basic modules. Additional biodiversity modules might be developed together with the respective specialists when required.

The former monitoring of the ETH was mainly based on (subjectively selected) permanent plots of usually 0.1 to 3.5 ha size, in which all living and standing dead trees with a minimum diameter (dbh) of 4 cm were numbered and measured periodically. Additionally, a full inventory (measurement of dbh by species) was carried out in some reserves on a compartment level (2-8 ha). The new concept combines measurements on permanent monitoring plots with a sampling inventory using a systematic grid. Full inventories are continued in small reserves < 30 ha. Permanent plots are best suited to study the spatial relationship and interactions between individual trees and different tree species, whereas the inventory by sample plots provides representative results for a certain area or stratum.

The monitoring concept envisages two intensities of monitoring, which differ in plot number and in the number of time series photographs (Table 1). The intensive monitoring provides representative results for a forest reserve. Extensive monitoring in additional reserves with similar site conditions helps to generalize the findings for each vegetation type. Up to now, 15 reserves have been selected for intensive and 29 for extensive monitoring (see Figure 1 in BRANG et al. 2009, this volume). The total area of permanent plots will be 100 ha, the number of sampling plots about 1400.

Table 1: Planned average number of observation units according to monitoring intensity.

Method	Intensive monitoring	Extensive monitoring
Permanent plots	5	1
Plots in sampling inventory	60-140	20-40
Time series photographs	10	3

The monitoring method for the permanent plots is compatible with the method used in reserve research by ETH (1948-2006) and also with the assessments on the long-term growth and yield research plots of WSL. Thus, many existing long-term data series will be continued. In addition to the previous measurements on permanent plots, the coordinates of the trees will be recorded, lying deadwood will be assessed (full inventory without coordinates) and, in some plots, a sampling of regeneration smaller than 4 cm in dbh is planned.

The method for the sampling inventory is similar to the Swiss national forest inventory. The sample plots consist of two concentric circles of 200 m^2 and 500 m^2 (Figure 1). In the inner circle all trees with a minimum dbh of 7 cm are measured, in the outer circle only trees with 36 cm dbh and larger. Habitat structures are recorded on all trees with a minimum dbh of 7 cm. They include dead wood in the tree crown, crown break, stem break, cracks in the stem, bark lesion, cavities at the tree base with decomposed wood, woodpecker and other stem cavities (Figure 2), polypores and root plates. Snags with a minimum dbh of 36 cm and living trees with a minimum dbh of 80 cm are also considered as habitat structures. The volume and quality of lying deadwood is assessed on line transects (3 transects of 15 m length per plot). Regeneration is recorded on a subplot of 2 or 20 m^2 according to its density.

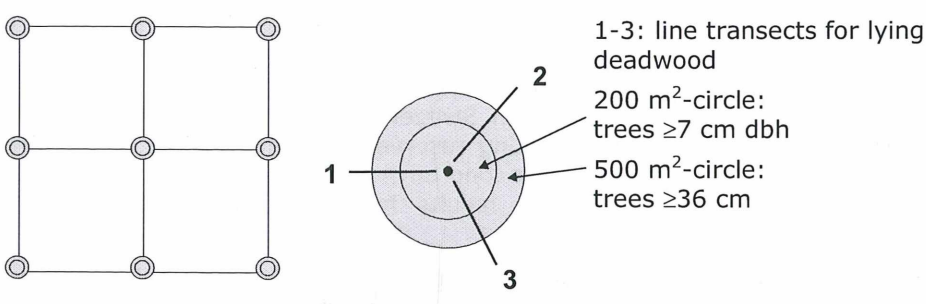

Figure 1: Sampling design for Swiss natural forest reserves

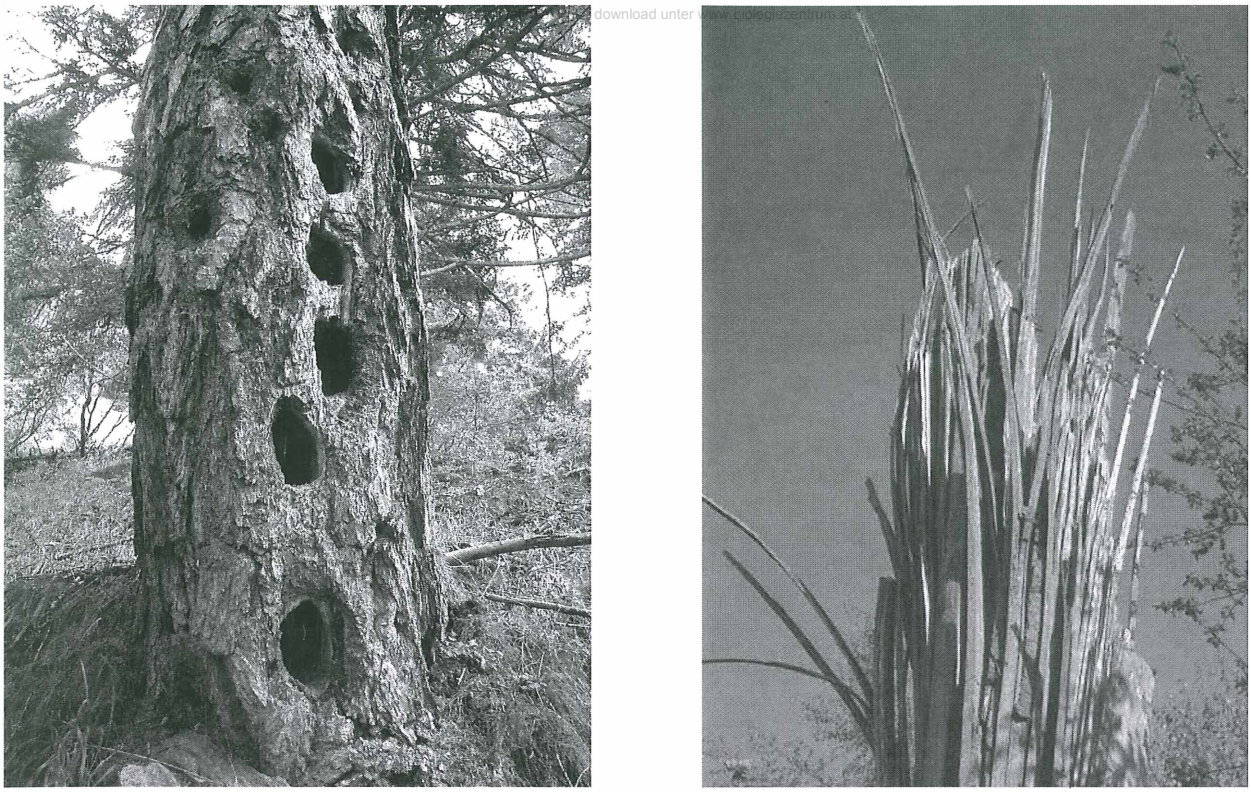

Figure 2: Examples of habitat structures: stem cavities (left) and broken and splintered stem (right).

A detailed description of the methods and the assessed attributes is underway. The data are recorded using FieldMap® software and stored in an ORACLE® database. All information required to understand the sampling is carefully archived to ensure that we and future generations are able to analyze all the gathered data.

References

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Website: www.waldreservate.ch

Contact

Dr. Peter Brang
brang@wsl.ch

Brigitte Commarmot

Raphaela Tinner

WSL Swiss Federal Institute for Forest
Snow and Landscape Research
Zürcherstrasse 111
8903 Birmensdorf
Switzerland

Lukas Rohrer

Prof. Dr. Harald Bugmann

Forest Ecology
Institute of Terrestrial Ecosystems
Department of Environmental Sciences
Swiss Federal Institute of Technology Zurich
8092 Zurich
Switzerland