Dynamic reconstruction of an uneven-aged beech-spruce stand using dendrochronological and inventory data

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Background

Data from forest growth research plots provide information for intervals only and therefore allow only a partial view of a stand development. Dendrochronological data instead can help to reconstruct retrospectively the dynamic component of stand development (Fig. 1). However, the reconstruction of uneven-aged stand is difficult due to the growth dynamics connected to the complex growth processes of single trees.

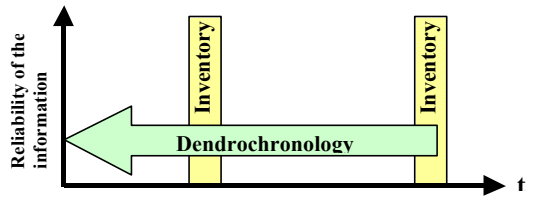


Fig. 1: Time reference and reliability of inventory and dendrochronological data

Objective

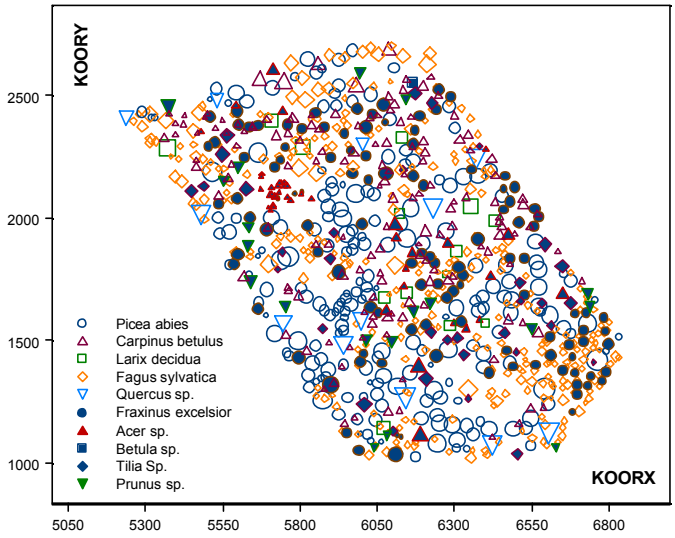
In this study we reconstruct the stand development in a selection forest, a former coppice with standards, combining dendrochronological and inventory data and discuss the potential of this integrated approach.

Fig. 2: View of a selection forest.

The main characteristic of selection forest is to have all the development stages, from the regeneration to mature trees, on the smallest possible spot. The aim is to harvest no more than the growth and to preserve the specific structure of the forest.

Material

A managed uneven-aged stand of 1,7 hectares at Basadingen, Switzerland is analyzed with data from the first inventory of 1988 and ring width data from discs taken at different heights of 26 randomly selected trees, harvested in 1998. The last stand survey was carried out in 2001. No trees were harvested. Coring is not allowed on these plots.



Methods of surveys

=> Inventory

Inventory consisted predominantly in a full census system of basic dendrometric data as specie, diameter, and height. A situation plane has also been performed (Fig. 3)

=> Dendrochronology

Ring width sequences were performed on wood discs taken at different heights of randomly selected biggest trees cut in 1998. A summary of dendrochronological material is given in the following table.

Species	# tree	# discs	# sequences
Spruce	16	19	27
Beech	7	7	12
Ashes	2	2	3
Hornbeam	1	1	1
Total	26	29	43

< Fig. 3: Structure of the stand analysed (Basadingen TG, CH).

Symbol size is proportional to the diameter at 1.3 m, DBH. The upper storey of the stand is composed mainly by spruce and beech with a few larches, oaks and ashes of DBH > 50 cm. In the middle storey beech, ash and hornbeam (20 cm< DBH <50 cm) are dominating. The lower storey (8 cm < DBH < 20 cm) is dominated by beech with spruce, maple and hornbeam. Total stand density is 527 trees/ha.

Results

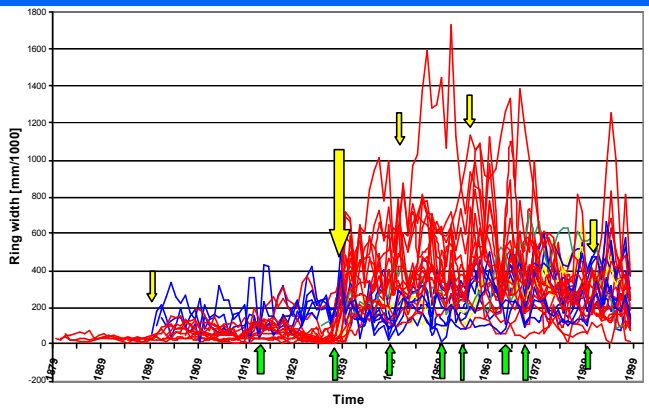


Fig. 4: Growth increment measured on the collected wood discs.

Red: spruce; Blue: beech; Yellow: ashes; Green: hornbeam.

The yellow arrows (Fig. 4, ⇩) show the management history of the stand: Until 1939 this stand was treated as a coppice with standard forest. Clearly visible is a harvest in1899. After 1899 beech (blue) established and showed an increased growth whereas spruce (red) was there already but could obviously not develop in the shadow of the old stand. The harvest of 1939 is described in the management plans as a very heavy thinning. Others lighter harvest can also be partially reconstructed. As a result of this spruce could develop much better. Spruce and beech show clearly the specific characteristics of these species: whereas beech is very shadow tolerant and may grow also under a closed canopy, this is not the case for spruce, which can survive but needs more light to develop.

The green arrows (Fig. 4, ⇧) show specific climatic influences to the growth. Drought or extreme heat during vegetation occurred in the years 1921/23, 1947/49, (1959), 1964, 1974/76, (1983), (1989), a cold period was 1939, 1956/57, 1972, 1978, 1984, 1996 according the weather stations in the Swiss plateau. Species specific reactions can be detected.

Conclusion

Research in uneven-aged forest cannot refer to a stand age as a base. All ages are present and the stand history is the result of the interaction between species and individual trees. Reconstructing the stand history with the help of cores or stem disks of harvested trees is often the only way to get more information about the stand development.

The case study of Basadingen allows to compare information from management plans with tree ring information, although the collected ring growth data is not representative for the whole stand, because of bias by cutting and disc height selection. Despite these facts, important points in stand history and species specific or individual development is clearly visible and may provide decision support for further management.