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# Dynamic Processes in Austrian Natural Forest Reserves

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## Abstract

The Austrian Natural Forest Reserve Programme has been started 22 years ago. Today it consists of 195 reserves with a total area of 8400 ha, in which forest management is not allowed in order to ensure a natural forest development. For current issues concerning biodiversity the Programme provides important reference areas.

Furthermore, research findings related to dynamic processes (increment/mortality) can respond frequently asked questions, for example regarding dead wood accumulation over time. Those results are currently available for a choice of forest associations. The future aim is to get information about deadwood enrichment and stand development phase for all forest association groups of the Austrian Natural Forest Reserve Programme.

## Keywords

Natural Forest Reserves, dynamic processes, deadwood, stand development

## Introduction

The Ministerial Conference on the Protection of Forests in Europe (MCPFE) in 1993 and the Alpine Convention in 1995 serve as political bases for the Natural Forest Reserve Programme. According to MCPFE, the Ministers for Forest and Environment committed to develop a network of forest protection areas representing all forest types. Furthermore, the Mountain Forest Protocol of the Alpine Convention contains a legal obligation to set up Natural Forest Reserves. Thus, the Austrian Natural Forest Reserve Programme was started in 1995.

Areas of near-natural forest have been selected and the abandonment of forest management measures in these areas has been contractually secured in order to ensure a natural forest development. At present, there are 195 reserves on a total area of approximately 8400 hectares. Stand and vegetation surveys were implemented at the time of each reserve establishment, hence vegetation-ecological and yield-science information is available.

Research in the Natural Forest Reserve Programme is undertaken by the Department of Forest Growth and Silviculture of the Austrian Research Centre for Forests (BFW) and focuses since 2013 on biodiversity-relevant aspects such as the presence of deadwood. The projects 'Biodiversitätsmonitoring für Bildungsgrundlagen in Naturwaldreservaten' (2013-2015) and 'Biodiversitätsreferenzflächen Naturwaldreservate' (2015-2017) have been funded by the Rural Development Programme (LE) and thus field surveys regarding stand structure, natural regeneration including browsing evaluation, vegetation, stand stability and the amount of deadwood could be implemented in more than 30 reserves. With regard to climate change and carbon dioxide storage capacity, the collected data now also provide information on current stand development phases (decrease in stand volume, increase in stand volume, equilibrium).

In the course of current surveys, the amount of deadwood is quantified. However, there is a lack of information on accumulation rates, which are of high importance according to current demands for higher biodiversity in forests. Assuming that stand mortality corresponds to deadwood accumulation, it is possible to determine the mortality rate using the results of stand development. In this way, statements about the forest development phases are possible on forest association group level. Data collection in Natural Forest Reserves in general takes place at forest association level (plant sociological associations). For evaluation, forest associations are summarized in groups.

## Methods

During the establishment as reserve, in most of them, a grid of angle counting sampling points was set up in order to determine the financial compensation for the reserve owners (FRANK & KOCH 1998). A comparison with currently collected data allows detailed information on dynamic processes in basal area, stand volume and number of stems. As part of the LE projects, the survey set was extended by additional modules such as fixed sample plot or deadwood survey (FRANK et al. 2014).

300 m² fixed sample plot

With fixed sample plots it is possible to get details about number of stems, distribution of diameter at breast height (DBH) and tree species composition. Compared to angle count samplings, the precision in low diameter ranges is higher. The data is collected on a clearly defined area of 300 m² (r = 9.77 m horizontal). Thus, repeatability is ensured and further surveys concerning other issues are possible on the same sample plots. By the use of horizontal distance, data is compatible with the angle count sampling.

deadwood survey

Deadwood surveys allow findings about volume, dimension, degree of decomposition, species composition and cause of death. Furthermore, they serve as basis for the assessment of decomposition rates as well as the stand and deadwood dynamics. The method is based on that of the Swiss National Forest Inventory for standing and lying deadwood, starting from a diameter of 10 cm (ROTH et al. 2003). Standing elements are measured on a sample plot of 300 m²; lying deadwood by using a line intersection method, positioned in the main cardinal directions.

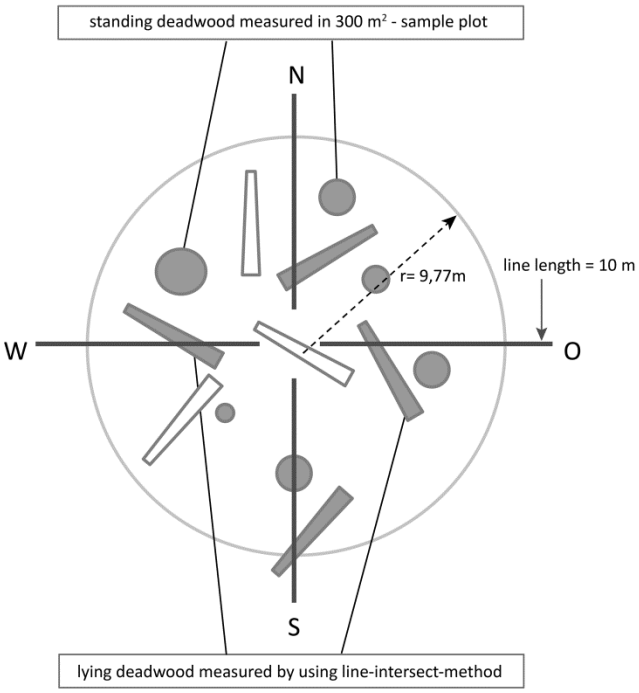


Figure 1: deadwood survey methodology in Natural Forest Reserves

## Results

Deadwood volumes differ widely, not only within the forest association groups, but also with regard to the respective natural forest reserve. Individual extreme deviations of more than 200 m³ deadwood volume per hectare are either the result of a low number of samples or caused by calamities such as wind throw or bark beetle gradations.

As expected, the lowest average deadwood volume is calculated for larch and pine forests at 27.1 (±7.0) $m^3ha^{-1}$. In spruce forests the amount of deadwood is significantly higher with 69.1 (±17.9) $m^3ha^{-1}$. Regarding broadleaved dominated forests, there are minor differences between oak and hop beech forests with 77.7 (±15.2) $m^3ha^{-1}$ and beech and lime forests with 85.5 (±12.1) $m^3ha^{-1}$. The highest average amount of deadwood is found in lowland forests and black alder-ash forests with 90.3 (±22.2) $m^3ha^{-1}$.

Conclusions on the stand dynamics of various forest associations are possible using the ratio of mortality to increment as index. A value greater than 1 means that mortality exceeds increment, the forest stand is in a phase of decreasing volume; a value less than 1 means a phase of increasing volume. An equilibrium is reached with an index value of 1.

Since mortality corresponds to deadwood accumulation, the ratio of increment and mortality can also be used to infer deadwood enrichment of a period. Thus, in addition to stand dynamics, the annual accumulation of deadwood can be estimated for different forest association groups in the reserves.

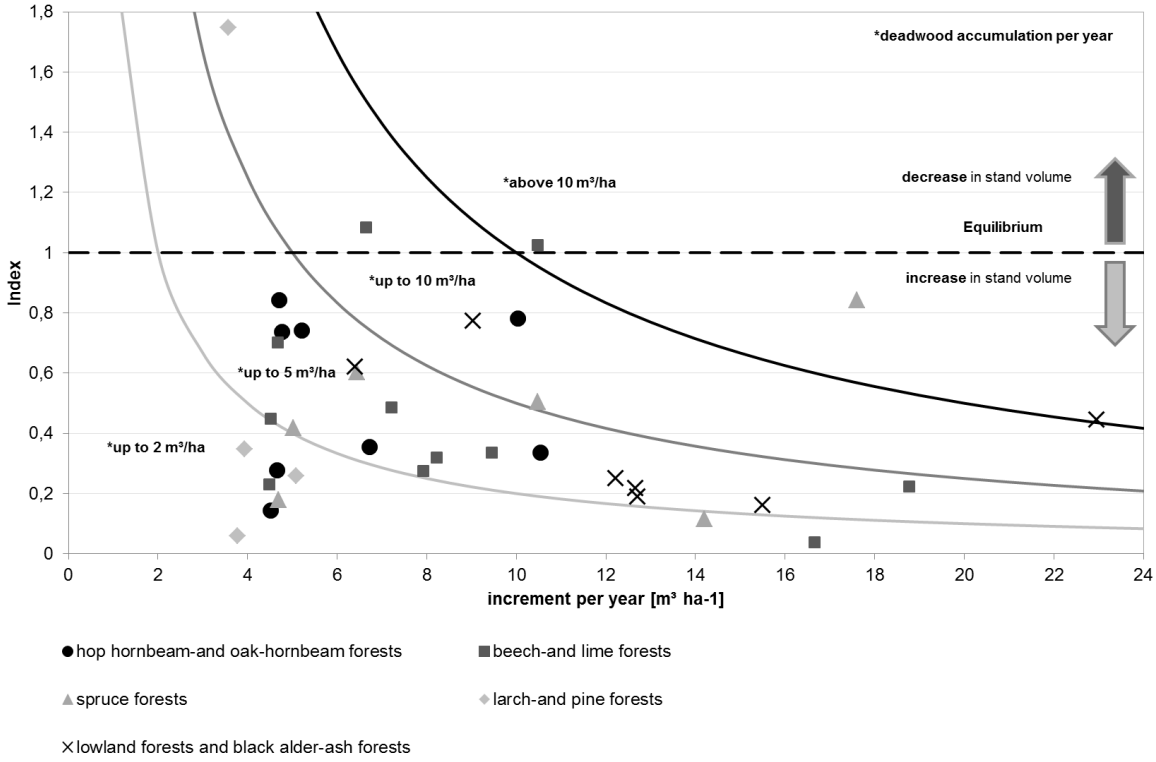


Figure 2: forest association groups in increasing/decreasing stand volume phase, respectively the annual deadwood accumulation

A large proportion of forest association groups investigated are in an increasing stand volume phase with an increment higher than mortality rate. High deadwood enrichment rates can be justified with disturbances, such as wind throw or bark beetle gradations.

## Perspective

The aim is to carry out surveys continuously in further Natural Forest Reserves and thus generate a broader data basis. In future, information on the amount of deadwood should be available for all forest association groups in the reserves. A validation of the index with respect to deadwood accumulation is only possible by means of a prospective repetition of the deadwood survey. The generated data from the Natural Forest Reserve Programme can serve as guidance for close-to-nature forest management and as reference for ecological inventories.

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