

## A Fagetum in the natural forest reserve Luxensteinwand - a rare element in the Waldviertel region

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### Abstract

Huge parts of the natural forest reserve Luxensteinwand are covered with deciduous forests representing a rare element in the coniferous dominated Waldviertel region. Changes in species composition and forest structure were investigated based on long term observations originating from 1990. Permanent sample plots and transects allowed to characterize the forest structure, stand volume, deadwood and natural regeneration. It was found that the standing volume and tree number/ha has increased and a change in tree species composition occurred due to wind disturbances and bark beetle infestations. The share of Norway Spruce decreased, whereas the share of European Beech (*Fagus sylvatica*) increased. Subsequently, interventions took place to stop the bark beetle outbreak and avoid further damages in the very close spruce-dominated forest. Apart from the mortality of very old trees, there was an accumulation of large dead wood observed in the NFR. In the total area more than 210m<sup>3</sup>/ha were found, where as the share of deadwood in relation to the living stand volume is 32%. Due to the existence of data from the years 1990, 2004 and 2015 it was possible to describe the changes in forest structure and the development of the natural reserve over a period of 25 years.

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### Keywords

Natural forest reserve, disturbances, natural regeneration, deadwood, *Fagetum*

### Introduction

Research in natural forest reserves provides insights about the natural dynamics that can serve as basis for sustainable forest management. The Austrian 'Natural Forest Reserves Program' was launched in 1995 to support the in-situ conservation of rare and endangered forest types and the study of natural dynamic processes, including the effect of natural disturbances and catastrophes (FRANK & MÜLLER 2003). Currently 195 natural forest reserves are included in the program and they allow to study natural dynamics of different forest communities being representative for Austrian forest ecosystems. The natural forest reserves serve as references for biodiversity assessments and ecological monitoring, as they are not subject to any human activities (FRANK & KOCH 1999; FRANK et al. 2005). A primary target for all natural forest reserves monitoring is the maintenance of the characteristic biological diversity for the different forest communities in Austria.

In this context huge parts of the natural forest reserve (NFR) Luxensteinwand are covered with deciduous forests representing a rare element in the coniferous dominated Waldviertel region close to the border with the Czech Republic. The owner of the 34 hectare area is the Fürstenberg Forst- und Güterdirektion Weitra. Most of the NFR are covered with deciduous forests. This represents a rare exception in the Waldviertel region, where otherwise Norway spruce (*Picea abies*) are prevalent. During the summer of 1990, the area was the object of extensive investigations for the first time. Large amount of data about the forest structure, vegetation and soil were collected and analysis of the forest structure were carried out. After 1990 the commercial harvesting was excluded from the area.

In 2004, the area of 'Luxensteinwand' was included into the so-called 'Natural forest reserve Program', an international reserve networking program of Austria. Since then, the Austrian Research Centre for Forests has been responsible for the research work in the reserve. Therefore, changes in species composition and forest structure were investigated based on long term observations originating from 1990. In 2004 a reinvestigation of the NFR was done, which formed the basis for the next documentation, which took place in 2015.

### Methods

Apart from the usual measurements about the forest structure, extensive documentation of deadwood, natural regeneration and the occurring vegetation was carried out. It was possible to make qualitative state descriptions and quantify the dangers in forest structure. Permanent sample plots and transects allowed to characterize the forest structure, stand volume, deadwood and natural regeneration.

For the long term monitoring circular permanent sample plots, 300m<sup>2</sup> in size, were established systematically on a 100x100m grid in each of the natural reserves. Trees taller than 1.3m were documented on the whole 300m<sup>2</sup> plot measuring their position, DBH, tree height, crown height and size. Additionally, damages were accessed. Standing and lying deadwood >10cm DBH/mid diameter was recorded through full enumeration on the study plot. In addition, general characteristics as altitude, aspect, slope gradient, geology, micro and meso relief and dominance of the tree layers have been assessed on each of the plots. Tree regeneration was counted (seedlings and saplings) separately for the different tree species. Additionally site parameters were investigated on each circular plot.

## Results

Due to the special blocky terrain an intensive commercial harvesting was never possible in the past. Parts of the NFR were also situated in a former deer enclosure which was already established in 1842. Since 1990 it did not exist anymore. The area is divided into two forest communities: The *Galio odorati-Fagetum* presents 85% of the area. Subdominant is the *Luzulo luzuloidis-Piceetum*.

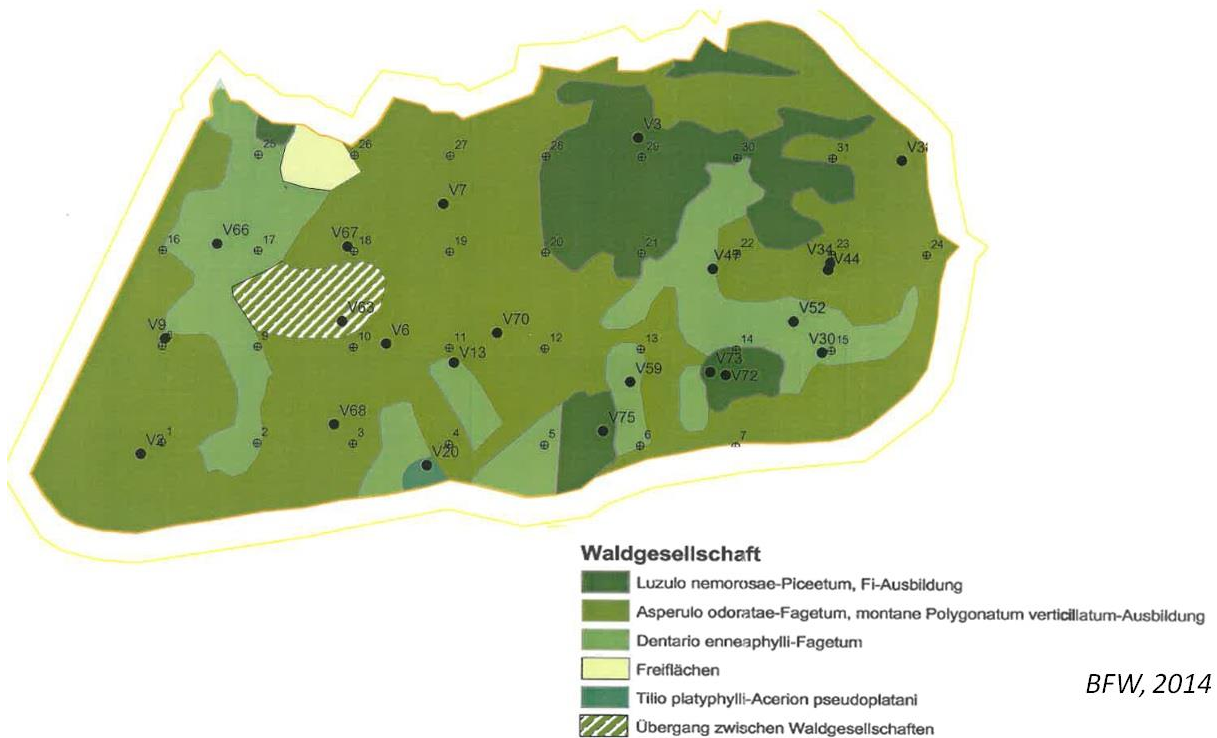


Figure 1: Map of the forest associations in the natural reserve Luxensteinwand

Between the two documented years, 2004 and 2015, a change in the forest structure and tree species composition had occurred due to wind disturbances and bark beetle infestation. Subsequently, interventions took place to stop the bark beetle outbreak and avoid further damages in the very close spruce-dominated forest. The share of Norway Spruce decreased, whereas the share of European Beech (*Fagus sylvatica*) increased.

With the collected data a growing stock volume of 650 m<sup>3</sup>/ha was calculated for the present conditions. (*Fagus sylvatica* 60%; *Picea abies* 30%; *Acer platanoides*, *Acer pseudoplatanus* and *Betula pendula* 10%). The number of trees/ha was estimated with 1660/ha and especially the smaller diameter classes had a large increase in stem numbers (Fig. 2). *Fagus sylvatica* is dominant in all tree diameter classes.

Apart from very old trees, there was an accumulation of large dead wood in the reserve which is now influencing the structure of the NFR too. The average amount of dead wood is 202 m<sup>3</sup>/ha whereas the share of deadwood in relation to the living stand volume is 32%. Because of the wind disturbances and bark beetle infestations more than 60% of the dead wood is *Picea abies*.

Due to the existence of data from the years 1990, 2004 and 2015 it was possible to describe the changes and the development of the forest reserve over 25 years. Between 1990 and 2015 there was a 10%-increase of the growing stock volume. Also the tree numbers/ha changed: + 78% over 25 years (Fig. 3).

Without the deer enclosure since 1990 there is less pressure on the trees. Now the older parts of the reserve are actually in the regeneration phases. Beside the increasing amount of growing stock volume the number of seedlings and saplings is raising. Over the 25 years the tree diversity is changing. The volume of *Acer platanoides*, *Acer pseudoplatanus*, *Tilia platyphyllos*, *Abies alba* and *Betula pendula* are decreasing. The forest will become more and more a mixture of *Fagus sylvatica* and *Picea abies*, which further stresses the importance of this natural reserve in the Waldviertel region dominated by coniferous tree species. Through the establishment of the natural reserve it was possible to serve as a node in a wider network of protected areas .

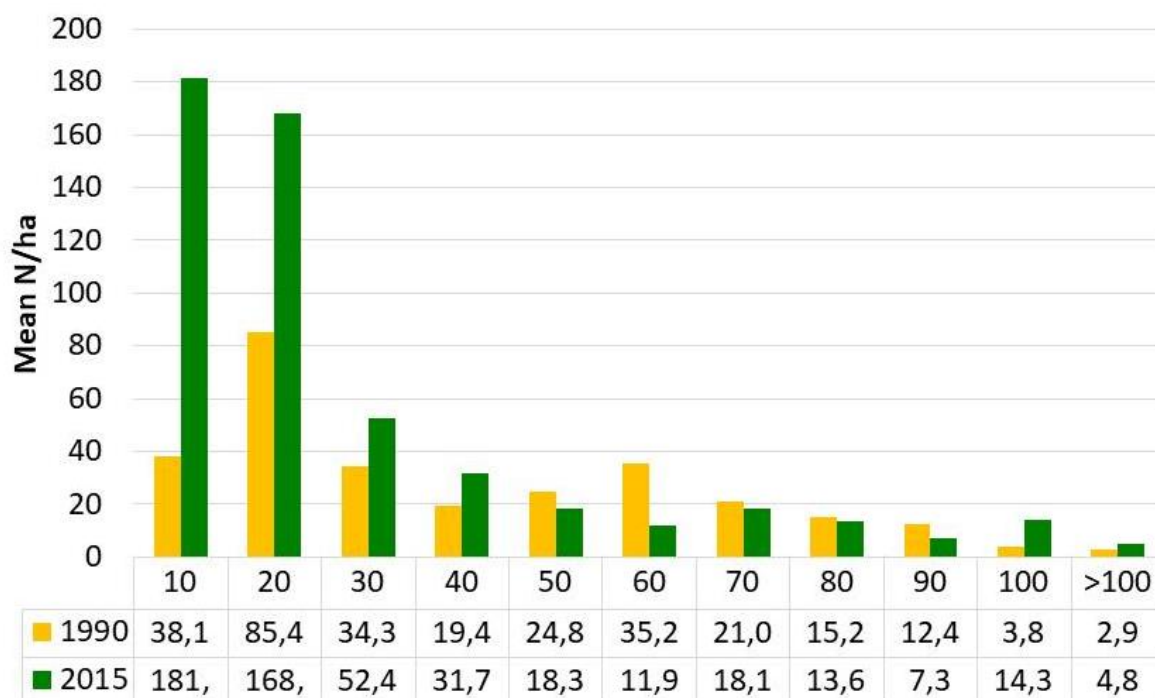


Figure 2: Distribution of the mean stem numbers for the diameter classes in the year 1990 and 2015

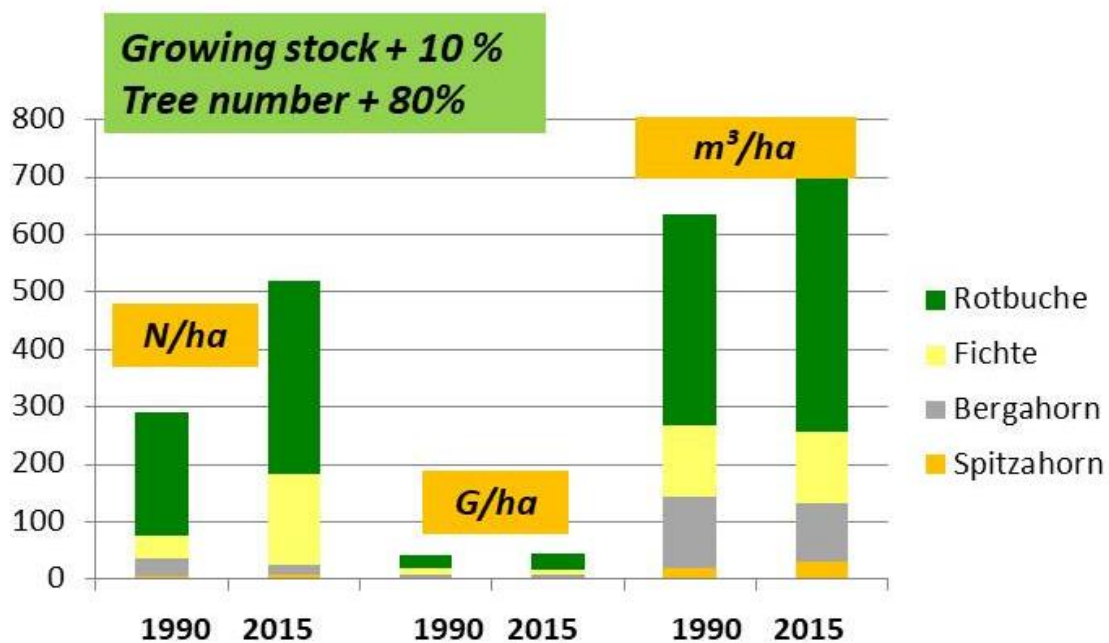


Figure 3: Change of growing stock, stem number and basal area

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