

Nature conservation – influencing factor on radial tree growth?

A conceptual approach of a new project

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Introduction

In line with an increasing ecological awareness in our society, nature conservation gains of importance. Due to the lack of economical demands in protected areas these areas are characterized by different conditions for tree growth compared to conventionally managed forests. On the one hand there is a climatic effect common to both protected as well as economically used forests. This effect can be quantified in different temporal sequences like for example pointer years, year-to-year or decadal variations and long term trends. On the other hand nature conservation might have a contrary effect on growth like forestry. One important difference is the absence of sudden increases in growth triggered by cutting of surrounding trees. As a consequence, a dissimilar tree growth, as investigated by tree ring width, will be expected in protected areas. These considerations result in the following questions:

- In which way does the protection of forest sites affect radial tree growth?
- Are there differences triggered by conservation measures, tree species or site ecological conditions?
- Will it be possible to separate the conservation signal from the climatic one? Do there exist changed climate/growth relationships for different temporal frequencies?

Strategy

Sampling will take place in both, protected and non protected areas. According to Schweingruber (1996) two samples of 12 to 15 trees per site and tree species will be taken. Thereby it will be aspired to include the whole spectrum of woodland types represented by, for example, different altitudes, expositions, soils and tree species. Only trees of an age of 100 years and older - due to statistical considerations - will be investigated.

In order to determine the impact of nature conservation, the dataset will be subdivided into two time intervals of 30 years: one before and one after the onset of conservation measures. For each time period a certain grouping is planned. Thereby it will be necessary to test the appropriate methods - cluster analysis (Neuwirth 2005) or principal component analysis (PCA) according to Wilson et al. (2001) or a combination of both. The resulting groups should combine sites with similar growth behaviour. This growth behaviour will be quantified with regard to different aspects:

- change of the average growth, for example within a nine year moving average;
- extreme years, e.g. z-transformed Cropper-values (Neuwirth 2006);

- site internal homogeneity expressed by statistical parameters like NET (Esper et al. 2001) or Gleichläufigkeit (Schweingruber 1985);
- similarity of growth behaviour, for example the Cross-Date Index (Rinn 2005);
- decadal variations, investigated with a 13 year moving average;
- long-term growth trend behaviour.

Afterwards, the attributes of the different groups have to be interpreted with regard to meta-data including site-specific information (see the following chapter). Subsequently, single year and time series analyses will be applied to evaluate the climate/growth relationship. The separation of the conservation signals will be carried out by comparing the results with those of a similar group analysis of the whole period under investigation.

Research area and Database

As research area Nordrhein-Westfalen and surrounding environs have been chosen. This decision is based on two aspects. At first, Nordrhein-Westfalen shows a multitude of topographical variations due to its location at the transition of North German Plane to the low mountain range. Secondly, due to the establishment of so called “Naturwaldzellen” (NWZ) in Nordrhein-Westfalen since the 1970’s by order of the Landesamt für Ökologie, Bodenordnung und Forsten (LÖBF) (see circles in figure 1) there exists a comprehensive ecological dataset resulting from a special kind of bio-monitoring for these sites.

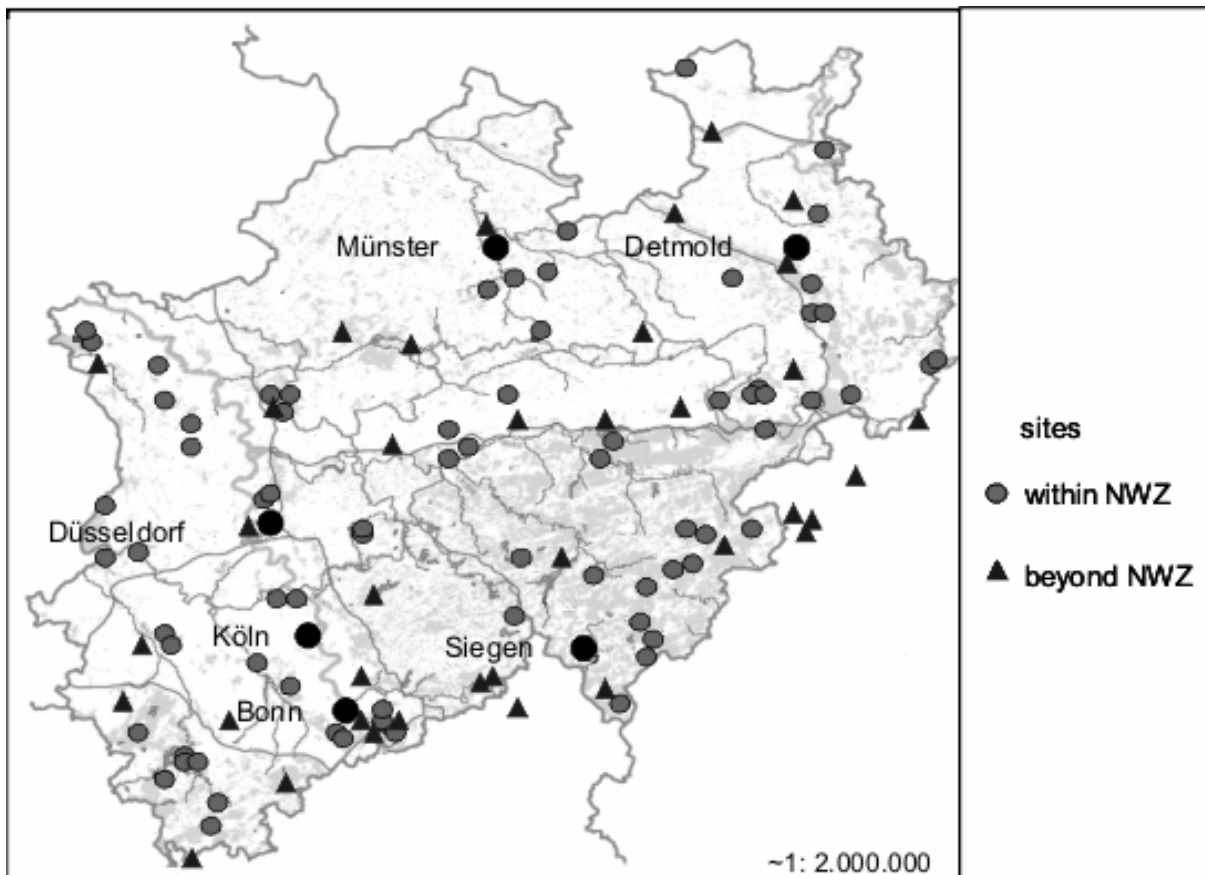


Figure 1: Research area of Nordrhein-Westfalen and surrounding regions with positions of protected (circles) and non protected sites (triangles). Every signature can include some chronologies, one for each tree species (altered after Schulte & Scheible 2005).

The NWZ are ecological forest test areas to control and understand natural tree growth. Any kind of human impact like forestry or collecting plants is strongly prohibited in these parcels. They should represent the most important woodlands concerning tree species, altitude, soil, flora, fauna, and other environmental and ecological factors and conditions.

Within this study a special dendroecological database consisting of dendrochronological, climatic and so called meta-data will be established. Concerning the dendrochronological part, the main focus will be set on collecting samples in the NWZ. In addition, data of the network of the dendrochronological working group at the University of Bonn (see triangles in Fig.1) will be used. In total, the network will include more than 200 chronologies for the important species in NRW (*Fagus sylvatica*, *Quercus robur*, *Quercus petraea*, *Picea abies*, and *Pinus sylvestris*). Climatic information will be supplied by the Climate Research Unit in Norwich (Mitchell et al. 2004). GRID data are available for the time span from 1901 to 2004 in a monthly resolution and a spatial resolution of 10 minutes. These data will be completed by daily data of the German Meteorological Service.

The meta-data include on the one hand site ecological information, like tree species, soil type, and altitude as well as information about conservation measures.

Aims and Potentials

With this presented strategy it will be possible to reach the following goals:

- completion of the forest ecological database of the LÖBF with tree-ring data;
- regional study of climate/growth relationship for NRW;
- new forest classification, e.g. a classification according to similar growth behaviour of trees derived from different sites;
- growth reaction on protection of woodland;
- a catalogue listing the effects of different conservation measures on radial tree growth; in this manner the conservation signal in the growth behaviour of trees at different sites (altitude, varying time of protection started, etc.) will be considered with regard to distinct conservation intensities of the sites, like NWZ, FFH, etc.

This project supplies a basis to create forest growth models and can also serve as decision tool to choose suitable conservation measures.

References

- Esper, J., Neuwirth, B., Treydte, K. (2001): A new parameter to evaluate temporal signal strength of tree-ring chronologies. *Dendrochronologia* 19 (1).
- Mitchell, T. D., Carter, T. R., Jones, P. D, Hulme, M., New, M. (2004): A comprehensive set of high-resolution grids of monthly climate for Europe and the globe: the observed record (1901-2000) and 16 scenarios (2001-2100). Tyndall Centre Working Paper No.55.
- Neuwirth, B. (2005): Interannuelle Klima/Wachstums-Beziehungen zentraleuropäischer Bäume von AD1901 bis 1971 – eine dendroklimatologische Netzwerkanalyse. Dissertation Uni Bonn, 162 pp. (http://ulb.uni-bonn.de/diss_online/)

- Neuwirth, B., Schweingruber, F.H., Winiger, M. (2006): Spatial patterns of Central European pointer years. *Dendrochronologia* (in press).
- Rinn, F. (2005): TSAP-WIN. Time Series Analysis and Presentation for Dendrochronology and Related Applications. Version 0.53 for Microsoft Windows. User Reference.
- Schweingruber, F. H. (1985): Dendro-Ecological Zones in the Coniferous Forests of Europe. *Dendrochronologia* 3: 67-75.
- Schweingruber, F. H. (1996): Tree rings and environment - Dendroecology. Paul Haupt, Bern, Stuttgart, Wien: 609.
- Schulte, U., Scheible, A. (2005) (Hrsg.): Atlas der Naturwaldzellen in Nordrhein-Westfalen. Landesanstalt für Ökologie, Bodenordnung und Forsten des Landes Nordrhein-Westfalen. Recklinghausen.
- Wilson, R. J. S., Hopfmueller, M. (2001): Dendrochronological investigations of Norway spruce along an elevational transect in the Bavarian Forest, Germany. *Dendrochronologia* 19: 67-79.