Needle shedding, radial and height growth of black pine *Pinus nigra* (Arnold) trees, growing on less stressed, dolomite site in Bosnia and Herzegovina

**Why this research?**

Crown status of conifers, or needle retention, together with radial/height growth, are important parameters in investigating forest health. In SE Europe, on Balkan Peninsula, needle trace method (NTM) was previously used on two pine species, growing on mountainous site under drought stress and fire influence (Poljanšek et al., 2014).

But... there is lack of knowledge of normal needle shedding process of *P. nigra* trees, growing on sites with little or no stress, whose results could represent the base for comparing needle shedding of stressed trees.

For this reason, we decided to search for *P. nigra* trees from less stressed site, growing without strong influence of pollution, insect or fungal attacks, drought stress or forest fires. Such trees have been found on more productive site, located in river Neretva valley on a low elevated hill base, growing in sub Mediterranean climate on shallow soil.

**Objectives**

1. Develop radial and height growth chronologies
2. Calculate needle trace proxies
3. Compare results to previous investigation from extreme mountainous site; (published in 2014: Tree growth and needle dynamics of *P. nigra* and *P. sylvestris* and their response to climate and fire disturbances. Trees, 1-13)

**Research areas**

Department of forest yield and silviculture investigates tree physiology, cambium activity and climate-tree growth relationships in natural and urban forests. We use pinning method for annual growth investigations, needle trace method for needle shedding, Li-cor measurements for photosynthetic analysis and main parameters of tree-rings; tree ring widths, density measurements, isotopic compositions. Together with institutes and universities from Bosnia, Wales, USA, etc, we investigated needle shed process of two pine species, reconstructed temperatures, drought indexes and sunshine hours for regions on Balkan Peninsula, and studied oak die off and cambium activity of some tree species.

**Main results**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Less stressed trees</th>
<th>More stressed trees</th>
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</thead>
<tbody>
<tr>
<td>Height in age of 50</td>
<td>18 m</td>
<td>8.3 m</td>
</tr>
<tr>
<td>Average radial growth</td>
<td>3.1 mm</td>
<td>1.5 mm</td>
</tr>
<tr>
<td>Mean needle age</td>
<td>2.5 years</td>
<td>4.5 years</td>
</tr>
<tr>
<td>Mean number of needle pairs on</td>
<td>950 short shoots</td>
<td>990 short shoots</td>
</tr>
<tr>
<td>the main stem</td>
<td></td>
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</table>

Sampled trees were up to 60 years old, 22 m high and 36 cm in diameter, and 35 cm of average annual height increment. Typical age trend is seen in radial/height growth. Over 20% and 60% of the needles were shed in age of one and two years, respectively. Total number of needles on the main stem decreased rapidly through time, from 1800 in juvenile phase to 500 needles in time before being cut. Needle density was around nine needles per cm of shoot length, but from the year 1995 onwards the density exceeds 12 needles.

**Conclusions**

Comparison showed, that the trees from lowland site grew faster/better than trees from mountainous site. We can conclude, that better productivity from less stressed, lowland site was confirmed with higher height and radial growth at comparable age.

Needles of trees from more productive (less stressed) site were on average shed 2 years younger, comparing to trees from mountainous site, while the mean number of all needles in crown from the same season was the same.

Results from this less stressed site can be used to compare needle shedding of trees from stressed sites of similar latitude.

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**Authors:**

Simon Poljanšek, Slovenian Forestry Institute, Slovenia
Dalibor Balían, Faculty of forestry, University of Sarajevo, Bosnia and Herzegovina
Tom Levanič, Slovenian Forestry Institute, Slovenia