Simon Poljanšek,

corresponding author, is trained dendroclimatologist, with interest in forest growth from mountainous, extreme sites and urban trees. He joined team as a PhD student in order to develop dendrochronological network in western part of Balkan Peninsula, continued with sunshine reconstruction and climatic signal test of blue intensity and needle trace method on black pine. Currently, he investigates drought stress of urban trees in Ljubljana, Slovenia.

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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.

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

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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...

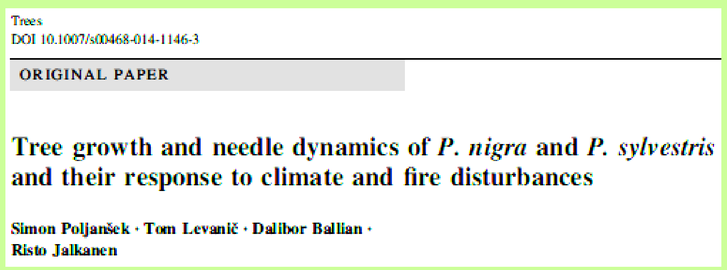
there is lack of knowledge of normal needle shedding process of *P. nigra* trees, growing on sites with little or no stress, whose results could represent the base for comparing needle shedding of stressed trees.

For this reason, we decided to search for *P. nigra* trees from less stressed site, growing without strong influence of pollution, insect or fungi attack, 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

- Develop radial and height growth chronologies
- Calculate needle trace proxies
- 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, 1-12.)


Trees
DOI 10.1007/s00468-014-1146-3

ORIGINAL PAPER

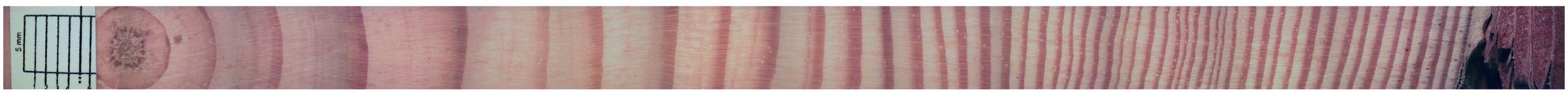
Tree growth and needle dynamics of *P. nigra* and *P. sylvestris* and their response to climate and fire disturbances

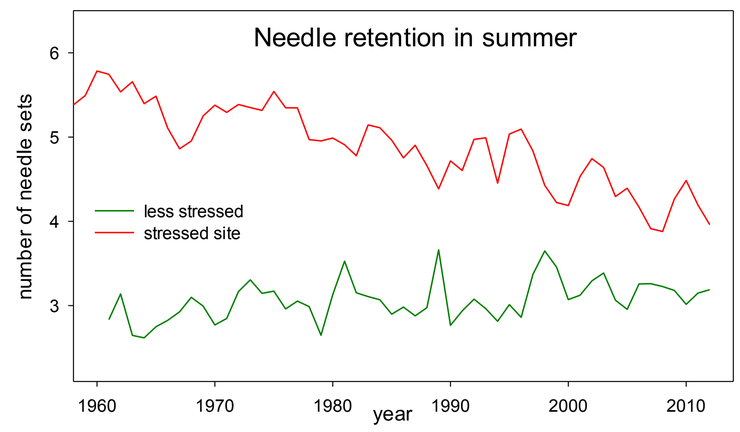
Simon Poljanšek · Tom Levanič · Dalibor Ballian · Risto Jalkanen

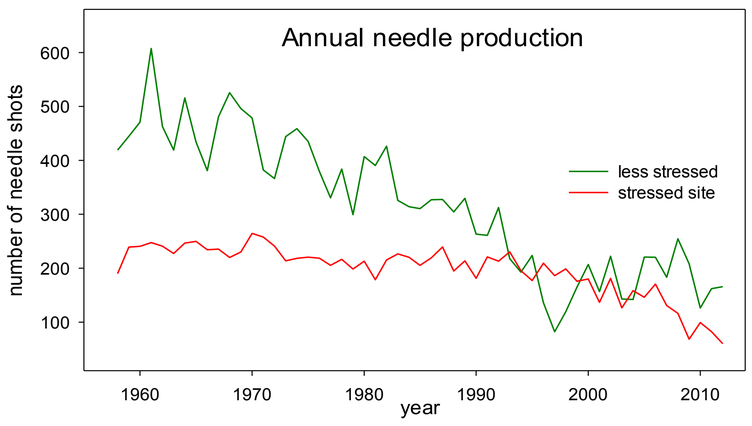
Main results

Parameter	Less-stressed trees	More stressed trees
Height in age of 50	**18 m**	8.3 m
Average radial growth	**3.1 mm**	1.5 mm
Mean needle age	**2.5 years**	4.5 years
Mean number of needle pairs on the main stem	**950 short shoots**	990 short shoots

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.







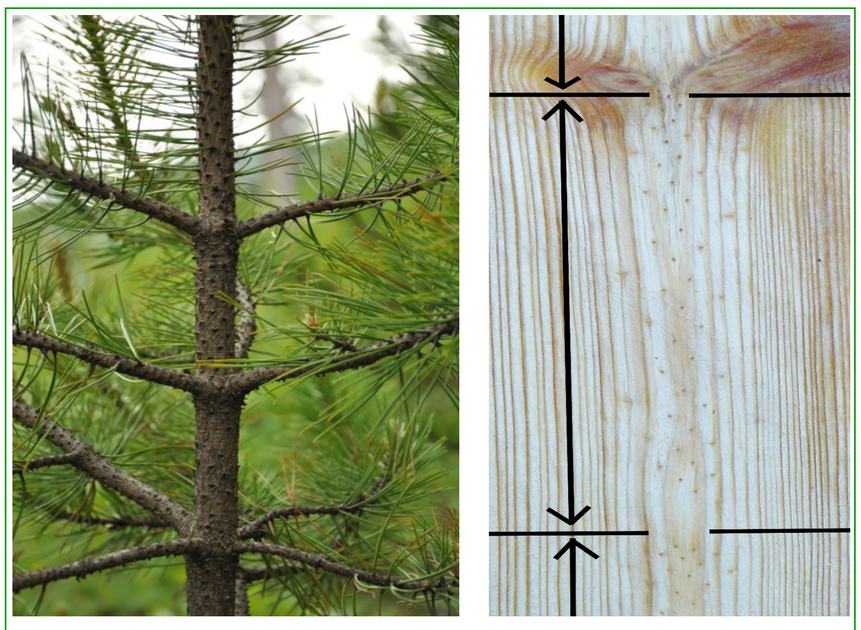
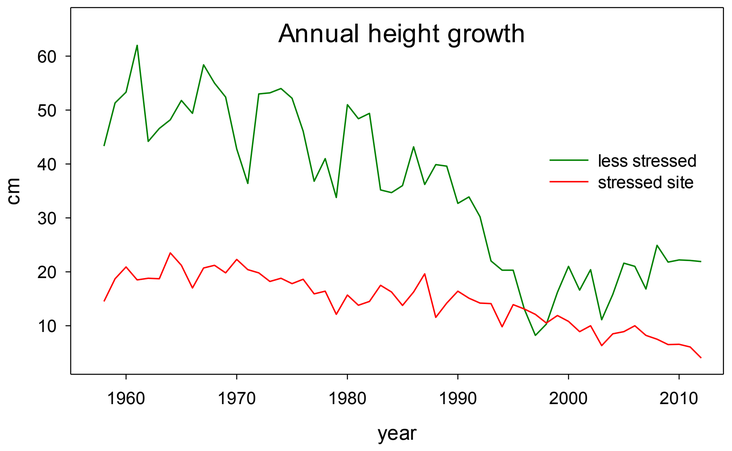
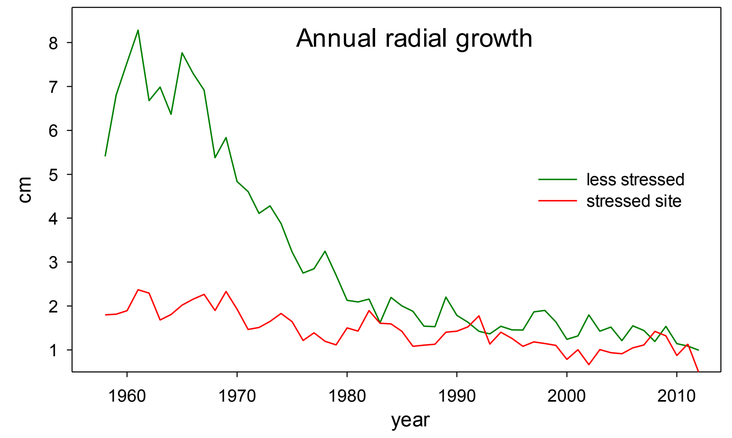


Figure left: main stem with branch whorls and the height increments between them. The upper height increment has still some needle pairs (needle shots) on, while bottom has shed all the needles.

Figure right: section through the stem with marked height increment with upper end, distinguished by branch whorl and the bottom one only with area without needles, where bud was formed.





How does climate influence needle shedding, and radial or height growth?

	Total number of needles	Needle density [n/cm]	Height increment cm	Radial growth [mm]	Needle shed [n]
Jan	-0,23	0,17	**-0,40**	**-0,38**	-0,17
Feb	-0,10	0,02	-0,06	-0,11	-0,20
Mar	-0,20	-0,12	-0,11	-0,21	-0,18
Apr	-0,06	**0,32**	-0,14	-0,05	-0,10
May	**-0,41**	**0,47**	**-0,45**	**-0,32**	**-0,29**
Jun	**-0,60**	**0,56**	**-0,62**	**-0,40**	**-0,52**
Jul	**-0,55**	**0,48**	**-0,61**	**-0,45**	**-0,43**
Avg	**-0,35**	**0,39**	**-0,41**	-0,25	-0,27
Sep	0,06	-0,03	0,06	-0,07	0,02
Oct	-0,21	0,13	-0,19	-0,14	-0,09
Nov	-0,02	0,24	-0,02	0,23	0,01
Dec	-0,21	0,17	-0,11	-0,03	-0,21
June-July	**-0,70**	**0,64**	**-0,75**	**-0,52**	**-0,59**

Correlation between needle proxy data and air temperature, bold values represent 95% significance (n=47).

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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