DENDROCHRONOLOGICAL SERIES FOR MOUNTAIN PINE IN RODNA MOUNTAINS

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Abstract

In this paper, dendrochronological series was elaborated for Mountain Pine in the Rodna Mountains, utilizing increment core from 18 trees. Calculations of statistical parameters was obtained with the ARSTAN ver. 41. Dendrochronological series covers the period 1862-2007, with significant replications after 1898 (> 5 trees). The age of the mountain pine specimens varied between 33 and 144 years with an average of 87 ± 28 years. Mean radial growth is 0.93 ± 0.59 mm·year^{-1} with a high variability. Individual mean chronologies sensitivity increased from 0.19 ± 0.04 for measured values at 0.23 ± 0.06 for residual growth indices, with maximum of 0.43 in sample number 18.

Key words: Mountain Pine, sample, tree ring, radial growth,

INTRODUCTION

Dendrochronological series is defined as a time series of annual ring parameter (width, total width of earlywood and latewood density, etc.) measured and transformed by specific methods - standardization - in series of indices (Popa, 2004). Environmental signal stored in tree-ring parameters (tree-ring width, maximum density and chemical composition etc.) is the result of complex interactions between environmental input and tree physiological output (Speer, J., 2010). Radial growth and its associated parameters for a growing season integrate current and past environmental conditions, as modified by the genetic background of species (Fritts, H, 1976).

The growth ring varies from one year to another (in the case of annual variation of the climate) or from one vegetation period (season) to another (in the case when the seasonal variation of climate is longer or shorter than a year, as far as both its width and its structure and density of wood are concerned. The annual tree ring constituted an archive a real database, regarding the secular and multi-secular variation of the environment factors at both global and mezzo-and micro scale levels.

MATERIAL AND METHOD.

Mountain pine (Pinus mugo) is the dominant component of the alpine and subalpine zone of Rodna. Dendrochronological series development for this species is difficult, so restrictive status for taking disks and also the low growth. For developing representative dendrochronological series of mountain pine for Rodna Mountains range were cut disk from a number of 18 exemplars of Lala Valley. Given the high variability of tree ring width of the samples, due to phenomena of varying eccentricity were measured a total of four rows arranged symmetrically. Measurements of the radius were checked and crossdated achieving the individual average for each disk.

The study sites are situated in the Pietrosu Massif – Piatra Neagra at 1600 meter altitude. Because of the small increment and the deformation, the extractions of the *Mountain Pine (Pinus mugo)* cores, is not possible. Each core was numbered and coded as PTRE51, PTRE52 and PTRE11. The samples were measured to the nearest 0.01 mm using digital positiometer. Cross dating was verified and corrected with computer program COFECHA.

Fig.1 Aspects from dendrochronological site for Mountain pine (Pinus mugo) - Piatra Neagră

RESULTS AND DISCUSSION

Dendrochronological series covers the period 1862-2007, with significant replications after 1898 (> 5 trees). The age of the mountain pine specimens varied between 33 and 144 years with an average of 87 ± 28 years. Mean radial growth is 0.93 ± 0.59 mm·year^{-1} with a high variability. Individual mean chronologies sensitivity increased from 0.19 ± 0.04 for measured values at 0.23 ± 0.06 for residual growth indices, with maximum of 0.43 in sample number 18. Average first order autocorrelation is 0.83 ± 0.09 for radial growth series, and 0.56 ± 0.14 to standard indices. By autoregressive modeling of growth indices the autocorrelation are statistically insignificant (0.01±0.10) in case of residual chronologies.

Statistical parameters of dendrochronological series were obtained with the program ARSTAN ver. 41 (table 1).

In time there is a high variability of radial growth, confidence interval for the mean curve in maintaining at significant values (fig. 2).

Table 1

The statistical parameters of dendrochronological series of *Mountain Pine*

Sample	First year	Least year	Number of year	Radial growth	Standard deviation	Sensibility	Autocorrelation
PTRE51	1898	2007	110	0,658	0,49	0,26	0,897
PTRE52	1895	2007	113	0,567	0,4	0,25	0,871
PTRE11	1874	2007	134	0,479	0,27	0,26	0,809
PTRE12	1875	2007	133	0,408	0,19	0,34	0,593
PTRE31	1875	2007	133	0,659	0,4	0,31	0,762
PTRE32	1875	2007	133	0,595	0,27	0,29	0,654
PTRE41	1943	2007	65	0,92	0,34	0,22	0,717
PTRE42	1943	2007	65	0,909	0,41	0,25	0,731
PTRE71	1899	2007	109	0,676	0,38	0,27	0,722
PTRE72	1897	2007	111	0,586	0,39	0,23	0,883
PTRE81	1906	2007	102	0,586	0,33	0,25	0,867
PTRE82	1911	2007	97	0,602	0,39	0,3	0,876
PTRE101	1853	2007	155	0,377	0,41	0,25	0,943
PTRE102	1855	2007	153	0,376	0,31	0,28	0,882

After 1980 there was a significant increase in standard deviation associated with the growth curve due to strong eccentricity especially visible in the outer third of disks, coupled with a significantly smaller width of tree ring. In terms of growth indices on remark the period 1970-1980 characterized by very low values of growth indices. This growth decline has multiple determinations, both climatic and anthropogenic influences due. Standard chronology presents obvious extreme values compared with the residual series. Growth index values differ from average by more than two standard deviations are found in years: negative - 1940, 1973, 1975 and positive - in 1931 and 2004. Due to the high variability of individual series the number of pointer years is reduced, being established two years negative (1934 and 1948) and two positive years (1939 and 2004). To increase the uniformity of mountain pine dendrochronological series requires first an increase in the number of samples analyzed, and secondly extend dendrochronological tests at different segments of the trunk.

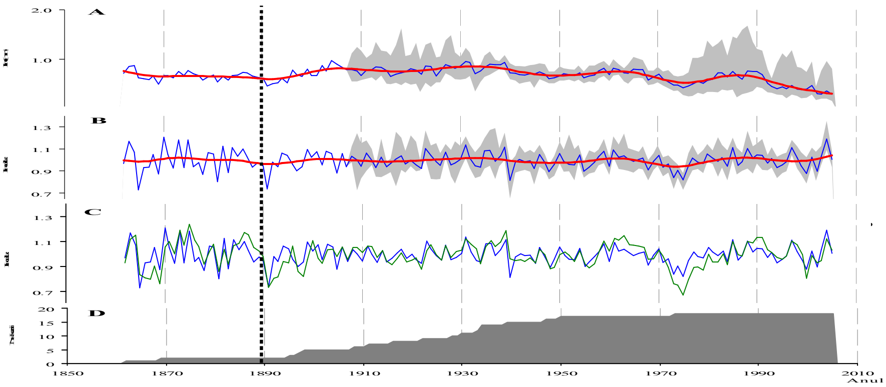

Figure 2. Dendrochronological series for mountain pine from Lala Valley (LALC): (A – mean growth series: blue – annual values, red – 20 years spline values, grey – confidence interval; B – dendrochronological series: blue – annual index values, red – 20 years spline values, grey – confidence interval; C – comparison of mean index chronologies: bleu – residual index series, green – standard index series; D – distribution in time of individual series; black dotted line – significance limit of dendrochronological series).

CONCLUSIONS

The annual tree rings, as natural archives provides important information for paleoenvironment studies. Variability of environmental factors is registered by trees throughout life through metabolic processes. This temporal dynamic is recorded codified by tree ring width (Fritts, 1976; Schweingruber, 1996), density (Polge, 1963), structure (Sass and Eckstein, 1995) or the concentration of carbon and oxygen stable isotopes (Schleser *et al.*, 1999) in wood formed each year.

In conclusion dendrochronological series for Mountain Pine the northern part of Rodna Mts. incorporating both a general Northern Hemisphere climate signal and specific influence of the Carpathian microclimate.

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