# MASTER DENDROCHRONOLOGICAL SERIES FOR STONE PINE (*PINUS CEMBRA* L.) AND SPRUCE (*PICEA ABIES* (L.) Karst.) FROM RODNA MOUNTAINS

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## Abstract

*The paper presents average correlation between the two series were obtained by integrating series of Lala and Pietrosul Rodnei for stone pine (LALA and PTRA), respectively Lala Valley, Pietrosul Rodnei and Putredu for spruce (LALB, BILA, PUTA and PITS).*

**Key words:** *Stone pine, tree ring, spruce, master dendrochronological series*

## INTRODUCTION

Forest ecosystems located at the upper latitude or altitude vegetation limit is particularly sensitive to climate changes because of their location to limit distribution of these species. Dendrochronological series is defined as a time series of annual ring parameter (width, total width of early wood and latewood density, etc.) measured and transformed by specific methods - standardization - in series of indices (Popa, 2004). 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.

## MATERIAL AND METHOD

Sampled site were located in timberline forests on altitude over 1500 m for Stone pine (LALA – 1650 m, PTRA – 1750 m) and for Spruce (LALB -1650 m, BILA -1550 m, PUTA-1500 m, PITS -1650 m.

In this paper has adopted a methodology for developing dendrochronological series in accordance with the general dendrochronology requirements and principles of ITRDB (Fritts, 1976; Cook and Kairiukstis, 1990; Popa, 2004). From each tree were extracted two cores at 1.30 m in height using a Pressler increment borer? Number of trees included in the survey range from 15 to 25 trees.

Annual ring width measurement was performed using the system Lintab at Forest Research Station Câmpulung Moldovenesc. Accuracy of tree ring width measurements was 0.001 mm (Rinntech, 2005). Values measured for each sample were recording in separate files for each experimental plot using the standard format TUCSON format (*.rwl).

Primary data processing was done with ARSTAN software ver. 4.1 (Cook and Krusic, 2006).

Individual series were checked and cross dated using the software TSAPwin (Rinntech, 2005), graphically comparing individual chronologies with average growth curve. Robustness check of cross dating process was done by statistical methods, respectively by moving correlation analysis on 50-year subperiods using the computer routines of COFECHA program (Holmes, 1983; Grissino-Mayer, 1997, 2001). Time series representing the variation of tree ring width is a combination of different signals.

For standardize growth series (Helama *et al.*, 2004) was chosen to apply a cubic spline function with frequency equal to 67% of the length of each individual series (Cook and Peters, 1981; Cook and Kairiukstis, 1990).

Dendrochronological series was achieved through robust biweight mean (Cook and Kairiukstis, 1990) which allows a reduction in the influence of outliers. Statistical calculation was done through the computer program routines ARSTAN ver. 4.1 (Cook and Krusic, 2006).

## RESULTS AND DISCUSSION

Comparative statistical analysis carried out allows the development of two reference series for stone pine and spruce growing at the upper limit of the northern part of Rodnei Mountains. These dendrochronological series were obtained by integrating series of Lala and Pietrosul Rodnei for stone pine (LALA and PTRA), respectively Lala Valley, Pietrosul Rodnei and Putredu for spruce (LALB, BILA, PUTA and PITS) (fig.1.).

Regarding the high frequency signal, that annual variability, the dynamics of the two series is relatively similar to some extreme differences between years. Spruce generally recorded in these cases differ from the average growth index greater than stone pine (1989, 1980, 1979, 1975.1947, 1913, 1893, 1876 etc.). Average correlation between the two series is 0.50 to reference period (1770-2008). Calculated by moving periods of 30 years reflect the presence of decades with independent dynamic of growth indices for spruce and stone pine. Thus, between 1830 and 1870 the correlation between spruce and stone pine decreases, with statistically non-significant values between 1850 and 1870s. Another period of reducing the correlation between two sets of growth index is observed during the decade 1900-1910.

Mean Gleichlaufigkeit coefficient between chronologies for stone pine and spruce is 0.70, with minimum values between 1850 and 1870. Correlation between growth index series from Rodna and the Alps is 0.30 for stone pine and 0.57 for spruce. Mean Gleichlaufigkeit coefficient has similar values for both stone pine and spruce (0.60).

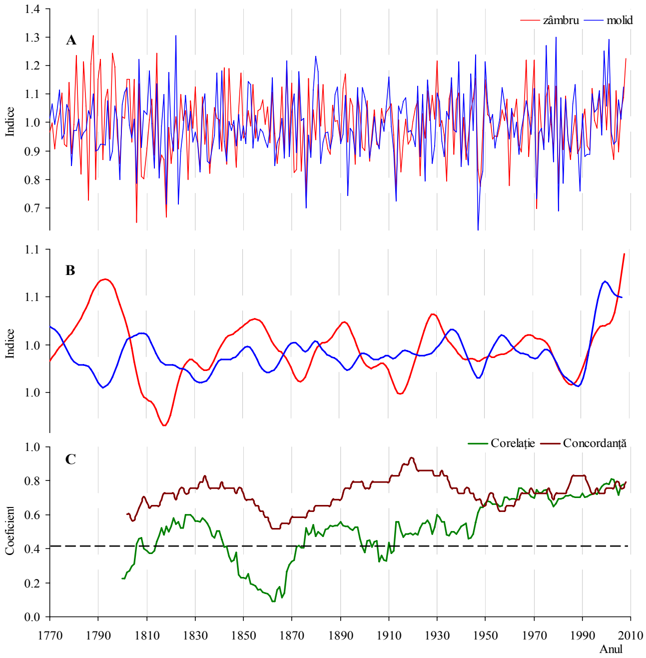


Fig. 1. Reference chronologies for stone pine and spruce from Rodna Mountains (A – annual values; B – decadal values spline of 20 years; C – correlation and Gleichlaufigkeit coefficient calculated on 30 years moving periods).

## CONCLUSIONS

Dendrochronological series for stone pine and spruce developed for 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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