CLIMATIC SENSIBILITY OF STONE PINE IN THE RODNA MOUNTAINS

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Abstract

In this study the analysis of correlation between meteorological parameters and chronologies was performed both for individual monthly values (from June precedent year to August current year of ring formation) and seasonal values: pON (previous October - November) and II (current June - July).

Related to the thermal regime, positive and statistically significant are current growing season temperatures, respectively in June (0.40) and July (0.33). Previous autumn temperatures are positively correlated with radial growth, but at the limit of statistical significance (October: 0.23 November: 0.24). Level of rainfall in February has a positive influence on radial growth processes, but at the limit of statistical significance.

Key words: Stone Pine, sample, tree ring, radial growth, climatic sensibility, response function model.

INTRODUCTION

Current global climate change raises heated discussions both scientific and political level (IPCC, 2007). Knowledge of forest species response and adaptation to climate change is a challenge for forestry research. Quantification of tree climate sensitivity requires an interdisciplinary approach and integrated.

This paper addresses issues of correlative relationship between meteorological factors (temperature and rainfall regime) and radial growth processes, expressed by growth indices, both in intensity and significance of the relationship and in terms of temporal stability. The analysis of correlation between meteorological parameters and chronologies was performed both for individual monthly values (from June precedent year to August current year of ring formation) and seasonal values: pON (previous October - November) and II (current June - July). To quantify climate model explaining the process of radial growth were applied two methods: stepwise multiple regression method and response functions, realizing them is a comparative analysis.

Experimental plot for spruce from Lala Valley is located in an ecosystem from the upper altitudinal limit on right the technical side of the stream Lala (47°31' N, 24°54' E) (fig. 1).

Fig. 1. Aspects from dendrochronological site for stone pine Lala – LALA.

MATERIAL AND METHOD

This paper addresses issues of correlative relationship between meteorological factors (temperature and rainfall regime) and radial growth processes, expressed by growth indices, both in intensity and significance of the relationship and in terms of temporal stability. Old forest ecosystems, less anthropogenically disturbed by timber extraction, is an opportunity to quantify the relationship between radial growth and changes in meteorological parameters, both in terms of statistical relationship and its temporal stability.

Study area falls in relation to regional climate in the region of mountain climate, elementary topoclimate mountain ridges, the slopes with the dominant northern and southern aspect.

Analysis of correlation between growth indices and meteorological parameters show a specific response dendroclimatic for timberline ecosystems (fig. 2).

It sees a positive correlation with the thermal regime of the current year of tree ring formation. Statistically significant are the average temperatures in July (0.29). It also noted a positive response and statistically significant to temperatures of the previous autumn (October and November (0.31)).

Regarding the minimum and maximum temperature the positive reaction of stone pine is evident, been observed a stronger influence of minimum temperature. On seasonal level are statistically significant temperatures in growing season (June-July: 0.29) and the previous autumn (October-November: 0.36).

Regarding rainfall regime, it is positively correlated with tree ring width for the months from April to May, and negative in October last year, but the intensity of correlation is weak and statistically insignificant.

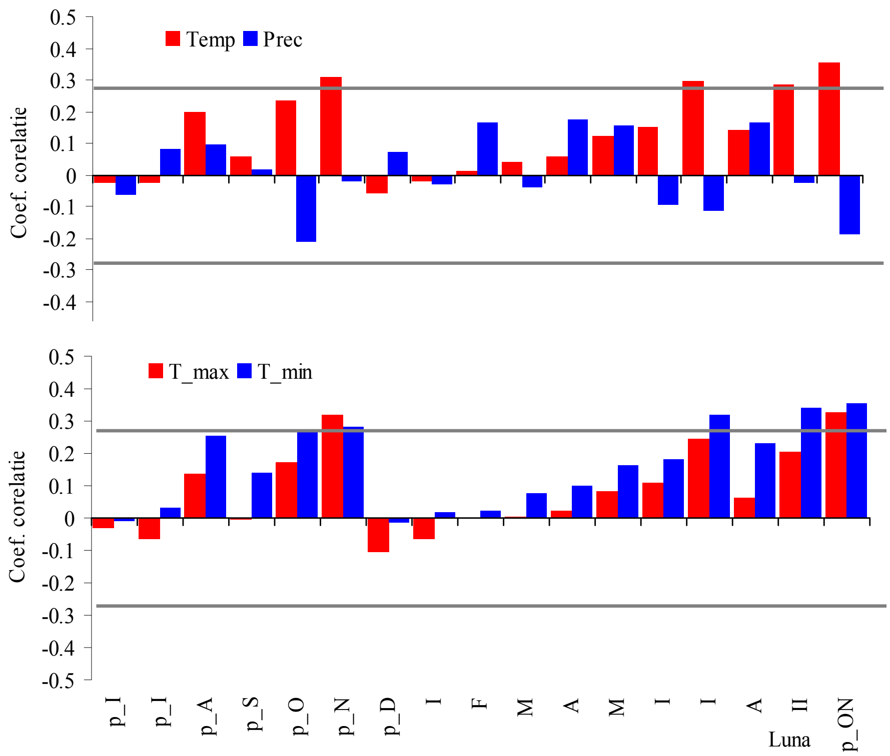

Fig. 2. Correlation between climatic factors and growth index for stone pine (LALA) from Lala area.

RESULTS AND DISCUSSION

By applying the method of analysis of response functions through which the autocorrelation between the meteorological parameters fell are confirmed and statistically significant the positive influence of temperatures from July, November (previous autumn) and the positive and significant influence of rainfall since April - May (fig. 3).

Developing a climate model of radial growth by stepwise multiple regressions led to the following regression equation:

$$I_i = 0.434 + 0.016 \cdot T_{pN_i} + 0.032 \cdot T_{I_i} + 0.001 \cdot P_{A_i} \qquad R^2 = 0.25$$

By applying the model-derived climate response functions, including the influence of all factors climatic analyzed (temperature and rainfall regime monthly) the dynamics of residual index are similar to those obtained by regressing model, however, observing an increase in variability is explained (R^2=0.39) (fig. 4).

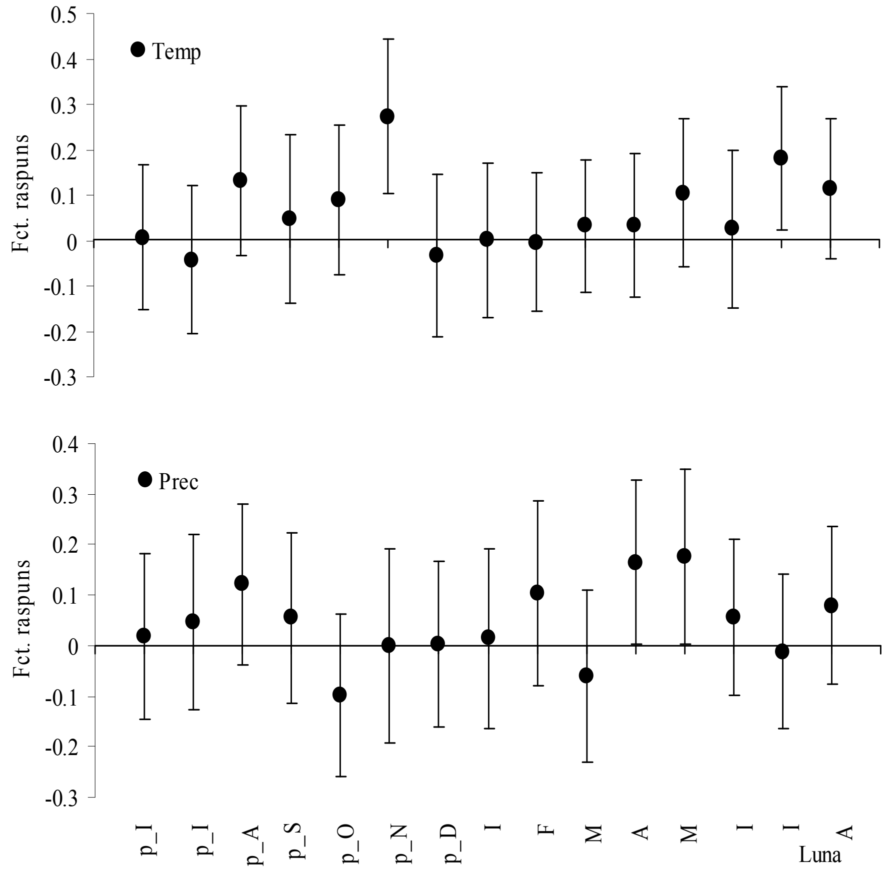

Fig. 3. Response functions for stone pine (LALA) from Lala.

Distribution of errors of the growth indices are similar in climate models implemented in the case of stone pine from Lala. Thus on remark the periods 1913-1919 and 1953-1957 where the model overestimates the growth indices, 1973-1980 and 1995-2000 respectively in which case we have an underestimation of radial growth. Otherwise error distribution is random and remains statistically acceptable limits.

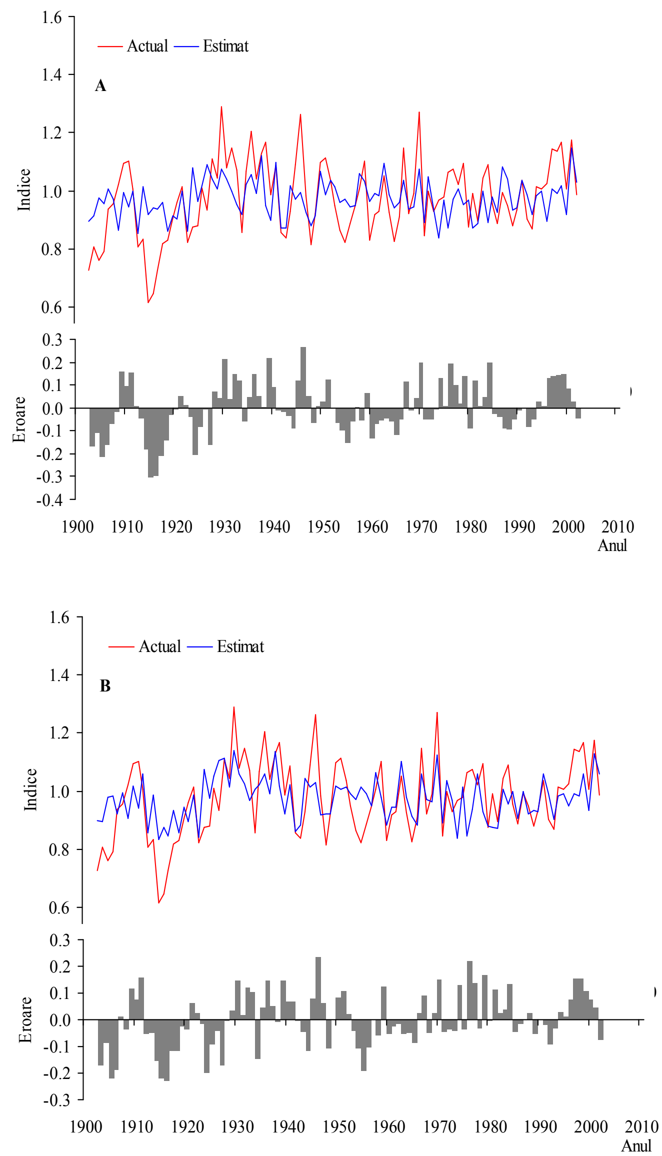

Fig. 4. Climatic modelling of growth index series for stone pine (LALA) from Lala (A: stepwise regressive model; B: response function model).

Thus the formation of the tree ring for stone pine from Lala Valley is limited by thermal regime of the previous autumn and July current year. Dendroclimatological behavior of stone pine from Pietrosul Rodnei area is similar to Lala area.

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, 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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