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Reconstructing Maximum and Minimum Seasonal Temperature from \textit{Quercus Persica} Tree Rings in Zagros Forests (Case Study of Dena Region)  

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Introduction  

Knowledge of past climate for forecasting and planning for future needs long-term and accurate climate data. Researchers have found that over certain protests caused by the climatic factors, the nature of past climate can be realized (Kaviani and Alijani, 1998, p.388). One of such sources is biological evidence. By studying the physical parameters of the tree, climate change during the life of the tree can be reconstructed (Ioder et al. 2007, Ch.3). Pan et al. (1997) found that a variety of oak species has the value dendroclimatoligical analysis.  

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Extensive studies have been conducted in the world and Iran in connection with the reconstruction of climatic variables using dendroclimatology knowledge. Among such studies one can refer to: Köse et al. (2011), Köse and Güner (2012), Jalilvand and Kazemi (2008), Safari et al (2011), Karamzade et al. (2011), Najafi et al. (2011), Amirchakhamghi and Sohrabi (2010), Azizi et al (2012), Arsalani et al. (2012), Portahmasebi et al. (2008), Balapour et al (2008) and Soosani et al. (2008). Knowledge of past climate of the biggest habitat of *Quercus Persica* in Dena region due to the lack of long-term data on climate, poverty of dendroclimatology studies in the region requires an extensive study of past climate parameters and this study is in line with these objectives.

**Materials and Methods**

Dena region is 51.12° to 51.88° along the eastern longitude and 30.51° to 31.51° along the north latitude with an area of approximately 4,500 km² and is located in the central Zagros, parts of Esfahan, Chahar Mahal and Bakhtiari, Fars province and Kohkiluyeh and Boyer-Ahmad province. To reconstruct seasonal maximum and minimum temperature, data of four weather stations of the region, i.e. Yasooj, Pataveh, Dasht-e Room and Hana were selected in the region and 30-year (1982-2011) data were analyzed. This study is categorized in two sections. First tree rings response to climatic variables was examined and in the second part, the seasonal temperature was reconstructed applying the growth tree rings. With this aim in mind, two dominant sites of *Quercus Persica* species in region were selected and a total of 36 growth samples in two Southwest and Northeast directions were extracted at breast height of 1.30 m perpendicular to the tree trunk using increment borer at the time of maximum plant growth at growth peak season in summer 2011.
After scanning the growth sample, numerating and measuring annual rings were done with an accuracy of 0.01 millimeter by LINTAB5 which is equipped with TSAP software (a new method of reading growth rings) from the skin to the kernel. Time consistency of the two species of each tree and all the trees of the site were performed using TSAP software. The GLK sign test was applied to check synchrony and homogeneity level of the growth trends of trees.

To eliminate non-climate tendencies, growth rings were standardized applying ARSTAN software (Cook, 1985). The residual chronology (RES) was used among the four constructed chronologies (RES, STD, RAW, ARS). For the constructed chronology, mean sensitivity (MS), the signal-to-noise ratio (SNR) and Expressed Population Signal (EPS) were also calculated. After constructing the appropriate chronology, in calibration stage applying the SAS software and Pearson correlation, the 30-year data (1982-2011) of regional climate stations were used to find the relation between the residual chronology of stations, with maximum average and minimum seasonal temperature of 4 meteorological stations. Then considering the gained results, the maximum and minimum seasonal temperature of the region were constructed applying the growth rings width. Then, the validity of the constructed data was tested using a meteorological station outside the region.

Discussion of Results and Conclusions

Considering the results, it seems that there is a good coordination between growth samples of each tree and all the trees together. This correlation was between the minimum amount of 75.4 and the maximum of 92.6% (75.4<=GLK<=92.6). According to the results of Pearson correlation, the relationship between climatic parameters and growth ring width was between 45 to 65 percent, with significant and positive coefficients effect. Results also point to the direct significant relationship between climate semi-cool parameters (before the growing season) and warm half of the year
(growing season) with growth ring width. Then, using a simple linear and multiple regression analysis, climatic parameters were considered as the dependent variable and growth ring width as independent variables and the final model to estimate the maximum and minimum seasonal temperature for weather stations was prepared. Based on the results of reconstructed temperatures, over the past 131 years, the mean of minimum temperature of autumn and winter had an increase of 0.2 degrees and the mean of maximum temperature of spring and summer had an increase of 0.2 and 0.1 degrees, respectively compared to the previous century. In order to test the accuracy of the reconstructed models of seasonal temperature, a comparison was made between the reconstructed minimum temperature of region’s stations and the data obtained from the synoptic station of Shahrekord which is somehow similar to Dena region in terms of climatic and topographic conditions and compared to the region, it has long-term climate data (as a control station). In general, we can say that during the last three decades, the coldness of winter has been reduced and the heat of the warm season is increased.