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Adaptive genetic potential of coniferous forest tree species under climate change: implications for sustainable forest management

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Mountain ecosystems are extremely vulnerable to climate change. The real potential for adaptation depends upon the existence of a wide genetic diversity in trees populations, upon the adaptive genetic variation, respectively. Genetic diversity offers the guarantee that forest species can survive, adapt and evolve under the influence of changing environmental conditions.
The aim of this study is to evaluate the genetic diversity and adaptive genetic potential of two local species – Norway spruce and European silver fir – in the context of regional climate change. Based on data from a long-term provenance experiments network and climate variables spanning over more than 50 years, we have investigated the impact of climatic factors on growth performance and adaptation of tree species. Our results indicate that climatic and geographic factors significantly affect forest site productivity. Mean annual temperature and annual precipitation amount were found to be statistically significant explanatory variables. Combining the additive genetic model with the analysis of nuclear markers we obtained different images of the genetic structure of tree populations. As genetic indicators we used: gene frequencies, genetic diversity, genetic differentiation, genetic variance, plasticity. Spatial genetic analyses have allowed identifying the genetic centers holding high genetic diversity which will be valuable sources of gene able to buffer the negative effects of future climate change. Correlations between the marginal populations and in the optimal vegetation, between the level of genetic diversity and ecosystem stability, will allow the assessment of future risks arising from current genetic structure.
Therefore, the strategies for sustainable forest management have to rely on the adaptive genetic variation and local adaptation of the valuable genetic resources.
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