Changes in the vegetation cover of East-Central Europe in the Holocene based on molecular diversity and distribution pattern of forest tree species

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The climate warming of the early Holocene period has shaped the distribution area of tree species forcing cold tolerant species to withdraw and promoting warm tolerant, broadleaf species to colonize new habitats towards the northern Europe. The Balkan Peninsula has served as an important refugia for many tree species during the glacial cycles of the Pleistocene, from where they were able to colonize Central Europe in the postglacial period. However, latest studies based on palynological studies as well as genetic diversity evaluations and DNA fingerprinting provided evidences of some population that survived the glacial cycles in situ, mainly at low elevations of the Carpathians and, in some parts of the Carpathian basin. In turn conifer species characterizing the woody vegetation in the cold period of the Pleistocene suffered a strong withdrawal and were outcompeted in most habitats by the colonizing broadleaf species. Swiss stone pine (Pinus cembra) has retreated to the high elevations close to the timber line, while Scots pine (Pinus sylvestris) inhabited edaphically extreme habitat types, like the ombrotrophic peat bogs or the rocky outcrops. Starting from the Middle Holocene, spruce (Picea abies) established the conifer belt in the Carpathians, occupying elevations between 1000-1700 asl, while Abies alba has become part of the mixed forests of beech and spruce without forming pure stands in the Carpathians. Beech-fir-spruce forests of the Carpathians with their delicate structure and geobotanical and floral composition have been strongly affected by the human impact, resulting mostly in pure spruce stands. Abies alba has become rare and threatened species of the Carpathians.
Latest studies based on vegetation modelling and molecular genetic approach likely forecasted that with the ongoing climate change the more drought tolerant Abies alba may become more frequent and able to establish on new habitats where spruce looks to undergo a serious decay. Beech will move upwards forming mainly pure or mixed stands on higher elevations. However, because of the longer generation time any new forest composition or the establishment of forest trees needs a longer time frame and species will not be able to succeed along with the fast climate change. Fine-scale genetic structure analysis of source tree populations can enlighten future possibilities, how human contribution may facilitate reorganization of mountain forests, and how people can mitigate the effects of the climate change to prevent the decline of mountain forest communities.