
Disentangling direct and indirect effects of climate change on ecosystem productivity in European temperate forests

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Abstract

Climate change directly affects forest functioning processes such as productivity. But it also alters forest biodiversity through changes in community composition, which in turn modifies forest productivity. Understanding the interplay between climate change, biodiversity and productivity is thus a decisive task for forest ecologists. Building on a novel approach using forest succession models to explore diversity-productivity relationships, we explored how climate change may affect these relationships, employing the model ForClim. We quantified how climate change affects the relationship between diversity and productivity along an environmental gradient in Central Europe, by comparing simulations run under "current conditions" and simulation under 2090-2100 conditions according to scenarios from three Regional Climate Models. The effect of climate change greatly varied across sites. We found that climate change mostly affects DPRs through the recruitment of new species, which ultimately results in enhanced complementarity, which thus highlights the importance of changes induced by indirect effects on species richness. Furthermore, a loss in tree diversity had a stronger effect on forest productivity in sites experiencing harsher conditions (especially drier) in the 2090-2100 period. By disentangling direct and indirect effects of climate change on ecosystem functioning, these findings explain why mixed-forests are expected to be more resilient to climate change.

Keywords: Biodiversity, Ecosystem functioning, Climate change, Forests, Gap models

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