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Impacts of forest cover and disturbance on Holocene forest biodiversity

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Forests play a critical role in carbon storage and actively mitigate climate change. By fostering biodiversity they offer further intrinsic and economic value through ecosystem functions and services. However, logging and the increasing frequency and intensity of wildfires and pest outbreaks pose significant disturbances to forests. Understanding the interactions between forest cover, biodiversity, and disturbance is essential for determining effective strategies for forest management and conservation.

To investigate past dynamics in diversity and forest cover, we utilized pollen-based vegetation reconstructions for the Northern Hemisphere over the past 10 000 years. We derived richness and forest cover and computed metrics for forest cover trends, centennial forest cover variability, and disturbance frequency and intensity. We analyzed the relationship of these potential drivers and forest cover and richness using loess models and explored spatio-temporal patterns.

Our findings reveal a negative relationship of richness with forest cover, with maximum richness observed at low to intermediate forest cover values. This indicates a potential tradeoff between high forest cover for optimal carbon storage and high biodiversity. Richness also demonstrates a normal response to centennial forest cover variability, supporting the intermediate disturbance hypothesis. Interestingly, we also find that increasing the cumulative disturbance intensity increases richness. This indicates a positive effect on forest richness from both many small and few large disturbances. This highlights the potential of disturbances to increase and maintain biodiversity in temperate and boreal forest.

These findings could help with designing forest management and conservation measures that align with carbon storage and biodiversity goals.