

## Popular abstract

### How forests cope with drought

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Drought is becoming more frequent and more severe in many parts of the world. This matters because forests store carbon, support biodiversity, regulate water, and provide many benefits to people. When drought strikes, a forest can respond in two ways: it can resist, by keeping its photosynthesis relatively stable through the dry months, and it can recover, by returning to normal once the drought ends. A forest that is strong in one of these is not always strong in the other.

This thesis asked whether healthier forests cope better with drought. Forest health, or forest integrity, was considered at two levels. Landscape-level integrity, measured by the Forest Landscape Integrity Index, describes how strongly a forest has been modified by human pressure, fragmentation, and loss of connectivity. Species-level integrity, measured by tree species diversity, describes how many tree species grow locally.

Using satellite measurements of forest photosynthesis, the study tracked how the world's stable forests responded to drought between 2001 and 2022, and used machine-learning models to link their resistance and recovery to forest integrity, climate, soil, topography, and tree cover.

The results showed a clear global contrast. Tropical and subtropical forests often resisted drought better, losing less photosynthetic activity during dry periods, but many recovered more slowly afterwards. Boreal and temperate forests often showed the opposite pattern. In most forests, resistance and recovery were negatively related: those that lost less during drought did not always bounce back faster.

Tree species diversity stood out as an important factor. More diverse forests generally resisted drought better, fitting the idea that a forest with many species holds a wider range of strategies for coping with water stress — some species may struggle while others keep functioning. Yet diversity was also linked to slower recovery. This does not mean diversity is harmful; many highly diverse forests are tropical and already very productive, leaving them less room to show rapid recovery.

Landscape-level integrity showed a weaker direct link to drought response than diversity did. This does not make intact landscapes unimportant — their effects, such as forest-edge conditions, connectivity, and local microclimate, may simply be hard to detect at a coarse global scale. Overall, forest drought resilience cannot be captured by a single measure. Resistance and recovery are different things, and they respond differently to diversity, tree cover, and climate. Protecting forests under climate change therefore means paying attention to both landscape condition and species composition, while remembering that global patterns can hide important regional differences.

**Keywords:** Geographical Information Science, forest drought resilience, forest integrity, tree species diversity, satellite remote sensing, climate change

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