

Kardol, P., Todd, D. E., Hanson, P. J. & Mulholland, P. J. (2010): Long-term successional forest dynamics: species and community responses to climatic variability. Journal of Vegetation Science 21: 627-642.

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Abstract

Long-term successional forest dynamics: species and community responses to climatic variability

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Abstract:

Question: Are trees sensitive to climatic variability, and do tree species differ in their responses to climatic variability? Does sensitivity of forest communities to climatic variability depend on stand composition?

Location: Mixed young forest at Walker Branch Watershed near Oak Ridge, East Tennessee, USA.

Methods: Using a long-term dataset (1967-2006), we analyzed temporal forest dynamics at the tree and species level, and community dynamics for forest stands that differed in initial species composition (i.e., chestnut oak, oak-hickory, pine, and yellow poplar stands). Using summer drought and growing season temperature as defined climate drivers, we evaluated relationships between forest dynamics and climate across levels of organization.

Results: Over the four-decade study period, forest communities underwent successional change and substantially increased in biomass. Variation in summer drought and growing season temperature contributed to temporal biomass dynamics for some tree species, but not for others. Stand-level responses to climatic variability were related to the responses of component species, except in pine stands. *Pinus echinata*, the dominant species in pine stands, decreased over

time due to periodic outbreaks of pine bark beetle (*Dendroctonus frontalis*). These outbreaks at Walker Branch could not be directly related to climatic conditions. Conclusions: The results indicate that sensitivity of developing forests to climatic variability is stand type-dependent, and hence is a function of species composition. However, in the long term, direct effects of climatic variability on forest dynamics may be small relative to autogenic successional processes or climate-related insect outbreaks. Empirical studies testing for interactions between forest succession and climatic variability are needed.

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[forest dynamic, gap dynamic, succession](#)

[forest ecology](#)

[climate: climate change](#)

[climate: microclimate, climate of stand](#)

Notes

Long-term successional forest dynamics: species and community responses to climatic variability

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Introduction

Methods

Site description

Tree diameter measurements

Biomass calculations

Forest stand types

Climatic factors

Data analyses

Statistical analyses

Results

Climatic variability

Individual tree species responses

Forest stand responses

Discussion

Conclusions and Implications

Acknowledgements

References

Supporting Information

Climate change; DBH; Global change; Growth; Insect outbreaks; Mortality; Palmer Drought Severity Index (PDSI); Precipitation; Summer drought; Temperature

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