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Reconstructing past and predicting future biodiversity in (sub-) tropical forests by harnessing their archive function

Anja Linstädter, Magnus Dobler, Liana Kindermann

University of Potsdam, Inst. of Biochemistry and Biology, Biodiversity Research / Syst. Botany, Germany

Abstract

Biodiversity data provides valuable information about species and habitats that exist in a particular ecosystem. This data helps conservationists to understand the functional relationships between different species and their habitats and to identify areas that are most in need of protection. Without accurate biodiversity data, it is thus difficult to make informed decisions about how to best protect and manage natural resources.

Measuring the status and trends of biodiversity is typically based on the assessment of a current condition relative to a previous condition or baseline. The ecological context for such an assessment is called a 'reference state'. However, a reference state is often challenging to quantify, or may even no longer be available in a contemporary ecosystem. This is also true for the woody vegetation in subtropical forests, woodlands and savannahs. Here, ecosystems are typically shaped by frequent natural disturbances such as wildfire and herbivory. In the past decades to centuries, the structure, composition and diversity of woody vegetation have often been massively altered by humans - either by direct human impact such as selective logging or by indirect human impact such as changes to the frequency and intensity of natural disturbances. These novel disturbance regimes may have detrimental consequences for biodiversity and natural resources, which are difficult to quantify without a proper reference state.

Here we argue that harnessing the archive function of individual trees and woody plant communities can complement or even replace the reference state approach. Based on large inventories collected along steep disturbance gradients in southern African savannahs and woodlands, we introduce a new method specifically designed to quantify disturbance impacts on tree individuals and whole stands. We contrast our results to those gained with a reference state approach. In a second step, we harness the demographic structure of woody vegetation to reconstruct temporal biodiversity changes from the past until today, and to project future changes. Our approach to generating temporal trends in biodiversity from snapshot data is also useful to inform conservation policies and management strategies.

Keywords: Biodiversity data, disturbance regime, savannahs

Contact Address: Anja Linstädter, University of Potsdam, Inst. of Biochemistry and Biology, Biodiversity Research / Syst. Botany, Potsdam, Germany, e-mail: linstaedter@uni-potsdam.de