Amphibian communities in disturbed forests: lessons from the Neo- and Afrotropics

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Summary

Timber harvesting is currently the most common commercial utilisation activity in tropical forests. Assessing the effects of logging on different aspects of biodiversity and general ecosystem properties is hence of prime importance if the few remaining areas of intact tropical forest are to be protected effectively and efficiently.

As we will point out in this chapter, tropical amphibian communities are an appropriate model system for studies on the impacts of human-induced environmental changes on the dynamics of complex biological systems. Here, we elaborate on patterns of diversity changes in tropical forest amphibian communities facing habitat alterations associated with selective logging in two globally important eco-regions (Côte d'Ivoire, Upper Guinea, West Africa and Guyana, the Guiana Shield, northern South America), and discuss findings from other previously conducted studies with similar focus.

A key statement that we stress on in this chapter is the fact that common measures of diversity, such as species richness and α-diversity only inadequately reflect processes of diversity change following anthropogenic disturbance. They also fail to describe actual impacts on the dynamics of complex biological systems. We argue that commonly used measures produce an incoherent and insufficient picture of diversity patterns and the underlying processes that shape these patterns. Thus, an understanding of higher levels

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of diversity, such as β-diversity and functional diversity (and hence compositional patterns) appears to be the key to effectively mitigating the impacts of human-induced disturbance on amphibian communities.

We show that the predictability of amphibian community composition depends on the respective level of anthropogenic disturbance imposed on a particular habitat. Hence, human activities that lead to changes in the structure of a forest, such as logging, not only alter simple system descriptors, such as the number of species in a given community, but rather alter the dynamics of the entire system. In this context, functional diversity is shown to be an important aspect underlying the actual mechanism that leads to the observed change of predictability patterns. Functional differences between species, rather than number of species per se appear to be the decisive factor in sustaining desirable ecosystem states and thus in maintaining important ecosystem services.

Because biological diversity appears to play a substantial role in ecosystem resilience required to safeguard essential ecosystem functions in the face of environmental change, we call for a critical revision of common diversity assessments approaches. We advocate the reconsideration of the uncritical use of widespread measures and descriptors of biodiversity on grounds of inconsistent patterns found throughout numerous studies, including those presented herein.

The complex nature of natural communities and the multiple aspects of biodiversity at different levels, make it necessary to incorporate processes acting on different organizational and spatial scales. When investigating the impacts of human-induced environmental changes on diverse vertebrate communities in the tropics, we should hence address compositional changes, as well as β-, and functional aspects of biodiversity. Special attention should also be drawn to the particular disturbance history of a given site and large scale cross-regional comparisons should be given priority. The consideration of these approaches in future studies would likely provide deeper insight in ecosystem processes at large scales and improve the effectiveness of current ecosystem management strategies.

Key words: anthropogenic disturbance, habitat alteration, logging, communities, Amphibia, diversity, predictability patterns, community dynamics, conservation, West Africa, northern South America

1 Introduction

Tropical forests cover 6 % of the planet. However, as early as in the late 1980s, an area of 142,000 km^2 was estimated to be lost every year, equalling 1 % of the total tropical forest area (Myers 1989). Deforestation rates have been increasing ever since (Lambin et al. 2003). The major threats to tropical rain