Responses of ecosystem components to biodiversity change

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Introduction

The world´s ecosystems currently face dramatic losses in biodiversity. Yet, little is known about whether such losses will lead to predictable effects at the ecosystem level.

For example, if a given number or group of plant species is lost from a system, it is unclear which effects this will have on other groups of organisms. In the worst case, co-extinctions could occur, leading to rapid and irreversible changes across all taxonomic levels.

Fig. 1: Aerial view of the field site (2006, C.Scherber)

Methods (Fig. 1)

An experimental research site near Jena (Germany) was set up in 2001. The site comprises 10 ha and consists of 82 grassland fields (each 20 x 20 m in size). Every field contains a given number of plant species, ranging from monocultures to up to 60-species mixtures. Data on organism abundances and ecosystem processes were collected between 2003 and 2006 by about 10 different research groups.

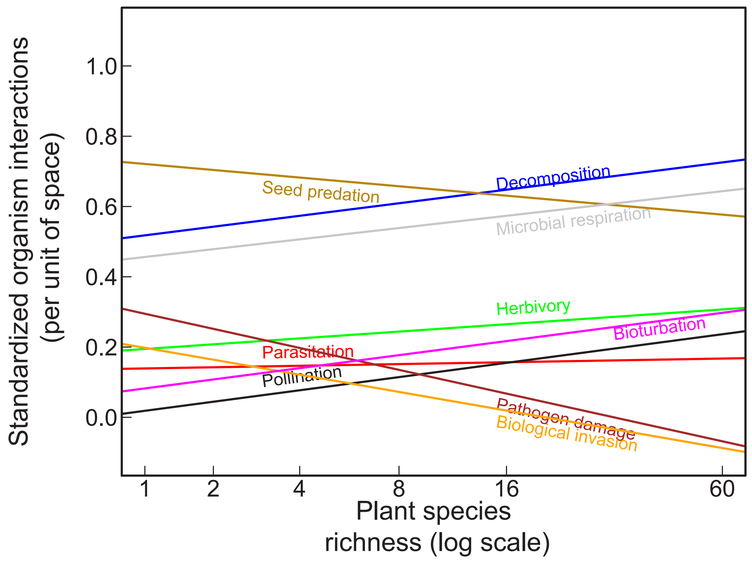

Fig. 2: Relationship between plant biodiversity (x-axis) and organism interactions (y-axis), averaged across years and scaled to [0;1]

Results and Discussion

Standardized organism abundances (Fig. 3)

Under a scenario of biodiversity loss, herbivore abundance declined more rapidly than carnivore abundance ($F_{1,71}$=10.31, P=0.002). Antagonists declined more rapidly than organisms involved in positive and/or neutral interactions, but the relationship was only marginally significant ($F_{1,71}$=3.65, P=0.06). Decomposer abundance was unaffected, while all other organism abundances declined significantly with declining plant biodiversity ($F_{1,71}$=8.96, P=0.0038).

Standardized organism species richness (Fig. 3)

The species richness of all organisms across trophic levels reacted very similarly to biodiversity loss. If plant species richness declined, the species richness of all other organism groups also declined (multivariate Pillai test statistic,$F_{8,73}$= 9.49,P=6.80 x 10^{-9}

Standardized processes (Fig. 2)

Ecosystem processes were strongly and highly significantly differentially affected by biodiversity loss. For example, positive interactions sharply declined with biodiversity loss, whzile negative interactions increased ($F_{1,81}$=23.33, P<0.0001).

These findings combined may have profound consequences from an applied point of view. Biodiversity loss may lead to an increase in antagonistic interactions at the expense of mutualisms.

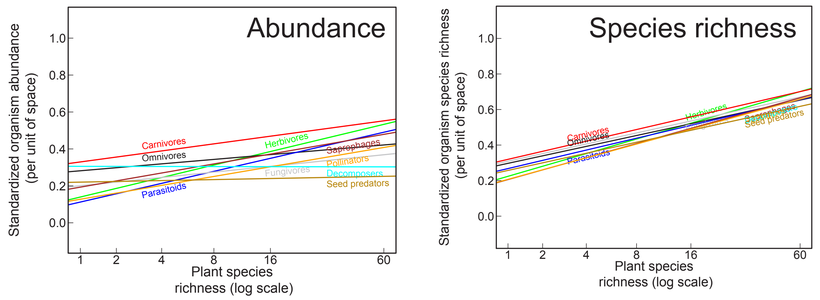

Fig. 3: Relationship between plant biodiversity (x-axis) and organism interactions (y-axis), averaged across years and scaled to [0;1]

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