Impact of invertebrate herbivory in grasslands depends on plant species diversity

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Invertebrate herbivores are ubiquitous in most terrestrial ecosystems, and theory predicts that their impact on plant community biomass should depend on diversity and productivity of the associated plant communities. To elucidate general patterns in the relationship between invertebrate herbivory, plant diversity, and productivity, we carried out a long-term herbivore exclusion experiment at multiple grassland sites in a mountainous landscape of central Germany. Over a period of five years, we used above- and belowground insecticides as well as a molluscicide to manipulate invertebrate herbivory at 14 grassland sites, covering a wide range of plant species diversity (13-38 species/m2) and aboveground plant productivity (272-1125 g x m(-2) x yr(-1)), where plant species richness and productivity of the sites were not significantly correlated. Herbivore exclusion had significant effects on the plant communities: it decreased plant species richness and evenness, and it altered plant community composition. In particular, exclusion of belowground herbivores promoted grasses at the expense of herbs. In contrast to our expectation, herbivore effects on plant community biomass were not influenced by productivity. However, effect size of invertebrate herbivores was negatively correlated with plant diversity of the grasslands: the effect of herbivory on biomass tended to be negative at sites of high diversity and positive at sites of low diversity. In general, the effects of aboveground herbivores were relatively small as compared to belowground herbivores, which were important drivers of plant community composition. Our study is the first to show that variation in the effects of invertebrate herbivory on plant communities across a landscape is significantly influenced by plant species richness.
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