Predator and prey traits interactively determine the strength of trophic cascades

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Abstract

The strength of ecological interactions is classically considered as driven by the densities of interacting species, a dogma dubbed "law of mass action". However, recent studies showed that inter- and intraspecific trait variation may also play an important role in driving the strength of ecological interactions. Here, we experimentally show in fish-zooplankton-phytoplankton lake enclosures that the strength of predator-prey interactions may depend interactively on the hunting mode of fish predators and the mobility-dependent predator avoidance ability of zooplankton prey. Compared to filter-feeding roach, visual-feeding perch reduced more severely both the abundances and body sizes of fast-swimming and large-sized

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zooplankters, which are also the most efficient phytoplankton grazers. In contrast, roach and perch had equal predation efficiencies on slow-swimming, small-sized zooplankters. The overall stronger effect of perch on the herbivorous zooplankton community resulted in higher phytoplankton concentrations and in lower abundances of epibiotic primary producers (essentially fixed on herbivorous planktonic microcrustaceans) in perch enclosures compared to roach enclosures. Specifically, the effect sizes of perch relative to roach on the concentrations of planktonic and fixed microscopic primary producers were of the same magnitude as the effects of roach relative to fishless controls. Our results demonstrate that the law of mass action is not sufficient to predict the strength of ecological interactions. Accounting for the potentially complex interplay between predator and prey behavioral and morphological traits is also necessary to accurately predict community dynamics.