
Interactions between green and brown food webs in aquatic ecosystems

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Abstract

Food webs can be split into two paths: the green food web relying on primary production and the brown food web relying on the decomposition of dead organic matter. These two food webs are connected through nutrient cycling (bottom-up coupling) and through generalist consumers (top-down coupling). Thus, perturbations in one food web can have cascading effects on the other and then deeply change community composition and ecosystem functioning. We investigated these interactions by an experiment in aquatic mesocosms performed in the Experimental Lake Platform of the CEREEEP Ecotron IleDeFrance. We crossed three treatments in 5 m³ mesocosms: daylight shading to specifically affect the green food web, organic carbon addition to specifically affect the brown food web and fishes addition as generalist top predators. We quantified abiotic compartments (dissolved carbon, sediments, mineral nutrients...) and biotic pelagic compartments from bacteria and phytoplankton density and composition to fish growth rate. We found that fishes affect phytoplankton, not through cascading effects mediated by zooplankton consumption, but probably by modifying the quality and the quantity of sediments and of dissolved organic carbon decomposed by bacteria that recycle nutrient limiting primary production. This effect of fish on the brown food web also increased phytoplankton density when light is depleted probably by compensating the decreased exudation of phytoplankton that stimulates nutrient recycling by bacteria. The organic carbon treatment weakly affected the ecosystem because of the weak degradation of some of the added compounds by bacteria. Our results emphasise that top consumers can deeply change the community not only through top-down control but also through bottom-up control by modifying the quantity and the quality of basal resources.

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