Interactions between green and brown food webs: consequences on ecosystem functioning and stability

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Abstract

Classical food-web theory on ecosystem functioning and stability has focused either on food webs based on primary production (green food webs) or on food webs based on detritus (brown food webs) and generally ignored nutrient cycling. However, nutrient cycling connects the two food webs, which questions traditional concepts of food web theory. Studying the mechanisms driving the interactions between green and brown food webs is crucial to understand the functioning and the stability of ecosystems.
We integrated these two food webs and nutrient cycling into simple ecosystem models and we investigated how interactions between these webs affect: (1) the cascading effects from one food web to the other one, and (2) ecosystem stability.

First, our results show that cascading effects between green and brown food webs depend on distinct mechanisms. The direction and strength of cascading effects of the green food web on decomposer production are determined by the carbon/nutrient limitation of decomposers whereas the effects of the brown food web on primary production are mainly driven by the relative proportion of direct/indirect nutrient cycling in the brown web.
Second, our results question the stabilizing effect of asymmetry between energy channels in ecosystems predicted by recent models. We show that asymmetry between green and brown food web channels has either stabilizing or destabilising consequences depending on the stoichiometric mismatch between producers and decomposers.

Keywords: food web, ecosystem functioning, stability

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