Nutrient recycling in complex food web models

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Abstract

The understanding of how food webs work and how they manage to persist along time has been being one of the main questions in ecology for decades. A lot of progress have been done, especially this last decade, and many mechanisms have been identified to promote food web stability. But most of recent studies largely ignore one fundamental process of ecosystem functioning : nutrients are recycled by decomposers and flow again in the food-web regarding on two paths : the green and the brown food-web. Our objective is to add the well documented process of nutrient recycling in food-web modelling to test the consequences of such an important process in ecosystem's stability. Food webs are here modelled by a set of ordinary differential equations which represents a size structured food web containing scores of interacting species. The simplest representation of nutrient recycling is implemented in such a model: nutrient are excreted either as mineral nutrient or as detritus decomposed at a fixed rate. The importance of nutrient recycling and its effects are also compared with the effects of nutrient enrichment. The main result of this study is that nutrient recycling only acts as an additional source of nutrient and not as a bottom-up effect increasing primary productivity when the top-down control applied by consumers is strong. This is due to the stability of recycling: even if species abundance varies a lot along time, the amount of recycled nutrient stays constant.

Keywords: Food web, nutrient recycling, stability, nutrient enrichment, size structured food web, detritus

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