Michał Filipiak Google Scholar; Web of Science; X (Twitter)

Stoichiometric constraints of consumer-driven nutrient cycling: Litter decomposition, detritivorous isopod and litter-dwelling ants

Imagine how life is shaped by the flow of nutrients through the food web. All organisms are components of Earth's biogeochemical system and can be considered a small cog in a large wheel, in which nutrients, i.e. chemical elements, flow from one sink to another in a never-ending cycle. This is the nutrient cycle. However, we often overlook the fact that the nutrient cycle is in the hands of consumers. It is the consumers who give life and movement to the circulation of otherwise inanimate matter.

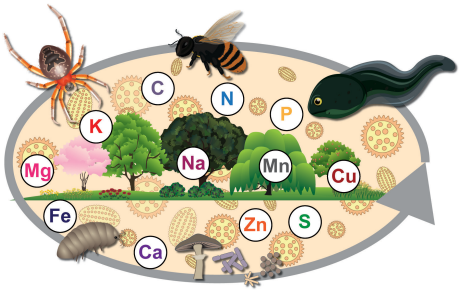
Recall the layer of litter that covers the forest floor. This is pool of nutrients connecting plants that cover different forest layers to the detrital decomposers inhabiting forest floor. These nutrients are further transferred to litter-dwelling predators. This stream of nutrients is remarkably abundant, yet difficult to use, because vital elements composing dead plant matter are diluted in a superfluous mass of carbon. This means that organisms using this stream of nutrients must have developed adaptive strategies that compensate for nutritional scarcity of their diets. Costs and benefits involved in such adaptation shape life histories of these organisms, affect the structure of biotic communities and ultimately influence ecosystem function.

How are consumers constrained by the specific and unbalanced proportions of elements? What strategies do they use to cope with these constraints? What significance may this have for consumers, food webs, and ecosystems? Answers to these questions are needed to understand the consumer–driven nutrient cycling that shapes the functioning of organisms, food webs and ecosystems. This ultimately gives us a better chance of protecting against alterations in nutrient cycling caused by anthropogenic changes.

My aim is to understand the mechanism behind the functioning of the consumer-driven nutrient cycle and the role that consumers have in this cycle. I will use the ecological stoichiometry framework and a combination of chemical analyses, fully controlled laboratory experiments, and a field study. I will investigate the stoichiometric constraints posed on consumers within forest litter-based stream of nutrients through the dynamic elemental composition of this stream. By dynamic elemental composition, I understand the fact that organisms act as nutrient carriers within the stream of nutrients and change the overall proportion of elements available for other trophic levels by selectively assimilating the needed elemental proportion to their bodies.

I will focus on a model system involving understudied feeding guilds that contribute to the stream of nutrients from forest litter through decomposers to predators. I will consider the role of stoichiometric constraints and mechanisms in mitigating these constraints in (I) litter microbial decomposition (model system: deciduous and coniferous forests), (II) detritivore body growth, development and fitness (model organism: isopod *Porcellio scaber*), and (III) ramification of nutrients in space by predators (model organisms: 6 species of litter-dwelling ants).

The nutrient depletion hypothesis posits that the contemporary rise in atmospheric CO2 levels favours carbon fixation at the expense of vital noncarbon element accumulation in plant tissues and products. The effects of this phenomenon extend beyond the boundaries of individual plants affecting consumers and ecological processes. Outcomes include increased stoichiometric mismatches and consequent shifts in animal populations and communities, posing a tangible threat of extinctions. Consequently, a comprehensive understanding of stoichiometric mismatches and the dynamic interplay between consumer-driven nutrient cycles becomes imperative.



Have a look at some of my other work

Popular-science videos: (1) Critical role of K:Na for bees; (2) Bees in nutritionally changing environments

Writing: (1) Wood beetles are nature's recyclers; (2) How to really help bees

Project: NutriB²