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Food webs made simple: The influence of body size on structure, dynamics, and functioning of complex trophic networks

Christian Guill, University of Goettingen, Germany

Trophic interactions are key to our understanding of the functioning of ecological communities. In my lecture I consider large and complex interaction networks, or food webs, that are formed by countless trophic interactions between the species of a community. Instead of characterising the dynamics of pairs of interacting species one by one, it is more instructive to identify general mechanisms that determine structure and stability of the entire networks. A key characteristic of species is their body size, as it determines to a large extent which species they prey on and to whom they are prey. In addition, species' metabolic rates (e.g. respiration or maximum ingestion) also depend on their body size. These rates control the strength of trophic interactions and thus the population dynamics of the species. The latter, in turn, determines which species of the community persist and which go extinct. In natural communities, predators are usually larger than their prey. This particular size structure of the trophic relations is in part due to mechanical constraints in the process of capturing and ingesting prey, but it also leads to dynamically stable communities. In fact, the stabilising forces of large predator-prey size ratios are so strong that even in communities with randomised size-ratios clear size-structured food webs emerge dynamically.