From winter to summer and back: linking seasonal food web models to community dynamics

Alix Sauve[*†1] and Frederic Barraquand[1,2]

[1]Integrative and Theoretical Ecology Chair, Labex COTE – Université de Bordeaux (Bordeaux, France) – France
[2]Institut de Mathématiques de Bordeaux (IMB) – Université Bordeaux Segalen - Bordeaux 2, Université Sciences et Technologies - Bordeaux 1, Université de Bordeaux, Institut polytechnique de Bordeaux, Centre National de la Recherche Scientifique : UMR5251 – 351 cours de la Libération 33405 TALENCE CEDEX, France

Abstract

Although effects of seasonality are increasingly well understood at the population level and for small communities, little is known on how seasonality affects large food webs. Theoretical perspectives put forth that some level of temporal niche partitioning could promote community persistence and stability. In particular, a recent theoretical study based on the empirical food web of Bialowieza forest in Poland proposes that the interaction turnover due to seasonality is such as to limit the risk of species extinction. Yet, theory on small systems suggests that seasonality can induce rich dynamics, including cycles of varied periods and chaos, which are prone to species extinctions. These contrasted results invite to further explore the consequences of interaction seasonality on community stability, from both structural and dynamical viewpoints. To that effect, we model the dynamics of the prey-predator community of Bialowieza forest by means of a Lotka-Volterra model with seasonal forcing on prey growth and predators' attack rates. With this model, we investigate on how climate change leading to more or less interaction turnover can affect community dynamics. We specifically explore the ability of the prey-predator community to persist over time, the community-wide synchrony of species abundances, and their temporal variability. To contribute to bridging the gap between the study of small systems and large communities, we extend the module-based approach previously developed for non-seasonal food webs, and explore how the seasonal dynamics of a large community relates to those of small communities.

[*]Speaker
[†]Corresponding author: alix.sauve@cri-paris.org