

An open-system approach to ecological networks

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Abstract

Biological diversity is essential for the maintenance of the ecosystems functions that support life in the planet. Inherent to this diversity is the seemingly endless way in which the biological entities of a natural system interact and affect each other at local and regional scales, conforming complex ecological networks permeable to external forcing. Existing approaches to capture and model such complexity typically make unrealistic or excessively restrictive assumptions. In a joint research with Sonia Kéfi, Pablo Marquet, Sergio Navarrete and Sergio Rojas we use concepts from open dynamical systems and meta-community theory to develop a framework in which the system dynamics is a function of both interspecific interactions in the focal system (e.g. a local community of coexisting species), and unobserved biotic and abiotic interactions with the local and regional environment (e.g. the metacommunity). Species in the focal system interact through direct exchanges of biomass (i.e. trophic interactions), as well as through altering the acquisition and/or transformation of biomass by other species (non-trophic interactions). Interactions are affected by environmental fluctuations and by migration and emigration processes, which can take place at different time scales and can be modeled by stochastic differential equations driven by a mixture of continuous and discontinuous processes. In this manner, the proposed framework provides a wider and more flexible representation of the complexity of ecological systems, in comparison with the closed system paradigm that isolates the system from the environment.

This conference is based on the joint paper [2], (see also [1]).

References

- [1] Mara A Freilich, Rolando Rebolledo, Derek Corcoran, and Pablo A Marquet. Reconstructing ecological networks with noisy dynamics. *Proceedings of the Royal Society A: Mathematical, Physical and Engineering Sciences*, 476(2237):20190739, 2020.

- [2] Rolando Rebolledo, Sergio A Navarrete, Sonia Kéfi, Sergio Rojas, and Pablo A Marquet. An Open-System Approach to Complex Biological Networks. *SIAM Journal on Applied Mathematics*, 79(2):619–640, 2019.