Functional Ecology

British Ecological Society

Beyond species loss: the extinction of ecological interactions in a changing world

Alfonso Valiente-Banuet, Marcelo A. Aizen, Julio M. Alcántara, Juan Arroyo, Andrea Cocucci, Mauro Galetti, María B. García, Daniel García, José M. Gómez, Pedro Jordano, Rodrigo Medel, Luis Navarro, José R. Obeso, Ramona Oviedo, Nelson Ramírez, Pedro J. Rey, Anna Traveset, Miguel Verdú & Regino Zamora

In a changing world, habitat loss, climate change, species declines and invasion of exotic species are the main drivers of the present biodiversity crisis, whose effects have been largely assessed by quantifying species extinction. However, a frequently overlooked component of biodiversity loss that often accompanies or precedes the complete disappearance of species is the disruption and loss of ecological interactions in which those species are engaged. Given that many key ecosystem functions depend on interactions between species, we present a new approach by modelling the relationship between the diversity of both species and interactions along a gradient of environmental deterioration. We explore how the degradation of ecological functions, and consequently of ecosystem services, can be accelerated or restrained depending on the balance between the rate of loss of species and of interactions.

We demonstrate that the extinction of interactions can be decoupled from the extinction of species, implying that ecological extinctions may occur well before species disappearance and affect species functionality and ecosystems services at a faster rate than species extinctions. This means that despite the considerable efforts of conservation biologists to secure viable populations of many species, their ecological extinction may have already occurred. By focusing on biotic interactions besides species, this study provides a deeper, process oriented understanding of the functional consequences of interactions loss.

Plant community dominated by the long-lived tree Beaucarnea gracilis i*n the Tehuacán-Cuicatlán Valley in South-Central Mexico. In this community young individuals of this species and others fail to regenerate after human disturbance that affected among-plant facilitation interactions and therefore population structure is biased towards adults.*

Photo credit. Alfonso Valiente-Banuet

Consequently, accounting for interaction losses as early warning signals of critical transitions is necessary to identify and quantify extinction debt. This novel approach will help to detect and provide early warning of thresholds of habitat deterioration from which the collapse of ecosystem functions is imminent.