Discontinuities, cross-scale dynamics and the organization of ecosystems

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Abstract

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Ecological structures and processes occur at specific spatio-temporal scales, and interactions that occur across multiple scales mediate scale-specific (e.g. individual, community, local or regional) responses to disturbance. Such multi-scale interactions and feedbacks are termed cross-scale dynamics. Despite their importance, explicitly incorporating cross-scale dynamics into research and management actions remains a challenge. The discontinuity hypothesis provides a fertile avenue for addressing this problem, by linking measureable proxies to inherent scales of structure within ecosystems. Specifically, the hypothesis proposes that where ecological processes are sufficiently different in temporal and spatial extent, they may introduce discontinuities (breaks) in the distribution and pattern of ecosystem attributes such as habitat structure and resource availability. These discontinuities in habitat structure and resource availability, in turn, may drive correspondingly discontinuous patterns in species attributes such as body size distributions, occupancy and range size patterns. Thus, analyses that identify the location of discontinuities in habitat or community attributes provide a straightforward method for evaluating multi-scale spatial and temporal structure. Here we outline a conceptual framework underlying discontinuities, and highlight areas where this approach has, as yet, been little tested. As an example, we introduce work exploring the appropriateness of the discontinuity approach in the context of taxa exhibiting indeterminate growth, specifically coral reef fish, and discuss its application to assessing the relative resilience of reef systems.

Keywords: Cross, scale, Disturbance, Functional groups, Hierarchy, Marine, Resilience

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