

SELF-ORGANIZED CRITICALITY AND THE FRACTAL SCALING OF A PREDATOR-PREY INTERACTION

ARONSON, Richard B., Institute of Marine and Coastal Sciences, Rutgers University, P. O. Box 231, New Brunswick, NJ 08903-0231, U.S.A.

In many cases, it is not possible to explain evolutionary-scale patterns by analogy to ecological processes. However, in at least some cases, biological interactions appear amenable to such extrapolation. The paleobiological literature contains examples of predation, competition, and herbivory in which the dynamics are similar on multiple spatiotemporal scales.

Dense populations of epifaunal, suspension-feeding ophiuroids, or brittlestar beds, are widely distributed, but they are rare and are restricted in their habitat distribution. On a small scale (meters to kilometers, hours to days), brittlestar bed distribution in the British Isles and the Bahamas is limited by predatory fishes and crabs. On an intermediate scale (tens to hundreds of kilometers, decades to centuries), predation by seastars may cause cycles of ophiuroid abundance in the western English Channel, beyond the stringent restrictions imposed by fish and crab predators. On a large scale (globally, millions to tens of millions of years), the Jurassic decline of brittlestar beds is associated with the diversification of predatory teleosts, neoselachian sharks, and decapod crustaceans.

Small-scale predator-ophiuroid interactions sum to produce analogous intermediate- and large-scale interactions. Predation effects on brittlestar beds appear to be scale-independent, or fractal. Fractal scaling may be a consequence of self-organized criticality, an inherent property of large, interactive systems.