Environmental coupling in ecosystems: From oscillation quenching to rhythmogenesis

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How landscape fragmentation affects ecosystems diversity and stability is an important and complex question in ecology with no simple answer, as spatially separated habitats where species live are highly dynamic rather than just static. Taking into account the species dispersal among nearby connected habitats (or patches) through a common dynamic environment, we model the consumer-resource interactions with a ring type coupled network. By characterizing the dynamics of consumer-resource interactions in a coupled ecological system with three fundamental mechanisms such as the interaction within the patch, the interaction between the patches, and the interaction through a common dynamic environment, we report the occurrence of various collective behaviors. We show that the interplay between the dynamic environment and the dispersal among connected patches exhibits the mechanism of generation of oscillations, i.e., rhythmogenesis, as well as suppression of oscillations, i.e., amplitude death and oscillation death. Also, the transition from homogeneous steady state to inhomogeneous steady state occurs through a codimension-2 bifurcation. Emphasizing a network of a spatially extended system, the coupled model exposes the collective behavior of a synchrony-stability relationship with various synchronization occurrences such as in-phase and out-of-phase.

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