



Scales of Vegetation, Animal and Geomorphic Interactions in Desertification in the US Southwest

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John Thornes produced a series of innovative papers considering the interactions between plants, animals and erosion. We use data drawn from field experiments and monitoring studies in the US Southwest integrated using process- and complexity-theory-based models to consider such interactions at a range of spatial and temporal scales. The approach is innovative in that it considers transport of resources by fluvial, aeolian and animal activity, as well as their interaction with an emphasis on spatial interactions among multiple vegetation types and multiple resources, and specific responses to a variety of endogenous and exogenous disturbances.

The conditions are evaluated that would result in the encroachment of shrubs into formerly pure stands of grass in the US southwest. Monitoring studies at the Sevilleta LTER site have enabled the direct observation of the process dynamics of this invasion in landscapes dominated by water erosion for the first time. At the Jornada Basin LTER site, both wind- and water-driven (separately and together) landscapes are investigated. Simulations using multi-century rainfall reconstructions suggest the stability of native grasslands under all historical rainfall conditions, even under conditions of periodic and severe drought. The observed shrub encroachment can only be explained by the combination of periodic droughts with a second disturbance, such as varying grazing intensities. The spatial pattern of the invading species is a function of the behaviour of the previously dominant species in redistributing resources during times of stress, illustrating the path-dependency of these systems.

We conclude that emergence of interactions at different scales leads to the development of catastrophic changes in the landscape and thus desertification. These results provide significant advances in the understanding of the resilience and sensitivity of desert ecosystems, and consequently their management.