

Self-organized multi-species vegetation patterns: the role of connectivity of environmental niches in natural water harvesting ecosystems

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Self-organizing vegetation patterns are natural water harvesting systems in arid and semi-arid regions of the world and should be imitated when designing man-managed water-harvesting systems for rain-fed crop. Disconnected vegetated and bare zones, functioning as a source-sink system of resources, sustain vegetation growth and reduce water and soil losses.

Mechanisms such as soil crusting over bare areas and soil loosening in vegetated areas feed back to the local net facilitation effect and contribute to maintain the patterned landscape structure.

Dis-connectivity of run-off production and run-on infiltration sites reduces runoff production at the landscape scale, and increases water retention in the vegetated patches.

What is the effect of species adaptation to different resource niches on the landscape structure?

A minimal model for two coexisting species and soil moisture balance was formulated, to improve our understanding of the effects of species differentiation on the dynamics of plants and water at single-pattern and landscape scale within a tiger bush type ecosystem.

A basic assumption of our model was that soil moisture availability is a proxy for the environmental niche of plant species. Connectivity and dis-connectivity of specific niches of adaptation of two differing plant species was an input parameter of our model, in order to test the effect of coexistence on the ecosystem structure.

The ecosystem structure is the model outcome, including: patterns persistence of coexisting species; patterns persistence of one species with exclusion of the other; patterns decline with just one species surviving in a non organized structure; bare landscape with loss of both species.

Results suggest that pattern-forming-species communities arise as a result of complementary niche adaptation (niche dis-connectivity), whereas niche superposition (niche connectivity) may lead to impoverishment of environmental resources and loss of vegetation cover and diversity.