



Vegetation patchiness: Pareto statistics, cluster dynamics and desertification.

N.M. Shnerb

Department of Physics, Bar-Ilan University, Ramat-Gan 52900 Israel (shnerbn@mail.biu.ac.il)

Recent studies [1-4] of cluster distribution of vegetation in the dryland revealed Pareto statistics for the size of spatial colonies. These results were supported by cellular automata simulations that yield robust criticality for endogenous pattern formation based on positive feedback. We show that this self-organized criticality is a manifestation of the law of proportion effect: mapping the stochastic model to a Markov birth-death process, the transition rates are shown to scale linearly with cluster size. This mapping provides a connection between patch statistics and the dynamics of the ecosystem; the "first passage time" for different colonies emerges as a powerful tool that discriminates between endogenous and exogenous clustering mechanisms. Imminent catastrophic shifts (like desertification) manifest themselves in a drastic change of the stability properties of spatial colonies, as the chance of a cluster to disappear depends logarithmically, rather than linearly, on its size.

[1] Scanlon et. al., Nature 449, 209212 [2007].

[2] Kefi et. al., Nature 449, 213217 [2007].

[3] Sole R., Nature 449, p. 151 [2007].

[4] Vandermeer et. al., Nature 451, p. 457 [2008].