FRIENDS OR FOES: USING PHYSICS TO UNRAVEL THE ROLE OF SOCIAL INSECTS IN SEMI-ARID ECOSYSTEMS

Juan A. Bonachela[1,2], R. M. Pringle[2,3], E. Sheffer[2], T. C. Coverdale[2], J. A. Guyton[2], K. K. Caylor[3,4], S. A. Levin[2], and C. E. Tarnita[2,3]

(1) Department of Mathematics and Statistics, University of Strathclyde, 26 Richmond Street, Glasgow G1 1XH, Scotland, UK.
(2) Department of Ecology and Evolutionary Biology, Princeton University, Princeton, NJ 08544, USA.
(3) Mpala Research Centre, Post Office Box 555, Nanyuki, Kenya.
(4) Department of Civil and Environmental Engineering, Princeton University, Princeton, NJ 08544, USA.
(E-mail: juan.bonachela@strath.ac.uk)

In the last few years, reaction-diffusion models have been used to replicate vegetation patterns in semi-arid ecosystems. According to these models, high precipitation rates allow for homogeneous plant coverage and, as precipitation decreases, the system self-organizes into specific structures (homogeneous vegetation with regular bare spots, labyrinthine vegetation formations, and regular vegetation clumps), which have been also observed using remote sensing pictures. These models predict that the latter pattern precedes a catastrophic shift into complete barren system, fact that has been postulated as an early-warning signal for desertification. In areas where social insects such as termites are present, however, there is more than meets the eye. At a coarse scale, termite mounds form a clump-like pattern that, when observed at a finer scale, can show much richer formations like the ones mentioned above. The combined effect of vegetation self-organization and the role of these insects gives rise to unexpected results. In this talk, we will discuss on the role of termites as ecosystem engineers in the Laikipia highlands of central Kenya. First, I will present a modified vegetation model that includes termite mounds with the aim to study the emergent dynamic and static properties of the composite system. Then, simple phase diagrams will allow us to understand that the increased water infiltration and nutrient accumulation on mounds increase the robustness and resilience of the ecosystem against droughts. Thus, termites are positive agents for their environment, and mounds act as oases of fertility that not only help the ecosystem resist desertification, but also contribute to its regeneration.

[1] Juan A. Bonachela, R.M. Pringle, E. Sheffer, T.C. Coverdale, J.A. Guyton, K.K. Caylor, S.A. Levin, and C.E. Tarnita, *Termite mounds can increase the robustness of dryland ecosystems to climatic change*, Science 347 (2015).