Geophysical Research Abstracts
Vol. 14, EGU2012-358, 2012
EGU General Assembly 2012

Runoff source or sink? Biocrust hydrological function strongly depends on the relative abundance of mosses

M.A. Bowker (1), D.J. Eldridge (2), and F.T. Maestre (3)

(1) US Geological Survey, Southwest Biological Science Center, Flagstaff, Arizona, United States (matthew.bowker@nau.edu), (2) Office of Environment & Heritage Department of Premier & Cabinet, University of New South Wales, Sydney, New South Wales, Australia (d.eldridge@unsw.edu.au), (3) Área de Biodiversidad y Conservación, Escuela Superior de Ciencias Experimentales, Universidad Rey Juan Carlos, Móstoles, Spain (fernando.maestre@urjc.es)

The redistribution of water in semi-arid environments is critical for overall ecosystem productivity. To a large degree, ecosystem engineers may determine the redistribution of water. Biological soil crusts (biocrusts) are one such group of ecosystem engineers. Their effects on infiltration have been somewhat controversial, varying from place to place and ranging from strongly positive to strongly negative. In addition, they coexist with and are modified by additional ecosystem engineers. We used a systems approach to examine the interactive effects of multiple engineers on infiltration processes across two analogous sets of interactors. First in Spain, we examined interactions among Stipa tenacissima, biocrusts, and the European rabbit; and in Australia, the interaction between biocrusts and the bilby (a rabbit-like marsupial). We focused on the effects of particular community properties of biocrusts such as species richness, total cover, species composition, and spatial patterning to characterize their variable effects on infiltration. We measured the early (sorptivity) and later (steady-state infiltration) stages of infiltration at two supply potentials using disk permeameters, which allowed us to determine the relative effects of different engineers and soil micropores on water flow through large macropores. In the Spanish case, structural equation modeling showed that both Stipa and biocrust cover exerted substantial and equal positive effects on infiltration under ponding, whereas indirectly, rabbit disturbance negatively affected infiltration by reducing crust cover; rabbits had negligible direct effects. The biocrust influence could be partitioned roughly equally between total cover and composition. All lichen species were negatively related to infiltration and almost all mosses were positively related to infiltration. In the Australian study, bilby forage pits had a direct and strong positive influence on steady state infiltration under ponding and most infiltration variables, and moderate effects on biocrust properties. Biocrust total cover and composition were again the most influential of biocrust community properties on infiltration, especially in the case of the composition effect on steady state infiltration under ponding. The key difference was that the Australian biocrusts primarily decreased infiltration. On dune runoff zones, later successional biocrusts (lichens, mosses, dark cyanobacterial crusts) of any type decreased infiltration rates compared to early successional crusts. On swale run-on zones, lichens impeded infiltration and mosses did not. These results highlight the importance of biocrusts as key players in the redistribution of water, and demonstrate the modulating role played by animal ecosystem engineers through their localized surface disturbances. Our studies highlight the central role of the relative abundance of mosses compared to other biocrust organisms as an underappreciated, and perhaps a key, determinant of biocrust hydrology.