Prioritizing Conservation Effort through the Use of Biological Soil Crusts as Ecosystem Function Indicators in an Arid Region

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Abstract: Conservation prioritization usually focuses on conservation of rare species or biodiversity, rather than ecological processes. This is partially due to a lack of informative indicators of ecosystem function. Biological soil crusts (BSCs) trap and retain soil and water resources in arid ecosystems and function as major carbon and nitrogen fixers; thus, they may be informative indicators of ecosystem function. We created spatial models of multiple indicators of the diversity and function of BSCs (species richness, evenness, functional diversity, functional redundancy, number of rare species, number of habitat specialists, nitrogen and carbon fixation indices, soil stabilization, and surface roughening) for the 800,000-ha Grand Staircase-Escalante National Monument (Utah, U.S.A.). We then combined the indicators into a single BSC function map and a single BSC biodiversity map (2 alternative types of conservation value) with an unweighted averaging procedure and a weighted procedure derived from validations performance. We also modeled potential degradation with data from a rangeland assessment survey. To determine which areas on the landscape were the highest conservation priorities, we overlaid the function- and diversity-based conservation-value layers on the potential degradation layer. Different methods for ascribing conservation-value and conservation-priority layers all yielded strikingly similar results ($r = 0.89-0.99$), which suggests that in this case biodiversity and function can be conserved simultaneously. We believe BSCs can be used as indicators of ecosystem function in concert with other indicators (such as plant-community properties) and that such information can be used to prioritize conservation effort in drylands.

Keywords: conservation planning, conservation prioritization, cryptogams, cyanobacteria, deserts, ecological indicators, ecosystem engineers, ecosystem function, ecosystem services, semiarid lands