INVITED ESSAY

New Frontiers in Bryology and Lichenology

Ecology and Management of Biological Soil Crusts: Recent Developments and Future Challenges

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Biological soil crusts, often referred to in the North American literature as microbiotic, cryptogamic, cryptobiotic, or microphytic crusts, are the dominant biological soil surface feature in arid and semi-arid landscapes. Crusts comprise a complex assemblage of organisms such as mosses, liverworts, cyanobacteria, algae, lichens, fungi, and bacteria growing on and within the uppermost layers of the soil. Their close association with the soil means that they are subject to processes operating at the interface between the biosphere and the atmosphere. This makes them useful indicators, or surrogates, of activities that impact upon the soil or the atmosphere.

The close association with the soil surface means that biological crusts and their component organisms play vital roles in ecosystem processes. They stabilize the soil against water and wind erosion, regulate the flow of water into soils, provide a sink for soil carbon, and organisms in the crust produce nitrogen that is often used by vascular plants. Biological soil crust organisms also provide favorable sites for the establishment and survival of vascular plant seedlings, and provide niches for soil invertebrates that are important for decomposition and mineralization processes.

During the past decade there has been increased interest in the roles of biological crusts in soil and ecological processes. Recent reviews (e.g., Eldridge & Greene 1994; Evans & Johansen 1999; West 1990) have reinforced the notion that crusts are essential components of healthy, functional ecosystems. Soil crust are now being included in routine assessments of rangelands (Green et al. 1994), and their roles in carbon and nitrogen production and water movement in desert areas are receiving renewed attention (Eldridge et al. 2000). Moreover, the scientific community is embracing the concepts of ecologically sustainable development as it applies to grazing systems, and crust organisms are seen as essential components of both local and regional biodiversity.

Soil crust ecology has now moved from a phase of discovery to one of consolidation. In the early 1970’s, Roderick Rogers pioneered the early work on soil crust lichens in Australia at a time when lichen taxonomy was in its infancy. The 1980s and 1990s were followed by more work on the ecology and distribution of crusts mainly in North America and Australia (West 1990). However, despite the large amount of work on crust organisms worldwide, there is still little known about their distribution at a local level and how they are affected by land management. The challenge over the next decade is to determine the links between crust organisms and landscape health, and to educate the general community and land management agencies about their importance as indicators of healthy, productive ecosystems (Scott et al. 1997).

Recent Developments in Soil Crust Ecology and Management

Soil crusts for harvesting essential resources.— Biological soil crusts are increasingly being recognized as keystone elements of desert ecosystems.