Don’t step there: microbiotic crusts of the Grand Canyon

by Susan B. Infalt

Microbiotic (cryptogamic) crusts are consolidated matrices of cyanobacteria, lichens, moss, green algae, and microfungi that cover the soil surface (Evans and Belnap 1999) in the spaces between larger, vascular plants. They develop in ecosystems that are naturally lacking fire and grazing by large mammals. Crusts can be up to 10 cm deep and may reach 100% cover in the spaces between plants (Evans and Belnap 1999). The cyanobacteria, bacteria, and lichens of these soil communities are capable of nitrogen fixation, and have been shown to be the primary source of nitrogen input into some arid ecosystems (Evans and Belnap) and can aide in erosion resistance of fine surface soils (DeFalco et al. 2001).

Evans and Belnap (1999) studied microbiotic crusts of the Colorado Plateau by comparing pristine sites to those of varying disturbance histories. They found that more disturbed sites had shifted to communities with fewer lichens and more cyanobacteria. This abundance shift also resulted in a decrease in the nitrogen fixing abilities of the crust, as lichens fix more nitrogen per unit area than cyanobacteria.

During our trip down the Grand Canyon, there were two campsites and one lunch site between river miles 194 and 220 (Figure 1) where we were specifically told by our intrepid guide, Scotty Stevens of O.A.R.S. whitewater outfitters, to stay off the microbiotic crusts. Having some background familiarity with microbiotic crusts, I followed directions, along with the others in our group. However, what I had believed about them had been somewhat incorrect.

Figure 1. Microbiotic crusts at river mile 220R. Note darkened soil surface above and to the right of the juvenile mesquite (left) and between rocks and shrubs to the right of ocotillo at center of photo (right).

I had known that these communities are responsible for nitrogen fixation in arid soils, that they help decrease wind and water erosion, and that they are extremely slow to recover once disturbed. I had also believed that microbiotic crusts resisted invasion by exotic annual grasses, and that if undisturbed they could provide uninvaded zones for the persistence of rare native grasses. However, this does not appear to be one of the beneficial ecosystem functions of microbiotic crusts.

DeFalco et al. (2001) conducted a study on microbiotic crusts and their associated plant communities in the northeast Mojave Desert. They found much greater productivity of annuals on crust soils compared to bare soils, and much greater biomass of exotic forbs and grasses. Only one native species in the study performed better on crust soil than on bare soil. It is believed that the exotic annuals respond to the higher nitrogen availability of the crust soils and are then able to grow faster and outcompete native annual species.

This poses a complicated management situation. Microbiotic crusts are valuable and unique, and should be conserved. However, they now appear to be providing exotic annual grasses with a competitive advantage over their native habitat associates. I suggest that special attention (i.e. control and/or removal) should be given by managers to the exotic grasses on and around microbiotic crusts. Some grasses are extremely aggressive, and it is unknown if the thatch they produce could potentially shade/crowd out microbiotic crust communities. Also, though exotics seem capable of germinating and establishing on undisturbed crust, park users should still be extremely careful about disturbing crusts as they may potentially slow colonization by exotic grasses.

REFERENCES

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