



It's Alive! Biological Soil Crusts of the Sonoran and Chihuahuan Deserts

Background

It might come as a surprise to learn that in the sublime expanses of the Sonoran and Chihuahuan deserts, some of the most interesting life around can be found in the dirt right in front of your feet! But if you shift your focus from the landscape and examine the ground for a few minutes, you may discover a diverse community of tiny organisms, all working together to perform vital ecosystem functions. Biological soil crusts form a living groundcover that is the foundation of desert plant life.

Composition and Appearance

Biological soil crusts, or BSCs, are made up of cyanobacteria, which sometimes look like areas of especially dark dirt on the ground. BSCs also include lichens and mosses, as well as green algae, microfungi, and bacteria. The visual appearance of BSCs varies by region. In the Sonoran and Chihuahuan deserts, BSCs tend to be flatter and less charismatic than the black, knobby crust more characteristic of the Colorado Plateau, or the more lush communities found in the northwestern U.S. Like many other life forms, desert BSCs can often be found growing under a shrub or bush that provides shelter from the sun and wind.

Purpose

The primary function of biological soil crusts is to hold the soil surface together. When wet, cyanobacteria move through the soil and bind rock or soil particles together, forming a web of fibers. Mosses and lichens have small, anchoring structures that hold the soil in place. All of these factors help to stabilize the soil, increasing its resistance to wind and water erosion.

BSCs don't even have to be alive to continue their work. Layers of abandoned sheaths, built up over long periods, can still be found clinging tenaciously to soil particles, providing stability in sandy soils up to 10 cm deep. Other BSCs that appear to be dried out seem to come alive when doused with water, like the moss shown at right. Dry and grey when found, a sprinkling of water causes it to become metabolically active again.

In addition to holding the soil in place, cyanobacteria are also nitrogen-fixers, meaning that they are able to convert atmospheric nitrogen to a form plants can use. This is especially important in desert ecosystems, where nitrogen levels are low and often limiting to plant productivity. BSCs also intercept and store water, nutrients, and organic matter that might otherwise be unavailable to plants.



Biological soil crusts at Tonto National Monument.



Moss activating in response to water. From left: dry, wet, green!

Threats

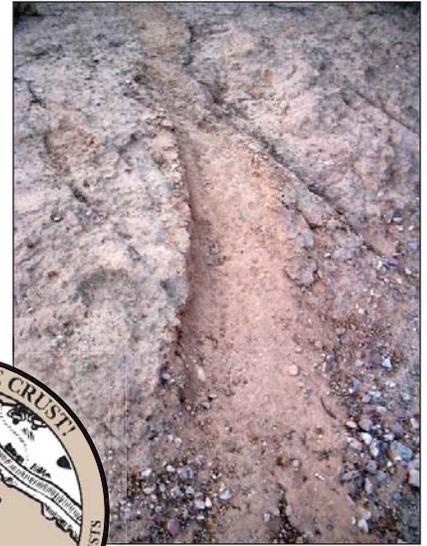
Unfortunately, many human activities can be harmful to soil crusts. Trampling and crushing caused by footprints or machinery are extremely harmful, especially when the crusts are dry and brittle. Tracks in continuous strips, like those created by vehicles or bicycles, form areas that are highly vulnerable to wind and water erosion. Rainfall then carries away loose material, causing channelization—especially on slopes. Impacted areas may never fully recover. Although a thin veneer of cyanobacteria may return in a few years, lichens and mosses may take up to 50 years to regrow.

What You Can Do

The best way to avoid damaging soil crusts is simply to stay away from them by always driving and riding on designated roads and trails and steering clear of roadside vegetation. When hiking, always walk on marked trails or on other durable surfaces, such as rock or in sandy washes. Keep a watchful eye, and don't bust the crust!

What We're Doing

As part of their our vegetation & soils monitoring program, the Sonoran and Chihuahuan Desert Networks scientifically monitor the cover and frequency of biological soil crusts at 12 National Park Service units across the Southwest. The information collected will be used to track dynamic soil function and help us to better understand the overall ecosystem health of these special places. Monitoring protocols are specifically designed to minimize impact to these fragile communities.



Above: Biological soil crust damage. The image at top left is a footprint. The other three images show damage caused by vehicles at Organ Pipe Cactus National Monument.
Below right: Soil crusts at White Sands National Monument.
Below: Ajo Mountain Drive, Organ Pipe Cactus National Monument.

