NATURALIST'S CORNER

The Desert Underground

Recent novels and nonfiction publications that discuss the role of trees in our ecosystems emphasize that there is a lot more going on underground than there is above. We have been awakened to the awesomeness of things not visible to us.

By contrast, we still know little about the amazing processes that occur in the soils of the world's deserts. A good number of us have walked or hiked in the deserts of Utah, New Mexico, Nevada, Arizona and California without much thought about what is going on underground.

Did you know that the plants you see in the desert are some of the longest-lived plants on the planet? Desert plants have adapted to long periods of drought, punishing heat, intense sun, desiccating winds, and nutrient-poor soils by growing slowly and deliberately, conserving energy by many special methods. They invest most of their growth efforts downward into the soil, favoring a strong foundation over lush foliage that would squander their precious water and resources.

Mojave Yuccas can live up to several thousand years. Creosote bushes are the oldest of desert plants. The average age of creosotes across the present-day Mojave Desert is likely 600-1000 years. One of the oldest creosote bushes, named the King Clone, can be found in a valley near Twentynine Palms in the Mojave Desert. It is estimated to be at least 10,000 years old!

Over centuries, these plants have developed extensive root systems, high concentrations of chemical defenses in their tissues, as well as dense stems that endure pathogens, herbivores, droughts, freezes, and most other threats. One thing they cannot survive? Bulldozers.

Unseen events in each stratum of desert soil shape the world above. At the surface, a living layer of microscopic algae, fungi, and bacteria binds the soil together. This layer is known by various names, including biological soil crust, cryptogamic crust, cryptobiotic crust, and macrobiotic crust.

When we gaze across the desert landscape, the dwarf-looking plants may appear to be small, but their roots can reach surprising depths. For example, a six-inch-tall Desert Primrose has roots about five to six feet deep, almost twelve times longer than the plant is tall! These deep plant roots grow down to soils still retaining moisture from rainfall many years earlier, providing a lifeline to plants during long intervals of drought. These deep roots also transfer carbon from the air down to the soil. Chunks or layers of cemented soil, called caliche, capture and hold carbon underground. Succulent plants, such as cacti and yuccas, have a different strategy. They have shallow roots, relying on other means to absorb water from the soil.

Our desert plants and soil microbes join forces by making a living glue that binds soil grains tightly together so wind can't pick up dust and soil. The soil also holds on to dangerous small particulate matter—as a result, we don't inhale these particles. This living glue captures and stores carbon underground in living systems for thousands of years—even after they die, so long as the soil isn't disturbed.

When living desert soil crusts are disturbed, though, storm winds readily pick up dust. In addition to blowing harmful particulate matter, desert storms can lift dangerous fungal spores that cause Valley fever from the soil into the air, raising the risk of serious lung infections.

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Deeper into the soil, plant roots are interconnected through their partnerships with special fungi. Plants need help to absorb water and nutrients from desert soils. In turn, fungi are powerful sponges, absorbing moisture and nutrients, but they can't make food. Plants will share carbohydrates they have synthesized, and fungi share the resources they have gathered—a good trade for all involved.

How does this work? The root systems of fungi are made up of thread-like mycelia that connect fungi to plant roots and plant roots to plant roots. These fungal connections serve as nature's underground internet, enabling plants to communicate with their neighbors. The fungal hyphae below ground inform the whole community of dangers like insect attacks and initiate the production of pest-repelling compounds in all plants connected to this network. This entire system is destroyed when bulldozers scrape the soil surface.

There are two different types of fungi. One grows around plant roots and produces mushrooms. The other grows inside plant roots and does not produce mushrooms. An entire essay would be needed to describe the different types of fungi and their functions.

Let's review a part of the carbon cycle. Humans and other animals utilize oxygen (O_2) that plants produce; plants utilize carbon dioxide (CO_2) that humans and other animals produce. Plants are crucial to combatting the serious problem of too much carbon in our atmosphere. They take in massive amounts of CO_2 and reassemble that carbon into support structures and sugar: Some carbon is stored in their stems and roots as lignin and cellulose; some of the carbon is integrated into sugars. This carbon is transported underground where it serves to grow more roots and becomes a part of the soil.

Our desert soils store carbon underground in a variety of ways. By-products from growth above ground become locked in hidden carbon storage vaults, both living and non-living—in the caliche, for example—for hundreds to thousands of years! Our long-lived native plants across desert landscapes are valuable ancient assets to our ecosystem and to us because individual plants can capture carbon out of thin air for multiple centuries or millennia and deposit it underground. This entire kingdom of incredible creatures works 24 hours per day, year after year, unseen and mostly unappreciated by us.

We once thought that carbon was held in meaningful amounts only in ocean creatures, in forest habitats and in humus (the dark organic material that forms in soil when dead plant and animal matter decays). Now we know that soils, including desert soils, are also a significant storage facility for carbon.

When desert soil is scraped and plants removed, as for example, across the tens of thousands of acres currently being scraped for industrial-scale wind and solar projects on desert public lands, the community of ancient plants is disrupted, and their connected underground fungal partners die. As a result, significant amounts of carbon are released from the soil back into the atmosphere, and no additional carbon can be sequestered in the soil. Recovery of plants to pre-disturbance cover may take 50-300 years. Complete ecosystem recovery may require over 3,000 years!

As we contemplate how to transition from fossil fuels to so-called "renewable" resources, we need to realize that the undisturbed functioning desert ecosystem is not a renewable resource. Scientific evidence suggests that the choices we make today to disturb desert ecosystems could continue to negatively impact these systems for thousands of years, even after the impacted area is mechanically restored upon site decommissioning.

Let's not destroy the best carbon sink we have in our beautiful southwestern deserts. Let's leave our hidden soil magicians alone to do their work. Undisturbed, deserts will continue to protect our atmosphere and protect us as they have for millennia.

~Terry Weiner

What makes the desert beautiful is that somewhere it hides a well.
-Antoine de Saint-Exupéry