RESTORING THE BROKEN PRAIRIE

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Lush grasses stretch in an endless sea. Wisps of cloud sweep overhead. Bison roam as bees drift from wildflower to wildflower. These are just some of the images evoked by the prairie, a flat and fertile land dominated by grasses. Unfortunately, this vision of the prairie has changed dramatically as agricultural, urban, and livestock developments have taken their toll on the landscape. The North American prairie, commonly known as the Great Plains, encompasses ten U.S. states and parts of Canada. In some parts of the U.S., over ninety-nine percent of prairie has been destroyed.[4] Luckily, recent understanding of our negative impact on the prairie has generated much discussion over methods of restoration and the future of prairie conservation, as we scramble to save what we have degraded.

Prairies have suffered various damages like species imbalance, fragmentation, soil degradation, and more, due to human encroachment. One of the main disruptors of the prairie is its biggest industry: agriculture. Factory agriculture, which seeks to maximize profit at the expense of the environment, has grown significantly in order to support the needs of the growing population. Copious use of fertilizer and manure produces excess nitrogen, which distorts the native prairie ecosystem by shifting the balance in soil minerals and affecting soil microbial communities.[4,6] Microorganisms, including bacteria and fungi, release digestive enzymes that are necessary to maintain soil fertility.[10]

Soil microbe imbalance exemplifies how the problems that affect the prairie are not always visible to the naked eye, and demonstrates the importance of restoration methods that manipulate the ecosystem from the ground up. Decreased biodiversity can be attributed to habitat loss and fragmentation.[9] Fragmentation occurs when a large region is divided into smaller, more isolated communities. Urban developments, fencing, and clearing land for agriculture have contributed to the fragmentation of the prairie, which causes habitat loss, decreased movements and lack of interaction due to isolation. One such disruption is that of the intricate system of prairie streams, which are able to support up to nearly half of all prairie birds.[8] Preserving prairie streams is thus crucial to facilitating nutrient transfer, irrigating plants, and attracting animals. Imbalance in biodiversity is also caused by competition between native species and exotic ones. This emphasizes the importance of soil, for exotic plants fare better in nitrogen-rich soil than native plants. Without continuous management or burning, these invasive species build up into monocultures that exclude native prairie species. The consequences of human actions thus make restoration a more challenging job than just reserving spaces and planting a few native species.

The most common methods used to restore the prairie are ones that mimic natural cycles. In the past, prairies have always

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been "managed." In fact, fires started by indigenous peoples, to stimulate growth of new grasses and attract animals, were more frequent than lightning-caused fires. In addition, herbivores such as bison would graze to ensure space for new crops of grasses.[2] Scientists have also attempted to forcibly introduce certain native species. Studies show that plant diversity in tallgrass prairies is proportional to bee diversity, and a strong bee population likewise ensures the growth of future plants.[7] The diversity and abundance of birds is also indicative of the ecosystem's health. To encourage bird and bee diversity, conservationists utilize seed mixes that contain native plants, as well as chronosequence methods (which is when a set of sites share similar features but different ages) in order to create a variety of habitats. Management burning is another popular method which maintains stable community composition by clearing debris. The timing of fires is important, as dormant season (spring and fall) burns favor certain species and are therefore less effective than growing season (summer and winter) burns.[4] The issue of excess nitrogen can be remedied by adding carbon to soil via sucrose and sawdust. The conditions for this to work, however, are very specific: weeds must be nitrophilic or nitrogen-favored and must suppress native species in the absence of carbon. When these conditions are met and enough carbon is added, the decrease in nitrate and weed biomass results in increasing light penetration, soil water content, and biomass of native prairie species.[5] Other methods, such as altering and building water channels, utilizing new cattle fences that allow small animals to pass through the bottom, and rooting out weeds, are more mechanical. Given the intricacies of the prairie system, from soil composition to animal diversity, conservationists must consider all factors when rebuilding the prairie.

One major problem is that the current altered environment, known as a degraded system, does not respond to restoration methods the way a natural prairie would. Degraded systems are shaped by lack of landscape connectivity and sufficient seed source,[1] and different recovery patterns in the soil that are influenced by root biomass, root quality, and soil microbes.[3] Alternative models are then used to better predict the outcomes of certain actions. An alternative model combines both positive effects of the restoration method and factors affecting the alternative states. The complexity of the prairie means scientists must identify multiple factors that can make a system resilient to management. Conservationists must also prioritize which obstacles need to be addressed first. The main goal is to disturb the constraints that keep the prairie locked in its degraded state, and in order to determine whether their actions have any effect, conservationists must repeatedly check and recalculate the constraints.

When one thinks of saving the environment, the prairie is often pushed to the side in favor of rainforest and ocean habitats. However, the prairie holds just as much cultural significance, biodiversity, and economic value as other ecosystems, which makes rebuilding it more important than ever. Soil degradation, lack of biodiversity, and rigidity of alternative states are just a few of the problems that prairies are currently facing. In order to remedy what humans have inflicted upon the prairie, conservationists lean towards restoration efforts that are as 'natural' as possible. Although some methods may seem futile, it is important to keep in mind that prairies, and ecosystems in general, require patience and innovation when breathing them back to life.

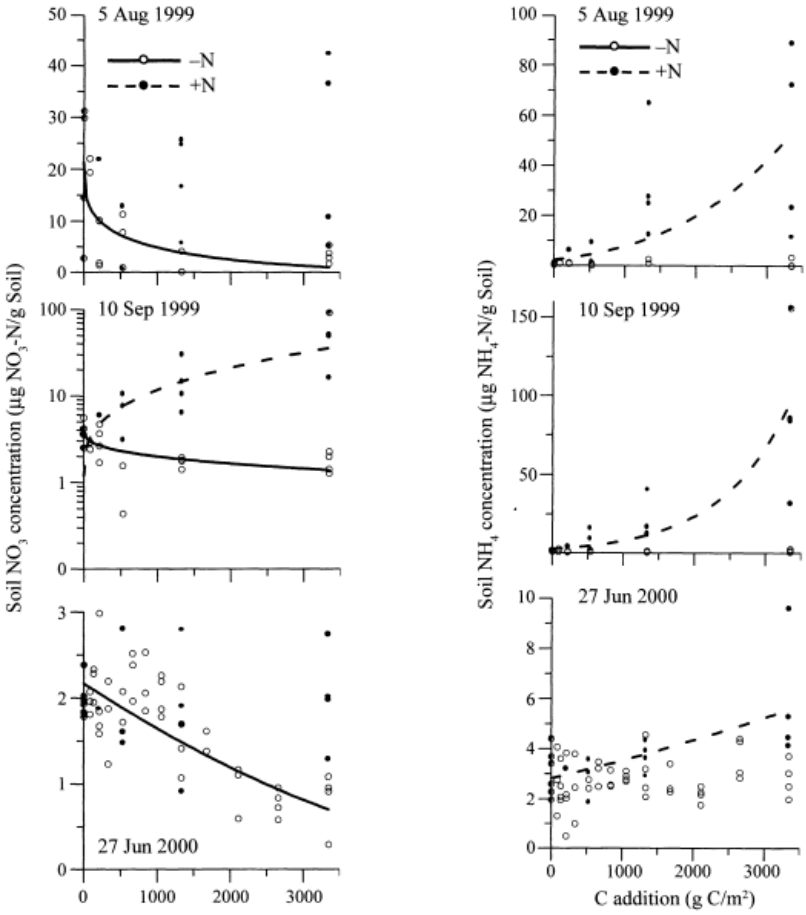
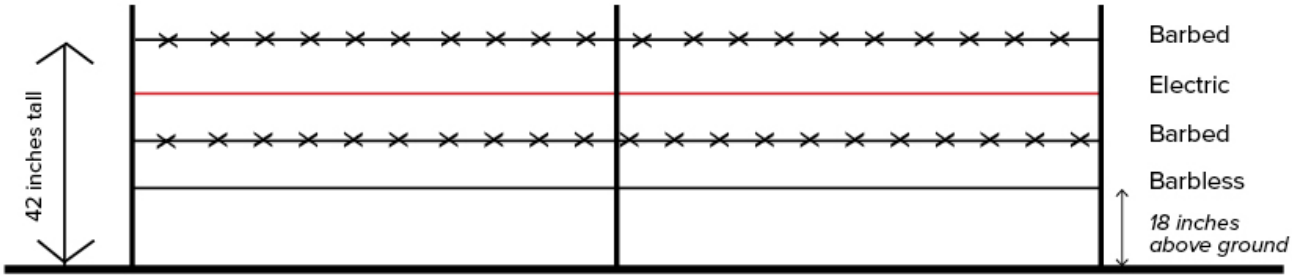


Figure 1: Soil NO_3 and NH_4 concentration regressed with carbon addition.[12]



Fence diagram

Figure 2: A fence that is barbless on the bottom increases connectivity and makes movement of animals easier.[13]

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IMAGE SOURCES

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