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# Land Ecology Essay II: Thresholds, Novel Ecosystems, and the Sanctity of History

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"Land ecology" honors the holistic approach to the knowledge needed to support land stewardship into our increasingly uncertain future. Here we share an expanded version of one of Brandon's recent essays.

## Thresholds, Novel Ecosystems, and the Sanctity of History

How is an ecosystem supposed to be? The answers determine how millions of dollars are spent and how ecosystems are transformed (or ignored), with effects lasting centuries. Conflict over this question used to be between industry and environmentalists. Now scientists are doing battle with one another, too.

The standard for ecosystem management, at least in principle, is the historical or "reference" condition.[1] Scientists and managers argue about how long ago we should look to, what historical ecosystems looked like, and what processes shaped them, but history captures much of what we value in nature. History set the evolutionary stage for the Earth's biological diversity, unspoiled by human domination (but perhaps aided by human activities, such as fire use). Historical soil-forming processes produced the deep, dark soils of the Great Plains (although humans produced them in the Amazon). We can bicker about the details, but history is at the core of every land management framework—land potential, wilderness, ecosystem health, historical range of variability, and resilience. When we allow ecosystems to deviate from historical conditions, we risk losing the diversity of life and our precious soil. In fact, we don't know what we are losing because we know so little about the machinery of evolution and ecosystem function. So historical conditions must be preserved and restored at even great cost. History is, in a word, sacred.

Proponents of "novel ecosystems," then, are heretics. These scientists propose that preservation or restoration of historical conditions is sometimes impractical.[2] The core of their argument is that ecosystems can cross ecological thresholds beyond which recovery to historical conditions is limited. Some ecosystems can cross thresholds and be restored with effort. Woody plants can be removed, allowing grass to recover and the fire cycle to be restored.[3] There is another kind of threshold, however. When soil is stripped away by erosion after careless grazing or earthmovers seeking minerals; when a suite of invasive plants pervade a landscape, then historical conditions cannot be entirely recreated.[4–6] Add to that climate change, which will prevent recovery of historical species, and we have difficult decisions to make.[7]

The problem is that we often choose to ignore the difficult cases. We abandon ecosystems because they are "irreversibly degraded."[8] Even if we believe they are not a total loss, they are placed at the bottom category of triage—treatment is indefinitely delayed. "Novel ecosystems" proponents offer us another option.[2] They suggest that we consider accepting these cases for what they are and managing them for whatever ecosystem services can be supported by the new state (Figures 1 and 2). Although the ecosystem differs from its historical state, it can have value as a wild ecosystem. We adapt. Or is the word—surrender?[9]

Some conservation and invasive species biologists are attacking the concept of novel ecosystem on two grounds.[10] First is that there are no ecological thresholds that would ultimately prevent restoration to historical conditions with enough effort. Second, a focus on ecosystem services is a challenge to the inherent value of biodiversity and complexity of undomesticated historical ecosystems.[11] "For those who care about global extinctions or about preserving historical ecosystems, [novel ecosystems] are bad news."[12]

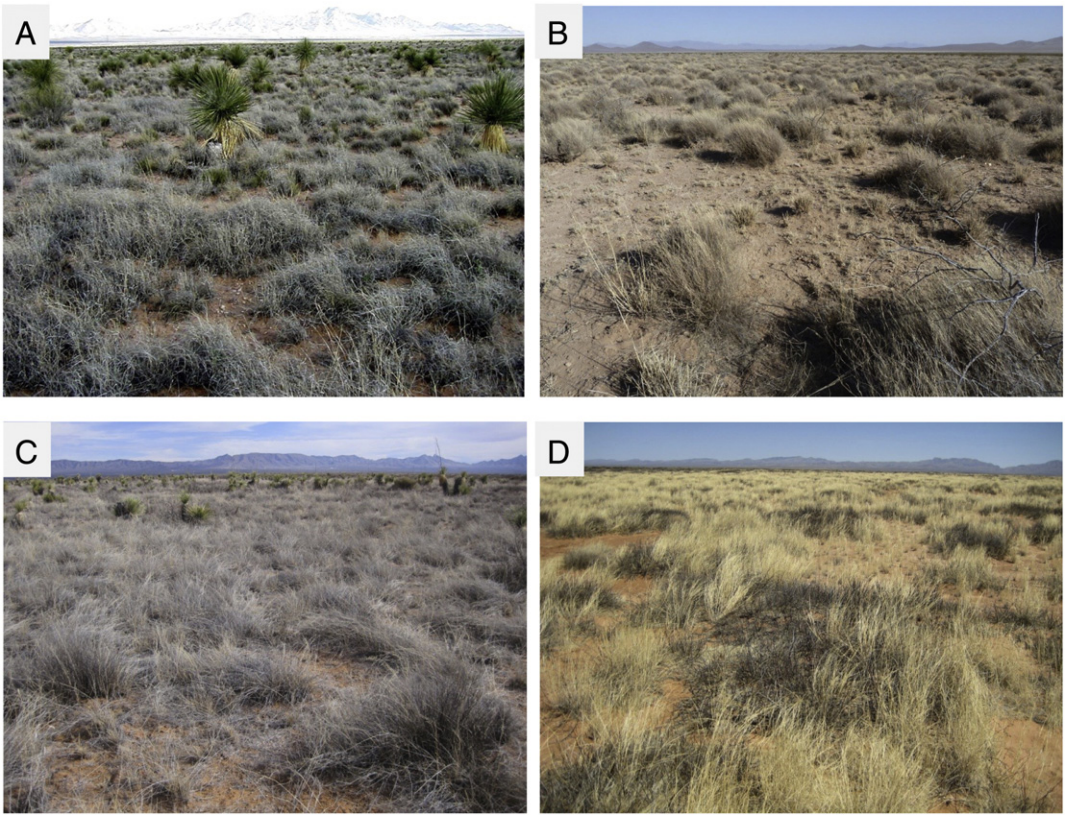


**Figure 1.** Four ways to have high perennial grass cover in sandy to gravelly soils of the Chihuahuan Desert of New Mexico. (A) A reference state featuring high cover of the valuable black grama grass (*Bouteloua eriopoda*) that dominated these landscapes before the early 20th century. (B) An area treated with herbicide to remove encroaching creosotebush (*Larrea tridentata*) that failed to recover black grama but is now dominated by bush muhly (*Muhlenbergia porteri*) and other grasses. (C) An area that was seeded with Lehmann lovegrass (*Eragrostis lehmanniana*) where black grama had been extirpated. (D) A mesquite duneland state, resulting from the loss of black grama and severe erosion, that experienced a massive recruitment of dropseeds (*Sporobolus* spp) in response to several years of high rainfall. All four areas have high grass cover and relatively stable soils, but the latter three states can be considered novel ecosystems. Should we try to restore them to black grama (which has not been successful in the past) or manage them for what they are?

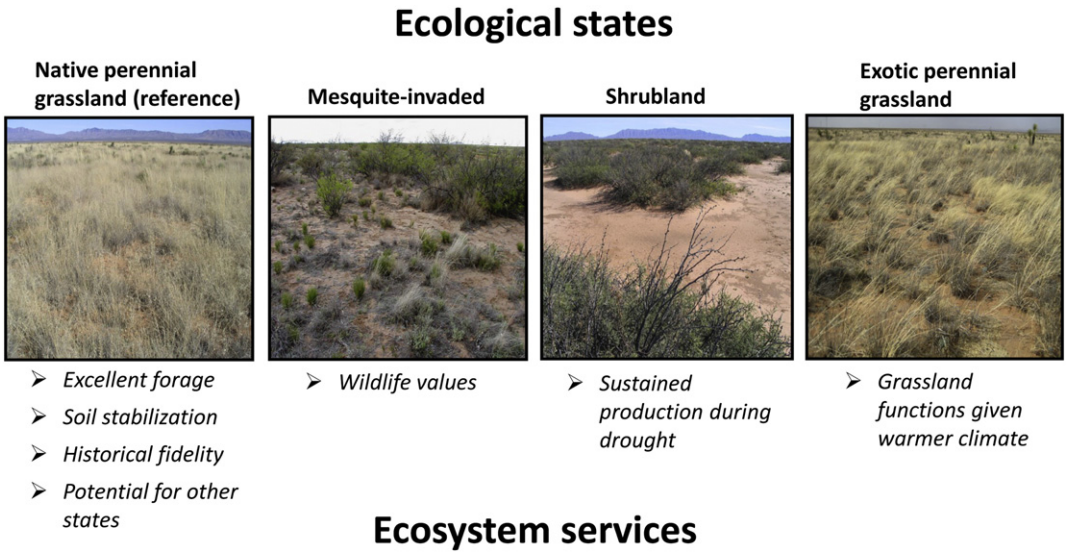


**Figure 2.** Alternative vegetation states of sandy soils of the Chihuahuan Desert (8- to 10-inch precipitation zone) and the ecosystem services provided by them. Although we could refer to the right three states as degraded and in need of restoration, we might also consider the potential benefits having all of these states coexisting in a landscape. Mesquite-invaded areas with higher woody plant cover may be valuable for songbirds and game species. Shrublands and exotic perennial grasslands (dominated by Lehmann lovegrass) may confer resilience to drought and warmer climates in the future. The few black grama grasslands that remain, however, provide valuable forage and support declining wildlife species,[13,18] but can undergo transitions to other states.

This critique, however, denies well-understood realities about ecosystem change and management. Although it is true that not all ecosystems that have been characterized as "crossing a threshold" are unrestorable, there is clear evidence that highly persistent or irreversible transitions have occurred in certain cases, often involving invasive species and soil degradation. In contrast to the assertion that "no proof of ecological thresholds that would prevent restoration has ever been demonstrated,"[10] I would take the opposite position that there is no evidence that restoration to the historical reference can occur even with intensive efforts in such cases.[4,6,13]

Does this viewpoint weaken conservation as the critics of novel ecosystems assert? I don't think so. Acknowledging that restoration potential is limited in some situations puts an even greater premium on preserving historical ecosystem states. We recognize that restoration cannot fully mitigate transformations from historical states.[13] Thus, valuing historical conditions and acknowledging the inevitability (and utility) of novel ecosystems are complementary views. Although rangeland professionals do not often use the term, management of novel ecosystems has been part of the profession since it was born. Despite its antiquity in land management, the recent literature on novel ecosystems reminds us that we must be stewards of all ecosystems, not just those that are "pristine." We can promote complexity, diversity, and a balance between production and environmental quality anywhere. This view, and the strategies stemming from it, is of immense value to the increasing number of us living in urban environments. And as climate-driven ecosystem change accelerates, both the rural and urban will have to reconcile management decisions with changing ecological potential.

The novel ecosystems critique also fails to acknowledge land use. Within wildland and low-intensity land uses such as rangeland, historical conditions will continue to be prized whether or not novel ecosystems are considered. This is because options for key ecosystem services, including wildness and soil fertility, tend to be maximized. A critical problem, however, is the loss of wildlands and rangelands to more intensive cropland and urban land uses.[14] Conversion of rangelands to cropland is accelerating in several parts of the world, including novel ecosystems such as some retired croplands in the United States (Conservation Reserve Program lands) or degraded forests in Argentina.[15,16] Furthermore, energy development may be increasingly focused on "degraded" ecosystems.[17] A decision to manage land as a novel ecosystem is a decision to retain wildland or rangeland land uses for the benefit of biodiversity conservation and related services.

It might reconcile the debate to consider the implications of novel ecosystems for land use. A decision to manage a novel ecosystem means that we will value and maintain an area as rangeland or wildland despite its limitations. We manage it to maintain biodiversity, ecosystem complexity, and low-intensity uses as well as it can. To condemn such areas as degraded, to wait in vain for restoration to occur, is to invite conversion to other land uses. Conservation biologists should not let the perfect, or the sacred, become the enemy of conservation.

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