



The boundary around these joe pye weeds is apparent when the clone is tall and flowering.

HOW VISITING THE ARBORETUM CAN HELP RESOLVE ECOLOGICAL DEBATES

Several debates in the ecological literature were the topic of a recent University of Wisconsin-Madison Plant Ecology Seminar. In seeking to resolve each debate, it seemed first that unnecessarily contentious language contributed to polarized views as much or more as basic facts and, second, that strong claims were often made without adequately defining terms. Our third observation was that Nature is complex enough to support multiple viewpoints. Our visit to the Arboretum allowed us to see evidence for opposing scientific arguments, indicating an under-appreciated service provided by urban reserves. The Arboretum's diverse lands and species support our resolution that no simple declaration is likely to prevail in all circumstances.

The “continuum” vs. “discrete communities”:

In an early ecological debate, UW's John Curtis argued strongly that vegetation changes gradually across landscapes (Curtis and McIntosh 1951), while Washington State University's Rexford Daubenmire (1966) insisted that vegetation changes abruptly. Curtis Prairie now has several shrub invasions that illustrate both patterns side-by-side. Clonal shrubs have obvious, sharp boundaries among the shorter herbaceous canopy. What if the authors had defined how abrupt/gradual a boundary would need to be to support his side? What if they had realized that perceptions can easily differ where clonal shrubs are present—if one focuses on the sharp boundary of sumac or gray dogwood (or a clone of joe pye weed; see header), while another emphasizes the continually varying understory?

Facilitation vs. competition:

In the 1990s, Mark Bertness, of Brown University, began emphasizing positive interactions among species, arguing that competition had received disproportionate attention in plant ecology (Bertness and Callaway 1994). Yet facilitation had long been a core concept in ecological succession, e.g., tall shrubs and trees facilitate growth of shade-tolerant plants—a pattern that is readily seen at the Arboretum. While Brooker et al. (2008) verified that competition is the topic of more ecological papers, facilitation is not “overshadowed” by competition. Even where invasive species outcompete native plants, there can be facilitation. In Curtis Prairie, we could see that reed canary grass and gray dogwood outcompete many of the herbaceous plants; at the same time, there was evidence that reed canary grass facilitates herbivory by rabbits and the dogwood facilitates nesting by birds. One species' competitor can be another's facilitator.

“By its own measures, conservation is failing”:

In 2012, Peter Kareiva et al. angered nature conservationists with that sweeping statement, arguing that nature preserves have excluded indigenous people, that nature is not fragile, and that the conservation message needs to change to include people. Critics were quick to respond (Revkin, NYT, 2012). Indeed, Kareiva’s employer, The Nature Conservancy (TNC), already involves indigenous people in reserve management, restores degraded lands, and updates its conservation approaches and messages. Had authors from both sides defined “conservation” and “failure,” they would likely agree on methods that are effective. As both Kareiva and TNC would likely approve, the Arboretum embraces cultural history (e.g., by highlighting Native American mounds), promotes eco-cultural restoration (Leaflet 25 at uwarboretum.org/research), and routinely involves people in restoration. The Arboretum manages to conserve much of Nature’s beauty and diversity by embracing visitor assistance in some areas while reducing impacts in others.

Restoration progress—easy and rapid or difficult and slow?

An analysis of 240 published papers (Jones and Schmitz 2009) reported “rapid recovery” *based on authors’ opinions* that a third of the ecosystems were recovered and that many did so within 10-42 years. The authors express “much hope,” countering the “despair” that results from “gloomy predictions” that restoration takes centuries. In contrast, the recent analysis of 621 wetland restoration projects by Moreno-Mateos and co-authors (2012) indicates uncertainty in how well ecosystem structure and function can recover “even after decades.” Using different criteria, Arboretum prairies support both claims—a preponderance of native species (>200 native plants; Cochrane et al. 2006) indicates recovery, while the continual need for restoration suggests otherwise. Despite 79 years of restoration work, Curtis Prairie still needs shrub control. Agreement *a priori* to use science-based criteria for “recovery” would foster objective judgments about restoration outcomes, which could help resolve such debates. Also authors should distinguish opinions that are and are not science-based, and either define or avoid subjective terms such as hope, despair, gloom, and success (Zedler 2007). On viewing impacts of species invasions vs. attempts

to control them at the Arboretum, we agreed that degradation is what is easy and rapid, while restoration is difficult and slow.

Restoration goals:

Novel targets and new descriptors are a current topic of international discussion among restorationists—not yet a heated debate. By definition, pristine ecosystems, once degraded, cannot be returned to a never-disturbed state. Still, some argue about how far back we can turn the clock (e.g., Donlan et al. 2005), how well we can mimic historical states, and how we should describe the process. A symposium at SER2013 addresses many viewpoints (“Constructing future Nature: Ethical conundrums in the design of ecosystems). Should future targets be considered novel (unprecedented in Nature) in order to be achievable (Williams and Jackson 2007, Seastedt et al. 2008), or should we broaden the concept of restoration to include more outcomes, given that human impacts are universal and all ecosystems are now novel in some respect? Broadening the definition would avoid having to rename our profession (e.g., Hobbs et al. 2009 and 2011 advocate “intervention ecology”), even if we use non-native species to achieve goals (Ewel and Putz 2004; Kirkman et al. 2007) or assist the migration of species by planting them in distant restoration sites predicted to have a suitable future climate (Vitt et al. 2010), or manipulate genetics to get species to grow in highly modified sites (Jones and Monaco 2009).

Looking forward

Leopold (1949) described an evolving land ethic that anticipates the need to change to meet new challenges. How, then, should the Arboretum plan to accommodate climate change (Harris et al. 2006), use a watershed perspective (NRC 2001; Miller et al. 2012), and implement adaptive restoration? We agreed that shifts in policy and practice do not require new nomenclature, only acknowledgement that “restoration” has broad meaning (Zedler et al. 2012). One powerful word, “restoration,” engages the public, draws participants to weekend work parties, excites donors, and captures our heritage. Historical conditions, whether pristine or not, serve as a vision, while adaptive restoration is a suitable implementation—learning while restoring.

The experimental approach is ideal for an arboretum dedicated to restoration, research, education, sifting and winnowing, solid science, and objective interpretation.

Through field tests in new restoration sites, such as Teal Pond Wetlands, we can learn how to restore sedge meadow vegetation where shrubs have been removed and many trees remain and urban runoff continually transports nutrients into the lowland. And an adaptive approach can be extended to the challenge of engaging more partners, changing policies, and improving regulations within and beyond the Arboretum's watersheds. Beyond contributing ~20 acres of land to accommodate the city's runoff, the Arboretum can protect its downstream wetlands and waters by engaging upstream neighbors to use less fertilizer on their lawns, not rake leaves into the gutters, and install rain gardens and rain barrels to reduce excess runoff. Restoring a quality environment requires everyone's understanding and participation. That it is appropriate for such efforts to be led by the University of Wisconsin should not require a debate.

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