



Research Brief for Resource Managers

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Non-Native Plants, Fuels, and Desert Revegetation

Abella, S.R., and L.P. Chiquoine. 2018. *The good with the bad: when ecological restoration facilitates native and non-native species. Restoration Ecology (in press).* <https://onlinelibrary.wiley.com/doi/10.1111/rec.12874>

To revegetate disturbed desert lands, practitioners require cost-effective techniques reliable in extreme, unpredictable desert climates. Reestablishing fertile islands is often a first step in restoring native plants and associated fauna on disturbed desert sites. Fertile islands are associated with the shaded, often nutrient-enriched soils below the canopies of perennial plants, usually shrubs. A key ecological function of these fertile islands is providing “nurse plant” effects, whereby the perennial facilitates recruitment of annuals or other perennials. The recruitment of many species of native annuals and perennials is mostly or solely dependent on the availability of nurse plants. The idea that first reestablishing fertile islands to concentrate sparse resources (nutrients, moisture, as well as seeds), thereby encouraging the natural recruitment of other species, underpins much of desert restoration science.

There is a potential problem with this idea in the contemporary environment, however. With the pervasive invasion of non-native grasses such as red brome (*Bromus rubens*), *Schismus* spp., and cheatgrass (*Bromus tectorum*), it is often now these species that exploit fertile islands in undisturbed desert ecosystems. However, these relationships can vary among years differing in rainfall, species of perennial plant, resident annual plant composition, and elevation/soil type.

Management Implications

- Restoring native perennials facilitated both native and non-native annual plants
- Vertical mulching had effects on annuals intermediate between those of outplants and interspaces between perennials
- Pairing treating non-native grasses with traditional desert restoration activities (e.g., outplanting perennials) may be needed to ensure native species benefit

In an ecological restoration context, does restoring fertile islands most benefit native or non-native annual species, and how might these relationships vary? Does the low-cost technique of vertical mulching (placing dead plant material upright in soil) have effects similar to restoring live perennial plants?



Outplanted perennial facilitating below its canopy a mixture of native and non-native annuals. This restoration site is along Keys View Road, Joshua Tree National Park (photo by S.R. Abella, 2017).

In a long-term partnership since 2008 with Joshua Tree National Park and with support from the Deserts Bioregion of the California Fire Science Consortium in 2017, we conducted a field and data synthesis of nine years of annual plant communities occurring below perennial plants the National Park Service (NPS) had outplanted in 2008. At 30 sites disturbed by road construction and that were revegetated by NPS, we measured annual and perennial plants in 2009 (one year after nursery-grown perennials were outplanted at the sites), 2010, 2011, and 2017 (nine years after restoration). We also made these same measurements below vertical mulch structures.

During certain years, both outplants and vertical mulch were key locations for elevated native annual plant diversity and cover, compared to interspaces between perennial plants. However, non-native annuals often benefited as much or more than native annuals. **In the ninth year (2017), which was the wettest, both native and non-native cover averaged 3× higher below outplants than in interspaces.** This presents a conundrum where the restoration action simultaneously benefited both native and non-native species. The restored structures further supported copious amounts of fuel production that could be a concern for fire management.

To address this conundrum, we suggest pursuing two complementary approaches: 1) shifting focus to restoring perennial species that do not necessarily form fertile islands, and 2) pairing restoring fertile island-forming species with treatments to reduce non-native species. While most native perennial species facilitate non-native annuals in North American hot deserts, a small subset of native perennials have neutral or even competitive effects on non-native annuals. These perennials appear to have relatively short average life spans (less than a few decades), frequently colonize disturbed sites, and may have combinations of traits averse to forming well-developed fertile islands and nurse plant effects. Desert globemallow (*Sphaeralcea ambigua*) and sweetbush (*Bebbia juncea*) exemplify these sorts of native perennial species and have supported the fewest non-native annuals in reference ecosystems and invasibility experiments. Further exploring the restoration potential of these types

of perennial species is warranted because they could provide restoration with functional benefits (e.g., covering soils, providing forage for wildlife), without facilitating non-native plants. But precisely because they may not serve as nurse plants, a shortcoming could be lack of facilitation of native plants. This drawback likely renders non-fertile island-forming species only a partial solution for desert restoration.

Limited research on the success of herbicide and other treatments at reducing non-native annuals in naturally established desert shrublands suggests that the second option – pairing outplanting with treatments to reduce non-native annuals – warrants further study for ensuring that native species are the beneficiaries of restored fertile islands.



Nine-year-old restoration site in 2017 containing outplants and vertical mulch. Note how annual plants are concentrated around the outplant and vertical mulch structures, such as in the bottom left of the photo.

Suggestions for further reading:

Abella, S.R., and K.H. Berry. 2016. Enhancing and restoring habitat for the desert tortoise. *Journal of Fish and Wildlife Management* 7:255-279. doi: 10.3996/052015-JFWM-046 (a public domain article, in the U.S. Fish and Wildlife Service-sponsored journal, reviewing techniques for habitat and fire management in the Mojave Desert).