sediments, and are analyzing marsh water and sediments for sulfides and nutrients. Experimental restoration projects have already begun, including an effort to raise Big Egg Marsh, where workers sprayed sand several inches deep on the marsh and several feet deep in adjacent tidal channels, and planted tens of thousands of smooth cordgrass (*Spartina alterniflora*) seedlings. So far, the sand has stayed in place and the seedlings are growing vigorously.

OTHER COMMUNITIES

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Short-term Responses of Desert Soil and Vegetation to Removal of Feral Burros and Domestic Cattle (California)

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Restoration projects undertaken on large spatial scales typically focus on reintroducing, removing, or manipulating ecosystem-scale processes, such as grazing or fire. However, in arid ecosystems, such as the Mojave Desert, ecological recovery following processes-based restoration may be protracted and uncertain due to the system's low productivity and event-driven dynamics, and, perhaps, the crossing of ecological or biophysical thresholds. Given how little is known about grazing disturbance in the Mojave or natural ecological recovery in arid conservation reserves (Lovich and Bainbridge 1999), we sought to 1) quantify the gradient of grazing effects on plant and soil attributes at increasing distances from artificial water points, and 2) document response of attributes of soils and plants for up to two years following grazing removal.

Since the 1860s, livestock have grazed the eastern Mojave, but there was little regulation of grazing intensity, seasons, or animal rotations until the establishment of the 1.6-million acre (0.61-million ha) Mojave National Preserve in 1994. Grazing was subsequently managed by rotation of active watering points over time across the landscape. Beginning in late 2001, cattle and free-roaming burros began to be removed from several grazing allotments in an attempt to facilitate conservation of desert tortoises (*Gopherus agassizii*).

During 2001-2003, we followed the methods of Herrick and others (2005) to measure the penetration resistance and aggregate stability of soils, abundance of ant mounds, extensiveness of gaps in plant canopy and plant bases, as well as percent cover, density, and species richness of plants. Given that cattle use of the landscape exponentially decreases with increasing distance from watering points (Andrew 1988), we predicted that sampled points closest to water would generally have more degraded soils and vegetation than points further from water, and that those most degraded points would exhibit the greatest change following grazing removal.

We established three permanent transects at 100 m, 400 m, and 1600 m from each of ten active stock tanks or wells (five in 2001 and another five in 2002) across two adjacent allotments of the preserve. To assist our predictions of longer-term responses to livestock removal, we also sampled at points within exclosures, when these occurred within the 1600-m radius of any of our tanks. Here, we describe results for one indicator—cover of native grasses (measured with line-point transects)—to illustrate phenomena and trends that we observed more generally across all our soil and plant indicators.

Elevations within the preserve range from 279 to 7,928 ft (85 to 2,417 m), and from 869 to 6,675 ft (265 to 2,035 m) within our two study allotments, which together totaled 0.54 million acres (0.22 million ha). The nearest weather station to our study area received 118 percent of the 48-year average of precipitation in the 12 months before the 2001 sampling, 53 percent before the 2002 sampling, and 99 percent before the 2003 sampling.

Cover of native grasses, such as Indian rice grass (*Achnatherum hymenoides*) and big galleta (*Pleuraphis rigida*), was correlated across wells with elevation, ranging from zero cover at all distances at the two lowest-elevation wells to greater than 15 percent at higher-elevation wells. At the eight wells where we detected native grasses, the lowest cover was at 100-m points (average across those wells was 0.4 percent in both 2002 and 2003), intermediate at 400-m points (4 percent in 2002, 4.1 percent in 2003), and highest at 1600-m points (6.4 percent in 2002, 5.9 percent in 2003) during all years. Within exclosures, 100-m points had higher native grass cover than their counterparts outside exclosures at all wells in all years. However, 400-m and 1600-m points had greater cover than their grazed (or recently grazed) counterparts at only one of four wells. Native grass cover was greatest in the wettest year (2001) and lowest in the driest year (2002), and across the preserve the loss in cover over time increased as distance from water increased, but significantly so only from 2001 to 2002.

Results from our study suggest several conclusions that are relevant to future recovery and management of the Preserve: 1) restoration may be a protracted process because of the aridity and low productivity of the Mojave, although recovery trajectories will vary among ecosystem components; 2) the slope of grazing-induced gradients in vegetation and soil variables varies across years with either precipitation or years since removal of grazing, depending on the variable; and 3) because grazing disturbance and recovery processes operate at several spatial resolutions, the amount of recovery observed will vary with the scale of observation, and with important covariates, such as elevation, soil texture, and pre-removal grazing intensities.

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Fifteen Years of Plant Community Dynamics During a Northwest Ohio Oak Savanna Restoration. 2004. Abella, S.R., Ecological Restoration Institute and College of Ecosystem Science, Northern Arizona University, Box 15018, Flagstaff, AZ 86011, sra8@dana.ucc.nau.edu; J.F. Jaeger and L.G. Brewer. **The Michigan Botanist** 43(2):117-127.

These researchers evaluated the 15-year restoration of an overgrown black oak (*Quercus velutina*) savanna in the oak openings region around Toledo, Ohio (see *ER* 19(3):155-160). Seventy-four acres (30 ha) of the 99-acre (40-ha) Mary's Savanna were treated with prescribed burns, while the rest was left as a control. The study showed that groundlayer vegetation changed significantly for both control and treated areas, with burn plots having more of an increase in species that require insolation, such as wild lupine (*Lupinus perennis*) and hoary puccoon (*Lithospermum caroliniense*). Burn plots showed a decrease in sapling density, but no changes in species richness or oak overstory density, which is still about twice as thick as a presettlement oak savanna would be.

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Successful Use of Topsoil Removal and Soil Amelioration to Create Heathland Vegetation. 2004. Allison, M. and M. Ausden, Royal Society for the Protection of Birds, The Lodge, Sandy, Bedfordshire SG19 2DL, United Kingdom, +44-1767-680-551, Fax: +44-1767-689-836, malcolm.ausden@rspb.org.uk. **Biological Conservation** 120(2):221-228.

Allison and Ausden compare the effects of 1) removing 10 inches (25 cm) of topsoil against deep plowing to 12 inches (30 cm), and 2) adding heathland vegetation clippings, bracken fern (*Pteridium aquilinum*) litter, or pine (*Pinus* spp.) mulch to create suitable conditions for establishing heathland vegetation in Kent, England. The study site was a grass field that had not previously been heathland. Results showed that topsoil removal decreased phosphorus more than deep plowing and that both treatments raised pH. Heathland vegetation was established on all plots treated with topsoil removal and heathland clippings, even though the remaining soil was only slightly acidic (pH 5.9-6.8). The authors suggest that a lack of competition may be the reason for the success of the heath vegetation, and that adding pine and bracken fern mulch could help acidify these types of sites.

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Effects of Fire Intensity on Vital Rates of an Endemic Herb of the Florida Keys, USA. 2005. Liu, H., University of Florida-TREC, 18905 SW 280 St., Homestead, FL 33031, 305/246-7001 x 231, hliu@cas.usf.edu; E.S. Menges, J.R. Snyder, S. Koptur and M.S. Ross. **Natural Areas Journal** 25(1):71-76.

These researchers assessed post-fire effects on the annual survival, annual growth rate, seedlings per 1 m^2, fruiting plants, and fruits per reproductive plant for Big Pine partridge pea (*Chamaecrista keyensis*), a plant endemic to the fire-dependent, pine rockland ecosystem. Prescribed fire temperatures, taken from steel plates laid on the ground, ranged from 100°F (38°C) to 649°F (343°C). Two years of results showed that the numbers of fruits and percentage of fruiting plants increased as fire intensity increased, but only during the first post-fire year. The authors suggest that low fire intensity at short return intervals (three or fewer years) may not provide enough stimulation for good recovery of Big Pine partridge pea.

CONTROL OF PEST SPECIES

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Spraying Glyphosate at Freezing Temperatures and Other Techniques for Controlling Garlic Mustard (Ohio)

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From 2000 to 2002, I investigated novel ways to control garlic mustard (*Alliaria petiolata*) in glaciated northern Ohio. During this time, I conducted experiments that explored three questions: 1) Can land managers spray Roundup Pro (glyphosate) earlier in the spring to minimize harming spring ephemerals? 2) Do adult plants produce viable seed after they have been pulled? and 3) How can pulled plants best be stored on-site?

My study sites were located near Wooster, Ohio, where forests are generally small, surrounded by agricultural land, and typically dominated by red maple (*Acer rubrum*), white ash (*Fraxinus americana*), and elms (*Ulmus* spp.) (Braun 1989). For the first trial, I examined the efficacy of a 1-percent Roundup Pro application to control first-year rosettes (those that had germinated the previous spring) under a variety of temperature conditions. In a floodplain area, I sprayed four 5-ft x 10-ft (1.5-m x 3-m) plots in late autumn—four in mid-winter, four in late winter, and left four untreated as controls. Treatments were replicated in 2001-2002 at an upland site. Garlic mustard density averaged 54 plants/m^2 in November of 2000 for the floodplain plots and 111 plants/m^2 in November of 2001 for the upland plots. Percent cover averaged 12.2 percent in 2000 and 64 percent in 2001. I selected spray times that spanned the cold-weather months (for example, the late autumn application was in November in 2000 and December in 2001). During 2000-2001, I sprayed only on days when there was no rain. In 2001-2002, I sprayed on days when temperatures were as close to freezing as possible during the target window. Although the label for Roundup Pro does not specify a temperature requirement (Monsanto 2002), a customer service representative told me that the product only works when air temperatures are above 40°F (4.4°C).

I found that an application of glysophate sprayed at 23.6 to 31.4°F (-4.7 to -0.3°C) reduced garlic mustard density by 84 to 94