Joint Fire Science Grant Update

Donovan Craig, Research Assistant

A key issue in the Mojave Desert is finding native plants that can re-vegetate burned areas while out-competing invasive species. Invasions of red brome (*Bromus rubens*) and Mediterranean grass (*Schismus arabicus*) are fueling the fires that were once uncommon in the Mojave. Moreover, little is known about the dynamics of plant species interactions after fire. Research focusing on the revegetation of burned areas has been initiated through a grant written by Scott Abella, Stan Smith (UNLV), Alice Newton (NPS), and Christina Lund (BLM).

I will be implementing research that examines up to 12 native species representing four functional groups: late-successional shrubs, early-successional shrubs, forbs and grasses. One experiment will examine all 12 species and will take place at Lake Mead National Recreation Area's nursery. Plots were established and will be planted with natives in both community and individual arrangements. Then competitive interactions among planted species and exotic invasives will be examined under high- and low-nutrient treatments. The objective of this experiment is to determine which natives have the greatest nutrient-reducing abilities and can effectively depress exotic grasses in both high- and low-nutrient environments.

Last fall, 138 experimental plots were installed at Lake Mead National Recreation Area.

By determining the most competitive, easiest-to-establish native species, we will provide managers with valuable information for selecting native species that will minimize future invasion.

Early Detection, Rapid Response in Clark County: The Weed Sentry Story

Weed Sentry—Jessica Spencer, Research Assistant

The Weed Sentry program was created in late 2003, to be an early detection, rapid response program for locating and eradicating new infestations of invasive plants on public lands in Clark County. Surveys are performed along roads, trails, shorelines and in some backcountry areas on lands overseen by the Bureau of Land Management, National Park Service, U.S. Fish and Wildlife Service and U.S. Forest Service. The primary goal of Weed Sentry is the early detection of invasive plant species. The rapid response aspect of the program is a cooperative effort between Weed Sentry and land managers. If a small population is detected, the Weed Sentry crew attempts to treat it at the time it is detected. If a population is too large for the Weed Sentry crew to treat within a couple hours, Weed Sentry brings it to the attention of land managers and recommends treatment options.

Herbicide treatment of an incipient population of *Peganum harmala*.

Since its inception, the Weed Sentry program has documented over 12,000 occurrences of invasive plants. Several of these occurrences represent incipient populations that have been treated and eradicated. Weed Sentry is currently expanding to tackle various research questions surrounding invasive species. This column will provide regular updates on the status of the Weed Sentry program.

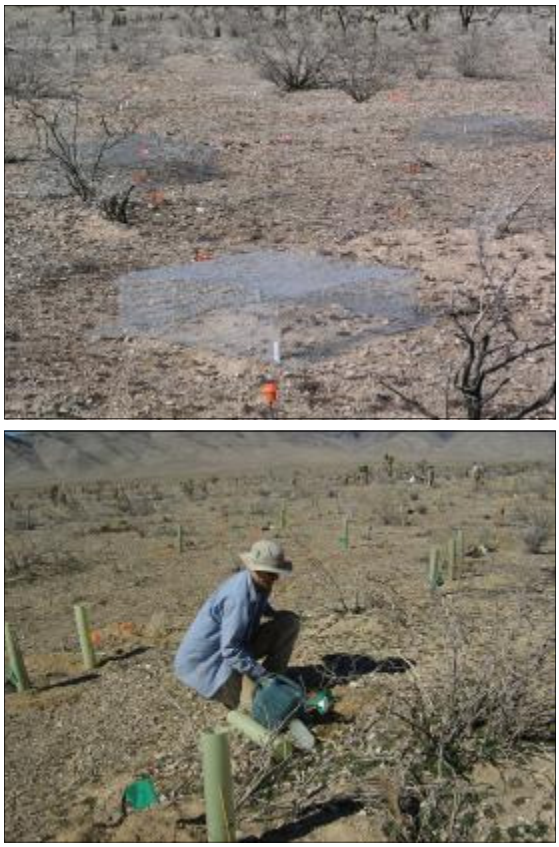
Joint Fire Science Grant Update

Donovan Craig, Research Assistant

This past spring, two field experiments were initiated on a burned area near Goodsprings, Nevada to test different revegetation techniques and to identify plant species that are most capable of establishing in burned areas. The first experiment examines seeding with questions pertaining to granivory and additions of water. We set up four replicate blocks with 20 plots per block. Each plot had one square meter seeded with one of the following community mixes: late-successional shrubs, early-successional shrubs, forbs, or a mix containing a grass species. Plant species being examined in this seeding trial include: *Larrea tridentata*, *Ambrosia dumosa*, *Eriogonum fasciculatum*, *Hymenoclea salsola*, *Bebbia juncea*, *Encelia farinosa*, *Sphaeralcea ambigua*, *Baileya multiradiata*, *Penstemon bicolor*, and *Aristida purpurea*. Further tests involving seed fates will be added to this study. No plant establishment as a result of seeding has been observed to date.

The second experiment involved outplanting nursery-grown plant species to the same burned area. We outplanted 320 plants comprising eight species: *Larrea tridentata*, *Ambrosia dumosa*, *Eriogonum fasciculatum*, *Encelia farinosa*, *Sphaeralcea ambigua*, *Penstemon bicolor*, *Muhlenbergia porteri*, and *Sporobolus airoides*. Shelters and slow-release irrigation (Rain Bird ®) treatments are being tested for their abilities to enhance plant survival. Thus far, many plants have perished, yet plants under shelters and shelters with slow-release irrigation have exhibited fewer mortalities overall.

Preliminary data and observations for these revegetation efforts further attest to the difficulties with plant establishment in burned desert areas, especially creosote-scrub communities. Many factors play a role in a plant's ability to survive outplanting or establish from seed. In the desert, as in most environments, adequate water is crucial. However, shelter from herbivory and intense solar conditions also seem to play a vital role in revegetation success.



Wire mesh exclosures were installed to investigate effects of granivory on seeding (top). Effects of shelters and slow release irrigation on outplanting mortality are also being tested (bottom).

The Utah State University Weed Mapping Workshop

Weed Sentry—Jessica Spencer, Research Assistant

A couple weeks ago, I attended a Weed Mapping Workshop put on by Steve Dewey and Kim Edvarchuk of Utah State University. It was a valuable course for people mapping any kind of vegetation, not just weeds. The most important lesson was that the way that you collect information must be determined by clientele's objectives. It is essential to define objectives so proper methods can be employed to produce a map with enough detail to address the client's questions. There are thousands of ways to produce a vegetation map. Do you use points, lines or polygons? How do you account for varying densities? How much detail is required? Most of these questions can be answered by ironing out objectives before rushing into the field to map.

The course provided several examples of methods that could be used to provide various levels of detail. It also covered how to effectively search based on your search criteria and the type of terrain. We practiced these methods in different field settings. There was a "final exam" that required us to go into the field and map weed populations with a GPS unit. We were responsible for defining objectives, determining search patterns and mapping populations of three different weeds. The course was very informative; I would recommend it to anyone who is either developing or refining a vegetation mapping project.

The Desert and Dryland Forest Research Group presents eight posters:

Wildfires and Invasive Plants in American Deserts

On December 9-11, 2008, the Society for Range Management hosted a special symposium: Wildfires and Invasive Plants in American Deserts. Four members of the Desert and Dryland Forest Research Group attended the symposium and workshops which were held in Reno, Nevada. The group presented eight posters during the Tuesday night poster session, highlighting a variety of relevant research projects the group has initiated. The following abstracts describe the research that was presented:

Early post-fire succession on a heavily visited Mojave Desert burn: Red Rock Canyon near Las Vegas, Nevada

Scott R. Abella[1], E. Cayenne Engel[2], Christina L. Lund[3], Jessica E. Spencer[4]

We examined plant recovery, soils, and soil seed banks on the 348-ha, 2005 Loop Fire in Red Rock Canyon National Conservation Area, 15 km west of metropolitan Las Vegas, Nevada. This burn is of special concern to resource managers because more than 900,000 people visit a scenic Loop Drive encompassed by the burn. We conducted sampling two years after the fire by measuring 10, 0.01-ha plots on the burn and on a paired unburned area. Perennial species composition shifted from dominance by late-successional native shrubs (e.g., blackbrush) on the unburned area to native perennial forbs (e.g., globemallow, desert marigold) on the burn. The burn was more species-rich, with richness of live plants averaging 26 (100 m^2 scale) and 239% (1 m^2 scale) greater. Fire and microsite (interspace, below creosote or yucca) interacted to affect 0-5 cm soil properties, with higher pH, conductivity, and total P and K on burned yucca microsites. Red brome density in 0-5 cm soil seed banks was four times lower on the burn, and its distribution among microsites reversed. Below-shrub microsites contained the most brome seeds on the unburned area but the least on the burned area. Intense fire below shrubs may have increased seed mortality, an idea supported by > 3-fold decreases we found in emergence density after experimentally heating seed bank samples to 100°C. Our study occurred after a post-fire period of below-average precipitation, underscoring a need for continued monitoring that characterizes moister years and evaluates aesthetic recovery on this heavily visited burn.

Management techniques for the control of Sahara Mustard (*Brassica tournefortii*) in the Mojave Desert

Dianne N. Bangle[5], Scott R. Abella[1]

In the southwestern United States, *Brassica tournefortii* (Sahara mustard) is a highly invasive plant that colonizes roadsides, beaches, sand dunes, and open desert threatening native annuals. Sahara mustard is believed to contribute to fuel loads in the Mojave Desert in areas where *Schismus* sp. and *Bromus* sp. occur. Sahara mustard may act as ladder fuel, thereby facilitating the spread of fire throughout the landscape. Manpower limitations and insufficient funding limits land managers ability to effectively control Sahara mustard. We tested seed germinability in Sahara mustard after fruiting plants were treated with either 2%, 5%, or 12% triclopyr. Sahara mustard seed pods were labeled based on three developmental stages prior to treatment. Application of herbicide decreased germination from control seeds, however effectiveness did not differ across concentrations of triclopyr (2, 5, and 12%). We also tested seed germinability in Sahara mustard after fruiting plants were separated from their resources and allowed to dry in the field. Seed pods were labeled by developmental stage before treatment. The three treatments consisted of; 1) pulling plants with roots intact; 2) pulling the plant and breaking the roots and leaf rosette from the inflorescence; 3) pulling off individual fruits. All treatments resulted in a decrease in germination from control seeds.

Post-fire plant recovery in the Mojave and Sonoran Deserts of Western North America

Scott R. Abella[1]

I systematically reviewed published literature that reported data on plant community recovery after fire in the Mojave or Sonoran Deserts. Re-sprouting by desert perennial species is generally limited but varies among species. For example, two studies found that an average of 75% of burned *Yucca schidigera* re-sprouted, whereas *Larrea tridentata* re-sprouting ranged from 3-37% among five studies. In chronosequence and permanent plot studies of community recovery, only weak trends were evident that species composition on burns was converging with unburned areas. For instance, time since fire explained only 9-19% of the variance in the Sørensen similarity of burned and unburned composition in studies with measurements up to 47 years after fire. In contrast, perennial plant cover and time since fire were closely related (r^2 = 0.39-0.99), suggesting that perennial cover recovers more rapidly than composition. Based on ordinating data from 13

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studies, overall perennial composition after fire differs between the Mojave and Sonoran Deserts. Dominant post-burn species variously included *Ambrosia deltoidea*, *Ephedra nevadensis*, *Gutierrezia sarothrae*, *Encelia virginensis*, *Sphaeralcea ambigua*, and grasses like *Achnatherum speciosum*. Some species exhibited versatility by being dominants in both burned and unburned habitat (e.g., *A. deltoidea*, *E. nevadensis*), at least in terms of their relative importance within communities even if their raw abundance declined after fire. While some general principles are suggested by analyzing the available literature as a whole, results suggest that more work is required for improving specific knowledge about plant recovery among fires, sites, species, and climates.

Burned and unburned desert near Goodsprings, NV.

Seeding effectiveness for eight Mojave Desert perennial species after a 2005 wildfire

E. Cayenne Engel[2], Scott R. Abella[1], Christina L. Lund[3]

In the Mojave Desert, where germination is largely dependant on the timing and amount of precipitation, seeding is a risky endeavor, but it is one of a limited number of restoration techniques available to managers attempting emergency revegetation on large desert burns. We monitored the seeding success of eight perennial shrub species in the 33,500-acre 2005 Goodsprings Fire within the Red Rock Canyon National Conservation Area two seasons after the aerial application of seeds. Seeded species consist of a mix of native perennial forbs, grasses, and shrubs. The seeding was divided into six plots totaling over 2700 acres that span different topographical features, soil types, and unburned plant communities. To date, seeding has not statistically affected the abundance of seeded species, although there are trends indicating that *Atriplex canescens* and *Sphaeralcea ambigua* may increase in abundance with seeding. Greenhouse seed bank trials produced no seedlings of seeded species in seeded or unseeded plots. The extraction method for seed isolation from the soil detected the presence of some of the seeded species, but in low abundance, and with no difference between seeded and unseeded plots. Many factors could affect seeding success including soil moisture availability, granivory, and use of species appropriate for existing site conditions and successional stage. We looked at the seeded species and associated plant communities coupled with the natural environmental variation across seeded plots to interpret the observed responses.

Abstracts continued on page 6

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Seed removal by granivores in burned Mojave Desert habitat: implications for revegetation

Alexis A. Suazo[6], Donovan J. Craig[7], Scott R. Abella[1]

Increased abundance of exotic annual grasses provide fuel for wildfires in North American desert habitats where fires were once uncommon events. Direct seeding techniques are used in an attempt to re-establish plant species important to desert ecosystem functions and processes. Granivorous ants and rodents are important components of North American deserts, and their seed-eating behavior can influence plant composition and establishment. Granivores can potentially consume large amounts of the seed used in revegetation, possibly slowing restoration efforts. To elucidate seed predation patterns by ants and rodents, we performed a seed removal experiment in burned and unburned creosote (*Larrea tridentata*) scrub desert habitats on the 2005 Goodsprings Fire in southern Nevada. We studied seed removal using wire cages that either excluded or included ant or rodent access to seeds. We offered 20 seeds of eight native species, and quantified seed removal by subtracting the number of seeds that remained in a Petri dish after a four day trial. Our results indicate that seed removal was three times higher in cages that allowed ant access in burned habitat, and seeds of *Penstemon bicolor*, *Encelia farinosa*, and *Sphaeralcea ambigua* suffered greater seed losses. Our results suggest that granivorous ants may play a significant role in the establishment of plant communities in burned areas by preferentially removing seeds of small seeded plant species. Therefore, managers may choose to sow species that are less susceptible to predation by ants in burned areas.

Vegetation reestablishment of Mojave Desert plant communities after 2005-2006 wildland fires

E. Cayenne Engel[2] and Scott R. Abella[1]

During 2005 above average precipitation from the previous winter and spring led to increased vegetative production, particularly for annual species including exotic invasive grasses. This biomass readily carried wildland fires. The result was over 125 fires greater than 5 acres in size in Clark Co., NV alone in 2005 and 2006. During winter 2007 and spring 2008 we sampled plant community composition in 15 burns and adjacent unburned sites from 2005-2006 burns in Mojave desert shrubland. We quantified the cover of perennial species and related their presence and abundance to abiotic site characteristics, soil chemistry, and unburned plant community composition to examine factors affecting vegetative recovery. After two growing seasons burned plots were dominated by the early successional perennial species *Dasyochloa pulchella, Encelia virgensis, Pleuraphis rigida,* and *Sphaeralcea ambigua,* in contrast to the unburned communities dominated by *Larrea tridentata, Ambrosia dumosa,* and *Coleogyne ramosissima.* The density of exotic *Bromus rubens* remained strongly reduced by the burn (1.9 ± 0.6 percent cover in burned plots, 14.0 ± 1.9 in unburned communities.) Elevation and latitude were correlated with burned community composition. Additionally, unburned plant community composition did not determine the recovery rate on burned plots and the similarity between burned and unburned plots was not associated with initial plant community or soil type. Burned plant community composition was associated with soil texture and total soil nitrogen; unburned plant communities were more closely associated with specific soil micronutrients. Understanding the process of post-fire recovery in an increasingly fire-rich landscape will help managers design effective restoration strategies.

Using a diverse seed mix to establish native plants on a Sonoran Desert burn

Scott R. Abella[1], John L. Gunn[8], Mark L. Daniels[9], Judith D. Springer[10], and Susan E. Nyoka[11]

Revegetating burns is a major challenge facing resource managers in the low- and unpredictable-precipitation deserts of the southwestern United States. We monitored the effectiveness of using a diverse, 28-species seed mix for establishing native plants on a 1.5-ha burn in the northern Sonoran Desert. Our objective was to compare species performances, which we assessed by measuring species frequencies and cover on five sampling dates to capture variation during a 32-month period following seeding. By 15 months after seeding, desert senna (*Senna covesii*) established best, with a frequency of 91% (based on 22, 10-m^2 plots) and a relative cover of 19%. Four other seeded species also became established in ≥ 50% of plots by 32 months after seeding. Several seeded species, including desert senna (which flowered only 7 weeks after seeding) and purple threeawn (*Aristida purpurea*), were observed with seed heads during one or more sampling periods. Although precipitation was only 67% of normal for 21 months following seeding and 71% of species established in < 10% of plots, we consider the seeding to have met short-term management objectives because of the subset of highly successful species. Our results also illustrate that caution should be used when evaluating seeding success: conclusions would have differed if the diversity of the seed mix had not included the successful species, and longer term monitoring was needed to detect some species in the seed mix that did not establish until 32 months after seeding.

Joint Fire Science Update

Donovan Craig, Research Assistant donovan.craig@unlv.edu

It has now been more than one year since the field trials for post-fire planting and seeding effectiveness were implemented. The seeding portion of the study, established at the end of January 2008, has had no plant establishment to date. As a result, we decided to examine the effects of granivory on seeded species. In Fall 2008, Alex Suazo and I implemented a study examining the roles ants and rodents play in seed removal. We established randomized blocks of cages in both burned and unburned habitat near Goodsprings, Nevada. The treatments consisted of ant-inclusion/rodent-exclusion cages, rodent-inclusion/ant-exclusion cages, and total exclusion cages. We added 20 seeds each of nine species into Petri dishes and placed them into the cages and allowed four days to pass until retrieving the seed dishes. We are repeating this each month throughout the year to account for changes in granivore activity. Preliminary results (fall and winter) indicate that seed removal is higher in the unburned area and that rodents are the driving force behind this (Figure 1). Rodents are targeting larger seeds like *Coleogyne ramosissima* while ants seem to be targeting small seeds like *Penstemon bicolor*. As we continue these trials throughout the year, we expect to see more activity by both ants and rodents.

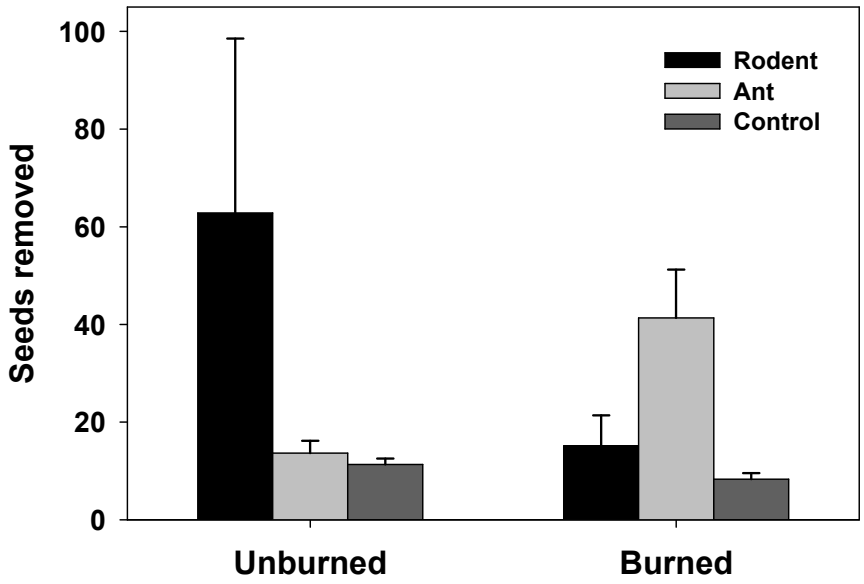

Figure 1. Preliminary results showing mean total number of seeds (±SE) removed by rodents and ants in burned and unburned habitat near Goodsprings, Nevada during the fall and winter 2008-2009. Control treatments had total exclusion of ants and rodents. (Figure by Alexis A. Suazo).

Results from the outplanting portion of the study are indicating that adding supplemental water in the form of slow-release water gel packs and protecting the plant with a shelter increase survival. Data from all species are included to reflect treatment differences only (Figure 2). Some plant species such as *Sphaeralcea ambigua* are also exhibiting a higher tolerance (thus survival) to outplanting. While all plant species did not start on equal terms (e.g. size), four

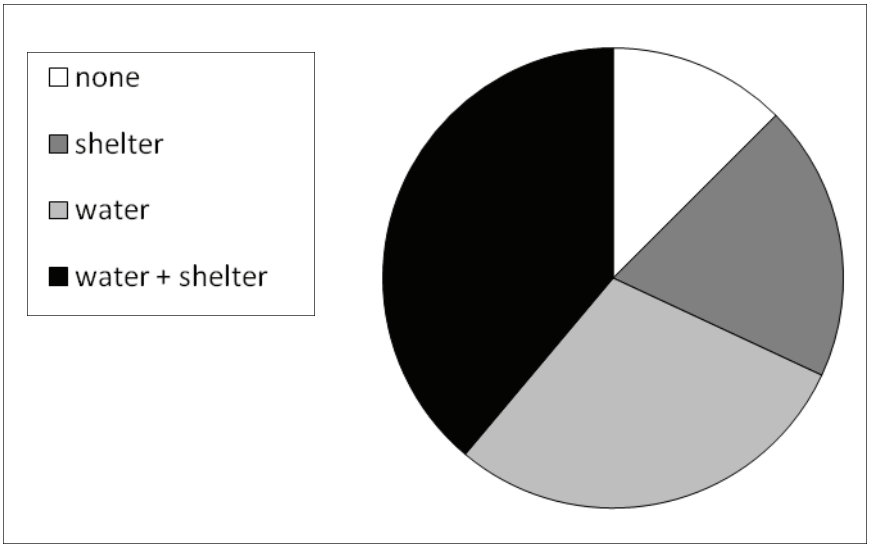

Figure 2. Proportions of surviving plants by treatment.

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A Newsletter of the UNLV
Desert and Dryland Forest Research Group

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Desert and Dryland Forest Research Group
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A note from the Desert and Dryland Forest Research Group…

This volume marks the second year of ***Mojave Applied Ecology Notes***, and a continued commitment to printing articles written by all players conducting ecological research and management throughout the Mojave. We intend to communicate between agencies, researchers and land managers and invite your article contributions. Please remember to announce your events and recent publications in the newsletter. You can submit information to jill.craig@unlv.edu.

Upcoming events: the Eastern Nevada Landscape Coalition's 10th Annual Meeting is June 12-13, 2009 in Ely, NV. Pre-registration opens April 15, 2009. For more information contact Betsy McFarland at 775-289-7974.

Joint Fire Science *(Continued from page 5)*

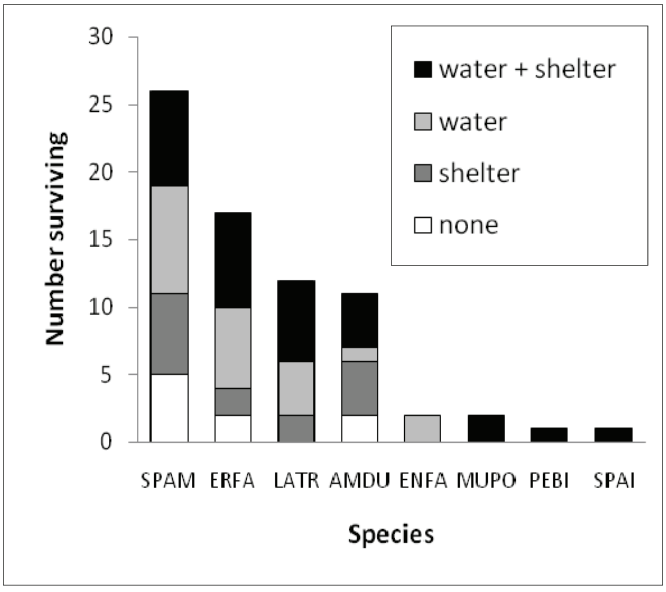

Figure 3. Species performance (number of surviving plants) in all treatments. See explanation in text for differences.

species were of equal condition prior to outplanting. *Sphaeralcea ambigua*, *Eriogonum fasciculatum*, *Larrea tridentata*, and *Ambrosia dumosa* were all nursery-grown, hardened, healthy plants in gallon-sized pots. *Encelia farinosa* were salvage plants from Lake Mead while *Muhlenbergia porteri*, *Sporobolus airoides* and *Penstemon bicolor* were outplanted from small cones instead of gallon-sized pots. Limited plant availability is a common stumbling block in revegetation projects; we will take into account differences in handling among species when interpreting survival percentages (Figure 3).

Synthesis Completed of Post-Fire Recovery of Native Perennials in the Mojave, Sonoran Deserts

Scott Abella, Ph.D. scott.abella@unlv.edu

Literature syntheses to develop status of knowledge reports are important to integrate and summarize the scattered scientific literature on a particular topic. The isolation and fragmentation of scientific literature on a topic is not necessarily a shortcoming of science. Rather, it is simply a consequence of having (1) research published in a diverse array of journals, (2) articles build on each other and therefore articles relevant to a particular topic can be published decades apart, and (3) funding virtually impossible to secure to do these periodic assessments of what we know and don't know (competitive science grants want researchers to jump into novel, new research, and land management agencies, although wishful for syntheses, cannot typically target funding out of their budgets for syntheses).

I was able to recently complete the third in a series of literature reviews (the first one was on burro grazing effects on Mojave vegetation, the second on Mojave revegetation). To synthesize post-fire recovery of perennial vegetation in the Mojave and Sonoran Deserts, I analyzed data systematically extracted from published literature to address several questions about post-fire recovery patterns.

Sprouting by desert perennials after being burned is generally limited but varies among species. For example, only 3-37% of *Larrea tridentata* sprouted compared to 64-86% of *Yucca schidigera* (the best-sprouting *Yucca* species examined). Four of five studies measuring recovery of perennial cover reported close relationships (r^2 = 0.67-0.99) between time since fire and cover (Fig. 1). In fact, three studies measuring the longest time since fire (≥ 37 years) found that cover had returned to within 10% cover of unburned areas within approximately 40 years. Conversely, post-fire species composition exhibited little convergence with unburned composition in five of six studies even 47 years after fire. *Sphaeralcea ambigua*, *Gutierrezia* spp., *Achnatherum speciosum*, *Encelia* spp., *Hymenoclea salsola*, and *Baileya multiradiata* had the highest abundances on burns relative to unburned areas, meaning that these species actually increased their relative abundance compared to other species after fire. Analyzing the literature as a whole suggested some generalities about recovery after fire (e.g., that perennial cover reestablishes faster than composition), but more work is required for improving specific knowledge about plant recovery among different fires, sites, species, and climates.

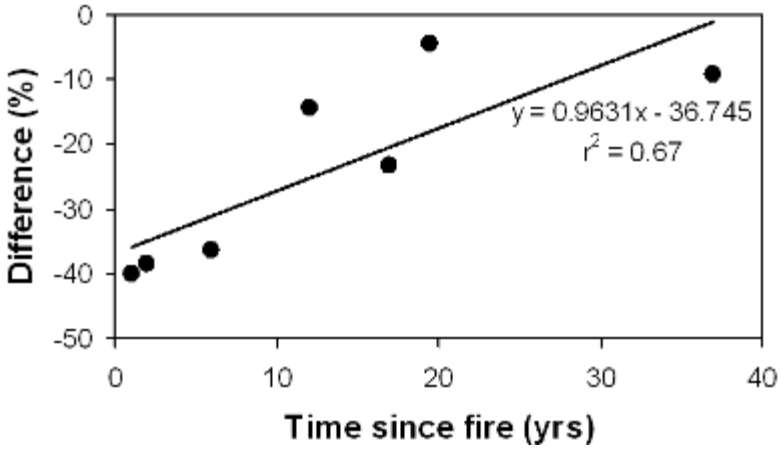

Fig. 1. Example showing one of the five studies that measured the natural reestablishment of perennial plant cover following wildfire in the Mojave Desert. This graph shows the difference between cover on burned and unburned areas (with zero at the top meaning that burned cover has recovered to levels on adjacent unburned areas) as a function of time since wildfire. The study used a chronosequence approach where each point on the graph represents a different aged wildfire. The studies generally found that native perennial cover on burns had returned to unburned levels within 40 years after fire, even though the cover was supplied by different perennial species on burned compared to unburned areas.

The citation of the full article published in Journal of Arid Environments follows, and a PDF is freely available from <http://faculty.unlv.edu/abellas2/>:

Abella, S.R. 2009. Post-fire plant recovery in the Mojave and Sonoran Deserts of western North America. Journal of Arid Environments 73:699-707.