Seed removal rates of Sahara mustard (*Brassica tournefortii*) by rodents and ants under different microsites in Lake Mead National Recreation Area.

Anna San, Biology Undergraduate

Exotic plant species can become invasive and out-compete natives for local resources when their natural predators are absent from the habitat they infest. Thus, invasive species pose a major threat where resources are limited in the desert ecosystem of Lake Mead National Recreational Area (LMNRA). For example, Sahara mustard (*Brassica tournefortii*) has an earlier phenology than most native plants, allowing the invasive species to out-compete natives for soil moisture and nutrients. There is little documented about the dispersal mechanisms of Sahara mustard in invaded habitats, but it may be dispersed via wind, adhesion to moving objects, or through secondary dispersal by seed consuming granivores. There is no known documentation of Sahara mustard seed predation by consumers native to LMNRA. Native granivores, such as ants and rodents, may benefit from eating seeds of invasive plants. The uneaten seeds buried in forgotten caches can germinate and proliferate the dispersal of the plant. Understanding the interactions between native seed granivores and Sahara mustard may provide insight for effec-

*(Continued on page 3).*
NEW BOTANISTS
join the Desert and Dryland Forest Research Group

Reported by Kate Prengaman, Botanist

Karin joins us from Alaska, where she was recently working as a Physical Therapist. Her botanical field experience includes the recent vegetation mapping project at our neighboring park, Parashant National Monument, and many other western parks. She has a BS in Forestry and a MS in Physical Therapy, both from the University of Montana, Missoula. Karin enjoys skiing, mountain biking, and hiking.

Julia joins us from Ohio, where she was recently working on research with Karner Blue Butterflies in oak savanna habitats. She has a BS in Biology from Brown University and is interested in pursuing research on conservation biology and habitat disturbance. Outside of work, she enjoys hiking, cooking, and snowboarding.

Carl joins us after a winter in Southern Arizona. He knows his Mojave plants after a field season with the Eastern Nevada Landscape Coalition. Carl also has botanical experience from work in Florida with the Nature Conservancy and water-quality analysis in Haiti. He has a BA from University of Arizona and is a masters-candidate at Miami University in Environmental Science. Carl enjoys camping, sport kite-flying, and photography.
Seed removal by rodents and ants (continued from page 1).

ative control of the invasive species. Alex A. Suazo and I conducted this project to provide a basic ecological understanding of native ant and rodent predation on Sahara mustard seeds. In order to assess seed removal, we used wire cages to manipulate access to seeds by ants and rodents (Figure 1). A total of 60 cages was established in five 100 m × 100 m study sites at LMNRA. Seed removal rates were measured from open areas and under shrub canopies. Over a five night period, we offered 0.5 g of Sahara mustard seeds and measured the amount of seeds removed.

Figure 2 shows seed removal patterns. Ants removed the greatest amount of Sahara mustard seed. Ants removed more seeds under open microsite conditions than shrub canopy conditions. Rodent seed removal was low and showed no differences between microsites. In control cages, more seeds were removed under shrub canopies than at open microsites. The control cages were designed to completely block ant and rodent access, but flying insects small enough to enter the cages could have removed some seeds. This suggests that our control cages may not have blocked all potential granivores.

Because Sahara mustard seeds are small (~1.0 mm diameter) and weigh little (~0.0014 g per seed), the pattern observed in Figure 2 may support the general observation that ants prefer smaller seeds compared to rodents that prefer larger seeds. Ants can easily carry light weight seeds back to nesting mounds while rodents may not pursue smaller-sized seeds because it may not be energy efficient. We also expect seed removal by ants to fluctuate from season to season. Ants are less active during cold seasons but become active foragers as the weather warms up, perhaps increasing seed removal. Because this study was based on data collected in early spring, additional trials of the remaining seasons should be performed in order to confirm these results. Even though Sahara mustard is an invasive species, ants may benefit from the seeds as they become an available resource. The role of ants as potential secondary seed dispersers of Sahara mustard should be evaluated.

Figure 2. Mean (±SE) rates of Sahara mustard seed removal in March 2009 during a five-night trial from five sites at LMNRA. The graph shows that the greatest amount of seed was taken by ants in an open microsite.

Anna San conducted this project through ENV 492 & 493 (undergraduate research/independent study). Anna is majoring in biology with a concentration in environmental sciences, she is also pursuing a minor in environmental studies.
As one of the National Park Service’s (NPS) 32 Inventory and Monitoring (I&M) networks nationwide, the Mojave Desert Network (MOJN) is in the process of developing several monitoring protocols for important ‘vital signs’ (i.e. indicators of ecosystem health and stability). One of these monitoring protocols is being developed for the early detection and monitoring of invasive exotic plant species. Invasive species, in general, are among the most serious threats to global biodiversity and hence, ecosystem health. As we are well aware of in the Mojave Desert, invasive plant species such as saltcedar (*Tamarix* spp.) and red brome (*Bromus rubens*) are creating major disruptions to the ecology of the desert Southwest through drastic alterations of the habitats in which they invade. Most land managers know the identities of these common invasive plants, as well as other highly invasive exotic plants such as Sahara mustard (*Brassica tournefortii*). However, what land managers would like to know (if possible) are the potential threats by exotic plants they may be less familiar with. Thus, in developing an invasive exotic plant monitoring protocol, one of the first steps was to compile a list of all known exotic plants occurring (or known to have occurred) within each of the seven parks in the MOJN and exotic species known to occur in the region, but not yet within the parks. Additionally, several species were included due to state or federal noxious status. Here I will highlight and summarize some of the key findings of this compilation effort.

The MOJN holds a diverse selection of park units, and thus holds the potential for a wide range of exotic plant species threats. In compiling the species known to occur within parks, a pattern of exotic species richness unfolded (see Table 1). Parks with less area have fewer documented exotic plants than parks with more area. Admittedly, this is somewhat of a simplistic view of exotic species richness in parks. However, as one may quickly see, LAME is an exception by having more than MOJA. Although, when considering the fact that LAME has an annual visitation rate that exceeds Yellowstone and Yosemite National Park’s combined ([http://www.nature.nps.gov/stats/](http://www.nature.nps.gov/stats/)), and a significant body of water, it comes as no surprise that it would also have slightly more opportunities for invasion.

<table>
<thead>
<tr>
<th>Park Name</th>
<th>Park Code</th>
<th>Size (ha)</th>
<th>Number of exotic plants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Death Valley National Park</td>
<td>DEVA</td>
<td>1,374,420</td>
<td>104</td>
</tr>
<tr>
<td>Great Basin National Park</td>
<td>GRBA</td>
<td>31,194</td>
<td>56</td>
</tr>
<tr>
<td>Joshua Tree National Park</td>
<td>JOTR</td>
<td>321,327</td>
<td>61</td>
</tr>
<tr>
<td>Lake Mead National Recreation Area</td>
<td>LAME</td>
<td>521,346</td>
<td>99</td>
</tr>
<tr>
<td>Manzanar National Historical Site</td>
<td>MANZ</td>
<td>329</td>
<td>23</td>
</tr>
<tr>
<td>Mojave National Preserve</td>
<td>MOJA</td>
<td>619,923</td>
<td>89</td>
</tr>
<tr>
<td>Parashant National Monument</td>
<td>PARA</td>
<td>424,242</td>
<td>71</td>
</tr>
</tbody>
</table>

The effort to compile a comprehensive list of exotic plants for the MOJN yielded a list of 350 species. However, it should be noted that not all of the species included are truly exotic by definition (i.e. species from other countries or continents). The list actually includes 46 species that are native to North America. Park lists may have defined some species as ‘exotic’ due to the fact that they would not be considered naturally occurring in the vegetation of

(Continued on page 5).
During the first and third week in January, the Northshore Road transplanting was completed with assistance from the Lake Mead National Recreation Area (LMNRA) Restoration and Nursery Crews, NPS volunteers, and the Nevada Conservation Corps. Preliminary surveys indicate 87% survival for transplants. The precipitation in January and February most likely assisted with this high survival rate. Plants will continue to be monitored over the next two years.

The gypsum restoration research project investigates which common Mojave Desert vascular plant species are most likely to survive salvage, storage and nursery care, and transplanting. It also provides the opportunity to ascertain the most effective methods to maintain and care for each species during salvage and after transplanting. This study will provide information to LMNRA on how to focus resources toward the most successful and applicable methods of restoration and rehabilitation of Mojave Desert gypsum communities.

**Inventorying in the Mojave Desert Network** *(continued from page 4)*.

the park (e.g. *Robinia pseudoacacia*, native to eastern U.S.), or the fact that some North American natives are classified as noxious in several states (e.g. *Solanum elaeagnifolium*). Parks are targeting these noxious natives and therefore they were included in the comprehensive list. The taxonomic breakdown of the 350 species also provides some interesting insight. There are 60 plant families represented and only 6 of these families account for 63 percent of the total number of species. These 6 families are Asteraceae (15%), Brassicaceae (9%), Chenopodiaceae (4%), Fabaceae (6%), Poaceae (25%), and Solanaceae (4%). Grasses (Poaceae) and plants of the sunflower family (Asteraceae) have been commonplace in plant invasions around the world. However, when it comes to true abundance or impact of a particular invader, this breakdown overlooks a few important species (i.e. plants of the Tamaricaceae family- saltcedar).

The main objective of this compilation effort was to be able to identify and prioritize the species based on threats to the MOJN parks. Of the 350 species, 154 were identified as having a medium to high impact on park resources, or they have a noxious status in a state covered by the Mojave Desert region. Of these 154 species, 80 are terrestrial plants that have been reported as occurring within park borders, 62 are terrestrial plants that have not been found in the parks, and 12 are strictly aquatic plants (i.e. floating or submerged). Many of the 80 plants occurring within parks are currently rare or are found in historic park landscaping. Thus, the list of actually widespread species is still relatively small. However, as we look back on past invasions, nearly all of them started as small, isolated populations that went undetected or ignored until real impacts were observed on the landscape. Thus, developing a comprehensive target list can help focus managers on the species to be alert for in early detection efforts.
ABSTRACT
Fire has become more extensive in recent decades in southwestern United States arid lands. Burned areas pose management challenges and opportunities, and increasing our understanding of post-fire plant colonization may assist management decision-making. We examined plant communities, soils, and soil seed banks two years after the 2005 Loop Fire, located in a creosote-blackbrush community in Red Rock Canyon National Conservation Area in southern Nevada’s Mojave Desert. Based on a spring sampling of 20, 0.01-ha plots, live + dead cover of the exotic annual *Bromus rubens* averaged nine times lower on the burn than on a paired unburned area. Perennial species composition shifted from dominance by late-successional native shrubs (e.g., *Coleogyne ramosissima*) on the unburned area, to dominance by native perennial forbs (e.g., *Sphaeralcea ambigua*, *Baileya multiradiata*) on the burn. Species richness of live plants averaged 26% (100 m$^2$ scale) and 239% (1 m$^2$ scale) greater on the burn compared to the unburned area. Only 5% of *Larrea tridentata* individuals resprouted, compared to 64% of *Yucca schidigera* and *baccata*. Fire and microsite (interspace, below *L. tridentata*, or below *Yucca*) interacted to affect several 0–5 cm soil properties, with higher pH, conductivity, and total P and K on burned *Yucca* microsites. *Bromus rubens* 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 *B. rubens* 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 heating seed bank samples to 100°C. Our study occurred after a post-fire period of below-average precipitation, underscoring a need for longer term monitoring that characterizes moister years.


This work was supported by Bureau of Land Management—Las Vegas, Christina Lund, Kevin Oliver & Nora Caplette

FYI:
2009 research proposal submitted to the Joint Fire Science Program not funded

Reported by Jill Craig, MSLA

Scott R. Abella, Program Manager of the Desert and Dryland Forest Research Group and Assistant Professor of the School of Environmental and Public Affairs, responded to the Joint Fire Science Program’s calls for research proposals focusing on one of 10 proposed areas of interest. His proposed research targeted area #4, which was “Improved fuels mapping in non-forested ecosystems.” The research proposal titled, “Developing a spatial and temporal landscape ecosystem model of fuel distribution in the Mojave Desert” was reviewed by a three-person panel and ultimately declined. Reviewers commented that the research would provide useful information but that the study was too ambitious, and too many study sites were proposed.
A New Resource at UNLV: The School of Environmental and Public Affairs

Edward Weber, Professor and Director of the new School

UNLV has a new School of Environmental and Public Affairs (SEPA) as of November 2009. The new school merges the departments of Environmental Studies and Public Administration into what we think is an exciting new interdisciplinary synthesis of environmental science, public and non-profit management, collaborative governance, and policy analysis. The fact that I am a lifelong Westerner in love with blue sky, sunshine, wide open spaces, and whitewater, combined with the challenge of building this new school at UNLV, enticed me to leave my position as the Edward Meyer Distinguished Professor of Public Administration and Policy at Washington State University to lead SEPA.

The new school believes that responding wisely to, and developing effective long-term problem solving capacity for, public problems and management challenges, whether environmental, natural resource-based, or otherwise, will require new levels of cooperation among experts across the public, non-profit, civic, and, in many cases, private sectors. We also believe that our primary purpose is to use our expertise to serve others. This means delivering value as teachers training future leaders. It means advancing knowledge in meaningful ways in our respective disciplines and using our expertise to help society resolve and better manage important public problems. And it means serving those in society and government with problem sets and educational demands specific to our areas of expertise. This is why a key theme that ties us together is our faculty’s strong track record and interest in applying what we know to real world problems. Whether it is in our research, or in enhancing our students’ expert abilities through our graduate degree programs in Environmental Science, the Master’s of Public Administration degree, our PhD in Public Affairs, or our graduate level certificate programs in Public Management, Non-Profit Management, Solar and Renewable Energy (coming soon), or Environmental Sustainability and Management (coming soon), we regularly work with and train front line officials charged with responsibility for solving important public problems.

What’s next for Yucca? Restoration


For more than 20 years the U.S. Department of Energy has been preparing to locate a radioactive waste dump at Yucca Mountain. Now that the project has been halted by President Obama, the Department is tasked with restoring the mountain landscape to its intact condition. Reclamation plans to re-establish the complex desert habitat; including the native plants that compose it, are (optimistically) proposed to be completed after just two years of up front labor. Restoration ecologist, Dr. Scott R. Abella offered insight into the possible complications involved with the implementation of desert restoration projects.

The full article can be accessed at:
The Interagency Weed Sentry Project comes to a close

Jill Craig, MSLA

The purpose of the Interagency Weed Sentry Project was to survey for exotic species on public lands in Clark County, Nevada and surrounding counties to facilitate early detection of exotics before they became extensive infestations. The Project was developed and tested beginning in 2003 and implemented from 2005 to September 2009. Funding was provided by the Multi Species Habitat Conservation Plan, Southern Nevada Public Land Management Act, and Lake Mead National Recreation Area base-funds. Specific project objectives were to:

1) Map exotic species distributions in Clark County to produce a GIS map of exotic species infestations. Notify agencies of new species of concern and new site locations of exotic species.
2) Treat small populations on-site. Report locations of larger infestations with recommendations for treatment to agency representatives. Monitor effectiveness of areas treated by the team by resurveying treated areas.

During the most recent Task Agreement (2006-2009), Weed Sentry appended an established database and map atlas of exotics in Clark County with infestations detected throughout a total of 1,522 miles surveyed. Additionally, 680,292 individual exotics were treated on federal lands by Weed Sentry. In February 2010, final project reports were accepted by County officials. In addition to surveying for and treating exotic species, several scientifically rigorous research studies were conducted by Weed Sentry to better understand habitat invasibility and the growth characteristics of specific exotic species. An assessment of the project was published: Abella, S.R., J.E. Spencer, J. Hoines, and C. Nazarchyk. 2009. Assessing an exotic plant surveying program in the Mojave Desert, Clark County, Nevada, USA. Environmental Monitoring and Assessment 151:221-230.