

Winter 2010

Mojave Applied Ecology Notes Winter 2010

Scott R. Abella

University of Nevada, Las Vegas, scott.abella@unlv.edu

E. Cayenne Engel

University of Nevada, Las Vegas

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Mojave Applied Ecology Notes

Winter 2010
Volume 3, Issue 4



Native Species Interactions with Red Brome: Suggestions for Burn-Area Revegetation



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“One of our focal areas of research is to identify native species for use in revegetation projects that reduce the establishment of exotic annual grasses, or at least do not strongly facilitate exotic species establishment.”

Article in press: native vegetation not strongly facilitating red brome establishment –

By Scott Abella

In deserts, native perennial plants often actually facilitate the establishment of exotic annual grasses. One of our focal areas of research is to identify native species for use in revegetation projects that reduce the establishment of exotic annual grasses, or at least do not strongly facilitate exotic species establishment. An initial research effort involving a competition experiment of red brome with native species and a correlational field study of brome distribution among native perennial plants is in press with the journal *Invasive Plant Science and Management*.

Interactions

The interactions between native and exotic species occur on a continuum from facilitative to competitive. A growing thrust in invasive species science is differentiating where particular native species occur along this continuum, with practical implications for identifying species

that might reduce the invasibility of ecosystems. We used a greenhouse experiment to develop a competitive hierarchy of 27 native species with red brome (*Bromus rubens*), an invasive annual grass in southwestern USA arid lands, and a field study to assess *in situ* responses of brome to native perennial species in the Mojave Desert. Native species most competitive with brome in the competition experiment included the annuals pincushion (*Chaenactis stevioides*) and bristly fiddleneck (*Amsinckia tessellata*) and the perennials eastern Mojave buckwheat (*Eriogonum fasciculatum*), sweetbush (*Bebbia juncea*), and brittlebush (*Encelia farinosa*) that reduced brome biomass to 49 to 70% of its grown-alone amount. There was no clear difference in competitive abilities with brome between annual and perennial natives, and competitiveness was not strongly correlated ($r = 0.15$) with the biomass of native species. In the field, sweetbush and brittlebush supported among the least cover of brome, suggesting congruence of the strong early competitive abilities of these species with *in situ* patterns of brome distribution. At the other extreme, brome attained its highest average cover

See *Red Brome* on page 5

Applied Ecology Research Group

University of Nevada Las Vegas
School of Environmental and Public Affairs
4505 S. Maryland Parkway
Las Vegas, Nevada 89154-4030

RESEARCH STAFF

Lindsay Chiquoine, Research Assistant
Donovan Craig, Research Assistant
Joslyn Curtis, Botanist
Adria DeCorte, Graduate Student
Karin Edwards, Botanist
Teague Embrey, Botanist
Cayenne Engel, Research Associate
Shannon Henke, Botanist
Sara McPherson, Graduate Assistant
Kate Prengaman, Botanist
Chris Roberts, Graduate Student
Sarah Schmid, Botanist
Alexis Suazo, Research Associate
Peter Van Linn, Graduate Student
Dr. Cheryl Vanier, Statistical Analyst

PROGRAM MANAGER

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

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www.unlv.edu/staff/cengel/AERGHome.htm

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Editor: Sharon Altman
sharon.altman@unlv.edu

Mojave Applied Ecology Notes is a newsletter published quarterly by the UNLV Applied Ecology Research Group. We specialize in working with resource managers to address key information needs for management through applied research.

DDFRG has a New Name

Beginning with this issue, the Desert and Dryland Forest Research Group has a new name: we are now the **Applied Ecology Research Group (AERG)**.

Lab Manager's Corner

By Sara McPherson

The Applied Ecology Research Group (AERG) laboratory and staff office space is housed on the fourth floor of the Science and Engineering building (SEB) on the University of Nevada Las Vegas (UNLV) campus. We currently have thirteen biological and ecological researchers as well as numerous undergraduate and graduate students that use eight specifically accommodating research work stations and utilize the climate controlled greenhouse for a wide array of high-profile research projects research.

As 2011 approaches, lab manager Sara McPherson is currently conducting a complete inventory of AERG laboratory equipment and archiving soil samples from multiple projects that range from Lake Mead National Recreation Area, to the Spring Mountains National Recreational Area, to various fire damaged areas throughout southern Nevada. More specifically, to prepare for analysis, each site sample is assigned a tracking number, transferred to a plastic bag and identified in the soil archiving database accordingly. These project samples are housed in secured laboratory cabinets until they are analyzed and the corresponding paper is published. AERG anticipates archiving and inventorying will increase the efficiency and effectiveness of its long term operational capacity.

The Greenhouse

The UNLV greenhouse is currently being used for various experiments and studies, including a biological crust study and a soil seed bank sample experiment as part of a desert burn seeding study.

For the biological soil study, the biological crusts were salvaged from the Northshore Road area at Lake Mead National Recreation Area prior to the realignment in October 2008 and placed in storage away from moisture and sunlight.

See Greenhouse on page 6

More on Red Brome: Post-Fire Establishment, the Experiments Continue

Trying to beat the brome: understanding establishment thresholds and choosing competitive native species at Parashant National Monument

By Cayenne Engel and Scott Abella

Desert fires fueled by exotic grasses like the omnipresent red brome (*Bromus rubens*) can be intense and cause widespread mortality of native vegetation. Native desert scrub communities such as those dominated by blackbrush (*Coleogyne ramosissima*) do not readily reestablish after fire (Abella 2009) and may even become more abundant in the post-burn landscape initiating a fire cycle that occurs at a greater frequency than the recovery time of the long-lived desert perennial community.

Management is therefore driven to intervene in this cycle for at least two reasons. First, fuels must be reduced on desert landscapes infested with exotic annual grasses, or the landscapes will eventually burn, as was demonstrated by the record 2005 fire season when nearly 3% of the entire Mojave Desert burned (Brooks and Matchett 2006). Second, some type of vegetation competitive with the exotic annual grasses must be established, to provide vegetative cover for purposes such as minimizing soil erosion, while hopefully reducing the fire hazard. The reestablishment of native vegetation following fire could be a biotic factor that could aid in preventing the establishment (or re-establishment) of exotic grasses after fire.

We are partnering with the Arizona Strip BLM field office (K. Harcksen) to identify mechanisms by which brome establishment can be hindered. Specifically, we will evaluate which plant species may function as the best species to use in restoration with the goals of post-fire establishment, and actively hindering brome establishment through competition. The primary objectives of this project are to specifically address competitive mechanisms that may limit *Bromus rubens* establishment and reproductive potential, and determine which native species may best produce a competitive environment for *Bromus rubens*. We will approach this by experimentally testing *Bromus rubens* establishment at different levels of light and nutrient availability and testing density-dependent relationships of native species

with *Bromus rubens* to address the influence of abundance and identity of native species on *Bromus rubens* biomass.

We are taking an experimental approach to assess the effects of light and nitrogen reduction (which naturally occurs with native perennial plant species) on brome establishment, abundance, and reproductive allocation. To do this, we are establishing 72 experimental plots in the Jacob06 fire in Parashant National Monument and applying five levels of shading, 15, 30, 50, 70, and 90 percent light reduction. Concurrently, we are applying sucrose as a carbon source to reduce the nitrogen availability.

The goal of this initial experiment is to mechanistically address what light reduction level is necessary to hinder *Bromus rubens* establishment. We hypothesize that at low levels of cover brome may be facilitated due to the lower temperatures and higher soil moisture associated with the shading, but as the shading level increases we expect to see detrimental effect due to low light level stress. Nitrogen

[See Parashant experiment on page 7](#)

Save the date: UNLV's Applied Ecology Research Group will give 5 presentations at the upcoming 36th Annual Desert Tortoise Council Symposium to be held at Sam's Town Hotel and Gaming Hall - 5111 Boulder Highway, Las Vegas, NV 89122.

The conference is Fri. - Sun. Feb.18-20, 2011.

We are not sure which day we will be presenting, so please check the conference schedule once it is posted.

Undergraduate and Graduate Programs in Environmental Science at UNLV

By Scott Abella

The School of Environmental and Public Affairs at UNLV houses B.A. and B.S. degrees in Environmental Studies and M.S. and PhD degrees in Environmental Science. These degrees are flexible, multi-purpose, interdisciplinary programs that can be tailored for both breadth and depth.

In the undergraduate degree, students can strategically use elective courses to focus their program in areas such as but not limited to:

- Ecosystem science and management
- Urban environments and planning
- Environmental economics and policy

These focus areas are not formally designated but can be designed based on the interest of the student and the employable skill sets a student wishes to develop. Minors can be formally declared and are listed in bold with examples of skill sets they can provide: **Biology** (skills in ecology), **Chemistry** (environmental chemistry), **Geology** (soils/geomorphology), **Physical Geography** (GIS, landscape analysis), **Landscape Studies** (urban ecology/planning), **Recreation** (land-use planning), **Solar and Renewable Energy** (energy planning), **Statistics** (environmental analysis), **Anthropology** (cultural resource management), **Journalism and Media Studies** (environmental journalism), **Economics** (environmental economics), **Sociology** (human-environment relations), and **Political Science** (environmental regulation).

The M.S. graduate program allows up to two formal concentration areas to be declared and can be in areas such as (but not limited to): **applied ecology, restoration ecology, environmental resource management, solar and renewable energy, urban environments, watershed management, quantitative environmental analysis, environmental modeling, environmental sociology, and policy and governance.**

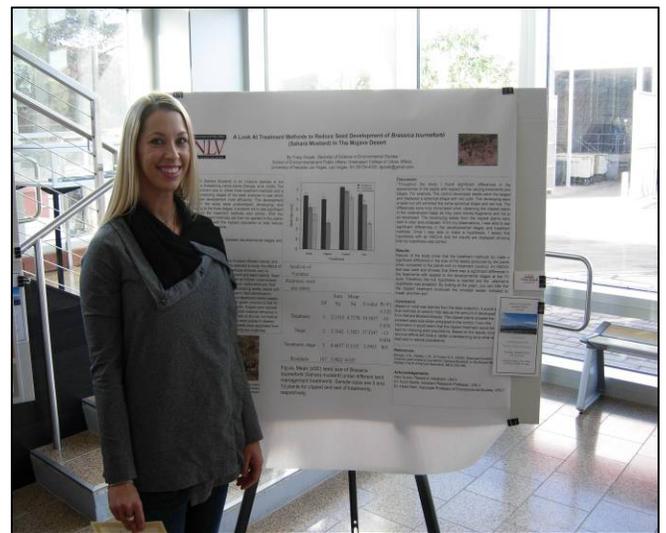
The PhD program can similarly take advantage of the multi-disciplinary focus and the array of statistics and experimental design courses available

at UNLV for a well-rounded program supporting a rigorous dissertation.

Our lab is currently accepting new graduate students who meet admission requirements, are academically engaged to the rigorous extent of committing to publish their graduate research in environmental journals, and are interested in research in applied ecology by developing a mutually beneficial graduate project.



Students can work on a variety of environmental topics, such as this study of plant recovery following wildfire in Red Rock Canyon near Las Vegas.



Students working with our lab are actively supported in presenting and publishing their research for disseminating the findings of environmental research and building their careers.

Red brome

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(19%) below littleleaf ratany (*Krameria erecta*), significantly greater than all but three of the 16 species evaluated. Cover of brome was only weakly related ($r = 0.19$) to area of the perennial canopy, suggesting that factors other than the sizes of perennial plants were linked to differences in brome cover among species.

Results suggest that (i) interactions with brome differ substantially among native species, (ii) these interactions are not as closely linked to biomass production as in more temperate regions, and (iii)

there is potential for identifying native species that can reduce invasion of desert ecosystems.

Interpretive Summary

Identifying native species, for use in revegetation and plant community augmentation projects, capable of reducing the fitness of invasive species is a major thrust in invasive species science and management. We sought to identify native species competitive with *Bromus rubens*, an exotic annual grass increasing fuel loads and facilitating fires devastating to resources in southwestern USA arid lands. In a greenhouse experiment screening the competitive abilities of 27 native species, we found that the native annuals *Chaenactis*

stevioides and *Amsinckia tessellata* and the perennials *Eriogonum fasciculatum*, *Bebbia juncea*, and *Encelia farinosa* mostly strongly competed with *Bromus*. In a companion field assessment of *Bromus* below different native perennial plants in the eastern Mojave Desert, *Bromus* cover varied more than 9-fold among 16 species. Species such as *Thamnosma montana*, *B. juncea*, *E. farinosa*, and *E. fasciculatum* showed promise in their ability to support low levels of *Bromus* cover, whereas *Krameria erecta* seems to facilitate *Bromus*. There is potential to develop lists of species for practitioners to recommend or avoid using in desert revegetation projects based on species' interactions with *Bromus*.

Species	This study: competition	This study: field	Brooks (2009): field
<i>Ambrosia dumosa</i>	Medium	Medium	Good
<i>Bebbia juncea</i>	Good	Good	Good
<i>Coleogyne ramosissima</i>	--	Medium	Medium
<i>Eriogonum fasciculatum</i>	Good	Medium	Medium
<i>Hymenoclea salsola</i>	Medium	Poor	Medium
<i>Krameria erecta</i>	--	Poor	Medium
<i>Larrea tridentata</i>	Medium	Poor	Medium
<i>Psoralea fremontii</i>	--	Medium	Poor
<i>Salazaria mexicana</i>	Good	Good	Poor
<i>Thamnosma montana</i>	--	Good	Poor

Summary of the performance of native perennial species with *Bromus rubens* in this study compared with Brooks (2009), Mojave Desert, southwestern USA. Species were ranked as poor, medium, or good in their ability for reducing *Bromus* biomass (greenhouse competition experiment) and for supporting low amounts of *Bromus* in the field (i.e. a 'good' rating indicates that *Bromus* is sparse below a species' canopy).

Abella, S.R., D.J. Craig, L.P. Chiquoine, K.A. Prengaman, S.M. Schmid, and T.M. Embrey. 2011. Relationships of native desert plants with red brome (*Bromus rubens*): toward identifying invasion-reducing species. *Invasive Plant Science and Management* (in press).

Greenhouse

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With this study we are examining recovery and rehabilitation of crust species with multiple combinations of treatments: average precipitation vs. above average precipitation, addition of wood shavings to look at effects on surface stability and possibly addition of a carbon source vs. no physical soil stabilizing mechanism, dry application of inoculants (BSC organism clumps) vs. wet slurry application, and a one or a combination of carbohydrate derivatives (D-mannitol, D-glucose, or a combination of both). All treatments are on salvaged native gypsum soils.

What we are hoping to discover is if the addition of a soil stabilizer and the carbohydrate derivatives will improve the recovery and possibly promote growth of biological soil crust organisms after they have been stored for approximately 2 years.



Containers of biological crusts salvaged from the Northshore Rd area at Lake Mead NRA, are housed in the UNLV greenhouse.



Plants germinated from seed collected at burned area plots are housed in the UNLV greenhouse.



For the Seed Bank study, seed bank samples were collected from 40 plots within burned areas on the north end of the Goodsprings fire, 2005. Half of the plots were aerially seeded with six native perennial plant species: desert needle grass, four-wing saltbush, blackbrush, Nevada joint-fir, California buckwheat, winterfat, antelope bitterbrush, and desert globemallow.

We collected seed bank samples from these sites to augment our annual field data collection aimed at evaluating the seeding effectiveness and post-fire regeneration of these sites. Seed bank samples grown in the greenhouse should result in the germination of species under ideal conditions that may not occur in the field, and allow us to more effectively tell whether seed from seeding efforts are viable in the soil even if they do not appear as recently emerged vegetation at the field sites.

Parashant experiment

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reduction may result in interactive effects with the shading, maybe shifting the level at which shading becomes an effective brome determinant.

The shading experiment will begin in January, 2011. Following the shading experiment, we will initiate greenhouse competition experiments among native annual species and red brome, and in Fall, 2011, we will outplant native perennial species that we anticipate to be good competitors with red brome, such as those found in Abella et al (2010). We will arrange the outplantings to test density dependant relationships of the native species and brome to provide information about the number of individuals of native perennials that would need to be established in a given area to adequately limit red brome establishment. See the recently published JFS report by Abella et al. where they found that early successional native forb communities, as opposed to middle and late successional or grass dominated communities, best resisted invasion.

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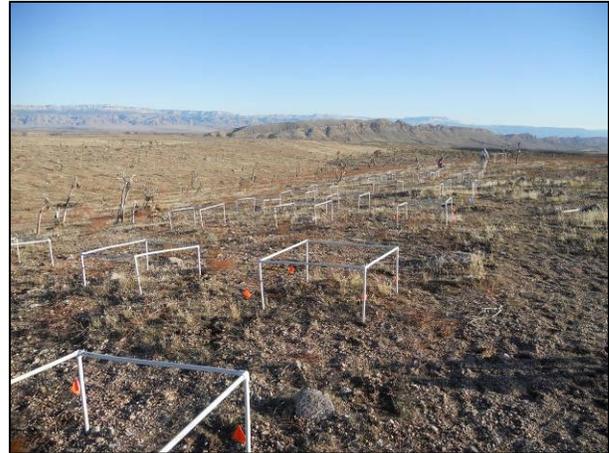


Figure 1. Frames for shade structures set in place along ridgeline in Jacob06 fire waiting for shadecloth application (Parashant).



Figure 2. Example of a shaded plot.

A new class at UNLV

AERG is happy to announce that in the Spring of 2011, UNLV will be offering ENV 794 (Restoration Ecology), which is a graduate student only course. We also regularly offer opportunities for motivated undergraduate students to work with our lab on projects as part of ENV 495 (internship) or ENV 492 (undergraduate research) and 493 (independent study).

Review of 2010 publications and in press articles

- Abella, S.R., D.J. Craig, L.P. Chiquoine, K.A. Prengaman, S.M. Schmid, and T.M. Embrey. 2011. Relationships of native desert plants with red brome (*Bromus rubens*): toward identifying invasion-reducing species. *Invasive Plant Science and Management* (in press).
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- Springer, J.D., S.R. Abella, and T.R. DeKoker. 2010. A survey of monitoring and management activities for conserving rare plants in national parks and protected areas, Arizona and Nevada, USA. Pp. x-x *in* Daniels, J.A. (ed.). *Advances in environmental research*, volume 8. Nova Science Publishers, Inc., Hauppauge, NY. xx pp. (in press).
- Abella, S.R. 2010. Exotic species. Pp. 1048-1050 *in* Warf, B. (ed.). *Encyclopedia of geography*, volume 2. SAGE Publications, Inc., Thousand Oaks, CA.

PDFs available from <http://faculty.unlv.edu/abellas2/>



University of Nevada - Las Vegas
School of Environmental and Public Affairs
4505 S. Maryland Parkway
Las Vegas, Nevada 89154-4030