Identifying Native Species for Use in Successful Revegetation Projects in the Desert Southwest

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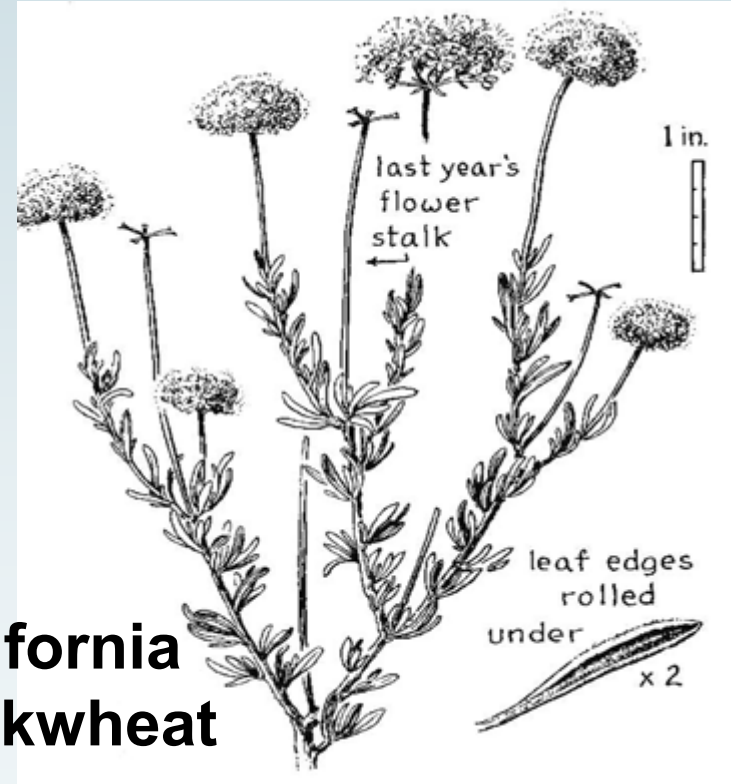


California buckwheat

03/30/2011

Many disturbance types

Lake Mead Natl. Rec. Area (Southern Nevada)

Reveg is expensive

Wildfire, SE of Vegas, BLM

Goal and Outline

To illustrate methods used in applied scientific studies to identify native species for use in revegetation, and to provide insight on species that may be successful

- **Literature review**
- **Species selection experiments**
- **Testing diverse seed mix for burn reveg**

Literature Review: Questions

(1) Which species have been most commonly and effectively planted or seeded?

(2) Which treatments have increased plant establishment?

(3) What are the relative performances of planting and seeding?

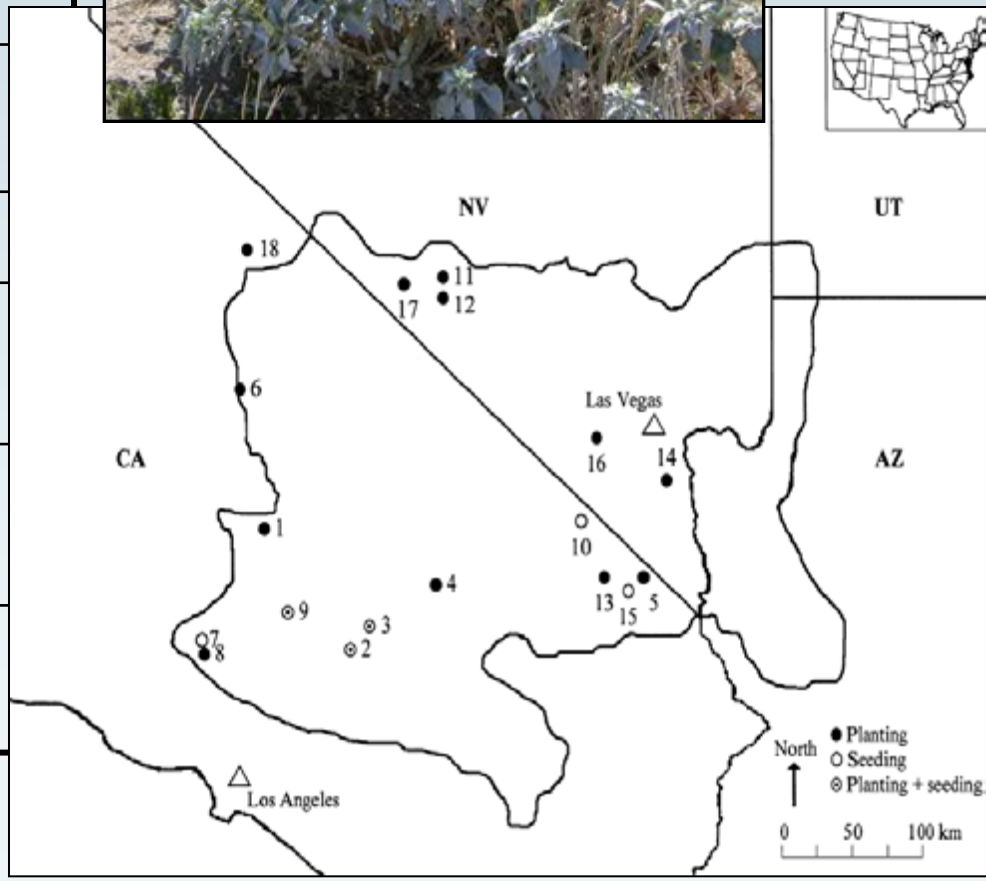
Methods

- Systematic review: included all published studies located using defined search criteria
- Article databases: Google Scholar, Agricola, Biological Sciences, Science Direct, and the journals Restoration Ecology, Ecological Restoration, and Native Plants Journal
- Search words: e.g., Mojave Desert, revegetation, rehabilitation, seeding
- Examined all references therein
- Criteria for inclusion (e.g., monitor 1 yr)

Results: Summary of Studies

	Planting	Seeding
No. studies	13	8
Environments, e.g.	Corridors, mine spoil	Old road, ag land
Precipitation (%)	27-148	33-157
No. spp/study	1-21	3-12
Care, e.g.	Irrigation, cages	Less common
Tmts tested, e.g.	Shelters, cages	Less common
Years monitored	1-5	1-5

Brittle-bush



Planting – species comparisons

- 40 total species, 36 of them shrubs
- 16 species planted in ≥ 2 studies
- ≥ 50% survival in 1 or more tmts:
  - White bursage 5/9 studies
  - Creosote 5/7 studies
  - Fourwing saltbush 4/5, alkali saltbush 2/3
  - Nevada jointfir (*Ephedra*), cheesebush (*Hymenoclea*), Mojave yucca 2/2


Bursage

Seeding – Species Comparisons

- 26 total species
  - White bursage est. in 3/3 studies (e.g. 0.1/m^2)
  - Saltbush spp. 3/3 (e.g., 0.6-4.2/m^2)
  - Creosote fails in 2/3 studies
  - In study of 12 spp: Palmer's penstemon 7 plants/m^2, desert marigold 3 plants/m^2

Saltbush

Marigold

Planting and Seeding Comparisons

- Few studies directly compared methods
- In comparing separate studies:
  - Bursage and saltbush spp. perform relatively well in both planting and seeding
  - Creosote performs well in planting but poorly in seeding

Creosote bush

Thoughts

- Species specificity
- Species that establish infrequently in nature (e.g., late successional creosote), establish better by planting than by seeding without supplemental tmt
- Species that need little tmt for establishing are a key for reveg
- Multifactor studies essential
- Reveg can meet management objectives in certain contexts

Fire in the Mojave Desert

- Nearly 3% of the entire desert burned in 2005 alone
- Kills animals, alters habitat
- Long recovery times: 40 yrs for cover, > 100 comp.


Red brome

Revegetating Desert Wildfires

- Importance of species selection
- Revegetation species must:
  - (1) compete
  - (2) establish
  - (3) food, function

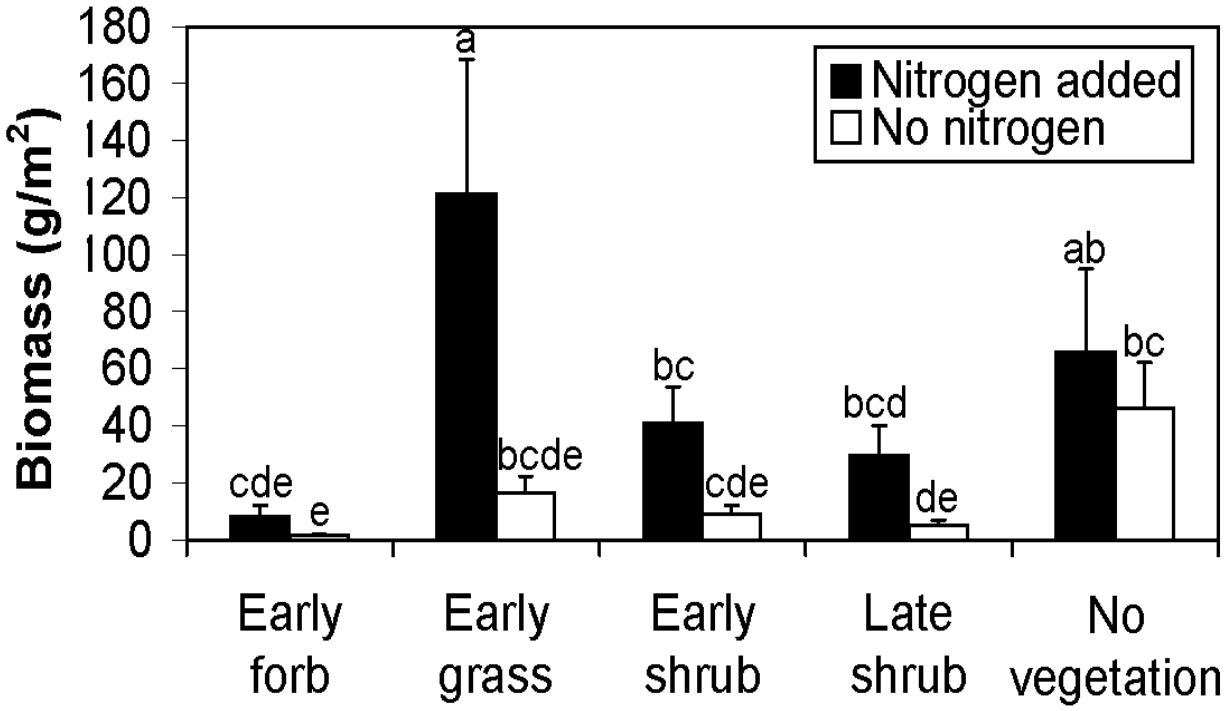
Study goal:

to identify candidate species through integrative field invasibility experiments, field studies, greenhouse experiments, and revegetation studies

Invasibility Experiment: Methods

- Invasion-reducing communities
- Five community types: early forb, early shrub, grass, late shrub, none
- Each of 12 species also grown individually
- *Bromus* or *Schismus* added, nitrogen added or not

Invasibility Community Experiment: Results



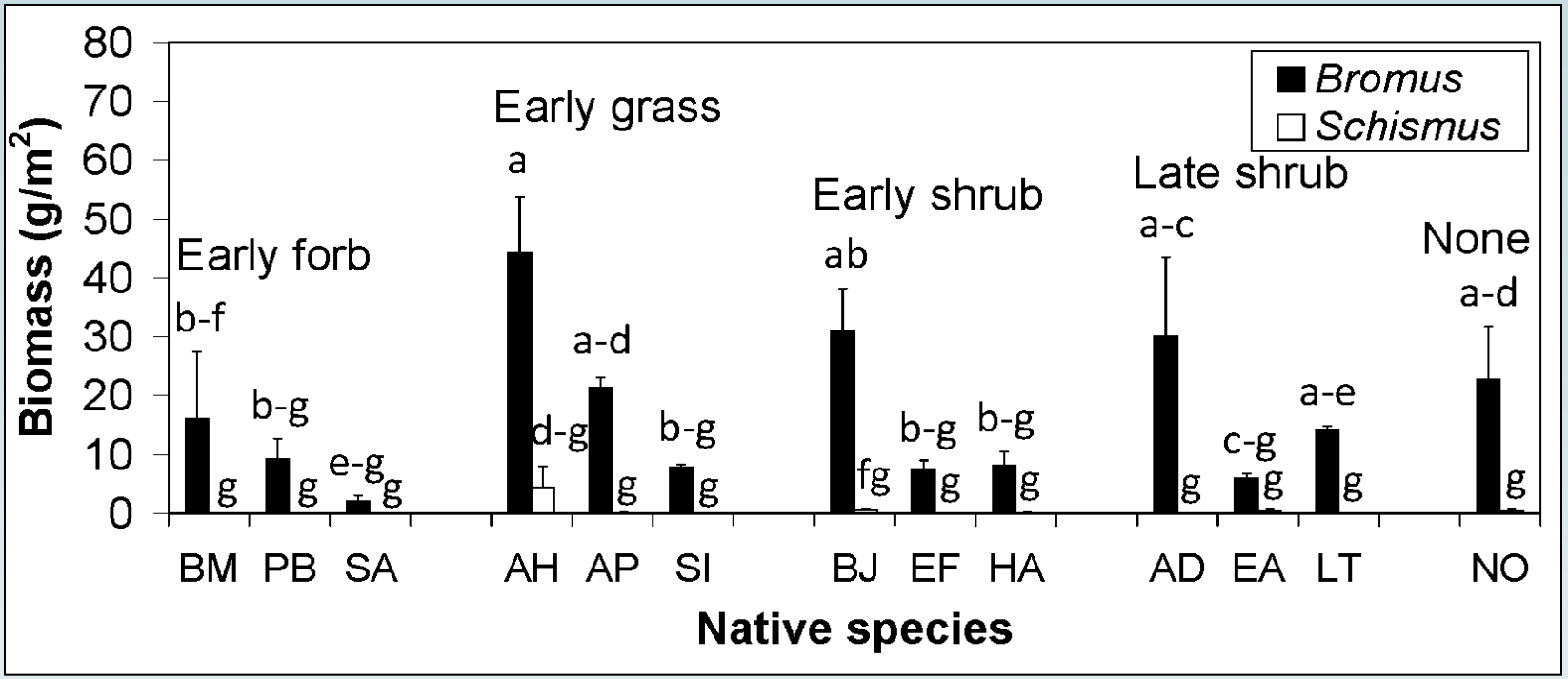
Early forb:
Baileya multiradiata
Penstemon bicolor
Sphaeralcea ambigua

Early grass:
Achnatherum hymenoides
Aristida purpurea
Sporobolus airoides

Early shrub:
Bebbia juncea
Encelia farinosa
Hymenoclea salsola

Late shrub:
Ambrosia dumosa**
Eriogonum fasciculatum
Larrea tridentata

Invasibility Species Experiment: Results



Globemallow

***Sphaeralcea ambigua* (SA – desert globemallow): 11-fold reduction**

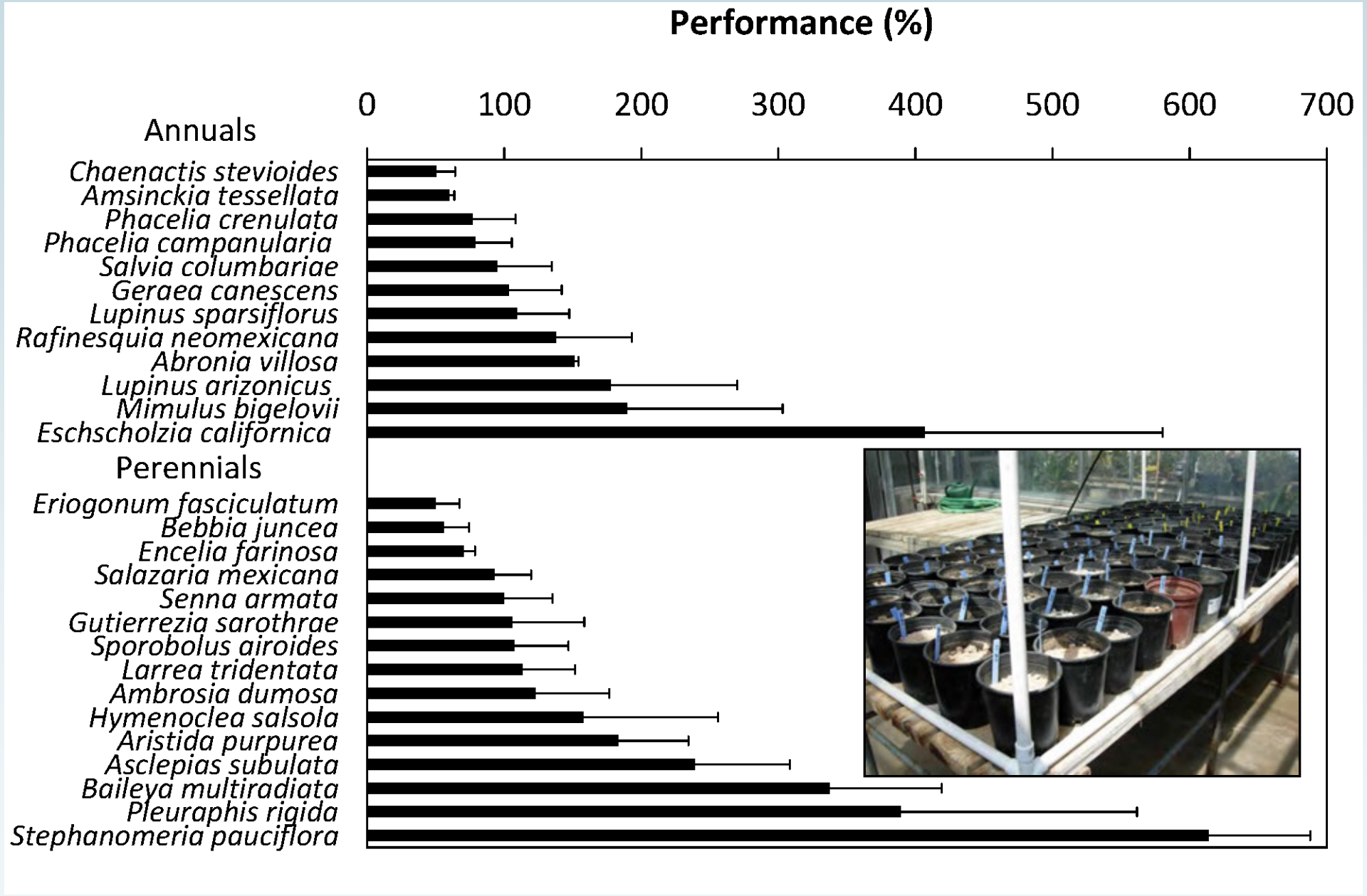
Correlation Study: Methods & Results

- **7 sites, *in situ* patterns**
- **Categorize *Bromus* cover below perennials**

Microsite	Median	95% CI[a]	n[b]
Interspace	1 a	1-2	56
Thamnosma montana	2 ab	2-5	22
Bebbia juncea	2 abc	0-9	7
Encelia virginensis	2 abc	1-19	7
Salazaria mexicana	2 abc	2-9	9
Encelia farinosa	3 bc	2-5	30
Coleogyne ramosissima	5 abc	2-5	40
Pleuraphis rigida	5 abcd	2-9	6
Menodora spinescens	5 bc	5-5	37
Psorothamnus fremontii	5 bc	2-9	29
Ambrosia dumosa	5 c	5-9	22
Eriogonum fasciculatum	5 bc	2-38	11
Gutierrezia sarothrae	5 bc	2-9	11
Hymenoclea salsola	9 bcd	2-38	10
Larrea tridentata	9 bcd	2-38	13
Ephedra torreyana	9 c	5-19	28
Krameria erecta	19 d	19-19	37

- ***Bromus* cover varied 19-fold among interspaces and native perennial plant microsites**

Greenhouse Experiment: Results

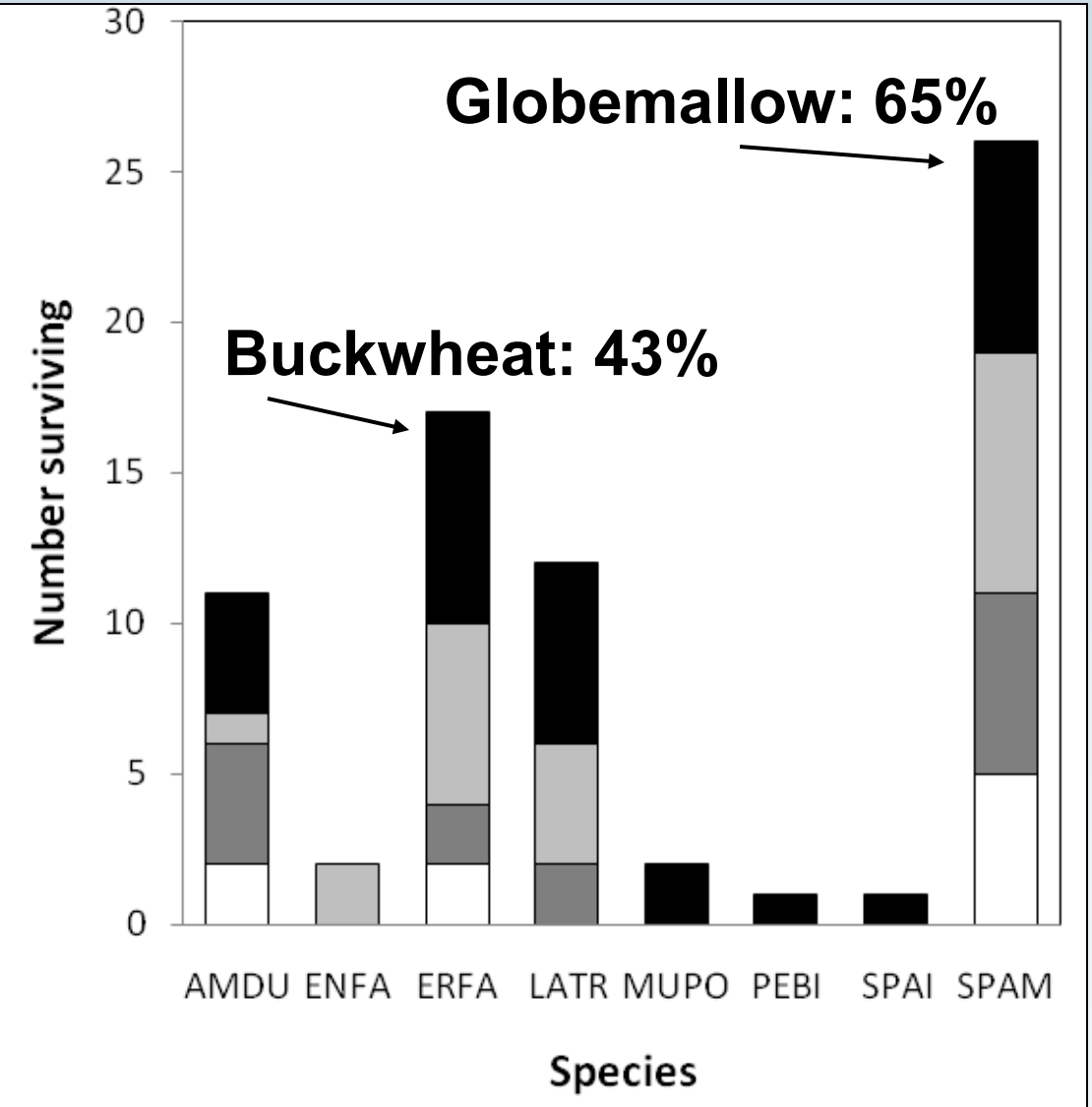


Revegetation Experiment: Methods

- 40, 1-yr old outplants of each of 8 species
- Shelter and water treatments
- Survival for 2 years (3 this spring)
- Seeded 10 species each at 500 seeds/m^2

Revegetation Experiment: Results

- **Planting effective, seeding not**

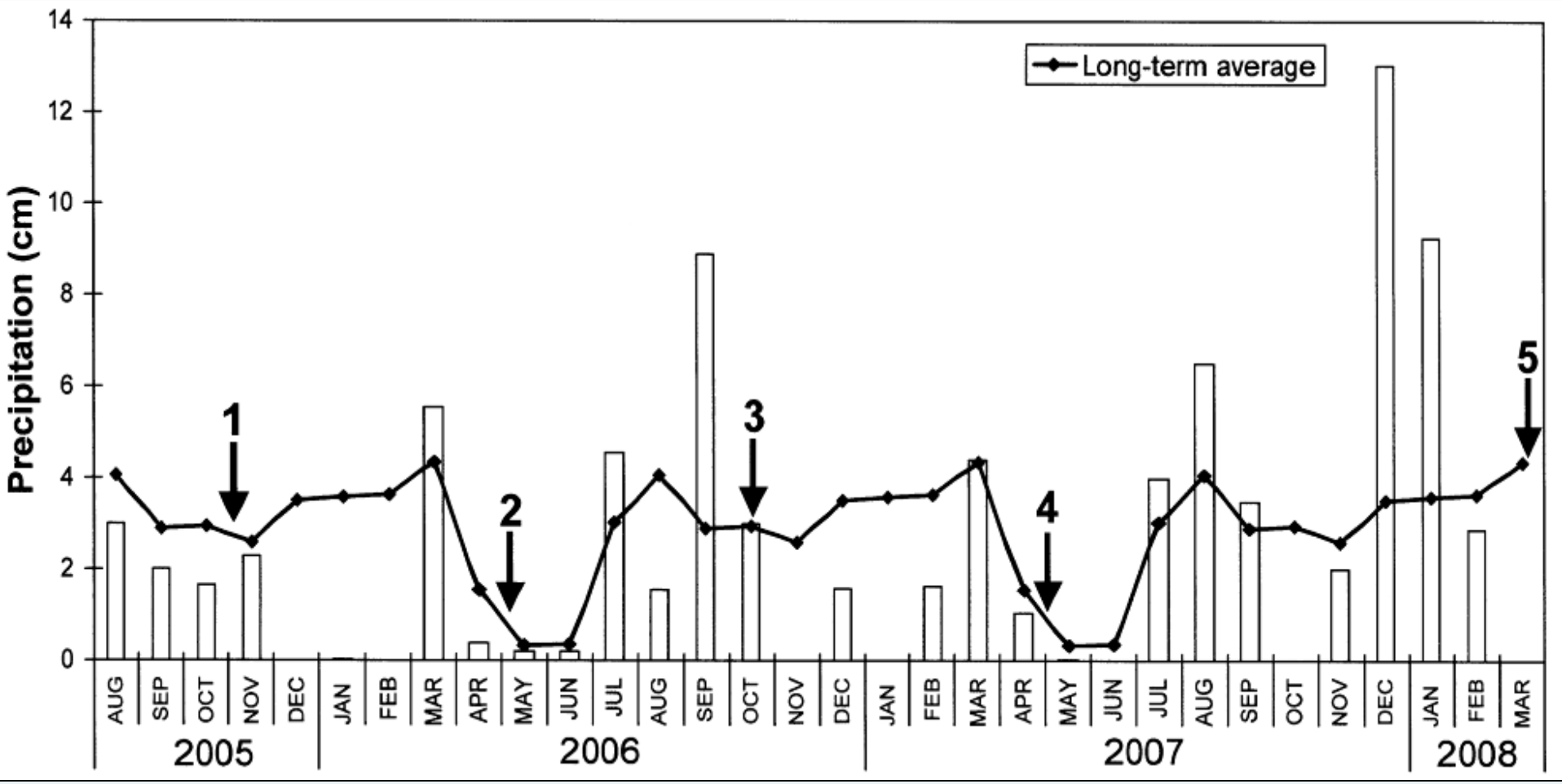


Globemallow

Testing Diverse Seed Mix

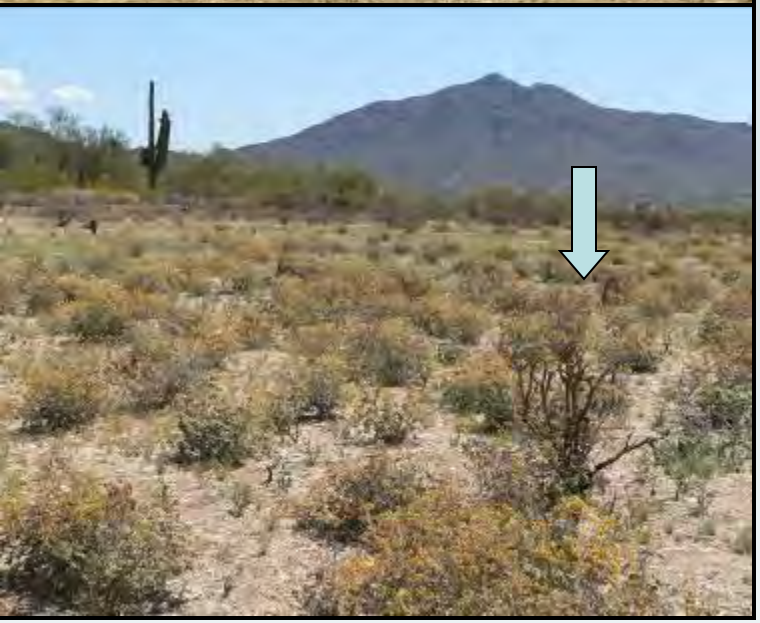
- Cave Creek Regional Park, Sonoran Desert uplands
- 28 natives seeded

Precip. only 67% of “normal”

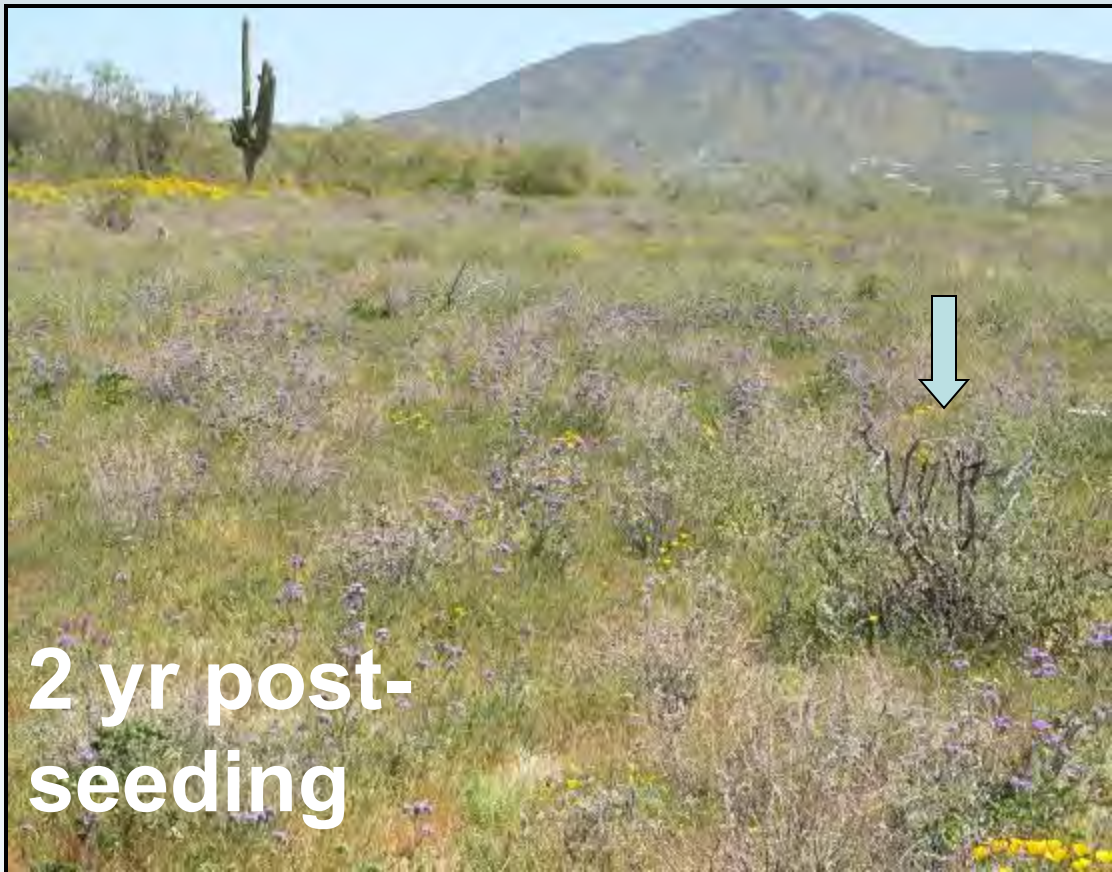


3 mo post-seeding

unseeded



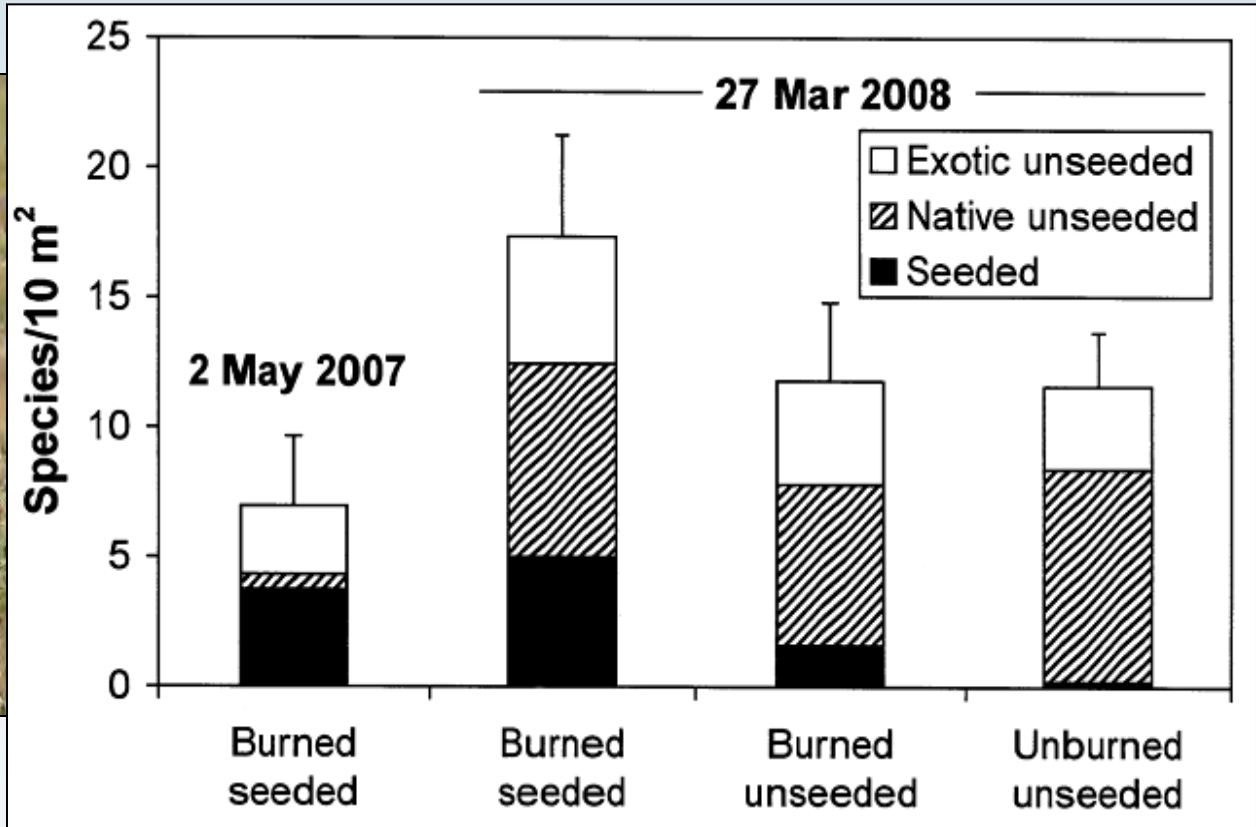
6 mo post-seeding



2 yr post-seeding

Species Establishment

- Of 28 seeded species, highly successful subset of 7 species made seeding successful, at least in the short term (32 months)
- Desert senna, purple threeawn, desert bluebells



Summary of Findings

- Experimental evidence that native vegetation types may exist in southwestern deserts that can reduce the establishment of exotic annual grasses
- Mimic natural successional patterns (e.g., desert senna, marigold)
- Early successional forbs, in particular globemallow, most effective

Implications of Findings

- Approach useful for screening species
- Match to management needs, reducing re-burning
- Seeding is a problem
- Need to understand which species work before propagating and seed increase

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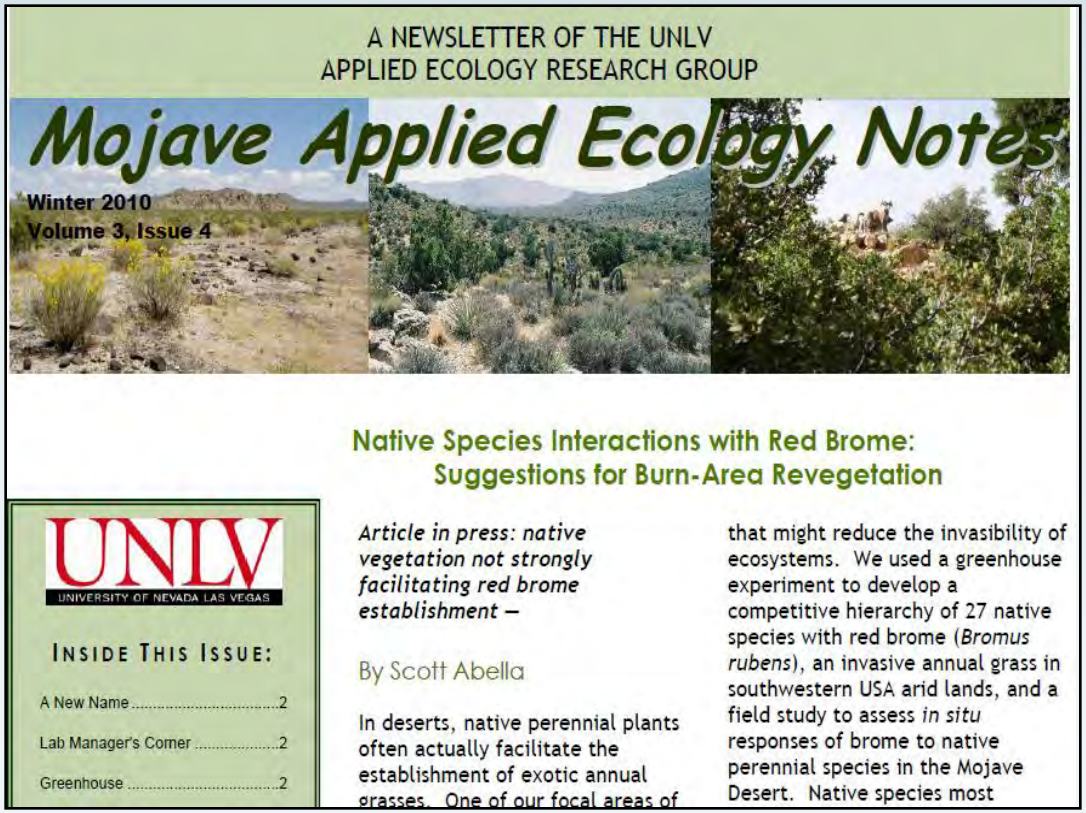

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Native Species Interactions with Red Brome:
Suggestions for Burn-Area Revegetation

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

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