

Seed bank limitation, management and overcoming cycles of exotic plants species hierarchical shifts



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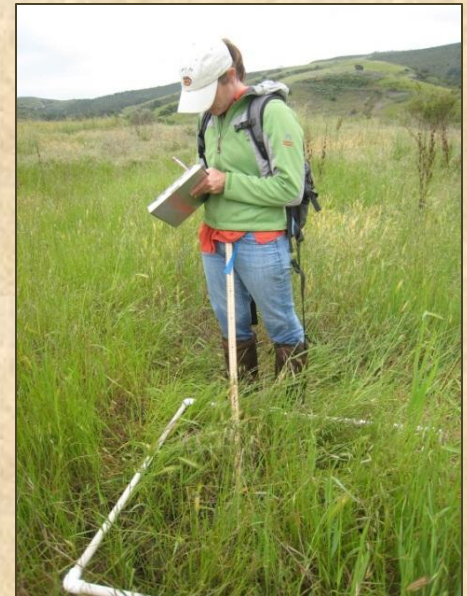
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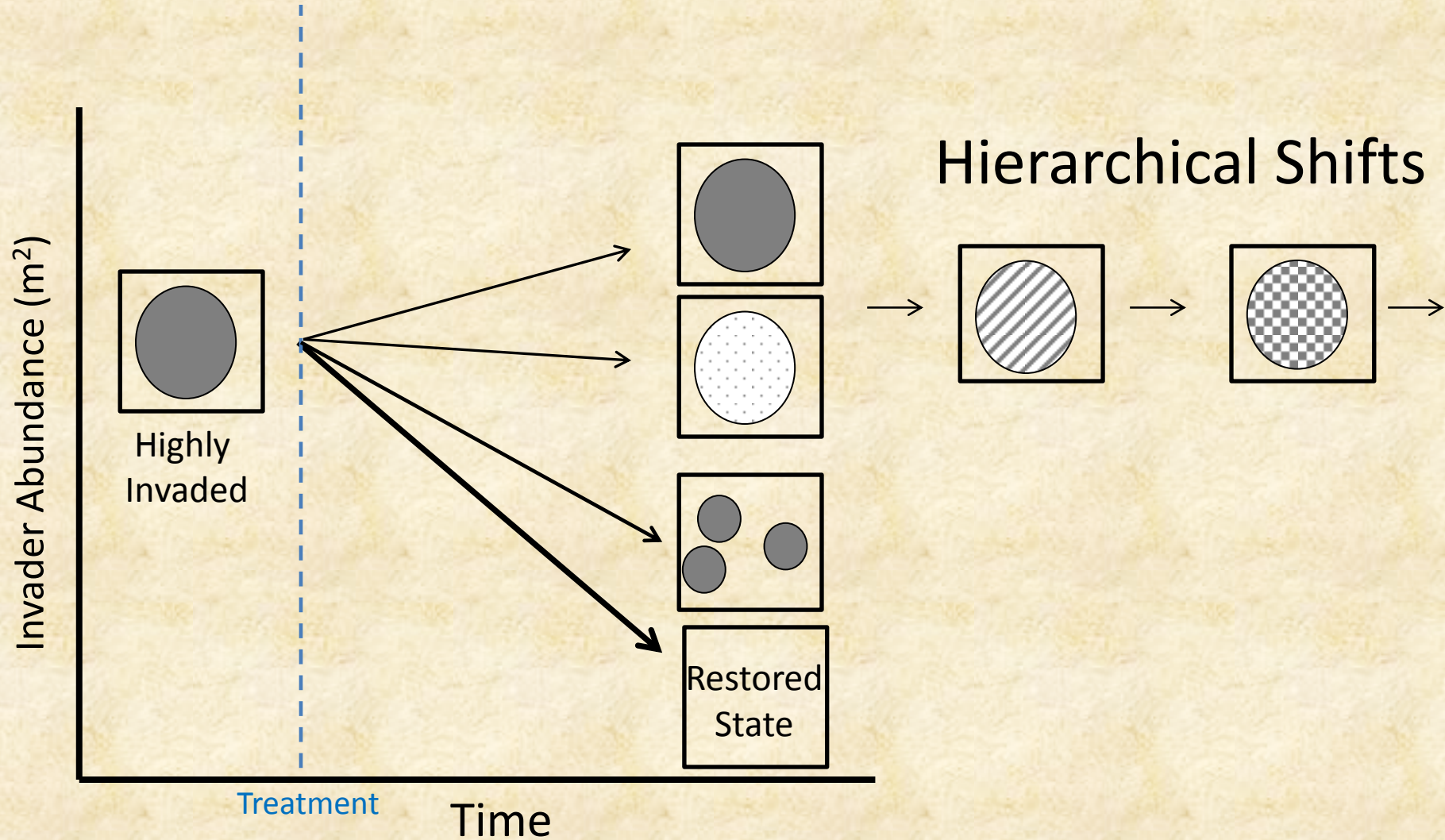


Order of Topic Emergence

- Restoration and seedbanks
- Introduction of the Orange County Invasive Plant Management Project
- General seedbank NROC seedbank results
- Vegetation and seedbank relationships
- Environment, management and land use history
- Integrating seedbanks into restoration and management

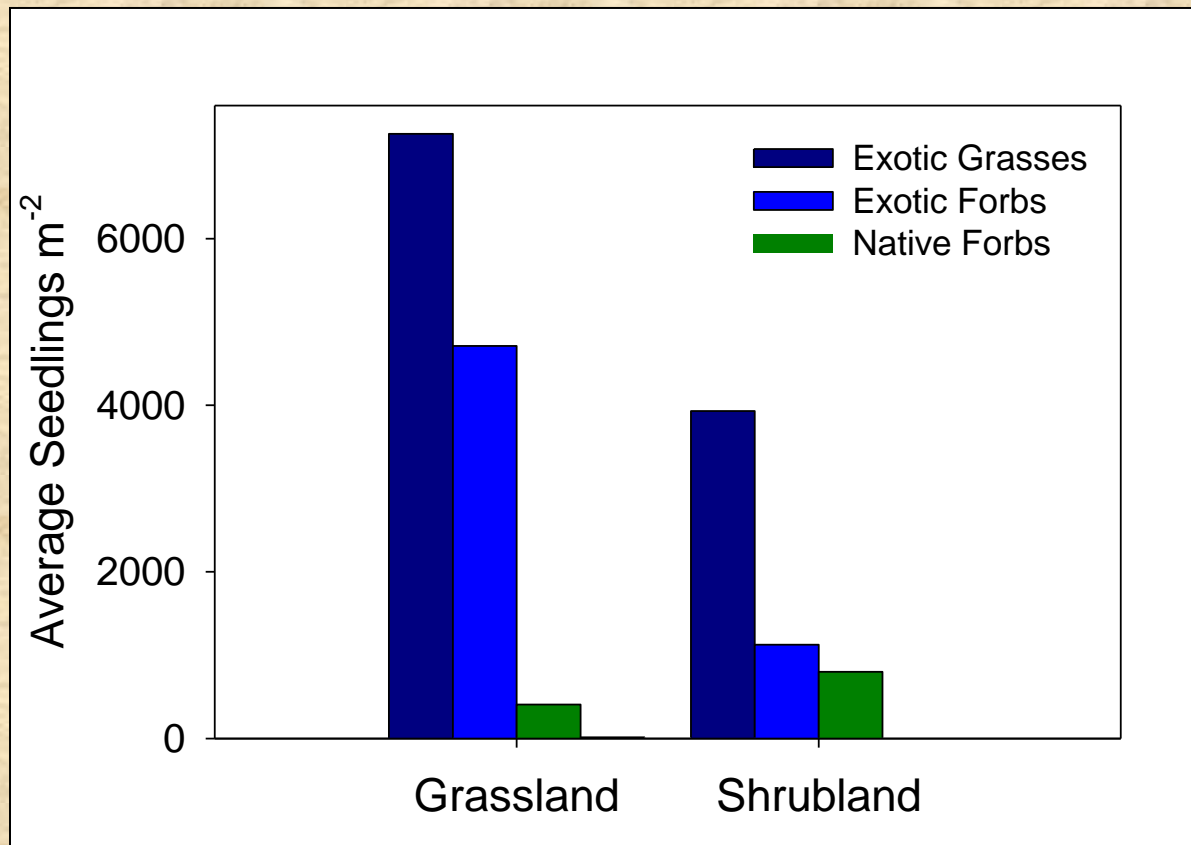


Restorations Have Multiple Potential Trajectories



Soil Seed Banks

- A long history of invasion has the potential to lead to native seed bank depletion over time (Bossuyt & Hermy 2003)
- Prolific seed production coupled with high dominance could lead to an imbalanced seed bank.



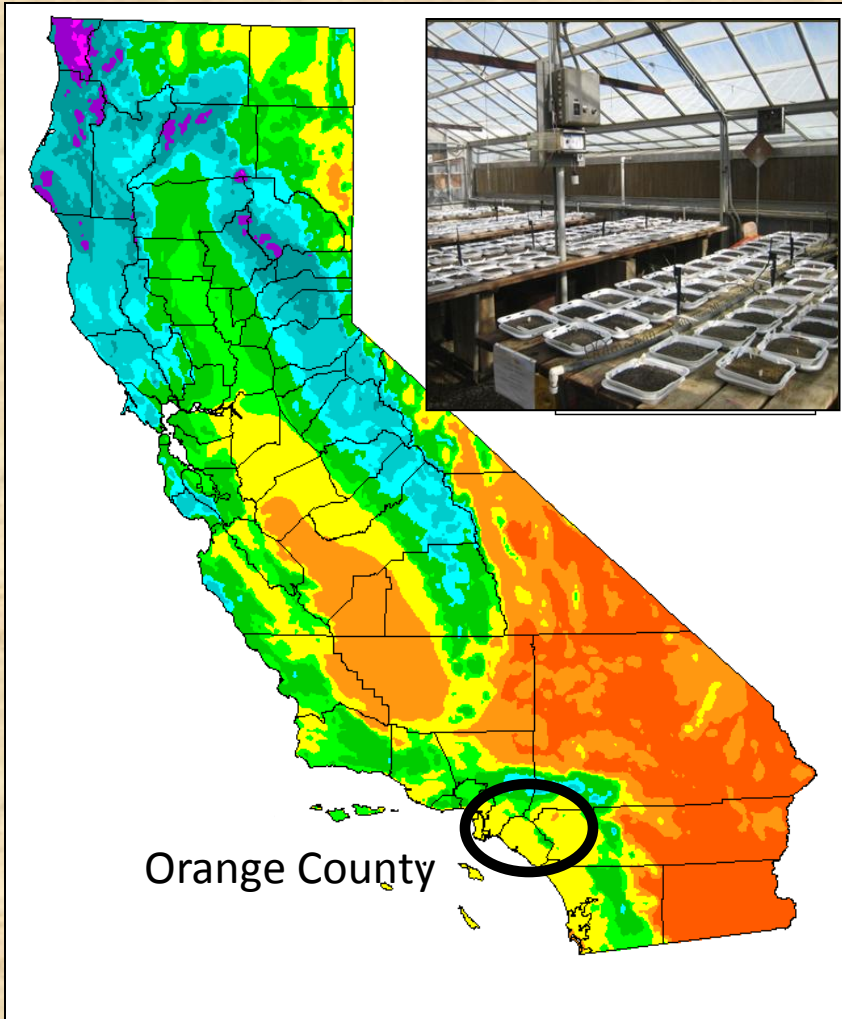
Modified from Cox and Allen 2008)

Orange County Invasive Plant Management Project

- Are native seedbanks of Orange County reserves intact or seed limited?
- How does the vegetative plant community relate to the seedbank?
- Are there environmental, land history or management variables associated with seedbank composition and microsite availability?
- How can seedbanks be integrated into management and restoration planning?



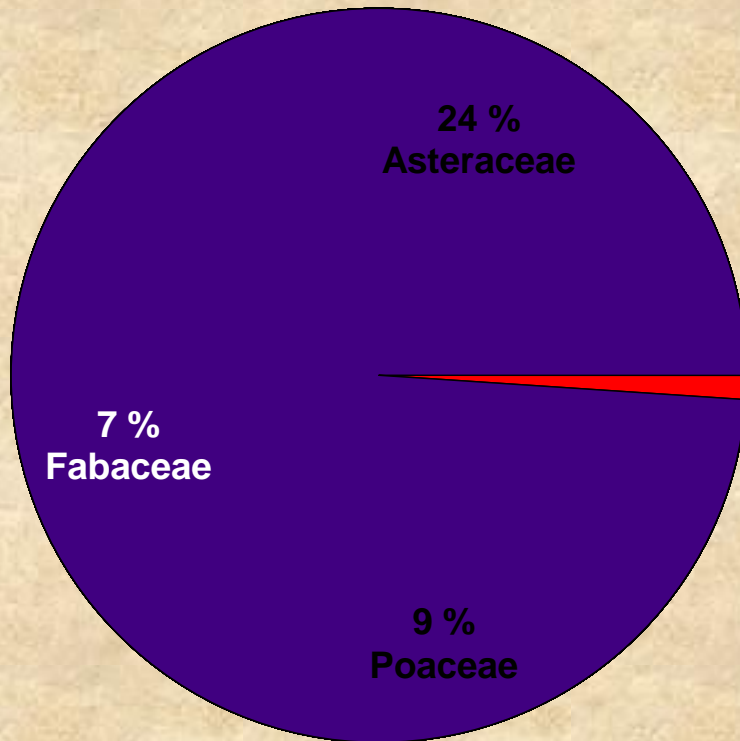
One hundred and thirty one sites in Orange County were surveyed spring of 2011



- Plant species percent cover collected from quadrats along five 10m transects.
- Soils were collected at 5cm depth, air dried and sieved.
- Composited samples at site level were mixed with sand (40%).
- Soils were spread into trays 2.5cm deep and maintained at field capacity
- Allowed to go dormant, smoke treated soils and repeated watering

Seedbank Species Composition

- 36 families
- 95 Species
- 45% Exotic species
- 54% Native species
 - (*Juncus bufonius* 20 %)
- 1 % unknown Species



Asteraceae



Phrymaceae



Poaceae



Lamiaceae



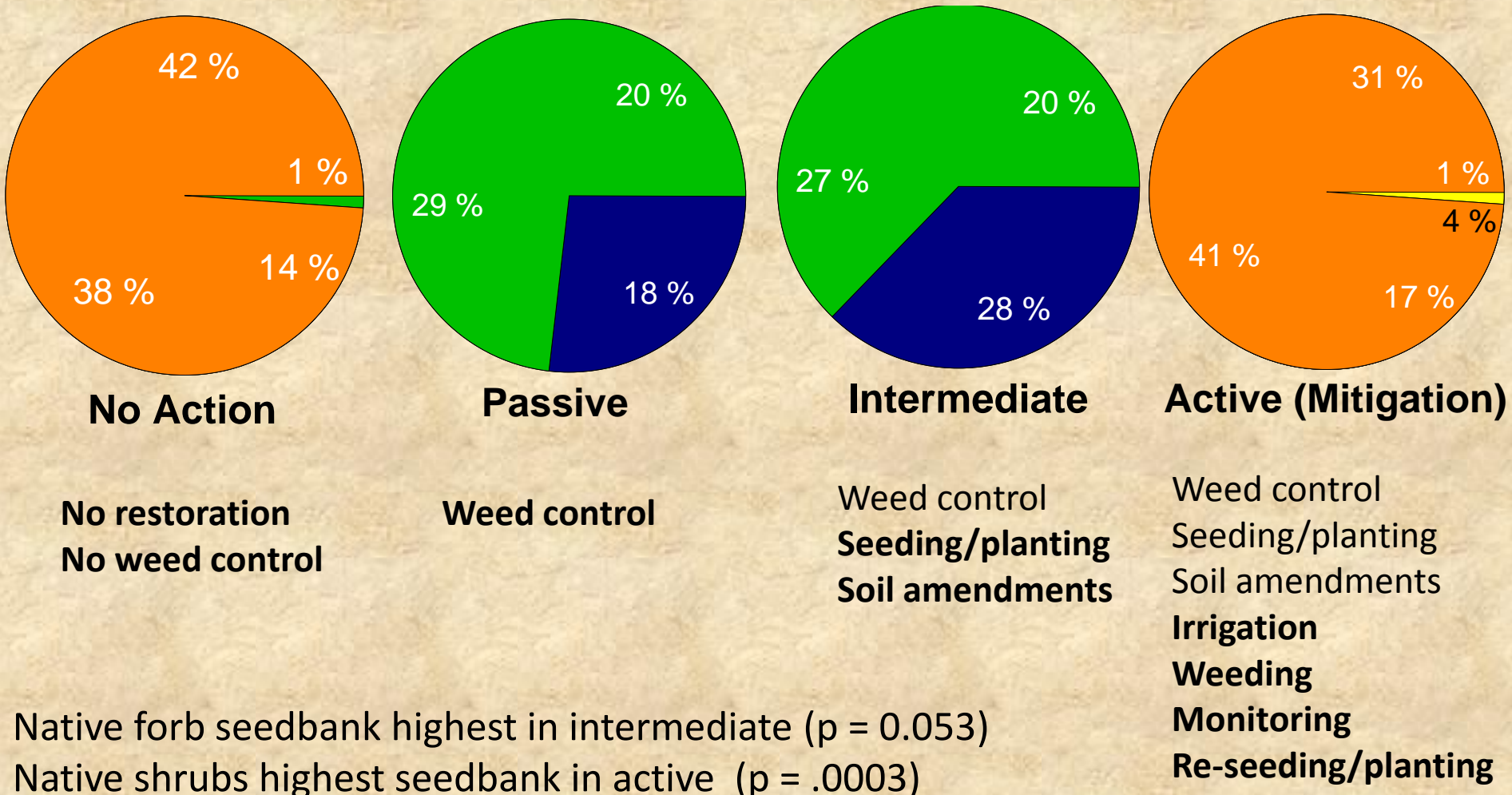
Aizoaeae



Cactaceae

Exotic species dominated seedbanks at all management levels.

- Exotic Grasses
- Exotic Forbs
- Native Forbs
- Native Shrubs
- Unknown



Native forb seedbank highest in intermediate (p = 0.053)

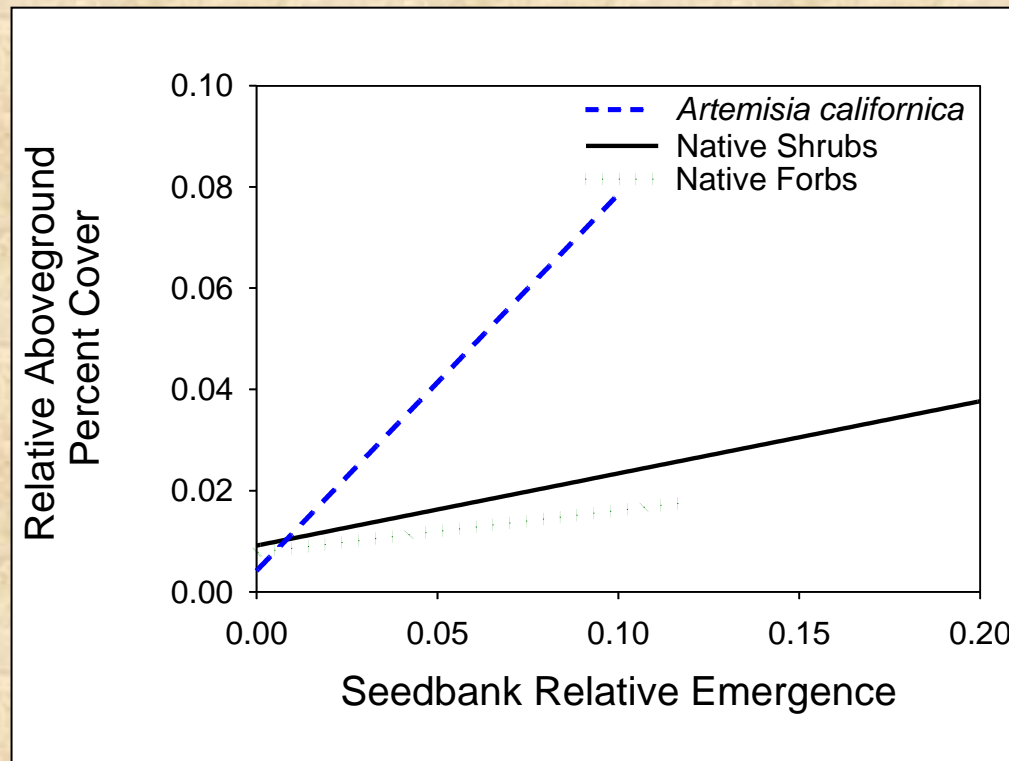
Native shrubs highest seedbank in active (p = .0003)

The Native Seedbank Correlates with Vegetation

3 % of species in seedbank only

47 % of species in vegetation only

Native succulents were absent from the seedbank.



Artemisia californica is the most abundant native species, only four other shrub species have abundance close to *A. californica*.

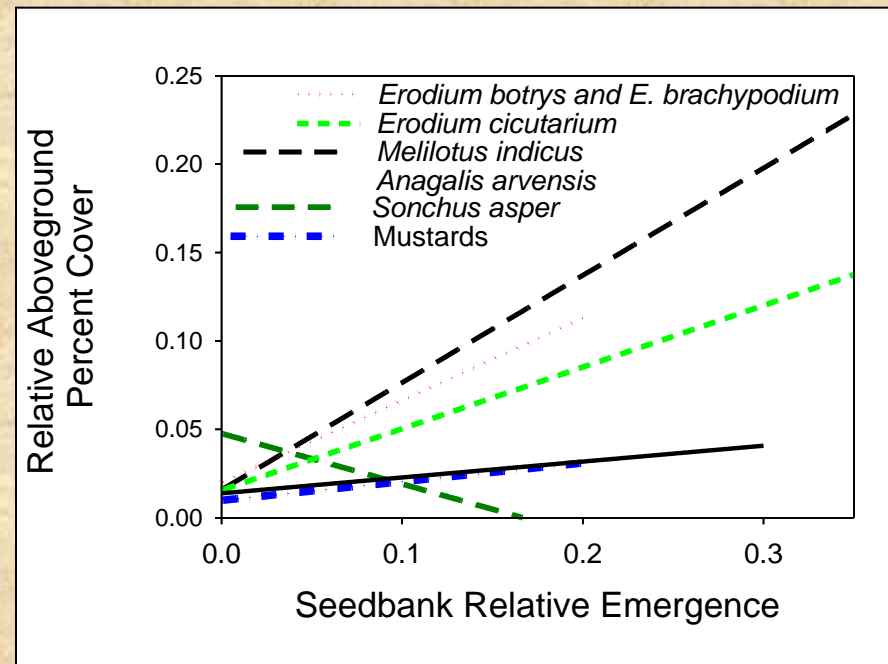
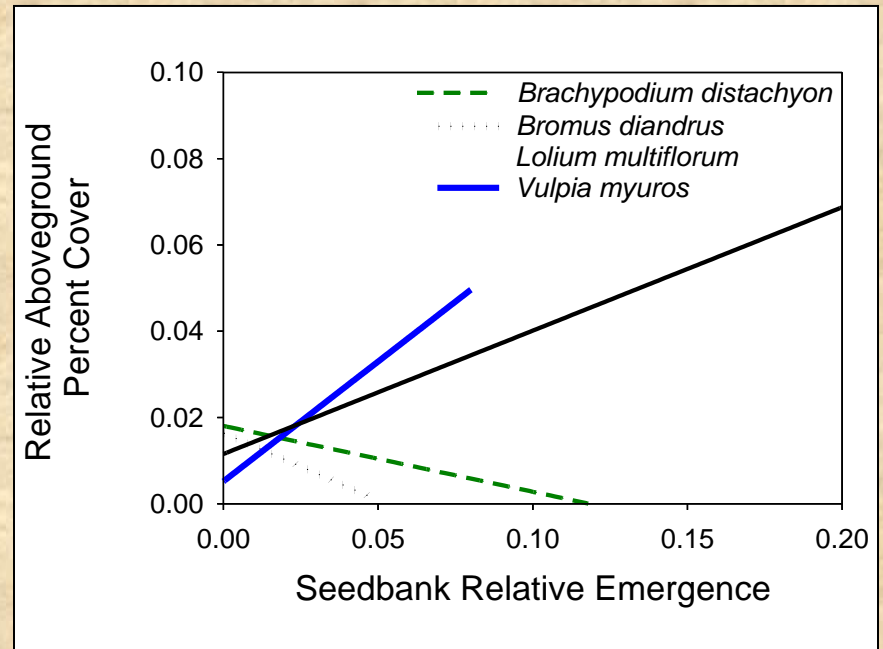
The Exotic Seedbank Correlated with Vegetation Better than Native seedbank

(All of the most abundant exotic species)

3% only seedbank

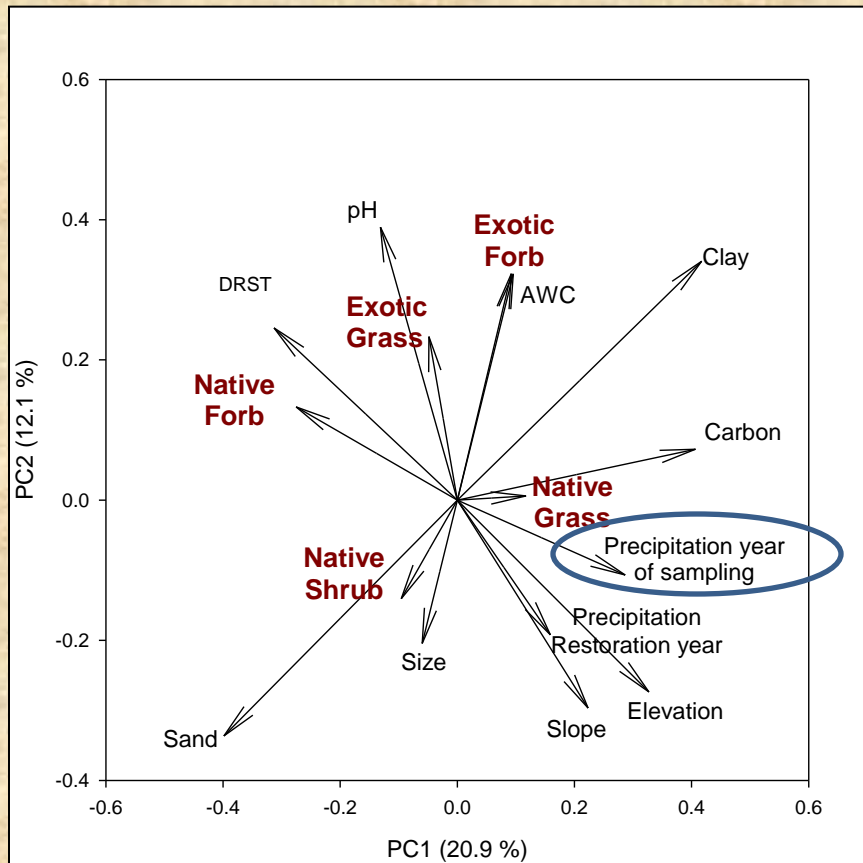
11 % only above ground
(less common species)

- Transient seedbanks
 - *Sonchus asper*
 - *Brachypodium distachyon*
 - *Bromus diandrus*
- Persistent seedbanks
 - *Erodium spp*

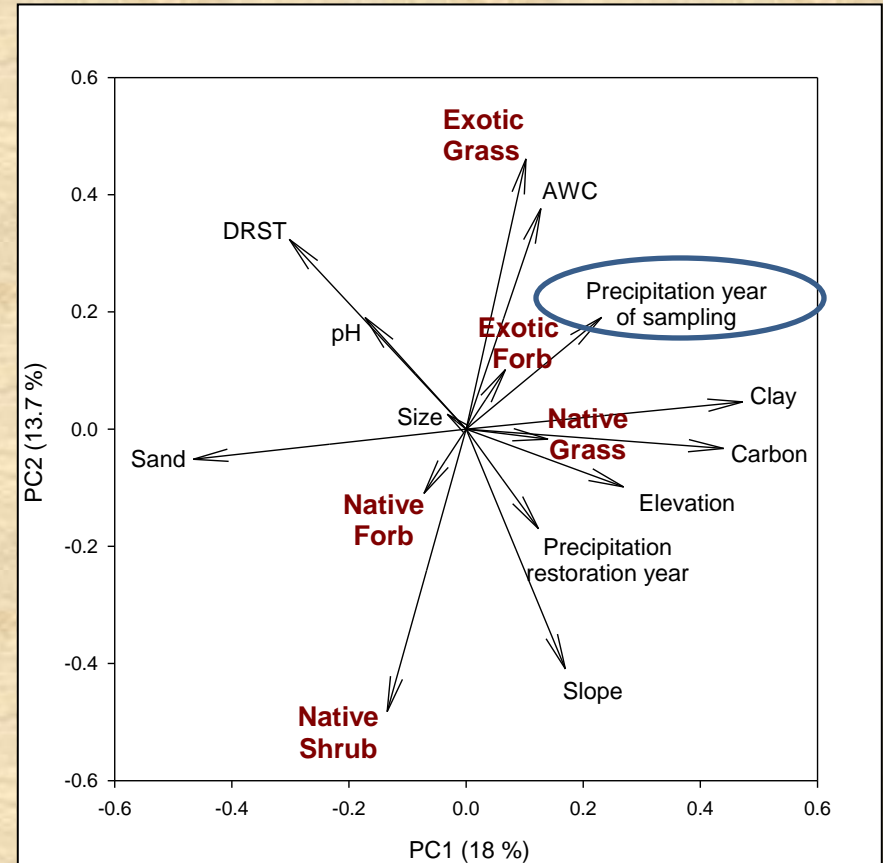


Seedbank and Vegetation Related Similarly to Environment

Seedbank



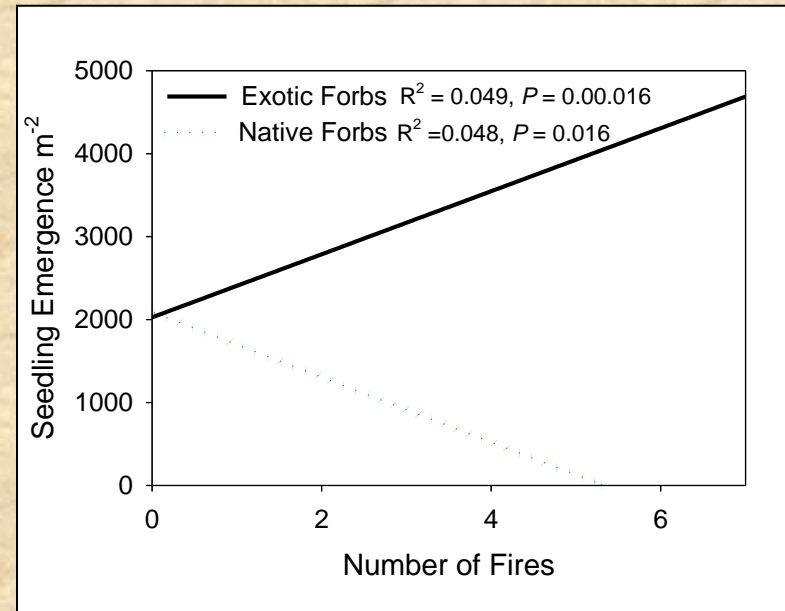
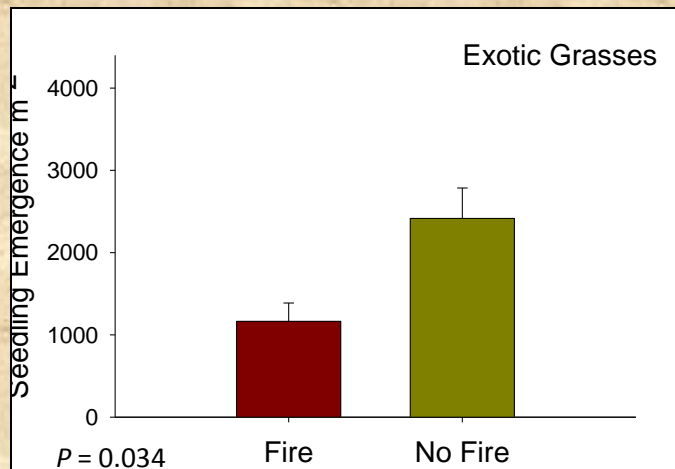
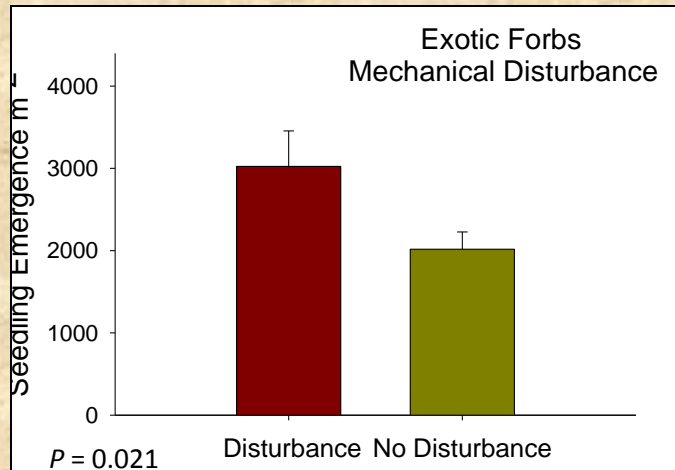
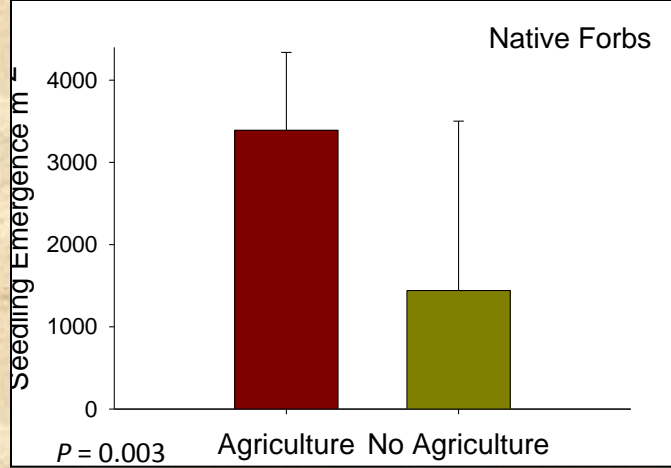
Vegetation



Land Use History Effects on the Seedbank

Sites having experienced:

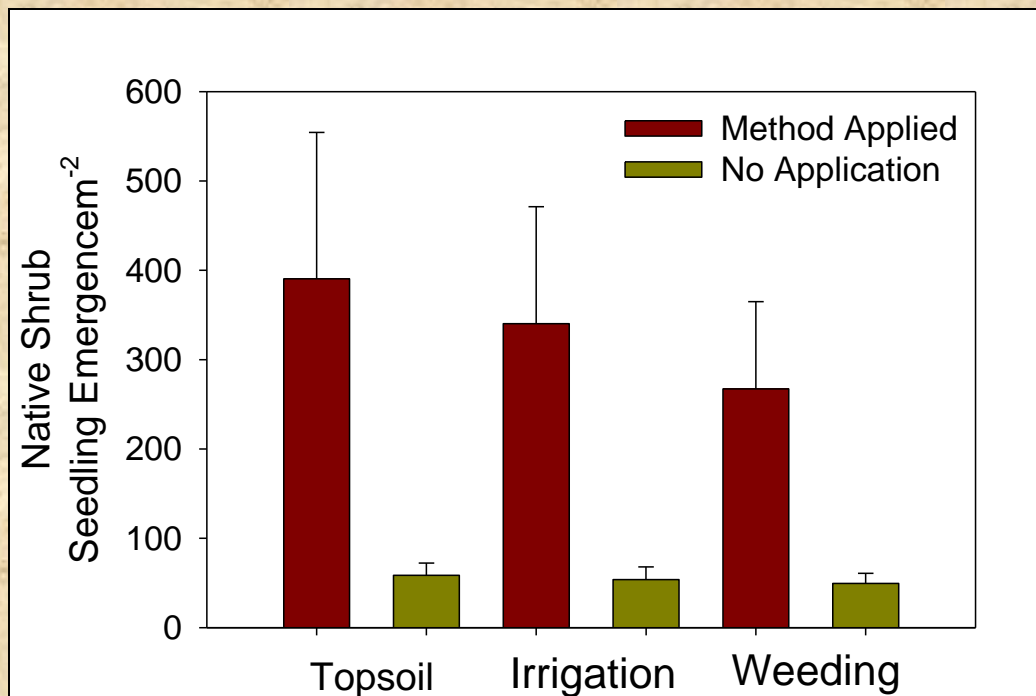
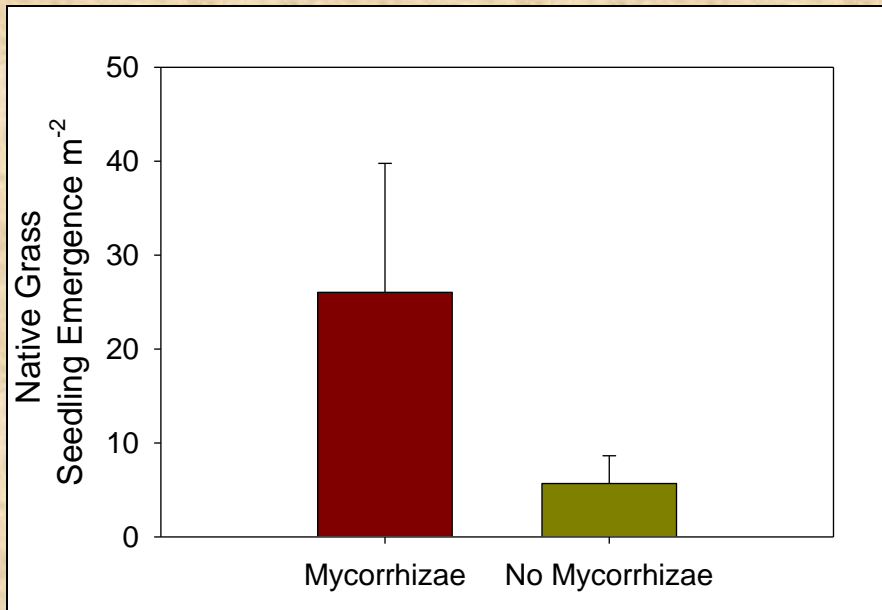
- Agriculture had larger native forb seedbanks.
- Mechanical disturbance had larger exotic forb seedbanks.
- Fire had smaller exotic grass seedbanks .
- Sites with more fires had larger exotic forb seedbanks and smaller native forb seedbanks .



Management Effects on Seedbanks

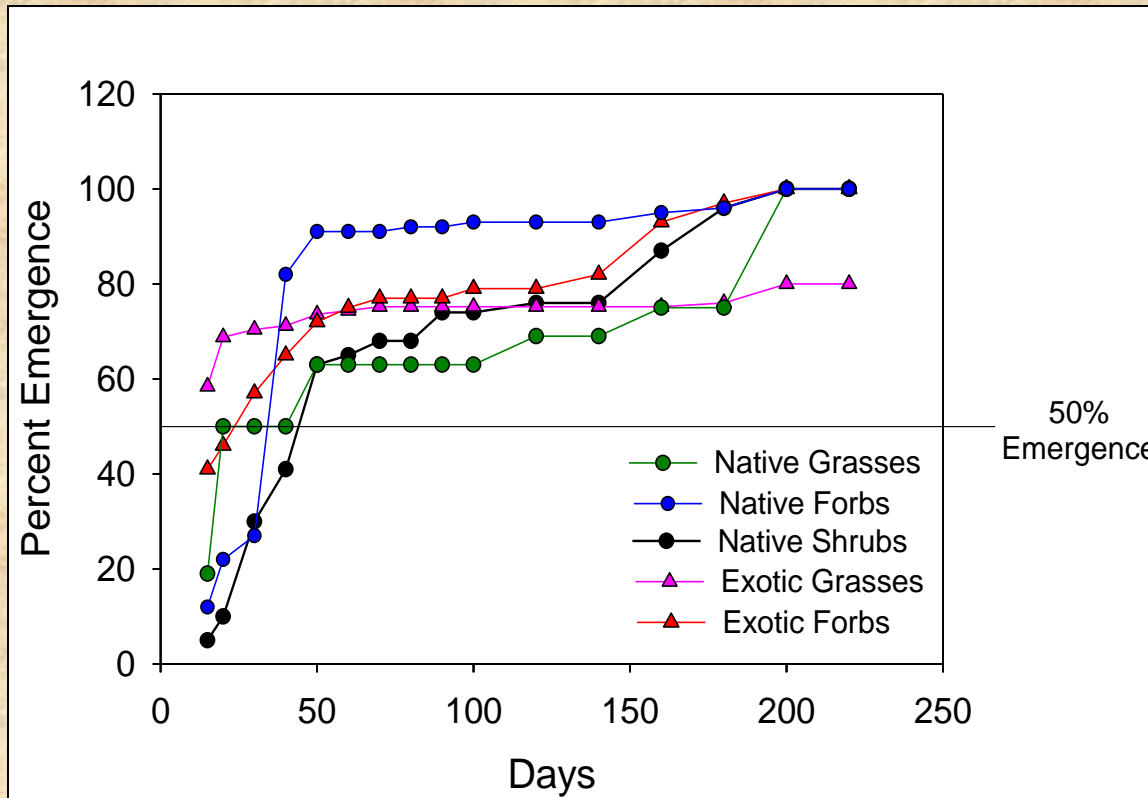
Sites experiencing:

- Inoculation with mycorrhizae had larger native grass seedbanks.



- Topsoil, irrigation and/or weeding had larger native shrub seedbanks

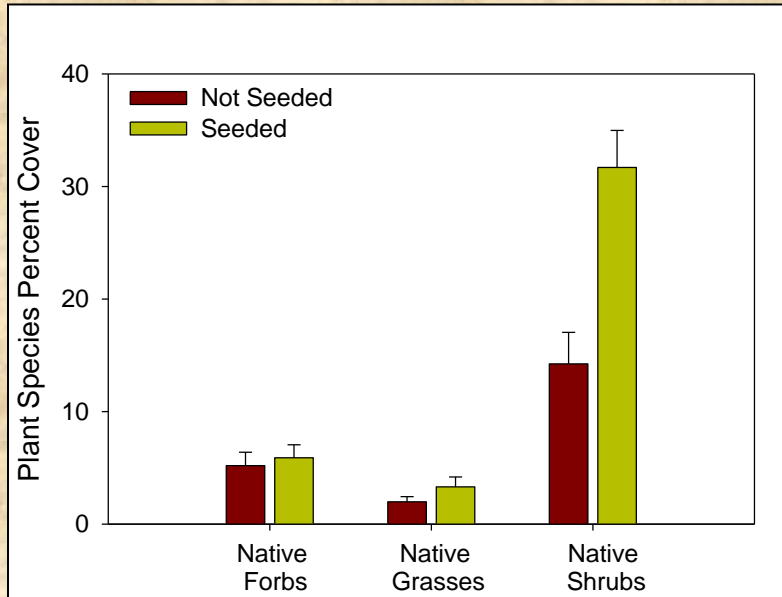
Exploit difference in exotic and native species phenology to control the exotic species seedbank



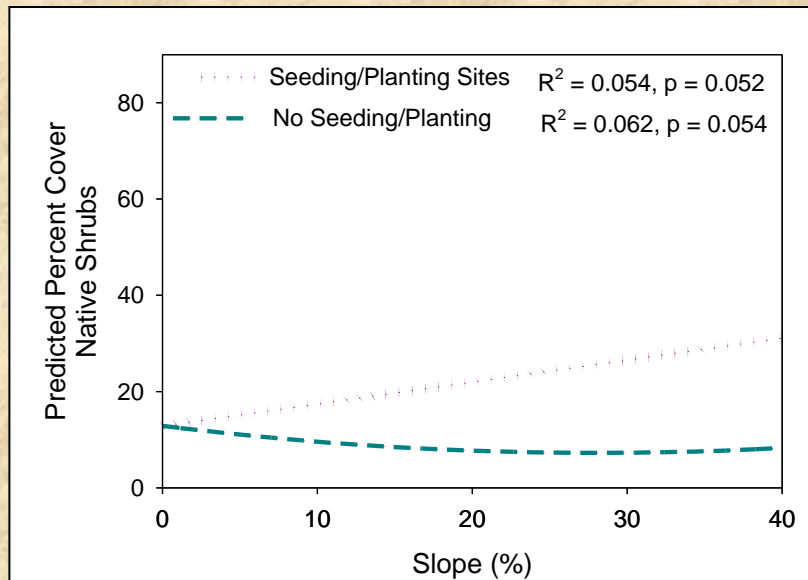
Management strategies

- Grow kill
- Selective weeding
- Patch management

Pairing Methods with Habitat

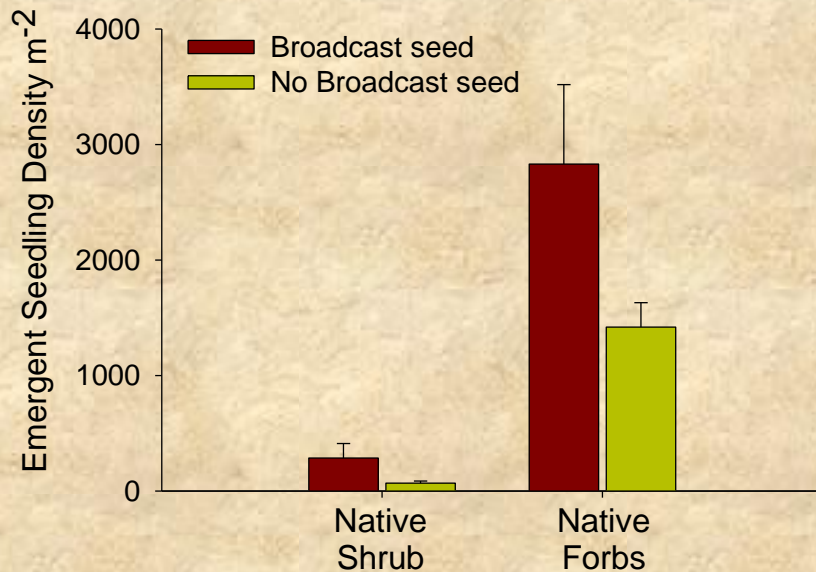
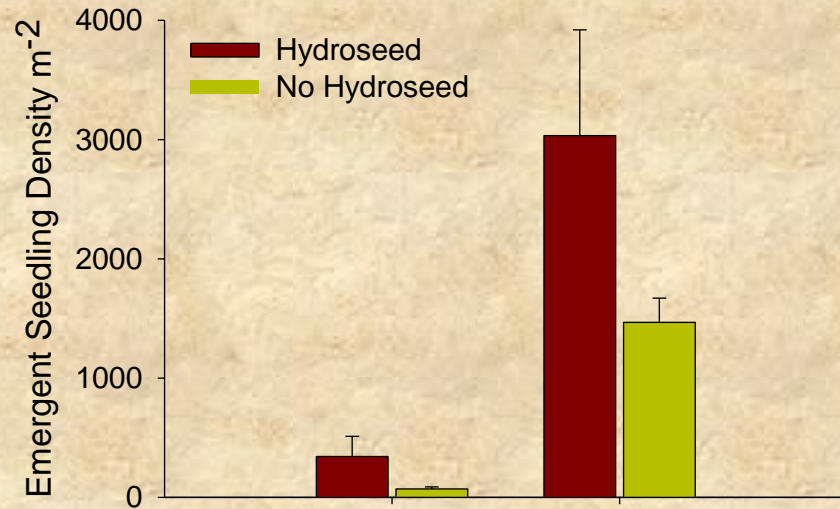


Native shrub percent cover significantly increased with native seed and/or plant input.

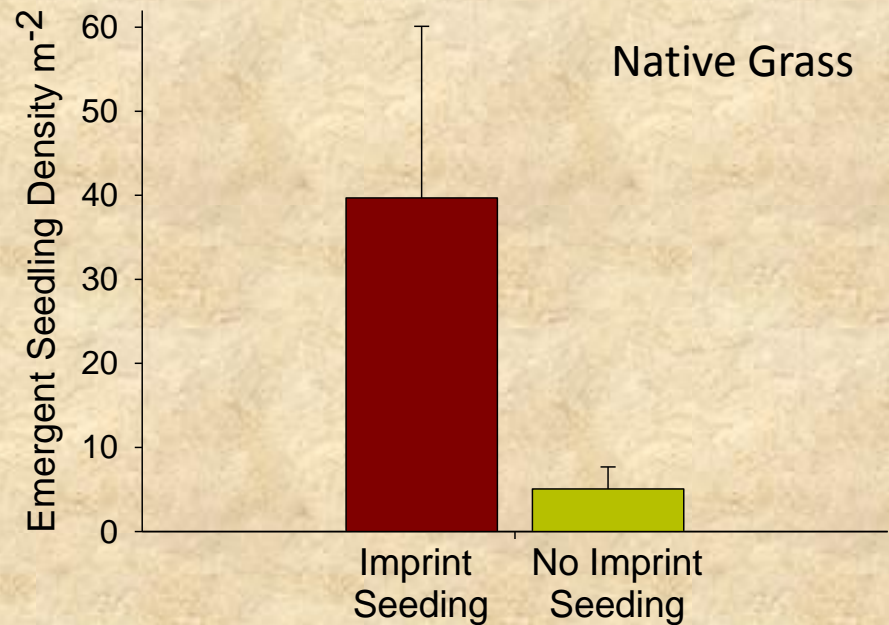


Habitats that should support native shrubs only saw increased shrub cover when seed/plants were added.

Not all Seeding Methods are Equal



- Native shrub cover was greater and seedbanks were larger in sites with hydro or broadcast seeding.
- Native grass seedbanks were larger in sites that experienced imprint seeding.



Conclusions



Avena seedling



Avena mature

- While diverse, NROC seedbanks are exotic dominant regardless of management level.
- Native shrub and grass seedbanks were small or not present at most management levels.
- Native species are likely seed and microsite limited.



Centaurea melitensis

Restoration Implications

- Management of the seedbank will be the most important strategy for restoration.
 - Controlling exotic seed input.
 - Mowing, Fire, Weeding...
 - Volunteers need awareness of tracking seed
 - Determination of current seedbank to guide management decisions (small scale seedbank experiments)
 - Re-establishing native seedbanks where depleted
 - Increasing microsites that facilitate native species seed persistence and seedling establishment.
 - Are there conditions or disturbances that lead to seedbank production and seedlings that establish as adults?
 - Control weeds and increase heterogeneity in the landscape.



Restoration Implications

- Site preparation is essential
 - Trade immediate results for long-term and higher levels of success.
 - Exploit differences in phenology of natives and exotics (grow kill cycles).
- Creation of establishment microsites
 - Important to identify where seedbanks are persisting and where they are not.
 - Seedbank = potential for future community
 - Vegetation only = risk to community loss to stochastic events (fire)
- Proper management methods need to be determined for different species and applied in the proper environmental conditions.
 - Native shrub and forb vegetation and seedbanks benefit from hydro and broadcast seeding, whereas native grass vegetation and seedbanks benefit from imprint seeding and mycorrhizal inoculation.



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Species Relative Contribution to the Seedbank of NROC

Brassica nigra/Hirshfeildia incanta

Conyza coulter
Juncus bufonius

Crassula connate
Festuca myuros
Bromus rubens

Lolium multiflorum/perenne
Anagallis arvensis

Medicago polymorpha