

Weedy vs. native plant response to intra- and inter-annual precipitation variation following restoration seeding in drylands



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Introduction

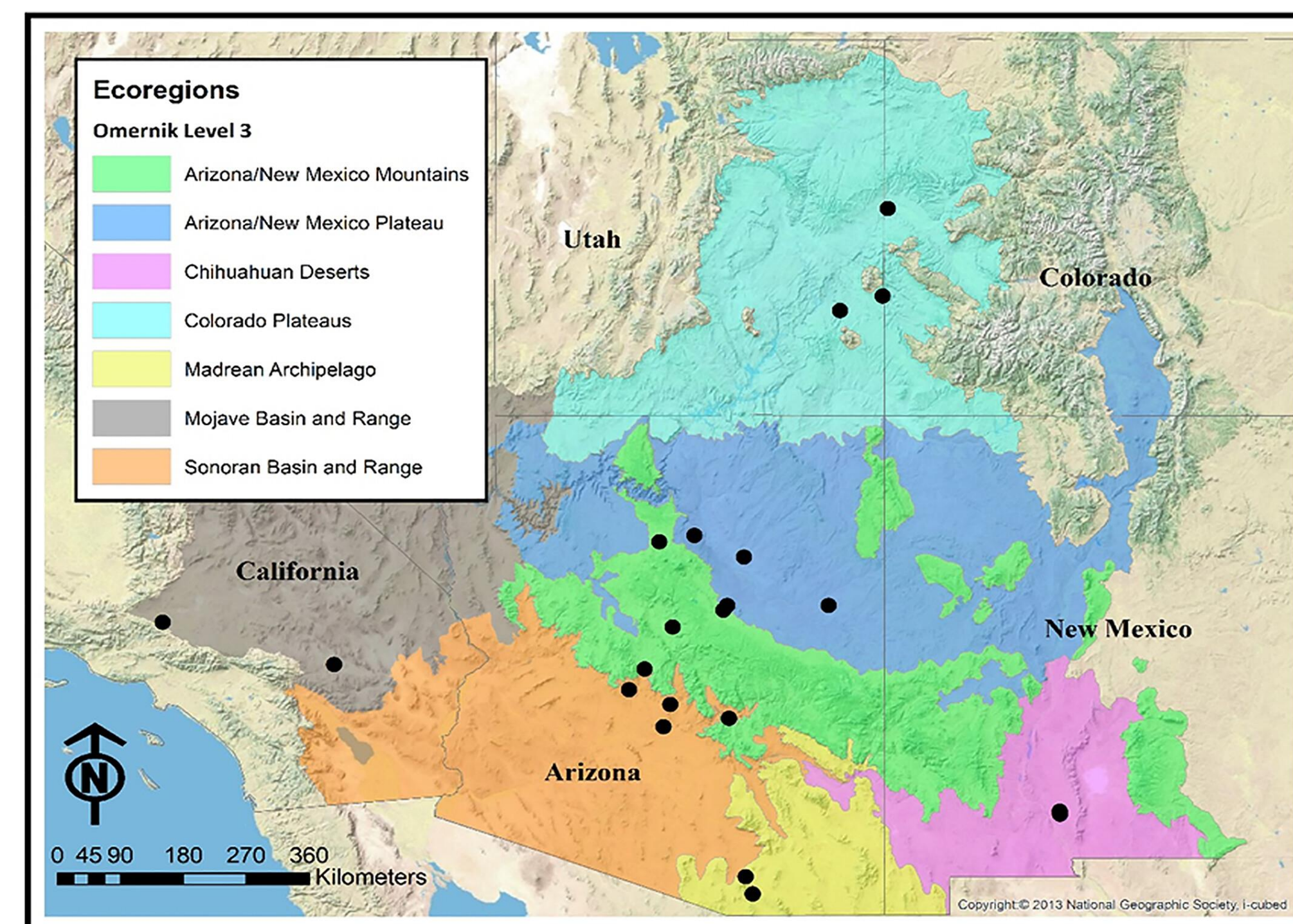
- Precipitation is a major driver of success in dryland restoration.
- The Southwestern US is projected to receive more overall precipitation, but it will likely be delivered in extreme events wherein more rain falls during a shorter period, and the drought interval between events increases.
- Climate change is increasing the unpredictability of precipitation patterns, both within and between years.
- RestoreNet, a USGS project, is a network of dryland restoration plots located at 21 sites which span an aridity gradient. Plots were established following a standardized protocol to allow for direct comparison between sites.

Objective

- Assess how native seeded species versus weedy species respond to inter- and intra-annual precipitation variation.
- Compare the performance of a climate change-adapted seed mix with a seed mix designed for current climate conditions.

Methods

- Utilized 14 of the RestoreNet sites: 6 in the Sonoran Desert and 8 on the Northern Arizona Plateau (all located in Arizona).
- Three types of plots:
 - Received no seed (control).
 - Seeded with site-specific mix optimized for current climate conditions.
 - Seeded with site-specific mix optimized for projected conditions with climate change.
- Monitored the seedling density by species in subplots for 3-4 years over 2018-2022.
- Compared actual precipitation to 30-year normals (1990-2020), based on cumulative precipitation since time of seeding.



Abbreviated seed mixes

Sonoran Desert

Current climate mix
Ambrosia deltoidea
Baileya multiradiata
Digitaria californica
Elymus elymoides
Lupinus sparsiflorus
Machaeranthera tanacetifolia
Poa secunda
Salvia columbariae
Sphaeralcea ambigua
Sporobolus cryptandrus

Projected climate mix
Aristida purpurea
Asclepias tuberosa
Baileya multiradiata
Bouteloua aristidoides
Bouteloua curtipendula
Bouteloua rothrockii
Poa secunda
Senna covesii



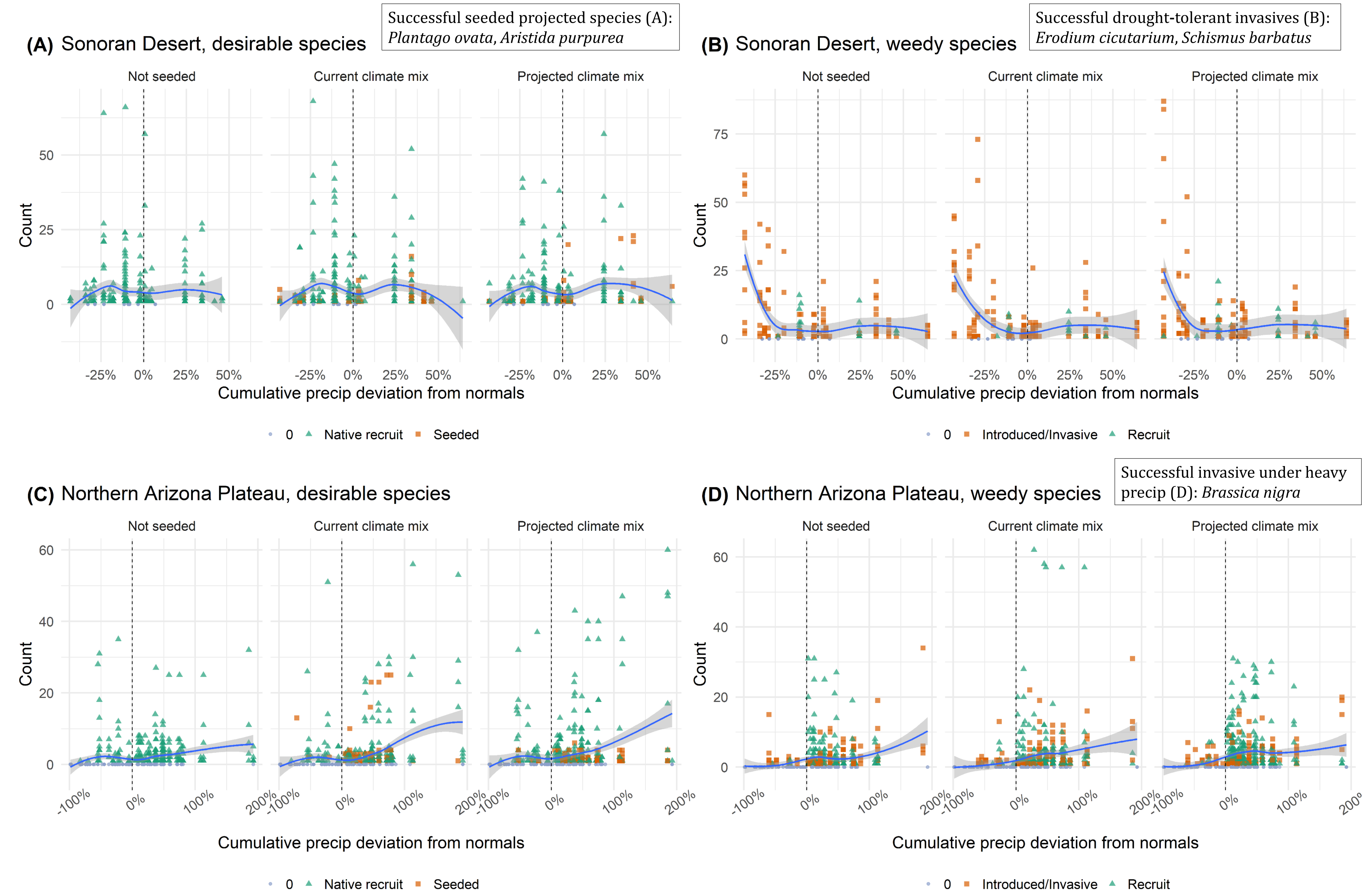
Sphaeralcea ambigua at the Lake Pleasant RestoreNet site in the Sonoran Desert

Northern Arizona Plateau

Current climate mix
Bouteloua eriopoda
Bouteloua gracilis
Baileya multiradiata
Elymus elymoides
Elymus trachycaulus
Hesperostipa comata
Leymus cinereus
Machaeranthera tanacetifolia
Pascopyrum smithii
Penstemon palmeri
Poa secunda
Sporobolus cryptandrus

Projected climate mix
Achnatherum hymenoides
Asclepias tuberosa
Baileya multiradiata
Bouteloua curtipendula
Bouteloua eriopoda
Elymus elymoides
Linum lewisii
Pascopyrum smithii
Pleuraphis jamesii
Poa secunda
Senna covesii
Sporobolus cryptandrus

Results

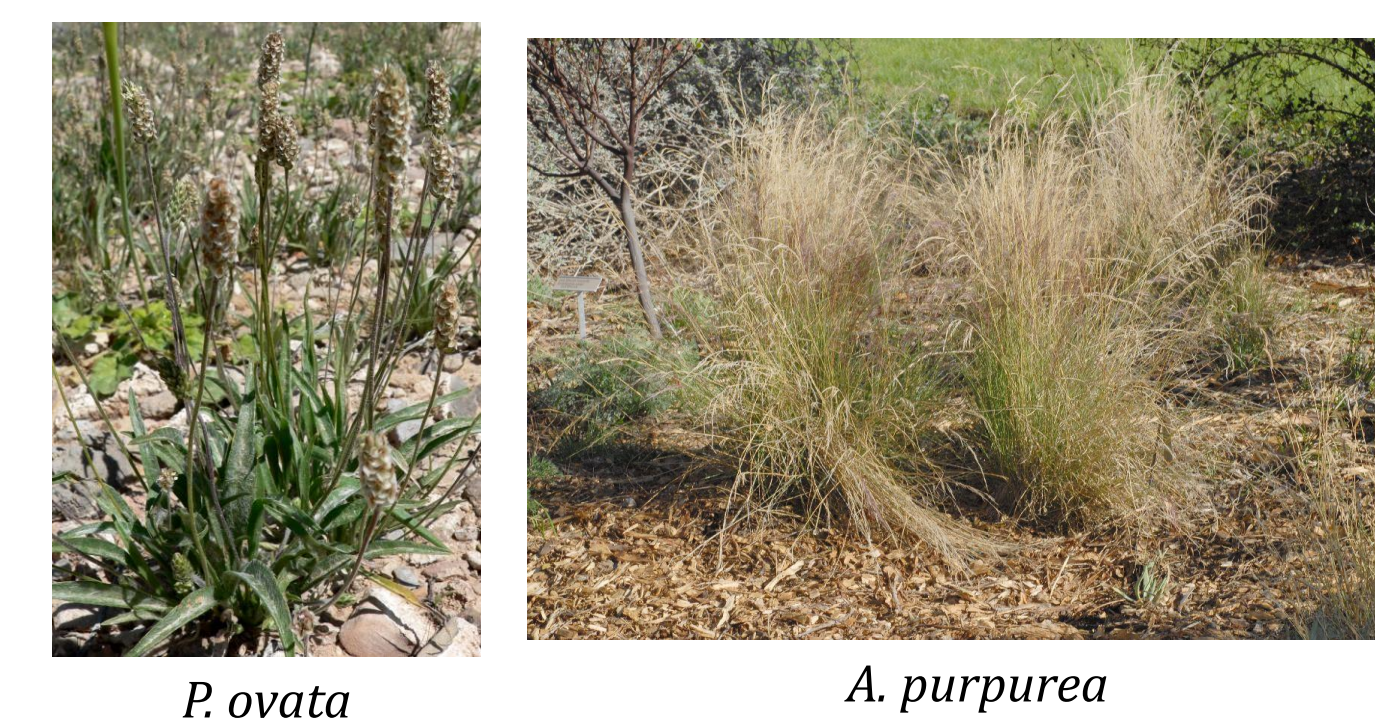


Graphs show seedling density response to precipitation variation (percent deviation from normals). Left of the dashed line indicates less precipitation than normal; right, more precipitation.

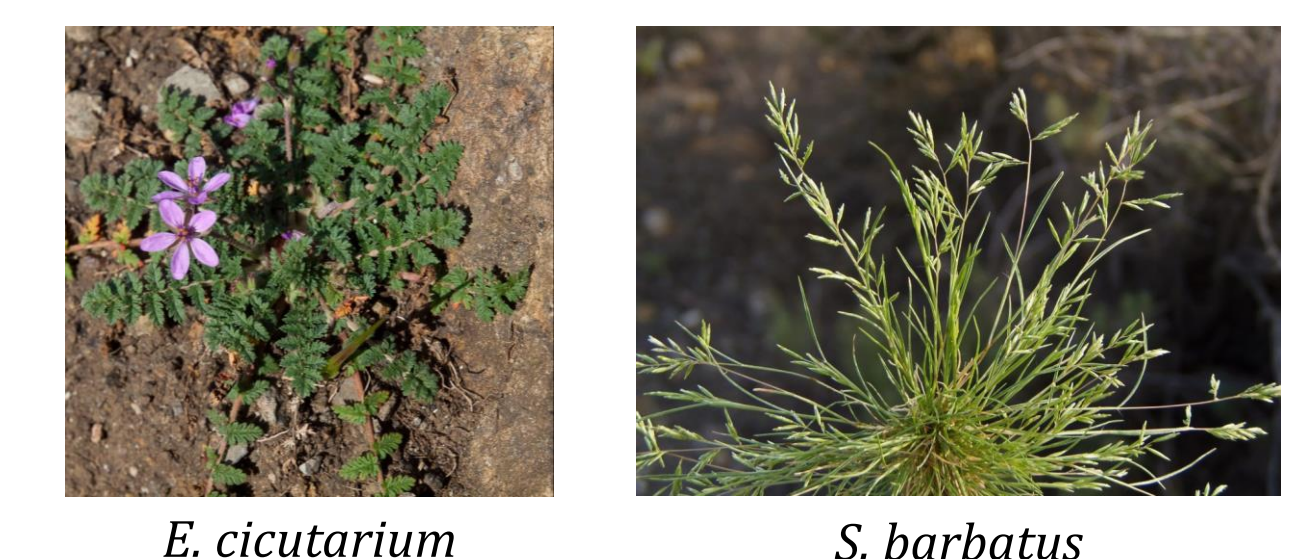
Desirable species include seeded species, and recruits that are native to the region. Weedy species include introduced/invasive species and unknown species that could not be identified.

Conclusions and future work

- The Sonoran Desert seeded species and native recruits had optimal germination at +25% and -20% precipitation deviation from 30-year normals.



P. ovata *A. purpurea*



E. cicutarium *S. barbatus*

- Invasive species *Erodium cicutarium* and *Schismus barbatus* were highly successful at -50% deviation.
- Plantago ovata* and *Aristida purpurea* were particularly successful in the projected climate mix for the Sonoran Desert.
- The Northern Arizona Plateau native species continued to increase in density with higher precipitation; however, density of weedy species also increased.
- Future work will include analyzing all 21 of the sites, incorporating cover data to understand the response of adult plants, and constructing a model that can capture these non-linear trends.