

# The Mojave Desert Native Plant Program:

**DEVELOPING NATIVE PLANT MATERIALS FOR  
MOJAVE DESERT RESTORATION**



# Mojave Desert Ecoregion



# Invasive Annual Grasses and Restoration?

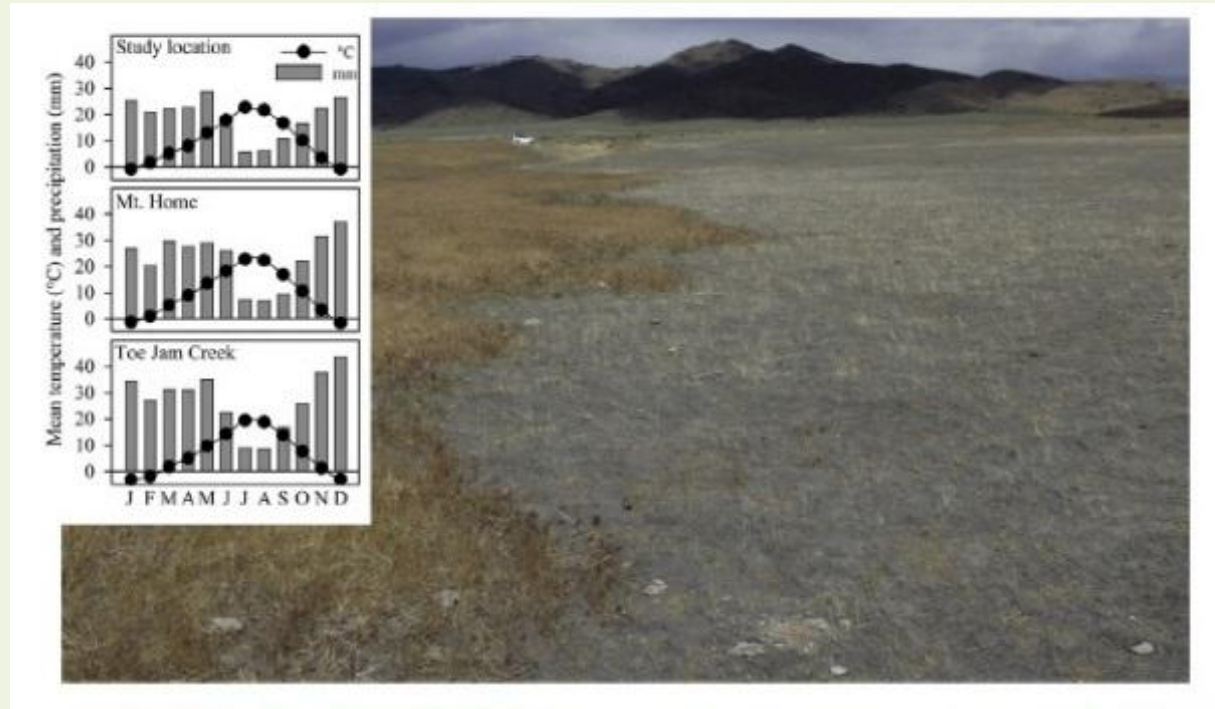


Aleta Nafus – BLM Southern Nevada District



Lynn Sweet – University of California Riverside

# Natural Die-Off Events in Cheatgrass



Owen W. Baughman, Susan E. Meyer, Zachary T. Aanderud, and Elizabeth Leger. 2016. **Cheatgrass die-offs as an opportunity for restoration in the Great Basin, USA: Will local or commercial native plants succeed where exotic invaders fail?** *Journal of Arid Environments* 124: 193-204.

# Loss of Native Species from Soil Seed Banks

Todd C. Esque, James A. Young, C. Richard Tracy. 2010. **Short-term effects of experimental fires on a Mojave Desert seed bank.** *Journal of Arid Environments*, 74: 1302-1308.

- Fire depleted both native and non-native seed densities
- Native seed densities were significantly lower than non-native seed densities both before and after fire

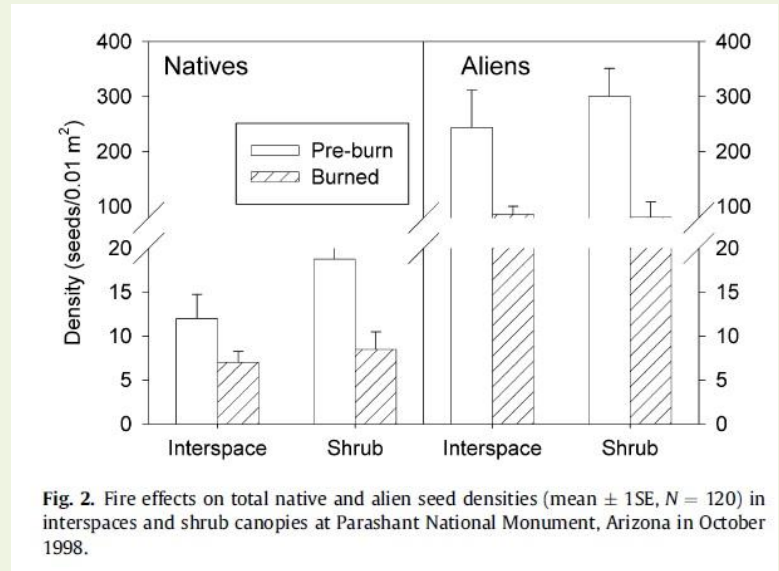


Fig. 2. Fire effects on total native and alien seed densities (mean  $\pm$  1SE,  $N = 120$ ) in interspaces and shrub canopies at Parashant National Monument, Arizona in October 1998.



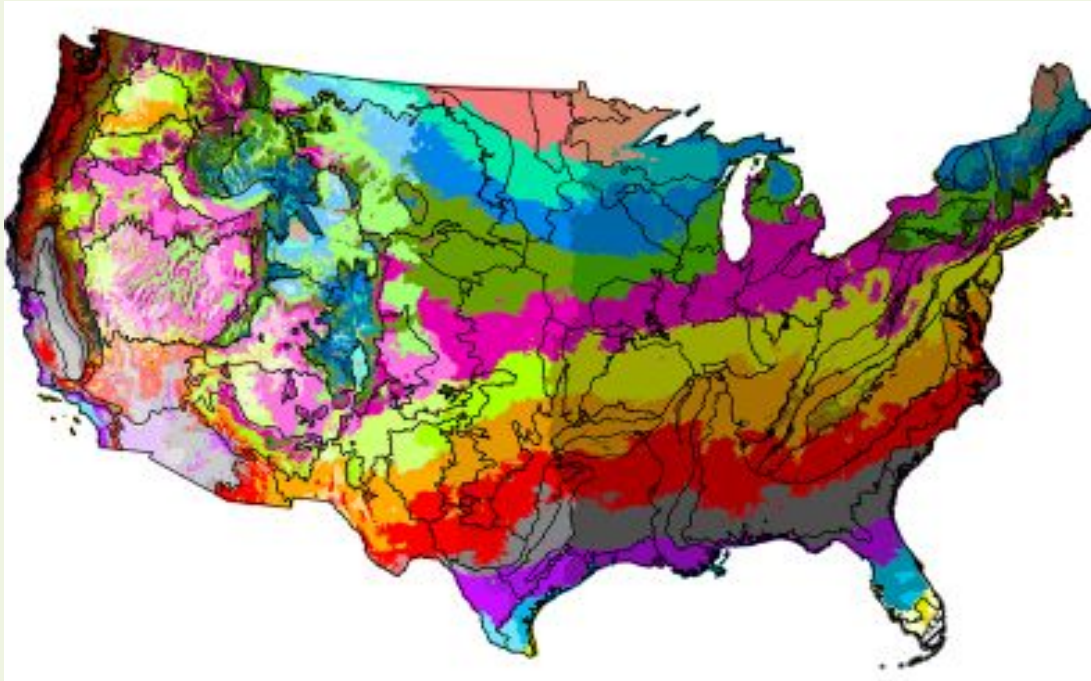
# Mojave Desert Restoration Challenges:

It's **H**ot and **DRY!** 



- No source-identified Mojave seed producers
- Wildland seed collection dependent on undependable precipitation
- Restoration seed germination dependent on undependable precipitation
- Heavy granivore pressure
- Container stock planting works, but requires watering
- Large acreage restoration impractical for container stock
- Competition from invasive species

# What are seed transfer zones?

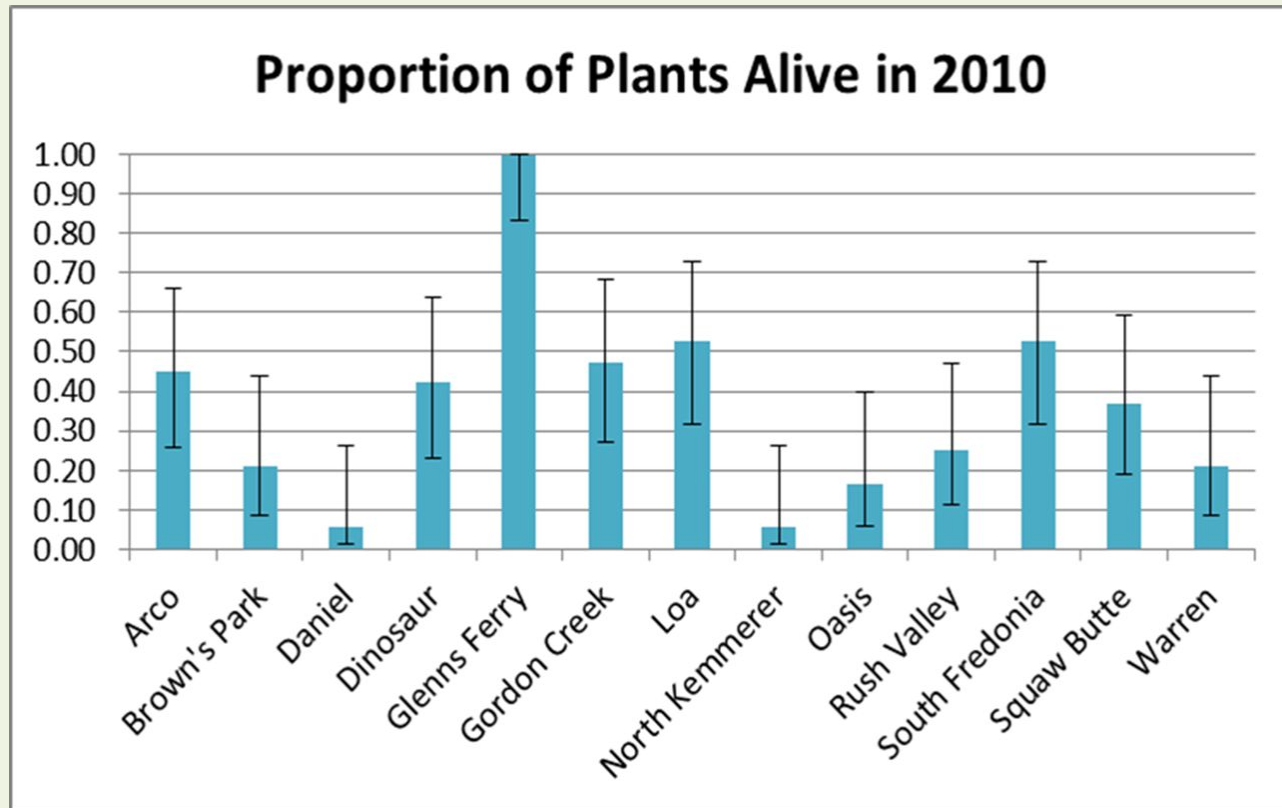


Bower et al 2013 Provisional seed transfer zones

Models based on:

- Temperature and precipitation (provisional)
- Genetic adaptation (empiric)

# Wyoming Big Sagebrush from 13 Locations Planted in Glenns Ferry, ID in 1987



*Sands & Moser,  
2013*



# A Path Towards Native Plant Restoration



**NATIONAL SEED STRATEGY**  
**for Rehabilitation**  
**and Restoration**  
**2015-2020**

The cover of the report features a top section with a stone wall texture. Below this is a photograph of a person with a backpack reaching for a plant in a field. To the right of the person is a close-up of green leaves. At the bottom is a photograph of a butterfly on yellow and orange flowers.



**Ecoregional Native Plant Programs:**

**Mojave Desert Native Plant Program**

A photograph of a desert landscape. In the foreground, there is a large, bushy plant with bright yellow flowers. The background shows a dry, hilly desert under a clear blue sky.

# Solving the Problem: From Seeds of Success to Ecoregional Programs

## SEEDS



## OF SUCCESS

## Seeds of Success Early Years:

- Seeds of Success wildland seed collection program began in 2001.
- Initial emphasis on seed banking, with Royal botanic Gardens, Kew Millennium Seed Bank.
- Standardized collection protocol, 1 collection for each species on the Kew species list.
- 2010 - Millennium Seed Bank project Phase I completed and Kew funding ended

# Solving the Problem: From Seeds of Success to Ecoregional Programs

## SEEDS



## OF SUCCESS

## Seeds of Success Today:

- SOS now has over 18,000 native seed collections in the National Collection
- Portions of each collection are held in long-term storage facilities for conservation
- Multiple collections of single species for research and restoration
- Program emphasis now on restoration, and collecting larger quantities for seed transfer zone and production research, and seed increase plantings

# A Path Towards Native Plant Restoration



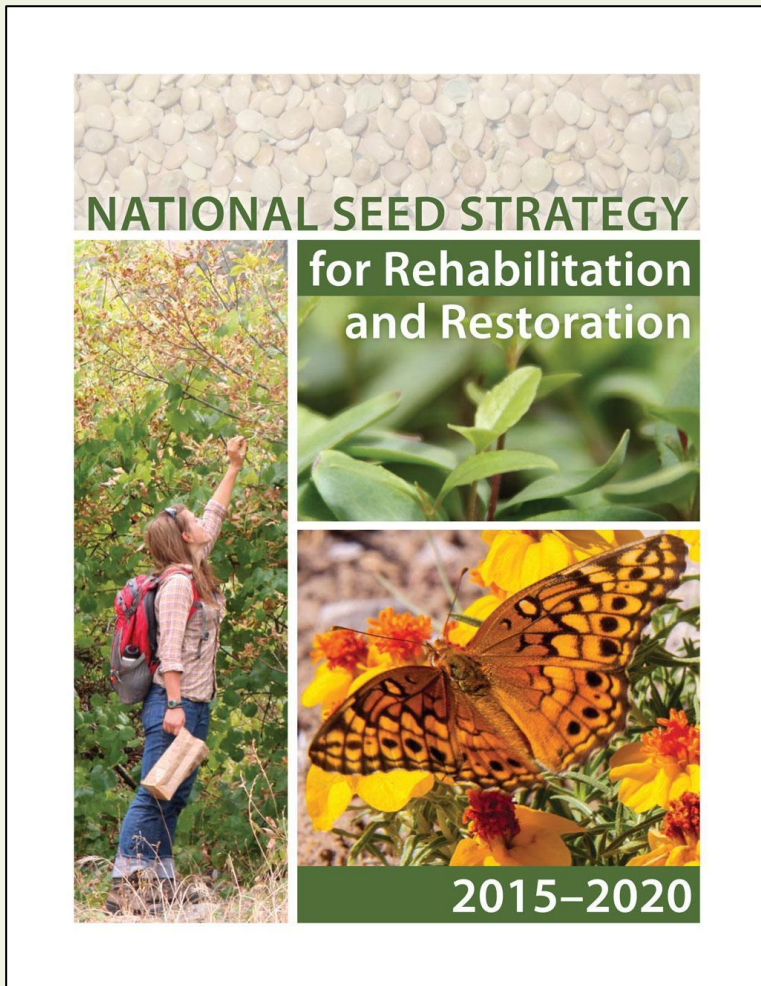
This panel contains a collage of images related to seed collection and restoration. At the top is a close-up of light-colored, rounded stones. Below this is the text "NATIONAL SEED STRATEGY for Rehabilitation and Restoration" in white on a dark green background. The collage includes a photo of a person with a backpack reaching for seeds in a field, a close-up of green leaves, and a monarch butterfly on yellow and orange flowers. At the bottom, the years "2015-2020" are written in white on a dark green background. A blue arrow points from the right side of this panel towards the final program box.

**Ecoregional Native Plant Programs:**

**Mojave Desert Native Plant Program**

A photograph of a desert landscape featuring a large, bushy yellow flower in the foreground, with a dirt path leading through the scrubland towards distant mountains under a clear blue sky.

# National Seed Strategy for Rehabilitation and Restoration



- Announced August 2015
- Calls for an **Unprecedented Level** of Collaboration
- Developed by the Plant Conservation Alliance (PCA)
- Only country in the world with a National Seed Strategy

# Plant Conservation Alliance Federal Committee

12 Federal Agencies   
Federal Committee – led by BLM

PCA also includes

- 325 Non-federal Partners
- 9 International Partners

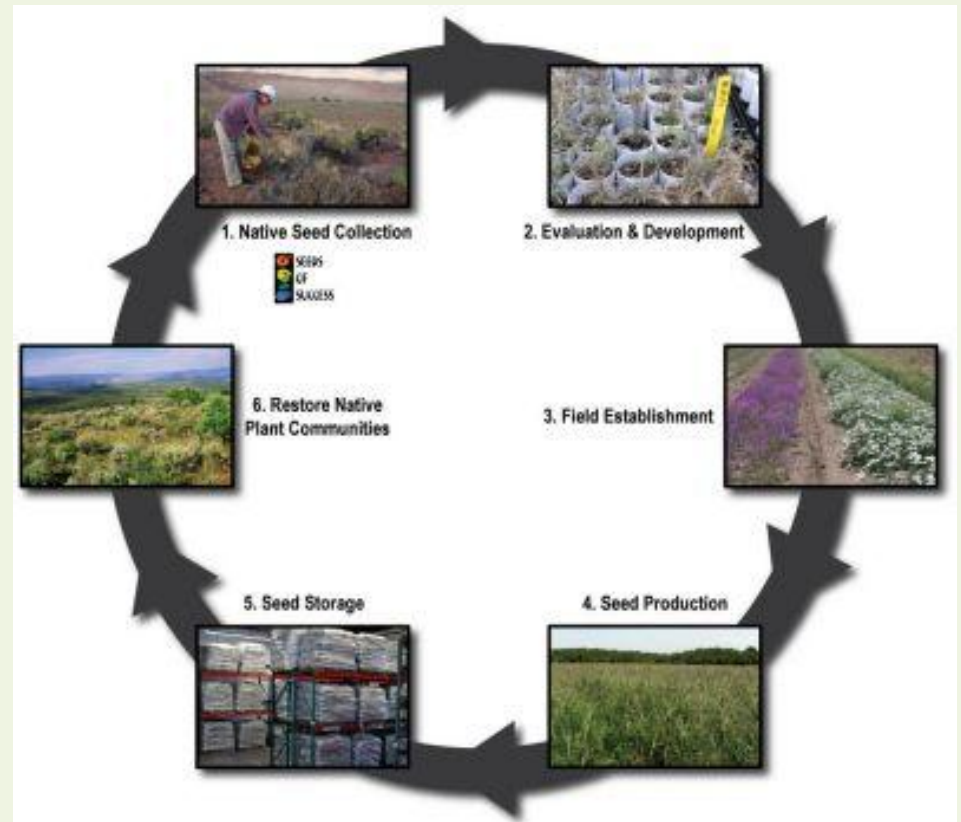
MEMORANDUM OF UNDERSTANDING  
among the  
BUREAU OF INDIAN AFFAIRS  
and the  
BUREAU OF LAND MANAGEMENT  
and the  
FEDERAL HIGHWAY ADMINISTRATION  
and the  
NATIONAL PARK SERVICE  
and the  
SMITHSONIAN INSTITUTION  
and the  
U.S. BOTANIC GARDEN  
and the  
USDA AGRICULTURAL RESEARCH SERVICE  
and the  
USDA FOREST SERVICE  
and the  
USDA NATIONAL INSTITUTE OF FOOD AND AGRICULTURE  
and the  
USDA NATURAL RESOURCES CONSERVATION SERVICE  
and the  
U.S. FISH AND WILDLIFE SERVICE  
and the  
U.S. GEOLOGICAL SURVEY  
ESTABLISHING THE  
FEDERAL NATIVE PLANT CONSERVATION COMMITTEE  
OF THE PLANT CONSERVATION ALLIANCE

This Memorandum of Understanding (MOU) is made and entered into by and between the Bureau of Indian Affairs, Bureau of Land Management, Federal Highway Administration, National Park Service, Smithsonian Institution, United States Botanic Garden, United States Department of Agriculture (USDA) Agricultural Research Service, USDA Forest Service, USDA National Institute of Food and Agriculture, USDA Natural Resources Conservation Service, U.S. Fish and Wildlife Service, and U.S. Geological Survey, hereinafter referred to as the Committee.

# Builds on 15+ Years of Work

**Congress created Native Plant Materials Development Programs in response to catastrophic wild fires in 1998 and 1999**

**The BLM and Forest Service have been working toward these goals since 2001.**



# National Seed Strategy

“The right seed in the right place at the right time.”

- Goal 1 : Identify seed needs and ensure the reliable availability of genetically appropriate seed.
- Goal 2: Identify research needs and conduct research to provide genetically appropriate seed and to improve technology for native seed production and ecosystem restoration.
- Goal 3: Develop tools that enable managers to make timely, informed seeding decisions for ecological restoration.
- Goal 4: Develop strategies for internal and external communication.





# Seed Strategy: Different Procurement Pathways Depending on Species Biology:



**Wildland collections**  
(e.g. Burrobrush)

**Benefits:**

Maintains wildland genetic diversity

Relatively cheap

Can be easily source identified



**Ecologically based germplasm**  
(e.g. Vegas Alkali Sacaton)

**Benefits:**

Wider genetic pool than traditional agricultural varieties

Can be constructed as needed from wildland populations to manage genetics

Relatively cheap cultivation practices can be worked out to provide grower dependability



**Small scale grow out**  
(e.g. Sand Verbena)

**Benefits:**

Preserve local genetic diversity

Good for lower demand species and lower demand areas

# A Path Towards Native Plant Restoration



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**Ecoregional Native Plant Programs:**

**Mojave Desert Native Plant Program**

A photograph of a desert landscape with a prominent yellow flowering bush in the foreground, sparse vegetation, and mountains in the distance under a blue sky. The entire content of this box is enclosed in a dashed-line border.

# Mojave Desert Native Plant Program Goals:

- Develop science-based seed transfer zones
- Coordinate native seed collection (SOS)
- Promote commercial production of genetically and ecologically appropriate native plant seed and container stock for restoration
- Develop effective seeding/planting strategies
- Develop restoration decision-making tools for managers (e.g. seed menus, seed zone mapping tool)
- Develop communication strategies within and across agencies

# Ecoregional Coordination

## A Network of Jurisdictions and Partnerships



### **Land Management:**

- **Bureau of Land Management**
- **National Park Service**
- **Department of Defense**
- **US Forest Service**
- **US Fish & Wildlife Service**
- **State Agencies**
- **Land Trusts/Conservancies**
- **Tribes**

### **Research Partnerships:**

- **US Geological Survey**
- **Rancho Santa Ana Botanic Garden**
- **USDA-Natural Resource Conservation Service**
- **Universities**

# Tucson Plant Materials Center

## Heather Dial

Germplasm development for BLM  
Southern Nevada District Office.  
From wild collections in southern  
Nevada:

- Existing Releases
  - Vegas Alkali Sacaton (*Sporobolus airoides*)
  - Moapa Alkali Muhly (*Muhlenbergia asperifolia*)
- Releases in Progress
  - Big Galleta (*Hilaria rigida*)
  - Bush Muhly (*Muhlenbergia porteri*)



# Tucson Plant Materials Center: Heather Dial

## Forb/Shrub Testing for Commercial Production (2011-2015):

- ❑ Virgin River Brittlebush (*Encelia virginensis*)
- ❑ Desert Globemallow (*Sphaeralcea ambigua*)
- ❑ Eastern Mojave Buckwheat (*Eriogonum fasciculatum*)
- ❑ Wright's buckwheat (*Eriogonum wrightii*)
- ❑ Wright's buckwheat (*Eriogonum wrightii* var. *subscaposum*)
- ❑ Desert Marigold (*Baileya multiradiata*)
- ❑ Smooth Desert Dandelion (*Malacothrix glabrata*)
- ❑ Yellow Cups (*Chylismia brevipes* ssp. *brevipes*)
- ❑ Blackbrush (*Coleogyne ramosissima*)
- ❑ Creosote (*Larrea tridentata*)
- ❑ Burrobrush (*Ambrosia dumosa*)



Eastern Mojave Buckwheat (*Eriogonum fasciculatum*)



Desert Globemallow (*Sphaeralcea ambigua*)

# Priority Species for Collection List:

## Rationale for prioritization:

- Broad range across Mojave Ecoregion
- High potential for restoration use /commercial production
- High value for desert tortoise forage/cover
- High value for pollinators



# High Priority Species

(Undergoing updates during winter 2016-2017.)

## Work Done, or in Progress:

- **Desert Globemallow (*Sphaeralcea ambigua*)**
- **Nevada Jointfir (*Ephedra nevadensis*)**
- Burrobrush (*Ambrosia dumosa*)
- **Desert Indianwheat (*Plantago ovata*)**
- Creosote (*Larrea tridentata*)
- Indian Ricegrass (*Stipa hymenoides*)
- Big Galleta (*Pleuraphis rigida*)

## High Future Priority:

- Bush Muhly (*Muhlenbergia porteri*)
- **Yellow Cups (*Chylismia brevipes*)**
- **Lanceleaf Browneyes (*Chylismia claviformis*)**
- Sixweeks Fescue (*Vulpia octoflora*)
- Needle Grama (*Bouteloua aristidoides*)
- Sixweeks Grama (*Bouteloua barbata*)
- Smooth Desert Dandelion (*Malacothrix glabrata*)
- Chia (*Salvia columbariae*)
- Cheesebush (*Ambrosia salsola*)
- Pincushion Flower (*Chaenactis fremontii*)
- Anderson Wolfberry (*Lycium andersonii*)
- White Ratany (*Krameria bicolor*)
- Littleleaf Ratany (*Krameria erecta*)





# US Geological Survey, Bureau of Land Management, National Park Service

Fred Edwards, Christina Lund, Kathleen Harcksen, Lesley DeFalco, Sara Scoles-Sciulla, Todd Esque,  
Jennifer Fox, and Jonathon Smith

## Experimentation with Restoration Techniques:

- Granivore Circumvention
  - Decoy seeding
  - Seed balls/wafers
- Aerial Seeding
- Hand Seeding
- Herbicide Suppression of Invasives
- Container Stock Planting
- Fire Restoration Study



Lesley DeFalco, USGS

# Fire Restoration Study, BLM Las Vegas District: Multiple Experimental Treatments

- Part of larger USGS research project
- Decoy seeding followed by native species seeding
- Island plantings
- Greenstrip plantings
- Herbicide treatments



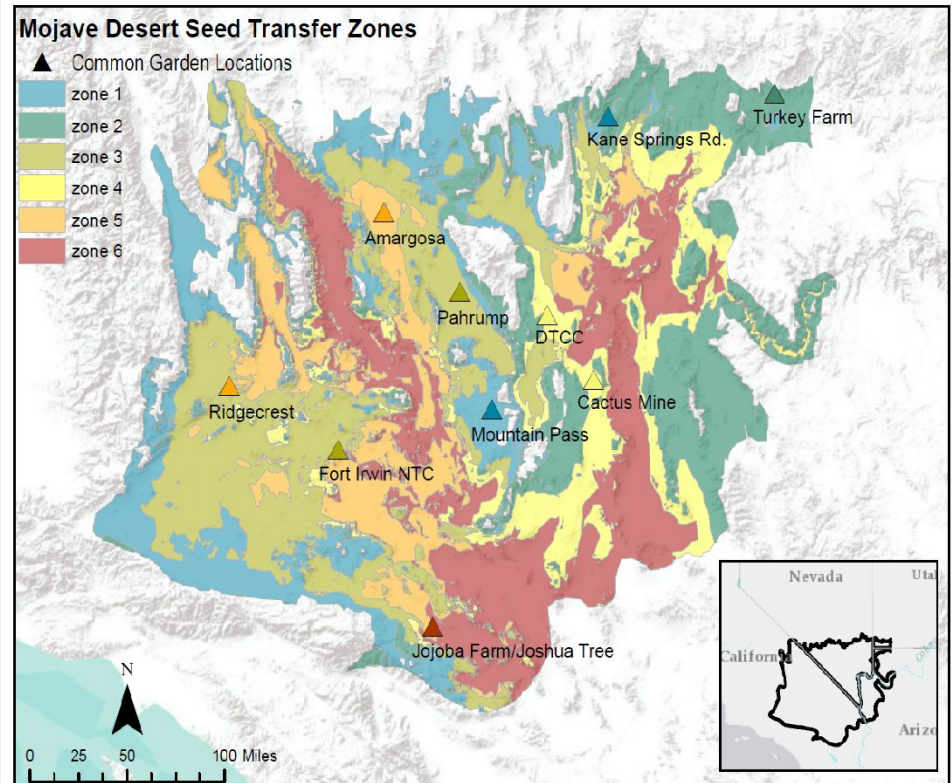
Photos: Jonathon Smith, BLM Las Vegas

# US Geological Survey, Henderson, NV

Dan Shryock, Lesley DeFalco, Troy Wood, Nathan Custer, and Todd Esque

## Development of Seed Transfer Zones:

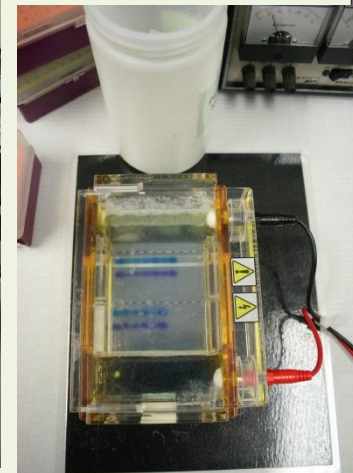
- Six Provisional Seed Zones for Mojave Ecoregion
- Development of 10 common garden research sites across all seed zones for testing
- Spatial genetics model development



# Rancho Santa Ana Botanic Garden

Lorraine Washburn, Sarah deGroot, Andy Siekkinen, and Naomi Fraga

- Seeds of Success seed and plant tissue collections for common garden testing (USGS) and genetic analysis
- Gap analysis to identify missing collection areas
- Mapping of seed and tissue collection sites
- DNA extraction and genetic analysis on target restoration species



Photos: Rancho Santa Ana Botanic Garden

# Tools and Resources

Dan Shryock, Lesley DeFalco, Todd Esque, USGS-Henderson, NV

## Seed Transfer Zones:

*Ephedra nevadensis*

*Sphaeralcea ambigua*

Mojave Desert Provisional Seed Zones

## Articles:

**Ecological**  
APPLICATIONS  
A PUBLICATION OF THE ECOLOGICAL SOCIETY OF AMERICA

[Explore this journal >](#)

Article

**Landscape genetic approaches to guide native plant restoration in the Mojave Desert**

Daniel F. Shryock [✉](#), Caroline A. Havrilla, Lesley A. DeFalco, Todd C. Esque,  
Nathan A. Custer, Troy E. Wood

Accepted manuscript online: 5 October 2016 [Full publication history](#)

DOI: 10.1002/eap.1447 [View/save citation](#)

Conserv Genet  
DOI 10.1007/s10592-015-0741-1



RESEARCH ARTICLE

**Landscape genomics of *Sphaeralcea ambigua* in the Mojave Desert: a multivariate, spatially-explicit approach to guide ecological restoration**

Daniel F. Shryock<sup>1</sup> · Caroline A. Havrilla<sup>2</sup> · Lesley A. DeFalco<sup>1</sup> · Todd C. Esque<sup>1</sup> ·  
Nathan A. Custer<sup>1</sup> · Troy E. Wood<sup>3</sup>

## Adaptive Distance Tools

- **Interactive spatial planning tools for seed sourcing**

- **User tutorial**

ArcGIS®  
Toolbox

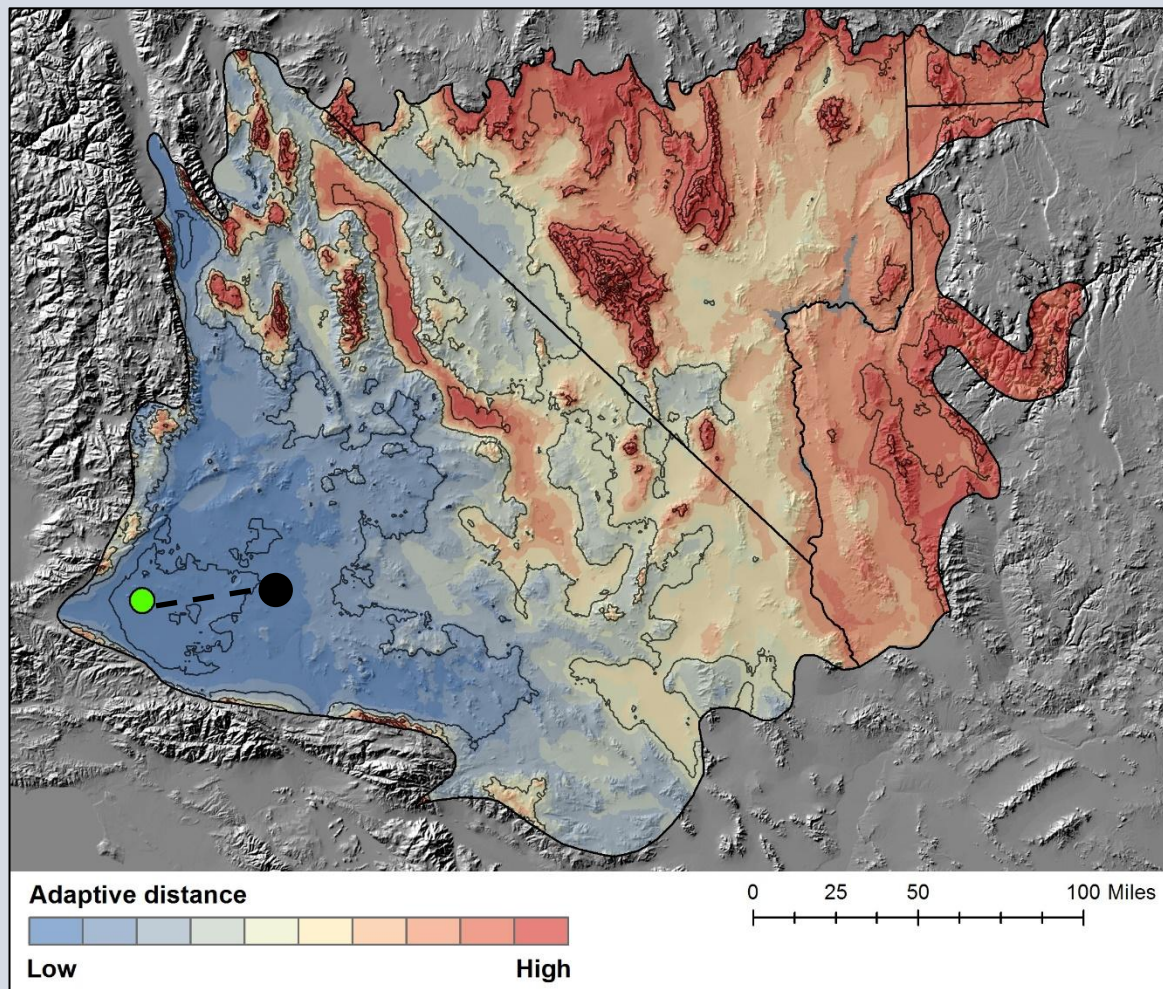


R scripts



# Local provenancing

- Choose seed source with lowest adaptive distance to restoration site
- Species-specific (genetic distance) and environmental versions



Ephedra nevadensis single-point adaptive distance

Point  
X Coordinate: 390032 Y Coordinate: 3858207

Output Adaptive Distance Raster  
L:\dist

Output Adaptive Distance Raster  
Provide the name and file directory for the output raster grid file. The tool will calculate a raster grid representing adaptive genetic distances from each cell to the input point. Values are standardized in units of Z scores.

OK Cancel Environments... << Hide Help Tool Help

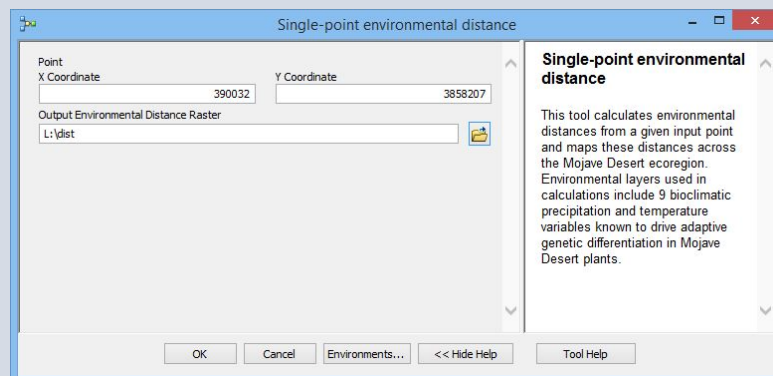
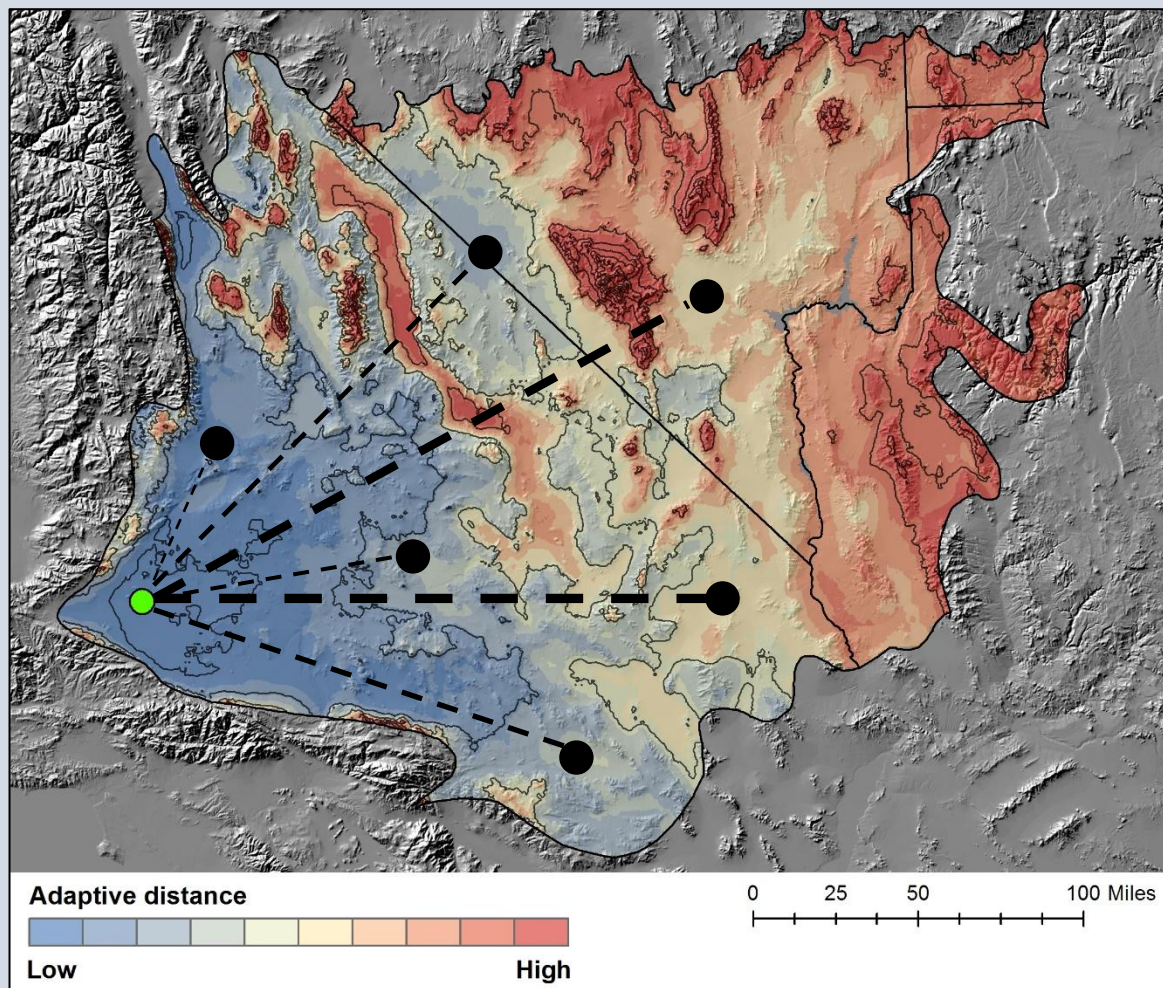
```
> epne.dist(623165, 3818879)
```



# Admixture provenancing

- Mix seed sources with low to moderate adaptive distances to restoration site

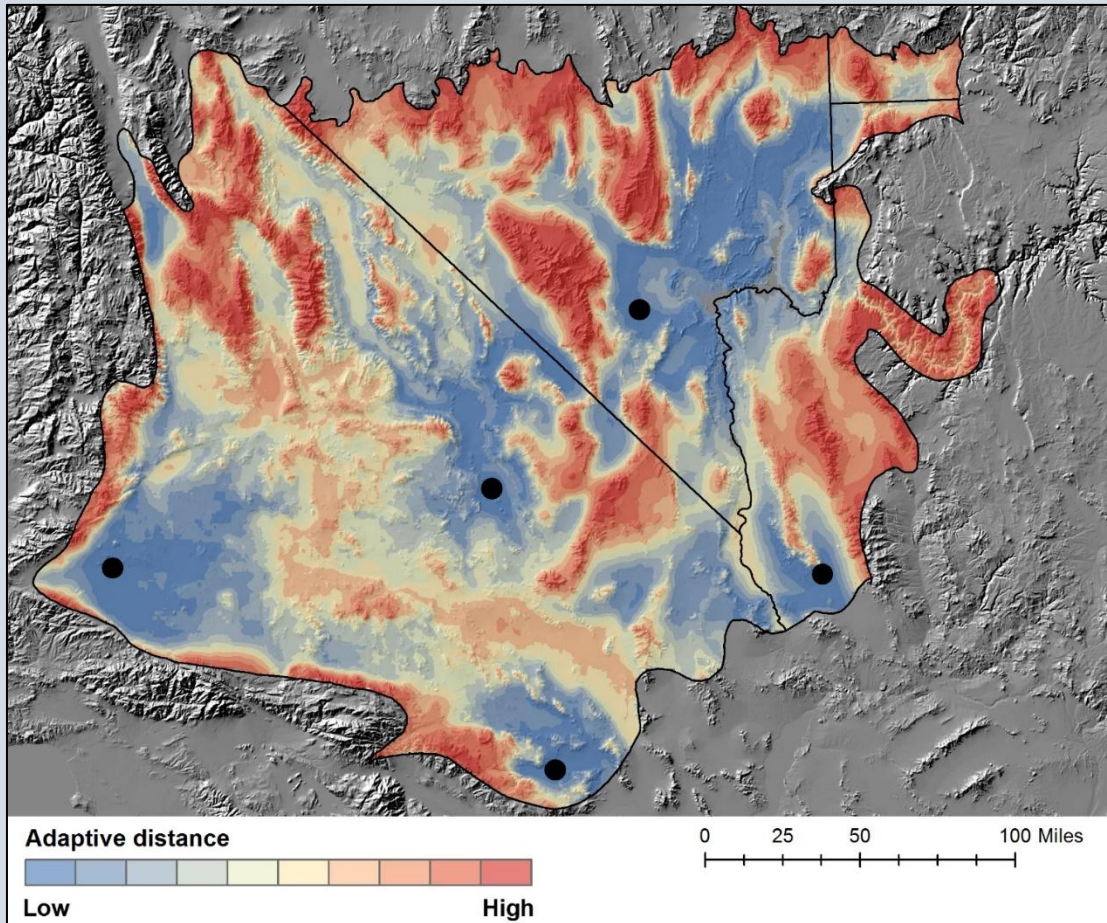
- Low cost of movement
- Moderate cost of movement



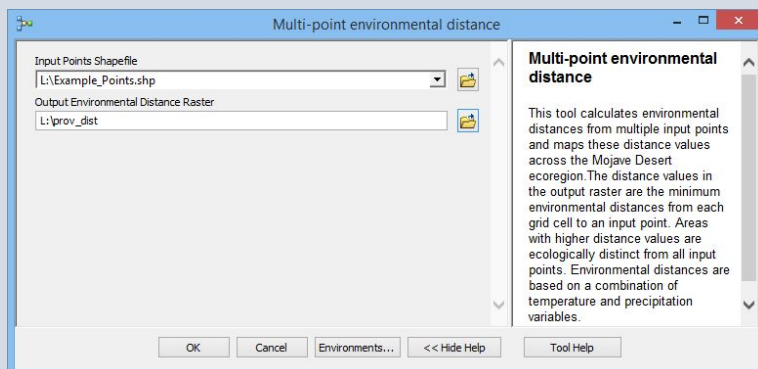
```
> epne.dist(623165, 3818879, Sources)
```



# Multi-point tools to guide sample collections



- Displays the minimum adaptive distance to any input point
- indicates overall environmental representation
- Visualize under-sampled areas



```
> environmental.dist.multi(Sources)
```





# Nurseries for Container Stock Production



- Joshua Tree National Park Nursery
- Song Dog Native Plant Nursery, Lake Mead National Recreation Area
- Nevada Division of Forestry Nursery, Las Vegas
- Mojave Desert Land Trust Nursery
- Victor Valley College Nursery
- The Living Desert Nursery
- Antelope Valley RCD Nursery

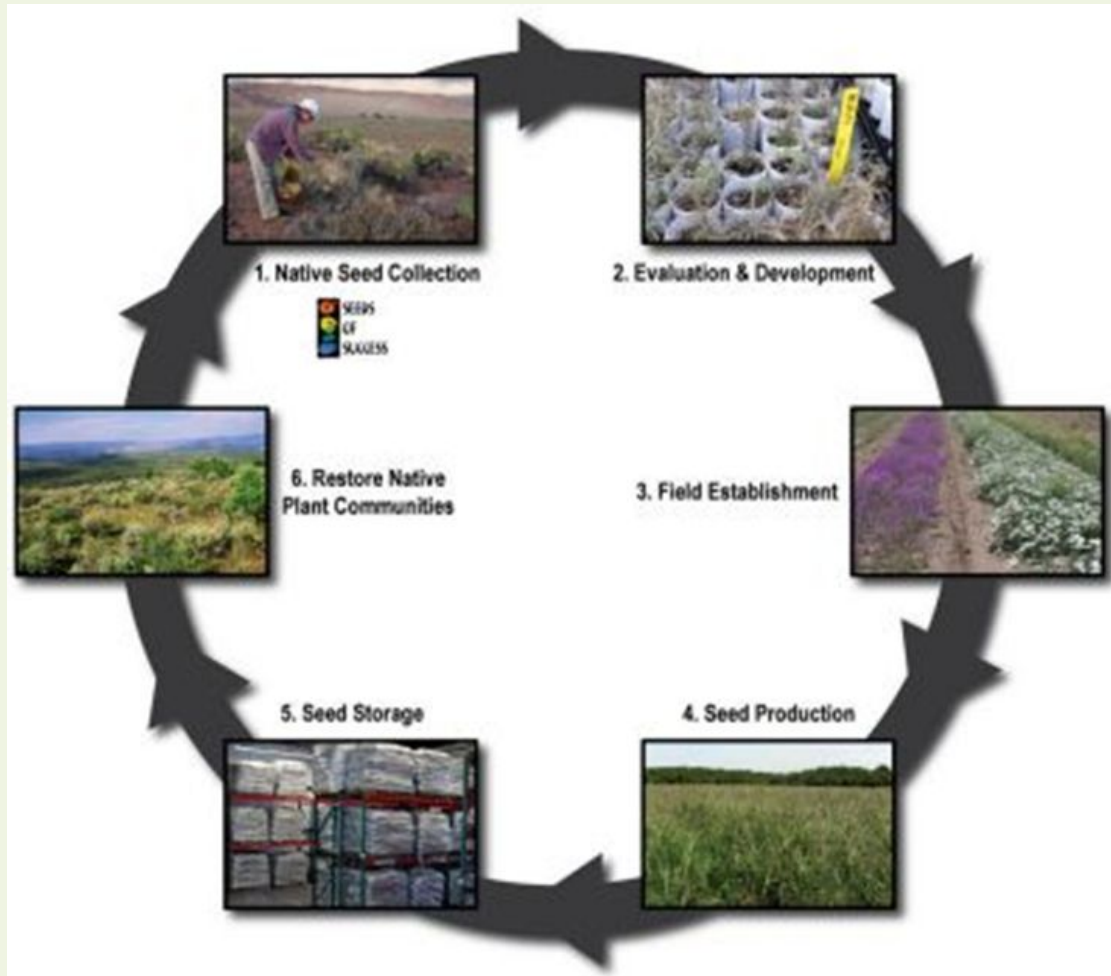
# Seed Producers Needed

## Concerns:

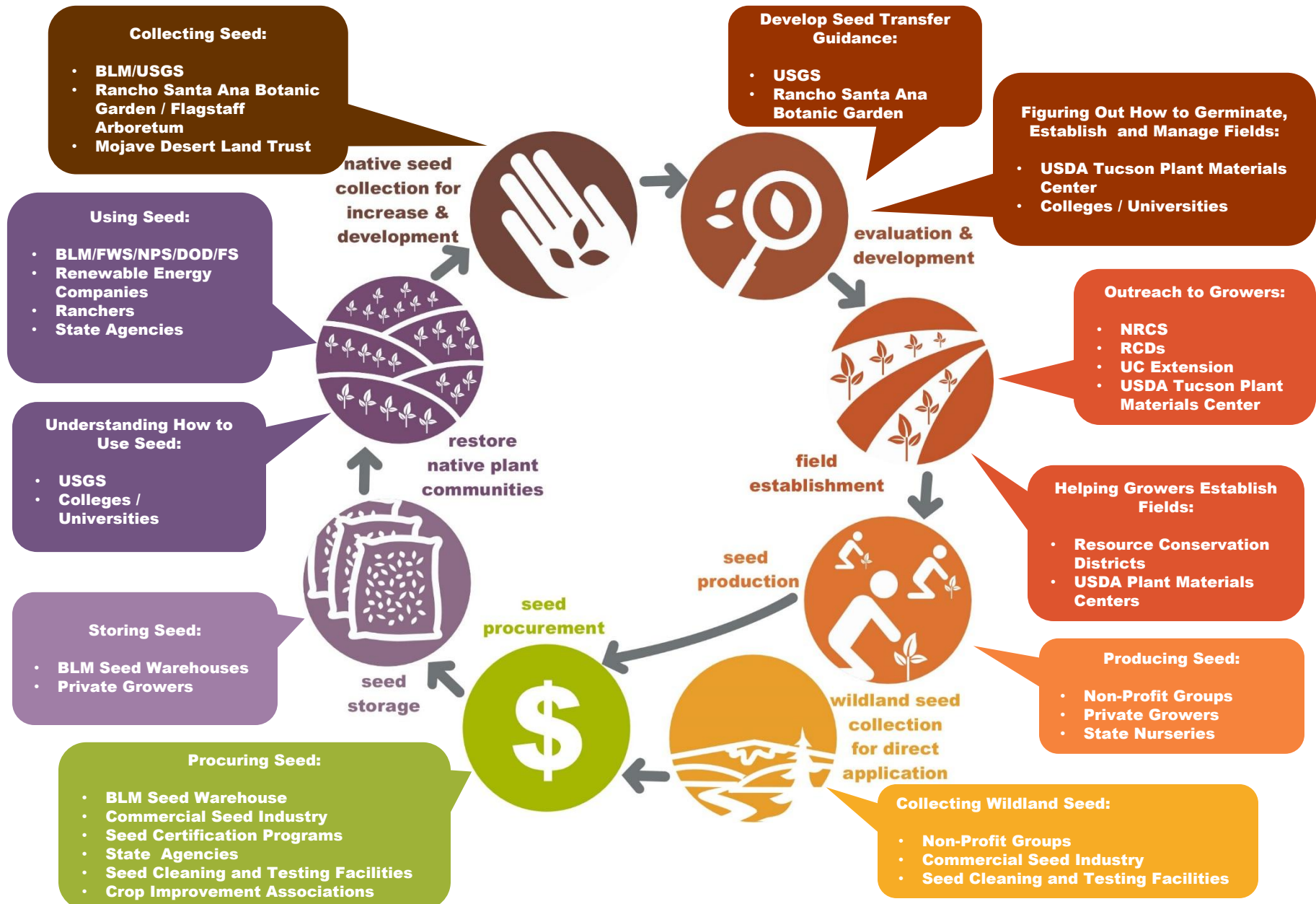
- Need to be in or near Mojave Ecoregion – suitable climate, and keep plants adapted to the Mojave
- Produced seed must be **weed-free**
- Need a stable seed market to maintain commercial viability
- Need a contracting option that works for both seed producers and buyers



# Cycle of Seed Collection, Development, Production, and Use



# Mojave Desert Partnerships within the Cycle of Seed Collection, Development, Production, and Use



# Mojave Desert Native Plant Program: Coordinating Availability with Needs

**Field  
Restoration  
Needs**

Site-Specific Habitat  
Restoration

Large-scale fire  
restoration

**Native Plant  
Material  
Availability /  
Restoration  
Tools**

Nursery Production  
Capability

Seed Increase  
Capability

Scientific Research – Seed  
Transfer Zones,  
Restoration Techniques

Seed Storage  
Capacity

Wildland Seed  
Collection Capability

**Mojave Desert Native Plant Program**

# Mojave Desert Native Plant Symposium

- Tentative reschedule date: November 14-16, 2017
- Barstow, CA
- Presentations on research, restoration tools, native plant materials development and availability, and restoration work happening across the Mojave Ecoregion
- Networking and idea sharing for identifying needs and sharing knowledge/resources





Contact: Judy Perkins, Mojave Desert Native Plant  
Coordinator: [jlperkins@blm.gov](mailto:jlperkins@blm.gov)  
760-833-7148.