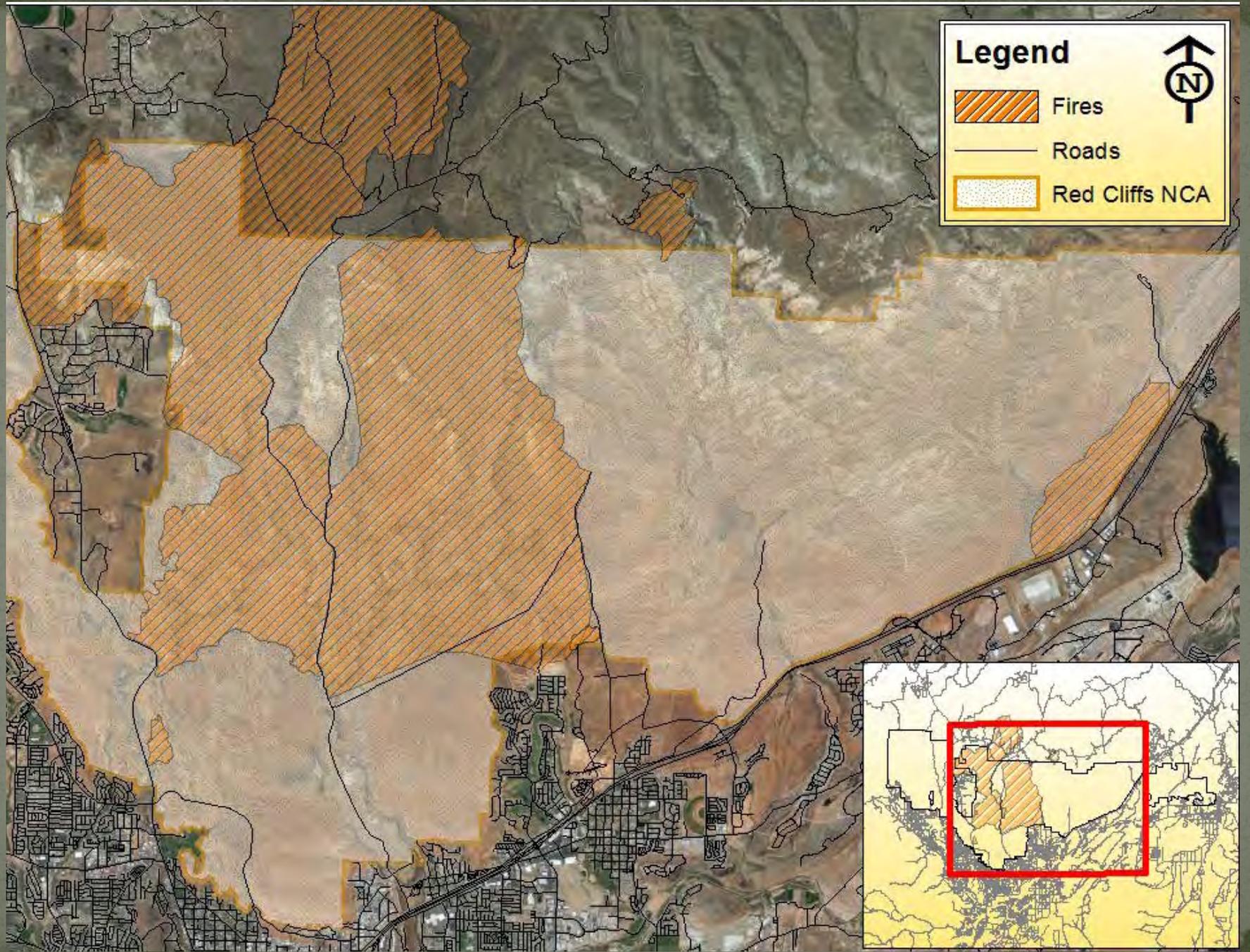


A large tortoise, likely a Galapagos tortoise, is shown in its natural habitat. The tortoise is positioned in the lower half of the frame, facing right, with its head and front legs visible. It is actively eating a small, purple-flowered plant. The tortoise's shell is dark brown with distinct scutes. The background consists of dry, reddish-brown soil and sparse, dry vegetation, including some purple flowers. The overall scene is brightly lit, suggesting a sunny day.

Revegetating Fire-affected  
Desert Tortoise Habitat in the  
Red Cliffs National Conservation Area





Fires burned approximately 25% of tortoise habitat within the Red Cliffs NCA in a single summer (2005)





# Direct Mortality

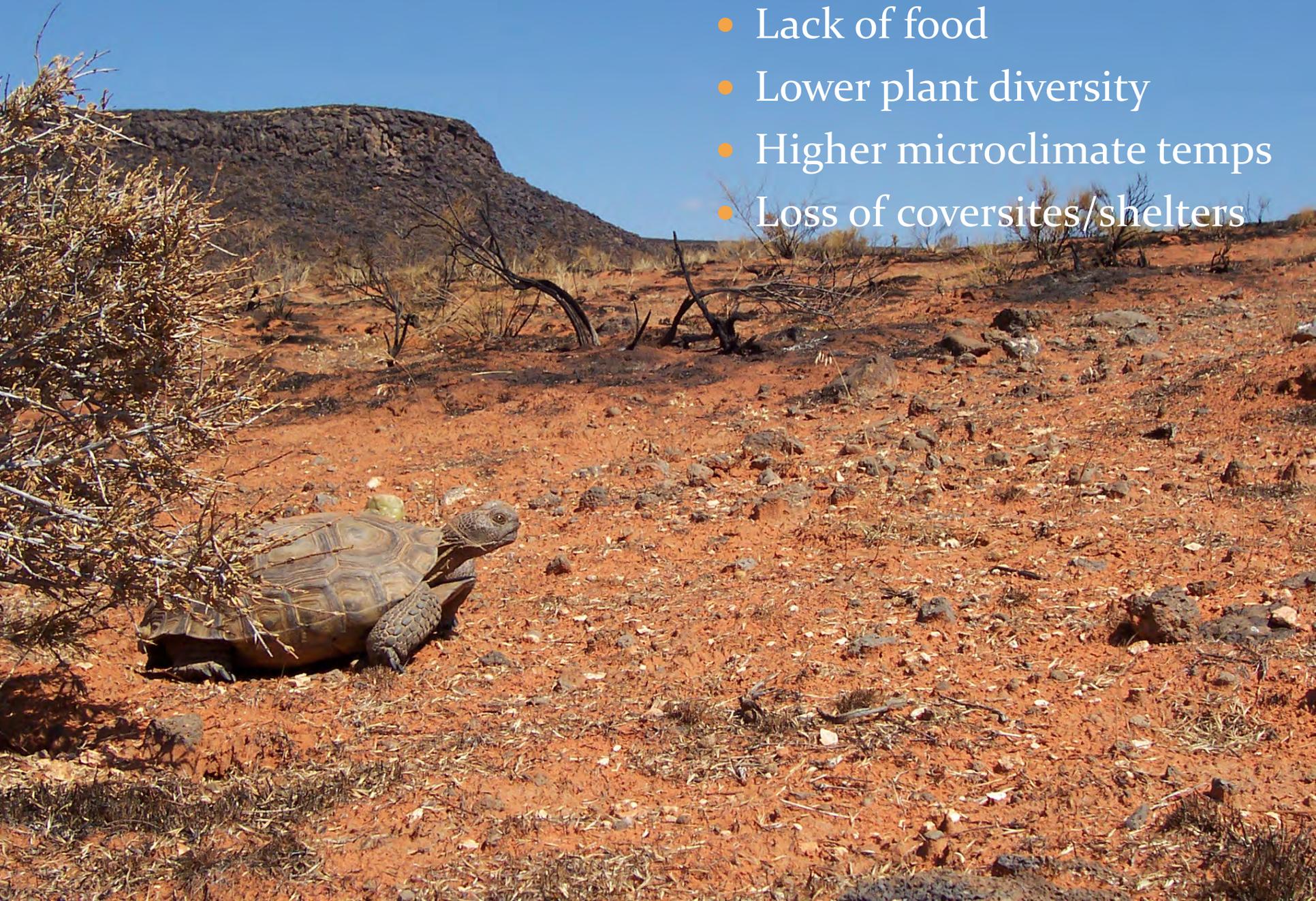
Estimated over 15% of adult tortoises died during the fires

- Contact with flames
- Exposure to lethal temperatures



# Long Term Fire Effects

- Lack of food
- Lower plant diversity
- Higher microclimate temps
- Loss of coversites/shelters





# Habitat Restoration

- Burned areas reseeded in 2006/2007
- Aerial application: (1+ million dollars spent)
  - Minimal to no native seed detected in plots
- Attempts to reseed burned areas using aerial and manual methods have proven ineffective and costly.



# Landscape Conservation Forecasting



Landscape Conservation Forecasting™ for  
Washington County's National Conservation Areas  
Report to the St. George Field Office, Bureau of Land Management  
September 2011



Photos: Red Cliffs (above) and Beaver Dam Wash (below) National Conservation Areas; L. Provencher, 2011.

By

Louis Provencher<sup>1</sup>, Joel Tuhy<sup>3</sup>, Elaine York<sup>4</sup>, Gen Green<sup>4</sup>, and Tanya Anderson<sup>2</sup>

The Nature Conservancy, Reno<sup>1</sup> and Las Vegas<sup>2</sup>, Nevada  
The Nature Conservancy, Moab<sup>3</sup> and Salt Lake City<sup>4</sup>, Utah

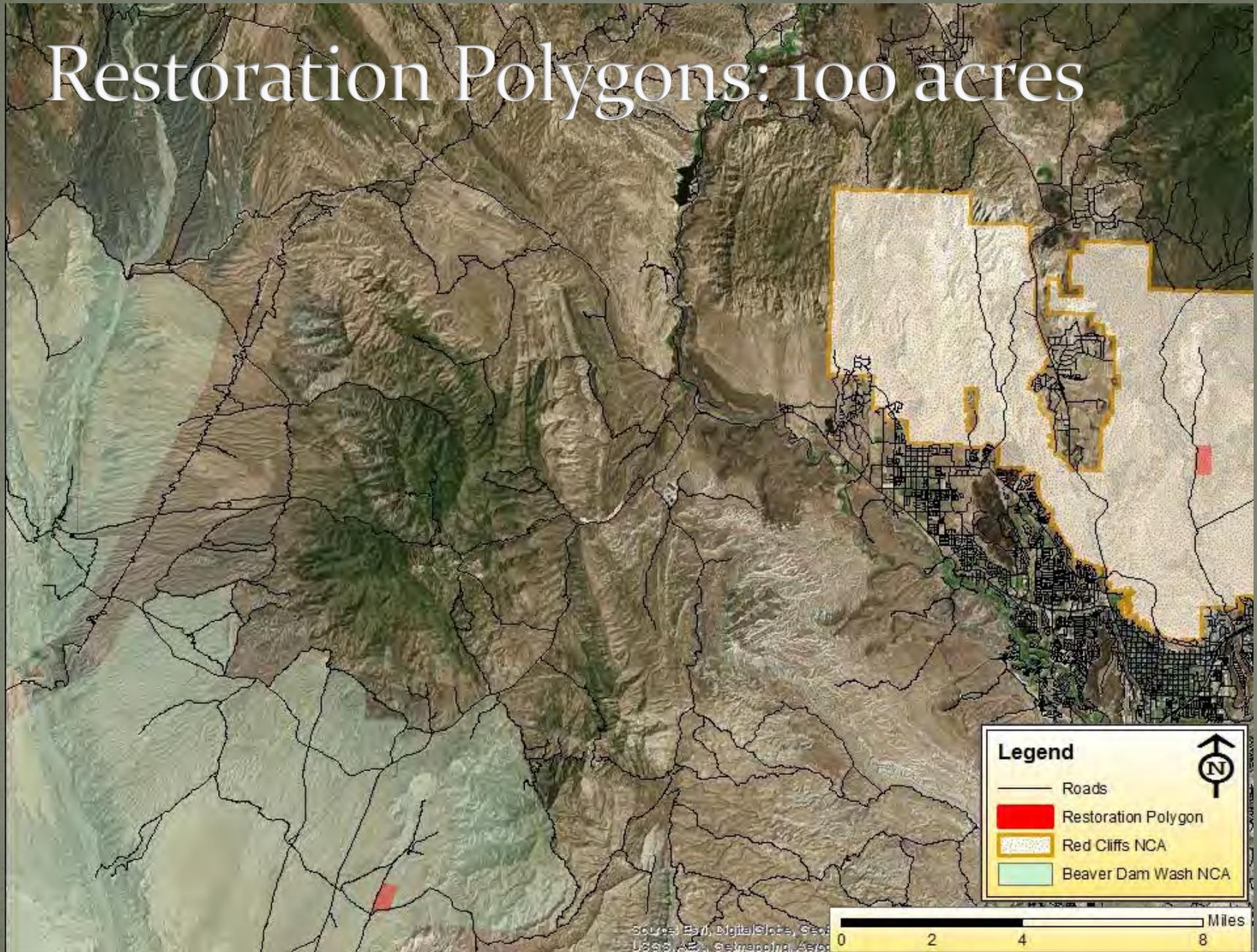
- The Nature Conservancy created detailed veg maps of the Red Cliffs NCA to identify problem areas
- Identified cost effective restoration methods to restore conditions
- Analysis identified outplantings to be a cost effective management strategy to restore habitat

# Partners/Cooperators

- Washington County HCP \$20,000
- UDWR Watershed Restoration Initiative \$30,000
- National Fish and Wildlife Foundation \$40,000
- The Nature Conservancy \$12,188
- Bureau of Land Management ~\$70,000
- In-kind funding from UDWR and BLM



# Restoration Polygons: 100 acres



Create “fertile” islands that will act as seed banks from which native plants can disperse





## Red Cliffs Plot

- Desert tortoise critical habitat
- Previously burned
- Low density of native shrubs
- High density of invasive plants
  - Cheatgrass
  - Red Brome
  - Mediterranean Grass
  - Filaree
  - Russian Thistle

# Native Seeds, Locally obtained



# Containerized Plants at UNLV

## Seedling establishment

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Photos by Dale Devitt

## Species List

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- White Bursage, *Ambrosia dumosa*
- Creosote, *Larrea tridentata*
- Brittlebush, *Encelia farinosa*
- Globe Mallow, *Sphaeralcea ambigua*
- Astragalus sp.
- Galleta grass, *Hilaria rigida*

# Containerized Plants at UNLV

**Seedlings in Greenhouse**



**Outdoor Shade Structure**



Photos by Dale Devitt

# Plant Delivery: Oct/Nov

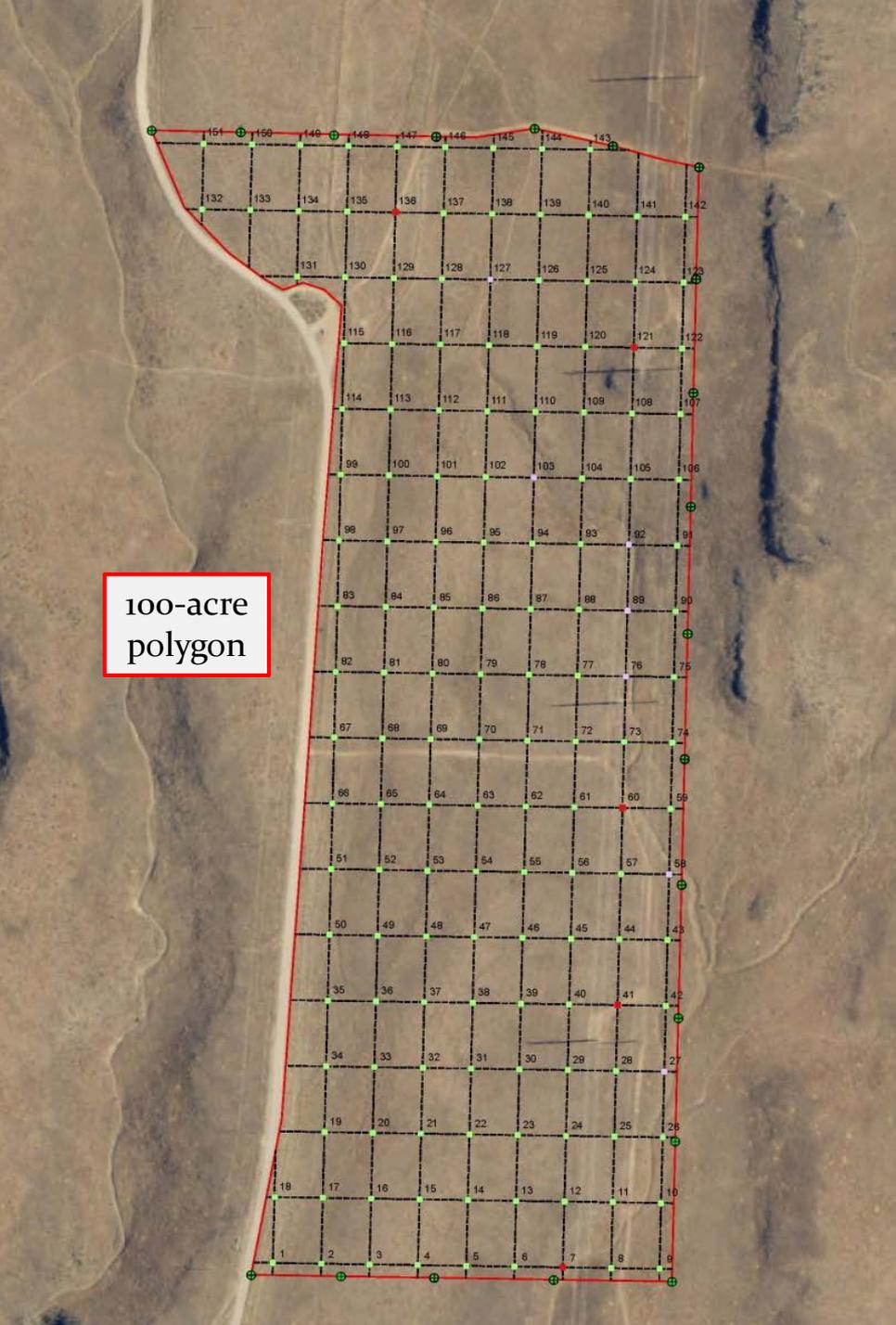




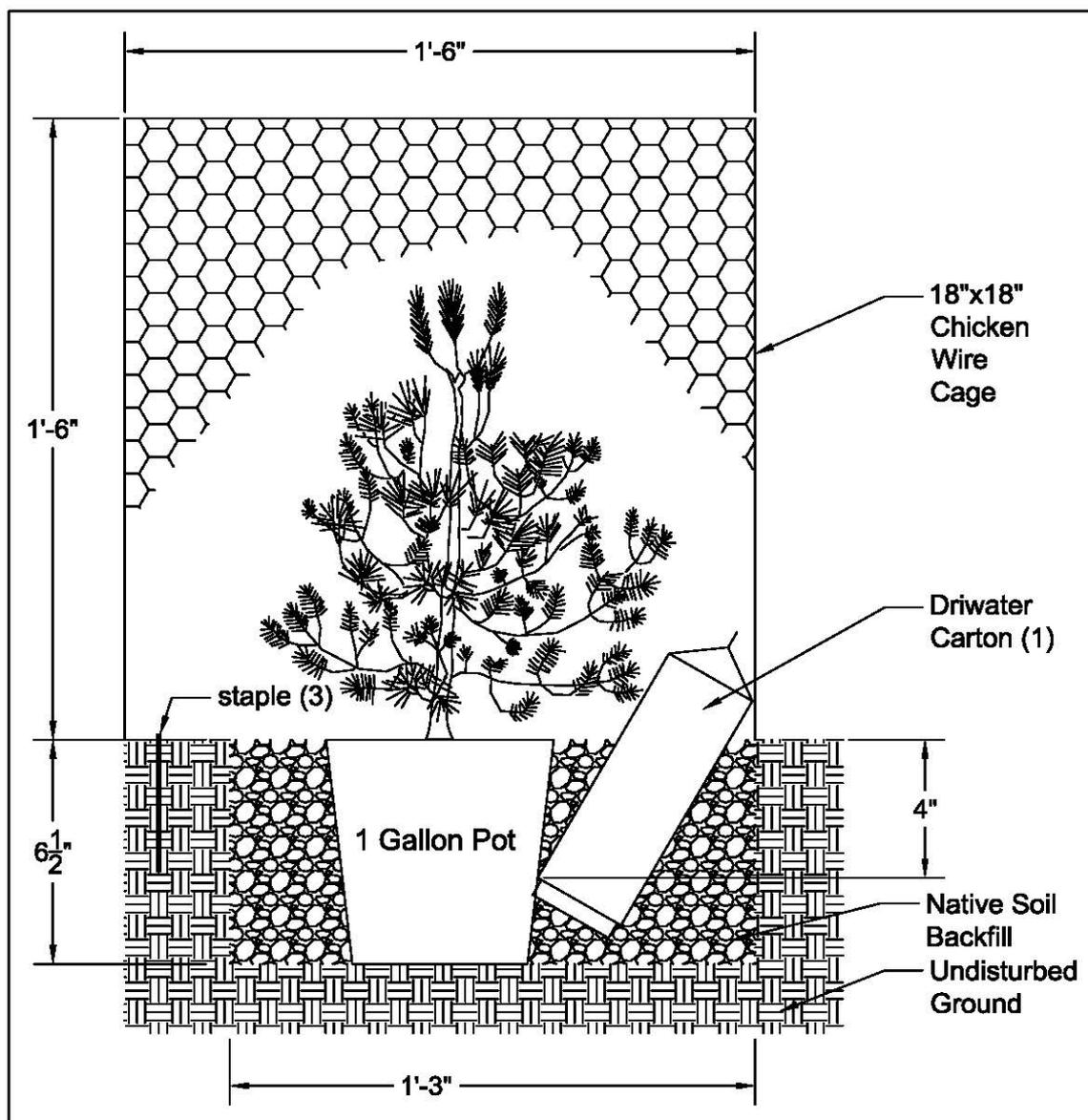
# Red Cliffs Study Area

November 2016

- 150 plots created from superimposed grid
- Planted 1,000 plants in 51 plots on the north portion of the study area



100-acre  
polygon



Plants were planted within 10 m radius of the plot center.

Each plant received 1 L of water when planted.

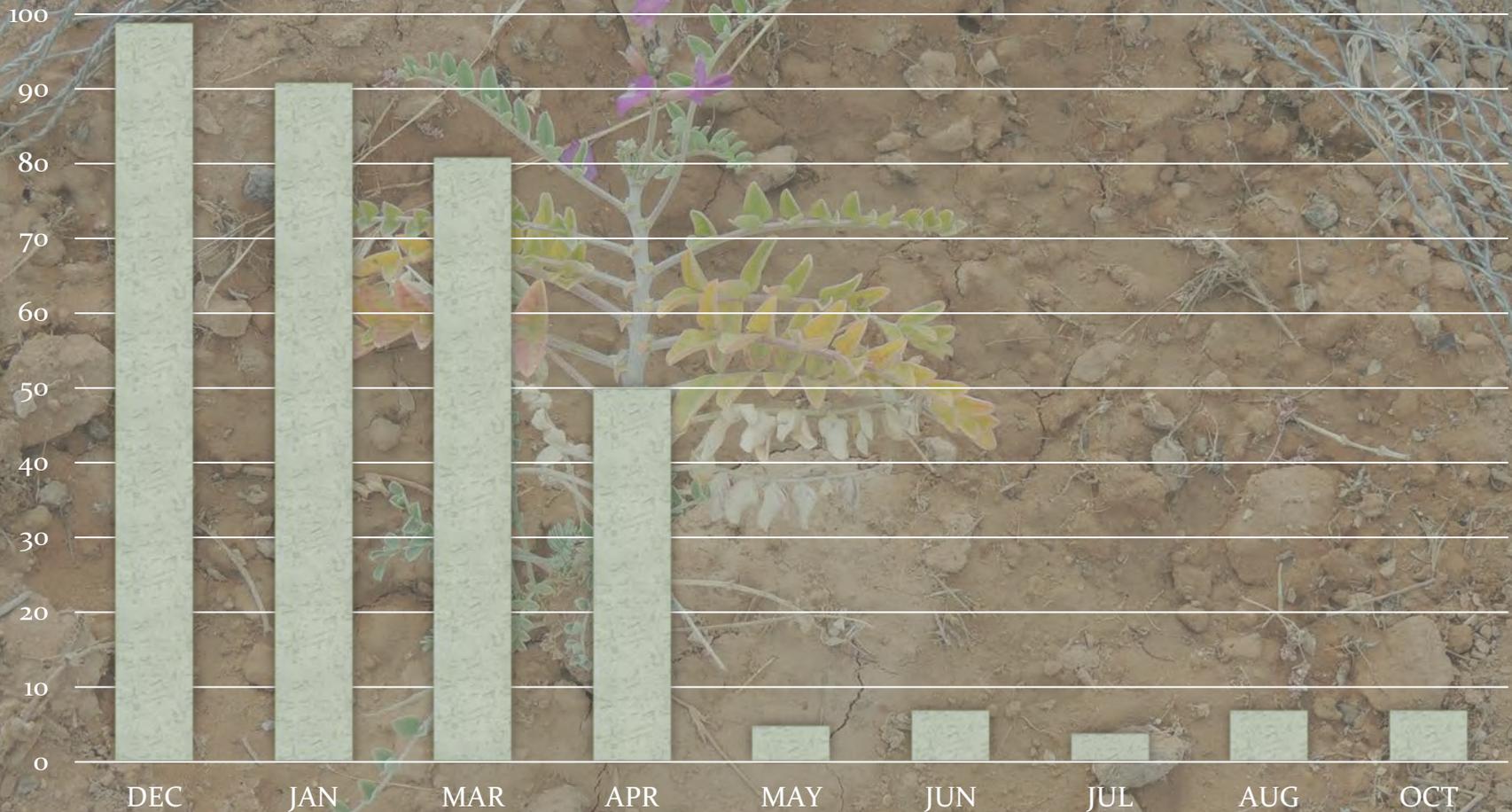
A portion of plants at each plot were protected with a double wrapped chicken wire cage.

Some plants received either water gel crystals or shade cloth.



# Plant Survival in Red Cliffs

## Nov 2016 to Oct 2017



# 2017 Restoration Strategy:

- Plant earlier in the year (early Nov or late Oct)
- Only planted a portion of available plots
  - Selected plots that were < rocky, w/ open spaces, < Bromus
- Increase supplemental water efforts
  - Water 1 L every 3 weeks
  - Increase spring watering efforts
- Improve planting technique
  - Dig deep holes and remove large rocks
  - Plants should be planted ½-1” below soil surface
  - Plant in depression to catch or “hold” supplemental water or natural rainfall
- Experiment with shade cloth/mesh on tops of cages

# 2017 Study Design

- 70 plots total
- Each plot had 54 or 60 plants
- Treatments included:
  - Uncaged
  - Caged
  - Shade cloth or
  - Water-gel crystals

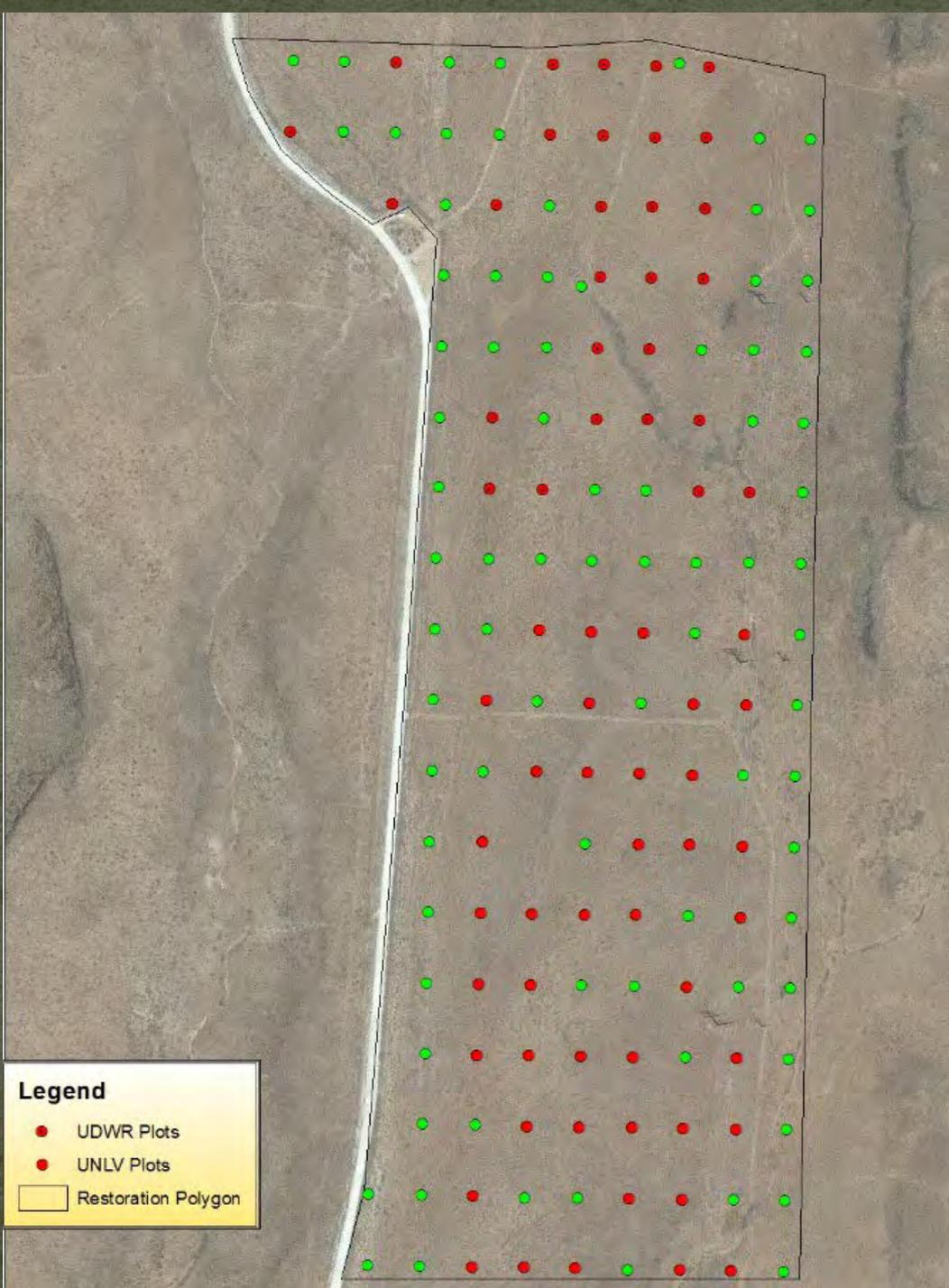


# Planting Design:

## Northern Area

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- 28 plots
- 54 plants per plot
- 6 species per plot
- 3 treatments
  - Control
  - Caged
  - Caged w/ mesh
- 3 replicates per plot



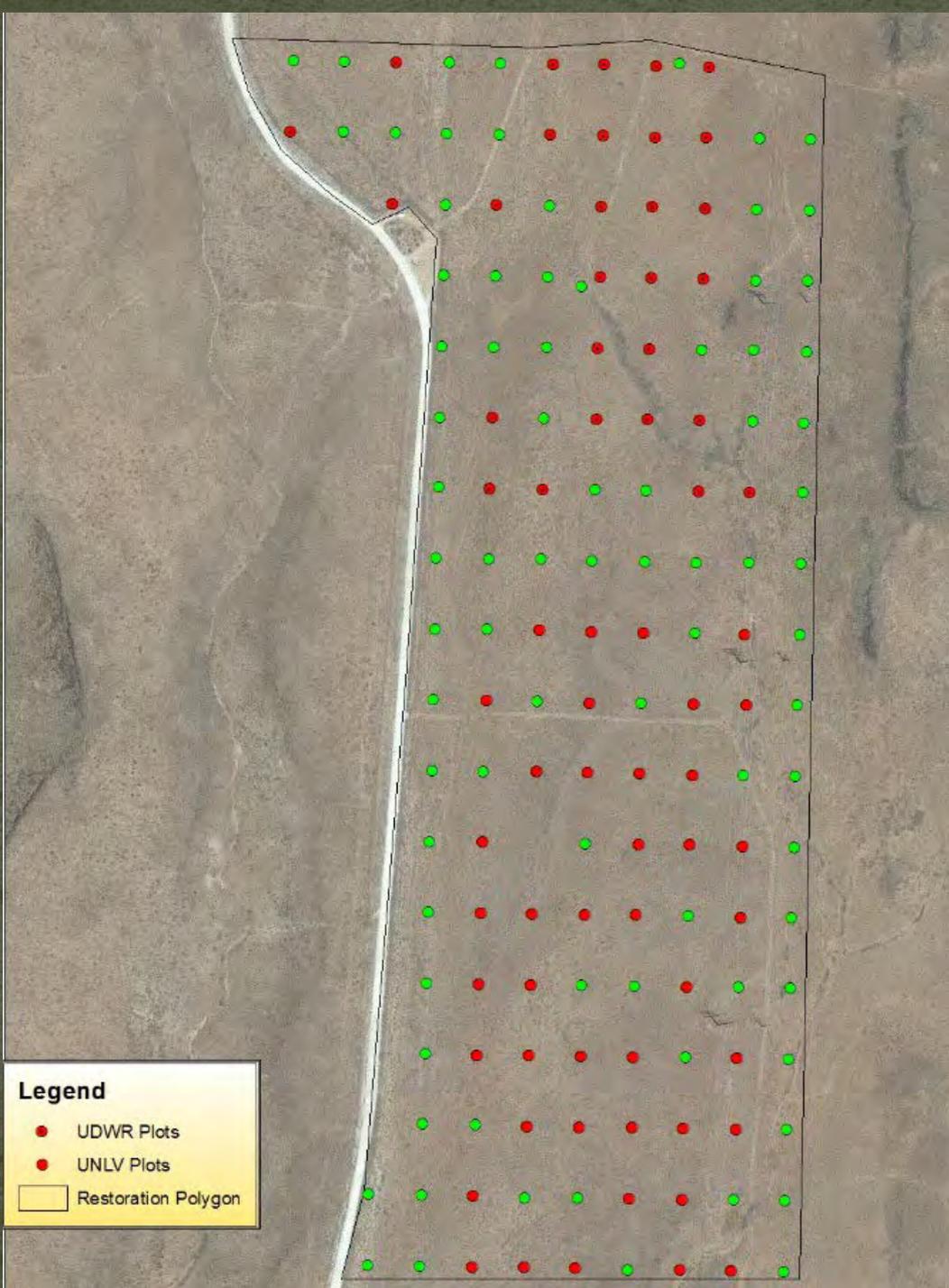
### Legend

- UDWR Plots
- UNLV Plots
- Restoration Polygon

# Planting Design:

## Southern Area

- 42 plots
- 60 plants per plot
- 5 species per plot
- 4 treatments
  - Control
  - Gel only
  - Caged
  - Caged w/ gel
- 3 replicates per plot





UNLV hired American Conservation Experience (ACE) crews to construct plant cages, and assist with planting efforts.

# 2017 Restoration Summary

- Planted a total of 4,032 plants (overall 5,040 plants)
- 6 species planted
- > 200 hours of effort from volunteers
- ~410 hours from UDWR, BLM, WC, USFWS
- Used 1.30 ACE crews
- Containerized plants have provided a seed base



# Outplantings Cost

## Costs:

- **Containerized plants**
  - \$3.50-4.50 per plant
- **Delivery:**
  - \$300.00 per truck; total cost \$2,100
- **Plantings:**
  - 24 plants/person/day w/ cages
  - Planning/logistics
- **Equipment**
  - Cage material
  - Gel packs
  - Shade cloth



# Plant Survival (%) in Red Cliffs

## Nov 2017 to May 2018



# Lessons Learned (so far...):



- Develop supplemental watering strategy early in project planning
- Suggest planting fewer plants in one season to reduce overall maintenance efforts
- Water all plants with material above ground/some “dead” looking plants may not be dead

# Restoration Monitoring



- What is the survival of containerized plants?
- Do cages provide protection and ultimately increase survival of plants?
- Do water gel crystals or shade cloth increase survival of plants?
- What is the impact of native plants on non-native plants?
- Are outplantings a cost-effective method to restore desert habitat?

# Future Restoration Efforts:



- We will continue to provide supplemental water to UDWR plants.
- UNLV will replace gel packs during the year.
- Modify restoration methods as necessary, to established cost effective long-term habitat restoration techniques for burned areas within desert tortoise habitat

# Collaborative Project



# Agency Partners

