National Park Service
Biological Resource Division

Riparian Weed Management and Restoration: Integrating Vegetation Management with Tamarisk Biocontrol

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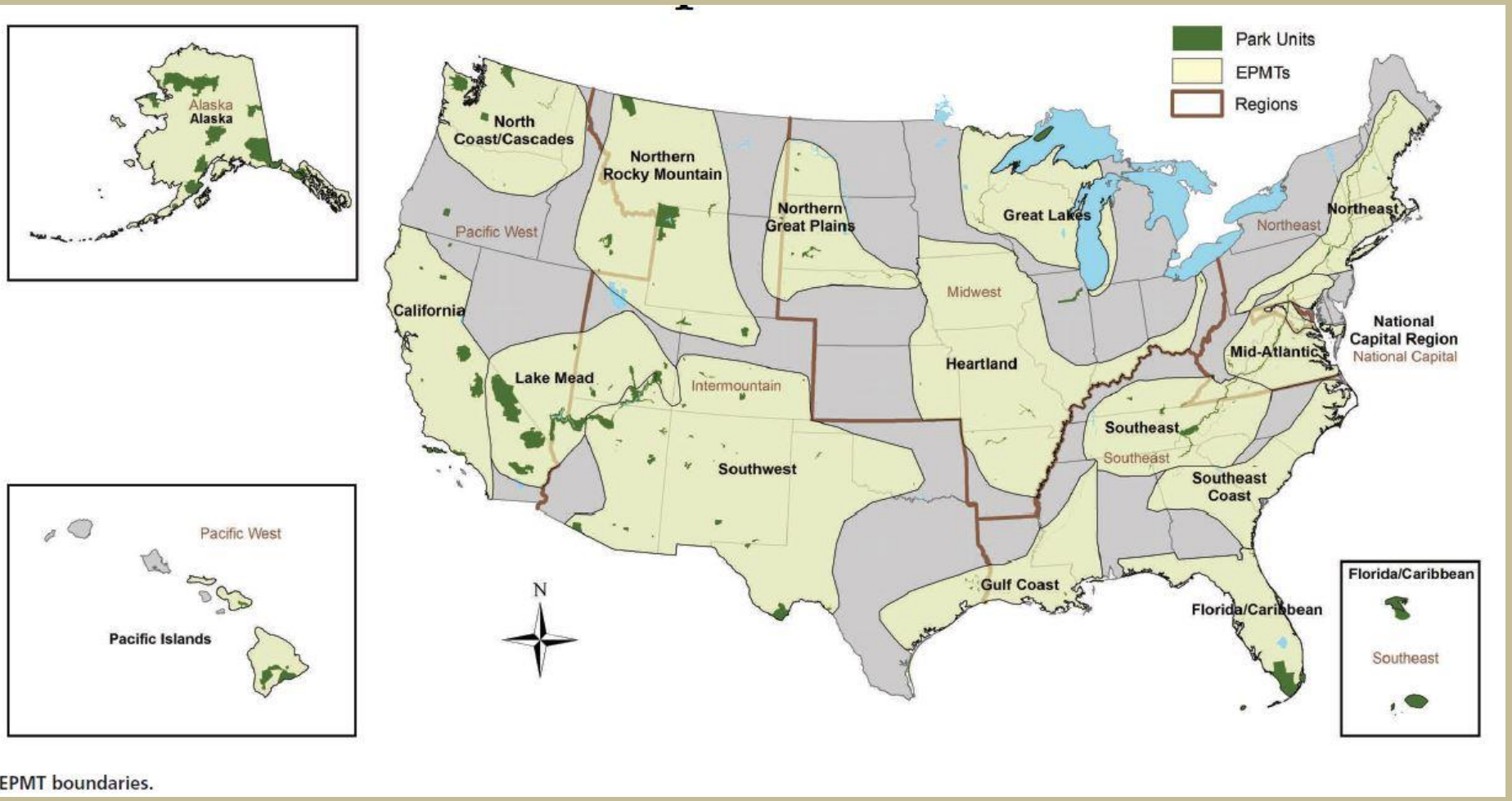
National Park Service

Riparian Restoration & Tamarisk Beetle Workshop
October 23, 2019
Palm Desert, CA

NPS Exotic Plant Management Teams



EPMT boundaries.

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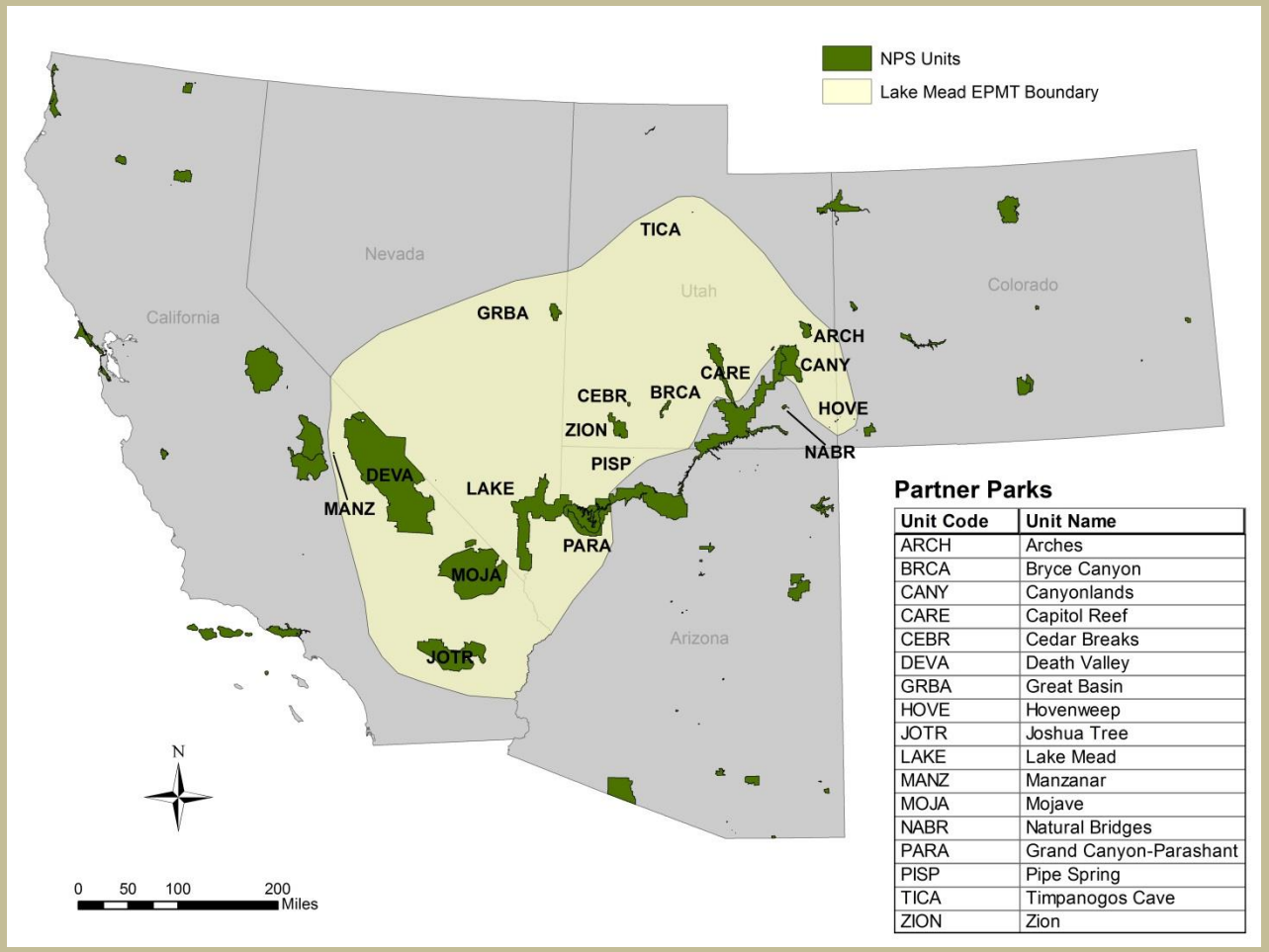
Lake Mead EPMT



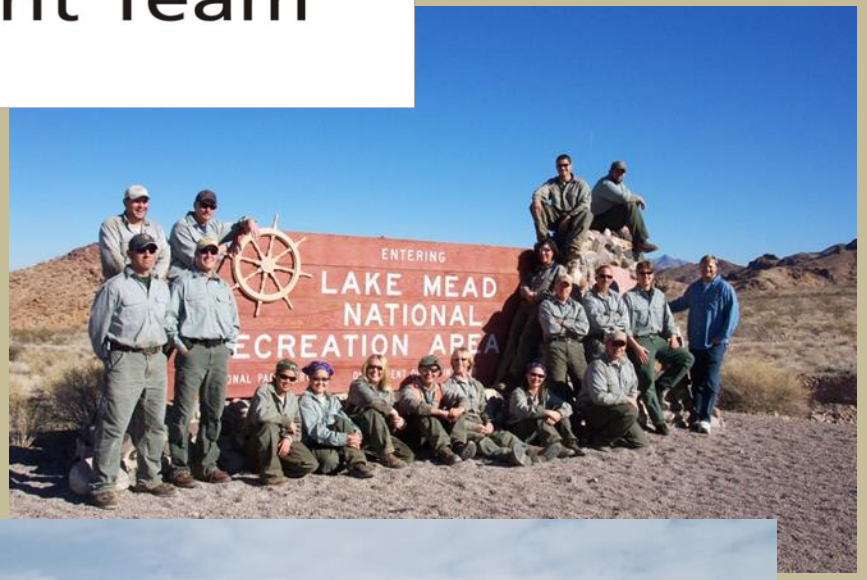
Partner Parks

Unit Code	Unit Name
ARCH	Arches
BRCA	Bryce Canyon
CANY	Canyonlands
CARE	Capitol Reef
CEBR	Cedar Breaks
DEVA	Death Valley
GRBA	Great Basin
HOVE	Hovenweep
JOTR	Joshua Tree
LAKE	Lake Mead
MANZ	Manzanar
MOJA	Mojave
NABR	Natural Bridges
PARA	Grand Canyon-Parashant
PISP	Pipe Spring
TICA	Timpanogos Cave
ZION	Zion

National Park Service

Lake Mead Exotic Plant Management Team

- Regional travelling crew
- Support Multiple NPS Units
- Interagency partnerships
- USFWS, BLM, BOR
- US Forest Service
- Southern NV Water Authority
- Clark County, NV



Pest Management Principles

- Prevention: keeping a pest from becoming a problem
- Suppression: reducing pest numbers or damage to an acceptable level
- Eradication: destroying an entire pest population

Integrated Pest Management

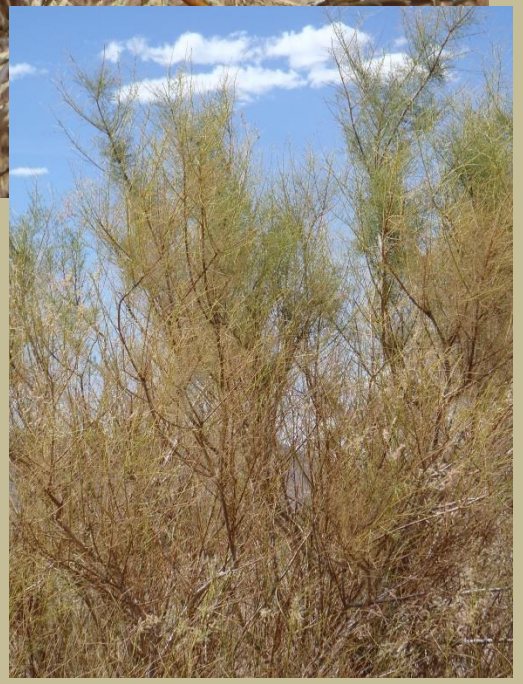
- Cultural
- Mechanical
- Chemical
- Biological

- Do not rely on one method or option

Tamarisk Leaf Beetle

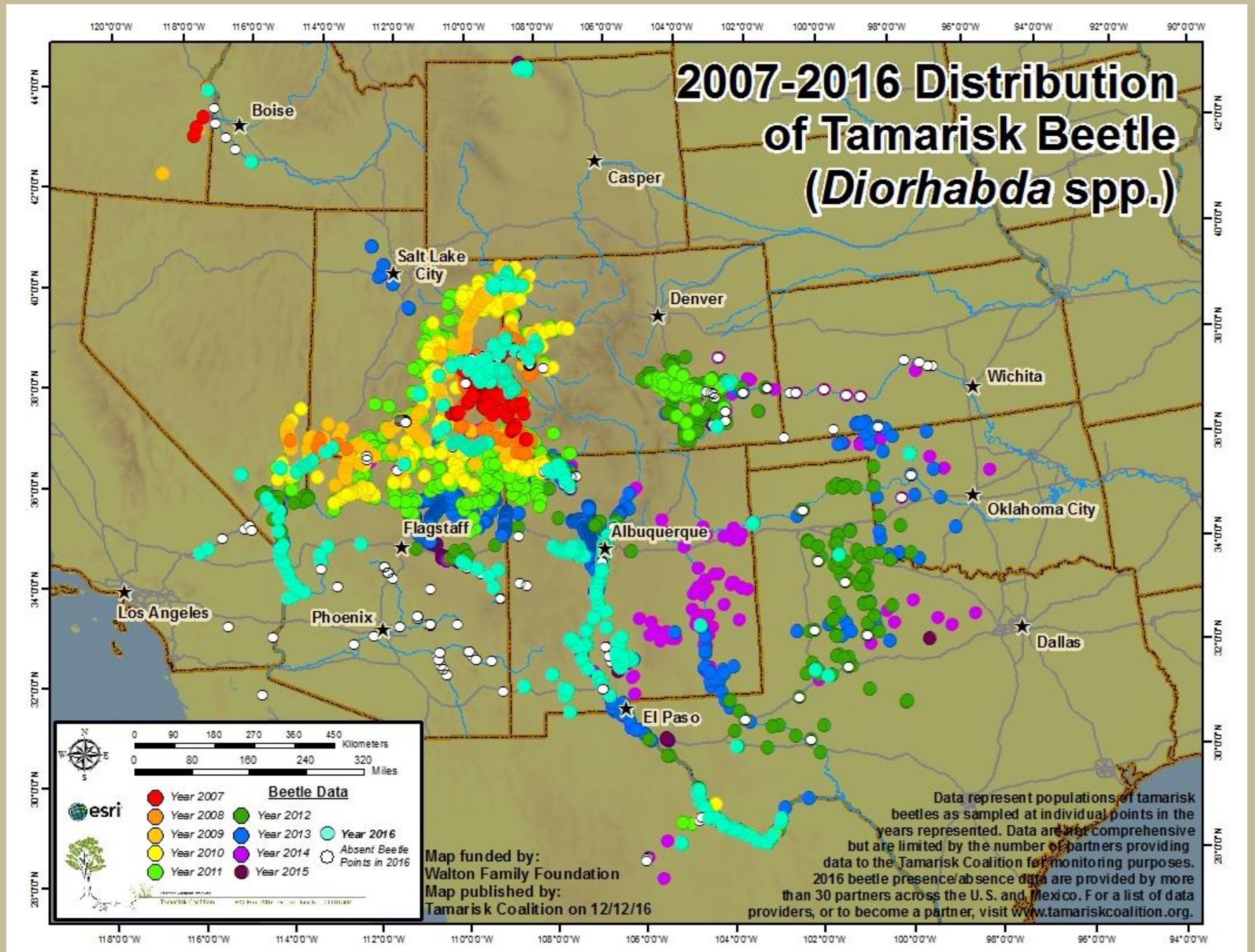
Diorhabda spp

Tamarisk leaf Beetle life stages: Adult, 3 stages of larvae, egg masses



Browning/Defoliation

Lake Mohave August 2013 Defoliation

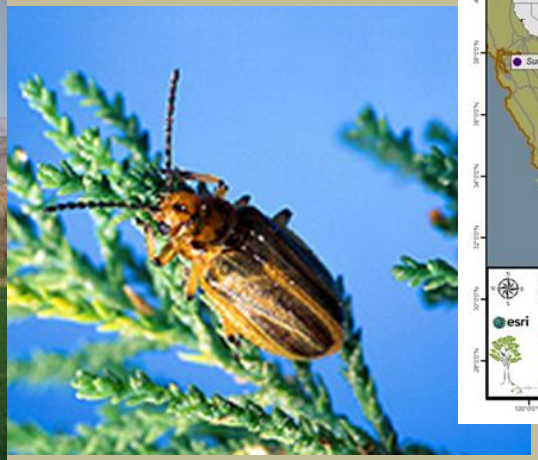

2007-2016 Distribution of Tamarisk Beetle (*Diorhabda* spp.)
Boise
Casper
Salt Lake City
Denver
Wichita
Oklahoma City
Flagstaff
Albuquerque
Los Angeles
Phoenix
Dallas
El Paso
0 90 180 270 360 450 Kilometers
0 80 160 240 320 Miles
Beetle Data
Year 2007
Year 2008
Year 2009
Year 2010
Year 2011
Year 2012
Year 2013
Year 2014
Year 2015
Year 2016
Absent Beetle Points in 2016
esri
Map funded by:
Walton Family Foundation
Map published by:
Tamarisk Coalition on 12/12/16
Data represent populations of tamarisk beetles as sampled at individual points in the years represented. Data are not comprehensive but are limited by the number of partners providing data to the Tamarisk Coalition for monitoring purposes. 2016 beetle presence/absence data are provided by more than 30 partners across the U.S. and Mexico. For a list of data providers, or to become a partner, visit www.tamariskcoalition.org.

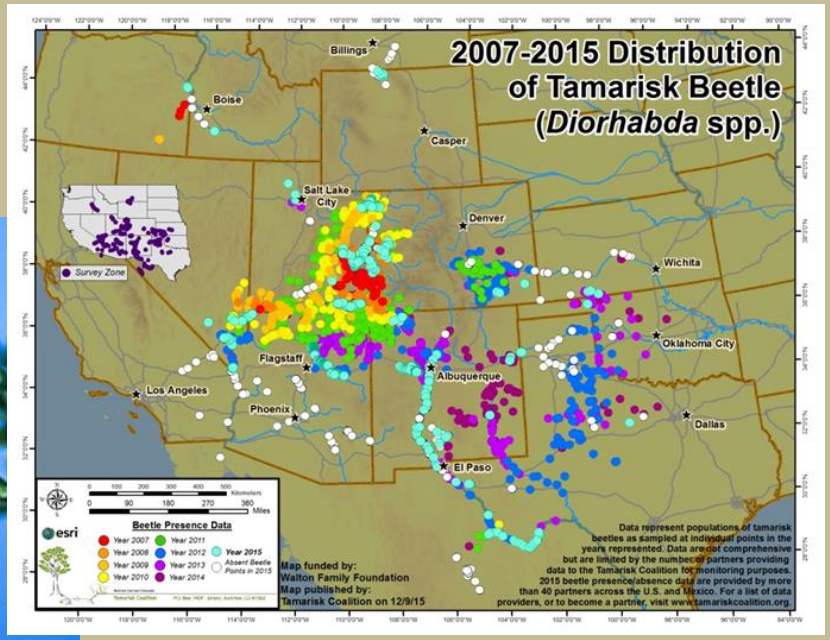
Overview of the Beetle and History

- Dr. C. Jack DeLoach, Research Entomologist, USDA, Agricultural Research Service, Temple, TX. and James L. Tracy and Juli Gould.
- Probably the most scrutinized and controversial bio-control release to date.
- USDA APHIS 2010 Memo
  - Termination of tamarisk beetle program at the federal level

Tamarisk Beetle Future: A lot of Unknowns

- Active science experiment
- Equilibrium? When and what is that
- Tamarisk response
- What level of Suppression





Advantages/Benefits of the Beetle

- Large Scale: Landscape/Watersheds
- No terrain limitations
- Ignores boundaries
- Ignores funding cycles
- Long term (beyond careers and initiatives)
- Self sustaining
- Selective
- Low impact/non ground disturbing
- Defoliation reduces crown fire potential
- Subtle phased mortality/control results, allowing time for native plant response
- Much cheaper more cost effective after initial up front investment

Difference/Disadvantages between Bio Control and other IPM

- No control of location (sensitive sites)
- No control of timing (i.e. bird nesting season)
- May not meet objectives on a local site basis
  - No eradication
  - Suppression only
- Aesthetics (brown out)
- Unknown response (short term and long term)

Unexpected results of Tamarisk Beetles

- Stimulated more active management of tamarisk that previously existed at a lower level
- Bio-mass removal
- Fire management concerns (fuel breaks)
- Increased awareness/education

Summary of Pre and Post Management Options

- No action
- Monitor and Document
- Determine passive or active restoration
- Switch weed species focus
- Survey and control other weeds on site
- Implement tamarisk control at a site level
- Restoration site selection (soils,hydrology,etc)
- Prepare for revegetation/native propagule collection and nursery grow out
- Bio-mass management

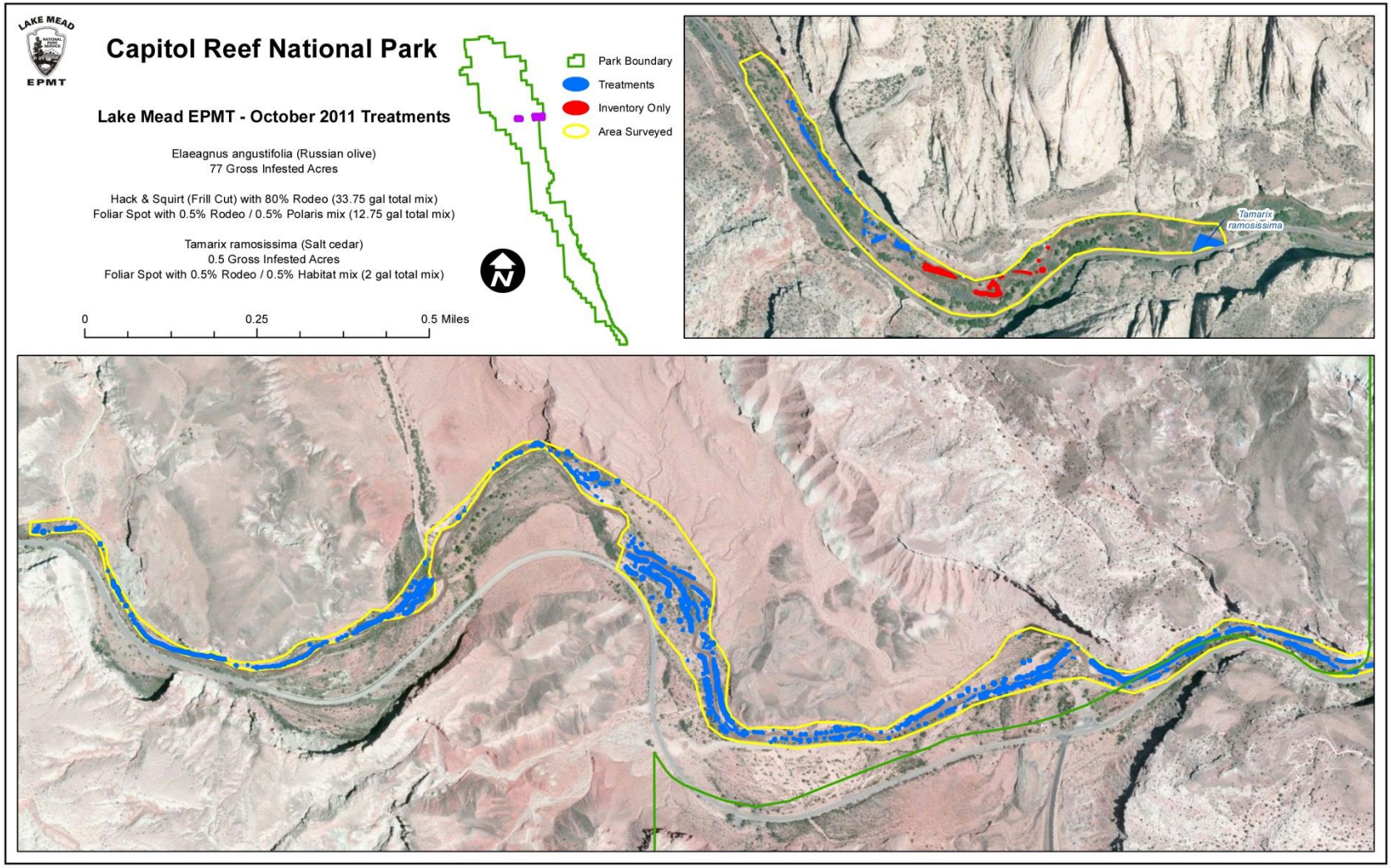
Secondary Weed Release

- Anticipate (expect) weeds that are present at lower density or cover levels to expand
- Tamarisk has outcompeted other weeds as well as desirable natives
- Re-focus active control on these “secondary” species to avoid replacing one weed for another weed

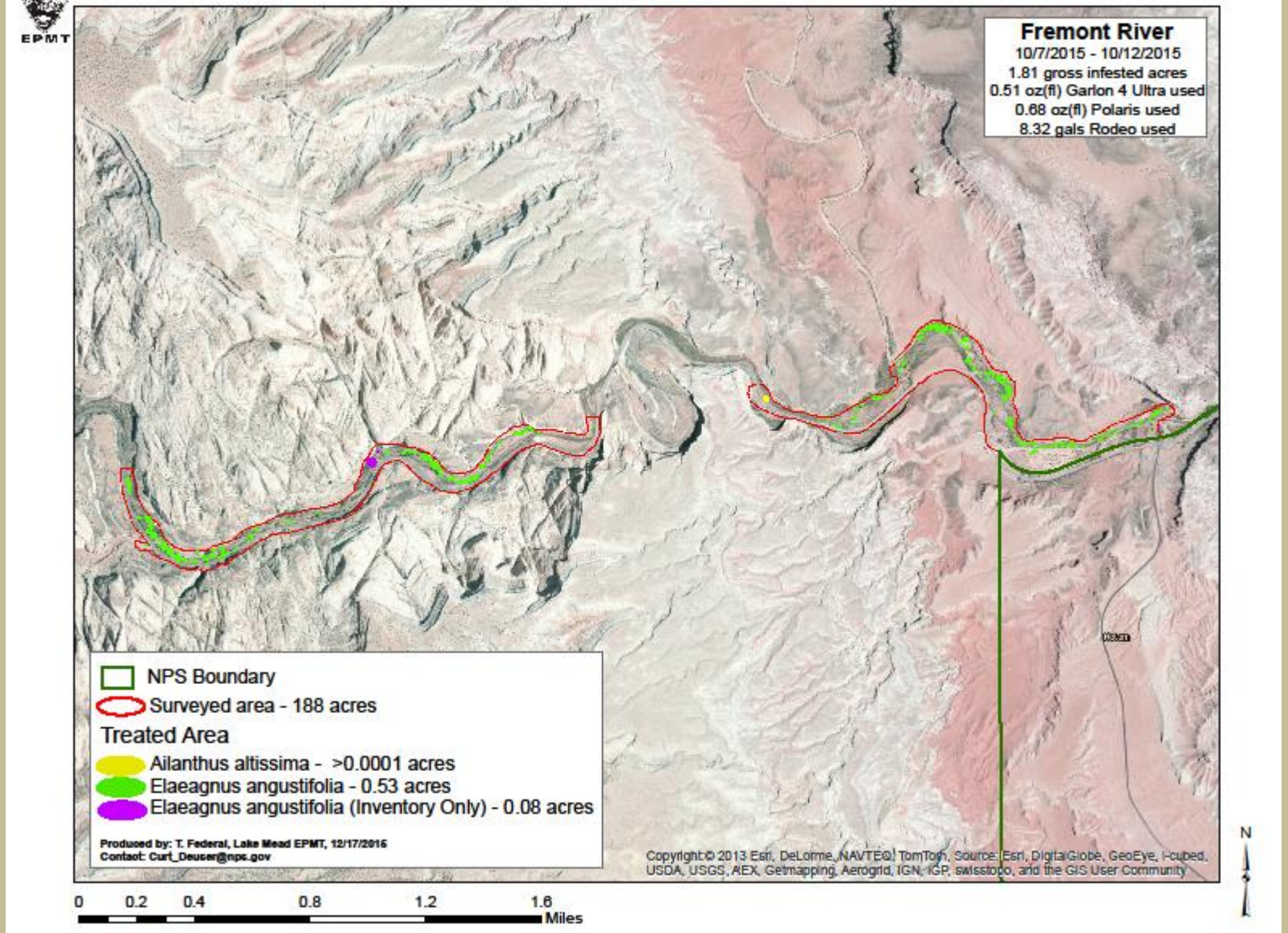
Other Common Riparian Weed Species of Concern

- Russian Olive
- Russian Knapweed
- Perennial Pepperweed
- Camelthorn
- Arundo
- Fountain Grass
- Ravenna Grass
- Athel tamarix
- Tree tobacco
- Siberian Elm
- Ailanthus
- Palm Trees

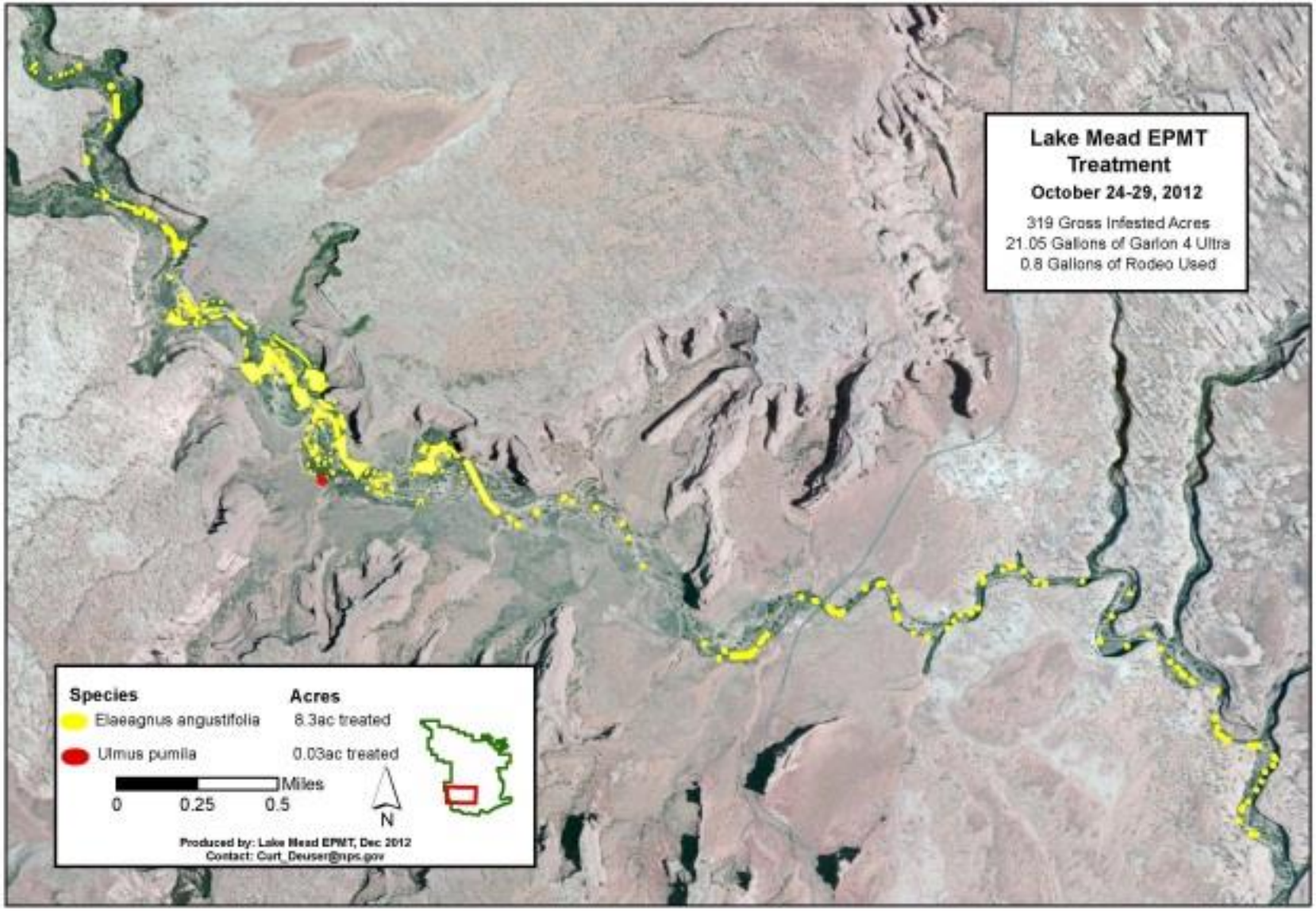
Weed Mapping: Fremont River, UT



FY16 CARE EPMT Treatments

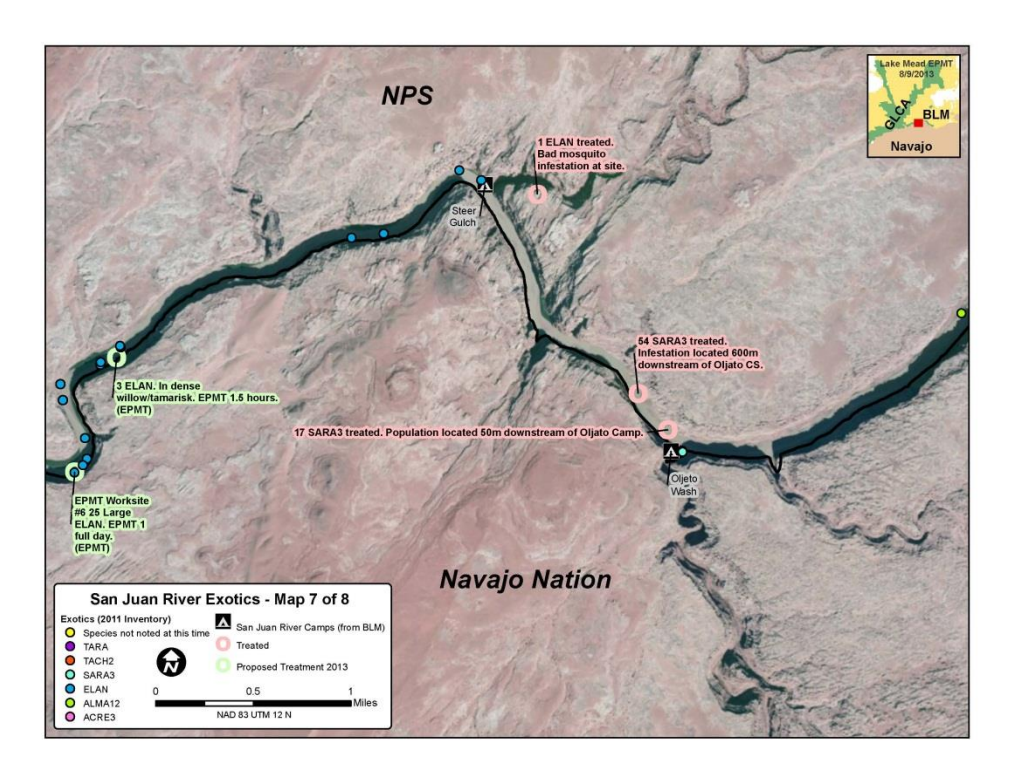


Arches National Park
Courthouse Wash



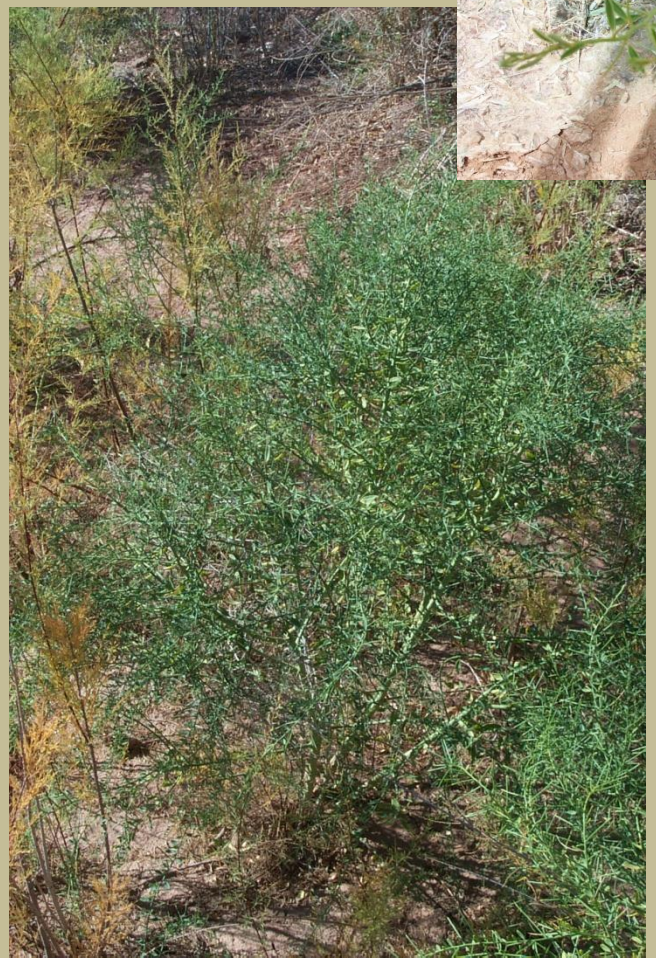
San Juan River Weed Control

- Mexican Hat, UT down
- Ravenna Grass
- Russian Olive
- Russian Knapweed
- Camelthorn
- NPS, BLM and Navajo Nation



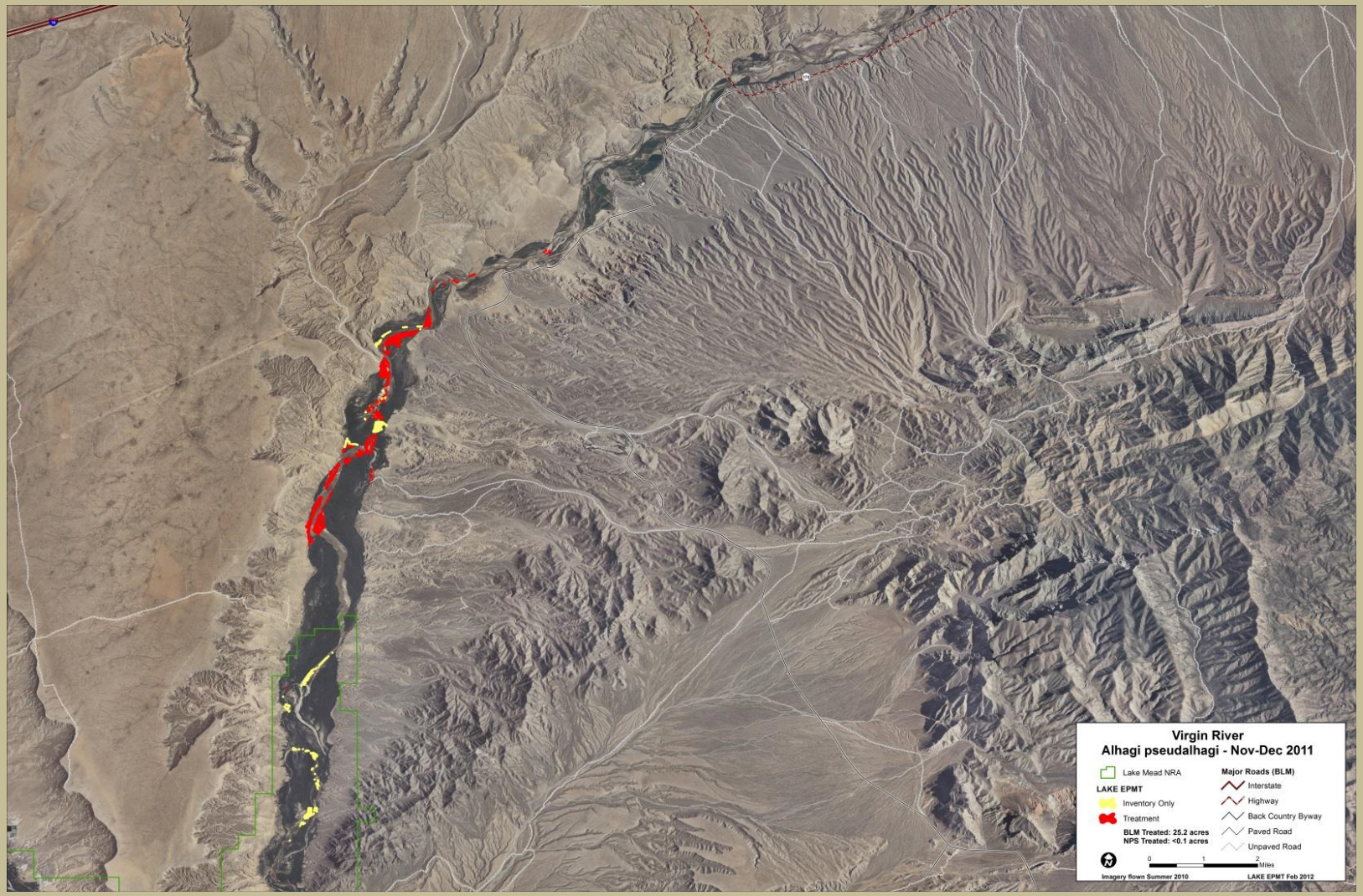
Camelthorn: *Alhagi pseudalhagi or maurorum*

- Legume
- Primarily spreads vegetatively
- Deep Rhizomes, underground shoots
- Floods
- Little Colorado River
- Lower Virgin River



Camelthorn at Grand Wash Lake Mead

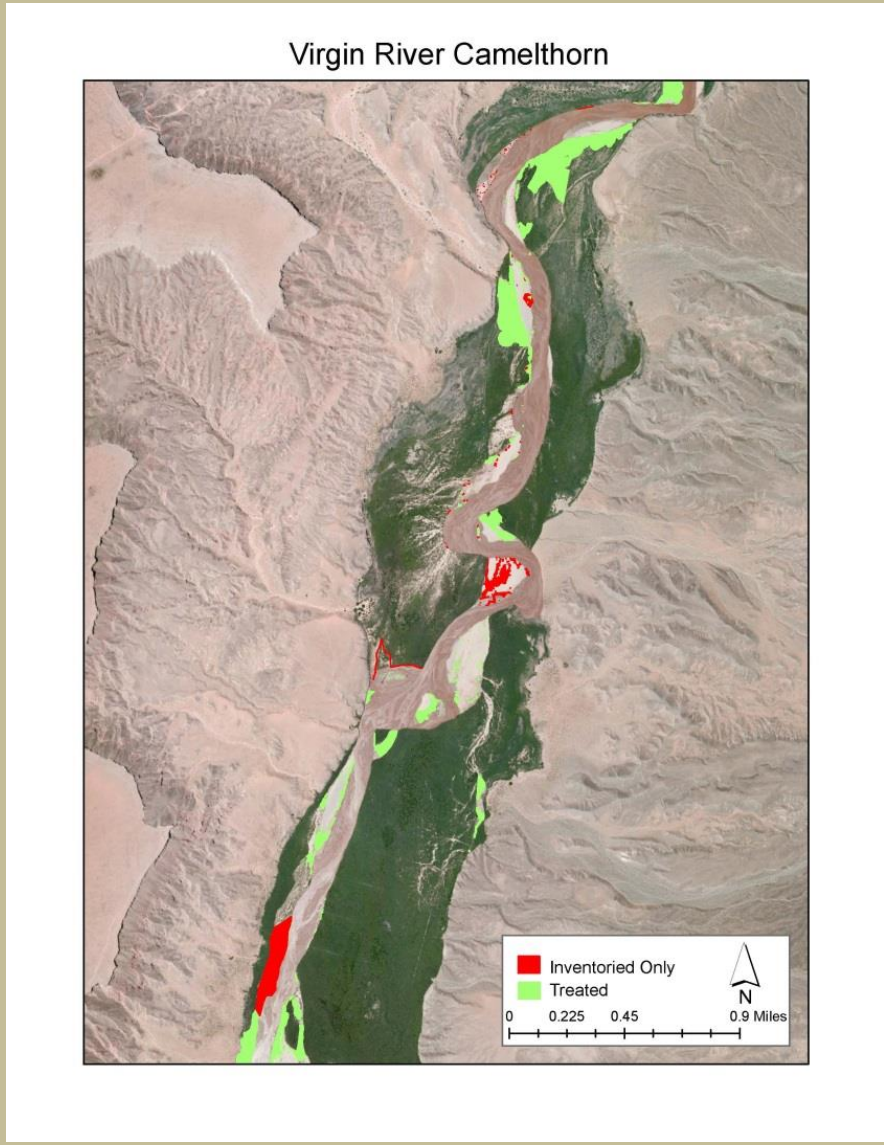
Lower Virgin River, NV



Camelthorn Treatments on the Lower Virgin River

Selective Camelthorn Treatments to allow for Desirable Plant Recruitment

Mapping Survey and Treatment



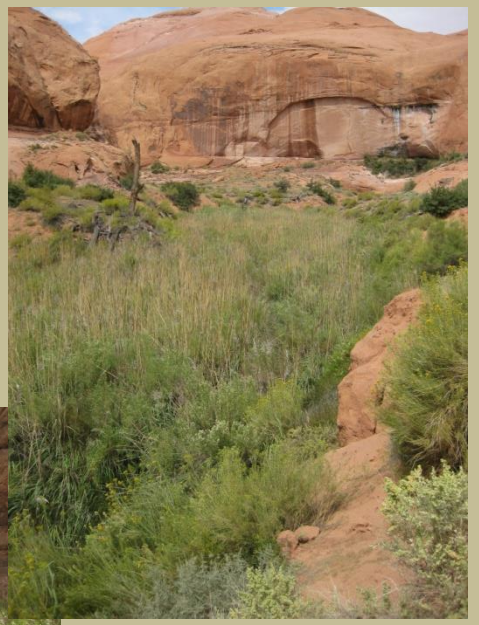
Russian Knapweed: *Acroptilon repens*

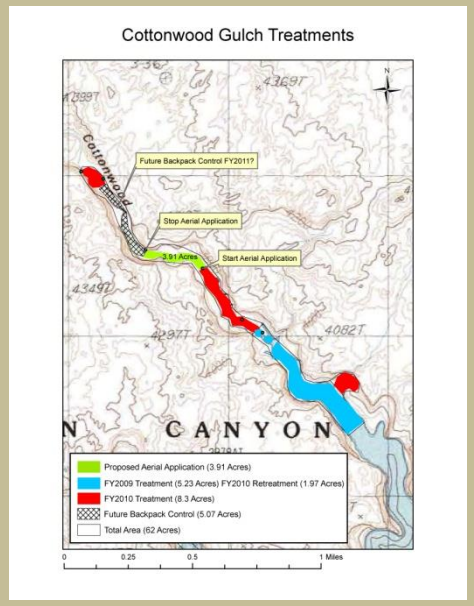
- Primarily spreads vegetatively
- Rhizomes
- Persistent

Ravenna Grass: *Saccharum ravennae*

- Perennial bunchgrass
- Not widespread
- Isolated patches
- Lake Powell, Lees Ferry, Upper Grand Canyon
- Moapa NWR, NV
- Littlefield/I-15, AZ
- EDRR

Glen Canyon Ravenna Grass





Perennial Pepperweed: *Lepidium latifolium*

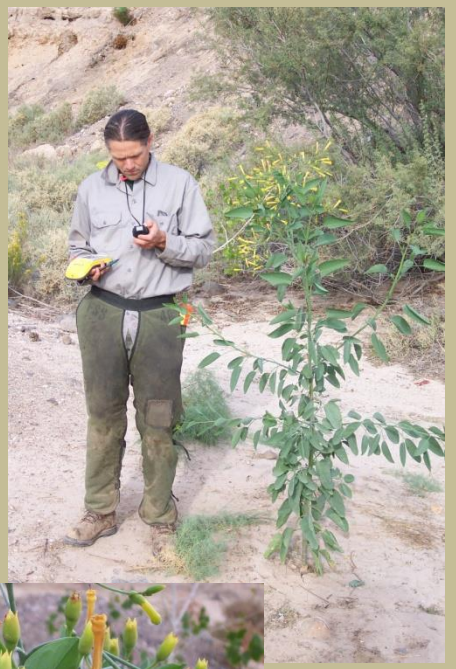
- Tall Whitetop
- Primarily spreads vegetatively
- Rhizomes
- Persistent
- Truckee
- Upper Colorado
- Las Vegas Wash

Athel: *Tamarix aphylla*

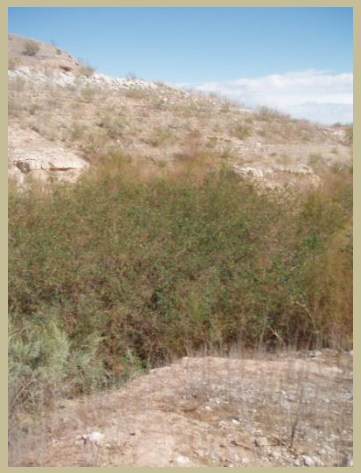
- Large evergreen tree
- Ornamental
- Starting to spread from seed
- Lake Mead (1984)
- Havasu NWR, AZ Sacramento Wash
- Hybridizing w/ salt cedar
- Important EDRR

Tree Tobacco: *Nicotiana glauca*

- Small tree, clonal suckers
- Isolated small patches
- Las Vegas Wash, Lake Mead, Havasu NWR Sacramento Wash
- Southern latitude
- Santa Cruz River
- LCR

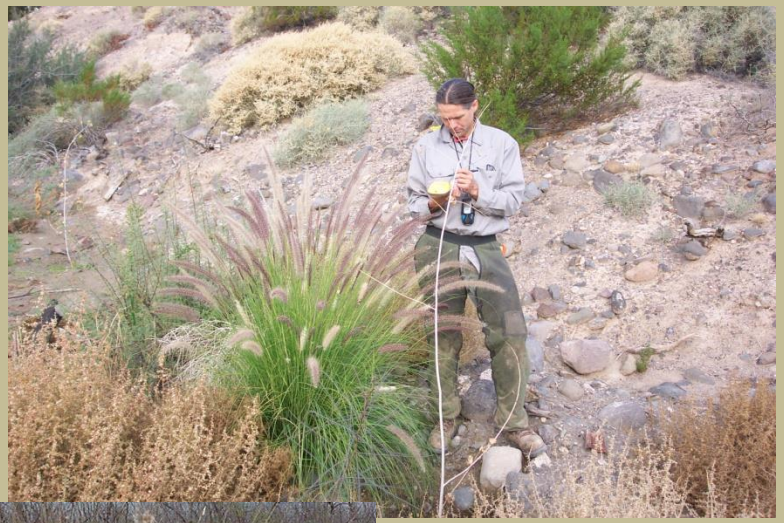


Tree Tobacco



Fountain Grass: *Pennisetum setaceum*

- Perennial bunch grass
- Ornamental
- Wind dispersed seed spreads similar to tamarisk
- Laughlin, NV, Lake Mohave, Bill Williams NWR, Big Bend, NV
- NV Noxious Weed



Giant Reed: *Arundo donax*

- Perennial grass
- *Phragmites* on steroids
- Large rhizomes
- Patches that converge
- Monotypic
- LCR, Virgin River, LV Wash
- S Cal Coastal Rivers, Rio Grande

Russian Olive: *Elaeagnus angustifolia*

- Tributaries of the Colorado Plateau
- Expanding on the main stem
- Seeds : round small marbles
- Slower spread
- Upper River, Colorado Plateau
- Upper Virgin River

Post Beetle Tamarisk Bio-mass Management Options

- Leave to degrade on site
  - Natural decomposition
  - Vertical mulch/micro-climate
  - reduce erosion winds and rain
  - no ground disturbance
  - Bird perch sites/snags
- Prescribed Burn/Broadcast (monotypic)
  - Salt laden litter and duff removal
- Other options include cutting and slash creation

Reasons for Removal

- Aesthetics
- Fuels mgt
- Clear Space for restoration or recreation

Control Methods

- Cut Stump
- Low Volume Basal Spray
- Foliar
- Heavy Equipment
- Biological Control (Tamarisk Leaf Beetle)

- Frill Cut/Hack and Squirt (Russian Olive)

- Target mortality 75-100%, results vary

Cut Stump

Cut Stump Method

Cut Stump

Stump Spraying

Stump Spraying

Cut Stump Herbicide Options

- Russian Olive: 75%-100% Glyphosate (Round-Up/Rodeo, others)
- Tamarisk: 20%-33% Ester Triclopyr (Garlon 4, others) mixed with basal oil (JLB Improved Oil Plus, others) beware of volatility
- Both: 8-12 ounces of Imazapyr/gallon of water (Habitat, Polaris, others)

Slash Mitigation

- Lop and scatter
- Pile (degrade or burn)
- Haul/Disposal
- Fire wood
- Chip/Mulch

Pile on site

Haul off site/Firewood

Trailer

Chipper/Mulch

Mechanical/Heavy Equipment

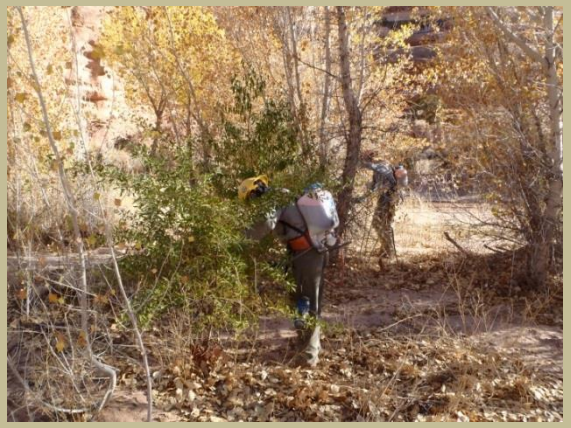
- Tree extraction, uproot plants with excavator/clam shell bucket
- Hydro-ax, grinder
- Bulldozer
- Access limitations
- Ground disturbance

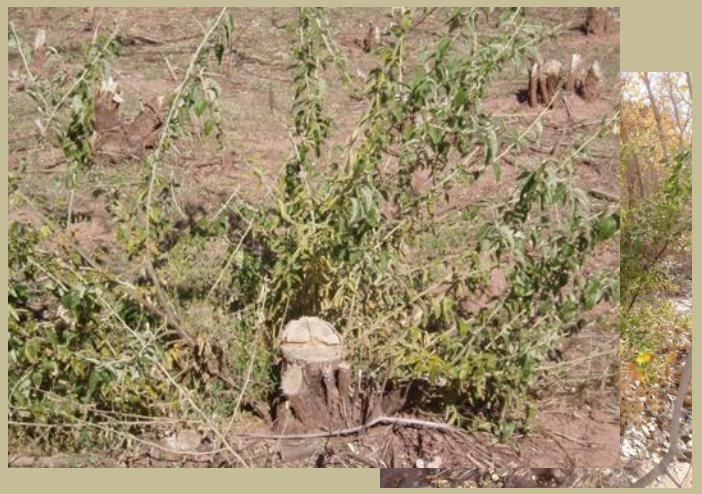
Hydro Ax/Grinder

Equipment Types

Skid Steer Grapple

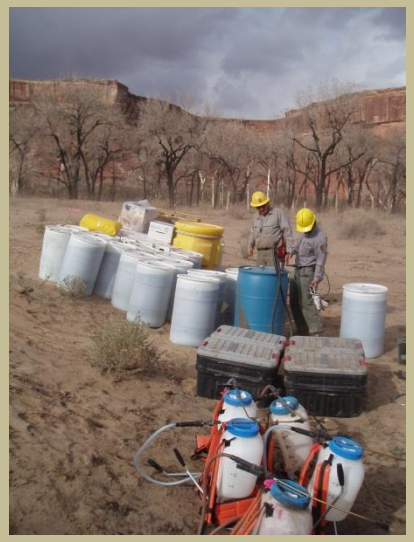
Low Volume Basal Spray





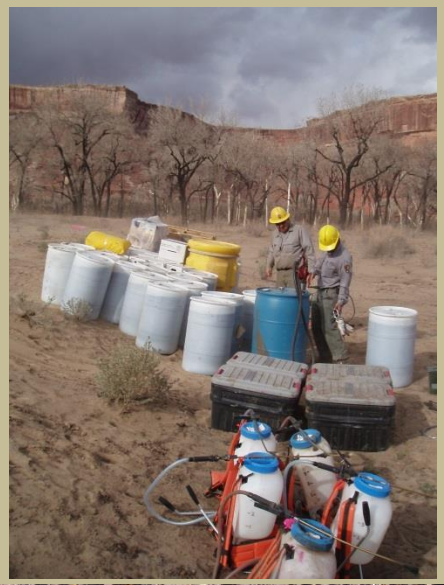
Low Volume Basal Spray

Post Fire Treatments



Low Volume Basal Spray 20%Ester Triclopyr w/80% basal oil

Low Volume Basal Spray



Burned Area Rehab Post Fire Treatments

Low Volume Basal Spray

- Re-sprouts
- Smaller diameter trees (<6inches, smooth bark)
- 20-33% Ester Triclopyr add remaining amount of basal oil
- Spray base of stems 6-18 inches in height
- No cutting or hacking
- Penetrates through bark into cambium
- Beware of volatility (avoid summer heat)

Foliar Treatment

- Glyphosate
- Imazapyr
- Triclopyr
- Others
- Low concentration formulas/refer to label
- Top of tree and at least two sides (>70% tree canopy coverage)
- Need more water than other methods
- Drift
- Efficient with good access (UTV/Truck tank sprayer)
- Backpack to Aerial (Helicopter)
- High density seedlings
- Dense cover of small trees

Foliar Treatments

Tree Gun Nozzle Sprayer

Logistics/Access

Site Recovery/Restoration

- Passive
- Active
- Site Potential
  - Soil/moisture
  - Hydrology
  - Post treatment WX Precip/Floods
- Grazers/beavers

Site Selection

- Amount of native plants/ percent cover, pre-existing on site
- Disturbance history & current regime
  - Flood frequency, stream cross cut elevation
  - Low or high terrace
  - Wildfire potential
- Hydrology
  - Depth to ground water
  - Depth to moist soil/capillary rise
  - Soil type/texture/chemistry

Go with what the site is capable of…. Under current conditions

- Remnant species can help/ historical info
- Many high terrace sites (drier and saltier) may convert to quail bush, halophytic communities mesquite, grasslands or even uplands

Site Recovery

- Some places may need help to recover (tamarisk dominated sites)
- Mixed native sites readily recover naturally
- Recovery can be challenging
  - High salinity
  - Lack of precip or flooding (post treatment)
  - Previously disturbed/site history, seed bank
- Be patient, many sites took years to become degraded, so expect years to recover

Long Term Beetle Suppressed Area Recommendations

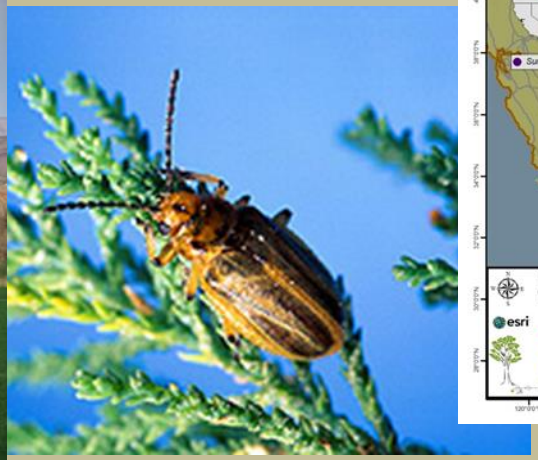
- If you plan to bulldoze the site do it now, don't wait for beetles to kill the trees
- Allow for a subtle transition to a desirable vegetation community
- Let trees degrade on site
- Dead trees: beneficial value, wind and rain drop interception, bird perch sites, eventual soil nutrient recycling
- Vertical mulch, micro-climate site benefits (shade and moisture retention)

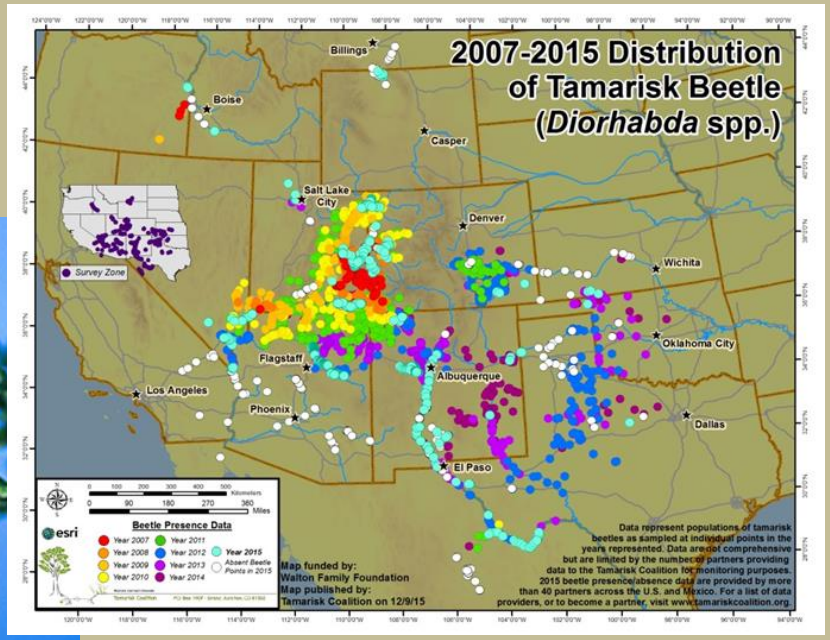
Active Tamarisk Control

- Still important
- Encroaching areas
- Less dense areas
- Early detection scenarios
- Do not over rely on the beetle to accomplish your objectives
- Successful

Tamarisk Beetle Future: A lot of Unknowns

- Active science experiment
- Equilibrium? When and what is that
- Tamarisk response
- What level of Suppression





Acknowledgements

- Tarl Norman, Supervisory Exotic Plant Specialist, NPS Lake Mead EPMT
- Rachel Skoza, Data Manager, NPS Lake Mead EPMT
- Numerous Lake Mead EPMT crew members

- Low Impact, Selective Herbicide Application for Control of Saltcedar and Russian Olive. Doug Parker and Max Williamson; USDA USFS Field Guide, 1996.
- Deep Planting Long-Stem Nursery Stock: An Innovative Method to Restore Riparian Vegetation in the Arid Southwest. Dreesen and Fenchel; Rangelands 36(2):52-56
- P.L. Nagler ET AL; Distribution and Abundance of Saltcedar and Russian Olive in the Western US; USGS, 2011

Thank You

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Deep hole planting

Plant Exclosures

Dead Defoliated Tamarisk

- Transplant or seed in the dead clumped areas
- Rake salt laden duff layer if seeding
- Mortality and subsequent revegetation sites may not be uniform so we could create a mosaic of propagule islands and suppress other weed invasion during the transition phase
- Ruderal weeds may be less of problem in beetle suppressed areas, slow and non-ground disturbing

Restoration Active vs Passive

- Transplanting
  - Rooted
  - Cuttings
  - Deep hole container planting
- Seeding
- Supplemental Irrigation
  - Avoid sprinklers
- Selective Targeted watering

Passive Restoration

- Monitor priority weeds during early years while the site is vulnerable/critical during the first 2-3 years post disturbance
- Survey, treat and monitor weeds in adjacent areas to create a buffer around your restoration in process areas
- Survey after nearby disturbance events (floods, fires, adjacent disturbances, etc.)

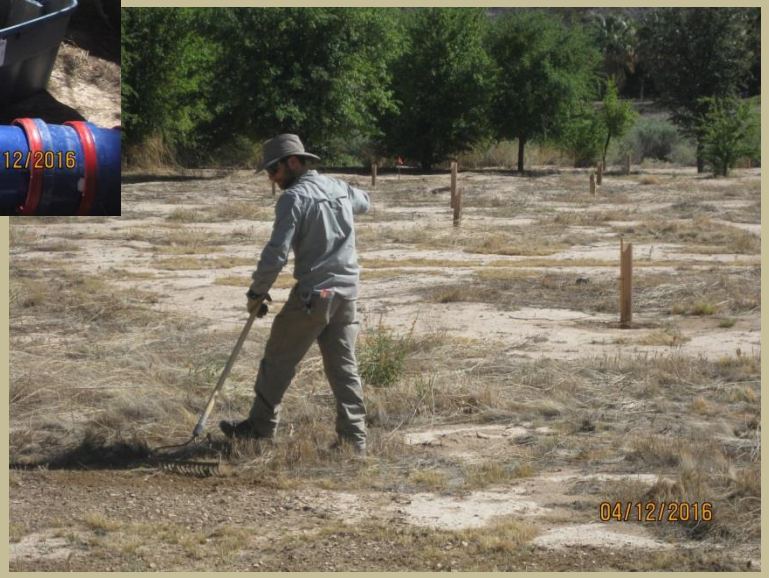
Active Revegetation

- Get control of weeds first then revegetate
- After revegetation occurs make sure to increase survey of weeds to detect early to reduce potential weed control impacts
- Selectively treat weeds/spot treatment or handpull adjacent to transplants
- Use plant exclosures/shelters

Create native propagule “Islands”

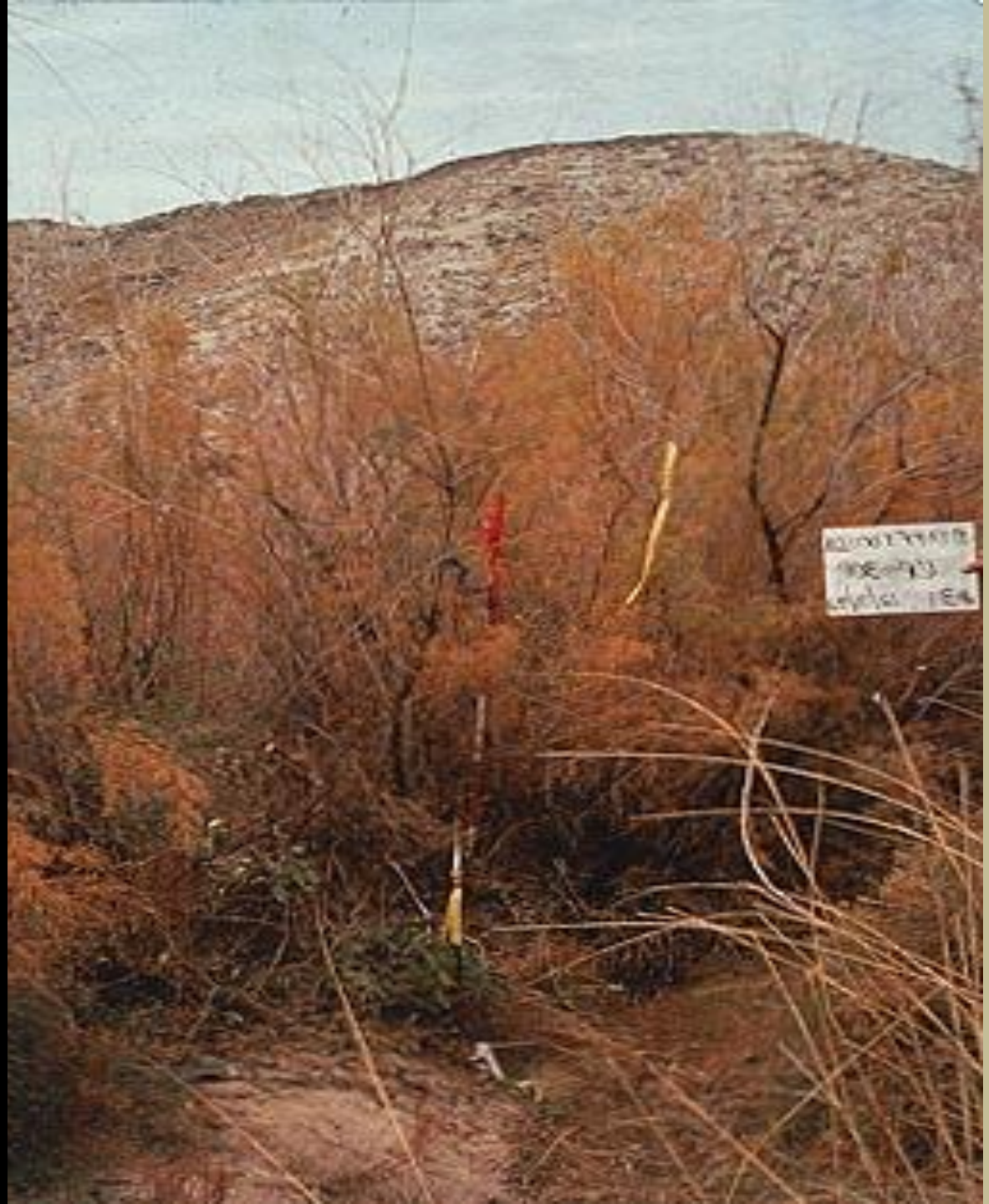
- Restorable areas
- Small % of total area
- More cost effective/prohibited
- Hydrology
- Soils
- Sustainable

Seeding and Raking



Watering

Irrigation Plumbing

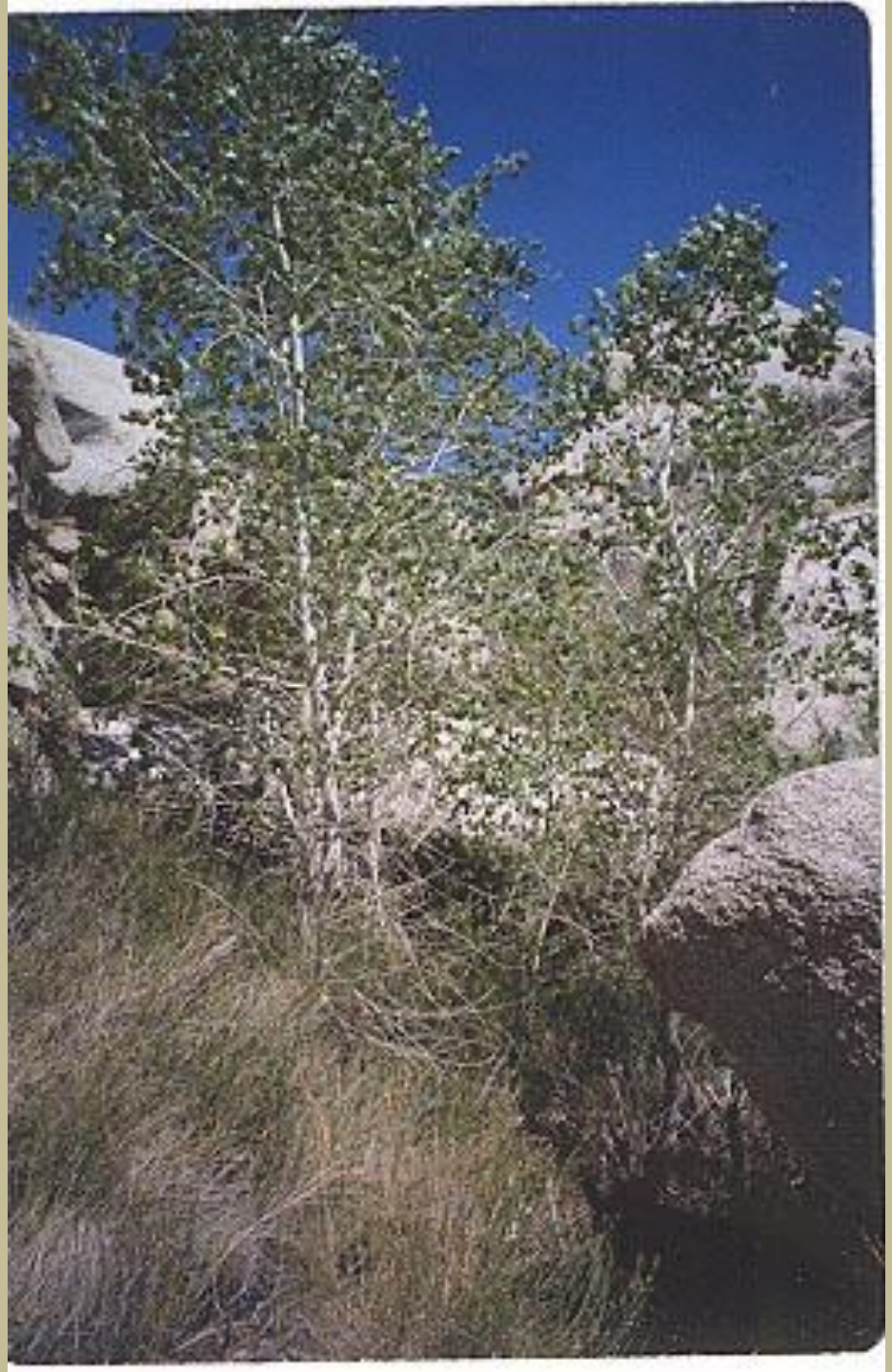


Site Before Treatment

One-Year Post Treatment

Four Year Post Treatment

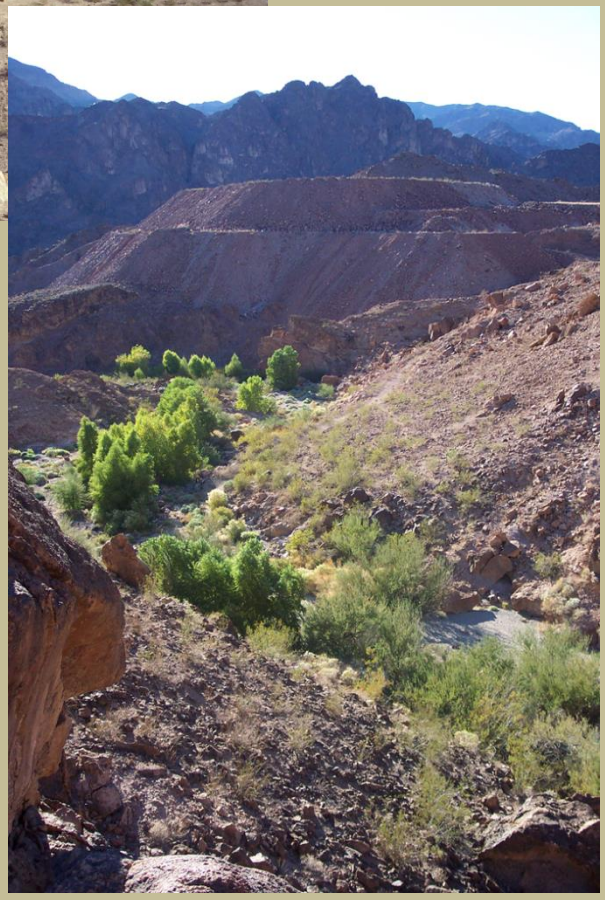

Cottonwood Regeneration
Second Year Post Treatment
Tamarisk stumps



Five Years

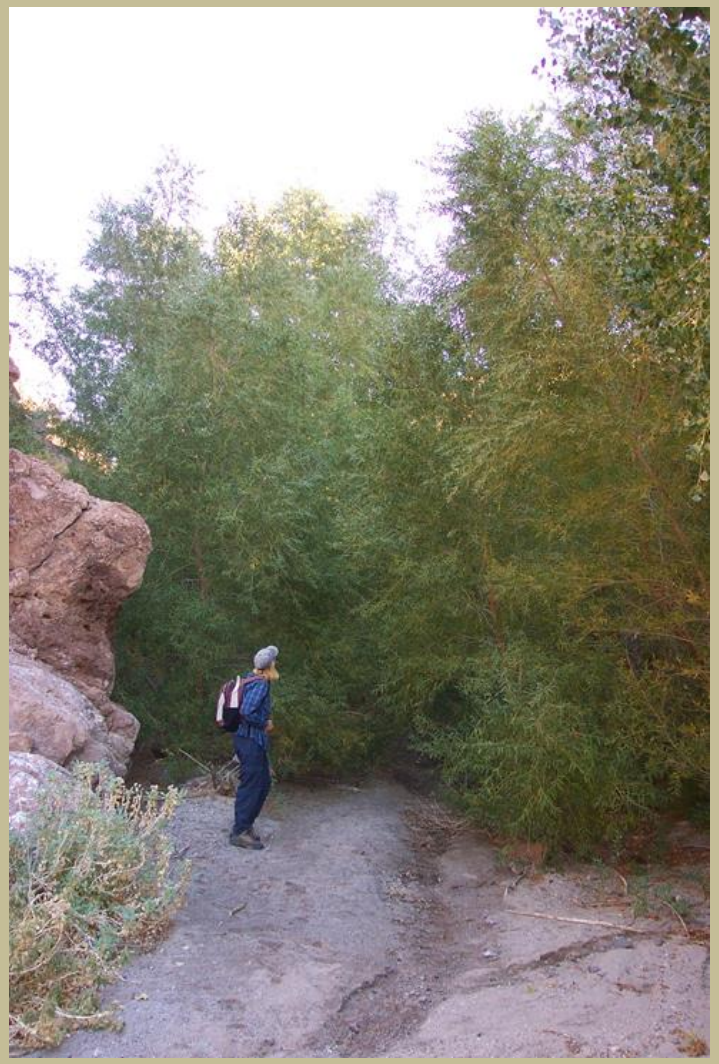
Post Treatment

Sugarloaf Spring, AZ Restoration



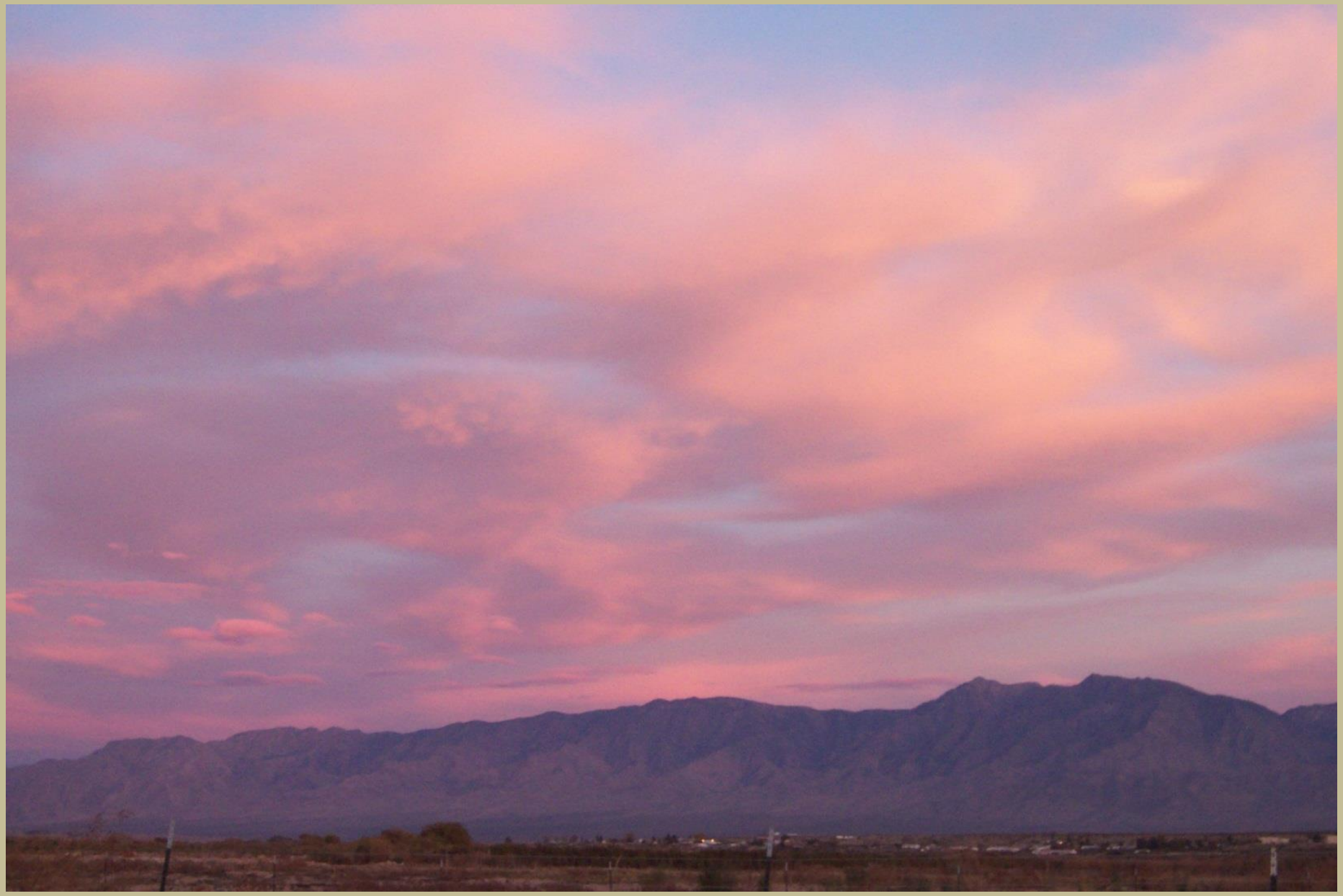
How Does Recovery Occur?

- Eliminate the direct competition
- **Soil moisture increases**
  - from removal of tamarisk
  - allows for native plant regeneration/recruitment
  - provides for active revegetation, seeding, transplanting, pole planting
- Tamarisk and other weed control, monitoring and maintenance is important for first 2-3 years



How long does it take and what plants come in?

- Depends on seed source plants available on site/Seed bank
- Dependent on precipitation, floods, timing
- Recommend active revegetation if trying to create a specific desirable habitat
  - act within the first 1-2 growing seasons following removal
- Russian thistle, kochia and bassia can be problematic



Virgin River