Sahara Mustard (*Brassica tournefortii*) Working Group

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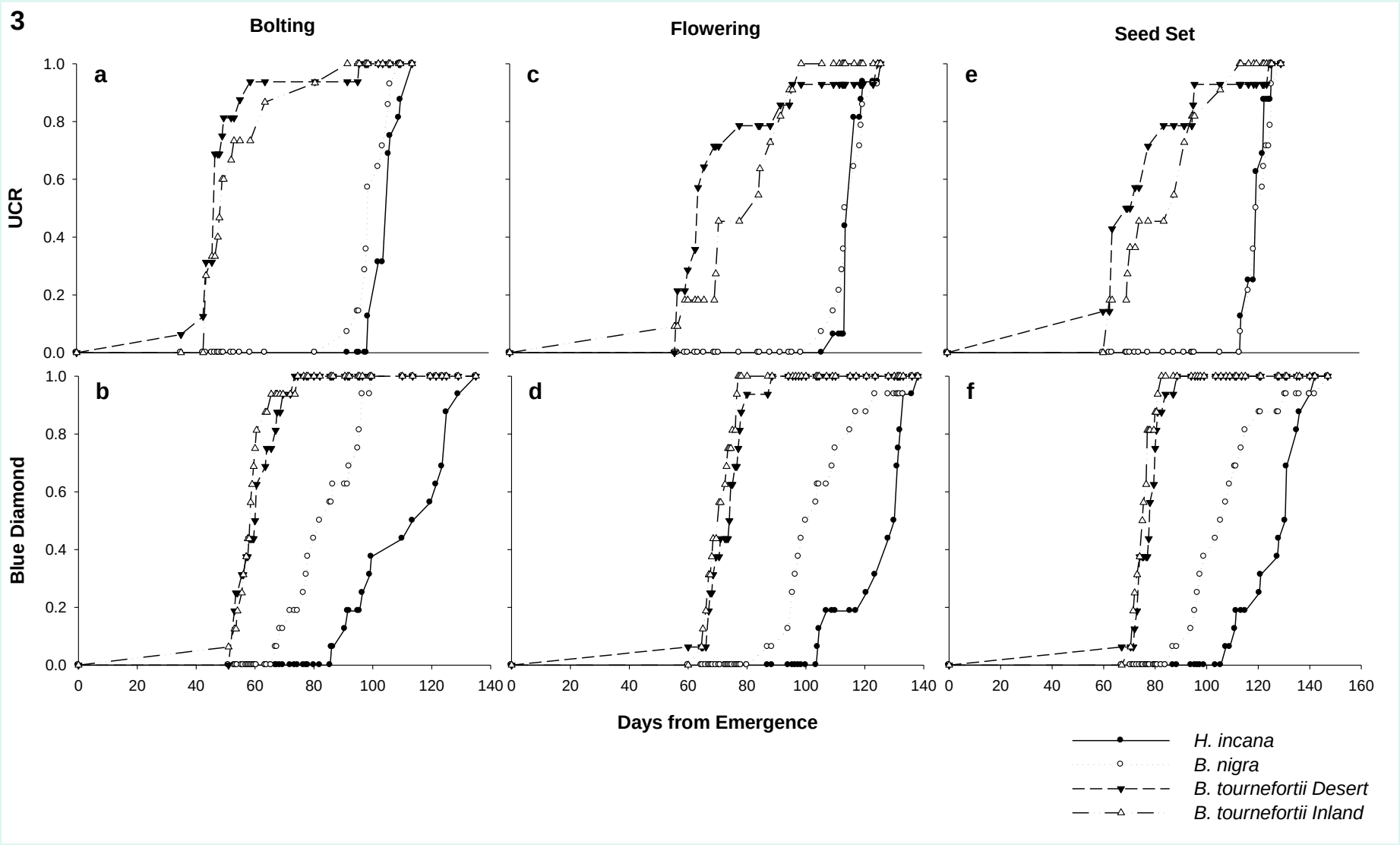
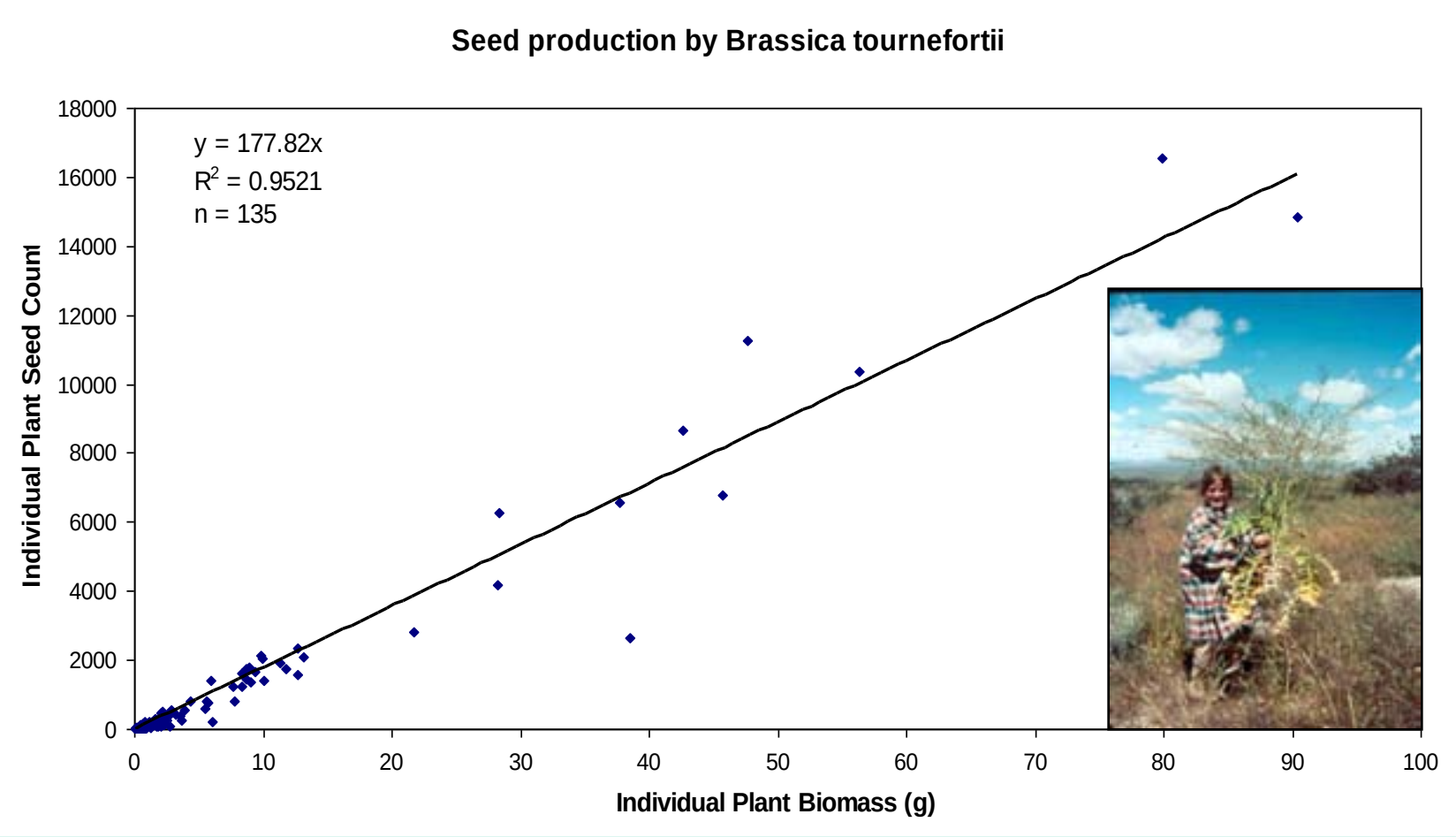
Lake Mead National Recreation Area
Exotic Plant Management Team

Sahara mustard has and earlier phenology than black mustard and Mediterranean mustard



Robin Marushia et al. in prep

high seed production can complicate control efforts



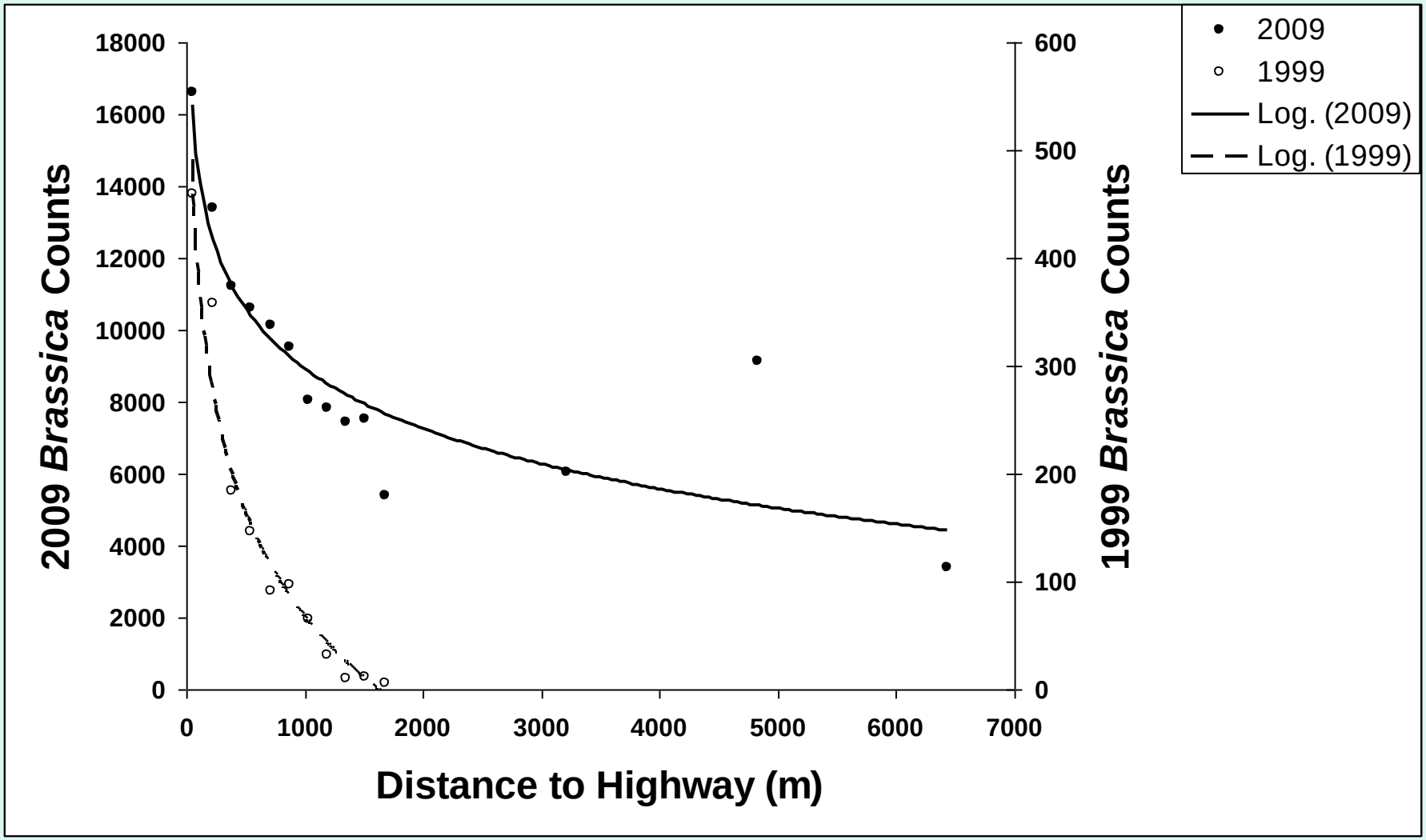
Trader et al 2006

Sandy soils or disturbances caused by fire, OHVs, or roadsides can can promote Sahara mustard

Postfire Landscapes

OHV Open Areas

Spread of Sahara mustard away from a paved highway in the Chemehuevi Valley, Spring 1999 and 2009

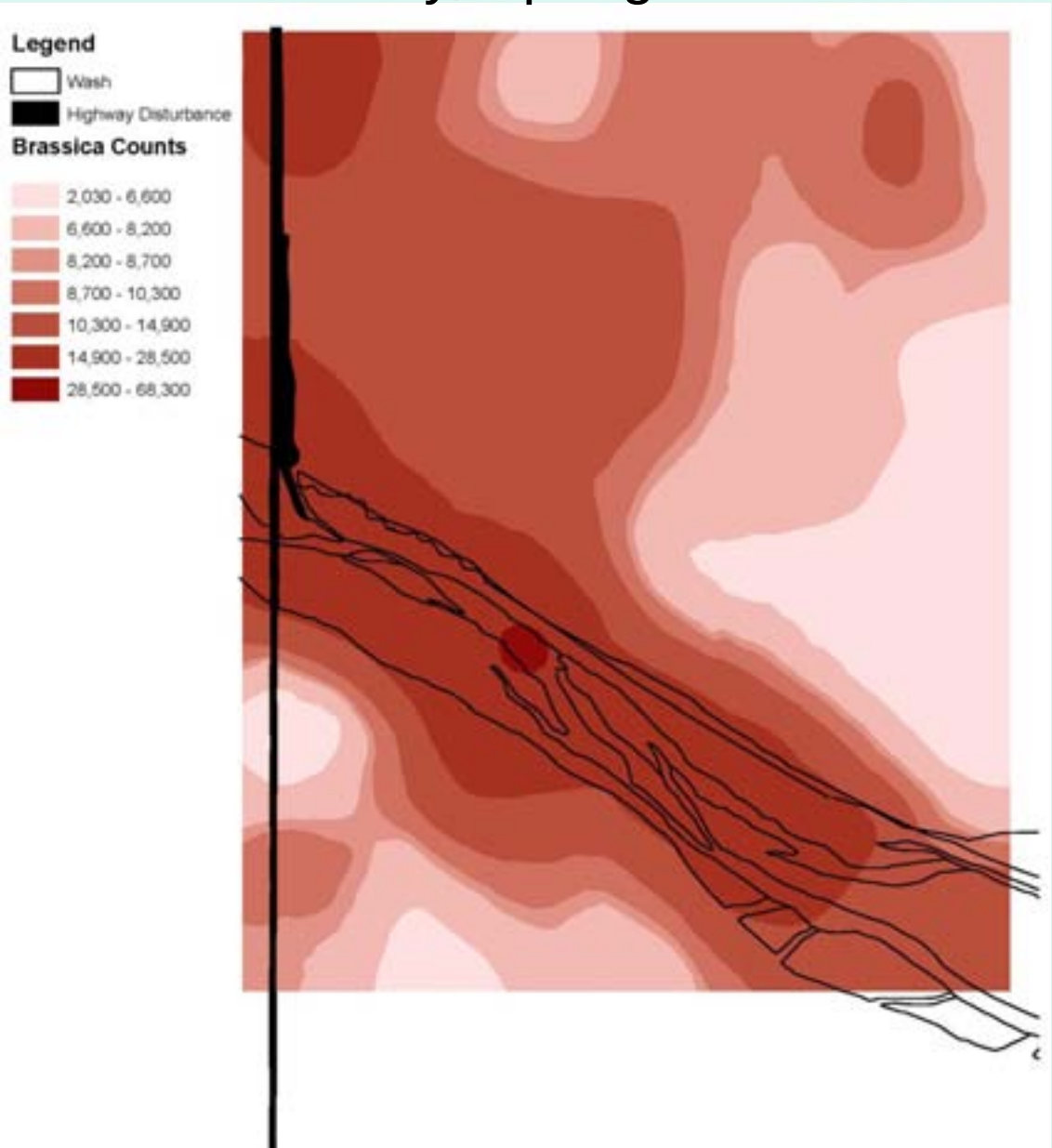


Kristin Berry et al. in prep

Ephemeral Washes Facilitate Spread Away from Roadsides and Other Disturbed Areas

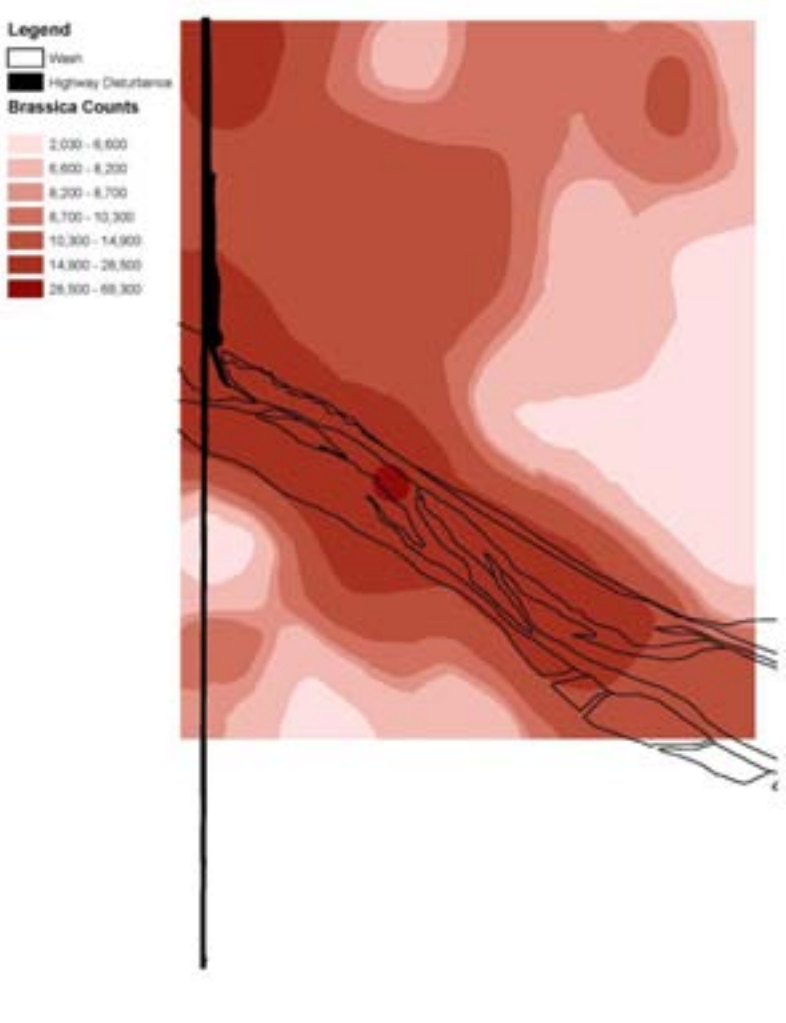
Washes have deeper and sandier soil than the surrounding landscape, conditions that Sahara mustard prefers.

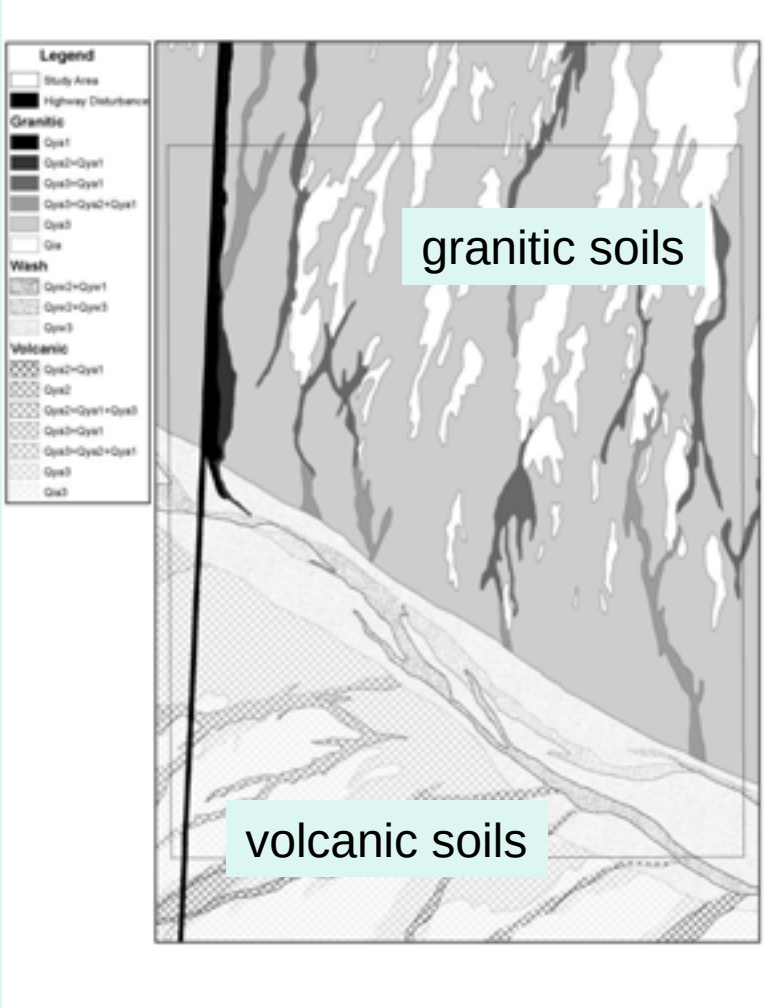
Patterns of Sahara mustard density in the Chemehuevi Valley, Spring 2009



Kristin Berry et al. in prep

Patterns of Sahara mustard density in the Chemehuevi Valley, Spring 2009

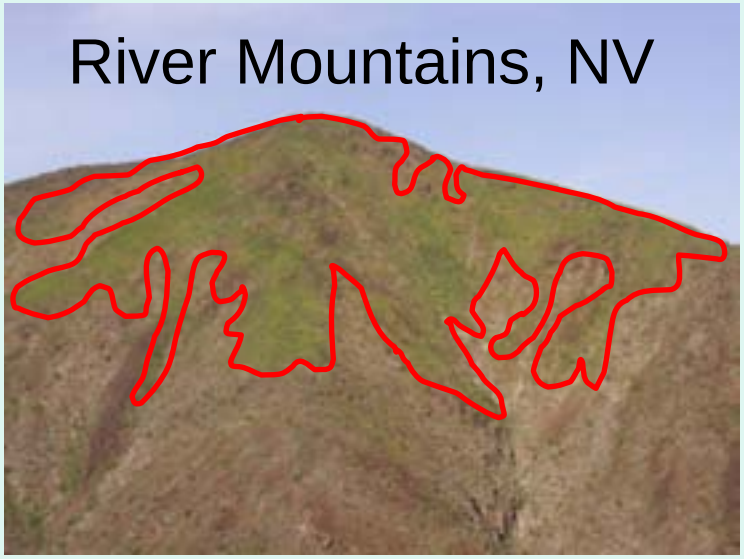


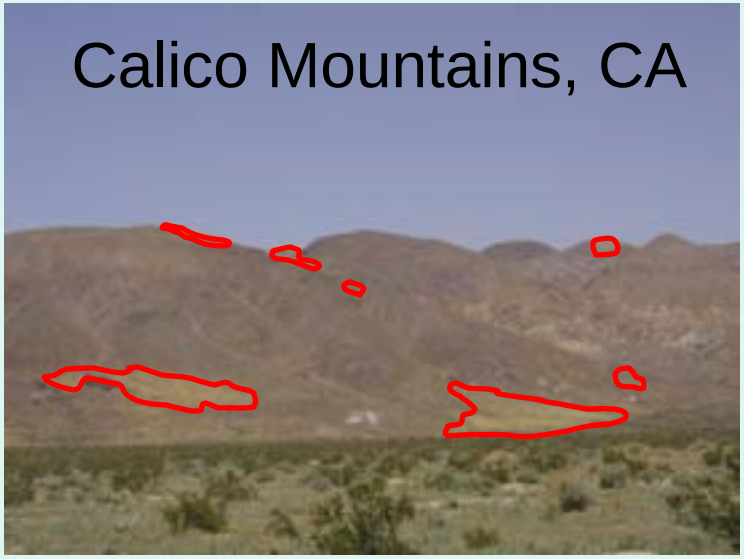


Kristin Berry et al. in prep

Recent Sahara mustard Dominance on Shallow/Rocky Soils on Hillslopes

During spring 2005 Sahara mustard was found in significant stands on mid-slopes and mountaintops where it had not been previously observed.

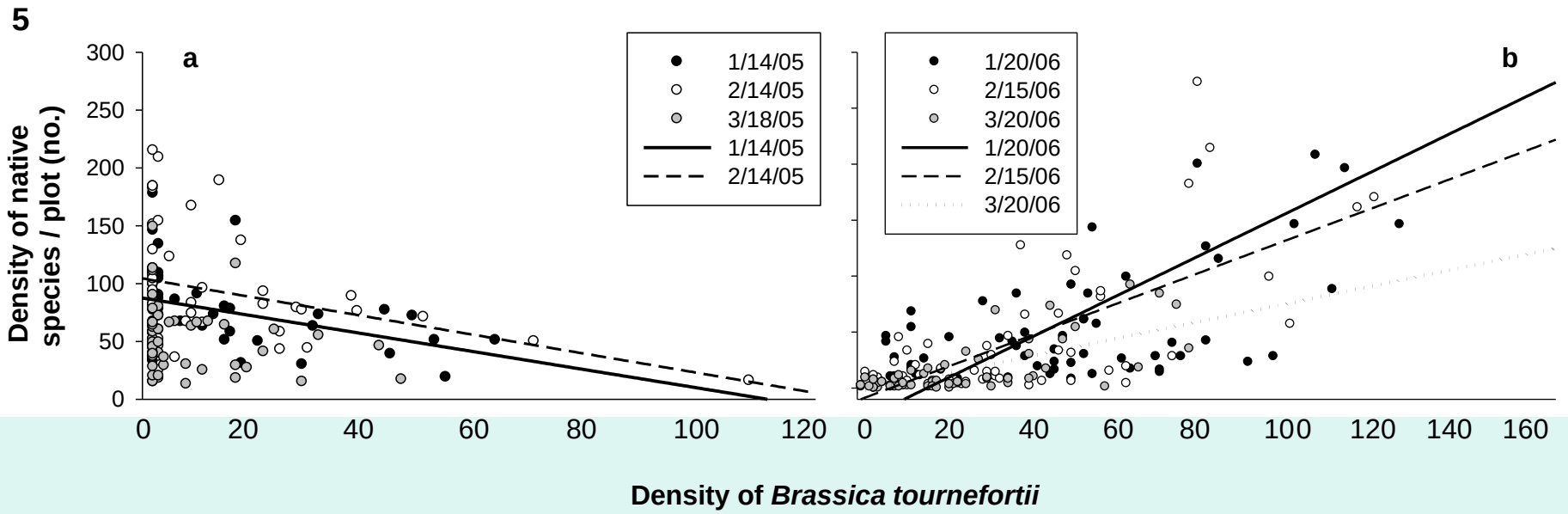




- These newly discovered populations occurred in areas that could not be any more different than the deep sandy alluvial soils that Sahara mustard most frequently dominates.

- Extremely high rainfall during winter 2004-2005 clearly led to the high biomass of these stands which must have established and were previously overlooked in previous years when rainfall was much lower.

Relationships between density of Sahara mustard and native annuals during a year of high (2005) and low (2006) rainfall

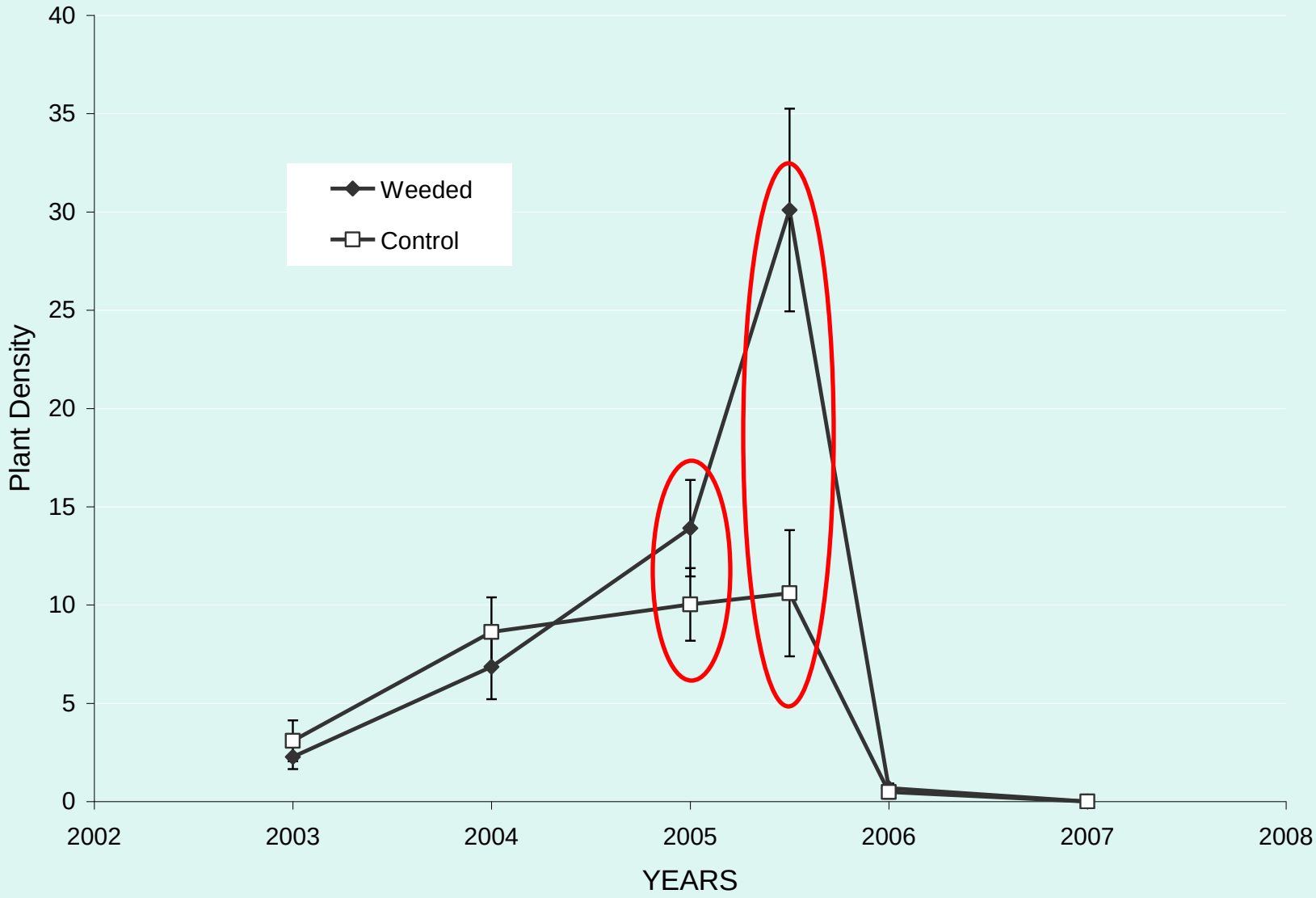


Negative relationship during a year of high rainfall
= competition due to a few very large plants

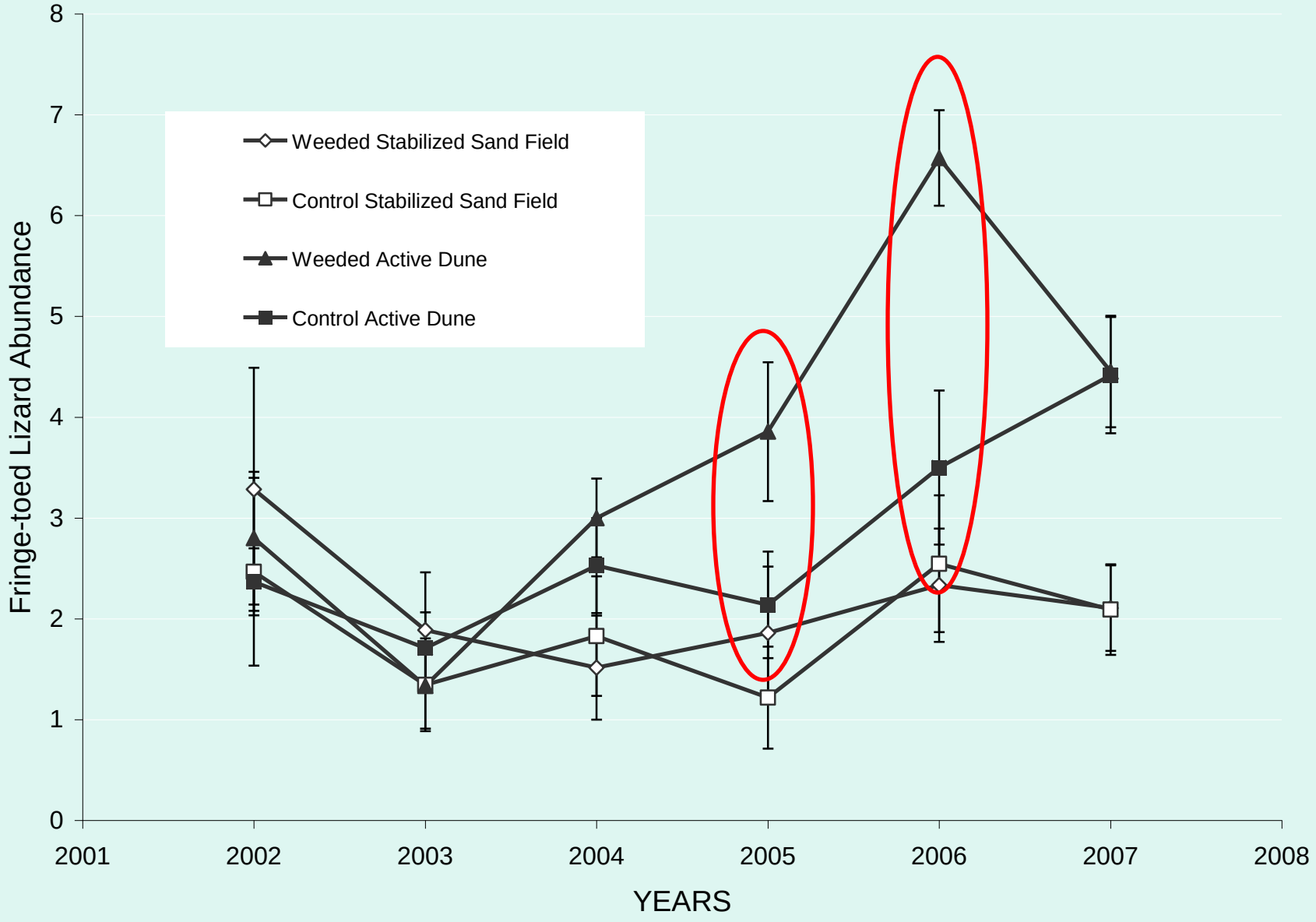
Positive relationship during a year of low rainfall
= lost of very small plants seeking out mesic microsites

Robin Marushia et al. in prep

Barrows et al. 2008



Barrows et al. 2008



Barrows et al. 2008

High biomass production may promote fire spread, but not likely as much as annuals grasses

Sahara Mustard Control and Research

Curt Deuser, Supervisory Restoration Ecologist, National Park Service, Lake Mead EPMT

Previous Control Efforts

- Mostly limited to hand pulling and hoeing
- Bagging and hauling after fruiting
- Rosette vs Bolting
- Effective
- Labor intensive
- Substrate dependent

Mechanical Limitations

Current Strategies

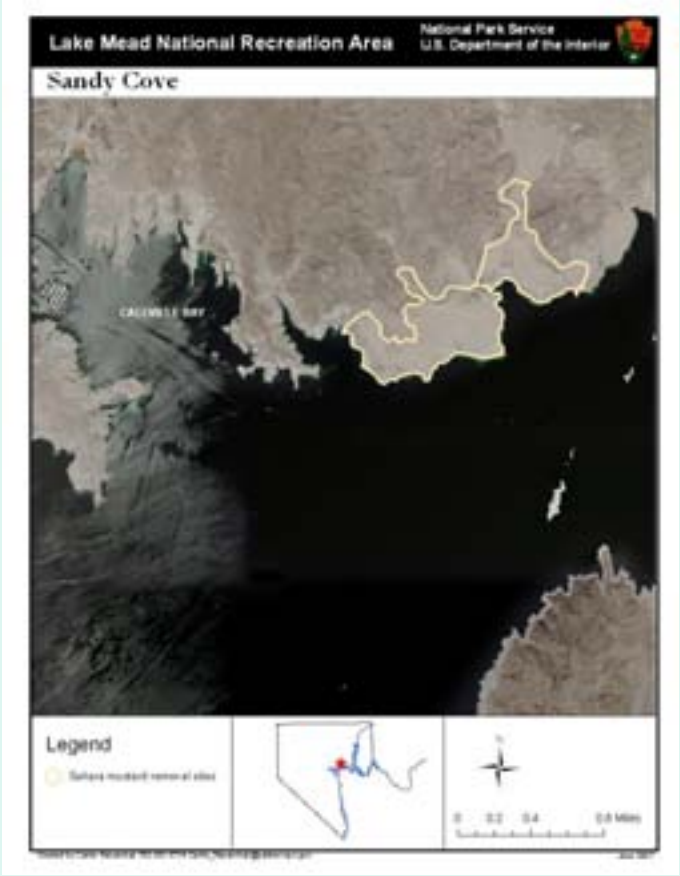
- Site led approaches
- Rare plant sites
- Habitat protection, Dunes
- Vector sites, corridors
- Isolated patches
- Keeping it out of un-infested areas

Current Control Prioritization

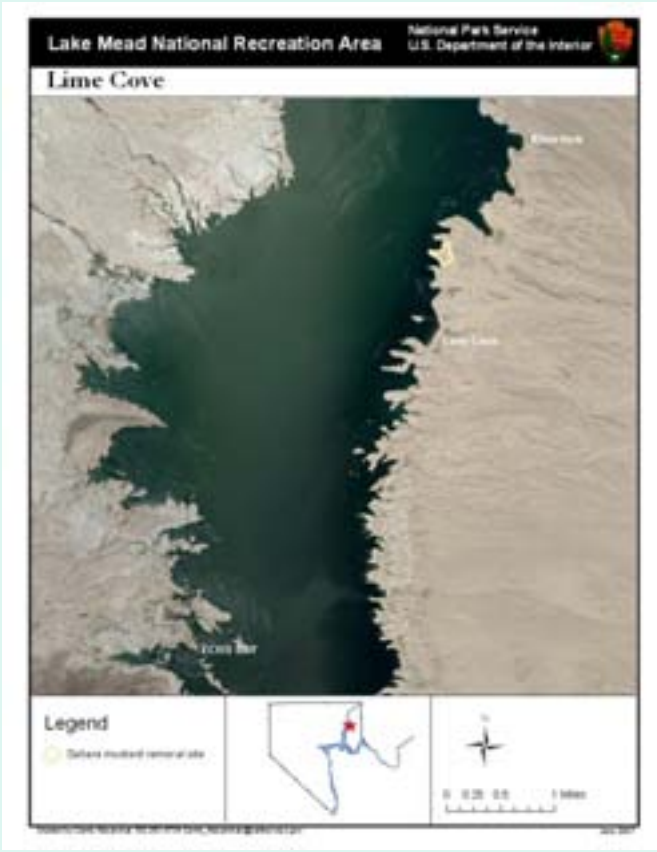
- Lake Mead NRA: rare plant sites, sandy soil endemics
- Mojave NP: Prevent establishment in Kelso Dunes
- Joshua Tree NP: road corridors, vectors

Lake Mead NRA Rare Plant Sites

- Astragalus geyeri var. triquetrus

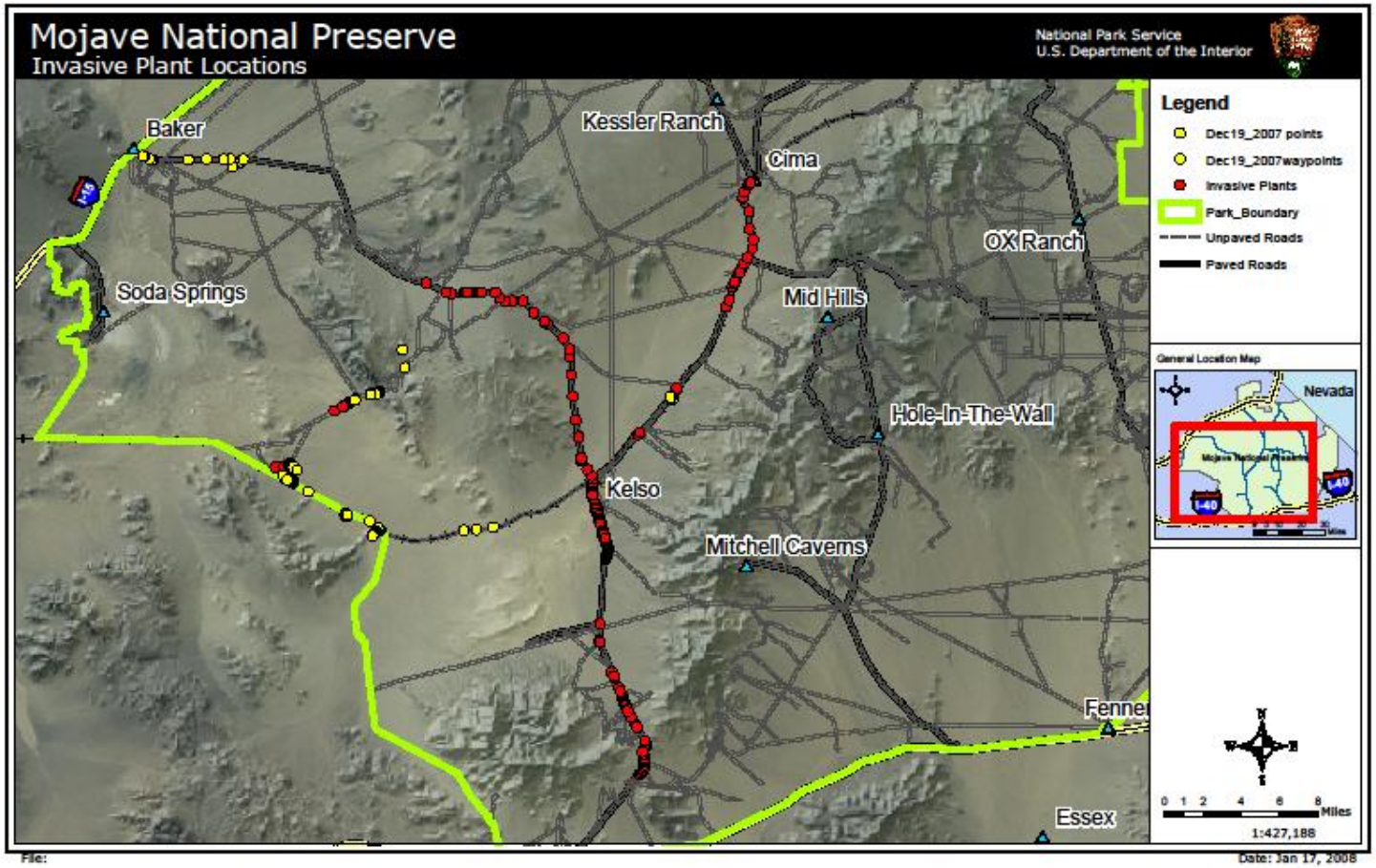


Eriogonum viscidulum



Mojave NP

Kelso Dune Protection



Joshua Tree NP

Roadsides, corridors, reduce seed source

Chemical

- Herbicide control minimal to untested
- Many herbicides have mustard species listed on the label
- Pre-emergent vs Post emergent
- Setting: Roadside vs Natural
- Spot treatment vs Broadcast
- Non target effects

Control Research Needed & Funded

- 2005 BRTO explosion throughout Mojave and Sonoran Deserts
- 2006 SNPLMA (USGS and NPS)
- Evaluate IPM methods
- Multiple herbicides

Herbicides Evaluated

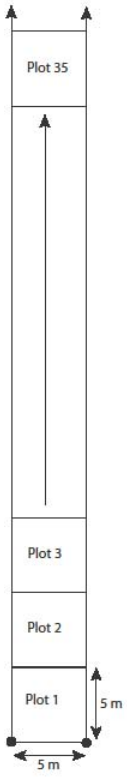
- Round-up pro: glyphosate (2% v/v)
- Telar: chlorsulfuron (.7grams/gal)
- Escort metsulfuron (.7 grams/gal)
- Veteran 720: 2,4-D & dicamba (1.5% v/v)
- Weedar 64: 2,4-D (2%v/v)
- Plateau: imazapic (1% v/v)
- Journey: glyphosate & imazapic (3.125% v/v)

Research Sites

- Toquop Wash, BLM NV, pre-emergents Oct 2006 and 2007 (Oust and Plateau)
- Katherine AZ, NPS, creosote plots, center post radius March 2008 and Feb 2009
- Devils Playground, CA, NPS, treatment blocks, Jan 2008 and 2009
- Toquop Wash, BLM NV, creosote plots, March 2009

Creosote Center Post Radius Plots

Block Unit Plot Design



Plot	Treatment
1	Escort
2	Veteran 720
3	Journey
4	Control
5	Glyphosate
6	Telar
7	Escort
8	Journey
9	Escort
10	Plateau
11	Control
12	Veteran 720
13	Telar
14	Glyphosate
15	Journey
16	Glyphosate
17	Control
18	Plateau
19	Plateau
20	Veteran 720
21	Telar
22	Veteran 720
23	Plateau
24	Telar
25	Journey
26	Journey
27	Glyphosate
28	Telar
29	Control
30	Plateau
31	Control
32	Escort
33	Veteran 720
34	Escort
35	Glyphosate

Evaluate

- Target mortality
- Non target plant effects
- Late stage/fruiting treatments
- Seed viability

Current Results

Preliminary Results of Control Experiments

- Experimental Frameworks
- Methods
- Preliminary Results

Steven Ostoja, US Geological Survey, Yosemite Field Station

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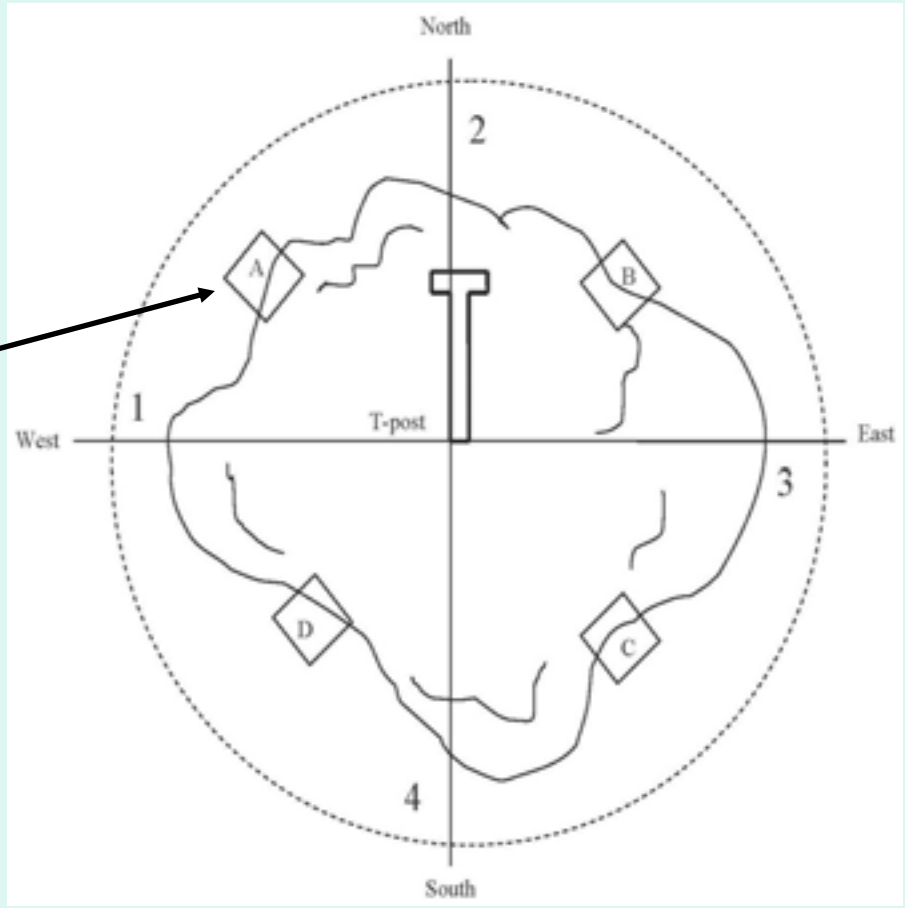
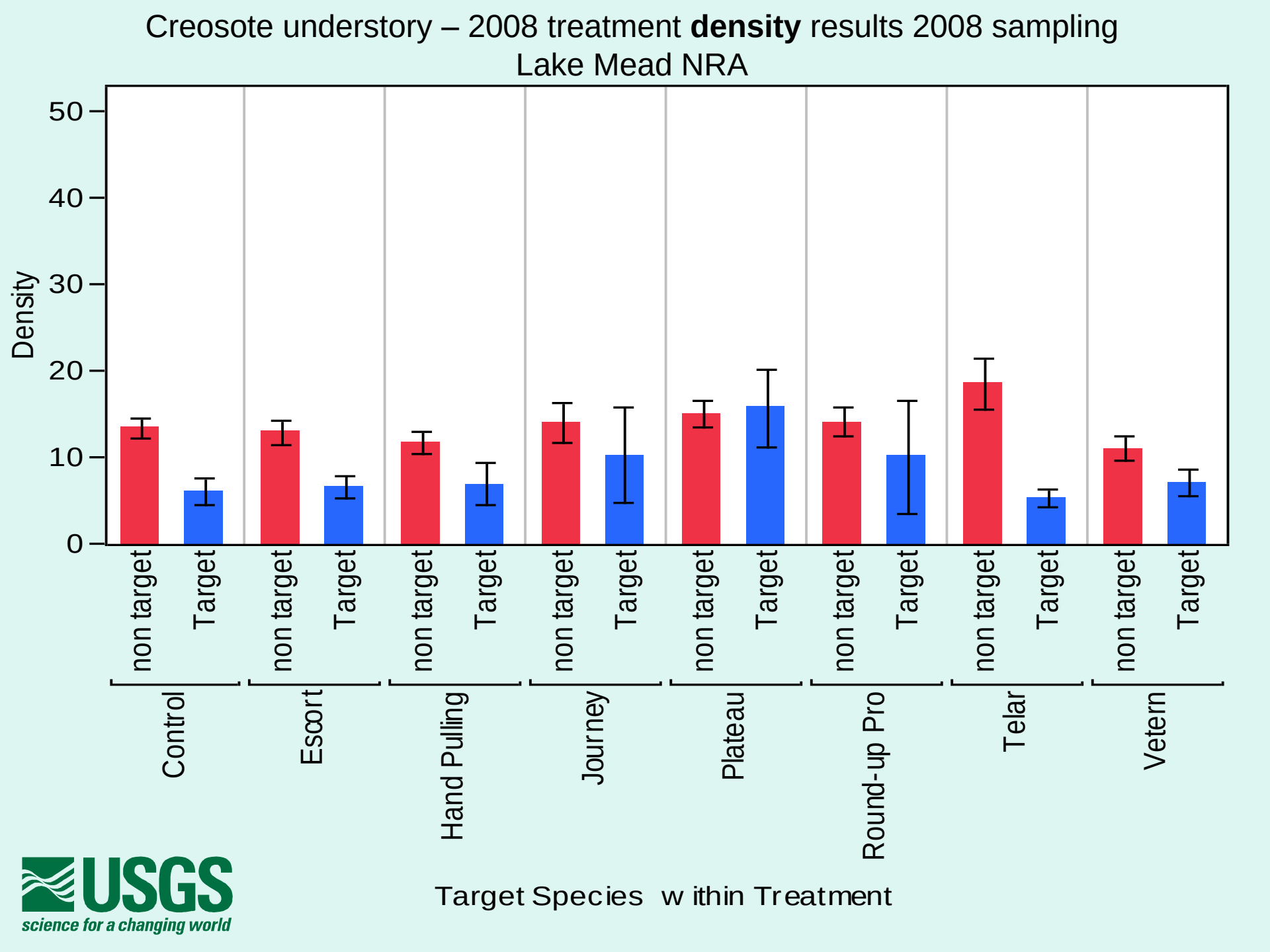
Experimental Frameworks

1. Creosote understory
   - Lake Mead NRA
     - 8 treatments
     - 2 years*
     - Density
     - Cover (Brto only)
     - Biomass
   - Joshua Tree NP
     - 3 treatments




Creosote understory – 2008 treatment **density** results 2008 sampling
Lake Mead NRA
Density
50
40
30
20
10
0
non target
Target
Control
Escort
Hand Pulling
Journey
Plateau
Round-up Pro
Telar
Vetern
Target Species w ithin Treatment
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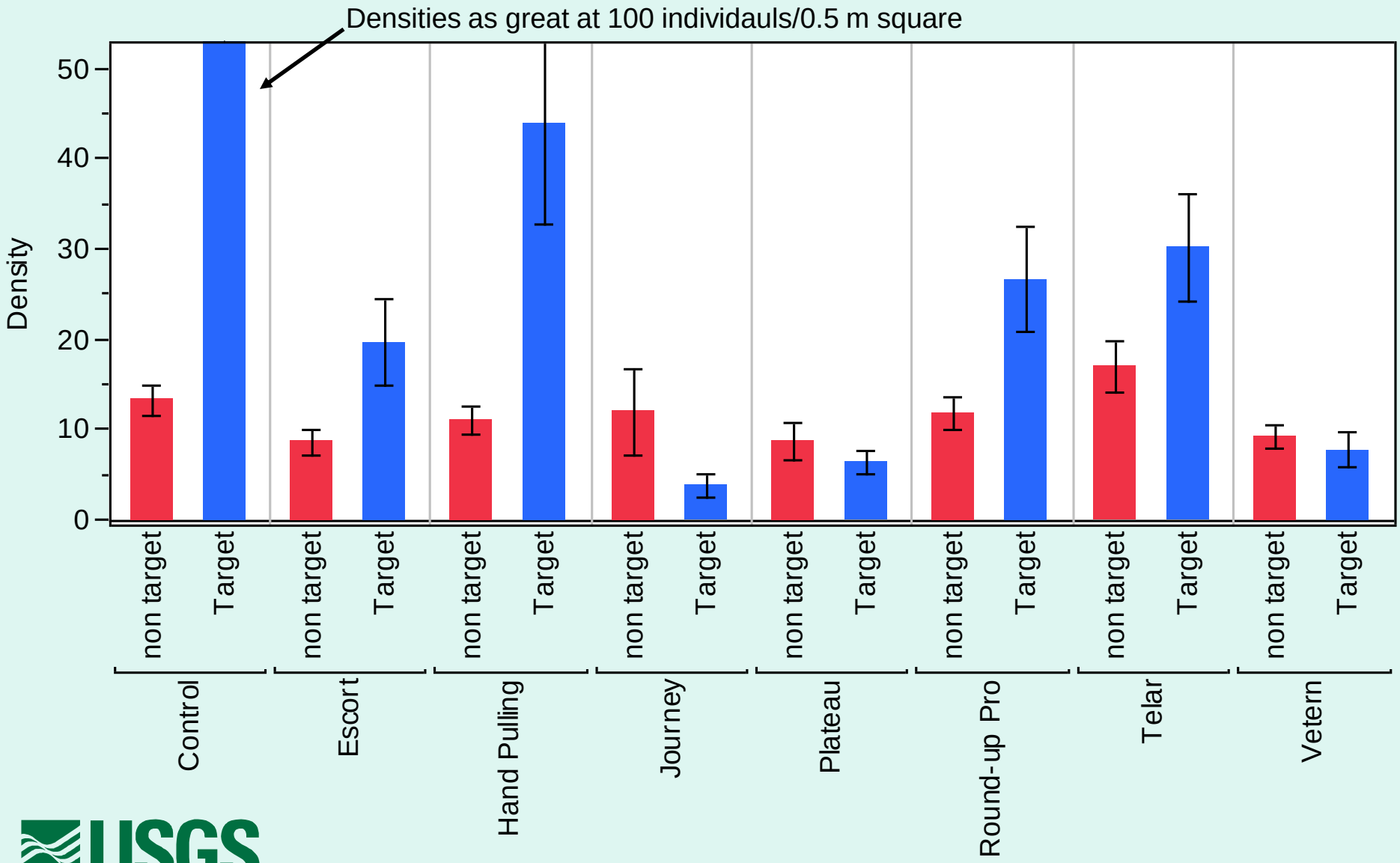
Creosote understory – 2008 treatment density results 2009 sampling
Lake Mead NRA



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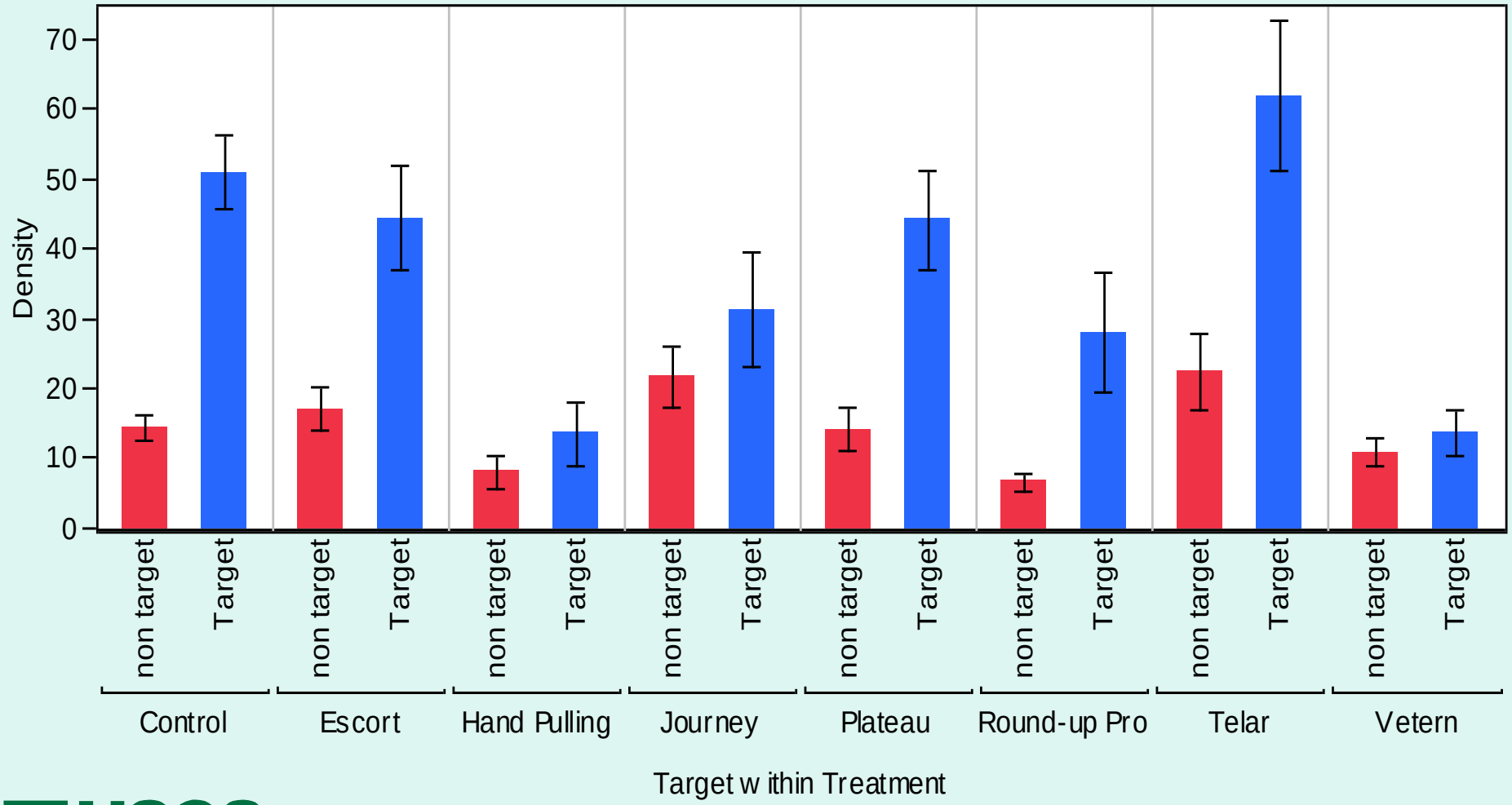
Creosote understory – 2009 treatment density results 2009 sampling



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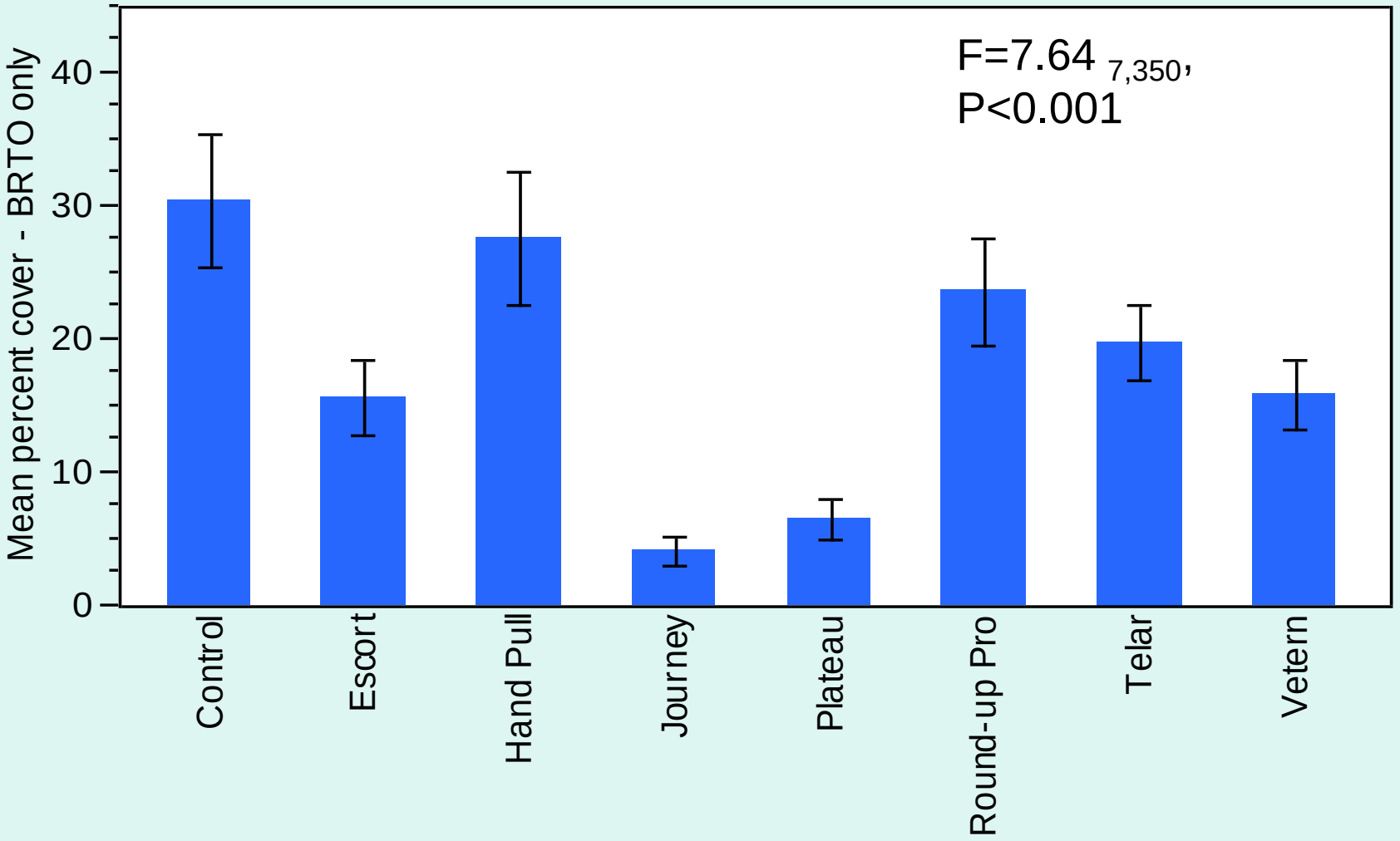
What might we attribute such high densities of Sahara mustard to?

Sahara Mustard Cover (%) – 2008 Treatment
Lake Mead NRA



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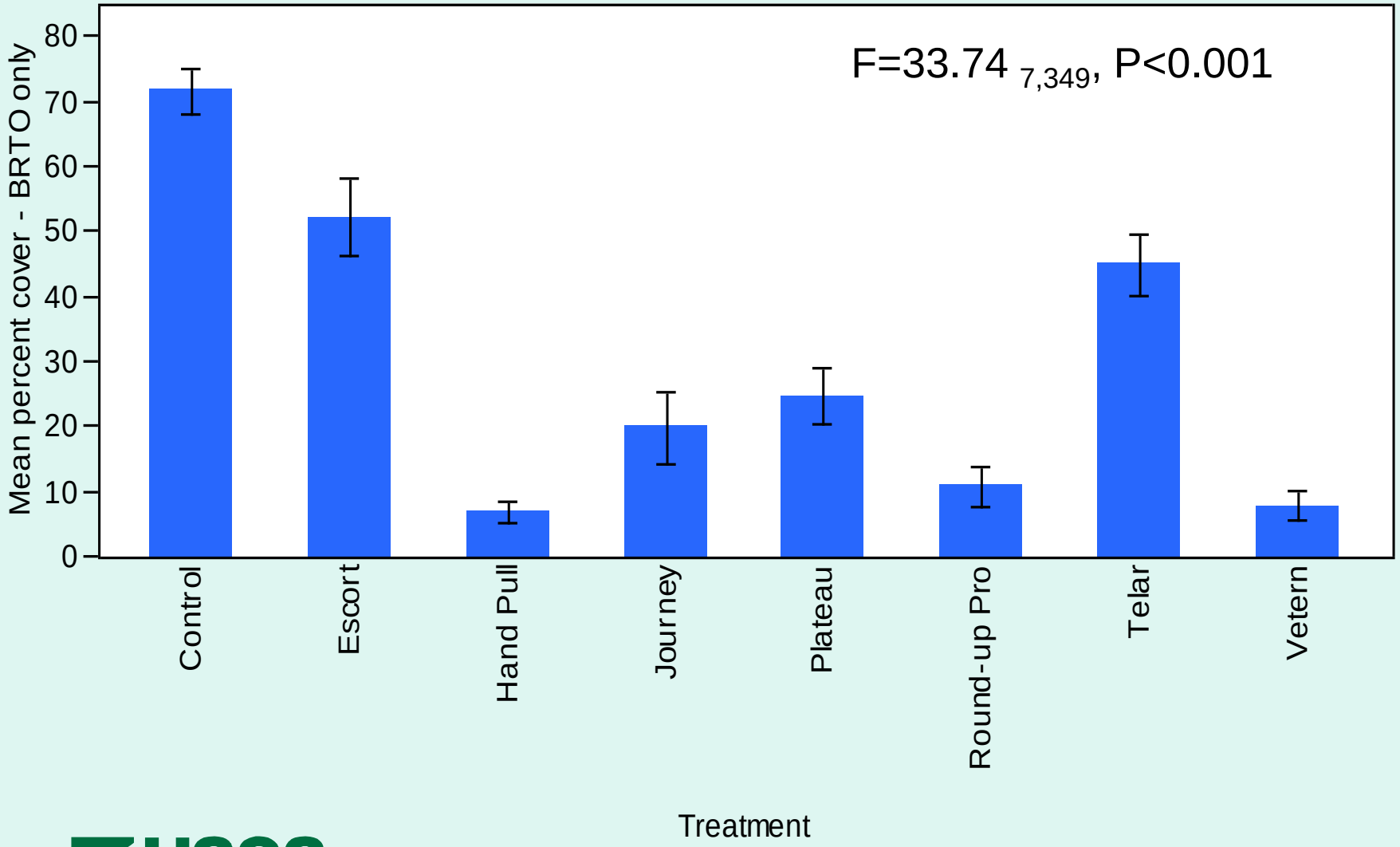
Sahara Mustard Cover (%) – 2009 Treatment
Lake Mead NRA



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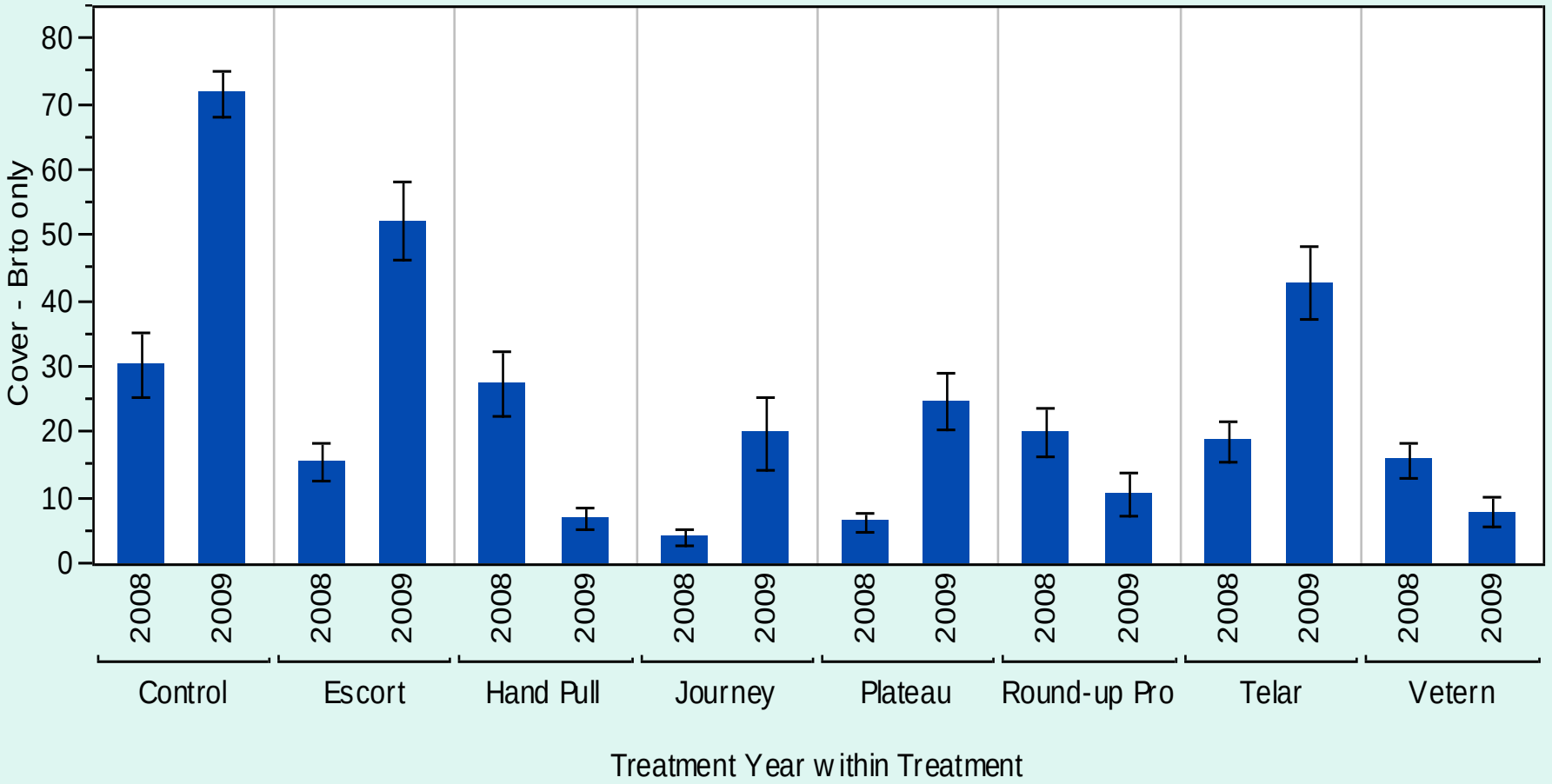
Sahara Mustard Cover (%) – Both Treatment Years
Lake Mead NRA



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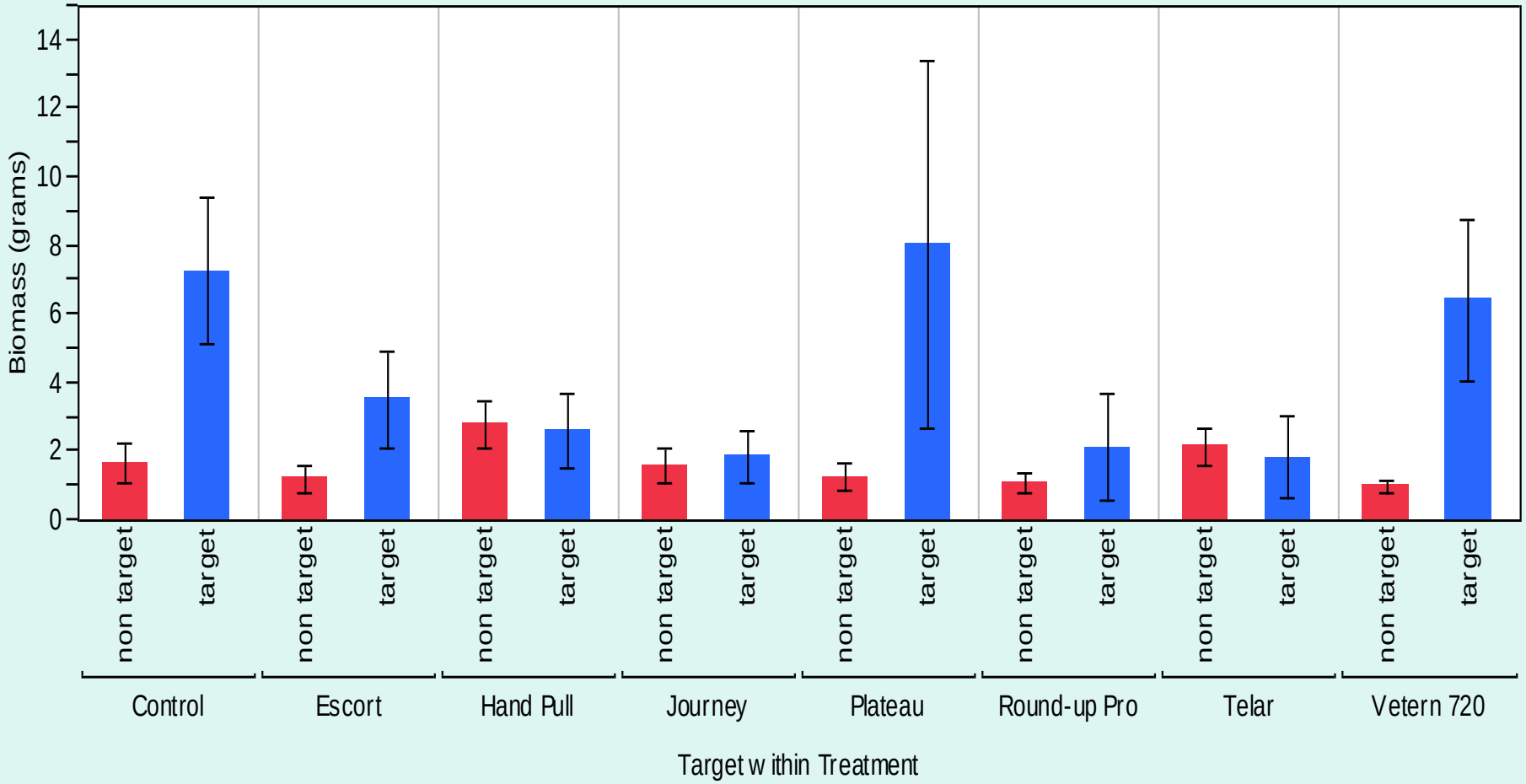
Sahara Mustard and non targets combined biomass (g) – 2008 Treatment
Lake Mead NRA



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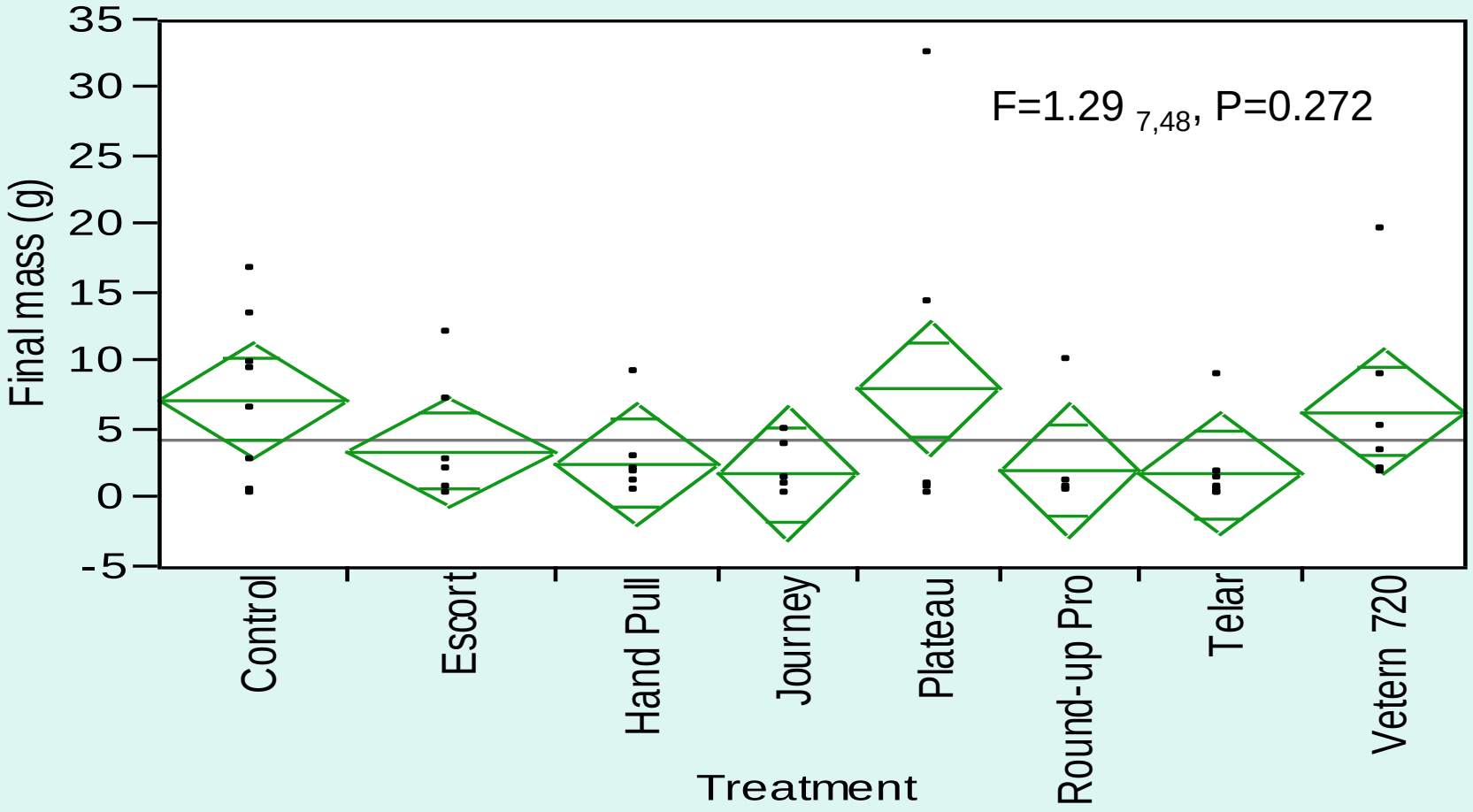
ANOVA for Sahara mustard biomass 2008 treatment
Lake Mead NRA



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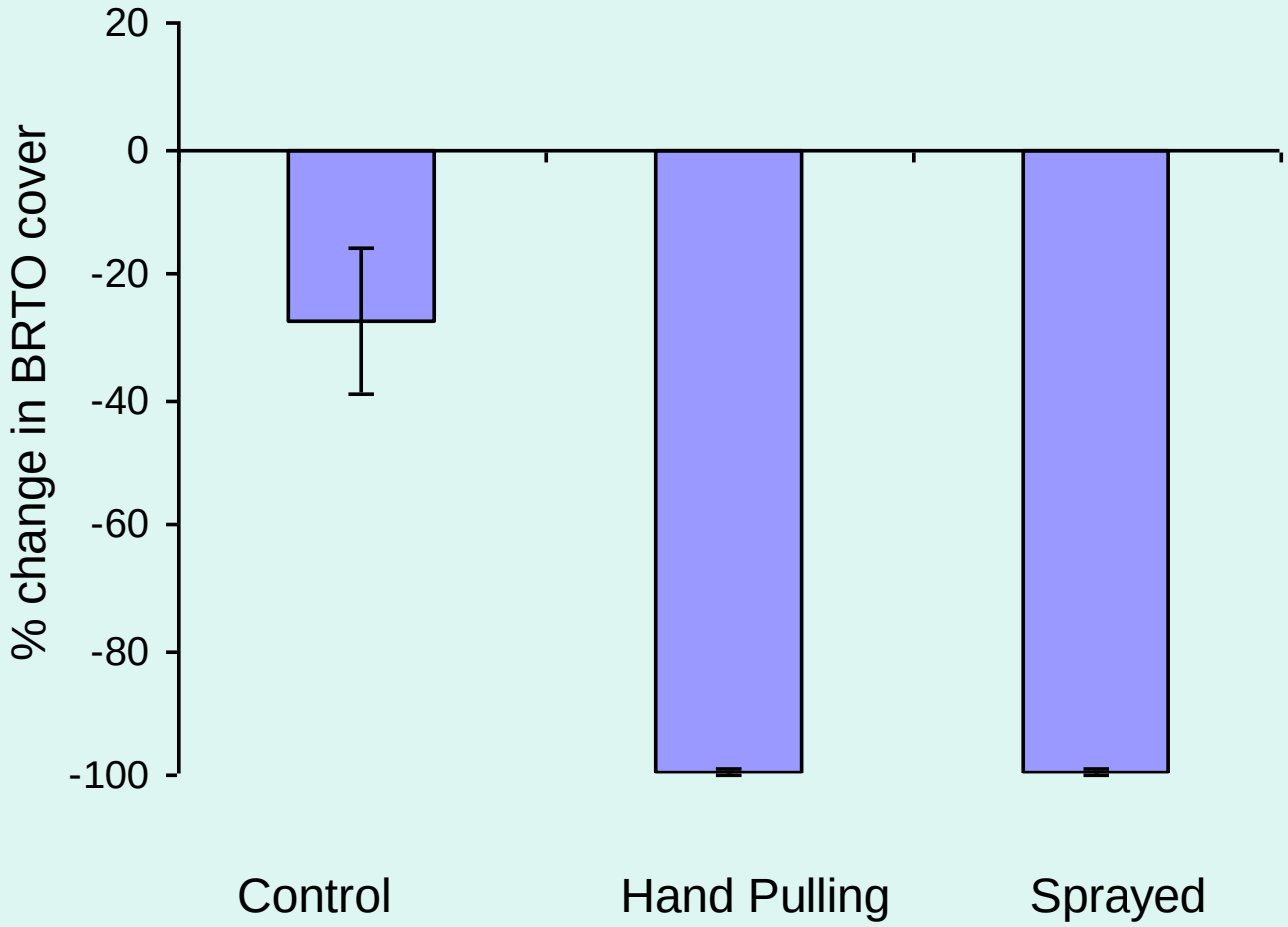
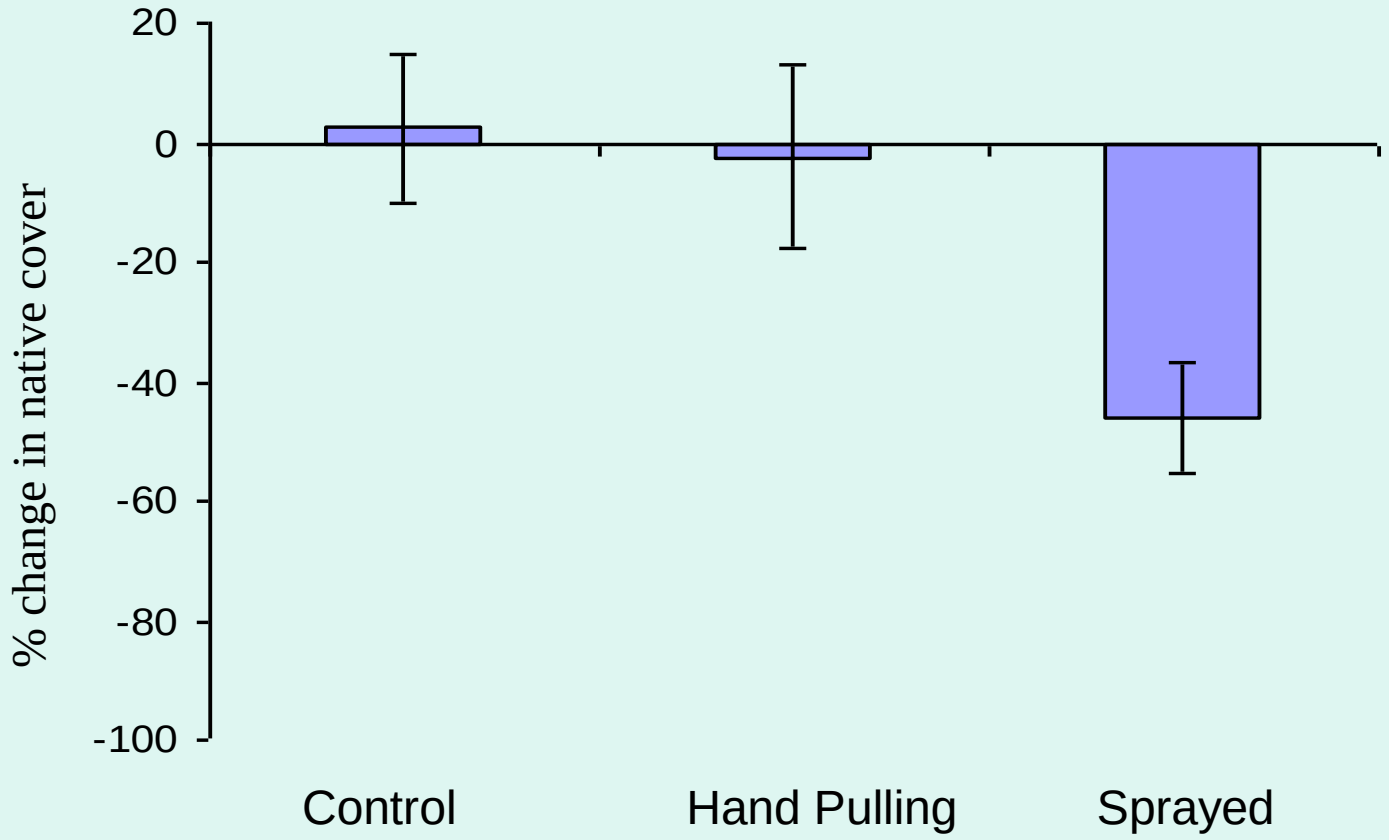
Sahara mustard creosote understory control Joshua Natl. Park



Jane Cripero, Joshua Tree NP

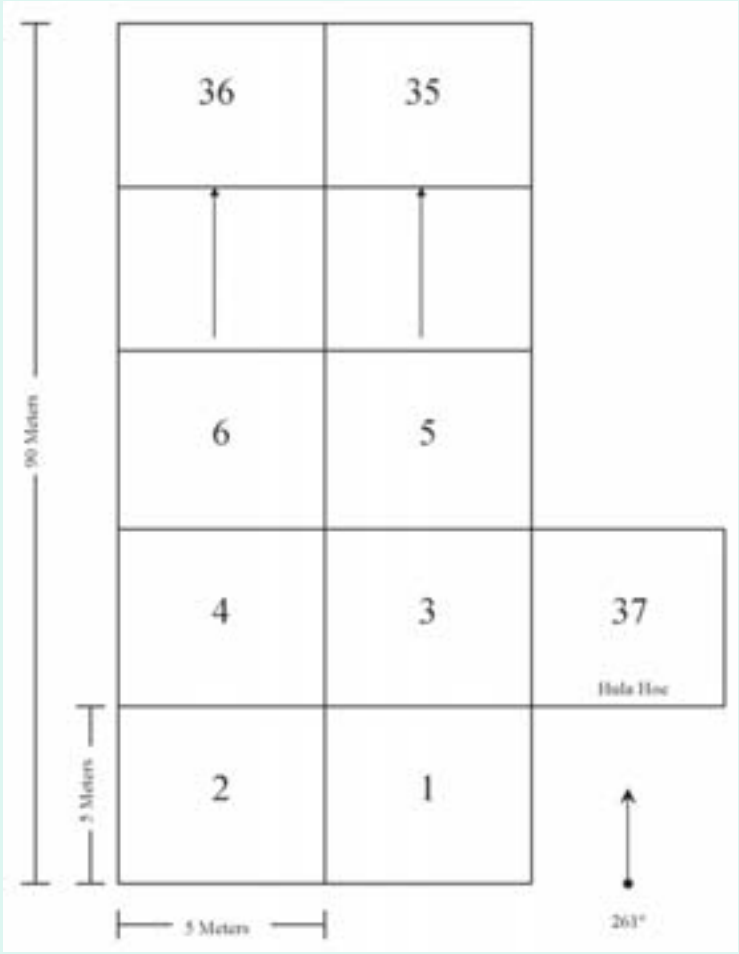
Sahara mustard creosote understory control Joshua Natl. Park



Jane Cripero, Joshua Tree NP

Experimental Frameworks

1. Creosote understory
   - Lake Mead NRA
     - Biomass
     - Cover (Brto only)
     - Density
2. Roadside surrogate
   - Mojave Natl. Preserve
     - Biomass
     - Density



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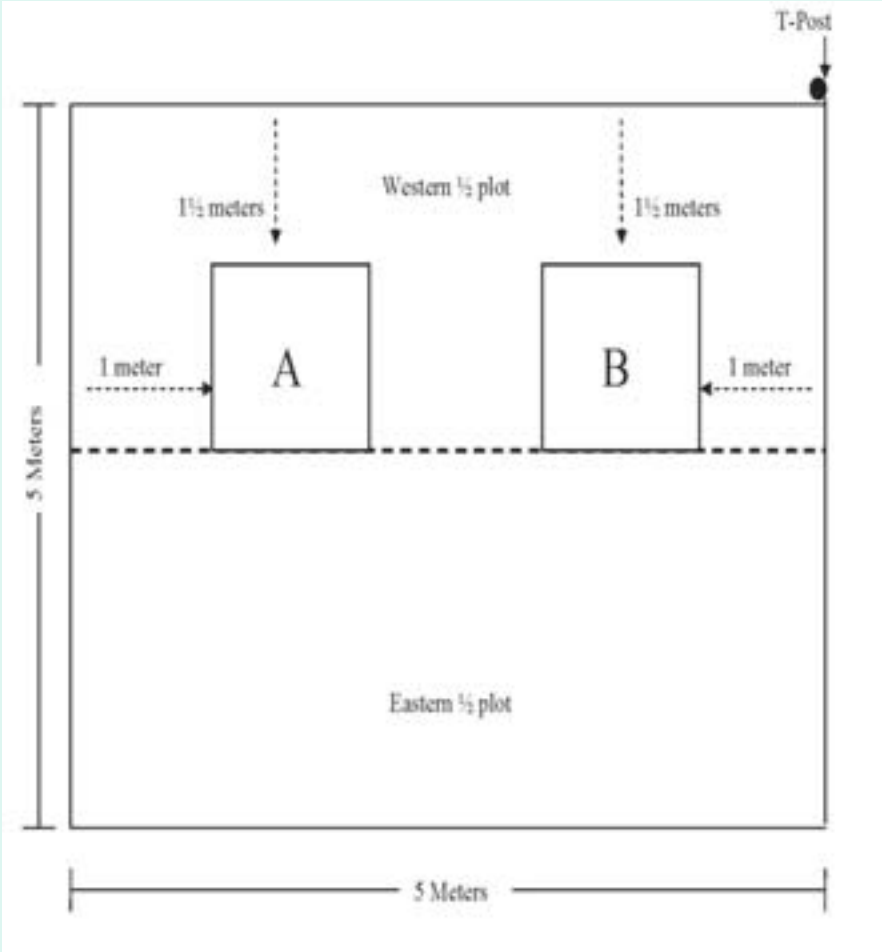

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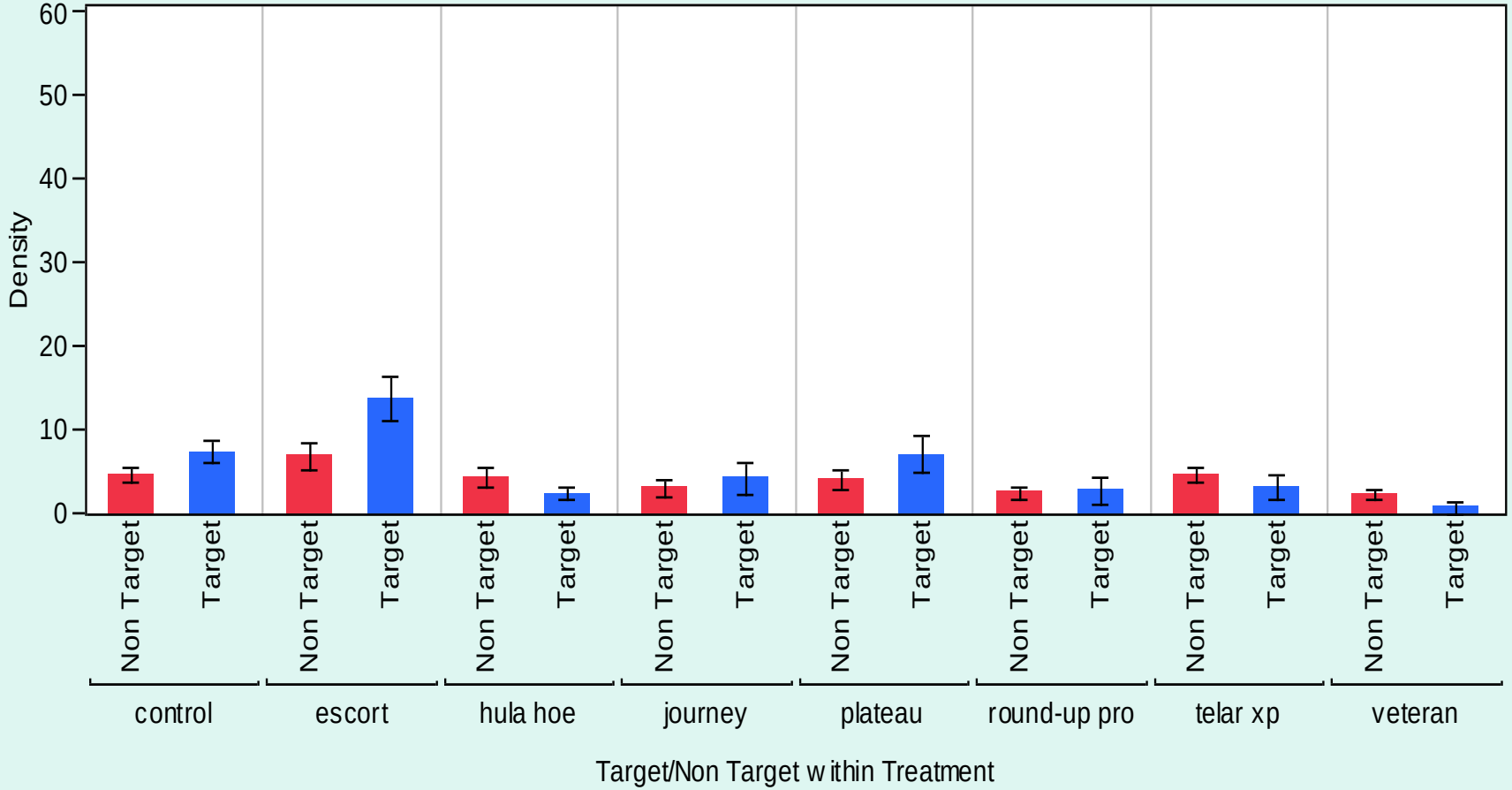
Roadside surrogate – 2008 treatment density results 2008 sampling
Mojave Preserve



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Roadside surrogate – 2009 treatment density results 2009 sampling
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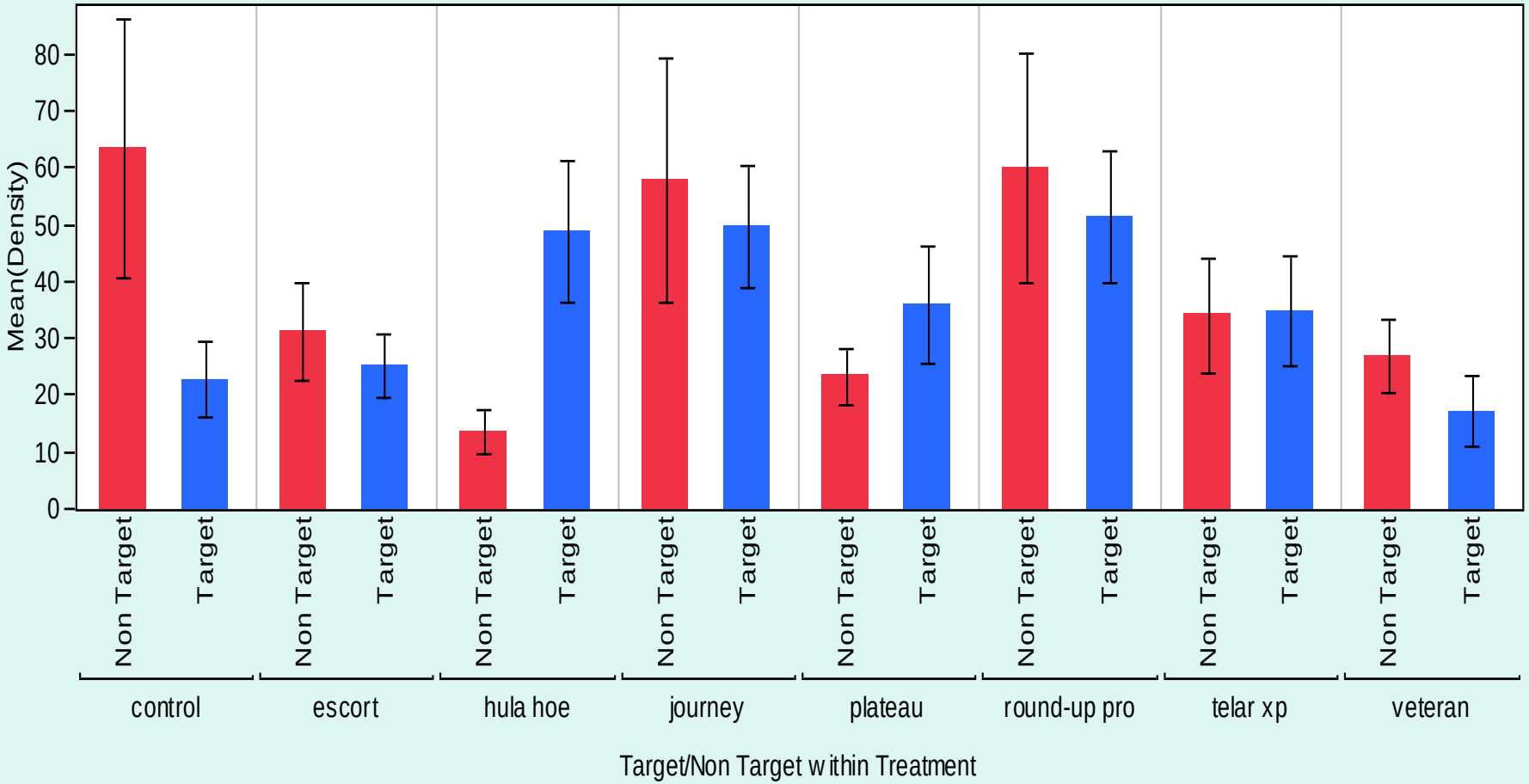

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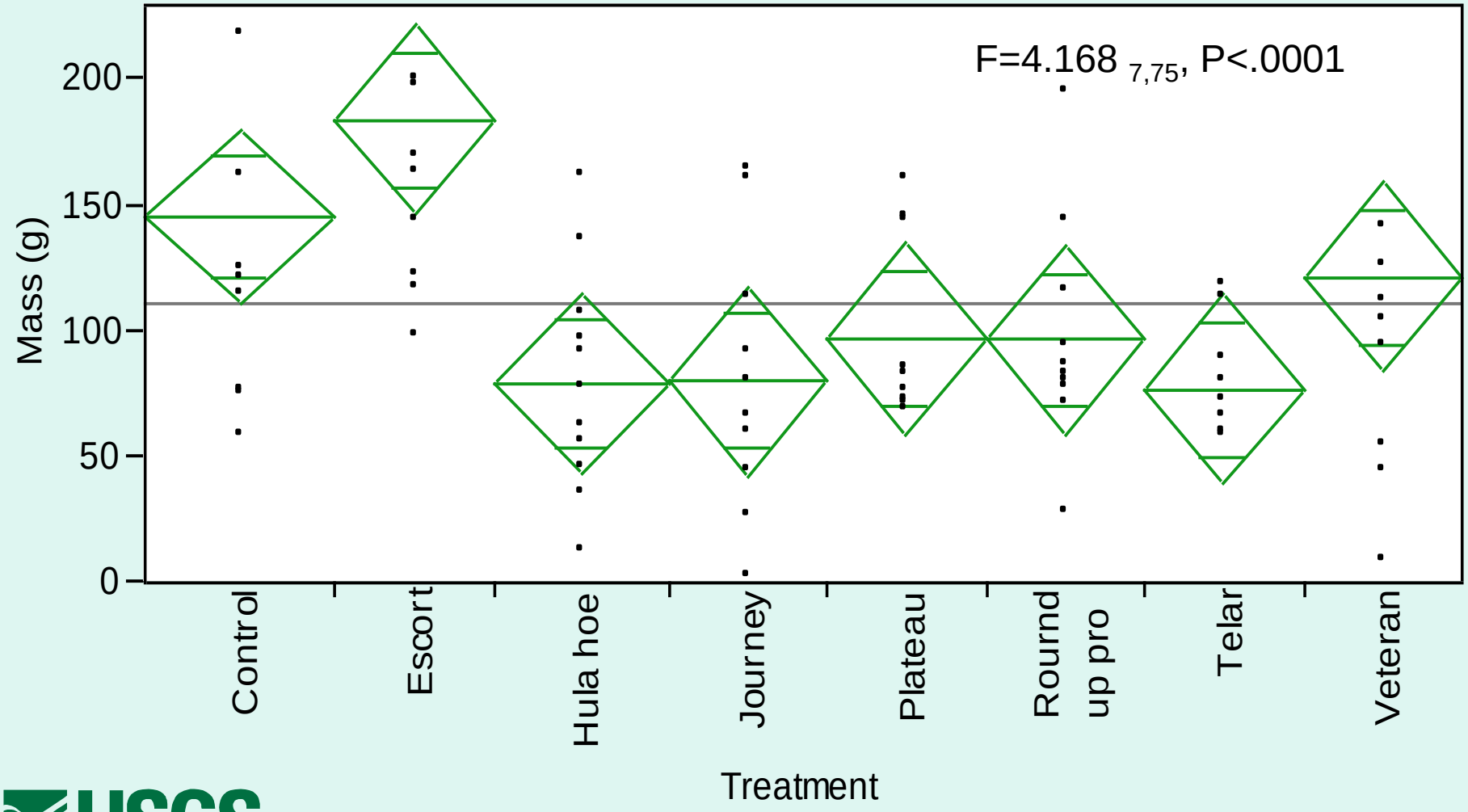
ANOVA for Sahara mustard biomass 2008 treatment
Mojave Preserve



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ANOVA Non Significant for non target species

Summary, Next Steps and Questions

- Treatments (chemical) appear to have application for control of Sahara mustard, while reducing negative effects to native species
- 2010 sampling for all 2009 treatments needed before conclusions can be drawn
- Publications and Management Brief
- Data suggest plant – animal feedbacks have a role in the plant population ecology of the species

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