Effectiveness Monitoring of Invasive Plant Control (especially Tamarisk – *Tamarix* spp.)

Principal Investigators:

Tom Dudley (U.C. Santa Barbara & U.N. Reno)

Matthew Brooks (US Geol. Survey, Biol Res Div – Henderson/Yosemite)

Virgin River, NV

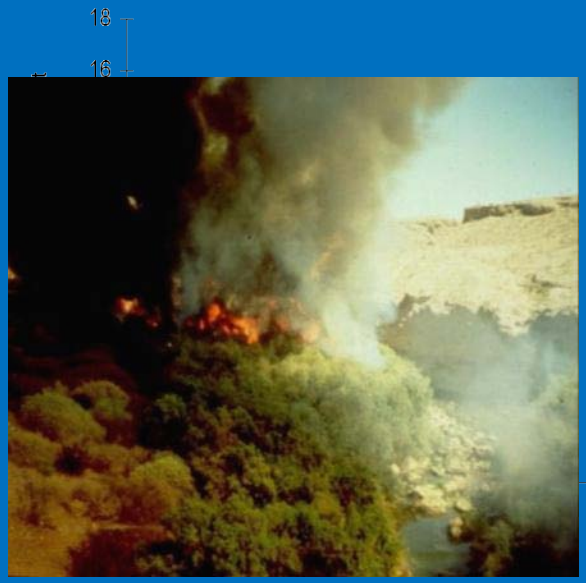
Why control Tamarisk?

Competes with native plants

Desiccates & salinates soils

High water transpiration

Erosion & sedimentation



Wildfire hazard

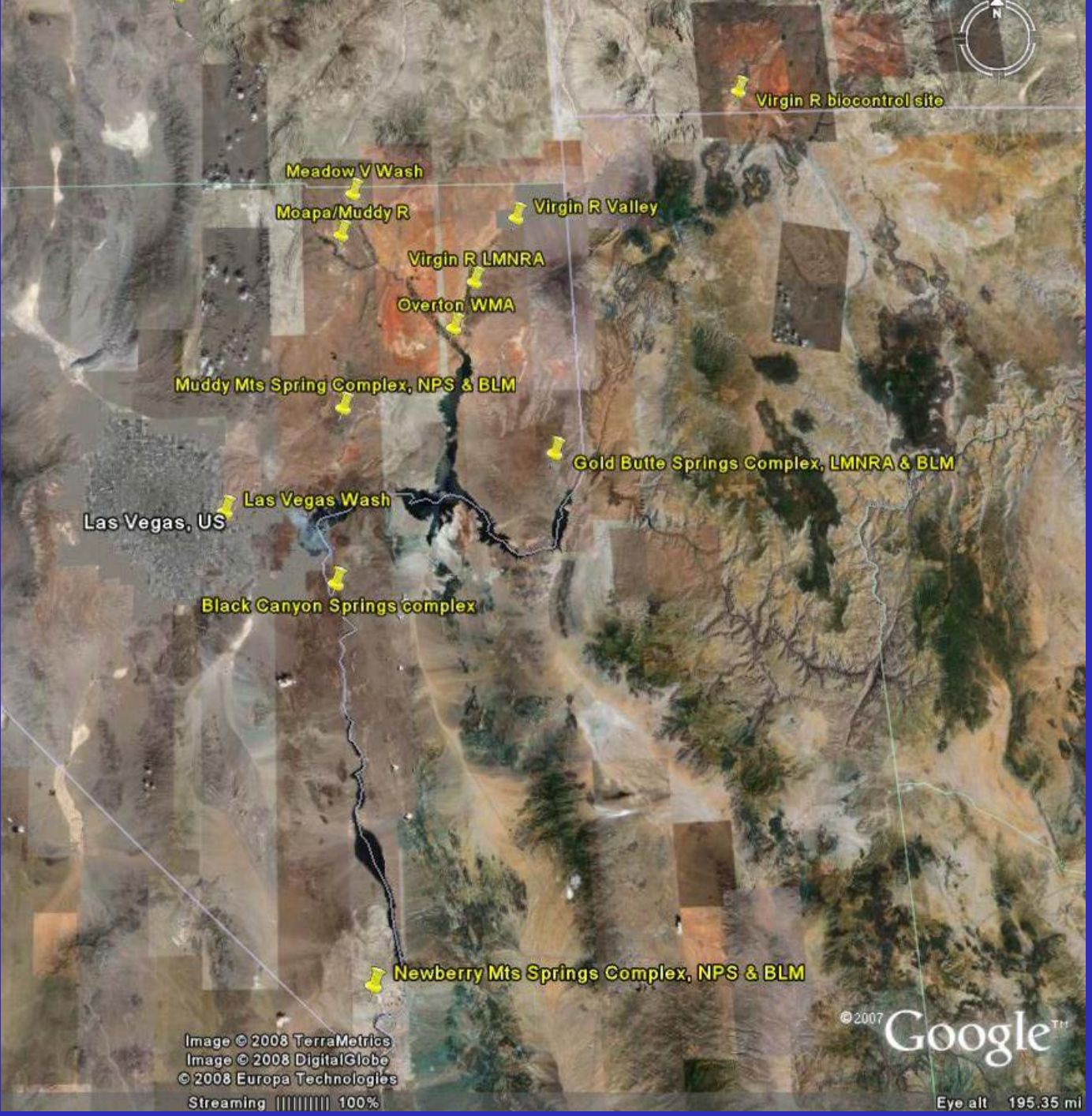
Low quality habitat

Two decades of tamarisk control & riparian restoration in Clark County springs and rivers

Co-operator treatments: NPS (Curt Deuser), BLM (Tim Rasch, Nora Caplette)

- Hand & mechanical treatments
- Stump & foliar herbicide applications

Do control efforts reduce tamarisk impacts?
Do native vegetation and wildlife recover?
What treatment methods are most effective?



Effectiveness Monitoring Sites

34 Spring Wetlands
35 Virgin River Floodplain Sites

2 – 12 years since treatment
Most matched with reference sites

Effectiveness Monitoring of *Tamarix* Control: **Vegetation**

Lead: Steve Ostoja, USGS-Bishop

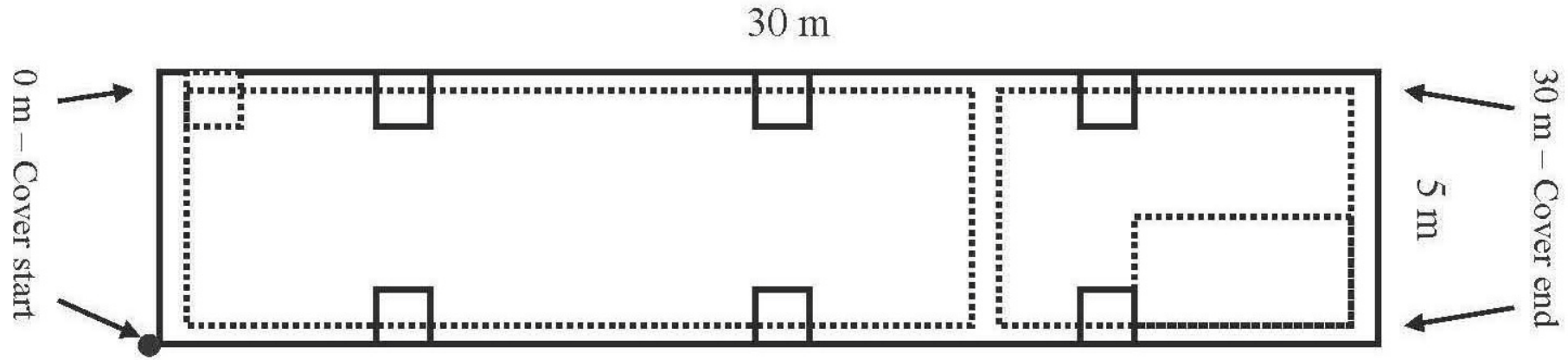
USGS science for a changing world

Virgin River

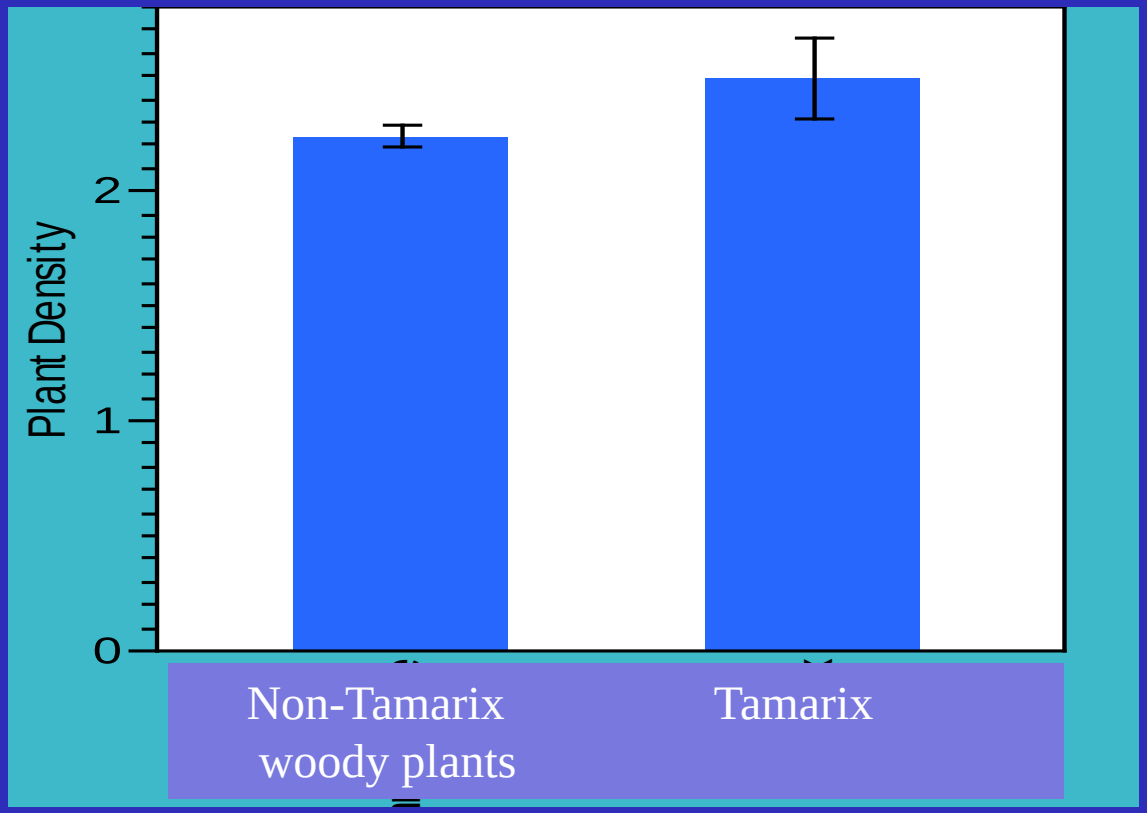
- 61 Control Plots
- 118 Treatment Plots

Upland Seeps and Springs

- 256 Plots
- All in NPS EPMT treated sites



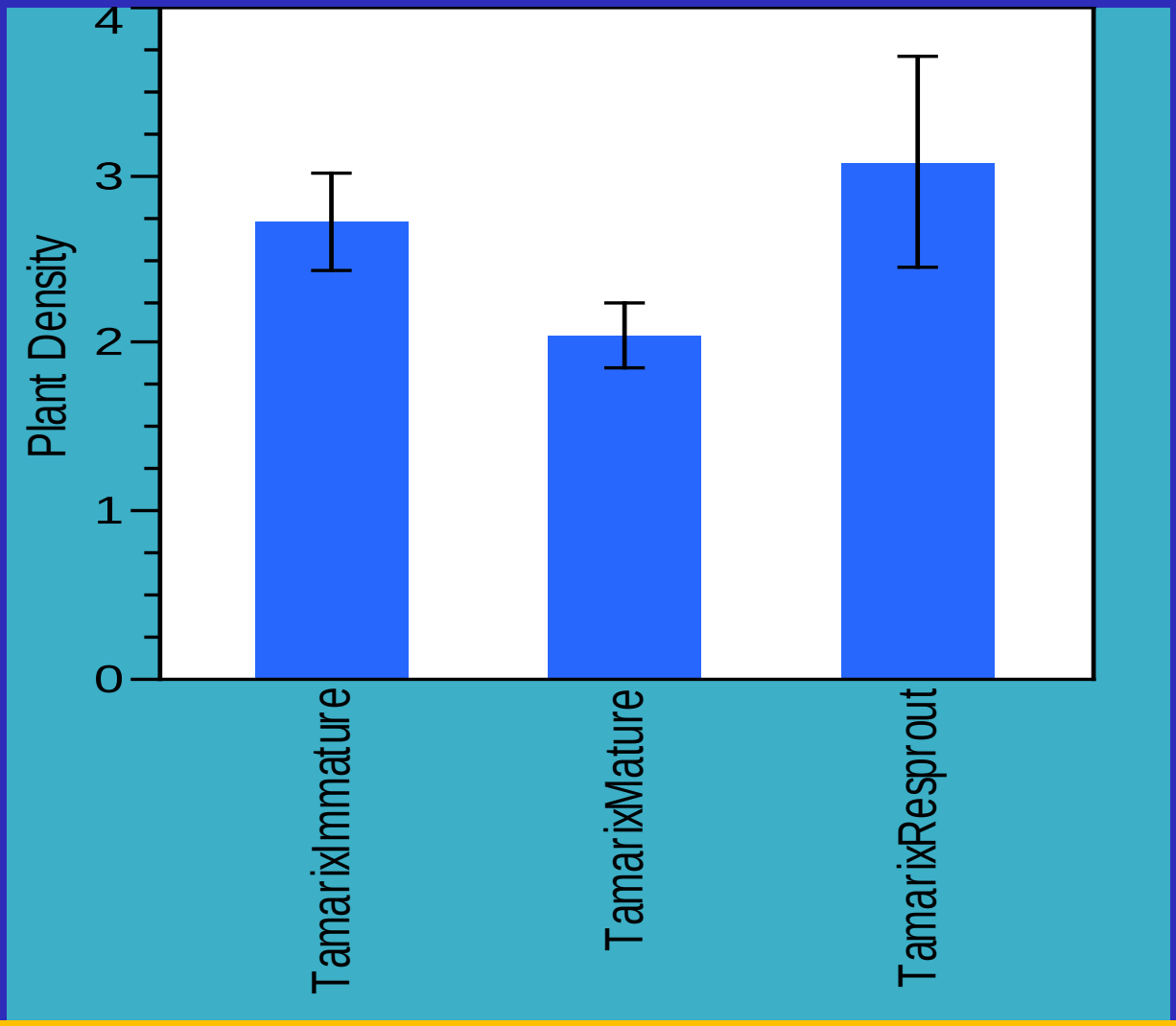
Upland Sites: *Tamarix* vs. Native densities



(Preliminary Results)

- Plant Density of Tamarix and Native species roughly equal
  --- Treatments do facilitate some native recovery
- Non-native forbs & grasses common as primary cover

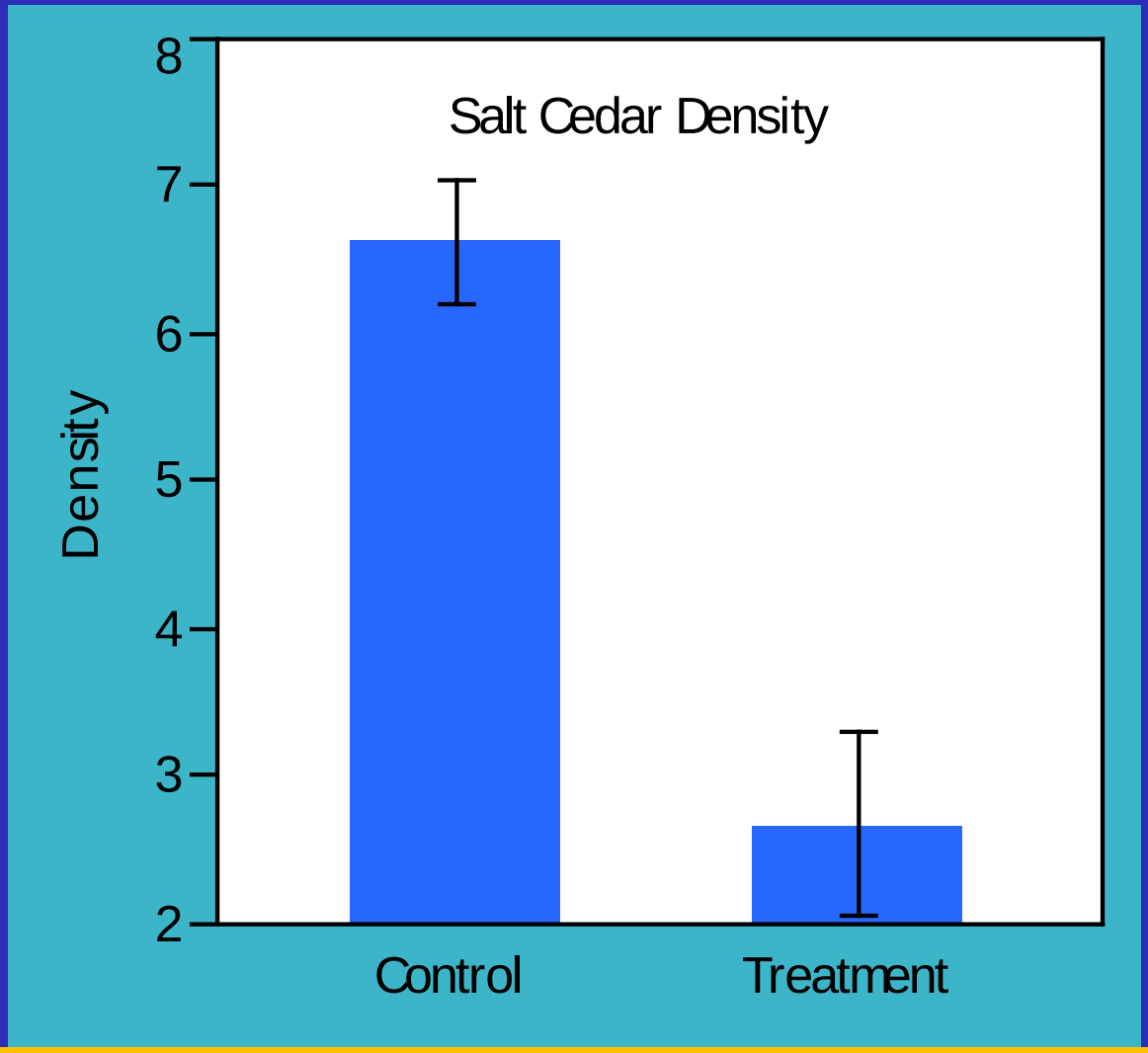
Upland Sites: Tamarix life-stage stem densities



- More Resprouts & juveniles than mature individuals
- Suggests effectiveness was low or unsustainable (preliminary)

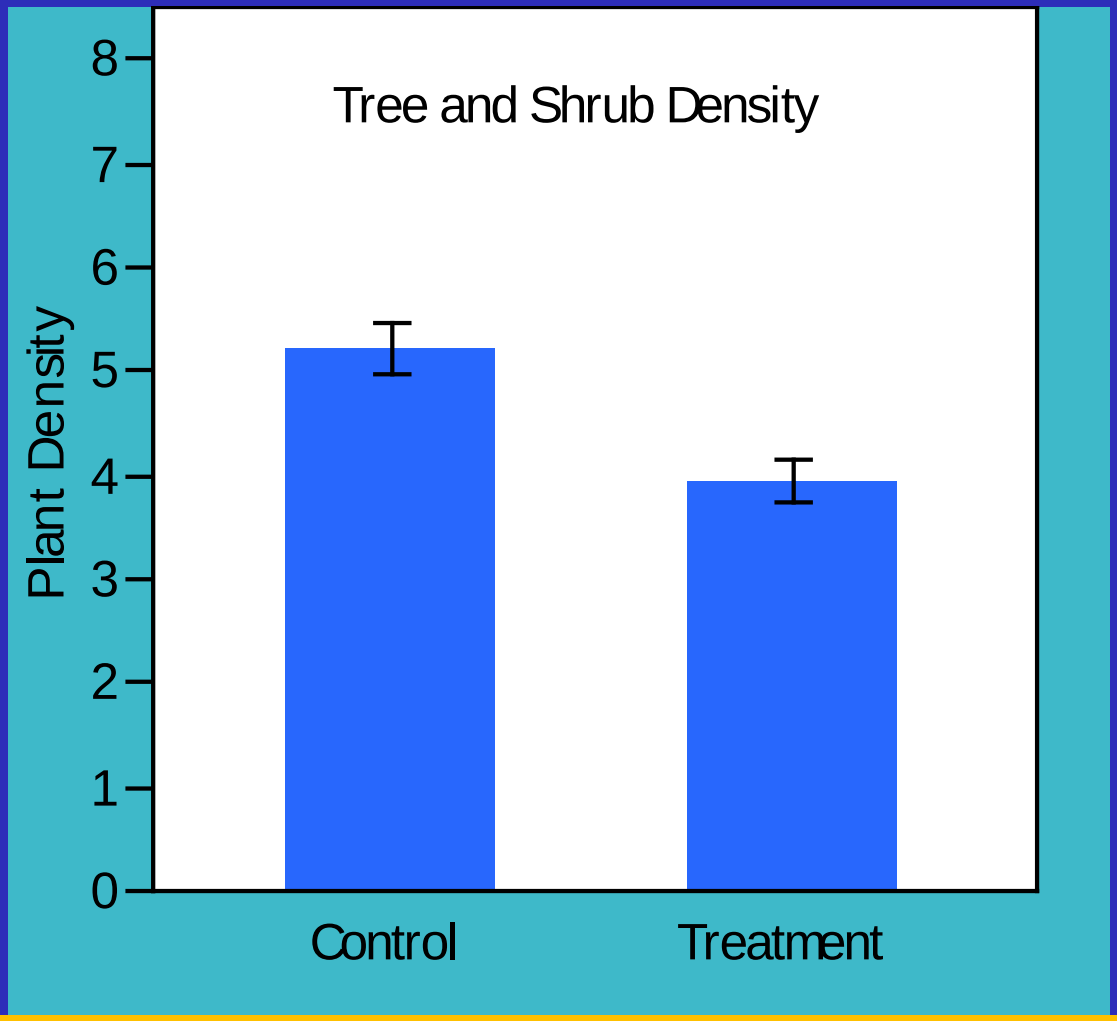

Virgin R Gorge
Littlefield
Mesquite Airport
Veterans Memorial Hwy
Mesquite
Bunkerville
15
170
Virgin River
(75 km reach)
Nev Ariz
Nevada
Arizona
Treatment site
Control site
Lake Mead

Virgin River: Preliminary Patterns and Results



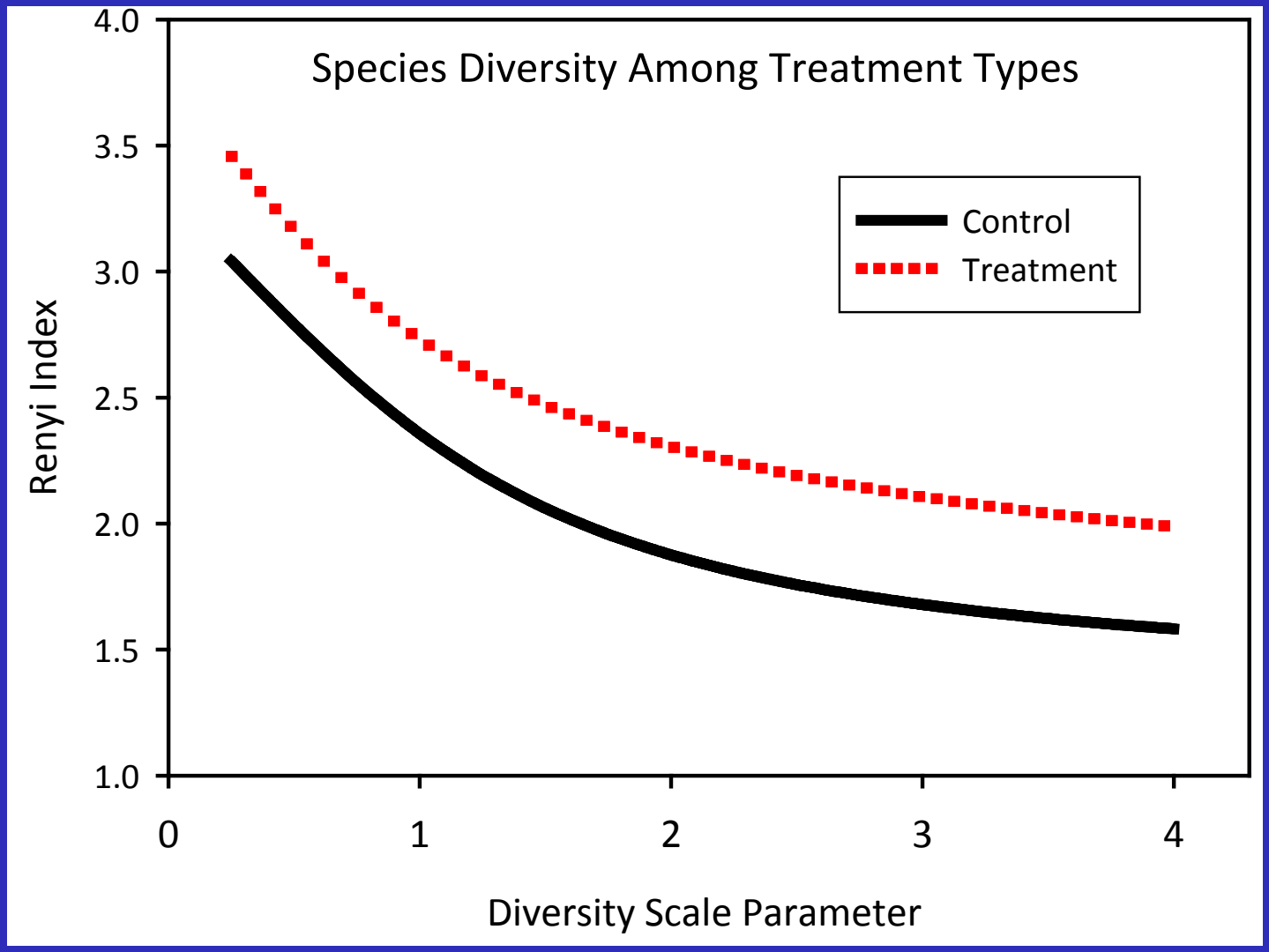
• Tamarix Density greater in Un-treated areas, so control efforts were moderately effective

Virgin River: Preliminary Patterns and Results

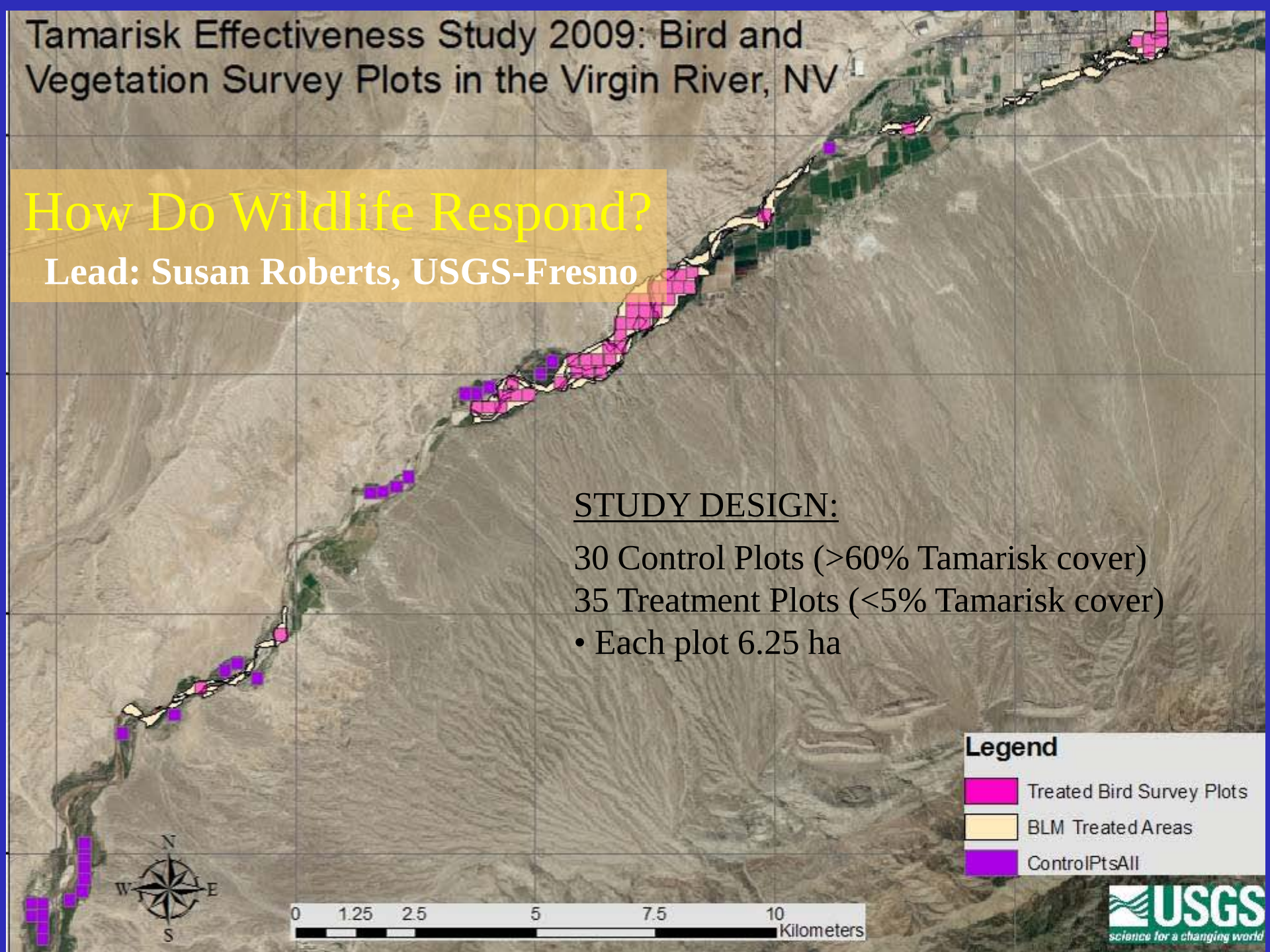


- Woody plant Density significantly greater in Control plots
- Non-*Tamarix* plants dominated in Treatments

Virgin River: Preliminary Vegetation Patterns



- Species Diversity is significantly greater in the Treated areas


Tamarisk Effectiveness Study 2009: Bird and Vegetation Survey Plots in the Virgin River, NV
How Do Wildlife Respond?
Lead: Susan Roberts, USGS-Fresno
STUDY DESIGN:
30 Control Plots (>60% Tamarisk cover)
35 Treatment Plots (<5% Tamarisk cover)
• Each plot 6.25 ha
Legend
Treated Bird Survey Plots
BLM Treated Areas
ControlPtsAll
N
W
E
S
0 1.25 2.5 5 7.5 10
Kilometers
USGS
science for a changing world

Impacts of Tamarisk Control on Bird Communities

April – July 2009: Field Data

Field Methods = Spot Mapping

- 8 surveys at each plot
  - 560 surveys total
- Map territories
- Identify species

Aug – Dec 2010: Analyze Data

Quantify & Compare:

1. Home range size
2. Abundance
3. Species Diversity

USGS science for a changing world

Tamarisk Control and Bird Communities

Preliminary Results:

Parameter	Control Plots	Treatment Plots
Abundance Index*	27.9 (0.5) birds	5.9 (0.2) birds
Species Richness	79 species (20 unique)	70 species (11 unique)
Number of Nests	16	1

- * Mean (standard error) of # individuals observed/ plot/ survey

USGS science for a changing world

Impacts of Tamarisk Control on Bird Communities

Disturbance promoted dominance by Russian thistle (*Salsola* spp.)

Treatment: tamarisk removed (<5% *Tamarix* canopy cover)

Control (>60% canopy cover by tamarisk)

Restoration with native saltbush (*Atriplex*) or screwbean (*Prosopis pubescens*) met fuel reduction goals, but not avian habitat needs

New Player / New Control Method

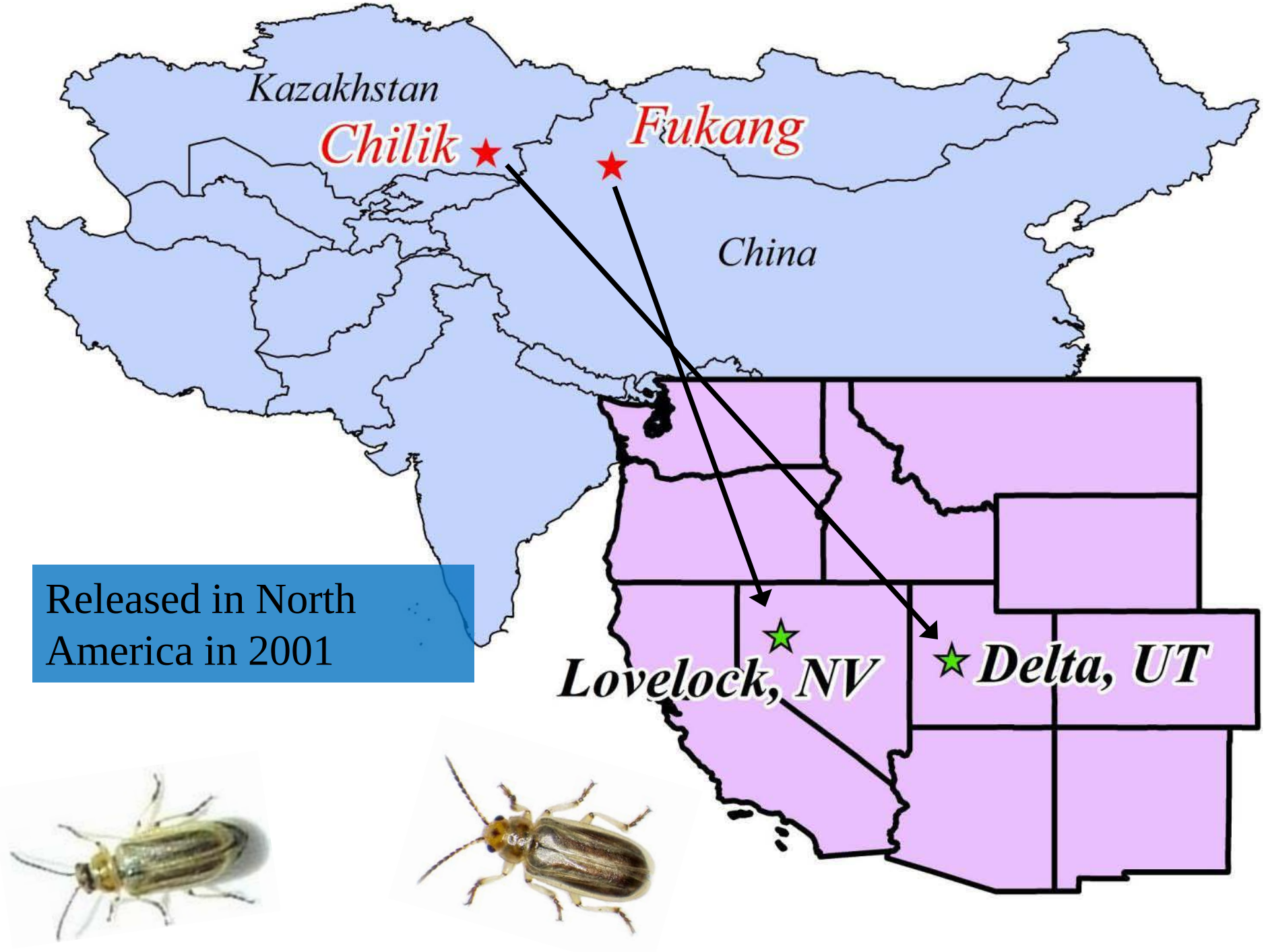
Biocontrol by *Diorhabda carinulata*

(Tamarisk Leaf Beetle)

Ed Kosmicki

Imported for BioControl of *Tamarix*
Released after 10+ years specificity testing

Larvae & Adults of *Diorhabda* feed only on Tamarix



Released in North America in 2001

Defoliation:
Scrapes foliage,
causes desiccation

June 11

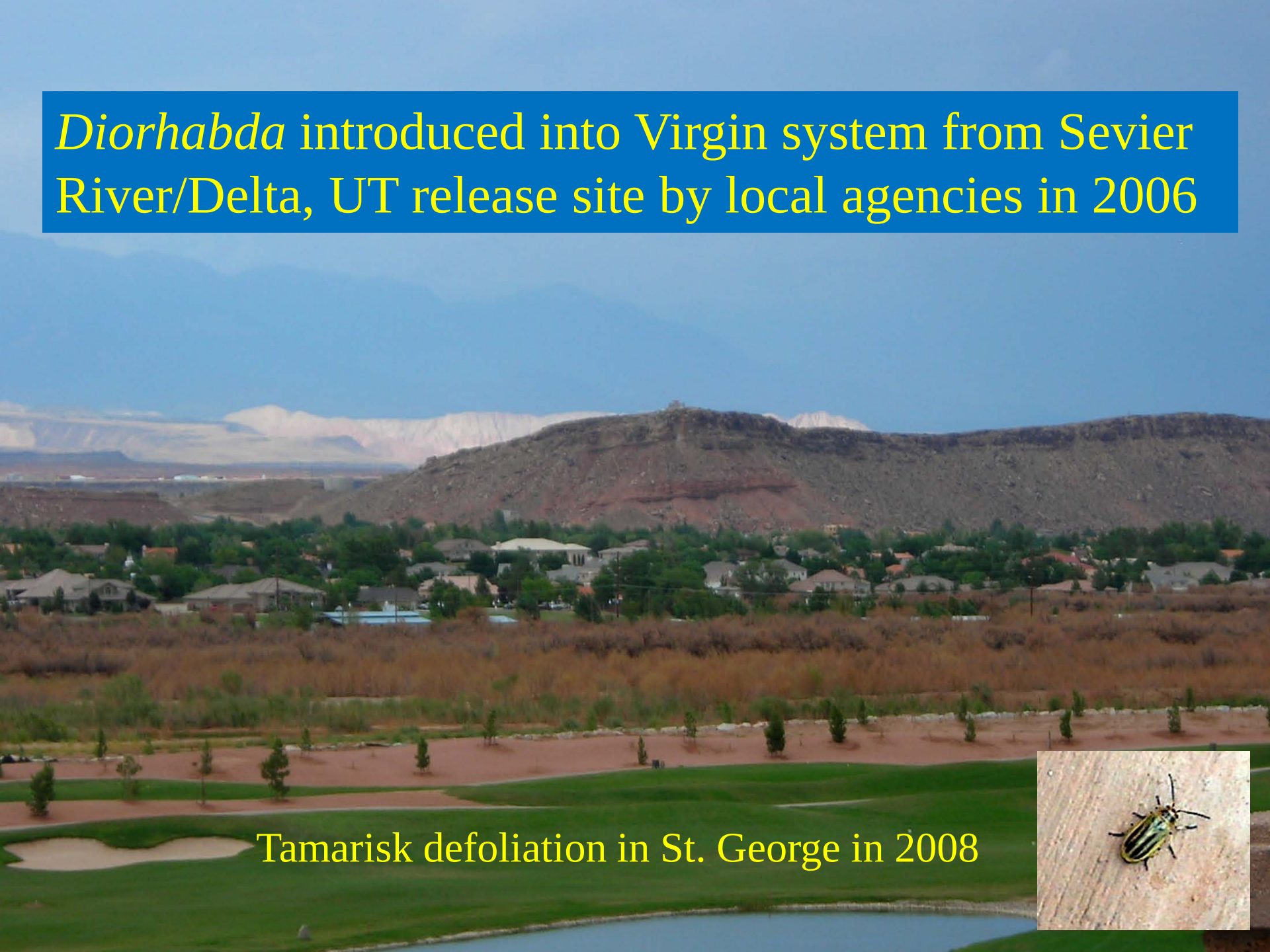
July 9

Humboldt River, NV

Impact can be Rapid & Dramatic

Re-growth in 4+ weeks
Dieback gradual &
Mortality slow

Diorhabda introduced into Virgin system from Sevier River/Delta, UT release site by local agencies in 2006



Tamarisk defoliation in St. George in 2008

Diorhabda Dynamics in Virgin Watershed 2006-2008

Carp NV

Meadow Valley Wash

Washington

2008 Dispersal zone

St George UT

2006-7 Defoliation

2008 Defoliation

Beaver Dam Wash

Littlefield AZ

Mesquite NV

Virgin Valley

Virgin River 2010 – Before Biocontrol (June 1) and After (July 1)

Littlefield AZ

Hypothesis: Gradual decline of *Tamarix* with recovery & establishment of native taxa

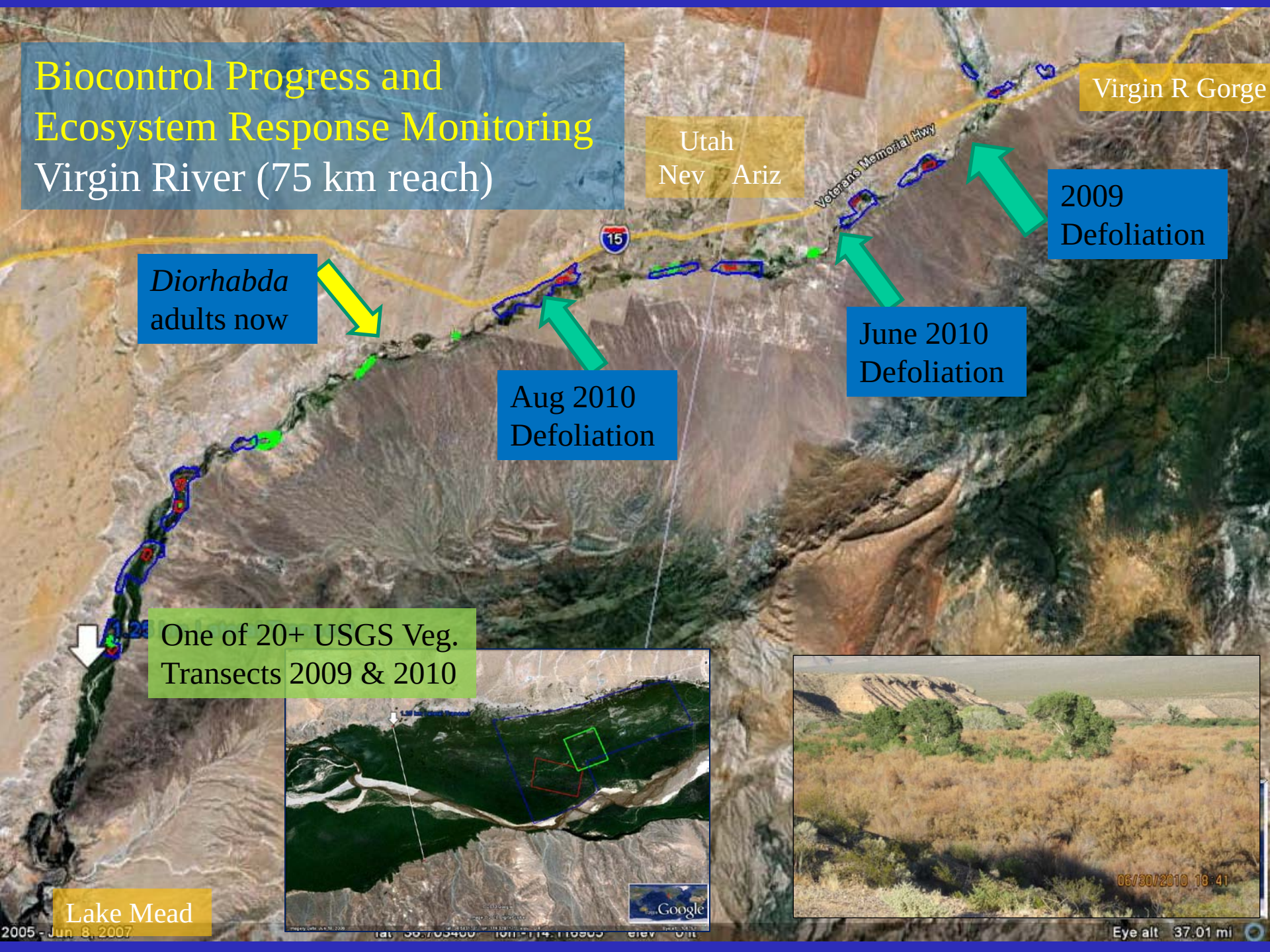
Ideally habitat is retained while weed reduction proceeds, unlike mechan-chemical treatments

Virgin River *Tamarix* Biocontrol – National focus of conservation concern & controversy

- Defoliation alters habitat structure for wildlife
- Lawsuit by Center for Biological Diversity over effects on southwestern willow flycatcher
- Potential elevated wildfire risk

Biocontrol Progress and Ecosystem Response Monitoring

Virgin River (75 km reach)



Biocontrol Monitoring Collaboration (10-yr goal)

– Clark Co. MSHCP has leveraged critical monitoring partners –

- Vegetation transects for length of Virgin R. (Annual)
  USGS National Invasive Species Program (NISP)
  (Shafroth, Belnap, Ostoja, Friedman)
- Insect monitoring
  Colorado Dept of Agric, Tamarisk Coalition (Bean, Jamison)
- Wildlife monitoring – Avian, Herptiles, Small mammals, Bats
  Arizona St. Univ., USGS-NISP, Stillwater Sciences, BOR
  (Bateman, Kuehn, Ostoja, van Riper, Kuczinska, Maier, et al.
- EvapoTranspiration and Groundwater monitoring
  UNLV, DRI, U of Utah, Bur. of Reclam. (Conrad, Devitt, Young , Hultine, Nagler)
- Remote sensing – Time-Science (Brown)
- Restoration – Partners in Conservation (McAlister), City of Mesquite (Willis), Tamarisk Coalition, Walton Foundation

Ecosystem Monitoring

Bi-weekly surveys for *Diorhabda* dispersal, life cycle and host plant impact

Annual vegetation transects: host plant architecture and associated species

Avian Community Assessment

Mike Kuehn, UCSB

Potential Negative Impacts

- **Nest exposure**
  - Species affected? Late nesters?
- **Loss of Tamarisk habitat** (slow)
  - Reduce avian diversity or abundance?

Potential Beneficial Impacts

- New **trophic level** to ecosystem
  - -Beetles used as food resource by nesting & migrating birds?
- **Net improvement of habitat**? (long-term)
  - Restoration X Biocontrol interaction

Benefits of a community-wide assessment

- Little known about avian reproductive success in Tamarisk
- Identify species affected by biocontrol
- Proxy species for willow flycatcher? (e.g., Yellow Warbler)
  - Larger sample sizes
  - Manipulations possible

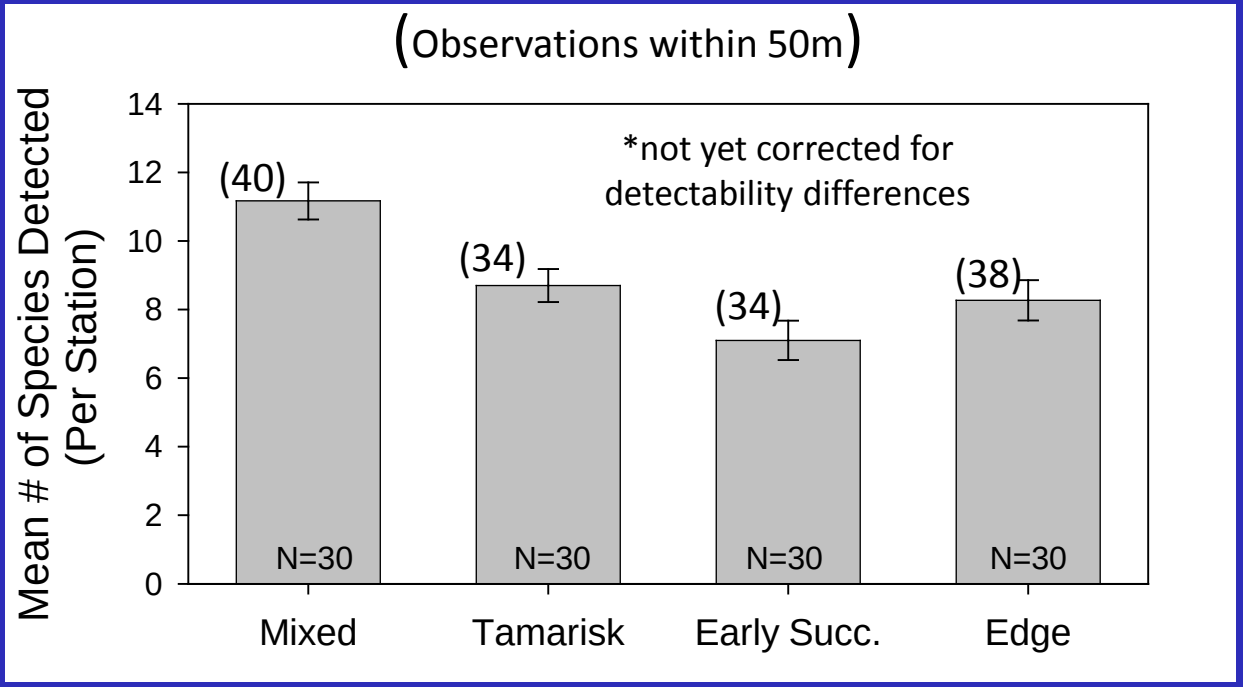
Point Count Surveys: Preliminary Results

Protocol
- 10 minute point counts
- All birds detected by sight or sound
- Estimate distance to each detection

Results
- 71 species recorded (all distances)
- 1 SWFL (nesting), 2 migrants?
- 4 YB Cuckoo (apparent nesting)

Provides baseline dataset to assess future avian populations

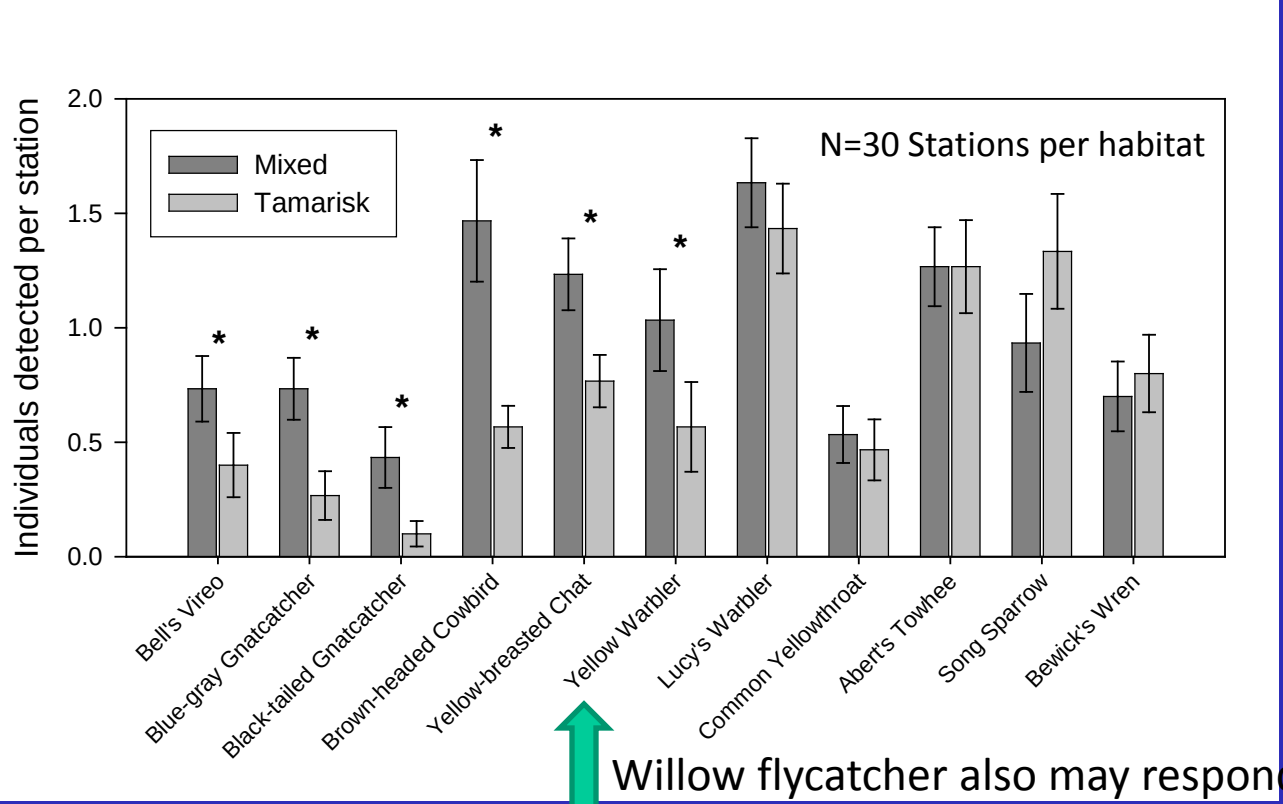
Avian Diversity By Habitat



Point Count Surveys: Preliminary Results

Relative Abundances: Mixed versus Tamarisk Habitats

- 6 of 11 species lower in *Tamarix*, including Yellow Warbler (SWFL proxy)
- Cowbirds rarer in Tamarisk too (fewer hosts?)
-



Willow flycatcher also may respond positively

Nest Monitoring: Preliminary Results

Protocol

- Monitor nests of all species present
- Status confirmed every 2-5 days

Black-chinned Hummingbird
Nest in tamarisk

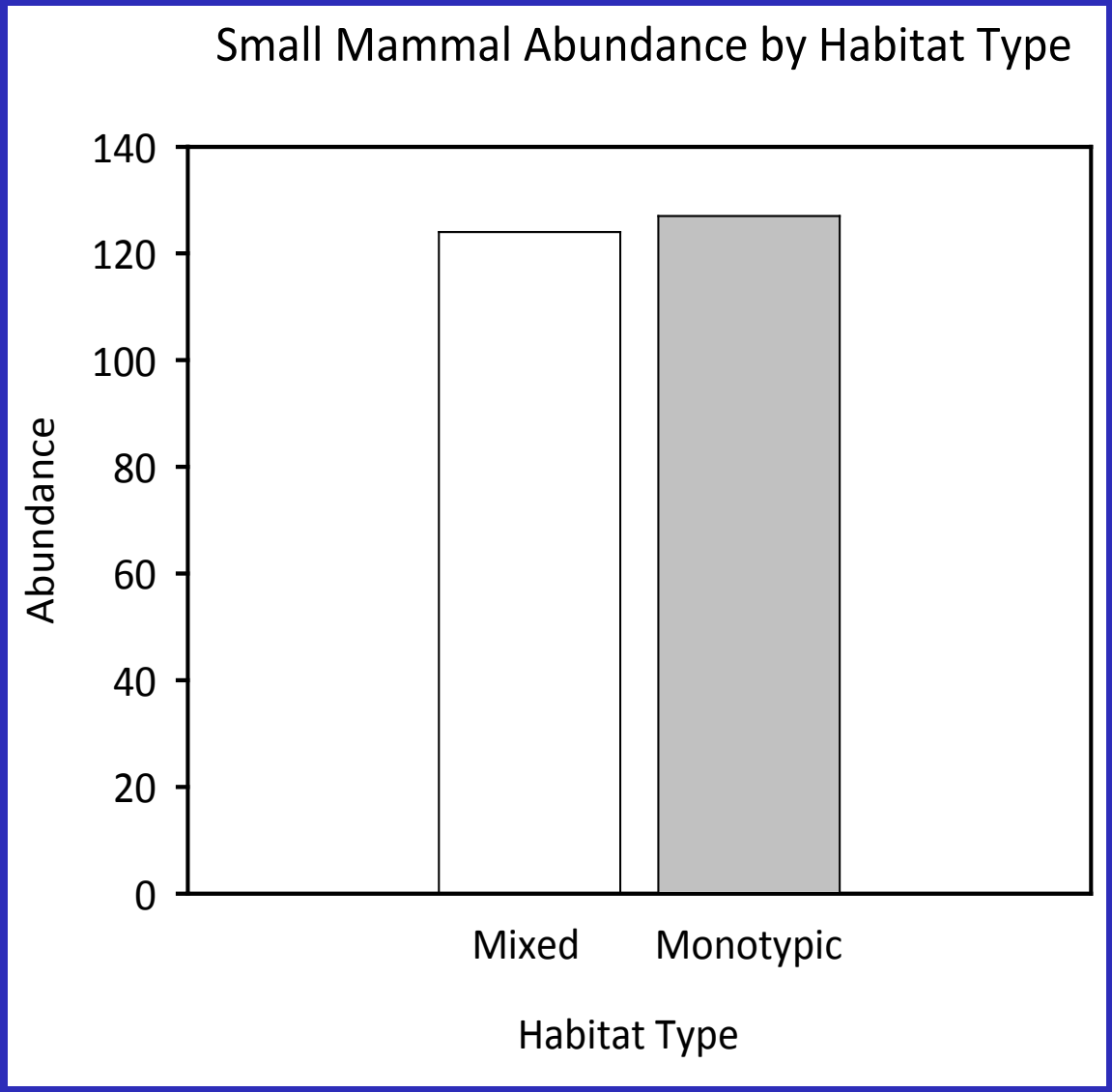
Bell's Vireo nest in Tamarisk

Habitat comparisons (nests of all species pooled)

- Daily probability of nest survival
  - Mixed (n=115 nests): **0.940**
  - Tamarisk (n=41 nests): **0.978**

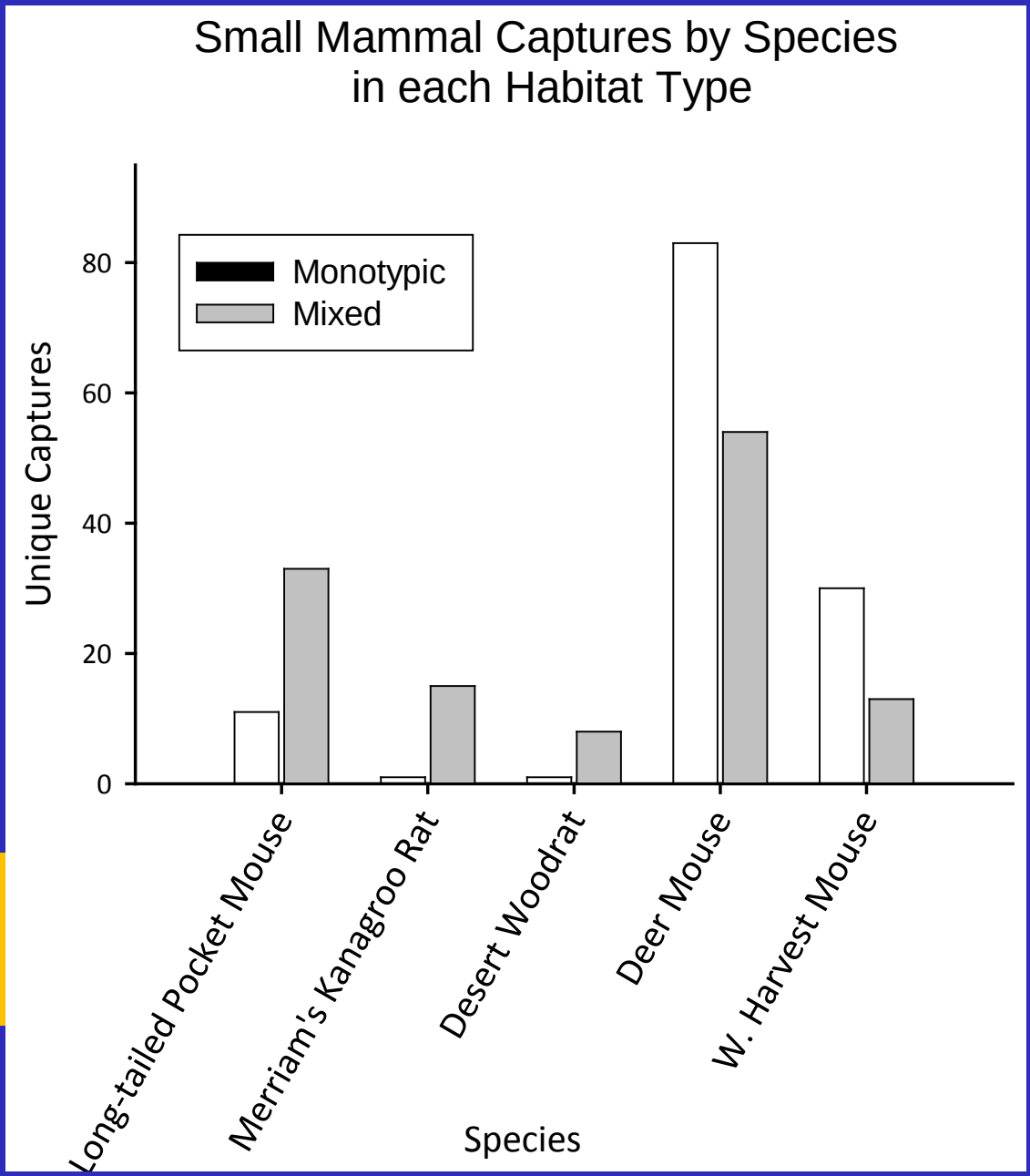
- **Small mammal Live trapping**
- 16 sites – 8 monotypic and 8 mixed grids
- 5 species
- 251 unique rodent captures
- Data are pre-beetle

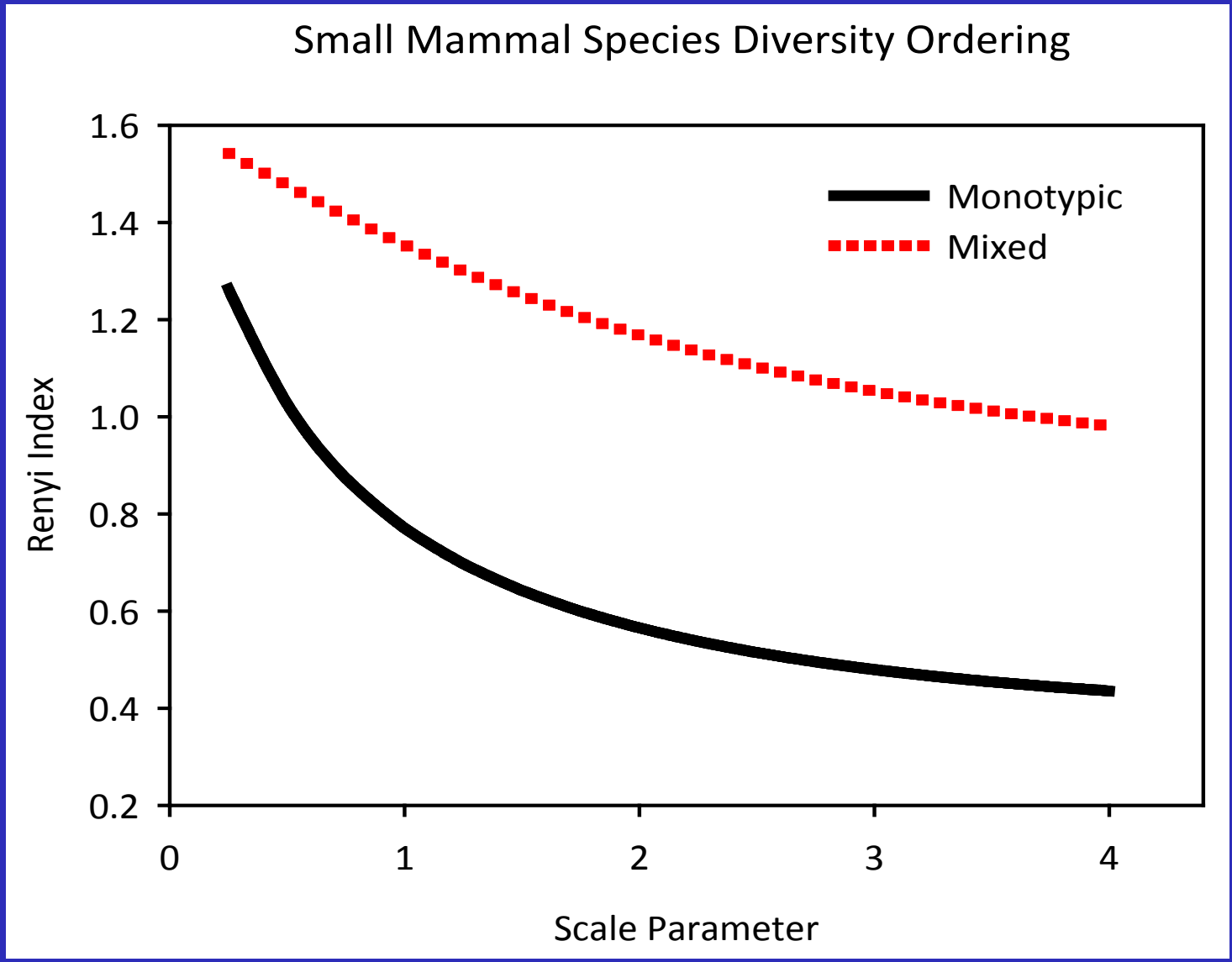
Ostoja (USGS) & Bateman (ASU) Funding: USGS National Invasive Species Program



- Similar overall abundance

- Species occurrences differ among habitat types





Significantly greater species diversity in mixed habitat type

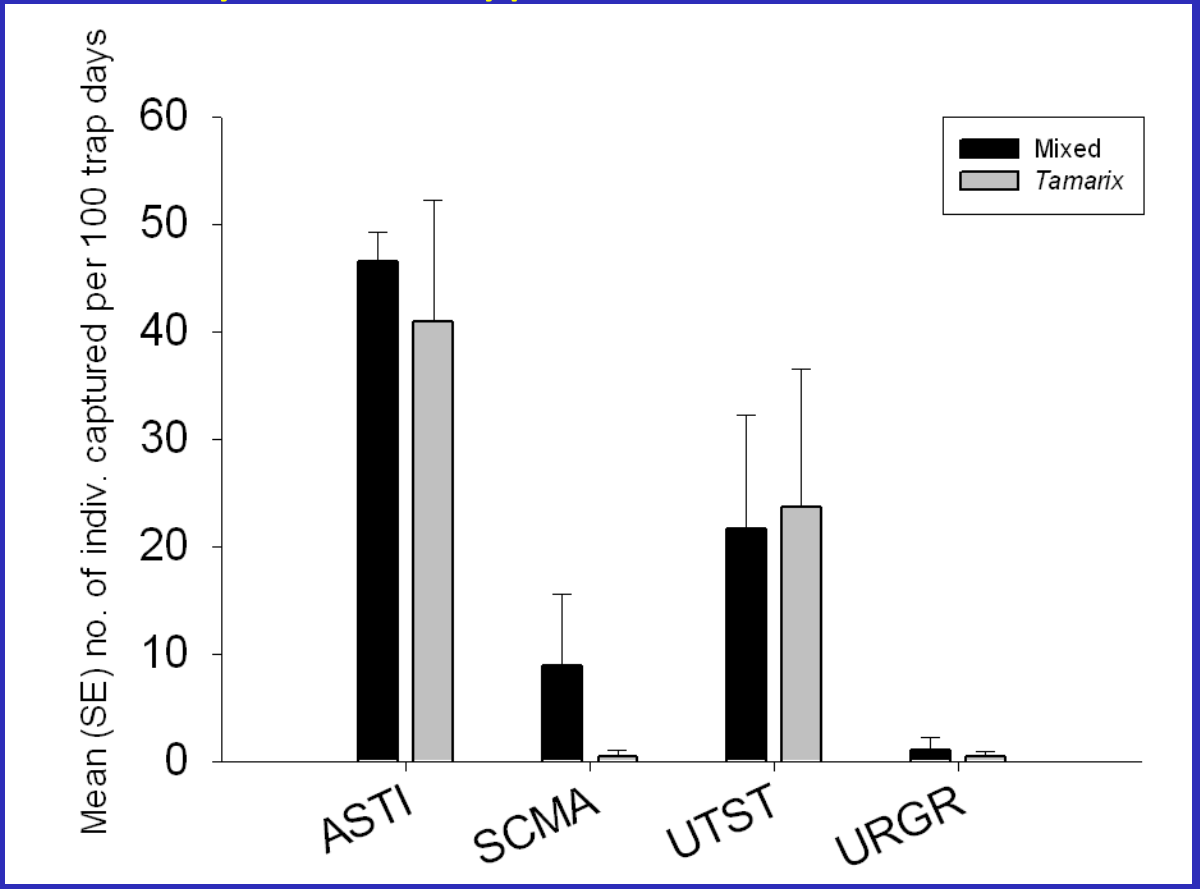
Increasing Tamarisk density will decrease diversity




- Live trapping methods
- 7 sites – 3 monotypic and 4 mixed
- 11 species of amphibians and reptiles
- >300 unique lizard captures in 2010 and feeding trials
- Data are pre beetle

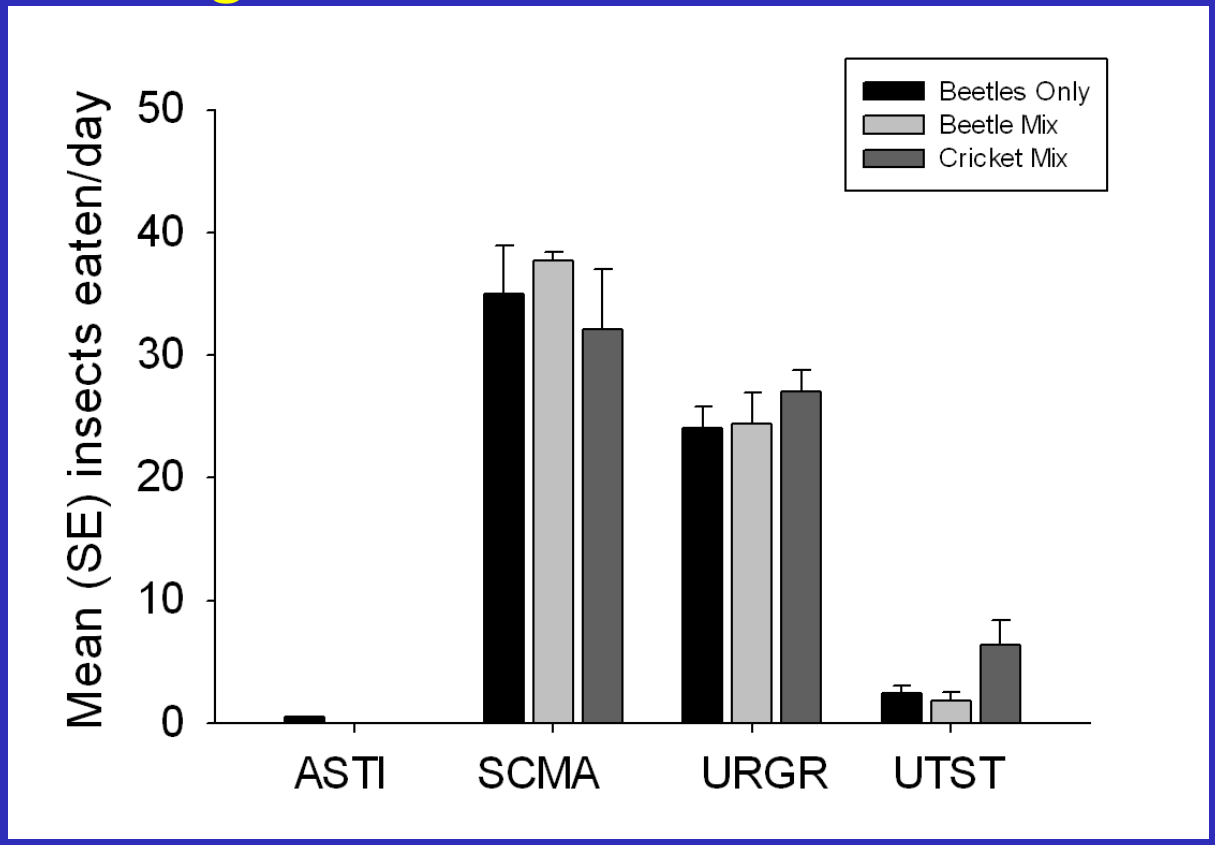
Heather Bateman (Ariz. State U. Polytechnic)

Abundance of most common lizard species by habitat type



- Similar overall abundance between mixed and monotypic habitat
- SCMA (desert spiny lizard) found mostly in mixed habitat

Feeding trials with insectivorous lizards

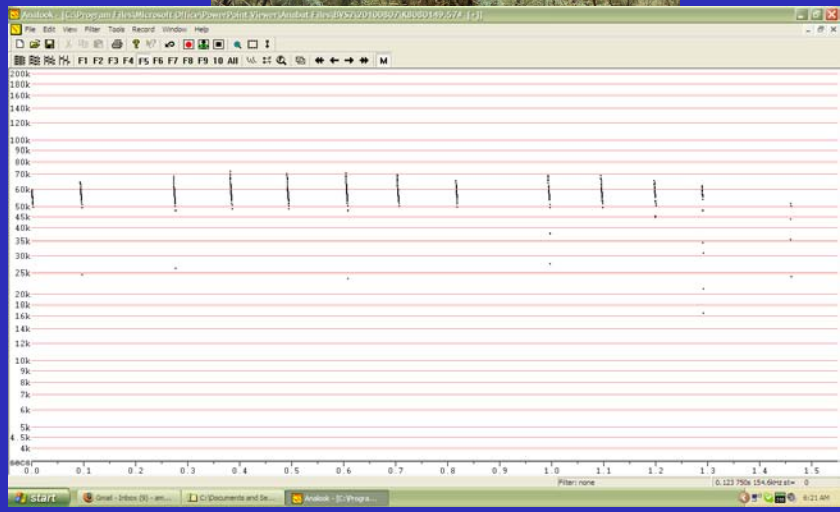


- Four species of lizards will eat tamarisk leaf beetle
- ASTI (tiger whiptail) confirmed to eat beetles from field study
- UTST (side-blotched lizard) may prefer crickets over exotic beetle

Bats and Veg Associations

Vona Kuzcinska & Amanda Stenman

ANABAT sonagram censusing



Water Savings from Reduced Evapotranspiration

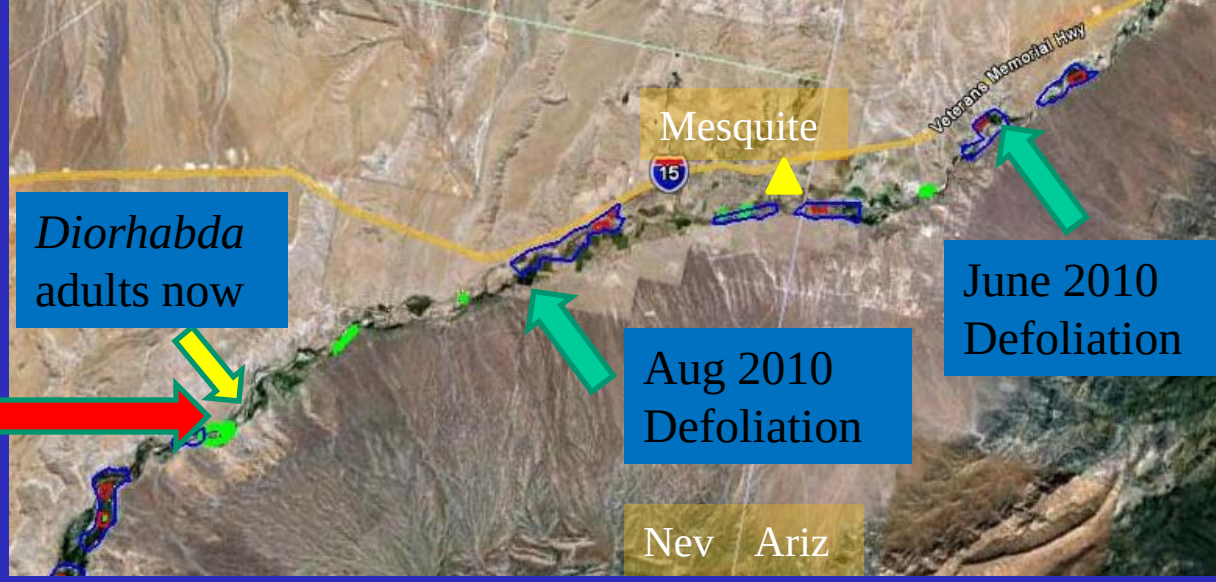
Eddy Covariance ET Monitoring - Riverside

Ben Conrad & Dale Devitt, UNLV, Mike Young - DRI

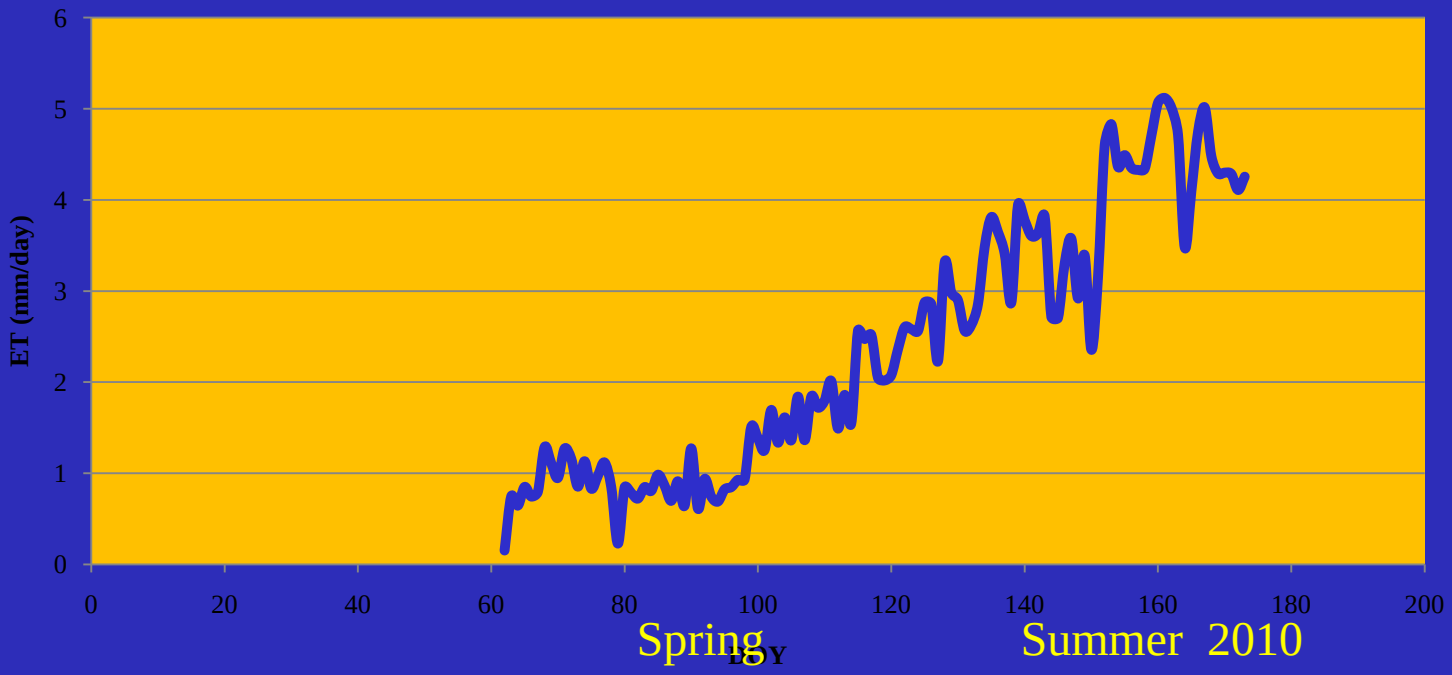
Sap-Flow & Groundwater Monitoring

Kevin Hultine, Univ. of Utah

Pre-Biocontrol ET



Meadowland/Riverside Eddy Flux Daily ET



Spring

Summer 2010

B. Conrad, UCSB/UNLV

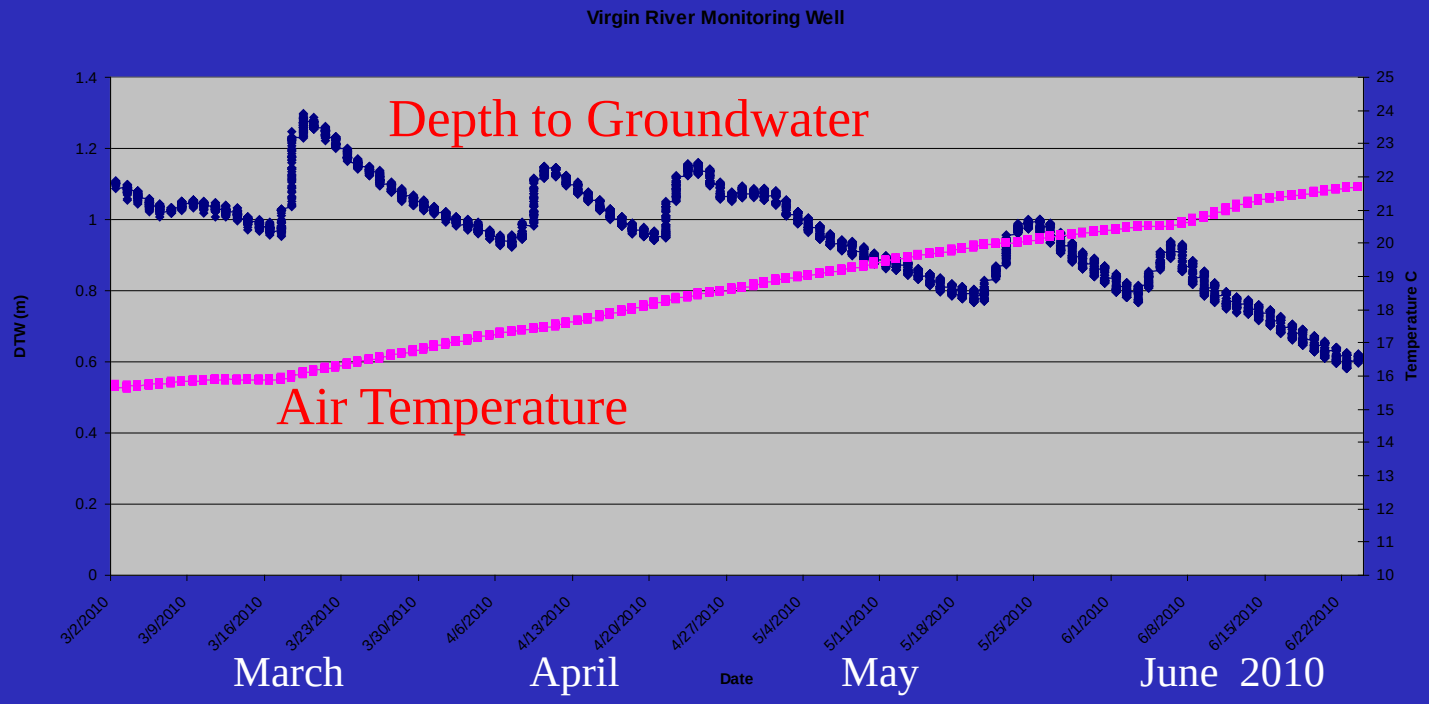
Tracking GroundWater Table

Responds to: Precipition in watershed

Changes in Irrigation regimes

ET variation related to photosynthesis,

temperature…or Defoliation



Tamarix, Biocontrol & Fire

Lead: Gail Drus (UCSB)

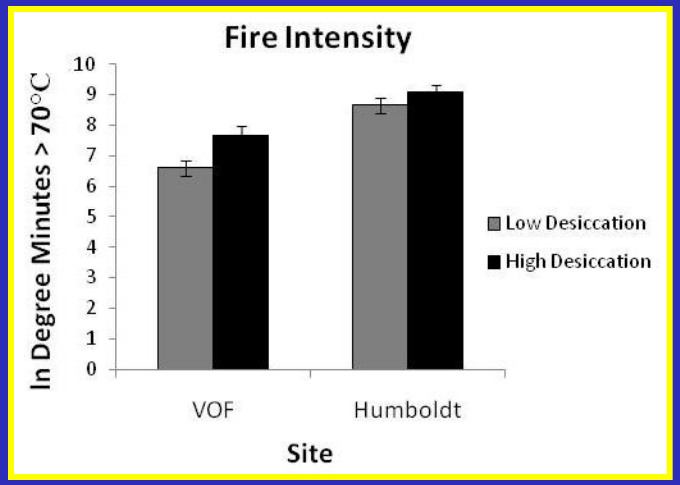
- Does biocontrol increase fire risk?
- Will fire risk decline over time?
- Do herbivory and fire interact to enhance mortality?
- How does tamarisk/fire regime affect native plants?

Defoliation and Fire Risk


Valley of Fire, Lake Mead NRA

Low-dose herbicide simulates beetle ‘defoliation’ = desiccation

Prescribed fire to compare flammability of green and desiccated foliage

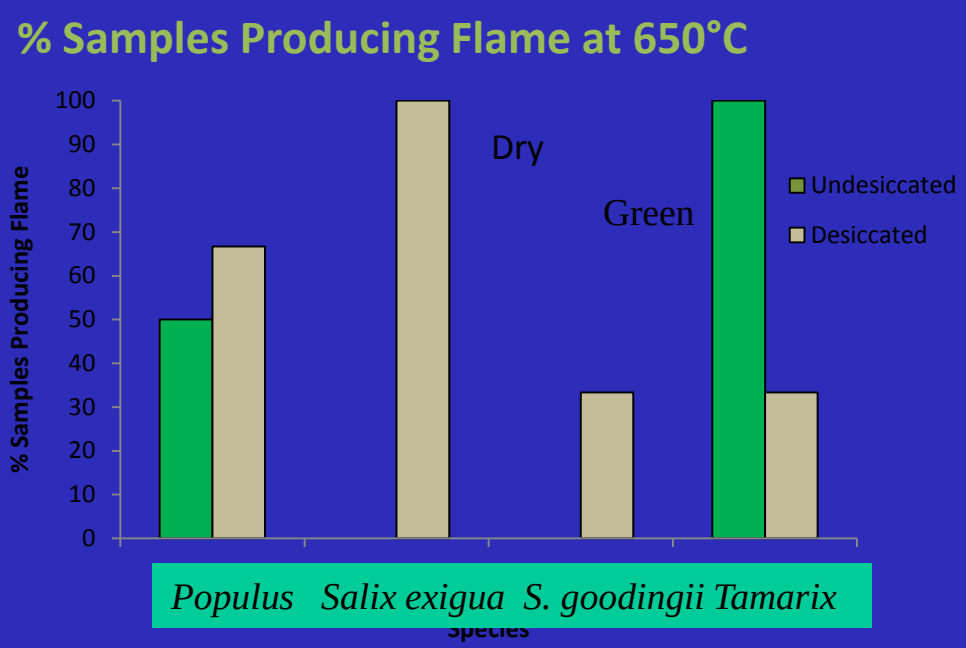


Desiccation caused minor increase in fire severity

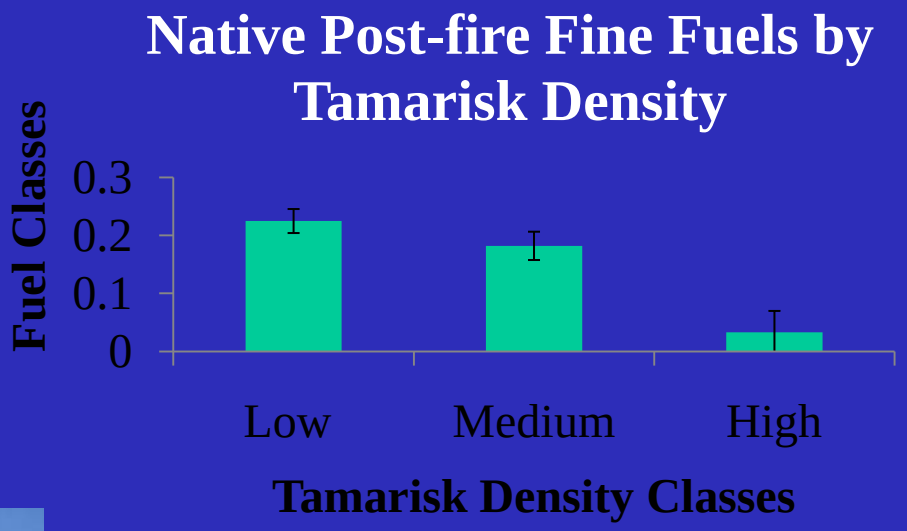
Fire risk is only slightly increased by biocontrol

Severe wildfires fueled by green foliage

Less ‘green’ = lower fire severity…so biocontrol effect is temporary



Tamarix is a threat to native plants
Higher abundance = increased impact



…and to wildlife, like SW willow flycatcher

Conclusion: Enhancing relative abundance of native riparian plants, with minimal physical disturbance, will:

1. Reduce wildfire risk & ecological impacts
2. Improve wildlife abundance & diversity
3. Improve ecosystem function & services (probably)

By BioControl and/or Restoration

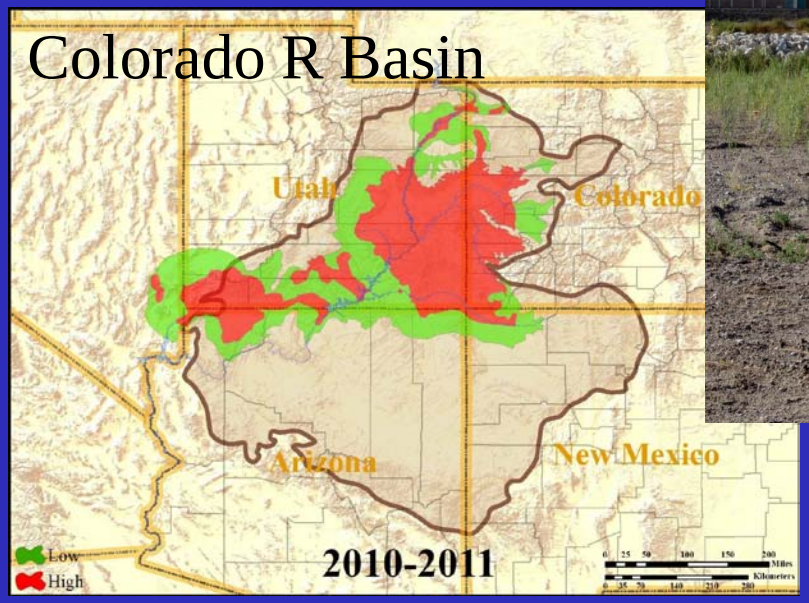
Tamarisk Coalition

The WALTON FAMILY FOUNDATION

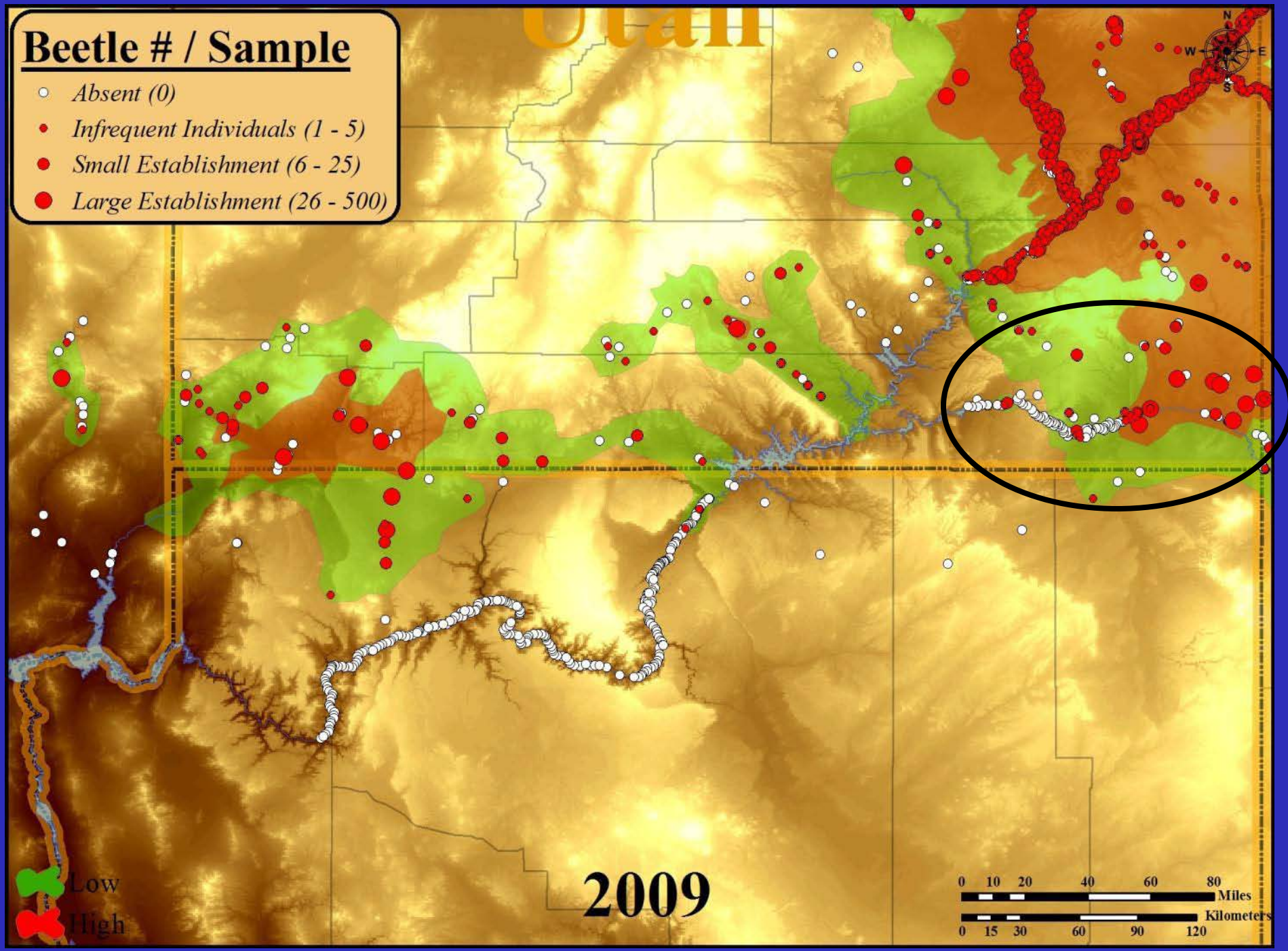
a non-profit alliance working to restore riparian lands

SWFL/*Tamarix* Restoration Action Plan

Start Sept 2010



Participants: US-FWS, Tamarisk Coalition, UCSB, USGS, SWCA, K. Lair


Beetle # / Sample
Absent (0)
Infrequent Individuals (1 - 5)
Small Establishment (6 - 25)
Large Establishment (26 - 500)
Utah
N
W
E
S
Low
High
2009
0 10 20 40 60 80
Miles
0 15 30 60 90 120
Kilometers

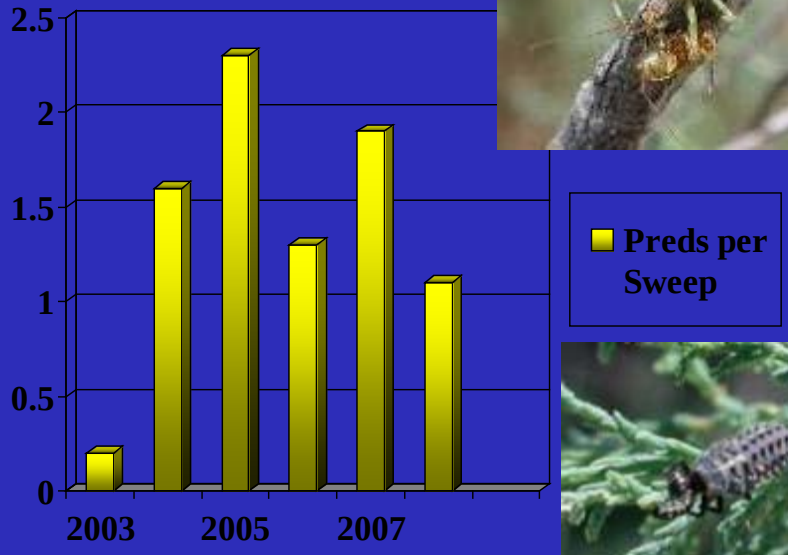

07/17/2010 08:38


07/17/2010 09:21

Insect Population Monitoring

Track larval and adult stages of *Diorhabda*; Impacts to *Tamarix*

1. Predators can limit establishment
2. May increase with new prey resource



Interactions with InvasivePlant Control and Revegetation