

Tamarisk, Management, and Implications to Pollinator Communities

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Insects and the Ecosystem

worldwildlife.org

Animals as pollen vectors

- 352,000 species of known flowering plants
- 88% are completely or partly reliant on animals for pollination
  - Main pollinators include bees, butterflies, moths, wasps, flies, birds, bats, beetles, and even some lizards

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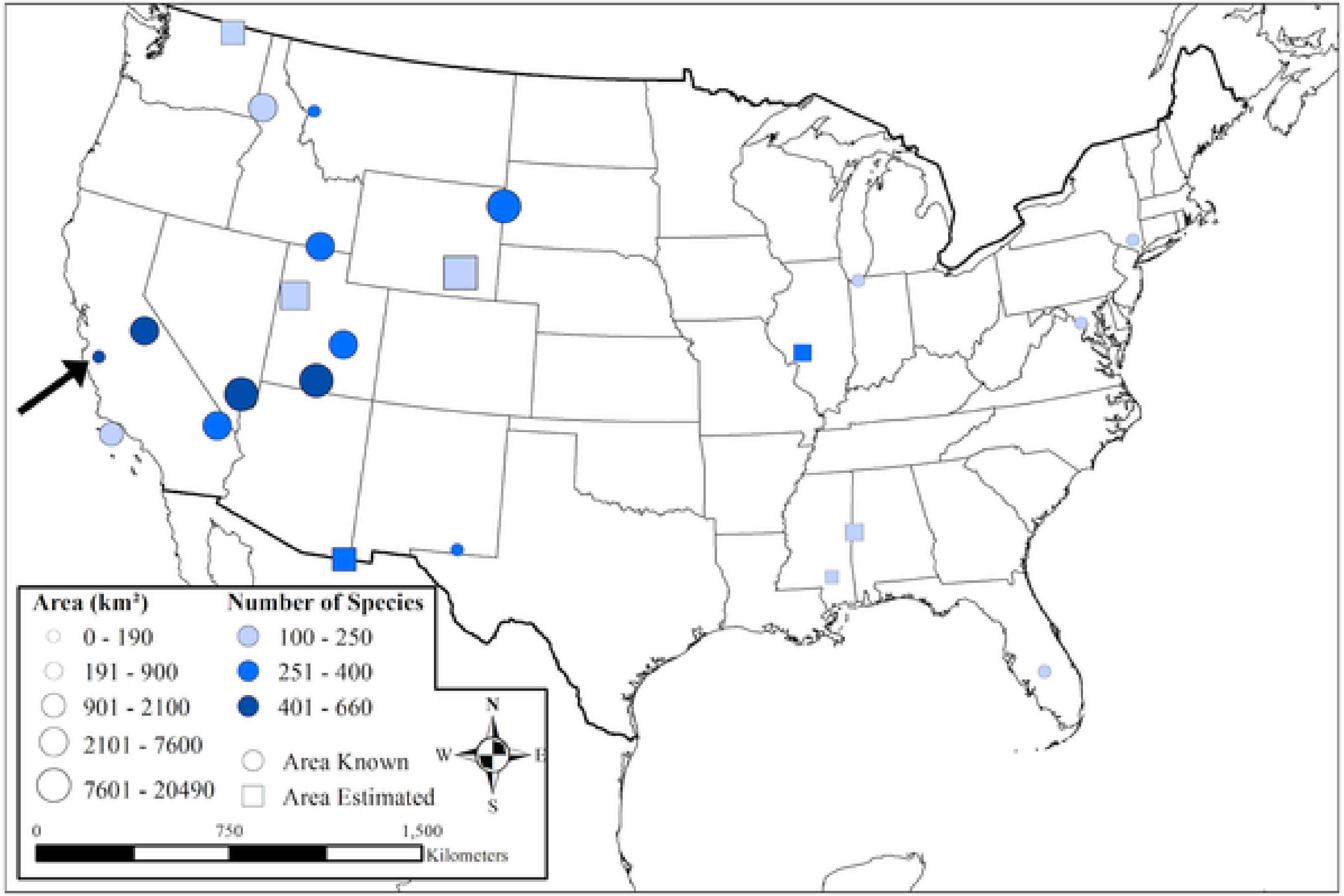
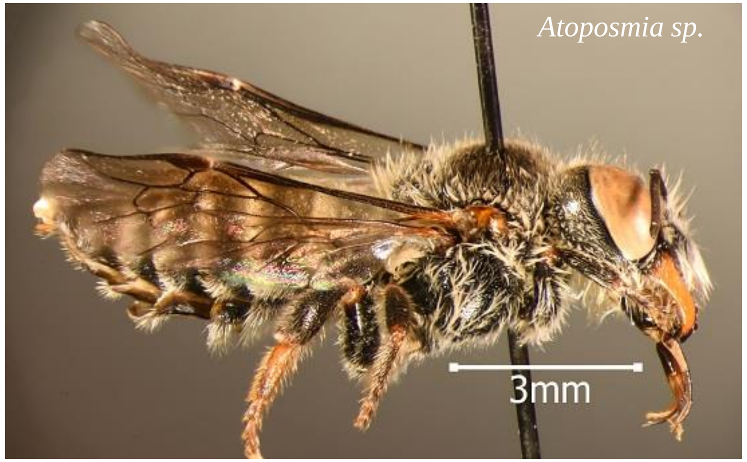
- Internationally, bee density largely concentrated in Mediterranean and arid habitats
- In the US:
  - San Bernardino Valley, AZ
  - Grand Staircase Escalante National Monument, UT
  - Pinnacles National Park, CA
  - Yosemite National Park, CA
  - Clark County, NV
    - 600 bees in Clark County



Michener 1979. Biogeography of the bees.
Meiners, J.M., T.L. Griswold, and O. Messinger Carril. 2019. Decades of native bee biodiversity surveys at Pinnacles National Park highlight the importance of monitoring natural areas over time.
Minckley and Radke, 2021. Extreme species density of bees (Apiformes, Hymenoptera) in the warm deserts of North America.
Melin et al. 2024. Fine-scale bee species distribution models: Hotspots of richness and endemism in South Africa with species-area comparisons.

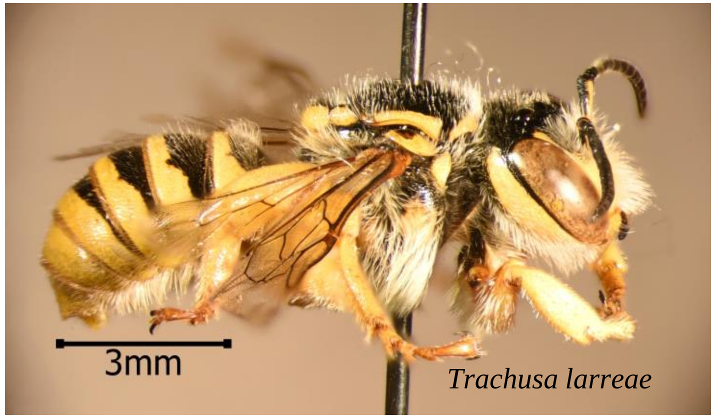
Diadasia sp.

Ashmeadiella xenomastax

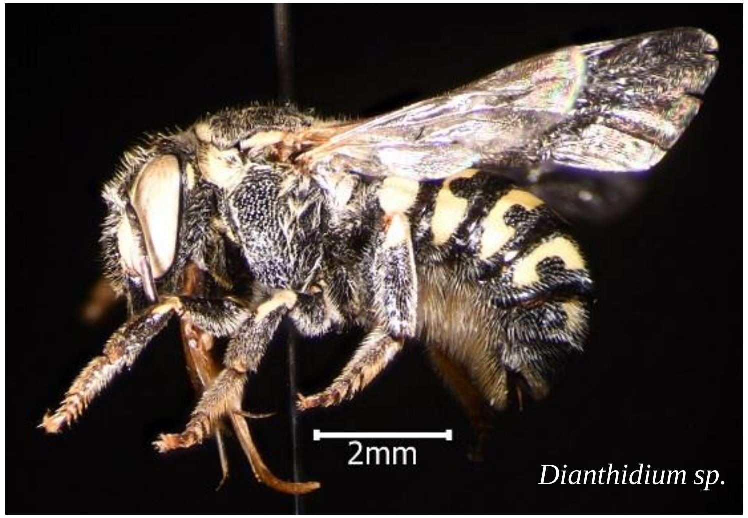


Atoposmia sp.


Lasioglossum dialictus



Trachusa larreae



Dianthidium sp.

Lasioglossum subgenus sisymbrii

Osmia sp.

Agapostemon sp.

POLLINATOR DECLINE

- Habitat loss and fragmentation
- Drought and climate change
- Changing fire regimes
- Increased flooding
- Invasive plant species

RIPARIAN HABITATS AND THREATENED AND ENDANGERED SPECIES

- Riparian habitats constitute less than 2% of the land area in the American Southwest (NPS 2024).
- 70% of threatened and endangered vertebrate species are dependent upon riparian zones for at least a part of their life cycle (National Fish and Wildlife Foundation 2024).

Southwestern Willow Flycatcher

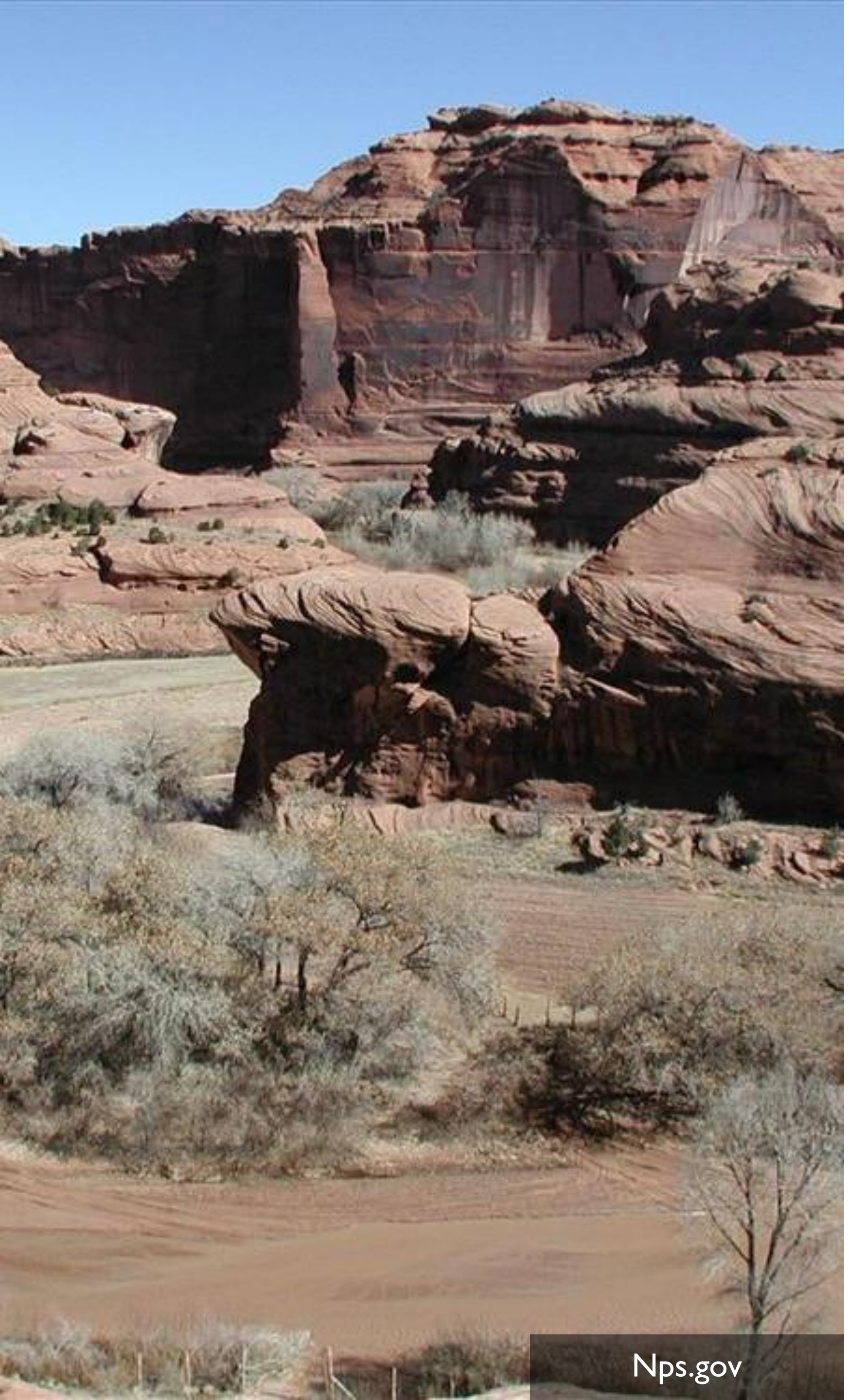
- Federally Endangered
- Decline largely due to loss and degradation of dense, native riparian habitat

nps.gov/articles/southwestern-willow-flycatcher.htm

Monarch Butterfly

- Proposed Threatened
- Widely distributed throughout the US, including NV
- Threats include habitat loss, pesticides, and disease
- Riparian areas are a focus for monarch conservation

fws.gov/initiative/pollinators/save-monarch



INVASIVE PLANTS OF RIPARIAN CORRIDORS

- Russian olive
- Bull thistle
- Giant reed
- Russian thistle

INVASIVE PLANTS OF RIPARIAN CORRIDORS

TAMARISK

- Native to regions of Asia, northern Africa, and southern Europe.
- Introduced to U.S in the1800s as an ornamental shrub, used in windbreaks and erosion control
- One of the greatest threats to riparian ecosystems
  - Estimated to have displaced over 1.6 million acres of riparian habitat in the western U.S (Shafroth et al. 2005).

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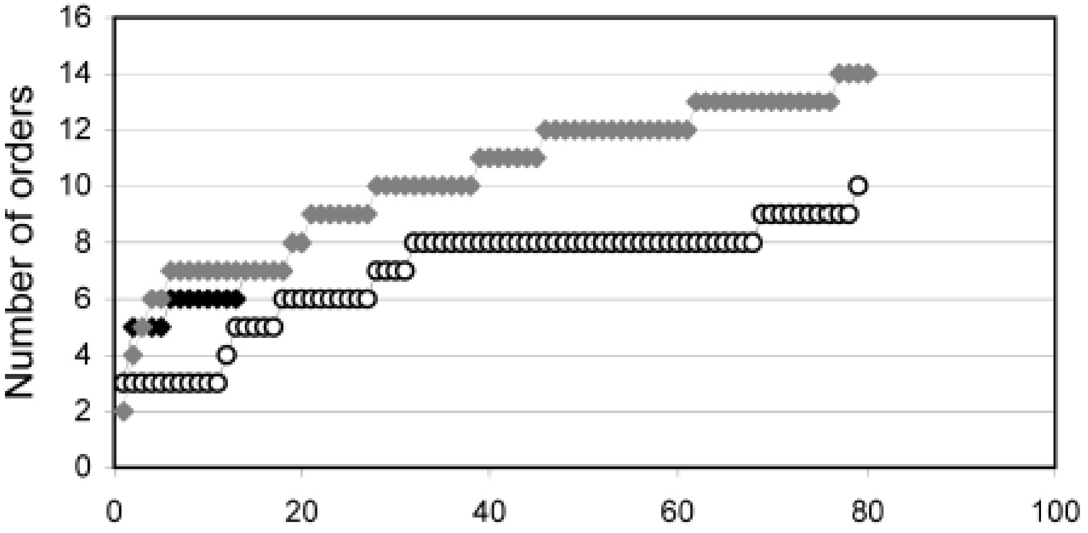
TAMARISK & POLLINATORS

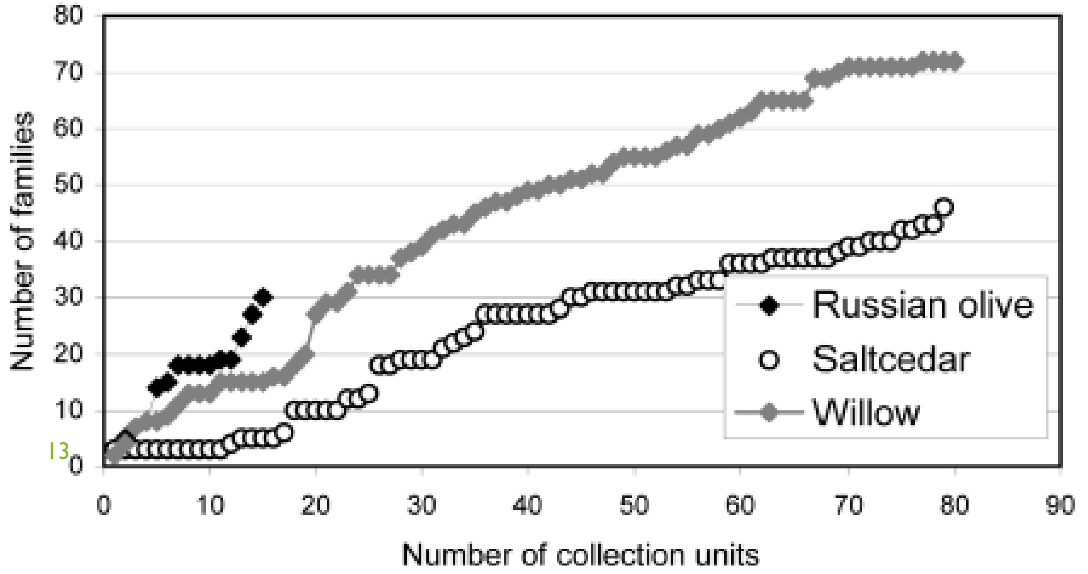
- Southwestern willow flycatcher nests and forages in Tamarisk

Southwestern Willow Flycatcher in the Tonto National Forest. Andre Silva, U.S. Forest Service, 2010.

TAMARISK & POLLINATORS

- Southwestern willow flycatcher nests and forages in Tamarisk
- Pendleton et al. 2011 – Native vegetation of willows, compared to salt cedar and Russian olive, had greatest number of arthropod orders and families
- Uhey et al. 2020 – Tamarisk habitat did not have less arthropod abundance or richness compared to willows and native shrub, but did contain altered arthropod composition





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[86] **Saltcedar**

Tamarix spp

Saltcedar

Stem	▪ Shrub or small tree; multiple large stems arise from root crown; up to 20 ft. tall, highly branched with reddish-brown bark; leaves turn yellow to red in autumn
Leaves	▪ Alternate; deciduous; green to blue-green, small (0.06-0.14 in. long), oval to lance-shaped, overlapping and scale-like
Flower	▪ Tiny with 5 white to pink petals; arranged in finger-like clusters at the tips of branches
Root	▪ Deep taproot with creeping roots
Other	▪ Often found along edges of waterways, lakes and ponds; known to occur in all Nevada counties ▪ Perennial; reproduces by seed, roots and stem fragments ▪ High concentration of salt in fallen leaves can impact growth of other plants ▪ Also known as tamarisk
Control	▪ Cutting, digging or burning MUST be combined with a chemical application to be effective ▪ An insect biological control agent is available ▪ Apply imazapyr to actively growing foliage during flowering; triclopyr, glyphosate or imazapyr as a cut stump or basal bark treatment

University of Nevada Cooperative Extension, 2010. *Nevada Noxious Weed Field Guide*

CUT STUMP

- Cut tree to trunk (stump)
- Apply herbicide to phloem
  - Phloem=living tissue that transports nutrients to organism

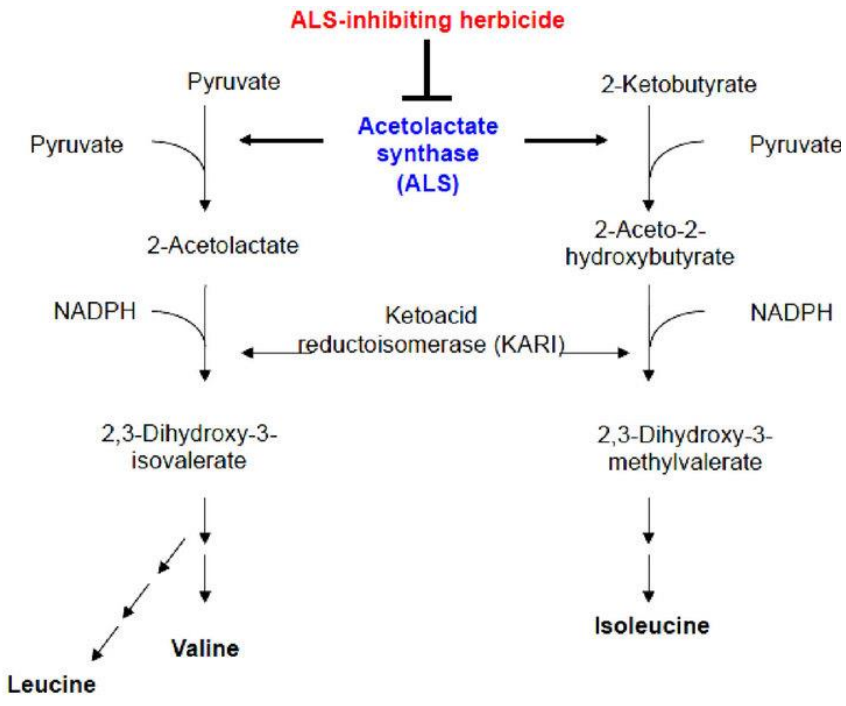
BASAL BARK

- Apply herbicide to outside of tree
- woody plants with **smooth** bark (that's important — easier to penetrate)

FOLIAR

- Apply herbicide to foliage
- Not as effective for tamarisk management

- Restricts the synthesis of acetolactate synthase (ALS)
- ALS enables production of branched-chain amino acids (BCAAs)
  - Restriction = stunted plant growth, cell death
- ALS is found only in plants and microorganisms
  - classified as “practically non-toxic” to non-target species by the EPA

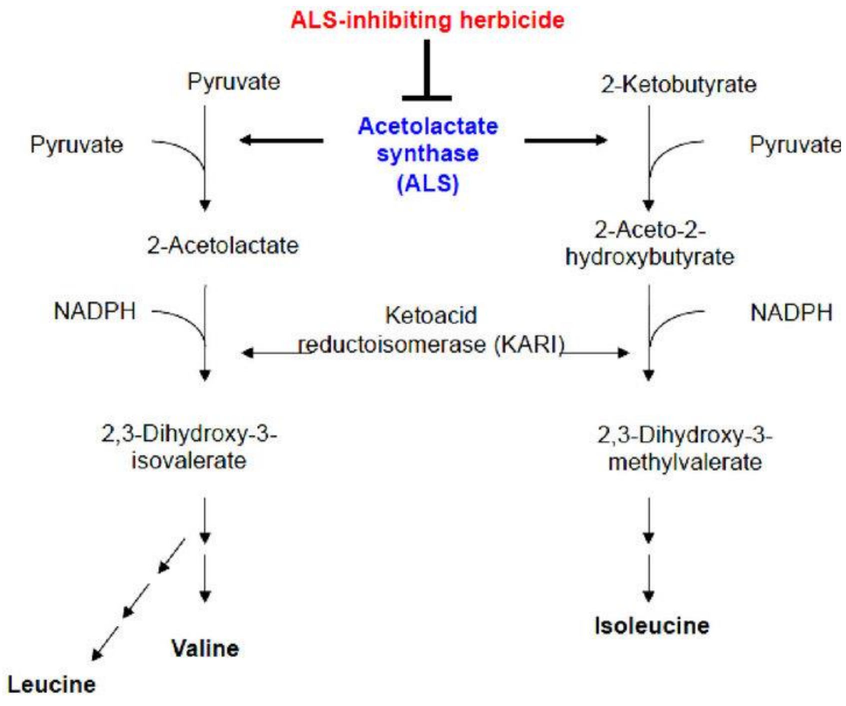


Endo et al., 2013.

TAMARISK CONTROL - HERBICIDE

Imazapyr

- Takes 25-142 days to break down in soil
- Habitat, Arsenal, and Chopper Generation 2
- Effective via cut stump or basal bark application
  - Most effective when plant is actively flowering



Endo et al., 2013.

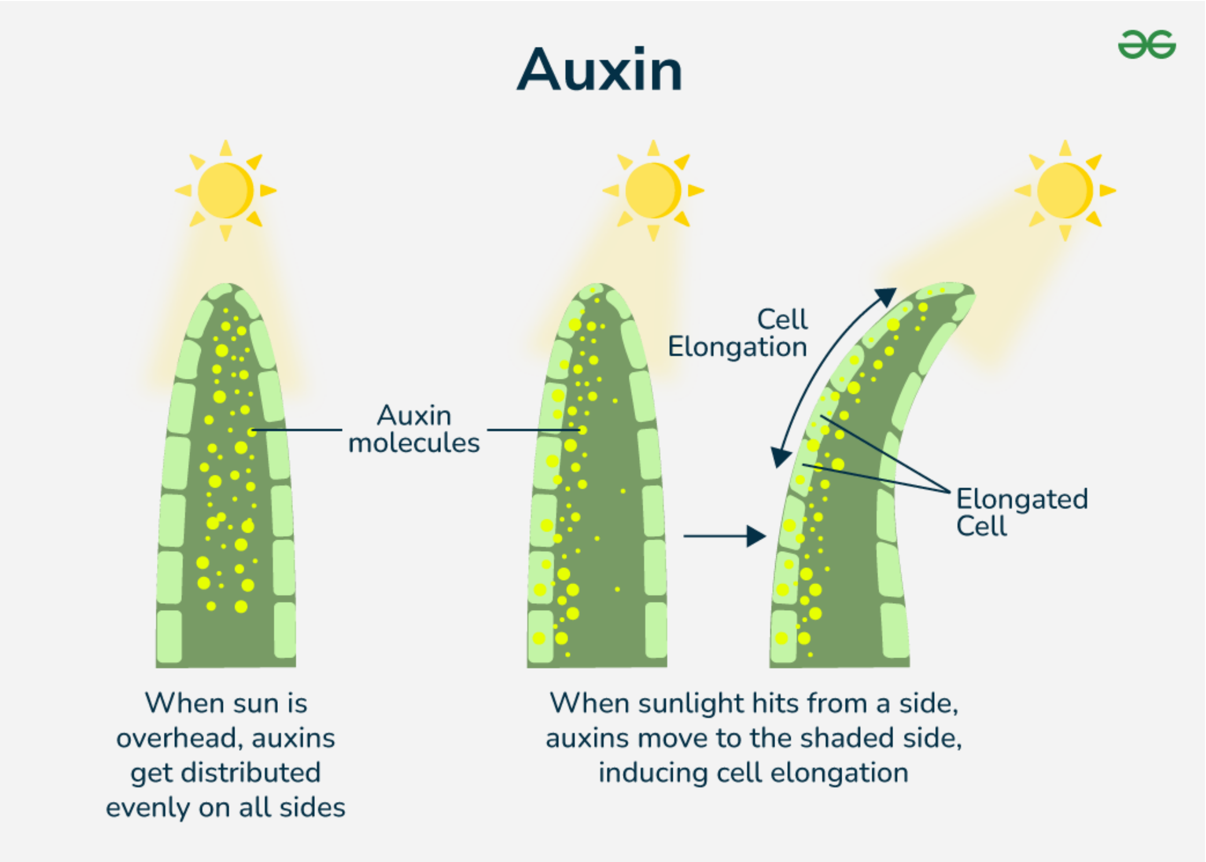
TAMARISK CONTROL - HERBICIDE

Imazapyr

- Primary impacts not studied
- Secondary impacts to pollinators from damage or death to non-target pollinator host species

Imazapyr & Pollinators

- Synthetic auxin
  - Uncontrolled cell growth = plant death
    - classified as “practically non-toxic” to non-target species; however, could impact pollinator host species
- Takes 10-46 days to break down in soil
- Garlon 3A, Garlon 4 Ultra, and Pathfinder II
- Effective via cut stump or basal bark treatment



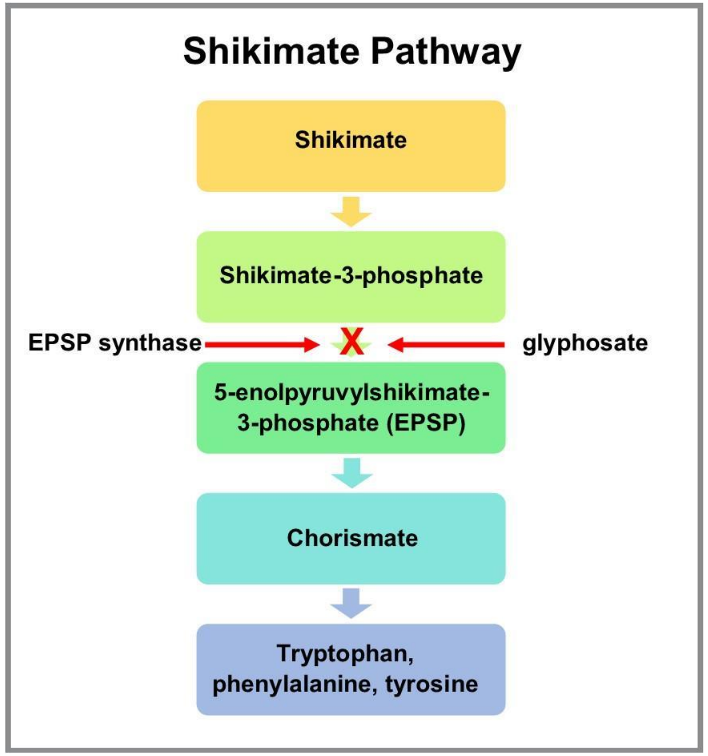
TAMARISK CONTROL - HERBICIDE

Triclopyr

- Primary impacts not studied
- Secondary impacts to pollinators from damage or death to non-target pollinator host species

Triclopyr & Pollinators

- Disrupts the shikimic acid pathway essential for amino acid formation
  - Pathway only present in plants and microorganisms
- Can take 2-180+ days to break down in soil
- Most effective applied via cut stump treatment
- Roundup, Rodeo, Aquamaster



College of Agriculture and Natural Resources, University of Maryland Extension. 2022

TAMARISK CONTROL - HERBICIDE

Glyphosate

POTENTIAL PRIMARY IMPACTS ON POLLINATORS

- Gut microbiome: may decrease flora leading to pathogen vulnerability
- ESPS restriction in gut bacteria
  - Altered metabolism, increased pathogen susceptibility, increased mortality

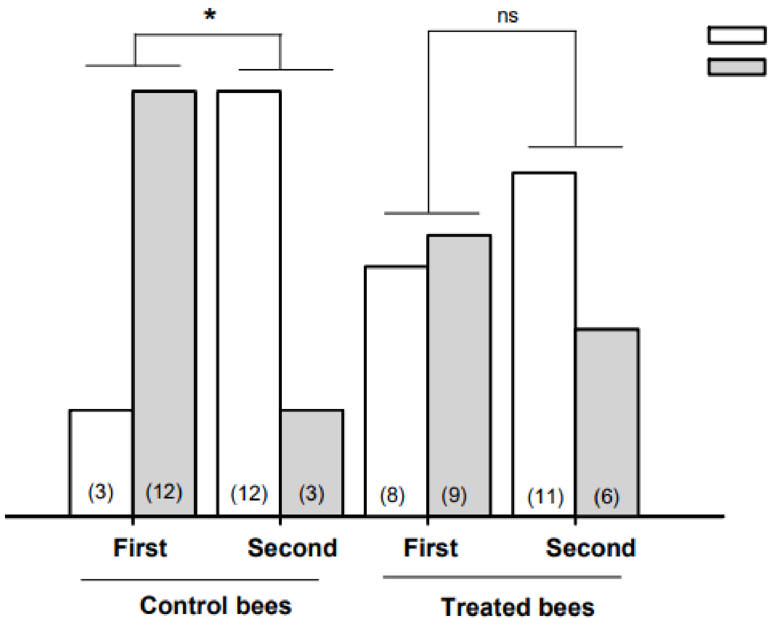
Glyphosate & pollinators

POTENTIAL PRIMARY IMPACTS ON POLLINATORS

- Olfactory: may impair olfactory input leading to impaired navigation to food sources

POTENTIAL PRIMARY IMPACTS ON POLLINATORS

- Cognitive: can impair the cognitive abilities needed for bees to retrieve and integrate spatial information
  - Homeward flights



Farina et al. 2019

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- Secondary impacts - Loss of host plants

Glyphosate & pollinators

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University of Nevada Cooperative Extension, 2010. *Nevada Noxious Weed Field Guide*

- Root crown removal or mechanical cutting with herbicide
- Root system must be completely removed with root crown removal
  - Vigorous resprout if cut
- Effective alternative if herbicide cannot be applied (e.g. in waterways)
- Cut material should be chipped and burned to reduce spread of seeds

Zoe Meyers. The Desert Sun, 2019.

OTHER CONTROL METHODS

MECHANICAL REMOVAL

Tamarix spp

Saltcedar

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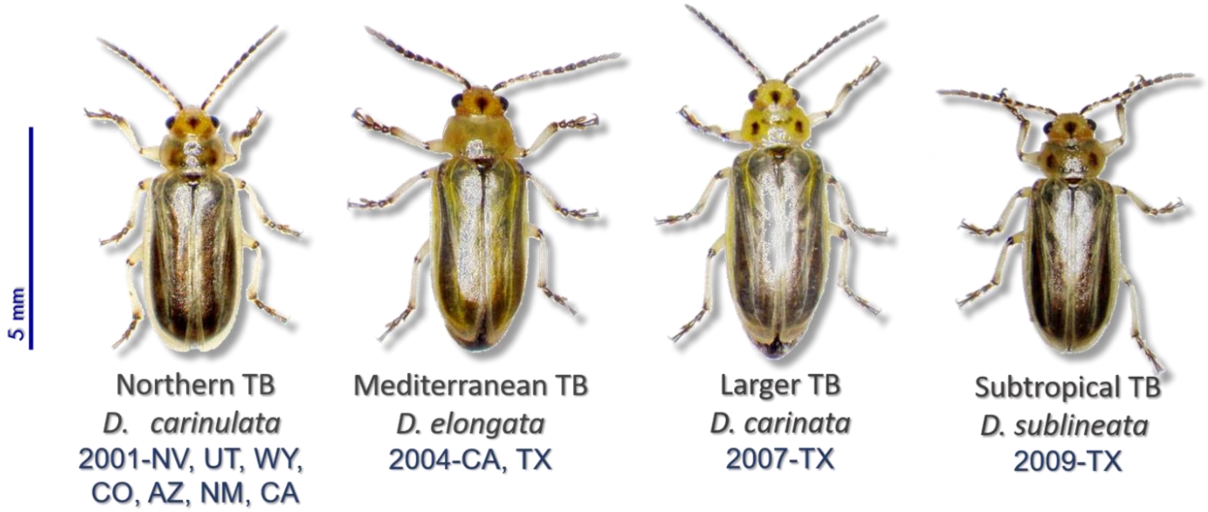
TAMARISK LEAF BEETLE

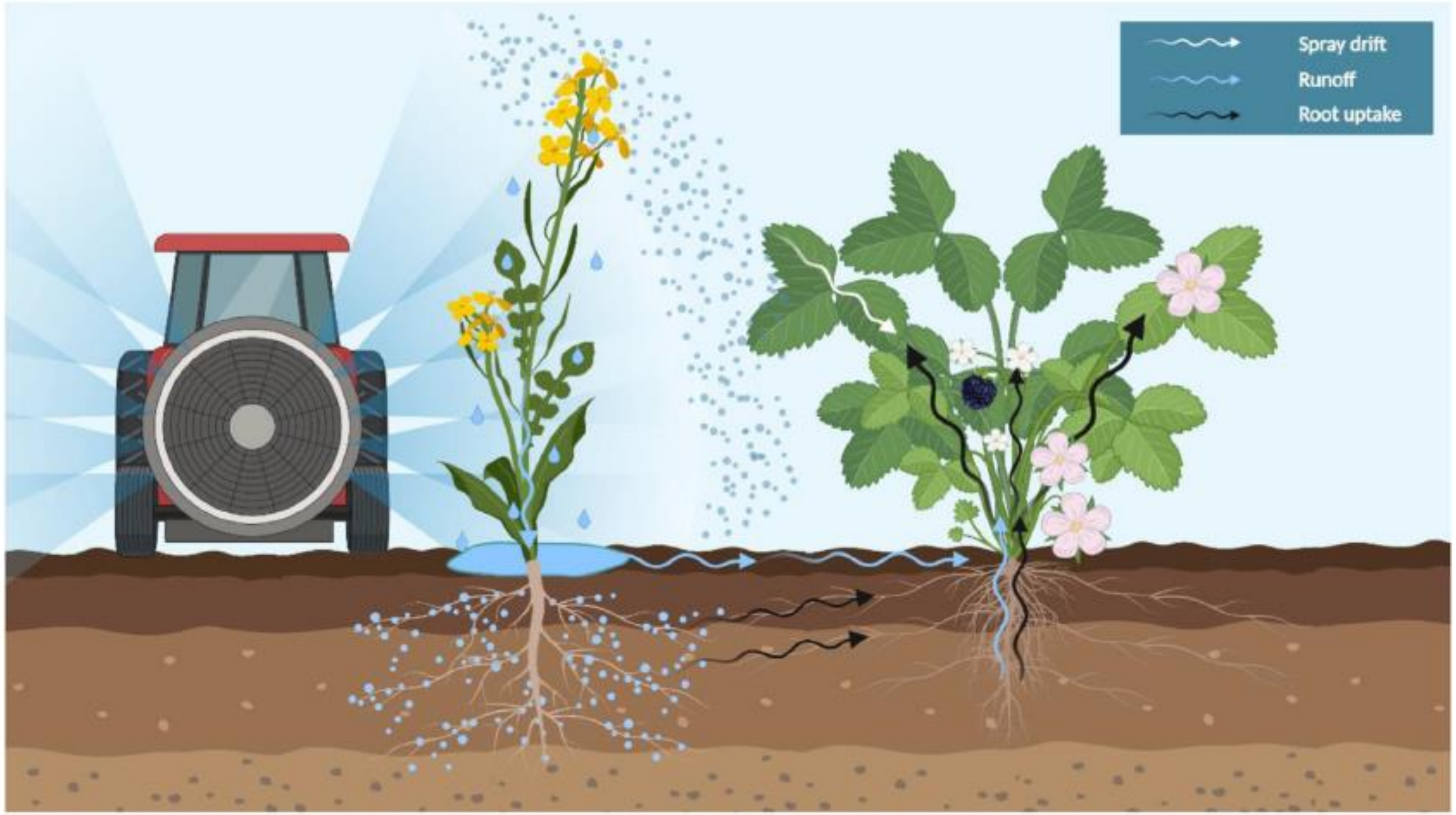


Rivers Edge West, What is the Tamarisk Beetle?

- Tamarisk leaf beetle (*Diorhabda* spp.) biocontrol
- Native to the Mediterranean region and western China
- Introduced in the U.S by Department of Agriculture in 2001
- Defoliate tamarisk
  - Will not eliminate tamarisk – only weaken the plants ability to photosynthesize
- Effective as a secondary control

TAMARISK WEEVIL

- Tamarisk Weevil (*Coniatus splendidulus*) biocontrol
- Native to the Mediterranean
- Accidentally introduced in Arizona in 2006
- Defoliate tamarisk
  - Will not eliminate tamarisk – only weaken the plants ability to photosynthesize
- Unknown how effective as a control method



Zioga et al. 2022

HERBICIDE EXPOSURE TO POLLINATORS

- Adjuvant may be added into an herbicide mix to improve efficacy
- Little information available to assess the risk of most adjuvants on pollinators
- Adjuvants with low wildlife toxicity: modified seed oils and silicones

Cal-IPC. 2015. Best Management Practices for Wildland Stewardship: Protecting Wildlife When Using Herbicides for Invasive Plant Management.

HERBICIDE
BEST MANAGEMENT PRACTICES

- Understand the type of wildlife and vegetation present in the area
- Map areas sensitive to soil compacting and vegetation trampling
- Flag native plants and/or use plant guards to protect desirable species
- Be mindful of soil conditions and potential for runoff

Cal-IPC. 2015. Best Management Practices for Wildland Stewardship: Protecting Wildlife When Using Herbicides for Invasive Plant Management.

HERBICIDE
BEST MANAGEMENT PRACTICES

- Timing and Weather
  - Relative Persistence
  - Avoid bloom times and bee activity
  - Temperatures and wind

Cal-IPC. 2015. Best Management Practices for Wildland Stewardship: Protecting Wildlife When Using Herbicides for Invasive Plant Management.

HERBICIDE BEST MANAGEMENT PRACTICES

- Pre-emergent effects
- Keep detailed records of treatments
- Conduct post-treatment monitoring to address effectiveness of restoration

HERBICIDE
BEST MANAGEMENT PRACTICES

Restoration

Pollinator Syndromes - flower traits that have evolved to aid the flower in successful reproduction

Pollinator Syndrome Traits

Trait	Butterflies	Flies	Moths	Wind
Color	Bright, including red and purple	Pale and dull to dark brown or purple; flecked with translucent patches	Pale and dull red, purple, pink or white	Dull green, brown, or colorless; petals absent or reduced
Nectar Guides	Present	Absent	Absent	Absent
Odor	Faint but fresh	Putrid	Strong sweet; emitted at night	None
Nectar	Ample; deeply hidden	Usually absent	Ample; deeply hidden	None
Pollen	Limited	Modest in amount	Limited	Abundant; small, smooth, and not sticky
Flower Shape	Narrow tube with spur; wide landing pad	Shallow; funnel like or complex and trap-like	Regular; tubular without a lip	Regular: small and stigmas exerted

Taken from U.S. Forest Service https://www.fs.fed.us/wildflowers/pollinators/What_is_Pollination/syndromes.shtml

- Seed or replant the area with competitive native species.
- Plant a variety of flowering native plants that attract bees, flies, beetles, butterflies, and hummingbirds.
- Plant both nectar plants for adult butterflies and moths and the host plants that their caterpillars feed on.

Restoration

Esque et al. 2021. Priority Species Lists to Restore Desert Tortoise and Pollinator Habitats in Mojave Desert Shrublands

Can be used as to guide seed collections and restoration of plant materials

Table 4.—Mojave Desert priority plant taxa (134 spp. among 57 taxonomic groups) for use in restoration and pollinated by animals, by selfing, or by wind. Higher order pollinator names include Hymenoptera (bees and wasps); Diptera (flies); Coleoptera (beetles); Lepidoptera (butterflies) and (moths). Detailed explanations for codes found in this table are at the bottom of the table. Habit: annual forb (AF), annual grass (AG), biennial (Bien), leaf succulent (LS), perennial forb (PF), perennial grass (PG), shrub (Shr), subshrub (sShr), geophyte (Geo), tree (Tr), stem succulent (SS).

			Pollinators served									
Taxa	Bloom season	Habit	Bee	Wasp	Fly	Beetle	Butterfly	Moth	Bird	Tortoise use	Disturbance recovery	Propagation method
Abronia villosa	Feb-Jul	AF	1					2, 1, [(6)]		F	Unk	S
Acmispon spp.			2				6, (7)	1			+w	S
A. brachycarpus	Mar-Jun	AF								F		
A. glaber	Jun	sShr								F		
A. oroboides	Mar-Jul	PF								F		
A. rigidus	Mar-May	PF								F		
A. strigosus	Mar-Jun	AF								F		
Ambrosia dumosa	Feb-Jun, Sept-Nov	Shr						5		C, F	−w, −/+ sd	S, stem cuttings, salvage
Ambrosia salsola	Mar-Jun	sShr						1		C	+w, +sd, +wr	S, stem cuttings, salvage
Amsinckia tessellata	Feb-Jun	AF	(2)		(3)		1	1		F	+sd, +wr, +c	S
Androstephium breviflorum	Mar-Jun	Geo	[1]							F	+w	Bulb transplant
Aristida purpurea	Feb-Jun	PG						(2)		F	Unk	S, tiller plugs
Asclepias erosa	May-Jul	PF	[11, (93)]	(3)	(√)		2, (1)			N	+wr, +sd	S; tuber transplant
Astragalus spp.			[(5)]				3			F	+wr, +w	S
A. acutirostris	Apr-May	AF										
A. didymocarpus	Feb-May	AF										
A. layneae	Mar-Jun	PF										
A. lentiginosus	Mar-Jun	PF										
A. nuttallianus	Mar-May	AF										
Atriplex spp.	Asynch - Jan-Oct			37			4	8, (2)		C	+/−w	S, stem cuttings
A. canescens		Shr										
A. confertifolia		Shr										
A. hymenelytra		Shr										
A. polycarpa		Shr										
Baccharis spp.	Asynch - year-rnd, or spg to fall		15, (1)					3, (1)		Unk	+wr?	S, stem cutting
B. glutinosa		Shr										
B. sarothroides		Shr										
B. sergiloides		Shr										
Baileya spp.			2, (4)					1		F	+ w, + wr, +sd	S, salvage
B. multiradiata	Apr-Jul	PF										
B. pleniradiata	Mar-Jun	PF										
Bouteloua spp.								2		F	Annuals	Annuals – S;
B. aristidoides	Aug-Sept	AG									−w;	Perennials – S
B. barbata	Aug-Dec	AG									Perennials +w	
B. curtipendula	May-Oct	PG										
B. eriopoda	May-Oct	PG										
B. trifida	Mar-Sep	PG										
Chaenactis fremontii	Feb-May	AF	[2, (29+)]		√					F	+w	S
Chilopsis linearis	May-Sept	Tr	1, (4)					6		C	+wr	S, stem cuttings
Chylismia and *Eremothera* spp.			16+					2+		F	+sd	S
C. brevipes	Feb-May	AF										
C. claviformis	Feb-May	AF										
E. boothii	Mar-Jun	AF										
Coreopsis bigelovii	Feb-Jun	AF						2		F	−w	S

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Riparian Plant-Pollinator Ecology Phase 2

Riparian Restoration Effectiveness to Improve Desert Riparian Bird and Pollinator Habitats

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Significant results

- Restoration treatments reduced tamarisk and increased native perennial plant cover.
- Planted species within the restoration treatments persisted and contributed to vegetation structure and invertebrate habitat, although limitedly in the 2021 restoration due mortalities of shrub and tree species.
- Native plants naturally recruited into planted areas and contributed to native plant cover.
- Drought conditions and cattle impacted planted and naturally recruited native plants, reducing aboveground biomass, seed production, and flower resources for invertebrates.
- A diversity of invertebrates was detected suggesting development of invertebrate and pollinator habitat, though invertebrate utilization of restoration patches was limited, suggesting potential that dispersal through the tamarisk monoculture, the small areas of native patches, or ongoing disturbance may have limited utilization. The restored patches, however, could be starting points to expand broader potential pollinator habitat.

Thank you!

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