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Distribution and Spread of Tamarisk Beetles (*Diorhabda* spp.) and Their Known and Predicted Effects on Riparian Ecosystems

Ben Bloodworth, Program Coordinator

Tamarisk (*Diorhabda* spp.) leaf beetle

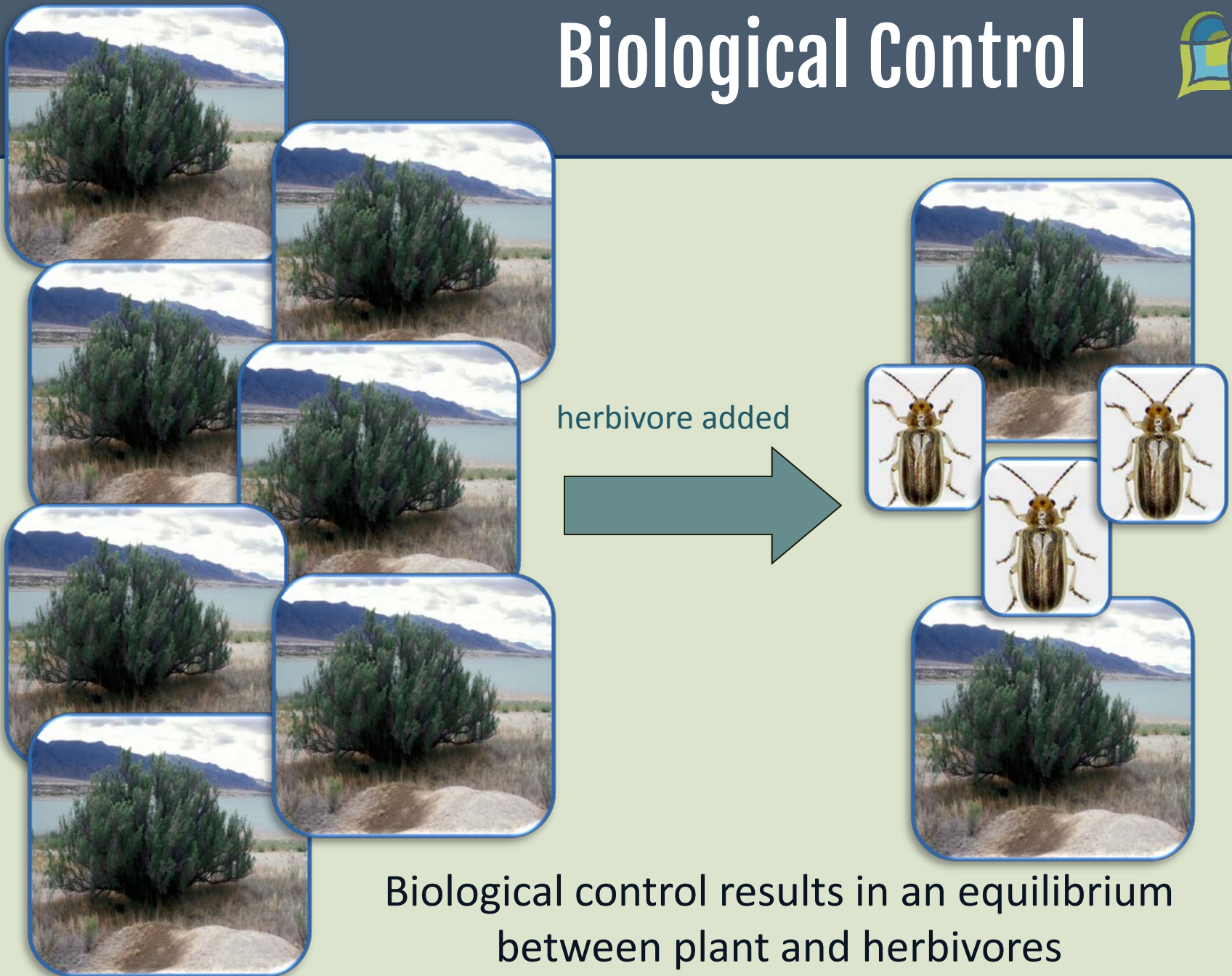


Photo courtesy of Ed Kosmicki



Photo Sonoran Joint Venture

Biological Control



Tamarisk Beetle – *Diorhabda* spp.



Beetles and larvae defoliating tamarisk



Courtesy of Dr. Dan Bean, Palisade Insectary

Beetles drop from host plant and
pupate in the leaf litter

larvae

pupae



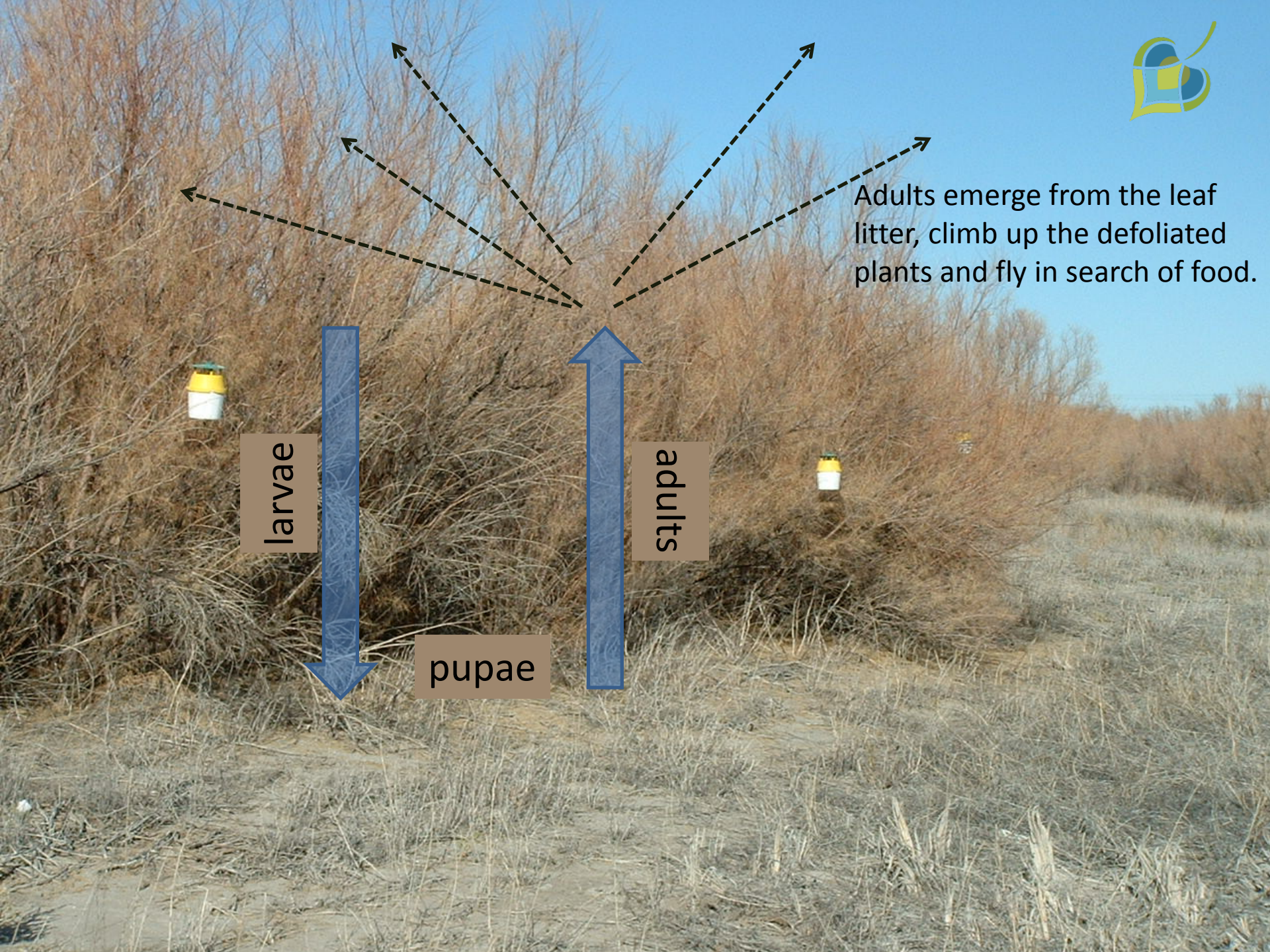


Adults emerge from the leaf litter, climb up the defoliated plants and fly in search of food.

larvae

adults

pupae







Monitoring the beetles



Date	GPS Point ID	UTM Coordinates	River m/km	Sweep 1	Sweep 2	Sweep 3	Sweep 4	Sweep 5	Eggs	Conatus Spp	Defoliation	Re-foliation	Photo	Comments
		Lat:		Adults									ID:	
		Long:		Early Larvae					<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	Direction	
				Late Larvae										

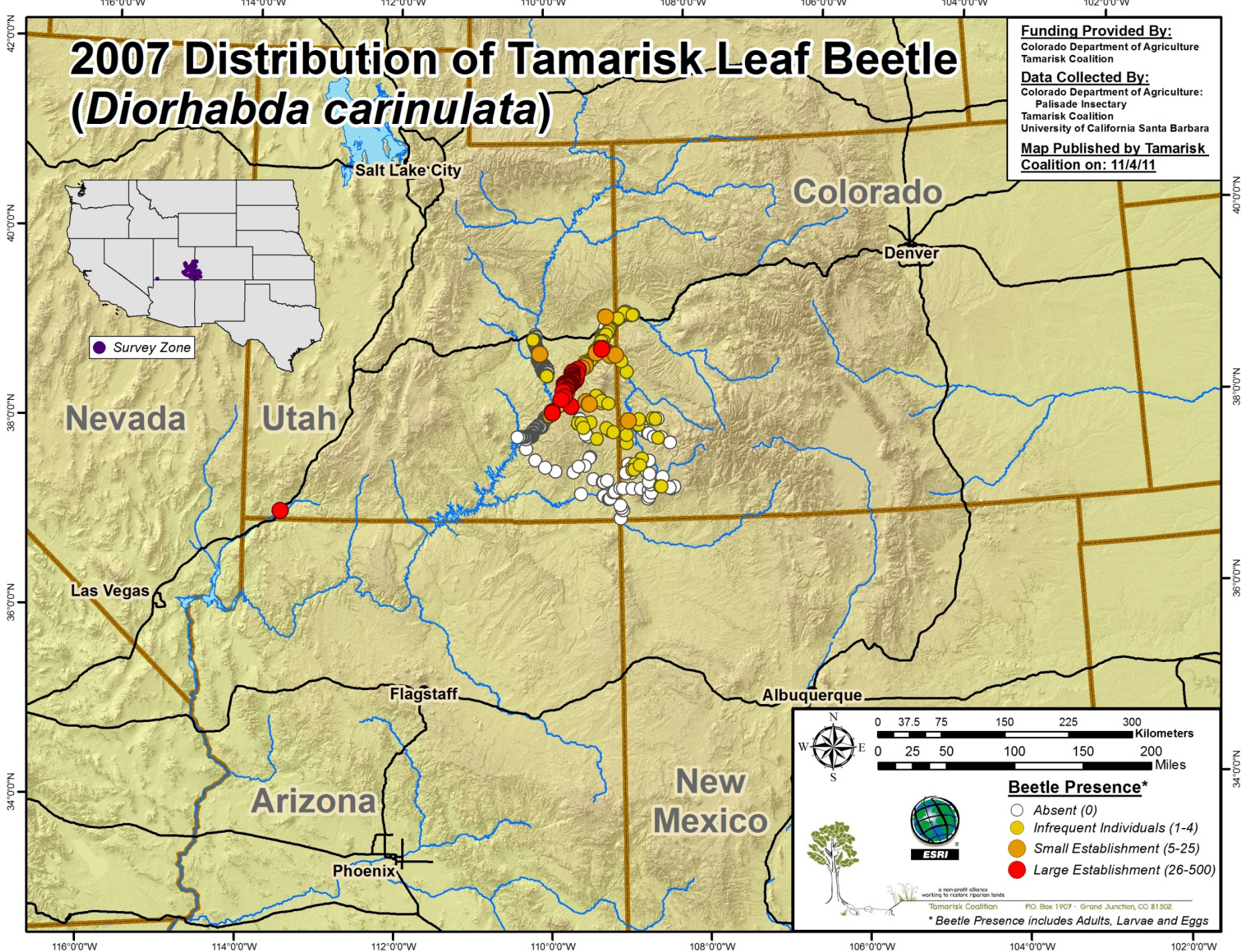


2007 Distribution of Tamarisk Leaf Beetle (*Diorhabda carinulata*)

Funding Provided By:
Colorado Department of Agriculture
Tamarisk Coalition

Data Collected By:
Colorado Department of Agriculture:
Palisade Insectary
Tamarisk Coalition
University of California Santa Barbara

**Map Published by Tamarisk
Coalition on: 11/4/11**

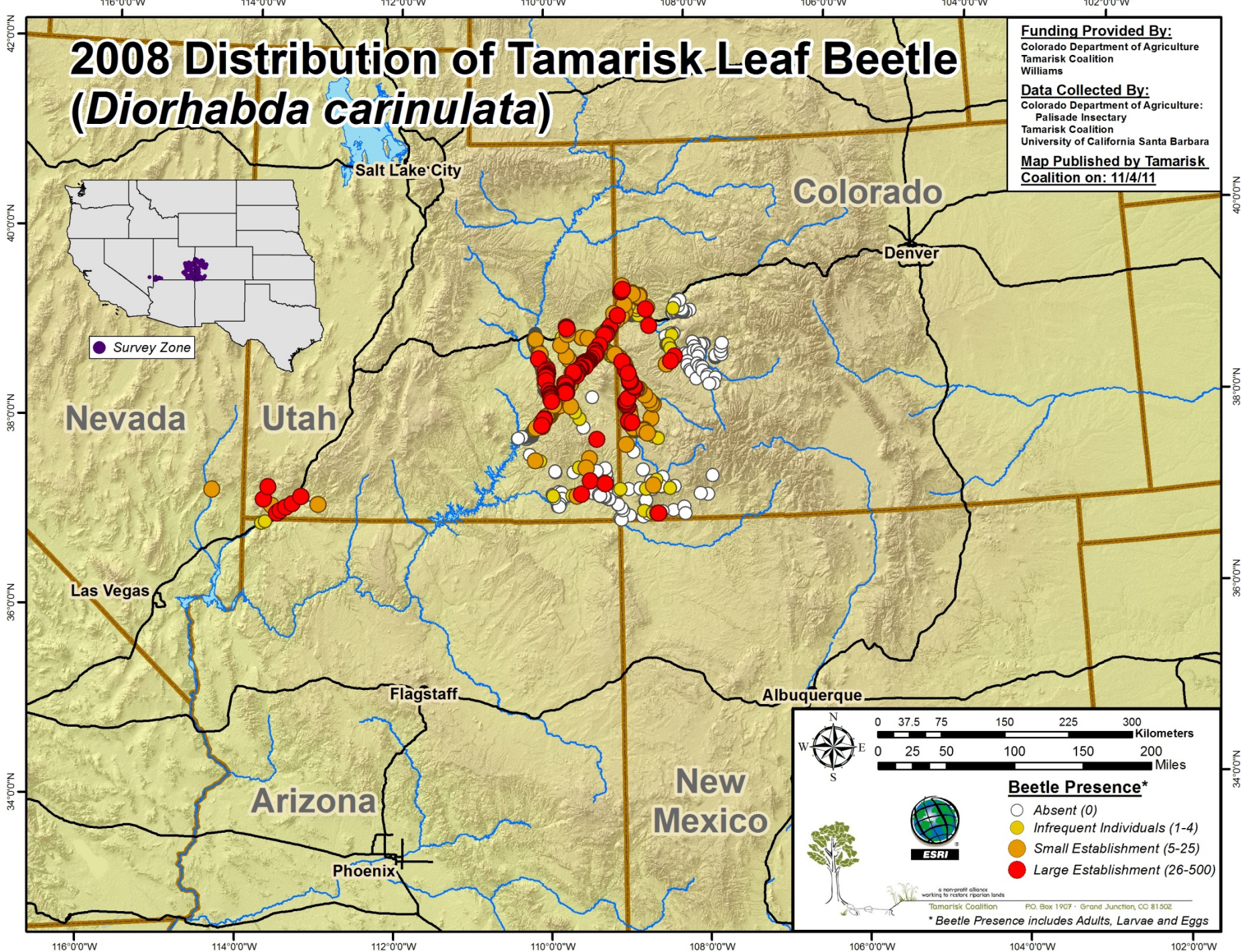


2008 Distribution of Tamarisk Leaf Beetle (*Diorhabda carinulata*)

Funding Provided By:
Colorado Department of Agriculture
Tamarisk Coalition
Williams

Data Collected By:
Colorado Department of Agriculture:
Palisade Insectary
Tamarisk Coalition
University of California Santa Barbara

**Map Published by Tamarisk
Coalition on: 11/4/11**



2009 Distribution of Tamarisk Leaf Beetle (*Diorhabda carinulata*)

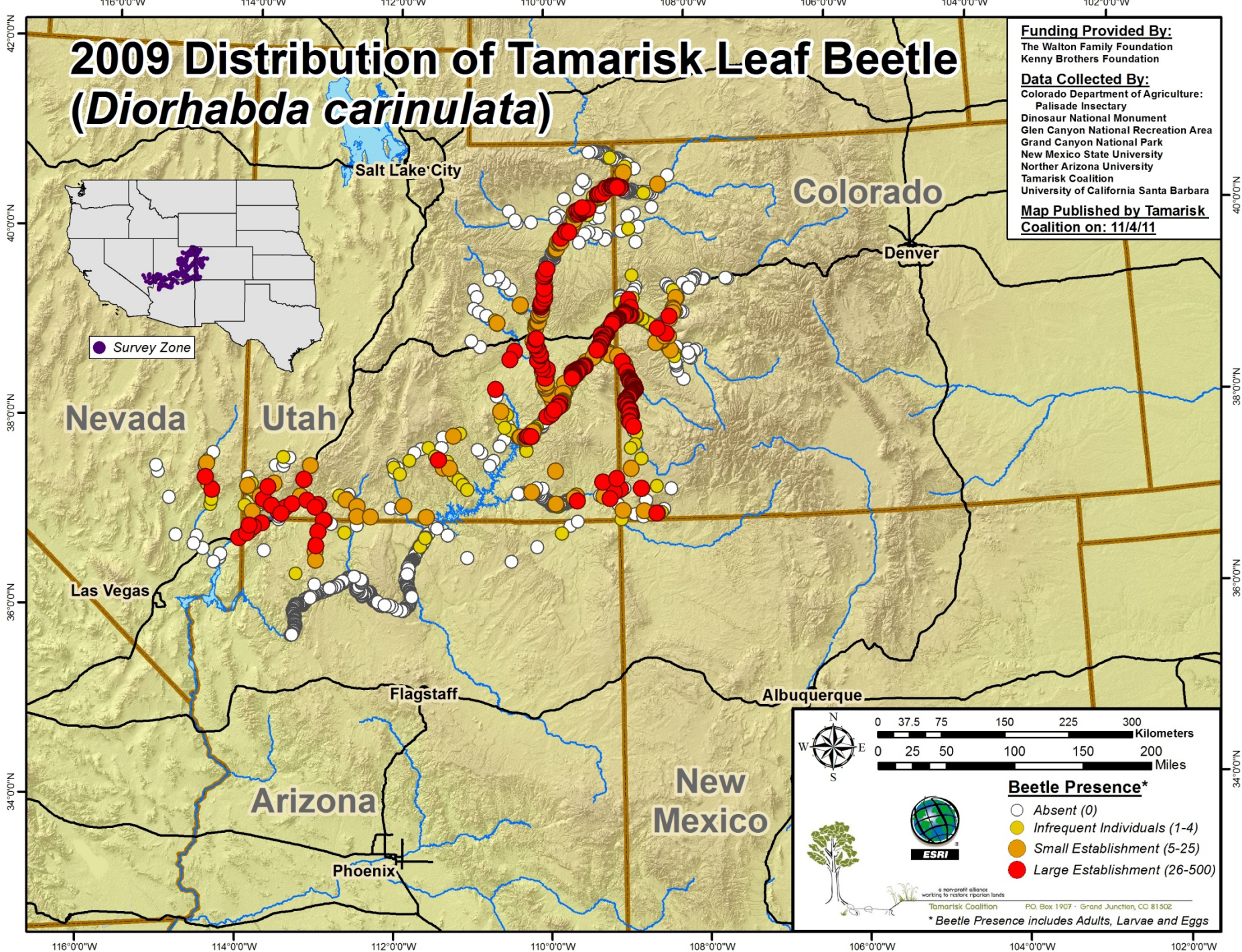
Funding Provided By:

The Walton Family Foundation
Kenny Brothers Foundation

Data Collected By:

Colorado Department of Agriculture:
Palisade Insectary
Dinosaur National Monument
Glen Canyon National Recreation Area
Grand Canyon National Park
New Mexico State University
Northern Arizona University
Tamarisk Coalition
University of California Santa Barbara

Map Published by Tamarisk
Coalition on: 11/4/11



2010 Distribution of Tamarisk Leaf Beetle (*Diorhabda carinulata*)

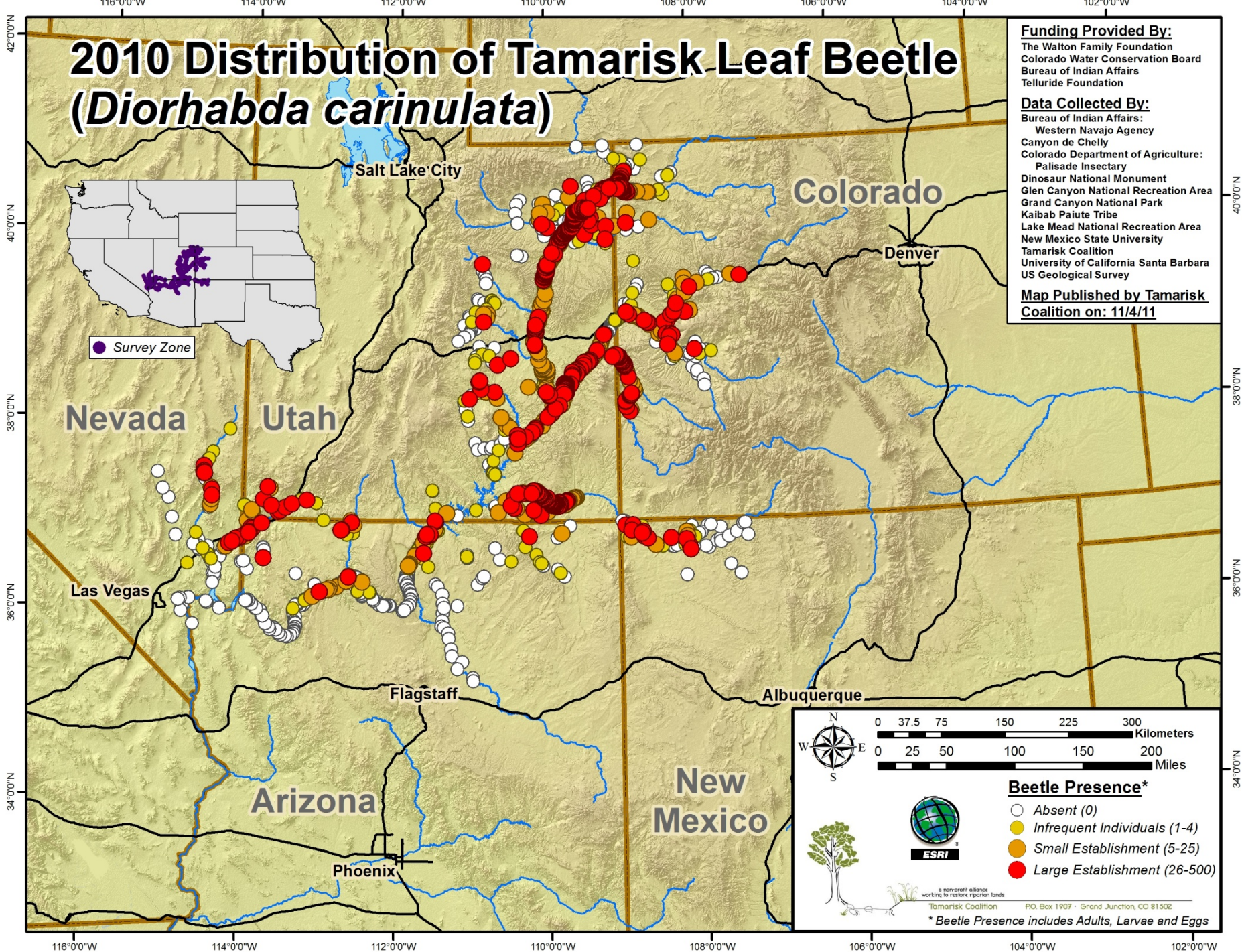
Funding Provided By:

The Walton Family Foundation
Colorado Water Conservation Board
Bureau of Indian Affairs
Telluride Foundation

Data Collected By:

Bureau of Indian Affairs:
Western Navajo Agency
Canyon de Chelly
Colorado Department of Agriculture:
Palisade Insectary
Dinosaur National Monument
Glen Canyon National Recreation Area
Grand Canyon National Park
Kaibab Paiute Tribe
Lake Mead National Recreation Area
New Mexico State University
Tamarisk Coalition
University of California Santa Barbara
US Geological Survey

Map Published by Tamarisk
Coalition on: 11/4/11

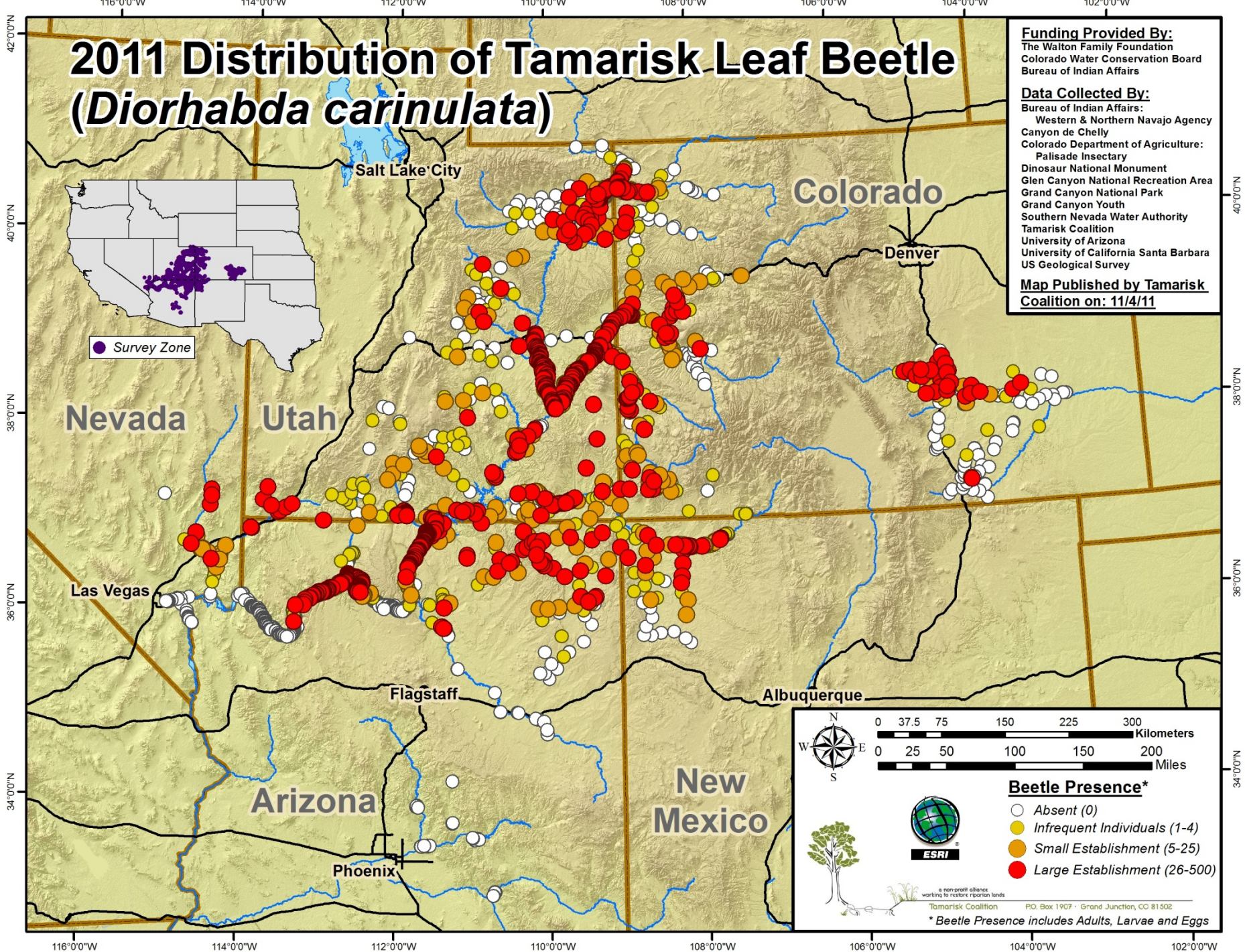


2011 Distribution of Tamarisk Leaf Beetle (*Diorhabda carinulata*)

Funding Provided By:
The Walton Family Foundation
Colorado Water Conservation Board
Bureau of Indian Affairs

Data Collected By:
Bureau of Indian Affairs:
Western & Northern Navajo Agency
Canyon de Chelly
Colorado Department of Agriculture:
Palisade Insectary
Dinosaur National Monument
Glen Canyon National Recreation Area
Grand Canyon National Park
Grand Canyon Youth
Southern Nevada Water Authority
Tamarisk Coalition
University of Arizona
University of California Santa Barbara
US Geological Survey

**Map Published by Tamarisk
Coalition on: 11/4/11**

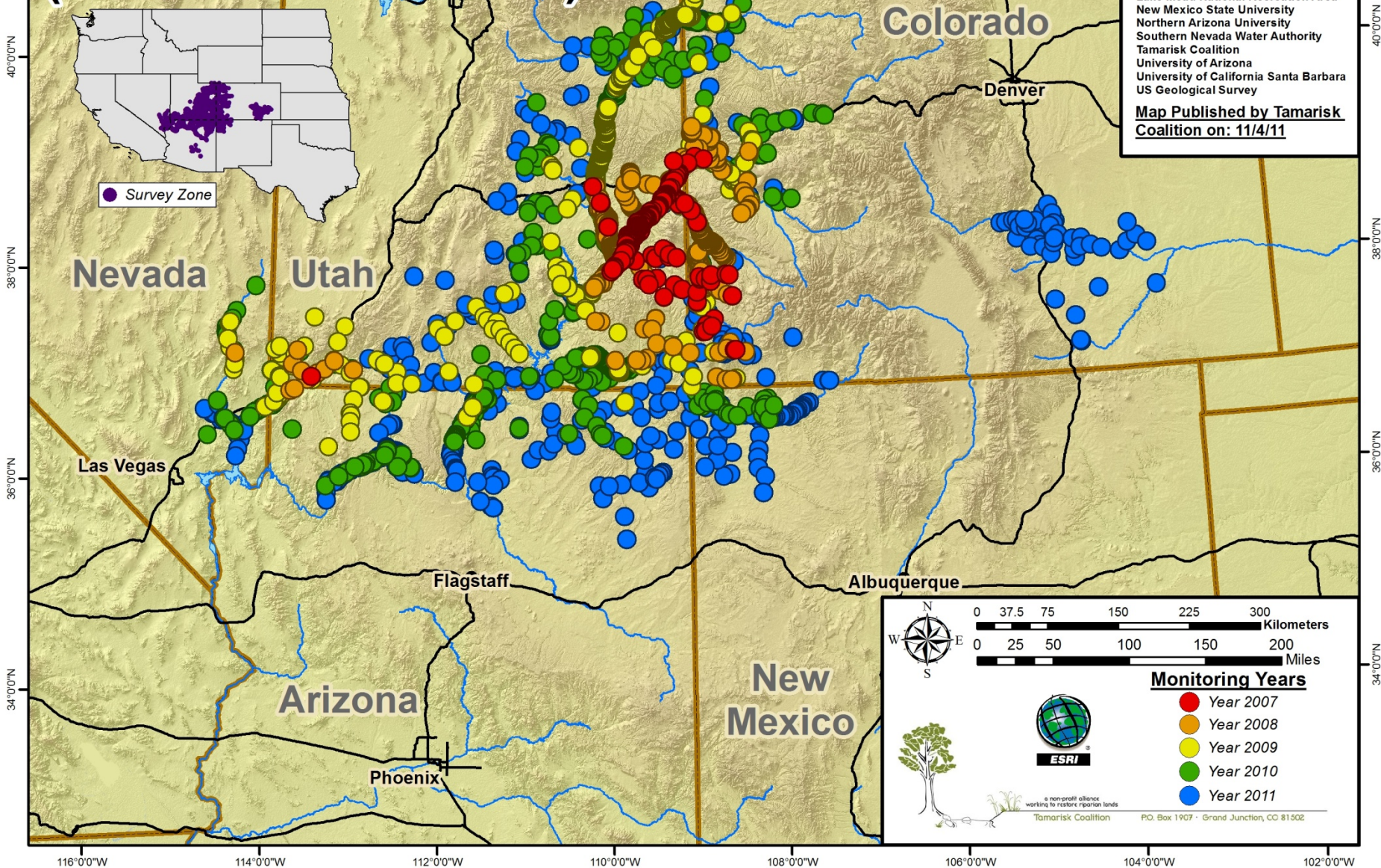


Yearly Distribution (2007 - 2011) of Tamarisk Leaf Beetle (*Diorhabda carinulata*)

Funding Provided By:
The Walton Family Foundation
Colorado Department of Agriculture
Colorado Water Conservation Board
Bureau of Indian Affairs
Telluride Foundation
Kenny Brothers Foundation
Williams

Data Collected By:
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**Map Published by Tamarisk
Coalition on: 11/4/11**



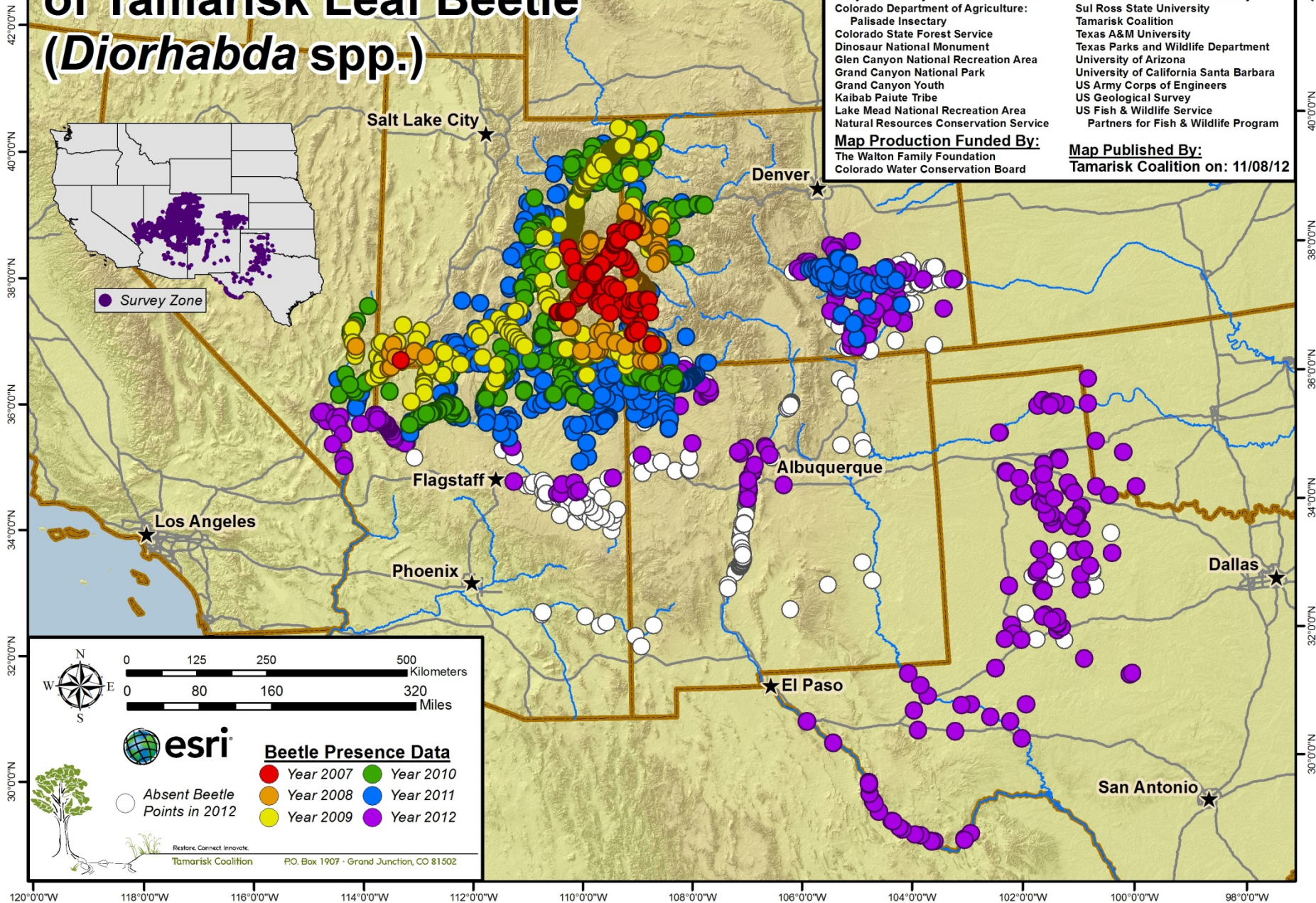
Yearly Distribution (2007 - 2012) of Tamarisk Leaf Beetle (*Diorhabda* spp.)

Data Collected By:

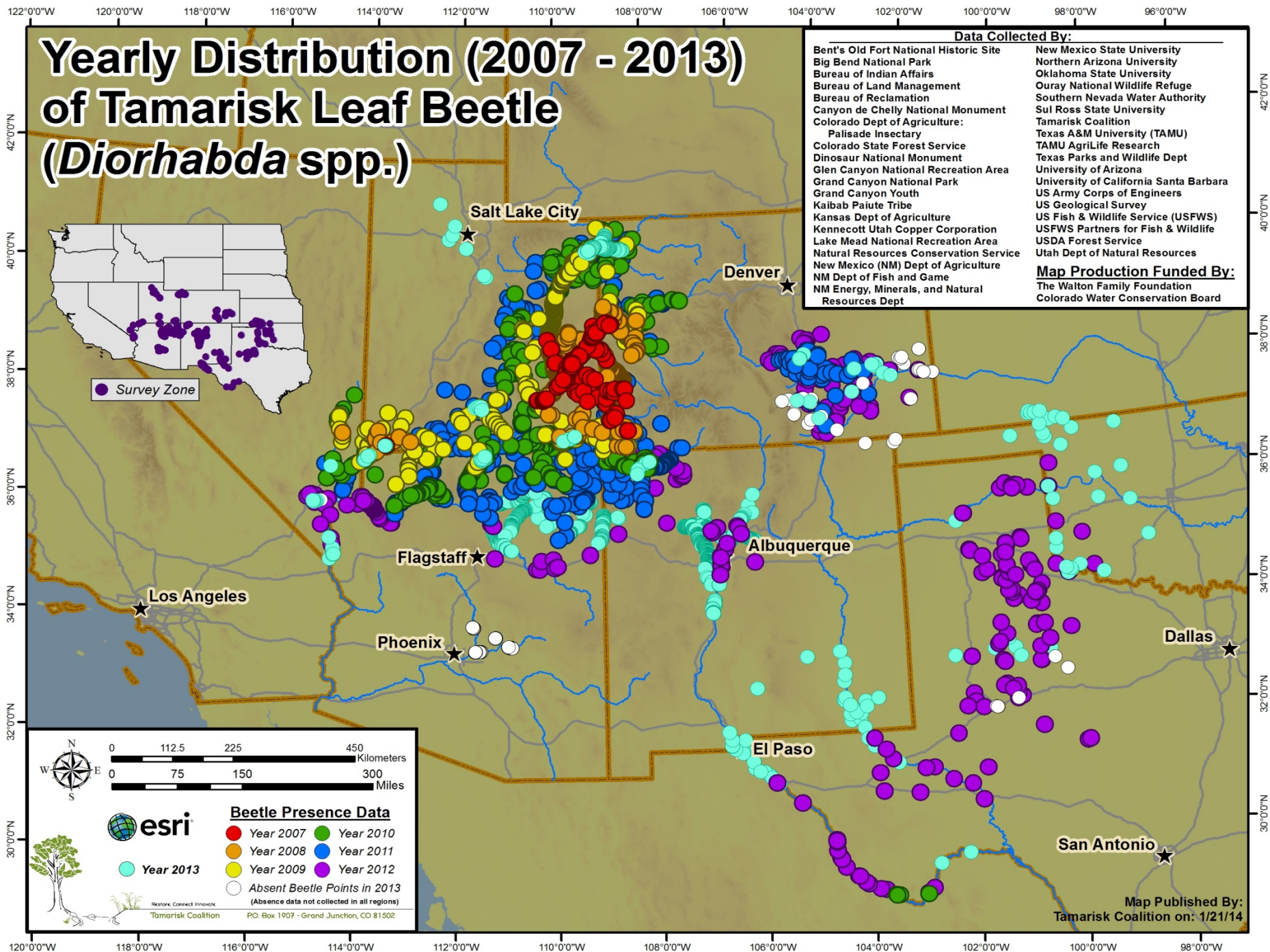
Bent's Old Fort National Historic Site	New Mexico State University
Big Bend National Park	Northern Arizona University
Bureau of Indian Affairs	Oklahoma State University
Bureau of Land Management	Ouay National Wildlife Refuge
Canyon de Chelly National Monument	Southern Nevada Water Authority
Colorado Department of Agriculture:	Sul Ross State University
Palisade Insectary	Tamarisk Coalition
Colorado State Forest Service	Texas A&M University
Dinosaur National Monument	Texas Parks and Wildlife Department
Glen Canyon National Recreation Area	University of Arizona
Grand Canyon National Park	University of California Santa Barbara
Grand Canyon Youth	US Army Corps of Engineers
Kaibab Paiute Tribe	US Geological Survey
Lake Mead National Recreation Area	US Fish & Wildlife Service
Natural Resources Conservation Service	Partners for Fish & Wildlife Program

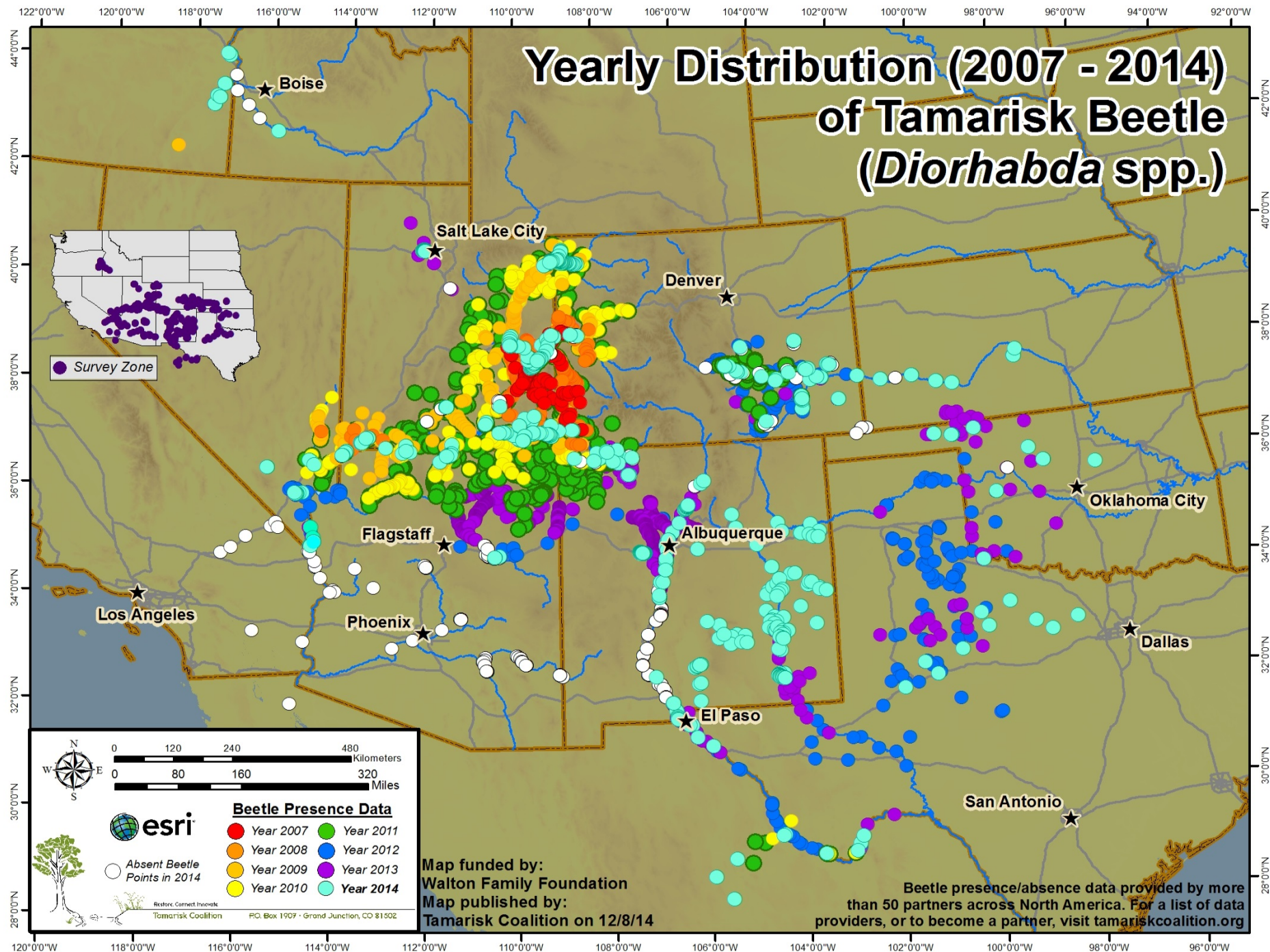
Map Production Funded By:
The Walton Family Foundation
Colorado Water Conservation Board

Map Published By:
Tamarisk Coalition on: 11/08/12

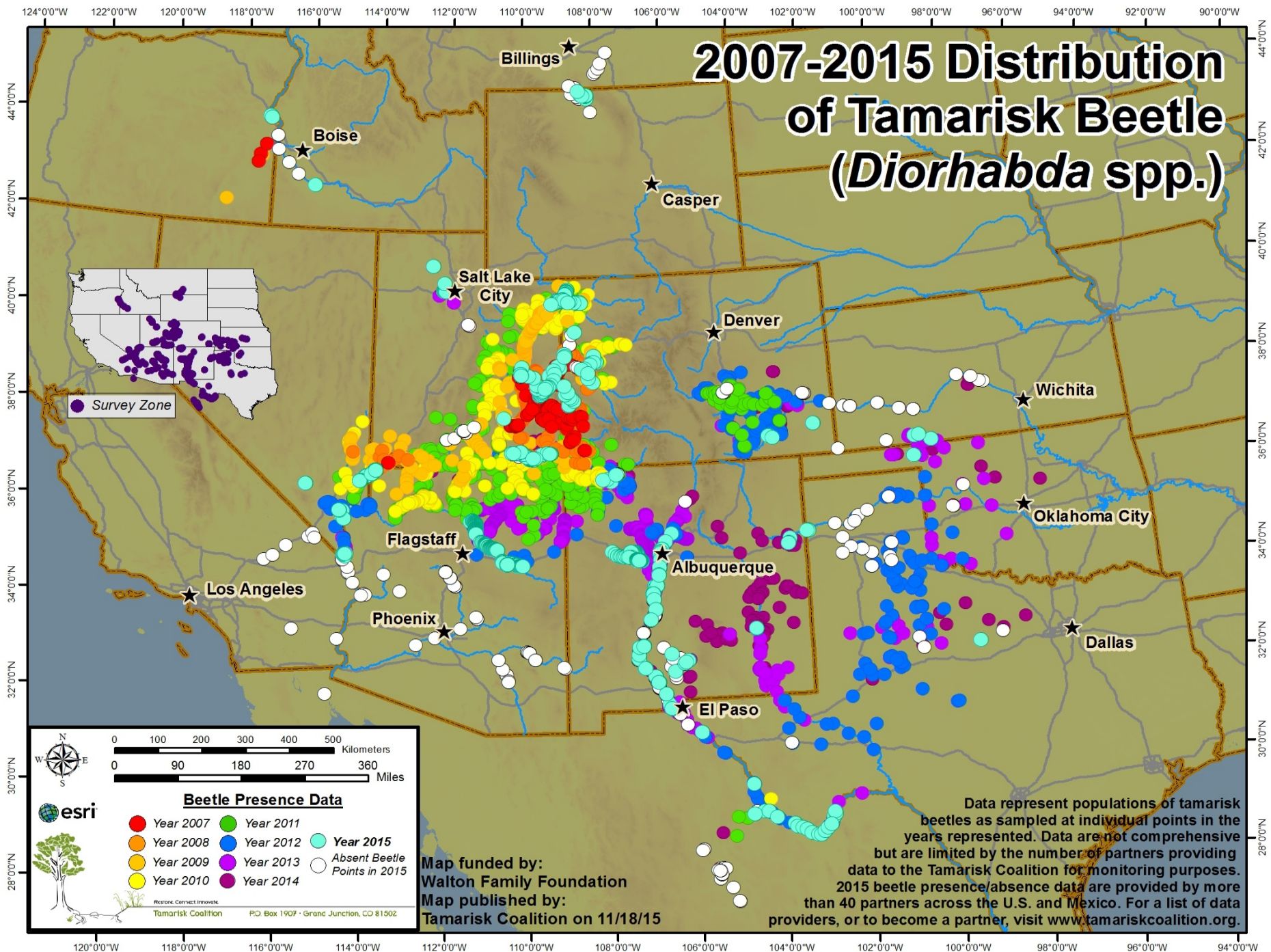


Yearly Distribution (2007 - 2013) of Tamarisk Leaf Beetle (*Diorhabda* spp.)

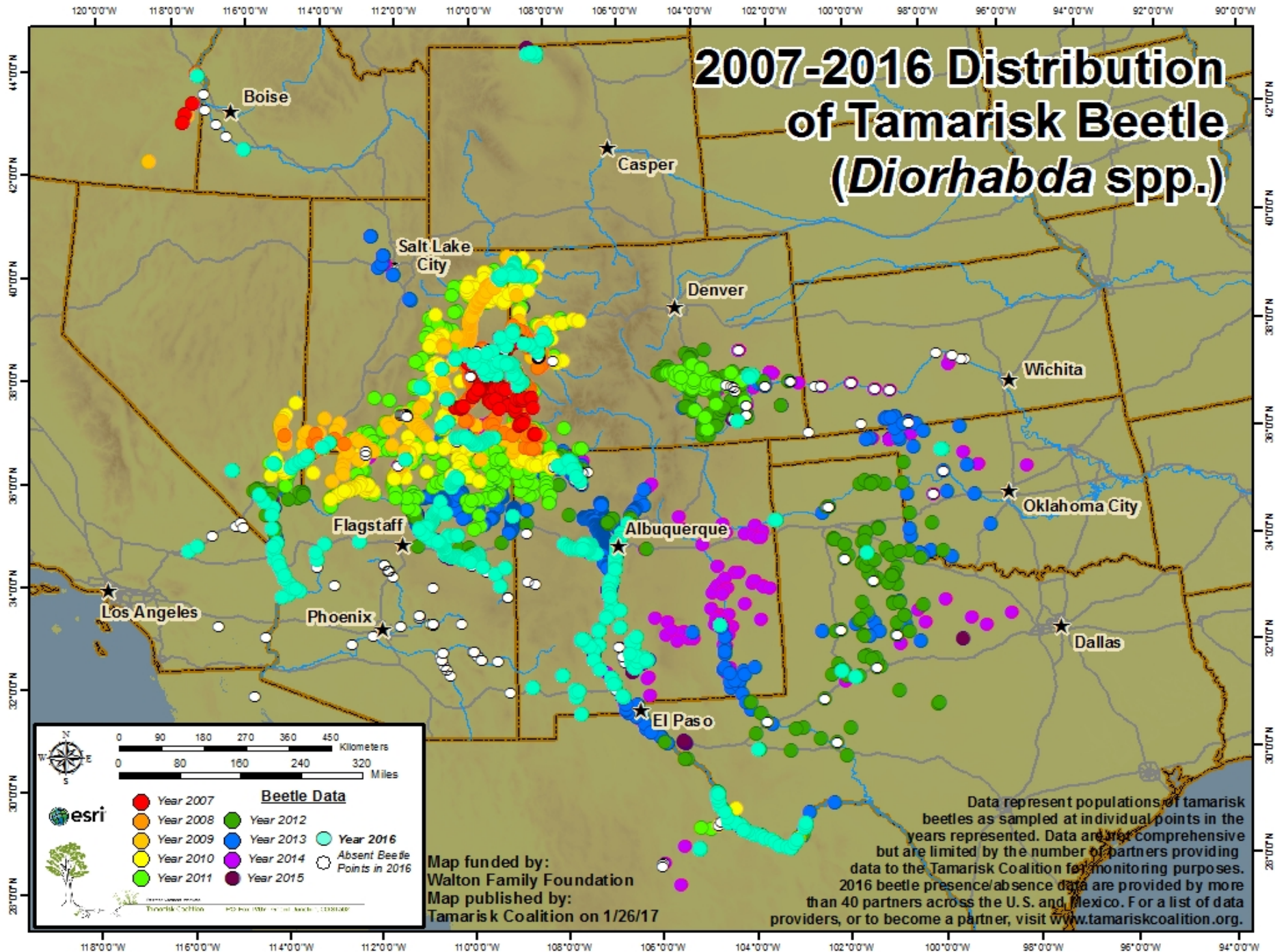




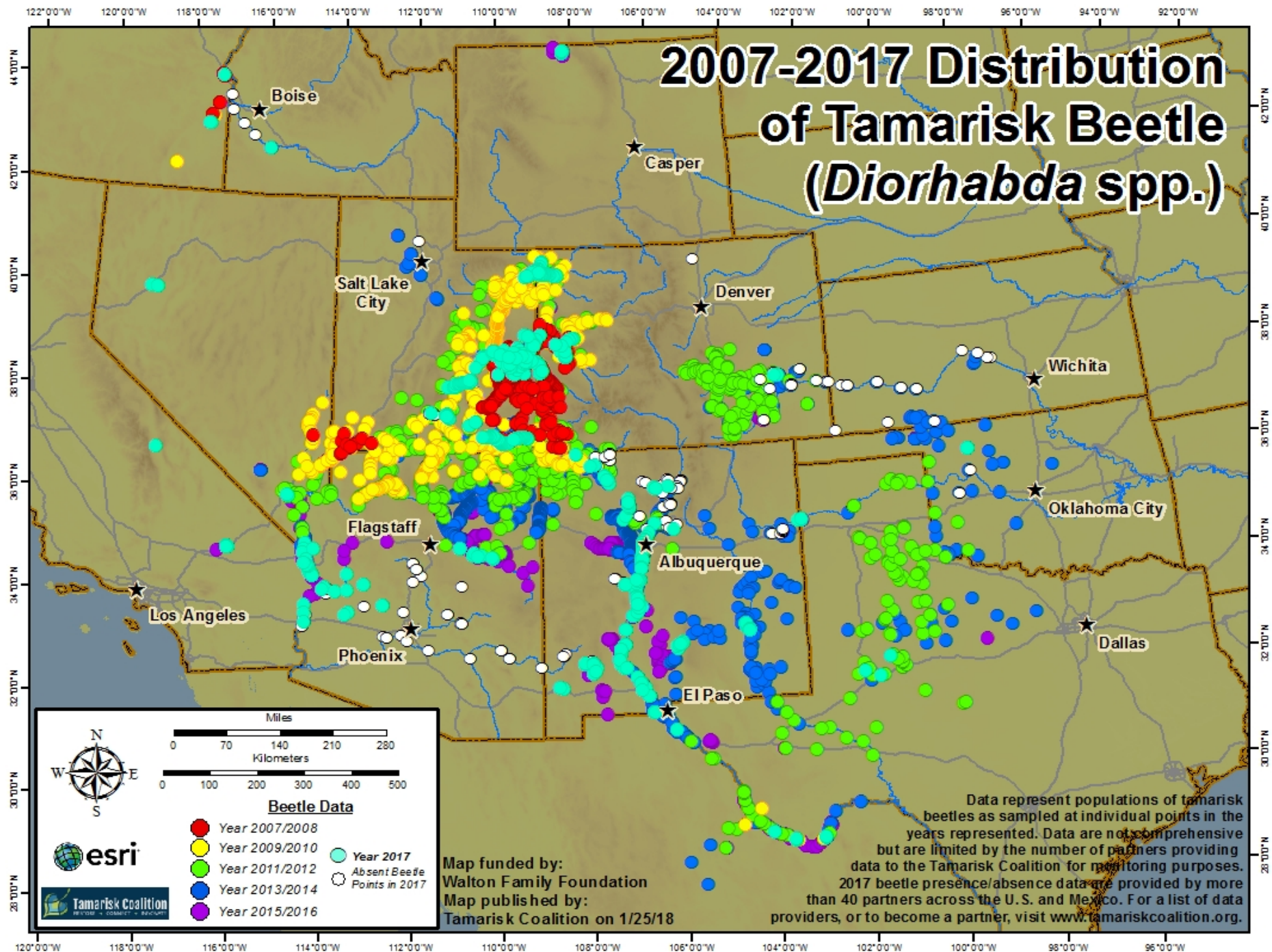
2007-2015 Distribution of Tamarisk Beetle (*Diorhabda* spp.)

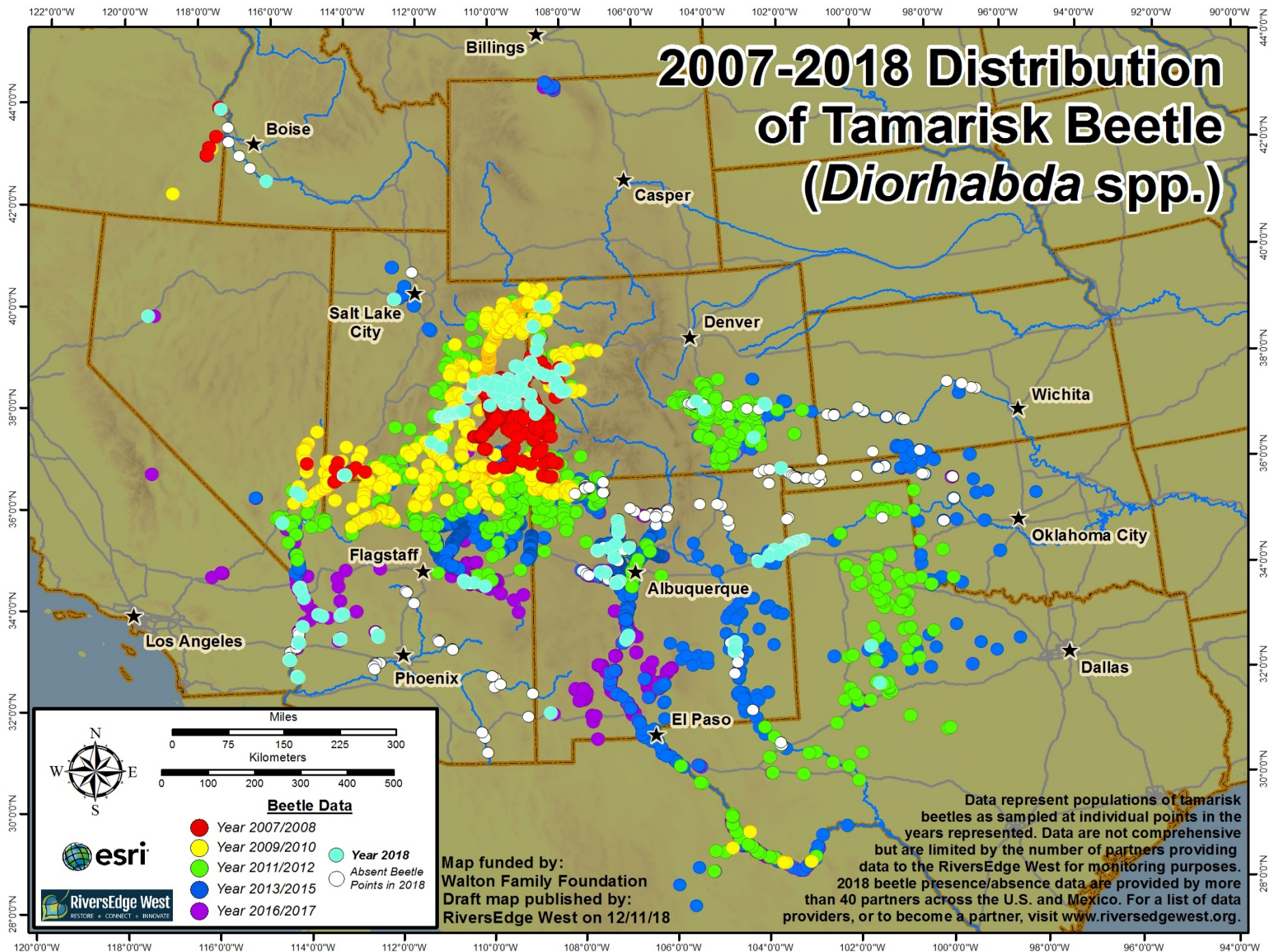


2007-2016 Distribution of Tamarisk Beetle (*Diorhabda* spp.)

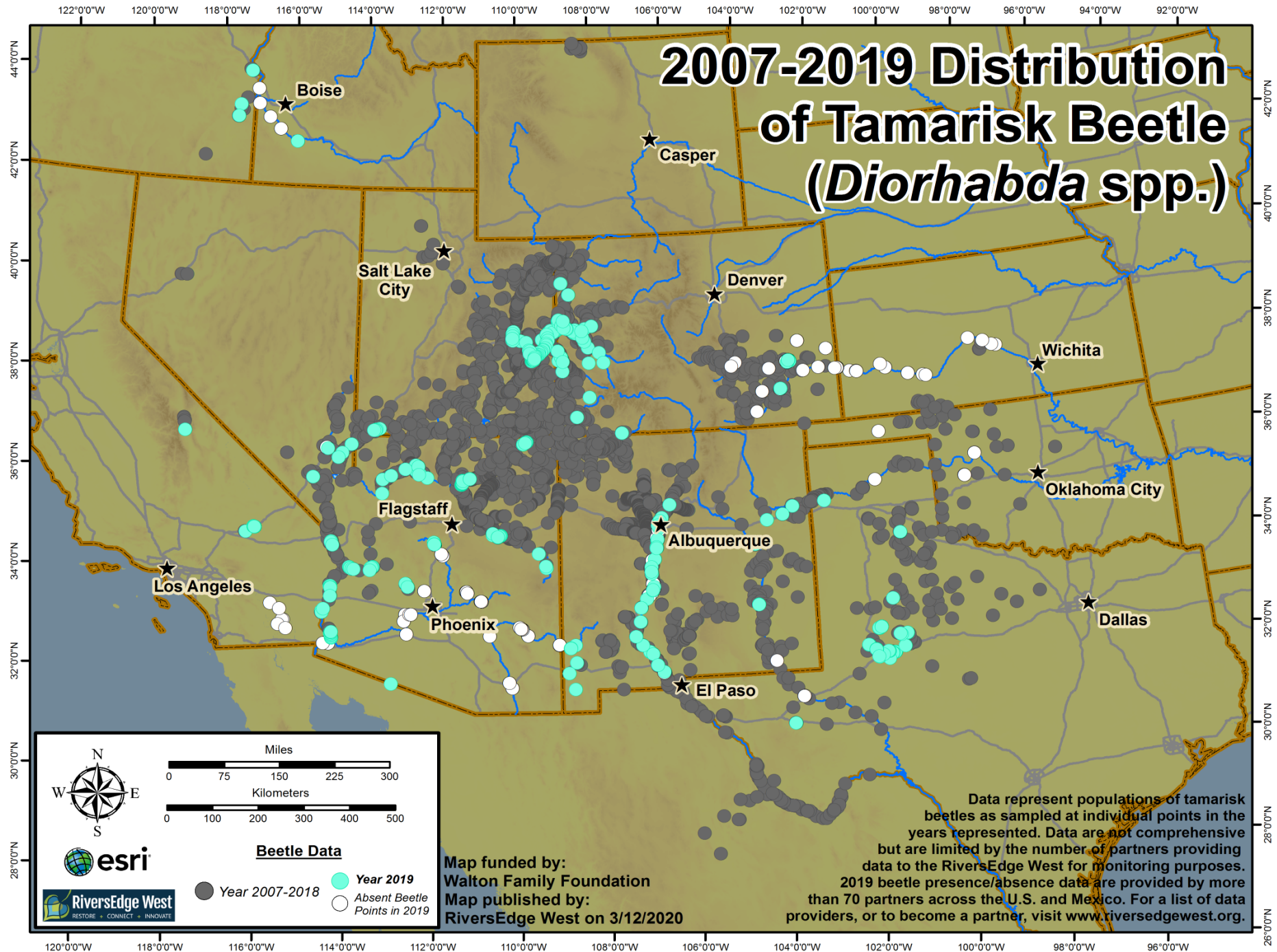


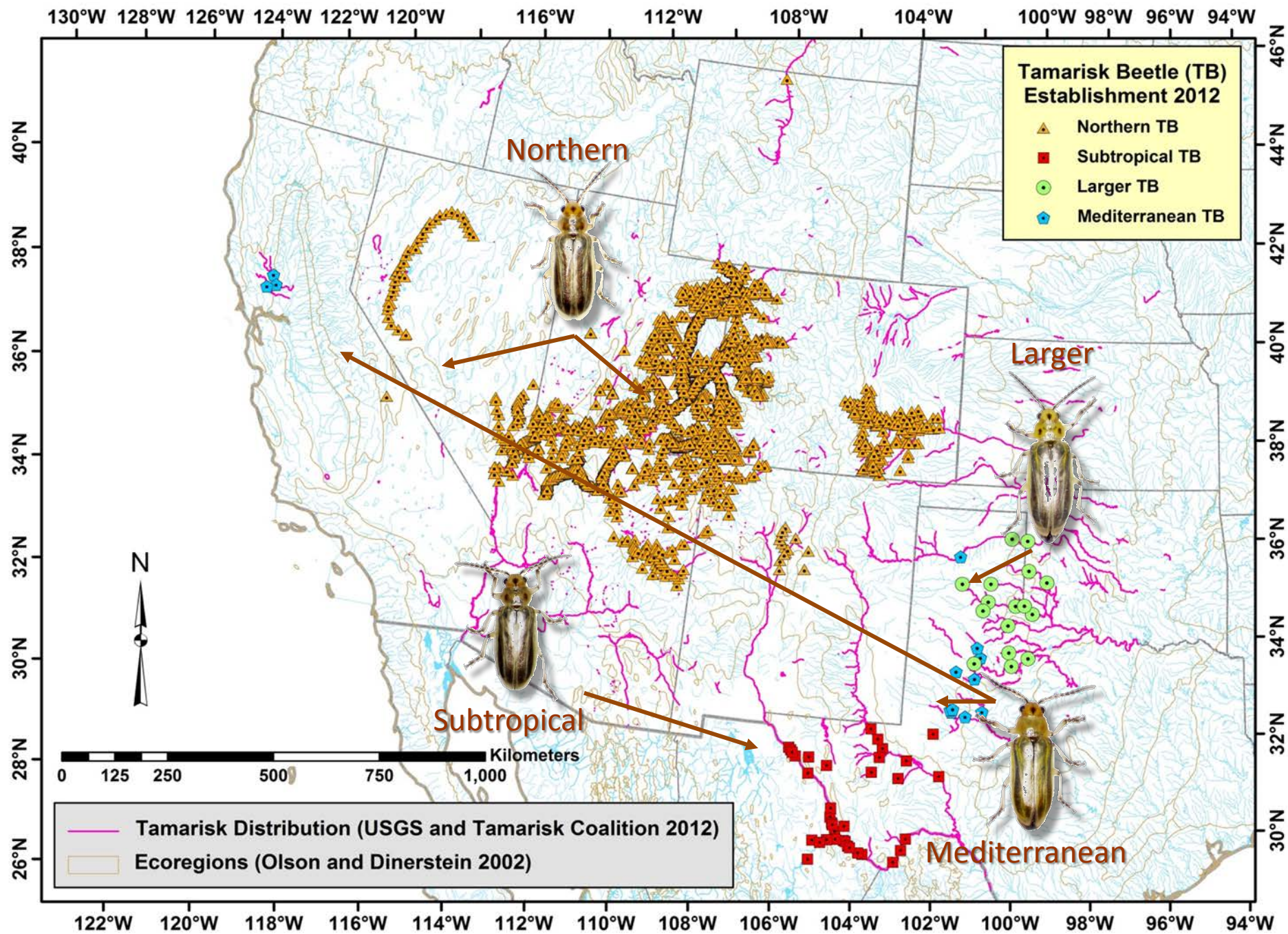
2007-2017 Distribution of Tamarisk Beetle (*Diorhabda* spp.)



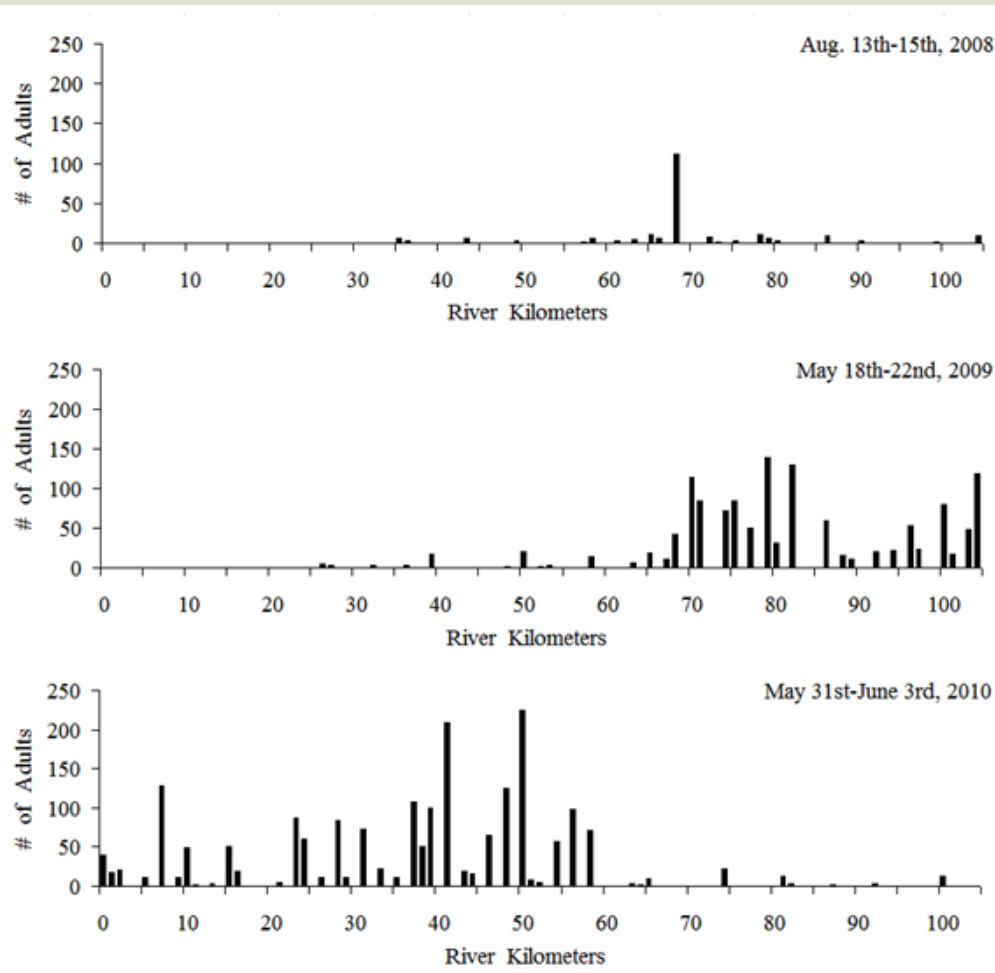


2007-2019 Distribution of Tamarisk Beetle (*Diorhabda* spp.)





Beetles will defoliate *Tamarix* and the timing and frequency will be variable.



Beetles will move over large distances, periodically defoliating tamarisk stands, as illustrated by their movements on the Dolores River.

2007 pre-beetle



2010 post-beetle



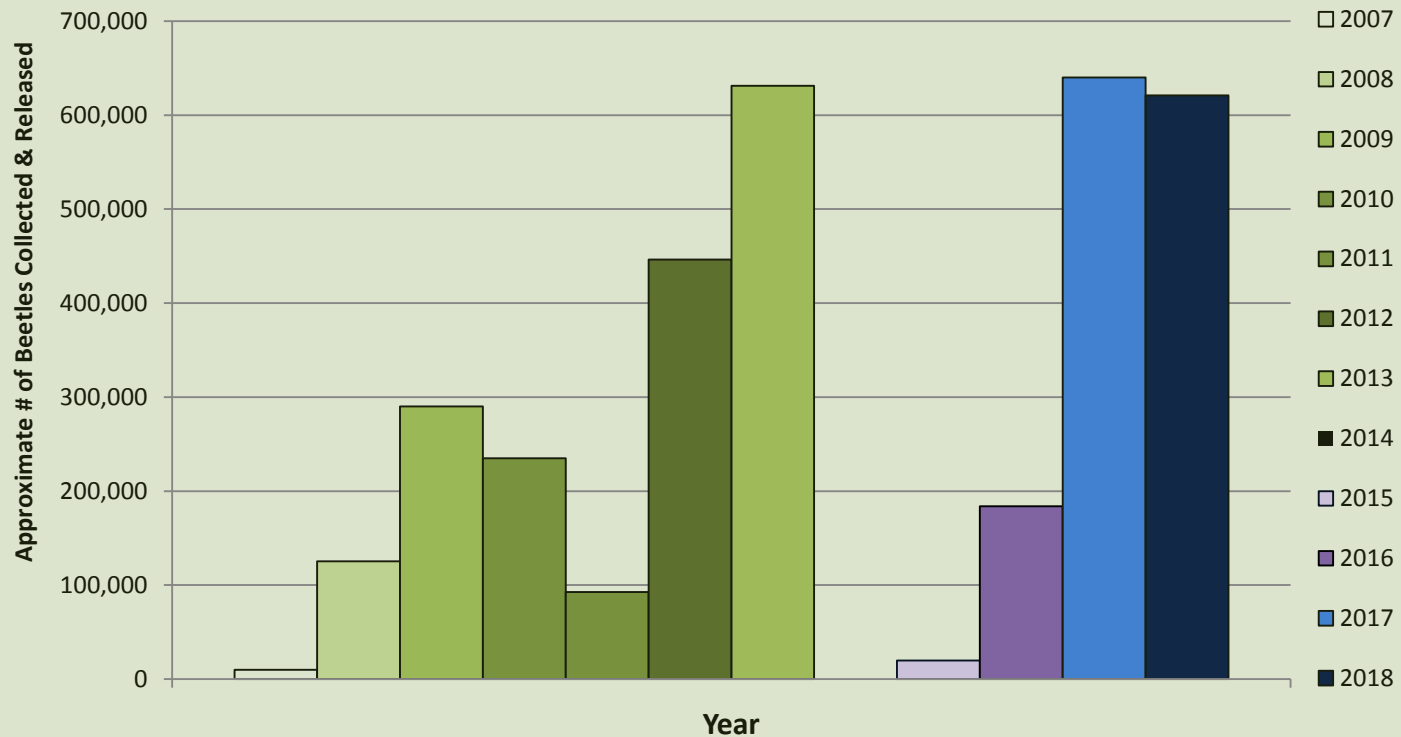
Stan Young ranch along East Salt Creek in Mesa County before and after beetles released.



Steady rise in populations across western CO with widespread defoliation in 2017 and 2018.



Approximate Number of *D. carinulata* Collected and Released in CO, 2007-2018





Beetles will defoliate *Tamarix* and the timing and frequency will be variable





Beetles will defoliate *Tamarix* and the timing and frequency will be variable

Virgin River Valley 2010 – Before
Biocontrol (June 1) and After (June 20)





Tamarix Response to Herbivory

***Tamarix* response will include a depletion of carbohydrate reserves, decreased canopy cover and decreased flowering**



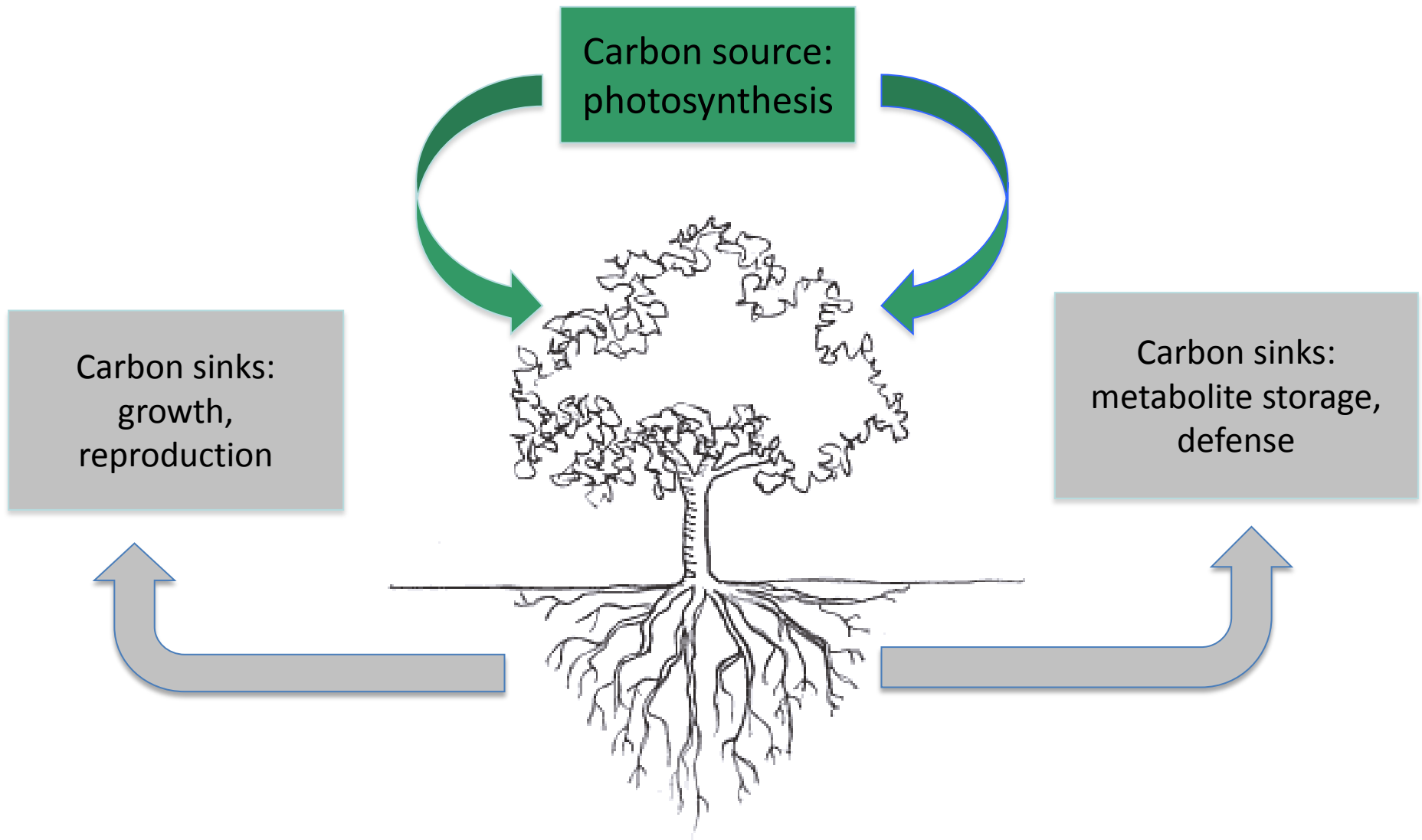
Owl Draw, Utah



Dolores River, Utah

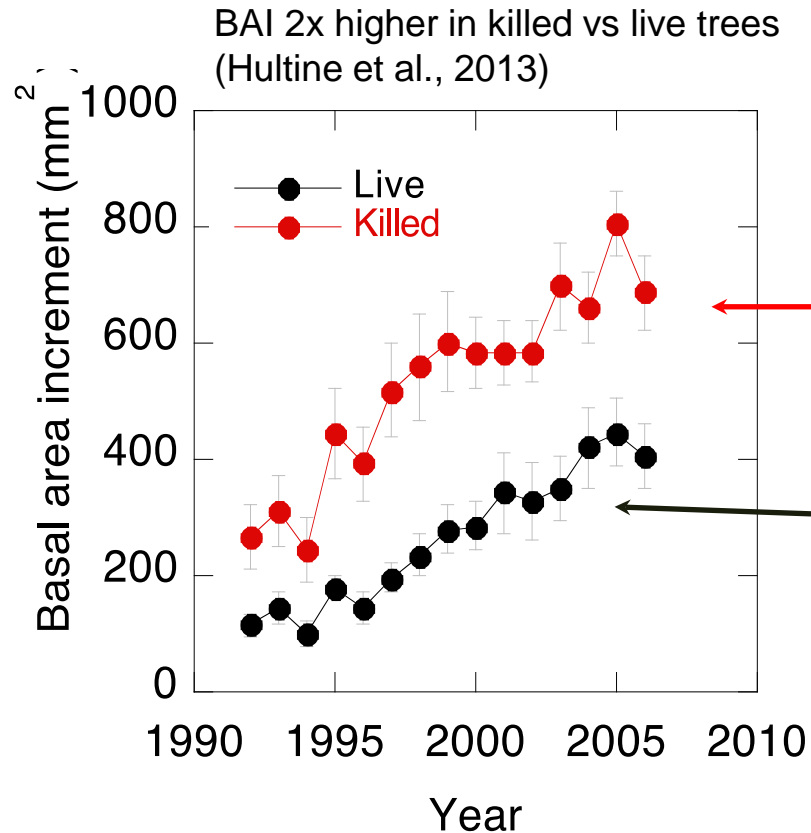


Growth Versus Carbon Storage

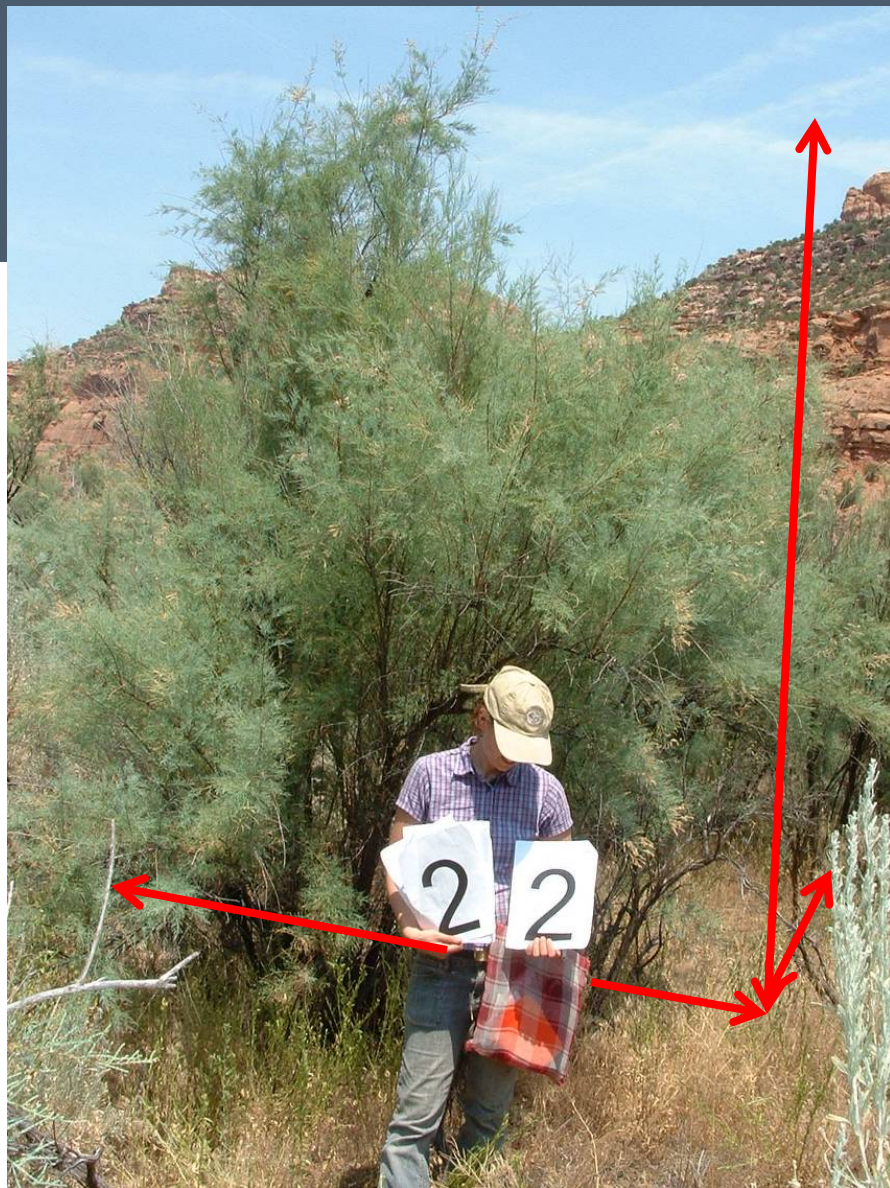




Growth Versus Carbon Storage



- Contemporary hypothesis: Allocation of photosynthates is highly regulated (Sala et al., 2012)



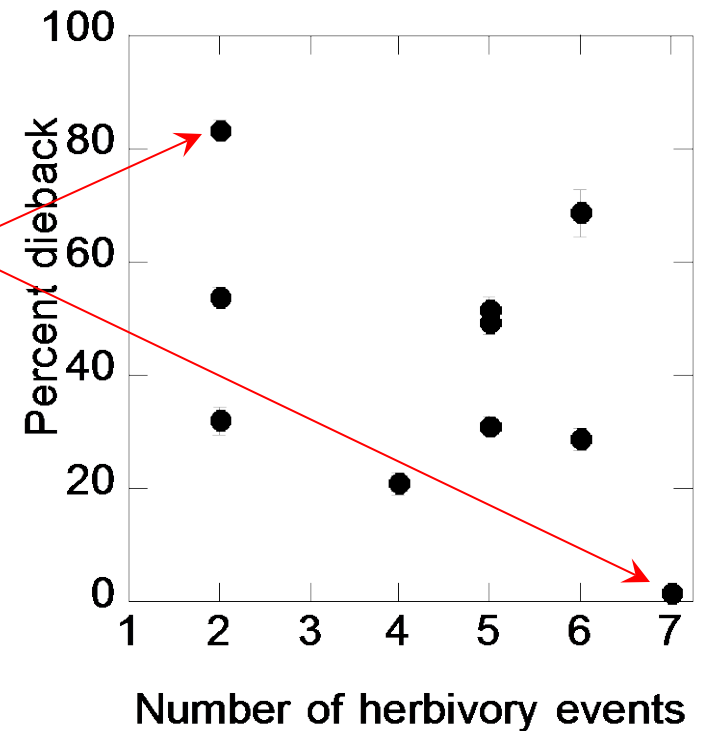
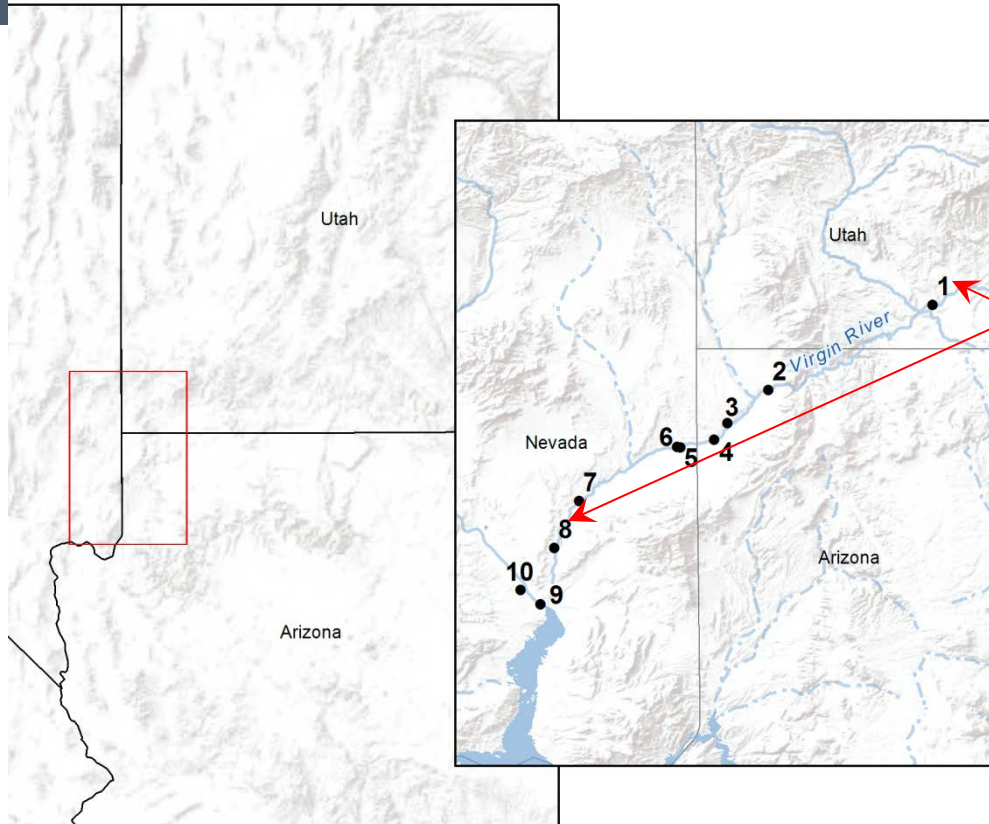
Bedrock 2007
(prior to beetles)



Bedrock 2010



Patterns of mortality are highly variable across the landscape



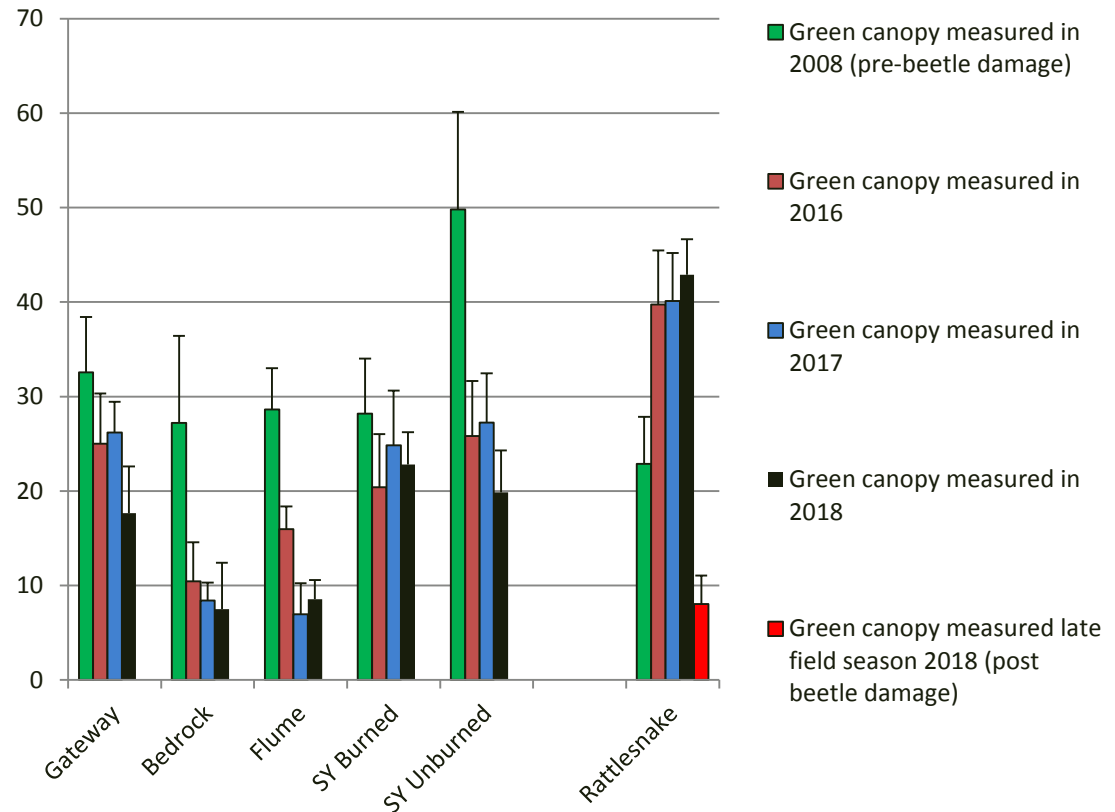
1000 tamarisk trees monitored ($n = 100$ / site)

No relationship between herbivory events and dieback



Canopy Volume 2008 vs.2016-2018

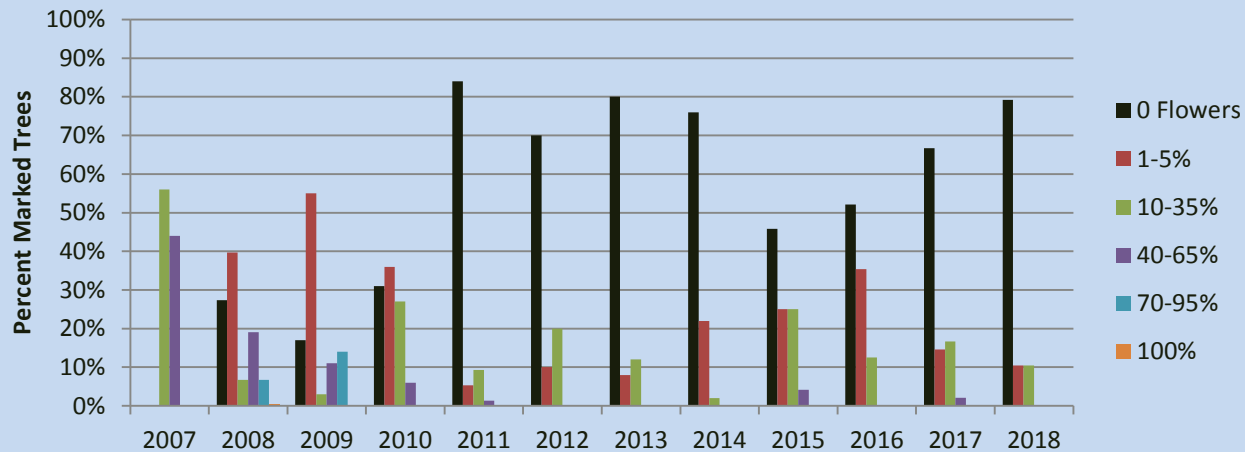
- As of 2018 mean canopy volume has decreased by an average of 46% at damaged sites (at least three defoliations) from measurements recorded in 2008.
- Whereas we see a 50% increase at the Rattlesnake Gulch from measurements taken in 2008.



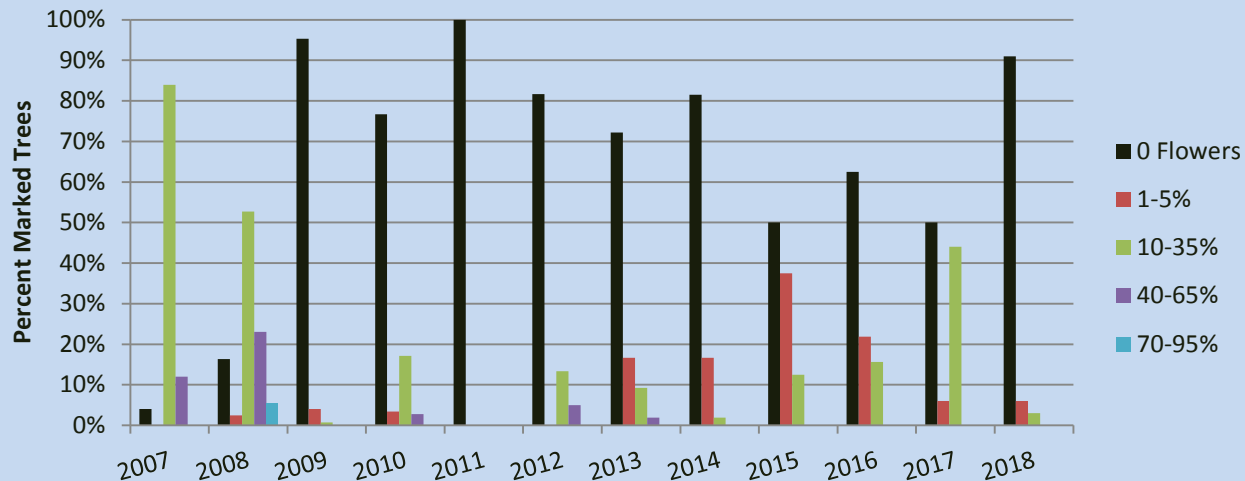
Flower Decline



Percent Blooms on Marked Tamarisk, Gateway Site, 2007-2018



Percent Blooms on Marked Tamarisk, Bedrock Site, 2007-2018





Inability to recover well from fire



Dewey Bridge, UT 10-5-09



Dewey Bridge UT 8-31-10



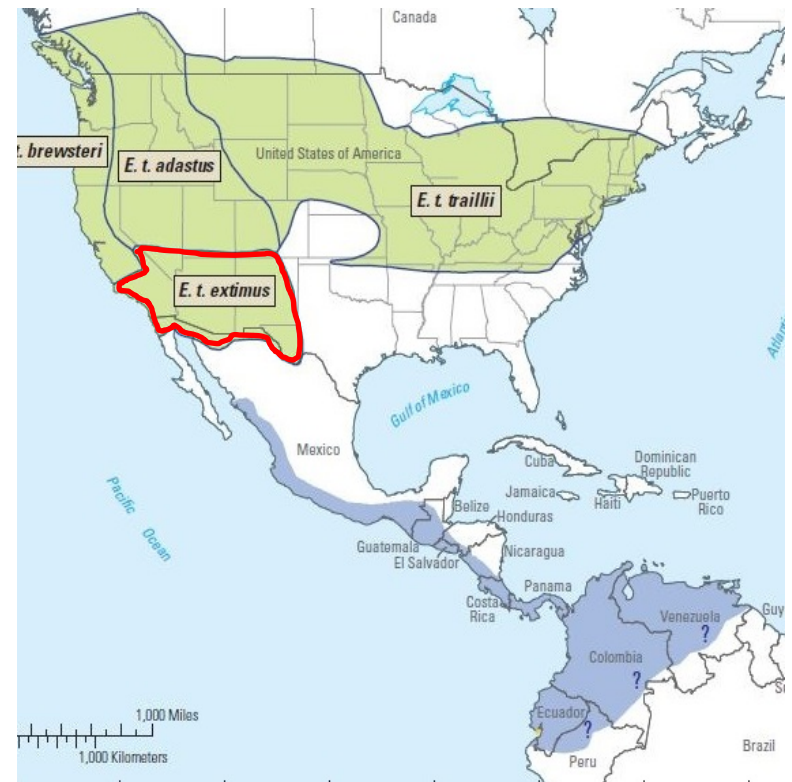
Overall Effects of *Diorhabda* on Tamarisk

- Cycles of defoliation / refoliation
- Decline in green biomass and vigor
- Decrease in canopy cover
- Decline in flowering/seed production
- Mortality variable
- Inability to recover well from fire



Southwestern willow flycatcher (*Empidonax traillii extimus*)

- Endangered subspecies of willow flycatcher
- Breed in AZ, NM, and adjacent portion of neighboring states
- Late migrants; arrive May–June





Southwestern willow flycatcher

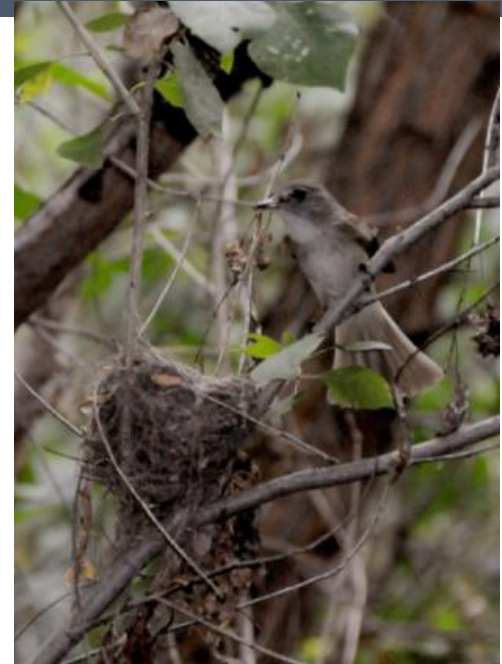
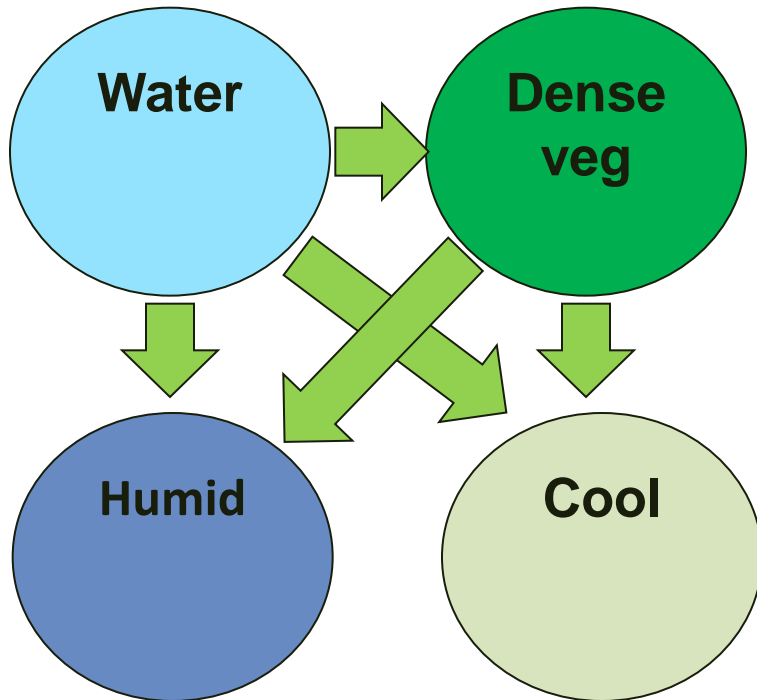


- Breed in dense, wet riparian habitats; strong affinity for surface water
- Select nest sites that are cool, humid, dense
- Use both native vegetation and tamarisk





Flycatcher Habitat Preferences



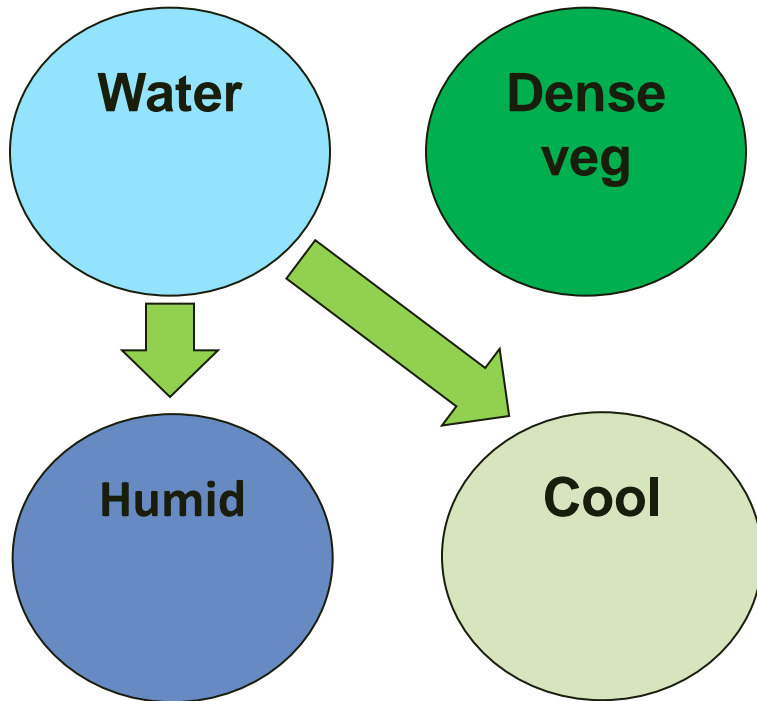
Concealment

Less time & energy on
thermoregulation

Eggs less likely to reach **lethal temp**
(**41°C = 106°F**) Webb 1987



Flycatcher Habitat Preferences – Beetle Effects



Less concealment

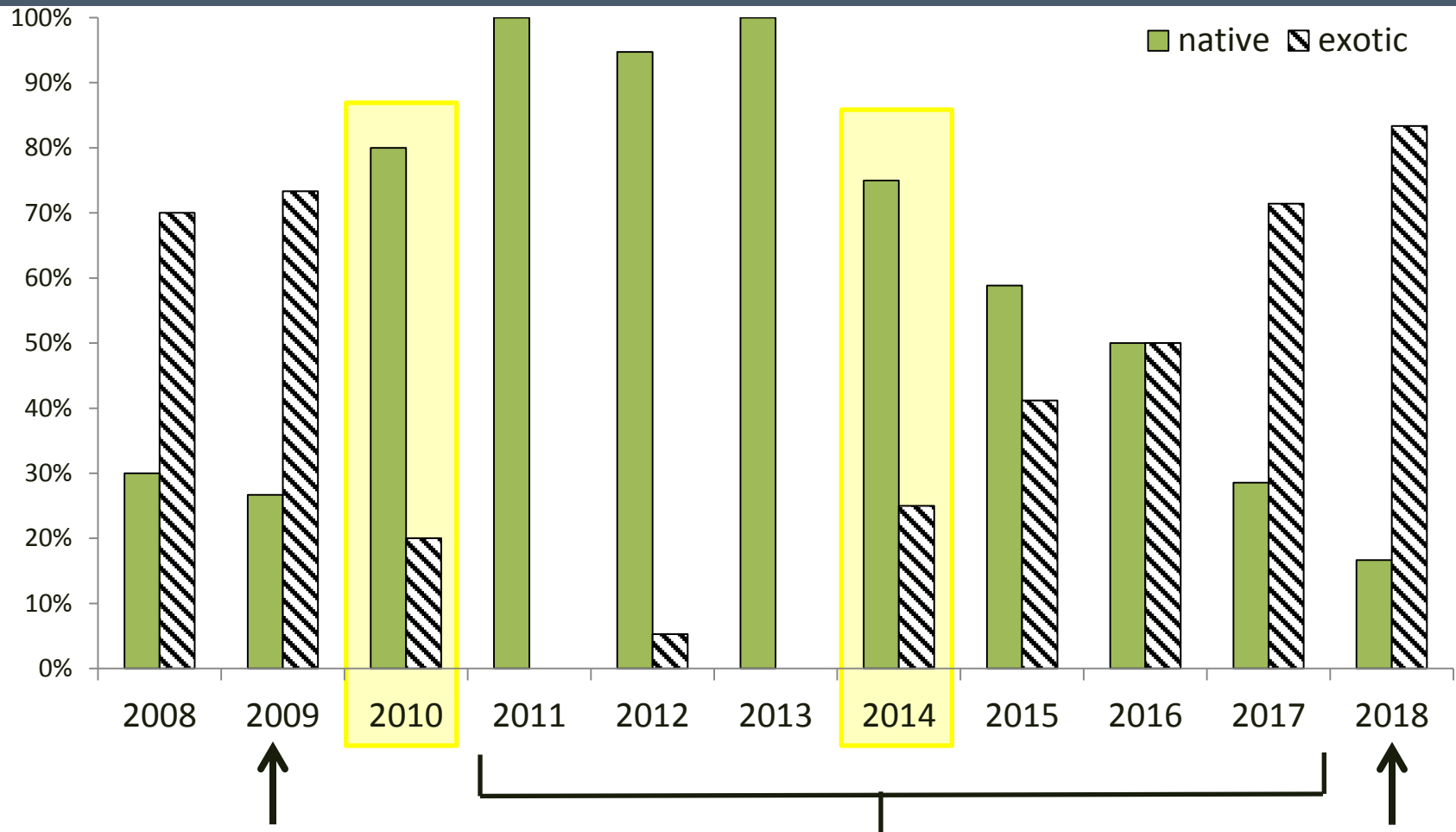
More time & energy on
thermoregulation

Eggs *more* likely to reach **lethal**
temp (41°C = 106°F) Webb 1987



Habitat use shifts (2010, 2014)

-- nest site dominant species (5m-radius)



Defoliation first coincides
with peak SWFL breeding

Defoliation occurring
after SWFL breeding



Solutions?



- Active restoration of riparian woodlands
 - Near existing flycatcher populations in tamarisk
 - < 30 km, closer is better
 - Careful site selection to maximize chances of success
 - near water
 - formerly occupied, beetle-affected flycatcher sites

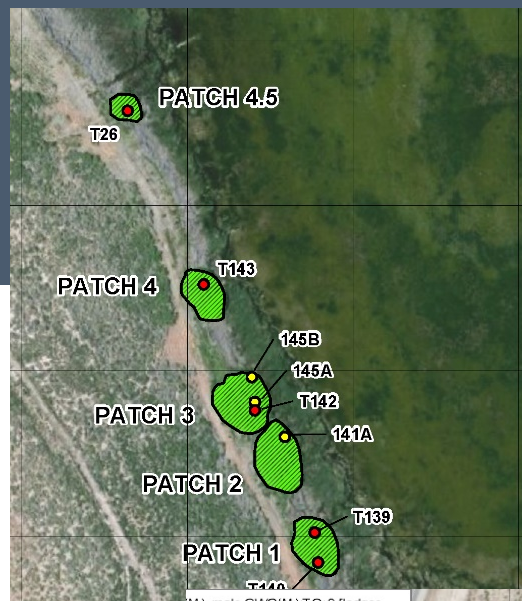


Solutions?

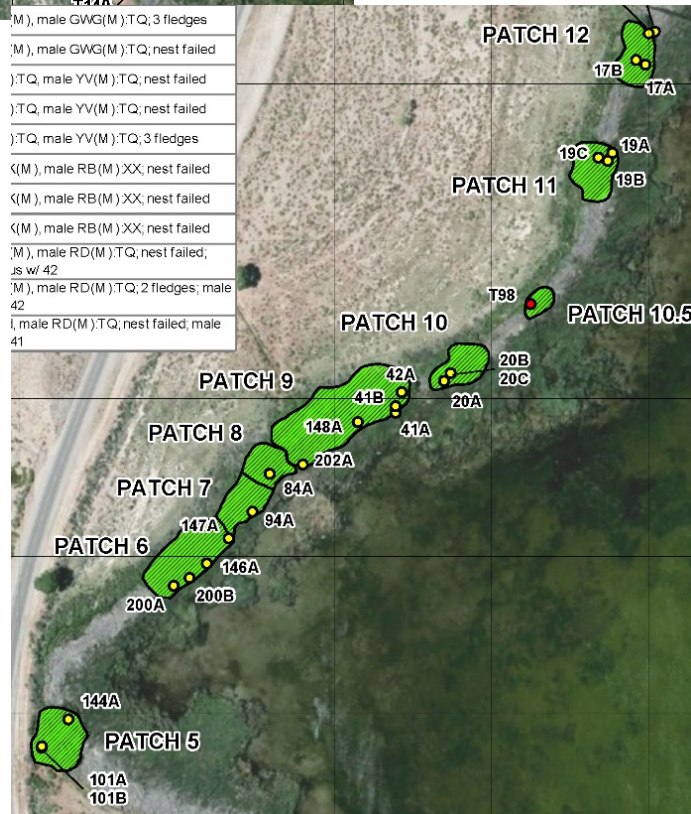
- How big?
 - These are not grizzly bears (or cuckoos)
 - Home range during breeding season 0.38 ha (Cardinal 2005)
 - 5-yr review: 1.1 ha per territory
 - Multiple small patches in close proximity can function as a larger patch



Small patch examples



(M), male GWG(M);TQ; 3 fledges
 (M), male GWG(M);TQ; nest failed
);TQ, male YV(M);TQ; nest failed
);TQ, male YV(M);TQ; nest failed
);TQ, male YV(M);TQ; 3 fledges
 <(M), male RB(M);XX; nest failed
 <(M), male RB(M);XX; nest failed
 <(M), male RB(M);XX; nest failed
 (M), male RD(M);TQ; nest failed;
 js w/ 42
 (M), male RD(M);TQ; 2 fledges; male
 42
 I, male RD(M);TQ; nest failed; male
 41



- Key Pittman (Lincoln Co., NV)
 - "String of pearls"
 - Coyote willow
 - Patches as small as 0.1 acre
 - Total size 3.5 acres
 - Supported up to 17 pairs



Do not discount the value of a site just because it's small!



- Mormon Mesa
 - Dense **coyote willow**
 - 3 patches, biggest 0.4 acre
 - nest sites
 - **Goodding's willow** overstory
 - singing perches, foraging
 - Total area ~ 2.5 acres
 - Surrounded by dead tamarisk



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riversedgewest.org/services/tamariskbeetle