Colorado's Biological Pest Control Program for Management of Weeds and Insect Pests

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Colorado Department of Agriculture, Conservation Services
Biological Pest Control, Palisade Insectary

Southern Rocky Mountain Ag Conference, February 5, 2019
Monte Vista, CO

Russian knapweed and the gall wasp *Aulacidea acroptilonica;* stem galls and emergence holes

Canada thistle rust fungus

tamarisk beetles

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Biological Pest Control Program
Palisade Insectary
Palisade, CO

1. The Insectary
2. Safety
3. Is Biocontrol Effective?
4. Biocontrol Programs
5. How to work with the CDA and Biological Pest Control


INSECTARY FACILITY
750 37 AND 8/10 ROAD
PALISADE, COLORADO
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1876

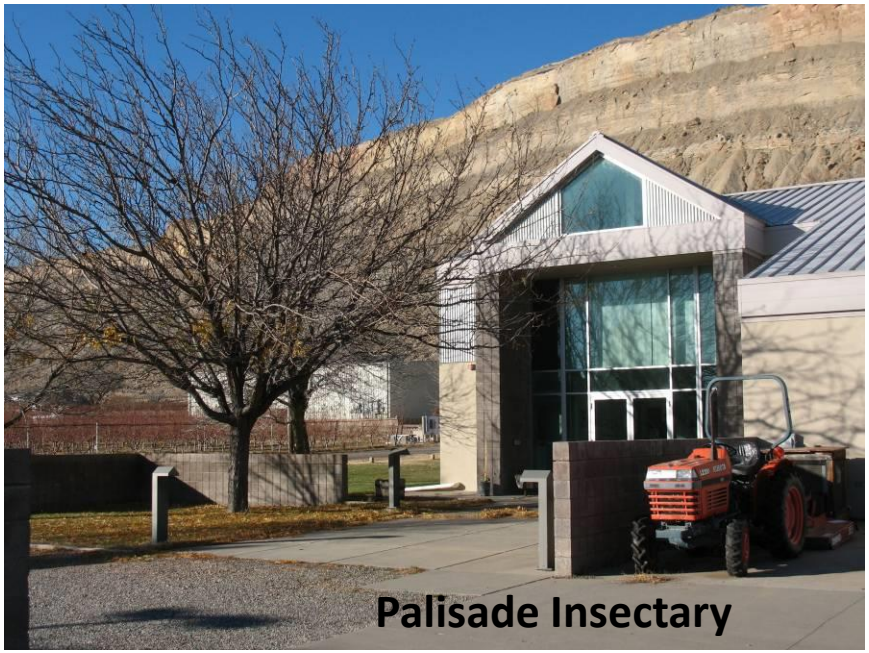
Palisade Insectary

- Began in the 1940's to fight Oriental fruit moth, a project that helped peach farmers and is still going

- Distributes over 20 biocontrol agents for the control of insect pests and weeds.

- Is a partner in pest management on a local, state, regional and national level

- Has three goals; **Implementation** of biocontrol, post release **monitoring** and **education** of end users and the public



It all started with Palisade peaches and a threat to the peach growers of the Grand Valley back in the early 1940s

Grand Valley Orchards

The Oriental fruit moth (OFM) is an **exotic invasive species** that entered the US from east Asia more than 100 years ago. By 1944 it was threatening Palisade's peach crop.

OFM adult

OFM larva and damaged peach

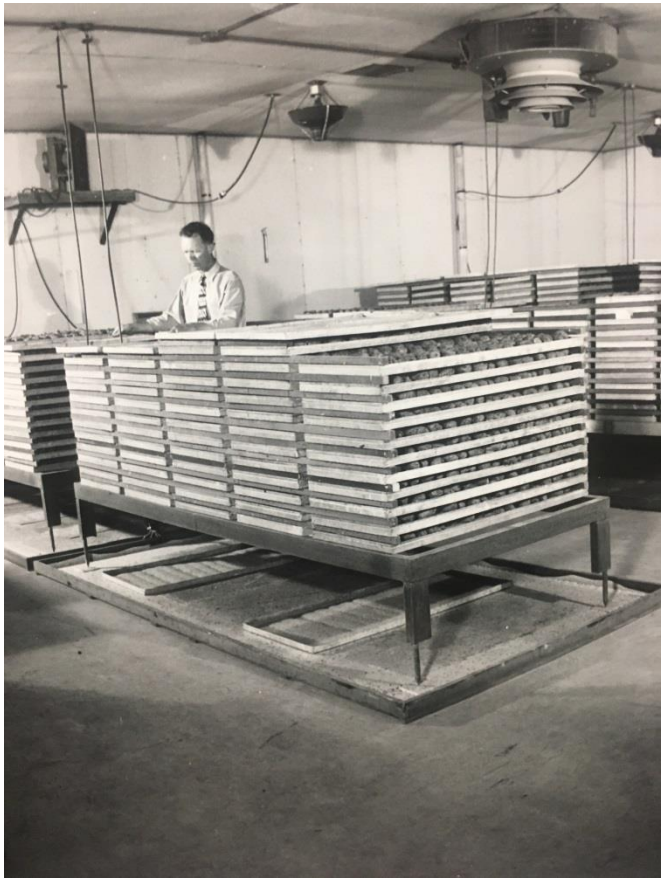
The Oriental fruit moth (OFM) is an **exotic invasive species** that entered the US from east Asia more than 100 years ago. By 1944 it was threatening Palisade's peach crop.

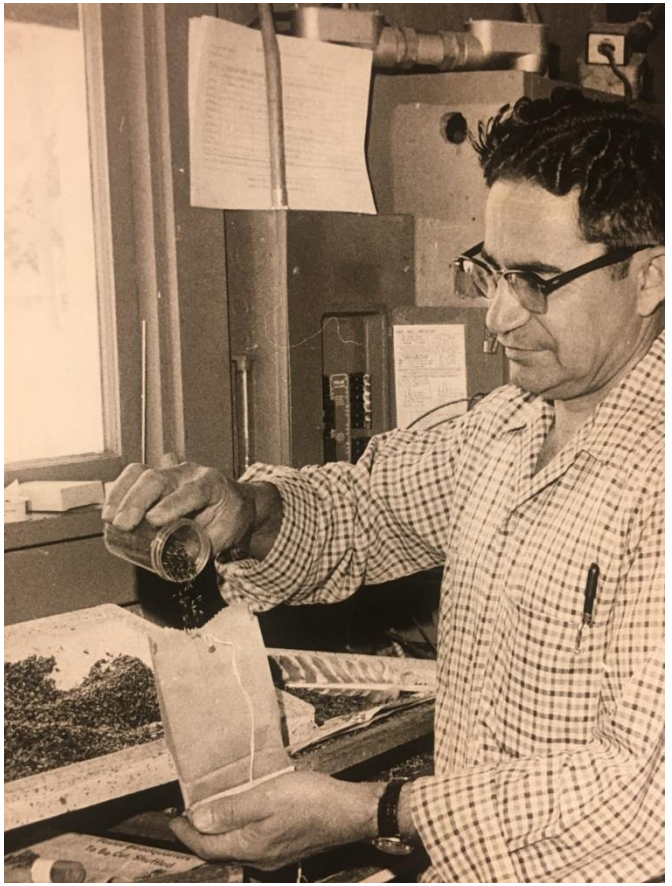
The parasitoid wasp *Macrocentrus ancylivorus* known as Mac, is a natural enemy of the OFM, destroying larvae in the late spring and minimizing damage to fruit

OFM adult

OFM larva and damaged peach

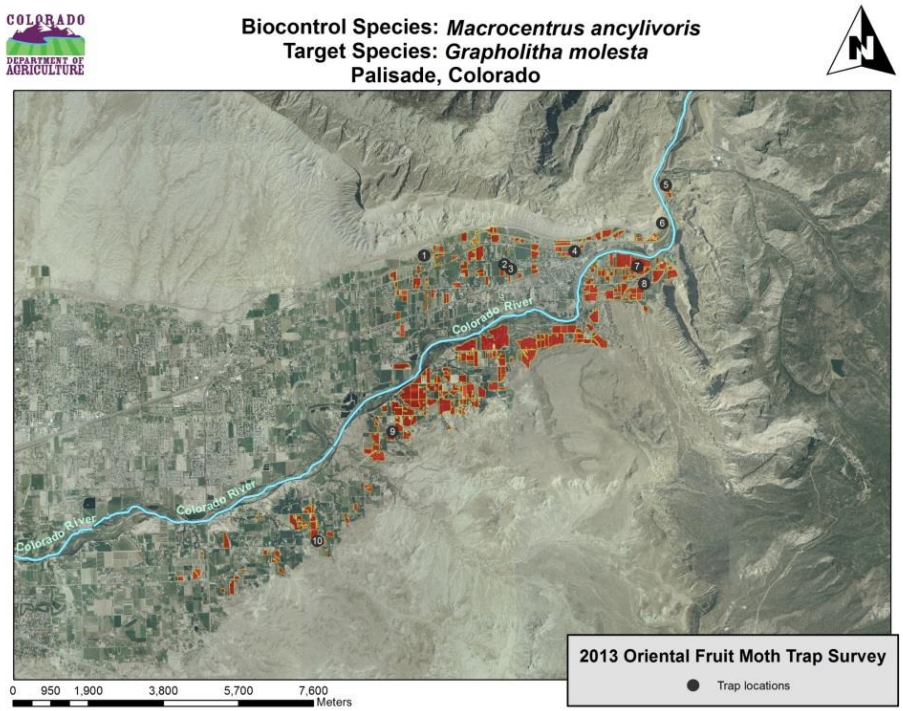
Mac rearing is on a large scale (**Implementation**)





Al Merlino measures out Mac into a paper bag for use by farmers who get 1 bag/acre of peaches

Monitoring This covers all the steps involved in tracking the biocontrol agent and target and evaluating the situation in order to make management decisions.



Working with peach farmers since 1945

Education End users need to know how to use biocontrol and what to expect. The curious public should also be well informed

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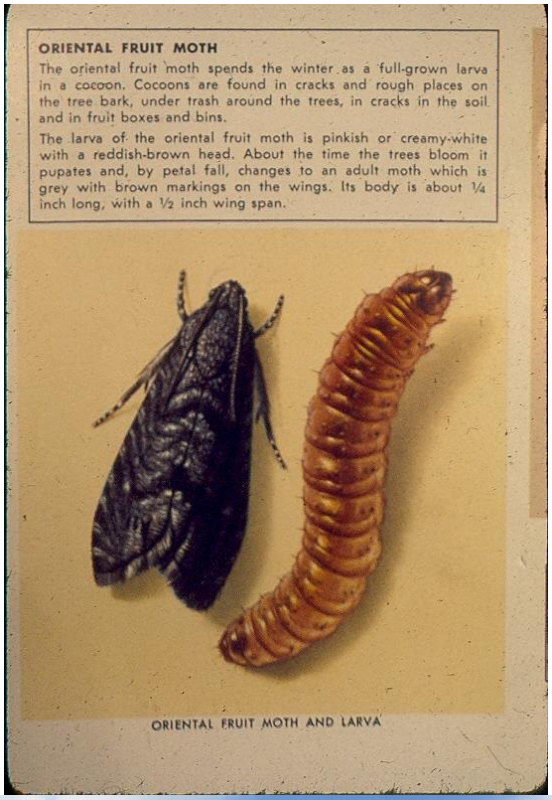
Insectary information booth at the International Honeybee Festival in Palisade 2017



Macrocentrus ancylivorus

Oriental fruit moth biological control using Mac, 1945-present, with farmer cooperation

2,567,000 released in 2018

Alfalfa weevil

Alfalfa weevil larva and parasitoids

Emerald ash borer

Cereal leaf beetle

Japanese beetle

Russian wheat aphid

Leafy spurge

Aphthona flava

Puncturevine

Goatheads with *Microlarinus* damage

Spotted knapweed

Cyphocleonus achates

Field bindweed

Mite damage

Dalmatian toadflax

Mecinus janthiniformis

Russian knapweed

What is biological control?

1. Biological control (biocontrol) is the use of natural enemies, including insects, mites and pathogens, to control pests, including insect pests and noxious weeds

2. Biocontrol is an ecologically based pest control method. The goal is suppression of the insect pest or weed, not eradication. Often the desired end result takes years to achieve.

The Value of Biological Control

- Safe
- Effective

Flea beetle on leafy spurge

Field bindweed gall mites

tamarisk leaf beetle collection

The Value of Biological Control

- Safe
- Effective
- Inexpensive
- Critical IPM component

Flea beetle on leafy spurge

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Cyphocleonus on spotted knapweed

tamarisk leaf beetle collection

The Value of Biological Control

- Safe
- Effective
- Inexpensive
- Critical IPM component
- Sustainable

Flea beetle on leafy spurge

Field bindweed gall mites

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tamarisk leaf beetle collection

The Value of Biological Control

- Sustainable

  - Self propagating
  - Co-evolve with target (weed or insect pest) to stay ahead of the development of resistance
  - Reduce pesticide use in an IPM program and so may aid in pesticide resistance management

Colorado River near Moab, 8-31-10

Colorado River near Moab, 8-31-10

Weed Biological Control is Safe

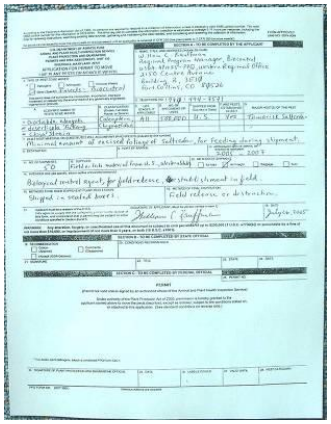
- **There has never been a case in modern weed biocontrol where a biocontrol agent switched host plants**

- **Weed biocontrol agents have never attacked crop plants**

Extensive host range testing done for every new agent

Weed Biological Control is Safe

- **There has never been a case in modern weed biocontrol where a biocontrol agent switched host plants**
- **Weed biocontrol agents have never attacked crop plants**
- **It takes <u>at least 10 years</u> to obtain a permit for open field releases of a weed biocontrol agent**



Is Biocontrol Effective?

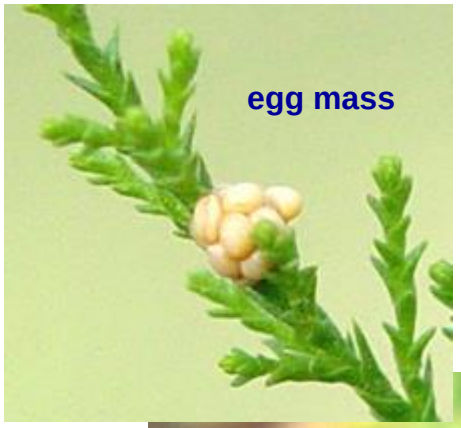
before biocontrol

after biocontrol

leafy spurge control near Pine, Colorado

Aphthona flea beetle

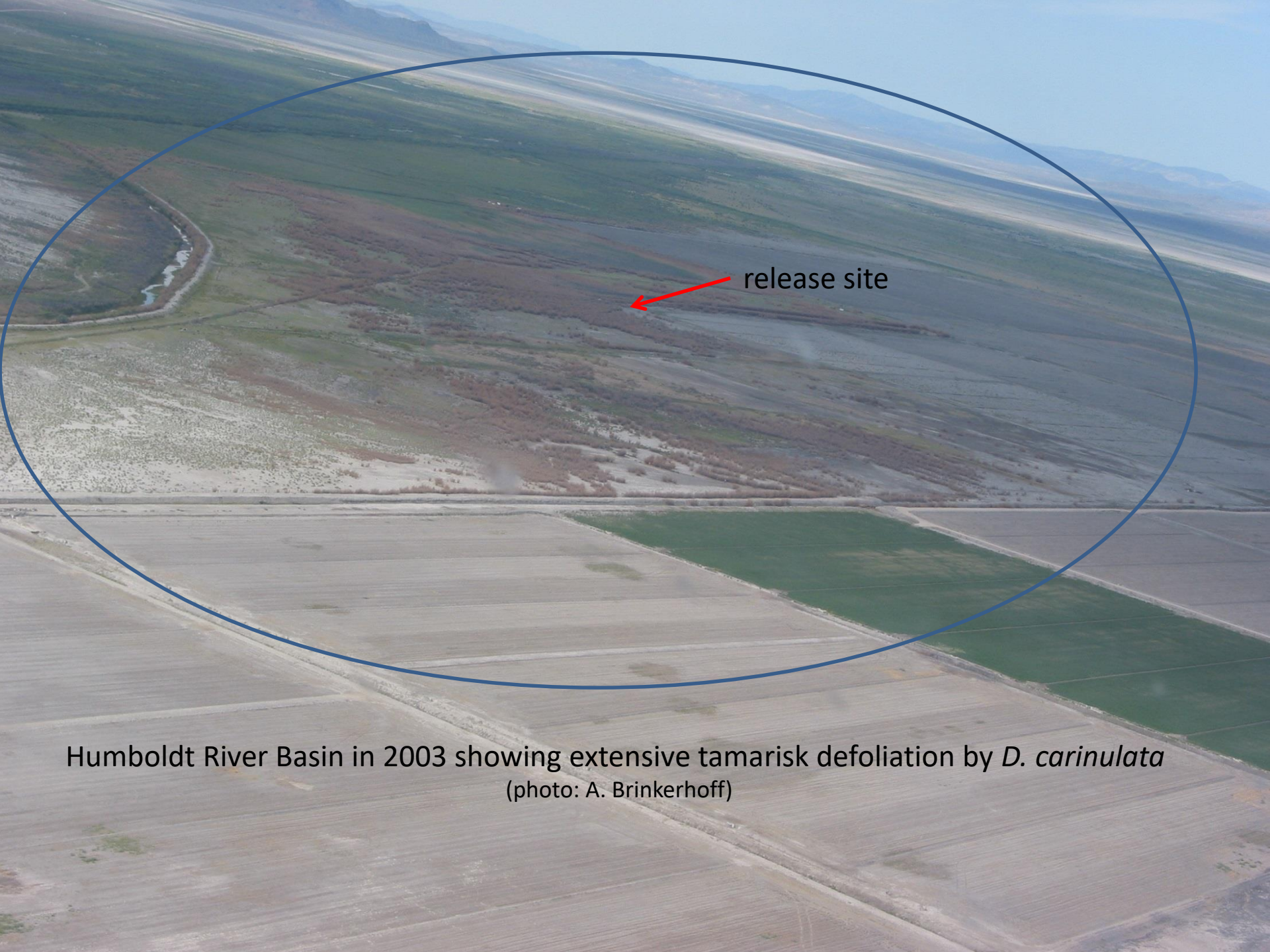
Oberea stem-boring long horned beetle



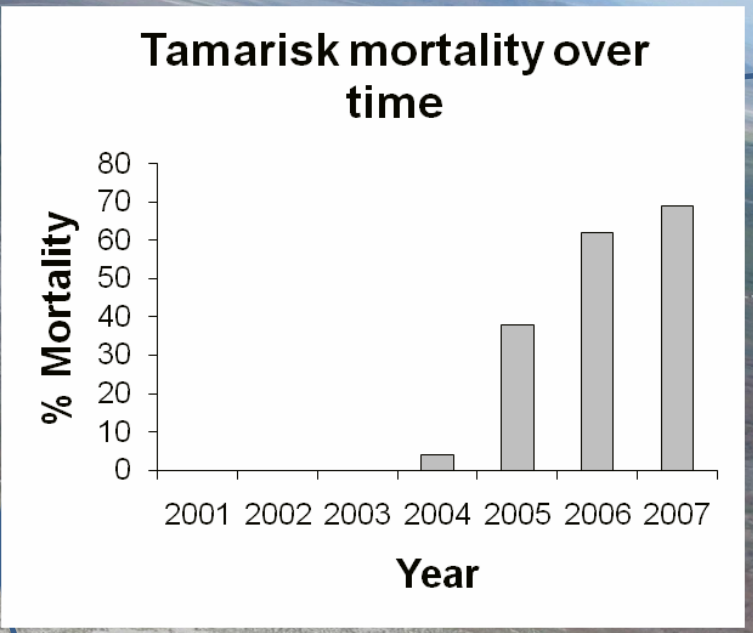
Adult

Diorhabda carinulata

Beetles were released in 2001, reached defoliation levels in late 2002, tamarisk defoliation occurred along a moving front
Lovelock, Nevada, July 2003

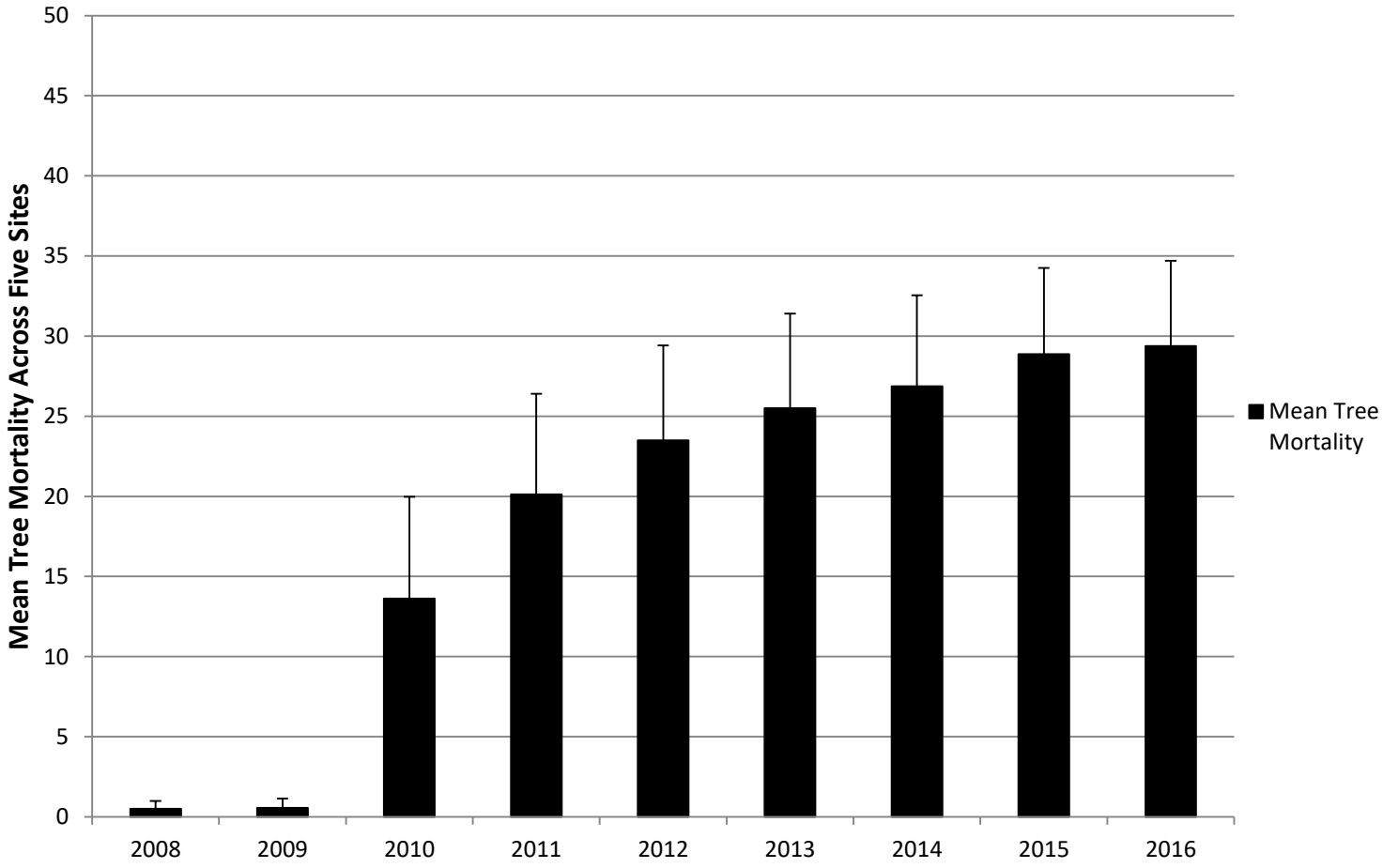


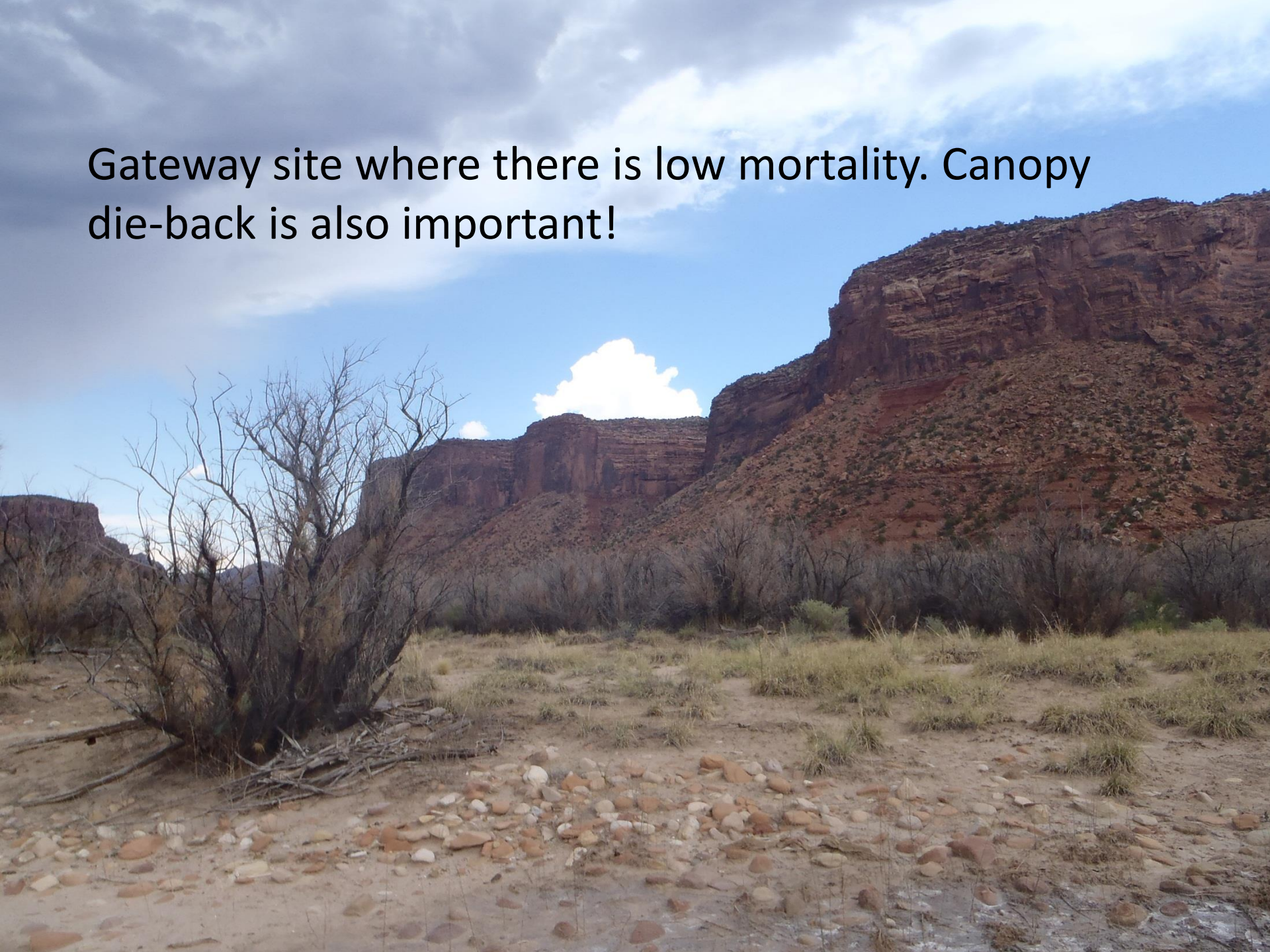
Humboldt River Basin in 2003 showing extensive tamarisk defoliation by *D. carinulata*
(photo: A. Brinkerhoff)

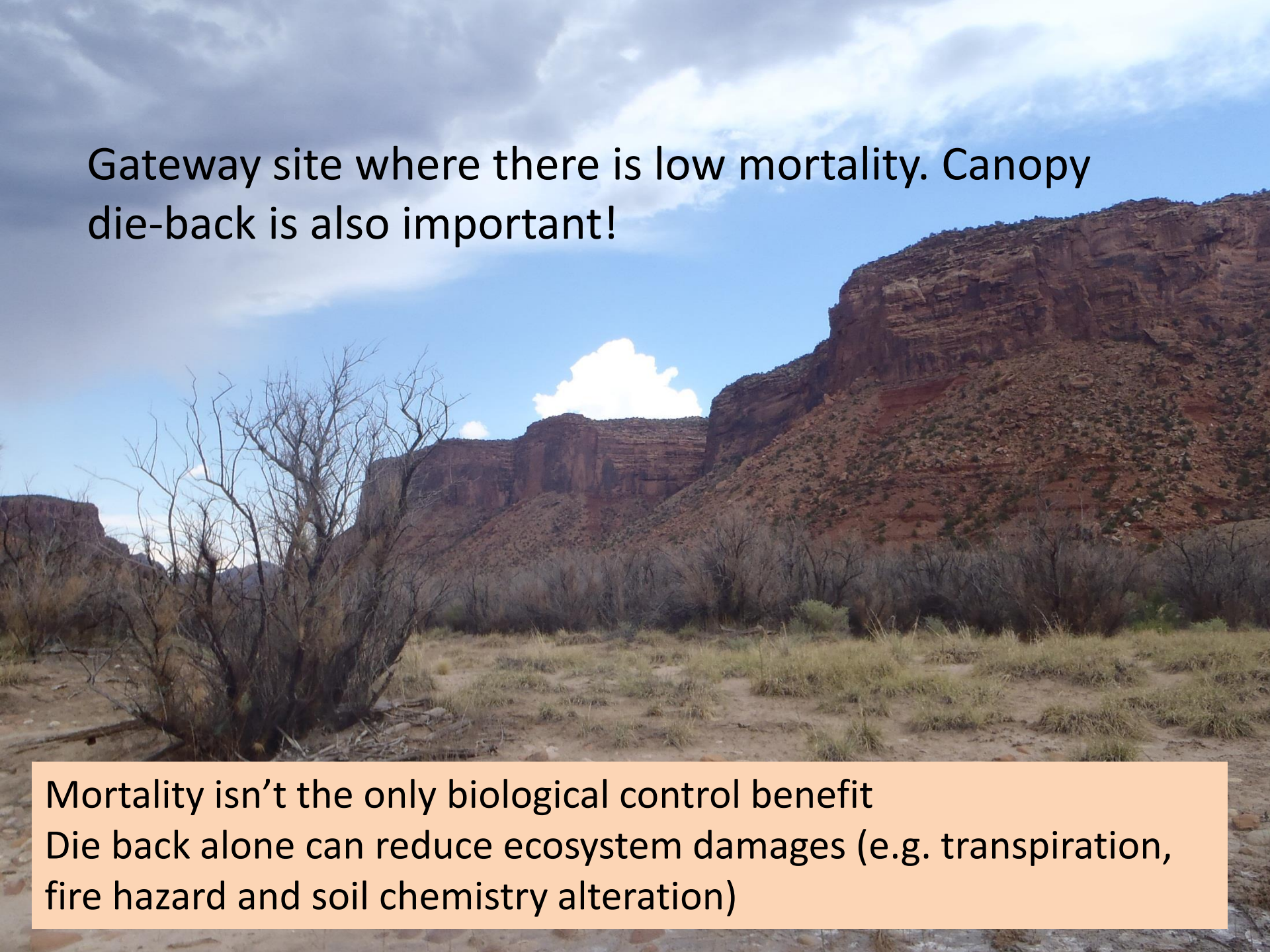


Humboldt River Basin in 2003 showing extensive tamarisk defoliation by *D. carinulata*
(photo: A. Brinkerhoff)

Mean Tree Mortality at Sites with at Least Two Defoliations, Western Slope

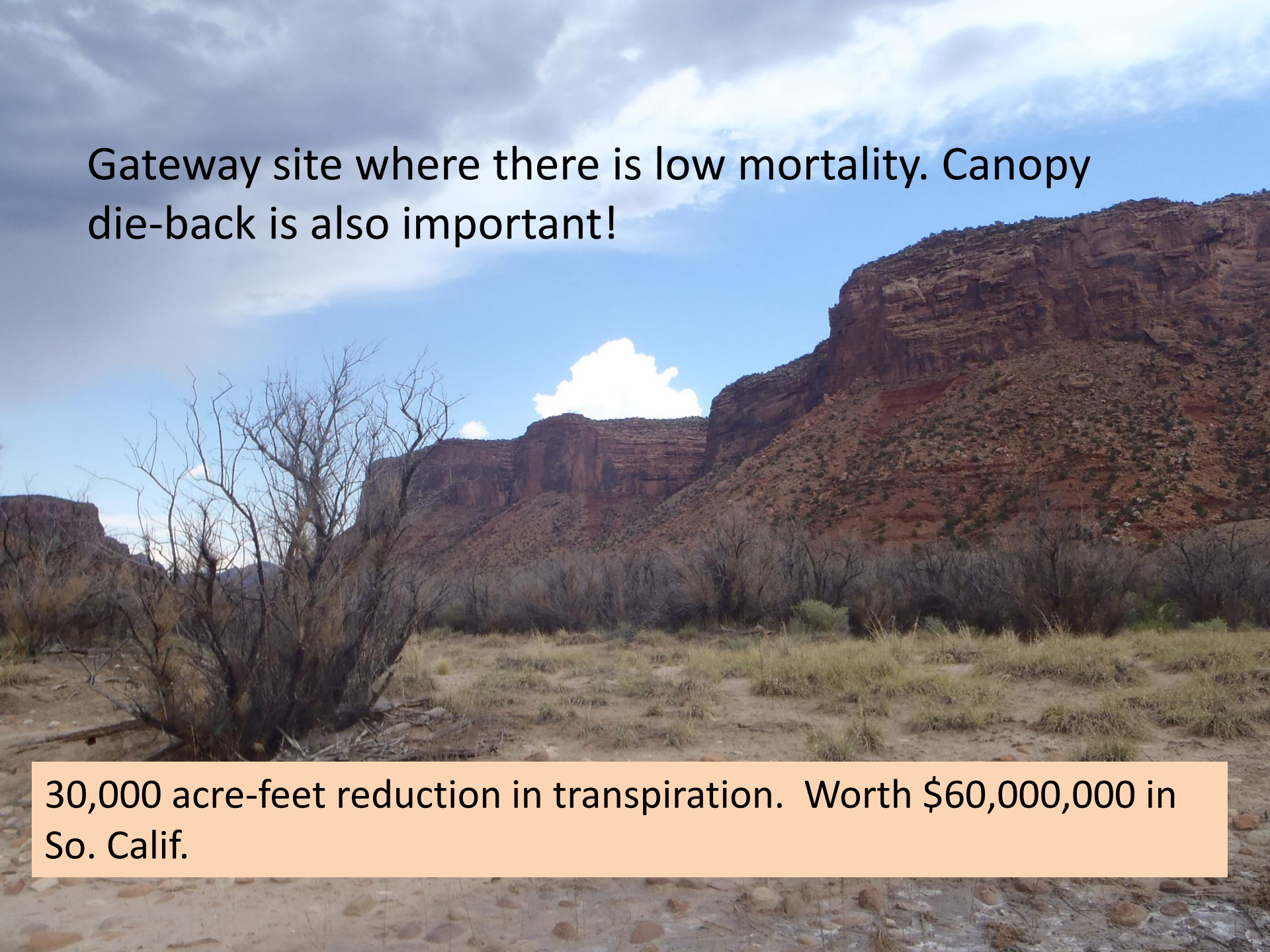



Gateway site where there is low mortality. Canopy die-back is also important!



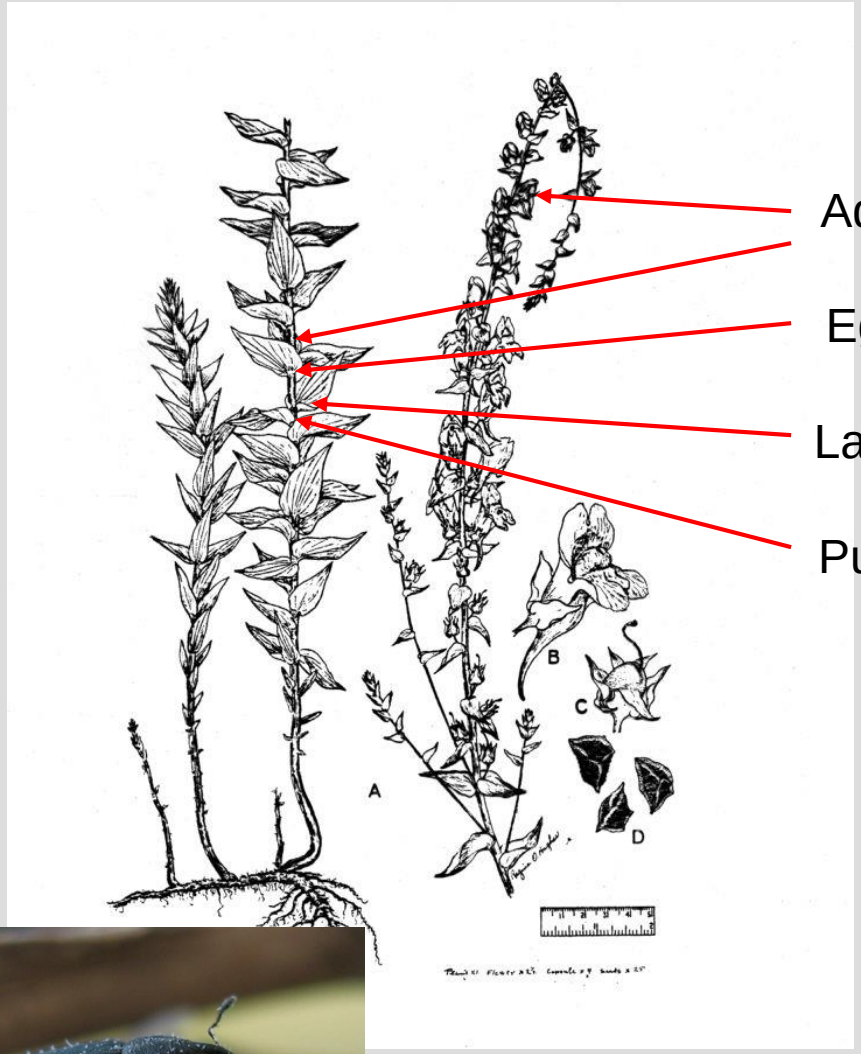
Gateway site where there is low mortality. Canopy die-back is also important!

Mortality isn't the only biological control benefit
Die back alone can reduce ecosystem damages (e.g. transpiration, fire hazard and soil chemistry alteration)

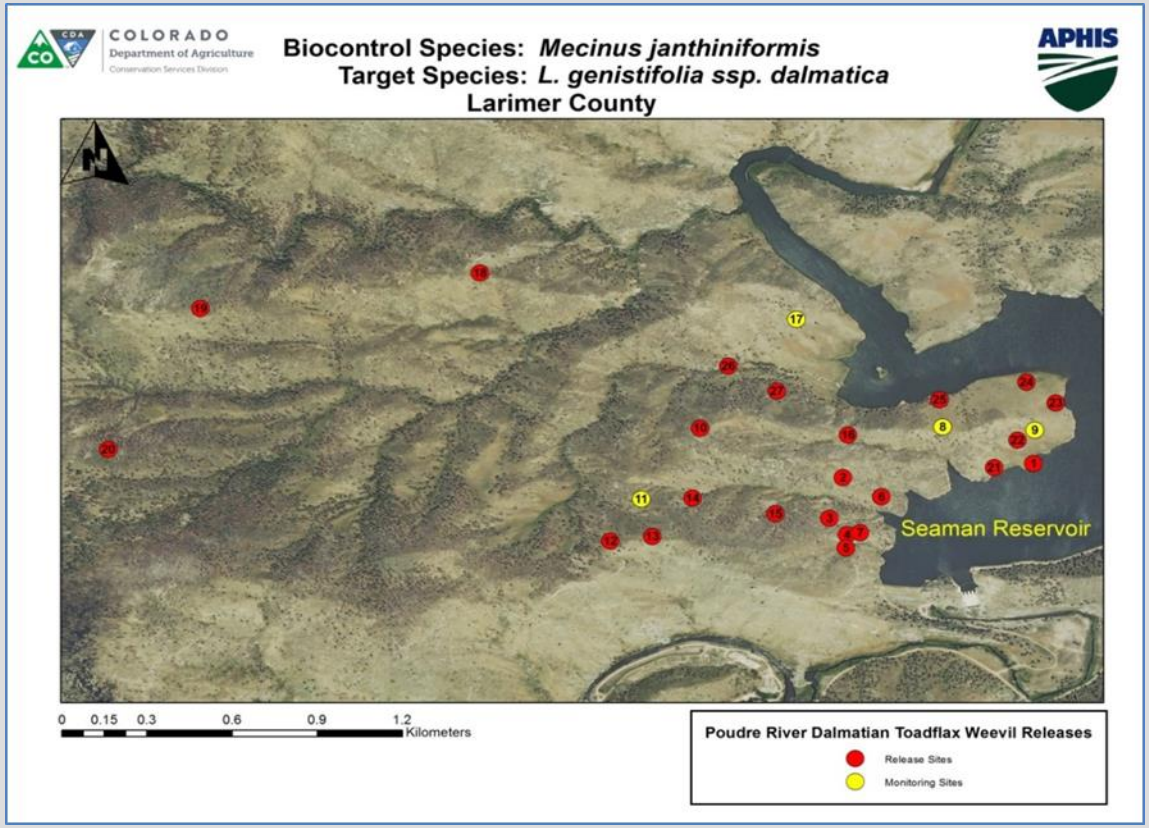

Gateway site where there is low mortality. Canopy die-back is also important!
30,000 acre-feet reduction in transpiration. Worth $60,000,000 in So. Calif.

Dalmatian toadflax

Mecinus janthiniformis



Release sites (red) and release and monitoring sites (yellow) near Seaman Reservoir, as part of the Poudre Partnership, developed after the devastating High Park/Hewlett fires (90,000 acres) of 2012.



Taken 6/13/2013, Steve Ryder prepares to make release of toadflax weevils

Taken 6/08/2016, Mike Racette notes complete absence of Dalmatian toadflax

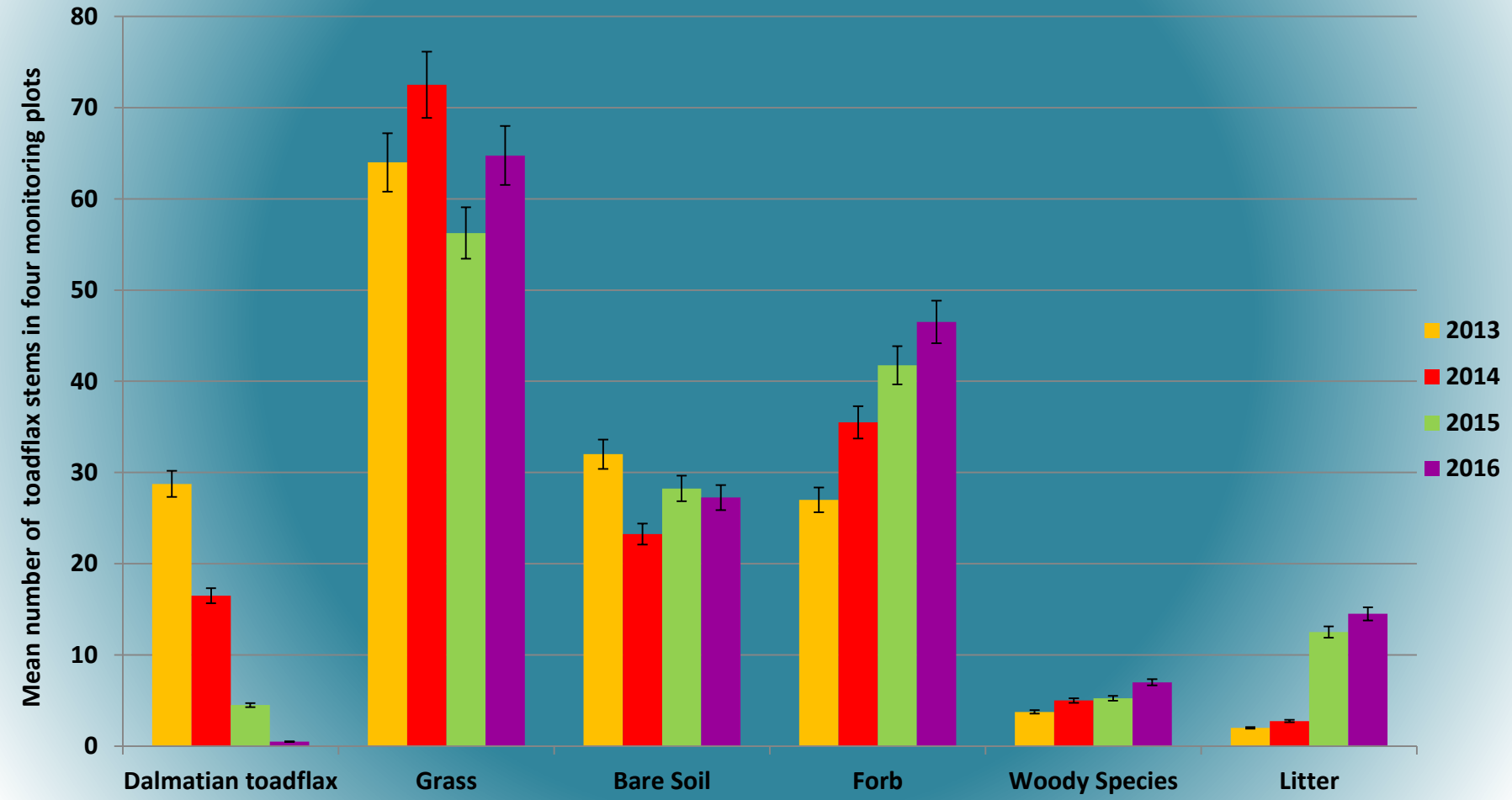
Toadflax infested meadow just above Seaman Reservoir, Larimer County, CO

Steve Ryder releases *M. janthiniformis* in toadflax infested meadow above Seaman Reservoir, 6/14/2013

This is the same meadow, photo taken 7/09/2016, no yellow flowers, no toadflax visible

Vegetation Composition Over Time

Point Intercept Data



Vegetation Composition Over Time

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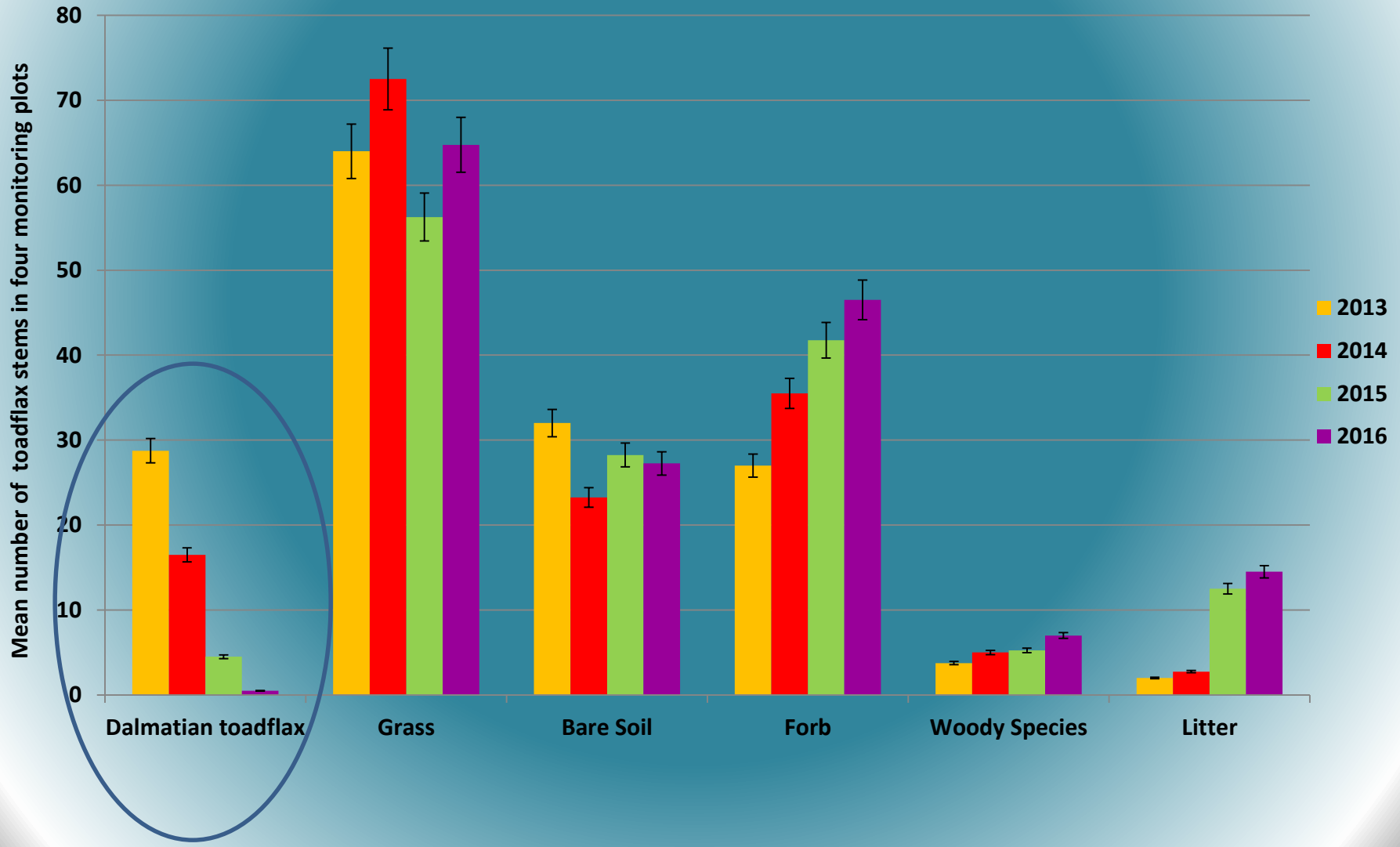


Three biocontrol projects

I. Russian knapweed

II. Field bindweed

III. Canada thistle

Russian Knapweed
(*Rhaponticum repens*)

- Perennial
- Flowers June-September
- Clonal growth
- Toxic to horses
- Sexual reproduction
  - Produces up to 1200 seeds/plant
    - 4x > than native range

Biological Control of Russian Knapweed

- 1997 CABI - foreign exploration for bio-control agents
- Two bio-control agents approved for release in the U.S. and Canada

Aulacidea acroptilonica (2008) Wasp

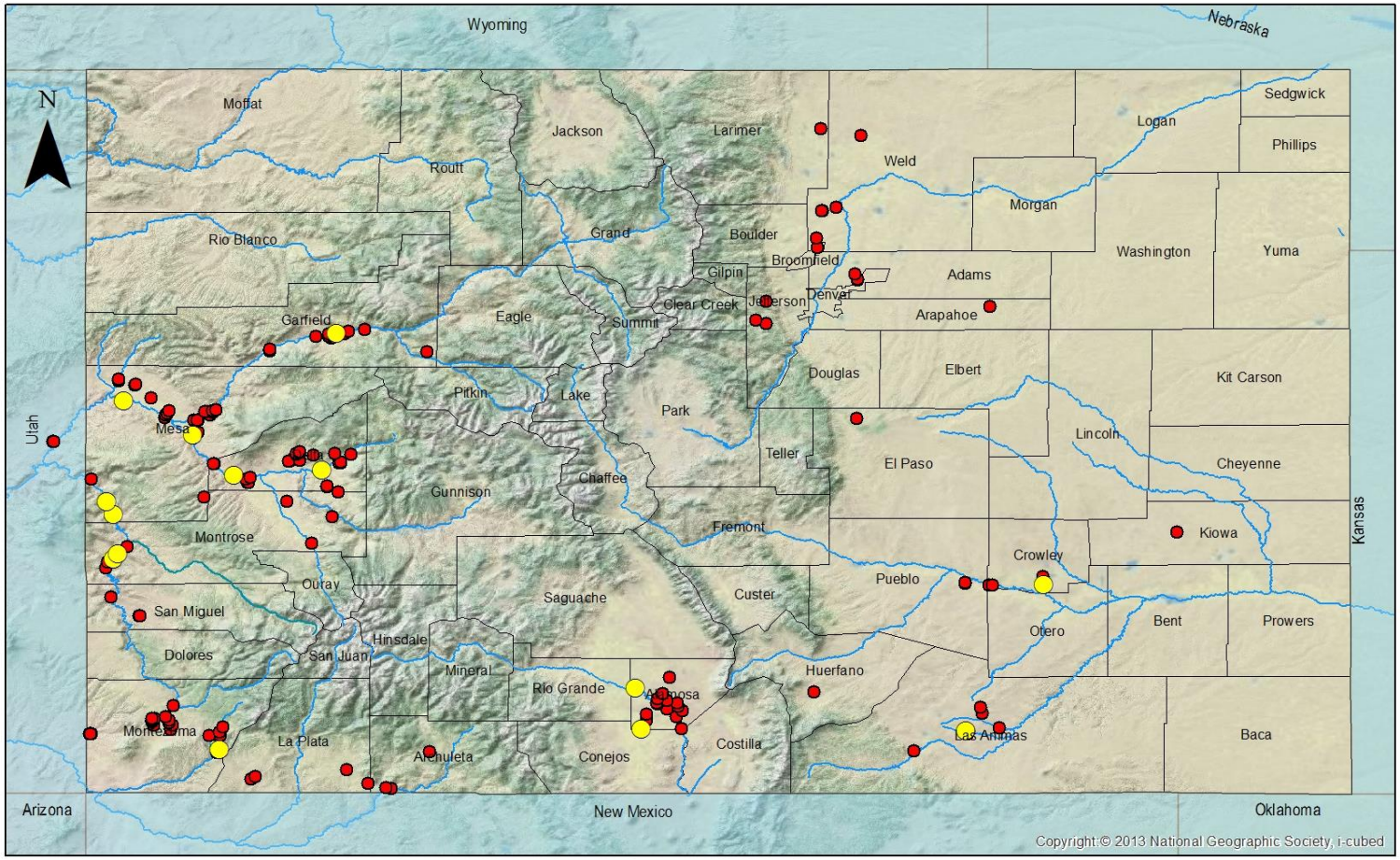
Jaapiella ivannikovi (2009) Gall midge


Jaapiella ivannikovi

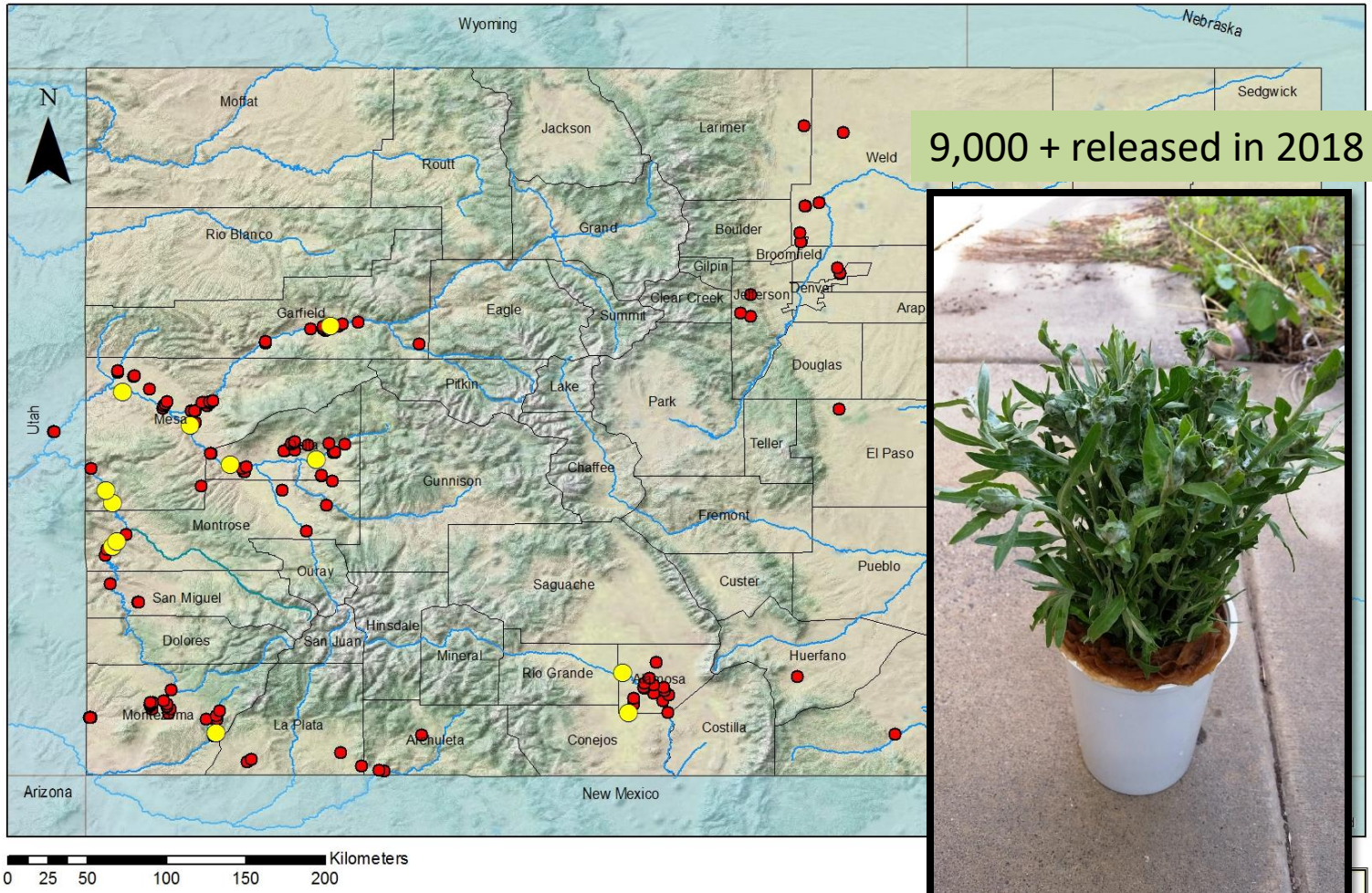
Jaapiella ivannikovi

- Rosette gall fly
- Eggs laid on growing tips
- Larvae pupate inside the gall after 2 weeks
- Up to 50 larvae found in one gall
- **4-5 generations/year**
- Reduces
  - Seed production
  - Shoot length
  - Biomass

Midge Release Sites



Midge Release Sites



9,000 + released in 2018

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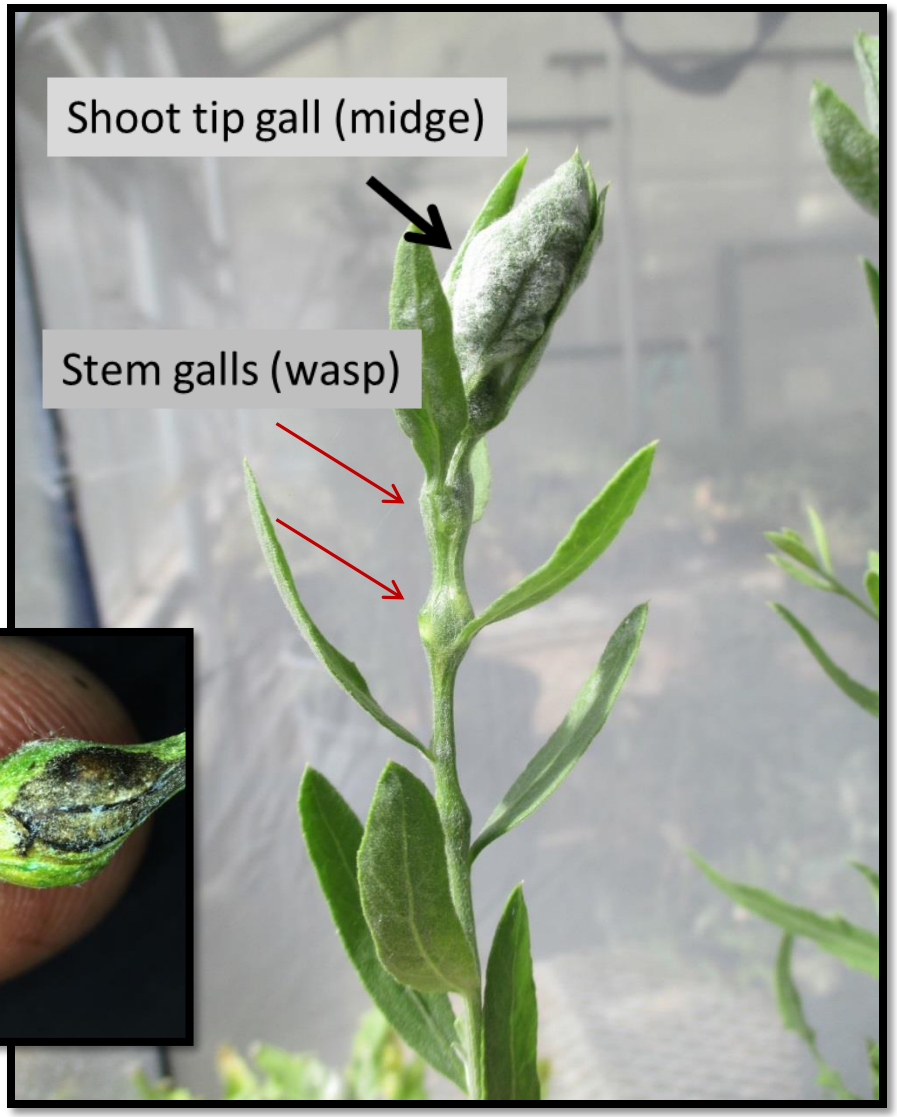
CSU research sites-Eads, Rocky Ford
Have not been able to establish flies, too dry

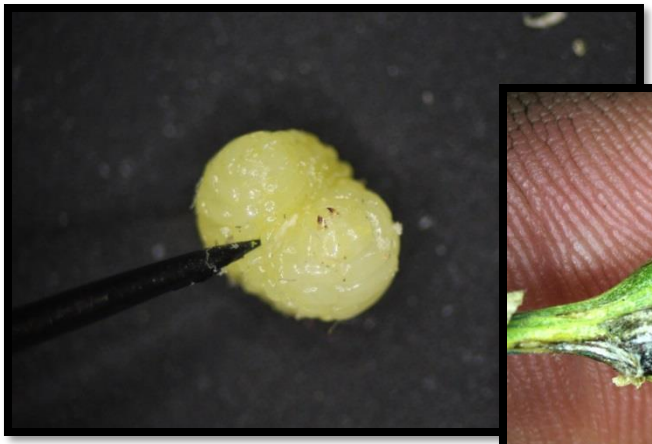
Aulacidea acroptilonica

- Stem galling wasp (1.7-2.3 mm)
- ♀ live ~ 5 days
- 1 generation per year
- Overwinter as 3rd instar larvae

Aulacidea acroptilonica Cont.

- Eggs laid into main & lateral shoots
- Nutrient diversion from flowers, seeds & growth
- Reduction in long distance dispersal
- Stresses Rk; therefore < competiveness





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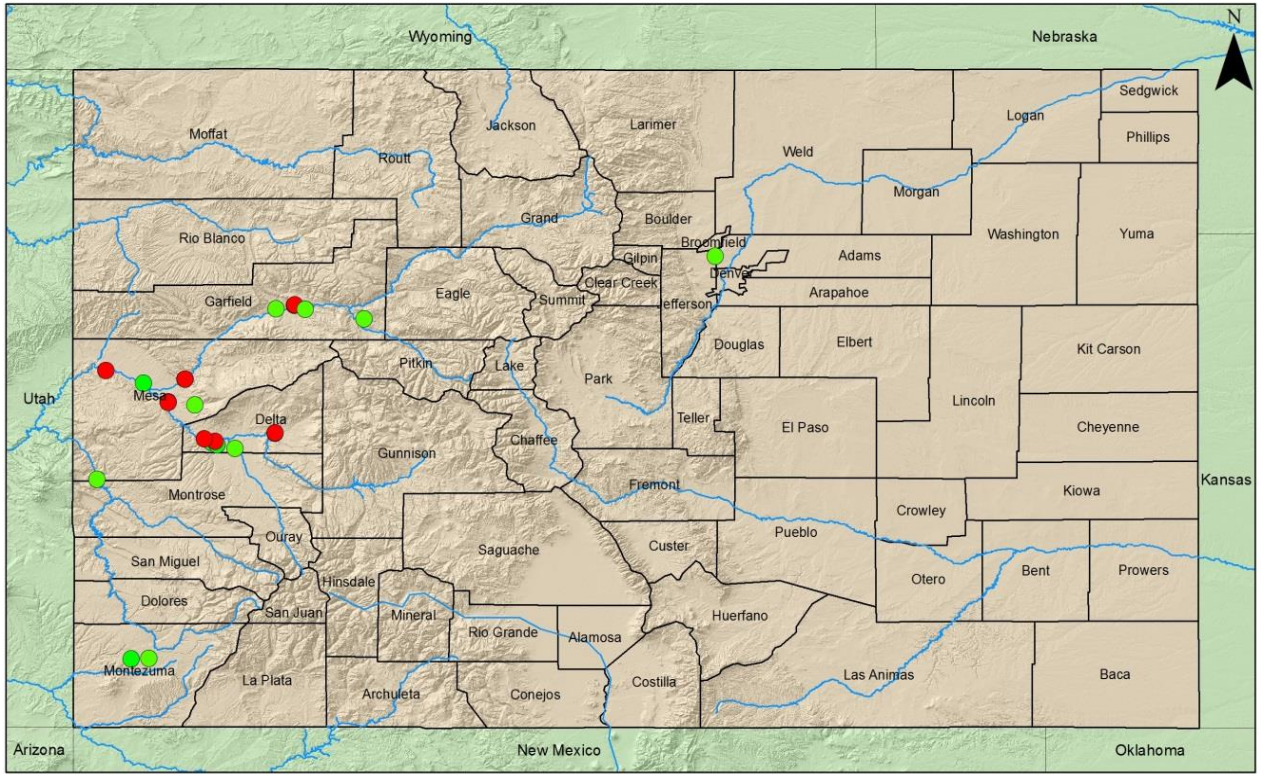
APHIS

Biocontrol Species: *Aulacidea acroptilonica*
Target Species: *Rhaponticum repens*
State of Colorado



0 30 60 120 180 240 Kilometers

1 cm = 34 km

Legend

- Gall Wasp releases with establishment
- Gall Wasp releases with no establishment

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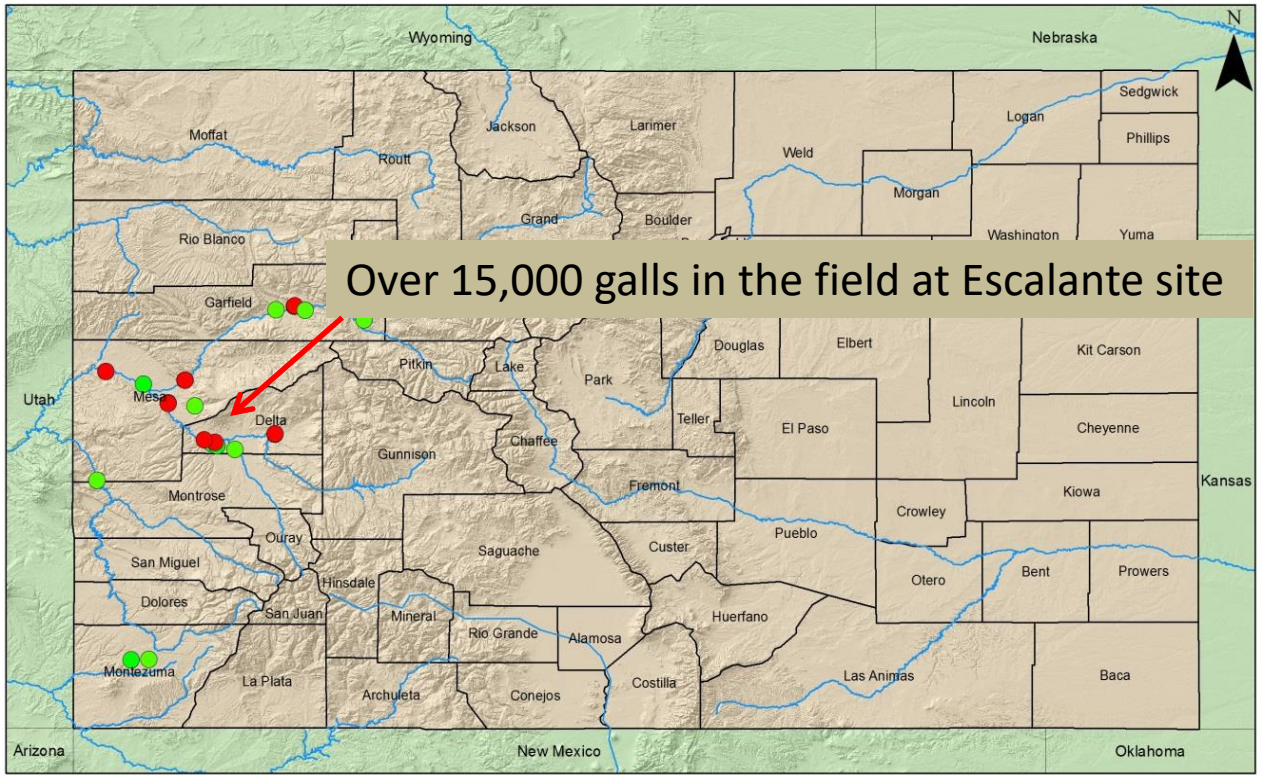

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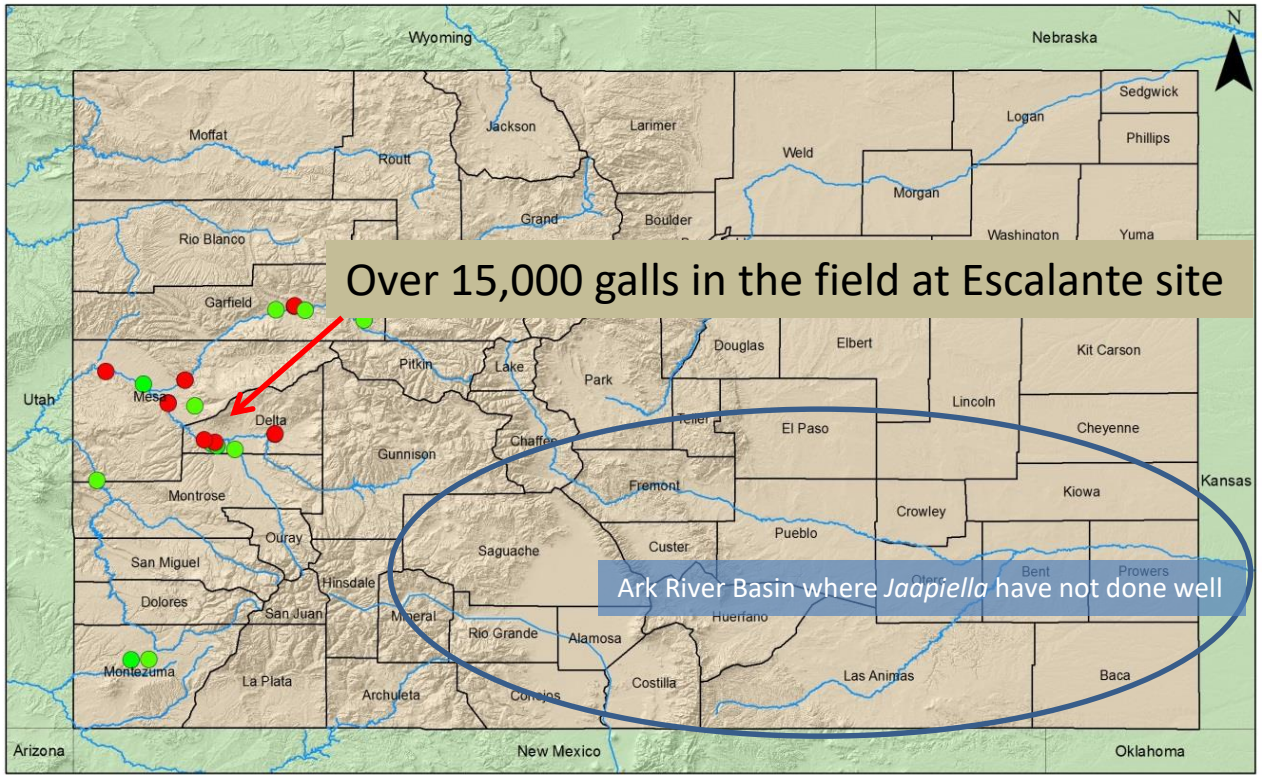
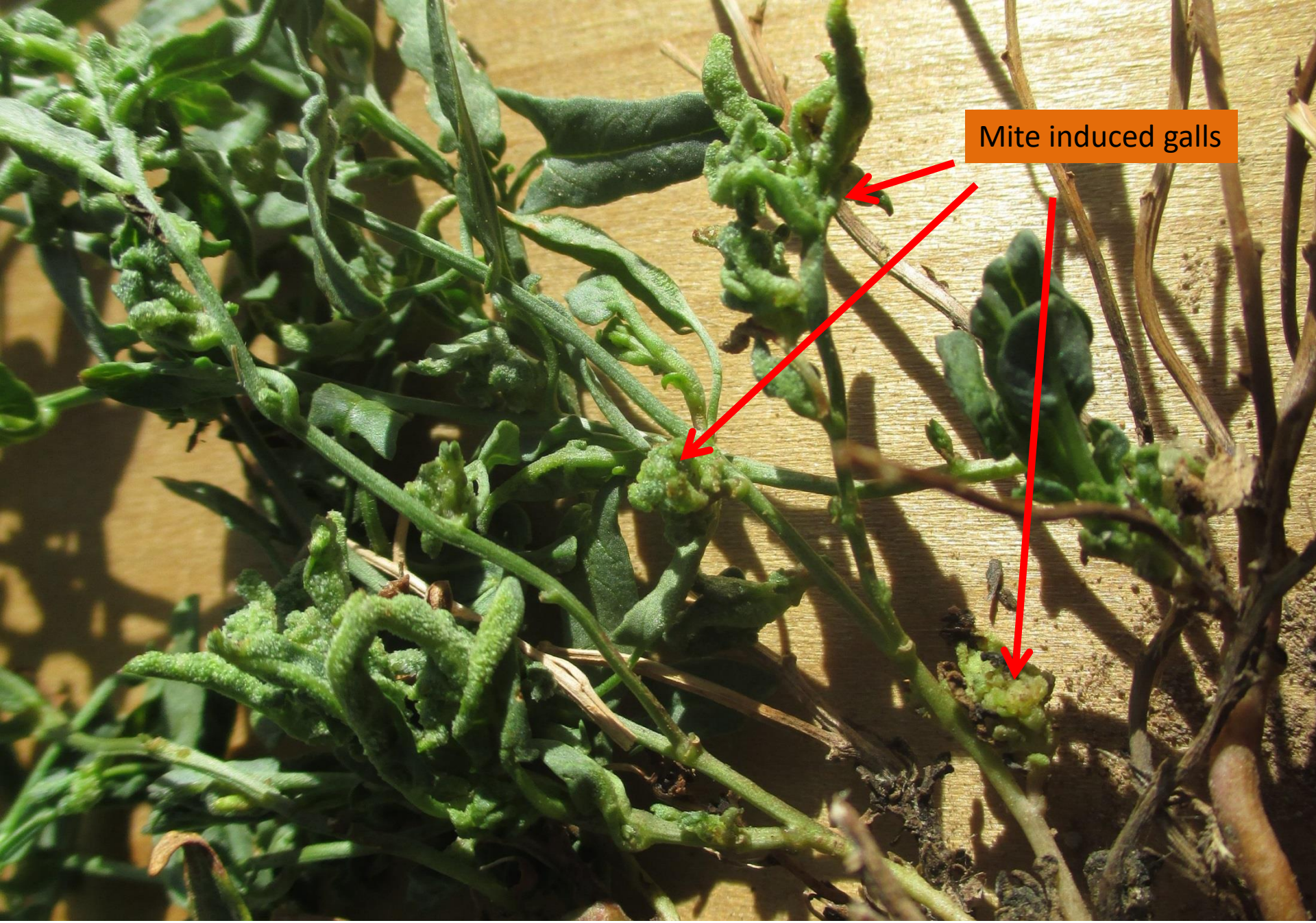


Field Bindweed

Aceria malherbae the bindweed mite


damaged field bindweed


Mite induced galls

Canada thistle control using a rust fungus, *Puccinia punctiformis*

- *Puccinia punctiformis* has been known for over 120 years
- *Puccinia punctiformis* has often been suggested as biological control
- The rust has a complex life cycle (five spore stages: pycniospores, aeciospores urediniospores, teliospores and basidiospores)

Aeciospores are prominent but not capable of initiating a systemic infection

P. punctiformis is a root parasite

Teliospores infect plants in the fall, producing basiospores which germinate and enter fall rosettes

Spring

Systemically infected shoots emerge leading to above ground infections

Sexual reproduction and dispersal occur above ground

Above-ground infections seen in the summer but the fungus may remain hidden in the root system for one or more seasons

Puccinia punctiformis in the spring. Plants are yellowish and smell like flowers, even though they are weeks away from flowering. These plants will die.


After crossing, in which pycniospores are transferred from one infected stalk to another, the infected stalk produces aeciospores which are rust colored.

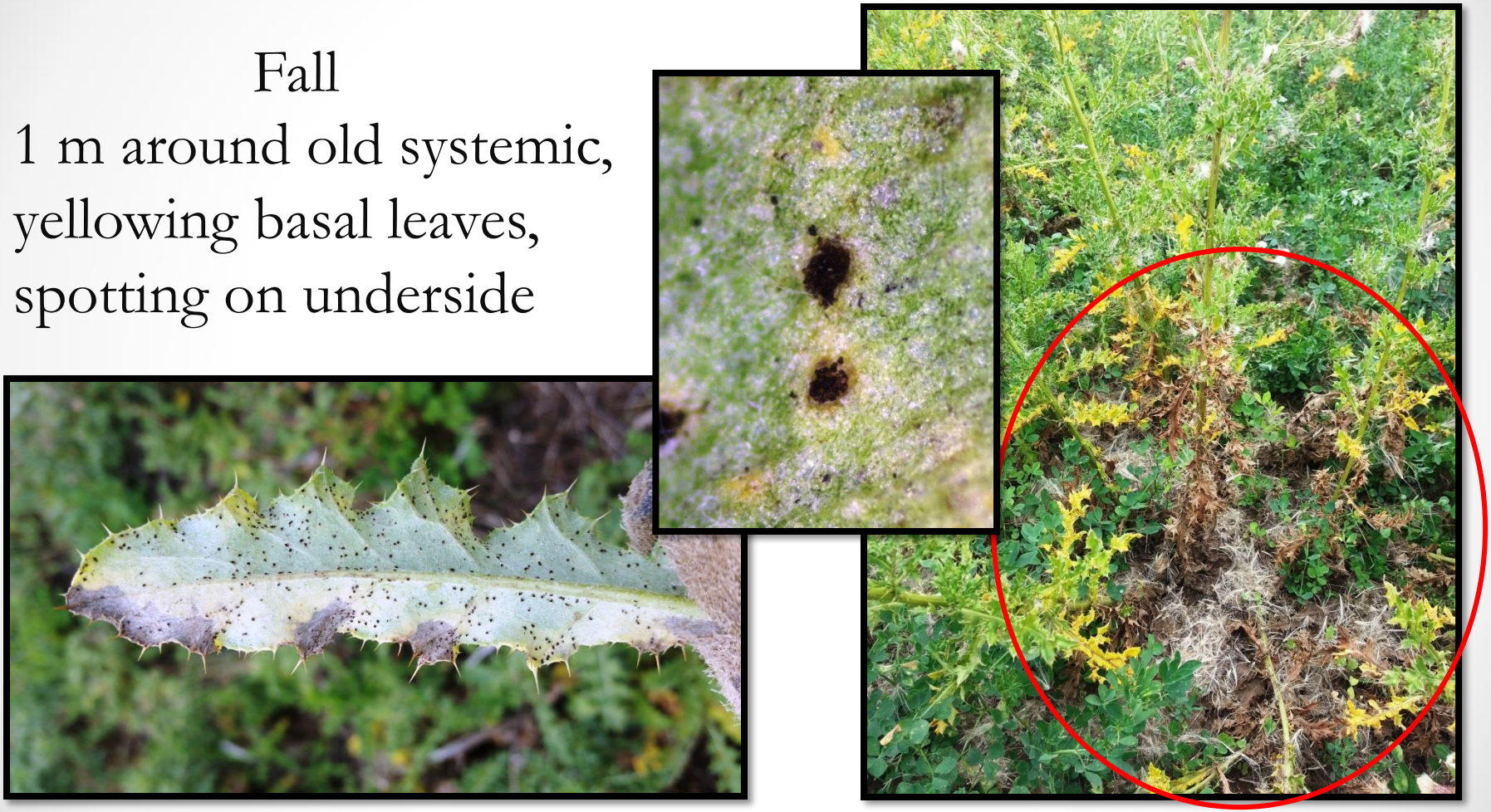
Aeciospores initiate foliar infection cycle

Systemically infected plant

How to Recognize Rust

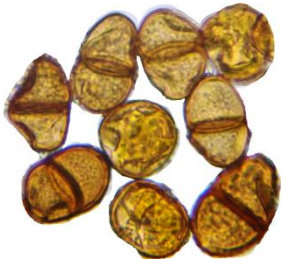
Fall

1 m around old systemic, yellowing basal leaves, spotting on underside



Teliospores which can bring about below ground infections

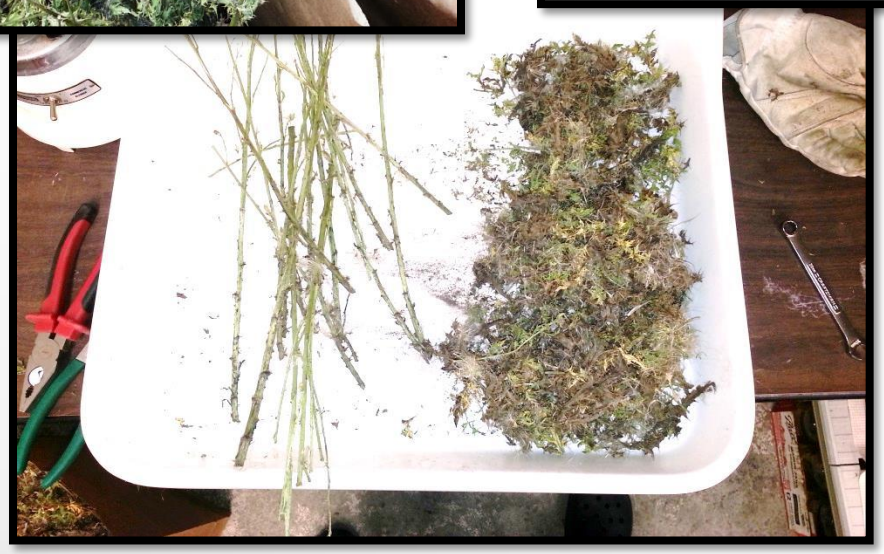
A yellowing leaf found near a systemically infected shoot contains teliospores



Taken through microscope, teliospores and uredinospores

Drying Canada thistle in grocery bags


1/2
tsp



Colorado's CT biocontrol monitoring program

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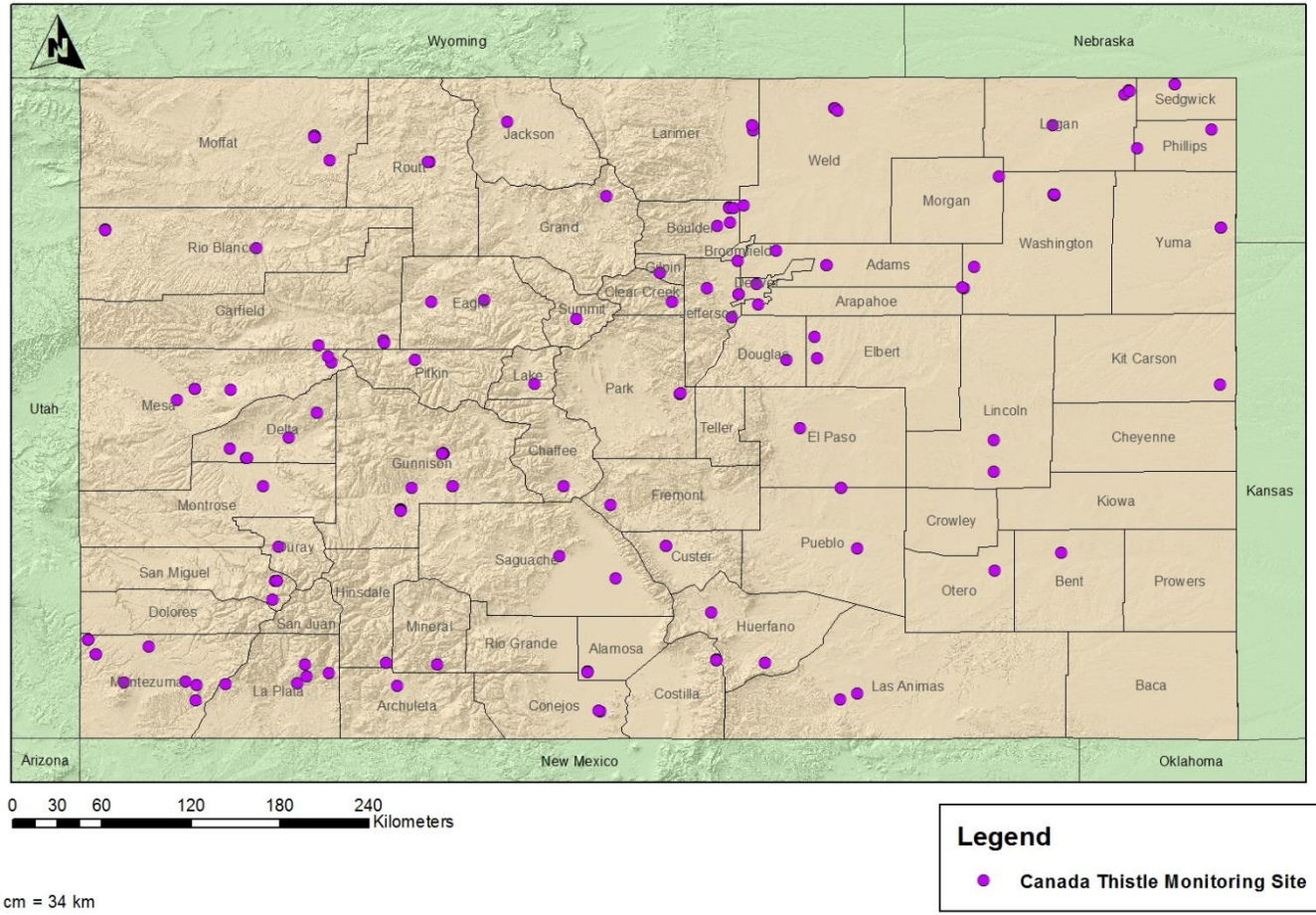
USDA ARS

Biocontrol Species: *Puccinia punctiformis*
Target Species: *Cirsium arvense*
State of Colorado



Year	Sites inoculated	Amount (g)
2013	8	1170
2014	80	1929
2015	92	3938
2016	107	5425
2017	59	1805
	In freezer	+7660

141 monitoring sites

400+ requests for CT biocontrol

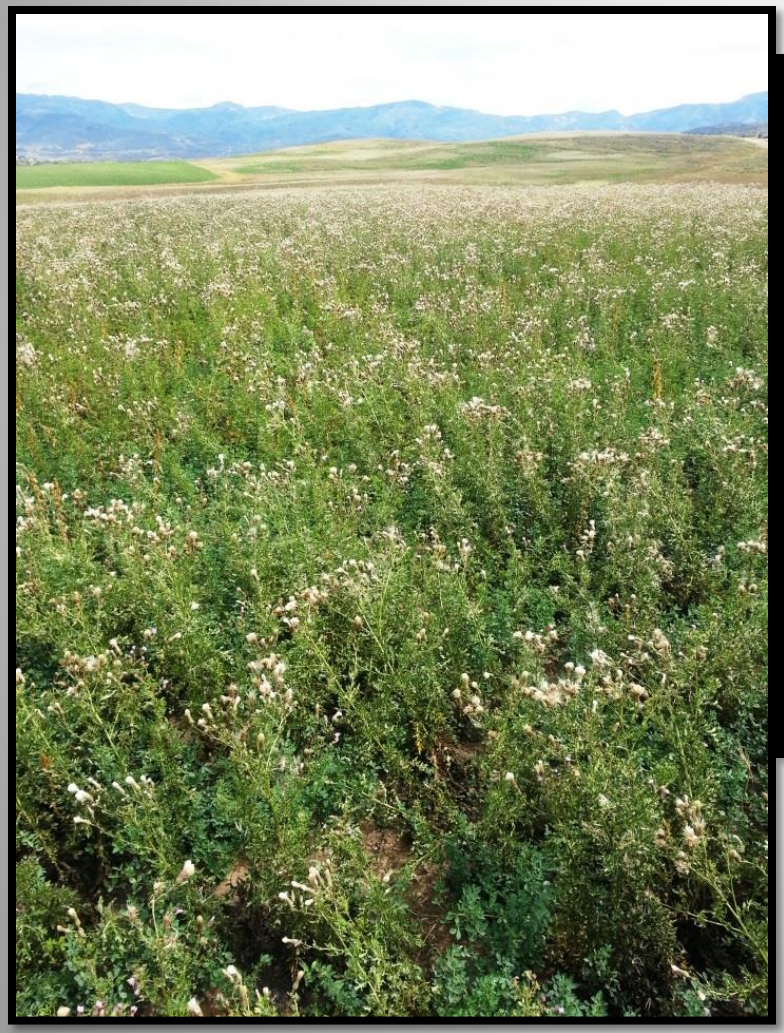
McFarland - ↓100%

2014

2017

Clay 2 - ↓99%

2014

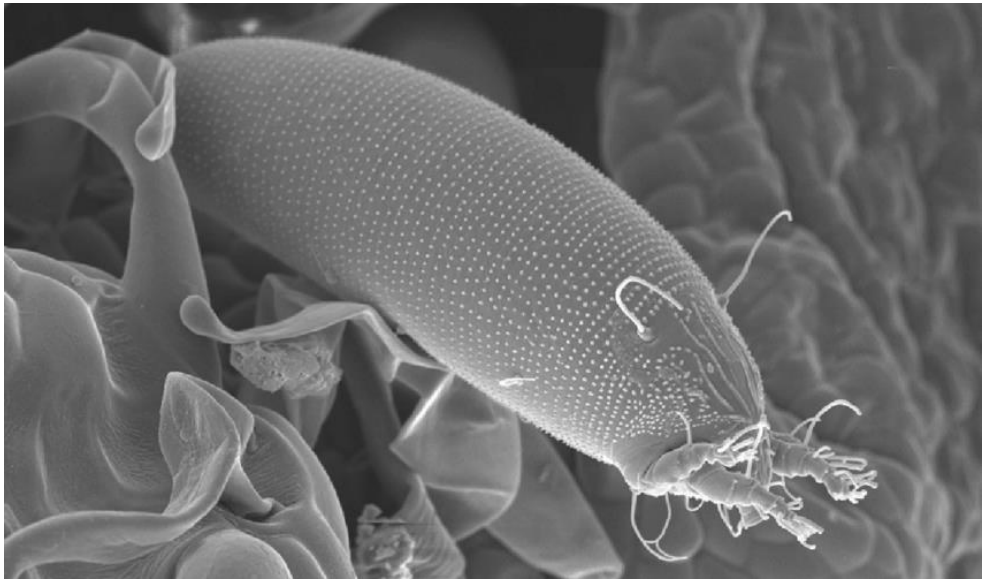


2017

Newly Approved Agents, permitted for release in 2019

Rhinusa pilosa a stem galling weevil for yellow toadflax

Aceria drabae, a mite for hoary cress (*Lepidium draba*)



Working with the Insectary

Palisade Insectary
(970) 464-7916
dan.bean@state.co.us

Search “Palisade Insectary”

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Search “Palisade Insectary”

- **Implementation**- obtain agents through Request-a-Bug program or work with us directly and possibly host a monitoring site or sites
- **Monitoring**- Host a monitoring site, watch biocontrol in progress
- **Education**- Host or attend a workshop, host a talk (like this one)

Setting up a monitoring transect

Public education

Insectary tours

Thanks to:
The Palisade Insectary, especially Nina Louden (musk thistle and tamarisk), Sonya Daly (Russian knapweed and maps), Jess McKenney, Karen Rosen (Canada thistle), John Kaltenbach, Mike Racette (toadflaxes and puncturevine) and Joel Price (Russian knapweed and Canada thistle)
The Colorado Department of Agriculture
Our cooperators, funders and collaborators

Tamarisk decline on the Green River following tamarisk beetle introduction