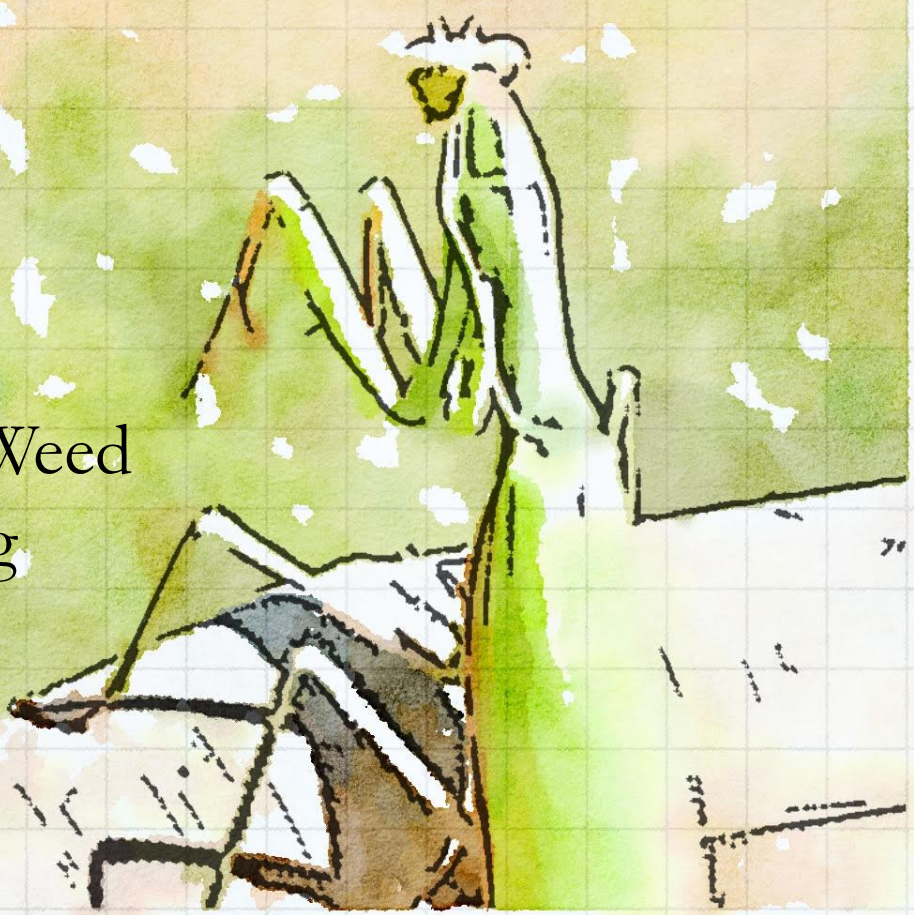
Biological Control Update

John Kaltenbach
Colorado Department of Agriculture

Upper Arkansas Cooperative Weed Management Area Meeting
November 14, 2019



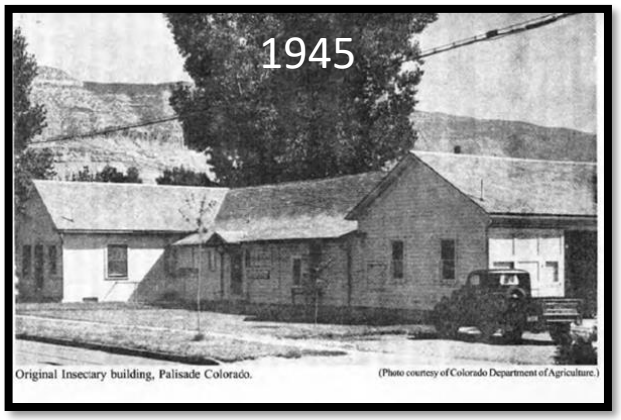
Overview

- Palisade Insectary
- Classical Biological Control
- Hoary Cress
- Houndstongue
- Other agents
- Program Updates

Palisade Insectary

- Located in Palisade, CO (5 mi E of GJ)
- CDA/Conservation Services
- 7 permanent employees 5 seasonal
- 13,000 sq. ft. + 1200 sq. ft. greenhouse

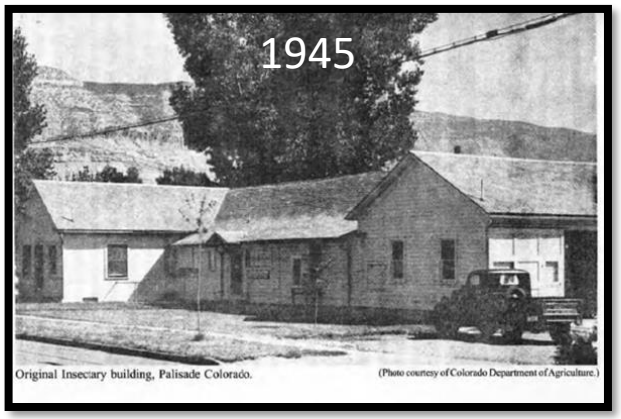
- Front Range – Broomfield office



Palisade Insectary

- 14 total pests
- 3 insect pests and 11 noxious weeds

- 25 agents, studying, researching, collecting and redistributing throughout the State.



What is Biological Control?

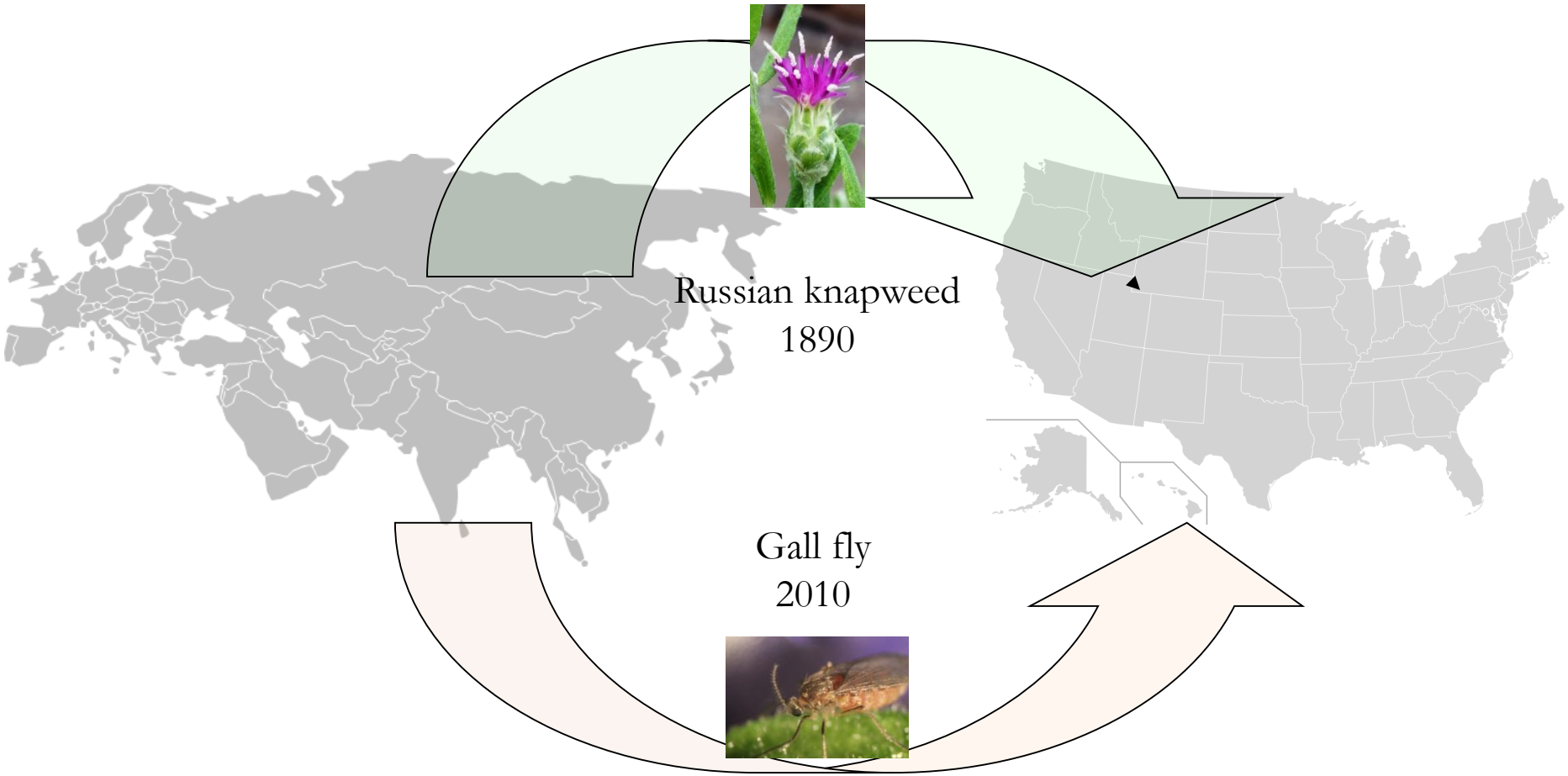
- Biological control (biocontrol) is the use of natural enemies, including insects, mites and pathogens, to control pests, including insect pests and noxious weeds

- Biocontrol is an ecologically based pest control method. The goal is suppression of the weed or insect pest, not eradication. Often the desired results take years to achieve

- Our Goal is to work with you to achieve your pest management goals

Classical Biological Control

The reunification of **host specific** natural enemies with invasive pests



The results of weed biocontrol are a **new equilibrium** between plant and herbivore and suppression of the weed

herbivore added

Long term ecological solution

Suppression

Never Eradication!

Goal of Biological Control

Reduce pest populations below a threshold of damage or economic injury

Reduce the overall pest pressure and help everyone reduce their use of pesticides

The goal is not to eradicate

Biological Control

- Safe
- Effective
- Inexpensive
- Sustainable

Classical Biological Control Safety

"Biocontrol" disaster: the cane toad in Australia

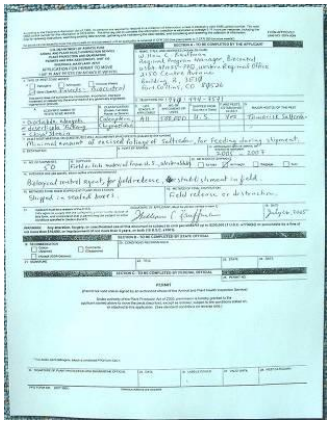
Cane toads were introduced into Australia from South America in the 1930s for use against a sugar cane pest. They never ate the pest but ate everything else, and are poisonous, and travel great distances

Beetles in cane

Toad on ground

Cane toads are not specialists

Steps in weed biological control



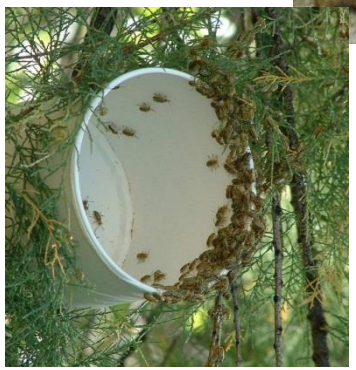
Identification of target/background research

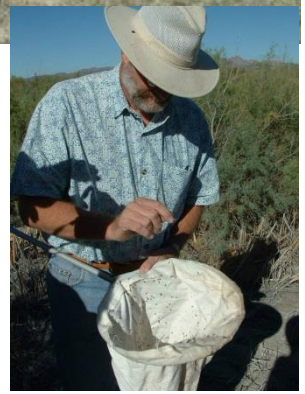
Overseas exploration and research to find agent or agents

Quarantine work including agent cleanup and host range testing

Approval from regulatory agencies (TAG, APHIS)

Field testing including monitoring





Full scale implementation

10 years or more

Classical Biological Control Safety

Classical Weed Biocontrol
512 Total releases with sufficient evidence
found 99% had no non-target impacts

Suckling, D. M., & Sforza, R. F. H. (2014). What magnitude are observed non-target impacts from weed biocontrol?. PloS one, 9(1), e84847.

Arthropod Biocontrol Safety

Nontarget effects recorded for 1.7% of the approximately 5,000 recorded cases of parasitoid or predator introductions

Of those non targets mostly minor effects ("host use" but not "population-level impact").

Lynch, L. D., & Thomas, M. B. (2000). Nontarget effects in the biocontrol of insects with insects, nematodes and microbial agents: the evidence. Biocontrol News and Information, 21(4).

Effectiveness

Analysis of 1,155 intentional releases, a total of 468 species (agents) against 175 species of target weeds

53.5% caused medium, variable or heavy levels of damage on the target weeds

23.9% caused heavy impact.

Schwarzländer, M., Hinz, H. L., Winston, R. L., & Day, M. D. (2018). Biological control of weeds: an analysis of introductions, rates of establishment and estimates of success, worldwide. BioControl, 63(3), 319-331.

Inexpensive

For successful programs all have benefit:cost ratios >1 (5:1 to >1,000:1) or positive net present values

Naranjo, S. E., Ellsworth, P. C., & Frisvold, G. B. (2015). Economic value of biological control in integrated pest management of managed plant systems. Annual review of entomology, 60.

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

Risks and limitations of biocontrol

- Non target effects
- Non target host impact is evaluated on similar species, similar ecological niche, threatened and endangered or economically important
- Choice and no-choice testing, Environmental assessment
- *Will not eradicate pest, may take years to work*

Biological Control Program

Implementation This covers all the steps from rearing or collecting agents to getting them out in the field to do their jobs.

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

Education End users need to know how to use biocontrol and what to expect. The public needs to be well informed when biological agents are used for weed and pest control.

Hoary Cress (*Lepidium draba*)

Hoary Cress aka Whitetop

- List B
- Toxic to Cattle
- Creeping perennial
  - extensive root system.
- Found in pastures, ditch banks, irrigated cropland, riparian areas, disturbed sites, including excessively grazed areas, waste areas, roadsides and open grasslands.
- Current control recommendations
  - Cultivation, mowing and herbicide.

Aceria drabae (Nal.)

Family: Eriophyidae

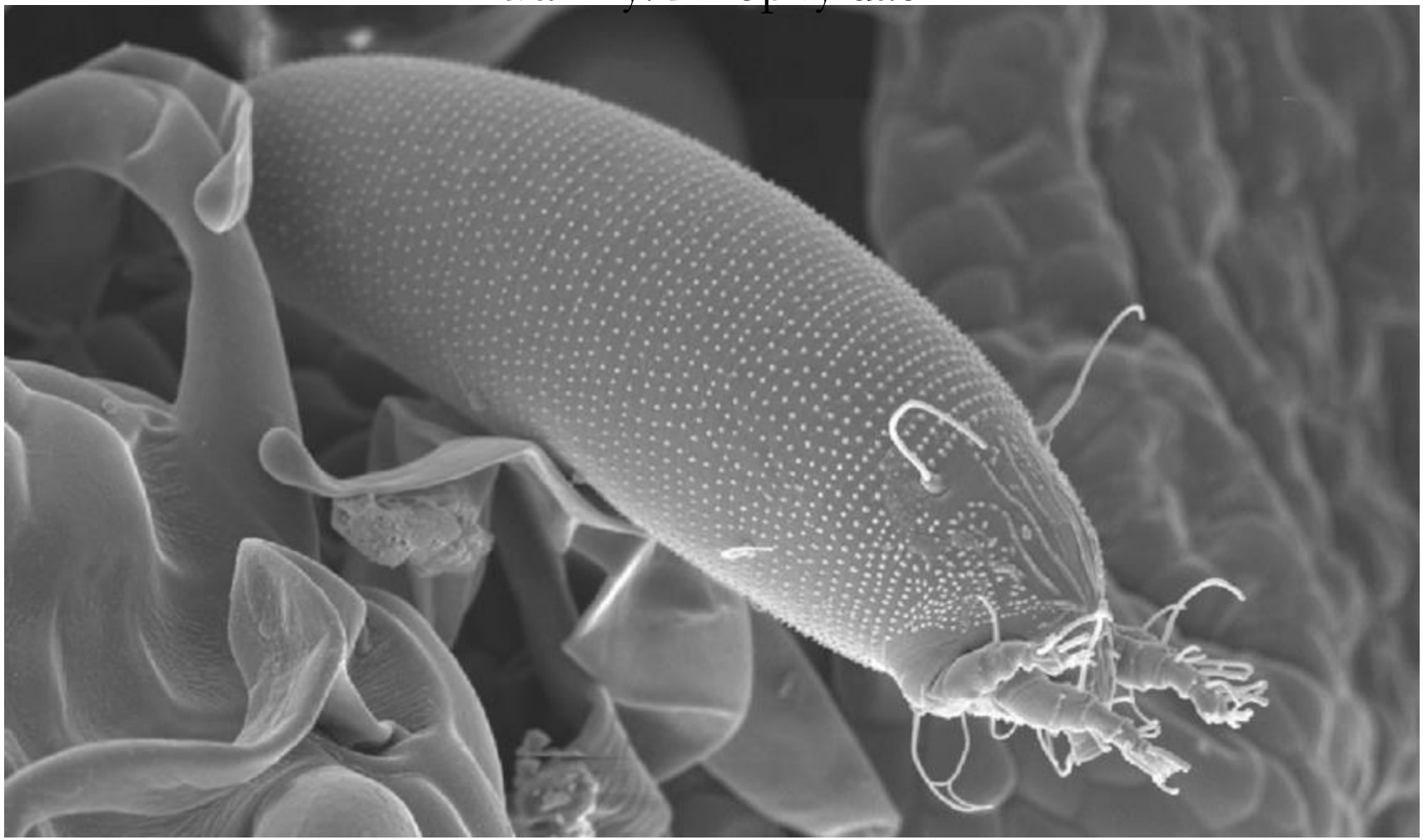


photo by Annie de Meij, Montana State University

USDA

United States Department of Agriculture

Marketing and Regulatory Programs

Animal and Plant Health Inspection Service

Field release of the gall mite, *Aceria drabae* (Acari: Eriophyidae), for classical biological control of hoary cress (*Lepidium draba* L., *Lepidium chalapense* L., and *Lepidium appelianum* Al-Shehbaz) (Brassicaceae), in the contiguous United States.

Environmental Assessment, January 2018

Aceria drabae is sufficiently host specific and poses little, if any, threat to the biological resources, including non-target plant species, of the contiguous United States

Host Specificity

Only a few eriophyoids can feed on host plants from more than one family (Lindquest and Oldfield, 1996; Oldfield, 1996; Skoracka et al., 2010).

Reports of polyphagia are most likely the result of misidentification of species (host and mite)

Native North American Lepidium and other native and economic Brassicaceae did not support development of the mite.

Aceria drabae (Nal.)

- Eggs are laid within galls (an abnormal growth of plant tissue caused by insects and mites) or on plant tissue or modified plant tissue.
- Nymphal stage, second molt occurs prior to becoming a sexually mature adult.
- Generation time from egg to adult is approximately 10 to 14 days depending upon temperature
- Mites overwinter on root buds or possibly in protected places at the base of the plant.
- As the plants develop in the spring mites feed on the developing tissue.
- As the plant develops flower buds A. drabae typically moves into these buds and induces gall formation
- As the plant senesce during the summer, mites migrate back down to the roots
- Mites are primarily dispersed by wind although being carried on the body of other insects may also occur.

(Littlefield et al., 2012).

What to Expect

Reduction of seed production
Reduction of plant biomass
Reduced spread

Houndstongue (Cynoglossum officinale)

Houndstongue

Biennial with a taproot
List B
Toxic to horses, cattle, sheep and goats.
Control: Cultivation, digging/hand pulling and herbicide. Weevils coming.
Habitat: Disturbed areas, trails, roadsides, logging areas, abandoned cropland, ranglands, pastures, riparian areas, and borders of wooded areas.

Mogulones crucifer


Vancouver
Surrey
Victoria
Everett
Seattle
Tacoma
Olympia
Okanogan-Wenatchee
National Forest
COLVILLE
RESERVATION
Spokane
Coeur d'Alene
WASHINGTON
Yakima
YAKAMA INDIAN
RESERVATION
Kennewick
Portland
Salem
Google

Important Note

Unauthorized collection, transportation, and release of *Mogulones crucifer* in the United States is a violation of the Endangered Species Act

Penalty is a maximum fine of up to $50,000 or imprisonment for 1 year, or both, and civil penalties of up to $25,000 per violation.

Mogulones borraginis

A Clogged Biological Control Pipeline: Time for a Solution

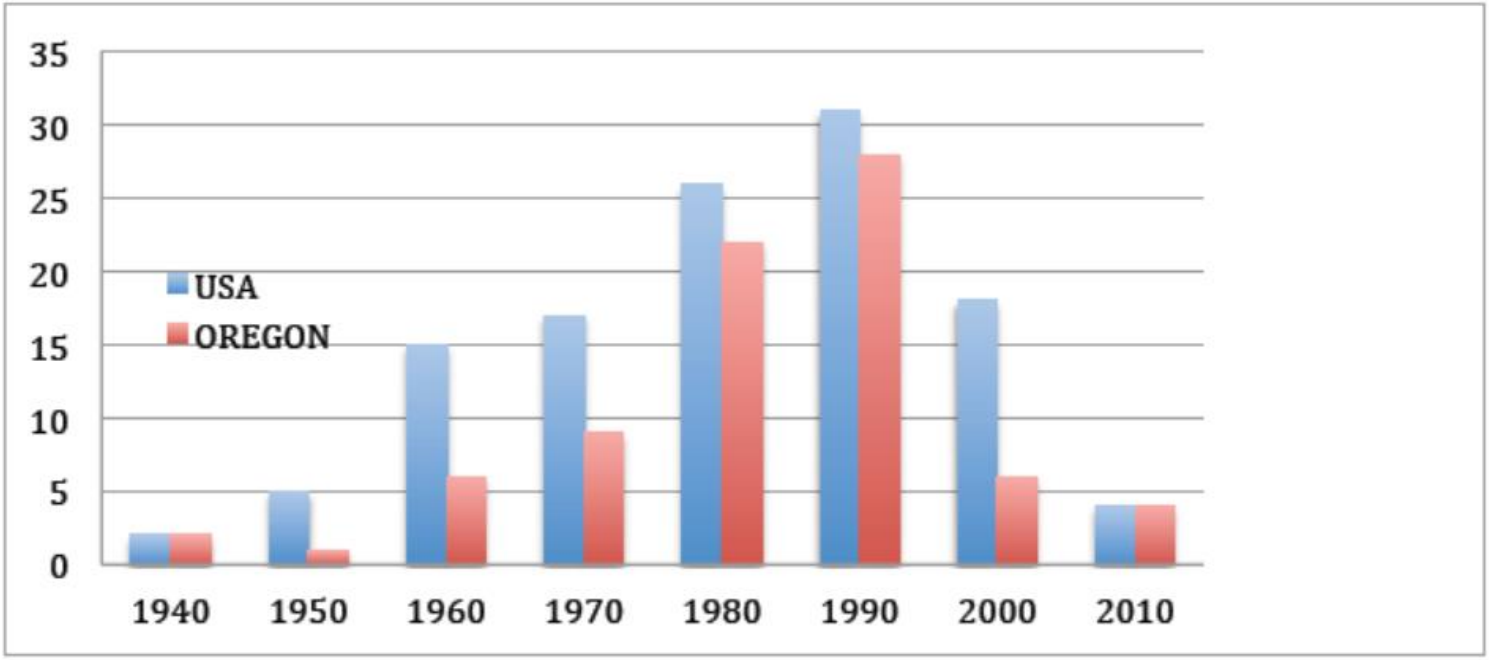


Fig. 1. Number of new biocontrol agents released by decade in US (blue) and Oregon (red). Note sharp decline in the 2000s.

Ceratapion basicorne

Agents in the Pipeline

Russian Olive Mite

Crupina vulgaris – common crupina,
Crupina rust

Gorse

Knotweed psyllid

Chinese tallow

Canada thistle rust fungus, a root parasite

Insectary Updates

- Canada thistle rust
- Tamarisk leaf beetle
- Russian knapweed
- Puncturevine

Life Cycle

Winter

Germinating basidiospores produce hyphae that travel down to survive in roots

Early Spring

Systemically diseased shoots from infected root

Late Spring

Spermagonia (yellow) cross to produce aeciospores (red-brown) on diseased shoots

Summer

Aeciospores blow to neighboring shoots that give rise to urediniospores

Fall

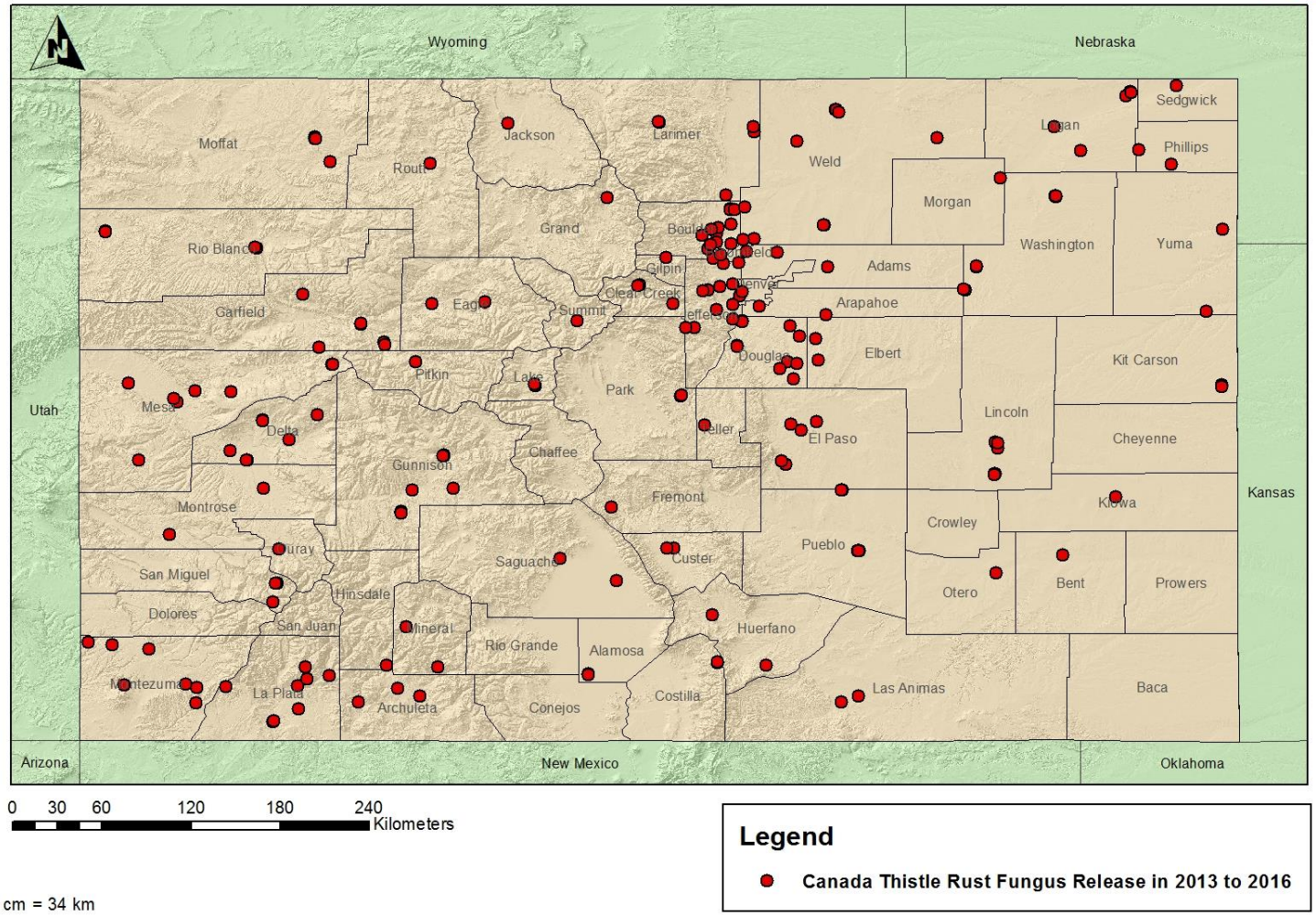
Uredinia produce teliospores on senescing leaves that infect rosettes

Canada thistle root system

COLORADO
Department of Agriculture

USDA ARS

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



Legend

- Canada Thistle Rust Fungus Release in 2013 to 2016

1 cm = 34 km

The rust fungus release sites spread throughout Colorado

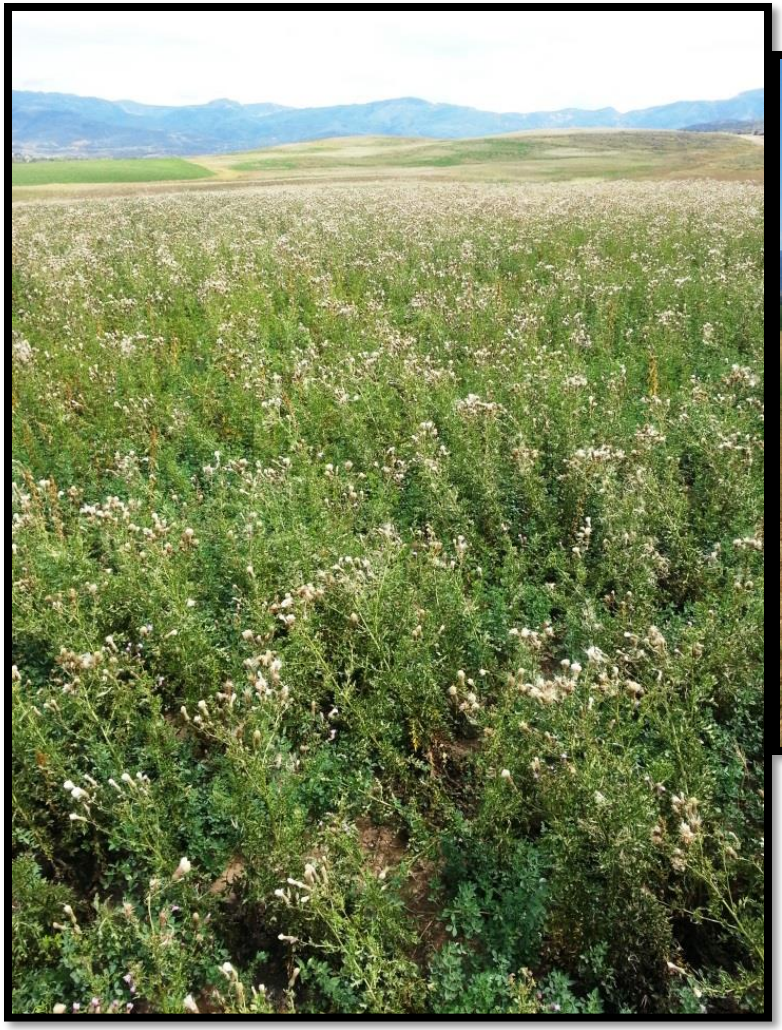
MC 1 - ↓100%

2014

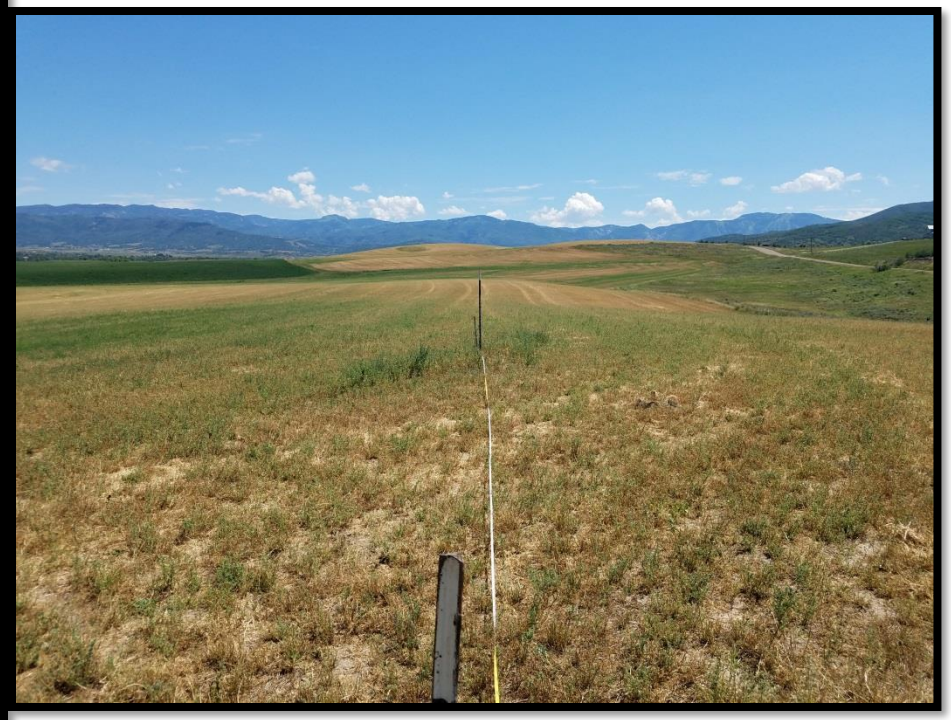
2017

Clay 2 - ↓99%

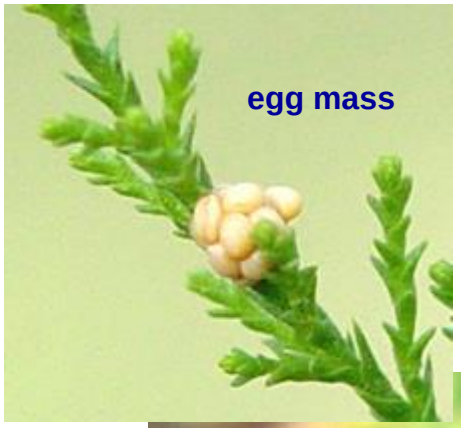
2014



2017



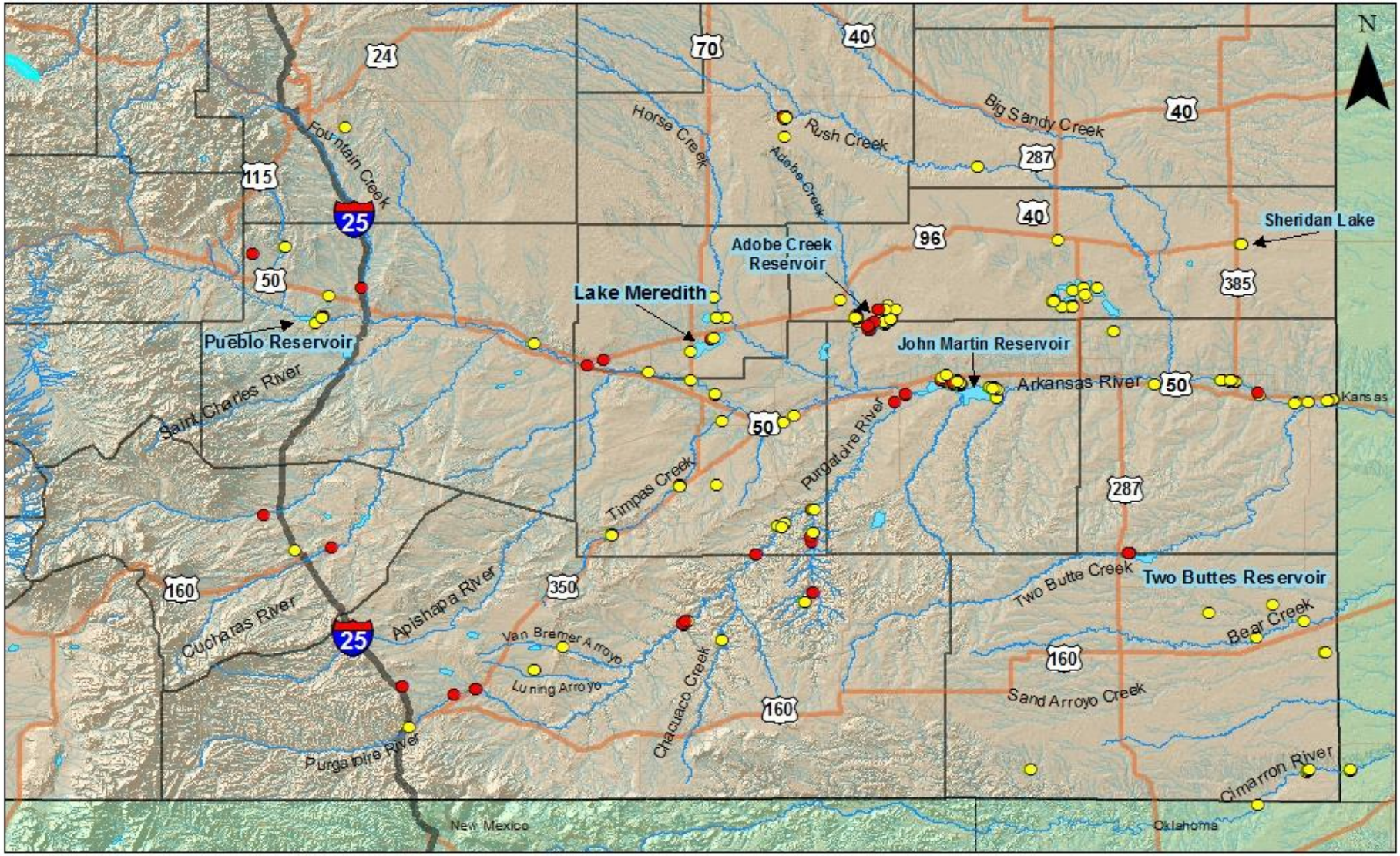

Goldfinch
9/21/18



Adult

Diorhabda carinulata

Tamarisk Beetle Surveys in Eastern Colorado



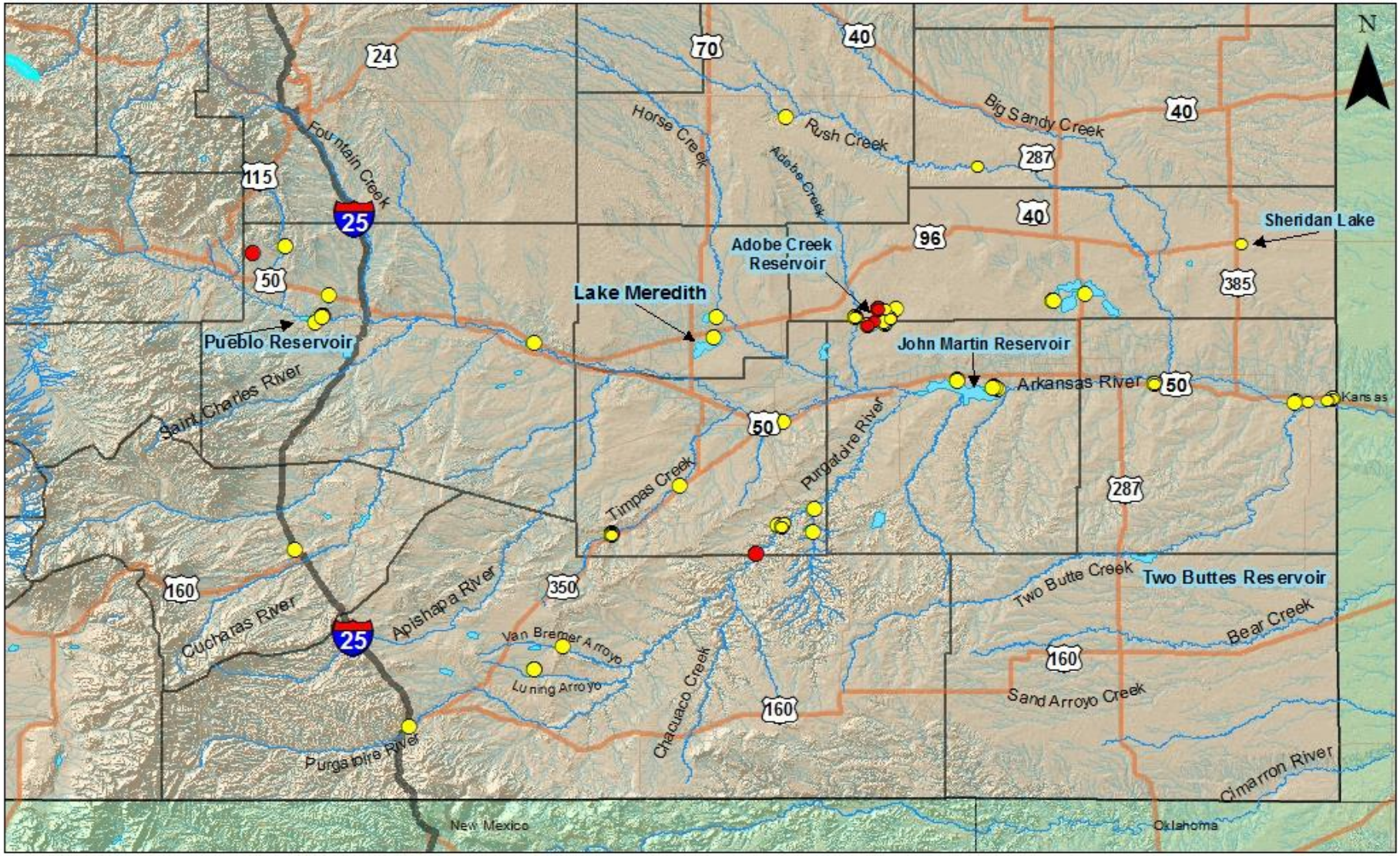
2012 to 2019 Beetle Sweep Points

- Beetle Recovery
- No Beetle Recovery

1 cm = 15 km

COLORADO
Department of Agriculture

Tamarisk Beetle Surveys in Eastern Colorado



2018 to 2019 Beetle Sweep Points

- Beetle Recovery
- No Beetle Recovery

1 cm = 15 km

COLORADO
Department of Agriculture

Russian Knapweed Biological Control In Colorado

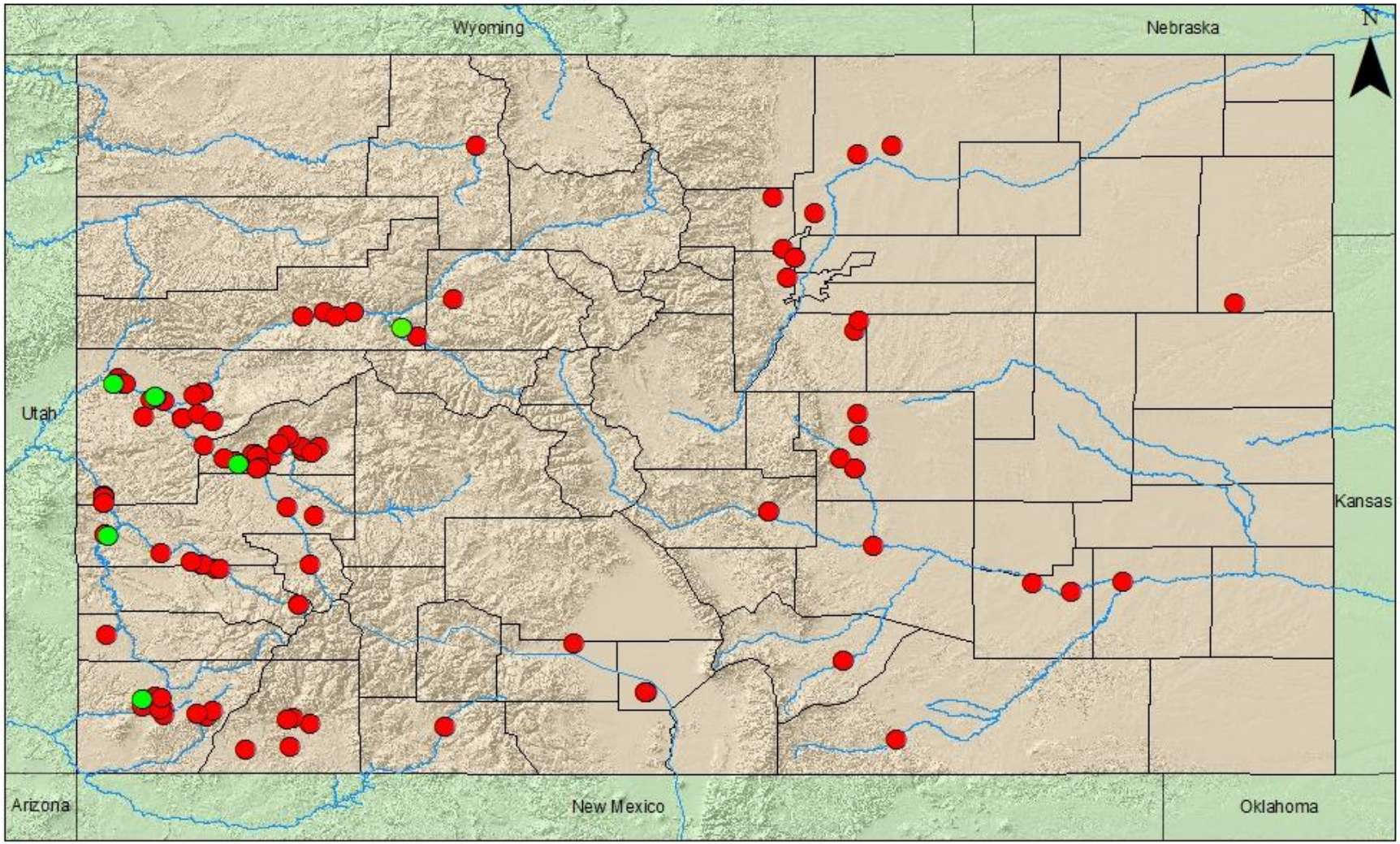
Aulacidea acroptilonica (2008) Wasp

Jaapiella ivannikovi (2009) Gall midge

COLORADO
Department of Agriculture

APHIS

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



1 cm = 34 km

2013 to 2019

Legend

- Gall wasp releases with establishment
- Gall wasp releases with no establishment

Puncturevine

Seed Weevil - *Microlarinus lareynii*

Feeds & develops within the seed

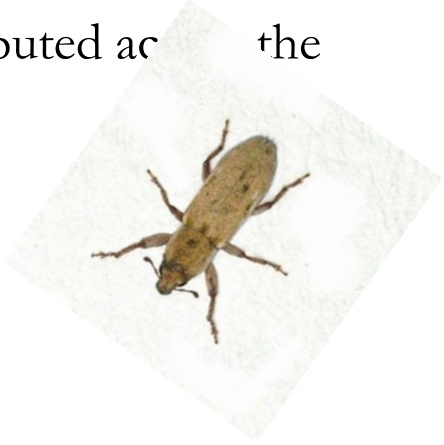
Stem Weevil – *Microlarinus lypriformis*

Feeds & develops within the stem

Both were introduced into Colorado in 1961

Did not do well due to our cold winters

Cold-hardy strain discovered in E. Colorado in 1978 and redistributed ac the state



- Can reduce puncturevine population to a manageable level
- Takes several years to exhaust seed bank

Acknowledgements

Insectary Staff

Dr. Dan Bean, Director

Specialists; Sonya Daly, Nina Louden, Mike Racette, Karen Rosen

Technicians: Kristi Gladem, Ryan Dennie, Teresa Rodriquez, Quinton Barrnett, Jessica Potter

Office manager: Mark Strickland

Funding

USDA APHIS PPQ & USDA APHIS PPQ CPHST

USDA ARS, USDA USFS, EPA, SERDP

STATE of COLORADO

Questions?
john.kaltenbach@state.co.us