Cooperative Agricultural Pest Survey
(CAPS)
Annual Report
Colorado
2015

Compiled by:
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Colorado Cooperative Agricultural Pest Survey 2015

This is a report of the activities and surveys accomplished in Colorado for the CAPS program in 2014 (funding year March 1st 2014-February 28, 2015). Program work was accomplished in collaboration with Colorado State University and the United States Department of Agriculture, Animal and Plant Health Inspection Service, Plant Protection and Quarantine (USDA, APHIS, PPQ).

Colorado State University cooperators completed the following surveys: Small Grains and Corn Bundled Survey, Grape Commodity Survey, Stone Fruit Commodity Survey, Karnal Bunt Survey. The Colorado Department of Agriculture (CDA) coordinated surveys for Forest Pests, the Emerald Ash Borer, and a Vegetable Pests Survey. CDA and CSU also performed work for biological control projects.

Year:	2015
State:	Colorado
Cooperative Agreement Name:	Infrastructure
Cooperative Agreement Number:	15-8505-0013-CA
Project Funding Period:	March 1, 2015 - February 29, 2016
Project Report:	**CAPS Infrastructure Report**
Project Document Date:	May 16, 2016
Cooperators Project Coordinator:	Jeanne Ring
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A. Compare actual accomplishments to objectives established as indicated in the workplan. When the output can be quantified, a computation of cost per unit is required when useful.

- **<u>Activities</u>:**
  - **Committee Service:**

    - Colorado State CAPS Committee: Bi-annual meeting
    - Western Plant Board Annual Conference Planning Committee 2015
    - Colorado Emerald Ash Borer Response Team: Committee member, attend bi monthly meetings to discuss changes in EAB management directives, quarantine management, outreach opportunities and media events. This is a collaborative program between multiple agencies, municipalities, academic institutions and non- profit entities.
    - Emerging Pests in Colorado (EPIC): Committee member, attend monthly meetings to discuss emerging pest issues and related educational opportunities for Colorado communities.
    - Colorado Wyoming Joint Risk (CWJR): Committee member. Meets quarterly to discuss agency changes in regard to incoming biological threats, pathways and management strategies.

  - **Other Survey Work:**

    - Farm Bill: Submitted proposals for Farm bill funding, procured trap and lure supplies, uploaded data into federal database and provided support to seasonal technicians and cooperators.
    - USDA/APHIS Gypsy moth survey: Assisted in trap installation, removal and data management.
    - Provide administrative and field support for seasonal survey technicians.

- Distribute survey supplies to cooperators
- Support USDA APHIS National Gypsy Moth Survey; Setting up traps (June), removing traps (September), enter data into Federal database (September)

- **<u>Outreach and Education</u>:**
  - **Interviews (TV/Radio/Newspaper/Magazines):**
    - One interview was requested focusing the movement of fire wood (June). All other media interviews relating to EAB were done through the CDA Quarantine manager.
    - Outreach materials (Pamphlets/ brochures/ posters): Outreach materials were created and distributed throughout the year.
    - Publications: Longhorn beetle identification books were purchased for a first detector workshop focusing on EAB and ALB.
    - Public Service Announcements (PSA): None

- **<u>Meetings</u>:**
  - **Conference calls:**
    - Western SSC Conference calls monthly-bi monthly
    - Flag Smut Conference Call (June)
  - **Conferences:**
    - Western Plant Board (May/ Denver, CO)
    - Plant Healthcare workshop (June/ Fort Collins, CO)

- ISA Rocky Mountain Chapter Annual Conference (Keystone, CO)
- Continental Dialogue on Non-Native Forest Insects and Diseases (November/ Denver Colorado)
- USDA Interagency Research Forum on Invasive Species (January/ Annapolis, MD)

  - **Webinars**
    - EAB National Survey
    - EAB University

- **Training:**
  - Buprestid, Cerambycid training (August/ Amhurst, MD)
  - Assisted in branch peeling workshops throughout the fall and winter
- **Other:**
  - Pro Green Expo, assisted at educational booth
  - Presented at both bi annual CDA inspectors meetings
  - Completed and submitted work and financial plans to USDA
  - Secured Interagency Contracts with CSU
  - Processed paperwork for cooperative agreements
  - Attended Front Range Urban Forestry Council Meetings regularly
  - Coordinated first detector workshop focusing on EAB and ALB
  - Attended EPIC (Emerging Pests In Colorado) meetings monthly
  - Set up educational both at Colorado State Fair promoting don't move fire wood and invasive pest outreach
  - Attended ISA Rocky Mountain Chapter annual meeting to provide educational booth and outreach material on EAB and forest pests
  - Attend Denver metro pest group meetings when available

B. If appropriate, explain why objectives were not met.
All obligations were met.

C. Where appropriate, explain any cost overruns or unobligated funds in excess of $1,000.
Not applicable

D. Supporting Documents
Not applicable

Year:	2015
State:	Colorado
Cooperative Agreement Name:	Forest Pest Survey
Cooperative Agreement Number:	15-8508-0013-CA
Project Funding Period:	March 1, 2015 to February 29, 2016
Project Report:	**CAPS Survey Report**
Project Document Date:	May 17, 2016
Cooperators Project Coordinator:	Jeanne Ring
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Write a brief narrative of work accomplished. Compare actual accomplishments to objectives established as indicated in the work plan. When the output can be quantified, a computation of cost per unit is required when useful.

The purpose of this project was to conduct an early detection survey of conifer infesting moths and non-native wood boring and bark beetles in and around the potential pathways of introduction. Insects have emerged as the most significant pests of U.S. forestland, accounting for a three-fold increase in the incidence of insect-induced tree mortality since 2002. In Colorado, nearly twenty percent of forested land has been impacted by insects in the last 20 years, mostly from three insects, mountain pine beetle, spruce beetle and Douglas fir beetle. These are native pests, but the exotic species targeted in this survey could have compounding effects on our forest health if they were to become established. Exotic insect species pose threats to Colorado's urban and woodland forests which provide important economic and environmental values such as improved air quality, energy conservation, reduced storm water run-off and increased property values.

The proposed survey was for 20 different sites using CAPS approved trap and lure combinations. The counties proposed for survey included Adams, Arapahoe, Boulder, Delta, Denver, Douglas, Jefferson, Mesa, Montrose and Weld counties. Larimer, Teller and Gilpin counties were added and Weld was not included this year.

Funding Amount	Total Number of Traps	Cost Per Unit
Proposed = $25,809	Proposed = 240	Proposed= $107.53
Actual =$25,809	Actual =240	Actual =$107.53

Survey methodology (trapping protocol):

Twenty sites were selected and 4 Lindgren funnel traps were set at each site, each with a different lure (see table 1). Traps and lure were set and monitored according to CAPS Approved Methods for 2015. The Lindgren funnel traps are "wet" traps using propylene glycol, and are serviced every two weeks. The other traps were serviced as necessary according to CAPS approved methods from May to October.

Samples are collected from the Lindgren traps every two weeks, and suspects are screened by Dr. Boris Kondratieff with Colorado State University for identification.

	Common Name	Scientific Name
Pest:	Pine shoot beetle	*Tomicus destruens*

	Red haired pine bark beetle Lesser spruce shoot beetle Japanese pine sawyer Siberian silk moth Pine tree lappet Rosy gypsy moth Sirex wood wasp Sixtoothed bark beetle European spruce bark beetle Mediterranean pine Engraver Six toothed spruce bark beetle	*Hylurgus ligniperda* *Hylurgops palliates* *Monochamus alternatus* *Dendrolimus sibiricus* *Dendrolimus pini* *Lymantria Mathura* *Sirex noctilio* *Ips sexdentatus* *Ips typographus* *Orthotomicus erosus* *Pityogenes chalcographus*

Table 1

Trap Type	# at each site	Lure	Target (s)
Lindgren funnel	1	ethanol and alpha-pinene	*Tomicus destruens* *Hylurgus ligniperda* *Hylurgops palliates* *Monochamus alternatus*
Lindgren funnel	1	70% alpha pinene 30% beta-pinene	*Sirex noctilio*
Lindgren funnel	1	3-part Ips lure: cis-verbenol; ipsdienol; 2me-3-buten-2-ol	*Ips sexdentatus* *Ips typograhus* *Orthotomicus erosus*
Lindgren funnel	1	chalcogran	*Pityogenes chalcographus*
Modified GM trap	4	Z5E7-12Ald Z5E7-12OH butylated hydroxytoluene Tinuvin	*Dendrolimus sibiricus* *Dendrolimus pini*
Wing trap	4	Z3Z6-9R10S-epo-19Hy Z3Z6-9S10R-epo-19Hy	*Lymantria mathura*

	Proposed	Actual
Sites (Locations):	20	20
Traps:	240	240

Number of Counties:	12
Counties:	Adams, Arapahoe, Boulder, Delta, Denver, Douglas, Jefferson, Mesa, Montrose, Larimer, Teller, Gilpin

Survey dates:

	Proposed	Actual
Survey Dates:	Install May and June, Remove October	Installed in May, Removed September-October

Benefits and results of survey:

	Positive	Negative	Total Number
Traps	0	240	240

Database submissions

Data was entered into the NAPIS database fall 2015

If appropriate, explain why objectives were not met.

All objectives were met.

Where appropriate, explain any cost overruns or unobligated funds in excess of $1,000.

Not applicable

Year:	2015
State:	Colorado
Cooperative Agreement Name:	Vegetable Survey
Cooperative Agreement Number:	15-8508-0013-CA
Project Funding Period:	March 1, 2015 to February 29, 2016
Project Report:	**CAPS Survey Report**
Project Document Date:	May 17, 2016
Cooperators Project Coordinator:	Jeanne Ring
Name:	Jeanne Ring
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Write a brief narrative of work accomplished. Compare actual accomplishments to objectives established as indicated in the work plan. When the output can be quantified, a computation of cost per unit is required when useful.

The purpose of this project was to conduct an early detection survey for 5 moth species that are pests of Solanaceous crops (see table below for pests). The proposal planned to place one trap for each of the 5 species at 70 sites (potato fields) for a total of 350 traps, and attempt to distribute the traps in each of 5 counties in approximate proportion to their typical potato acreage. In the San Luis Valley (SLV) the typical acreage planted in potatoes would have equated to the following site totals; Alamosa-22 sites, Rio Grande-20 sites, Saguache-18 sites, Costilla-6 sites and Conejos- 2 site.

The first round of funding arrived on February 4th 2015 (19.73%) and the remaining amount (80.27%) was received on June 17th 2015. A seasonal technician was hired on May 18th and trap set up was completed early July 2015 . Traps are currently being serviced per CAPS approved methods.

Funding Amount	Total Number of Traps	Cost Per Unit
Proposed = $16,644	Proposed = 340	Proposed= $47.61
Actual =$16,644	Actual= 340	Actual= $47.61

1. <u>Survey methodology (trapping protocol)</u>:

Sites were selected by visually confirming the presence of potato fields. At each site, 5 traps were installed 20 meters apart with the appropriate trap and lure combinations (see table 1). Trap data was collected at the time of set up and lure changes occurred per CAPS approved methods. Samples were collected during lure changes and later delivered to Dr. Boris Kondratieff at Colorado State University for screening. Trap removal will occur October 2015.

	Common Name	Scientific Name
Pest:	Old world boll worm	Helicoverpa armigera
	Egyptian Cottonworm	Spodoptera littoralis
	Cotton Cutworm	Spodoptera litura
	Guatemalan Potato Moth	Tecia solanivera
	Tomato leaf miner	Tuta absoluta

Table 1			
Target(s)	**Lure**	**Trap Type**	**Change lure**

Helicoverpa armigera	Z11-16Ald Z9-16Ald butylated hydroxytoluene	Plastic Bucket Trap	Every 28 days
Spodoptera litura	Z9E11-14Ac Z9E12-14Ac	Plastic Bucket Trap	Every 84 days
Spodoptera littoralis	Z9E11-14Ac Z9E12-14Ac	Plastic Bucket Trap	Every 84 days
Tuta absoluta	E3Z8Z11-14Ac E3Z8-14Ac	Large Plastic Delta Trap	Every 28 days
Tecia solanivora	E3 – 12Ac Z3 – 12Ac 12Ac	Paper Plastic Delta	Every 30 days

	Proposed	Actual
Sites (Locations):	70	70
Traps:	350	350

Number of Counties:	5
Counties:	Alamosa, Rio Grande, Saguache, Costilla, Conejos

2. <u>Survey dates</u>:

	Proposed	Actual
Survey Dates:	Install traps May and June, remove traps October	Installed traps May-early July, removed September-October

Benefits and results of survey:

All of the targeted pests in this survey have the potential to arrive and establish in Colorado based on climate and host plant availability and/or predicted distributions. If one or more of the targeted pest were to establish in Colorado there could be severe adverse economic and/or environmental effects. Early detection of an invasive species, prior to establishment, provides regulators and land managers more options for eradication, control and management. Currently, there are inadequate state funds to complete this survey. Potatoes are the fourth most valuable field crop in Colorado behind corn, wheat and hay, with the 2010 crop valued at $293 million. Colorado is ranked 4th in the US in total potato production, and 3rd in the US for seed potato production1. Over 90% of all of the potato production occurs in the San Luis Valley of Colorado, in the counties of Alamosa, Rio Grande and Saguache, and it is the primary industry in the area.

	Positive	Negative	Total Number

Traps	0	350	350

Database submissions:

Data for each species was entered into the NAPIS database fall 2015

If appropriate, explain why objectives were not met.

All objectives were met

Where appropriate, explain any cost overruns or unobligated funds in excess of $1,000. *

Not applicable

Year:	2015
State:	Colorado
Cooperative Agreement Name:	EAB Survey
Cooperative Agreement Number:	15-8508-0013-CA
Project Funding Period:	March 1, 2015 to February 29, 2016
Project Report:	**CAPS Survey Report**
Project Document Date:	May 17, 2016
Cooperators Project Coordinator:	Jeanne Ring
Name:	Jeanne Ring
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Write a brief narrative of work accomplished. Compare actual accomplishments to objectives established as indicated in the work plan. When the output can be quantified, a computation of cost per unit is required when useful.

The objective of this project is to conduct an early detection trapping survey of emerald ash borer in high risk areas of Colorado. Working collaboratively with Colorado PPQ traps and cell locations as identified by the U.S. Forest Service's Forest Health Technology Enterprise Team (FHTHET) Survey Sampling Design 2015 cells were divided up. The Colorado Department of Agriculture selected 30 cells for trapping. All traps have been set and will be serviced according to National EAB trapping protocols.

The total award for this survey was $11,250 of which $2,700 was allocated for trapping activities. The remaining $8,550 is budgeted for outreach materials. Currently no outreach money has been spent yet.

Funding Amount	Total Number of Traps	Cost Per Unit
Proposed = $2,700	Proposed = $30	Proposed= $90
Actual = $2,700	Actual = $30	Actual = $90

Survey methodology (trapping protocol):

	Common Name	Scientific Name
Pest:	Emerald Ash Borer	*Agrilus Planipennis*

	Proposed	Actual
Sites (Locations):	30	30
Traps:	30	30

Number of Counties:	13
Counties:	Alamosa, Adams, Arapahoe, Boulder, Douglas, Eagle, Garfield, Grand Junction, Jefferson, Larimer, Morgan, Montrose, Pueblo

Survey dates:

	Proposed	Actual
Survey Dates:	Trap set up May-June Replace lure July, Removal September	Installed April-June, Replaced lure July, Removal September

Benefits and results of survey:

Emerald Ash Borer was detected in Boulder, Colorado in September 2013. Since that time a Federal quarantine has been established and a delimitation survey has been performed to identify areas where the insect is present. Currently the only confirmed detections are in the City of Boulder, however the likelihood of future spread into new areas warrants further survey activities. Early detection of the Emerald Ash Borer, prior to or early in its establishment in new areas, would provide regulators and land managers more options for eradication, control and management.

	Positive	Negative	Total Number
Traps	0	30	30

Database submissions:

Data for EAB trapping was entered into IPHIS fall of 2015.

If appropriate, explain why objectives were not met.*

All objectives were met.

Where appropriate, explain any cost overruns or unobligated funds in excess of $1,000.

Not applicable

Year:	2015
State:	Colorado
Cooperative Agreement Name:	Nursery Survey
Cooperative Agreement Number:	15-8508-0013-CA
Project Funding Period:	March 1, 2015 to February 29, 2016
Project Report:	**CAPS Survey Report**
Project Document Date:	May 30, 2016
Cooperators Project Coordinator:	Jeanne Ring
Name:	Jeanne Ring
Agency:	Colorado Department of Agriculture
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Telephone:	303-869-9076
E-mail:	Jeanne.

Write a brief narrative of work accomplished. Compare actual accomplishments to objectives established as indicated in the work plan. When the output can be quantified, a computation of cost per unit is required when useful.

The purpose of this project is to conduct an early detection survey of potentially harmful biological pests in commercial and retail plant nurseries. These nurseries facilitate the movement of various plant materials which can harbor invasive weeds, insects and diseases. If allowed to establish, these biological pests could negatively impact Colorado's agricultural industry, local economies and the environment.

Sixty plant nurseries and garden centers were selected throughout the front range of Colorado for trapping and visual survey of targeted pests. Twelve total targets were selected, two of which require trapping protocols and ten of which are surveyed by visual inspection. All survey activity (trapping and visual) is being completed in adherence to the 2015 CAPS approved methodology. Targeted pests in this survey have the potential to arrive and establish in Colorado through the horticultural industry.

Funding Amount	Total Number of Traps	Cost Per Unit
Proposed = $12,228	Proposed = 120	Proposed= $101
Actual =$12,228	Actual =120	Actual =$101

Survey methodology (trapping protocol):

	Common Name	Scientific Name
Pest:	Emerald Ash Borer	Agrilus Planipennis
	Japanese wax scale	Ceroplastes japonicus
	Scots Pine Blister Rust	Cronartium flaccidum
	Pine Saw fly	Diprion pini
	Light Brown Apple Moth	Epiphyas postvittana
	Needle Blight of Pine	Mycosphaerella gibsonii
	Japanese beetle	Popillia japonica
	Alder Root and Collar Rot	Phytophthora alni
	Wingless Weevil	Otiorhynchus dieckmanni
	Knotweed Complex	Polygonum spp.
	Myrtle Spurge	Euphorbia myrsinites
	Dyers Woad	Isatis tinctoria

	Proposed	Actual
Sites (Locations):	60	60
Traps:	120	120

Number of Counties:	10
Counties:	Adams Arapahoe

	Broomfield Boulder Denver Douglas Elbert Fort Collins Jefferson Larimer

Survey dates:

	Proposed	Actual
Survey Dates:	Site selection March-May, Trap set up May-June Trap removal October	Site selection March-May Trap set up May-July Trap removal Setember-October

Benefits and results of survey:

	Positive	Negative	Total Number
Traps	0	120	120

Database submissions:

Data for each species was entered into the NAPIS database fall of 2015.

If appropriate, explain why objectives were not met.

All objectives were met

Where appropriate, explain any cost overruns or unobligated funds in excess of $1,000.

Not applicable

Year:	2015

State:	Colorado
Cooperative Agreement Name:	Small Grains and Corn Bundled Survey
Cooperative Agreement Number:	15-8508-0013-CA
Project Funding Period:	March 1, 2014 to February 28, 2015
Project Report:	**Final Report: Small Grains and Corn Bundled Survey**
Project Document Date:	May 30, 2016
Cooperators Project Coordinator:	Jeanne Ring
Name:	Lou Bjostad, Janet Hardin
Agency:	Colorado State University
Address:	Dept. of Bioagricultural Sciences and Pest Management
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Telephone:	(970) 491-5987
E-mail:	Janet.Hardin@colostate.edu

Write a brief narrative of work accomplished. Compare actual accomplishments to objectives established as indicated in the work plan. When the output can be quantified, a computation of cost per unit is required when useful.

Per CAPS trapping protocols, pheromone traps were set at wheat and corn fields in 2015 to survey for the moth species listed below. Traps for 3 species of moth were set at each wheat field and 5 traps at each corn field. The total number of traps in the survey depended on availability of fields of each crop (permission from growers). Sweep surveys were also conducted for New Zealand wheat bug (*Nysius huttoni*), the cucurbit beetle (*Diabrotica speciosa*) and the aphid *Sipha maydis* in wheat fields adjacent to the moth traps. We surveyed for the aphid because it was discovered in Colorado for the first time on the Western Slope in spring of this year, and is considered a potential threat to wheat production. In addition, in May 2015 the USDA requested that states conducting Small Grains Commodity Surveys of wheat fields include inspection for signs and symptoms of flag smut, *Urocystis agropyri*. Traps were set at 11 wheat fields in Kit Carson, Yuma, and Washington counties. Traps were also set for moths at 5 corn fields in Weld County and 9 corn fields in Larimer County, for a total of 25 wheat/corn sites. At corn fields, visual surveys were made while corn plants were in bloom (tassels and silks) to survey for the cucurbit beetle and cotton seed bug (*Oxycarenus hyalipennis*). Trapping continued into October. No individuals of the targeted *Spodoptera* spp. were found, nor were other target species (including flag smut in wheat) observed during visual surveys. Interestingly, for the second year a moth species closely resembling *S. littoralis* and *S. litura* was captured on two occasions in *S. litura* traps at corn fields in Weld and Larimer counties. These two individuals were submitted to Dr. Boris Kondratieff at the C. P. Gillette Museum of Arthropod Diversity at Colorado State University, who confirmed that (as in 2014) they were *S. ornithogalli*, the yellowstriped armyworm.

Because traps for *Helicoverpa armigera* typically attract the native species *H. zea*, which is nearly identical in outward appearance to the target species, all individuals of *Helicoverpa* captured in any trap were retained and genitalic dissections performed to be certain that the targeted pest species was not collected. 2,875 moths were so dissected, and no *H. armigera* were found.

Funding Amount	Total Number of Traps	Cost Per Unit
Proposed = $17,290	Proposed = 100	Proposed= $172.90
Actual = $17,290	Actual = 103	Actual = $167.86

Survey methodology (trapping protocol):

	Common Name	Scientific Name
Pest:	Old World Bollworm	*Helicoverpa armigera*
Pest:	Egyptian Cottonworm	*Spodoptera littoralis*
Pest:	Cotton Cutworm	*Spodoptera litura*
Pest:	False Codling Moth	*Thaumatotibia leucotreta*
Pest:	Cucurbit Beetle	*Diabrotica speciosa*
Pest:	New Zealand Wheat Bug	*Nysius huttoni*
Pest:	Cotton Seed Bug	*Oxycarenus hyalipennis*

	Proposed	Actual
Sites (Locations):	25	25
Traps:	3 (each wheat), 5 (each corn)	3 (each wheat), 5 (each corn)

Number of Counties:	5
Counties:	Kit Carson, Larimer, Washington, Weld, Yuma

Survey dates:

	Proposed	Actual
Survey Dates:	May-October	June-October

Benefits and results of survey:

None of the target pests were detected in either the visual or sweep surveys. This result provides some security to Colorado wheat and corn producers that these exotic pests are absent and do not pose a threat to trade in these commodities.

	Positive	Negative	Total Number
Traps	0	103	103

Database submissions:

Sweep surveys of wheat fields and visual surveys of corn were completed. Contents of the sweep surveys were retained and screened for *Diabrotica speciosa, Nysius huttoni, Sipha maydis*, and/or *Oxycarenus hyalipennis*. Trap contents were screened as they were serviced and specimens of *Helicoverpa* retained for dissection. *Helicoverpa* traps intercepted a large number of *H. zea*. Genitalic dissections of those moths were performed to be certain that no *H. armigera* were among them. All data have been entered into NAPIS fall 2015.

If appropriate, explain why objectives were not met.*

All objectives were met.

Where appropriate, explain any cost overruns or unobligated funds in excess of $1,000. *

There were no cost overruns or unobligated funds.

Year:	2015
State:	Colorado
Cooperative Agreement Name:	Karnal Bunt
Cooperative Agreement Number:	15-8508-0013-CA
Project Funding Period:	March 1, 2015 to February 29, 2016
Project Report:	**Final Report -- Karnal Bunt Survey**
Project Document Date:	May, 30 2016
Cooperators Project Coordinator:	Jeanne Ring
Name:	Lou Bjostad, Janet Hardin
Agency:	Colorado State University
Address:	Dept. of Bioagricultural Sciences and Pest Management
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Write a brief narrative of work accomplished. Compare actual accomplishments to objectives established as indicated in the work plan. When the output can be quantified, a computation of cost per unit is required when useful.

Wheat samples were collected from 10 grain elevators in Kit Carson, Yuma, Washington, Morgan and Weld counties. Samples were submitted to the USDA testing laboratory in Phoenix, AZ for analysis.

Funding Amount	Total Number of Traps	Cost Per Unit
Proposed = $4,192	Proposed = 10 elevators	Proposed= $419.20
Actual = $4,192	Actual = 10 elevators	Actual =$419.20

Survey methodology (trapping protocol):

	Common Name	Scientific Name
Pest:	Karnal Bunt	*Tilletia indica*

	Proposed	Actual
Sites (Locations):	10	10
Traps:	4 samples from each elevator	4 samples from each elevator

Number of Counties:	5
Counties:	Elevators located in Kit Carson, Yuma, Washington, Morgan and Weld counties. Wheat in samples also came from Lincoln (and perhaps other) counties in Colorado.

Survey dates:

	Proposed	Actual
Survey Dates:	During wheat harvest, when wheat being received at elevators	During wheat harvest (July 2015)

Benefits and results of survey:

	Positive	Negative	Total Number
Traps	0	40	40

Database submissions:

Data has been uploaded into NAPIS.

If appropriate, explain why objectives were not met.

All objectives were met.

Where appropriate, explain any cost overruns or unobligated funds in excess of $1,000. *

There were no cost overruns or unobligated funds in excess of $1,000.

Year:	2015
State:	Colorado
Cooperative Agreement Name:	Stone Fruit Commodity Commodity Survey
Cooperative Agreement Number:	15-8508-1745-CA
Project Funding Period:	June 29, 2015 to June 30, 2016
Project Report:	**Farm Bill Survey Report**
Project Document Date:	August 2016
Cooperators Project Coordinator:	Jeanne Ring
Name:	Lou Bjostad, Janet Hardin
Agency:	Colorado State University
Address:	Department of Bioagricultural Sciences and Pest Management
City/ Address/ Zip:	Fort Collins, Colorado 80523-1177
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E-mail:	Janet.Hardin@colostate.edu

Write a brief narrative of work accomplished. Compare actual accomplishments to objectives established as indicated in the work plan. When the output can be quantified, a computation of cost per unit is required when useful.

As proposed, all survey work was conducted on the West Slope of Colorado at 3 sites in Mesa County, 2 in Delta County and one in Montrose County, the prime growing areas for stone fruits in the state. Sites selected for the survey were associated with known and suspected pathways of introduction for the targeted pest species. In April and May (following full leaf extension until average daily temperature reached 95°F), trees in peach, cherry, plum, apricot, nectarine, almond, pluot and aprium orchards were inspected visually and the leaves of trees that displayed symptoms perhaps indicative of PPV were sampled. A total of 161 samples from 20 orchards were submitted to Tamla Blunt, diagnostician at the Plant Diagnostic Clinic at CSU for analysis. None proved to be infected with PPV.

Pheromone traps for the 3 moth species listed below were installed at each of 6 sites according to protocol described in the national Stone Fruit Commodity Survey. Delta traps were set for Summer Fruit Tortrix (*Adoxophyes orana*) and wing traps for False Codling Moth (*Thaumatotibia leucotreta*) and Plum Fruit Moth (*Grapholita funebrana*). Traps were inspected monthly and serviced at appropriate intervals according to recommendations for each specific lure. Vinegar traps for Spotted Wing Drosophilid (SWD) were also set up at each site and serviced every 1-4 weeks. None of the target moth species were found in the traps, nor were any SWD flies found in those traps.

Visual surveys for any and all insect pest species, including Japanese Wax Scale and the Fruit-piercing Moth, were also conducted during trap check visits at each site. Visual surveys were also conducted for Asiatic brown rot (*Monilia polystroma*) and brown rot (*Monilinia fructigena*). None of the target species (or evidence of them) were found at any of the orchard sites.

Funding Amount	Total Number of Traps	Cost Per Unit
Proposed = $ 11,664	Proposed = 24	Proposed= $486
Actual = $ 11,664	Actual = 24	Actual = $486

Survey methodology (trapping protocol):

	Common Name	Scientific Name
Pest:	Summer Fruit Tortrix	*Adoxophyes orana*
Pest:	False Codling Moth	*Thaumatotibia leucotreta*
Pest:	Plum Fruit Moth	*Grapholita (Cydia) funebrana*
Pest:	Spotted Wing Drosophilid	*Drosophila suzukii*
	Visual Surveys:	

Pest:	Japanese Wax Scale	*Ceroplastes japonica*
Pest:	Fruit-piercing Moth	*Eudocima funebrana*
Pest:	Asiatic Brown Rot	*Monilia polystroma*
Pest:	Brown Rot	*Monilinia polystroma*

	Proposed	**Actual**
Sites (Locations):	6	6
Traps:	24	24

Number of Counties:	3
Counties:	Delta, Mesa, Montrose

Survey dates:

	Proposed	**Actual**
Survey Dates:	May – October 2015	April/May – October 2015

Benefits and results of survey:

	Positive	**Negative**	**Total Number**
Traps	0	24	24

Database submissions:

All data have been submitted.

If appropriate, explain why objectives were not met.

Included in the original plan were surveys for Apple Maggot (*Rhagoletis pomonella*) and Plum Curculio (*Conotrachelus nenuphar*). These surveys were of interest to CDA due to export/import concerns expressed by the state of Arizona. However, it was decided that the current survey (as proposed) was insufficient to address those requirements, and since no CAPS approved methods currently exist, surveys for these pests was proposed for future surveys.

Where appropriate, explain any cost overruns or unobligated funds in excess of $1,000. *

There were no cost overruns or unobligated funds in excess of $1,000.

Year:	2015
State:	Colorado
Cooperative Agreement Name:	Grape Commodity Survey
Cooperative Agreement Number:	15-8508-1659-CA
Project Funding Period:	July 13, 2015 to July 14, 2016
Project Report:	**Farm Bill Survey Report**
Project Document Date:	August 2016
Cooperators Project Coordinator:	Jeanne Ring
Name:	Lou Bjostad, Janet Hardin
Agency:	Colorado State University
Address:	Department of Bioagricultural Sciences and Pest Management
City/ Address/ Zip:	Fort Collins, Colorado 80523-1177
Telephone:	970-497-5987
E-mail:	Janet.Hardin@colostate.edu

Write a brief narrative of work accomplished. Compare actual accomplishments to objectives established as indicated in the work plan. When the output can be quantified, a computation of cost per unit is required when useful.

Per CAPS protocols and approved survey methods, traps were set for the 5 moth species at vineyards in Mesa, Delta, Montrose, and Larimer Counties.

At each survey location, delta traps were set up for the European grapevine moth (*Lobesia botrana*); wing traps were set up for false codling moth (*Thaumatotibia leucotreta*); and bucket traps were used for trapping Egyptian cottonworm (*Spodoptera littoralis*), cotton cutworm (*S. litura*), and the honeydew moth (*Cryptoblabes gnidiella*). Pheromone lures specific for the appropriate target species were used in each trap. Traps were inspected monthly and serviced at appropriate intervals according to recommendations for each specific lure. In addition, vinegar traps for spotted wing drosophilid (*Drosophila suzukii*, SWD) were also set up in September at seven vineyard locations on the Western Slope. SWD continues to be a fruit pest of interest and concern to fruit production in Colorado.

Visual surveys for wax scale and cotton seed bug were conducted at the same vineyard locations. While conducting visual surveys for the non-lepidopteran insect pests, foliage was examined for symptoms of infection by two phytoplasmas – Australian grapevine yellows (*Candidatus* Phytoplasma *australiense*) and Flavescence dorée (*Candidatus* Phytoplasma *vitis*) – as well as one fungus (Rotbrenner, *Pseudopezicula tracheiphila*).

None of the target moth species were found in the traps, nor were any SWD flies found in those traps. Interestingly however, one *Spodoptera ornithogalli* was found in a *S. litura* trap on one date in September in Larimer County. Identification of this species was confirmed by Dr. Boris Kondratieff at the C.P. Gillette Museum of Arthropod Diversity at CSU. This is only the third known occurrence of this species in Larimer County; the other two specimens were found in CAPS pheromone traps set for *S. litura* at corn fields.

Also of interest was the discovery of grapevine phylloxera (*Daktulosphaira vitifoliae*) leaf galls at one vineyard in Larimer County. This is the first known occurrence of this insect in the state of Colorado. It naturally occurs on native species of *Vitis* in eastern North America but has long been known as a destructive pest of commercial *V. vinifera* cultivars. While not a quarantine pest in the U.S. it continues to be of concern and its presence in Colorado should be monitored.

Funding Amount	Total Number of Traps	Cost Per Unit
Proposed = $ 19,868	Proposed = 55	Proposed= $361
Actual = $ 19,869	Actual = 55	Actual =$361

Survey methodology (trapping protocol):

	Common Name	Scientific Name
Pest:	European grapevine moth	*Lobesia botrana*
Pest:	Egyptian cottonworm	*Spodoptera littoralis*
Pest:	Cotton cutworm	*Spodoptera litura*
Pest:	Honeydew moth	*Cryptoblabes gnidiella*
Pest:	False codling moth	*Thaumatotibia leucotreta*
	Visual Surveys:	
Pest:	Wax scale	*Ceroplastes japonicus*
Pest:	Cotton seed bug	*Oxycarenus hyalipennis*
Pest:	Australian grapevine yellows	*Candidatus* Phytoplasma *australiense* 16SrXII-B
Pest:	Flavescence dorée	*Candidatus* Phytoplasma *vitis* 16SrV
Pest:	Rotbrenner	*Pseudopezicula tracheiphila*

	Proposed	Actual
Sites (Locations):	11	11
Traps:	55	55

Number of Counties:	4
Counties:	Mesa, Delta, Montrose, Larimer

Survey dates:

	Proposed	Actual
Survey Dates:	May-September	July-October

Benefits and results of survey:

	Positive	Negative	Total Number
Traps	0	55	55

Database submissions:

All data has been submitted

If appropriate, explain why objectives were not met.

All objectives were met.

Where appropriate, explain any cost overruns or unobligated funds in excess of $1,000. *

There were no cost overruns or unobligated funds in excess of $1,000.

Year:	2015
State:	Colorado
Cooperative Agreement Name:	**Collection and redistribution of biological control insects for the control of invasive toadflax species (*Linaria* spp.)**
Cooperative Agreement Number:	15-8508-0013-CA
Project Funding Period:	March 1, 2015 to February 29, 2016
Project Report:	**Final Accomplishment Report: Collection and Redistribution of Biological Control Insects**
Project Document Date:	May 30, 2016
Cooperators Project Coordinator:	Jeanne Ring
Name:	Andrew Norton, Janet Hardin
Agency:	Colorado State University
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City/ Address/ Zip:	Fort Collins, CO 80523-1177
Telephone:	(970) 491-7421
E-mail:	Andrew.Norton@colostate.edu

Write a brief narrative of work accomplished. Compare actual accomplishments to objectives established as indicated in the work plan. When the output can be quantified, a computation of cost per unit is required when useful.

Accomplishments:

Objective 1: Redistribute *Mecinus* spp. onto appropriate populations of *Linaria* spp. because toadflaxes continue to spread and we continue to receive requests for effective biocontrol agents for these noxious weeds.

Redistribution of *Mecinus janthiniformis* on Dalmatian toadflax (*Linaria dalmatica*): On two dates in June 2015 we visited two locations in Larimer County which serve as field insectaries and collected a total of 1,920 *M. janthiniformis*. These were then released at 6 locations on private property in northern Larimer County, including 4 locations at The Nature Conservancy's Phantom Canyon Preserve. In August we revisited those sites and established clusters of circular vegetation monitoring plots, modified from the format used by the U. S. Forest Service, and recorded baseline data on the toadflax infestation and composition of the local plant community.

Field insectary site where *M. janthiniformis* were collected.

Release of *Mecinus janthinus* onto yellow toadflax (*Linaria vulgaris*): In November 2013 we accepted delivery of stems from the yellow toadflax population in Montana where *M. janthinus* first became successfully established in the United States. We kept the stems in a cold chamber through the winter, and in spring of 2014 allowed weevils to lay eggs on caged yellow toadflax plants. After laying eggs for a few days on a given plant, weevils were removed and transferred to fresh plants. Plants exposed to oviposition by *Mecinus* were then transferred outdoors to our shade house structure on the CSU campus and maintained in cages through the season. In autumn we harvested the vertical stems and placed them into cold storage. We then allowed weevils to emerge at room temperature and/or gently extracted them from the stems in preparation for field release onto an infestation of yellow toadflax in a Douglas County open space south of Castle Rock. 397 weevils were released there in June 2015, and baseline monitoring plots established later in the summer.

Summary of Objective 1 Accomplishments: We collected a total of 1,920 *Mecinus janthiniformis* from 2 locations in Larimer County. We subsequently released those weevils at 6 other Larimer County Dalmatian toadflax sites. We also recovered 397 *M. janthinus* that emerged from stems overwintered in cold storage and released them onto yellow toadflax in Douglas County.

Objective 2: Collect demographic data on the status of *Mecinus janthiniformis* populations at at least three locations researched in past years and compare data on site characteristics in an effort to better define what may determine the level of impact to be expected post-release.

Weevil demography and rate of attack: The *Mecinus* spp. weevils are stem-borers with one generation per year. Females lay eggs in the stems from spring into summer; the eggs hatch; the larvae feed on the inside of the flowering stems and develop through all life stages, becoming adults by autumn. The new adults spend the winter in the stems and emerge the following spring. This life cycle makes it relatively easy to determine reproductive effort and success by collecting stems and splitting them open.

Three adult *Mecinus janthiniformis* in a Dalmatian toadflax stem

Our late spring/early summer visits to former release sites showed variable numbers of old *L. dalmatica* stems remaining on the landscape. Rather than using Y2014 stems to make demographic assessments of *M. janthiniformis* at these sites we sampled mature stems of the year in August and September and dissected them to determine weevil population size and rate of attack. This is similar to the methods used by VanHezewijk et al. (2010). 20–25 stems were collected from each of 8 locations where weevils had been released 7-10 years previously, 1 location where weevils were released 2 years previously, plus 1 location where no weevils had been released for a total of 10 sites. In the laboratory these were measured, then carefully split open and the following data recorded: length of the center axis of the stem, number of oviposition scars, number of weevil larvae (alive and/or dead), number of weevil pupae (alive or dead), and number of adult *Mecinus*, living or dead. We also noted the presence of any exit holes and parasitoid wasps. Since determination of oviposition from plant scar tissue is problematic, we assessed the level of weevil impact at each site by summing the numbers of weevils (all life stages) and calculating the rate of attack as the number of weevils per centimeter of stem length. We then compared the rate of attack between sites.

Figure 1 displays our results and demonstrates that higher numbers of weevils can impact the size of the toadflax plants. Weevils were present at every site, including in very small numbers at the one non-release site – the releases nearest to that site had been made at distances of 4.9 miles (released in 2010) and 0.8 mile (2014). At one site (Lory, in Table 1; also the isolated data point in Fig. 1) we had established stem count transects in 2004; releases were subsequently made by land managers in 2013 and 2014 as close as ~627 m from our original transects. The rate of weevil attack at that location was the highest of any site. The presence of weevils at the non-release site and their high numbers at the location with recent releases so near by confirm our previous observations that, once released, *Mecinus janthiniformis* not only establishes readily but also begins dispersing to other areas within a year. This is one of the goals and results of successful biological control programs.

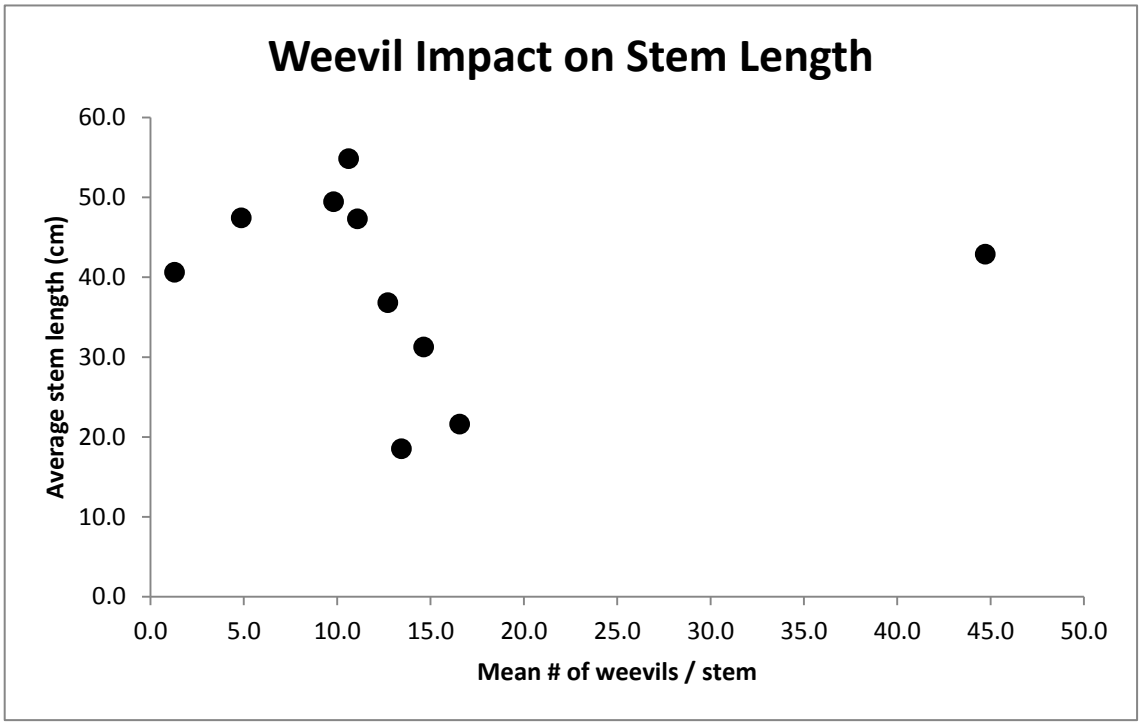

Figure 1. Stem heights and rate of weevil attack at ten study sites.

Density of Dalmatian toadflax infestations: We revisited 16 Dalmatian toadflax sites where we had collected density data 6 – 11 years previously and did repeat stem counts along 21 transects. Transects were originally established while conducting other research projects and were either 50 or 100 m in length. Weevils had been released at or near all but one of these sites. We counted toadflax plants where the stems emerged from the soil within a meter on either side of the transect line, thus sampling in a band 2 m wide. We recorded densities as stems/m^2 and calculated the percent change in density. Despite the frequently high population levels of *Mecinus janthiniformis*, all but two transects reflected an increase in toadflax of at least 9%, and at the one non-release site (Phantom, Table 1) the increase was an astounding 2,964%. This confirms anecdotal observations of an explosion in the population of Dalmatian toadflax along the northern Front Range of Colorado in the last 2-3 years.

Table 1. Change in Stem Density

Transect	Initial Stem Counts	Initial Density (stems/m^2)	2015 Density	% Change in Density
Horsetooth	2004	1.15	3.73	223
Phantom	2004	0.89	27.23	2,964
Lory	2004	2.47	3.34	35
Colp 1	2006	166.63	34.27	**-79**
Colp 3	2006	179.76	13.55	**-92**
Red Mtn 3	2008	3.45	3.77	9
Red Mtn 4	2008	2.28	6.07	166
Red Mtn 5	2008	2.55	3.40	33
Red Mtn 6	2008	1.90	8.86	368
Red Mtn 9	2008	1.30	1.60	23
Abbey 1	2009	0.86	6.43	651
Abbey 2	2009	1.13	3.63	222
Abbey 3	2009	1.23	5.69	364
Abbey 5	2009	2.03	15.10	644
Abbey 6	2009	1.28	3.28	156
Abbey 7	2009	0.72	2.16	200

One site in Boulder County (the Colp transects, Table 1) reflected a decrease of 79% and 92% along the two transects. The attack rate at this site was the third highest of all sites sampled. Plants at the site were markedly smaller in size and stems were notably deformed and gnarled as a result of plant responses to weevil oviposition and tunneling. Weevils have been present at the Colp site for 9 years. Despite the regional trend of increasing toadflax populations, the results at this site suggest that the level of *Mecinus* impact could increase with a shift in conditions.

The data in Table 1 could also suggest that the presence of *Mecinus* may have impacted the rate of toadflax recruitment at the other sites. However, given that this sampling represents two discrete moments in time and the release history differed between locations, it is possible that other stochastic factors influenced the results recorded here.

We also attempted to correlate stem density with the rate of weevil attack among release sites (see Figure 2). However, there was no significant correlation between them.

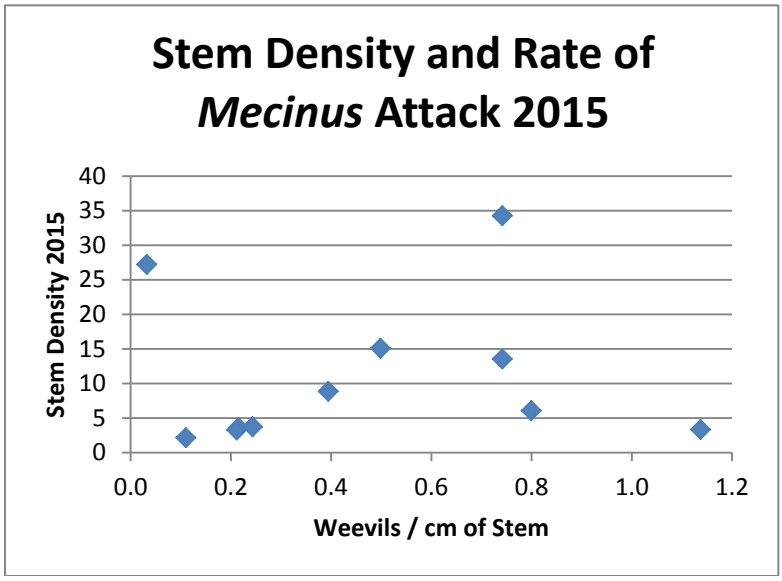

Figure 2. Relationship between stem density and weevil attack rate in 2015

In addition to repeating stem counts along transects established in previous years we revisited 6 circular monitoring plots at 3 locations on a private ranch and made repeat assessments of the plant community and toadflax density, as was first done after releases were made in 2009. There was no general pattern discernible other than a moderate decrease in bare ground and an increase in toadflax cover, consistent with general observations on the local landscape. Interestingly, cheatgrass cover declined at one site that is apparently grazed regularly by cattle. There was no pattern apparent in the plant species composition; new native species appeared and others disappeared between the two sampling events.

A concern in weed control programs is that after removal or reduction in the dominance of one noxious weed species, another invasive may take its place. This was not evident in these plots. However, given that populations of plant species can fluctuate over time, and Dalmatian toadflax is known to experience years of cyclic abundance (Robocker 1974), these sampling events – of both stem counts and plant community composition – are at best snapshots of what actually occurs on the landscape. The best method of assessing true change over time would be to sample the same plots or transects every year for several years (nine to ten years has been suggested in the literature – see Weed and Schwarzländer, 2014), which can be challenging in regard to funding availability and logistics.

Site characteristics: We had hoped to correlate *Mecinus* population data with edaphic site factors. Along the Front Range of Colorado Dalmatian toadflax tends to be most prevalent on south- or east-facing slopes but is not limited to these situations. Indeed, our study sites varied in slope from flat to over 30° and the aspects of our monitoring transects varied even more widely. Our five transects at Red Mountain, all with a 7-year history of *Mecinus* presence, expressed widely different changes in stem density. Because of this variability between release

sites, we found no weather stations that were aligned closely enough with study locations to allow us to make correlations on a scale relevant to localized site conditions. An indication of the extent to which conditions at different sites can significantly affect interactions between a weed plant species and its specialized herbivore are illustrated in the work of Bonsall et al. (2003).

Factors that influence fluctuations in plant populations are many, and perhaps synergistic. In May 2015 the northern Front Range experienced one of the wettest Mays on record, leading to unusually high flows and even flooding in rivers and streams of the South Platte basin. Dalmatian toadflax produces abundant seed (estimated at potentially > 400,000 per plant) that can remain viable in field soil for 10 years (Robocker 1974). It is possible that the timing and increased soil moisture led to the flush of seed germination we observed at some study sites. Our results, despite the considerations mentioned above, are similar to those documented by Weed and Schwarzländer (2014) in their study of Dalmatian toadflax and *Mecinus* sites in Idaho. They also suggested that weevil impact may be "low at sites receiving relatively large inputs of precipitation."

A dense patch (near monoculture) of toadflax seedlings
at a release site on the Phantom Canyon TNC preserve

Summary of Objective 2 Accomplishments: We visited and assessed the change in Dalmatian toadflax stem density at 14 former release locations as well as 2 sites where weevils had not been released when the sites were first assessed in 2004 and 2006.

Objective 3: Release *Rhinusa linariae* onto appropriate infestations of yellow toadflax in order to increase the likelihood that this troublesome noxious weed will be brought under control in the state of Colorado.

In collaboration with colleagues in British Columbia and in possession of all appropriate permits, we collected *Linaria vulgaris* plants heavily galled by *Rhinusa linariae* from a site near Kamloops and transported them to Colorado, where they entered our USDA-approved quarantine room in August 2014. There we placed the galls into moistened perlite and allowed the pupae to eclose and emerge as adults. Adult weevils were then transferred to caged trays containing moistened perlite and sprigs of toadflax inserted into moistened florist's foam. Since adult weevils are also known to overwinter within galls (Jordan 1994), after a few weeks we began dissecting weevils carefully out of the galls and placing them with the others. Weevils fed to a limited extent on the foliage but spent most of their time down inside the perlite. In October, after all galls had been examined and adult weevils removed, we placed the boxes of perlite into a cold chamber for the winter. Weevils were maintained at temperatures just above freezing and L:D was regulated to match contemporary outdoor daylength.

Heavily galled root crowns collected in British Columbia

Adult *R. linariae* in quarantine

In June 2015, when our collaborator in Douglas County indicated that toadflax plants were approaching appropriate size, we brought the weevils out of cold storage and allowed them to emerge into cages in the laboratory. We then released 263 adult *Rhinusa* weevils on two dates at two locations in a Douglas County open space where *L. vulgaris* is infesting pine/oak woodland and control of yellow toadflax by means other than biological control is problematic. The releases were made on the Palmer Divide at elevations ~ 2,210 m (7,250 ft.). At both release locations we erected cages to confine weevils onto dense patches of yellow toadflax. At the open site we used a 6' x 6' x 6' cage borrowed from the Colorado Department of Agriculture; at the second site we constructed smaller cages to fit underneath the oak canopy. Cages were left in place until the end of July, after adults had completed laying eggs and reached the end of their lifespan. In September we returned and established a cluster of 4 circular monitoring plots and collected baseline data on toadflax density and the composition of the plant community.

Cage in open

Cages under oak canopy

Summary of Objective 3 Accomplishments: We succeeded in rearing adult *Rhinusa linariae* in quarantine from galls (pupae) obtained in British Columbia and subsequently overwintered the adults in a cold chamber. We have established 8 circular monitoring plots at these release locations and recorded baseline data on the level toadflax infestation and on the native plant community.

We have great hope that these weevils will become established, have a strong impact on the weed population, and subsequently become abundant enough for redistribution to other sites. Monitoring these releases in the next few years will be vital in that effort.

Project Summary: We visited Dalmatian toadflax locations with existing populations of *Mecinus janthiniformis*, assessed them for collectability, and collected and redistributed weevils to additional toadflax infestations. We collected demographic data on *M. janthiniformis* populations and their associated infestations of Dalmatian toadflax. We reared *Rhinusa linariae* from yellow toadflax root crown galls and recovered *M. janthinus* from yellow toadflax stems and released them onto yellow toadflax infestations in the field.

M. janthiniformis was first released in Colorado in 1997 and has thus been a factor in the toadflax landscape for only 18 years. *M. janthinus* was first released in 2009 and *Rhinusa linariae* was released in the field this year. While some of our findings are as yet inconclusive as to the impacts of these weevil species, this study is a step forward in determining the success of biological control of the toadflax species in Colorado.

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Benefits and results of work:

In the course of collecting and distributing these biological control agents we worked in cooperation with personnel at the Colorado Department of Agriculture insectary, the Larimer County Weed District, Larimer County Open Space Program, The Nature Conservancy, Douglas County Open Space, USDA Forest Service and USDA-APHIS-PPQ, private land owners, as well as researchers in British Columbia.

Funding Amount
Proposed = $15,962
Actual = $15,962

	Proposed	Actual
Sites (Locations):	Not enumerated	NA

If appropriate, explain why objectives were not met.*

All objectives were met.

Where appropriate, explain any cost overruns or unobligated funds in excess of $1,000. *

All funds were obligated and there were no cost overruns.

Year:	2015
State:	Colorado
Cooperative Agreement Name:	Biological Control of Russian knapweed and yellow toadflax
Cooperative Agreement Number:	15-8508-0013-CA
Project Funding Period:	March 1, 2015 to February 28, 2016
Project Report:	**Final Report Biological Control of Russian knapweed and yellow toadflax**
Project Document Date:	**May 30, 2016**
Cooperators Project Coordinator:	Dan Bean and John Kaltenbach
Name:	Jeanne Ring
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E-mail:	Jeanne.Ring@state.co.us

Write a brief narrative of work accomplished. Compare actual accomplishments to objectives established as indicated in the work plan. When the output can be quantified, a computation of cost per unit is required when useful.

There were four objectives listed below, which are listed in the work plan. Progress has been made on all four objectives but we are at least four months away from completion of the projects for the season and compilation of final numbers for projects.

1. To collect, rear, and release the toadflax stem borer *Mecinus janthinus* for control of yellow toadflax (*Linaria vulgaris)* and the Russian knapweed gall midge, *Jaapiella ivannikovi* for control of Russian knapweed (*Rhaponticum repens*).

2. To monitor establishment and impact of *M. janthinus* on yellow toadflax and *J. ivannikovi* on Russian knapweed at sites throughout Colorado.

3. To monitor changes in vegetation, other than the target weeds, at *M. janthinus* and *J. ivannikovi* release sites.

4. To provide weed biocontrol agents to cooperators outside of Colorado, at the request of the USDA APHIS. These agents will include *J. ivannikovi*, which we now have in numbers sufficient for redistribution, and *M. janthinus* and *A. acroptilonica* (if collection numbers permit us to do so) as well as other agents established in Colorado but not commonly found in collectable numbers in other states. These include *Aceria malherbae* for field bindweed mite and *Hylobius transversovittatus* the purple loosestrife stem root borer and *Cyphocleonus achates*, the knapweed root weevil, as well as others that we have available in Colorado.

Accomplishments:

1. Collection and release of *J. ivannikovi* and *M. janthinus.*

We reared Russian knapweed gall midges, *J. ivannikovi*, in our greenhouses on live Russian knapweed plants. We also collected galls from the Insectary garden where gall formation has been optimized through occasional mowing. In the greenhouses knapweed was planted at regular intervals so that we had a continuous supply of fresh plants which we rotated into the greenhouse. From March to mid-April we steadily increased gall numbers (infested plants) so that we had gall-bearing plants (about 200) when field season began. We put out whole potted plants for these releases of greenhouse material and cut bouquets of gall bearing material cut from the Insectary garden. We released 2,423 *Jaapiella ivannikovi* galls at sites across the state (Figure 1) during the 2015 field season. Galls were collected from field sites, greenhouse plants and the Insectary garden. The Reid property (see Figure 2) continues to be the most productive site for field collected galls. We have approximately 150 gall bearing Russian knapweed plants in the greenhouses and we have gall bearing plants in the Insectary garden.

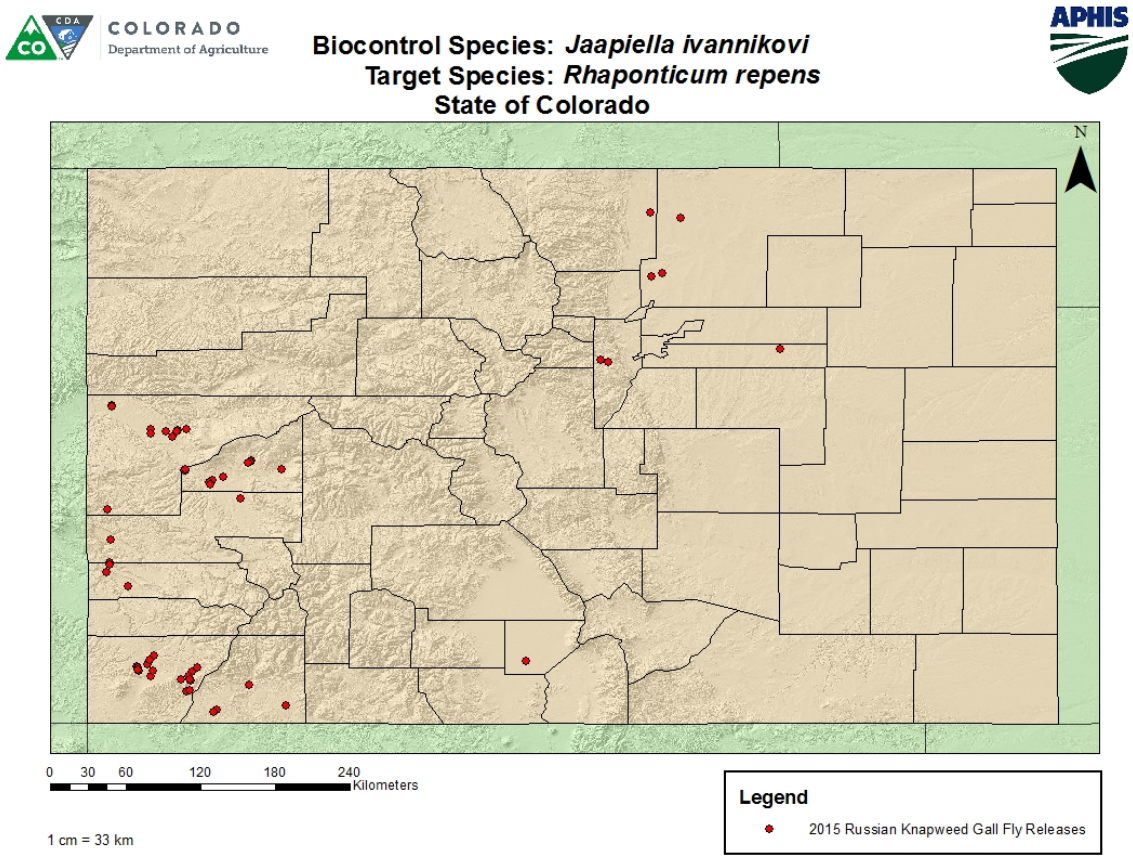

Figure 1. *Jaapiella acroptilonica* releases, 2015

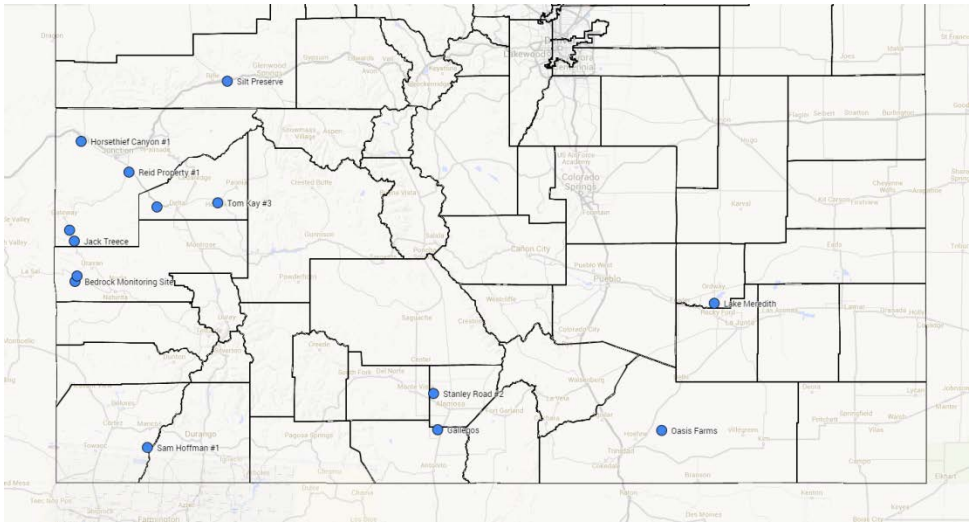

Figure 2. Russian knapweed long term monitoring sites, 2015

We received 200 gall wasps, *Aulacidea acroptilonica*, through R. Hansen (USDA APHIS). We released 66 of them onto caged plants within the greenhouse, 66 of them into a small cage in the Insectary garden and 68 into a small cage at the Escalante Wildlife Management Area. We had galled plants in the greenhouse but none that we could positively identify in the

cages at the wildlife area or in the garden. We have spoken to R. Hansen about gall identification and he told us that galls are more difficult to find in the field than those of *J. ivannikovi*. Plants that were galled in the greenhouse were move outside at the end of the field season and galls will be monitored for wasp emergence during the spring of 2016.

We have surveyed 13 monitoring sites where Russian knapweed gall midges were released and have counted Russian knapweed stems at 13 sites (Figure 2). Nine out of the 13 sites showed a decrease in overall Russian knapweed stem density in the 16 m^2 area surrounding the point of introduction. We will wait to see if this trend continues into 2016. The most notable successes were in establishing gall flies at sites on the western slope. The biggest difficulties have come in establishing gall flies at sites on the Front Range and eastern plains. We failed to recover galls at the Oasis Farm site and at the Lake Meredith site, both in the Arkansas River basin. Attention will be focused on these areas during the spring and summer of 2016.

Mecinus janthinus were reared on yellow toadflax in our greenhouses. We recovered 1,348 yellow toadflax weevils from the toadflax stems reared in the greenhouses. These were divided between cooperators in Boulder County, Douglas County and Rio Blanco County. We also received 200 weevils from Montana through USDA APHIS cooperators. These were released in La Plata County, CO on US Forest Service land.

Early season surveys of our existing release sites showed overwinter establishment at four out of 13 sites (see Figure 3 for site locations). None of those four sites were shown to have high enough populations to enable collection and redistribution although all four sites continue to be promising for future redistribution collections.

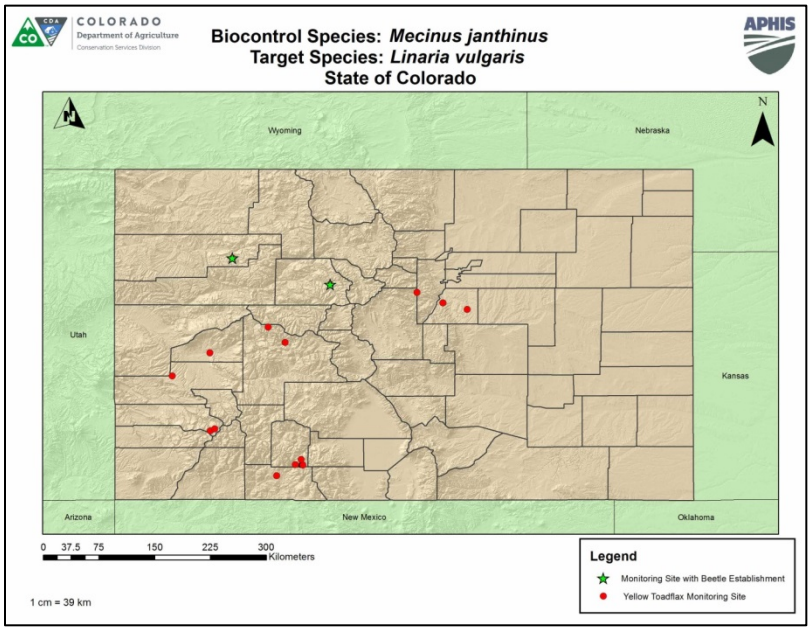

Figure 3. Monitoring sites for *M. janthinus* on yellow toadflax. The two sites shown as green stars are ones where beetles have been established for at least three seasons.

2. Monitoring establishment and impact of *M. janthinus* and *J. ivannikovi*. *M. janthinus* have been released at 13 monitoring sites and we recovered weevils at four of them during early season monitoring (Figure 3). The four recovery sites include two sites on the Front Range and two sites that have shown establishment since 2011. We have yet to see collectable numbers although there is promise for future collections. *J. ivannikovi* were recovered at multiple sites and in areas far removed for the original release locations. We will report on successes with this agent in the final report but it is clear that we are ready for redistributions from our field sites to locations outside of Colorado, at the request of the USDA APHIS.

3. Monitoring changes in vegetation composition at biocontrol sites. We monitored 9 sites (yellow toadflax) and 13 sites (Russian knapweed) for changes in vegetation following biocontrol implementation. We have yet to note shifts in vegetation patterns.

4. Providing biocontrol agents for establishment in other states. We collected and shipped 9 releases of the bindweed mite, *Aceria malherbae*, for distribution out of Colorado. Our policy is to work with other states to get mites established working through the USDA APHIS.

Agent	Target	Stage	Location	# Releases	Total Agents
Aceria malherbae	Field Bindweed	Gall	Nevada	2	2000
Aceria malherbae	Field Bindweed	Gall	Wyoming	5	5000
Aceria malherbae	Field Bindweed	Gall	Montana	2	2000

The Palisade Insectary rears the purple loosestrife root boring weevils, *Hylobius transversovittatus*. The weevils are reared on an artificial diet where they develop to adulthood. Weevils are shipped as adults. We shipped out 700 adult weevils to two cooperators. Weevils were shipped in two batches to each of the cooperators. The final tally appears below.

Agent	Target	Stage	Location	Total Agents
Hylobius transversovittatus	Purple loosestrife	Adult	Washington	350
Hylobius transversovittatus	Purple loosestrife	Adult	Utah	350

Biological Control in Wildfire Recovery

In 2013 the Palisade Insectary joined with a consortium of agencies (including the USDA APHIS) and local weed control groups to form the Poudre Partnership. The Partnership was formed to devise and implement strategies for weed control throughout the vast High Park and Hewlett Gulch fire burns west of Ft. Collins, CO. The project presents challenges in coordination for agencies and landowners as well as in delivering weed control to a vast (about 90,000 acres) area that is severely disturbed by fire. Our role was to provide *Mecinus*

janthiniformis to control tens of thousands of acres of Dalmatian toadflax which became dominant following the fire. We were also tasked with providing data on the efficacy of biocontrol in this setting. Given the increased numbers of wildfires and the impact of fire on invasive plants we view this project as a model for rapid deployment of biocontrol agents following fires or other major disturbances. We released agents at 20 sites (5,000 total) and set up 4 sites for long term monitoring, both of toadflax density and vegetation cover. Below is a map of the area with our release and monitoring sites marked. In the spring and early summer of 2015 we monitored toadflax densities and vegetation composition at the four monitoring sites. We also surveyed toadflax adjacent to the monitoring sites and found *Mecinus* present. The biocontrol releases have established and we now have growing populations of *M. janthiniformis* in the region. We have not measured a significant impact yet but monitoring will continue at our four sites.

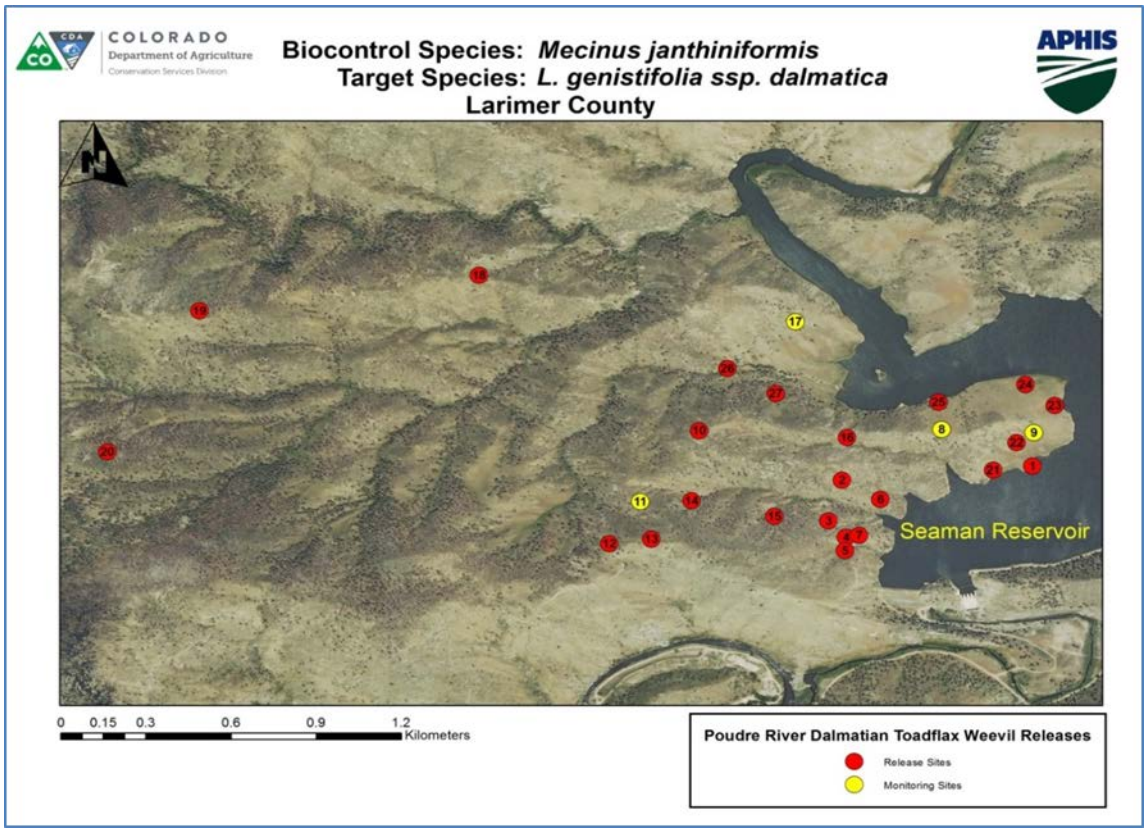

Figure 2. Release sites for *M. janthiniformis* in areas burned by the High Park and Hewlett Gulch fires of 2012. The North Fork of the Cache la Poudre River is seen in the lower right corner.

Site Site # shown on map	Transects with weevils	Total number of weevils	Weevils present/transect point	Furthest distance along transect weevils present
8	5	37	18%	50 meters
9	4	20	8%	46 meters

11	6	86	26%	50 meters
17	6	100	28%	48 meters

Our monitoring program consists of target weed stem counts at the release point and beetle and vegetation densities measured using 6x50m transects radiating out from the release point. This spring we found beetles in most of the transects and at some locations near the monitoring sites we found high enough densities of weevils to make our first collection from this area (we collected and redistributed 250 weevils).

Benefits and results of work: Russian knapweed is one of Colorado's top five worst weeds in terms of area covered and economic impact. We have established the gall midge at numerous locations and have made the midge available to end users in Colorado. We anticipate that we will be able to redistribute midges to other states starting in 2016 (we have already done so in Utah). We have released *Aulacidea acroptilonica* at two sites but have not yet recovered wasps from the field. We also have them in culture in the greenhouse and are continuing to work to overcome the fact that they are univoltine and difficult to rear in continuous culture. We are planning to establish field nursery sites that will enable us to make large scale releases in Colorado.

Yellow toadflax is a major and rapidly growing problem which is spreading within Colorado as well as around the west. In many instances, particularly in Colorado's high mountain forests and meadows, yellow toadflax is nearly impossible to control using herbicides and mechanical removal. We have released the yellow toadflax stem boring weevil, *M. janthinus* at approximately 20 sites, mostly in remote and mountainous areas where other control methods are difficult. In many of our release areas biological control is the only practical way to reduce stand densities of this weed. Unfortunately our established populations remain small and continued monitoring is essential in order to decide if the agent will be effective and how long it will take to see a population level impact on yellow toadflax.

We continue to provide other agents as needed by states outside of Colorado. This includes efforts to establish the field bindweed mite, *Aceria malherbae*, in other states. Given our success with the mites there is great promise, especially in the west, for achieving bindweed control with them. We are one of only two facilities that currently rears and distributes *Hylobius transversovittatus* for purple loosestrife (PLS) control. We receive a steady but small stream of requests for this insect coming from states where PLS is a devastating weed.

The Poudre Project offers a template for the rapid deployment of biological control to contain a weed that has exploded in density due to fire disturbance. This could save hundreds of thousands of dollars in control costs in post burn remediation efforts.

If appropriate, explain why objectives were not met.

We met nearly all of our objectives for 2015. The only objective that we fell sort on was providing the knapweed root boring weevil *Cyphocleonus achates* to cooperators outside of Colorado. We were unable to locate large collectible number of the weevils as is often the case. The insects appear to emerge in large numbers in somewhat unpredictable patterns in the field making it difficult to project collection numbers.

Where appropriate, explain any cost overruns or unobligated funds in excess of $1,000. *

There were no cost overruns or unobligated funds.