Cooperative Agricultural Pest Survey (CAPS)

Annual Report
Colorado
2010

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Colorado Cooperative Agricultural Pest Survey 2010

This report summarizes the activities and surveys of the Colorado CAPS program between March 1, 2010 and February 28, 2011. The cooperators for this year's work include Colorado State University (CSU), Colorado State Forest Service (CSFS), and the United States Department of Agriculture, Animal and Plant Health Inspection Service, Plant Protection and Quarantine (USDA, APHIS, PPQ). The other surveys and biocontrol activities were carried out by Colorado Department of Agriculture (CDA) are ongoing.

CSU cooperators carried out the following surveys: Small Grains Commodity-Based Survey, Karnal Bunt Survey, Grape Commodity-Based Survey (in coordination with CDA), Plum Pox Virus Survey, and Black Walnut Thousand Cankers Survey. CSFS conducted surveys for Gypsy Moth and Emerald Ash Borer. CDA and CSU also performed work for biological control. USDA, APHIS, PPQ set traps for the Emerald Ash Borer survey. CDA conducted the Pine Commodity-Based Survey and the Potato Cyst Nematode sampling with lab analysis performed at the CSU Plant Diagnostics Lab in Fort Collins.

Summary of Projects and Cooperators

Project/Survey	Cooperator(s)
Lobesia/Grape Commodity-Based Survey	CSU and CDA
Small Grains Commodity-Based Survey	CSU
Pine Commodity-Based Survey	CDA
Emerald Ash Borer	CDA, CSFS and PPQ
Thousand Canker Survey	CSU
Weed Survey and Biocontrol Project	CDA
Monitoring *Diorhabda elongata*	CSU
Karnal Bunt Survey	CSU
Potato Cyst Nematode Survey	CDA and CSU

Included in this report is a brief summary of the activities that have been carried out for the 2010 CAPS season.

PEST DETECTION

Infrastructure/CORE Activities

The Infrastructure funding provided through the CAPS program is essential to conducting the pest detection surveys in Colorado, as well as increasing public awareness and communication of the threats posed by non-native, invasive species. The nine survey projects carried out in the past year in Colorado could not have been conducted without this support. In addition to coordinating the cooperative efforts of the institutions involved in CAPS, the following activities were completed:

- John Kaltenbach, State Survey Coordinator, was an interim member of the National CAPS Committee during 2010.

- Coordinating the development of an Emergency Plant Pest Response plan and participated in a PPQ directed Table Top Exercise.

- Participated in several seminars and trainings via Webinar including; EAB Outreach, EAB University courses, GPDN Emergency Response, and training the trainer for First Responders.

- Held three meetings of the Colorado Firewood Task Force; participants include representatives from the following institutions, Colorado Department of Agriculture, Colorado State University, Colorado State Forest Service, Colorado State Parks, Rocky Mountain National Park, US Forest Service, Bureau of Land Management, Jefferson County, Adams County, City of Fort Collins. The Task Force has and continues to work on getting the “Don’t Move Firewood” message out to Colorado businesses, institutions and the general public.

- An EAB/Firewood awareness press release was sent out by the Colorado Department of Agriculture during the week presiding Memorial Day and the unofficial start of the camping season.

  Outreach; materials developed and activities:
  - A trailer wrapped in the Don't Move Firewood message. The trailer will be moved to various locations around the state and to other Rocky Mountain States.
  - "Buy It Where You Burn It" posters.
  - "Don't Move Firewood" banner stands that were used at ProGreen Expo and the Colorado State Fair.
  - "Don't Move Firewood" Postcards developed in coordination with Don'tMoveFirewood.org.
  - Bookmarks were developed and printed with the "Don't Move Firewood" message for distribution in packets to out of state hunters.
  - Outreach materials distributed include: "Don't Move Firewood" stickers (300), temporary tattoos of ALB and EAB (500), business card magnets (100), vinyl clings (300) that were all provided by Don't MoveFirewood.org.

- The Colorado State CAPS committee held a meeting in January, 2011, to go over the results of the surveys for 2010, and a conference call was held in June to provide updates and planning opportunities, as well as to develop survey plans for the following year.

Lobesia/Grape Commodity-Based Survey

Project Coordinators: Dr. Louis Bjostad, David James and Janet Hardin (CSU) and John Kaltenbach (CDA)

Objective

The Colorado Department of Agriculture and Colorado State University cooperatively conducted an early detection pheromone trap/visual survey for the following grape associated pests:

Target Pests

- Passionvine mealybug (*Planococcus minor*) - Ranked #22 on NPPL 2010
- Cotton cutworm (*Spodoptera litura*) - Ranked #7 on NPPL 2010
- Summer fruit tortrix moth (*Adoxophyes orana*) - Ranked #12 on NPPL 2010
- False codling moth (*Thaumatotibia leucotreta*) - Ranked #30 on NPPL 2010
- Egyptian Cottonworm (*Spodoptera littoralis*) - Ranked #20 on NPPL 2010
- Fruit Piercing Moth (*Eudocima fullonia*) - Ranked #29 on NPPL 2010
- Cotton Seed Bug (*Oxycarenus hyalinipennis*) - Ranked #28 on NPPL 2010
- European Grape Vine Moth (*Lobesia botrana)*- CAPS FY 2009 AHP Master Pest List

Target Areas

Vineyards and orchards were targeted for this survey. Traps were placed at a total of 11 sites in the following counties: Delta (3 sites), Mesa (1 site), Montrose (2 sites), Larimer (2 sites), Fremont (2 sites) and Adams (1 site) (see Figure 1a and 1b). This is one more site than outlined in the work plan. Traps were placed on time in May and were removed September and October.

Summary

Traps were placed in May and were removed in September. Visual surveys were performed at each site during trap check and lure replacement. Most sites were visited every other week. The objectives of the survey were accomplished and no target pests were found.

Small Grains Commodity Survey

Project Coordinators: Dr. Louis Bjostad, David James and Janet Harden (CSU)

Objective

The purpose of this project is to conduct early detection commodity-based survey in wheat fields.

Target Pests

- Old World Bollworm (*Helicoverpa armigera*): Ranked #3 on NPPL 2010
- New Zealand Wheat Bug (*Nysius huttoni*) Ranked #23 on NPPL 2010
- Cotton cutworm (*Spodoptera litura*) Ranked #7 on NPPL 2010
- Egyptian Cottonworm (*Spodoptera littoralis*): Ranked #20 on NPPL 2010
- Silver Y Moth (*Autographa gamma*): Ranked #66 on NPPL 2010
- European grapevine moth (*Lobesia botrana*) Ranked #98 on NPPL 2010
- Maritime garden snail (*Cornella vibrate*): Ranked #45 on AHP List 2010
- Conical Snails (*Cochlicella acuta* and C. *barbara*): Ranked #46 on AHP 2010 List

Target Areas

The 5 counties with the highest wheat production totals were targeted for this survey along with Larimer County. The counties and sites surveyed included 5 in Kiowa, 5 in Kit Carson, 5 in Yuma, 4 in Washington, 3 in Cheyenne, and 4 in Larimer.

Summary

Traps were placed in early June and were removed in late August/September. Wheat fields were targeted for this survey. The objectives of the survey were accomplished and no target pests were found (Figure 2). Figure 2 map shows: Old World Bollworm, New Zealand Wheat Bug , Cotton cutworm Egyptian Cottonworm, Silver Y Moth, and European grapevine moth.

Karnal Bunt Survey

Project Coordinators: Dr. Louis Bjostad, David James and Janet Hardin (CSU)

Objective

Colorado State University collected grain samples to be tested for karnal bunt. Karnal bunt surveys were done by visiting granary locations and collecting wheat grain samples to be sent on to Olney, Texas for optical scanning. The objectives of the survey were accomplished and Karnal Bunt was not detected.

Summary

Grain elevators located in the eastern plains of Colorado were targeted for this survey and grain samples were taken from a total of 7 counties. Forty samples were taken from Weld, Morgan, Washington, Sedgwick, Kit Carson, Phillips, and Yuma counties (Figure 3).

Gypsy Moth Detection Survey

Project Coordinator; Sky Stephens (CSFS)

Objective

The objective of this project was to conduct an early detection trapping survey of gypsy moth in every county of Colorado.

Target Pests

- European gypsy moth (*Lymantria dispar*)
- Asian gypsy moth (*Lymantria dispar asiatica*)

Target Areas

High risk areas are defined by having significant concentrations of host trees in close association with human activities, typically urban areas, other settlements and recreation

areas. Uninhabited native forest, agricultural and range lands and all lands above 10,000 feet above sea level are excluded.

Summary

A total of 1,693 gypsy moth delta traps with lure were deployed, monitored and collected in 2010. Traps were set throughout the state starting in late June. The funding for the gypsy moth survey was not received until June 22, 2010, which caused a delay to the start of trap deployment. However, the majority of the traps were set by the end of July which, for our higher elevations is early enough based on their phenology.

The traps were set at a rate of approximately one per square mile with a higher density of traps set in and around Boulder, Denver, Jefferson, Larimer and El Paso counties (Figure 4). Delimitation traps were set around the 2009 positive catch locations in Westminster (N 39.84962 W -105.02714), Commerce City (39.8123 W -104.92399) and Pueblo (N 38.33923 W -104.69809). In addition to the delimitation traps, visual egg mass surveys were conducted that the three locations by CDA, CSFS and PPQ personnel. All the traps were collected in October.

One male gypsy moth was collected in 2010 and sent to the OTIS lab for DNA analysis was determined to be a European gypsy moth. Delimitation trapping will be conducted around the positive catch location in 2011: Longmont N 40.10427 W -105.06407.

Pine Commodity-Based Survey

Project Coordinator: John Kaltenbach (CDA)

Objective

The objective of this project was to conduct an early detection trapping survey of non-native bark beetles and conifer infesting moths in sprawling rural forest communities of Colorado.

Target Pests

- Pine shoot beetle (*Tomicus destruens*) Ranked #5 on AHP List 2010

- Siberian silk moth (*Dendrolimus superans sibiricus*) Ranked #6 on AHP List 2010
- Pine-tree lappet (*Dendrolimus pini*) Ranked #20 on AHP List 2010
- Rosy (Pink) Gypsy Moth (Lymantria mathura) Ranked #14 on AHP List 2010
- Small white-marmorated longhorned beetle (*Monochamus sutor*) Ranked #23 on AHP List 2010
- Sakhalin pine sawyer (*Monochamus saltuarius*) Ranked #35 on AHP List 2010
- Red-haired pine bark beetle (*Hylurgus ligniperda*) CAPS Priority Pest List 2010
- Lesser spruce shoot beetle (*Hylurgops palliates*) CAPS Priority Pest List 2010

Target Areas

Traps were placed in four mountain communities in Colorado; Conifer, Evergreen, Woodland Park, and Estes Park.

Summary

Beginning in May, 6 Lindgren funnel traps baited with alpha-pinene and ethanol were placed in each town for the Pine Shoot beetle, Red-haired pine bark beetle, Lesser spruce shoot beetle and Sakhalin pine sawyer. Two Lindgren funnel traps were placed in each town baited with lure for Sirex wood wasp. Thirty traps were placed in each town for Rosy Gypsy moth and 10 traps were placed in each town for Siberian Silk moth. Lure for the Pine tree lappet was not available so it was not trapped. Traps were check every two weeks through October. Collections were taken from the Lindgren traps every two weeks and the moth traps were checked once a month. The objectives of the survey were accomplished and no target pests were caught (Figure 5a and 5b). Figure 5a and 5b maps show insects: Pine shoot beetle, Siberian silk moth, Rosy Moth, Small white-marmorated longhorned beetle, Sakhalin pine sawyer, Lesser Spruce shoot beetle, and Red-haired pine bark beetle.

Potato Cyst Nematode Survey

Project Coordinator: John Kaltenbach (CDA)

Objective

The objective of this survey was to detect any presence of the Potato Cyst Nematode in the soil of potato fields in Colorado.

Target Pests

- Potato Cyst Nematode (*Globodera pallida*) (2010 Priority Pest List)
- Golden Nematode (*Globodera rostochiensis)*

Target Areas

For the PCN National Survey, the majority of sampling was done in the San Luis Valley where all of the Colorado potato seed production occurs. A few additional acres were sampled in Yuma County in commercial production fields.

Summary

Sampling for the Potato Cyst Nematode (PCN) began in late May and concluded in October, and a total of 3,326 samples were taken. In the San Luis Valley, sampling was performed under contract with Biel Crop Consulting Inc. and Smith Environmental and Engineering. Each of these entities took a total of 1,450 samples for a total of 2,890, one acre per sample. Of this total, 2,530 acres were taken in fields of seed potatoes, and 360 acres of commercial potatoes were sampled. An additional 76 acres of commercial potatoes were sampled in Yuma County by the Colorado Department of Agriculture and Colorado PPQ.

The objective was to sample 3,300 acres, which was exceeded. However, 120 acres were to be sampled in Yuma County but only 76 were taken due to rain. All samples were analyzed and no target pests were found (Figure 6).

Emerald Ash Borer Survey

Project Coordinators: Sky Stephens (CSFS), Lisa Peraino (PPQ), and John Kaltenbach (CDA)

Objective

The objective of this project was to conduct an early detection trapping survey of emerald ash borer in high risk areas of Colorado.

Target Pests

- Emerald ash borer (*Agrilus planipennis*)

Target Areas

High risk areas are defined by having significant concentrations of host trees, nursery stock and firewood, typically urban and recreation areas.

Time line

- Trap deployment: June/July
- Trap maintenance: August
- Trap collection: October

Summary

A total of 100 emerald ash borer prism traps were deployed monitored and collected by Colorado State Forest Service personnel. Traps were deployed throughout the state with focus on Fort Collins, Loveland, and Estes Park. The CDA deployed traps in Colorado Springs and Pueblo and USDA, APHIS, PPQ deployed 84 traps in the Denver metro area. The majority of the traps were set in late May and June, with the remainder set in July. CSFS EAB trap setting is done in conjunction with gypsy moth trap setting. The funding for the gypsy moth survey was delayed by 1 month causing the EAB trapping to be delayed.

Suspect specimens were collected from 9 of the CSFS EAB traps during their maintenance and final collection. The collected specimens (15 individuals) included native Buprestids, metallic wasps and other beetles, but no emerald ash borer.
In addition to the EAB purple prism trap survey, visual surveys were conducted at approximately 3 sites following calls from the public, including one call to the national EAB Hotline.

Visual surveys were also conducted for the predatory wasp *Cerceris fumipennis*. This wasp has been found to predate EAB as well as other buprestids. Using the methods outlined at http://www.cerceris.info/, twenty sites were visited and surveyed for suitable *Cerceris* habitat and presence. There are historical records of Cerceris fumipennis in Colorado, however no wasps were found. Of the 20 sites, 7 had suitable habitat that warrant further visual surveys in 2011.

The overall objectives for the EAB survey were accomplished and no emerald ash borer specimens were identified during 2010 (Figure 7).

Thousand Cankers Black Walnut Survey

Project Coordinator: Whitney Cranshaw (CSU)

Surveys of black walnuts present in eastern Colorado were conducted in summer and early fall 2010 to assess the extent of infection with thousand cankers disease. This survey expanded upon and complemented preliminary surveys of the previous season. During 2010, surveys were particularly focused on determining new communities with positive infections in order to define the borders of thousand cankers disease in eastern Colorado (Figure 8).

Assessments of thousand cankers were done by visual examination of tree canopies for symptoms. During examination black walnut trees were rated using a 0-2 scale:

- 0 - no symptoms of thousand cankers present

- 1 - symptoms of tree problems present (e.g., branch dieback, leaf yellowing), but symptoms not fully consistent with thousand cankers;
- 2 - symptoms present consistent with thousand cankers (e.g., recent wilting, extensive recent crown dieback).

Samples from trees in category 2 were collected, when possible, to make positive confirmation of thousand cankers. Such follow-up confirmations were always conducted if symptoms were noted in communities not previously reported to have thousand cankers disease present. Trees assessed in category 1 are noted for priority follow-up in 2011 survey.

A second survey priority was to locate and map all black walnut trees in communities where thousand cankers tree mortality is in early stages (e.g., Lyons, Canon City, Pueblo, Denver). This information can be used, with survey in subsequent years, to track distribution patterns and rate of tree mortality due to this disease.

2010 Results

Black walnut has been located within 25 of 26 eastern Colorado counties. Of these, 12 counties now have one or more communities with positive infections of thousand cankers disease (Table 2).

Surveys of 2010 confirmed positive infections in two counties where the disease had not previously been known (Pueblo, Fremont). (Note: Trees involved in initial confirmation had been surveyed in 2009 and given a “1" rating.) These were found in the communities of Pueblo and Canon City respectively. (The latter community is among those that have relatively large black walnut plantings, with over 250 trees). In addition two new communities (Lyons, Longmont) were found to have positive infection with thousand cankers in a county previously reported as being positive (Boulder).

Thousand cankers still has not been observed over broad areas of eastern Colorado, including counties closest to eastern neighbor states (Kansas, Nebraska). No new communities were noted with infections among the counties that currently comprise the eastern edge of the

disease within Colorado (Crowley, Otero). Furthermore thousand cankers disease has not been found within many of the larger communities in northeastern Colorado (Fort Collins, Fort Morgan, Greeley, Loveland, Sterling).

Plum Pox Virus Survey

Project Coordinator: Dr. Ramesh Pokharel (CSU)

Objective

The primary objective of this project is to survey for Plum Pox Virus in the major production areas. This survey will complement the work being conducted in other states in support of a National Plum Pox Survey. The target pest is listed as a PPQ Domestic Program Additional Pests of Concern for Fiscal Year 2010.

Target Pests

- Plum Pox Virus (PPV)

Target Areas

The survey was conducted in the stone fruit growing area of Colorado on the west slope, in Mesa, Delta and Montrose counties to rule out the presence of PPV in Colorado (Figure 9).

Summary

Leaf samples from peach, plum, nectarine and plum were collected from 33 different fruit orchards during the 2010 growing season using a hierarchical sampling method for PPV. The samples were tested in Plant Diagnostic Laboratory of Colorado State University by double antibody sandwich ELISA method. All the samples tested were negative to PPV during the test, indicating the absence of PPV in Colorado.

Surveys for PPV in orchards adopted a hierarchical sampling method. This involves collecting 8 leaf samples from each of 25 percent of the trees in an orchard. Trees to be sampled were selected in groups of 4, with 32 leaves that are collected from the four trees being ELISA

tested as four 8 leaf samples. These leaves from each orchard were lumped together during the survey to save time during the survey to catch up the time period less than 95° F as per weather forecast. However, the total number of samples to be collected was determined by the following formula: Number of trees per acre x number of acres of in the orchard divided by 4.

In addition, additional leaf samples were included from abnormal trees or twigs in each orchard. The orchard selection was random as well as growers' quick response and willingness to participate in PPV survey. However, the survey tried to cover wide stone fruit growing areas in Mesa, Delta and Montrose Countries of Western Colorado (Table 1) which are the most stone fruit growing areas in Colorado. Since no stone fruit breeding program and or stone fruit grafting nursery business are present in the state, the survey focused grower fields covering most of the stone fruit growing areas in Colorado. For PPV survey, two summer helps were hired and trained to collect the samples. The survey work was supervised by Dr. Ramesh Pokharel, Fruit Pathologist and Nematologist. The survey was conducted before daily temperatures exceed 95 degrees F as virus titer in leaves declines significantly and samples from infected trees would be likely produce false negative results.

The leaf samples were collected in an ice cooler and upon arrival to research center they were stored in a walking cooler maintain at 4^{o} C until they were shipped. All together 33 fruit orchards of plum, peach, nectarine and apricot were sampled for PPV detection. One orchard consisted of 15-20 samples based on orchard size. These samples were shipped to Plant Diagnostic Lab of Colorado State University at Fort Collins by overnight mail where the samples were tested for PPV by double sandwich antibody ELISA test.
In laboratory, 32 random leaf samples were selected to make a sub-sample and 15-20 sub-samples from each survey samples were tested by tested double sandwich antibody ELISA method comparing a positive PPV control supplied by APHIS. All samples with ELISA tests turned to be negative to PPV. This survey results indicated that these orchards are free from PPV. However, more extensive surveys will be needed in future to make sure that PPV is not present in Colorado fruits, and we have proposed to continue the survey work in 2011 growing season also.

Biological Control

Monitoring Diorhabda elongata releases in Colorado.

Project Coordinator: Dr. Andrew Norton (CSU)

Summary: This document reports on the results from the *Diorhabda* monitoring protocols implemented at Dinosaur National Monument, Horsethief Canyon, and Adams County, Bonny Reservoir, Phillips Ranch and Green Ranch from 2006 – 2010. As of the end of 2010, 4 of 6 releases have established. Although in previous years we had evidence of reproduction following release at the remaining 2 sites, east of the Continental Divide these populations have gone extinct.

In 2009, *Diorhabda* were released by private citizens on the Phillips Ranch and Green Ranch in Fremont County. These releases were not funded by CAPS, APHIS or State funds. However, we agreed to monitor their impact, beginning in 2010.

Diorhabda carinulata population densities and spread following release.

We visited release sites at Bonny Reservoir, Dinosaur National Monument and Horsethief Canyon throughout the summer to measure *Diorhabda* abundance and tree health. We were able to make all planned site visits to all sites.

At both Dinosaur and Horsethief Canyon, beetle populations have expanded dramatically since the first releases in 2006. 2 years of extensive defoliation have resulted in smaller *Tamarix* at both sites. At these older release sites *Diorhabda* populations were greater in 2010 than in 2009, but produced similar levels of defoliation. At both Dinosaur and Horsethief, peak *Diorhabda* densities reached nearly 200 individuals per tree by the beginning of July. This resulted in defoliation levels of 60 – 72% by the beginning of August (Figure 10a, 10b).

At the Fremont County sites, *Diorhabda* was abundant in 2010, the second year after release. Peak densities of the beetle occurred in the first or second weeks of August, later in the season than for the West Slope sites. Peak densities for a timed visual survey reached nearly 17 and 70 insects per tree at the Green Ranch and Phillips Ranch sites, respectively. These values are similar to the densities seen in 2007 at the west slope sites 1 year after release (Figure 11)

Diorhabda feeding resulted in some defoliation on the last sample date of the season. Approximately 25% and 40% of the foliage was either missing or dying at the Green Ranch and Phillips Ranch sites respectively. There was greater defoliation at Phillips Ranch, where there were also more *Diorhabda*. However, it should be noted that this late in the season it is difficult to determine if foliage is missing because of feeding damage or because the tree is beginning to senesce.

No *Diorhabda* were found at either Bonny Reservoir site in 2009 or 2010 (Figure 12). We did not re-visit the Adams County site as the county had decided to discontinue their partnership and bulldoze the site at the end of 2008.

Monitor the effects of *Diorhabda* on vegetation, including effects on saltcedar and on proximate native vegetation.

For 4 years in a row there have been substantial populations of *Diorhabda* at both the West Slope sites. When compared to 3 years ago, the average size (measured as height * max. width * width perpendicular to max.) tree size has declined by an almost 60% at Dinosaur and by 36% at Horsethief (Figure 13). One of the trees at Dinosaur and one at Horsethief are apparently dead at this point. In 2010 trees continued to decrease in size at Dinosaur, but were slightly larger at Horsethief.

Over the same period three trees at the initial Bonny Reservoir release (Bonny #1) increased in size by 65%. Over the two years we have been sampling Bonny Reservoir #2, trees have increased by 27% on average.

Surrounding plant community:

Once each year in June we have quantified the plant community structure underneath 2, 1 x 1 m^2 plots under each marked tree. In 2010 percent cover increased and species richness decreased at both West Slope sites (Figure 14). However, percent cover of native species appears to be responding in the same manner and rate as for exotic species. These data indicate that so far there is no evidence that exotic, weedy vegetation is responding to the additional light and water available post- *Diorhabda* defoliation by excluding native species. So far at least, concerns that other noxious species will replace *Tamarix* if *Diorhabda* reduces the density of this species appear to be unfounded. However, it is still early in the process and as *Diorhabda* continues to reduce *Tamarix* tree size other weedy vegetation could take advantage of this space.

Arthropod communities on Populus, Salix and Tamarix:

In 2008 we began comparing the arthropod community of tamarisk with that of two other co-dominant riparian tree species, coyote willow (*Salix exigua*) and cottonwood (*Populus deltoides*). Arthropods are important food sources in terrestrial food webs, and understanding what influences patterns of diversity and abundance of these species is essential for developing informed management practices in natural systems. Of particular importance is determining what impact non-native species such as tamarisk have on arthropod abundance and diversity, and what impact control strategies for tamarisk (such as biological control) have on food web structure. Between 2008 and 2010 we counted and identified the arthropods from tamarisk, willow and cottonwood trees located at 4 *Diorhabda* release sites in Colorado. Every two weeks throughout the growing season we collected the arthropods from 400 cm of foliage (= 1 sample) from each of 10 individual trees of each species at each site. To date we have categorized 11,089 individual arthropods representing 333 species.

A) Patterns of abundance: On average we `found more arthropods per sample on tamarisk (9.9) than on willow (2.6) or cottonwood (1.4). This was also true when examining only plant-

feeding species (average per sample = 9.2, 2.0 and 1.1 for tamarisk, willow and cottonwood, respectively). However, the majority of the difference in herbivore abundance per sample between tamarisk and the other tree species is due to high densities of two arthropod species found only on tamarisk: The biological control agent *Diorhabda carinulata* and the exotic tamarisk specialist *Opsius stactogalus*. Over all sites, 32% of all herbivore individuals found on tamarisk were *Diorhabda* and 54% were *Opsius*. If these two non-native herbivore species are removed from the analysis, willow holds more herbivore individuals per sample on average (2.1) than cottonwood (0.9) or tamarisk (0.6). The number of predatory individuals was greatest on tamarisk (0.5 per sample) followed by willow (0.4 per sample) and cottonwood (0.2 per sample). These differences in predator numbers are dwarfed by the differences in herbivores, above. The abundance of omnivorous species was greatest on willow (0.19 individuals per sample), followed by tamarisk (0.13) and cottonwood (0.09). The average number of species recorded per site per tree species per year is greatest on willow (38.0). Tamarisk averaged 33.6 species and cottonwood averaged 21.3 species. Taken together, these data show that the non-native tamarisk holds fewer species of arthropods than the native willow but more than native cottonwood. However, due to the presence of two introduced species tamarisk now holds a much greater overall abundance of arthropods than either native tree.

B) Patterns in diversity: Over all sites and years, we found more species on willow (211) than on cottonwood (126) or tamarisk (182). The average number of species recorded per site per tree species per year is greatest on willow (38.0). Tamarisk averaged 33.6 species and cottonwood averaged 21.3 species. That the average number of species per site year is much lower than the total number of species found over all sites and years indicates that there is significant variation between sites and years in arthropod community composition. This same pattern of greater diversity on willow, followed by tamarisk and the cottonwood is seen examining only herbivore species (22.7 species per site per year on willow, 16.0 on tamarisk, 12.6 on cottonwood). However, when examining predatory species, tamarisk holds more species on average (15.0) than willow (12.2) or cottonwood (6.7). The greater predator richness on tamarisk than the other two tree species is likely being driven by the abundance of the two non-native herbivores.

Weed Survey and Biocontrol, 2010

Project Coordinator: Dan Bean (CDA)

Tamarisk biocontrol monitoring

In 2010 our USDA APHIS CAPS funded work on tamarisk biocontrol was restricted to mapping and monitoring of previously released beetles. We continued to map beetle presence in western Colorado as part of a larger Colorado basin project in cooperation with the Tamarisk Coalition. Beetles were found in all western Colorado drainages that have tamarisk. The Dolores River drainage was completely colonized and defoliated by beetles (see Figure 15) and beetles are well established on the Colorado, Gunnison, Green, Yampa and Mancos Rivers. Defoliation was recorded at all of our monitoring sites (Figure 16) except the Gunnison and Salt Creek 3. It remains mysterious why those sites consistently lack major defoliation episodes. At our highest elevation site (Williams, in Hayes gulch near Parachute) we saw limited defoliation and over half of our monitored plants escaped beetle damage in 2010.

Mortality was recorded at six of our sites this year (Figure 17). At all sites showing mortality beetles had defoliated plants at least three times. Two sites showed high mortality; the Knowles Canyon site, which we discuss below, and the Flume Canyon site. At Flume beetles have defoliated the plants four times. Plants appear to be water stressed since the site lacks year-round running water and we don't know the depth or extent of groundwater there. At the Stan Young (SY) sites beetles have been defoliating since 2008 and plants showed significant die back in 2010 although mortality was low the apparent impact of beetles was high (Figure 18) with most plants showing substantial loss of green biomass and large numbers of dead branches. On the Dolores River beetles have been hitting plants at the Gateway monitoring site for three years yet no mortality has been recorded. This site has year around water and plants appear to be very healthy. The Salt Creek #3 site is in the midst of dense beetle populations yet it has not experienced the periodic defoliations that nearby sites have.

The Knowles Canyon site was particularly interesting since tamarisk plants in the presence of beetles have not recovered from fire (Figure 19). The fires burned through the monitoring site early in 2007 and large numbers of beetles entered the site late in 2007. During 2008-2010

beetles defoliated the resprouting tamarisk at least 4 times which prevented the complete recovery of tamarisk usually seen at burned sites. Instead plants either ceased resprouting (which we classified as mortality) or they continue to attempt to send up green shoots from the base of the plants, only to have them defoliated by beetles (Figure 20). None of the 25 marked trees has recovered the green volume initially measured in 2006. Beetles have also defoliated tamarisk plants that are in the willow banks near the river (Figure 21). This shows that they can locate trees in the midst of dense stands of native vegetation and that they will decrease the competitive ability of tamarisk.

We have developed a method of holding *D. carinulata* for extended times in the state of diapause. We have tested various treatments for inducing cold hardiness in beetles and have successfully held beetles for 10 months at -5° C and have been able to reestablish cultures from survivors of this treatment (30-50% survival after 10 months). The method includes a step down in temperature, holding beetles at a short day photoperiod and keeping relative humidity high.

Yellow Toadflax

The stem boring weevil *Mecinus janthinus* had previously been released in large numbers on yellow toadflax at a number of sites in western Colorado with no establishment so we discontinued attempts to establish it on yellow toadflax. In 2009 we received *M janthinus* from cooperators in Montana who had collected them from yellow toadflax where they have been recently found well established and apparently thriving. Our release resulted in oviposition on yellow toadflax in the summer of 2009 and **successful overwintering on yellow** and the appearance of adults at our Oakridge field site, near the White River, in the spring of 2010. Adults could be found on yellow for two months after spring emergence. The field site, which is near the White River, was heavily grazed during the field season and grazing appeared to damage many of the plants that could have hosted the next generation of *M janthinus*. We will continue to monitor the site in 2011 but due to the issue of periodic grazing we will not do further releases of yellow toadflax adapted beetles at that site.

We received approximately 800 adult beetles collected from yellow toadflax in the spring of 2010. We released them at three additional sites; one near Minturn, CO and two sites above the White River, on National Forest lands on Burro Mountain. At the Burrow mountain site our release cage was stolen and we failed to find the cage or recover beetles. At the other Burro Mountain site we released approximately 200 beetles while they were still within the stems of yellow toadflax, having overwintered from 2009 (Montana collected). The release was made June 17 but the high elevation of the site and the cool spring caused yellow toadflax at the site to be barely above ground at that date. In spite of the apparent mismatch of beetle release and plant phenology we did find oviposition holes in yellow toadflax during a survey in August 26, 2010 and we sacrificed one plant and found a pupa within (Figure 22) which is a good sign that beetles were able to remain in the area after release and oviposit successfully on plants as they came up. We will monitor the site in 2011.

Through the Toadflax Consortium we had received 300 root galling weevils ***Rhinusa linariae*** for release in 2008. Caged releases were made at two sites; one near the town of Paonia (Delta County) and the other near the White River (Oakridge Site). The cage was vandalized at the Paonia site in 2009 and in 2010 we dug up and surveyed four yellow toadflax plants and sweep-sampled all plants at the Oakridge site and failed to find either adult beetles or root galls. We will continue to survey the area since this site is near to our *M. janthinus* release but we won't put the cage up again in 2011.

Dalmatian toadflax

The CDA continued to monitor five *M. janthinus* Dalmatian toadflax release sites in western Colorado. At two of the sites beetle presence and density was monitored while at three of the sites we monitored for beetle presence as well as for impact on Dalmatian toadflax and change in vegetation composition. Beetles continued to spread out from release sites and declines in Dalmatian toadflax were noted at three of the sites.

Russian Knapweed

We received several small shipments of Russian knapweed gall flies from USDA APHIS through Rich Hansen, during the spring and early summer of 2010. The flies had not

established from releases made in 2009 but we believe this is because flies were released on relatively mature plants which did not provide suitable substrate for gall formation (galls are formed on growing bud tips, see Figure 23). We released galls directly into a cage containing growing Russian knapweed and recorded new gall formation. Subsequent releases were made on caged Russian knapweed and a small release (three galls) was made in the open next to the cage. Flies hit plants inside and outside of the cage and we recorded over 150 galls formed in the knapweed garden next to the Insectary. This included 5 galls found 60 meters away from the release area on an isolated patch of Russian knapweed. A few galls were dissected during the season to count individuals within a gall and to get some idea of developmental time and appearance of the immature stages. We found that flies appear to have multiple (2-3) generations in our garden setting. They require new sprouts so we mowed a patch of knapweed midway through the season. As new sprouts were formed they were immediately galled by flies. We also failed to find overwintering flies in galls produced late in the season. This could be reason for concern. We planted a large new patch of Russian knapweed in the fall and will continue to work on indoor rearing of flies.

Leafy Spurge

The CDA monitored 16 leafy spurge sites in Rio Blanco County for beetle density, stem density and vegetation responses to biocontrol. We found good establishment of *Aphthona* beetles at 8 of our sites and at two sites we have seen a significant decline in stem density.

Other Targets and Agents

The Insectary continued to distribute the bindweed gall mite *Aceria malherbae* with approximately 514 releases made in Colorado with assistance provided for many more releases made through county weed managers. At one monitoring site in Ouray County we measured a dramatic decline of field bindweed and a high rate of galling on existing plants. There were also 88 releases of larvae of the bindweed moth, *Tyta luctuosa*. *T. luctuosa* adults were recovered in the Grand Valley for the 6th consecutive season indicating a well-established population.

There were 63 releases of the stem boring weevil, *Mecinus janthinus*, on Dalmatian toadflax and we continued to release of larvae of the moth *Calophasia lunula* with 23 releases made in 2010. There were 83 releases of *Aphthona* spp. made and 3 releases of *Oberea erythrocephala* made from insects collected in the field in Colorado. We made 63 Canada thistle gall flies and 81 releases of puncturevine weevils, *Microlarinus* spp. *Cyphocleonus achates* (92 releases) and *Larinus minutus* (42 releases) were released on spotted and diffuse knapweed in Colorado and at sites in Arkansas in cooperation with the University of Arkansas. We continued to produce *Hylobius transversovittatus* the root boring weevil for use against purple loosestrife. We ship these beetles to cooperators throughout the US and we remain of the few sources for them. We also continued to rear and release *Macrocentrus ancylivorus* for use against the Oriental fruit moth, a major pest of peaches. This past season we reared and released 1.3 million wasps for release in the Grand Valley. We also have a pheromone-based monitoring program for Oriental fruit moth and we continue to find moths in the valley.

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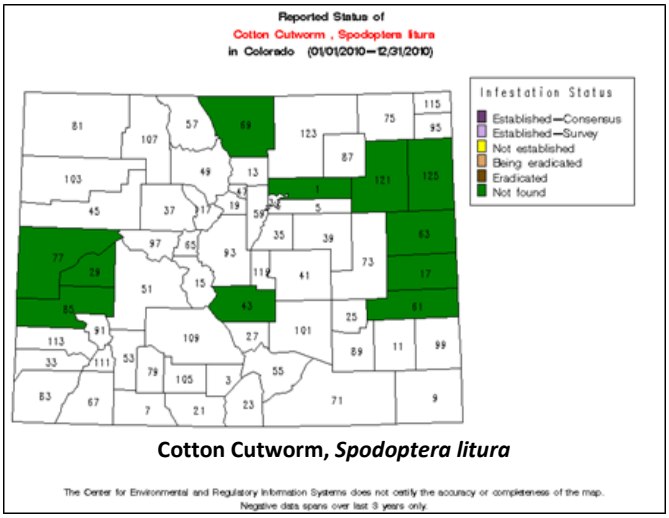
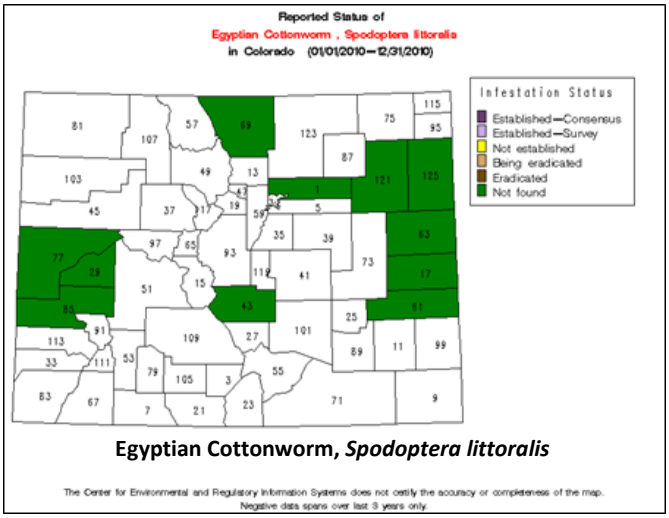
All figures, maps and photos available in higher resolution

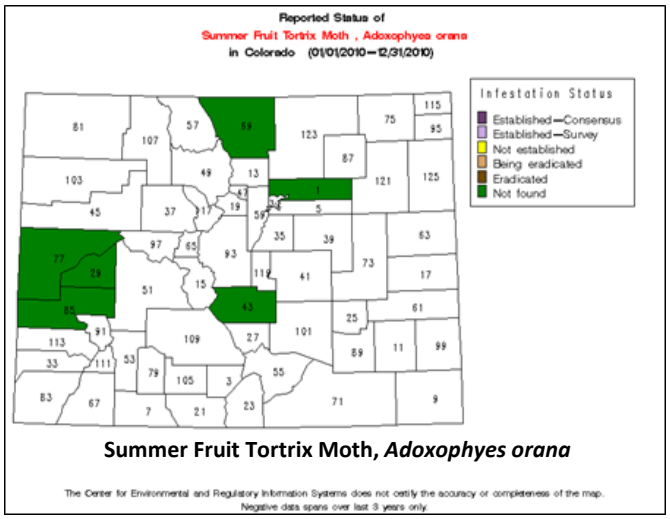
Figure 1a: NAPIS maps showing Colorado counties surveyed during the Lobesia/Grape Commodity-Based Survey in 2010



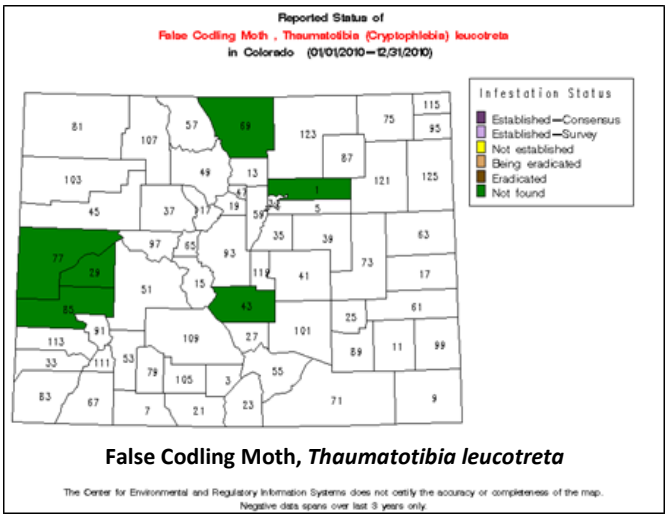
Cotton Cutworm, *Spodoptera litura*



Egyptian Cottonworm, *Spodoptera littoralis*

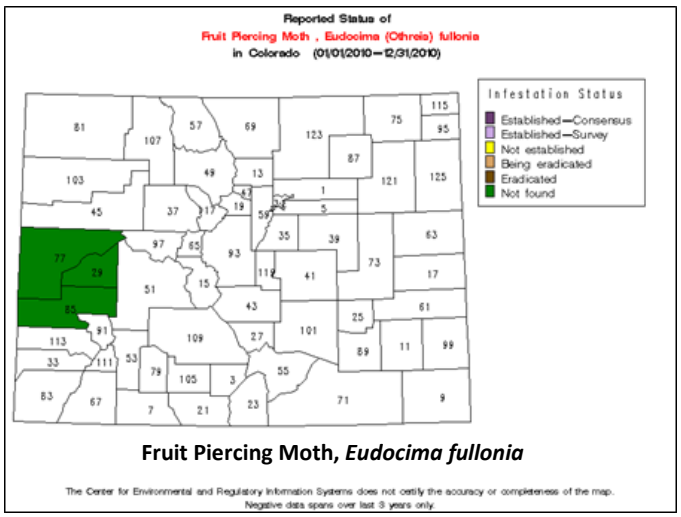


Summer Fruit Tortrix Moth, *Adoxophyes orana*

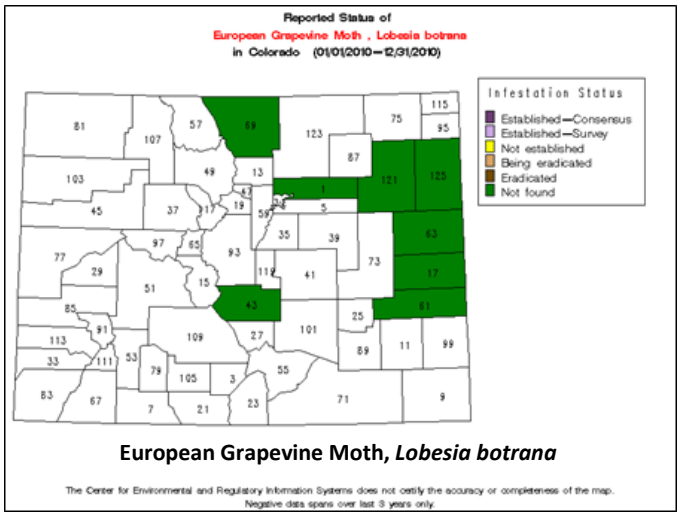


False Codling Moth, *Thaumatotibia leucotreta*

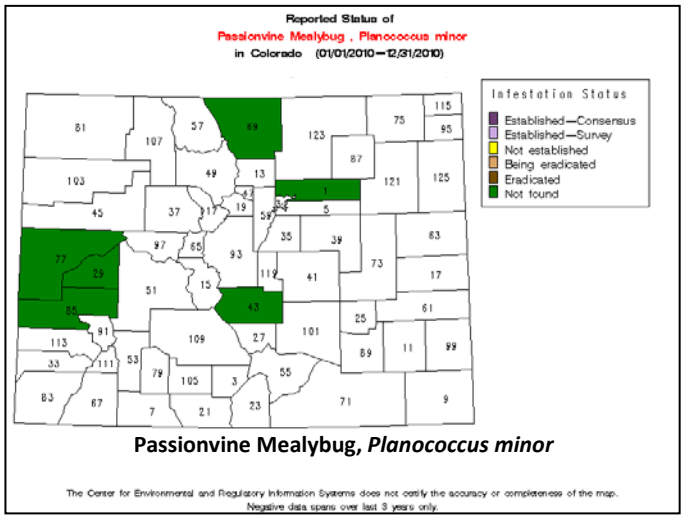
Figure 1b: NAPIS maps showing Colorado counties surveyed during the Lobesia/Grape Commodity-Based Survey in 2010



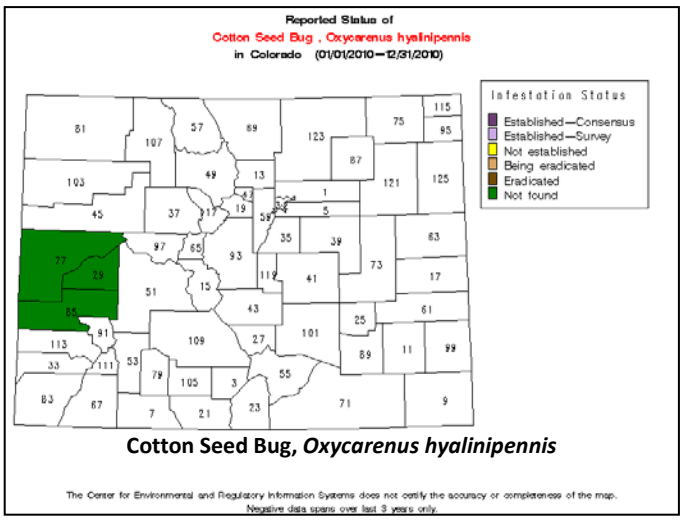
Fruit Piercing Moth, *Eudocima fullonia*



European Grapevine Moth, *Lobesia botrana*

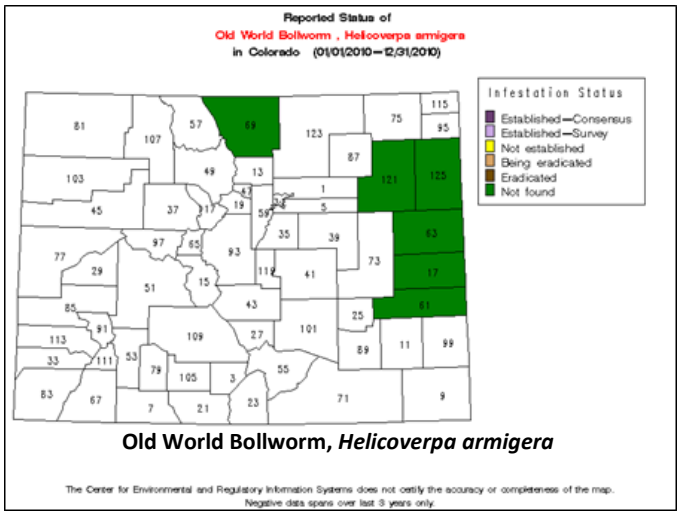


Passionvine Mealybug, *Planococcus minor*

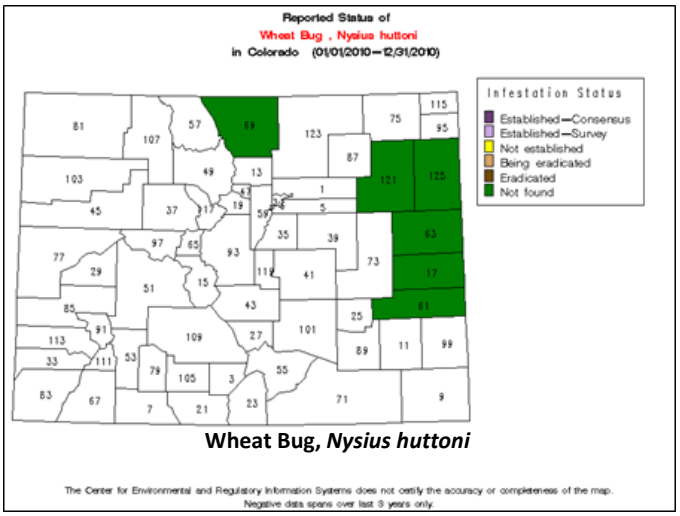


Cotton Seed Bug, *Oxycarenus hyalinipennis*

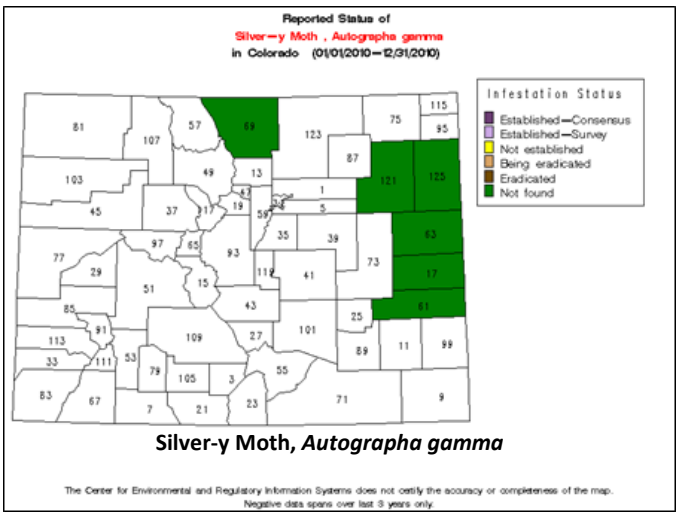
Figure 2: NAPIS maps of Colorado counties surveyed for Small Grains Commodity-Based Survey in 2010



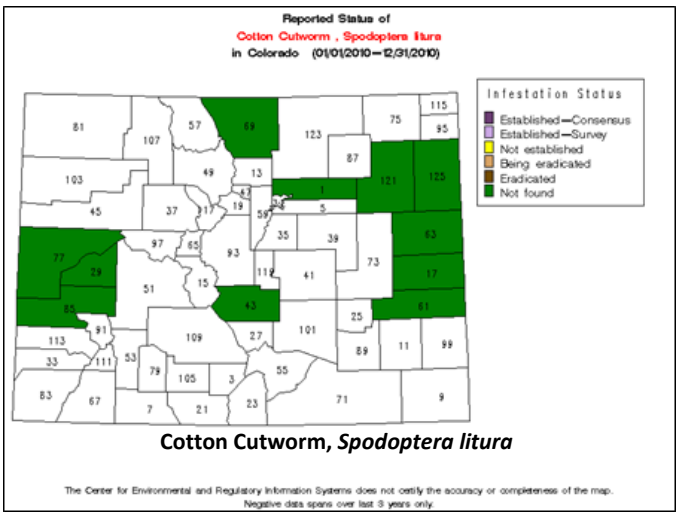
Old World Bollworm, *Helicoverpa armigera*



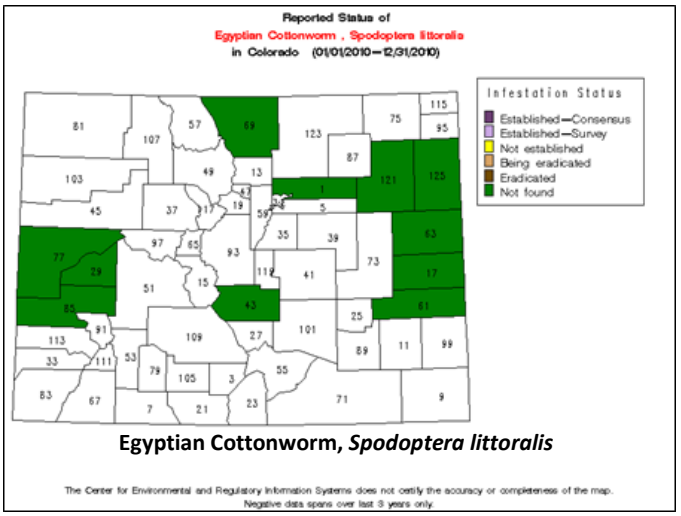
Wheat Bug, *Nysius huttoni*



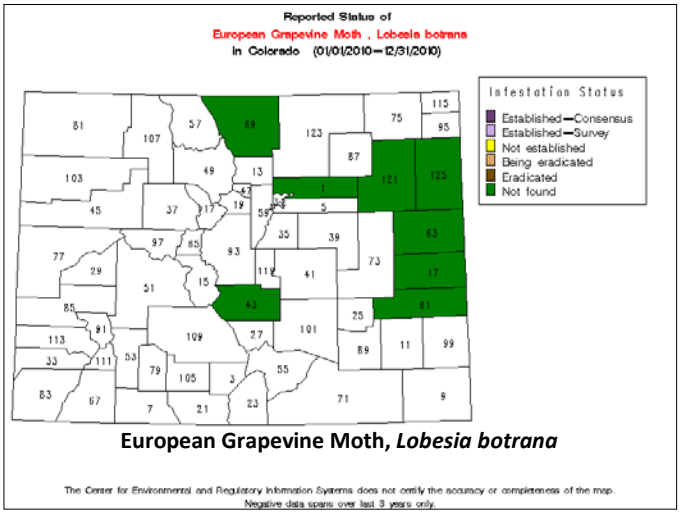
Silver-y Moth, *Autographa gamma*



Cotton Cutworm, *Spodoptera litura*



Egyptian Cottonworm, *Spodoptera littoralis*



European Grapevine Moth, *Lobesia botrana*

Figure 3: NAPIS map of counties surveyed for Karnal Bunt.

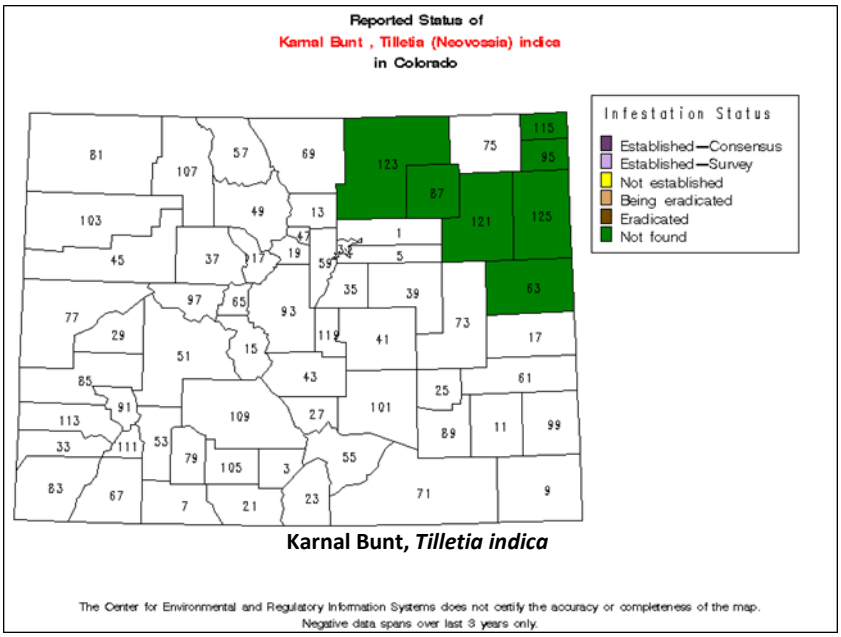
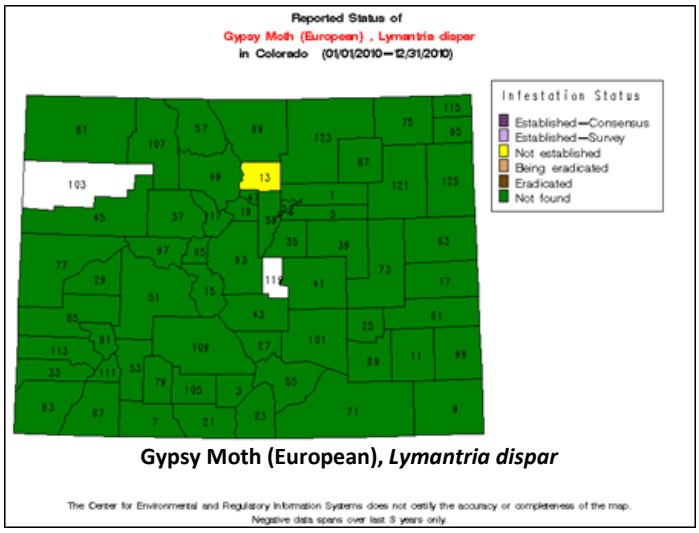


Figure 4: NAPIS maps of European and Asian gypsy moth trapping in Colorado, 2010



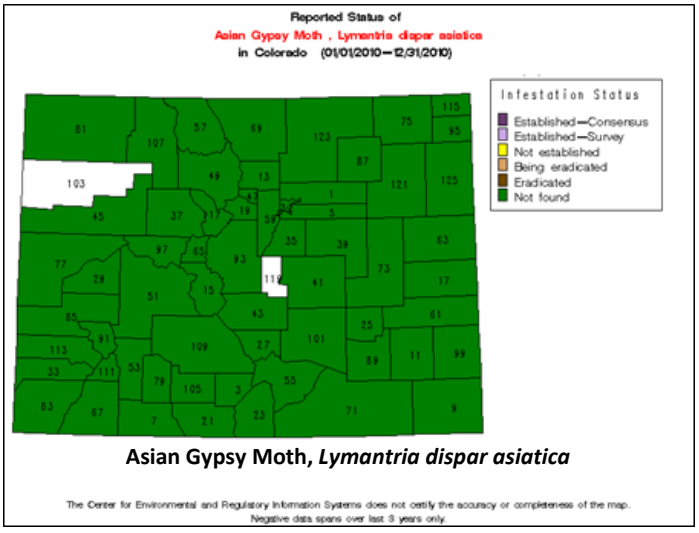


Figure 5a: NAPIS maps of Colorado counties surveyed during the Pine Commodity-Based Survey, 2010

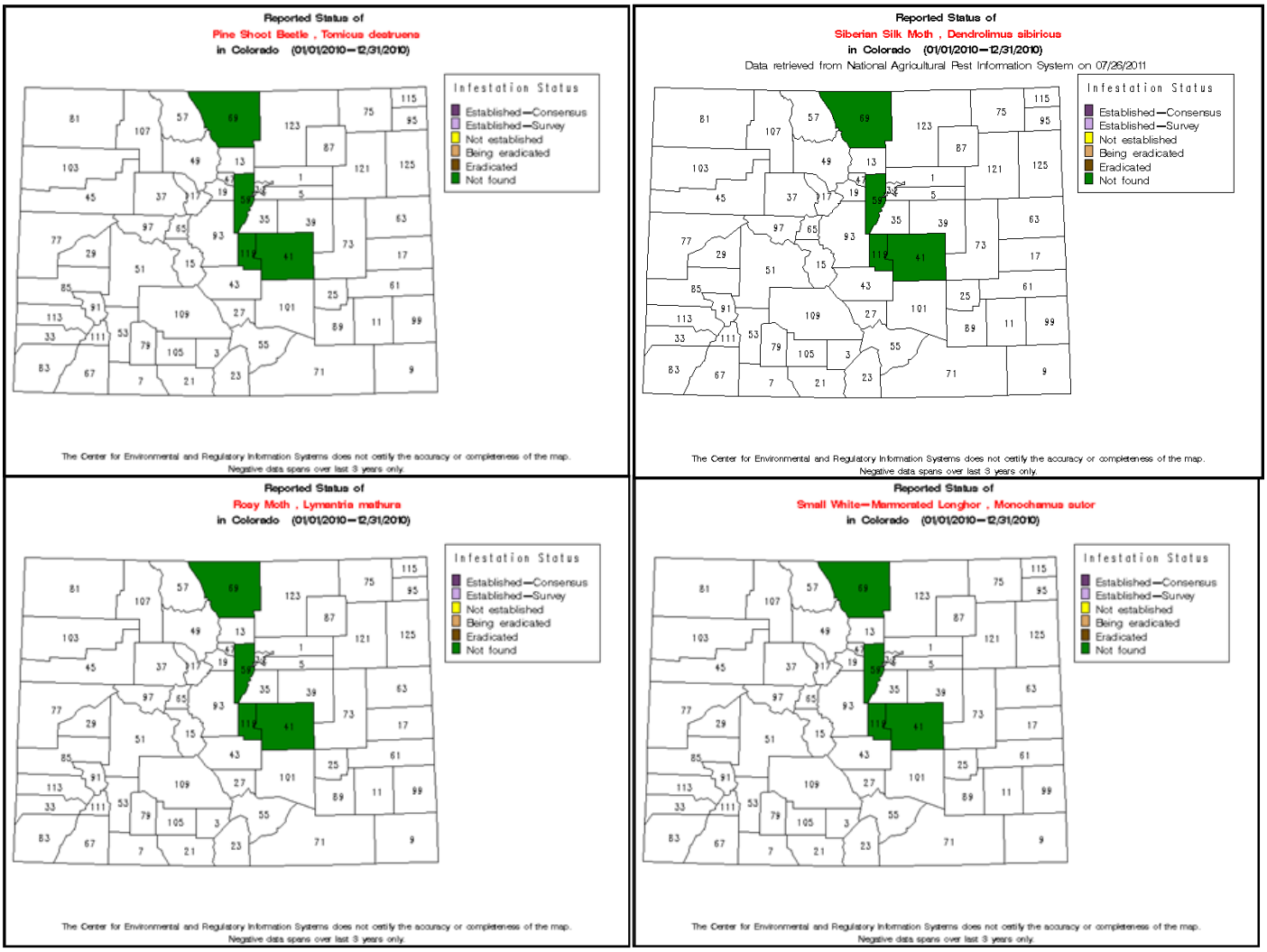
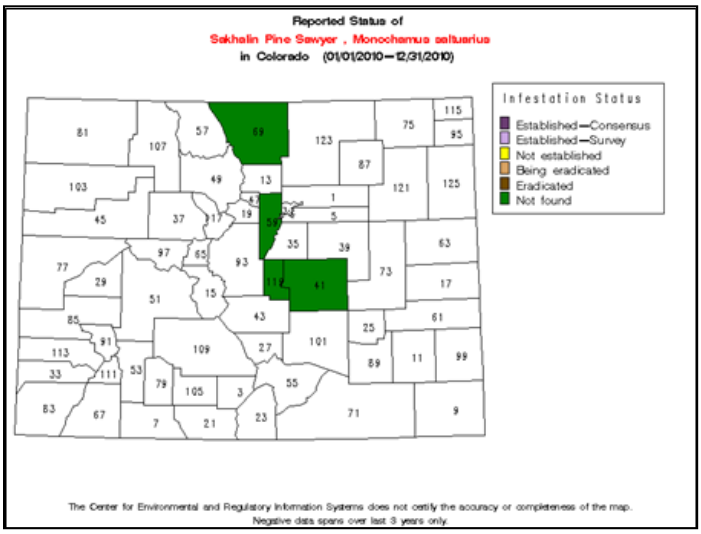
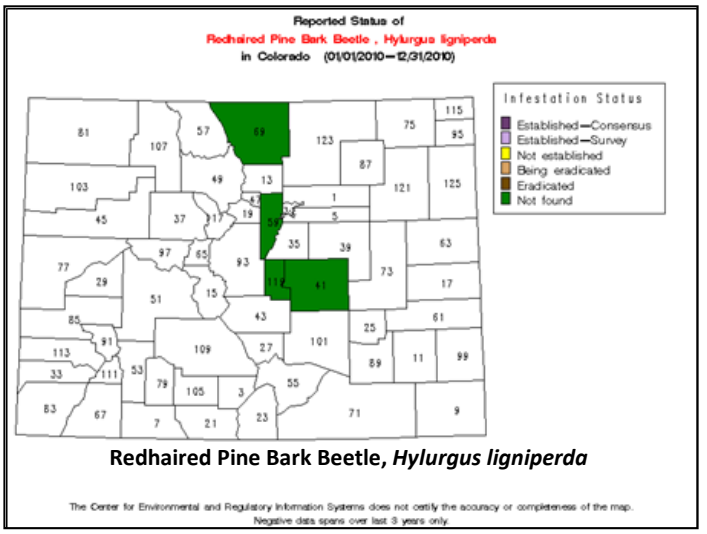
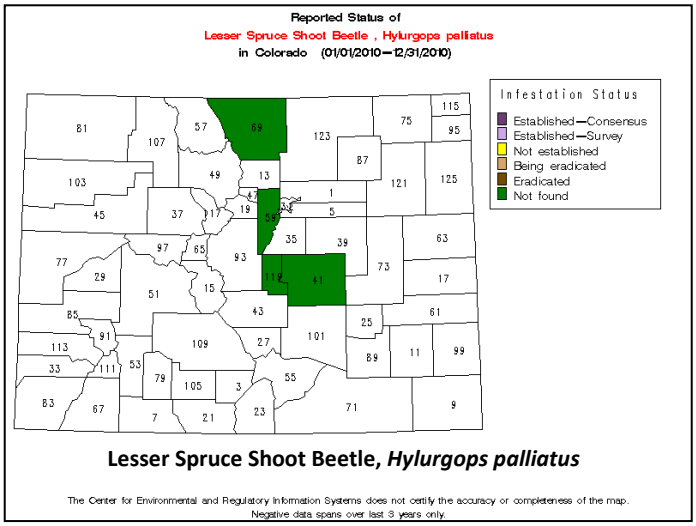


Figure 5b: NAPIS maps of Colorado counties surveyed during the Pine Commodity-Based Survey, 2010



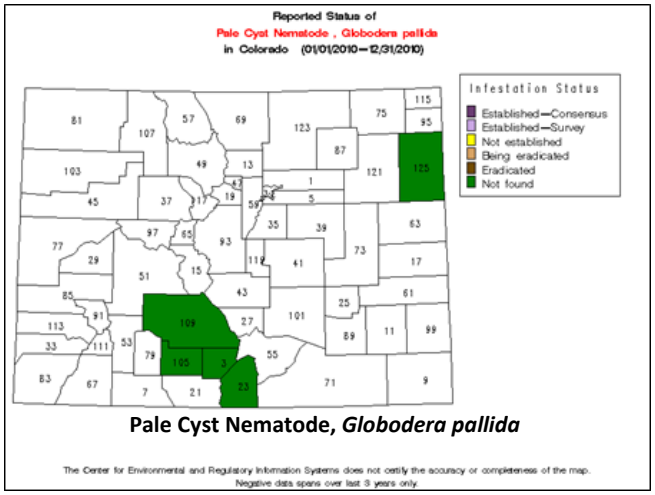


Redhaired Pine Bark Beetle, *Hylurgus ligniperda*



Lesser Spruce Shoot Beetle, *Hylurgops palliatus*

Figure 6: NAPIS maps of Colorado counties surveyed for nematodes during 2010



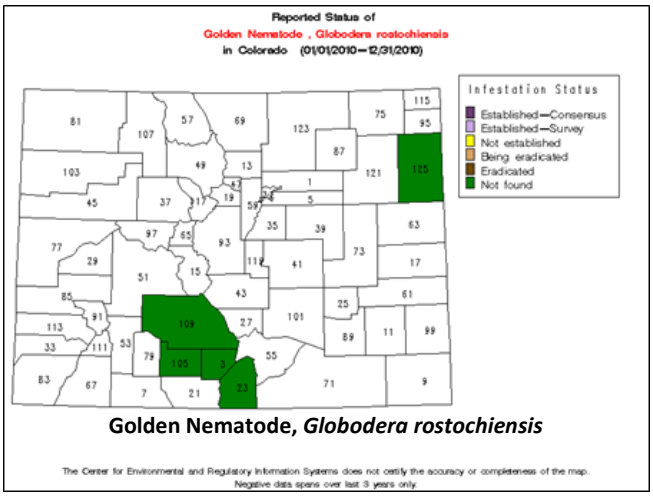


Figure 7: NAPIS map showing Colorado counties surveyed for EAB, 2010

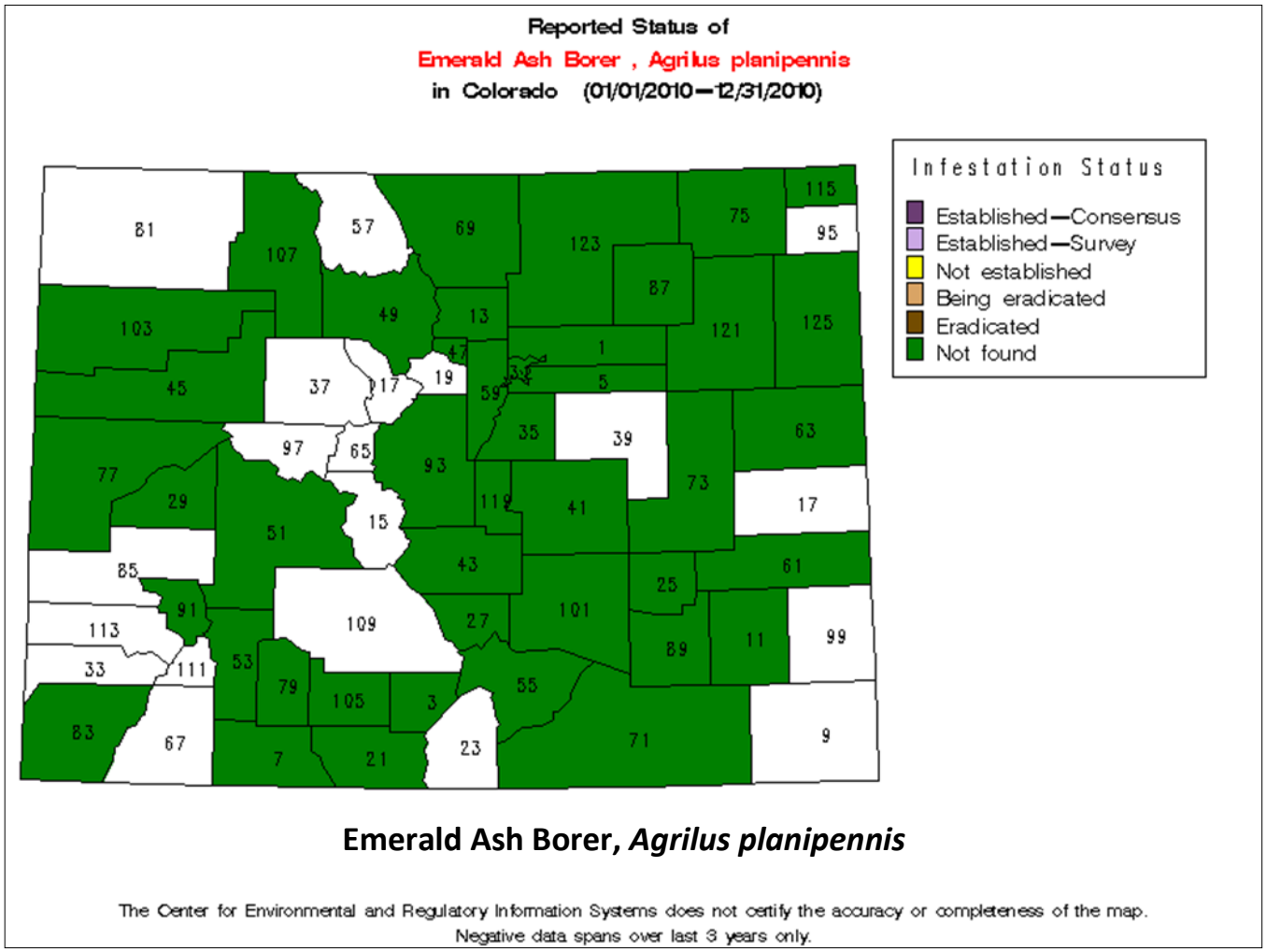


Figure 8: NAPIS map showing Colorado counties surveyed for Thousand Canker Disease in 2010

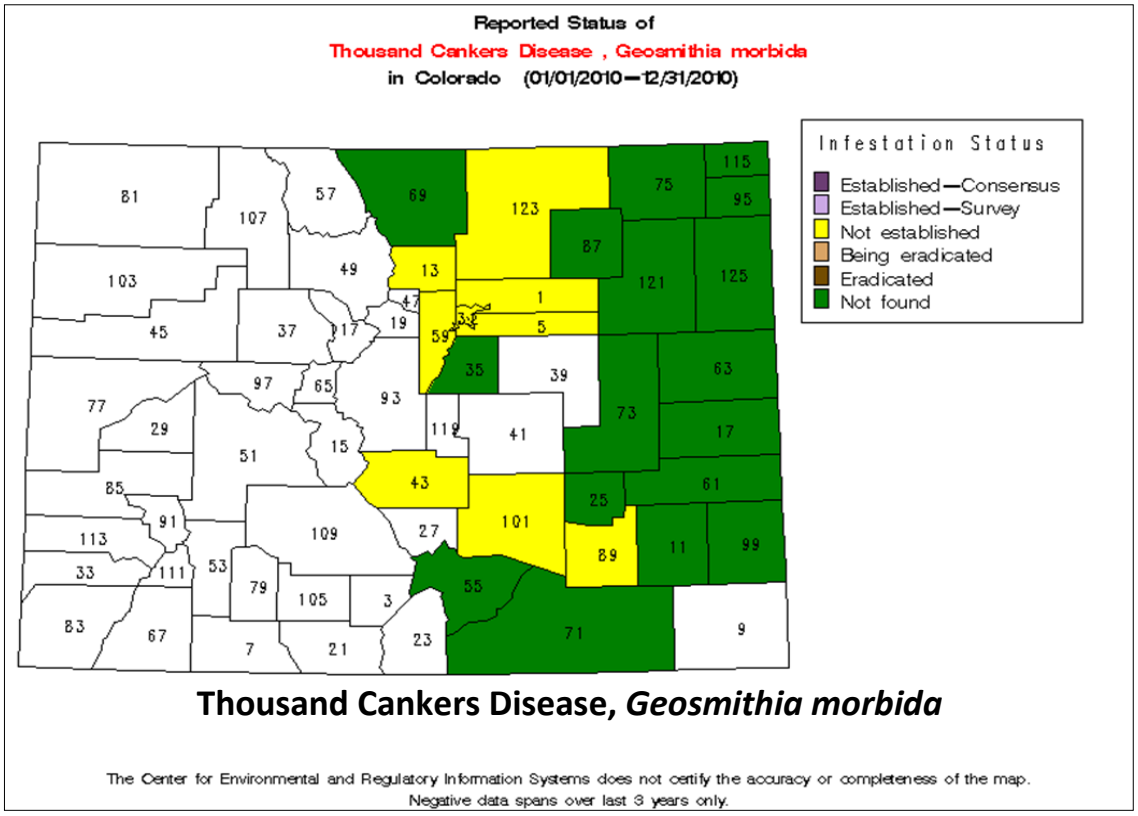


Figure 9: NAPIS map showing Colorado counties surveyed for PPV in 2010

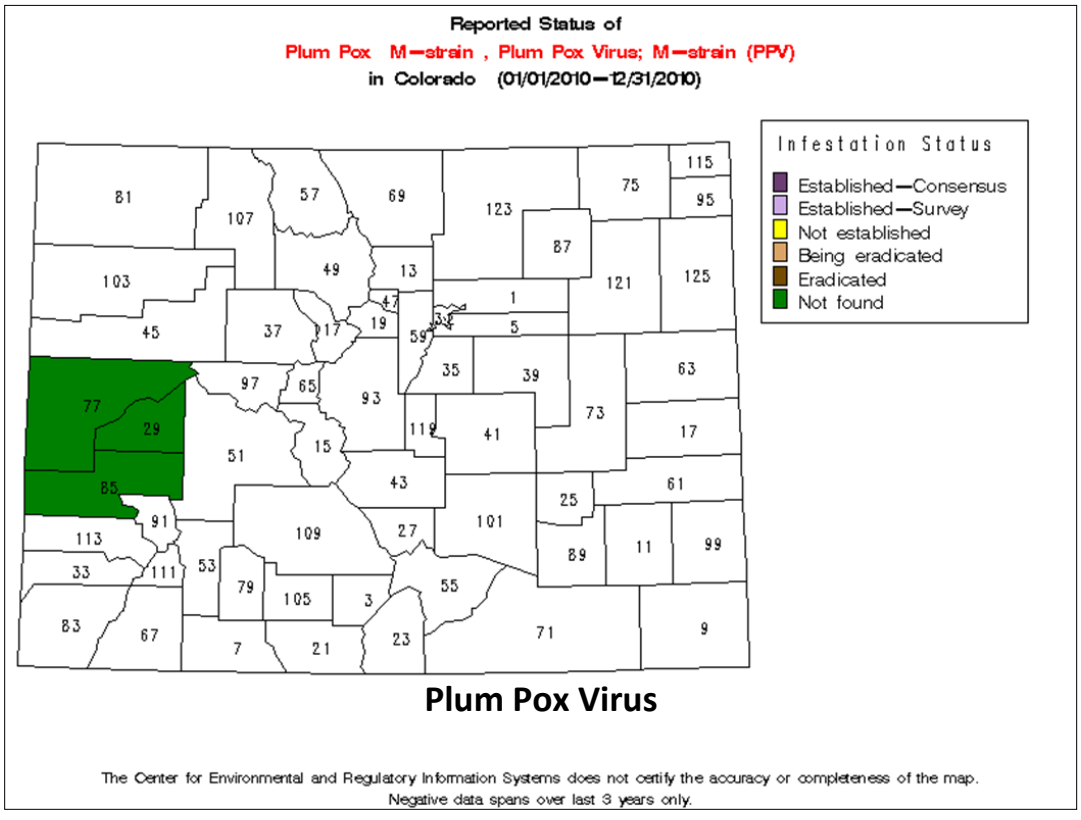


Figure 10a: Tree health (top) and *Diorhabda* abundance (bottom) at Dinosaur National Monument. Light gray shaded portion: dead. Light green: foliage yellowed. Dark green: healthy foliage.

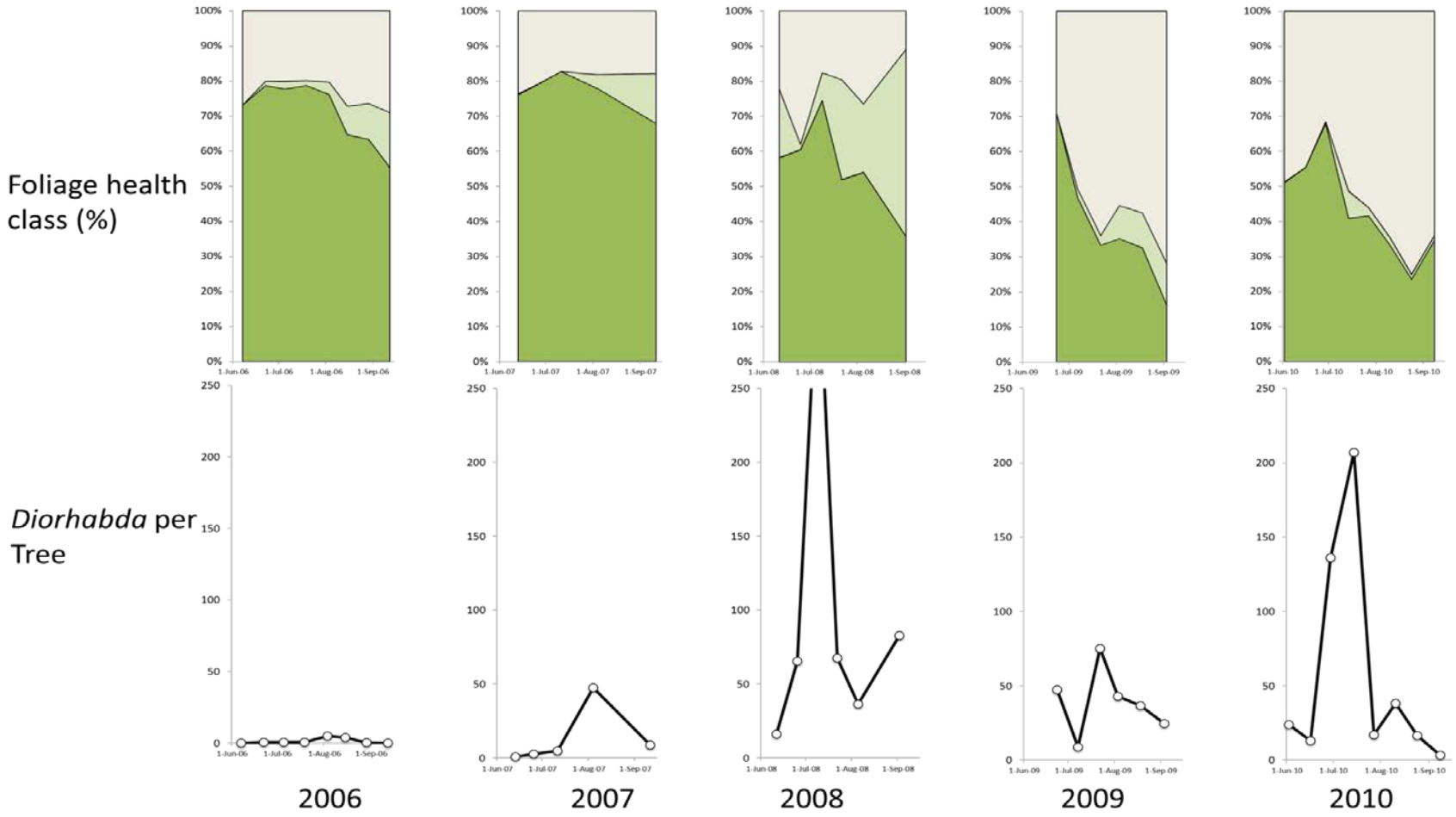


Figure 10b: Tree health (top) and *Diorhabda* abundance (bottom) at Horsethief Canyon. Light gray shaded portion: dead. Light green: foliage yellowed. Dark green: healthy foliage.

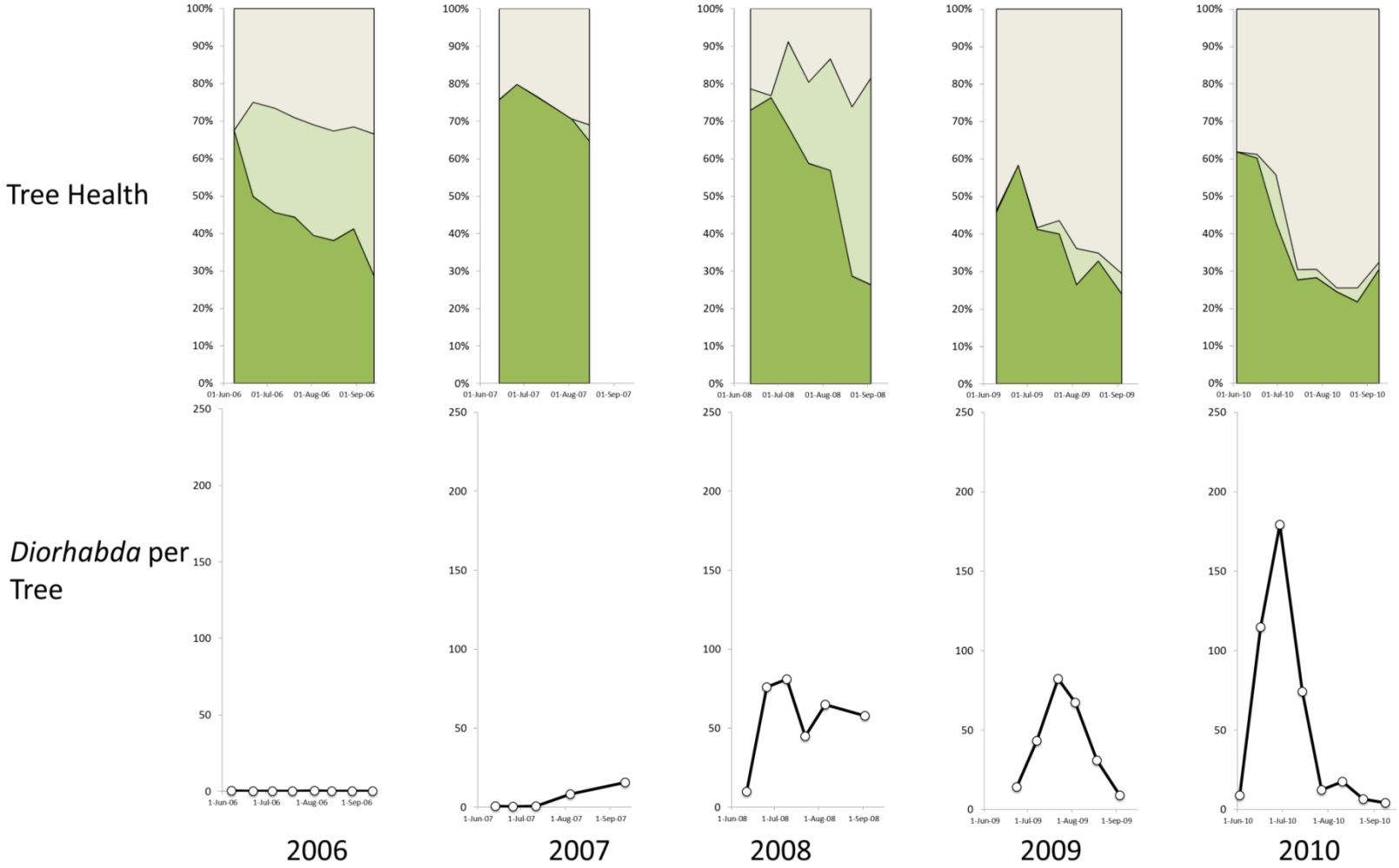


Figure 11: Tree health (top) and *Diorhabda* abundance (bottom) at Green Ranch (left) and Phillips Ranch (right). Light gray shaded portion: dead. Light green: foliage yellowed. Dark green: healthy foliage. *Diorhabda* was released at these sites in May 2009 by private landowners.

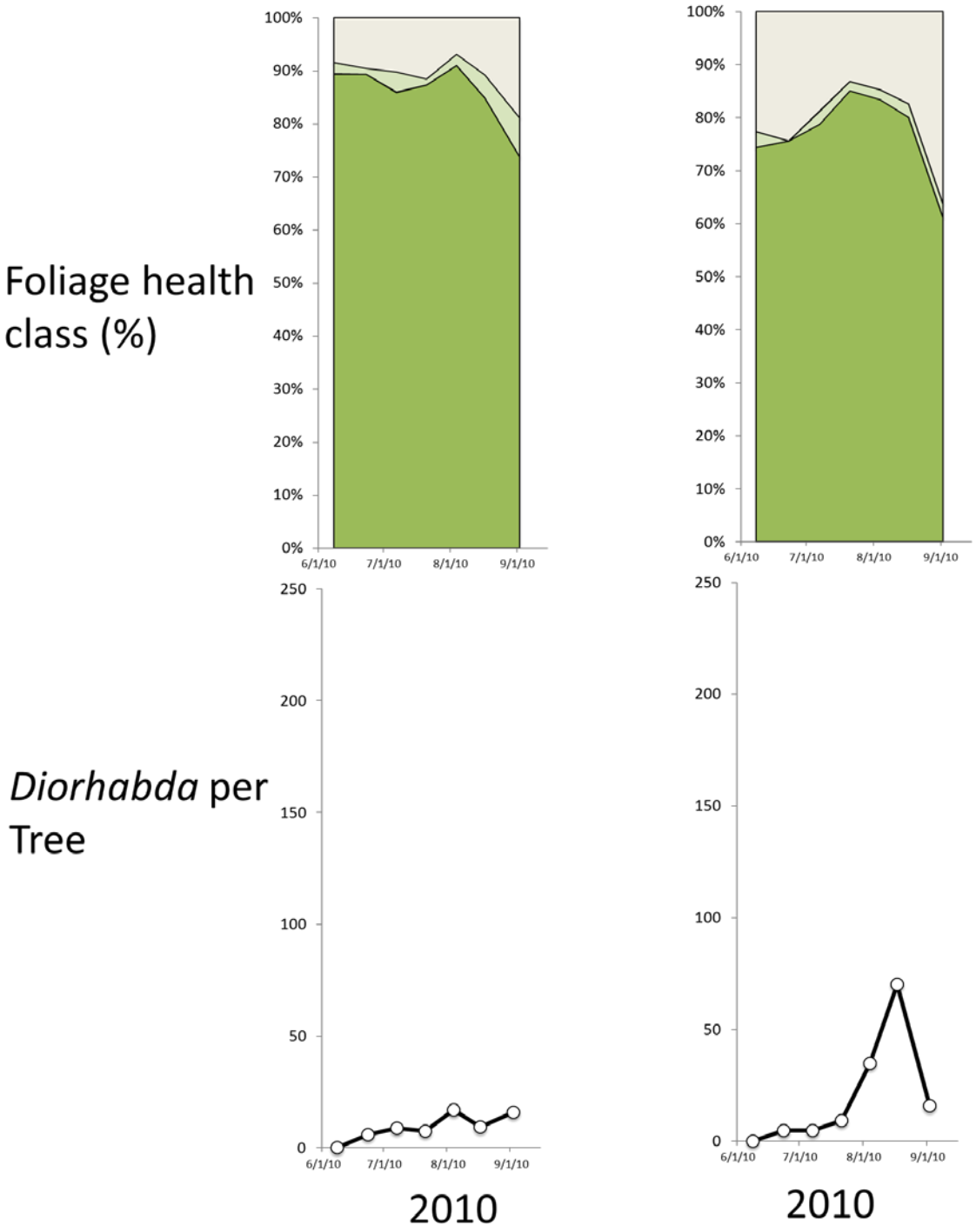


Figure 12: Tree health at Bonny Reservoir # 2. Light gray shaded portion: dead. Light green: foliage yellowed. Dark green: healthy foliage. *Diorhabda* was released at this site in 2008 but did not establish

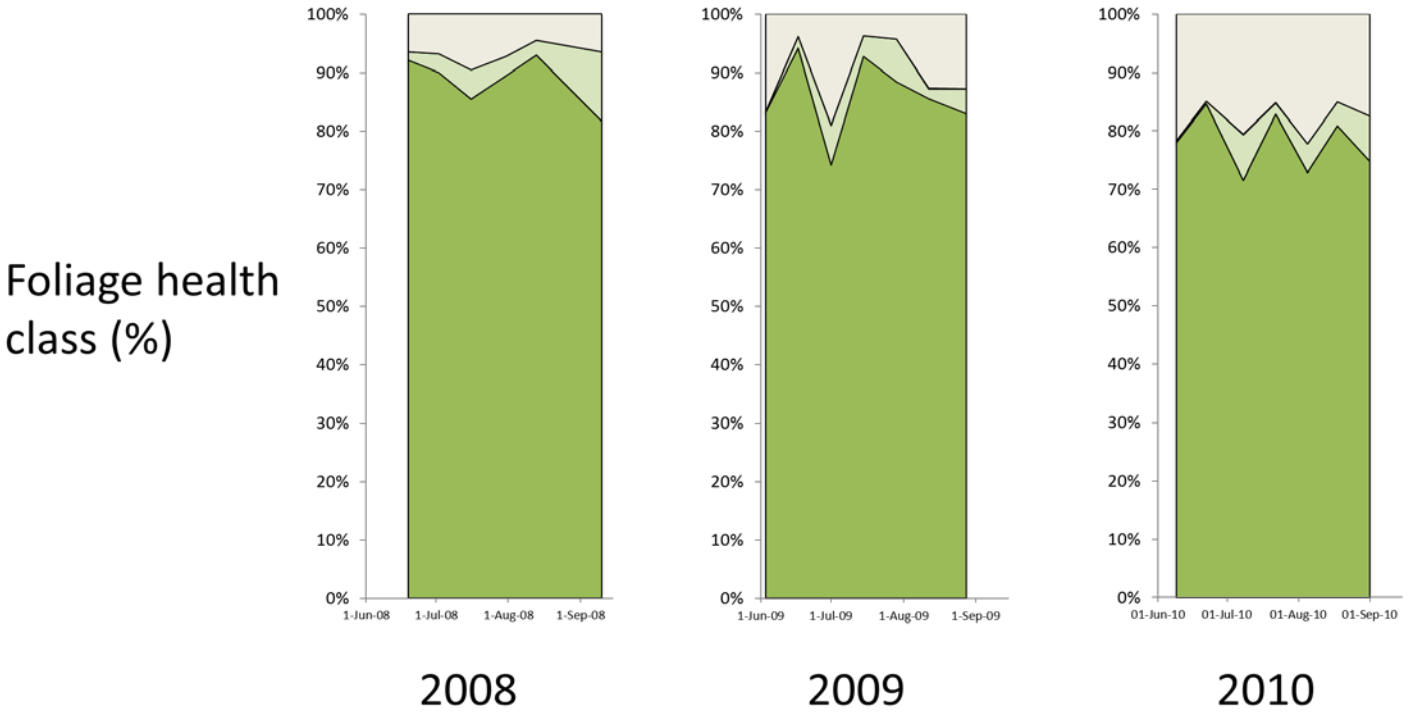


Figure 13: Tree size at 4 *Diorhabda* release sites, 2006 – 2010. *Diorhabda* first established at Dinosaur and Horsethief in 2006. The beetle did not establish at the other two sites.

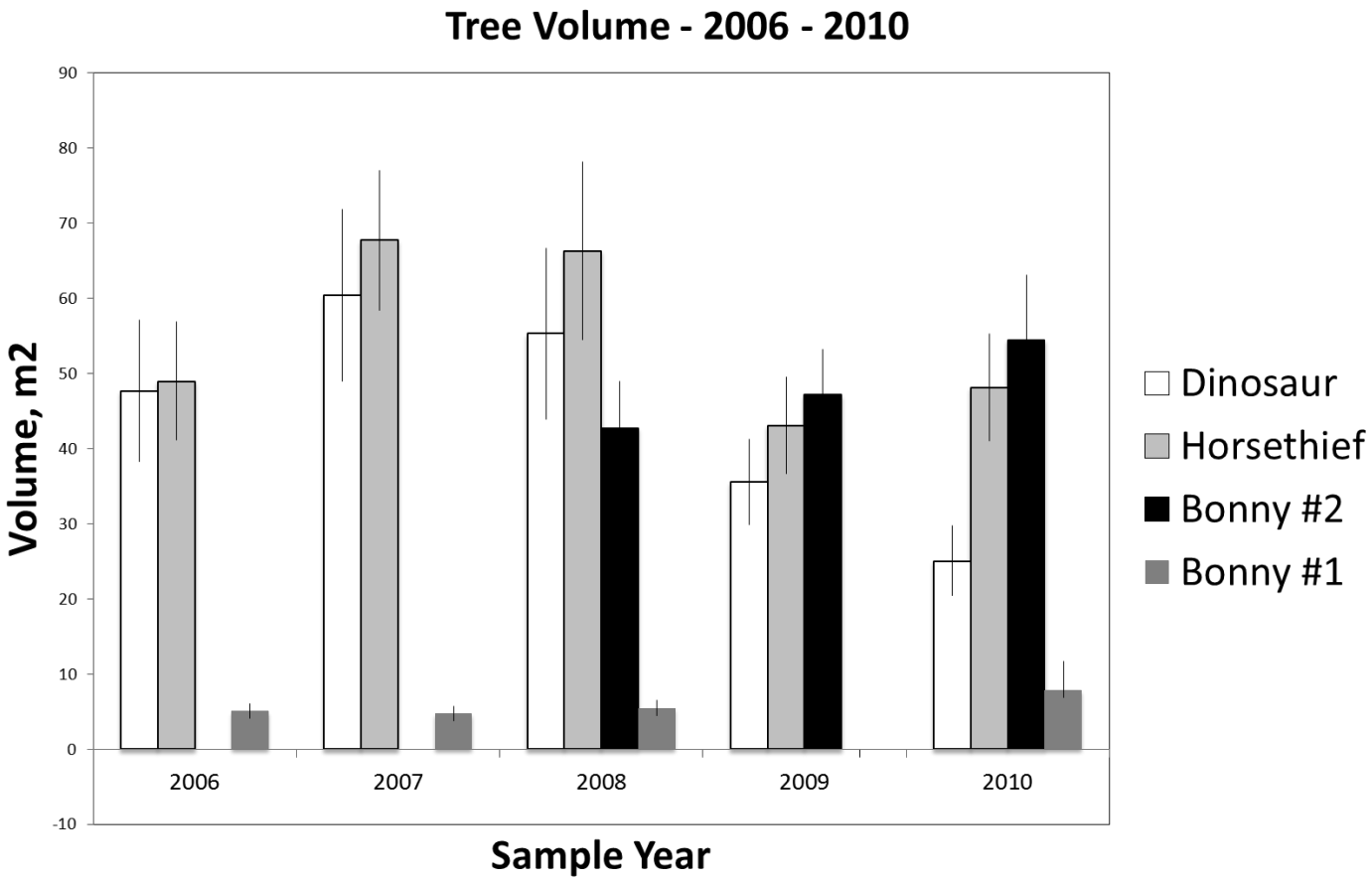


Figure 14: Plant species richness (left of pair) and percent cover for Dinosaur National Monument (top) and Horsetheif canyon, 2006 – 2010.

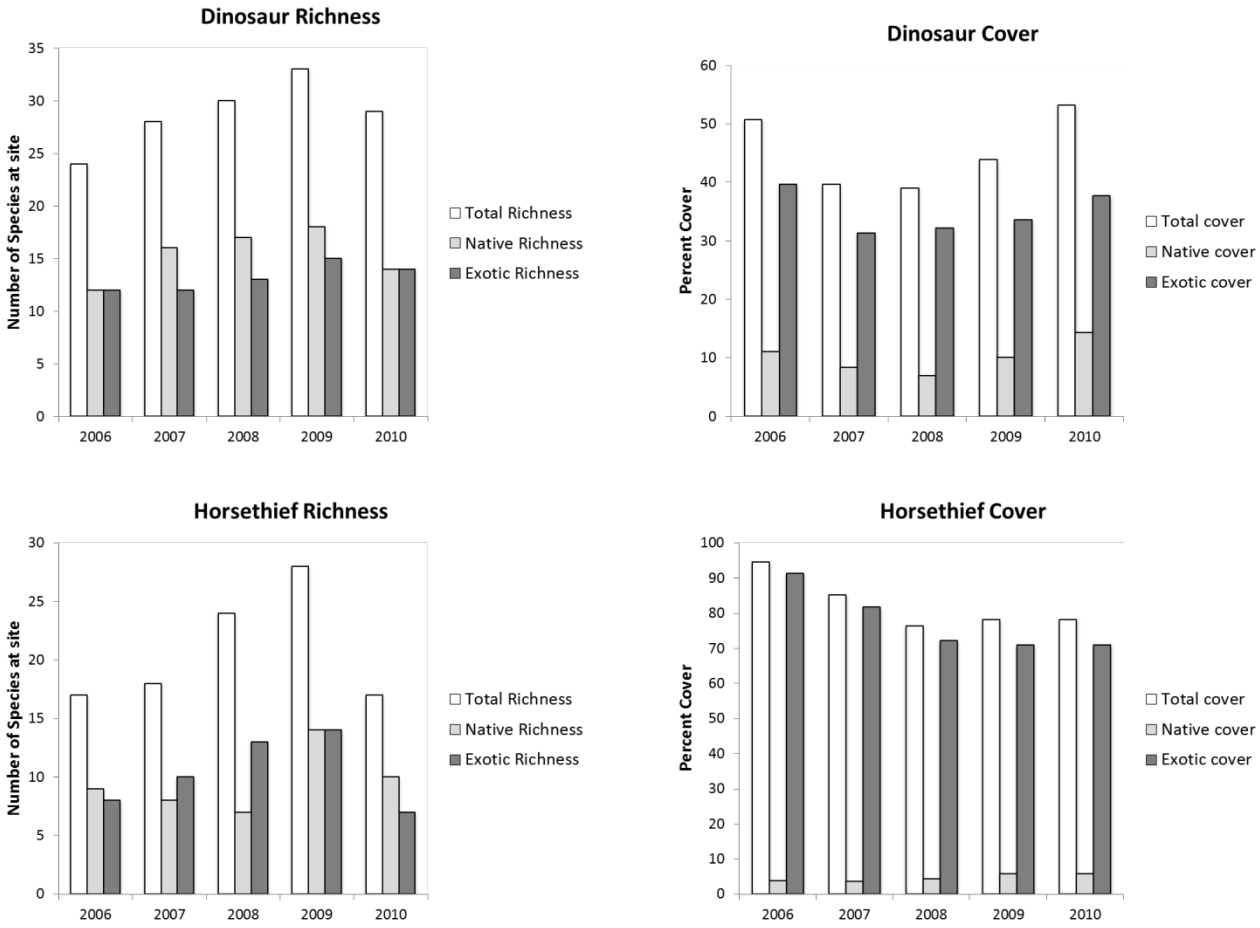


Figure 15: Distribution of the tamarisk leaf beetle in the Colorado River Basin as determined by sweep sampling. The map was compiled by Levi Jamison working for the Colorado Department of Agriculture and Tamarisk Coalition and by Nathan Ament working for the Tamarisk Coalition. Surveys were done by Tamarisk Coalition personnel as well as by Levi Jamison who had a joint appointment with the Tamarisk Coalition and the Colorado Department of Agriculture.

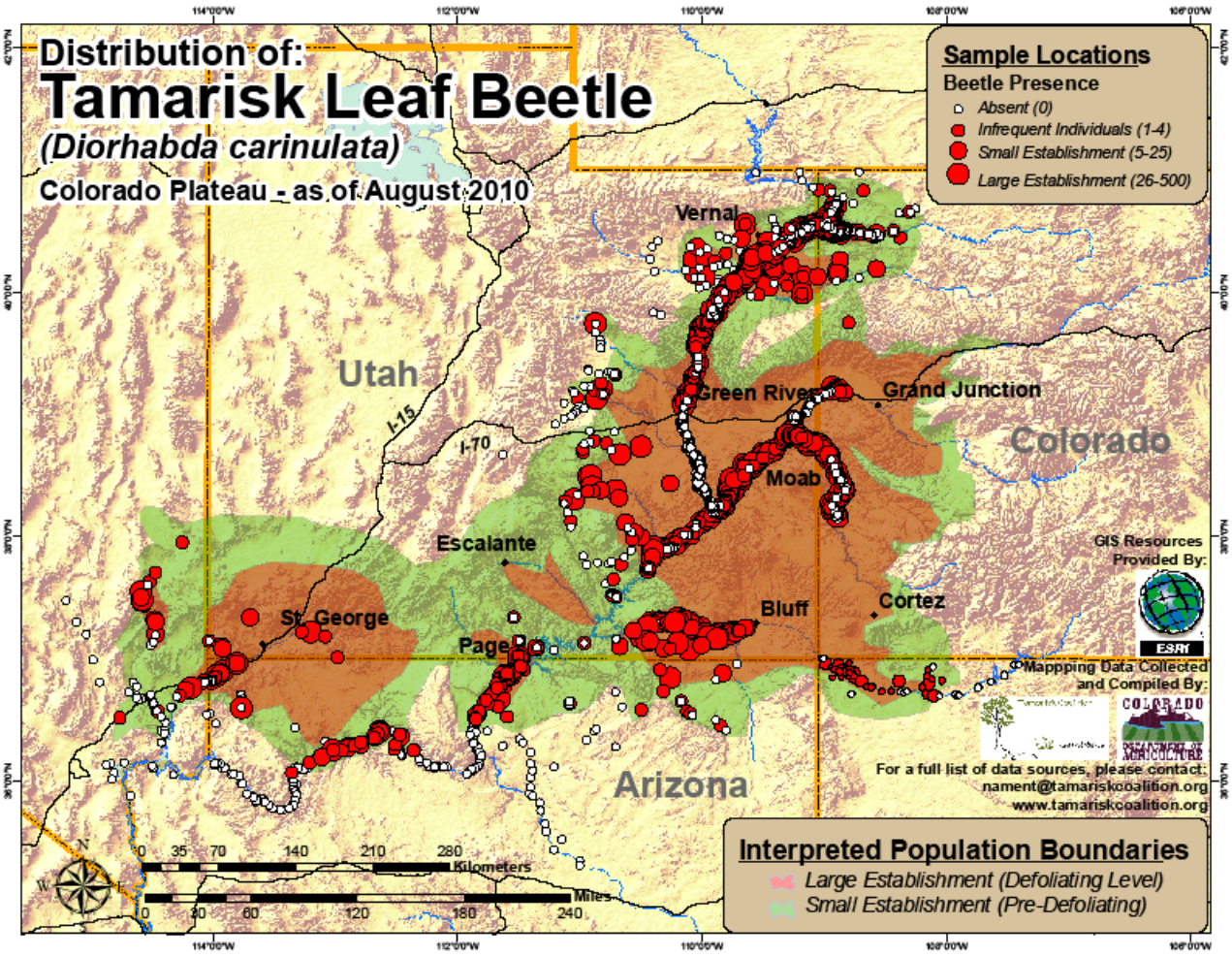


Figure 16: Monitoring sites in western Colorado marked with blue stars. There are six sites in the Grand Valley between Grand Junction and the Utah state line. These are two sites on Salt Creek (BLM land) two sites on East Salt Creek (Stan Young property), one site on the Colorado River (Knowles Canyon) and one site on a small tributary near the town of Fruita (Flume Canyon (BLM). The CDA monitored on site near Parachute, CO and one site on the Gunnison River. There are two sites on the Dolores; one near the town of Gateway and one near the town of Bedrock. The CDA also assists in monitoring two sites on Ute Mountain Ute land, results not shown in this report. The CDA assists researchers at CSU, under the direction of Dr. Norton, in monitoring the Horsethief site on the Colorado River The CDA monitored 10 tamarisk biocontrol sites in 2010 and assisted with three others. In addition the CDA monitored two sites on the Arkansas River in 2010 but no beetles were recovered from these sites.

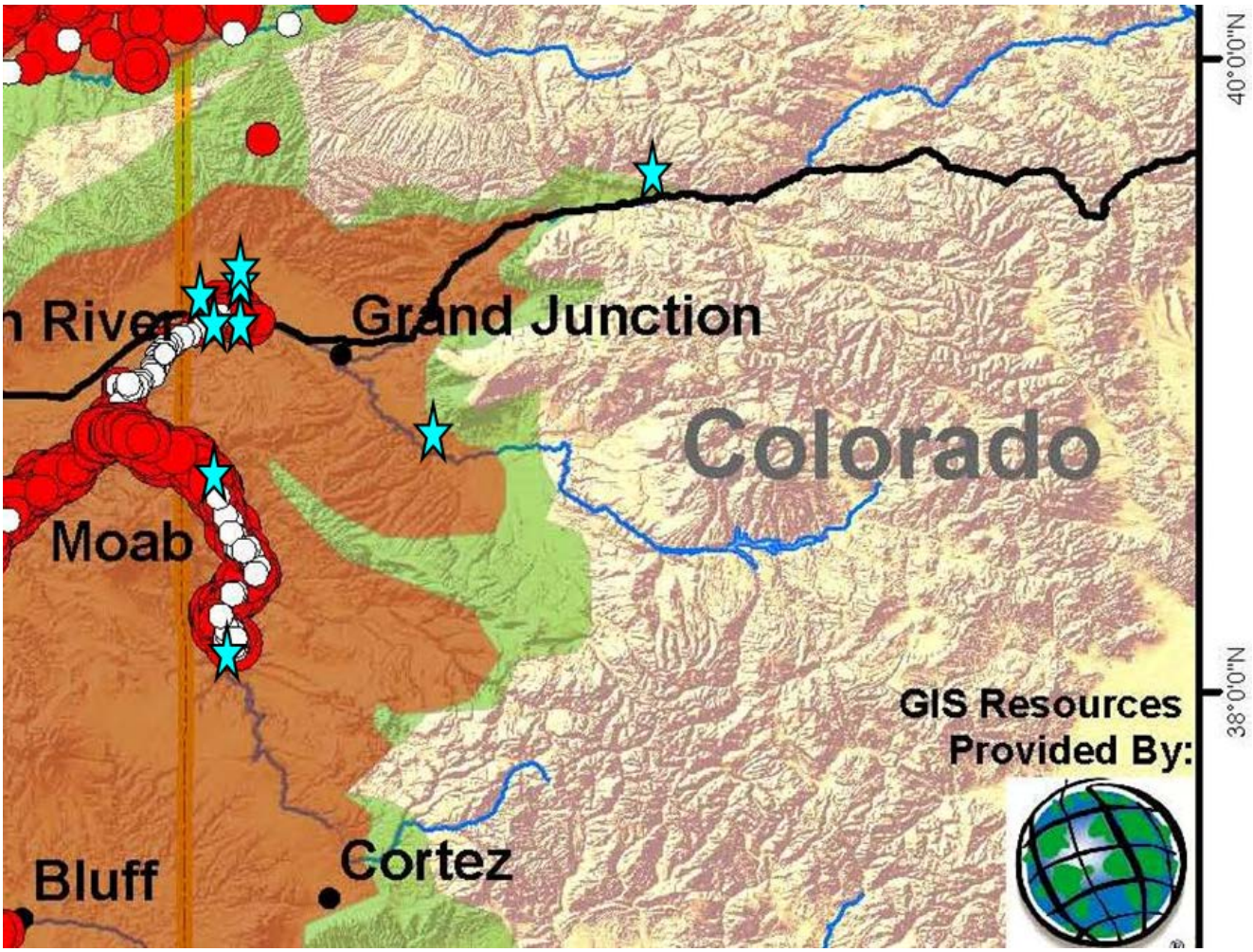


Figure 17: Mortality at 10 tamarisk monitoring sites in western Colorado at the end of field season, 2010. Knowles is a site on the Colorado River, SY burned and unburned are sites on the property of Stan Young, a private landowner, on a tributary of the Colorado River. Salt Creek 2 and 3 are also on a tributary of the Colorado. Flume is a tributary of the Colorado near the town of Fruita, Williams is a site in Hayes Gulch, a tributary of the Colorado near Parachute, CO, and the Gunnison site is on the Gunnison River downstream of Delta, CO. Gateway and Bedrock are on the Dolores River. The Knowles site burned in 2007 and beetles have been active on regrowth since then. The Flume site is on an intermittent stream where plants may be water stressed for parts of the summer.

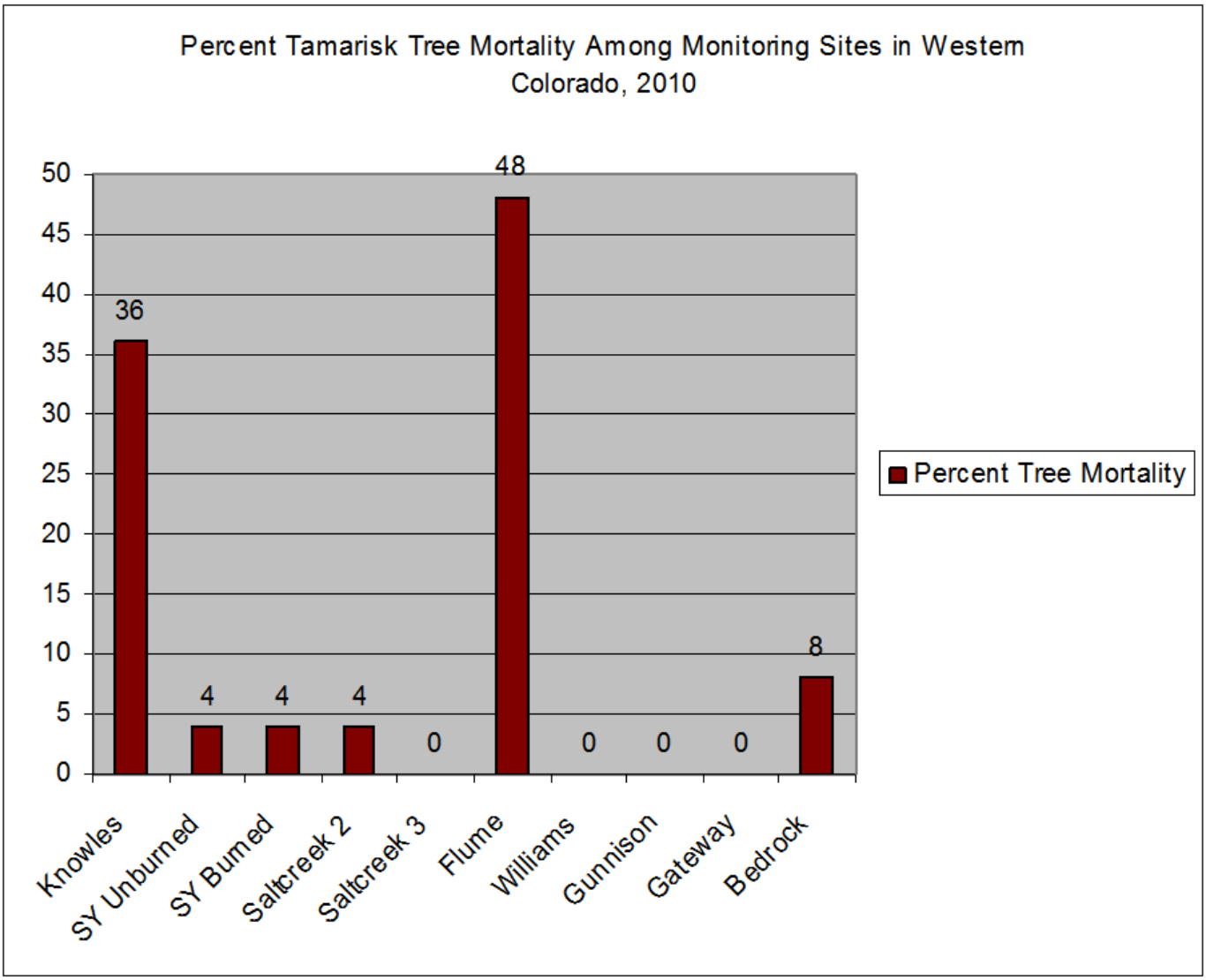
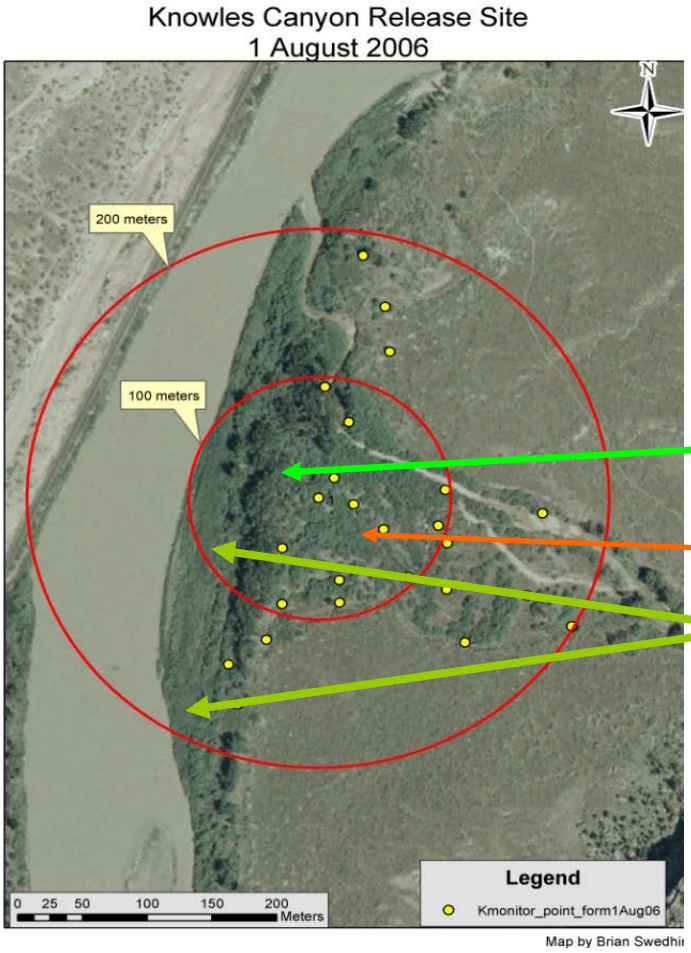


Figure 18: Impact of defoliation by beetles on the Stan Young property, near the SY unburned monitoring site. Note the brown tamarisk is not dead but has some resprouting at the base of most plants. Also note that the gray-brown plants are not recently defoliated but rather have failed to recover from previous defoliation events.

2007 pre-beetle photo **2010 post-beetle photo**

Figure 19: The Knowles Canyon monitoring site as it was in 2006 before the fire that burned out most of the tamarisk and damaged the cottonwood gallery. The concentric circles are 100 and 200 meters form the release point of beetles. Yellow dots mark the location of monitoring trees. In 2007 the site burned. In 2010 the monitoring trees were relocated through the use of GPS and some remains of tags.



Knowles Canyon monitoring site on the Colorado River

cottonwood gallery

tamarisk

Figure 20: Tamarisk at the Knowles Canyon site resprouted after fire. Under normal conditions resprouted plants can grow 6-8 feet in a year and will be nearly completely recovered in three years. Plants have attempted to resprout numerous times but have been prevented from fully recovering by the presence of defoliating populations of beetles. These photos were taken from near where the arrow is pointing in Figure 6; an area once dominated by tamarisk.

Figure 21: Aerial view of Knowles Canyon monitoring site, August, 2010. The arrow points to what was once a dense tamarisk thicket which was burned by an escaped campfire in 2007. Trees have failed to regrow in the presence of *D. carinulata*. Beetles defoliate resprouts and shoots coming from the base of the plants. Mortality has reached 36% at this site due to a combination of fire and beetle activity. Note defoliated tamarisk in the midst of the willow thickets near the riverside.

Figure 22: Two stem galls on Russian knapweed used for propagation in the Insectary garden. *Jaapiella ivannikovi* pupa and the silken cocoon from which it was removed. In a single large gall there can be 10-15 insects.

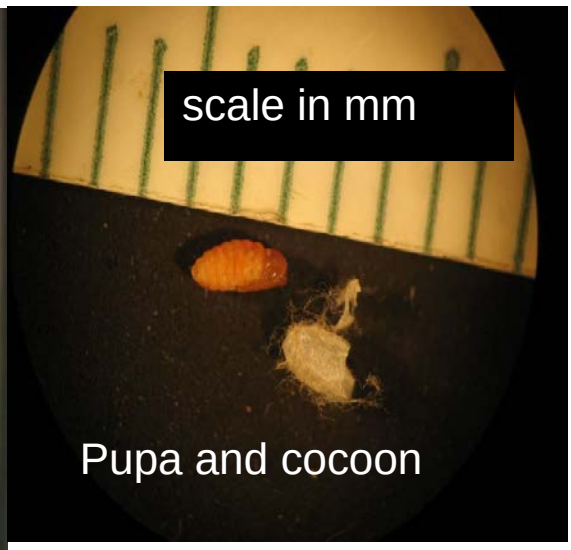
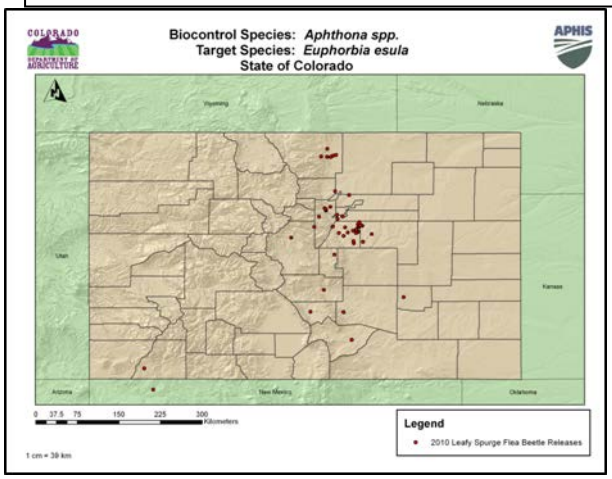
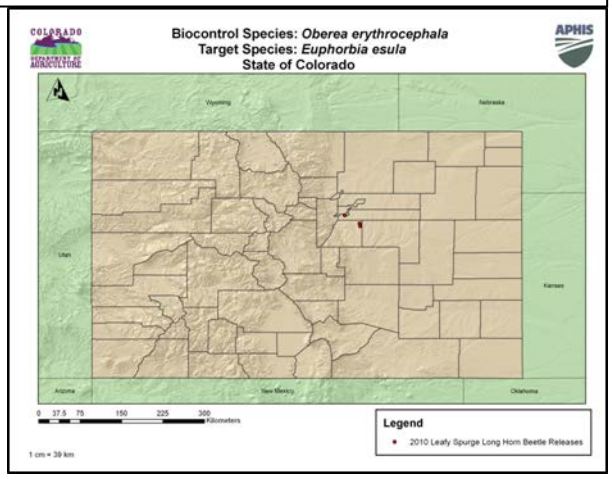
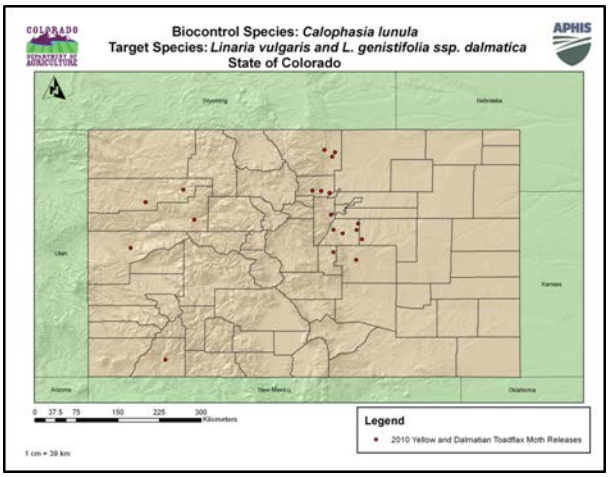


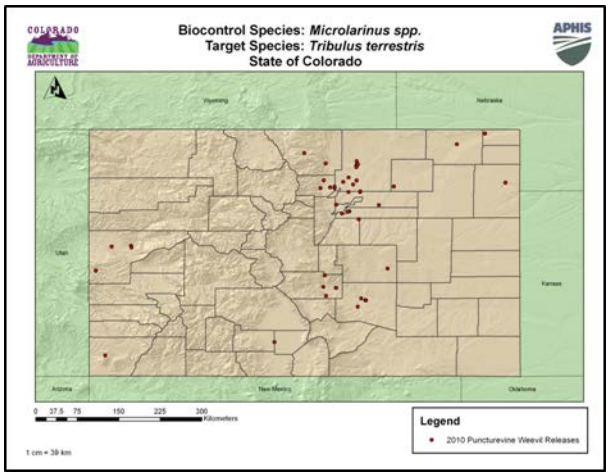
Figure 23: Stem of yellow toadflax split to reveal a pupa of *M. janthinus* (at the end of the knife blade). The photo was taken 8-26-10 at the Burro Mountain site at 8,500 feet in the White River Nat'l Forest. Releases of overwintered adult beetles, in stems, were made at the site on 6-17-10.

Figure 24: Release sites for 2010









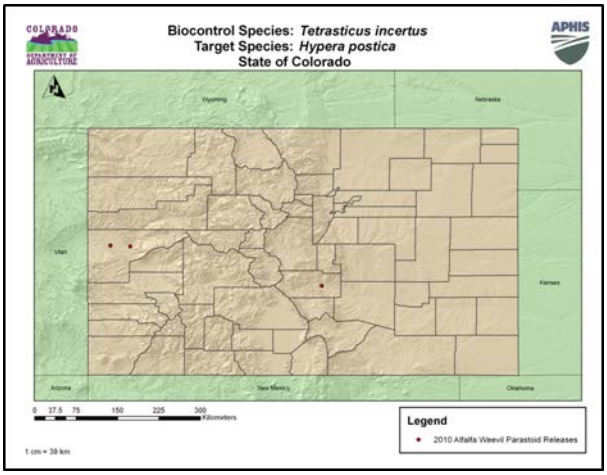
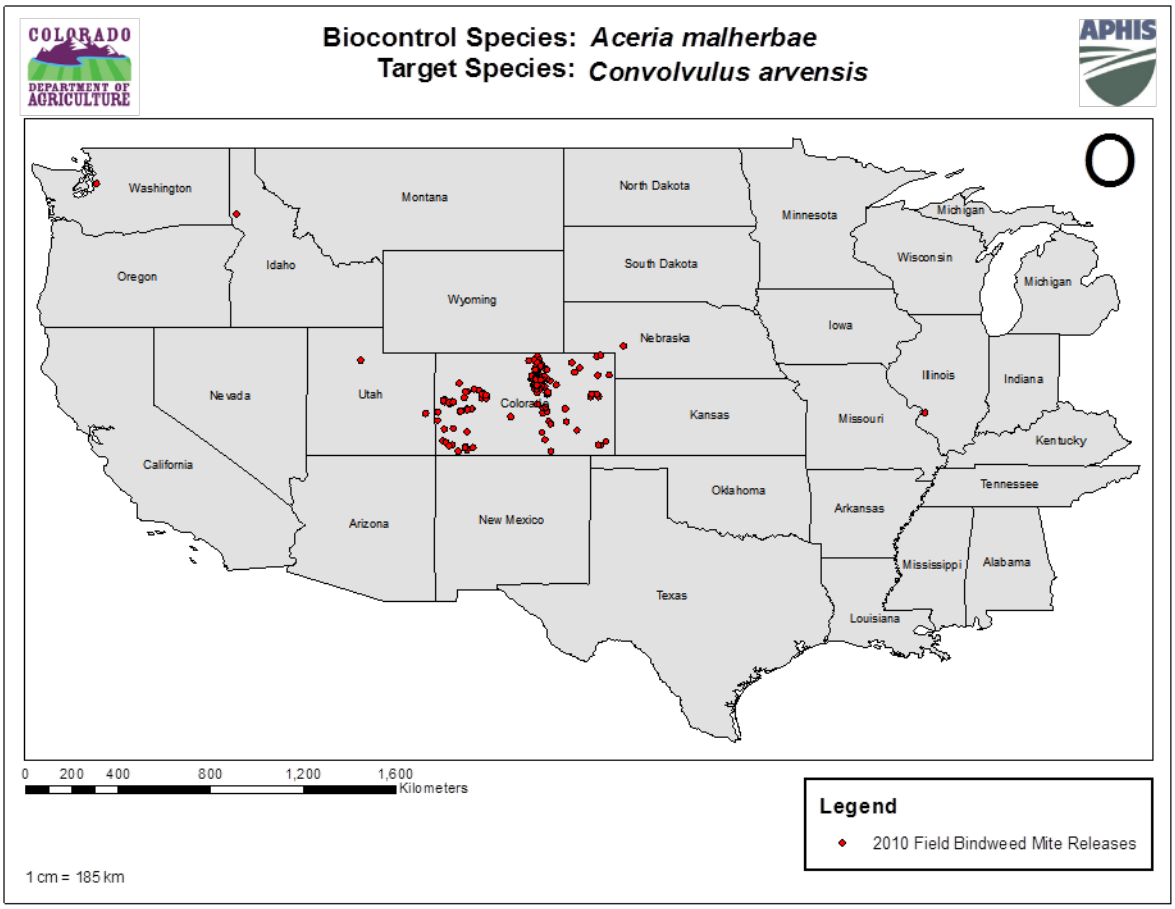
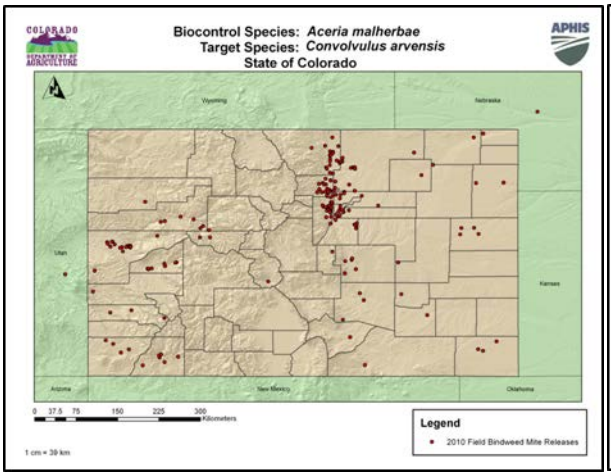


Figure 25: Release sites for 2010





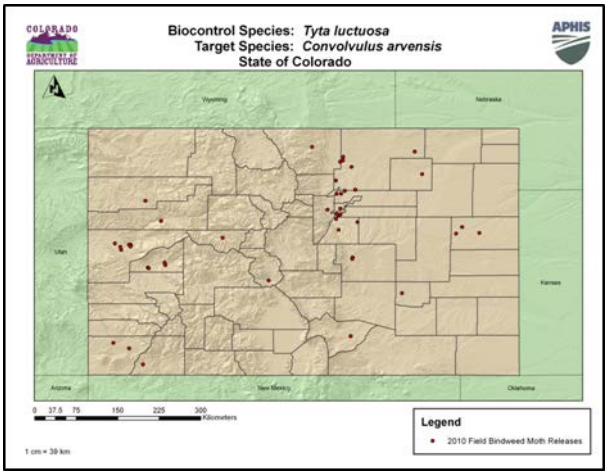
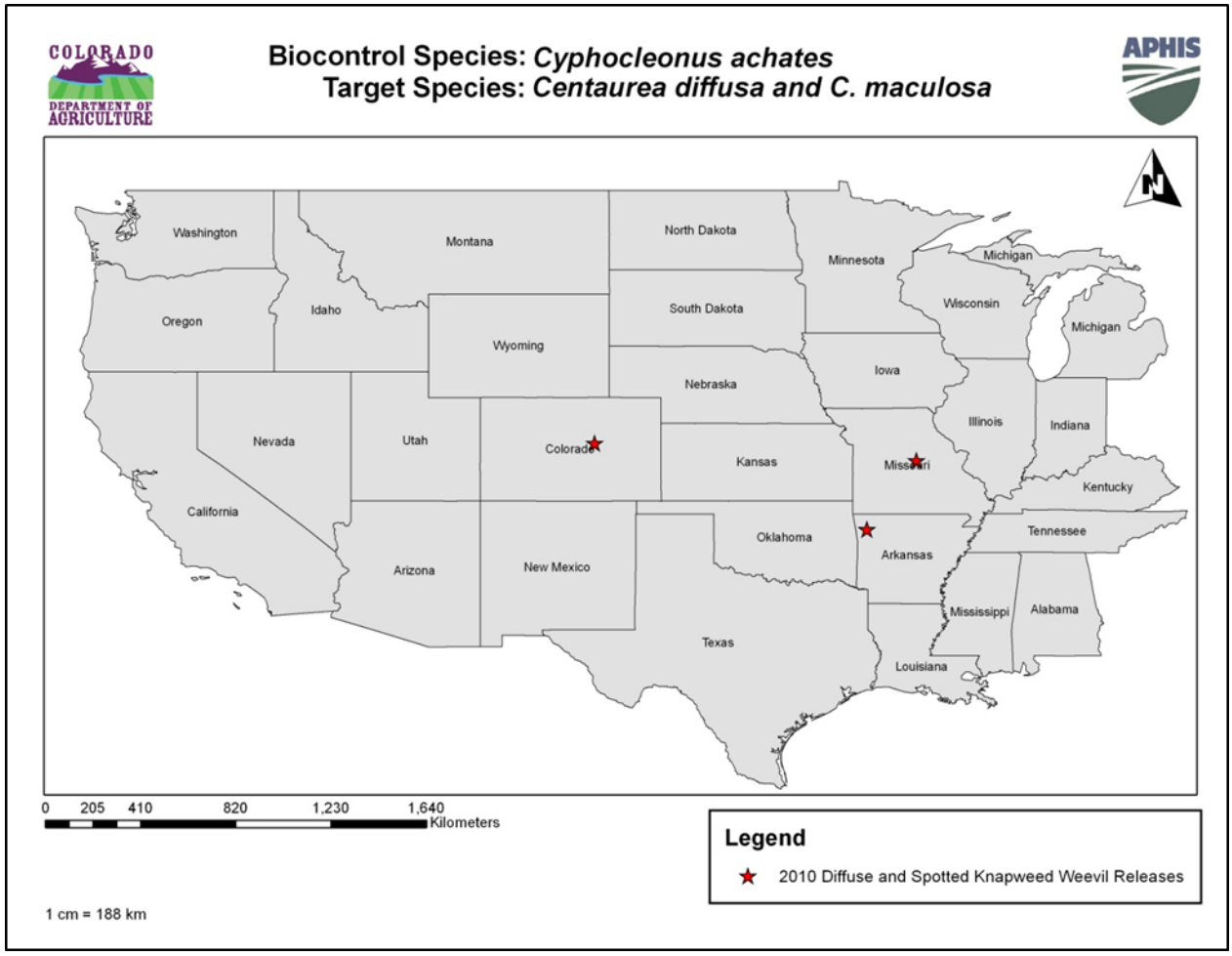
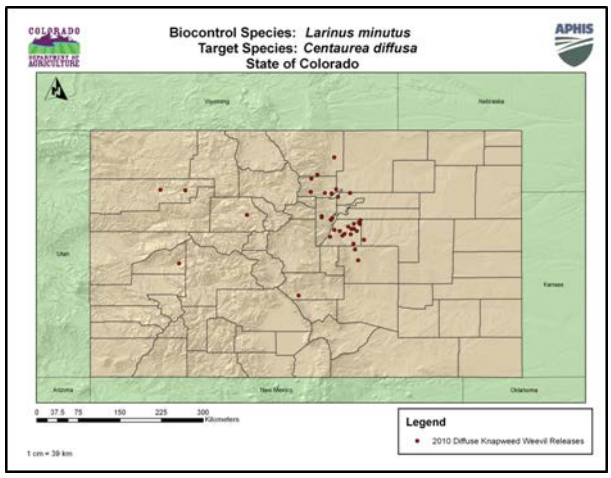


Figure 26: Release sites for 2010





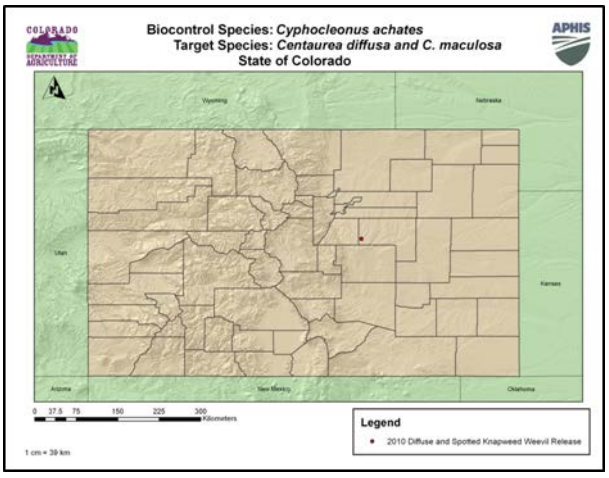


Table 1. Information on crops and coordinates of the PPV survey orchards in Western Colorado, 2010 growing season.

Sample No.	Crop	Grower/Orchard	Longitude	Latitude
1	Plums	Dick P.	39.05673	-108.41563
2	Plums	Jim Miller	39.09270	-108.68930
3	Plums	Songster	39.07865	-108.37823
4	Plums	Steve Ela	38.81618	-107.78762
5	Plums	White Buffalo Farm	38.89875	-107.56312
6	Peaches	Brant Harrison	39.12740	-108.32280
7	Peaches	Charla	38.90587	-107.93693
8	Peaches	DC Eric's	38.82280	-108.34190
9	Peaches	Dick P.	39.05778	-108.41655
10	Peaches	Fruit Basket	39.04132	-108.46782
11	Peaches	Fruita 23 Rd	39.17850	-108.62757
12	Peaches	Gallen	39.09117	-108.37522
13	Peaches	Gerry's	39.08052	-108.38005
14	Peaches	Jim Miller	39.09232	-108.68823
15	Peaches	Morton	39.08413	-108.37515
16	Peaches	Orchard Mesa	39.04317	-108.46750
17	Peaches	Roger's Mesa	38.79613	-107.78743
18	Peaches	Steve Ela	38.81630	-107.78718
19	Peaches	Theresa High	39.08478	-108.39615
20	Peaches	White Buffalo Farm	38.89813	-107.56583
21	Peaches	Z's	39.05193	-108.42772
22	Nectarine	Brant Harrison	39.12970	-108.32348
23	Nectarine	Orchard Mesa	39.04233	-108.46812
24	Apricot	Brant Harrison	39.12957	-108.32360
25	Apricot	DC Eric's	38.82983	-108.34983
26	Apricot	Dick P.	39.05745	-108.41628
27	Apricot	Fruit Basket	39.04128	-108.46778
28	Apricot	George's	39.07982	-108.37878
29	Apricot	Jim Miller	39.09293	-108.68903
30	Apricot	Morton	39.08433	-108.37515
31	Apricot	Orchard Mesa	39.04262	-108.46587
32	Apricot	White Buffalo Farm	38.89773	-107.56445
33	Apricot	Z's	39.04890	-108.42937

Table 2. Status of thousand cankers disease among eastern Colorado communities. Towns with "+" were noted to have positive infections of thousand cankers; Those with "-" were surveyed but not found to have infected black walnut. NS indicates the community did not receive a survey visit.

County	City	2009	2010
Adams	Aurora	+	+
	Brighton	+	+
	Commerce City	+	NS
	Northglenn	+	NS
Arapahoe	Englewood	+	+
	Littleton	+	+
Bent	Las Animas	-	-
Boulder	Boulder	+	+
	Lafayette	+	NS
	Hygiene	-	-
	Longmont	-	+
	Lyons	-	+
	Niwot	-	NS
Broomfield	Broomfield	+	NS
Cheyenne	Cheyenne Wells	-	-
Crowley	Olney Springs	+	NS
	Ordway	-	-
Denver	Denver	+	+
Douglas	Castle Rock	-	-
Elbert	No black walnuts located in survey of Elizabeth or Kiowa		
El Paso	Colorado Springs	+	NS
	Security	+	NS
Fremont	Canon City	-	+
	Penrose	-	NS
Huerfano	La Veta	-	NS
	Walsenburg	-	-
Jefferson	Arvada	+	+
	Golden	+	No trees left
	Lakewood	+	+
	Morrison	+	NS
	Westminster	+	NS
	Wheat Ridge	+	No trees left
Kiowa	Eads	-	-
Kit Carson	Burlington	-	-
Las Animas	Trinidad	-	-
Lincoln	Limon	-	-
	Hugo	-	-

County	City	2009	2010
Larimer	Berthoud	+	-
	Fort Collins	-	-
	Laporte	-	-
	Loveland	-	-
Logan	Crook	-	NS
	Iliff	-	NS
	Merino	-	NS
	Sterling	-	-
Morgan	Hillrose	-	NS
	Fort Morgan	-	-
Otero	Cheraw	-	-
	Fowler	-	-
	LaJunta	-	-
	Manzanola	-	+
	Rocky Ford	+	+
Phillips	Haxtun	-	NS
	Holyoke	-	-
Prowers	Lamar	-	-
Pueblo	Avondale	-	-
	Pueblo	-	+
	Vineland	-	-
Sedgwick	Julesburg	-	-
	Ovid	-	-
	Sedgwick	-	-
Washington	Akron	-	-
	Otis	-	NS
Weld	Dacono	-	-
	Erie	+	+
	Fort Lupton	-	-
	Frederick	-	-
	Greeley	-	-
	Johnstown	-	NS
	Mead	-	NS
	Milliken	-	-
	Platteville	-	-
Yuma	Wray	-	-

Table 3: 2010 Weed biological control releases			
Agent	**Target**	**# of Releases**	**Total Agents**
Aceria malherbae	Field bindweed	514	514,000
Aphthona spp.	Leafy spurge	83	83,000
Calophasia lunula	Toadflaxes	23	7,181
Cyphocleonus achates	Knapweeds	92	9,150
Hylobius transversovittatus	Purple loosestrife	11	2,550
Jaapiella invannikovi	Russian Knapweed	1	15 (galls)
Larinus minutus	Knapweeds	42	8,450
Macrocentrus ancylivorus	Oriental fruit moth	1,308	1,308,000
Mecinus janthinus	Dalmatian toadflax	63	12,330
Mecinus janthinus vulgaris	Yellow toadflax	2	800
Microlarinus spp.	Puncturevine	81	16,200
Tyta luctuosa	Field bindweed	88	60,927
Urophora cardui	Canada thistle	63	6,330
Oberea erythrocephala	Leafy spurge	3	325
Tetrasticus incertus	Weevil, Alfalfa	3	3000