Cooperative Agricultural Pest Survey (CAPS)

Annual Report
Colorado
FY2009

Compiled by:
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Plant Industry Division

Annual Report for Colorado

Cooperative Agricultural Pest Survey

March 31, 2010

Compiled by John Kaltenbach, SSC Colorado

Colorado Cooperative Agricultural Pest Survey 2009

Survey

The activities and surveys in Colorado for the CAPS program have been completed for the period March 1, 2009 to February 28, 2010. The following document contains information on the 9 CAPS projects carried out in Colorado. The cooperators for this year's work with the Colorado Department of Agriculture 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)(Table 1).

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

Table 1.

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

Outreach

The following is a list of outreach activities for the CAPS calendar year:

- "Don't Move Firewood" poster distribution: 100 delivered to Colorado State Parks and 150 to the US Forest Service for posting at campgrounds throughout the state.

- The Colorado Reader on Invasive Species was published (issue Invasive Species – September 2009). I helped package the Reader for distribution to classrooms throughout the state and delivered 8,000 to Academy School District in Colorado Springs as part of their Colorado Proud School Meal Day. More than 1,000 classrooms received the 8 page publication and activity guide across Colorado.

- Two radio interviews following a "Don't Move Firewood" Press Release.

- A banner has been placed at the top of the online reservation page for Colorado State Parks. The state parks page is part of ReserveAmerica.com. The banner reads:

Firewood Notice: **PLEASE DON'T BRING FIREWOOD FROM OUT OF STATE!** If you are planning to camp during an upcoming trip to Colorado, please help protect our public lands by buying local firewood near your destination campground. Firewood can spread harmful insect pests and diseases. If you have brought firewood from another state, please contact the Colorado Department of Agriculture immediately for instructions on how to dispose of it.

- Set up a booth at the Colorado State University Extension Forum in Fort Collins in September, the Colorado State Fair in Pueblo and ProGreen Expo in Denver.

- Produced and printed a new outreach brochure for "Exotic Pests of Fruit and Ornamental Trees and Shrubs" and a new firewood poster titled "Buy It Where You Burn It".

Other State Survey Coordinator Activities

The following CAPS Committee meetings were held: February 3rd, 2009 meeting to go over CAPS calendar of activities and deadlines, finalize survey activities for the year, to facilitate information sharing among all collaborators and identify any areas for cooperation. On June 4th, 2009 a meeting was held to go over expectations for 2009 and planning for 2010.

New state records reported between March 1, 2009 and February 28, 2010:

- *Raglius alboacuminatus*, Black Lygaeid Seed Bug (the tuxedo bug) in Boulder County.
- *Cantareus (Helix) aspersus (aspersa),* Brown Garden Snail, found in Larimer and Jefferson Counties.
- *Puccinia hemerocallidis*, Daylily Rust, found in Jefferson County on nursery stock.
- *Monarthrum mali,* Apple Wood Stainer, found in Denver County.
- *Saperda discoidea*, Longhorned Beetle, found in Arapahoe County.
- *Parelaphidion aspersum*, Longhorned Beetle , found in Arapahoe County.

Attended Risk Assessment 101 training in Sacramento, CA, provided by USDA APHIS PPQ CPHST.

In January, 2010 I was asked and accepted a position on the National CAPS Committee to represent the Western Region State Survey Coordinators.

Pest Survey

Grape Commodity-Based Survey

Colorado Department of Agriculture - Plant Industry Division
Project Coordinators: John Kaltenbach
In cooperation with:
Colorado State University - Dept. of BioAgricultural Sciences & Pest Management
Project Coordinators: Lou Bjostad and David James

Objective

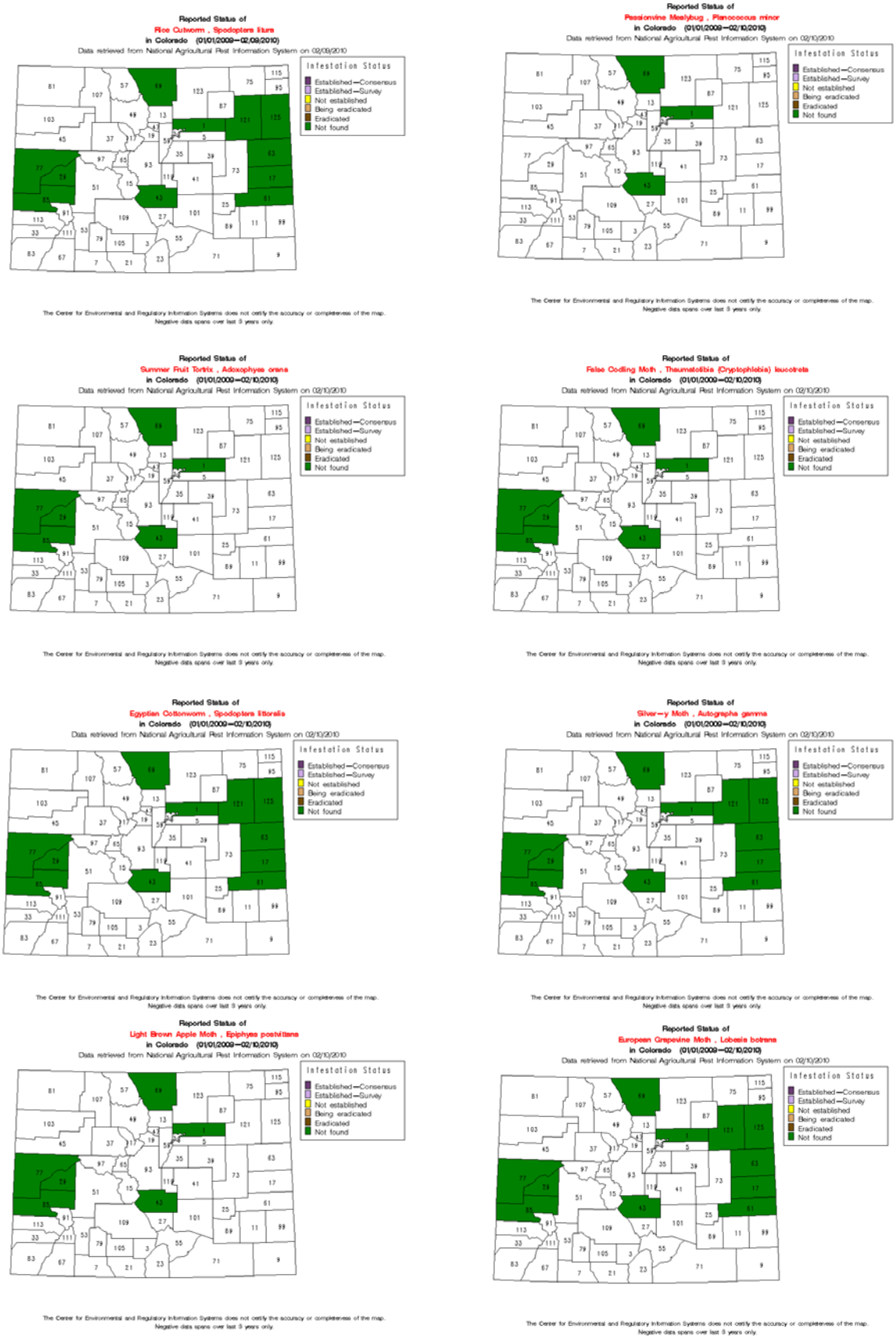
Nine sites in three western slope counties and 4 sites in three counties along the Front Range were surveyed for the following insects:

- Passionvine mealybug (*Planococcus minor*)
- Cotton cutworm (*Spodoptera litura*)
- Summer fruit tortrix moth (*Adoxophyes orana*)
- False codling moth (*Thaumatotibia leucotreta*)
- Egyptian Cottonworm (*Spodoptera littoralis*)
- Silver Y Moth (*Autographa gamma*)
- European grape vine moth (*Lobesia botrana*)
- Light Brown Apple Moth (*Epiphyas postvittana*

Methods and Results

Colorado State University conducted this survey at 9 sites in grape production counties. Traps were placed at four sites at Mesa County, three sites in Delta County, and 2 sites in Montrose County. CDA placed traps at 2 sites in Denver County and 2 sites in Fremont County. Traps were placed in May and were removed in late August/early September. Visual surveys for the passionvive mealy bug were conducted at some of these trap sites. Vineyards and orchards were targeted for this survey. No target pests were found (Figure 1).

Figure 1. NAPIS map of counties and insects surveyed for in the Grape Commodity Survey in Colorado.



Small Grains Commodity Survey

Colorado Department of Agriculture - Plant Industry Division
Project Coordinator: John Kaltenbach
In cooperation with:
Colorado State University - Dept. of BioAgricultural Sciences & Pest Management
Project Coordinators: Lou Bjostad and David James

Photo of a wheat field used in this survey.

Objective

The purpose of this project was to continue a trapping survey for early detection of the following insects:

- Old World Bollworm (*Helicoverpa armigera*)
- Passionvine Mealybug (*Planococcus minor*)
- New Zealand Wheat Bug (*Nysius huttoni*)
- Rice Cutworm (*Spodoptera litura*)
- Egyptian Cottonworm (*Spodoptera littoralis*)
- Silver Y Moth (*Autographa gamma*)

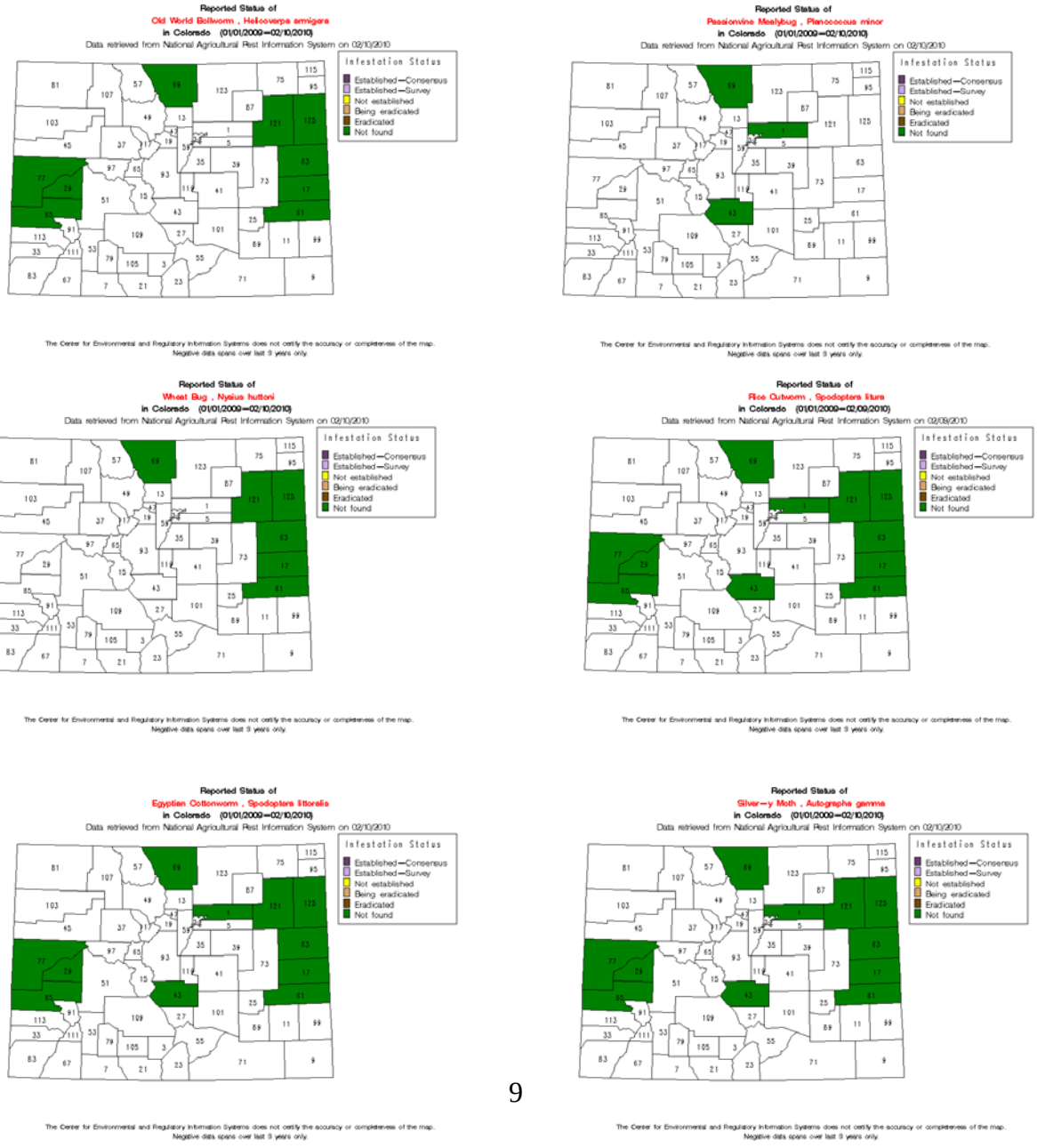
This was done to help maintain a pest-free zone in Colorado for these pests, and to provide a means for early detection of insect pests that could pose restrictions for products exported from Colorado.

Methods and Results

Pheromone-baited Pherocon 1C wing-style traps were installed at sites in wheat fields. This year's survey was targeted at the high wheat producing counties found on the eastern plains. The counties surveyed included 5 in Kiowa, 2 in Cheyenne, 5 in Kit Carson, 5 in Yuma, 4 in Washington, and 4 in Larimer County.

All trap contents were initially screened by Janet Hardin and/or David James at Colorado State University. Suspect material was sent to Boris Kondratieff, systematic entomologist at Colorado State University. No targeted pests were found (Figure 2).

Figure 2. NAPIS map of counties and insects surveyed for in the Small Grains Commodity Survey in Colorado.



Karnal Bunt

Colorado State University - Dept. of BioAgricultural Sciences & Pest Management
Project Coordinators: Lou Bjostad and David James

Photo of a granary sampled for Karnal Bunt in 2009.

Objective

The purpose of this project was to continue the Karnal Bunt National Surveys in Colorado to help monitor the distribution and spread of Karnal Bunt in the United States and facilitate wheat exports by identifying areas free of disease.

Methods and Results

Surveys were performed by Janet Hardin and David James of Colorado State University, Department of Bioagricultural Sciences and Pest Management. Karnal Bunt surveys were done by visiting granary locations and collecting wheat grain samples to be sent on to Olney, Texas for optical scanning. This year 40 samples were collected from 5 counties. Hold-back samples were taken and stored at Colorado State University. Counties targeted for this survey were those that had not been sampled in the last few years. All samples tested negative for Karnal Bunt (Figure 3).

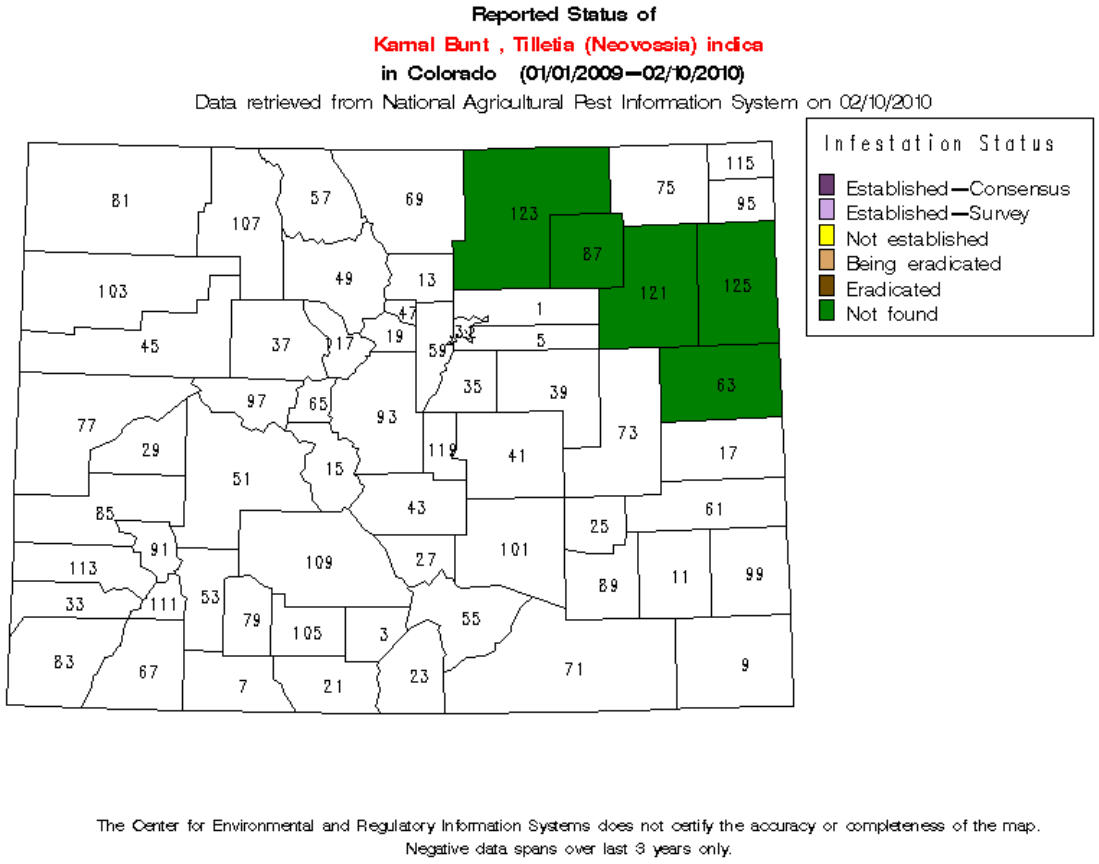


Figure 3. NAPIS map of counties surveyed for Karnal Bunt in Colorado.

Gypsy Moth Survey

Colorado State Forest Service
Project Coordinator: Ingrid Aguayo

Summary

The Gypsy Moth Survey program for this year was coordinated by Ingrid Aguayo until July and a new forest entomologist for Colorado State Forest Service (CSFS), Stephanie (Sky) Stephens, started on September 21. This year CSFS hired three hourly workers to deploy the traps. They were given appropriate background and training for this task.

Methods and Results

The traps were deployed from May 28 through July 10, 2009. This year a total of 1,500 traps were deployed throughout Colorado, in municipal, private and state lands. Each trap was labeled and its location was registered with a lat/long coordinate. In addition, 25, delimiting traps were set around the 2008 positive trap catch in Boulder, with no positive catch.

Trap collection was finished by November 7, 2009. The slow collection is due to trap number and lay-out throughout the state. The process of checking moth catch was carried out by Sky Stephens. There were three traps found positive with one male gypsy moth in each trap. The positive traps were located in Westminster, Commerce City and Pueblo. Dr. Kondratieff at CSU confirmed identification of species, and the traps were sent to Otis laboratories for molecular analysis. All three specimens were identified to be typed North American with the FS1 marker and Nla positive and Bam negative (N+B-). Thus, the specimens are considered North American as that falls within the usual variance we normally see within the US population. Visual survey for egg masses and delimitation trapping will be conducted around the three sites in 2010.

Pine Commodity-Based Survey

Colorado State Forest Service
Project Coordinator: Ingrid Aguayo

Summary

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, and delimiting surveys if needed. Ingrid Aguayo was the project coordinator until July and a new forest entomologist, Stephanie (Sky) Stephens, started on September 21.

Target Pests:

1. Pine shoot beetle (*Tomicus destruens*)
2. Siberian silk moth (*Dendrolimus superans sibiricus*)
3. Pine-tree lappet (*Dendrolimus pini*)
4. Pink (Rosy) Gypsy Moth (Lymantria mathura)
5. Sirex Woodwasp (*Sirex noctilio*)

Methods and Results

Traps were placed beginning in June in four mountain communities in Colorado; Conifer, Evergreen, Woodland Park, and Estes Park. Eight traps were placed in each town for the Pine Shoot beetle and Sirex woodwasp. Fifteen traps were placed in each town for Pink Gypsy moth and 60 traps were placed in each town for Siberian Silk moth and Pine Tree Lappet. The process of checking the traps and forwarding suspect specimens is being done and was finish in November. There were no positive finds.

Emerald Ash Borer Survey

Colorado Department of Agriculture - Plant Industry Division
Colorado State Forest Service
USDA, APHIS, Plant Protection and Quarantine
Project Coordinators: John Kaltenbach (CDA) Ingrid Aguayo (CSFS) and Lisa Peraino (USDA, APHIS, PPQ)

Summary

Sampling for the Emerald Ash Borer using purple prism traps baited with Manuka and Phoebe Oils was performed by the CSFS, PPQ and CDA. A total of 200 traps were placed, 100 by the CSFS, 80 by PPQ and 20 by CDA.

Methods and Results

Sites were selected for the presence of ash trees in a variety of locations, including campgrounds, urban forests and residential trees. There were a number of campgrounds throughout the state that did not have any ash trees. Traps were put up starting in late June and taken down in September and October. No Emerald Ash Borer, or suspect Emerald Ash Borer were been found.

Potato Cyst Nematode Survey

Colorado Department of Agriculture - Plant Industry Division
Project Coordinator: John Kaltenbach
In cooperation with:
Colorado State University – Plant Diagnostic Clinic
Project Coordinators: Ned Tisserat and Tamla Blunt

Summary

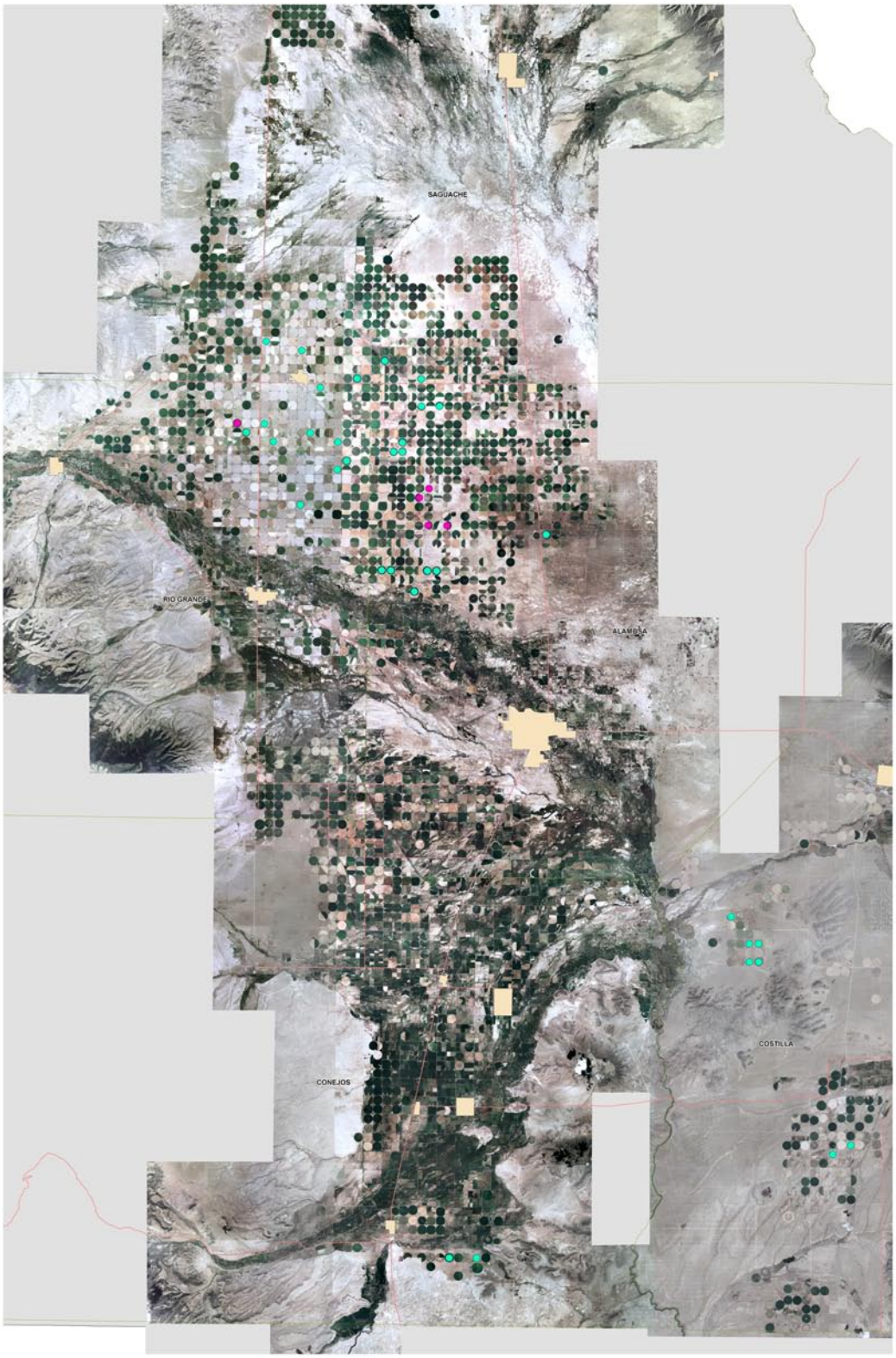
Sampling for the Potato Cyst Nematode (PCN) began in late August and finished in October 2009. There were 3,278 samples have been taken and analyzed at the Colorado State University Plant Diagnostic Clinic. The analysis was completed on Febrauary 26, 2010 and all data for the project was entered into the Integrated Survey Information System and NAPIS.

Methods and Results

For the PCN national survey, we sampled 3,278 acres (3,038 seed field acres and 240 productions acres). The samples were taken in the San Luis Valley, which is the only area of the state where seed potatoes are grown. CDA contracted the sampling to Biel Crop Consulting Inc., which had performed the sampling in 2007 and 2008. In three years of survey, all seed fields have been sampled at least once, and an effort was made during 2009 to sample fields that were not sampled in 2008. For the seed field sampling, most of the sampling is done in fields that were in seed potatoes in 2008, with the exception of fields that had seed potatoes destined for Canada. In all, 39 fields were sampled, 34 seed fields and 5 commercial fields (Figure 4). Sampling was started on August 31, 2009 and was completed on October 21, 2010. The soil analysis started in September 7, 2009 at the Colorado Plant Diagnostic Clinic in Fort Collins. The lab analysis was completed February 28, 2010 and all samples were negative for *Globodera pallida* and *G. rostochiensis*.

Figure 4: Fields Sampled for Potato Cyst Nematodes in 2009

- Seed potato fields
- Commercial potato fields



Japanese Beetle Survey

Colorado Department of Agriculture - Plant Industry Division
Project Coordinator: John Kaltenbach

Summary

The objective of this survey was to map the distribution of *Popillia japonica* (Japanese beetle) in the Denver Metro area of Colorado and to evaluate the effectiveness of eradication efforts through detection surveys. The goal was to set 300 traps, and we ended up setting a total of 323. Of these, 82 were positive for Japanese beetle for a total of approximately 109,219 adult beetles caught. The majority (95%) of beetles were caught at 4 golf courses in the south central part of Denver (Figure 5). The remaining 5% were found in the communities immediately surrounding the golf courses and at two nurseries as part of the Japanese beetle – free certification program.

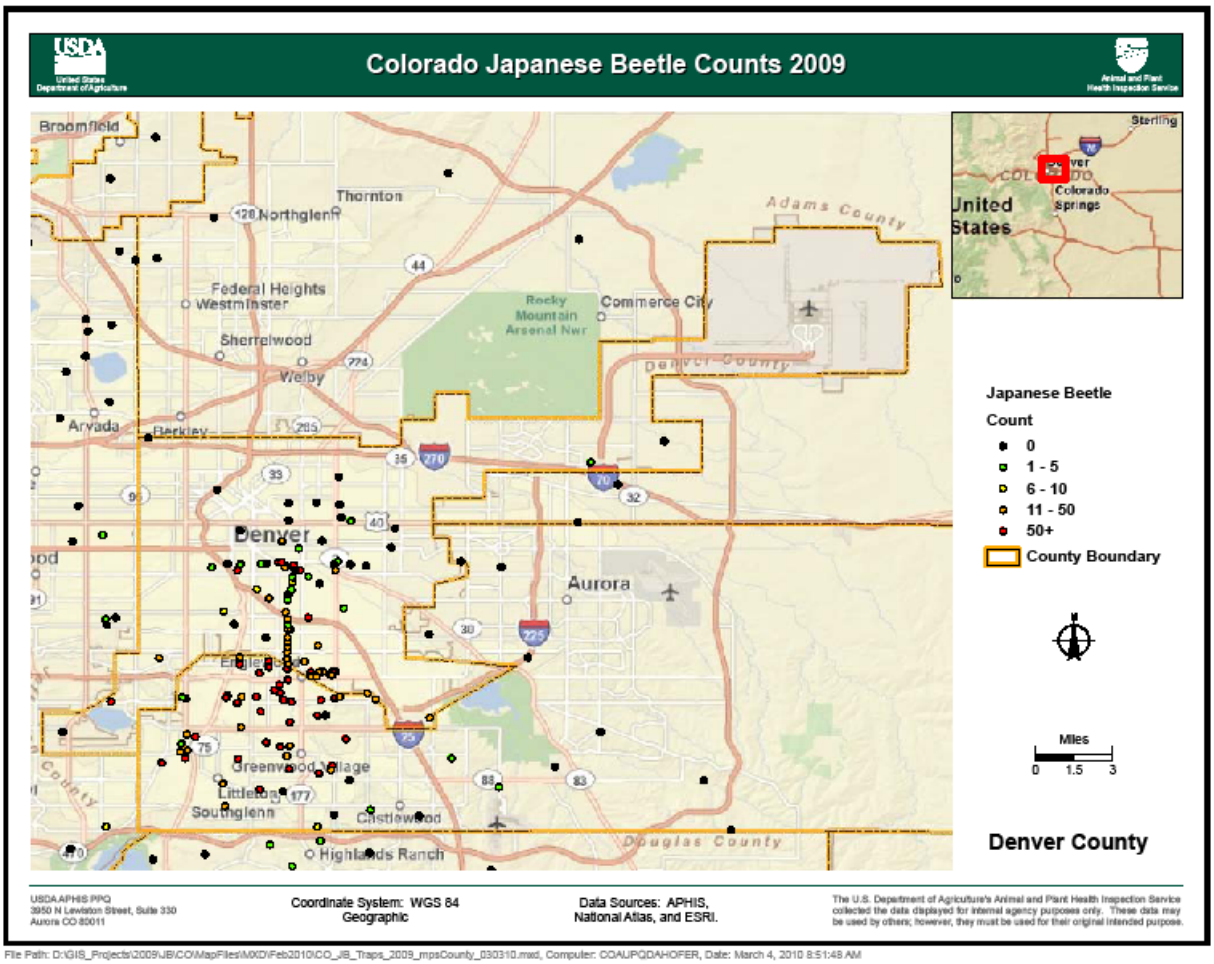


Figure 5: Japanese beetle counts in the Denver area for 2009

Methods and Site Selection

Japanese beetle traps baited with pheromone and floral lure were placed in and around the area by June 15th. At the golf courses, 10 traps were placed at the boarder of each course, and then in 8 transects (north, south, east, west, northwest, southwest, northeast and southeast) from each course. Four traps were placed on each transect, one every ½ mile for 2 miles. Traps were also placed at nurseries that were interested in obtaining certification for shipment to Japanese beetle-free States based on the Japanese Beetle Harmonization Plan.

Monitoring *Diorhabda elongata* releases in Colorado

Colorado State University - Dept. of BioAgricultural Sciences & Pest Management
Project Coordinator: Andrew Norton

Project Objectives:

a) Work with USDA-ARS and APHIS, Bureau of Reclamation, and the Colorado Department of Agriculture to continue the monitoring program for *Diorhabda elongata* releases in Colorado.

b) Monitor *Diorhabda elongata* population densities and spread following release.

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

d) Monitor relevant environmental parameters, including site microclimate and the abundance of native predators.

Summary:

I have completed all field data collection for all objectives for the 2009 season. These data have been entered into our database and have been checked for accuracy. Results by objective are presented below.

Results by Objective:

a) Work with USDA-ARS and APHIS, Bureau of Reclamation, and the Colorado Department of Agriculture to continue the monitoring program for *Diorhabda elongata* releases in Colorado.

b) Monitor *Diorhabda elongata* 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 did not re-visit the Adams CO site as the county had decided to discontinue their partnership and bulldoze the site at the end of 2008. We were able to make all planned site visits to all sites with the exception of Dinosaur National Monument. On the first two sampling dates of the summer late afternoon thunderstorms flooded and closed the road.

Diorhabda densities about equal (Horsethief) or lower (Dinosaur) in 2009 than in 2008 (Figure 6, 7). These densities were sufficient to significantly defoliate trees at both west slope sites. Data on foliage quality of the survey trees show a pattern of less green foliage in response to *Diorhabda* densities in both 2008 and 2009 (Figure 11, 12). Note that these data represent the quality of the existing foliage and do not take into consideration that much of the foliage was missing after *Diorhabda* feeding, or that the trees were overall smaller in 2009 than in 2007 or 2008. Tree size at both west slope sites has declined in the last two years, most likely in response to successive defoliation events (Figure 13). In contrast to these results for the west slope, no *Diorhabda* were found at either Bonny reservoir site in 2009 (Figure 9, 10).

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

For three years in a row there have been substantial populations of *Diorhabda* at both the west slope sites. When compared to two years ago, the average size (measured as height

* max. width * width perpendicular to max.) tree size has declined by an average of 30% at Dinosaur and by 32% at Horsethief. One of the trees at Dinosaur is apparently dead at this point. In contrast, the trees at Bonny Reservoir #2 have increased in size by 11% over the last year (Figure 13). In 2009 we will re-measure the Bonny#1 trees in addition to the trees at the other active sites to determine if reductions in volume are only seen at sites with active *Diorhabda* populations.

Surrounding plant community:

Once each year in June we have quantified the plant community structure underneath 2, 1 x 1 m2 plots under each marked tree. Since sampling started in 2006 species richness (the number of species present at the site) has increased at both west slope sites, with greater or equivalent increases in native versus exotic plant species. In contrast, both the Adams County and Bonny Reservoir #1 sites experienced a reduction in richness from 2006 – 2008 (Figure 14, 15, 16, 17). From these same data we estimated percent cover for each site by native / exotic status. In all cases the percent cover under the focal trees has declined since the start of the monitoring program, with no strong evidence that native or exotic species are responding differently (Figure 18, 19, 20, 21). Taken together, 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 and 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:

Richness – Herbivore communities on *Salix* had on average more species within a site (22.5 species on average) than *Tamarix* (17.5 species) or *Populus* (13.25 species). Richness per sample (the number of species per sample, on average) was greatest on *Tamarix* (1.81 species per sample), followed by *Salix* (0.94 species) and *Populus* (0.39 species). The greater per-sample richness on *Tamarix* is likely the result of the presence of the introduced *Opsius stactogalus* and *Diorhabda carinulata*. Both species were found

at 3 of the 4 *Tamarix* sites and were present in a high proportion of the samples. Over all sites, we found 63 species of herbivores on *Salix*, 46 species on *Tamarix* and 36 species on *Populus*. . Of the three tree species *Salix* had the highest endemism rate as 34 of the 63 species on *Salix* (68%) were found only on *Salix*. 16 of the 46 species on *Tamarix* (34%) were found only on *Tamarix* and 9 of the 36 species on *Populus* (25%) were found only on *Populus*.

Tamarix had a higher number of predator species per site (average = 17.5) followed by Salix (15.25) and then *Populus* (10.25). *Tamarix* also had a higher number of species per sample (1.18) than Salix (1.11) or Populus (0.51). Surprisingly, there was no pattern of greater predator richness at sites with established *Diorhabda* populations than sites without, indicating that predator richness does not appear to have increased in response to *Diorhabda* presence.

Abundance – When present, both *Opsius* and *Diorhabda* comprised the overwhelming majority of insects on *Tamarix* (Figure 22) and this resulted in *Tamarix* have far more insects per sample than the other riparian tree species. Interestingly, although *Opsius* was the most common insect at Adams, Dinosaur and Horsethief it was not found at the Bonny Reservoir site. In the absence of the two introduced species *Salix* had on average more arthropod individuals than *Tamarix* and *Populus*, and this was true for both predatory and phytophagous species (Figure 23). These data do not indicate that the great abundance of *Opsius* or *Diorhabda* at sites where either is present has increased the abundance of predatory taxa. Interestingly, the sites where *Diorhabda* has not been able to persist (Adams County and Bonny Reservoir) had the highest densities of predatory taxa in 2008, perhaps indicating that predation is a factor in establishment failure at some sites.

Figure 6: *Diorhabda* densities through time at Dinosaur National Monument.

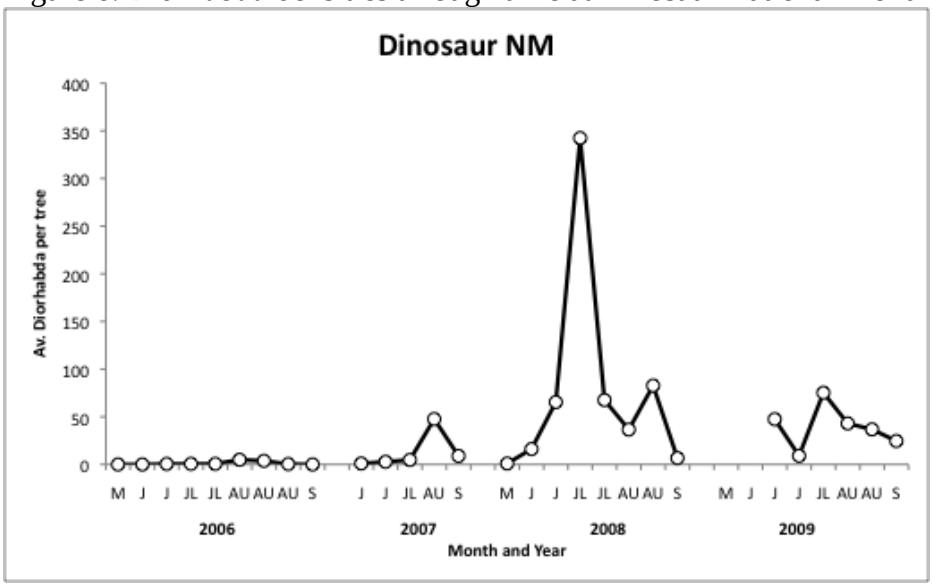
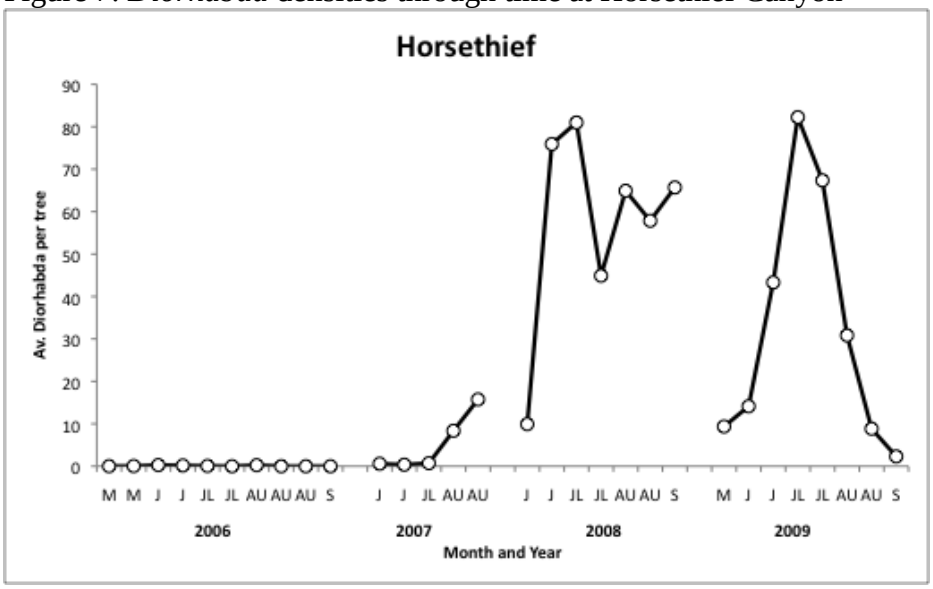


Figure 7: *Diorhabda* densities through time at Horsethief Canyon



Figures 8-10: *Diorhabda* population densities through time at the eastern release sites. Note scale change from previous two graphs.

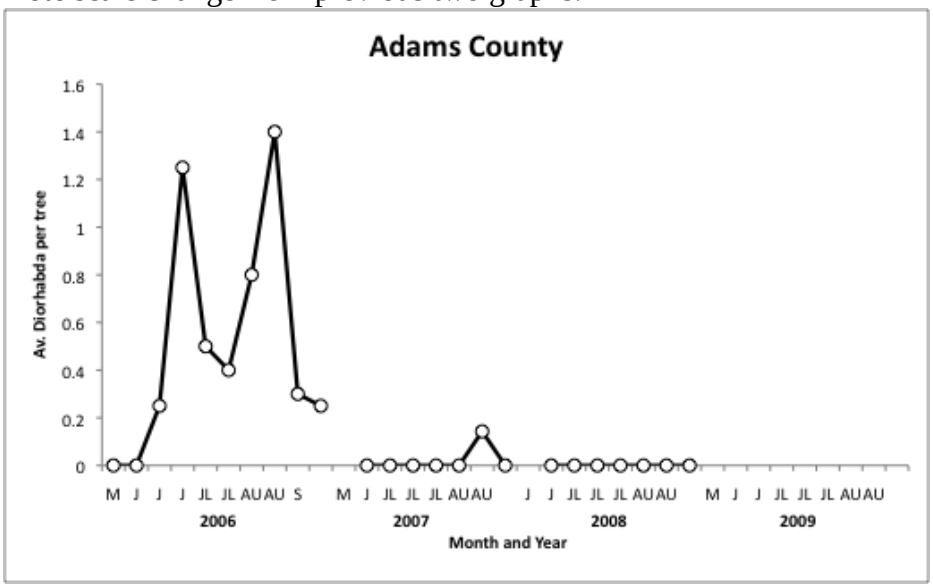


Figure 9:

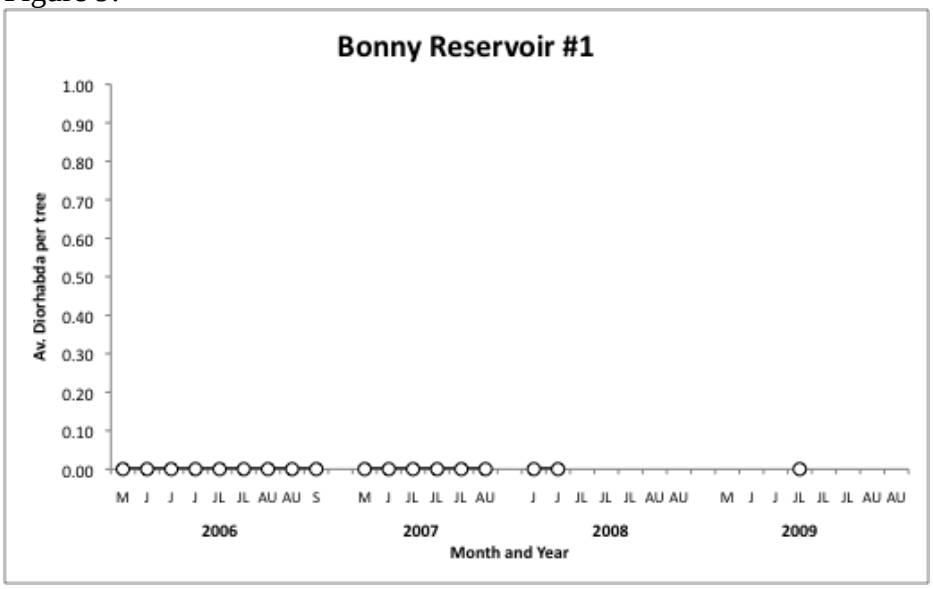


Figure 10:

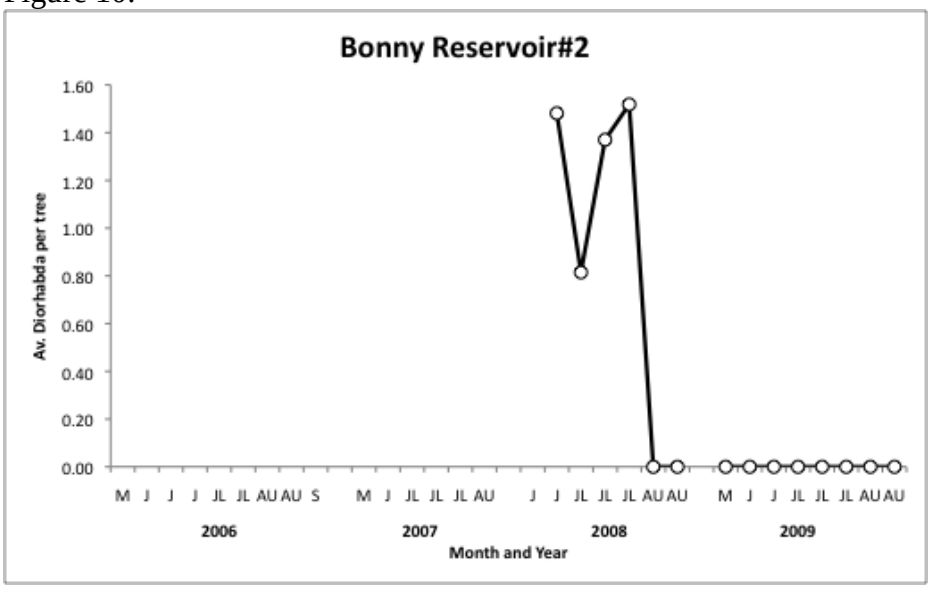

Bonny Reservoir#2
Av. Diorhabda per tree
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
M J J J JL JL AU AU S M J JL JL JL AU J J JL JL JL AU AU M J J JL JL JL AU AU
2006
2007
2008
2009
Month and Year

Figure 11: Foliage quality at Dinosaur National Monument.

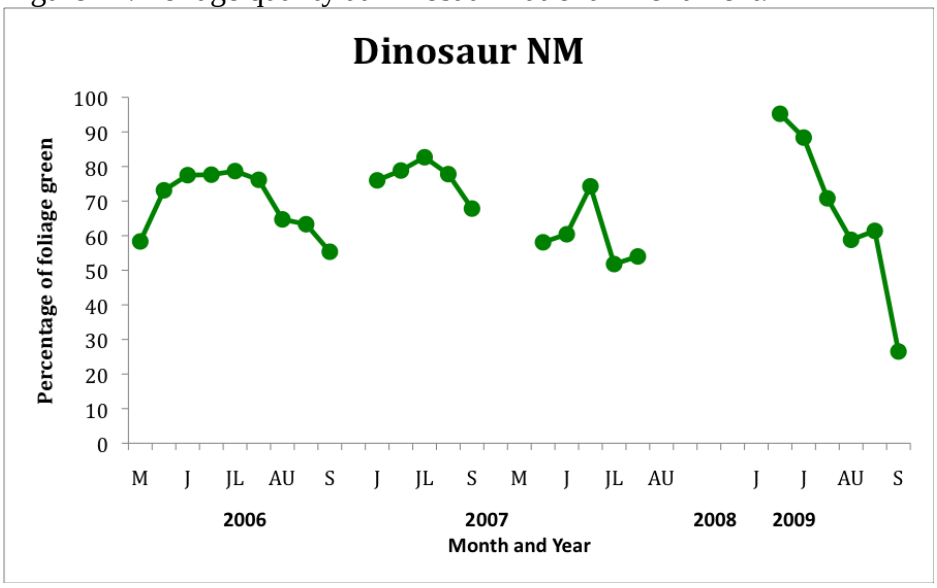


Figure 12: Foliage quality at Horsethief Canyon.

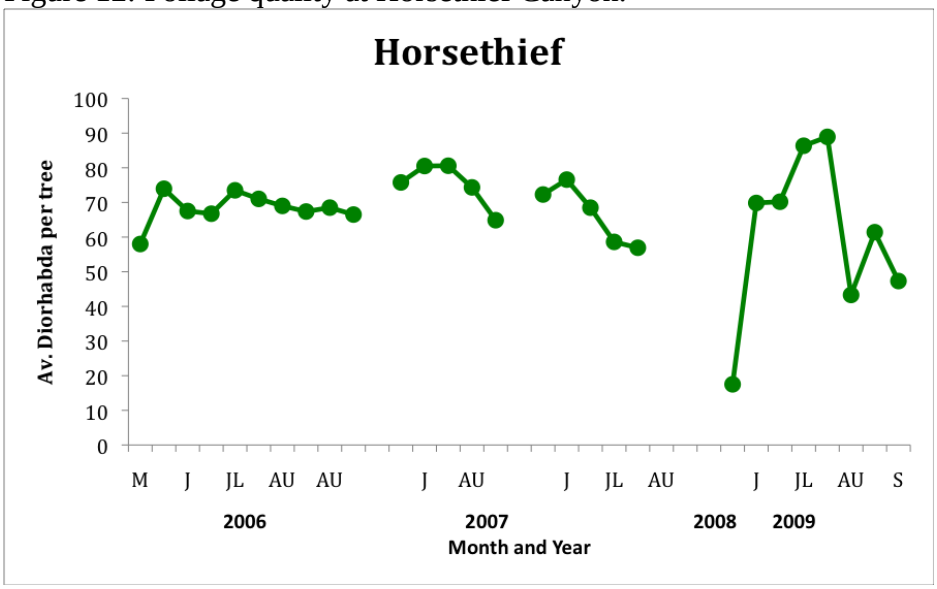


Figure 13: Tree volume at the release sites.

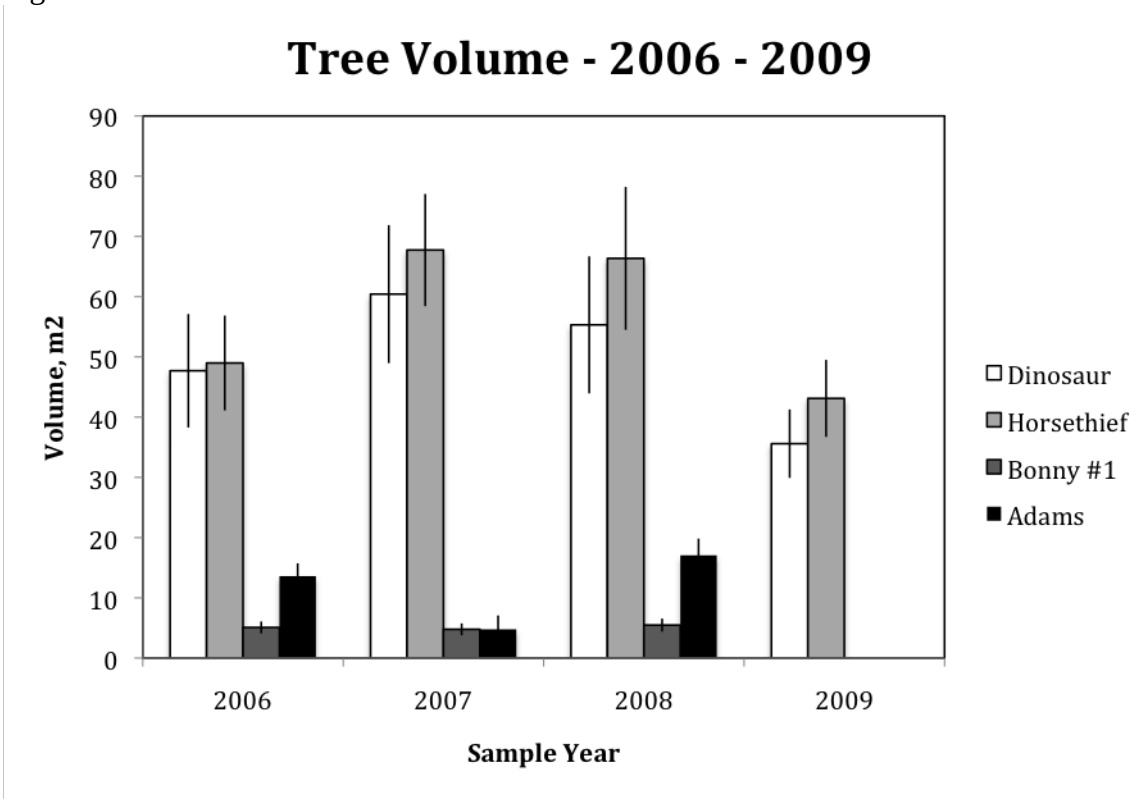


Figure 14 – 17. Species richness of the surrounding plant community.

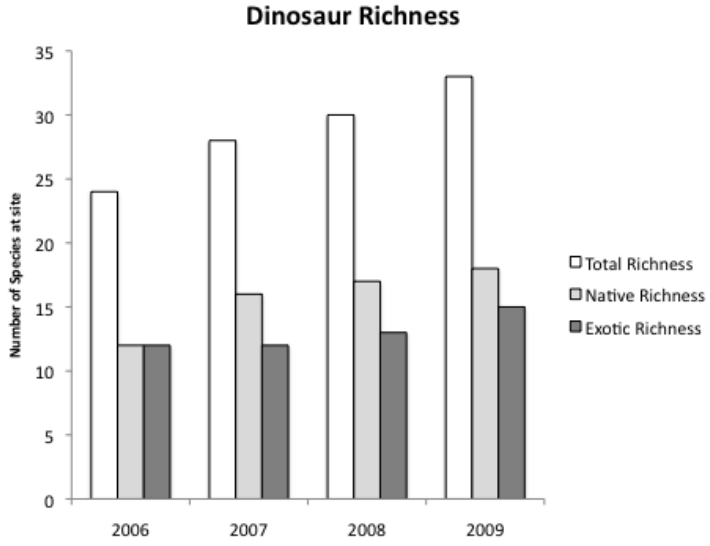


Figure 15:

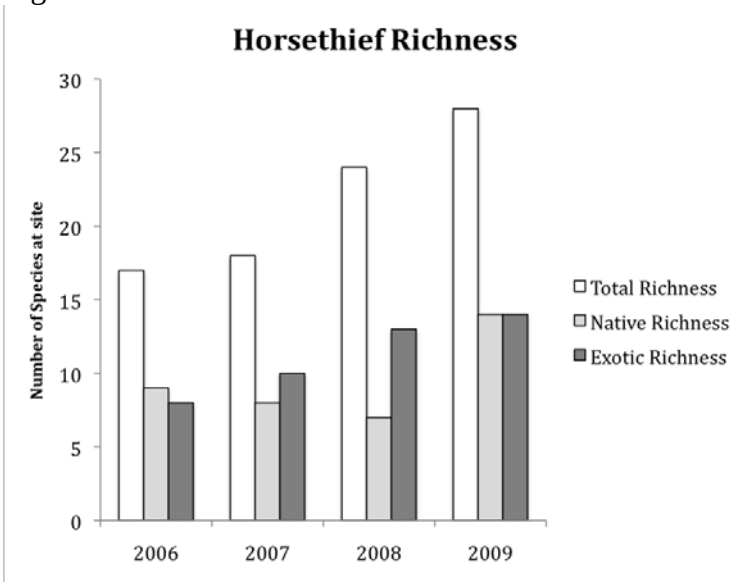


Figure 16:

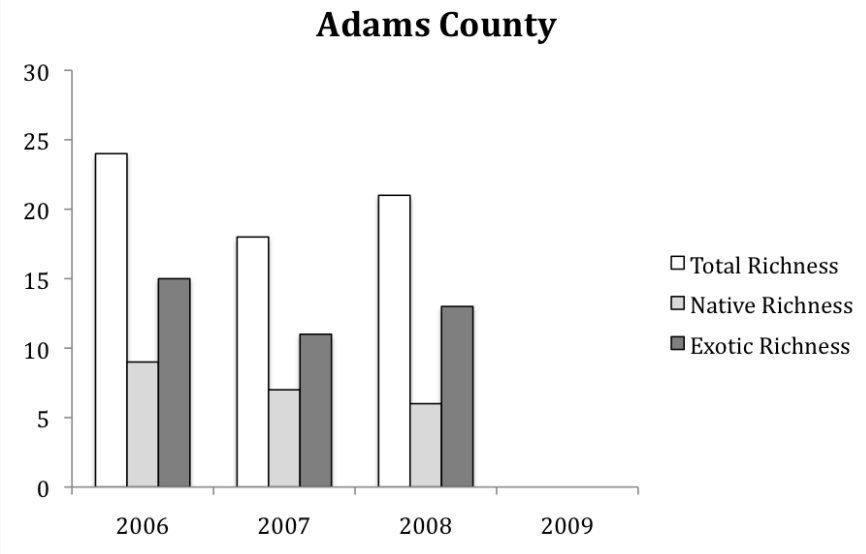


Figure 17:

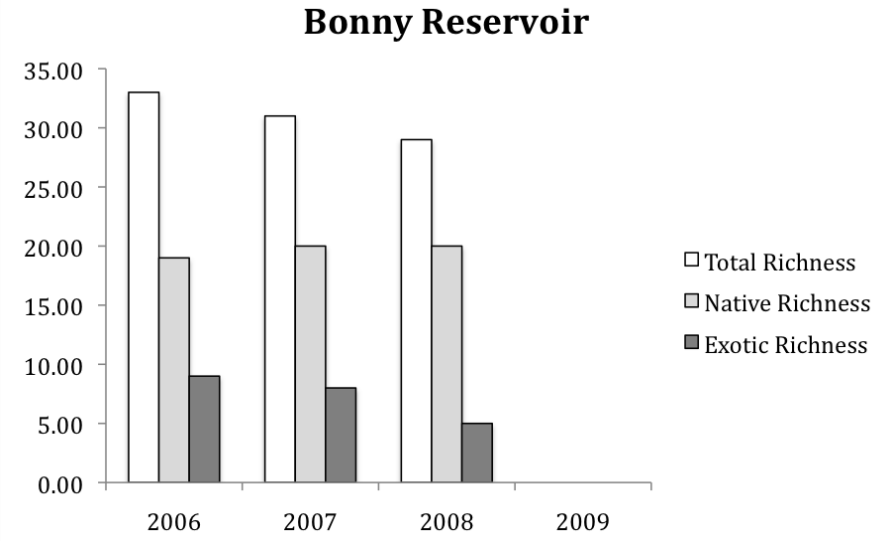


Figure 18-21: Percent cover by exotic / native status of surrounding vegetation.

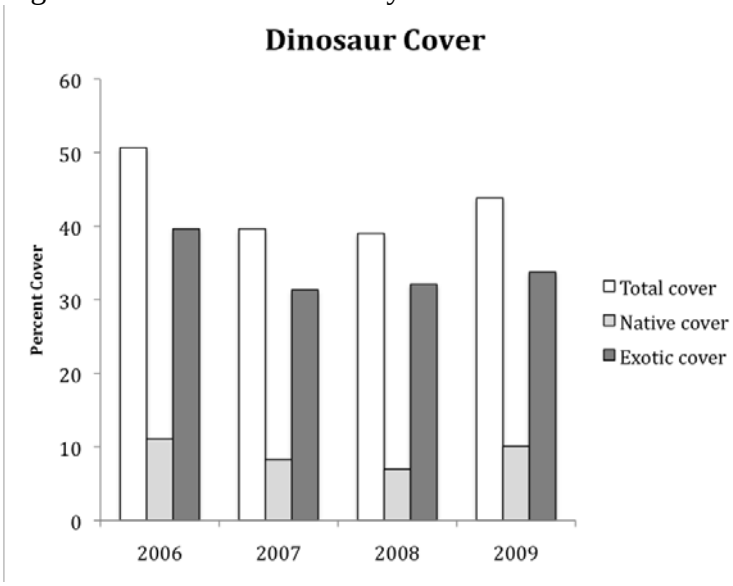
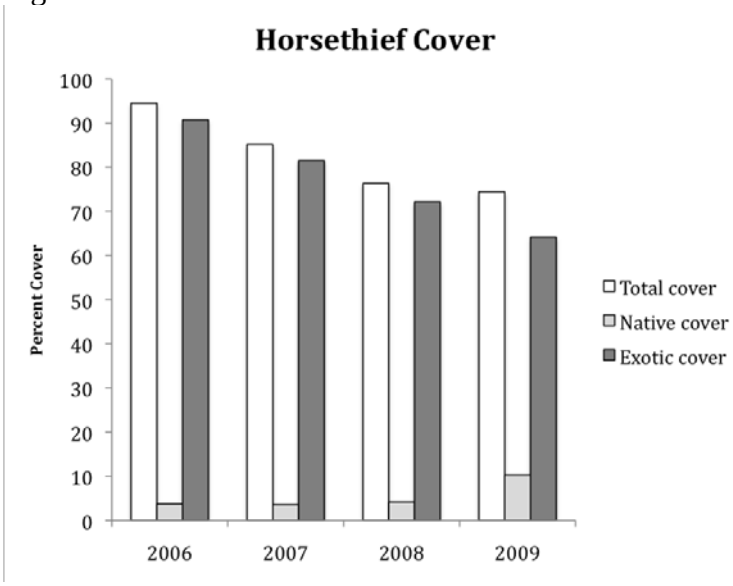


Figure 19:



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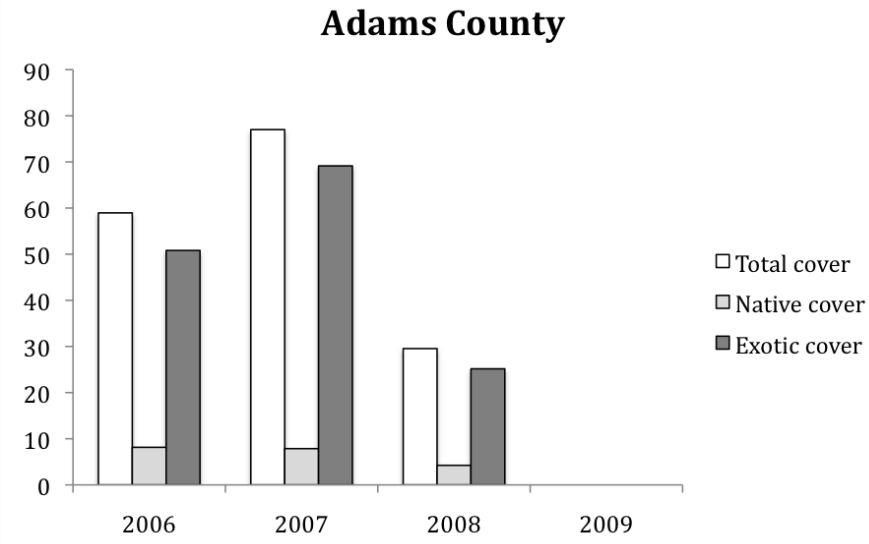


Figure 21:

Figure 22: Abundance of arthropods on three riparian tree species. A = Adams County, B = Bonny Reservoir #2, E = Dinosaur National Monument, H = Horsethief Canyon.

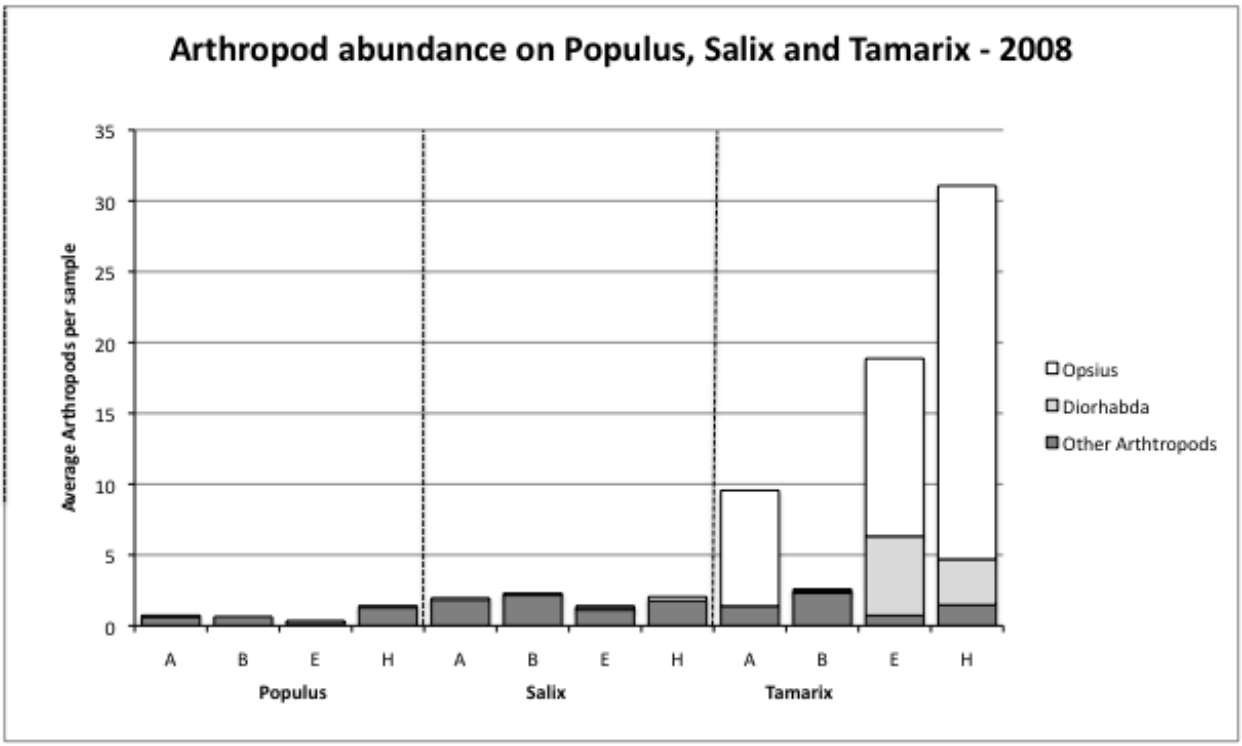
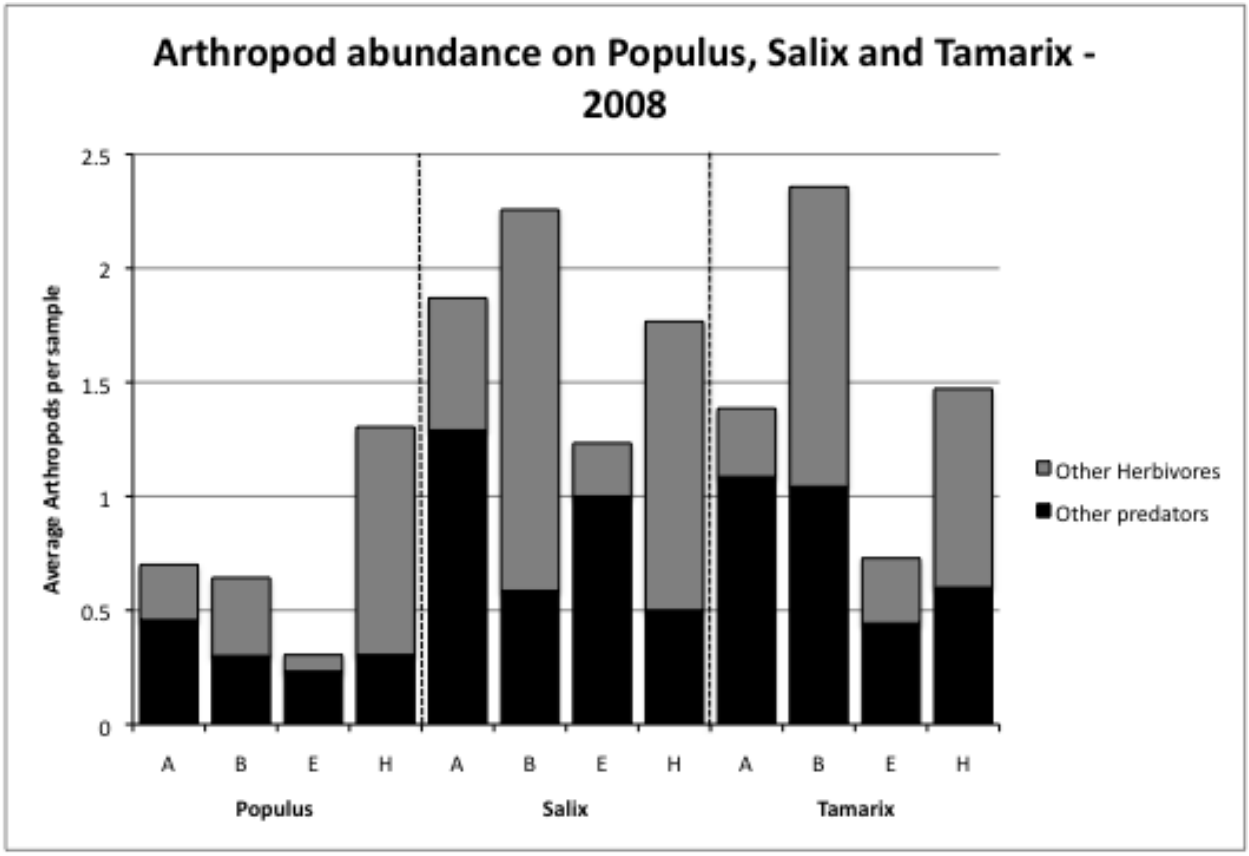


Figure 23: Abundance of herbivore and predator arthropods on three riparian tree species. Herbivores do not include the non-native *Opsius stactogalus* or *Diorhbda carinulata*. Legend as above.



Weed Survey and Biocontrol

Colorado Department of Agriculture – Conservation Services Division
Project Coordinator: Dan Bean

Summary

Yellow Toadflax

The Toadflax Consortium, co-chaired by Rose De Clerck-Floate (AAFC Lethbridge) and Andrew Norton (CSU) sent three hundred root galling weevils ***Rhinusa linariae*** to the Insectary for release in 2008. Caged releases were made at two sites; one near the town of Paonia (Delta County) and the other near the town of Buford (Rio Blanco County). The beetles develop underground in root galls so we couldn't easily monitor progress. No adults were noted in the late spring of 2009 when adult emergence was expected. One cage was inadvertently destroyed by county employees and the toadflax was accidentally sprayed with an herbicide whose chemical identity was unknown to the applicator. The site was abandoned. The other cage, in Rio Blanco County, remains in place and thus far no beetle activity has been noted. We are leaving the cage in place for one more winter since it has been reported that this species can take two years to develop. More adults will be requested from the toadflax consortium for release in the spring of 2010.

The stem boring weevil *Mecinus janthinus* has previously been released on yellow toadflax at a number of sites in western Colorado with no establishment. For this reason we no longer recommend using this species in yellow toadflax control. This recommendation could change following the encouraging developments of 2009. In Montana *M. janthinus* was found to be established on yellow toadflax and the CDA received a small shipment of the yellow toadflax adapted beetles from Montana in July. Beetles were released within a cage in Rio Blanco County and they remained active as adults for well over a month. Oviposition holes were found in yellow toadflax stems and one larva and one pupa were recovered from yellow toadflax stems. This is the most encouraging indication that *M. janthinus* could be an effective agent on yellow toadflax. The site will be closely monitored next spring to determine if overwintering took place. If so then beetles will be moved to at least two other sites. We also anticipate receiving additional weevils from Montana.

Dalmatian toadflax

The CDA continued to monitor five *Mecinus janthinus* release sites in western Colorado. Monitoring included beetle presence, toadflax density and at three sites vegetation response. There were three sites are in Mesa County and two sites are in Garfield County. *M. janthinus* has continued to move out from three release sites in Mesa County and Dalmatian toadflax densities at the releases sites have continued to decline. In Garfield County the releases were done in 2008 and no decline has been seen in Dalmatian toadflax densities yet.

Tamarisk

In 2009 our USDA APHIS funded work on tamarisk biocontrol was restricted to mapping and monitoring of previously released beetles. We mapped 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 by beetles (Figure 24) and beetles were well established on the Colorado, Gunnison, Green, Yampa and Mancos Rivers. The Dolores River was completely defoliated by mid July but extensive regrowth was noted in September. The Colorado River from the town of Fruita to the Colorado state line showed extensive defoliation by August 1. Areas that had been defoliated multiple times, starting in late 2007, showed extensive die back of tamarisk trees (Figure 25). Our monitoring site at the mouth of Knowles Canyon had experienced a major fire in 2007 and tamarisk regrowth was vigorous at the end of 2007 and in the late spring of 2008. Beetles moved into the site in 2008 and the regrowth was defoliated at least twice. In 2009 regrowth was minimal and most resprouts has feeding beetles.

The CDA has 14 tamarisk leaf beetle monitoring sites established and monitored 12 of these sites in 2009. The other two sites were not monitored in 2009 but will again be monitored in 2010. Sites monitored in 2009 include 5 sites on tributaries of the Colorado River, 2 sites on the Dolores River, 2 sites on the Mancos River, 1 site on the Gunnison River and 2 sites on Fountain Creek, a tributary of the Arkansas River. In addition 1 site on the Colorado River was intensely monitored by Andrew Norton's group

from CSU. At all sites monitored by the CDA 25 trees were marked within a 200 m radius of the release. Marked trees were monitored for vegetation quality including volume, beetle presence and defoliation level. Complete defoliation of all marked trees was noted at 5 sites while partial defoliation was seen 4 sites and beetle presence was noted at 11 out of the 12 sites. A full summary of tamarisk monitoring in 2009 will be given in the final report.

Laboratory cultures of 7 ecotypes of Diorhabda (noted in bold below) are being maintained and methods are under development for holding cultures in the state of diapause for long term storage. The ecotypes include 4 of the 5 recently recognized sibling species of *Diorhabda*. *Diorhabda carinulata* originated from central Asia and includes the **Turpan ecotype,** the **Fukang ecotype** and the **Chilik ecotype**. *Diorhabda carinata* originated in central Asia and includes the **Uzbek ecotype**, *Diorhabda elongata* originated in Greece and Crete and includes the **Posidi ecotype** and the **Crete ecotype**. *Diorhabda sublineata* originated in North Africa and includes the **Tunisia ecotype**.

Russian Knapweed

The CDA continued to maintain a Russian knapweed garden for potential use when biocontrol agents become available. We received a small shipment the Russian knapweed gall fly *Jaapiella ivannikovi* in the form of stem galls originating from insects cultured in quarantine by the USDA APHIS. Galls were set up in an incubator and observed for adult emergence (Fig 26). Four adults emerged (Fig. 26) and we put them out in on caged Russian knapweed plants in the Insectary garden. We also put out remaining galls in anticipation of further adult emergence. We found no evidence of galling on the stem tips of the plants but we'll monitor the cage for gall formation in the spring when new shoots are present on the knapweed plants.

Leafy Spurge

The CDA continued to monitor 16 leafy spurge sites in Rio Blanco County. We measure leafy spurge stem densities at 16 m^2 surrounding agent release points, leafy spurge densities on one hectare surrounding release points and vegetation response on one hectare surrounding release points. Most releases were of the leafy spurge flea beetle Aphthona spp but we also released the long horned beetle *Oberea erythrocephala* and

have recovered them at most of the 16 sites. In addition to sites in Rio Blanco Country we are monitored 5 sites on or near the Front Range.

Other Targets and Agents

The Insectary continued to distribute the bindweed gall mite *Aceria malherbae* with approximately 580 releases made in Colorado. In addition there were 48 releases of larvae of the bindweed moth *Tyta luctuosa*. Monitoring for *T. luctuosa* continued in the Grand Valley and adults were found to be widespread and to occur throughout the season. Pheromones were tested with little success; other formulations will be tested in 2010. No *T. luctuosa* have been found in the field outside of a relatively small area in western Colorado. There were 213 releases of the stem boring weevil, *Mecinus janthinus*, on Dalmatian toadflax. This was possible due to greatly increased collection in state and from productive sites in other western states. Dalmatian and yellow toadflax sites received 23 releases of larvae of the moth *Calophasia lunula*. *C. lunula* was also found established at a number of sites in western Colorado. There were 73 releases of *Aphthona* spp made and 2 releases of *Oberea erythrocephala* although a substantial number of *O. erythrocephala* were released in the experimental monitoring program and those numbers will show up in later tallies. Large numbers of Canada thistle galls were collected at the end of 2008 which translated to 77 releases of adults in 2009. Puncturevine weevils (*Microlarinus* spp.) were released at 82 sites which is the most we've had in at least 5 years. *Cyphocleonus achates* (6 releases) and *Larinus minutus* (30 releases) were released on spotted and diffuse knapweed. Efforts to locate more productive collection sites for *C. achates* were disappointing but will continue in 2010. There were 70 releases of *Trichosirocalus horridus* on musk thistle

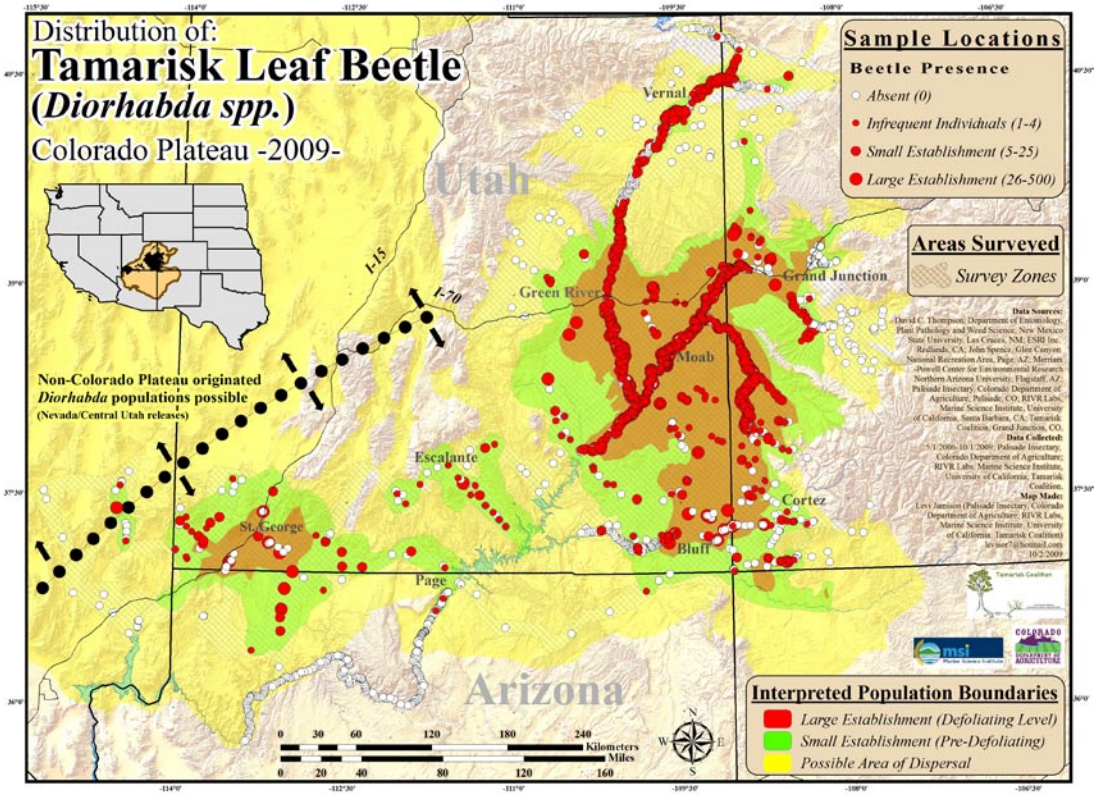


Figure 24. Distribution of the tamarisk leaf beetle in the Colorado River Basin as determined by sweep sampling. The map was compiled by Levi Jamison working for the Colorado Department of Agriculture to survey western Colorado and the Tamarisk Coalition to survey Utah, Arizona, New Mexico and Nevada.

Figure 25. Photos taken along the Colorado River between the Loma boat landing and the Colorado/Utah state line. Tamarisk has been defoliated at least 3 times in the past year and a half. The tamarisk plants have died back and willows and other native are growing up through the tamarisk plants.

Figure 26. Stem gall on Russian knapweed sent to the CDA for propagation (left). *Jaapiella ivannikovi* adult newly emerged from stem galls, highly magnified ventral view (right).

Table 2: Weed biological control releases, 2009			
Agent	**Target**	**# of Releases**	**Total Released**
A. malherbae	Field bindweed	581	581,000 (est)
Aphthona spp	Leafy spurge	73	73,000
C. lunula	Toadflaxes	29	13,332
C. achates	Knapweeds	6	525
L. minutus	Knapweeds	30	5,745
M. janthinus	Dalmatian toadflax	213	42,700
Microlarinus spp	Puncturevine	82	16,400
T. horridus	Musk thistle	70	7,000
T. luctuosa	Field bindweed	48	36,285
U. cardui	Canada thistle	77	7,730
O. erythrocephala	Leafy spurge	2	200

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