Lady Beetles, Buckthorn, and Bees
Answering Ecological Research Questions in Your Own Landscape.

Mary Gardiner, Chelsea Smith, Ian McIlvaine, and Scott Prajzner
Exotic Lady Beetles in North Central U.S.

Exotic lady beetles released into the U.S. for over 100 years both accidentally and to control agricultural pests.

To date, over 100 species of exotic lady beetles have been released.

Currently, four species of exotic lady beetles are found in the North-Central U.S.

- *Coccinella septempunctata*
- *Harmonia axyridis*
- *Hippodamia vareigata*
- *Propylea quatuordecimpunctata*
Native Lady Beetle Species

Ohio has many species of native lady beetles; in this study we are interested in 10 species which are found within agricultural habitats. Many native species have declined following the introduction of exotic species. As a volunteer, your efforts will contribute to understanding the extent of this decline and the development of conservation strategies.

Convergent
Oval, red. Pronotum with two white dashes angled towards each other forming a “V” pattern. Each wing cover with 6 spots; fewer may be present. Decreasingly common.

Parenthesis
Oval, red to orange. Pronotum black with white along the front edge. Parenthesis-shaped spot on hind portion of each wing cover. Sometimes parenthesis does not completely connect. Somewhat common.

Pink
Oval and somewhat flattened, bright red to pink. Pronotum has two black triangular spots. Six spots on each wing cover. Common.

Twice-stabbed
Very small and round with a black pronotum and black wing covers. Each wing cover has six spots, with a central spot at the base of the pronotum. Rare.

Orange-spotted
Very small and easy to miss on sticky cards! Pronotum black with orange spot on each side. Black wing covers each with 5 orange spots. Rare.

Polished
Small and round. Pronotum black with a white border and two white lobes which extend back. Red to orange wing covers with no spots. Common.

Nine-spotted
Round, orange to red. Very similar to 7-spotted lady beetle but with 4 spots on each wing cover and one central spot. Exceedingly rare.

Three-banded
Round, red to orange. Pronotum black with white along front edge. Wing covers each with three black bars. Rare.

Mystery Lady Beetle?
If you find a lady beetle on your sticky trap that is not shown here, please mark it as “other lady beetle” on the data sheet. If you would like to view additional lady beetle images, as well as lady beetle “look-alikes,” or would like to learn more about these beneficial insects, check out our web site: ladybeetles.osu.edu

Thank you for your participation!
Project Objectives:

1. **Evaluate** the current status of native and exotic lady beetles across Ohio

2. **Examine** the influence of patch and landscape scale variables on coccinellid communities found in residential gardens

3. **Educate** the public about the importance of conserving and enhancing lady beetles and other beneficial insects in our landscapes.

http://ladybeetles.osu.edu
BLBB Program

Fence post
2 Sticky Card Traps
Instruction Card
ID Card
Data Sheets
Mailing Envelopes
BLBB Data Collection

Select a sampling site – food or flower garden of any size

Mark your calendar: 2 sampling periods (2011 dates below)

       June (12-18) or (19-25)
       August (15-21) or (22-28)

Approximate center of garden space

Open the sticky trap and attach to step-in fence post

Allow to collect insects for 7 days
BLBB Data Collection and Analysis

Data Sheet – June Collection

Contact Information
- Name of Participant:
- Mailing Address:
- Phone number:
- E-mail:

Garden Information
- Garden sampled was located at mailing address:
- Is garden part of the OSU Phytology Garden Network:
- Garden site address:
- Garden:
- Results:

Garden Layout
- A brief description of the garden layout:
- The number of lady beetles (L. decemlineata) observed:
- The number of non-native lady beetles observed:
- The number of non-native lady beetles recorded:

Buckeye Lady Beetle Blitz

BLBB 2009 Results

We had a total of 88 members in the BLBB volunteer network in 2009. These individuals conducted a survey of native and exotic lady beetle abundance in food and flower gardens across Ohio. The locations these gardens are shown on the map below.
BLBB Program

2009: 193 collection sites,
89% return in June and 84% in Aug

2010: 258 collection sites,
84% return in June and 77% in Aug
BLBB Program 2009-10

Ten species found in BLBB gardens

Exotic Multicolored Asian Lady Beetle & Fourteen spotted, Native Orange Spotted most common species collected.

![Graph showing lady beetles per sticky card (Mean +/- SEM) for June and August, with asterisks indicating significant differences.](graph.png)
BLBB Program 2009-10

Three species more common in June versus August:

Native Orange Spotted, Exotic Fourteen Spotted and Seven Spotted
BLBB Program Actual versus Reported

Under estimation of exotics and over estimation of native species

** Data analyzed using a generalized linear model, negative binomial distribution
Since the introduction of exotics some native species are in decline.

Two-spotted and nine-spotted lady beetles, from common to rare.

Convergent lady beetle appears to be declining.

State Insect of Ohio!
Loss of Native Coccinellidae – WHY?

Rapid decline since the 1980’s possibly due to:

• Land use change

• Pesticide use practices

• Disease

• Increased competition with exotic Coccinellidae
**Hypotheses**

1. *Exotic Lady Beetles are eating the eggs of native species*

2. *Exotic lady beetles are out-competing native species for prey*

3. *The presence of exotic lady beetles has increased shared parasitoids and diseases.*

**Prior to Exotic Introduction**

- Native egg predation by native coccinellids

**Exotic Introduction**

- Both native and exotic species consume eggs of native species.
- Fewer aphids available in croplands due to exotic consumption of shared prey.
- Presence of exotics allow parasitoid populations to build, increasing parasitism of native species.
We knew this is happening in the lab........
Do exotic lady beetles eat native lady beetle eggs in the field?

Does this explain the decline in native lady beetles?
Study Species:  
• Exotic  
• Declining Native  
• Common Native

Habitats (N=24):  
• Alfalfa  
• Grassland  
• Soybean

Experimental Procedure:  
• Treatments remained in field for 48 h, number of eggs remaining determined.

• Experiment was carried out twice during the summer of 2010: mid-June: 6/8-6/11 (in alfalfa and grassland only) and the end of July: 7/26-7/29 (in all habitats).
Experiment 1: Key Findings

1. All species experienced significant egg predation in alfalfa and grassland (open treatment had fewer eggs remaining compared with caged treatment) (Figures A-C).

2. The amount of predation incurred in alfalfa and grassland sites was not significantly different (Figures A-C).
Experiment 1: Key Findings

1. All species experienced significant egg predation in alfalfa and grassland (open treatment had fewer eggs remaining compared with caged treatment).

2. The amount of predation incurred in alfalfa and grassland sites was not significantly different.

3. *H. convergens* experienced significantly more predation than the other two focal species.
Experiment 2: Key Findings

1. All species experienced significant egg predation in all crops (open treatment had fewer eggs remaining compared with caged treatment).

2. There was variation in the amount of predation incurred by *H. convergens* and *H. axyridis* in soybean alfalfa and grassland habitats.
Experiment 2: Key Findings

1. All species experienced significant egg predation in all crops (open treatment had fewer eggs remaining compared with caged treatment).

2. There was variation in the amount of predation incurred by H. convergens and H. axyridis in soybean alfalfa and grassland habitats.

3. Across study habitats, predation of H. convergens and C. maculata did not differ. Both incurred significantly greater egg predation compared with H. axyridis.
IGP surveillance using video systems

Data was collected from 18 fields (4 soybean, 5 alfalfa, and 9 grassland) between 6/18/2010 and 8/13/2010.

Camera system designed by Matt Grieshop, MSU
Guild of Egg Predators

Soybean

- 100% Daddy Long Legs

Alfalfa

- 80% Daddy Long Legs
- 20% Grasshopper

Grassland

- 27.1% Lacewings
- 12.5% Gryllidae
- 6.3% Acrididae
- 10.5% Pill Bugs
- 22.9% Daddy Long Legs
- 8.3% Lady Beetle
- 10.4% Slugs
- 2.1% Katydid
Future Studies....

1. Determine how the group of egg predators varies by exotic and native lady beetle species and by foraging habitat.

2. Learn more about the guild of predators attacking eggs, have their populations changed in recent decades?

3. Examine additional competitive interactions between native and exotic lady beetles.
Why are exotic lady beetles so abundant?
Common Buckthorn Impacts

- **Soybean Aphid.** Invasive pest first detected in U.S. in 2000. Common buckthorn provides food source and overwintering site.

- **Exotic Earthworms:** Prefer common buckthorn litter over native trees and shrubs, found in higher abundance in common buckthorn-invaded areas. High earthworm populations and rapid litter decomposition have negative impacts on soil biota.

- **Forest Understory:** Reduced light, loss of native herbaceous plants, often replaced by common buckthorn seedlings. Reduced light, loss of native herbaceous plants, often replaced by common buckthorn seedlings.

- **Loss of Native Biodiversity:** The presence of exotic lady beetles in soybean production fields provides an abundant food source for the multicolored Asian lady beetle, an introduced predator of soybean aphid, leading to a decline in native lady beetle species.

- **Exotic Lady Beetles:** Presence of exotic lady beetles in soybean production fields provides an abundant food source for the multicolored Asian lady beetle, an introduced predator of soybean aphid, leading to a decline in native lady beetle species.

- **Soybean Production:** Soybean aphid reduces plant quality and yield and increases the use of pesticide in soybean production.

- **Vegetable Production:** Infested soybean fields produce winged aphids which can disperse into vegetable crops and transmit several plant viruses.

- **Public Support for Biological Control:** Household nuisance. In addition, some have reported allergic reactions to the beetles.
Common Buckthorn Invasion

Shrub/small tree

Introduced in early 1800’s as a landscape/hedge plant

Naturalized throughout northern Midwest and Northeast.

Fast growing, tolerates diversity of growing conditions, lacks natural enemies, high reproductive and dispersal capacity.
Common Buckthorn Identification

**Appearance:** Up to 25 ft height, multiple stems at base

**Leaves:** Oval with pointed tip, margins finely toothed (3-5 pair upward-curved veins) Glossy, hairless and smooth.

**Branches:** Buds and leaves are opposite. End in short spines.

**Bark:** Rough, grey to brown with light-colored lenticels. Inner bark yellow and heartwood orange or pink.

**Flowers:** *Early spring.* Dense clusters, 4-petaled, yellow-green.

**Fruit:** ¼ inch purple/black in color. Present in fall.
Project Goals

USDA NIFA Funded in 2009, Biology of Weedy and Invasive Species Program

(Mary Gardiner, Andy Michel, Doug Landis, Dave Lusch, and Matt O’Neal)

Our goal is to examine whether reducing common buckthorn abundance at landscape scales will reduce the impacts of those species it supports.
Soybean Aphid and Common Buckthorn

Common buckthorn supports soybean aphid in the fall, winter, and spring:
Our Research Questions

1. Does the amount of buckthorn in the landscape influence colonization of soybean fields by soybean aphid?

2. If so, at what spatial scale does buckthorn abundance influence colonization of fields? (miles, tens of miles, hundreds of miles?)

Are Ohio aphids migrating from local buckthorn infestations or moving much longer distances from Michigan or Ontario?
Our Research Questions

1. Does the amount of buckthorn in the landscape colonization of soybean fields by soybean aphid?

2. If so, at what spatial scale does buckthorn abundance influence colonization of fields?

3. Are landscapes with significant buckthorn invasion a source of multicolored Asian lady beetles?

Understanding the scale of aphid movement from common buckthorn to soybean will inform regional management of all species.
Mapping Common Buckthorn

Our first step is to map the distribution of common buckthorn across the north central U.S.

Combination of modeling and on-the-ground survey techniques

Using satellite images we are estimating the distribution of common buckthorn across the north central states. (Dr. Dave Lusch, RSGIS, MSU)

Common buckthorn holds its leaves late into the fall. We look for late season “greenness” in satellite images along fencerows, forest edges as an indicator of possible buckthorn presence.

Buckthorn distribution also predicted using ecological niche modeling, identify areas with conditions most likely to support common buckthorn.
Our modeling efforts must be done in conjunction with on-the-ground surveying!

The Buckthorn Watch Program

Current Projects:


http://buckthornwatch.org
http://buckthornwatch.org
The WHAT, WHEN, WHERE and WHO of Buckthorn Watch:

**WHAT** do Buckthorn Watch volunteers do?

Find and report common buckthorn infestations

- Location
- Size of patch
- Density of patch
The WHAT, WHEN, WHERE and WHO of Buckthorn Watch:

**ANYTIME:** You can identify common buckthorn any time of year. However, its easiest to identify in the spring (flowers) or fall (fruits)

Take these pictures with you to the field, on the ID bookmark!
The WHAT, WHEN, WHERE and WHO of Buckthorn Watch:

**ANYWHERE:** Parks, woodlot edges, urban areas, along roadsides, hiking trails, railroad right-of-ways, fencerows between crop fields, maybe even your neighbor’s yard!
The WHAT, WHEN, WHERE and WHO of Buckthorn Watch:

**ANYONE:** We are all negatively impacted by the presence of these species and must work together to reduce their impacts.

Farmers, master gardener groups, natural areas stewards, school groups; any individuals willing to help are encouraged to participate in Buckthorn Watch.
Sign up as a member of Buckthorn Watch, visit the Report page of our website today!
We partnered with the Midwest Invasive Species Information Network to collect data on the distribution of common buckthorn. You will be transferred to their website where you register as a member of Buckthorn Watch.
After you register you will receive login information by email.
Welcome to the MISIN!

Account Login

Username: buckthornwatch
Password: **************

[ ] Remember me Login

(Forgot Your Password?)

Create an Account

In order to complete the necessary training modules and record an invasive species observation, you will need to register. All information will be kept confidential. If you are already registered to use MISIN, you may login using your existing username and password.

Register Now
Report Sightings: OSU Buckthorn Watch

Welcome to Buckthorn Watch!

We are partnering with the Michigan Invasive Species Information Network to map the distribution of common buckthorn across the north central U.S.

If this is your first visit, you will need to complete a short tutorial to assist with common buckthorn identification. Proceed to Step 2 (Species Training) below and select the "Common Buckthorn" training module from the list of "Available Training Modules". Once completed you will be able to proceed to Step 3 (Report Sighting).

If you are a returning network member and have already completed the Common Buckthorn training module then proceed to Step 3 (Report Sighting).

STEP 1
Register and Login

STEP 2
Species Training

STEP 3
Report Sighting

Common Buckthorn / Learn More...
Common Buckthorn (*Rhamnus cathartica*)

**Habit:** Deciduous, woody shrub to small tree ranging from 3-7.5 m (10-25 ft) in height and reaching 25 cm (10 in) in diameter.

**Leaves:** Simple, opposite to sub-opposite, oval, dark green, smooth and shiny; small teeth along margins; veins that curve from base towards leaf tip; early leaf out, long growing season.

**Stems:** One to several stems from the base; stems branch towards the crown; twigs with thorns often found near the tips; bark is brown to gray, peeling with age, dotted with vertical light-colored lenticels; inner bark is orange.

**Flowers:** Small, green-yellow, four-petaled, clustered in leaf axils; bloom May-June: fragrant.

**Species Summary**

- **Common Name:** Common Buckthorn
- **Scientific Name:** *Rhamnus cathartica*
- **Family:** Rhamnaceae (Buckthorn Family)
- **Duration:** Perennial
- **Habit:** Shrub
- **USDA Symbol:** RHCA3

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**How Do I Report An Invasive Species Sighting?**
Volunteers complete a short ~10 minute module and assessment to learn more.
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STEP 1
Register and Login

STEP 2
Species Training

STEP 3
Report Sighting
Step 1: Locate your common buckthorn patch.

This patch is next to where I park my car at my apartment!
Step 2: Enter some information about the patch.

Step 3: Submit your report!
You will be able to review your submission

More Buckthorn Watch Options

Aphid Hunt

Interested in Joining Aphid Hunt? Click the Participate button to send an email to the Aphid Hunt project with your Buckthorn Watch observation data included.

Have Site Photos?

You can send us your Buckthorn Watch site photos by using the form below. Your Name and Email will be taken from your MISIN profile. You can upload jpg, jpeg, gif, and bmp files and the file size should be less than 2 megabytes (MB).

Select A Photo To Email:  
Browse...  Submit
Aphid Hunt

If you report a common buckthorn infestation and are willing to return to your site to survey it for aphids we would greatly appreciate your help.

Aphid Hunt participants will receive an email in the spring and fall that indicates a 2 week “open season” to survey their reported buckthorn patches for aphids.

During spring and fall hunts, 200 leaves are inspected and the number of winged and wingless aphids recorded and collected in a zip-close bag.

Any aphids found will be mailed to the Buckthorn Watch team (postage and shipping materials provided).
APHID HUNT

The Buckthorn Watch program is collecting data on soybean aphid populations. As described on the IMPACTS page of this website, the presence of common buckthorn has facilitated the invasion of the soybean aphid, a damaging crop pest. We will survey the abundance of this pest on common buckthorn in the spring and fall.

Interested in participating in this Aphid Hunt? Review the information below for details on how you can get involved!

Soybean Aphid Life Cycle: The soybean aphid overwinters on common buckthorn in the egg stage. In the spring aphids feed on common buckthorn for 1-3 generations, then winged forms are produced that migrate to soybean fields. Multiple generations can occur during the summer on soybean. Wingless aphids will be produced within soybean fields when plants are in good condition. When plants begin to deteriorate, winged aphids are produced that migrate to other soybean fields. In the fall when soybean plant begin to dry out and the temperature declines, soybean aphids migrate from soybean to common buckthorn. This is the only time that both male and female aphids are present. During the rest of the year all aphids are female and reproduce clonally, or without mating. The male and female aphids mate on common buckthorn in the fall and females lay eggs near leaf buds. CLICK HERE to examine a diagram of this life cycle.

Identifying Soybean Aphid: Soybean aphids are small (about the size of a pin head). They are light green to yellow soft bodied insects. They are
Mapping Common Buckthorn

Send us your pics!
Large scale invasive plant removal?

Its been done before!

Beginning in early 1900’s widespread and successful removal of Barberry to reduce black rust in wheat.

“Help us locate every bush..”
Volunteers Needed for Bumble Bee Study – Scott Prajzner

Help us study bumble bee health in your own backyard!

Our research will help with understanding how different residential environments affect bumble bee health.
Bee Healthy Landscapes
Acknowledgements:

All Our Volunteers!

Denise Ellsworth and Pam Bennett

Amos Ziegler

The Stewardship Network

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