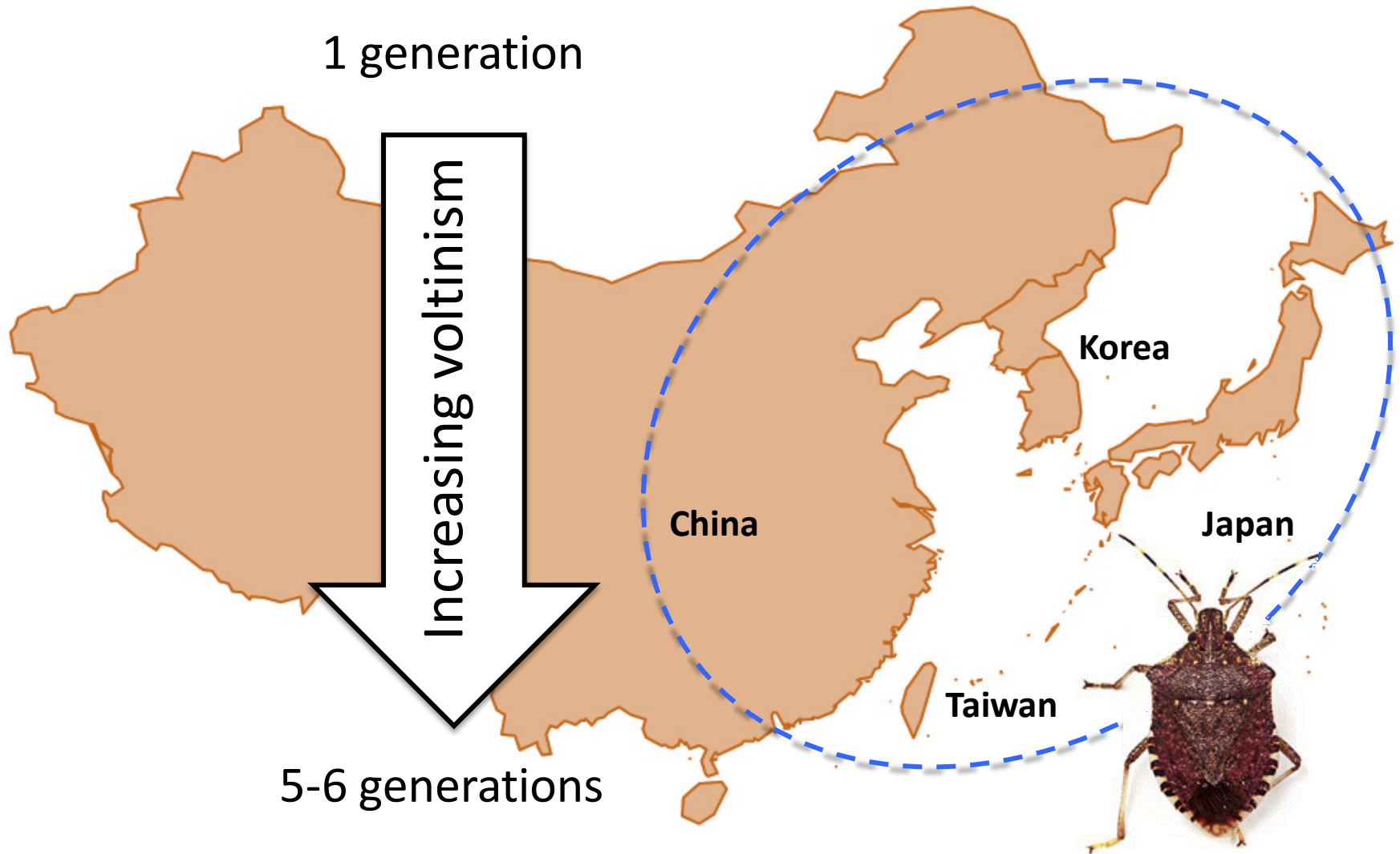


# Brown Marmorated Stink Bug (BMSB) – Biology and Management



**Nik Wiman, Silvia Rondon, Vaughn Walton,  
& Peter Shearer**

# Origin of BMSB



# Background

- First detected 1996, Allentown, PA
- Initially urban nuisance
- Emerged as pest 2010
  - \$37 mil. apple crop
  - 100% losses peaches
  - Major impacts
    - Small fruits
    - Vegetable crops
    - Soy and corn



# Background

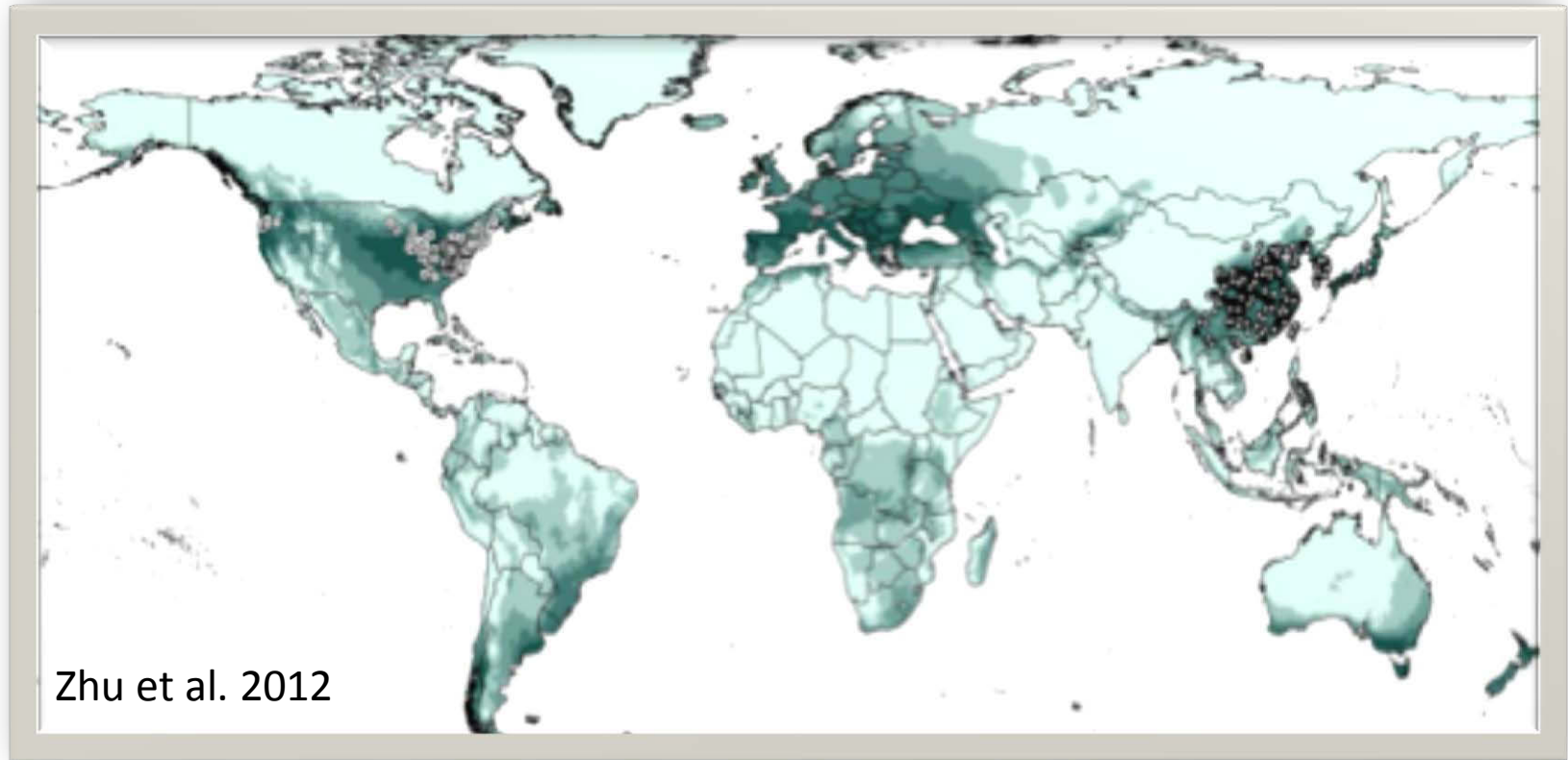
- First identified from PDX in '04 (ODA)
- Possibly introduced much sooner
  - West and East coast pops identical
    - Points to a single U.S. introduction
      - However, new interceptions continue
      - Major ports on both coasts
- Human-assisted dispersal around the U.S.\*
  - People relocating, RV's, shipping, etc.



\*Good intrinsic dispersal capacity too



# BMSB: a worldwide pest?



- PNW (Coastal and Inland) highly suitable habitat
- Potential for a single, contiguous US population

# BMSB Life History



Photos: UMD

- Overwinter as adults, aggregate in structures
- Natural overwintering sites have been found in WV
  - Under bark on dead trees
  - Rock outcrops

# BMSB Life History



**28 eggs**



**“red ring”**



**“black ring”**



**“red ring”**

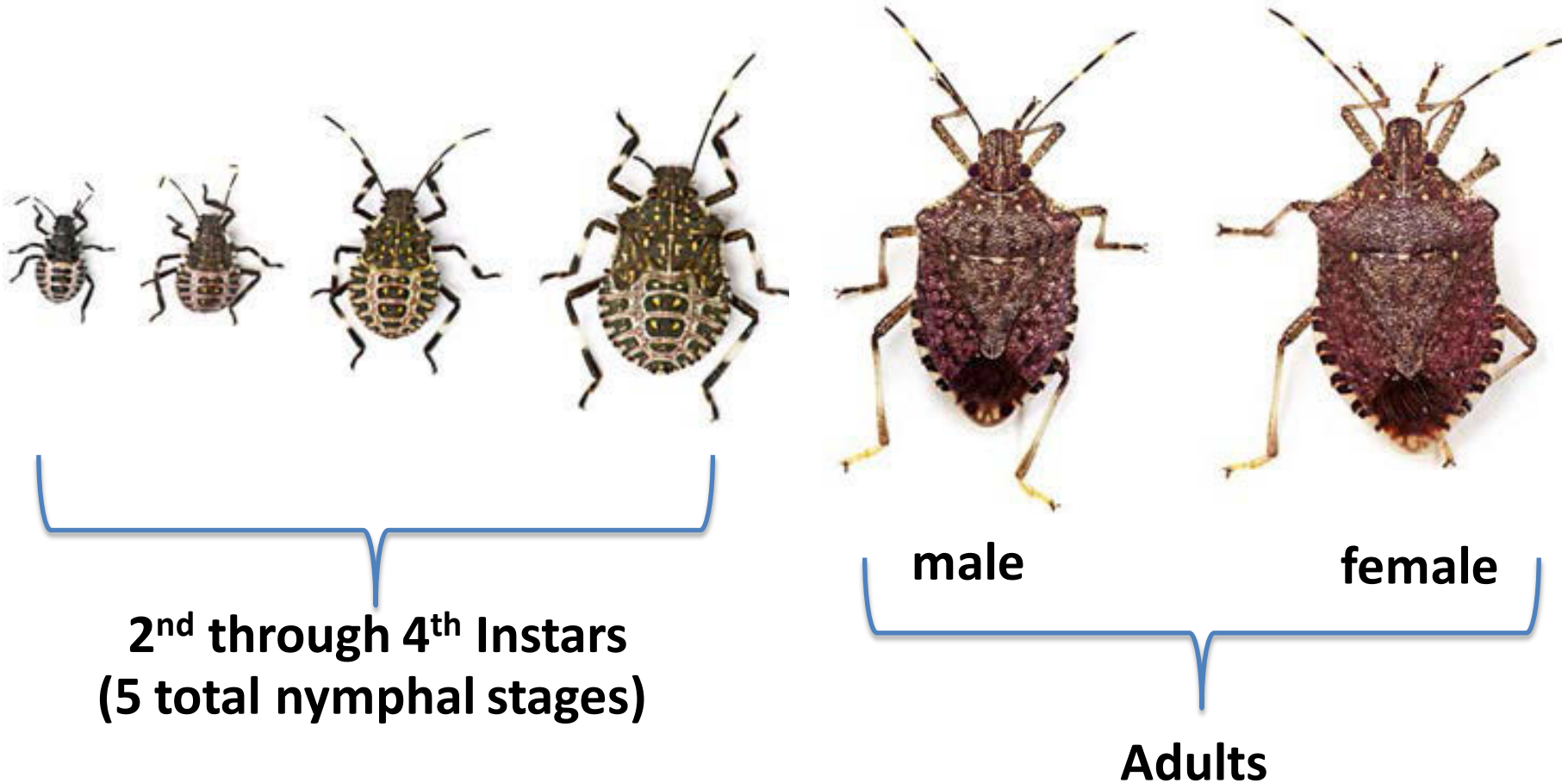


**Broad leaf**



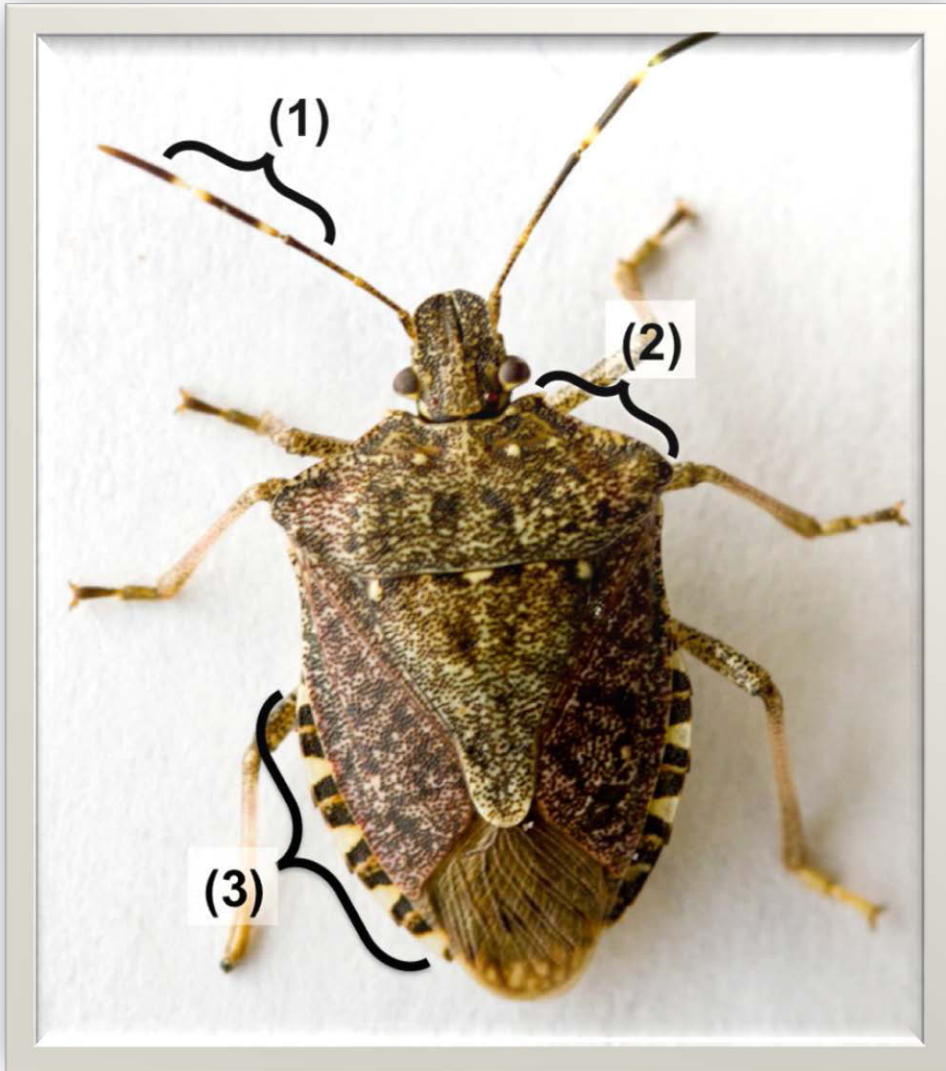
**Twig**

# BMSB Life History





# Identification of BMSB



- ① White bands on charcoal antenna
- ② Smooth anterior pronotal margin, AKA “shoulder”
- ③ Banding pattern on abdominal margin

# Identification of BMSB



- Underside of abdomen may be brightly colored
  - No other SB have this in OR
  - Speckled pigment
- New adults are white → gray → tan → colored phase

# Identification of BMSB

*Banasa dimiata*



*Chinavia hilaris*



*Chlorochroa  
ligata*



*Euschistus conspersus*



*Euschistus*



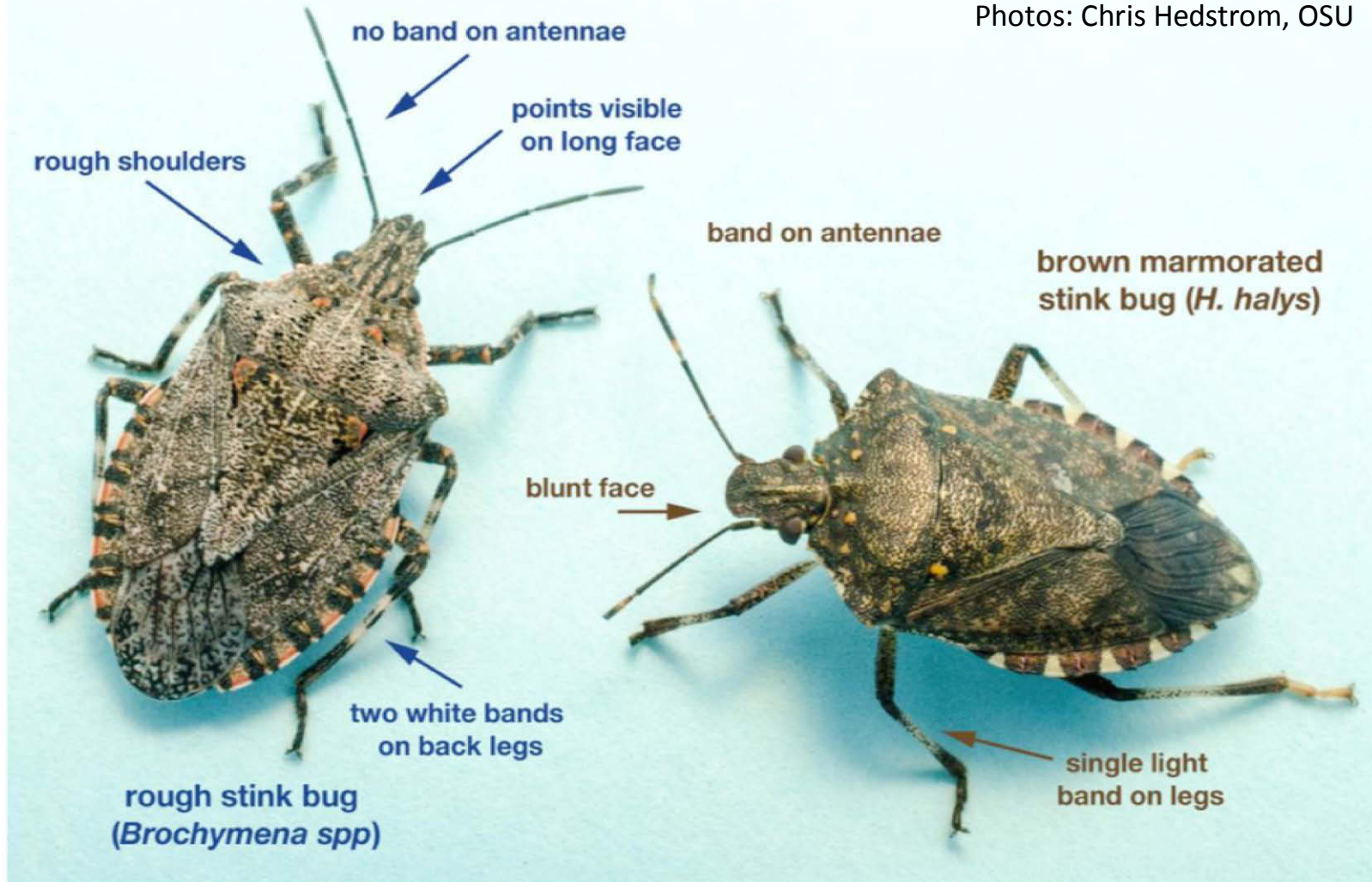
*Thyanta custator*





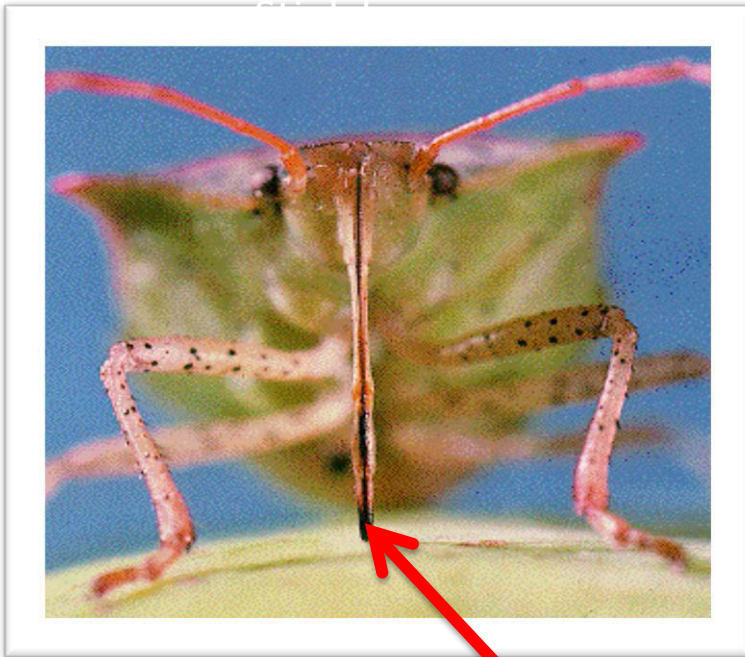
# Identification of BMSB

Photos: Chris Hedstrom, OSU



# Stink bug feeding

Relative of aphids, psylla, leafhoppers, & scales. “Piercing-sucking” mouth parts are inserted into food, saliva enzymes are injected, and fluids sucked out.



Mouth parts



# Stink bug damage in tree fruit





# BMSB: a severe stink bug

- *Full* life cycle on fruit tree
- Damage adults *and* nymphs
  - Diff. biology from native SB
- Fruits, nuts, *and* vegetative feeding, even woody tissue
- Feeding mechanism
  - Disease transmission
  - Secondary infection
- Voltinism will affect damage
  - How many gens in OR?

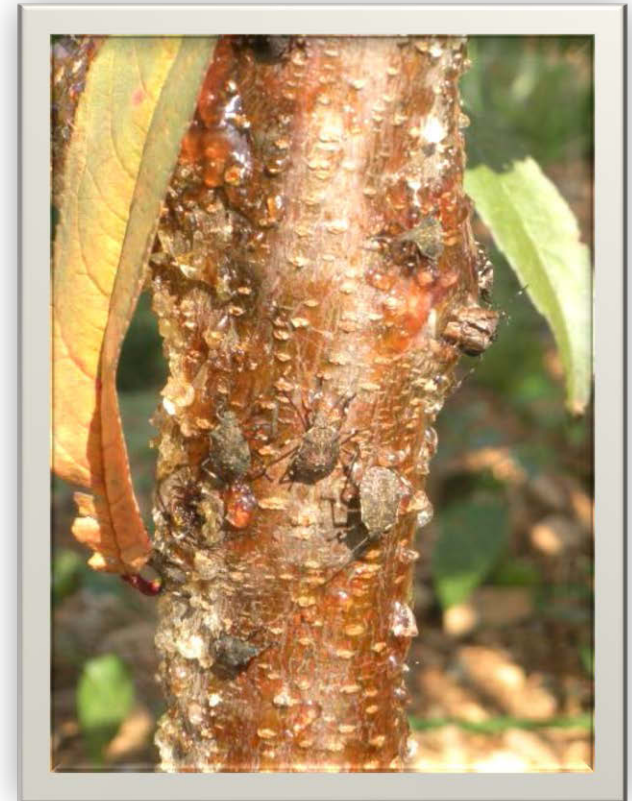


Photo: Tracy Leskey, USDA

# BMSB damage – tree fruits



Photos: Tracy Leskey, USDA

# BMSB damage – sweet corn



- Sweet corn is a high-preference crop
- Up to 100% of ears with injury, Beltsville MA 2011



# BMSB damage – veg crops



Fig. 5. Severe infestations of brown marmorated stink bug can result in total loss of fruiting vegetable crops.



Fig. 6. Brown marmorated stink bug feeding scars on tomato fruit.



Fig. 7. Spongy area left by stink bug feeding on bell pepper.



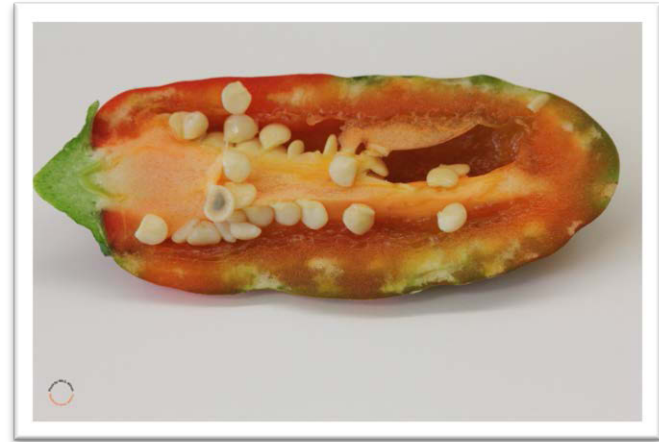
Fig. 8. Brown marmorated stink bug feeding scars on bell pepper.

- Stylet damage
  - Discoloration
  - deformation
- Corking damage
- Secondary infections

Courtesy of Tomas Kuhar, VA Tech



# BMSB damage - jalapeño



- Another high preference host that is easily damaged

# BMSB damage - beans



# BMSB damage - soybean



Jeff Graybill, Penn State



"stay green symptom"

# BMSB: chemical control

- Barriers to effective chemical control:
  - Stylet feeding: insertion avoids residues
    - = low residual activity of insecticides
  - Locomotion: low body contact with residues
    - Only tarsi (feet) make contact with surface residue
  - Hard bodied: lower contact activity
    - Low absorption of material
  - Population reservoirs
    - Repeated or constant immigration events from urbans and natural habitats
- EPA section 18 approval: bifenthrin (pyrethroid) and dinotefuran (neonic)

# BMSB: a threat to IPM

Orchard	Number of targeted insecticide applications		Mean insecticide interval $\pm$ SEM*		A.I.M. score		Total	
	2010	2011	2010	2011	2010	2011	2010	2011
A	3	20	10.6 $\pm$ 1.9	7.2 $\pm$ 0.4	0.06 $\pm$ 0.02	0.19 $\pm$ 0.02	0.89	5.26
B	5	7	22.2 $\pm$ 5.7	18.8 $\pm$ 2.5	0.40 $\pm$ 0.10	0.46 $\pm$ 0.10	3.63	5.47
C	4	12	18.5 $\pm$ 1.3	11.4 $\pm$ 1.4	0.18 $\pm$ 0.05	0.29 $\pm$ 0.06	1.78	5.31
D	7	42	10.6 $\pm$ 1.0	4.1 $\pm$ 0.3	0.21 $\pm$ 0.05	0.18 $\pm$ 0.02	3.28	8.16
All Orchards	19	81	14.0 $\pm$ 1.3 a	7.1 $\pm$ 0.6 b	0.20 $\pm$ 0.03 a	0.24 $\pm$ 0.02 a	9.58	24.2



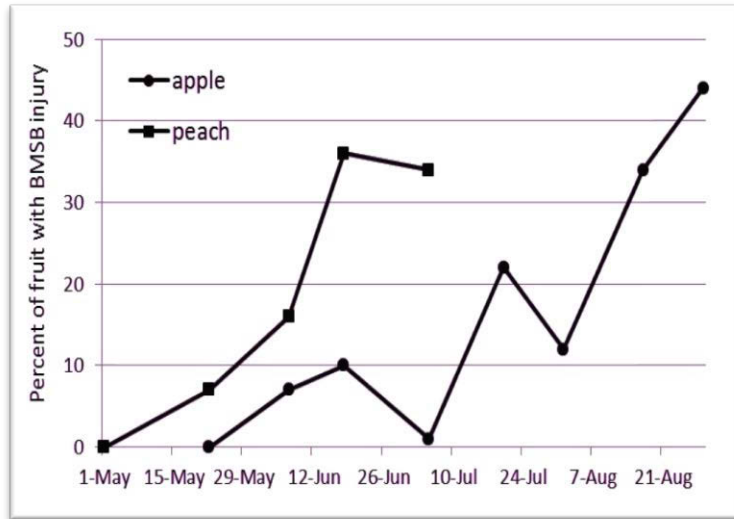
Before



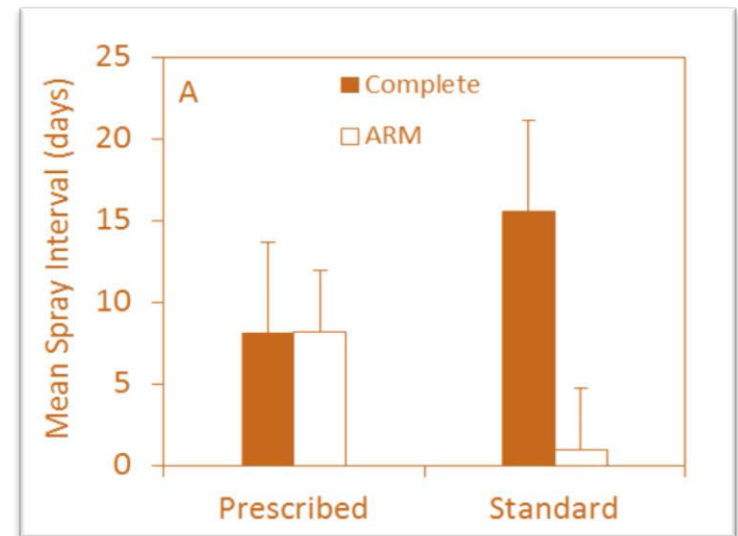
After

- 2010, the year growers got stung by BMSB
- 4-fold increase in insecticide applications ensued

# BMSB: a threat to IPM



- In 2012 , BMSB pressure was relatively low in Virginia.
- Unchecked BMSB populations still caused approximately 45% damage on apples
- To reduce pressure on natural enemies and delay resistance: alternate row middle (ARM) at 7 day intervals
- These programs kept BMSB damage at 10 % or below





# OSU Surveys

Two approaches:

- Active searching
- Reports
  - Citizens
    - Media-generated
    - Garden damage
    - Overwintering bugs
  - Growers
    - Our highest concern
    - Please report!

**BMSB@oregonstate.edu**



## New insect in Nampa, the brown marmorated stink bug, caused extensive crop damage on East Coast



AP

The brown marmorated stink bug, known best for devastating peach crops on the East Coast in 2010, was recently discovered in Idaho by a Nampa couple. Officials from the Idaho State Department of Agriculture say that, as far as they know, these are the only ones in the state.

Posted: Friday, June 22, 2012  
12:00 am

5 comments

Posted on June 22, 2012



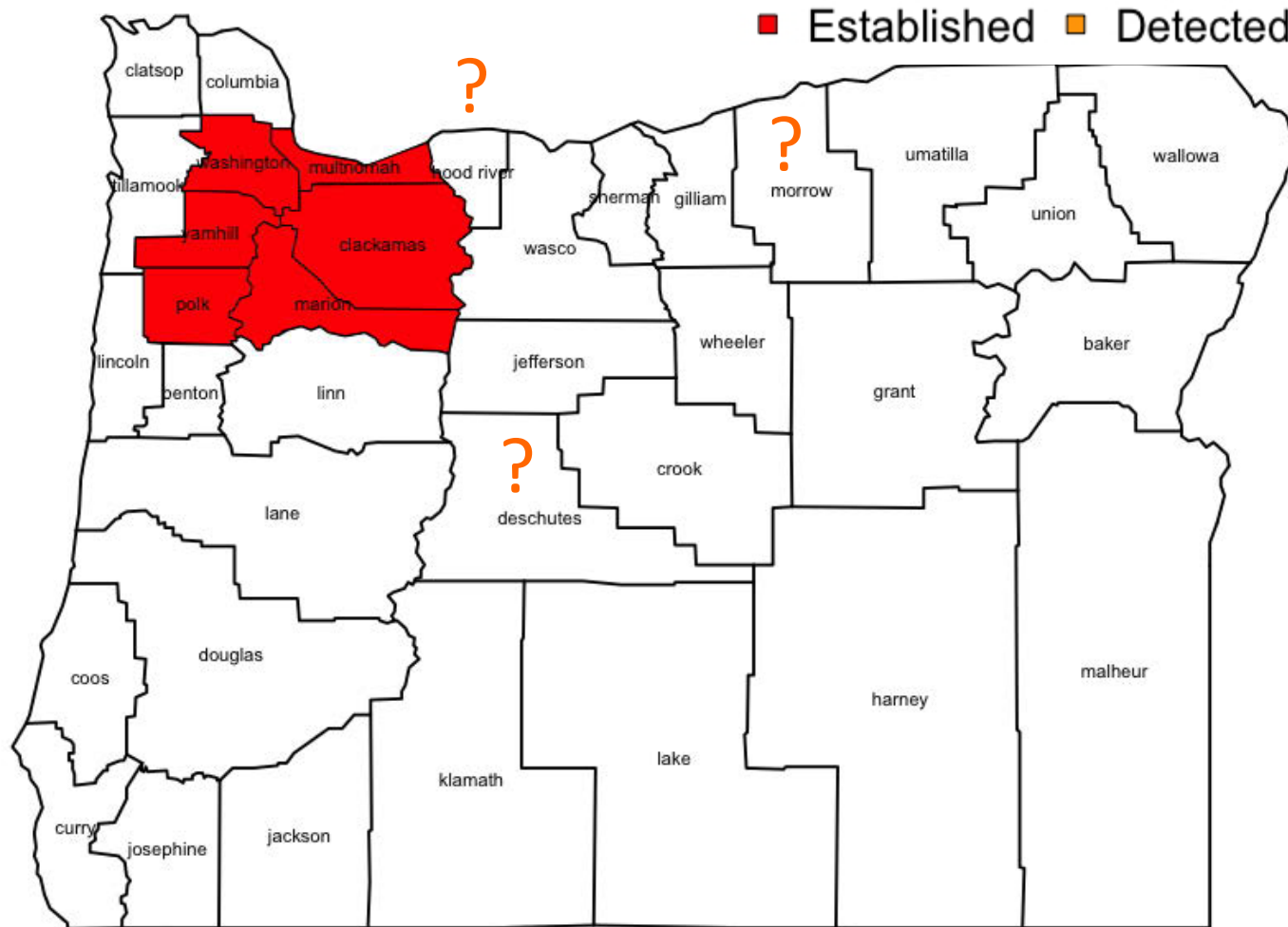
by **Torrie Cope**

**NAMPA** — A bug that has caused major damage to crops in the eastern U.S. has made an appearance in Idaho for the first time in Nampa.

Lloyd Knight, administrator of the Division of Plant Industries at the Idaho State Department of Agriculture (ISDA), said the brown marmorated stink bug was found at a Nampa residence by a couple that moved to the area from Maryland over the winter. The couple, familiar with the damage that type of bug caused to crops on the East Coast, brought a bug in a box to the ISDA to be



# Distribution of BMSB – 2011

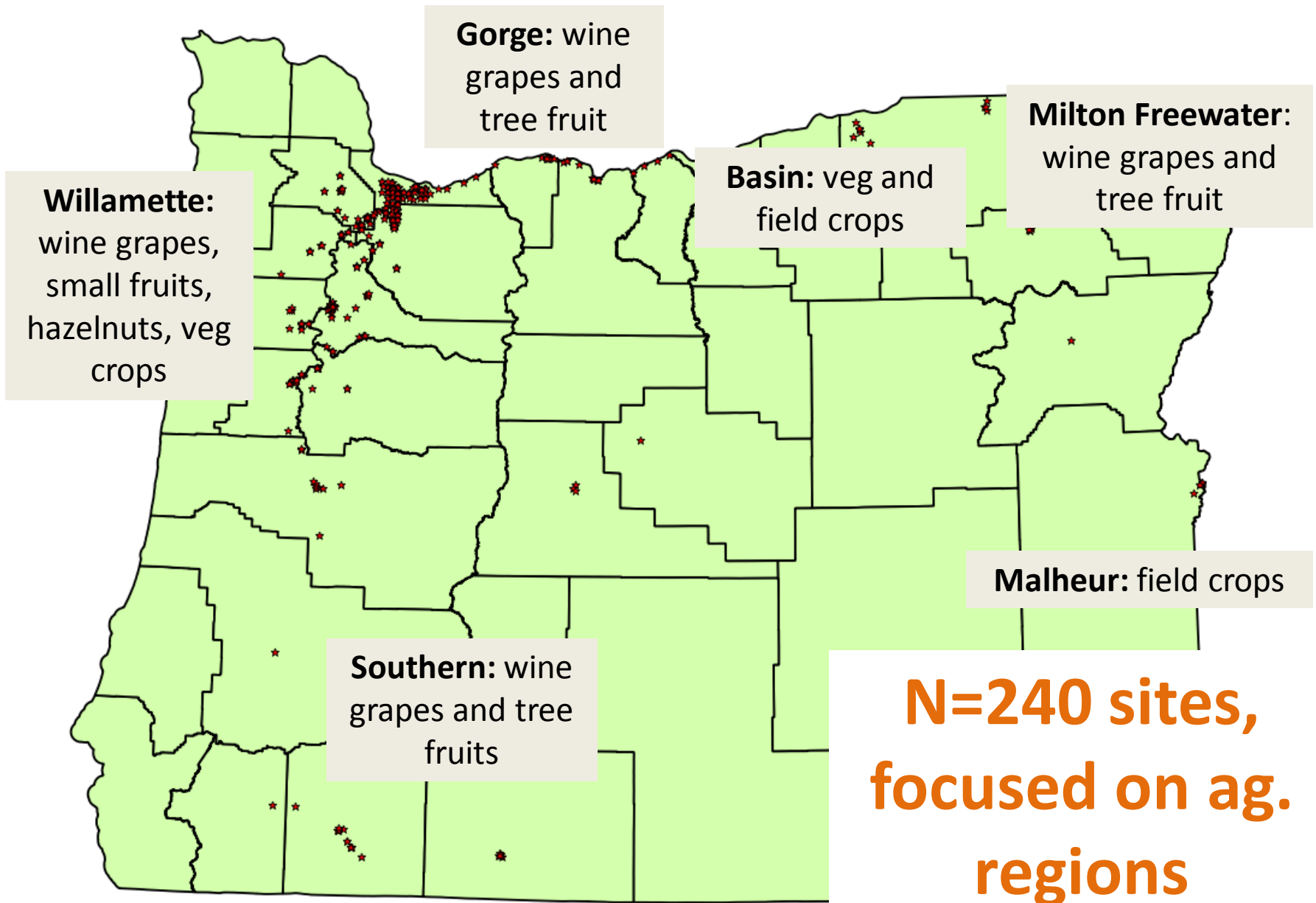


NAPIS (National Ag Pest Information System <http://pest.ceris.purdue.edu/>)

# Methods – host plants and distribution

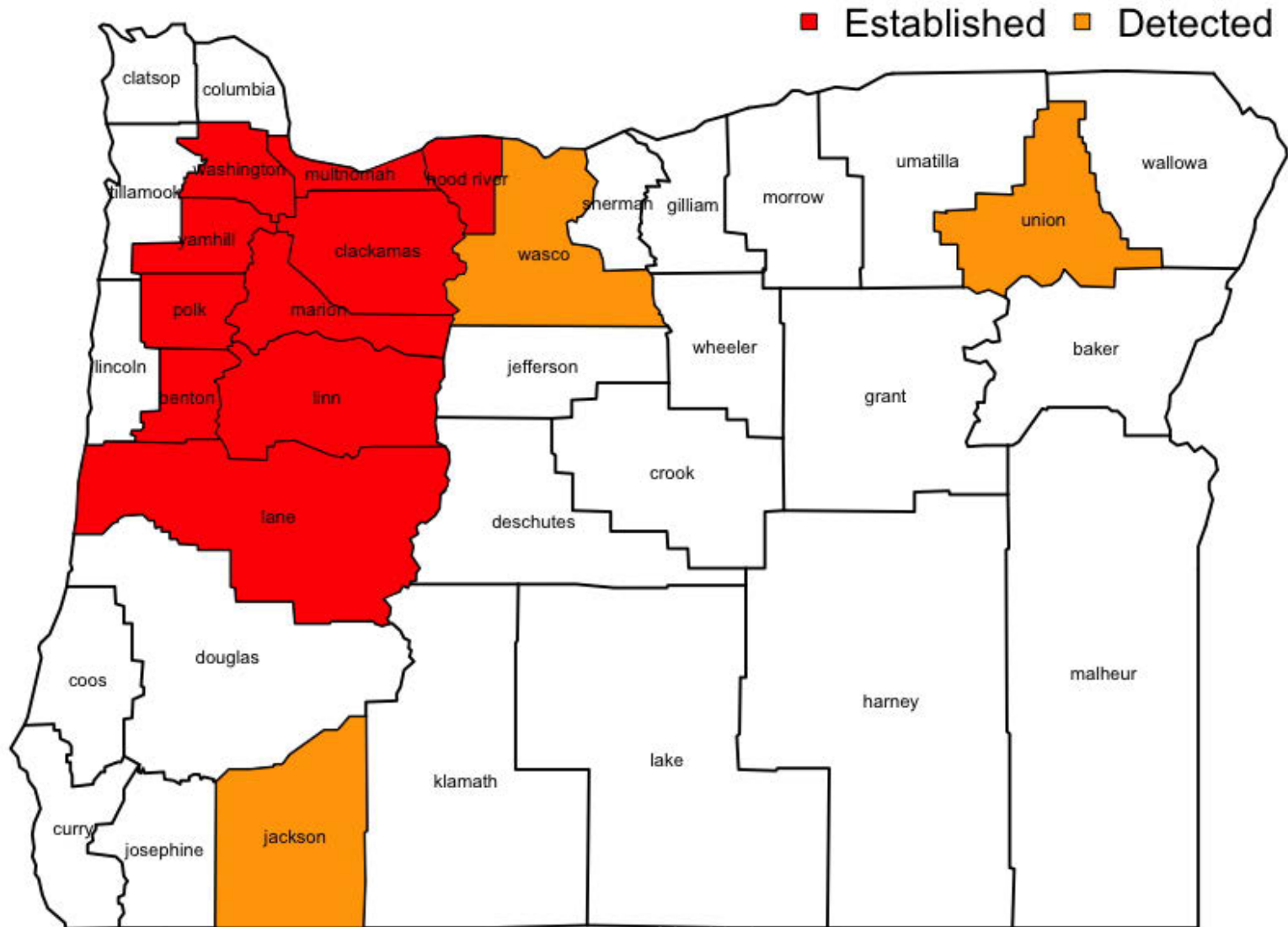
- Beat samples: hit everything in reach
- Record BMSB and host plants
- Geo-explicit data (GPS)
- Walk about 2 km/site
- **Urban**, natural, rural, agricultural





**N=240 sites,  
focused on ag.  
regions**

# Co. Distribution of BMSB – 2012



N. Wiman, OSU 2012

2012 Survey for Brown Marmorated Stink Bug (*Halyomorpha halys*), Oregon State University

# County Maps are Very Limited

BMSB could turn up anywhere in the Willamette Valley or in The Gorge, but lets look at more detail...

Focus on specific regions:

## 1. Portland Area

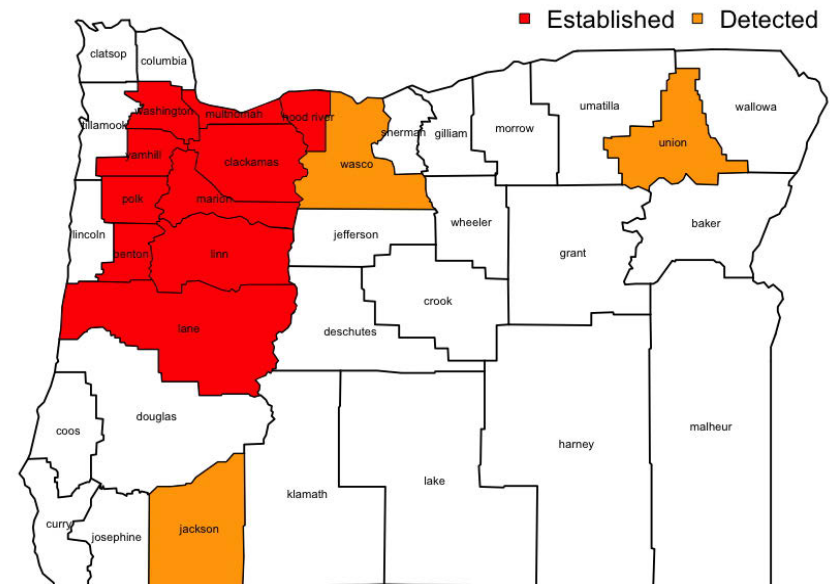
- "epicenter"

## 2. Willamette Valley

- First agricultural finds

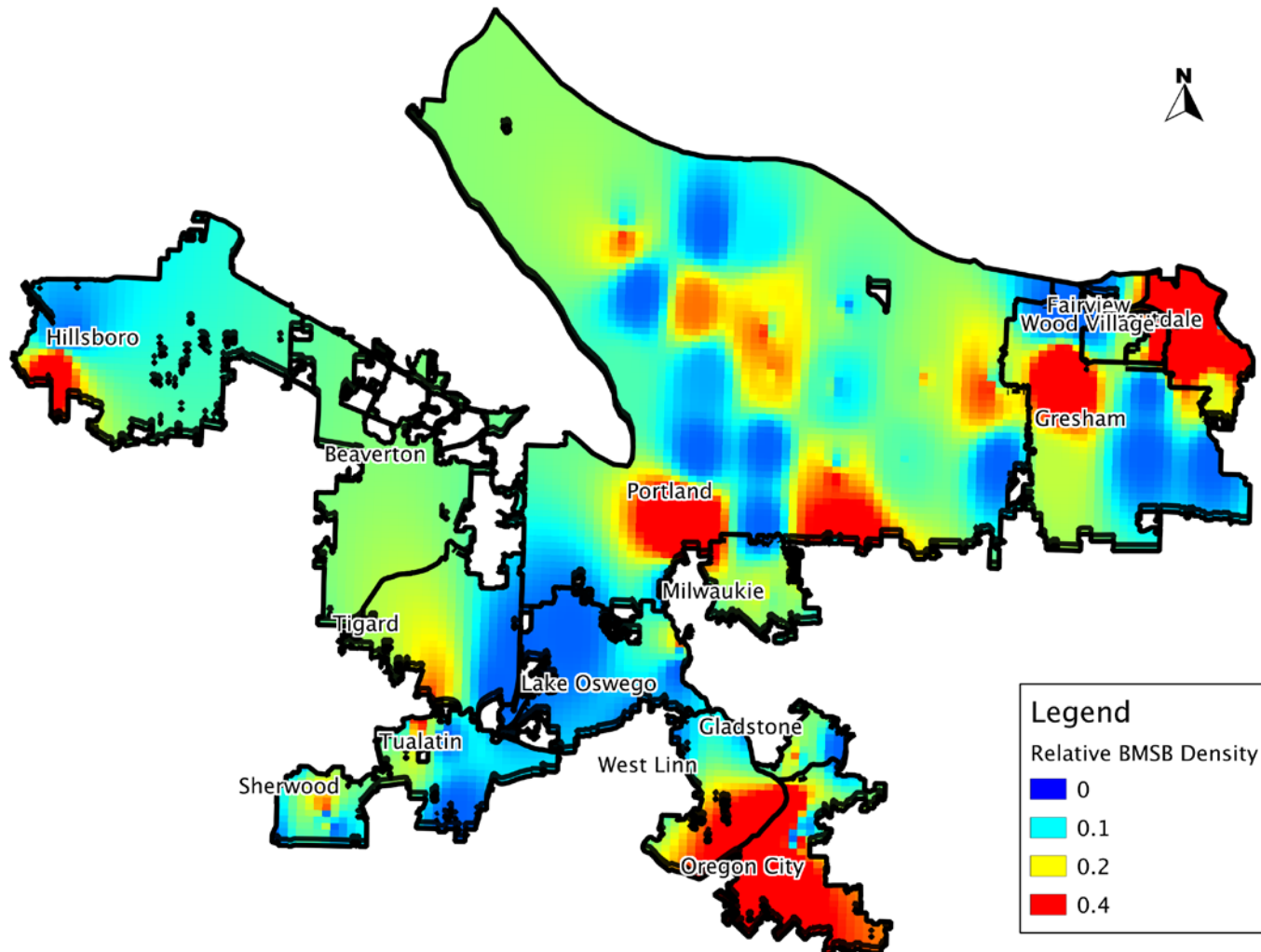
## 3. The Gorge

- Where BMSB is expanding



2012 Survey for Brown Marmorated Stink Bug (*Halyomorpha halys*), Oregon State University

# 1. Greater Portland area

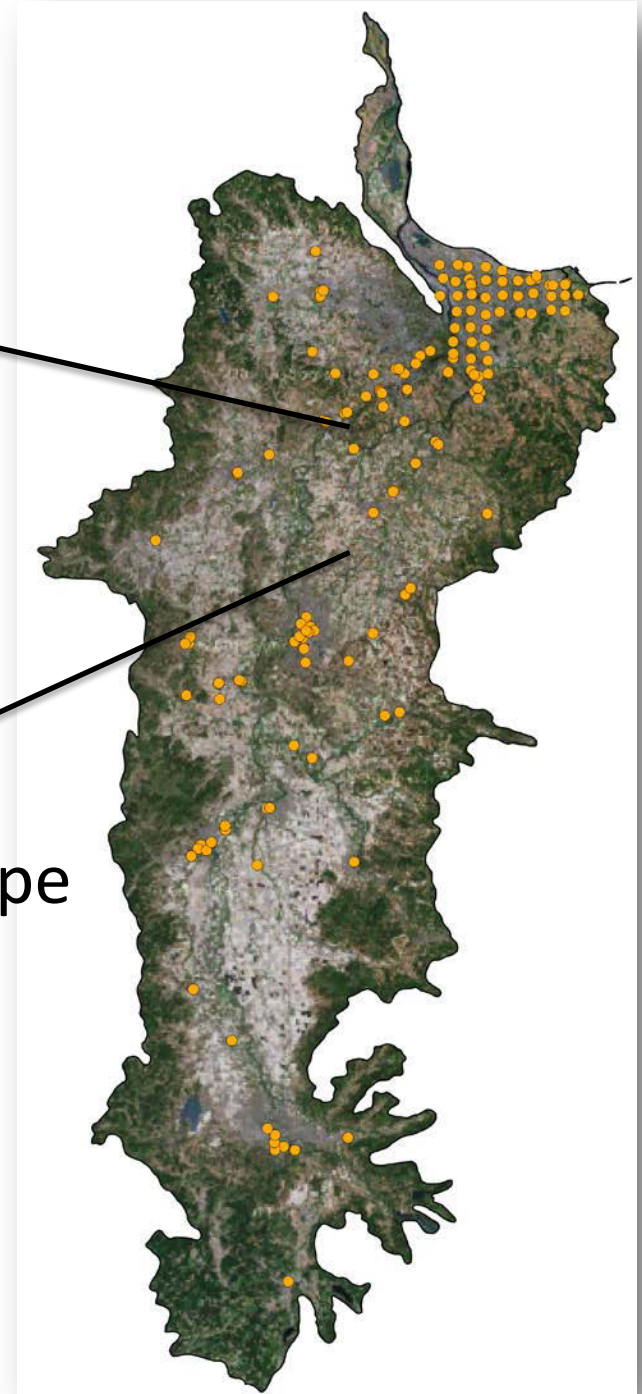




## 2. Willamette Valley



- Fragmented agricultural landscape
- Large areas of non-host crops
  - Grass seed, christmas trees
- Smaller plantings of high-value, horticultural crops
- Interspersed with urban areas



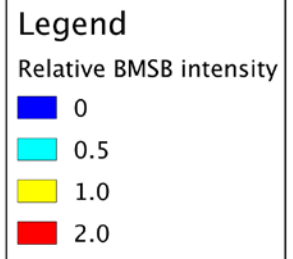
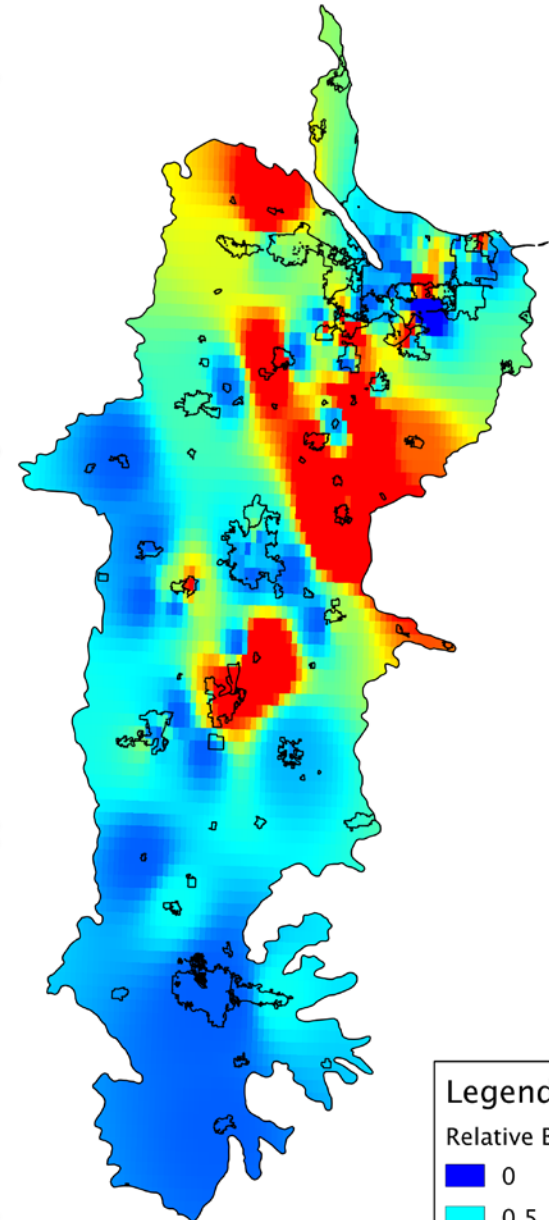


## 2. Willamette Valley

Very common, widespread, and locally very abundant in Northern Valley, **high crop risk**

Locally abundant in mid-valley, including Covallis, Albany, and Lebanon

Lowest densities in the Southern Valley,  
Just becoming established



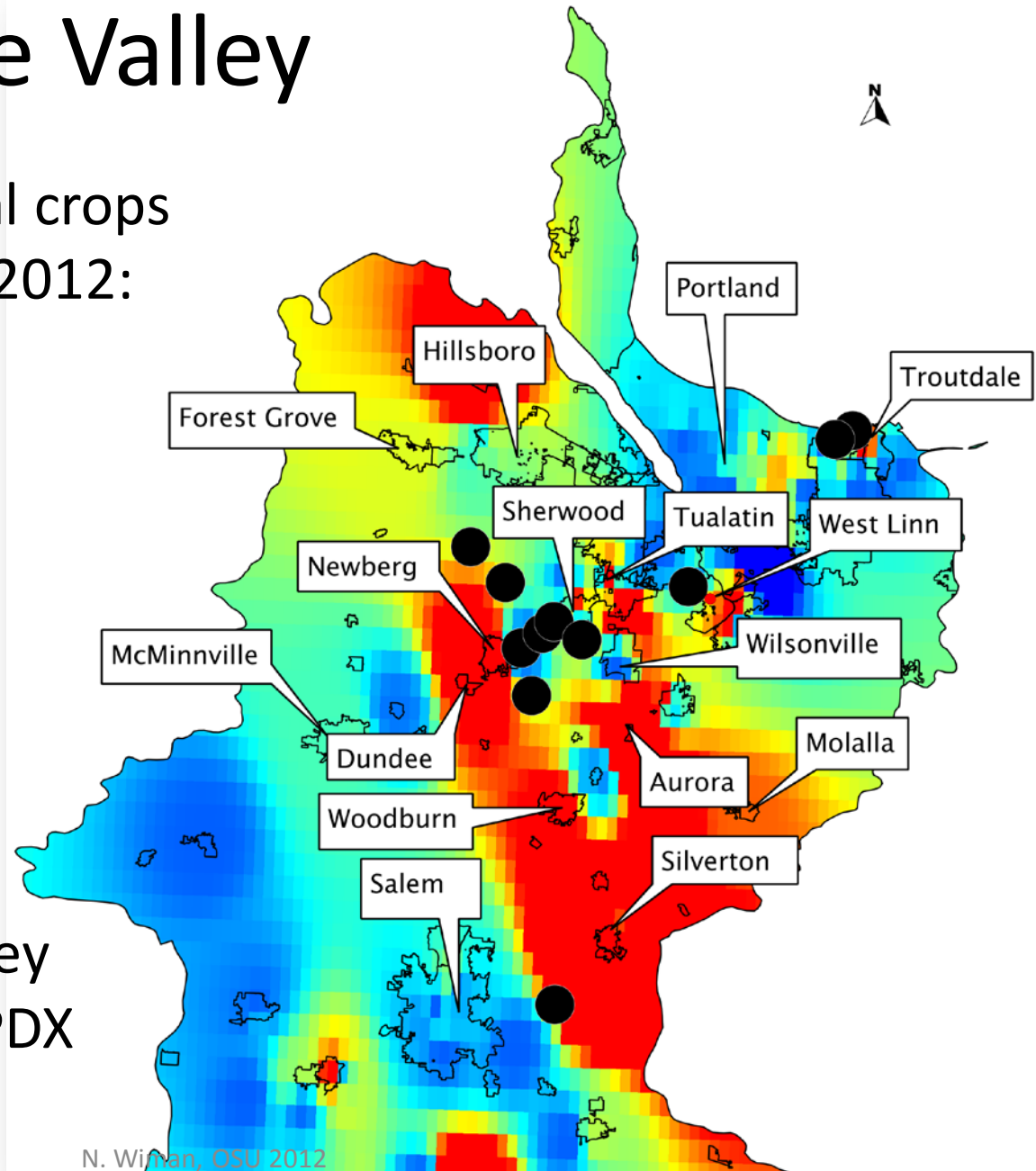
## 2. Willamette Valley

- BMSB in commercial crops for the first time in 2012:

- Hazelnut (5)
- Orchard (1)
- Vineyard (3)
- Blackberry (2)

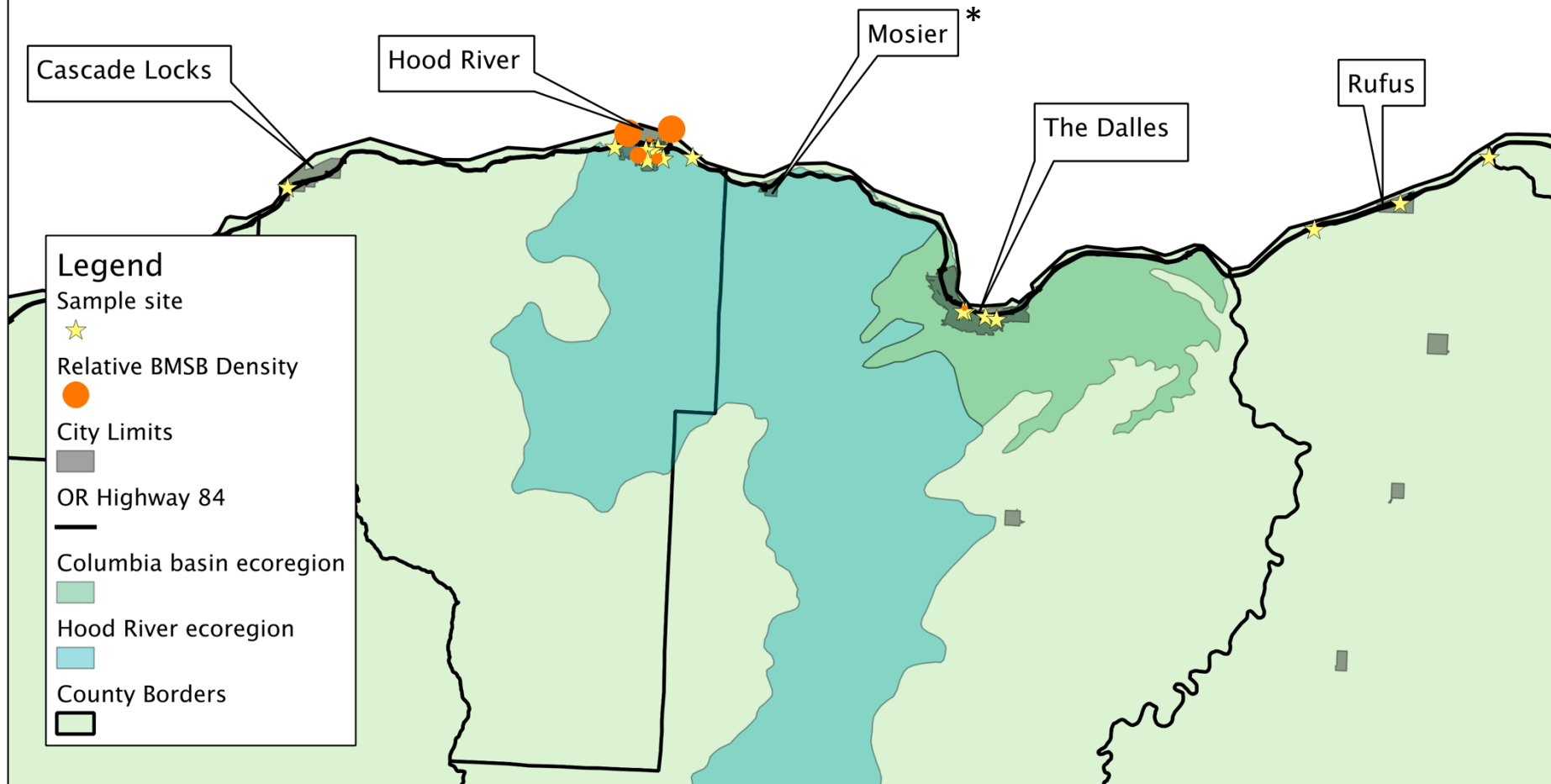
### Risk Areas:

- Tualatin River Valley
- Farms bordering PDX
- NE Valley Farms

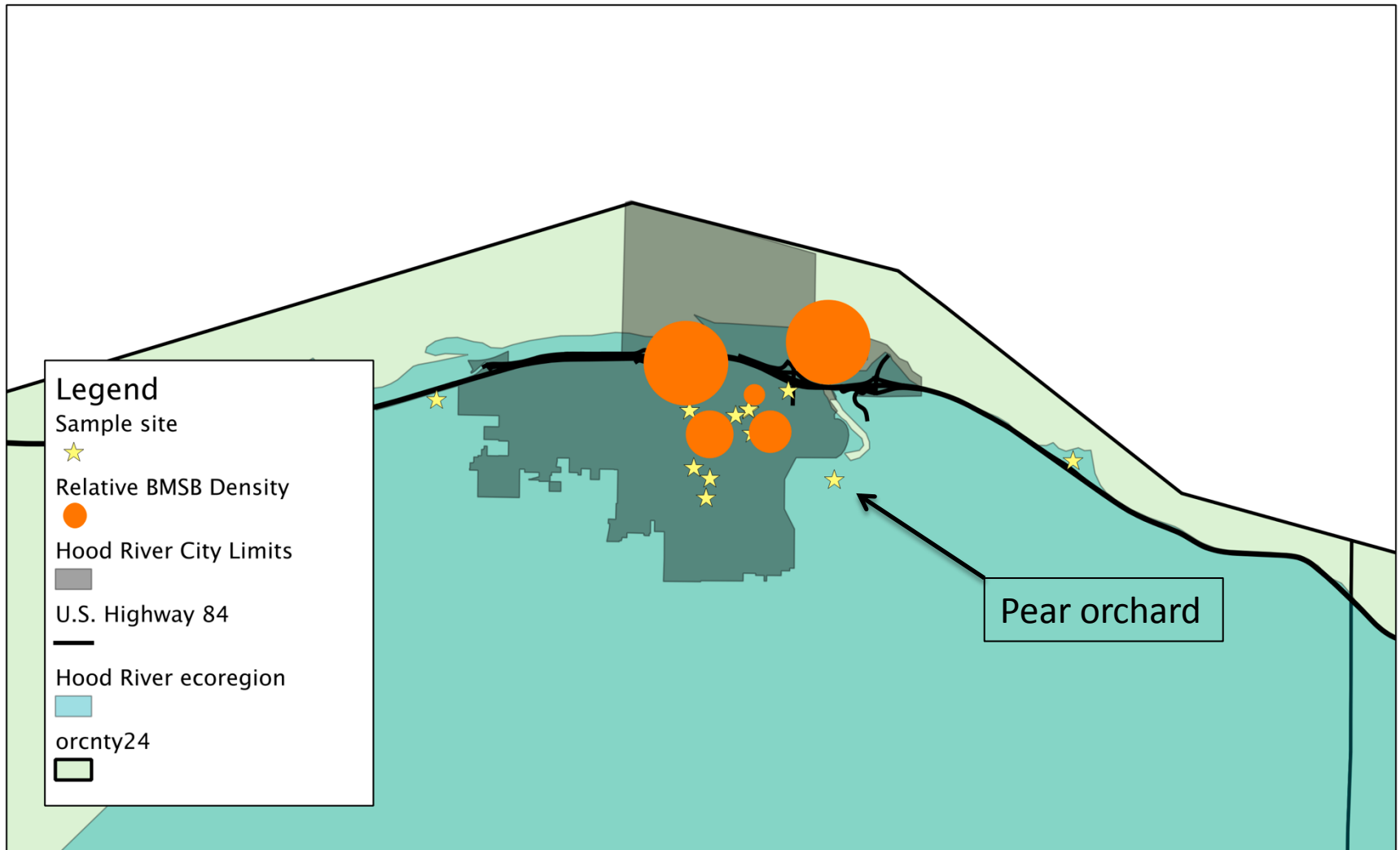


\*Confirmed BMSB report

# Columbia River Gorge

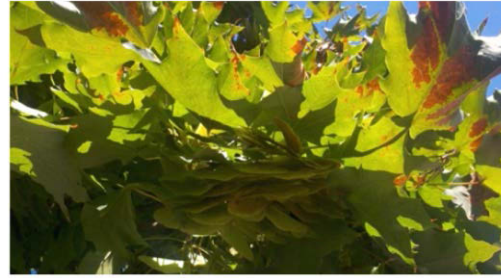


# Columbia River Gorge, Hood River





# The Dalles



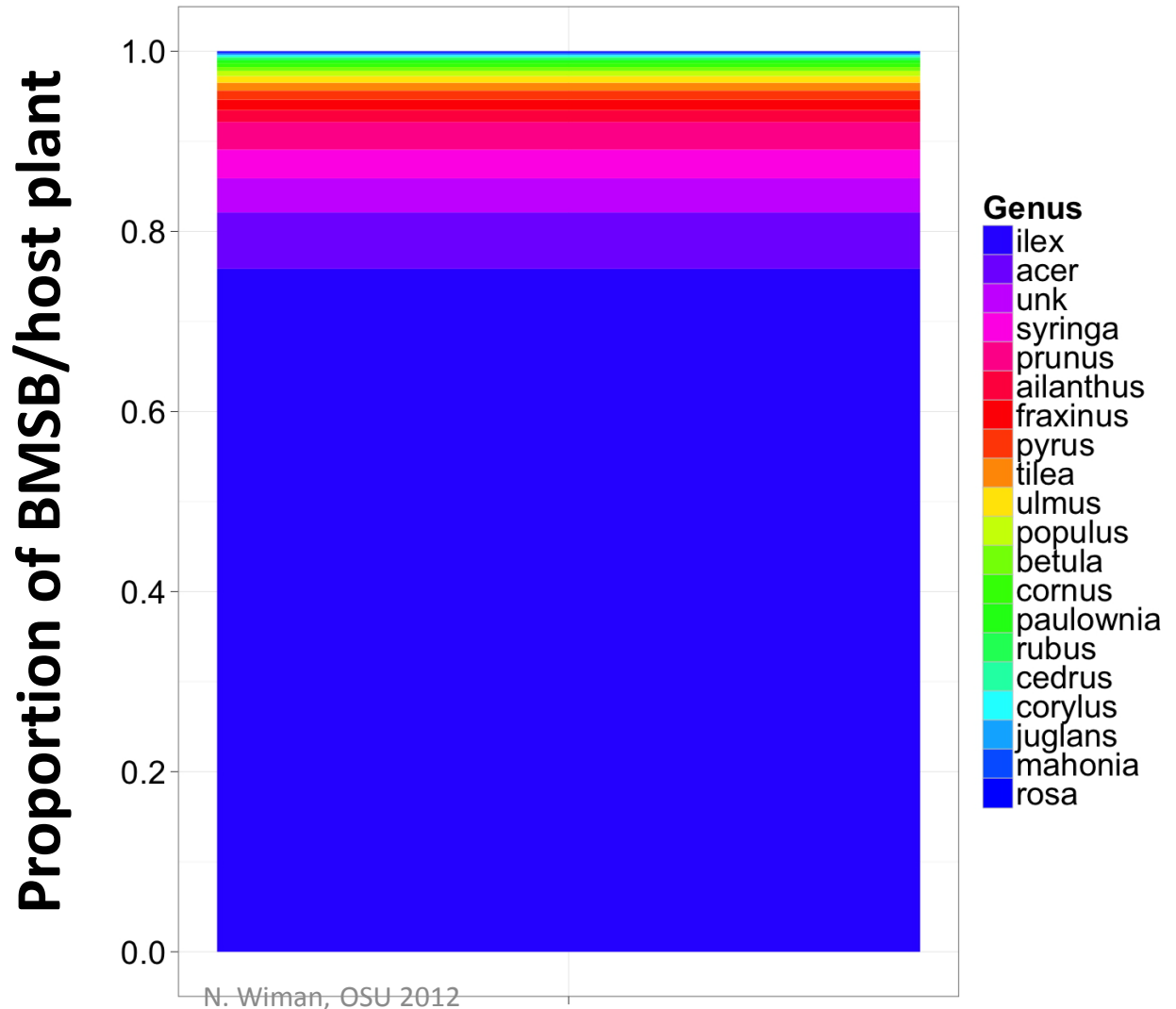


# Host use patterns – proportions

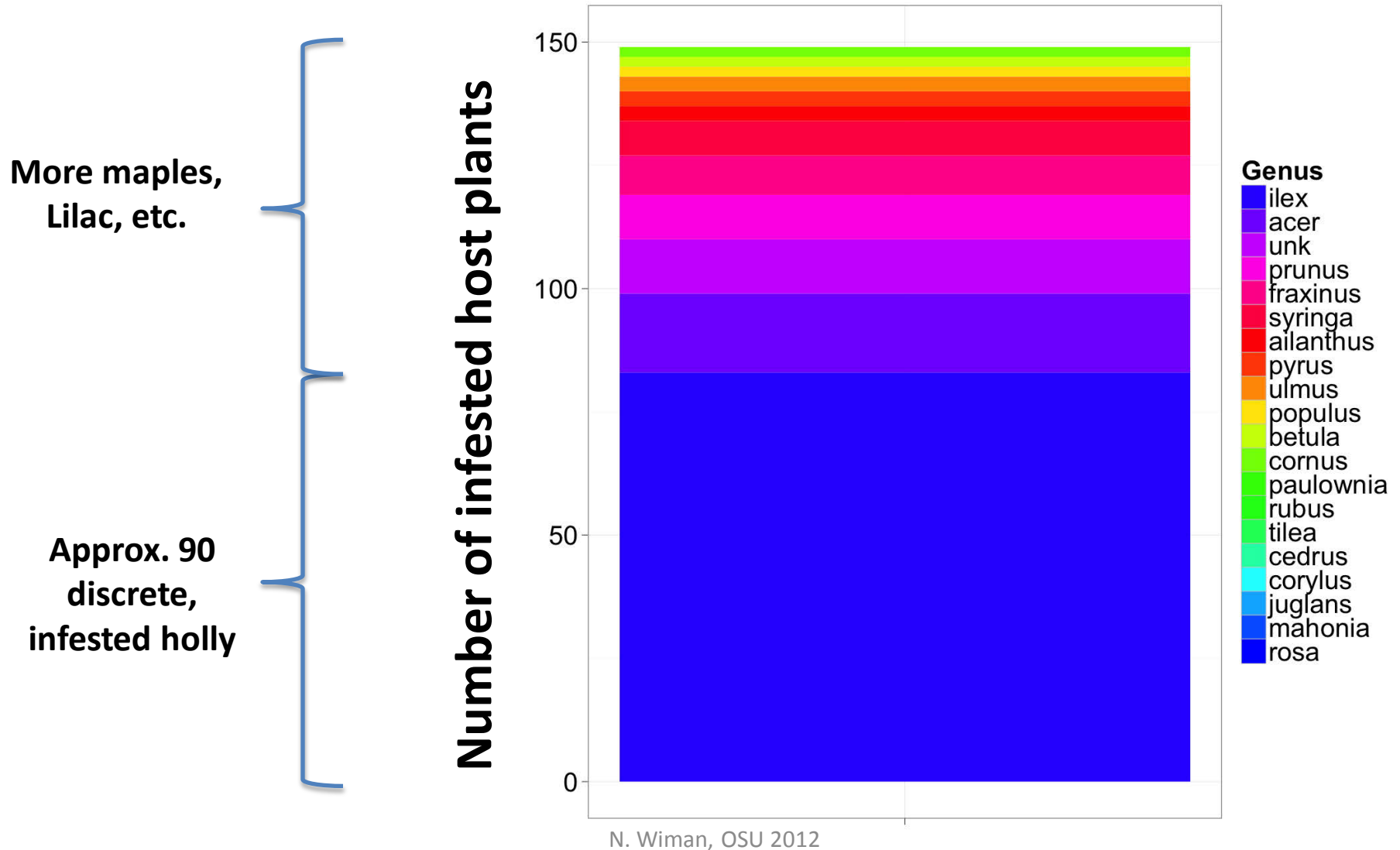
**Ornamental,  
natural and  
crops species:**

Maples, lilac,  
cherry, tree of  
heaven,  
catalpa, ash,  
linden, elm...

**English holly,  
an important  
host plant**



# Host use patterns – Frequency



# English Holly – *Ilex aquifolium* L.



Holly orchard

- First imported OR in 1869
  - It flourished
  - Some originals still living
- (1986) 1800 acres in PNW
- \$2 Million industry
  - Cuttings Nov.-Dec

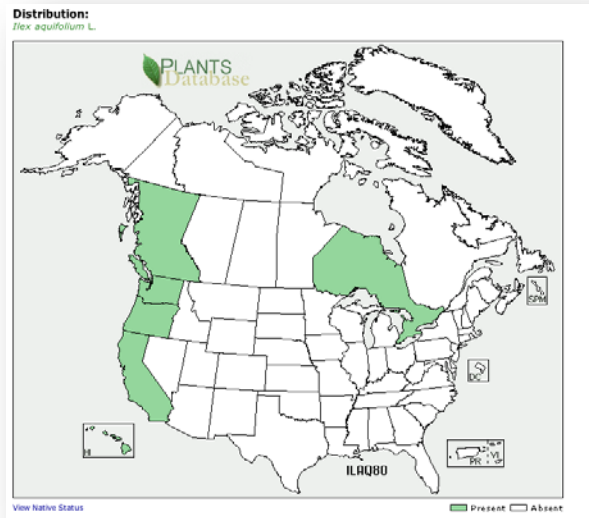


Holly border on vineyard





# English holly is an invasive plant



Plants.USA.gov

Home / All Titles / Madroño / Jan 2010 / pg(s) 1-10

## Madroño

Published by: **California Botanical Society**

« previous article : next article »

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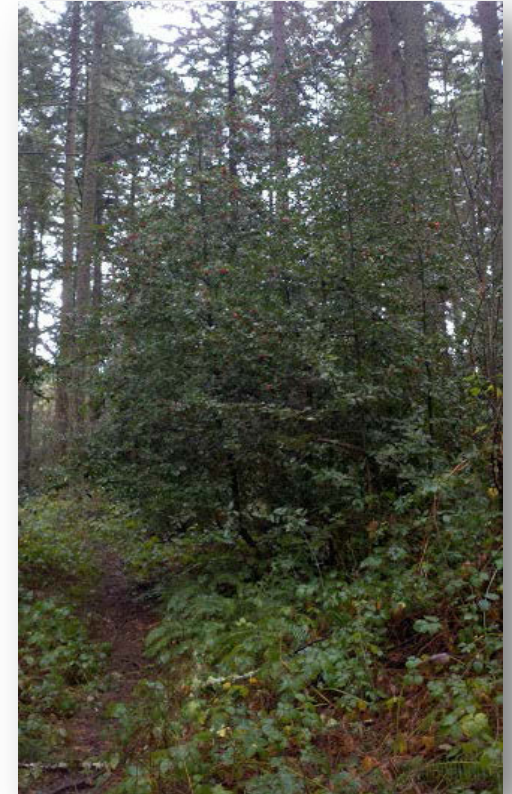
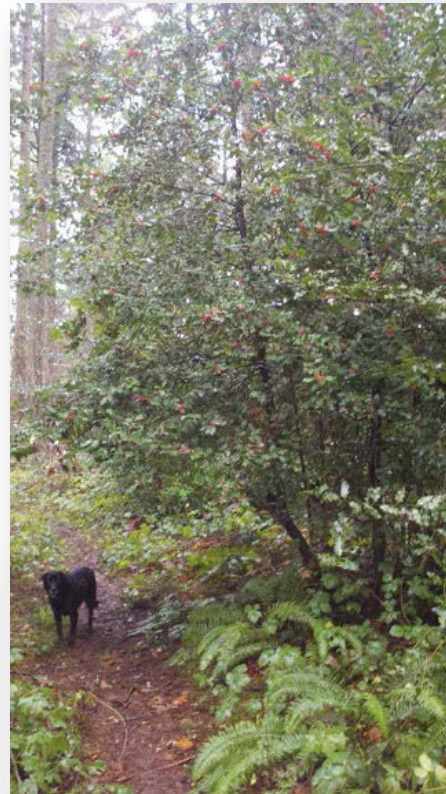
Madroño 57(1):1-10. 2010

doi: <http://dx.doi.org/10.3120/0024-9637-57.1.1>

### Invasive Hollies (*Ilex*, Aquifoliaceae) and Their Dispersers in the Pacific Northwest

Peter F. Zika

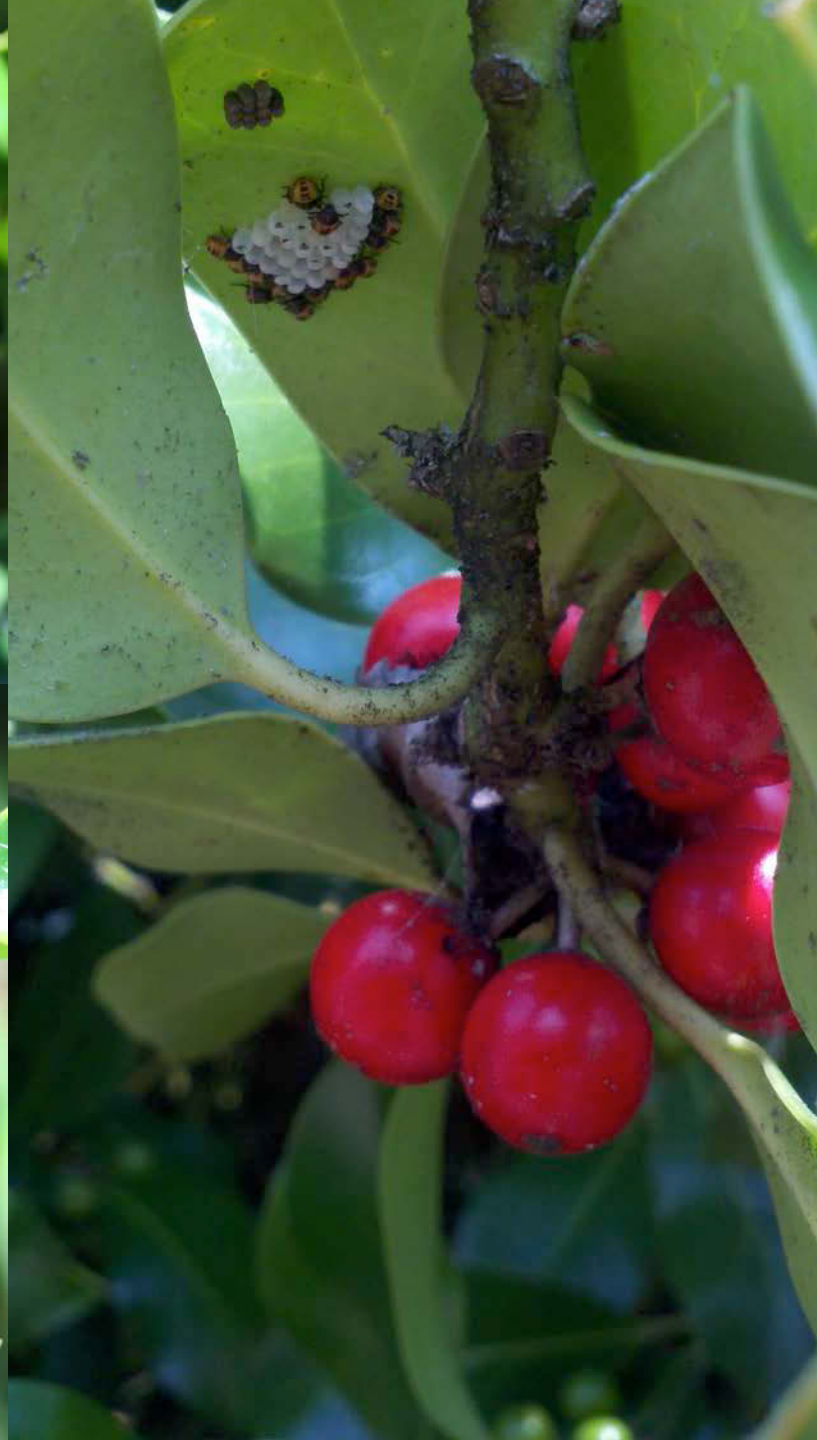
University of Washington Herbarium, Box 355325, Seattle, WA  
98195-5325 [Zikap@comcast.net](mailto:Zikap@comcast.net)



Invasive holly in McDonald Forest near Corvallis

N. Wiman, OSU 2012







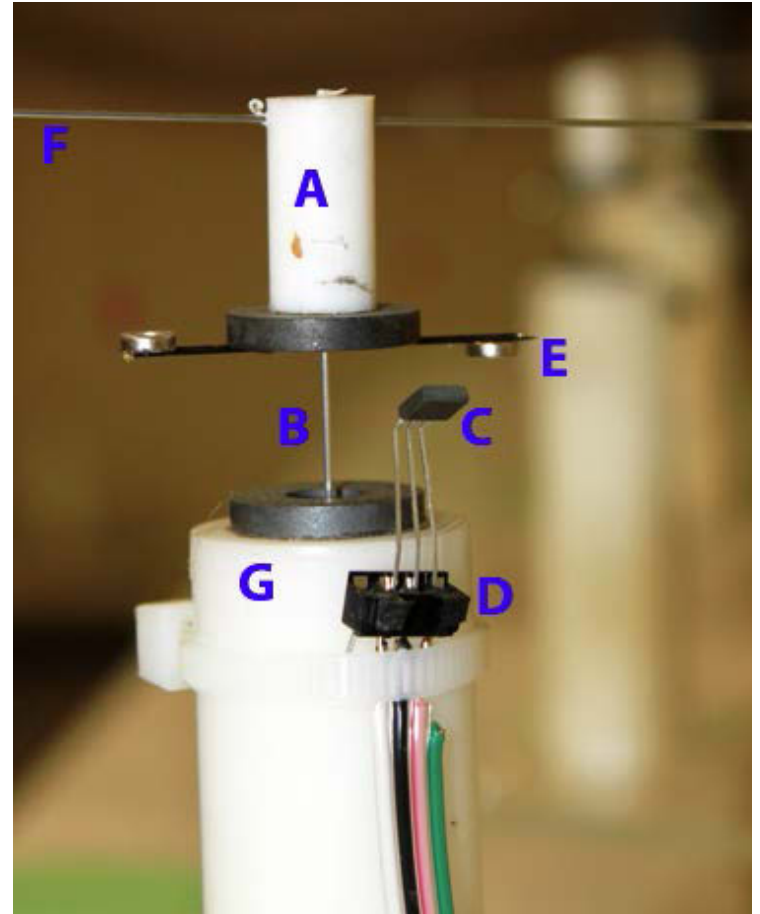
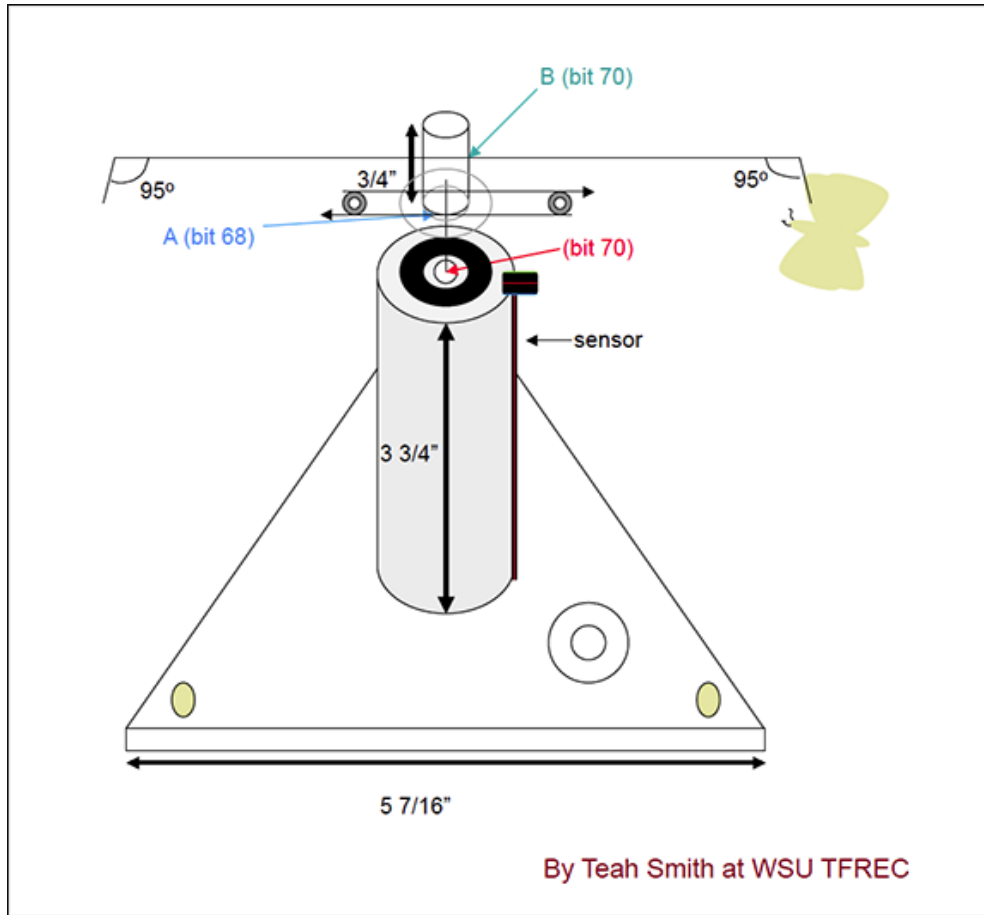
N. Wiman OSU 2012







# Dispersal studies

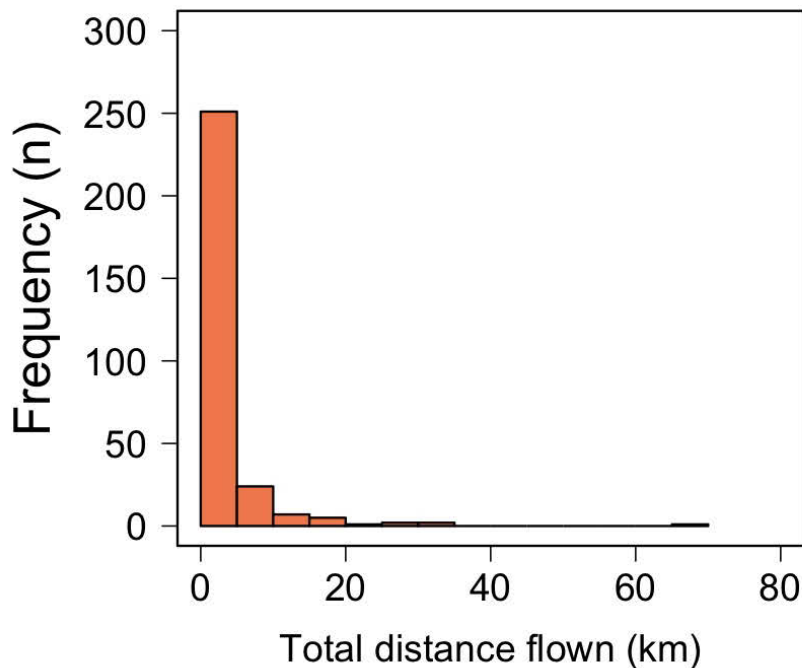




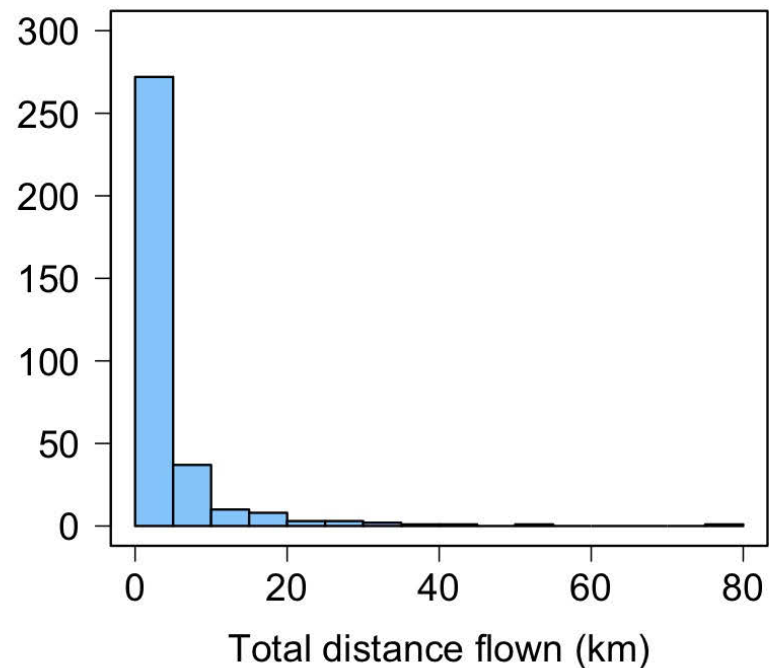
# Flight distance in 24 h

- Most flew < 5 km (short distance fliers)
- A few flew up to **72 km (45 mi)**

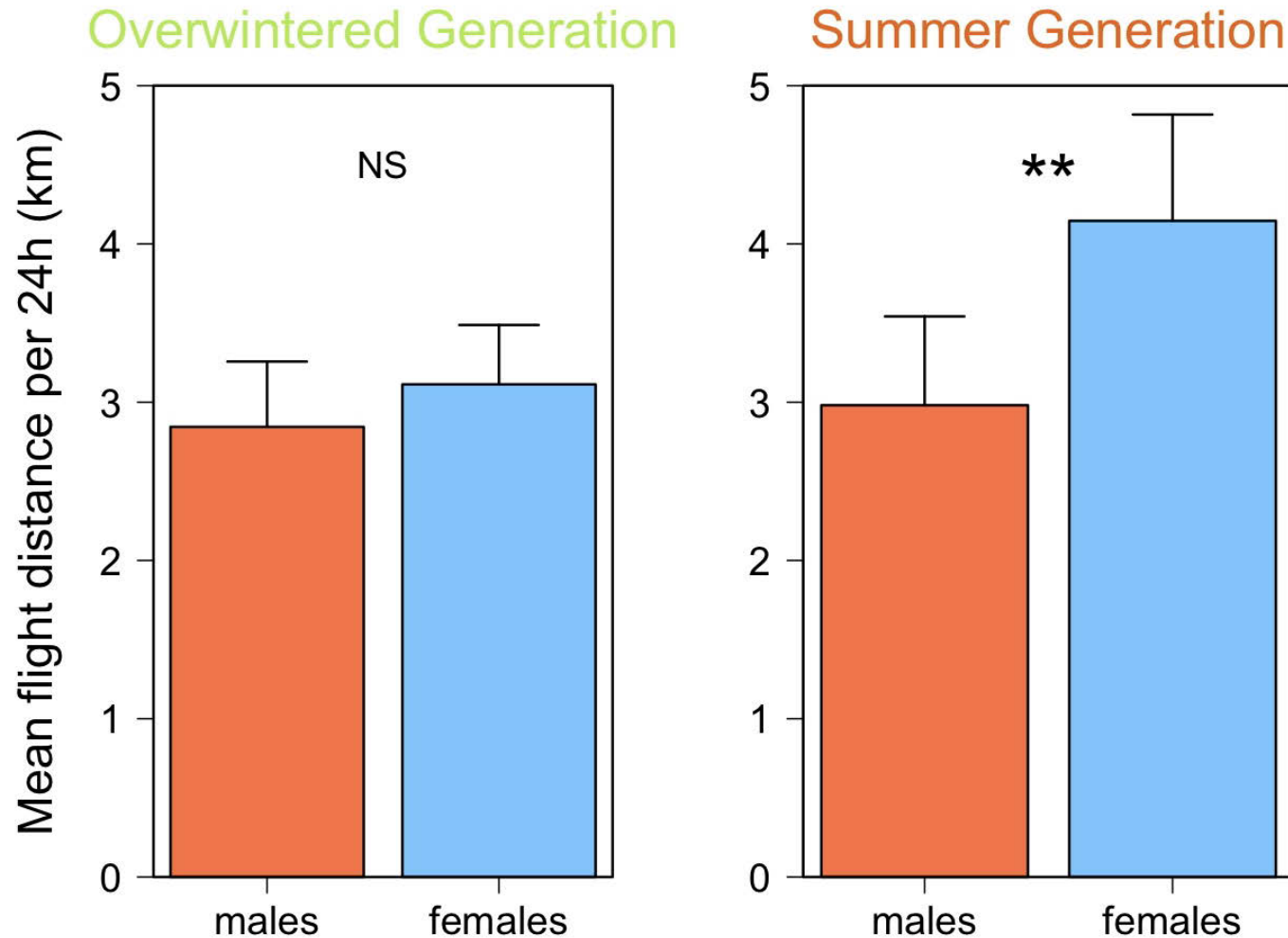
**Males**



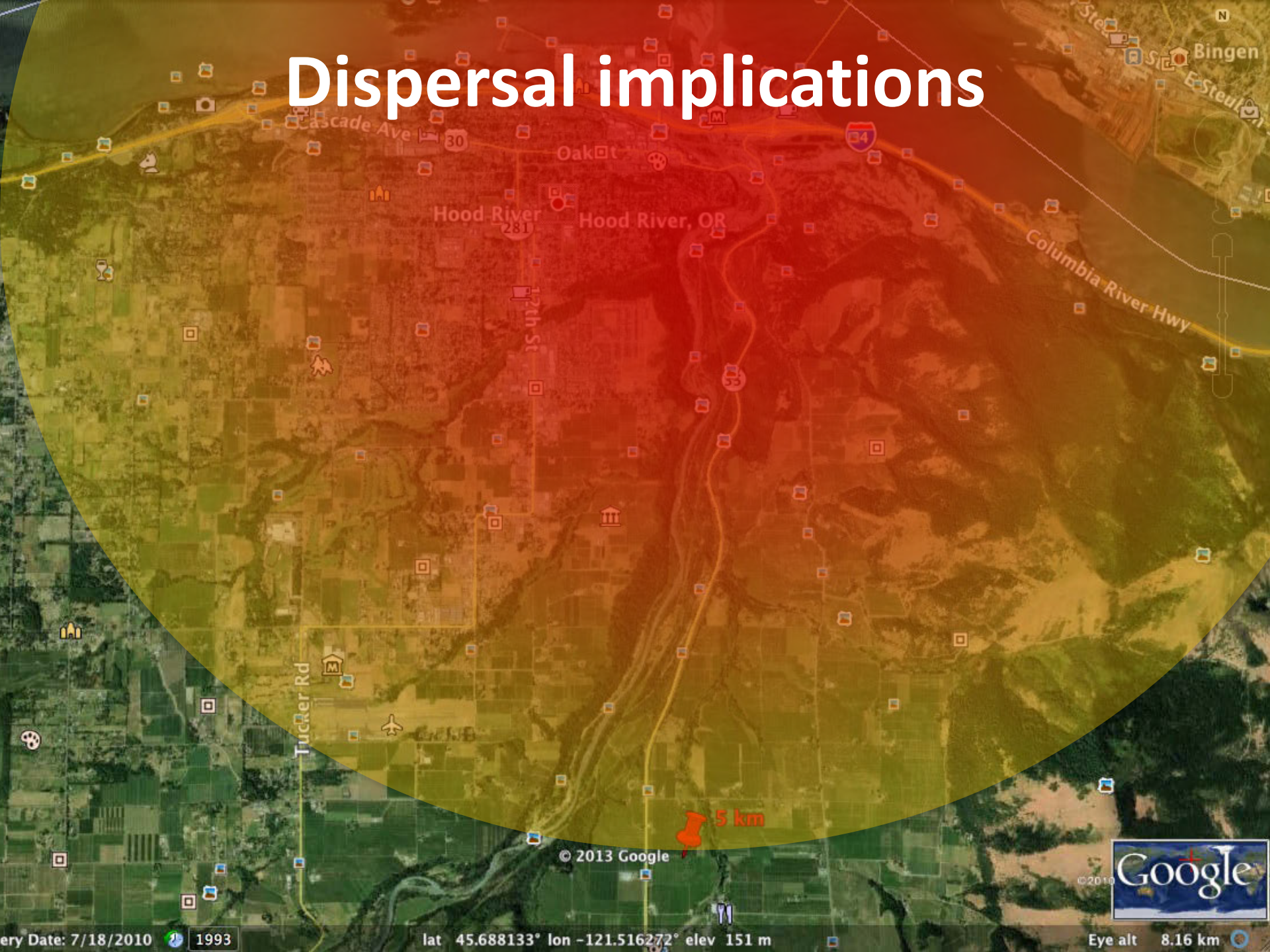
**Females**



# Summer generation females



# Dispersal implications





# Biological control – native enemies

- Egg predation and parasitism survey
- Wild egg masses
- Sentinel egg masses placed in field for several days
  - Egg masses from lab cultures  
Frozen at -80 C
    - Kills the eggs
    - Eggs remain attractive to natural enemies



Allows us to work in crops



# Biological Control – assessing



**Parasitism – failure to  
complete development**



**Pupal parasitoid dissected  
from egg**

# Natural enemies: egg masses

	Wild	Sentinels
% Hatched Eggs	78.86%	3.14%
% Predated Eggs	3.57%	13.46%
% Undeveloped Eggs	10.37%	1.05%
% Eggs Parasitized	4.06%	6.08%
% Masses w/ Parasitism	8.75%	16.67%
% Masses w/ Predation	17.50%	29.17%
% Masses Guard Parasitoids	3.33%	2.78%



# Biological Control

***Trissolcus cosmopeplae***

***Trissolcus euschistii***

- Native stink bug egg parasitoids that are adapting to BMSB eggs
- Chemical cues
- Biological & chemical egg defenses
- BC should improve over time



# Biological Control – Crabronidae





# Biological Control – Classical

- *Trissolcus halyomorphae*
  - Imported egg parasitoid from Beijing
  - Held in OSU quarantine facility
  - Under testing: will it attack beneficial stink bugs?
    - **No-choice tests**
      - Native species egg mass
      - Can it develop on non-target species?
    - Choice tests
      - BMSB vs. native species eggs
      - Which eggs are preferred



# Predators and rare spp.

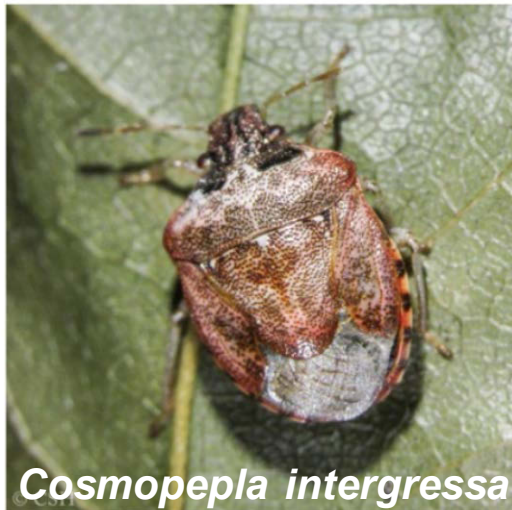
***Podisus serieventris***



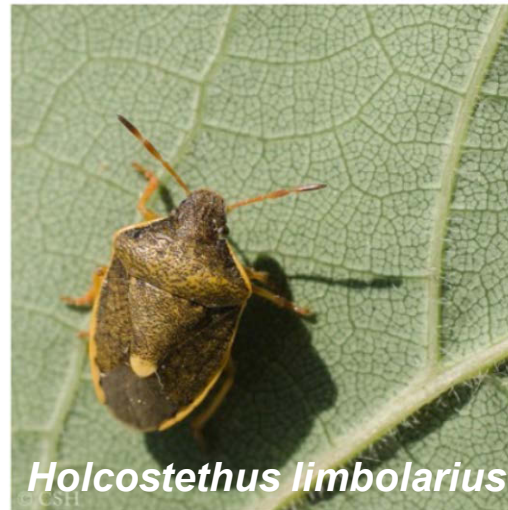
***Apateticus spp.***



***Cosmopepla intergressa***



***Holcostethus limbolarius***

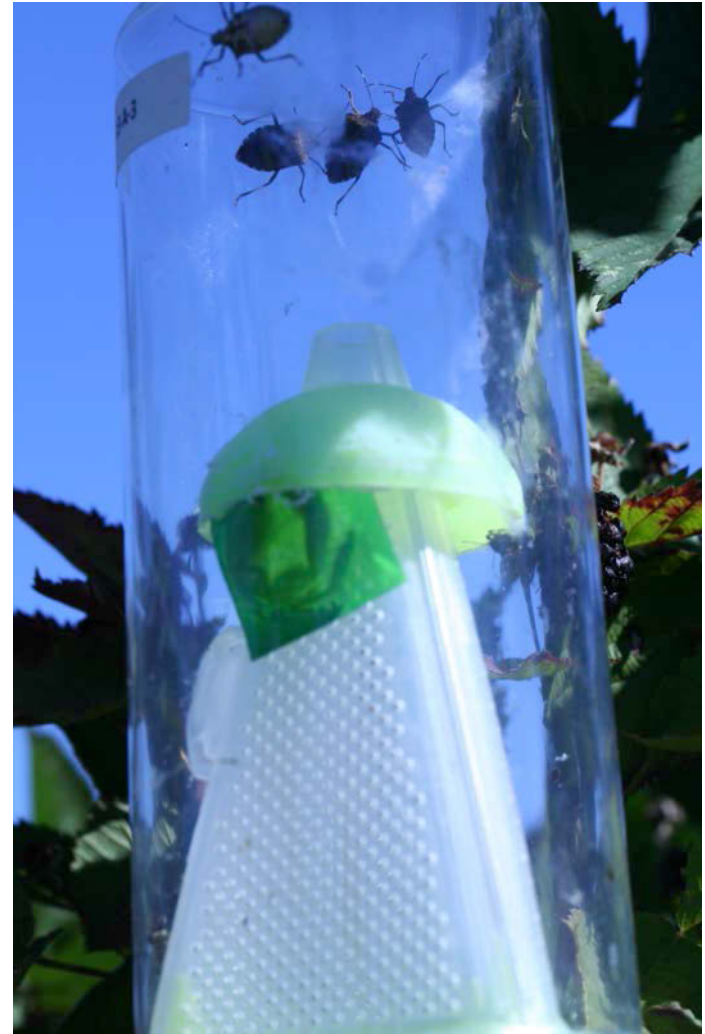


# Monitoring – black pyramid traps



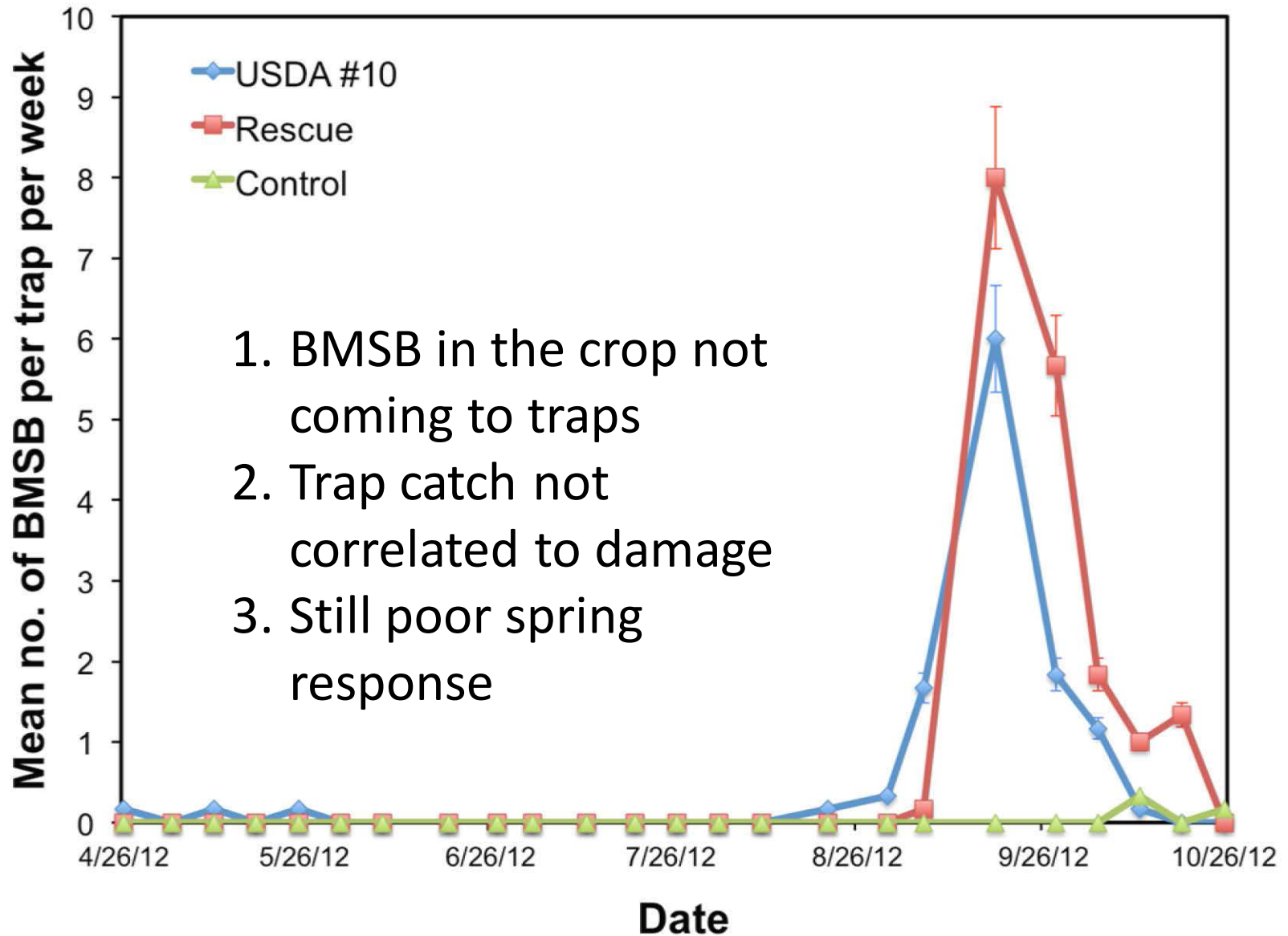


# Monitoring – Commercial lures





# USDA lure performance



# OSU BMSB Team

## Tree fruits



**Peter Shearer**

## Vegetable crops



**Silvia Rondon**

## Hazelnuts, wine grapes



**Vaughn Walton**

## Biocontrol specialist



**Jeffrey Miller**

## Ornamental crops



**Jana Lee**

## GRA



**Chris Hedstrom**

**Funding from USDA-NIFA-SCRI #2011-51181-30937**

# Thanks for your attention.

**Brown Marmorated Stink Bug**  
*Halyomorpha halys*



Adult shown actual size

Egg masses contain about 28 eggs and develop black triangles before hatching

Eggs

Stage 1

Stage 2

Stage 3

Stage 4

Stage 5

apples

peppers

tomatoes

hazelnuts

Photos: C. Hedstrom, T. Leskey, & Virginia Tech

Feeds on over 100 host plants including economically important crops and ornamentals


**Oregon State UNIVERSITY** Extension Service

<http://BMSB.hort.oregonstate.edu>

Authors: C. Hedstrom, N. Wiman  
V. Walton, P. Shearer, S. Rondon, J. Lee

Circles show approximate size of nymphs during life cycle

**Possible look-a-likes of BMSB in Oregon**




**Brown Marmorated Stink Bug**  
*Halyomorpha halys*

- banded antennae
- smooth "shoulders"

**This invasive pest poses a VERY SERIOUS threat to Oregon Agriculture**


**Box-Elder Bug**  
*Boisea rubrolineata*

- narrow body
- black and red color
- body not shield-shaped




**Conspers Stink Bug**  
*Euschistus conspersus*

- smaller body
- antennae light colored
- can have green underside



**Rough Stink Bug**  
*Brochymena sulcata*

- no banding on antennae
- rough, toothed "shoulders"



**If you suspect BMSB, please e-mail**  
**BMSB@oregonstate.edu**  
<http://BMSB.hort.oregonstate.edu>

## For reporting BMSB and more information:

Email: [BMSB@oregonstate.edu](mailto:BMSB@oregonstate.edu)

Web: <http://BMSB.hort.oregonstate.edu>