What the bug is that?

Todd Murray
Agriculture & Natural Resource Unit Director
Washington State University Extension
Washington State Invasive Species Council
Seattle 1999 - World Trade Organization Conference

- World Trade increased at a rate of 7.5% annually from 1950 to 2007
- This rate has increased since 2007 and will significantly increase in the next 20 years (WTO, 2013)

Seattle 2009 – Spotted Wing Drosophila
SPOTTED WING DROSOPHILA: *Drosophila suzukii*

- Native to Costal Asia and Japan

E. LaGasa, WSDA
SWD Distribution in North America

- 2008 - California fruit
- 2009 - OR, WA and FL; British Columbia CA
- LA, SC, NC, MI & UT in 2010
- WI, PA, VI, CN NJ in 2011
- 2013 widespread in over 30 states
- 2014 widespread and distributed throughout the world and in over 42 mainland US
Pest Status in the Pacific Northwest

- At 20% fruit loss, the 2008 fruit value would lose $118.3 million in losses to OR & WA (Bolda et al. 2009)

B. Gerdeman, WSU
Why is SWD so destructive?

D. suzukii ovipositor highly adapted for cutting.

Non suzukii ovipositor

B. Gerdeman
August 2013

I’ve been picking huckleberries in the same spot for over 80 years and I ain’t never had no worms in my berries before. Every damn berry was wormy this year. Fix my berries. I pay taxes dammit!”

*Skamania County resident dramatization*
August of 2013 – Indian Heaven Wilderness Area (GPNF)

- **V. membranaceum**
  - Thinleaf huckleberry
- **V. ovalifolium**
  - Alaska blueberry
- **V. deliciosum**
  - Cascade blueberry
<table>
<thead>
<tr>
<th>Year and date</th>
<th>State</th>
<th>Location (decimal coordinates)</th>
<th>Elevation (m)</th>
<th>No. berries picked</th>
<th>Adult D. suzukii reared from sample*</th>
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</tbody>
</table>

- **Adult SWD reared from 18 locations (2013-2015)**
- **Elevations ranging from 610 m - 1570 m**
SWD present in all three locations in 2013

<table>
<thead>
<tr>
<th>Site</th>
<th>Percentage</th>
<th>Elevation (ft)</th>
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</thead>
<tbody>
<tr>
<td>Peterson Prairie</td>
<td>47%</td>
<td>2900 (907m)</td>
</tr>
<tr>
<td>Hidden Lake</td>
<td>28%</td>
<td>4000 (1220m)</td>
</tr>
<tr>
<td>Clear Lake</td>
<td>18%</td>
<td>5150 (1570m)</td>
</tr>
</tbody>
</table>
What’s the Big Deal?

• 11 species of *Vaccinium* and 10 species of *Rubus* in this National Forest, let alone other potential hosts

• Utilizing higher altitude fruits a key feature of SWD in Japan [Mitsui et al. (2010)], India [Guruprasad et al. (2009)].
For almost 10,000 years, people have been traveling to Indian Heaven Wilderness to harvest huckleberries.
What is a Pest?

- Summer of 1998

It Gets Complicated

• Red Turpentine Beetle, *Dendroctonus valens*
  • Native to North America
• Introduced to China
  • New fungal association resulting in aggressive attack and high tree mortality
• Threat of reintroduction to North America with new fungal associate!

Sun et al. Annu. Rev. Entomol. 2013. 58:293–311
2013
Russia, a coastal town 150 km northeast of Nakhodka.
Port of Vancouver, WA
August 2014

A new atypical AGM pathway
Regulated Movement of Species

• 65 full-time personnel inspect incoming plant shipments at 17 Plant Inspection Stations

• Imports of 3.15 billion plants in 2007

• In 2010, average workload of 43 million plants per inspector

Liebhold et al. 2012
Front Ecol Environ; 10(3): 135–143

*Adapted from J. LaBonte ODA
ISPM-15 “treated” crates of Chinese iron castings, at receiving business, Portland, September 2006
Live pupa of horn-tail wasp

Live larva of clear-wing moth

Adult, found alive, of horn-tail wasp, *Tremex fuscicornis*
Not-so-bright outlook

• 1. Changing climate produces susceptible hosts
  • Changing climates will shift origins of imports
• 2. Increased number of species introduced
• 3. Relative decreased regulatory support

Over 70%!!!

“There is a 32% risk that a new borer that is as damaging or more costly than the emerald ash borer will invade in the next 10 years.” (Aukema et al. 2010)
New Bugs in the PNW

- Oregon Department of Agriculture documented 66 new introductions since 2007 (LaBonte 2014)
- Washington State Department of Agriculture documented 70 new introductions since 1991 (Looney et al 2017)
From: Shadow Surveys: How Non-Target Identifications and Citizen Outreach Enhance Exotic Pest Detection
Am Entomol | © 2016 Entomological Society of America
Asian Longhorned Beetle

Don't Delay! Report ALB Today!

New Maps Available! Also watch our informational videos below.

Below is our revised ALB landscape guide, but all the pests. Read on for more.

LANDSCAPER'S GUIDE

ASIAN LONGHORNED BEETLE

HOST TREES
$100,000,000

- Removal and total destruction of more than 1,700 trees
- 92,000 trees were treated.
Cost < 1,000,000

C.L. Campbell
The Invasion Curve
Washington Pest Watch:

A “new” network led by the Washington Invasive Species Council and partners with the goal of harmonizing messaging, resources, and reporting pathways between existing programs.

U.S. Department of Agriculture Animal and Plant Health Inspection Service
- Plant Protection and Quarantine
- Wildlife Services

Washington State University
- Washington State University Extension
- Washington State University Plant Pest Diagnostic Clinic
- Western Plant Diagnostic Network

Washington State Department of Agriculture
- Plant Protection Division Pest Program

Washington State Department of Natural Resources
- Urban and Community Forestry Program
Washington Invasive Species Council
Early Detection and Rapid Response

Washington Pest Watch:

**Educational Tools**
- First detector handbook - similar to
  - Intro to Washington Pest Watch
  - Intro to invasive species
  - Target species
  - How to participate
  - How to take good photos
  - Appendix: partners
- Slide series
- Washington Pest Watch Publication Series
- WA Invasives app trifold brochure
  - about invasive species
  - how to get and use app
- Washington State USDA Hungry Pest trifold brochure
Invasive Species in Washington State

How can you help?

See it? Reporting it!

1) Phone:
- Emergency Aquatic Invasive Species Hotline
  - 1-888-WDFW-AIS
- WA/OR/ID Feral Swine Hotline
  - 1-888-268-9219

2) Mobile app:
- WA Invasives for iOS and Android

3) Website:
Invasive Species in Washington State

How can you help?

See it? Reporting it!

Local WSU Extension office
https://extension.wsu.edu/

BC Invasive Species Council
- http://bcinvasives.ca/

ID Invasive Species Council
- http://invasivespecies.idaho.gov/

OR Invasive Species Council
- https://www.oregoninvasivespeciescouncil.org/

WA Invasive Species Council
Japanese beetle

- Native to Japan
- First detected in southern New Jersey in 1916
- By 1972 it was found in 22 states
- 430 known host plants
- Annual turf damage=$156m
- Most important turf pest in the US
- Oregon trapped over 12,000 beetles in August 2017
- Found in British Columbia in 2018
Lifecyle
Look for it! Report it!
Spotted Lanternfly

- Discovered in 2014 in PA
- Native to SE Asia
- Feeds on 70+ species including:
  - Apples, grapes and hardwoods
  - Tree of heaven (*Ailanthus altissima*)

Until November 2017, this invasive insect was only known to Pennsylvania. It has now been reported from Delaware (Nov. 20, 2017), New York (Nov. 29, 2017, Sept. 11, 2018, and Oct. 19, 2018), Virginia (Jan. 10, 2018), New Jersey (July 17, 2018), Connecticut (Oct. 22, 2018), and Maryland (Oct. 25, 2018)
Spotted Lanternfly

EGGS
October – June

HATCH AND FIRST INSTAR
May – June

SECOND INSTAR
June – July

FOURTH INSTAR
July – September

THIRD INSTAR
June – July

Illustrations by Dolores Widowski
What to look for…
What to look for...

WARNING: CHRISTMAS TREE SPOTTED LANTERNFLY COULD INFEST HOMES

BY JASON HALL ON 10/15/18 AT 5:14 AM

Adult spotted lanternfly with wings open. The spotted lanternfly makes use of over 70 different plant species, including fruit trees, ornamental trees, woody trees, vegetables, herbs and vines, including agricultural crops like grapes.

NEW JERSEY DEPARTMENT OF AGRICULTURE
Emerald Ash Borer

• Native to Eastern Russia
• First noticed in Michigan and Ontario, Canada in 2002
• Quickly moved throughout the Northeast and Midwest—in 28 states
• Has killed tens of millions of ash trees in US
• Projected damage at $10.7 billion from 2009 to 2019 (Kovacs et al. 2010).

• Rapid dispersal is due to:
  • Movement of wood packing material and firewood
  • The beetle’s own dispersal capabilities (~20mi/yr)(Bauer et al., 2004)
• USDA APHIS removing the quarantine???
Emerald Ash Borer

Identification

• Size: 0.4 – 0.5 inches
• Metallic green
• Coppersy red under wing cover
• Several native lookalikes

Debbie Miller, USDA Forest Service, Bugwood.org

Pest and Disease Library, bugwood.org
Emerald Ash Borer
Look for...

“D-shaped” emergence holes

Epicormic growths and shoots on the main stem
Emerald Ash Borer Management

- Population size and distribution make eradication beyond reach
  - Do not contribute to the spread
  - Adhere to quarantines
    - Do not move firewood, green ash lumber or brush
- Preventive insecticide use for high-value trees
  - Most effective in healthy trees
  - Limit use to within 15 miles of a confirmed outbreak

David Cappaert, MSU
European Chafer
*Amphimallon majale*

Native to Western and Central Europe.
European Chafer
*Amphimallon majale*

- Adults active mid-June through July
- Brick red to light brown
- ½ inch
- Up to 50 eggs
Evening Swarms
European Chafer
*Amphimallon majale*

- Larvae feed from fall to spring usually in the first 2” of soil
- Pupae begin in April
- One generation per year
Adult swarms are visible in late spring and early summer.

Adults live for about two weeks, and fly for ~five days.
<table>
<thead>
<tr>
<th>JAN</th>
<th>FEB</th>
<th>MAR</th>
<th>APR</th>
<th>MAY</th>
<th>JUN</th>
<th>JUL</th>
<th>AUG</th>
<th>SEP</th>
<th>OCT</th>
<th>NOV</th>
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</tr>
</thead>
</table>

1st instars hatch and begin to feed
3rd instar grubs overwinter in earthen cells, or....
... 3rd instar grubs feed throughout the winter.

3rd instar grubs overwinter in earthen cells, or....
1st instars hatch and begin to feed

pupation in spring
Vertebrate predators destroy turf by digging for tasty grubs!

3rd instar grubs overwinter in earthen cells, or...

…3rd instar grubs feed throughout the winter.

1st instars hatch and begin to feed.

Adult swarms are visible in late spring and early summer.

Pupation in spring.
Damage

- Grubs feed on fibrous roots
- Feed on all lawn and pasture grasses, many cereal species
- Causes frequent die-back, especially in any sub-ideal growing conditions
Damage to lawn from vertebrates digging for grubs
Damage to lawn by Crows

Peter Isaacson
Deslsaa Horticultural Consultants Inc.
Surrey, British Columbia
Damage
Damage
Distribution

- Detected in British Columbia in 2001 (MG!)
- Light trap surveys in Blaine, WA in 2002 – not found
- Detected periodically in Japanese beetle surveys (four locations in 2008, including Spokane)
- Detected in SeaTac in 2016 (MG!)
Survey techniques

- Cut turf back in 12x12 inch square to look for grubs

- Management at:
  - 5-10 grubs/sq ft, low maintenance
  - 15-20 grubs/sq ft, daily irrigated
Management

- **Promote healthy/drought tolerant lawns**
  - Mowing high, irrigation, nutrition

- **Foresee increased pesticide use upon introduction**

- **Cultural methods**
  - Frequent watering during flight
Survival of 2\textsuperscript{nd} Instar Chafer Larvae 2 Weeks Post Treatment

- Control
- B. thuringiensis tenebrionis
- M. anisopliae
- H. bacteriophora low rate
- H. bacteriophora high rate

Peter Isaacson
DessIsaa Horticultural Consultants Inc.
Surrey, British Columbia
Turf Health

- High Maintenance Turf…
  - Mowing
    - 2 to 3 inches
    - 1 x week
    - Returning clippings
  - Fertilization
    - 4 x year, twice in spring and twice in the fall
    - 1 lb N per 1,000 sq ft per application (4 lbs per 1,000 sq ft annually)
  - Irrigation
    - 4 x week at ¼ inch per application
    - Memorial Day to Labor Day

Alec Kowalewski
Associate Professor, Turf Specialist OSU
European Chafer Report Form

The European chafer is a new turf pest in Washington State, and we need your help to map its spread. Use this form to submit relevant details regarding a sighting of European chafer in Washington State. The most reliable way for us to track this pest is for you to upload a picture of your suspect grub or associated damage using this form.

Pictures help us verify the identification, which is important since many insects look alike. You may also mail suspect specimens and collection information to Chris Looney, WSU Extension, 1111 Washington St. SE, Olympia, WA 98504.

You can learn more about European chafer at many websites, including:

WSU Extension
MSU Extension
City of Burnaby

PestWatch: European Chafer FS078E
European Fire Ant  *Myrmica rubra*

- Vast native range from Ireland to Siberia (Czechowski et al., 2000)
  - Broad range illustrates potential to spread around the U.S.
- First found in MA in 1908
  - Established throughout the northeast in NH, NJ, PA, WA D.C., RI, ME (Groden et al., 2005)
  - Also in British Columbia and parts of Washington State (Seattle)
European Fire Ant
*Myrmica rubra*

**Identification**
- Adults are approx. 0.2 in long
- Head and thorax are deeply striated (grooved) (see photo)
- Do not form nest mounds
European Fire Ant  
*Myrmica rubra*

Identification

- Prefer moist nest sites
- Densely packed infestations  
  - many have an average of 1.25 nests per square yard
- Wide variety of micro-habitats utilized (Groden et al., 2005)
European Fire Ant
Myrmica rubra

Damage
• Highly aggressive
• Conflicts with humans are rising as the ant spreads
  • Prefers nest sites near rivers, lakes, and gardens
  • Increasing conflict with recreationists

Peter Grainger, CTV News, Vancouver, B.C.
Viburnum Leaf Beetle

- Ontario in 1947
- 1996 found in NY and surrounding states
- Found in Vancouver 2001 and Whatcom County in 2004
Current Distribution in the PNW

- Spokane WA
Pyrrhalta viburni

- Eggs overwinter on stems in protected wounds.
Pyrrhalta viburni

- Larvae hatch and begin to feed in spring as leaves appear
VLB Larvae
• In June, mature larvae migrate to the soil to pupate for about 1-2 weeks.
VLB Adults
VLB Adults

- Adults emerge in July and feed on foliage
- Adults lay eggs into green stems
- Adults active until first killing frost
Damage
Damage
Host Susceptibility

**Susceptible**
- *V. dentatum* complex - arrowwood
- *V. opulus* - European cranberrybush
- *V. opulus var. americana* - American cranberrybush
- *V. rafinesquianum* - Rafinesque viburnum
- *V. sargentii* - Sargent viburnum

**Resistant**
- *V. burkwoodii* Burkwood viburnum
- *V. x carlcephalum* Carlcephalum viburnum
- *V. carlesii* Koreanspice viburnum
- *V. x juddii* Judd viburnum
- *V. plicatum var. tomentosum* doublefile viburnum
- *V. x rhytidophylloides* Lantanaphyllum viburnum
- *V. rhytidophyllum* leatherleaf viburnum
- *V. setigerum* Tea viburnum
- *V. sieboldii* Siebold viburnum
Impact on wildlife

- LOSS OF SOUTHERN ARROWWOODS (VIBURNUM DENTATUM) IS ASSOCIATED WITH CHANGES IN SPECIES COMPOSITION AND MASS GAIN BY SPRING MIGRANTS USING EARLY SUCCESSIONAL HABITAT

- Smith & Hatch (2017) reported:
  - Decrease in diversity
  - Changes in capture rates, both decrease and increase in species
  - No evidence in mass gain after infestation
PestWatch: Viburnum Leaf Beetle FS202E

PEST WATCH: VIBURNUM LEAF BEETLE
Home Garden Series
Red Lily Leaf Beetle
Lily Leaf Beetle in North America

- Introduced from Europe in 1945
- First US records 1992, Cambridge
- Rapid spread soon after…

http://lilybeetletracker.weebly.com/map.html
Lily Leaf Beetle in Washington

Discovered in Bellevue in 2012
Lily Leaf Beetle: *Lilioceris lilii*

- Brilliant red beetles
- Emerge in spring to feed, mate, and lay eggs
- Adults make a distinctive, squeaking sound when pestered.
Lily Leaf Beetle: *Lilioceris lilii*

- Up to 450 eggs laid per female

- Eggs laid in small batches on the underside of leaves

- 4-8 days to hatch
Lily Leaf Beetle: *Lilioceris lilii*
Lily Leaf Beetle: *Lilioceris lilii*

- Larvae are ready to pupate in the soil after three to four weeks.

- Adults emerge three to four weeks later, and get to work eating foliage until fall.
Lily Leaf Beetle: *Lilioceris lilii*

- Primarily attack *Fritillaria* and *Lilium*
Impacts to the Understory

- *Lilium columbianum*
- *Calochortus*
- *Nomocharis saluensis, Polygonum sp., Convalaria sp.* (Hesse 1932), *Solanum dulcamara* (Slate 1953, Tempere 1926), *Solanum tuberosum* (Fox-Wilson 1943, Mohr 1966, Franz 1974, Slate 1953), and *Chimonobambusa marnorea*
PestWatch: Lily Leaf Beetle FS084E

Introduction
The Lily leaf beetle (LBB), Lilioceris lilii is a bright red beetle in the Chrysomelid family native to Europe and Asia. In its native range, LLB is a pest of Asian and hybrid lilies.

Distribution
Lily leaf beetle was first discovered in North America in Montreal, Canada, in 1865. In 1927, LLB was found for the first time in the United States in Cambridge, Massachusetts. Since then, LLB has spread through New England and now occurs in Maine, New Hampshire, Massachusetts, New York, Connecticut, Rhode Island, and Vermont. In the spring of 2017, an alert homeowner reported this beetle to the Washington State Department of Agriculture and LLB was recorded in Washington State for the first time. Upon investigation, LLB was found in the southwest neighborhoods of Bellevue, just east of Seattle.

Identification and life cycle
Adult beetles are 1/8 to 3/8 inch long and conspicuously colored: bright scarlet red, with the head, scutellum, legs, and antennae black (Figure 1). Adult beetles are very active and mobile, and they make a distinctive chirping or squeaking noise when provoked. Adult beetles overwinter in the soil and emerge in the spring to feed on developing foliage and seed heads.

Lily leaf beetles can complete their life cycle on tree lilies (Cult. eggs) and ornamental lilies (Cult. eggs). Adult beetles lay eggs in small batches on the underside of host plant leaves, laying up to 450 eggs during the season (Figure 2). The oval, orange-brown eggs hatch in one to two weeks. Larvae are orange to light green, but cover themselves in excrement and remain camouflaged.
Azalea Lace Bug (*Stephanitis pyrioides*)

- Completely fried azaleas in 2007
- Confirmed in 2008 in King County
- Confirmed in 2009 in Portland
- Kissing cousins to the Rhodie lace bug (*Stephanitis rhododendri*)
Azalea Lace Bug

- Damage recognized by tar-like spots and stippled leaves
# Novel Hosts

Based on Garden & Nursery Observations and Host Plant Trials (ODA)

<table>
<thead>
<tr>
<th>3 New Host Families:</th>
<th>14 New Host Genera</th>
</tr>
</thead>
<tbody>
<tr>
<td>Betulaceae</td>
<td>Epigaea</td>
</tr>
<tr>
<td>Caprifoliaceae</td>
<td>Gaultheria</td>
</tr>
<tr>
<td>Rosaceae</td>
<td>Kalmiopsis</td>
</tr>
<tr>
<td></td>
<td>Phylliopsis</td>
</tr>
<tr>
<td></td>
<td>Prunus</td>
</tr>
<tr>
<td></td>
<td>Vaccinium</td>
</tr>
<tr>
<td></td>
<td>Viburnum</td>
</tr>
</tbody>
</table>

30 New Host Species
Impact of Azalea Lace Bug to Native Understory

• Impact to native understory
  - Kalmiopsis leachianum
  - Gaultheria shallon
  - Rhododendron groenlandicum
  - Vaccinium ovatum & V. uliginosum