Declining Bigleaf Maples in Oregon: What’s Going On?

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**Bigleaf maple**  
*Acer macrophyllum*

- Largest maple species in North America (can grow to over 100 ft tall (biggest leaves, too!))
- Can live for over 200 years
- Common in moist floodplains and upland riparian zones growing in coarse or gravelly textured soils, tolerates short-term flooding
- Supports the greatest moss load of all tree species in the Pacific Northwest
- Important early season nectar source for pollinators, habitat for Puget Oregonian snail
- Figured wood is prized for guitars, veneers, etc.
Investigations of Bigleaf Maple Decline
2011-2018
Conducted/Sponsored by: WADNR, ODA, USFS, OSU, UW

Questions:
1. What is the severity and extent of declining maple health in the PNW?
2. What relationships exist among declining maples, tree symptoms, diseases, insects, site factors, or climate?
Disease Investigations 2011-2016 (WDNR, ODF, USFS, OSU)

Looked at foliage, stems, roots, soil:

- *Xylella fastidiosa* (bacterial scorch)
- Foliar fungi including maple anthracnose, which is hard to distinguish from *Xylella*
- Verticillium wilt (root/stem/branch fungus)
- Cankers (*Neonectria, Nectria*) (stem fungi)
- Phytophthora (root pathogen)
- Armillaria (root fungus)

Results: No pathogens consistently associated with bigleaf maple decline
Insect Investigations
2011-2018 (USFS)

Focused on clarifying the role of leafhoppers in bigleaf maple decline:

- Identification of primary leafhopper species affecting maple, WA (2016)
- Developed trapping methods and protocols, WA (2017)
- Canopy monitoring with sticky traps, WA (2018)
- Insecticide study, WA site (2016)
- Roadside survey, NW OR (2018)
- Characterize tree symptoms (2011-2019)
*Empoasca elongata* Delong, 1931

= *Empoasca elongella* Metcalf, 1968
Prior records of *Empoasca elongata*

Described from a series of 16 females and 7 males collected at *Friday Harbor, San Juan Island, Wash.*, July 26, 1928, by Martha Schakleford, from shrubs in coniferous and alder forests. Also from a series of 12 specimens in E. D. Ball's collection from *Sacramento and Spreckles, Calif.*, and *Helper, Utah*, collected in August and September, 1906 and 1907 (Delong 1931).

Reported as a factor causing necrotic tip dieback on holly oaks in southern California (Loos 1965, Brown and Eads 1969)
“Hopperburn”

Potato leafhopper, *E. fabae*, causes damage on red maple in the eastern US; not known to vector disease.
2017-2018 Bigleaf Maple Canopy Trapping

**Empoasca elongata**

- Most abundant leafhopper
- Very high populations (3 to 48 times more than other leafhopper species)
- Two peaks (early July, mid-August)
Results indicate that *E. elongata* may play a significant role in maple decline.
Imidacloprid Injection Study

2018 = Third year of data collection
Data Collected:

1. **Site Factors** - location, elevation, aspect, slope, proximity to water, distance from the coast, etc.

2. **Tree Data** - DBH, tree/forest position, seed crop, damages (% by crown third: yellow margin, cupped, reduced size, sparse, chlorotic, wilted, deformed, dead), overall health between points

3. **Leafhopper Data** - timed search; sticky trap catch (number of leafhoppers by species/morphotype caught during 3 week period in July, 2018)
2018 NW Oregon Roadside Survey of Bigleaf Maple

Number of Sample Points
Cascades = 14
Coast = 10
2018 NW Oregon Roadside Survey of Bigleaf Maple

Empoasca elongata leafhopper was:
- present at all sample points
- less abundant in the coastal areas
2018 NW Oregon Roadside Survey of Bigleaf Maple

Tree damage severity varied by ecoregion and within ecoregion

Severity Class Frequencies within Ecoregions

<table>
<thead>
<tr>
<th>Ecoregion</th>
<th>Severity Class</th>
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<tbody>
<tr>
<td>Cascades</td>
<td>None</td>
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<tr>
<td>Coast</td>
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<tr>
<td>Cascades</td>
<td>Moderate</td>
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<tr>
<td>Coast</td>
<td>High</td>
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</tbody>
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Damage Severity Class
- None
- Low
- Moderate
- High

Other Data Point
2018 NW Oregon Roadside Survey of Bigleaf Maple

No consistent relationship between leafhopper trap catch abundance and tree damage
General Trends in Leafhopper Damage, Frequency, and Severity*

↑ North to South
↑ Coast to Cascades
↑ Lower Elevation (outside of coastal fog belt and below ~1500 ft)

*based on empirical and non-emirical observations
Leaf Symptoms

- Yellow tipping with “wedge-shaped” leaf tip necrosis*
- Cupping
- Reduced size
- Wrinkling
- Misshapen
- Thickened leaf tissue of severely reduced leaves
Tree Symptoms

Progressive decrease in leaf size from bottom to top of tree
Tree Symptoms

- Gradual top-down decline
- Chlorosis
- Epicormic sprouting
- Premature leaf drop (late July)
- Sparse crowns
- Mortality
Tree Symptoms

May affect all sizes of trees
“Hopperburn” Comparison

*Empoasca elongata* on bigleaf maple

Potato leafhopper, *E. fabae*, on eastern maples

Photo: Amy Fulcher, University of Tennessee, Knoxville

Photo: Steven K. Rettke of RCE

On alfalfa
Environmental variables positively associated with maple decline:

- Higher temperatures
- Decreased precipitation
- Vapor pressure deficits
- Proximity to paved roads
- High levels of developed land
- Low levels of forested or herbaceous land
Data indicates bigleaf maple prefers cooler, moister summers, and that hotter, drier summers are detrimental.

- Ring widths of bigleaf maple were negatively correlated with summertime temperatures, vapor pressure deficits, and drought.
- Summer mean, minimum, and maximum temperatures were negatively correlated with ring width, indicating that bigleaf maple grows more in years with cooler summers.
Working Hypothesis

- Climate change (warmer and drier) is the primary driver of widespread maple decline.
- Native *Empoasca enlongata* leafhoppers are favored by a warmer, drier climate and are a significant amplifying factor, especially in areas with droughty or shallow soils or sites with high levels of solar exposure.
- Other disturbance agents such as Armillaria root disease, foliar diseases, and other sucking insects sometimes may contribute locally to maple decline but are not significant on a large scale.
Questions?