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

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for the greatest good

Bigleaf maple
Acer macrophylum

- 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.


August, 2010

Investigations of Bigleaf Maple Decline 2011-2018

Conducted/Sponsored by: WADNR, ODA, USFS, OSU, UW

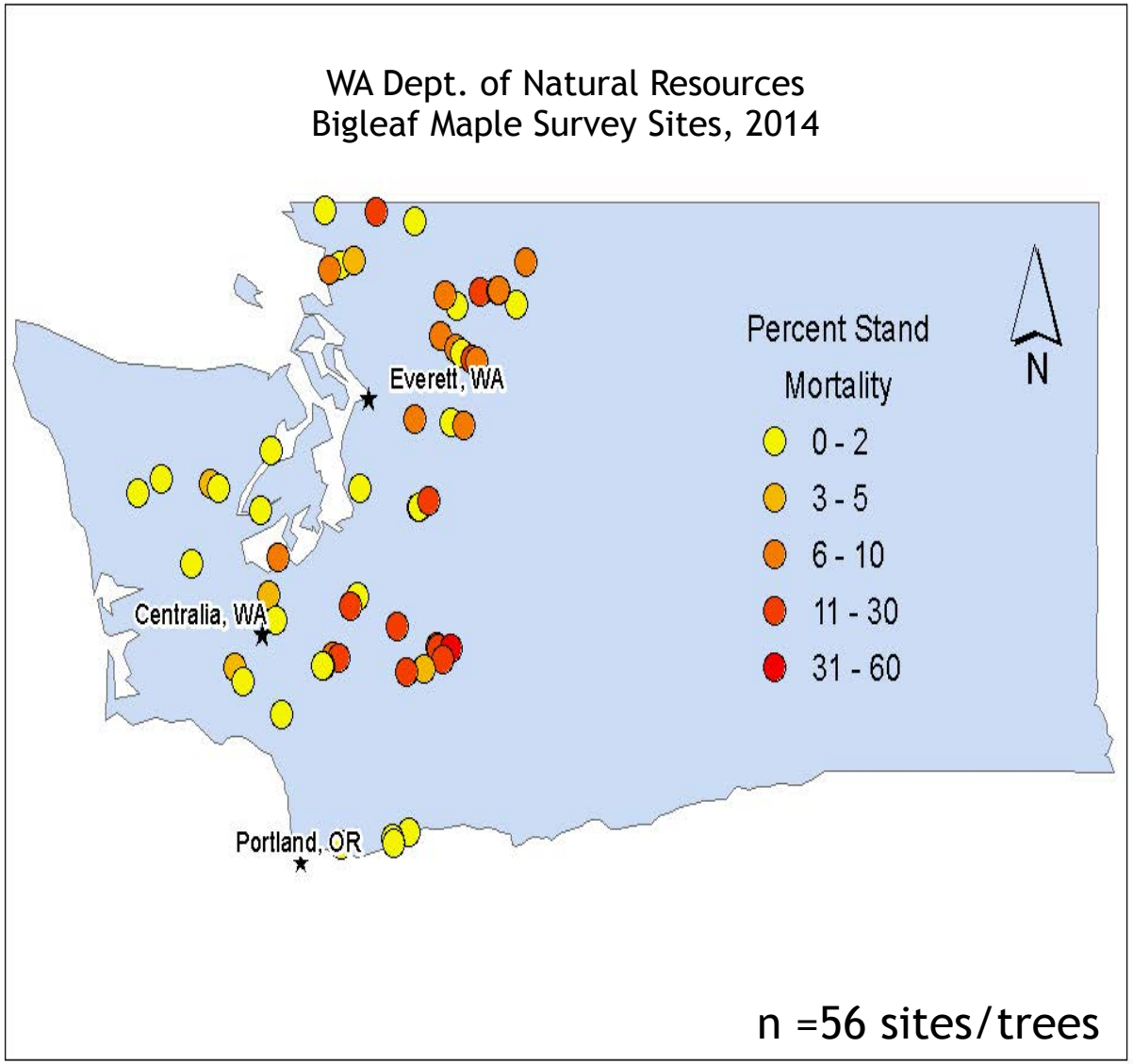
Questions:

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

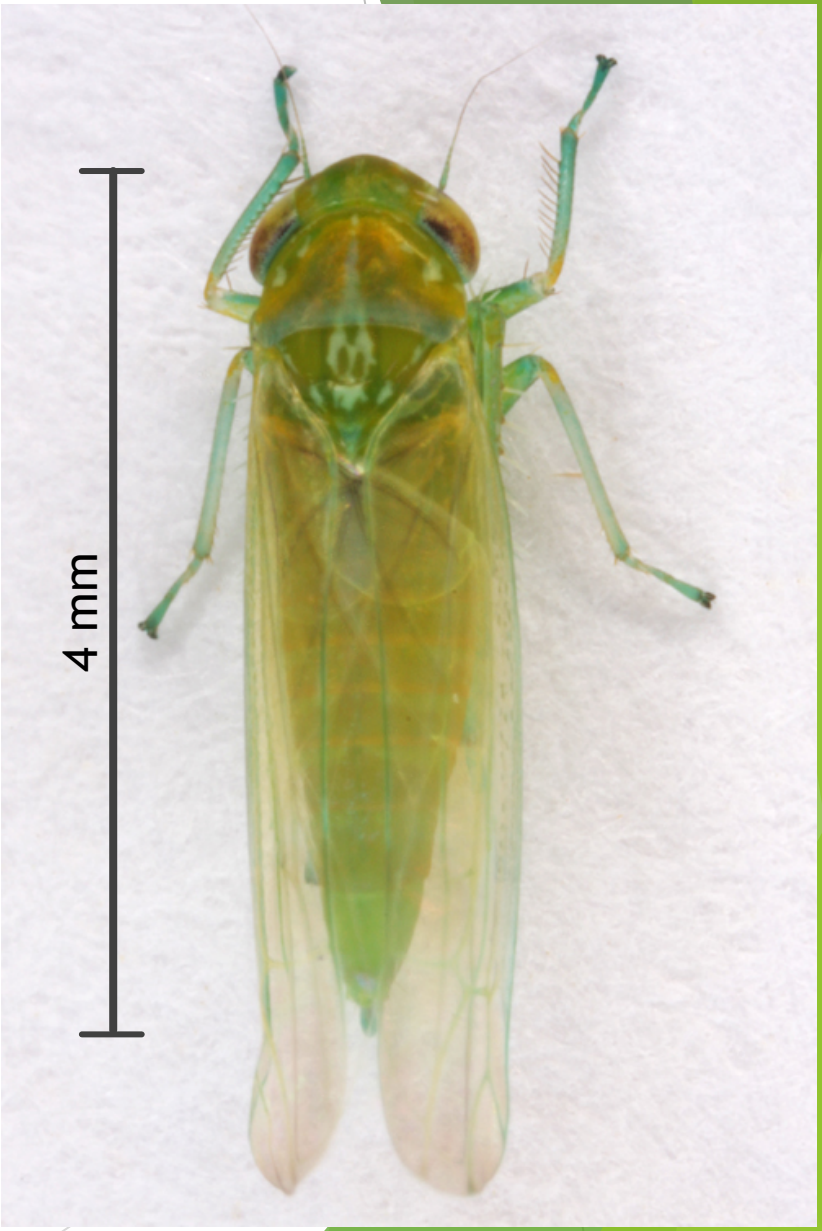
Insect Investigations 2011-2018 (USFS)

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

Photo: Amy Fulcher, University of Tennessee, Knoxville

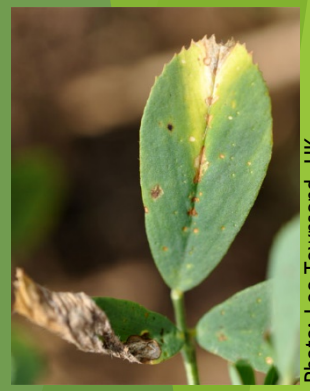


Photo: Lee Townsend, UK

On alfalfa

Photo: Steven K. Rettke of RCE

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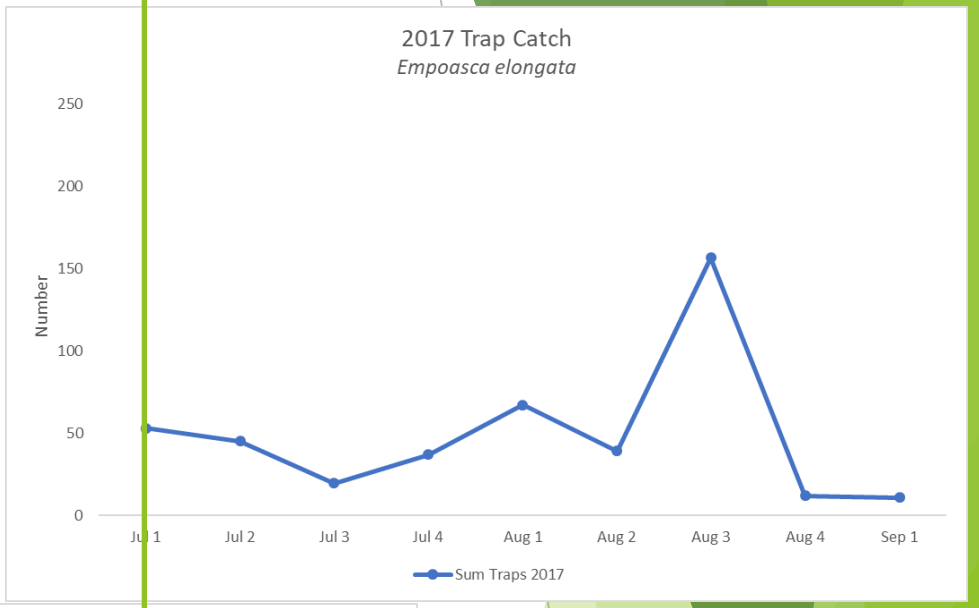
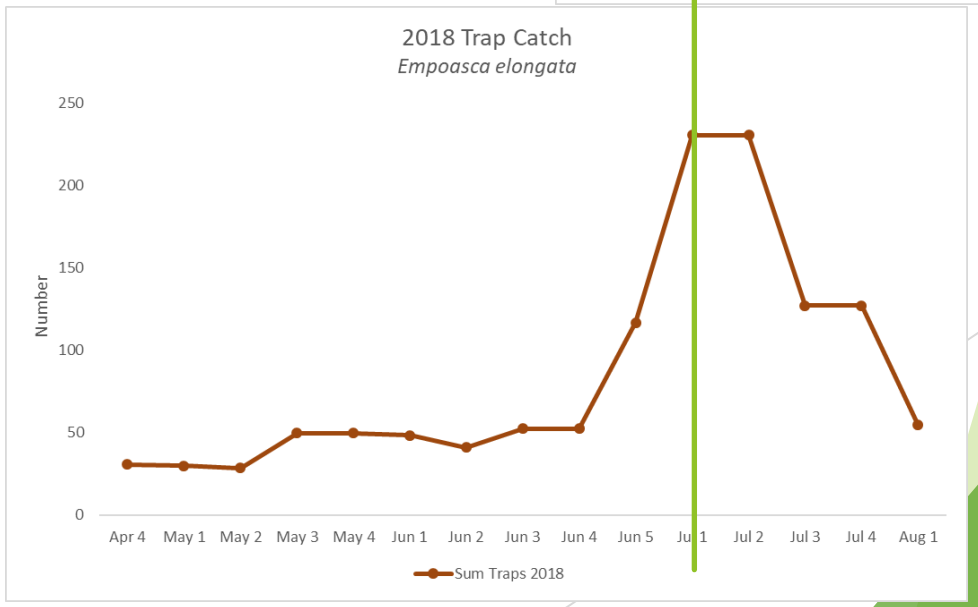
2017-2018 Bigleaf Maple Canopy Trapping

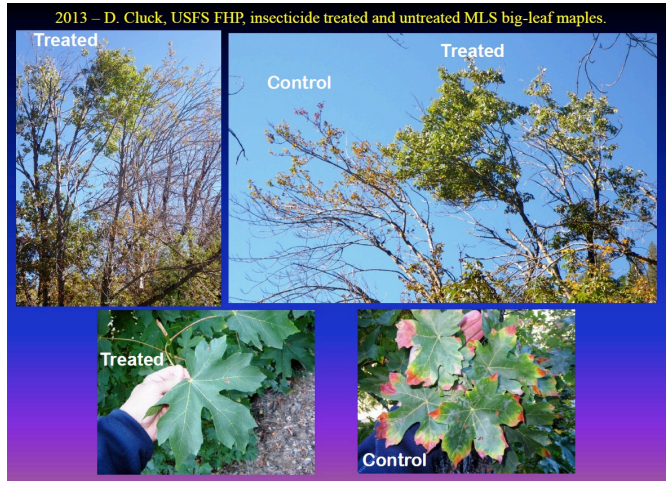
Empoasca elongata

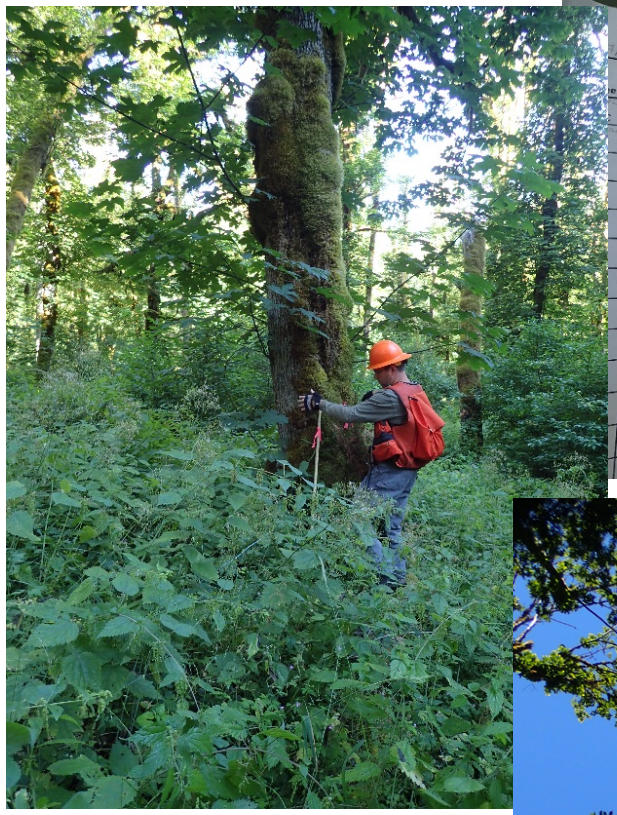
- Most abundant leafhopper
- Very high populations (3 to 48 times more than other leafhopper species)
- Two peaks (early July, mid-August)

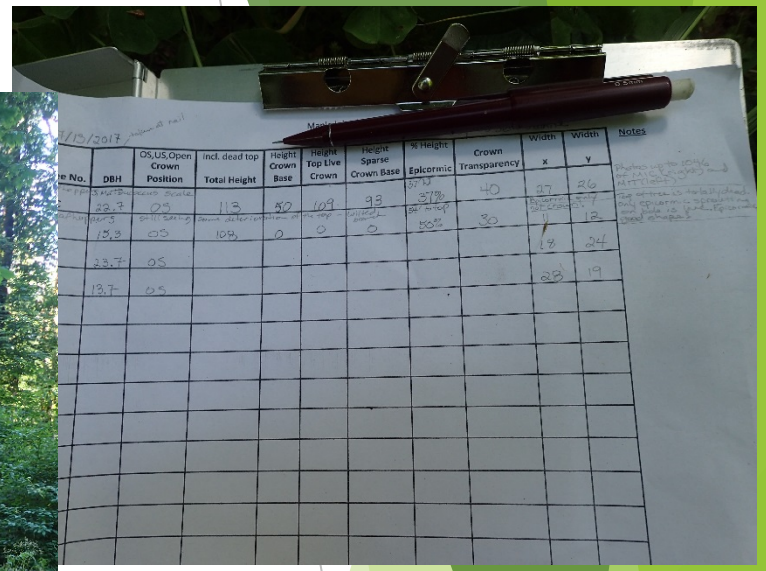




Imidacloprid Injection Study, 2016-18







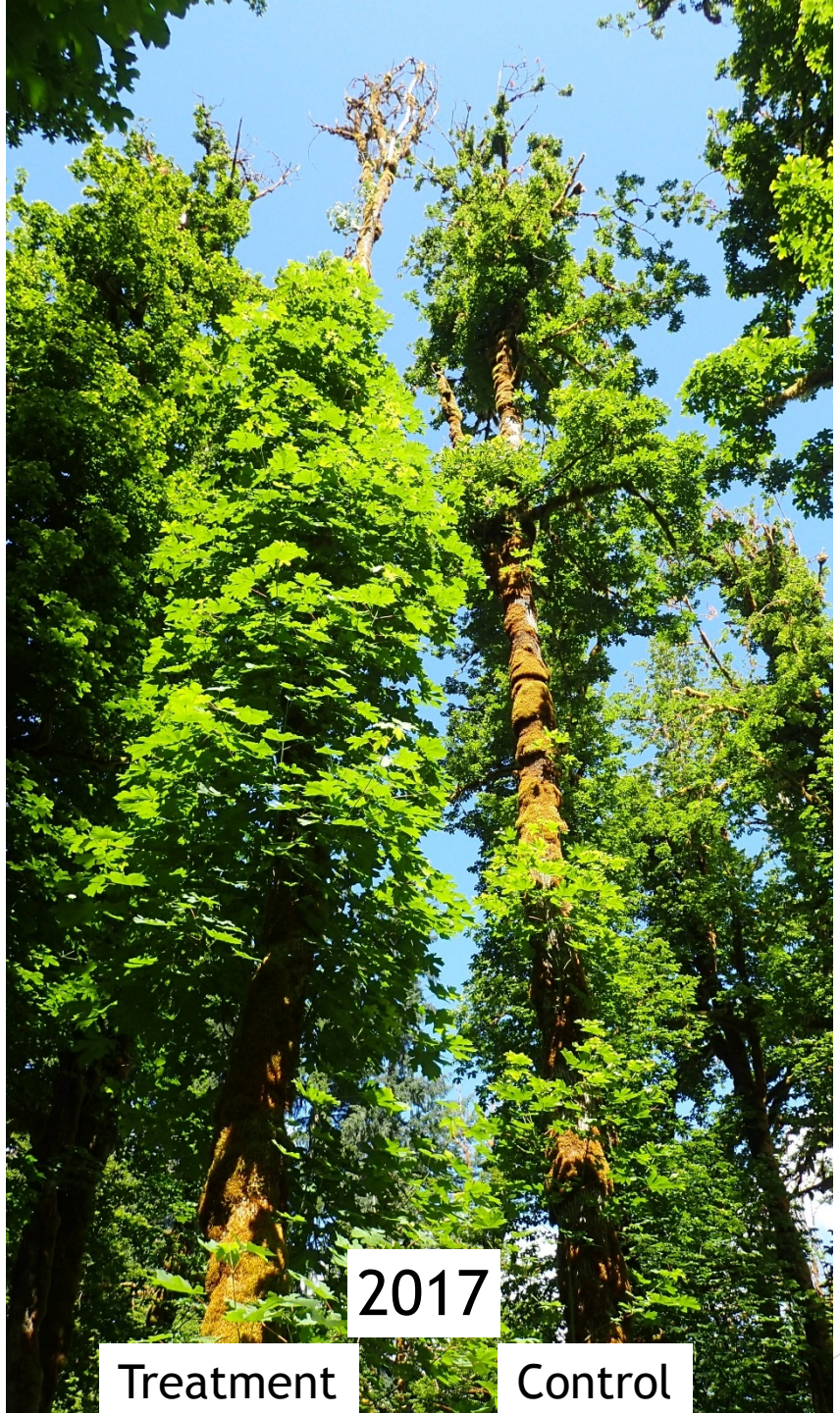
Results indicate that *E. elongata* may play a significant role in maple decline

Treatment Control

Imidacloprid Injection Study

2018 = Third year of data collection


2016
Treatment
Control

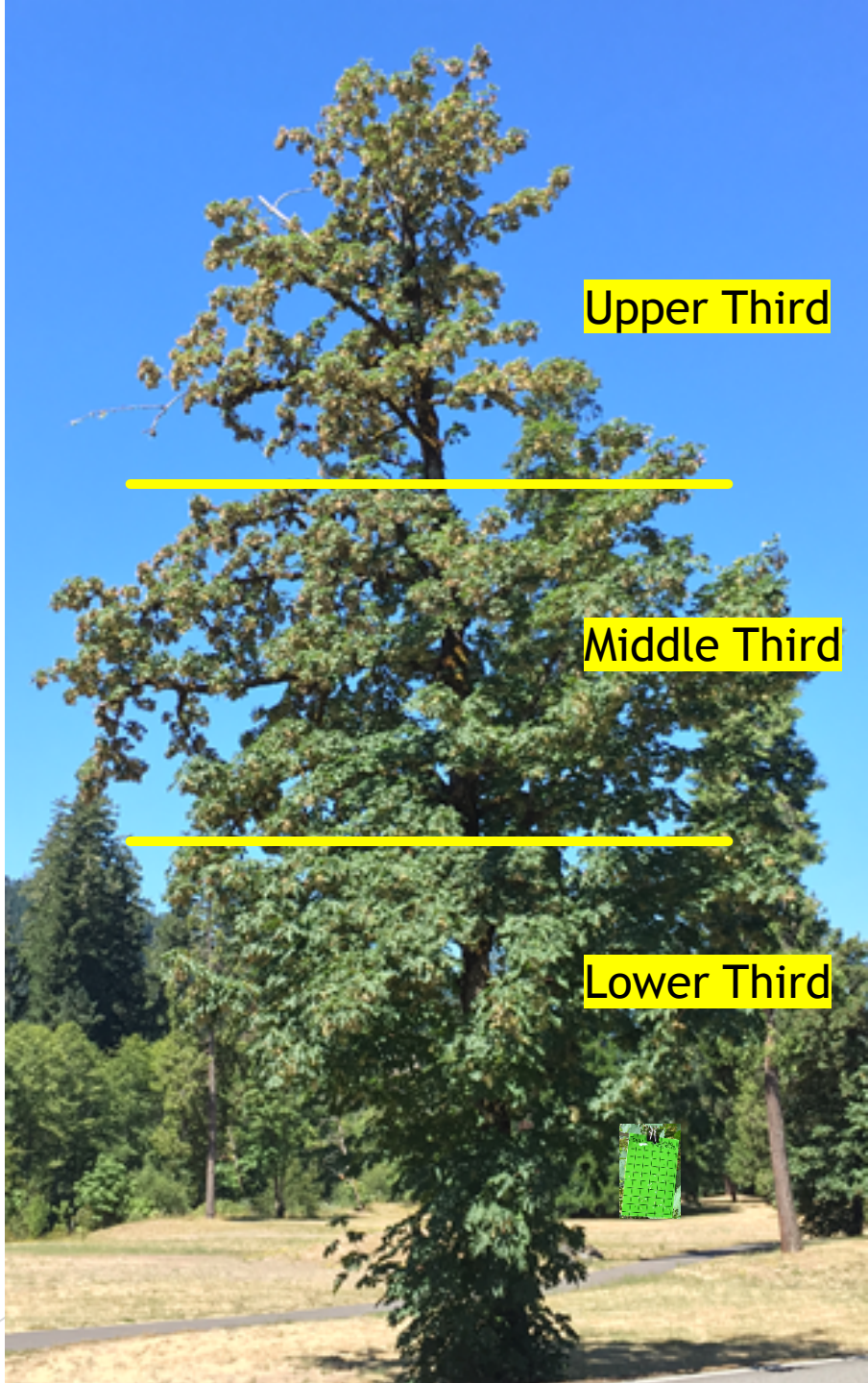

2017
Treatment
Control


2018
Treatment
Control

2018 NW Oregon Roadside Survey of Bigleaf Maple

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)

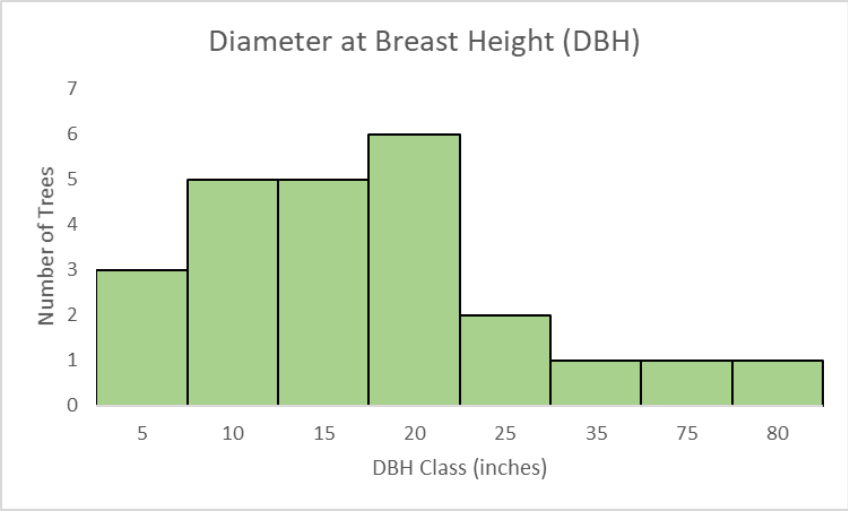


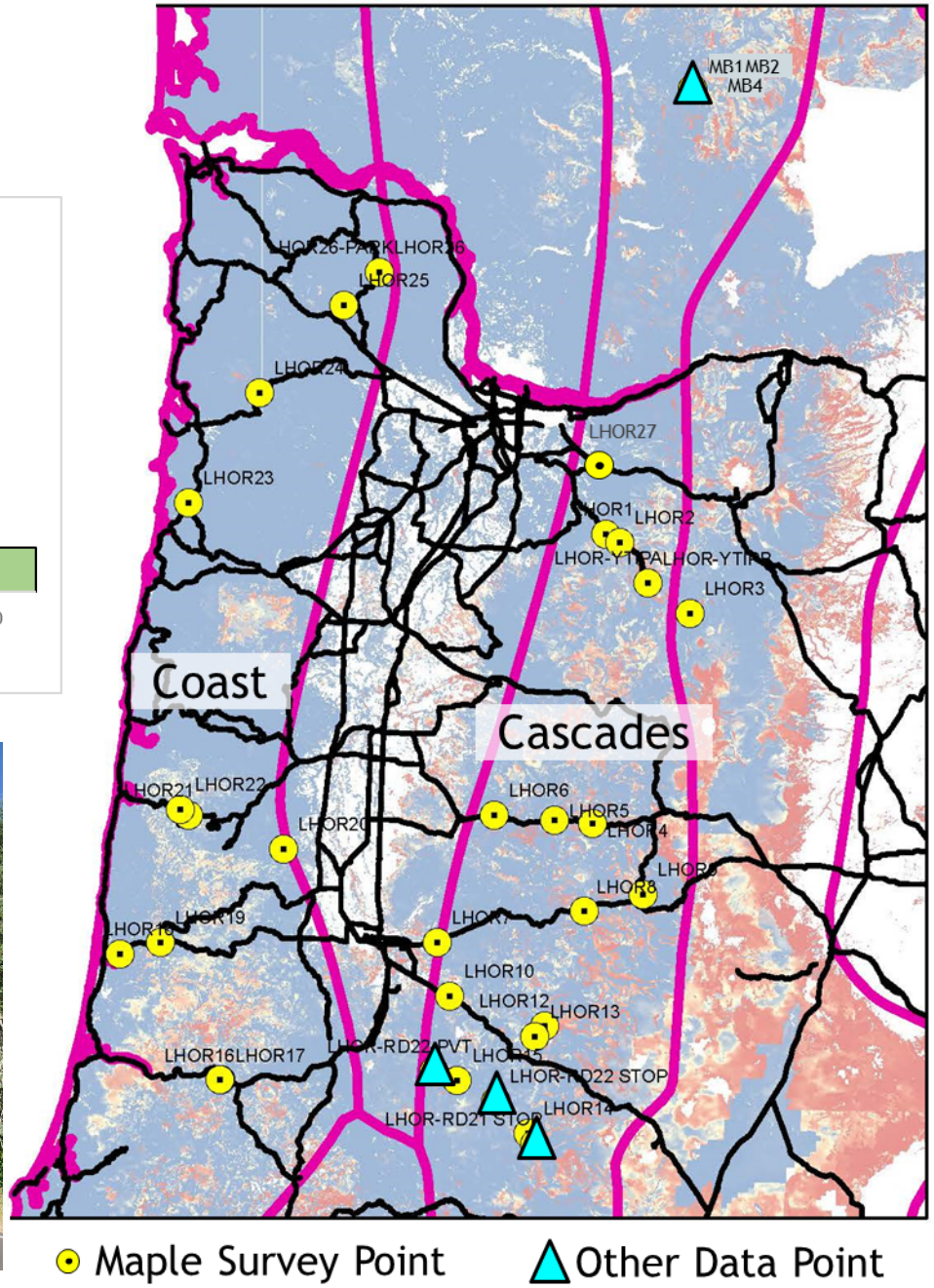
2018 NW Oregon Roadside Survey of Bigleaf Maple

Number of Sample Points

Cascades = 14

Coast = 10

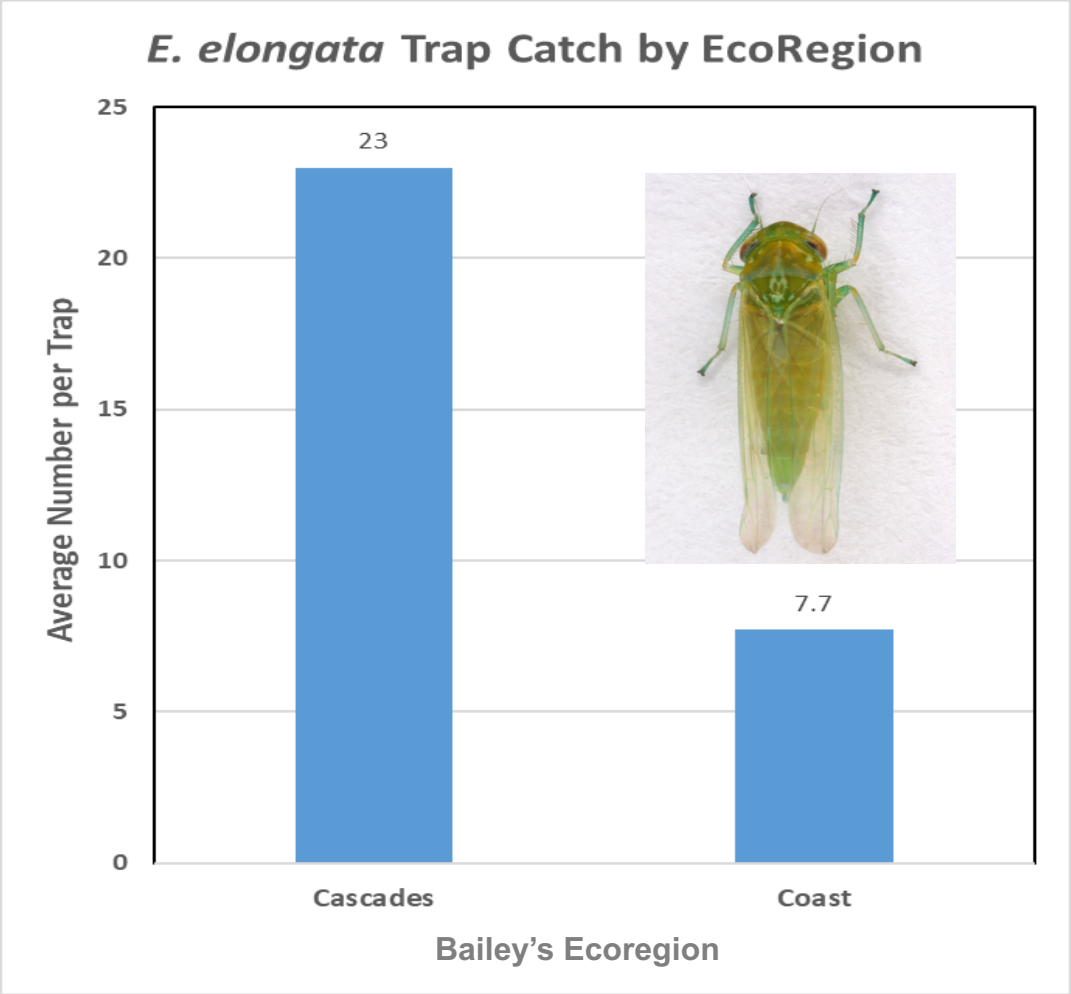


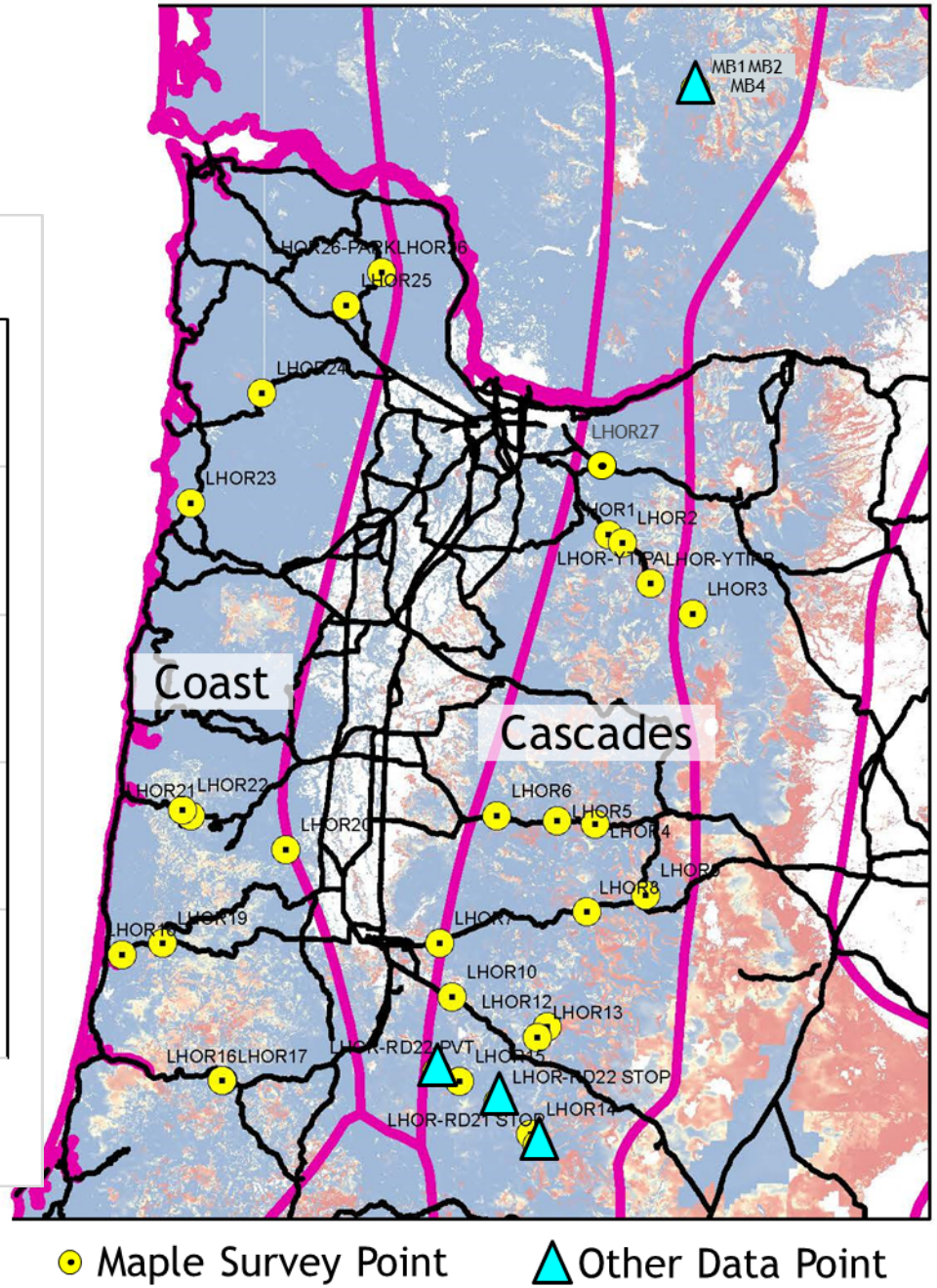


2018 NW Oregon Roadside Survey of Bigleaf Maple

Empoasca elongata **leafhopper was:**

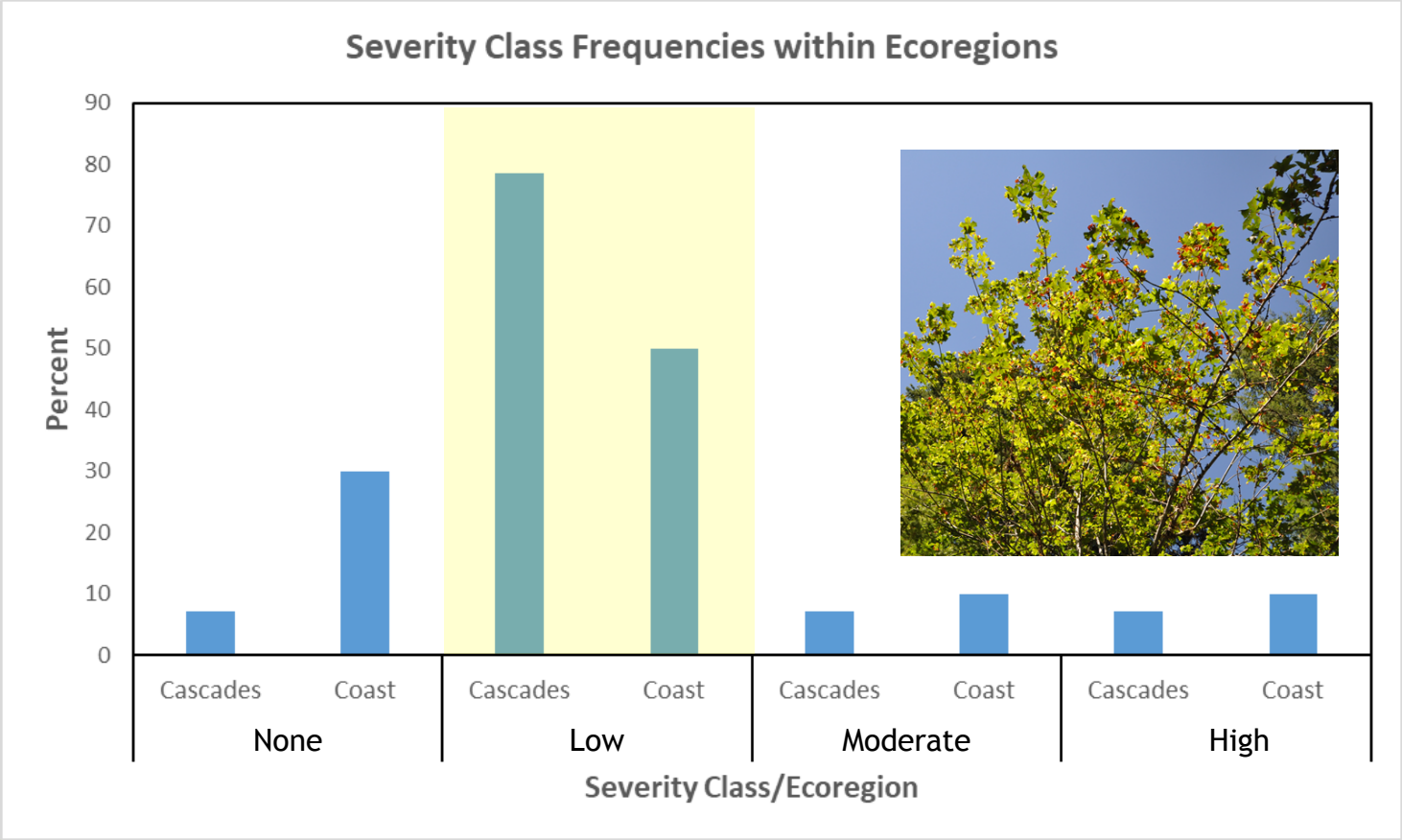
- **present at all sample points**
- **less abundant in the coastal areas**

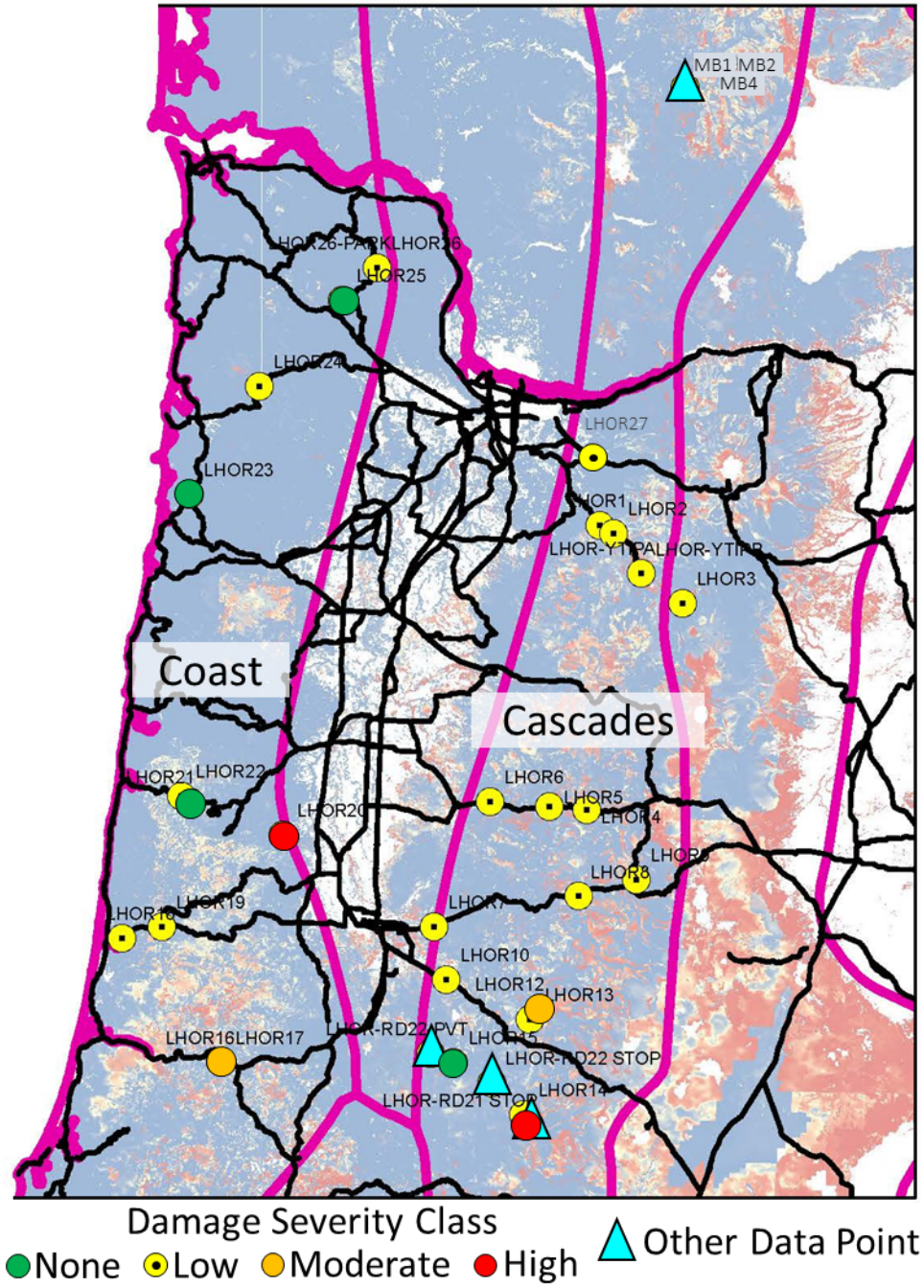




2018 NW Oregon Roadside Survey of Bigleaf Maple

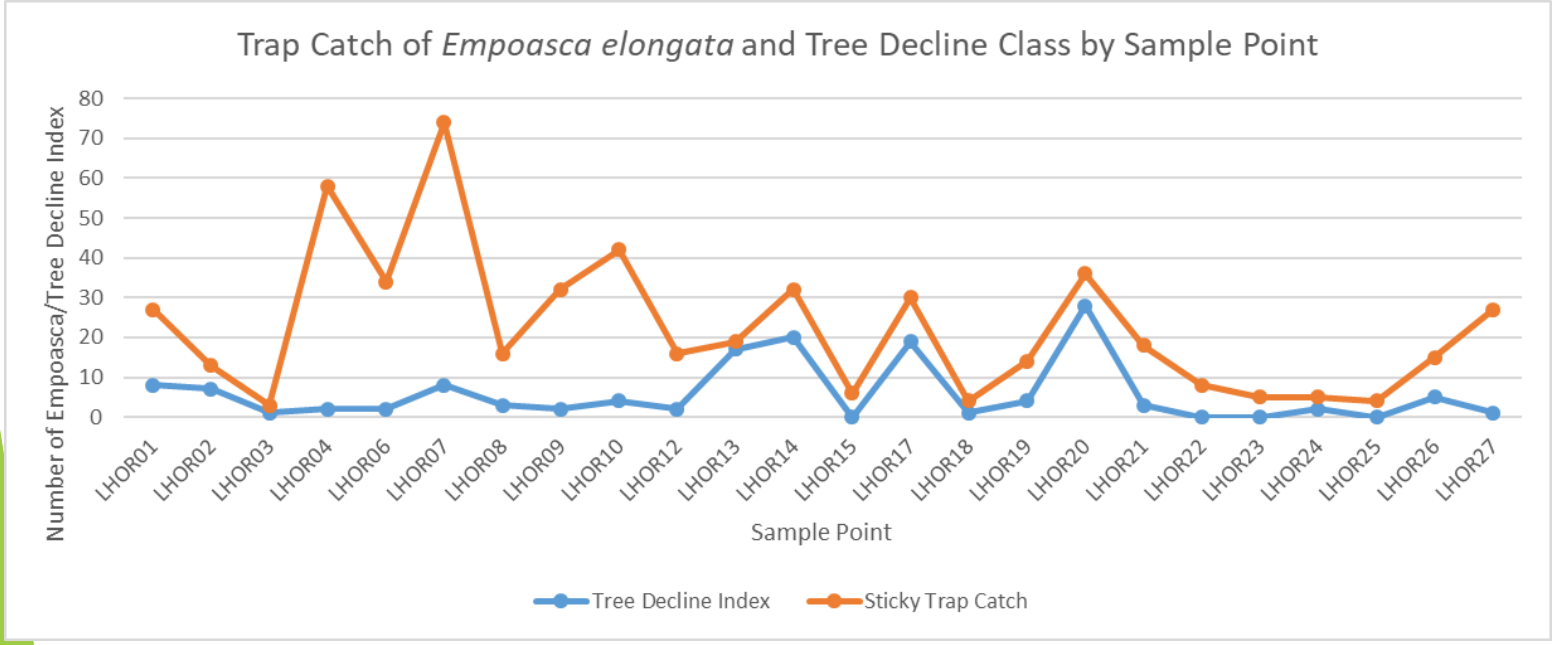
Tree damage severity varied by ecoregion and within ecoregion

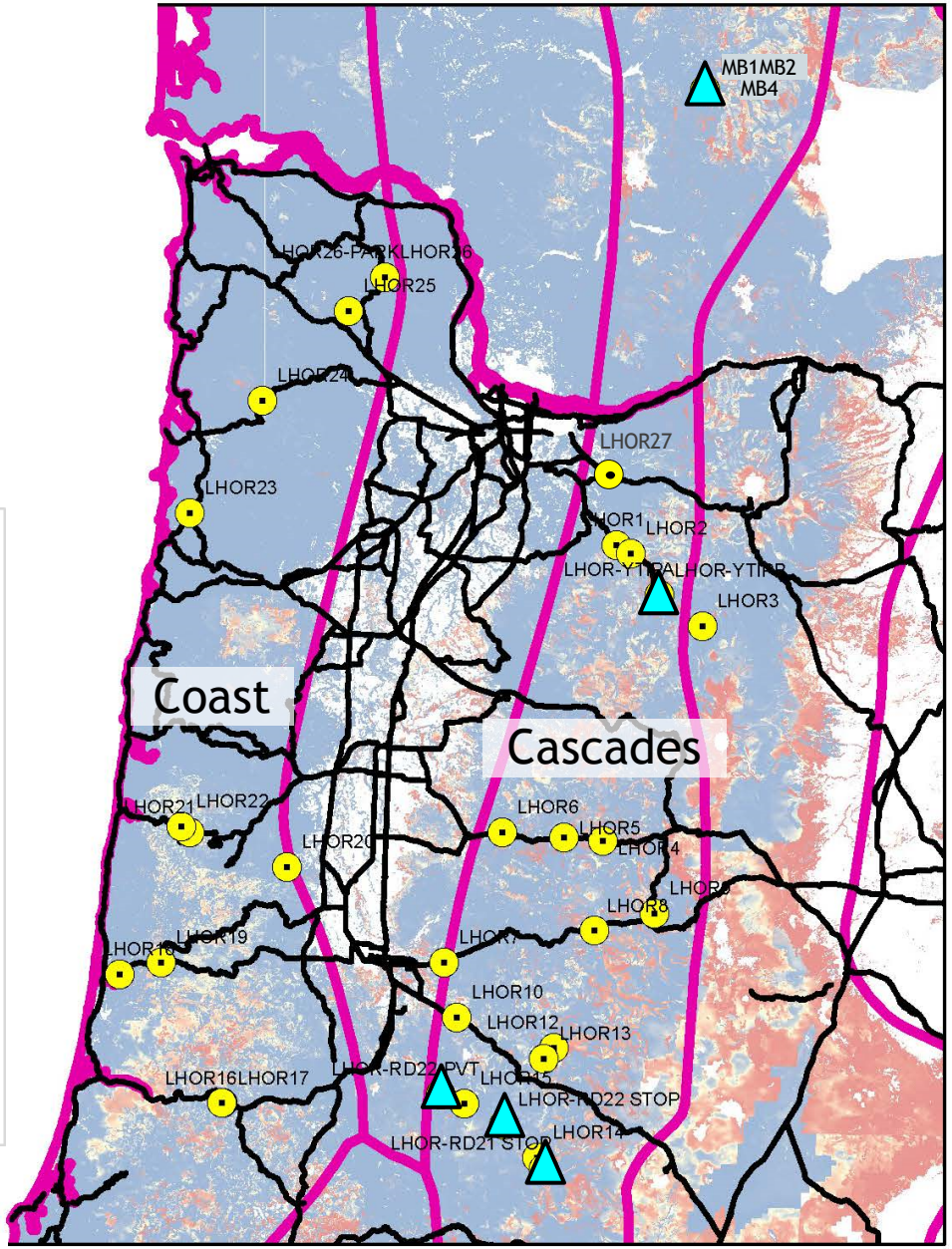




2018 NW Oregon Roadside Survey of Bigleaf Maple

No consistent relationship between leafhopper trap catch abundance and tree damage



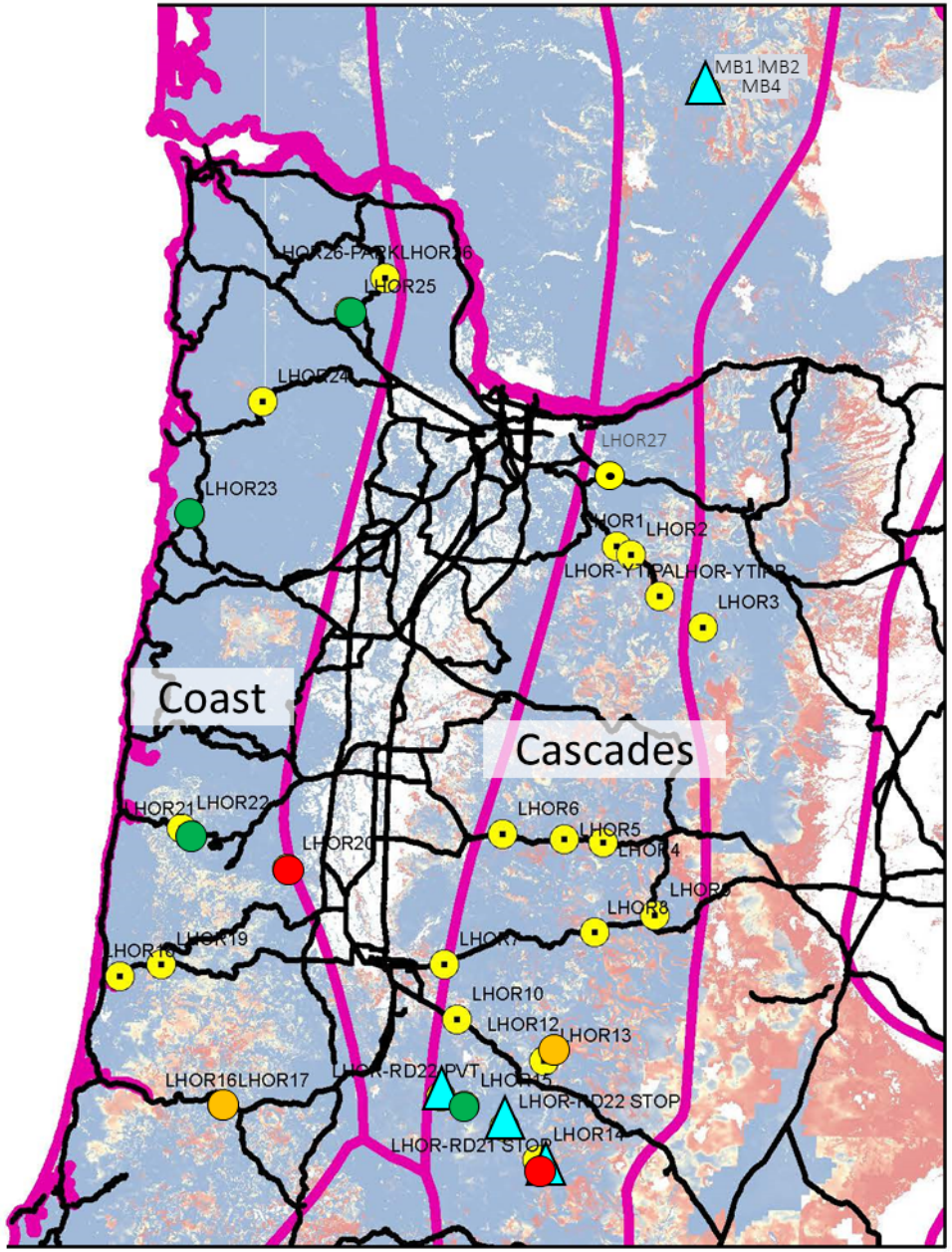


2018 NW Oregon Roadside Survey of Bigleaf Maple

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)

Coastal Fog Belt



Damage Severity Class

None Low Moderate High Other Data Point

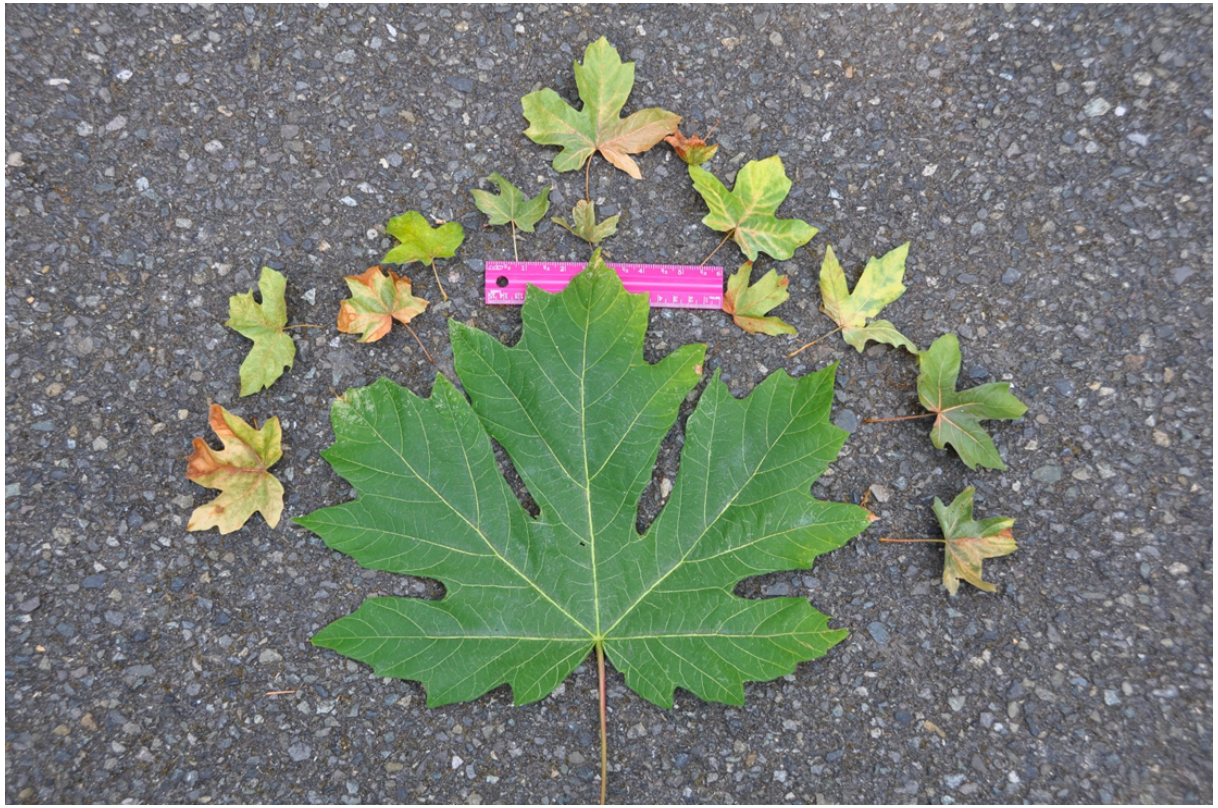
*based on empirical and non-empirical observations

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

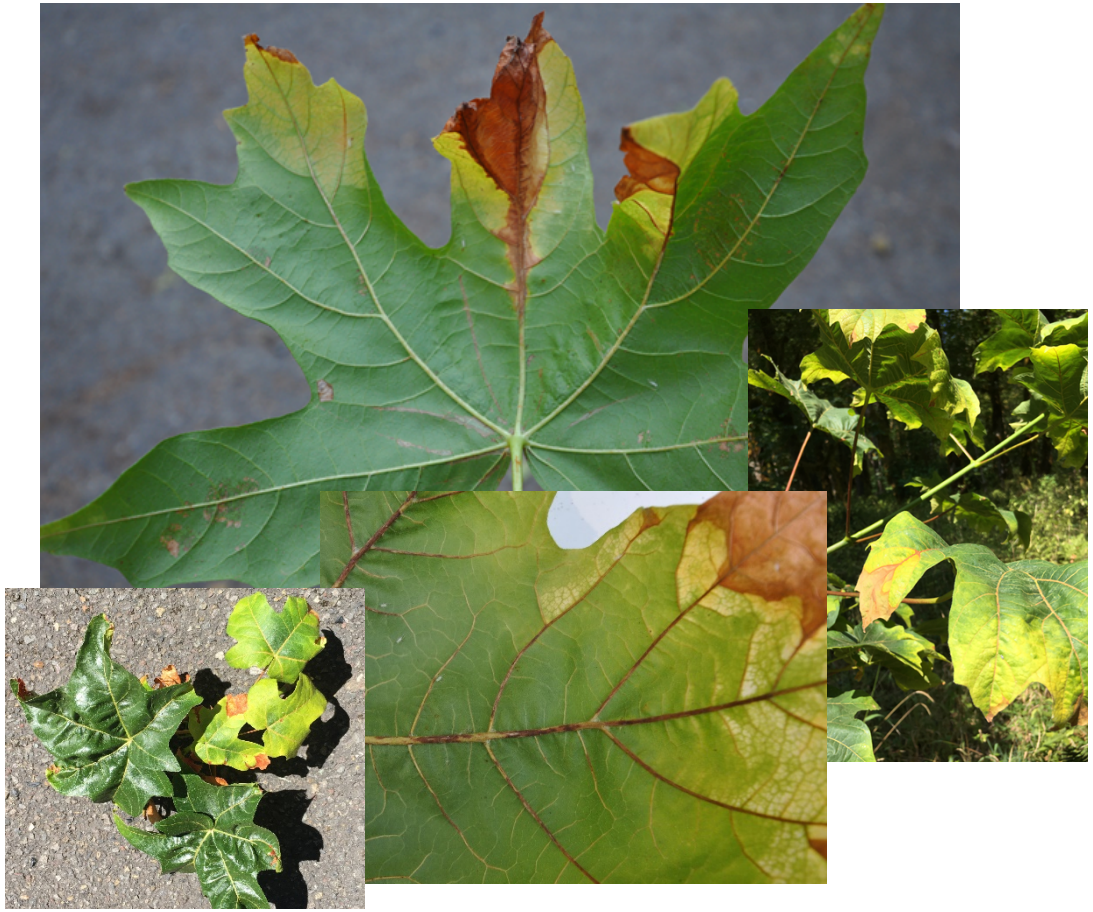
- Gradual top-down decline
- Chlorosis
- Epicormic sprouting
- Premature leaf drop (late July)
- Sparse crowns
- Mortality

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

Photo: Steven K. Rettke of RCE

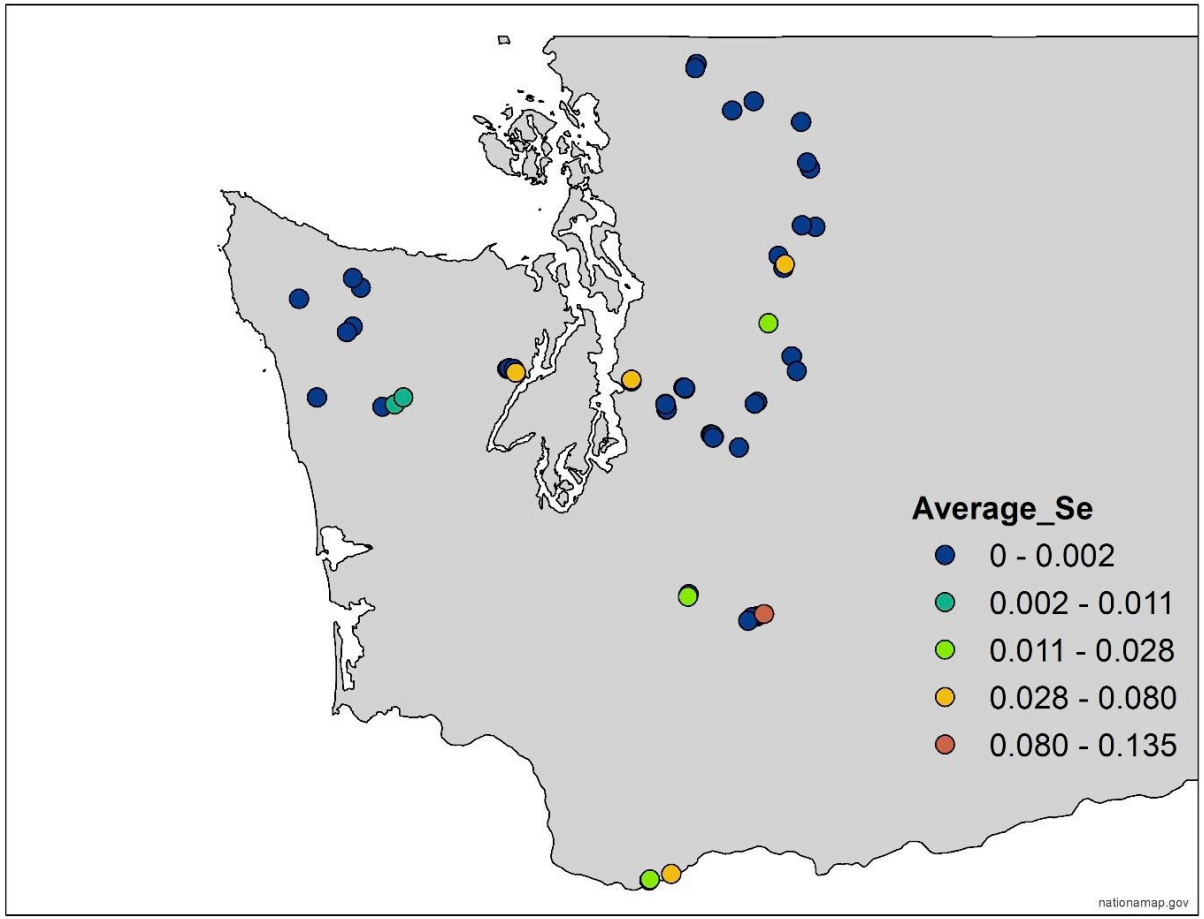
Photo: Lee Townsend, UK

On alfalfa

Jake Betzen MS Thesis, UW 2017-2018

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

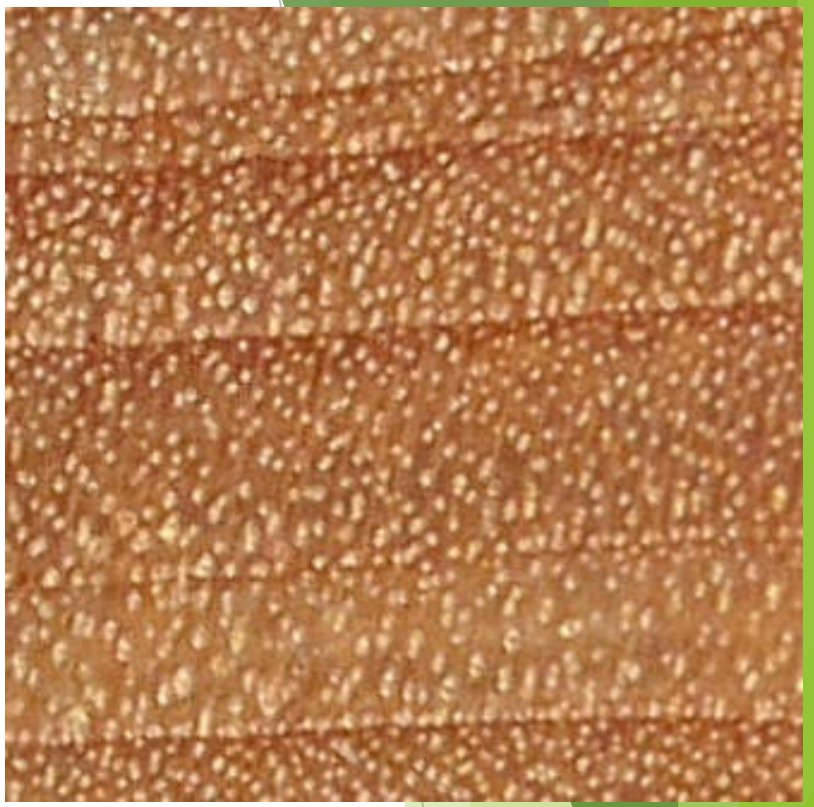


Severity of decline on 59 random bigleaf maple sample sites (Betzen 2018)

Jake Betzen MS Thesis, UW 2017-2018

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.



Bigleaf maple growth rings
from:http://www.hobbithouseinc.com/personal/woodpics/_anatomy/diffuse%20porous/maple/_maple.htm

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?