Laurel Wilt Disease:

Invasion Potential and Ecosystem Impacts

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LWD Invasion Potential?

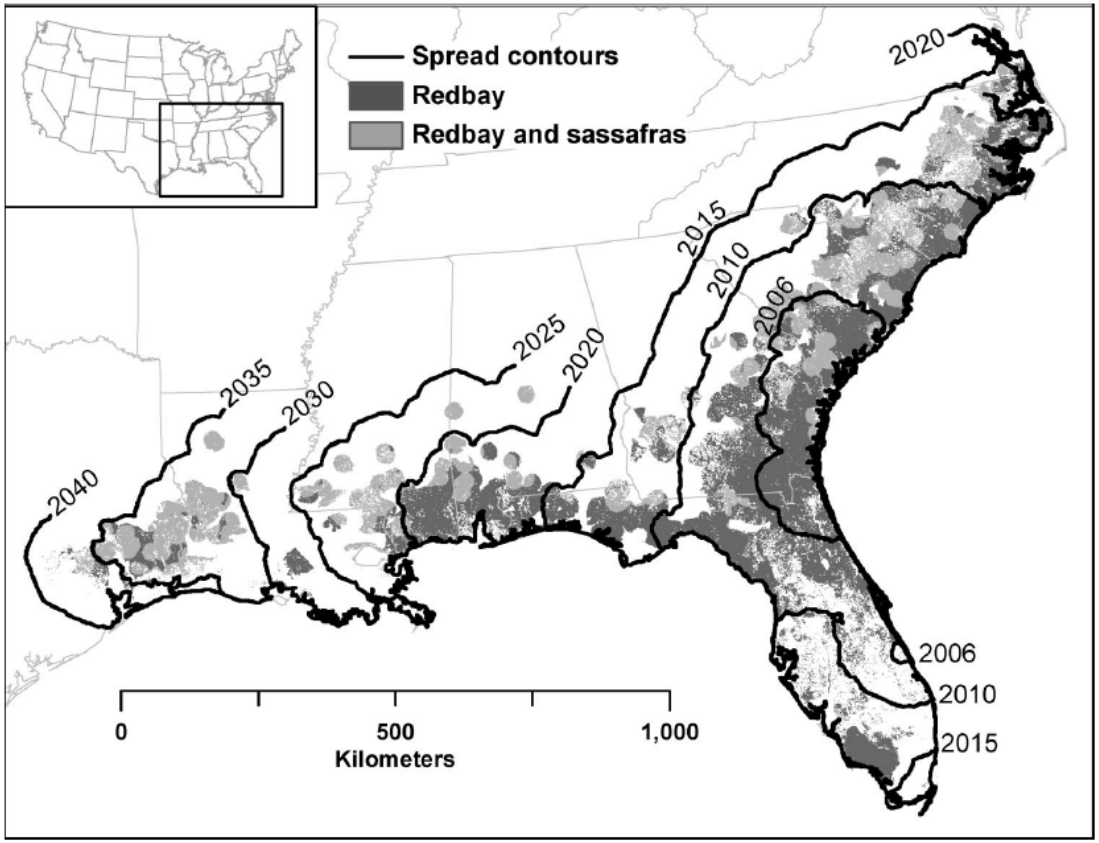


Fig. 6. Predicted extent of *X. glabratus* spread in the eastern United States through time, based on cost-weighted distance modeling from three points of origin, and overlaid on a map of host density.

North American Hosts

Redbay/swampbay

Avocado

Sassafras

Northern spicebush*

Pondberry- endangered

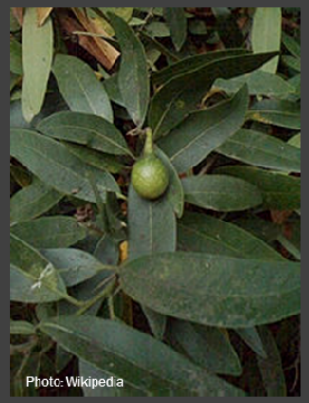
Pondspice- endangered

California laurel*

Silkbay

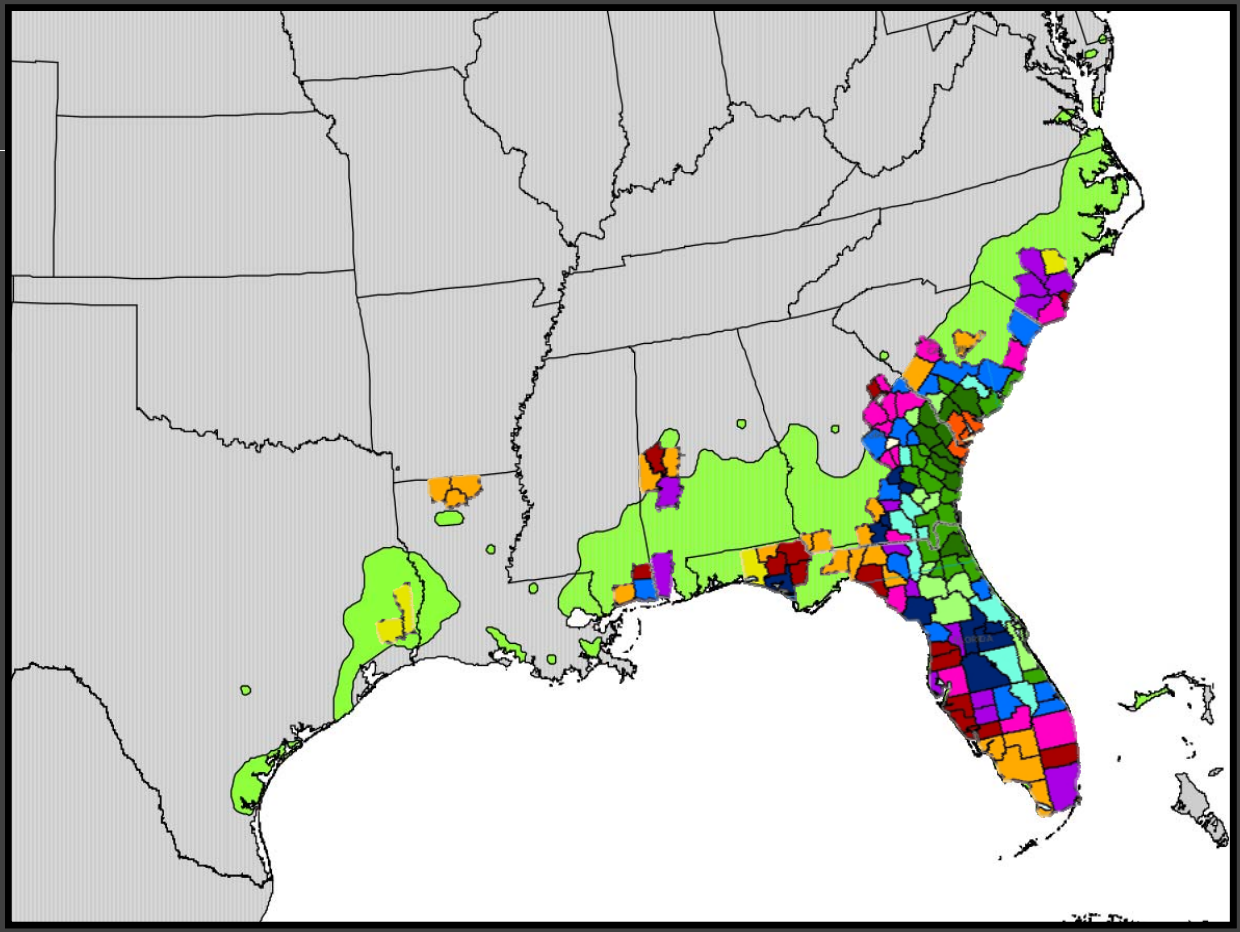
Camphortree

Lancewood

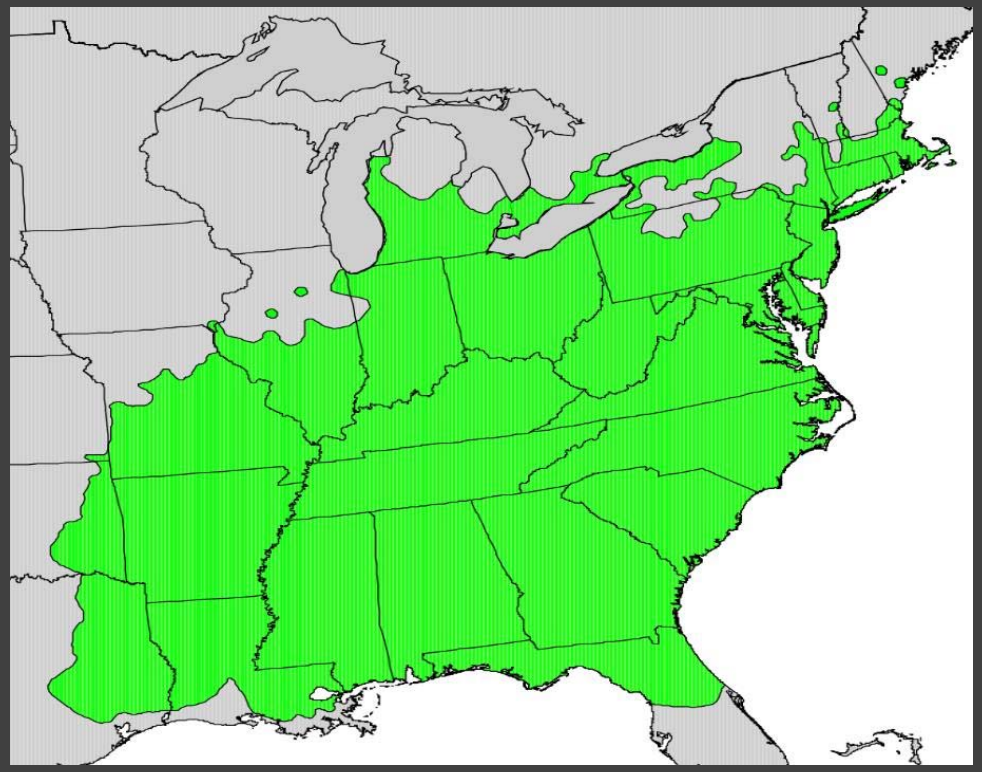


* Species that have developed Laurel Wilt after artificial inoculation.

LWD Invasion Potential in Sassafras?



Sassafras



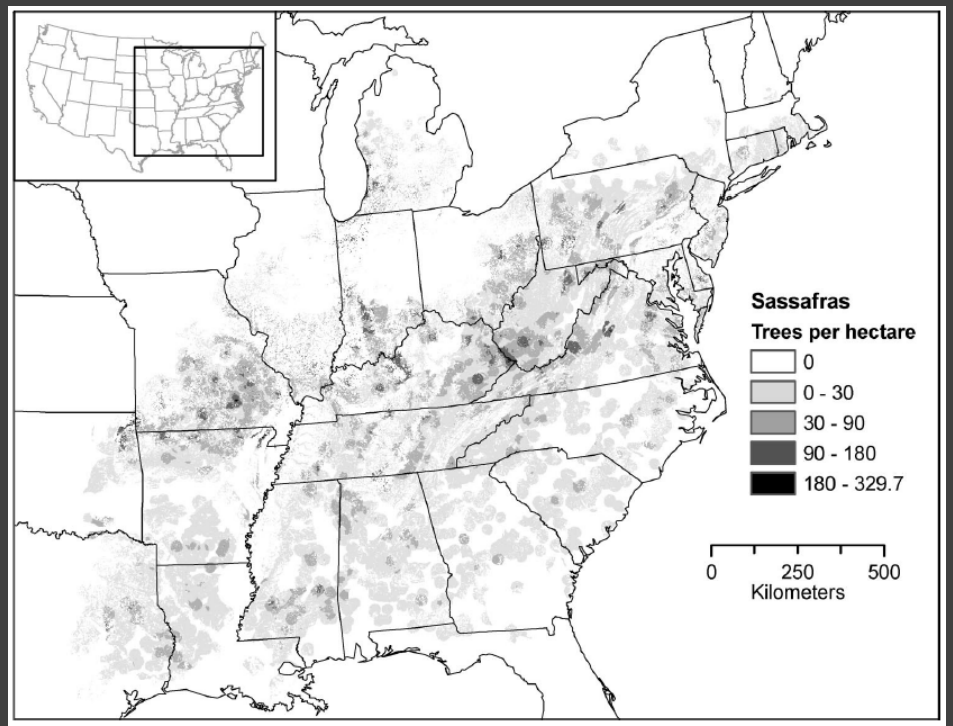
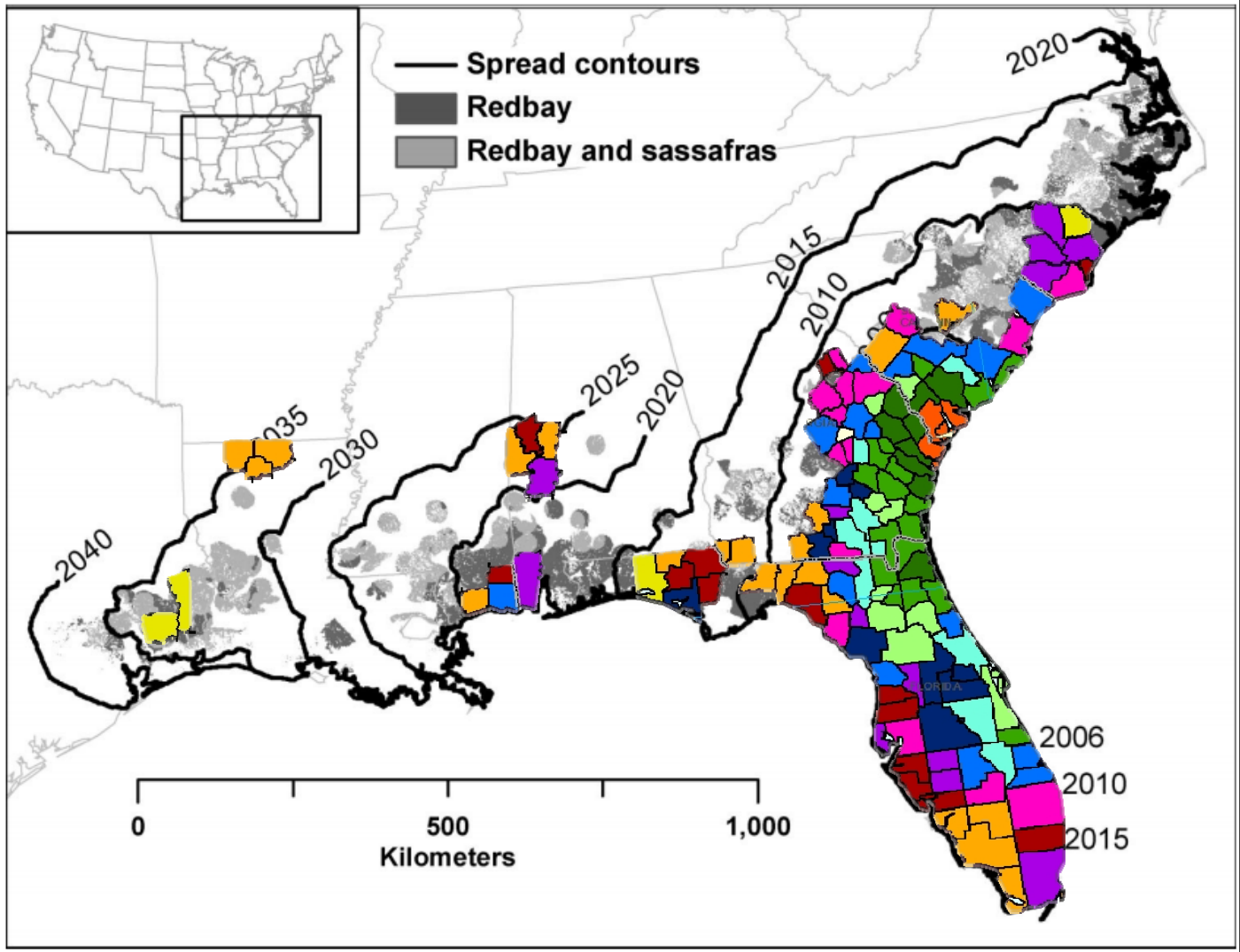


Fig. 3. Map of sassafras density in trees per hectare.

Will LWD Threaten Sassafras in the North?

Modeling Biological Invasions

- Initial attempts require a quick and dirty answer
- *<u>However:</u>*
- Too often, little or no additional work is done to add biological relevance to initial models
  - Lack or have limited biological data
  - Are expert-based rather than empirically-based
  - Trade speed for biological relevance


Spread contours
Redbay
Redbay and sassafras
2020
2015
2010
2025
2020
2030
2040
2006
2010
2015
0
500
1,000
Kilometers

Cold Temperature Physiology

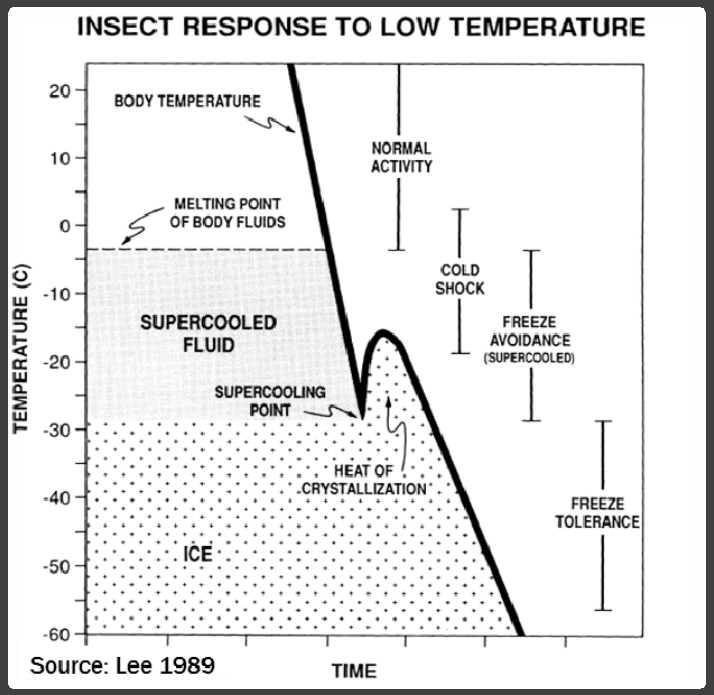
Experimentally determine:

Supercooling point

Tolerance to cold exposure

Outcome:

Better informed invasion potential of RAB in North America

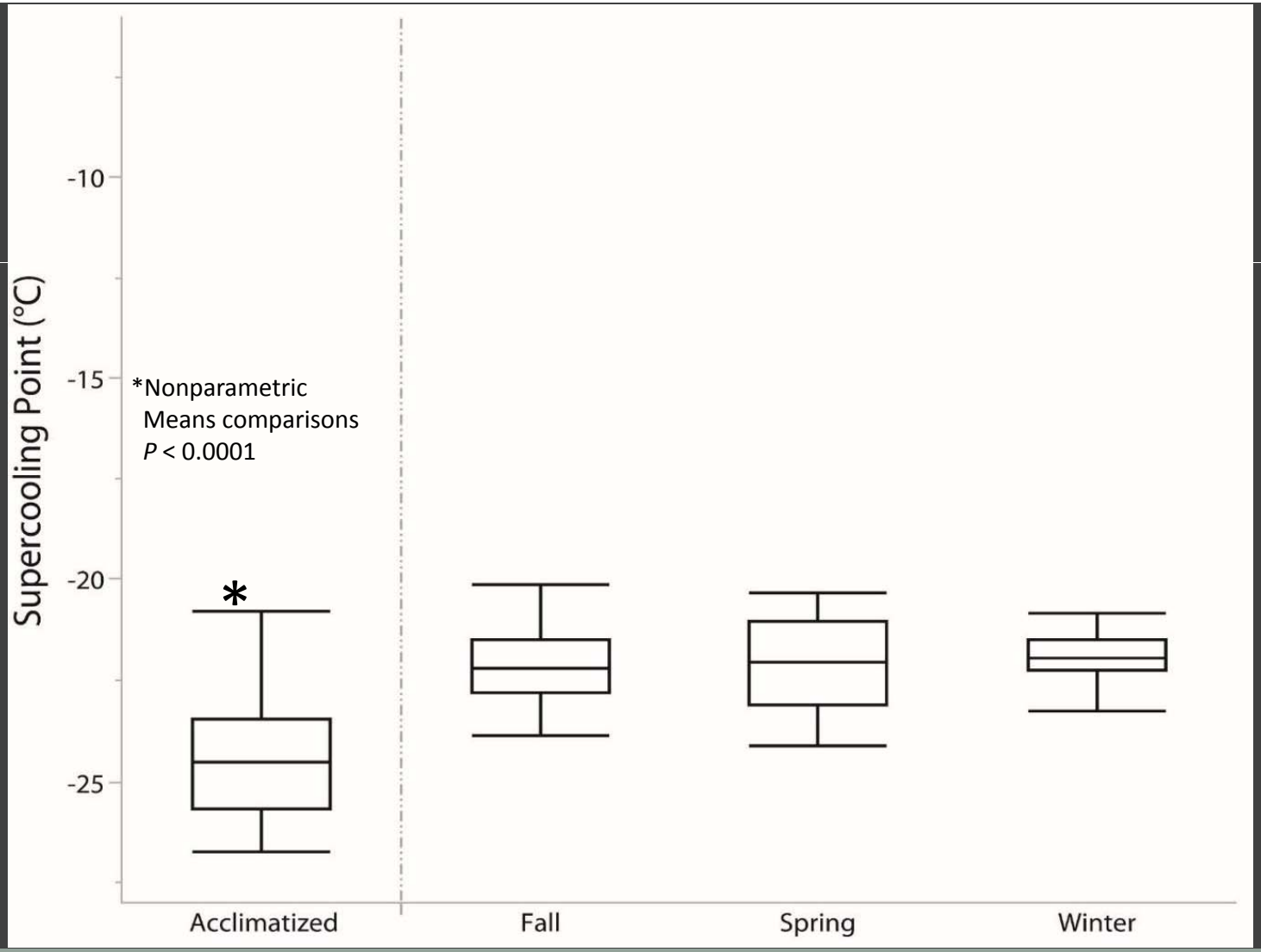


Supercooling Point

Measured using 3 treatment types

- Summer
  - June-August, 2011
- Artificially acclimatized
  - 7C:2C (10hrs:14hrs)
  - May, 2012
- Fall-Spring
  - Sept. – May (**2013 – 2014**)

100% mortality of RAB tested

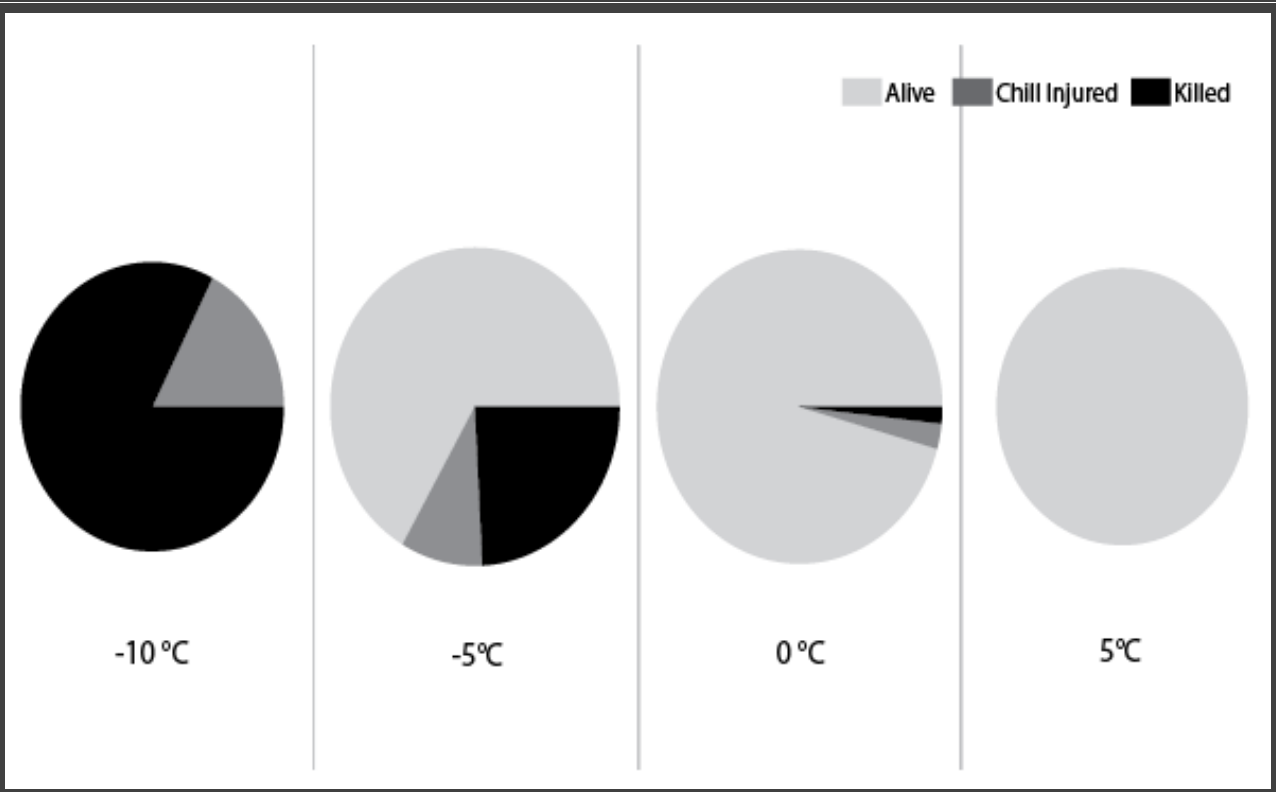

Supercooling Point (°C)
-10
-15
-20
-25
*Nonparametric
Means comparisons
P < 0.0001
*
Acclimatized
Fall
Spring
Winter

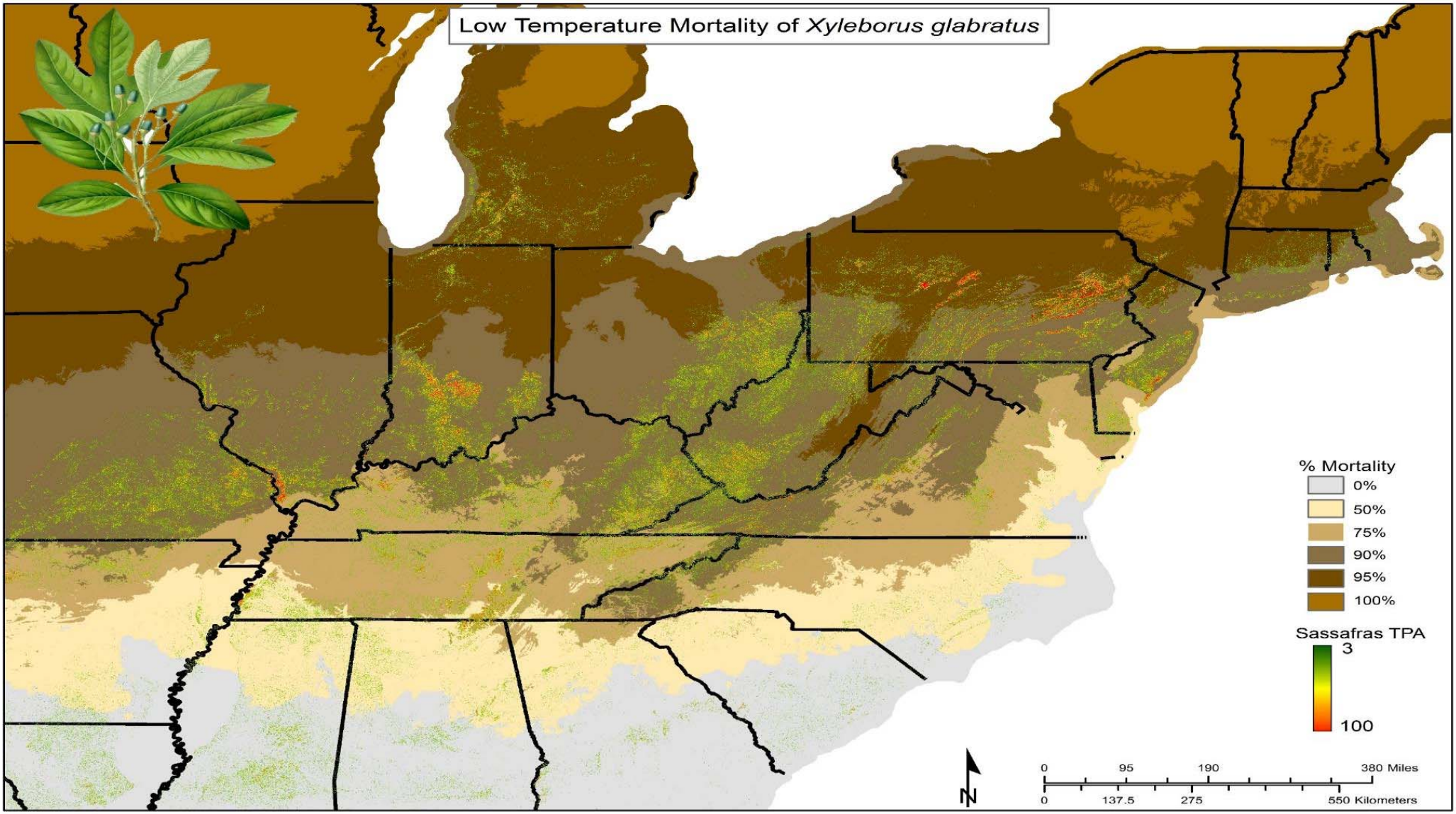
Cold Tolerance

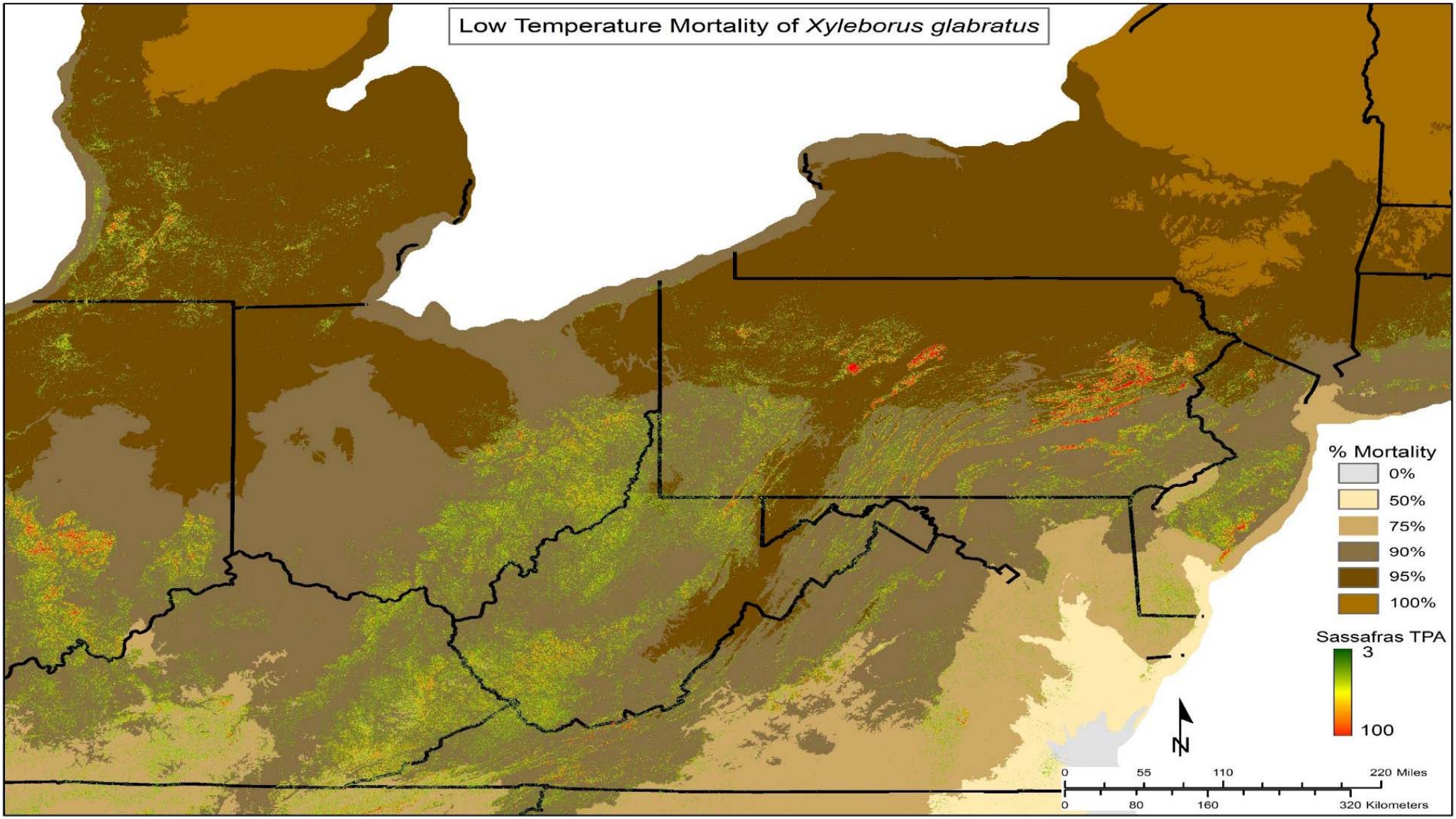
Low temperature trials for extended time periods

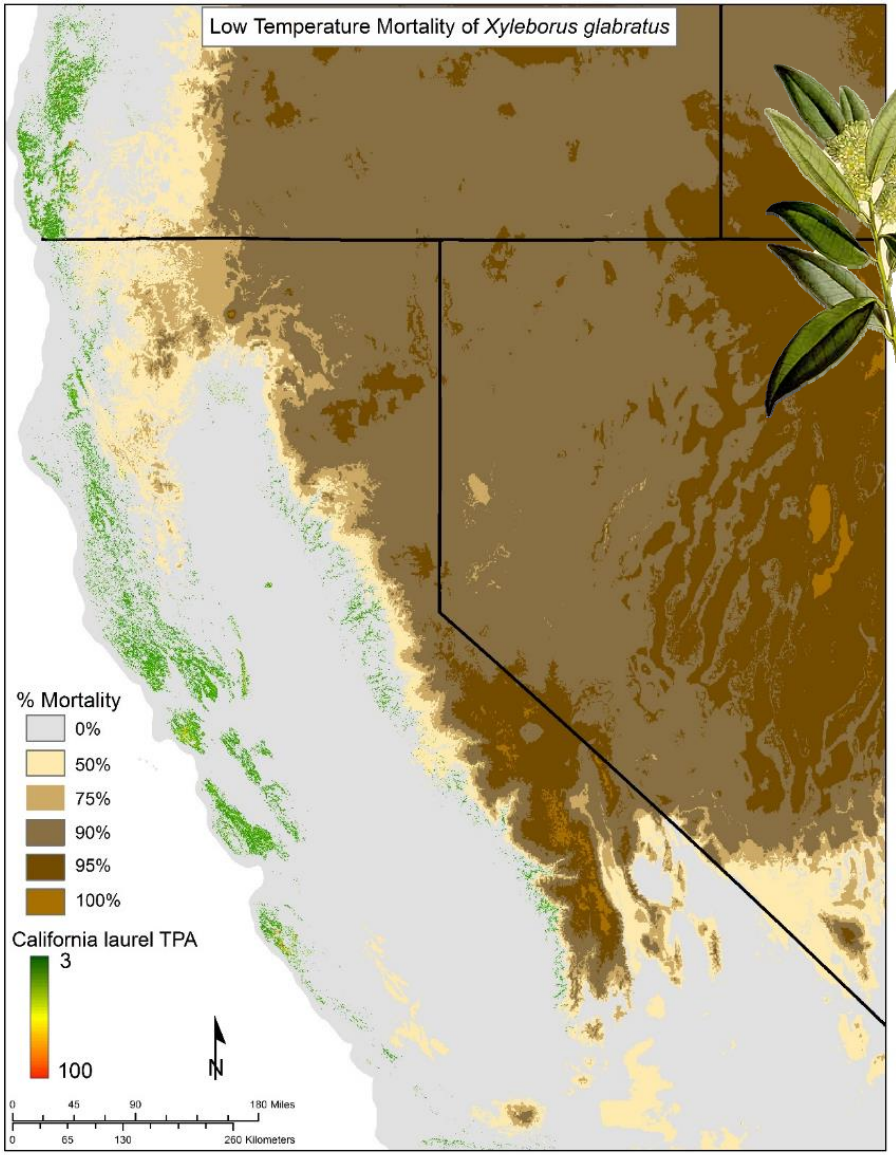
- 5°C, 0°C, -5°C, -10°C
- 6, 8, and 10 hours
- Acclimatized, summer, and winter collected

Cold Tolerance




Low Temperature Mortality of *Xyleborus glabratus*
% Mortality
0%
50%
75%
90%
95%
100%
Sassafras TPA
3
100
N
0
95
190
380 Miles
0
137.5
275
550 Kilometers


Low Temperature Mortality of *Xyleborus glabratus*
% Mortality
0%
50%
75%
90%
95%
100%
Sassafras TPA
3
100
N
0
55
110
220 Miles
0
80
160
320 Kilometers


Low Temperature Mortality of *Xyleborus glabratus*
% Mortality
0%
50%
75%
90%
95%
100%
California laurel TPA
3
100
N
0
45
90
180 Miles
0
65
130
260 Kilometers

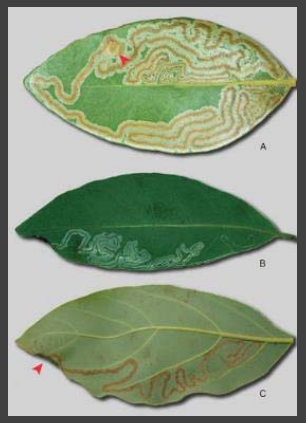
General Results

- RAB may be able to survive the harsh winters of upper latitudes of the U.S.
- Cold winters may offer only limited or no help in protecting N.A. laurel species

Other Impacts?

Effects will radiate through ecosystems

- 1st trophic level
  - Herbivores of NA lauraceae



Phyllocnistis hyperpersea

Redbay, Avocado, SE USA-Central America

Phyllocnistis subpersea

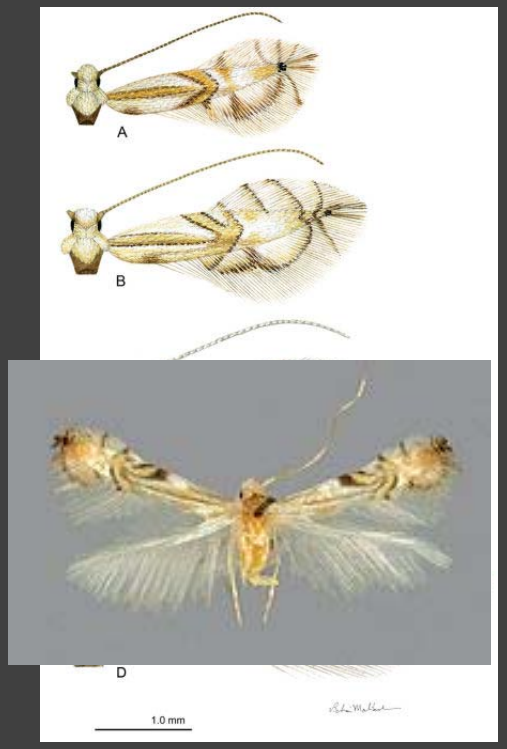
Redbay, SE USA

Phyllocnistis longipalpa

Redbay, S FL only

Phyllocnistis perseafolia

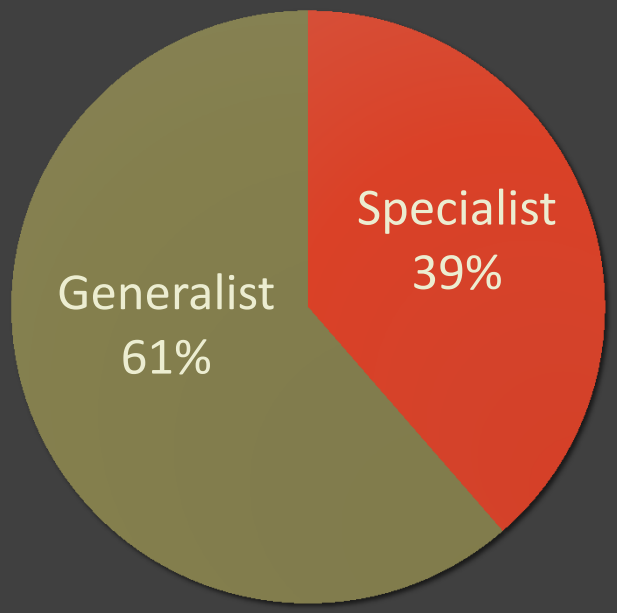
Avocado, Columbia

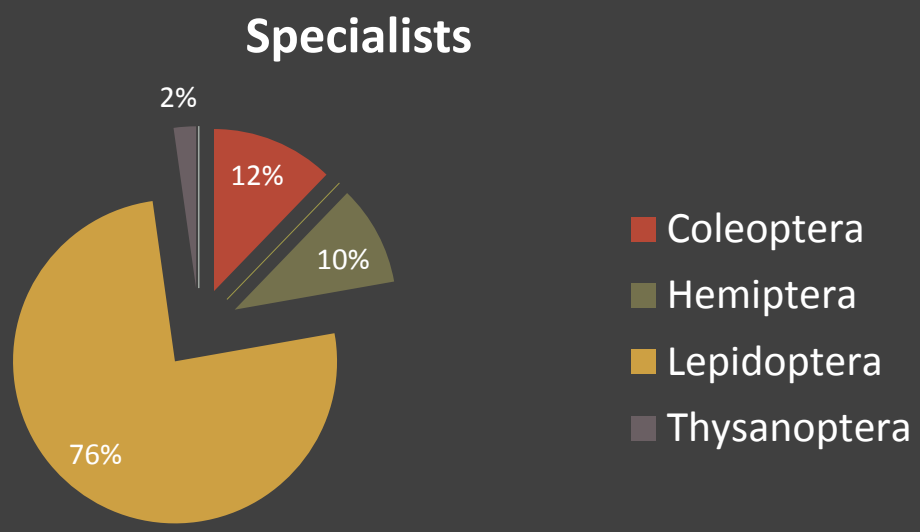


Davis and Wagner 2011

Herbivores of N.A. Lauraceae (Preliminary)

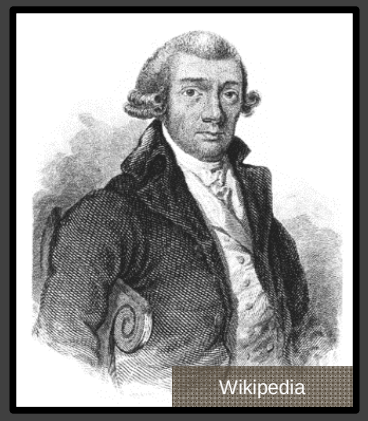
> 300 species and counting…

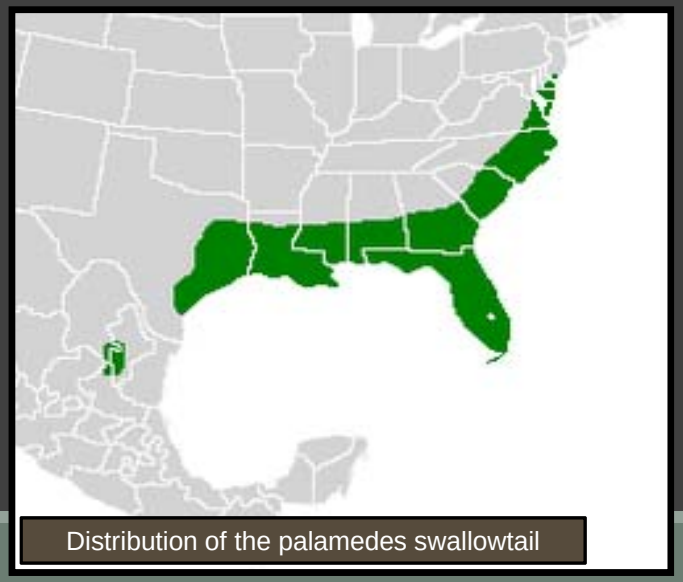




Palamedes swallowtail butterfly

- *Papilio palamedes* Drury described in 1773
- Endemic to the southeastern US
- Primary pollinator of the yellow-fringed orchid (Robertson & Wyatt 1990)


Wikipedia


Distribution of the palamedes swallowtail

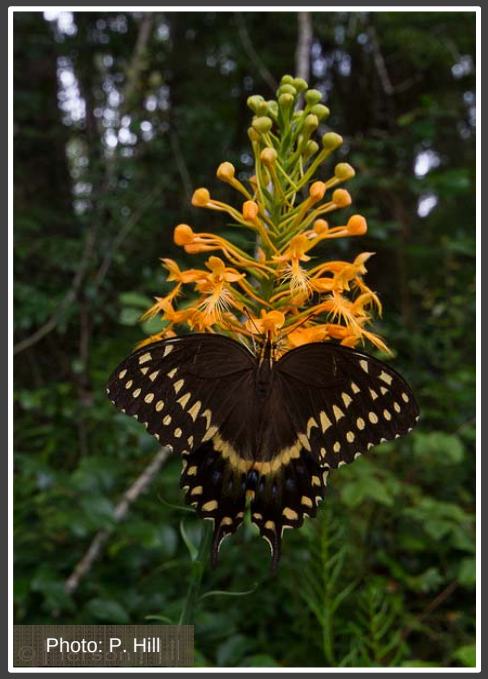
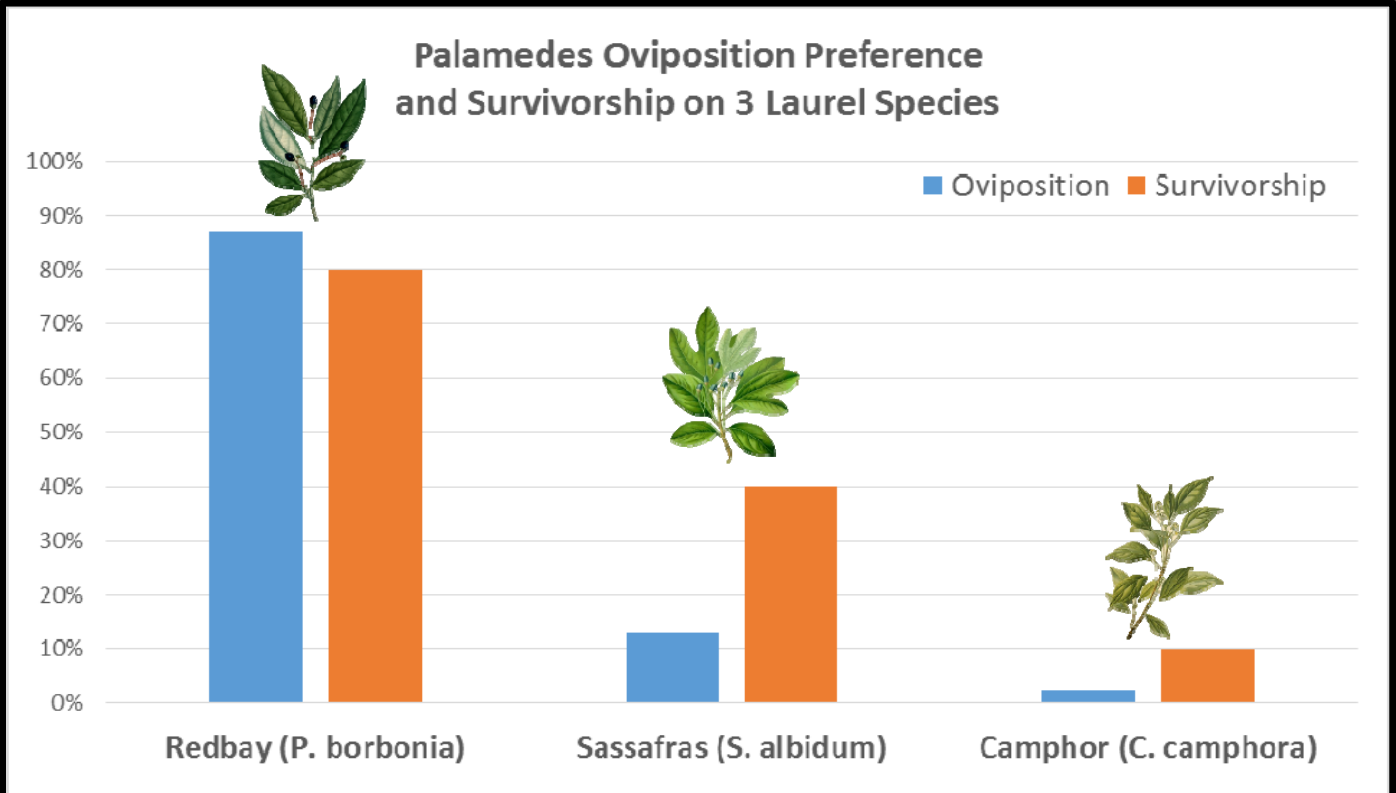


Photo: P. Hill

Palamedes swallowtail



(Lederhouse et al. 1992, Scribner et al. 2000, Chupp & Battaglia 2014)

Photo: B. Katzung

Redbay

Photo: A. Chupp

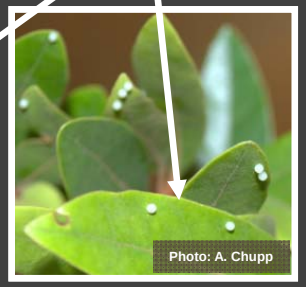
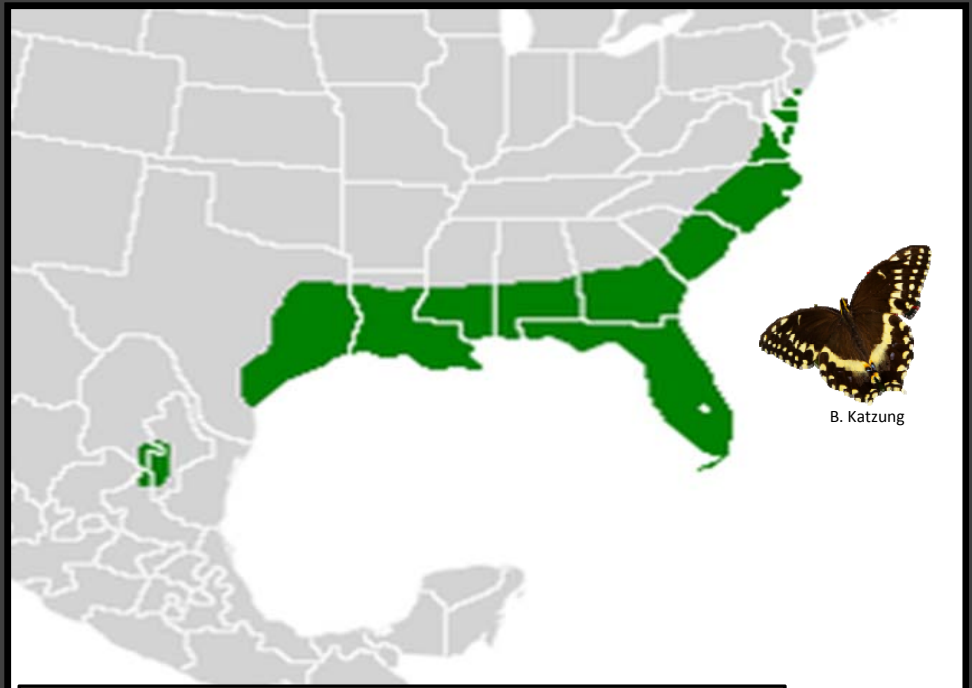
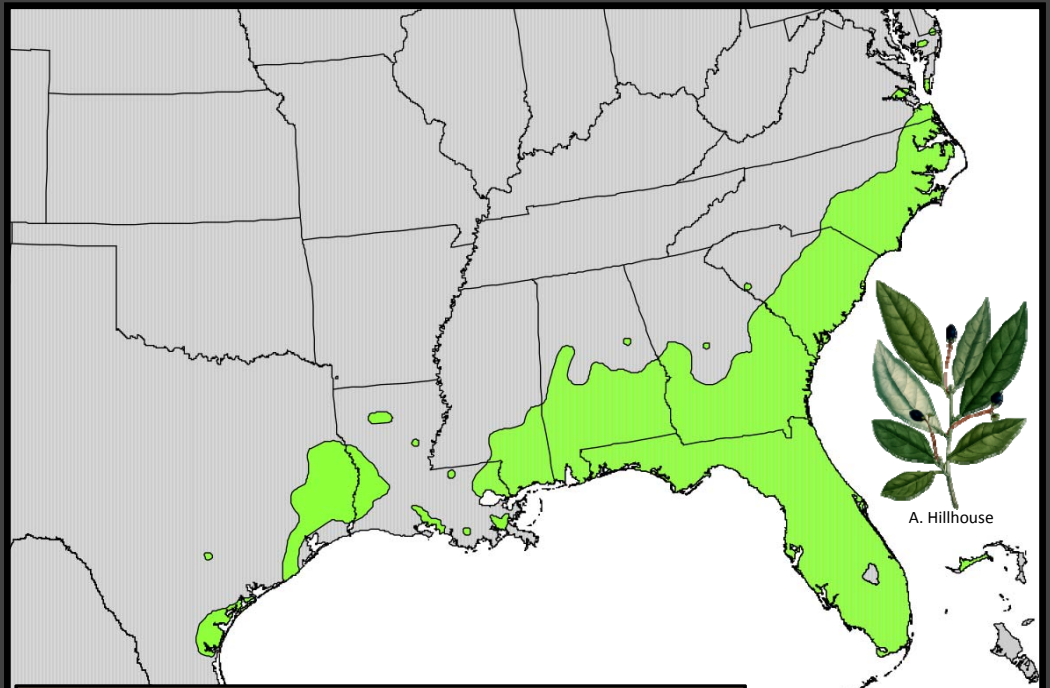


Photo: A. Chupp

Palamedes swallowtail & redbay

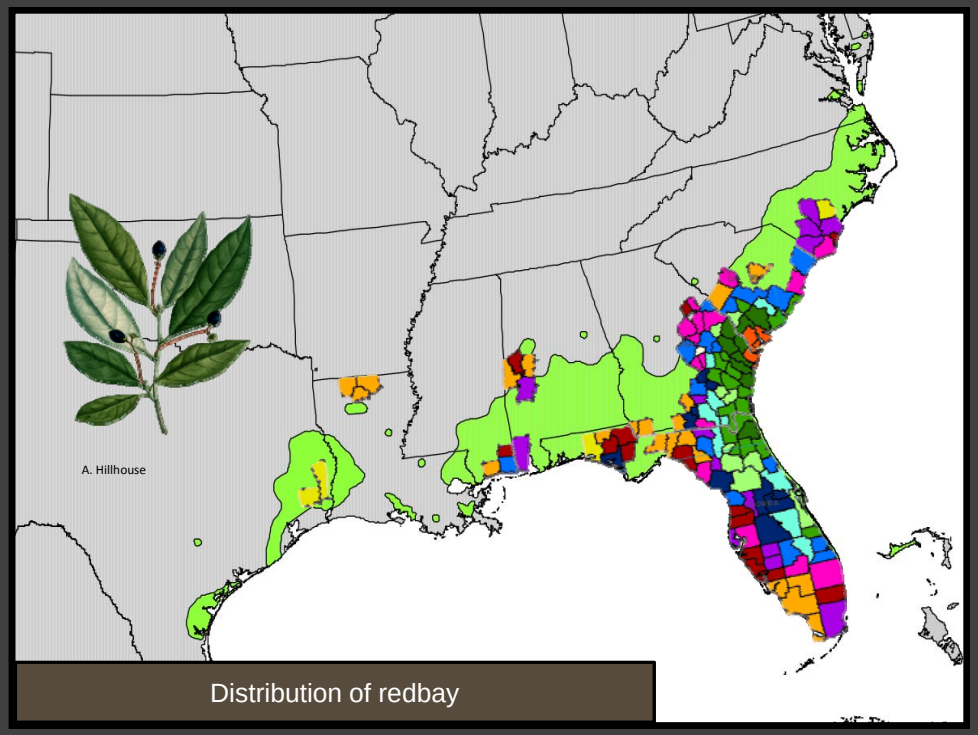


Distribution of the palamedes swallowtail



Distribution of redbay

Laurel Wilt Disease



Distribution of redbay

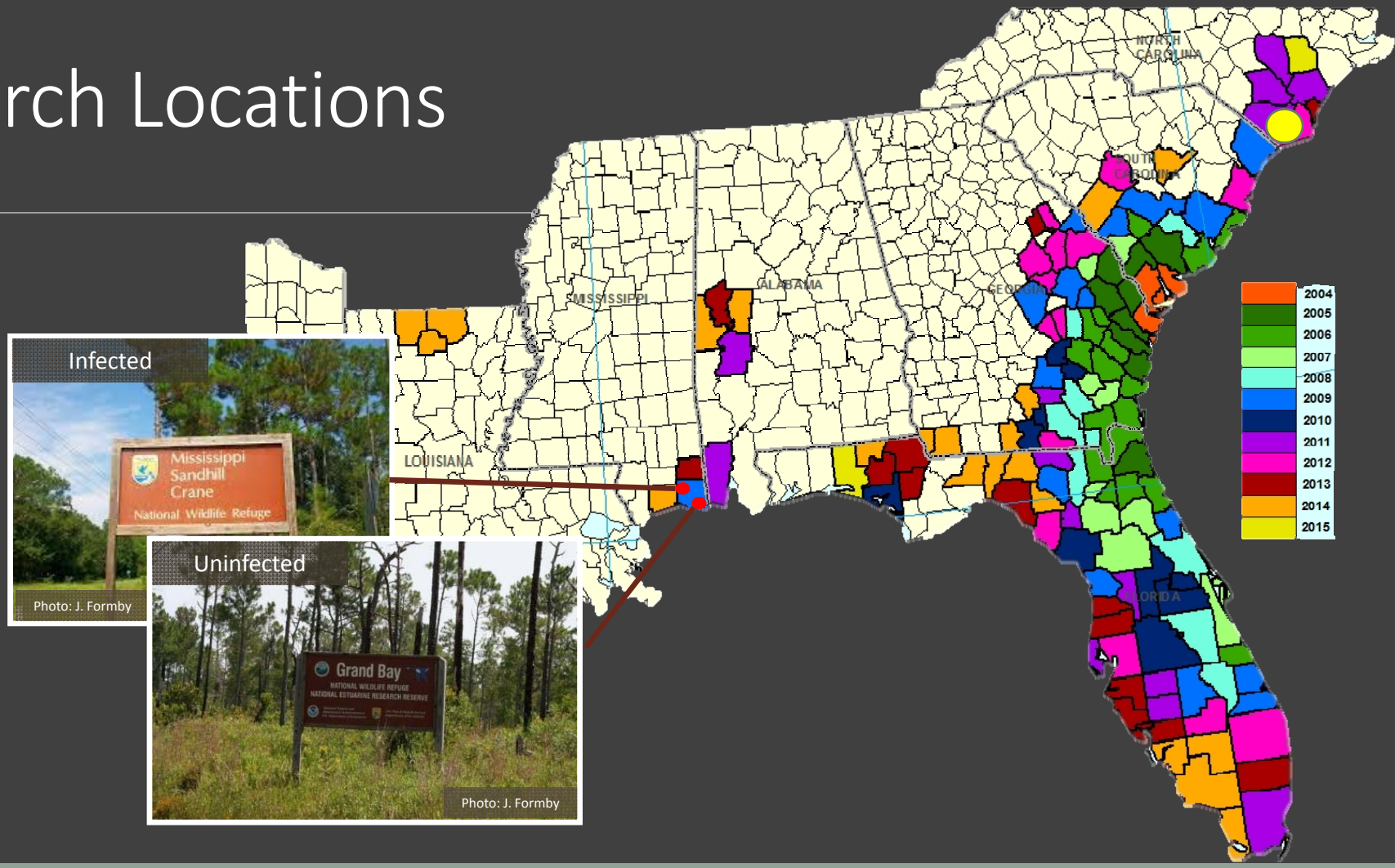
Mortality of redbay

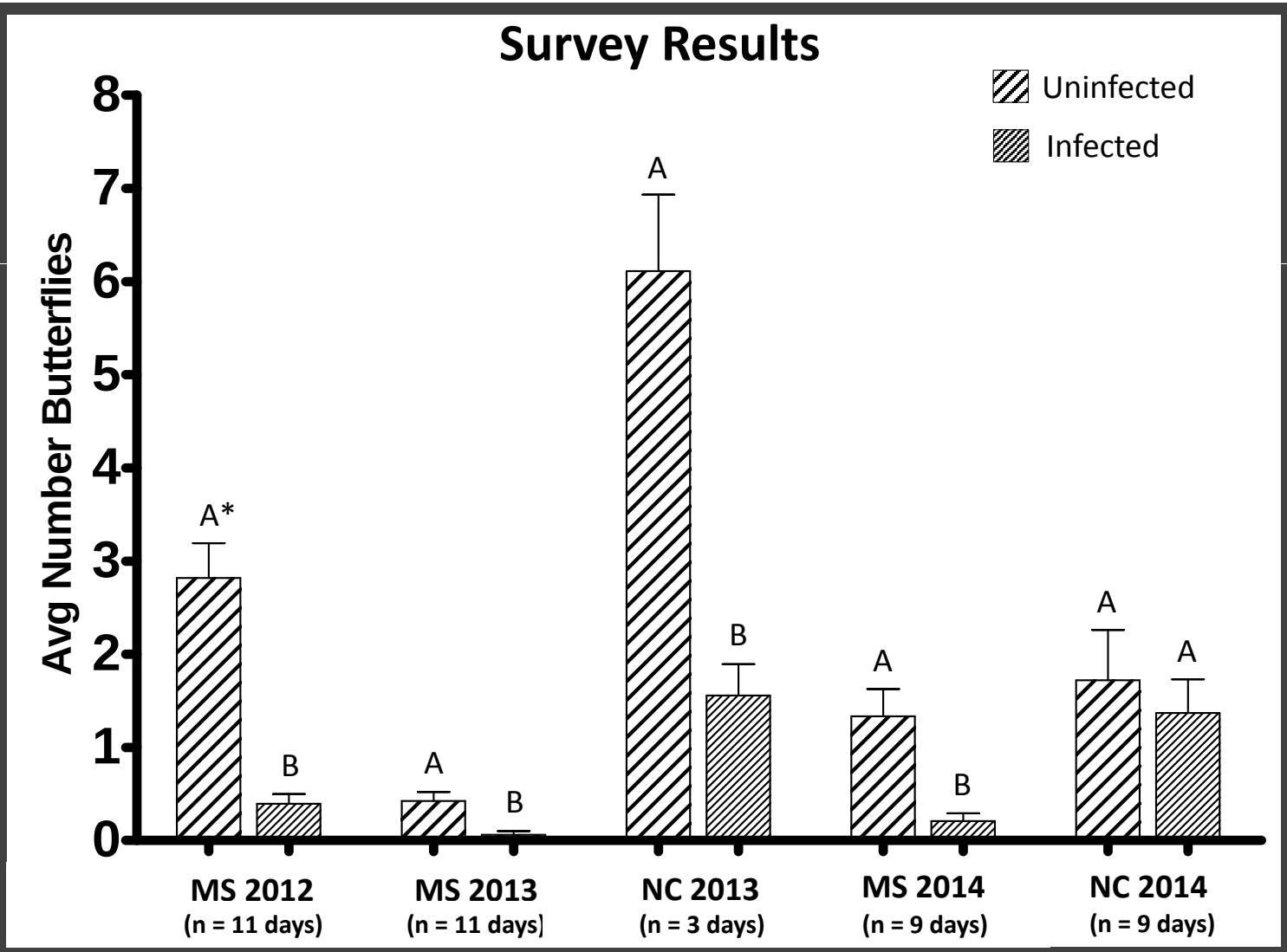
Palamedes survey

- 2 stand types
  - Infected vs control (uninfected)
  - Infected stands = LWD present ≥3 years
- "Pollard transects"
  - ~400 meters (1/4 mile)
  - 15 meters from observer
  - 3 transects per treatment


Photo: J. Formby

Research Locations





Paired t-tests
*Letters denote significant differences [α=0.05]

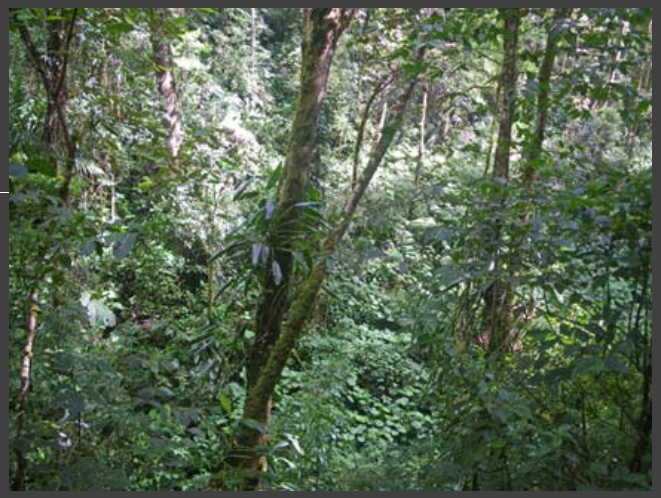
Implications

- In sites with LW present ≥3 years (infected stands), there is a ~3 fold decrease in palamedes abundance
- Extinction or long term suppression of redbay may lead to the loss of the palamedes swallowtail throughout much of its range
- Other multi-trophic cascade effects may become evident as LWD continues to alter the ecosystem

Photo: B. Katzung

Other Ecosystems?

- Family Lauraceae
  - ~ 55 genera,
  - ~ 2500 species
  - Importance:
    - Tropical timber
    - Ethereal oils
  - Two areas with extremely high diversity and endemism:
    - Asia
    - Central & South America



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Questions?


Photo: A Chupp