Integrating Biological Control and Insecticides for Area-Wide Management of Emerald Ash Borer

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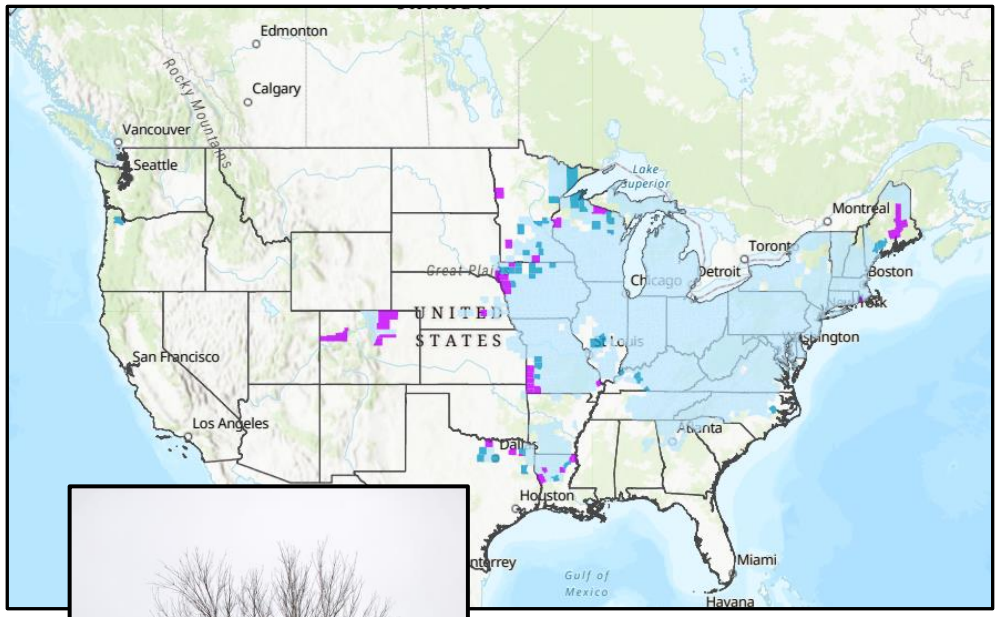
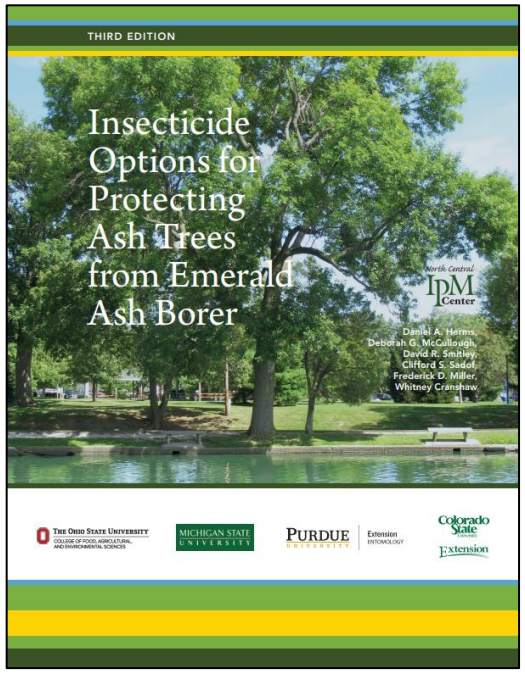
Emerald Ash Borer Distribution and Management



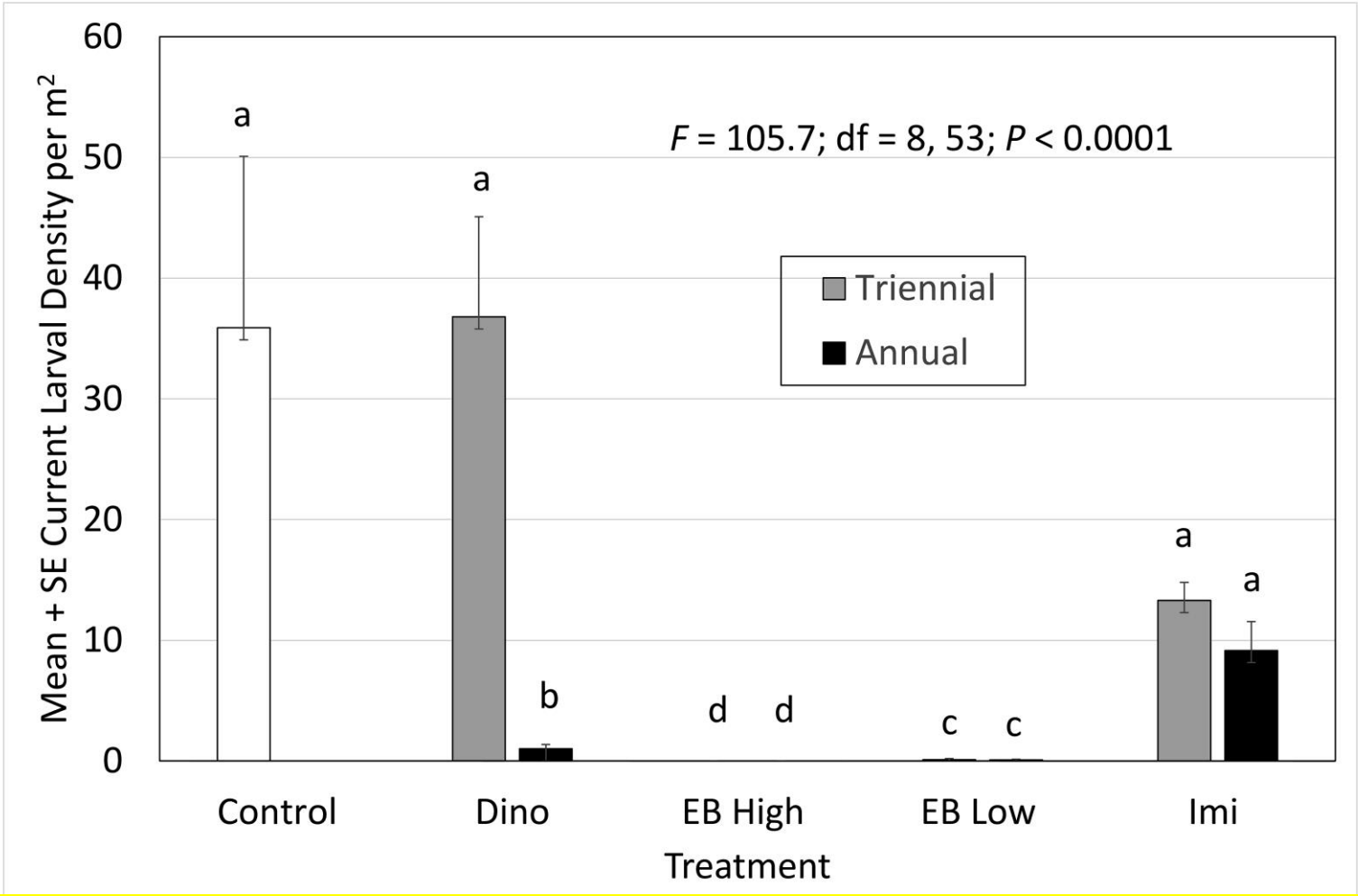
- EAB now occurs throughout most of the eastern U.S. with disjunct populations in Colorado and Oregon.
- Management options: salvage/removal, insecticides, and biological control.

EAB Insecticidal Control Options

- Dinotefuran (Safari basal trunk spray)
- Imidacloprid (Mauget Imicide)
- Emamectin benzoate (TREEåge tree IV or injection)



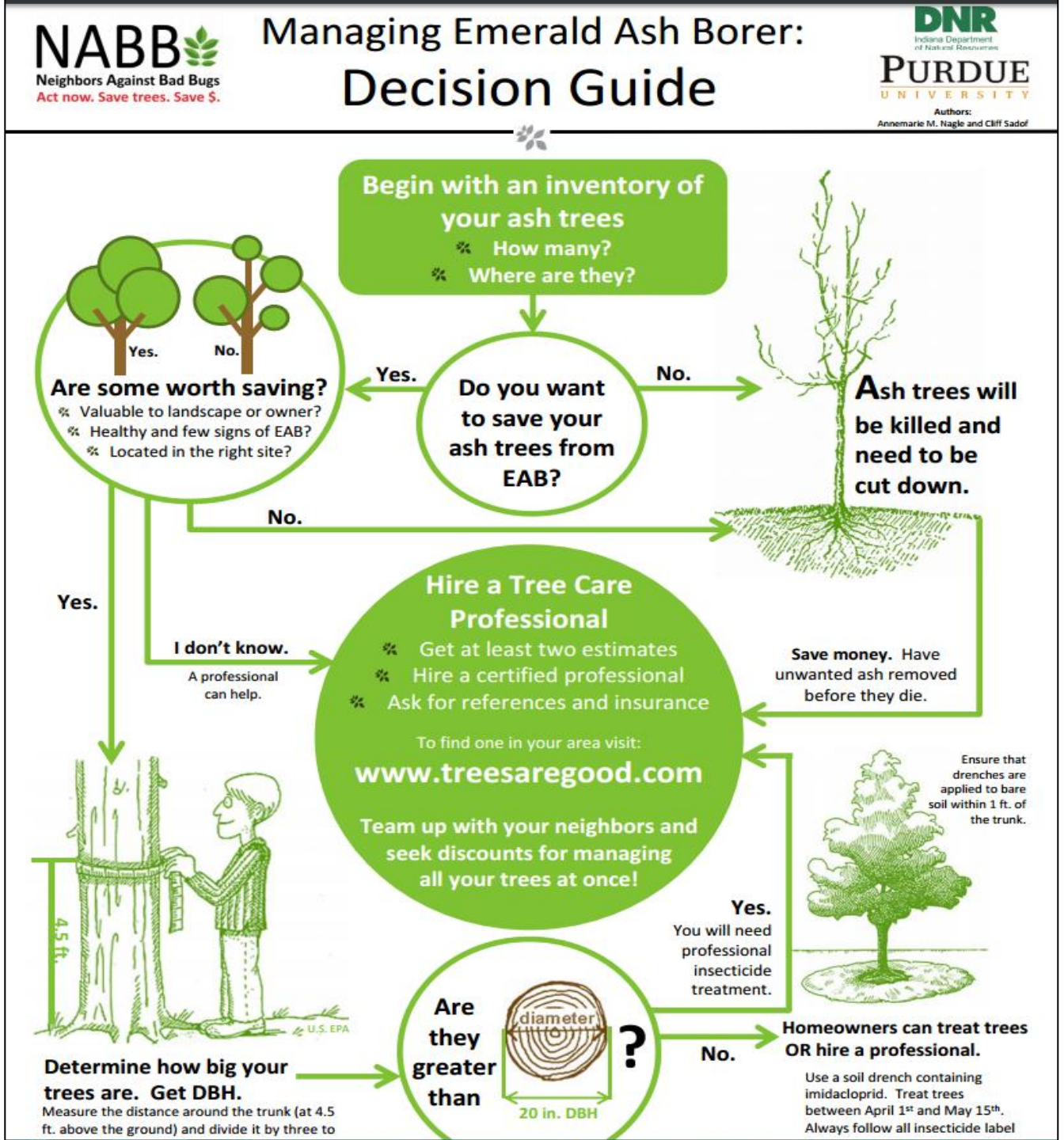
Insecticide Efficacy: Michigan



- Emamectin benzoate is the most effective option.

Insecticide Guidelines

https://extension.entm.purdue.edu/EAB/PDF/NABB_DecisionGuide.pdf



Insecticide Treatments

Advantages

- Very effective and reliable
- Can ensure survival of high value trees
- May provide some neighboring effects

Disadvantages

- Expensive and labor intensive
- Technical skills required
- Must be reapplied
- Environmental impacts

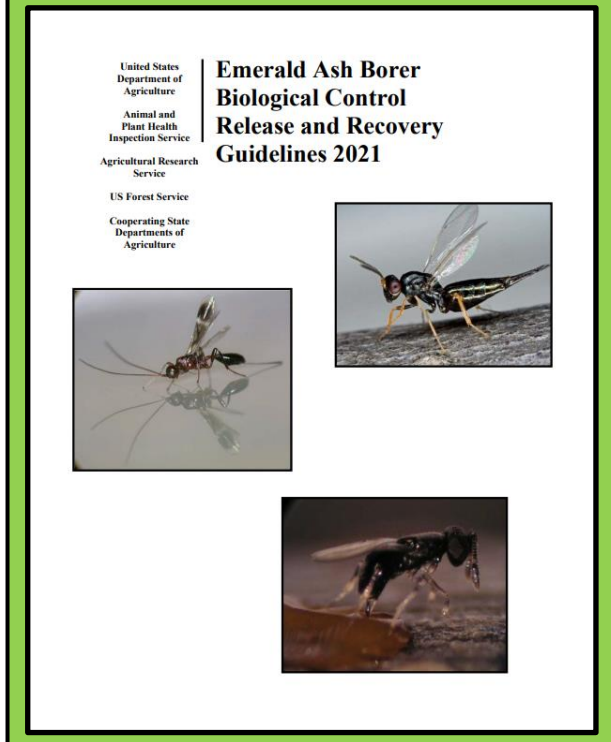
Biological Control of EAB

Three introduced species:

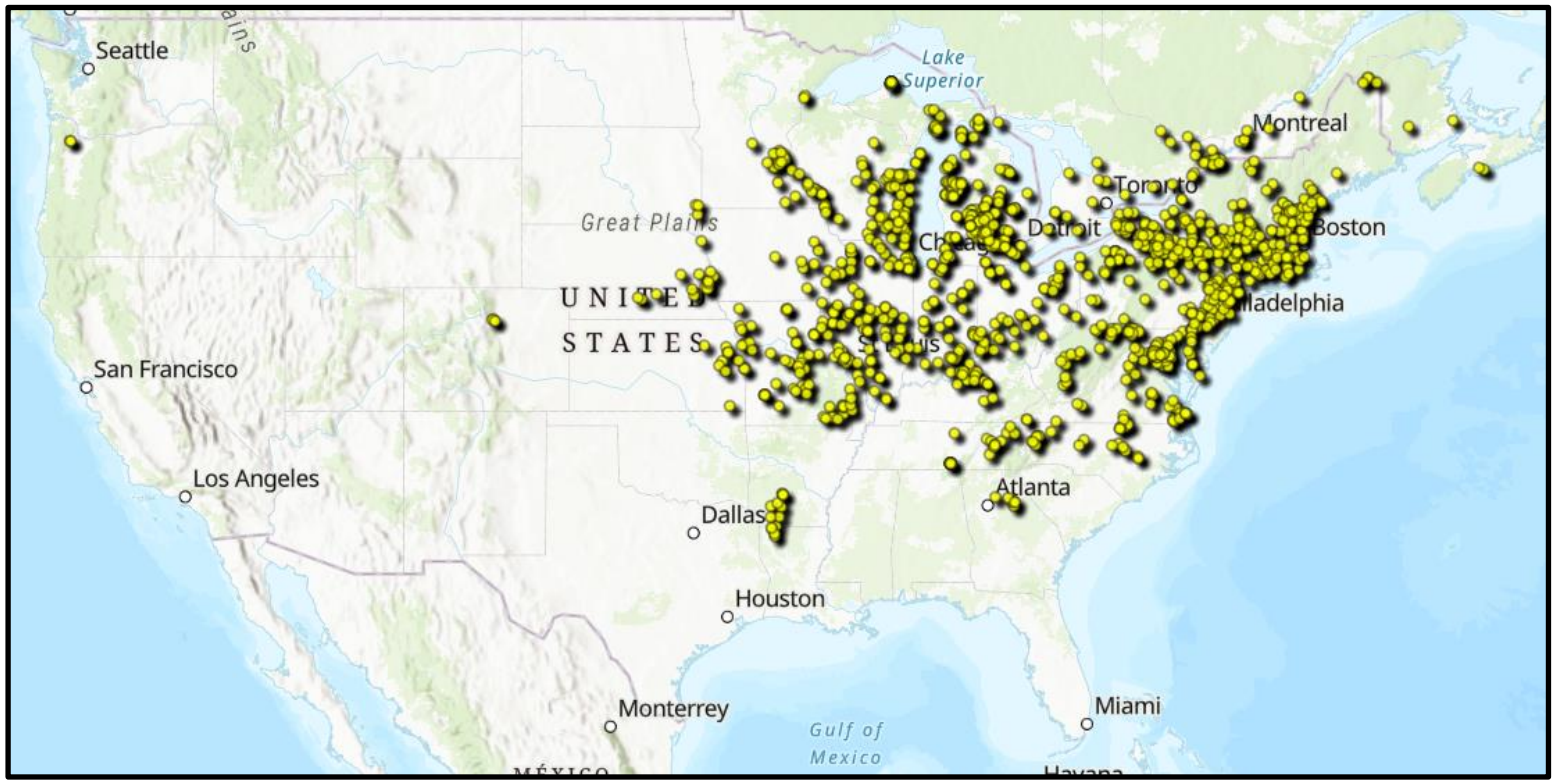
***Oobius agrili*:**
attacks EAB eggs

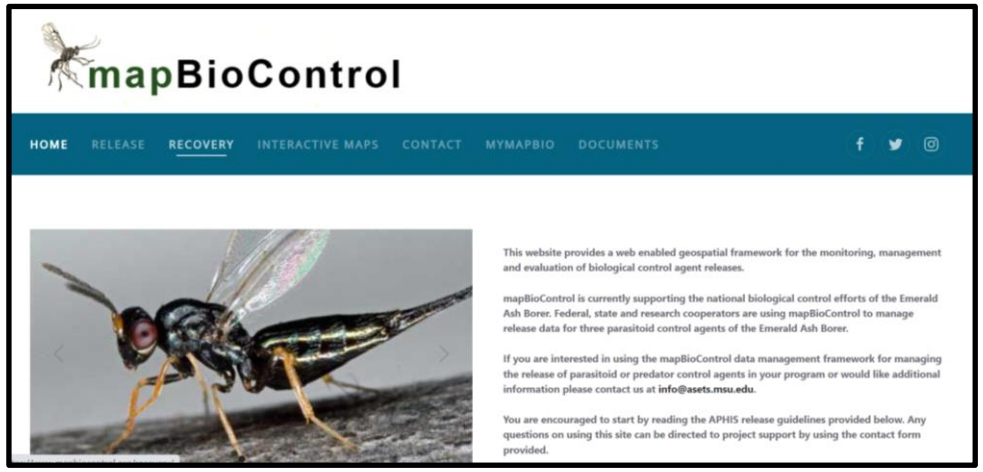
***Tetrastichus planipennisi*:**
attacks late instar larvae

***Spathius galinae*:**
attacks late instar larvae



Parasitoid releases





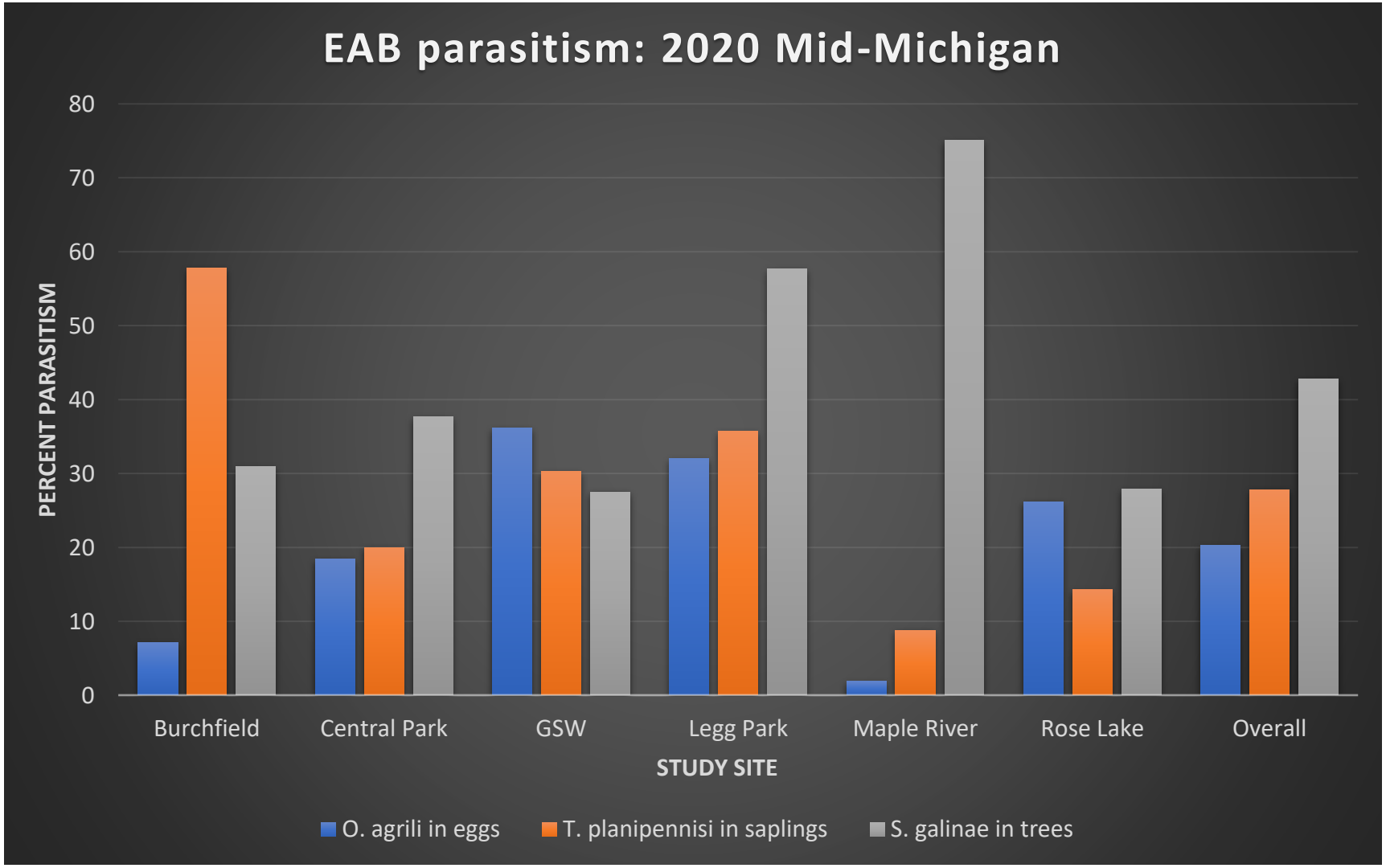
https://www.mapbiocontrol.org/

EAB Biological Control: Introduced Species

Oobius agrili

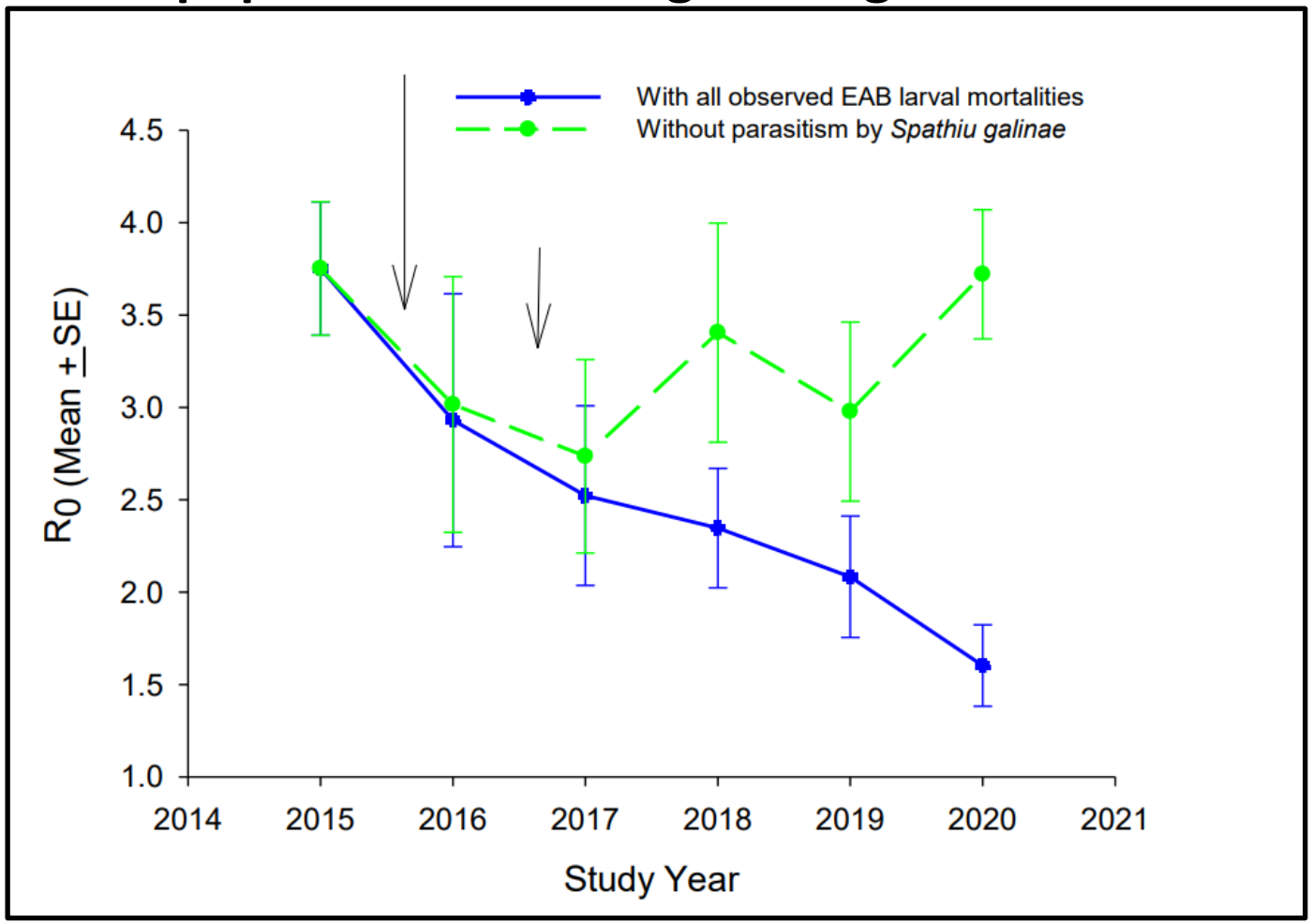
T. planipennisi

Spathius galinae



EAB Biological Control: *S. galinae*

EAB population modeling: Michigan 2015-2020



- **Models based on life table studies demonstrated that *S. galinae* significantly reduced EAB populations from 2018-2020**

EAB Biological Control: Natives

Native parasitoids

- Several native species attack EAB
- Most common: *Atanycolus cappaerti* and *Phasgonophora sulcata*

Woodpeckers

- Multiple species forage on EAB larvae
- Frequently the most dominant and consistent EAB mortality factor in forests

EAB Biological Control

Advantages

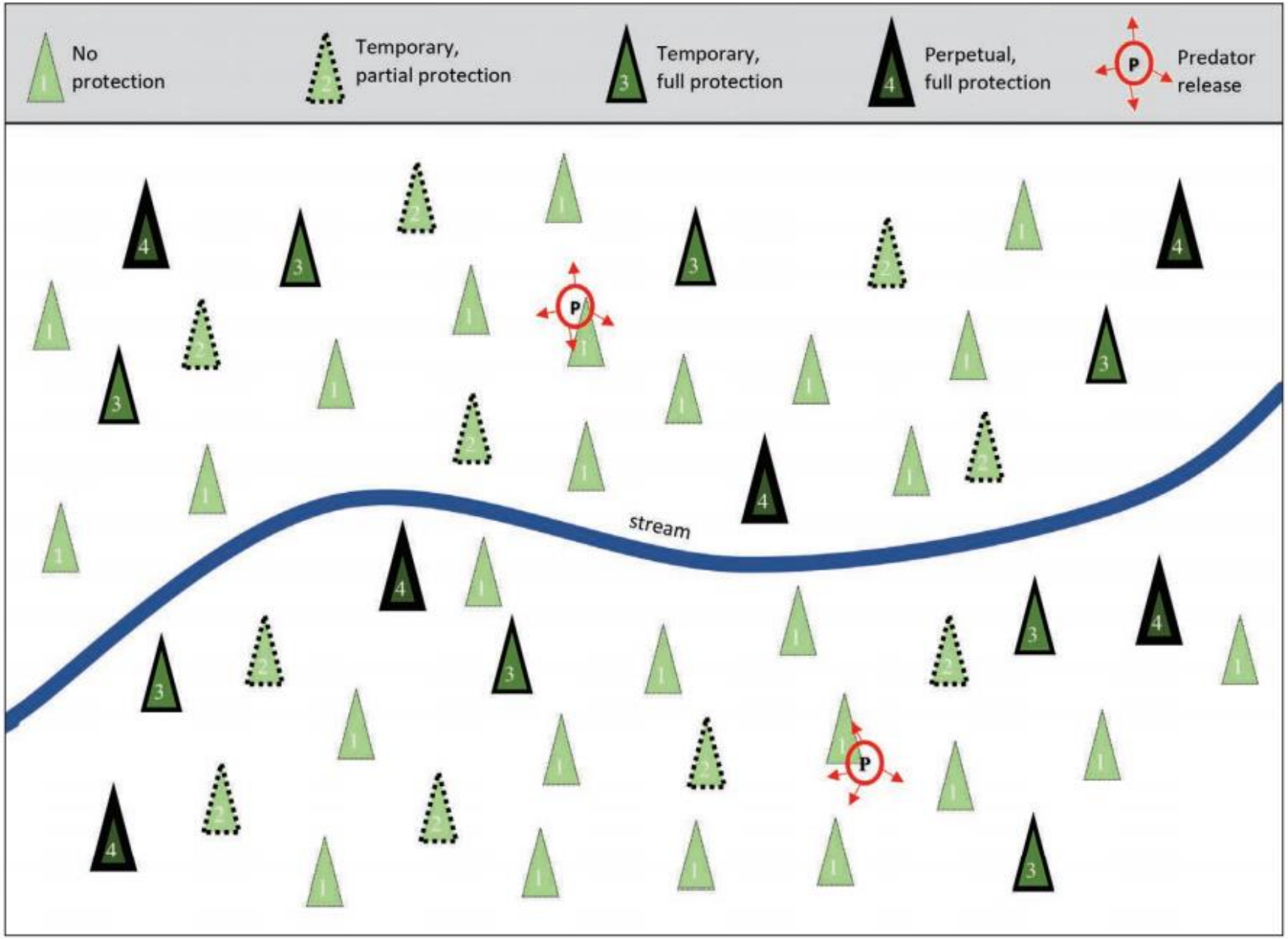
- Landscape scale impacts
- Self-perpetuating/permanent
- Environmentally friendly

Disadvantages

- Initial investment is expensive
- Establishment difficult for some species
- Delayed (lag) response to pest populations increases
- Bark thickness can limit parasitism

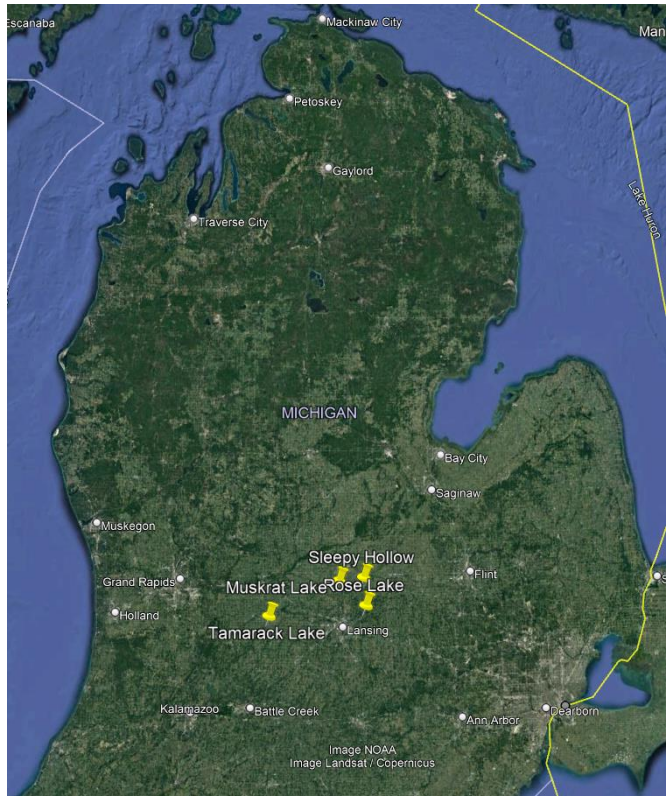
Integrating Biological Control and Insecticides for Area-Wide Control

- Not practical or ecologically responsible to chemically treat every ash tree
- Biological control alone cannot act quickly enough to save trees
- Treated trees will not support EAB and thus will not attract parasitoids
- Treated trees will lower EAB populations in the area through direct mortality and “halo” effect
- Parasitoid populations will build in untreated trees
- IPM approach will facilitate parasitoid populations growth and reduce EAB populations below damaging levels

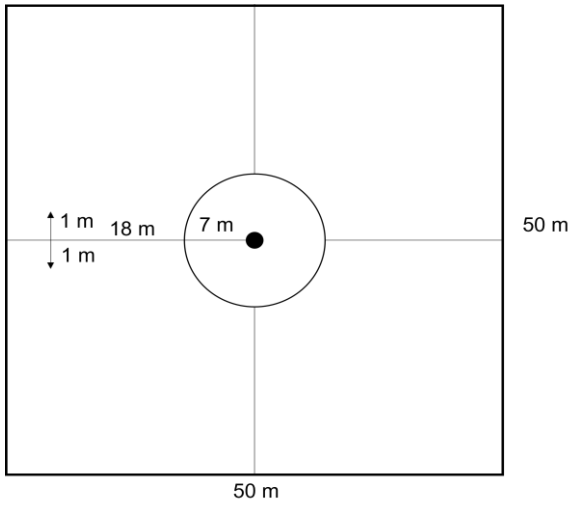


Mayfield, A.E et al. 2020. Integrating chemical and biological control of the hemlock woolly adelgid: a resource manager's guide. FHAAST-2018-04.

Study Sites



- Four post-EAB invaded sites selected in 2022.
- High densities of pole sized ash and recruits.
- Sites range from 11-26 ha.
- Overlaid 50 x 50 m grid at each site.
- Inventoried tree species and health of trees, recruits, saplings and seedlings.



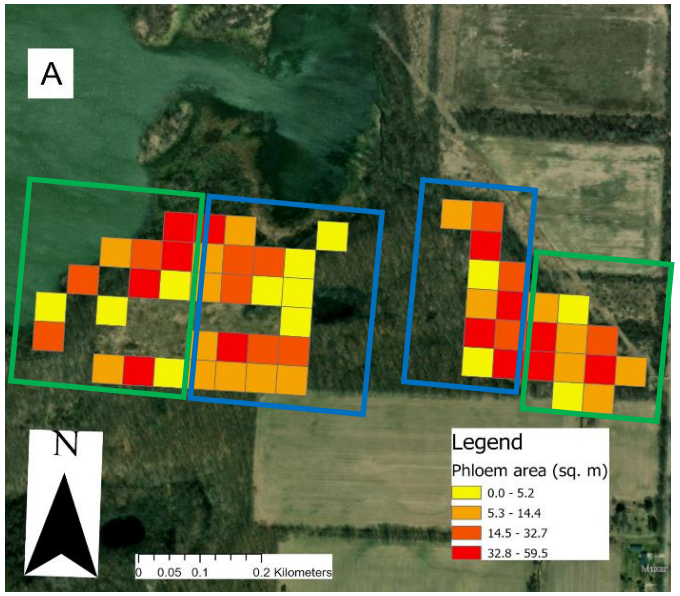
Study Methods

Summer 2022:

- Delineated treatment blocks within each site based on ash phloem area (2.0 – 6.5 hectares).
- Released parasitoids evenly across all sites.

Winter 2022:

- Dissected ash trees and recruits to assess EAB densities and parasitoid establishment and abundance.



Study Methods

Summer 2023:

- Insecticide treatments 6/14 blocks:
  50 % of live ash DBH treated. All trees >3 inch DBH.
- Recorded canopy condition of all monitoring trees.
- Deployed sentinel larval logs for monitoring larval parasitoids.
- Additional releases of *O. agrili.*
- Identified tree pairs (girdled/healthy) for monitoring EAB/parasitism.

Winter 2023:

- Dissect tree pairs.

Summer 2024:

- Record condition of monitoring trees.
- Deploy sentinel larval logs.

Winter 2024:

- Dissect tree pairs.

2025:

- Repeat 2024.

2026

- Insecticide treatments.

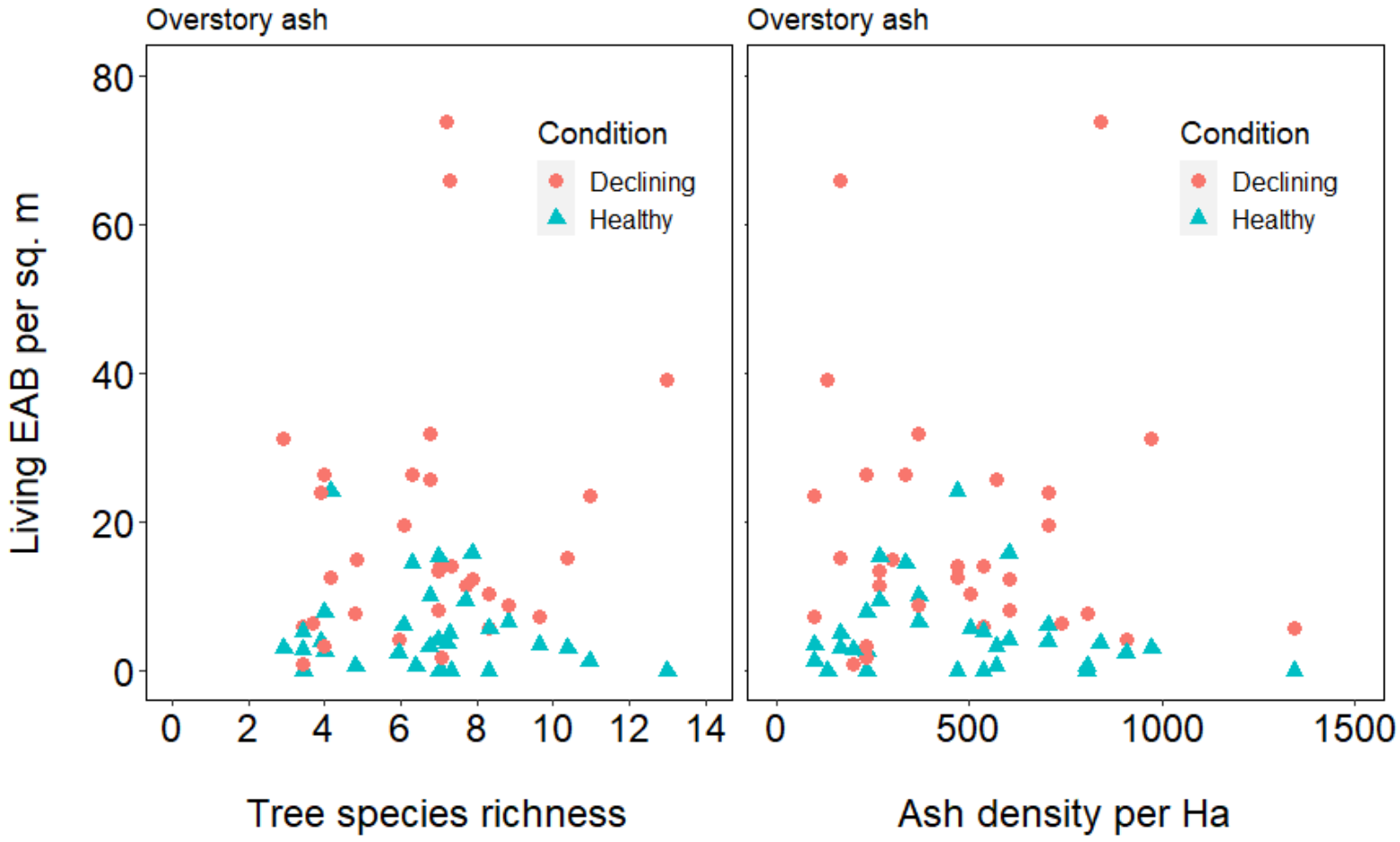
Preliminary Results: EAB Density

Richness:

- Main effect:
  - $\chi^2 = 0.524$, $P = 0.469$
- Interaction with tree condition:
  - $\chi^2 = 2.964$, $P = 0.085$

Density:

- Main effect:
  - $\chi^2 = 0.911$, $P = 0.340$
- Interaction:
  - $\chi^2 = 1.785$, $P = 0.182$



- **Tree diversity and ash density did not influence EAB densities.**

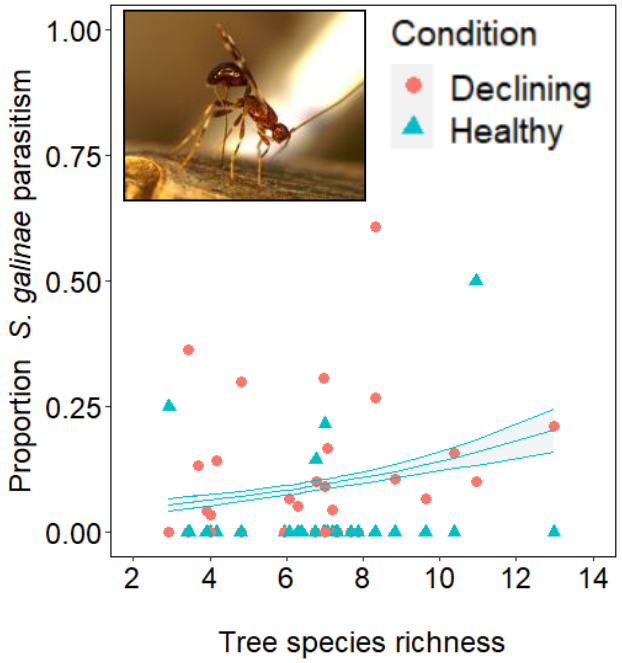
Preliminary Results: Parasitoids and Tree Richness

Overstory ash: > 10 cm DBH

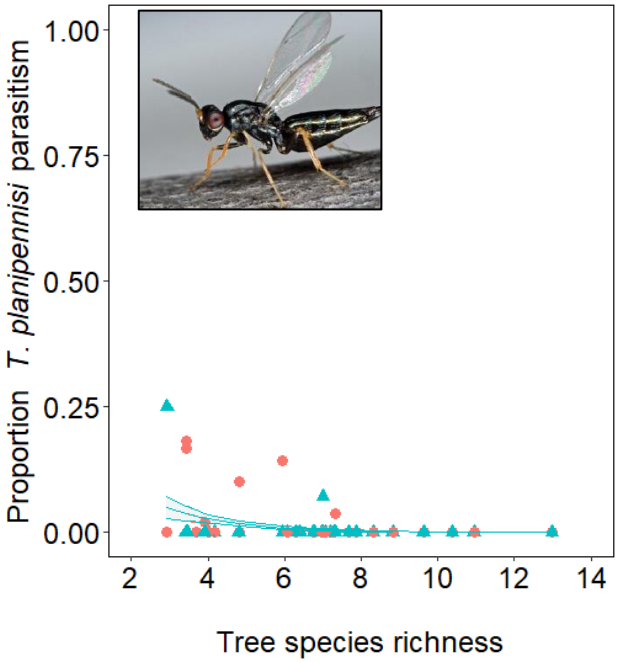
- *S. galinae*: positively associated with richness
- *T. planipennisi*: negatively associated, but weak effect
- *Atanycolus spp.*: No effect
- *P. sulcata*: No effect

Ash recruits: 2-10 cm DBH

- No effect of richness on any species



$\chi^2 = 9.318$, $p = 0.002$

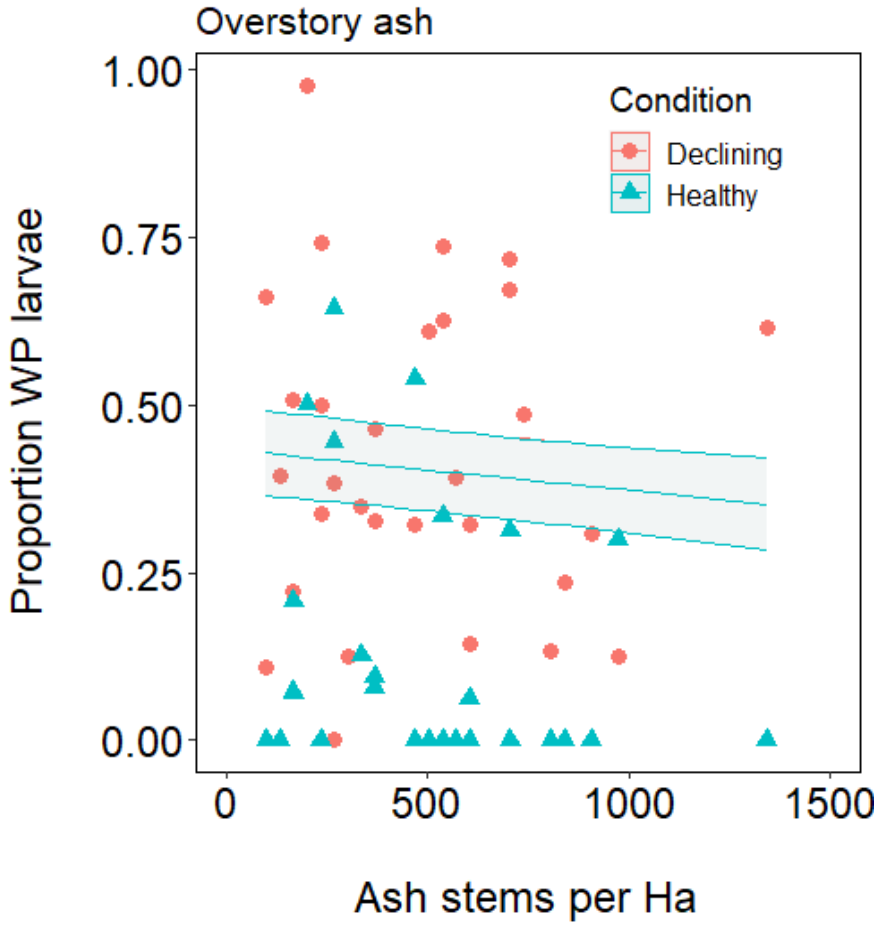


$\chi^2 = 12.093$, $p < 0.001$

Preliminary Results: WP Predation

- Overstory ash:
  - Richness: No effect
  - Ash density: negative effect on WP predation
  - Ash basal area: no effect

Photo: NaturalCrooks.com

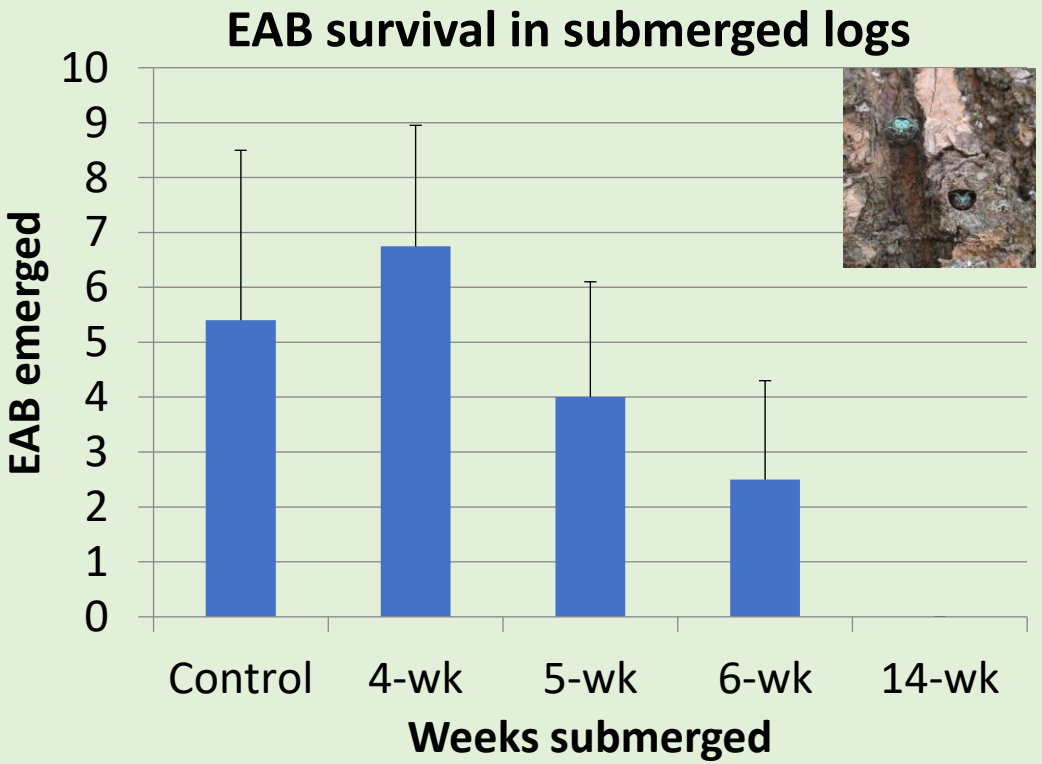


$\chi^2 = 5.863$, $p = 0.015$

Summary

- Parasitoid releases and insecticide treatments completed
- *S. galinae*, *T. planipennisi*, *Atanycolus* spp., and *P. sulcata* confirmed at all sites, *Oobius agrili* at 2 of 4 sites.
- Tree diversity and ash density had no or minimal effects on EAB and parasitoids, but ash density negatively effected WP predation
- Long term monitoring will be required to determine the efficacy of this management strategy
- Ultimate objective is to develop an effective strategy for managing high priority ash stands

Black ash submergence studies



- Splint quality of the outer rings of sapwood began to decline after 4-6 months of submergence.
- However, inner rings remained intact and pliable for up to 18 months of submergence.


Thank you !