The Impact of EAB Biological Control Agents on Ash Forest Structure in CT

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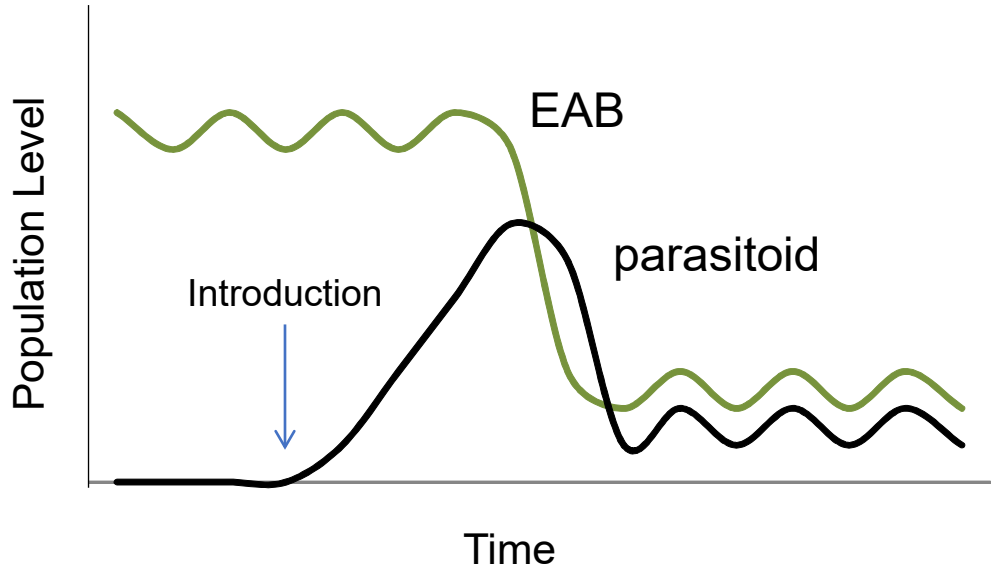
What is Biological Control?

- Using one organism to manage another. Targets can be plants, animals, fungus or bacteria
- Three Major Types
  - Classical Biological Control
    - invasive pest
    - biocontrol organisms come from native range of pest
    - Permanent solution
  - Conservation Biological Control
    - Manage environment to benefit existing natural enemies e.g. reduced pesticides, planting food plants
  - Augmentative Biological Control
    - Invasive or native pest
    - Mass reared natural enemies released
    - Control organisms not expected to establish
    - Often used in greenhouses and other contained systems

Why Parasitoids?

- Tightly linked physiologically with hosts
- Tightly linked with host habitat
- Limited ability to switch hosts
- High fecundity



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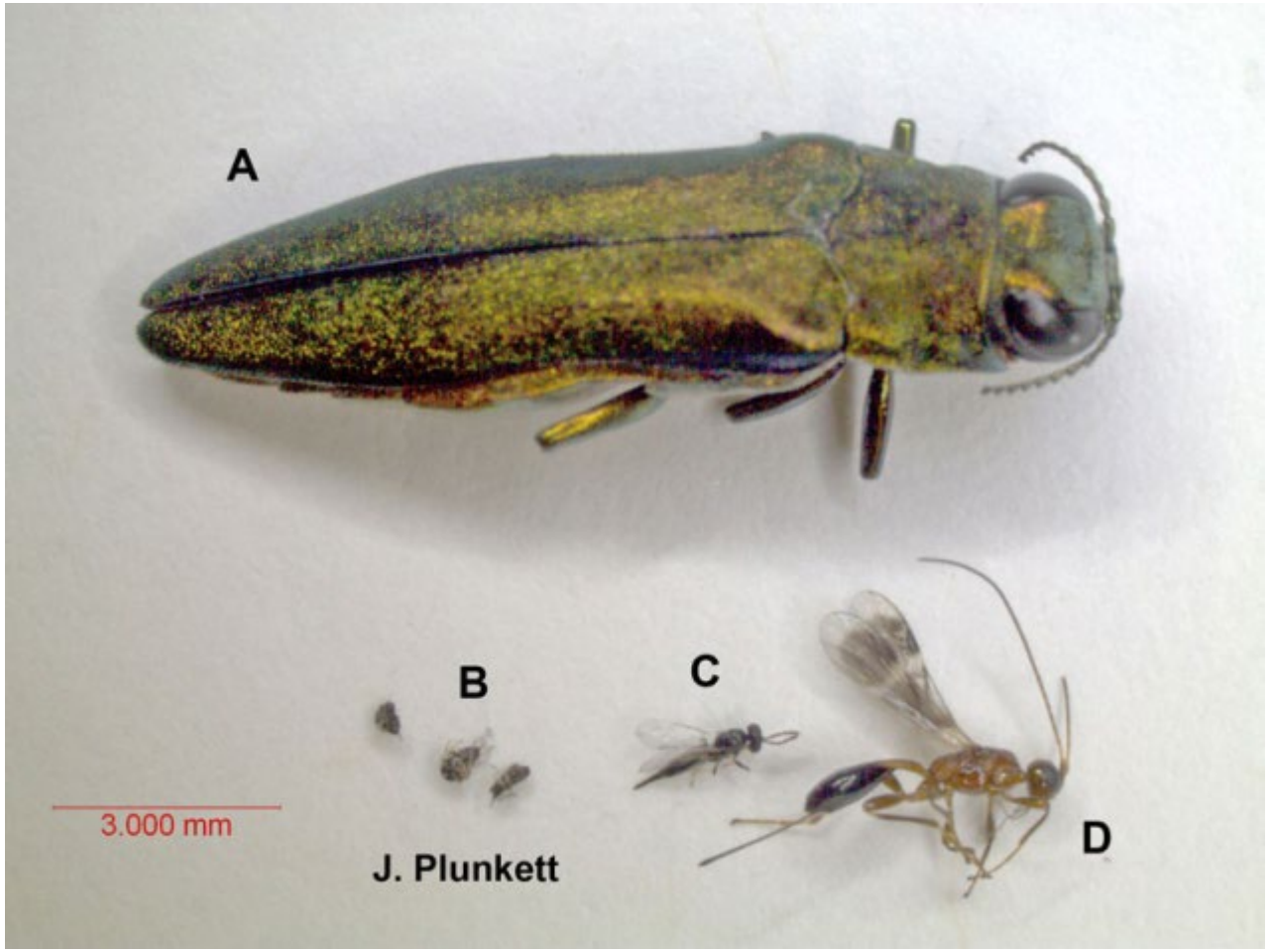
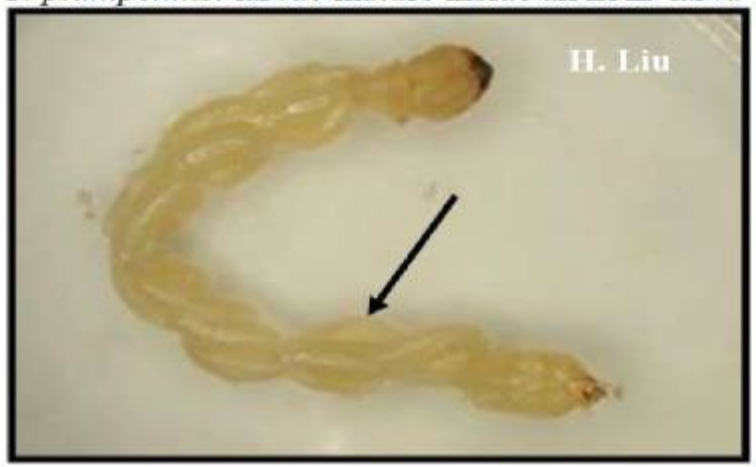
Emerald Ash Borer Parasitoids



Emerald Ash Borer Parasitoids

Tetrastichus planipennisi

T. planipennisi larvae mature inside an EAB larva



Tetrastichus planipennisi

- Endo-parasitoid of EAB from China
- Attacks and kills up to 50 percent of EAB larvae.
- The female parasitoid lays eggs inside EAB larvae
- *Tetrastichus* completes at least four generations each year
- One EAB larva can produce up to 127 *Tetrastichus* adults.
- They survive the winter as larvae inside their host or host gallery under the bark of ash trees.

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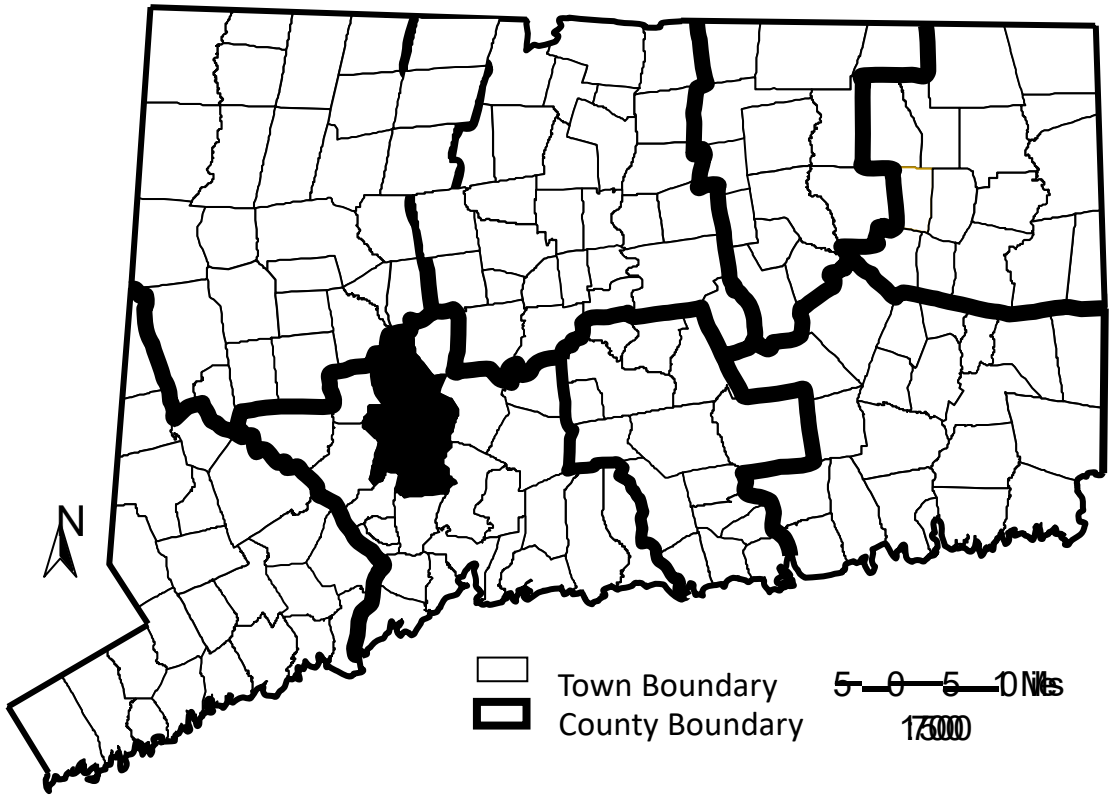
Spathius galinae

- *Spathius* spp. have a longer ovipositor than *Tetrastichus*, can parasitize larvae in bigger trees
- *Spathius galinae* - collected from EAB populations infesting *Fraxinus pennsylvanica* trees in the Vladivostok area (Duan et al., 2012a).
- *Spathius galinae* – ecto-parasitoid attacking 2nd to 4th instar EAB larvae
- Started releases in 2016



2012

- Emerald Ash Borer first detected in Connecticut in 2012
- Releases of *T. planipennisi* started in 2013 in 2 sites.
- As EAB spread throughout the state, parasitoid releases continued. Each year, new release sites were chosen at the edge of the known EAB infestation range
- Starting in 2016, *S. galinae* was added to the releases
- Releases at each site were conducted for 2 years. In year 3, establishment of the parasitoids was assessed through peeling and other sampling means.

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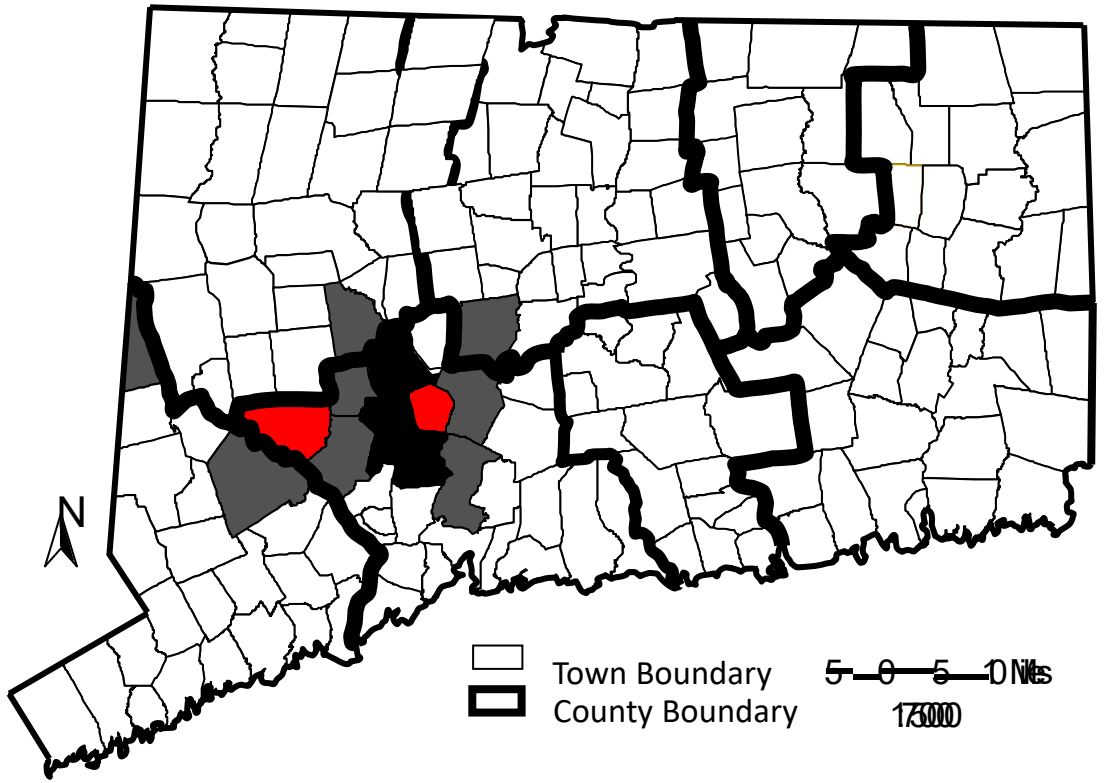

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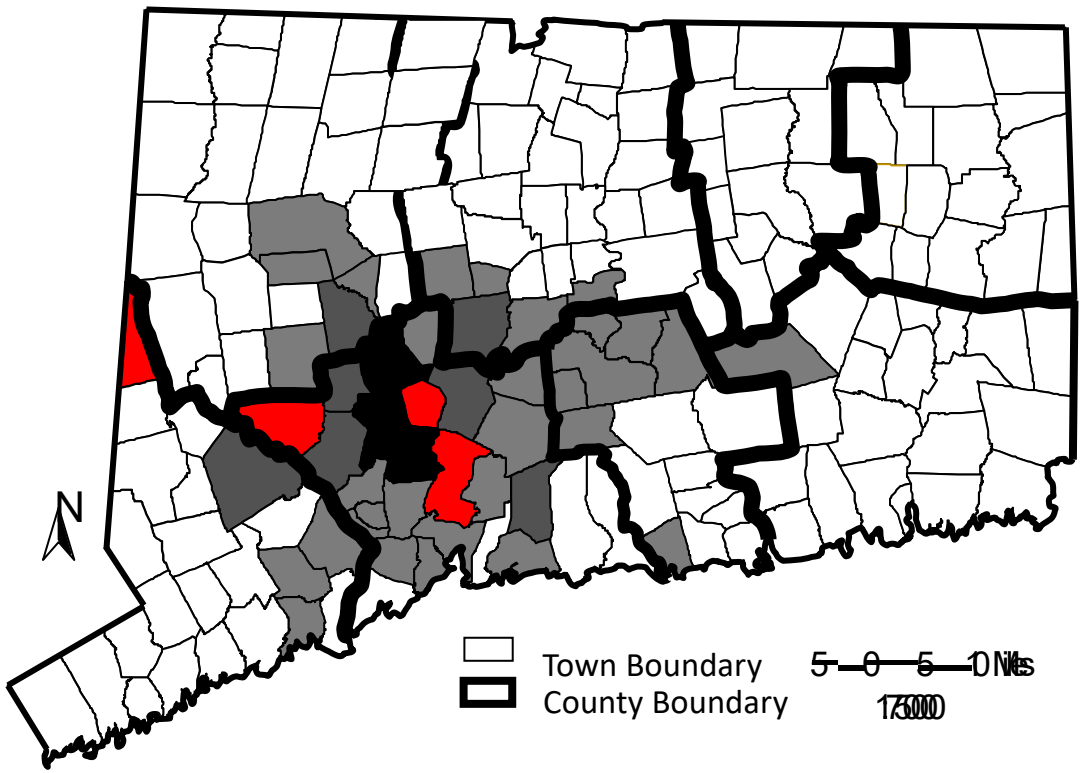

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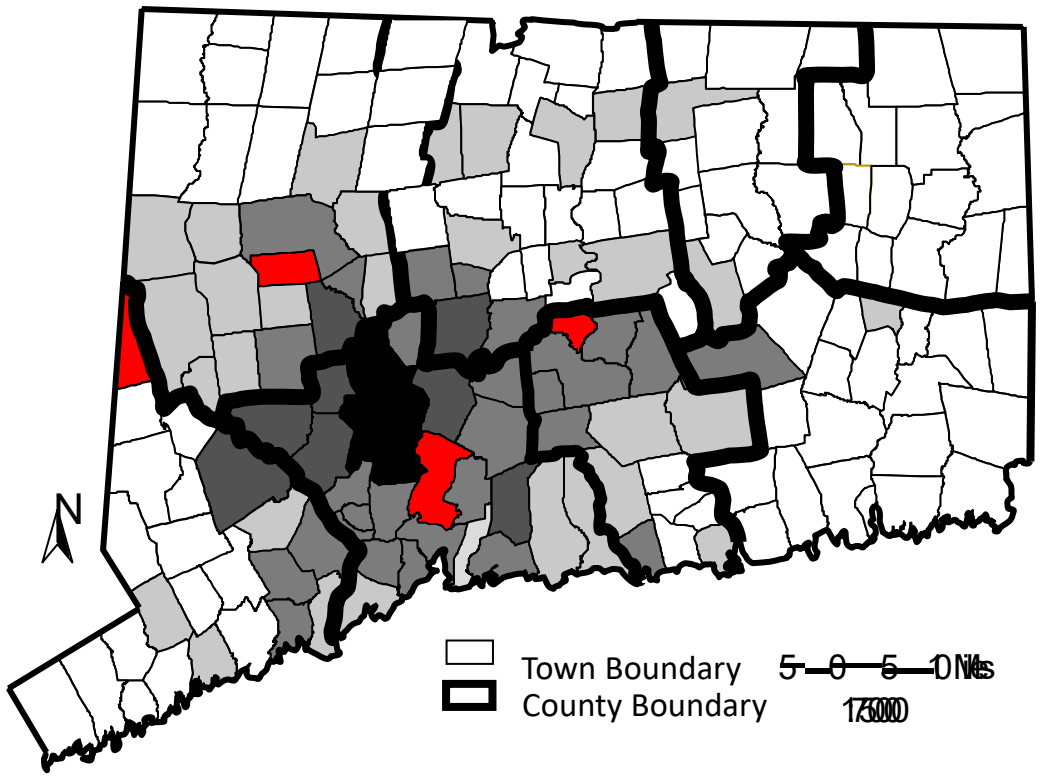

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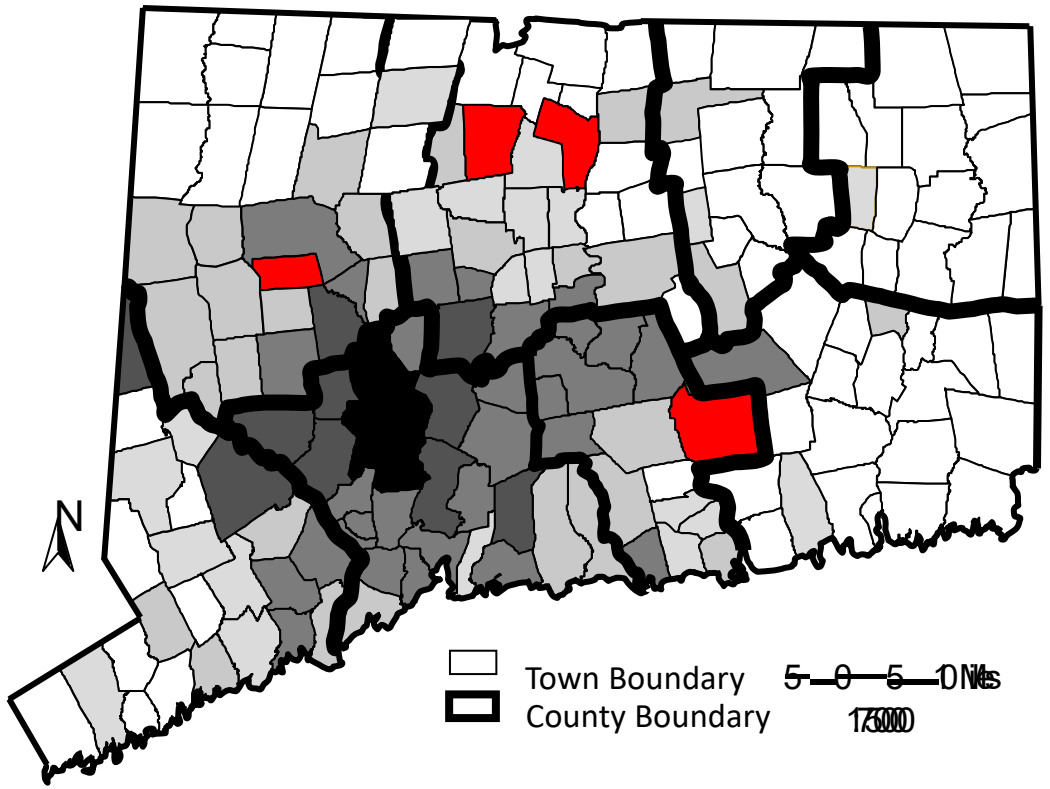

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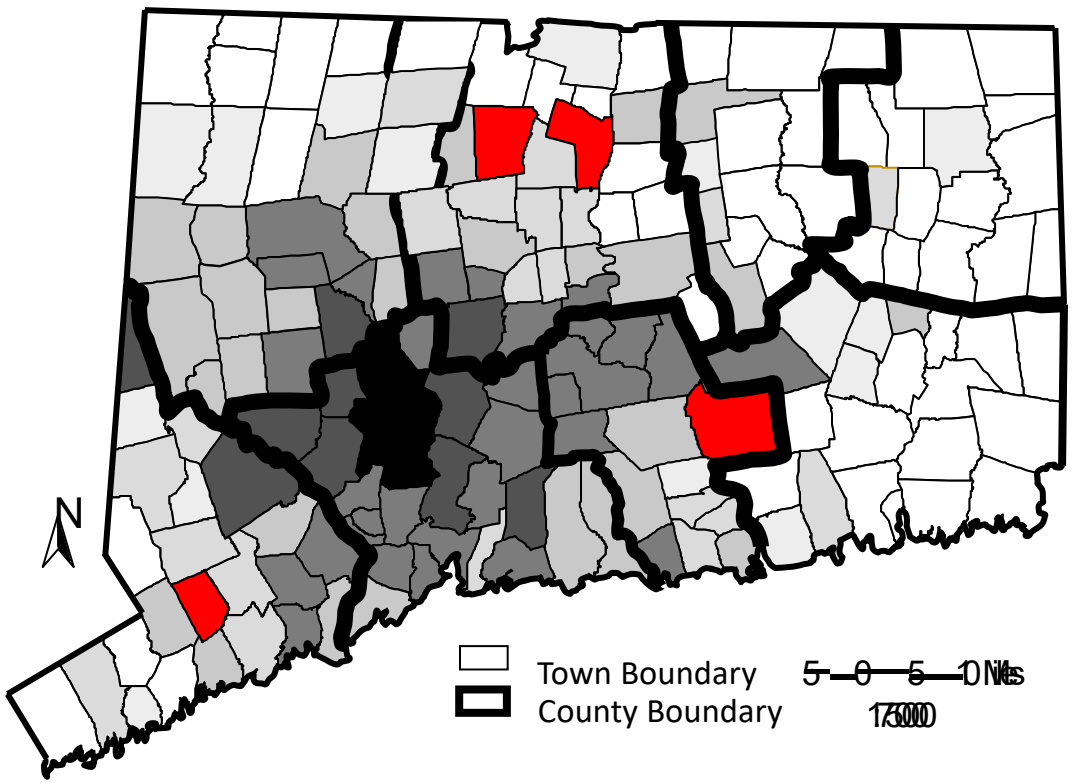

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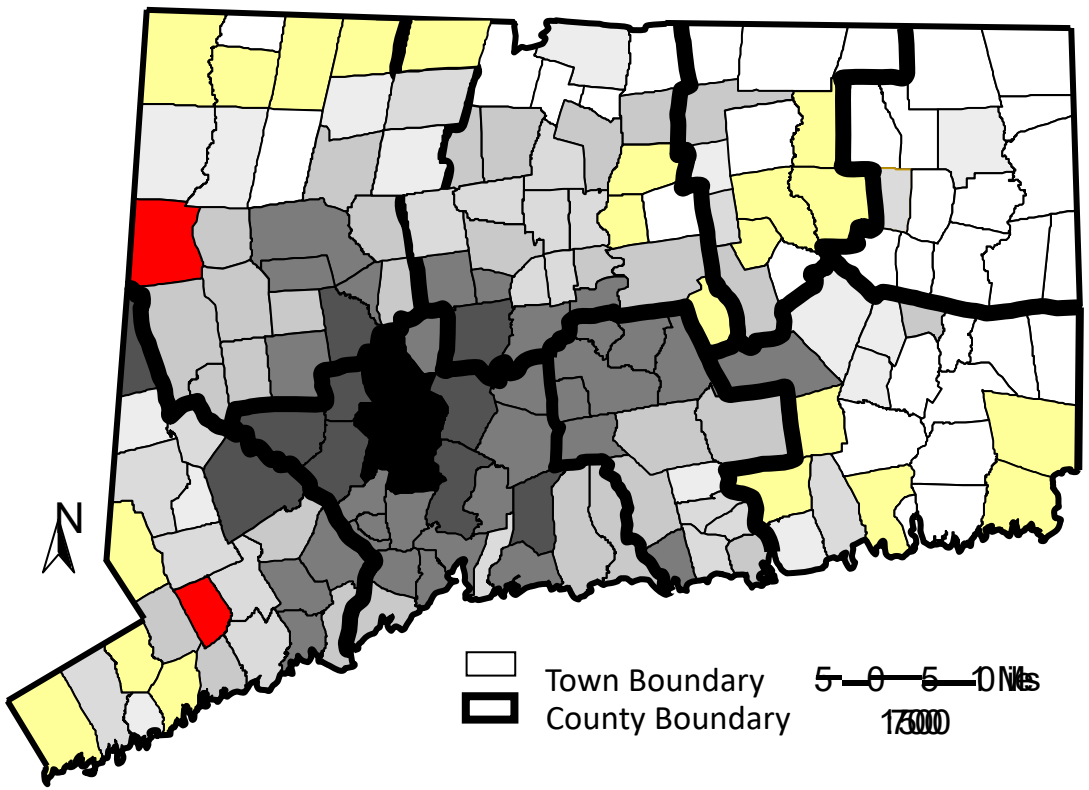

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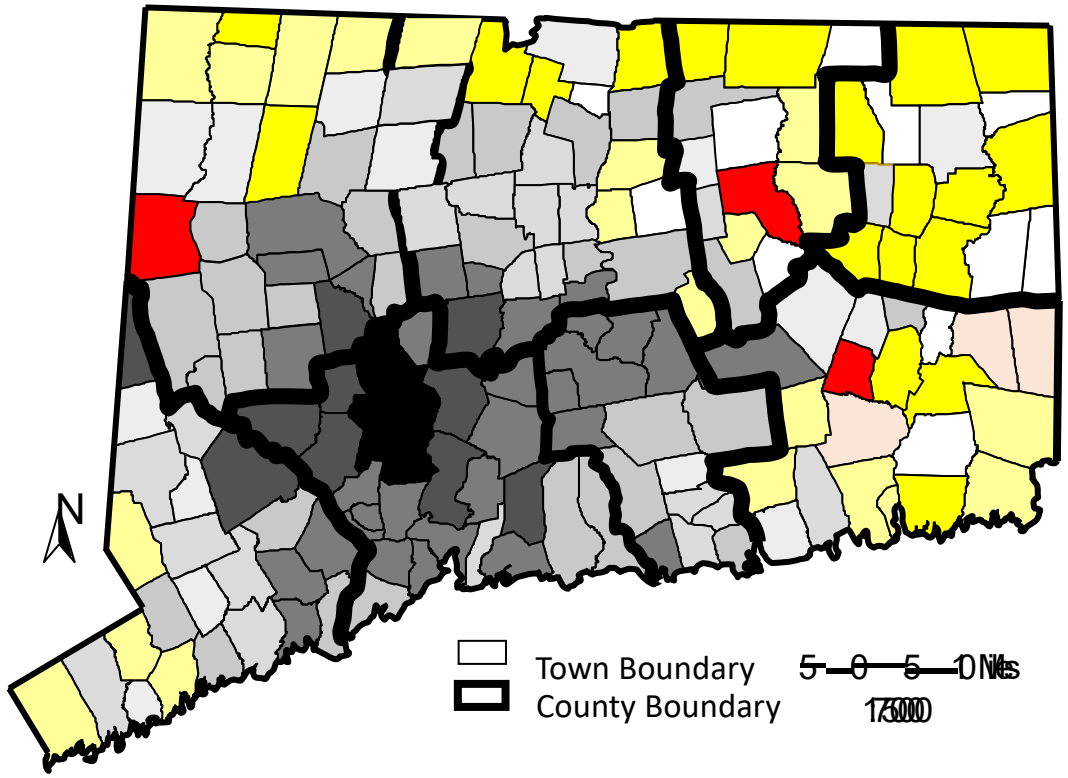

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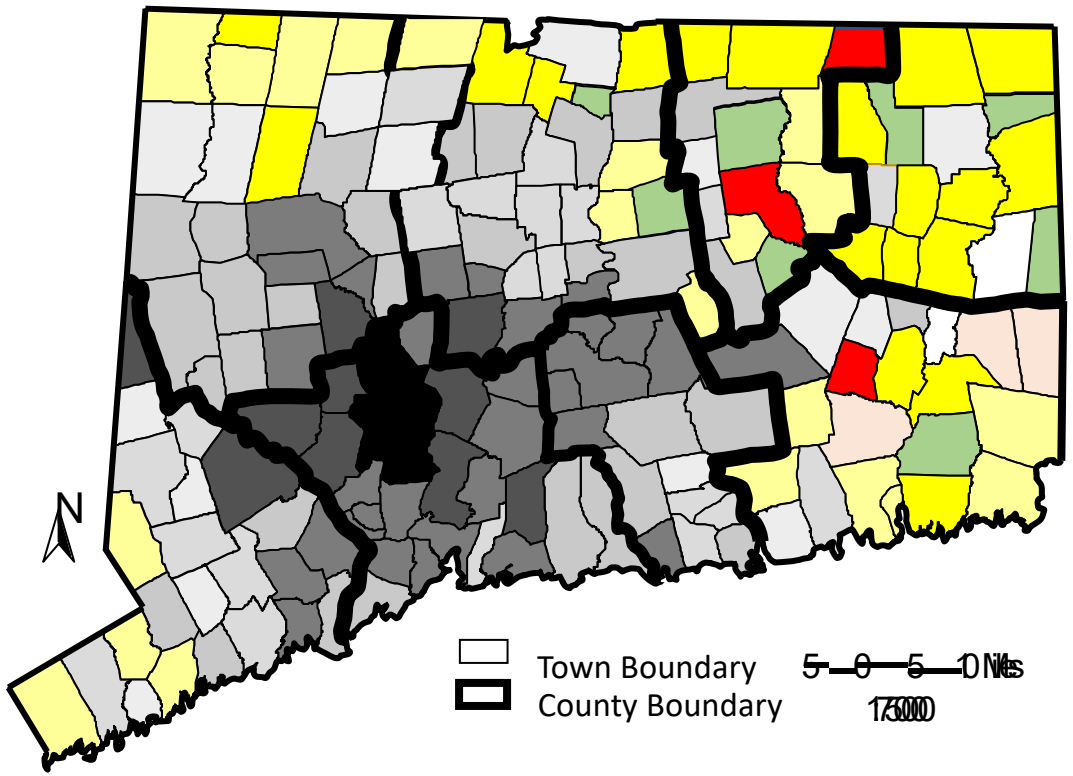

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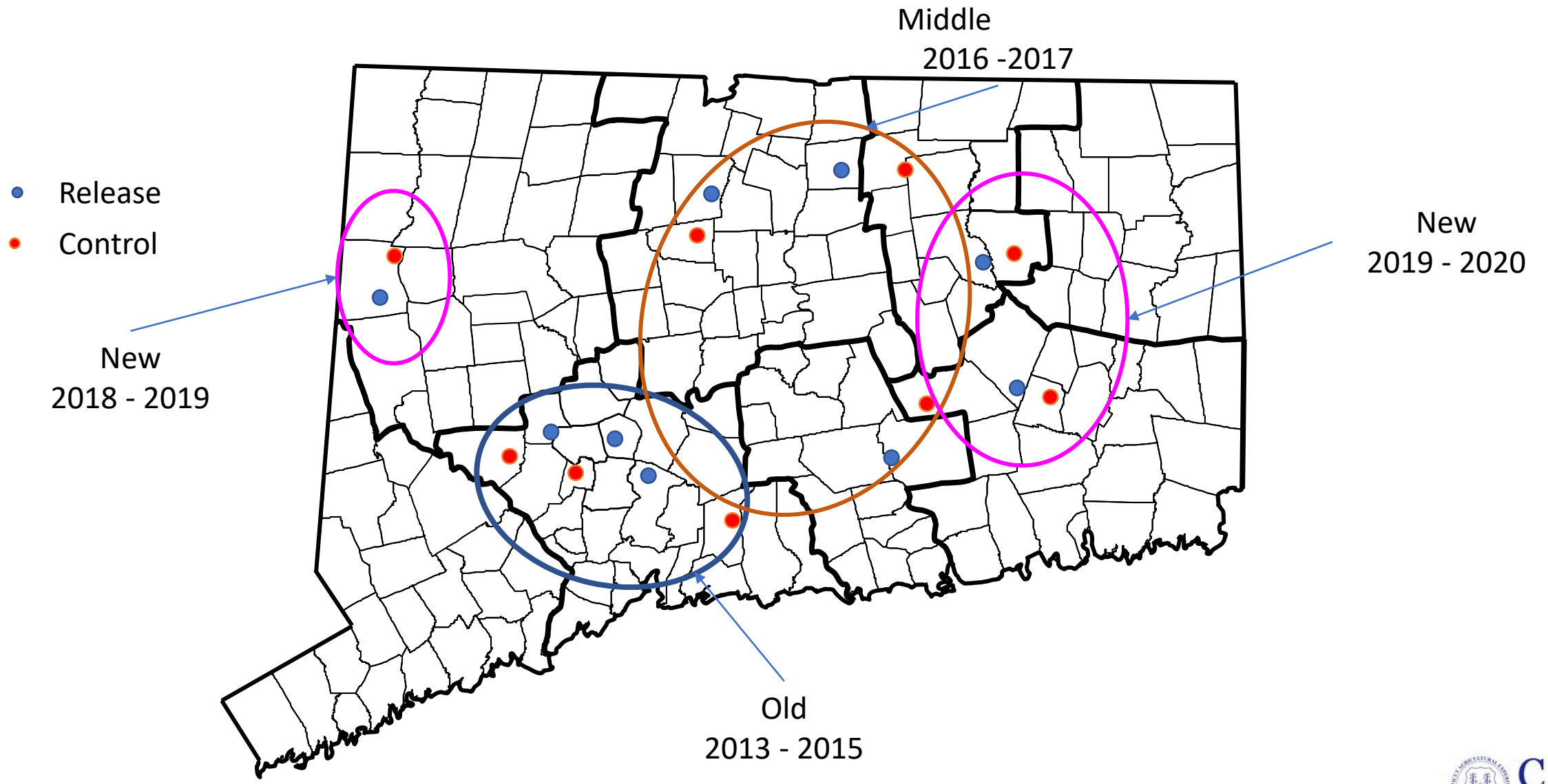
Persistence of EAB Larval Parasitoids after Release and Initial Recovery

- Questions
  - Will EAB larval parasitoids be able to maintain populations in areas after the EAB population drops
  - Will the presence of parasitoids, or rate of parasitism be correlated with EAB larval density
  - Will ash stand structure be changed by the presence of parasitoids

Persistence of EAB Larval Parasitoids after Release and Initial Recovery

- Design of Experiment
  - 3 release and 3 control sites for each of 3 release ages – 8 yo, 6 yo and 2 yo
  - Characterize plots by size, density and condition of ash present
  - Determine presence of parasitoids by sentinel logs
  - Characterize plots by EAB larval density and parasitism rate by peeling trees

Release and Control Sites



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Characterize plots by size, density and condition of ash present

For each site 4, 50 X 2 m transects.

- Using a forestry chain, start from a random ash and walk to next visible ash no matter what direction. For each tree within one meter of either side of the line including the starting and ending trees, measure DBH, rate canopy and note presence/ absence of EAB signs and symptoms. Continue in this fashion until the chain reaches 50 m.
- For trees below 1 cm DBH, tally number present within 1 meter of either side of line for each 10 m stretch.

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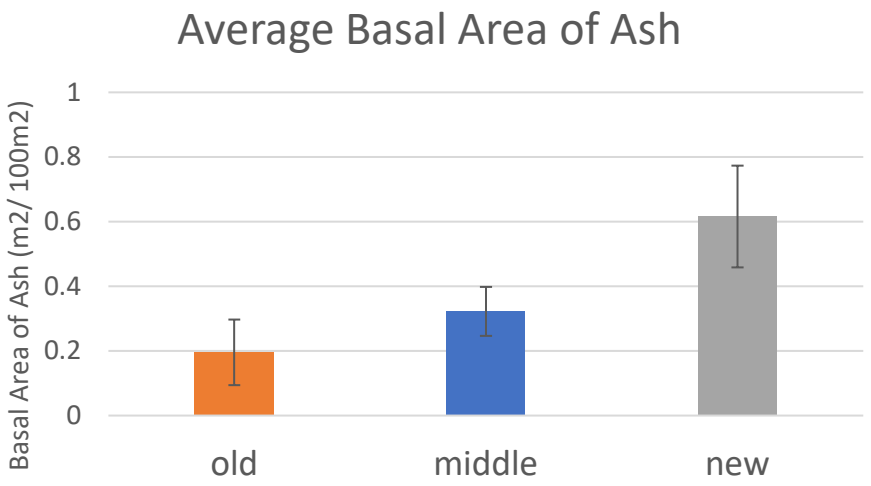
Determine presence of parasitoids by sentinel logs

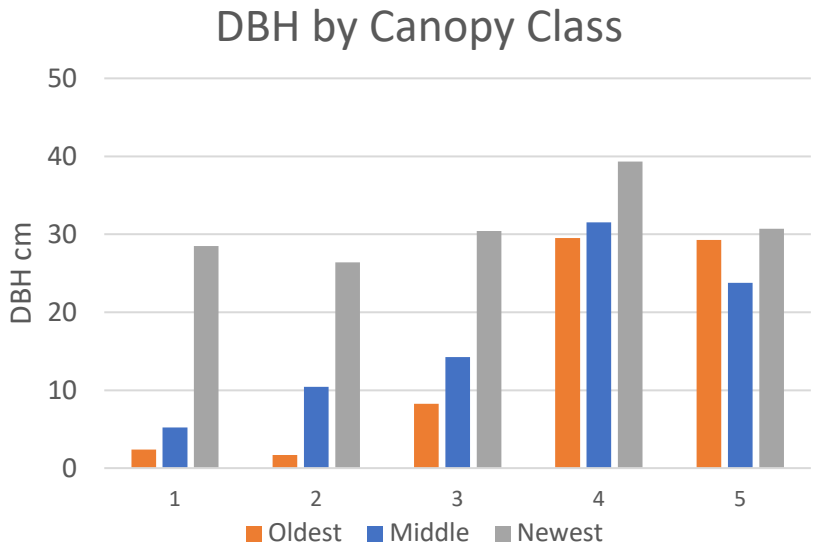
- 2020 – all release sites in old and middle age sites 2 reps each
- 2021, 2022 – all release sites, and control sites
- Total of 18 logs needed per rep
- 2 reps (total logs = 36/ year) starting in July
- Logs deployed for 2 weeks, then sent to BIIR for rearing and dissection

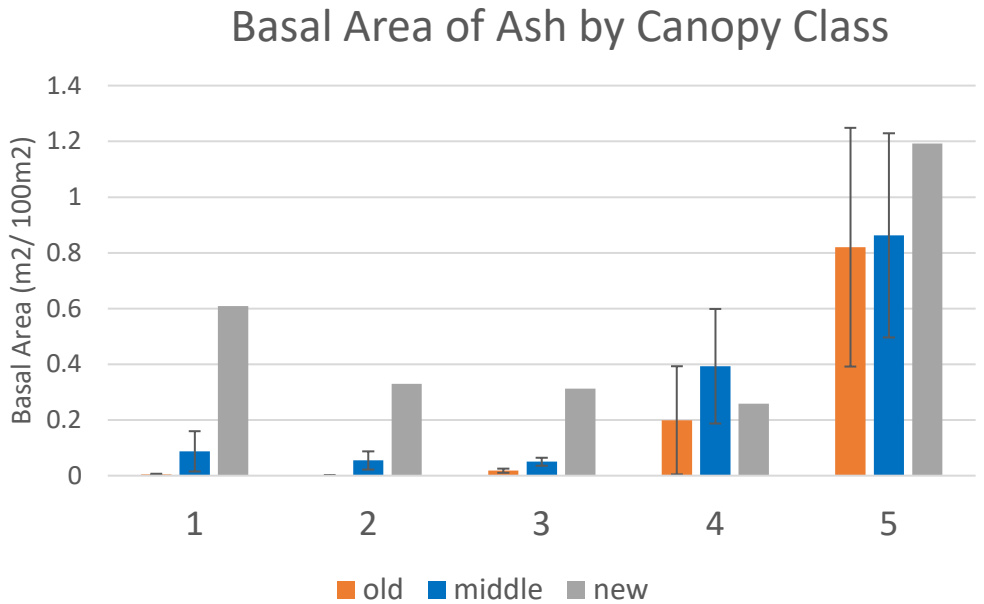
Characterize plots by EAB larval density and parasitism rate by peeling trees

- For each site, choose up to 5 trees that have living phloem
- If possible, choose 3 trees between 2 and 6 DBH and 2 between 8 and 12 cm DBH. If not, choose up to 5 trees between 2 and 12 cm DBH
- As we are attempting to ascertain EAB larval density, trees were chosen based on these criteria without regard to signs or symptoms of EAB presence.
- Peel trees using draw knives. Using standard protocol count and record by meter, old and new wood pecks and exit holes. Collect and note stage and status of any EAB present. If any parasitoids are present, collect and note stage status and number.

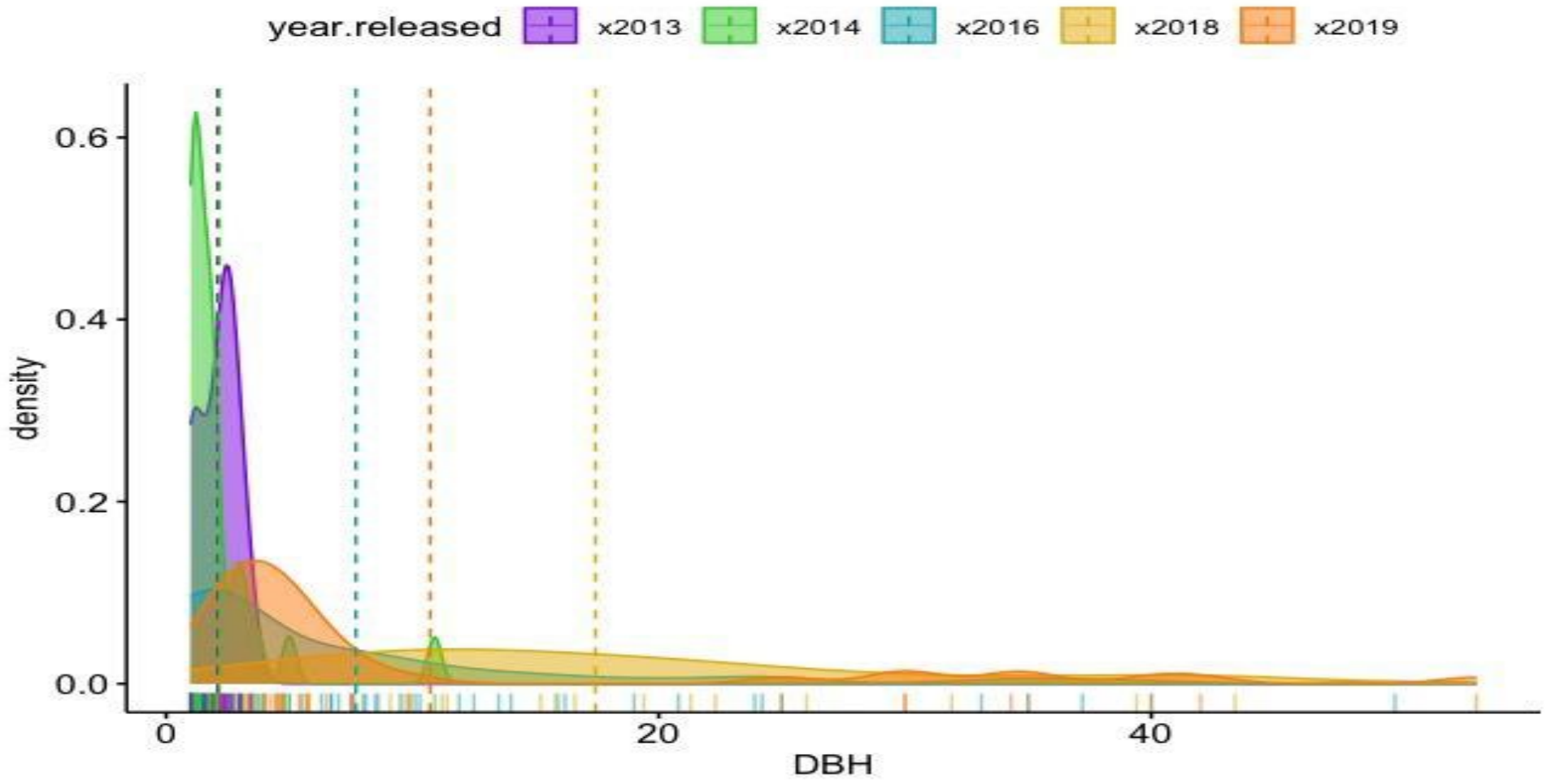
Characterize plots by size, density and condition of ash present



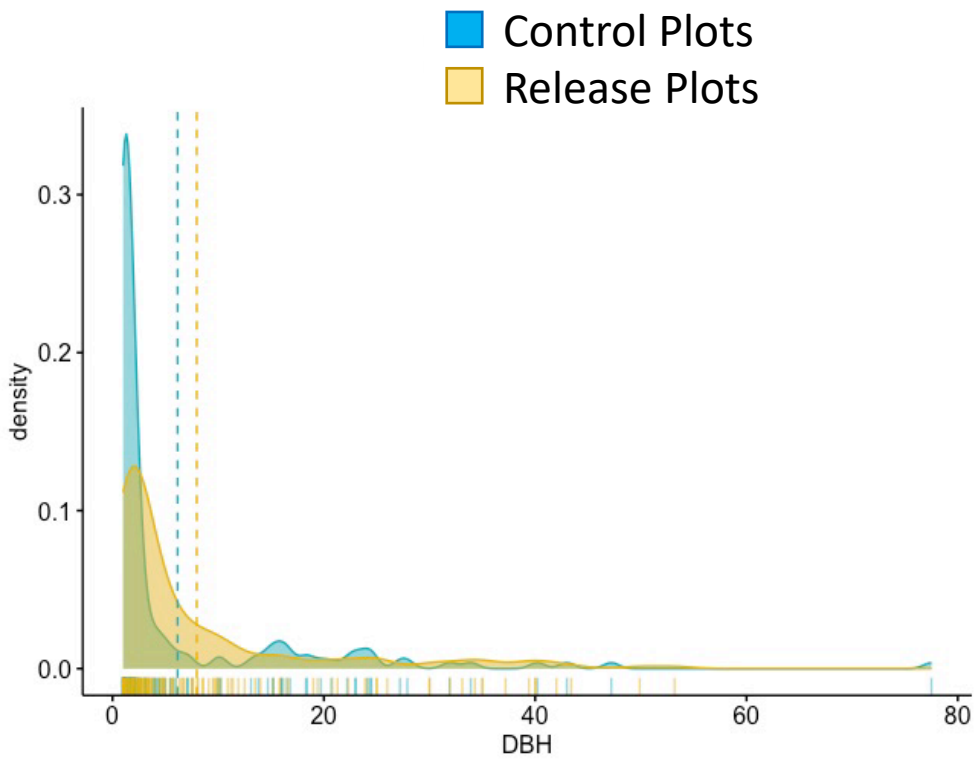




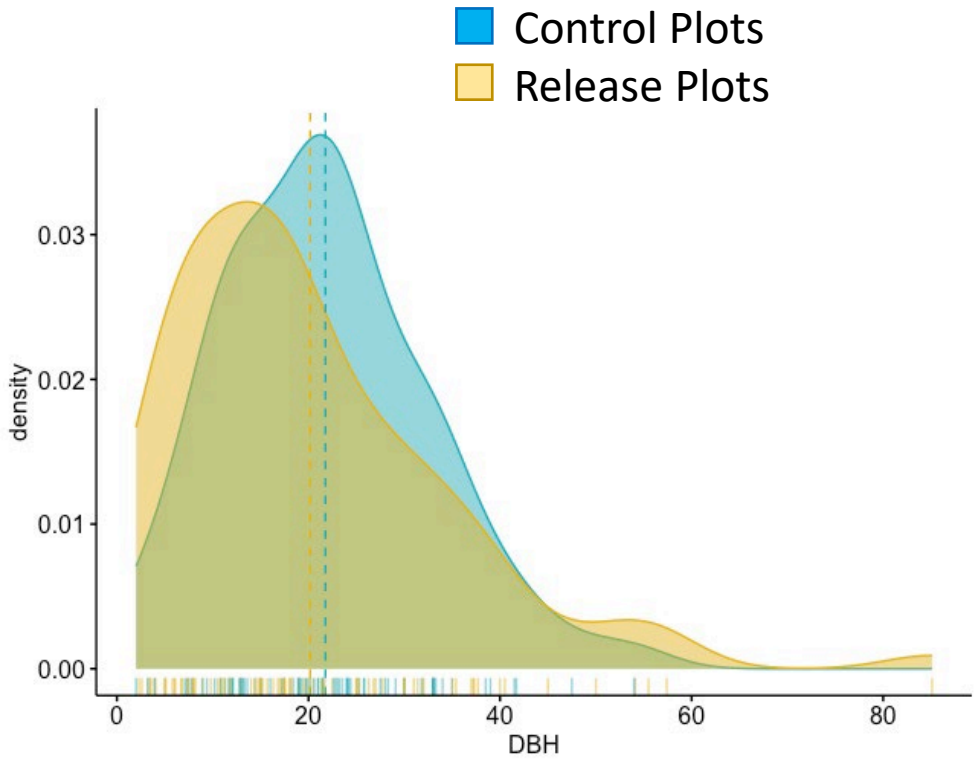
Release Age – Forest Structure



Control vs. Release Plots – Forest Structure



Living Trees



Dead Trees

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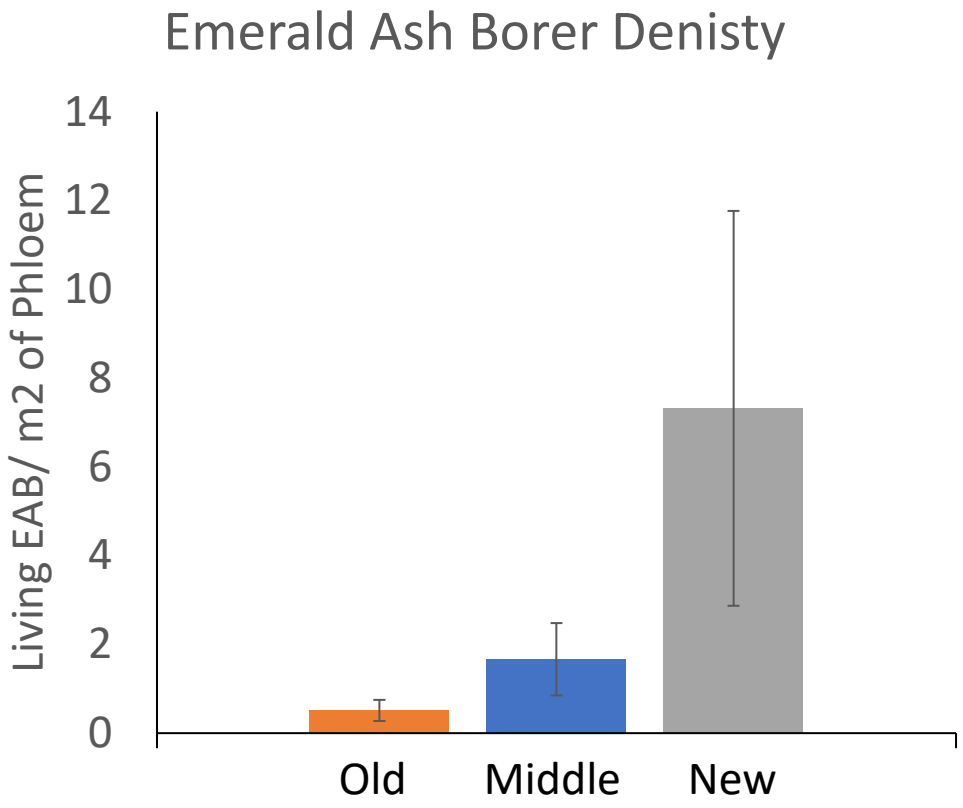
Summary of Parasitoid Detections

			Release Dates	Sentinel Log			Peeling		All
	Age	R/C		SL20	SL21	SL22	21	22	
Prospect	1	R	13/14		T	S			T & S
Beacon Falls	1	C							
Middlebury	1	R	13/14	T		T			T
Southbury	1	C							
Hamden	1	R	14/15	T&S		T			T & S
Northford	1	C			S		S		S
Simsbury	2	R	16/17		S			0	S
Fishers	2	C					S	0	S
East Haddam	2	R	16/17	T			T&S		T & S
Colchester	2	C							
East Windsor	2	R	16/17	T				S	T & S
Ellington	2	C						S	S
Rock Cobble	3	R	18/19		S	S	T		T & S
Kent Land Trust	3	C			S	T	T		T & S
Coventry	3	R	19/20		S	S	T		T & S
Mansfield	3	C				S	T		T & S
Lebanon	3	R	19/20						
Bozrah	3	C				S	S		S

Characterize plots by EAB larval density and parasitism rate by peeling trees



Conclusions

- There are striking patterns of ash size, density and condition across the release age
  - Basal area of ash decreased with the age of the infestation
  - Overall, smaller healthy ash in older plots
- Release plots had higher median DBH for healthy trees than control plots
- Sentinel logs complemented the data from peeling
  - For plots with no larvae found by peeling we could still confirm parasitoid presence
- Emerald Ash Borer density decreased with the age of the infestation
  - In part this was fueled by the lack of living ash of the appropriate size, many small trees showed no evidence of attack.
- Parasitism rates were similar across release age treatments and release/ control plots
  - Although the density of EAB larvae varied widely across the treatments, the rates of parasitism were similar. If larvae were present, they were as likely to be parasitized in the oldest treatments as in the newest ones

Questions?
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