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Mortality of emerald ash borer in urban populations in Ontario, Canada

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Background

- high larval mortality due to tree resistance (Duan et al 2010 Env. Ent 39:1513-1522) in ash growing in woodlots

- woodpeckers cause significant mortality to pre-pupae, puape.

- In Canada, significant economic & ecological impact occurres in cities but no study of EAB larval mortality in urban EAB populations.

Goal

Quantify impact of natural mortality factors on urban EAB populations

Methods

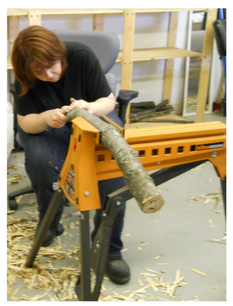
- Sampled ash in 3 cities in Ontario, Canada (Oakville, Toronto, Sault Ste. Marie) 3 or 4 times per year between 2010 and 2012. Removing 3 trees each time a sample was taken

- collected all wood >5 cm in diam. (in 2010, other years a representative sub-sample was taken).

- Wood peeled to extract EAB larvae. These were identified to size (small, medium, large), health (alive/dead) and location in tree (trunk, lower, middle or upper crown branches). If dead the cause of mortality was recorded.

- To study the timing of mortality and partition external vs. internal mortality factors, half of the wood was peeled immediately after sampling. The other half was placed in sealed containers for 4-6 weeks, then peeled

- Analysis: life table, quantify causes of mortality, derive density – mortality relationships for EAB.



Results

1) Most mortality in younger stages and caused by unknown factors;

Which stages were killed:

	small	medium	large	prepupae	pupae	Σ
cannibalized	0	4	2	0	0	6
dead	0	1	1	0	0	2
diseased	82	145	78	12	9	326
missing	42	3	7	0	4	56
predated	0	2	16	0	2	20
unknown	163	22	4	1	8	198
Σ	287	177	108	13	23	608

2) Most mortality occured in the trunk and lower branches.

Where larvae were killed:

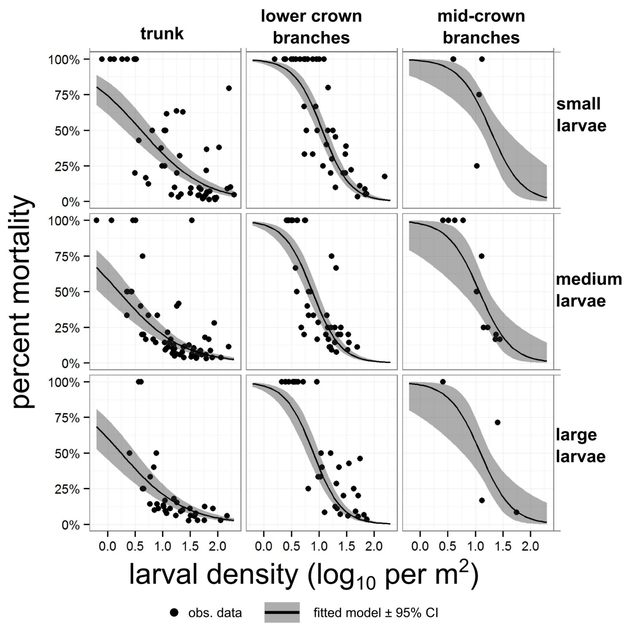
	trunk	branches: lower	branches: middle	branches: upper	$\Sigma_{branches}$	Σ_{all}
cannibalized	3	3	0	0	3	6
dead	2	0	0	0	0	2
diseased	193	114	19	0	133	326
missing	22	29	4	1	34	56
predated	7	8	5	0	13	20
unknown	138	48	10	2	60	198
Σ	365	202	38	3	243	608

3) Woodpecker attacks tended to occur in the trunk and lower branches

	trunk	branches: lower	branches: middle	branches: upper	$\Sigma_{branches}$	Σ_{all}
wood pecker attacks:						
Oakville	246	426	86	11	523	769
Sault Ste. Marie	176	250	51	53	354	530
Toronto	520	646	77	0	723	1243
Σ	942	1322	214	64	1600	2542

4) EAB mortality decreased with increasing density.

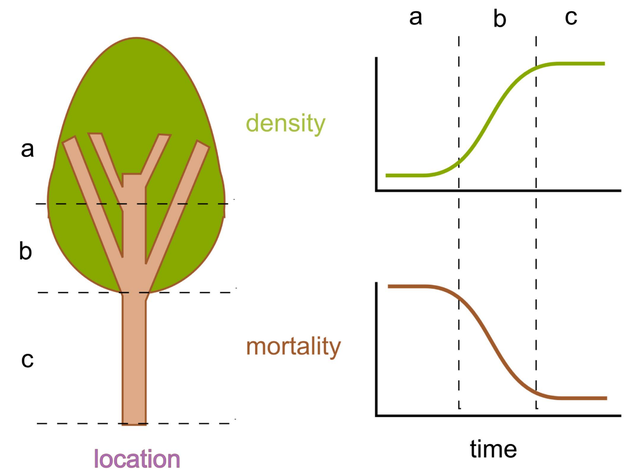
Pattern is consistent across different larval stages but varies depending on where in the tree the larvae were found.



Discussion

A Hypothesis:

Given that EAB attacks branches first, our data show low density populations in these locations suffer high mortality (a). Then, as densities increase EAB moves into the trunk and mortality begins to decrease (b). Eventually EAB has infests the whole tree, and almost no mortality occurs (c)



Our Result

1) Explains why new infestations seem to errupt.

New populations grow fast once they move out of the branches. Suggests populations are likely established well before first detection.

2) Supports need for early detection methods

By time populations are large enough to be detected by visual signs and symptoms, traps, etc.. they have gone past the low densities subject to high mortality. To find EAB early we must look where they are likely to be!

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