EAB and its early detection: New methods offer new options

J. Fidgen & K. Ryall
Canadian Forest Service
Great Lakes Forestry Centre

Outline

- Visual surveys
- Trapping
- Branch sampling
- Application of branch sampling

Symptoms

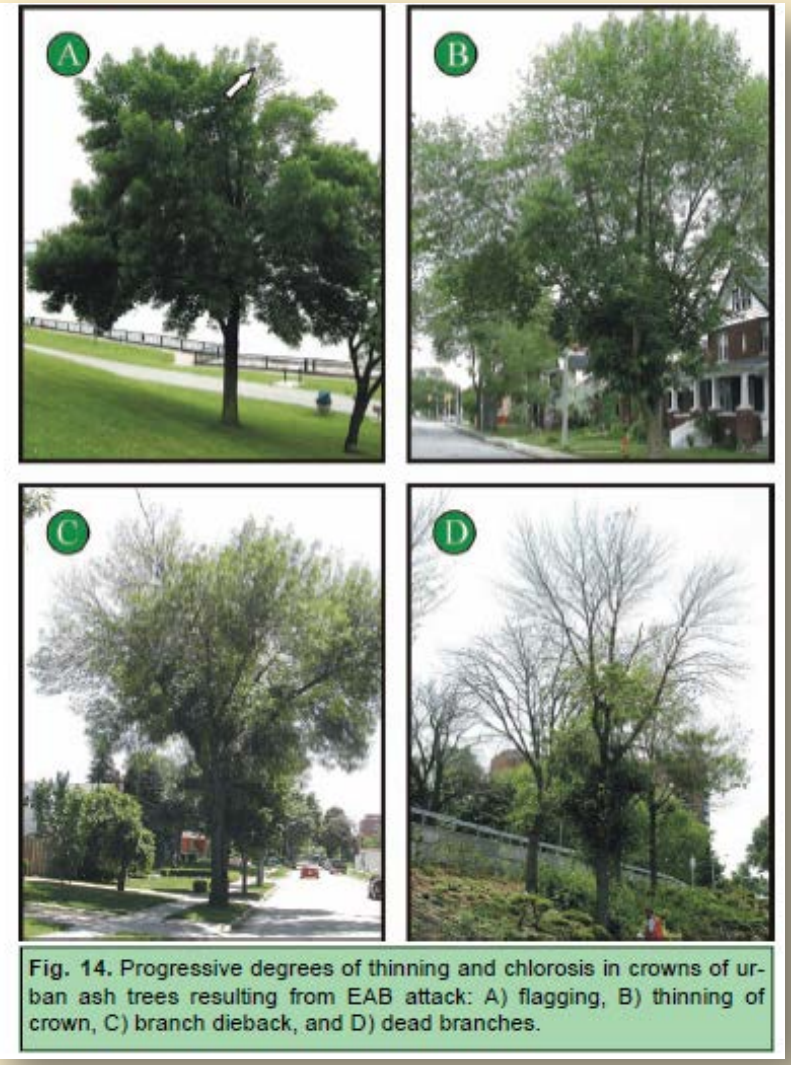


Fig. 14. Progressive degrees of thinning and chlorosis in crowns of urban ash trees resulting from EAB attack: A) flagging, B) thinning of crown, C) branch dieback, and D) dead branches.

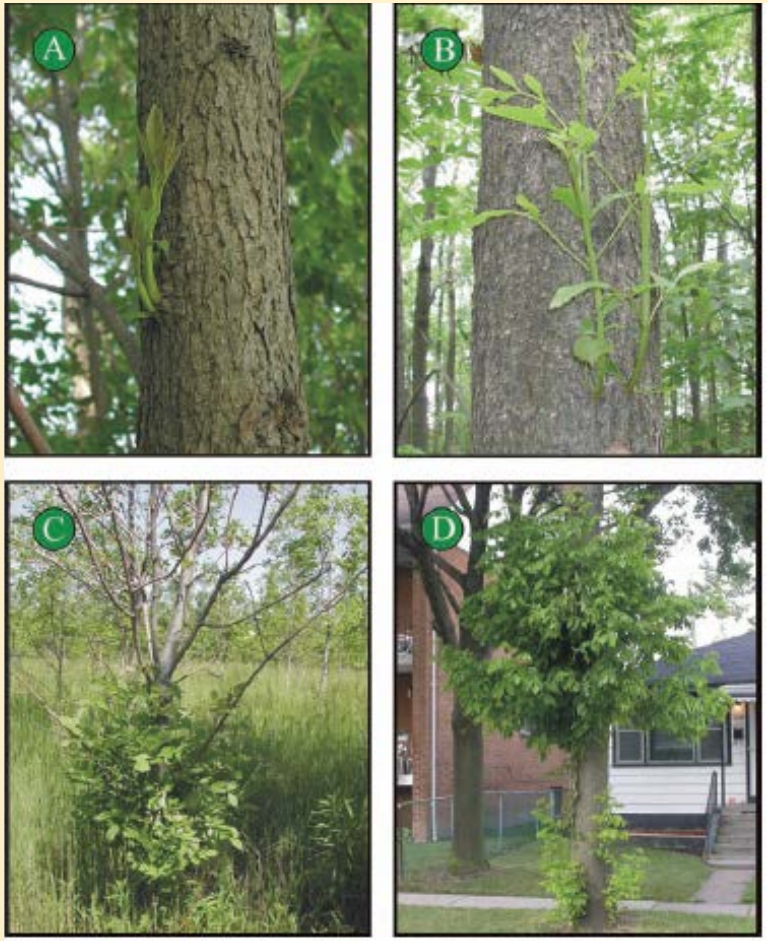


Fig. 15. Epicormic shoots on the boles of ash trees; A) and B) newly sprouted shoots on woodlot trees, C) at the base of the bole on a plantation-grown tree, and D) on the bole and roots of a suburban tree.

Woodpecker

Galleries/ Exit Holes

Fig. 19. The serpentine larval galleries of EAB exposed by peeling back the bark of the host tree: A) early stage gallery, B) complete gallery with larva entering pupal chamber, C) many distinct galleries under bark, and D) intermingled galleries under bark of severely infested tree.

Bark Windows

- Assists in detection of trees of concern
- Quick procedure
- Allows for wide-scale detection surveys
- Relatively poor tool for use on ‘healthy-looking’ trees

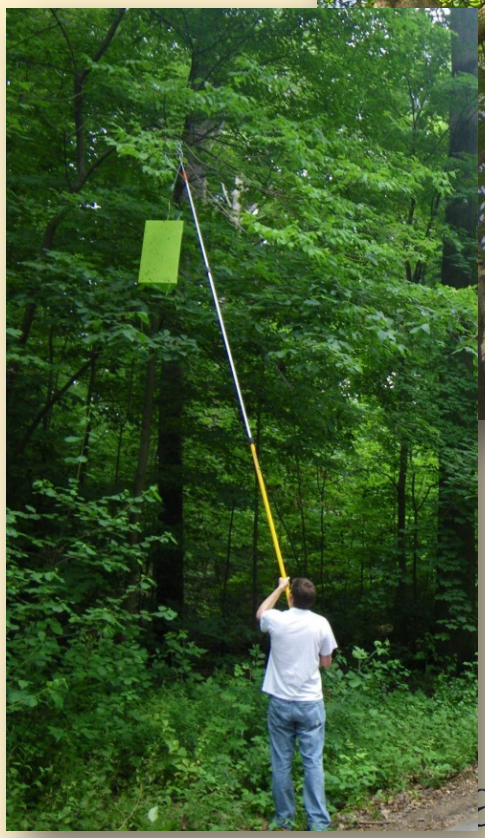
Challenges with EAB survey

- While visual surveys are relatively straightforward… It is difficult to detect new infestations until it is too late:
  - Often present for several years
  - Heavily-infested trees
- **Need** to develop sampling methods for early detection & monitoring
  - Find populations earlier
  - Buys more time and widens management & control options

Ground-based surveys – Asymptomatic trees

Trapping

- Single prism traps hung in ash trees are commonly used in US and Canada
- The baits used vary with color and design of trap, placed in top centre of trap
- Large steel hooks are used to attach trap to tree,
- Traps are checked 1 or more times throughout season (June-Aug) for presence of EAB
- Process of servicing traps and cleaning samples is messy



Purple Prism Traps

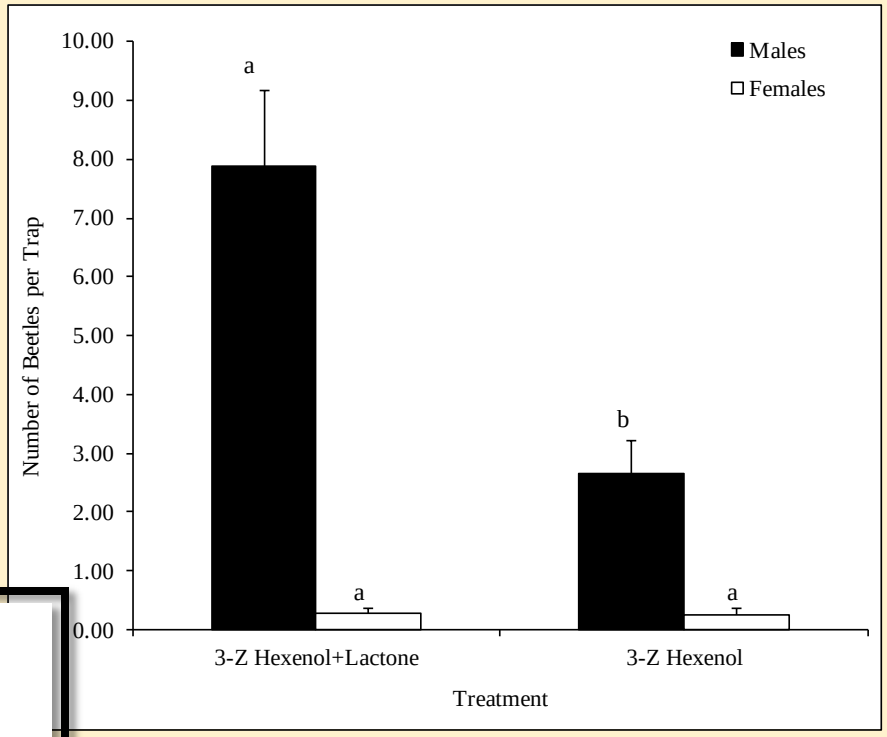
- Used in the USA
- Baited with Manuka/ Pheobe oil (smell of bark and wood)
- Double-deckers* also use green leaf volatiles (Z-3 hexenol or GLV)
- Traps placed in open (DD) or low in tree near bole

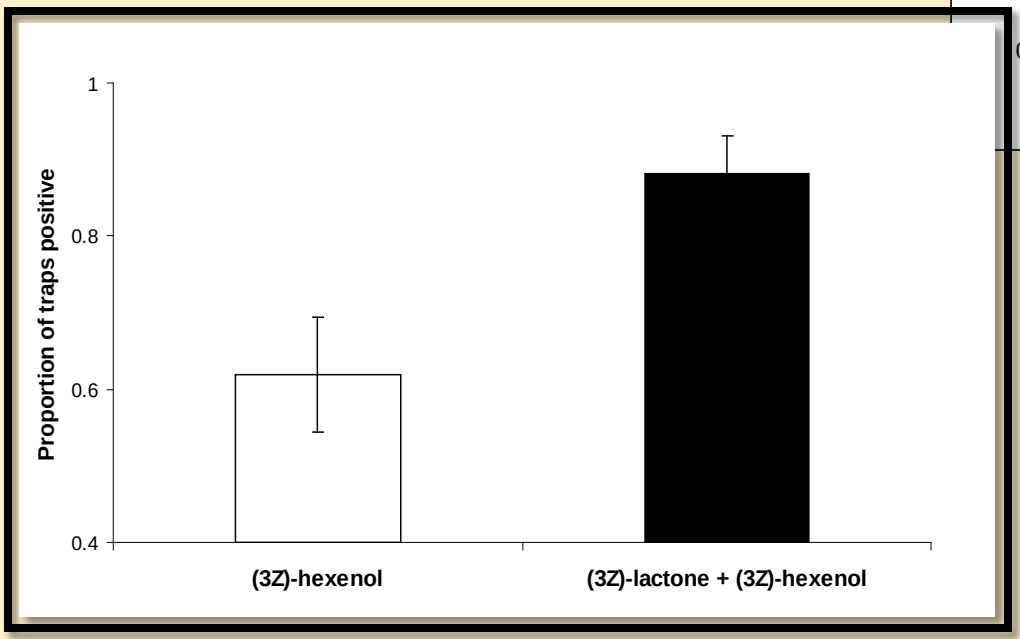
Green Prism Traps

- Use GLV (CFIA surveys)
- May also use lactone (EAB pheromone)
- Upper canopy, exposed to direct sunlight, where EAB adults are mostly like to be flying and feeding

Lactone

- Adding a 3 mg 3Z-lactone lure significantly improves capture rate and proportion of locations positive for EAB





Canada

Lindgren Funnel Traps

- Placed at varying heights in tree
- Baited with Manuka/ Pheobe oil or GLV
- Not commonly used for monitoring
- However, used for dissemination of fungal pathogens into populations of EAB (Lyons et al. 2012)

Trap Trees

- Trees are girdled to induce stress and attract EAB
- Trees examined for signs and symptoms of EAB
- Then, they are peeled to reveal larval galleries
- Sticky traps can also be deployed; EAB as well as potential natural enemy wasps can be surveyed
- Not practical for widespread use…

Branch Peeling

Sampled trees in:
•Toronto
•Pickering
•Oakville
•Sault Ste Marie
•Most with NO signs of EAB

Hypothesis

- Infestation begins in the **crown** of ash trees, on suitable branches

- Supporting evidence:
  - Within-tree distribution of bronze birch borer and two-lined chestnut borer
  - Preferences by EAB for diameter and bark thickness

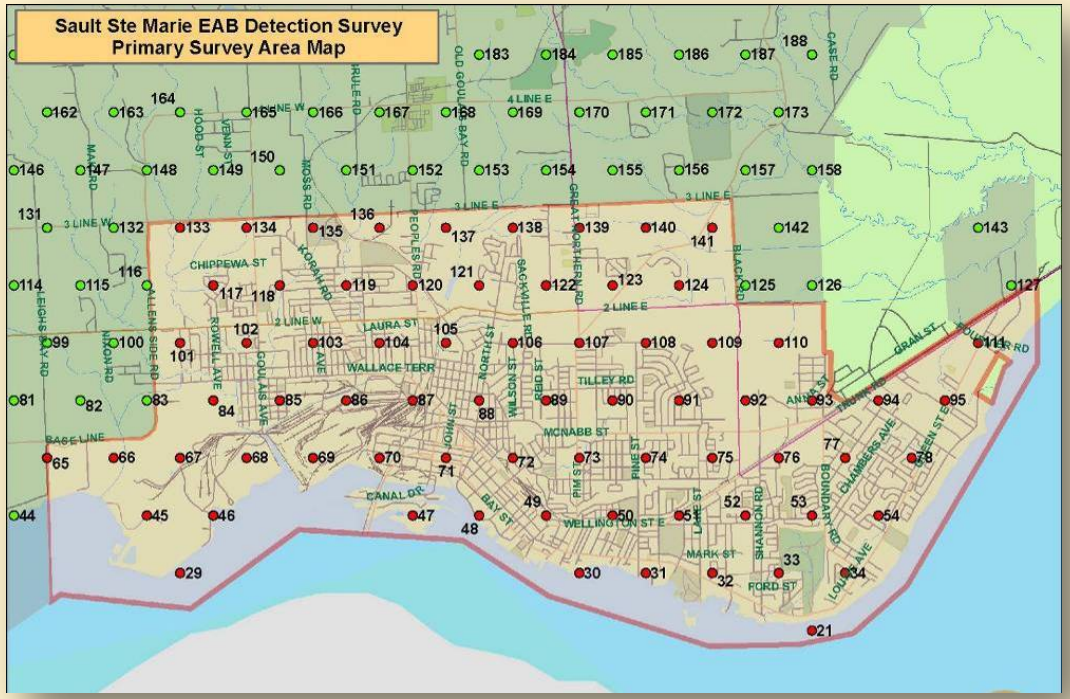
Hypothesis Supported!!

- Sampled 48 infested trees showing no signs or symptoms of emerald ash borer attack

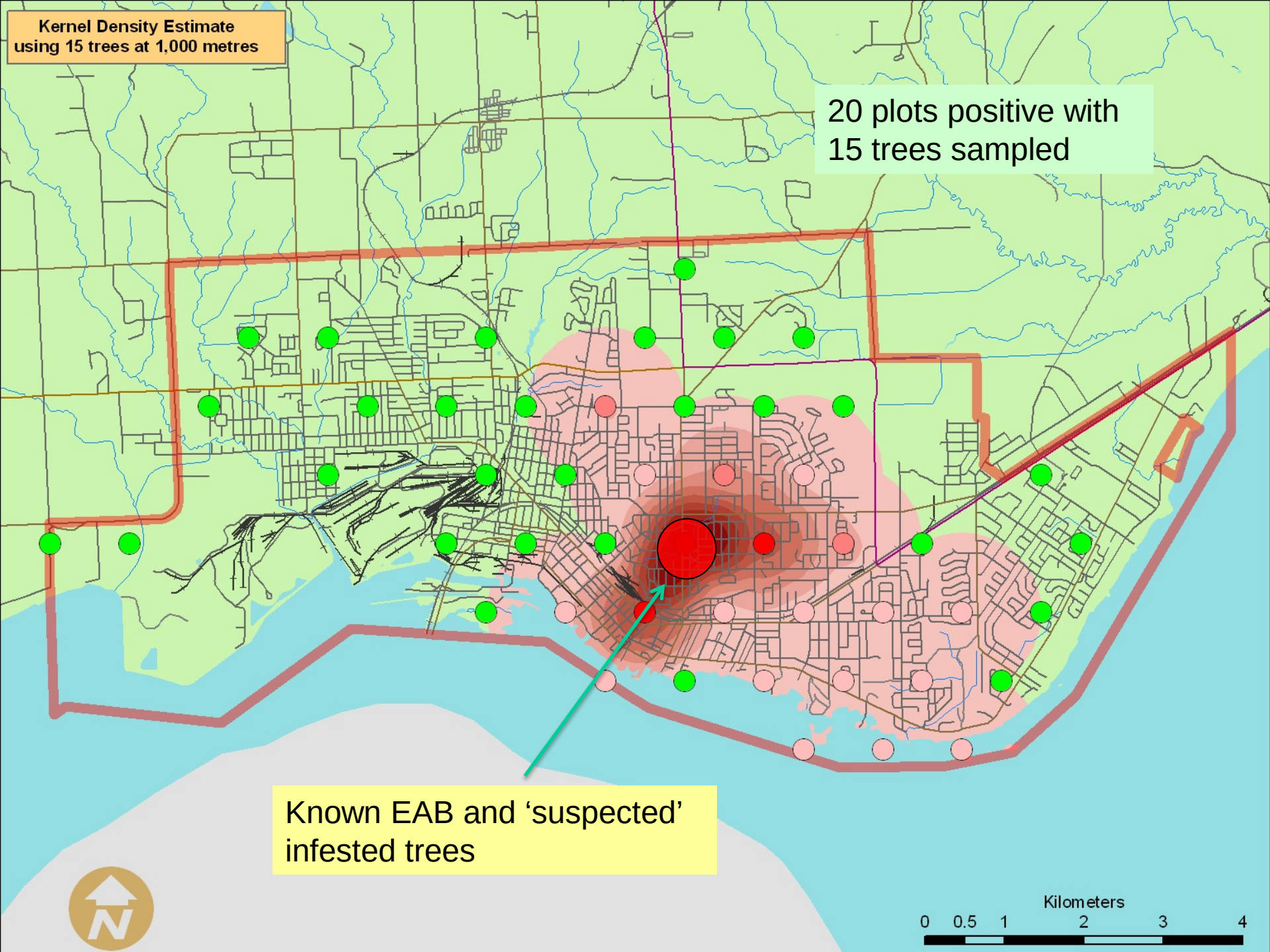
Method	# infested trees detected	Accuracy
Visual inspection	0 of 48	0
Bole window	11 of 47	23
Crown sampling	45 of 48	**94**

Deploying Branch Sampling

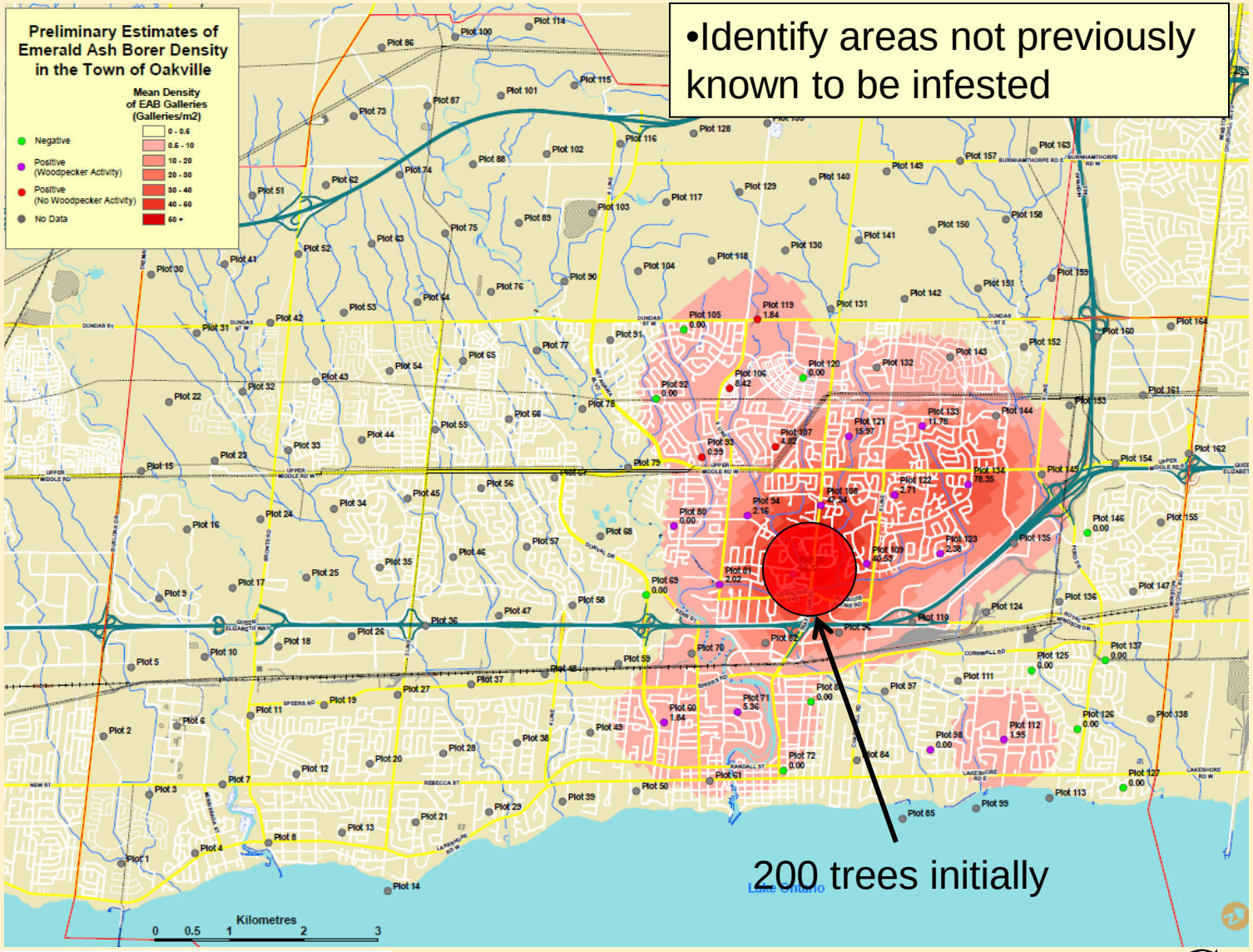
- Used grid sampling, 1-km spacing
- Sampled 5 suitable ash trees (street trees)
  - Quantified EAB gallery density
  - SSM and Oakville examples



Natural Resources Canada | Ressources naturelles Canada


Kernel Density Estimate
using 15 trees at 1,000 metres
20 plots positive with
15 trees sampled
Known EAB and ‘suspected’
infested trees
Kilometers
0 0.5 1 2 3 4

Town of Oakville



- Identify areas not previously known to be infested

200 trees initially

Peeling Procedure

Detectability of the Emerald Ash Borer (Coleoptera: Buprestidae) in Asymptomatic Urban Trees By Using Branch Samples

KRISTA L. RYALL,[1] JEFFREY G. FIDGEN, AND JEAN J. TURGEON

Canadian Forest Service, Great Lakes Forestry Centre, 1219 Queen Street East, Sault Ste. Marie, ON, Canada P6A 2E5

Environ. Entomol. 40(3): 679–688 (2011); DOI: 10.1603/EN10310

- Branch sampling method
  - Open-grown urban street trees
  - Remove 2 branches from mid-crown
  - ‘Whittle’ bark from basal 50 cm of a 75 cm long branch piece
  - 75% probability of detection
  - Detects low-density EAB infestation
  - Can be carried out with yearly pruning operations in fall

Natural Resources Canada Ressources naturelles Canada

Frontline

Forestry Research Applications

Canadian Forest Service - Sault Ste. Marie — Technical Note No. 111

Detection of Emerald Ash Borer in Urban Environments Using Branch Sampling

K. L. Ryall, J. G. Fidgen, J.J. Turgeon

The emerald ash borer (EAB), *Agrilus planipennis* Fairmaire (Fig. 1), a non-native insect pest of Asian origin, presently infests large numbers of ash (*Fraxinus* spp.) trees in Ontario and Québec and could soon spread to other provinces.

Fig. 1. Adult emerald ash borer

Fig. 2. Healthy-looking ash trees with no visible sign or symptom, but determined to be infested with EAB using branch sampling.

One of the many requirements for effective management of EAB is early detection of infestations, when densities are still low and before signs and symptoms are obvious. *Visual surveys* rely on external signs and symptoms (e.g., exit holes, larval tunnels seen through cracks in the bark, feeding by woodpeckers or squirrels) that may not be noticeable for 2 to 3 or more years after the arrival of the population, particularly if the infestation begins in the upper part of the tree. *Sticky traps* baited with an attractant have the potential to detect EAB adults in an area before signs or symptoms become visible, but may not necessarily provide information on the infestation status of individual trees.

Ryall et al. (2010) sampled many ash trees with no obvious sign or symptom of EAB attack (Fig. 2) and showed that *branch sampling* was an effective method of detecting EAB-infested trees; indeed, 74% of the infested trees would have been discovered if the method described below had been used. The purpose of this note is to describe this basic sampling technique.

Caveats

- Best for open grown trees
  - 20-40 cm DBH
  - 5-15 cm diameter branches
  - South & west aspect preferable
  - Sample top portion of branch first
- Less applicable for:
  - Smaller (<20 cm DBH) or woodlot / closed canopy trees

    (Branches may be too small)
- Detection rate lower at very low EAB density, 55%

Time / Costs

# Trees / plot	Minutes/ tree
5	48
10	31

- Supply costs: $200-3000
  - knives, drawblades, vices, bucket trucks, etc
- Our estimate: 35 minutes / tree for complete whittling
- Crew of two: minimum 100-120 trees per work-week
- More efficient to sample more trees per plot (?)
- 13-19 minutes for first detection
  - Stop whittling after first detection to save time (?)

Questions?

Thanks to:

Jozef Ric, Dusanka Stojanovic-Djordjevic
Jason Doyle, Steve Matsumoto
Scott McKay, Ben Gasman, Mary Orr
John McNeil, Rick Lipsett
Hugh Evans, Laura Fidgen, Chuck Jones,
Al Keizer, Roger Scharbach, Ron Fournier
Taylor Scarr, Pat Hodge, Eric Cleland,
Ed Czerwinski, Susan McGowan

City of Toronto, Oakville, Pickering,
Burlington, Brantford, Sault Ste Marie
CFS OMNR CFIA

Detection survey research (Legg et al.)

- Model output:
  - # trees to sample for various probabilities of detection
  - *Stop sampling when first infested tree is found
- RANDOM selection of trees for sampling
- Tested in several municipalities

5,000 Tree Population				
Infestation	0.50%	1%	2%	4%
Prob>X	5K	5K	5K	5K
60	180	100	45	25
70	230	130	45	30
80	320	165	80	40
90	450	230	120	60
95	>500	305	150	80
99	>600	460	250	120

Sample up to 150 trees for 95% probability of detecting of infestation, or 3% of total number of trees