SLAM: A Strategy to SL.ow A.sh M.ortality Caused by Emerald Ash Borer

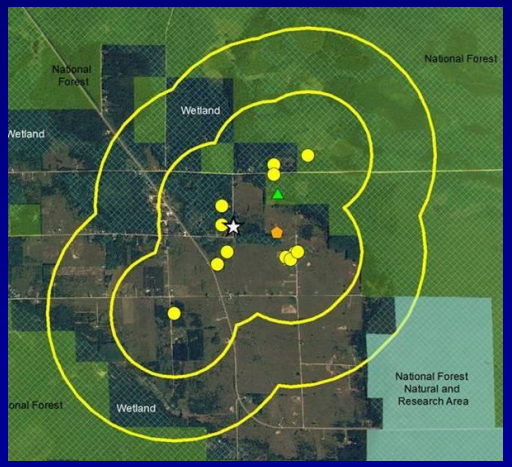
Dr. Deborah G. McCullough
Dept. of Entomology & Dept. of Forestry
Michigan State University

Dr. Rodrigo Mercader
Dept. of Biology, Washburn University

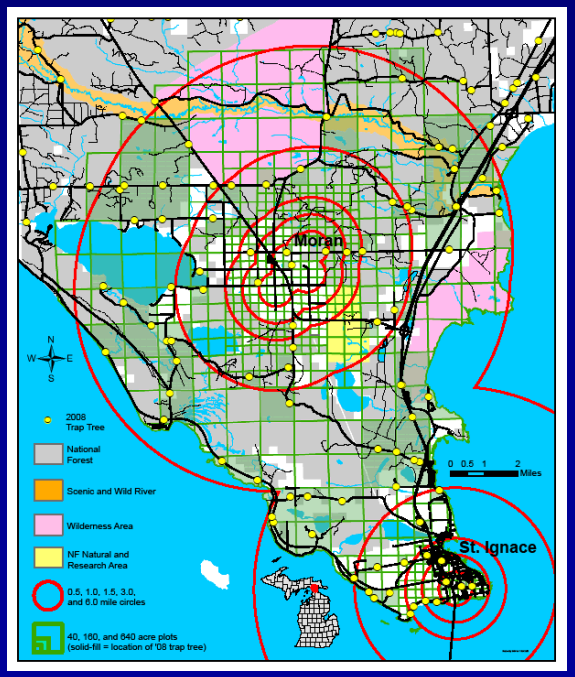
SLAM Pilot Project – Moran & St. Ignace

- Fall 2007: EAB outlier site was identified when a girdled tree was debarked near Moran, MI. Delimitation survey identified 13 trees with low larval densities with 0.5 miles.
- A single infested tree was found in 2007 at St. Ignace.

Moran - 2007



2009 Project Area



SLAM Pilot Project Cooperators

Michigan State University

Michigan Tech University

MI Dept. of Agriculture

MI Dept. Natural Resources

USDA Forest Service – NA Forest Health Protection; Northern Research Station; Hiawatha NF

USDA APHIS

Funding: Forest Service, ARRA

SLAM EMERALD ASH BORER SLOW ASH MORTALITY PILOT PROJECT

SLAM = SL.owing A.sh M.ortality

Goals: Reduce the rate of EAB population growth to delay the onset & slow the progression of widespread ash decline & mortality.

Develop, implement & evaluate an integrated strategy appropriate for individual sites.

Focus is on the **ash resource** (*not SLEAB*!)

Tactics to suppress EAB population growth

- Girdled & debarked ash trees function as "sinks."
- Systemic insecticide treatment (emamectin benzoate): TREE-äge® applied as a trunk injection provides nearly 100% control of EAB adults & larvae for up to 3 years.
- Ash utilization: Timber harvests reduce phloem available to EAB & provide value to landowners.

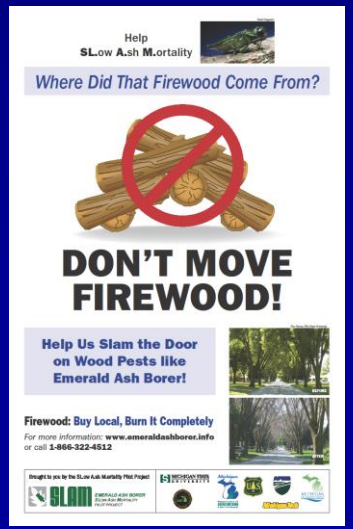
Tools: Outreach & Regulatory Efforts

Raise awareness of EAB & the SLAM program; build support for SLAM (residents, landowners, tourists, tribes)

Reduce potential transport of infested ash firewood by residents & tourists

Inform residents, stakeholders, tourists about regulations. Encourage local ash utilization.

SLAMEAB.info website

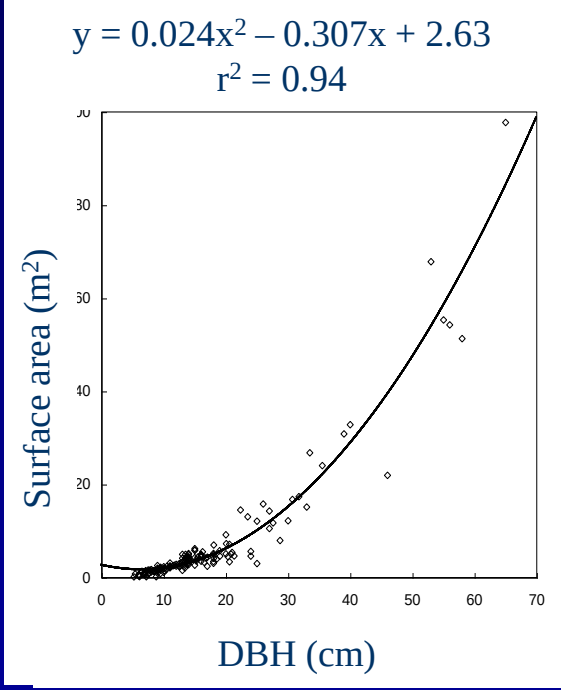


Tools: Intensive Surveys - 390 km^2 project area

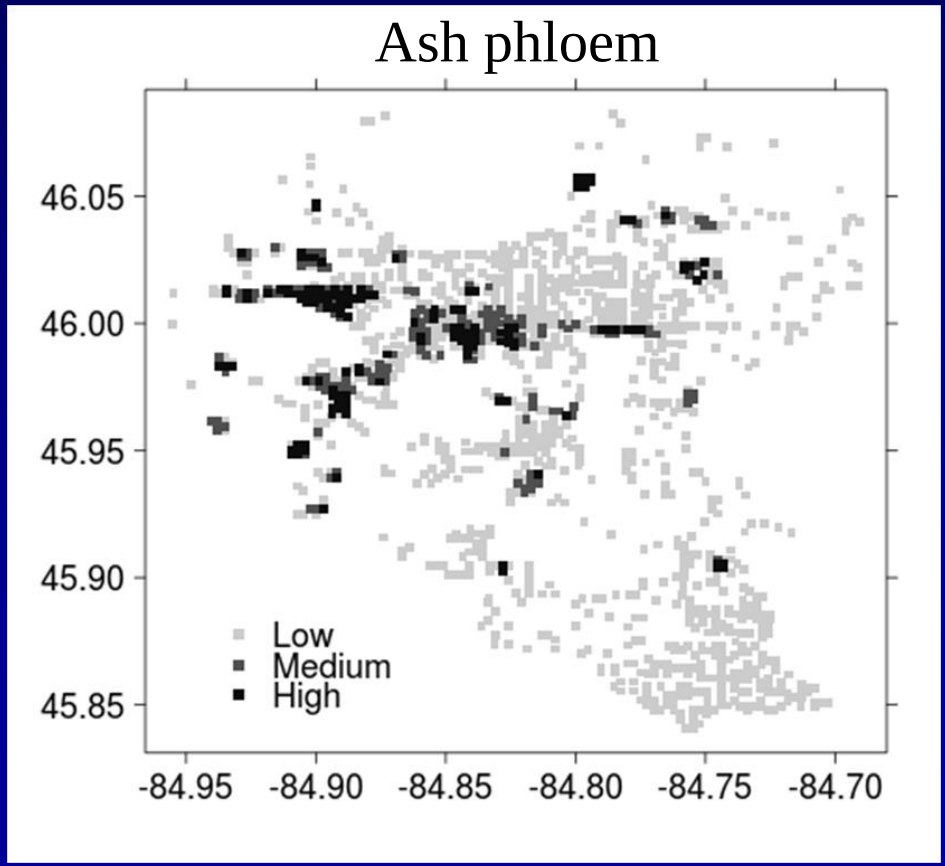
A. DTs: Girdled ash Detection Trees debarked in fall to assess EAB distribution, density & development.
B. ATs: Artificial Traps (APHIS baited purple prisms in ash canopies) supplemented DTs.
C. Ash inventory: distribution & size of ash trees tallied in forested, rural & urban areas.

Tools: Ash Inventory & Ash Phloem Model

Extensive inventory of ash across the project area in 2010 & 2011. Inventory data & ash phloem model were used to calculate & map ash phloem for each grid cell.



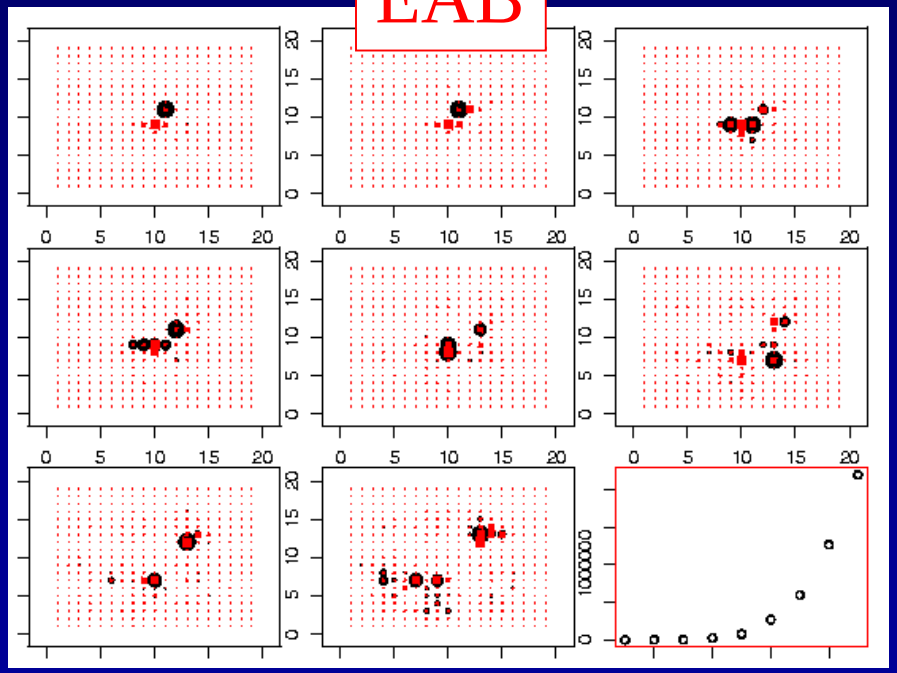
McCullough & Siegert. 2007. J. Econ. Entomol.



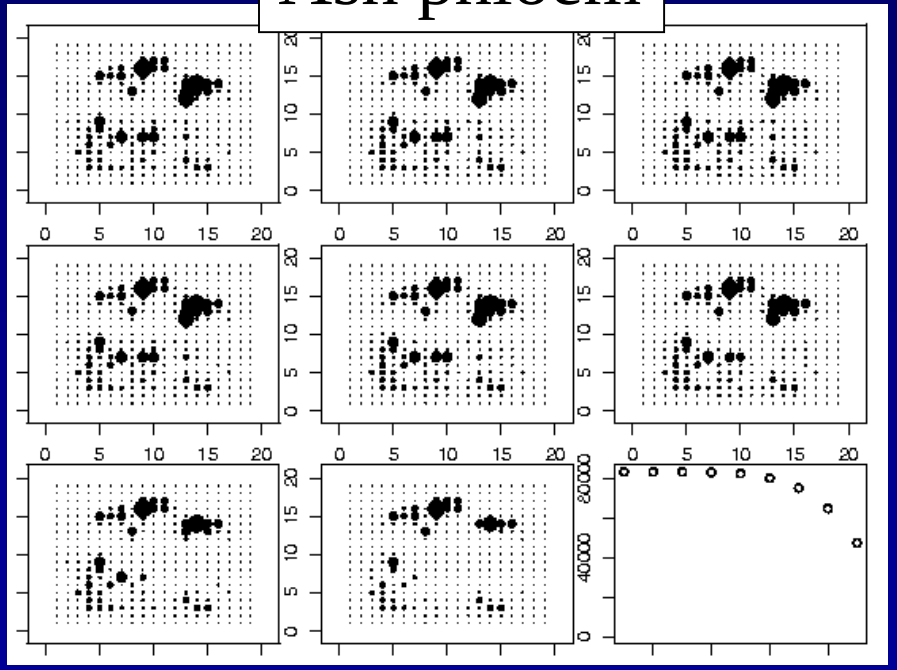
Tools: Coupled Map Lattice Model

1. Adult EAB disperse
2. Adults reproduce (1 & 2-year cohorts tracked)
3. Phloem is consumed by larvae
4. EAB population grows

EAB



Ash phloem

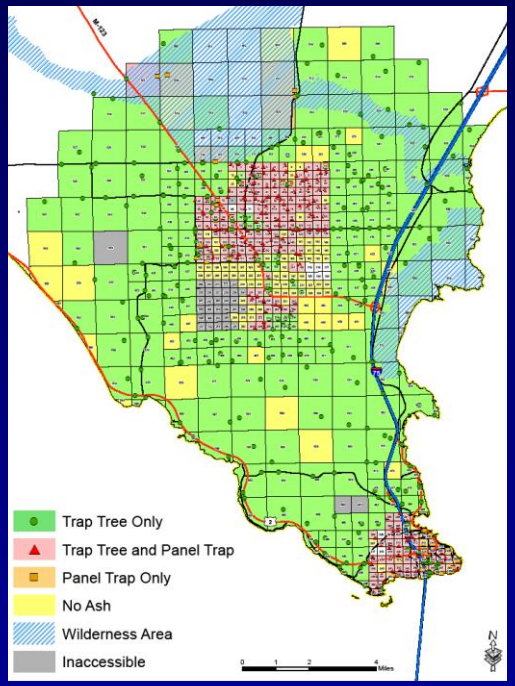


Mercader et al. 2011. CJFR; Mercader et al. 2011. Pop. Ecol.

Systematic trap grids (DTs, ATs or both) were established in a 6 mile radius around known infested trees annually.

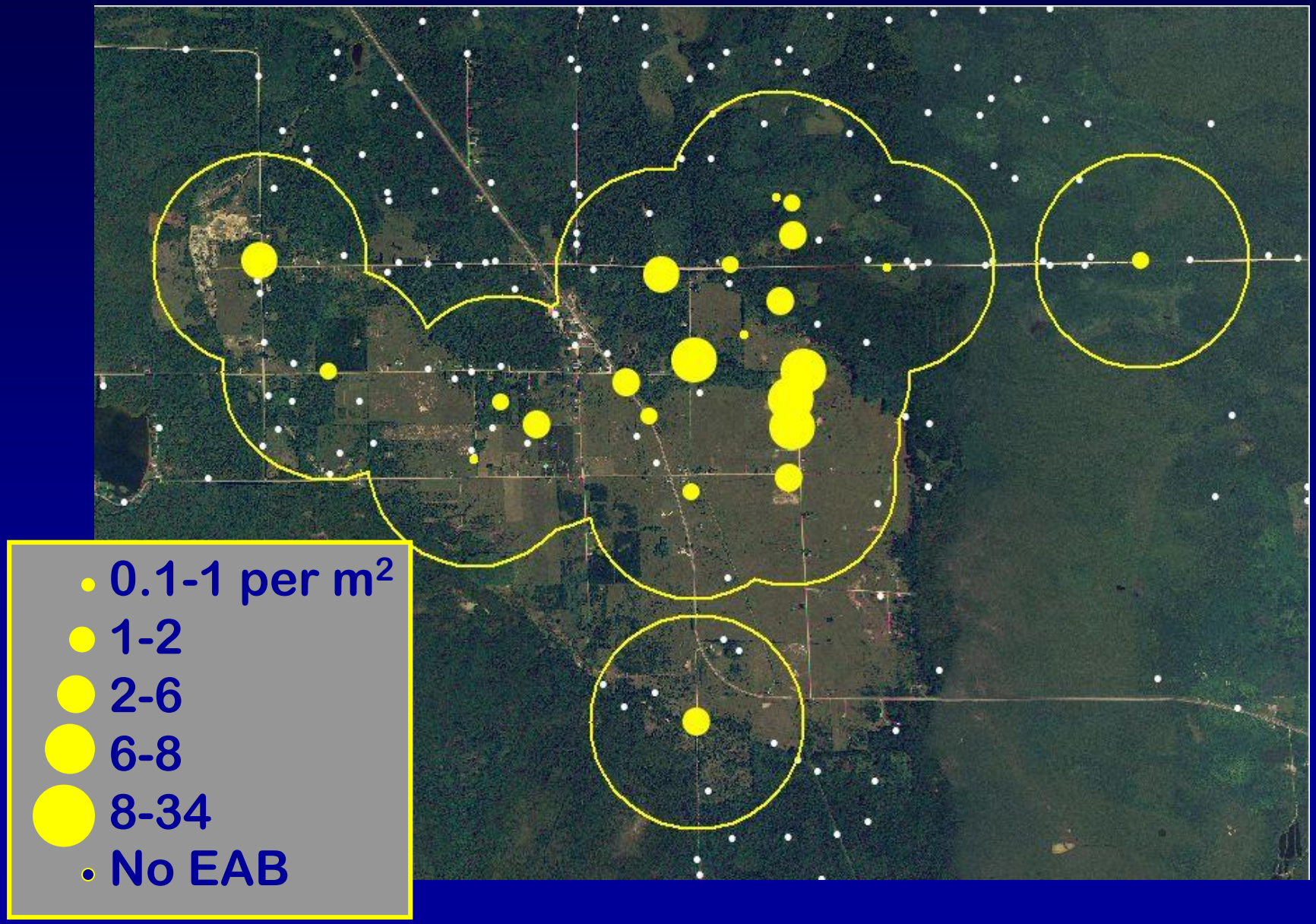
1 trap per 40 acres	≈1-2 miles
1 trap per 160 acres	1-3 miles
1 trap per 640 acres	3-6 miles

Number	2008	2009	2010	2011
DTs	444	603	748	855
ATs	229 (171)	331 (99)	475 (0)	480 (0)

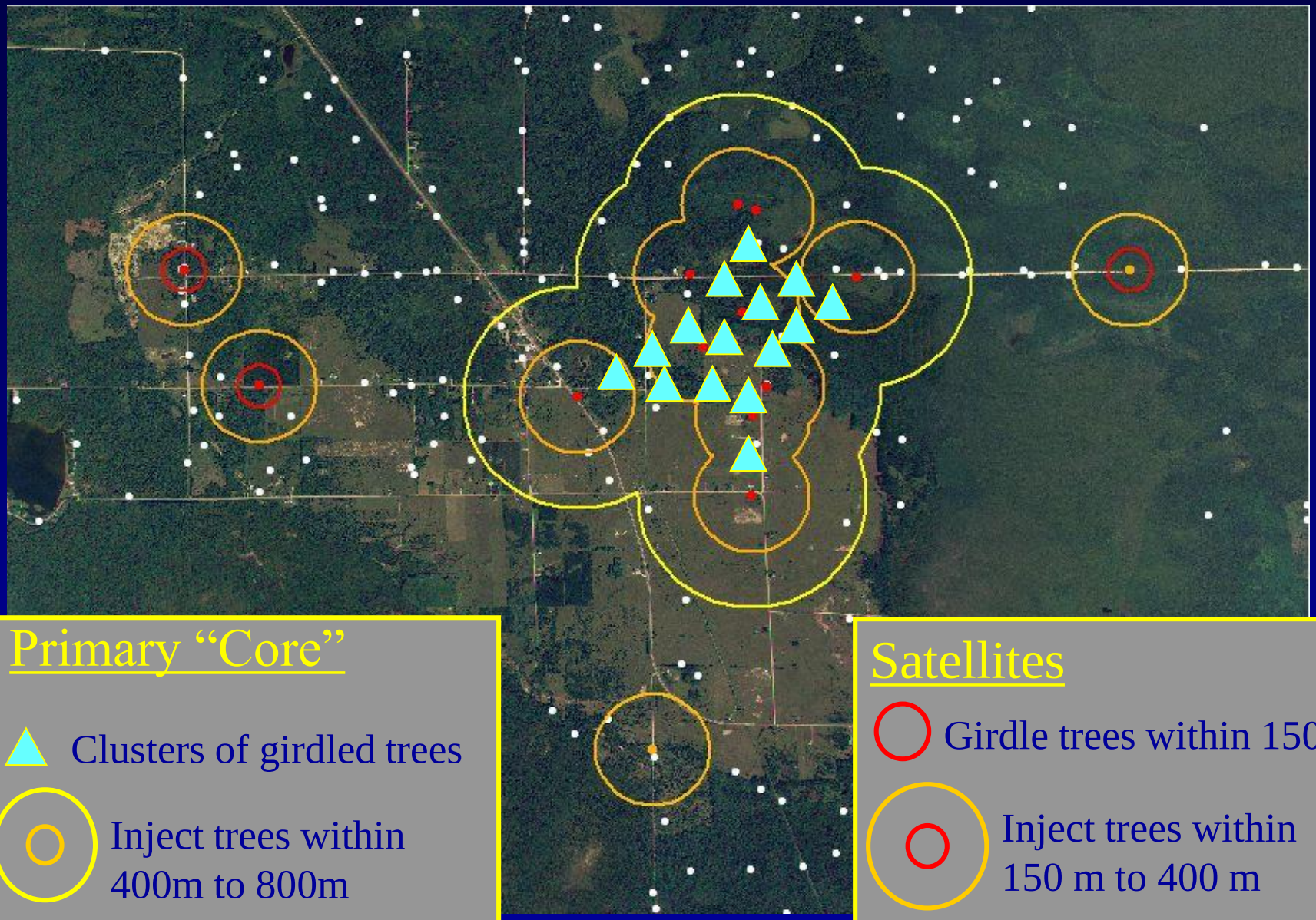


Project Area: > 390 km^2

Moran: 2009 larval counts from DTs plus 800m buffers



Proposed Treatments for 2009 (but not realized!)



Primary "Core"

Clusters of girdled trees

Inject trees within 400m to 800m

Satellites

Girdle trees within 150m

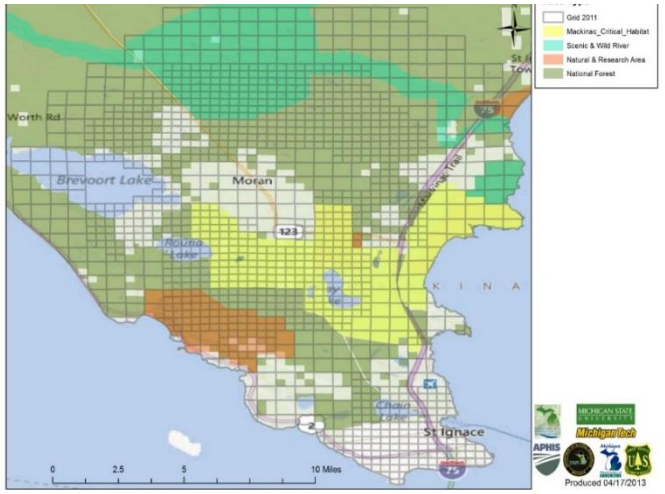
Inject trees within 150 m to 400 m

Insecticide use in the SLAM Project area was limited by:

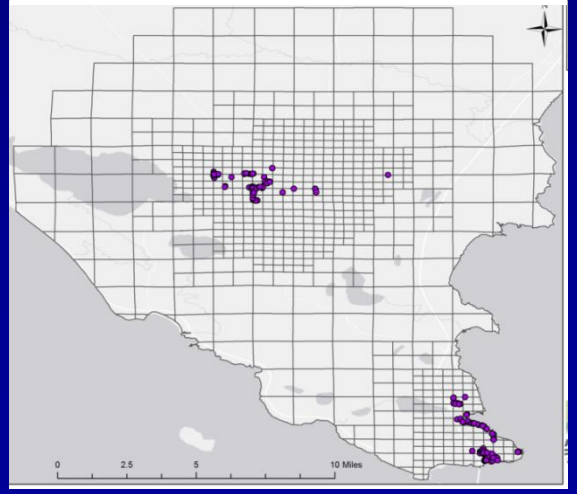
(1) Hiawatha National Forest
(2) HNF Wilderness area & (3) HNF Research Area
(4) Endangered dragonfly habitat (expanded in 2009)
(5) Wild & Scenic River corridor

Most treated trees were on right-of-ways along roads.

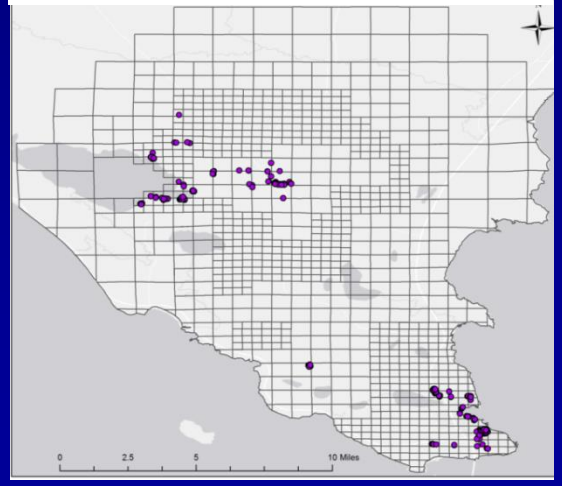
Protected areas



2009: 229 trees

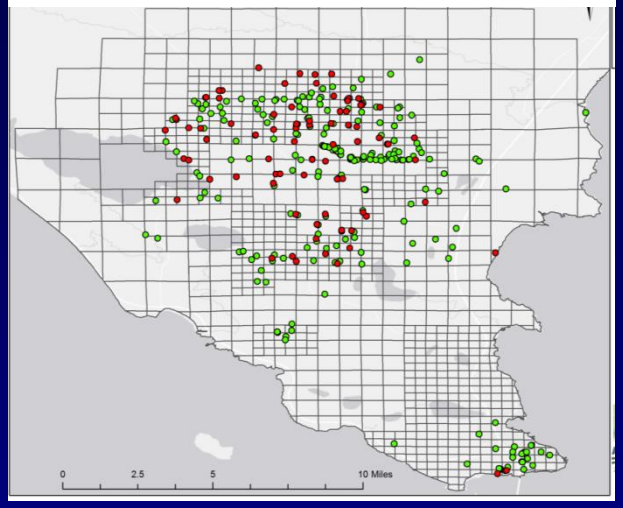


2010: 358 trees

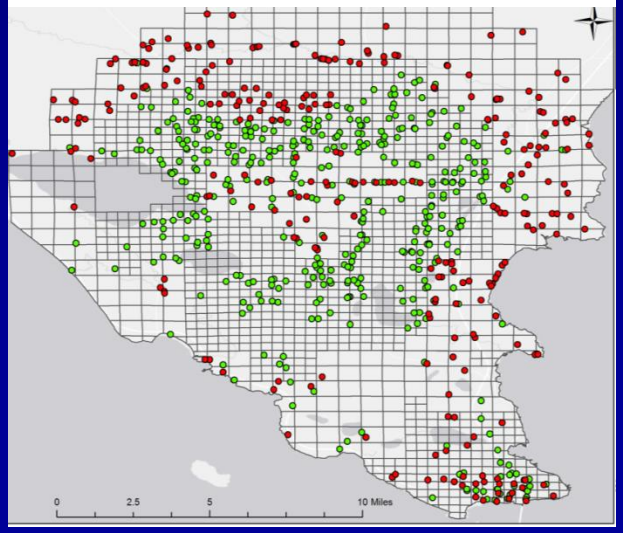


Positive DTs & ATs

2010

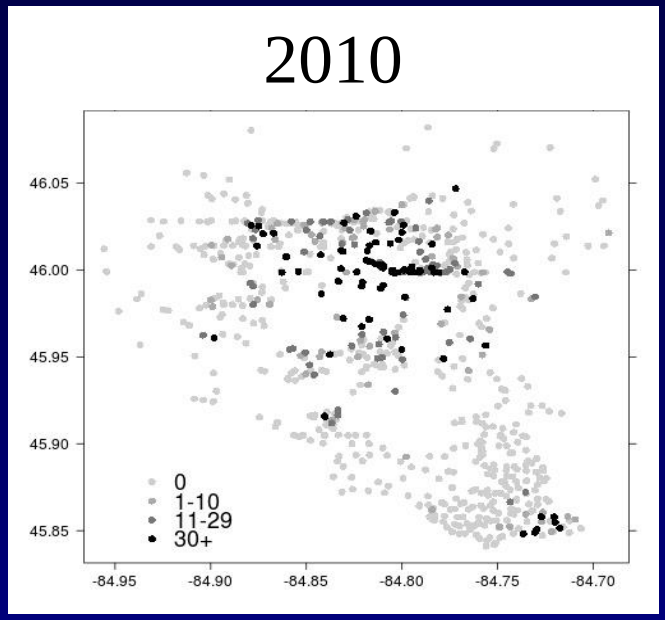


2011

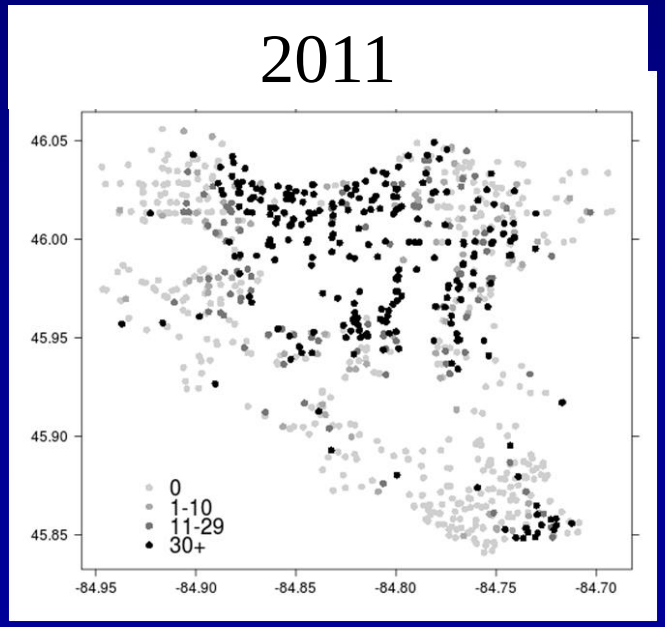


Larval Counts in DTs

2010



2011



Results from SLAM Pilot Project

McCullough et al. 2015. Can Entomol. 147: 349-358.

McCullough. 2015. SLAM. EAB University Webinar
www.emeraldashborer.info

McCullough & Mercader. 2012. Int. J. Pest Manage. 58: 9-23

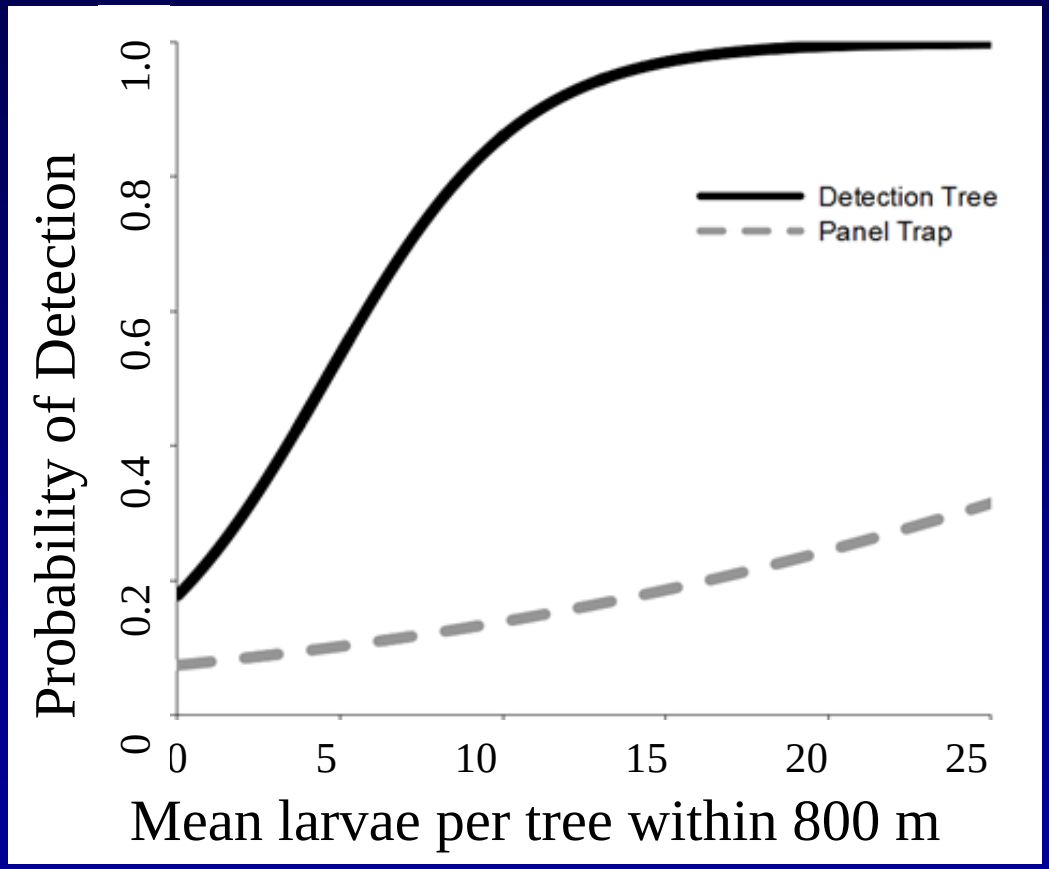
Mercader et al. 2016. Forest Ecol. Manage. 366: 87-97.

Mercader et al. 2015. Forest Ecol. Manage. 350: 70-80.

Mercader et al. 2013. Environ. Entomol. 42: 1027-1039.

Mercader et al. 2012. J. Econ. Entomol. 105: 272-281.

Girdled ash Detection Trees were much more effective than baited Artificial Traps.

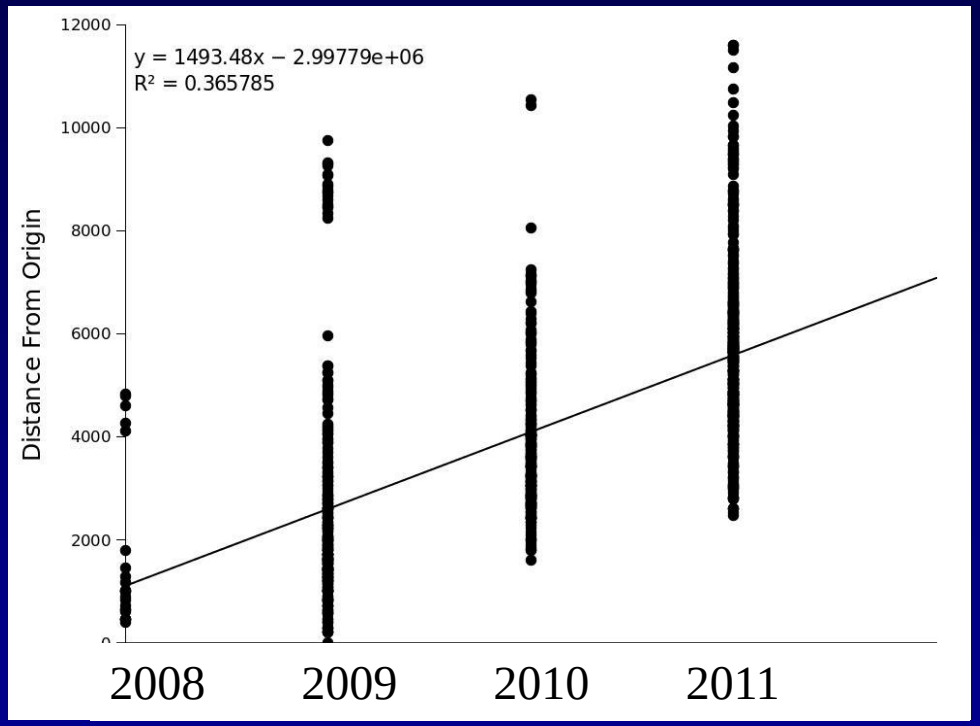


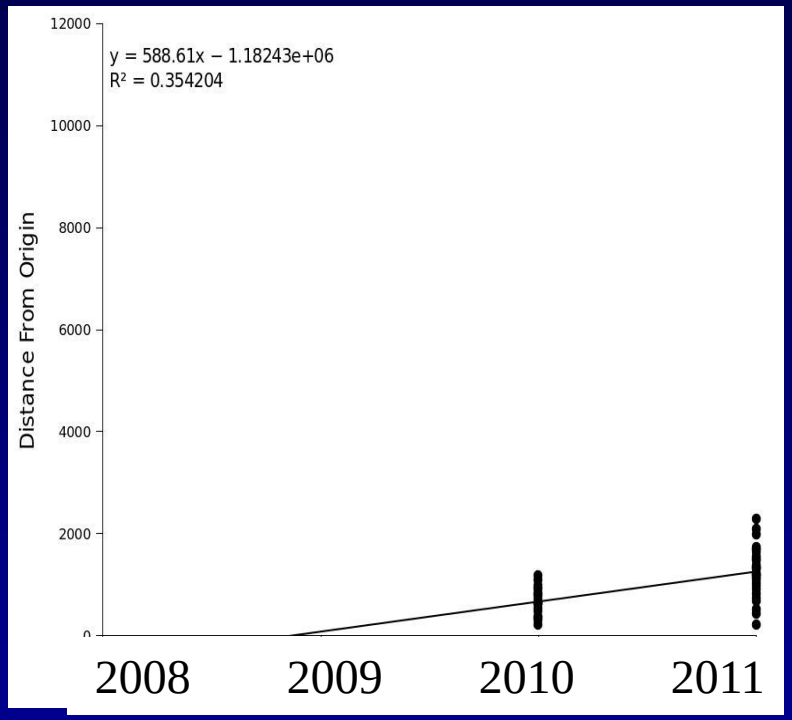
Mercader et al. 2013. Environ. Entomol.

Estimated rates of EAB spread

Moran: 1.50 -1.75 km per yr

St Ignace: 0.58 km per yr





The larger Moran infestation likely became established earlier than the St. Ignace infestation, or more EAB were originally introduced, or both. Infestations merged in 2010.

Mercader et al. 2016. For. Ecol. Manage.

Key Result: TREE-äge injections slowed EAB population growth

Effects of insecticide treatment persisted at least 2 years.

- 2010 injections slowed EAB population growth in 2011
- 2009 injections slowed growth in 2010 & in 2011

Number of treated trees was significant (P=0.009).
Area of treated ash phloem was not (P=0.21).

Insecticide treatment did not exert a detectable effect on spread of the infestation.

McCullough et al. 2015. Can. Entomol.
Mercader et al. 2015. For. Ecol. Manage.

Key Result: Sinks (girdled & debarked ash trees)

Sinks reduced EAB population growth the following year but the effect did not persist for 2 years.

Number of sinks reduced population growth (P=0.015).

Sinks had a small but detectable effect on EAB spread. Effect depended on the proportion of ash phloem in a grid cell that was in girdled trees & on EAB density.

Interactions were significant; Sinks attract EAB & larval counts on nearby trees can increase (spillover effect).

Lessons Learned…

- Treat as many trees as possible with TREE-äge to slow EAB population growth. This insecticide remains effective for up to 3 years.

- Treating *more* trees has a greater effect on slowing EAB population growth than selectively treating *large* trees.

- Insecticide treatments did not slow EAB spread. Long distance EAB dispersal behavior & cues that trigger dispersal not well understood.

(Mercader et al. 2012; Env. Entomol.)

- Treating trees with TREE-äge retains ecological services provided by mature trees & can protect future seed source.

Lessons Learned…

- Heavily infested ash trees should be removed, ideally before high densities of EAB adults can emerge.

- Ash utilization can provide value for landowners. Merchantable trees (>12 inch DBH) represent a small portion of the ash resource in forested settings but produce a high proportion of the EAB.

- Simply removing ash trees, however, is not a SLAM strategy. Ash removal had a small effect on EAB population growth & eventually increased spread rates.

- Combine ash removal with other tactics (sinks, TREE-age)

Lessons Learned…

- Girdled ash trees are highly attractive to EAB in low density sites & are the most effective detection tool.

- Choose small (4-8 inch DBH) trees for detection trees. Small trees can be efficiently girdled & debarked.

- Debarking girdled ash trees in low density sites:
  (1) Provides useful data on EAB density & development
  (2) Kills larvae on those trees, slowing population growth
  (3) Retains beetles in the area, slowing spread

- Coupling girdled trees with "toxic trees" should be highly effective.

Acknowledgements

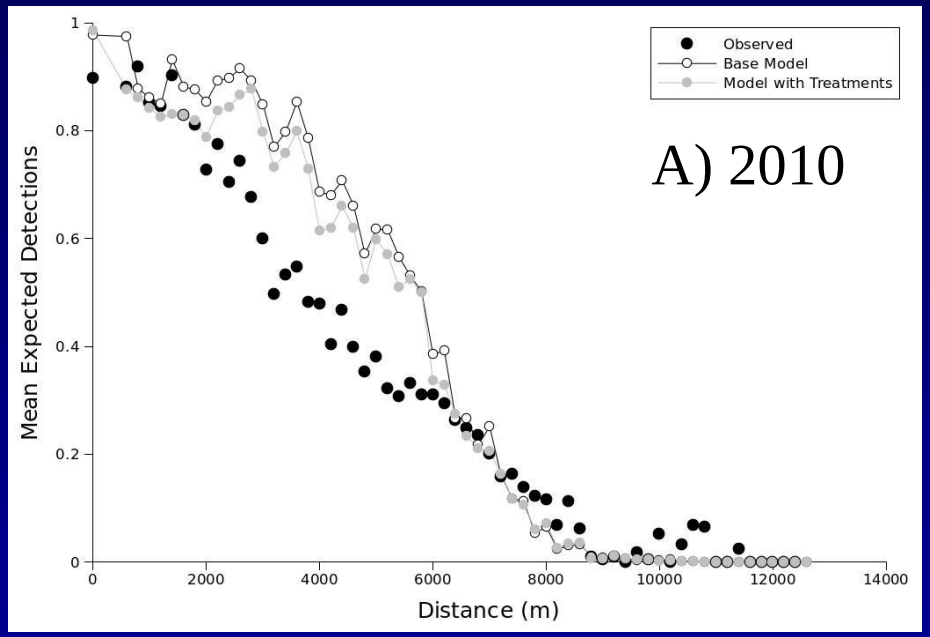
SLAM Management Board: John Bedford, Bob Heyd, Steve Katovich, Deb McCullough, Brenda Owen, Therese Poland, Andrew Storer, Amos Ziegler

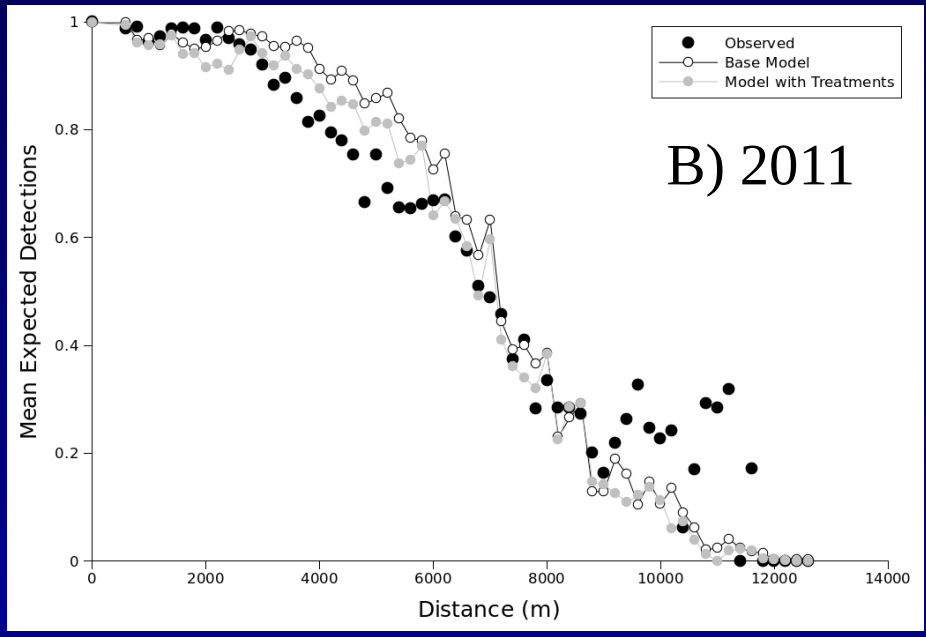
Also thanks to Gabriel Carballo, Noel Schneeberger, Travis Perkins, Anne Collins, Nate Siegert, Ken Rauscher, Jean Perkins, Sandy Liebhold, MDA inspectors, the survey crews, & media people in the UP.

Funding: US Forest Service NA FHP & ARRA




Strong fit between our simulation model & EAB distribution in Moran (r^2 = 0.937). Including treatment effects improved the fit. Fit was shaky near the edge of the project area (very low EAB density = low detection ability).





Model allowed us to compare predicted versus observed EAB population growth & spread

Mercader et al. 2016. For. Ecol. Manage.