What's Under the Bark?

Forest Insect Research in Michigan

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Special thanks to:

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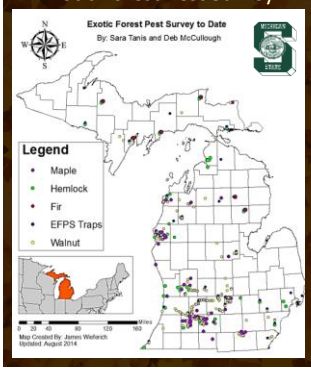
MDARD: Mike Philip, John Bedford

US Forest Service: Therese Poland

MI Dept. Natural Resources: Bob Heyd

2013 Michigan Exotic Forest Pest Survey



Exotic Forest Pests

- Cost more than $4 billion annually
- Homeowners and governments bare the cost

Michigan Forests are Important

- Ecosystem Services
  - Energy, property value, carbon sequestration
- Food Source
  - Wildlife and people
- Cultural value

Why survey for exotic forest insects?

- Small populations go unnoticed
- Populations take time to build
- Hard to predict
- Difficult to eradicate

Early Detection…

Rapid Response

Forest Insect Invasion is a 3-step process

1. Arrive = Introduction
   Foreign and domestic pathways; Countered by regulation, quarantines, detection at ports and borders.
2. Survive = Establishment
   Suitable hosts, climate and adequate numbers of colonists needed to ensure reproduction; Countered by detection surveys, eradication or insect/forest management.
3. Thrive = Invasive-ness
   Populations increase, spread and cause damage. Economic and ecological impacts accrue.

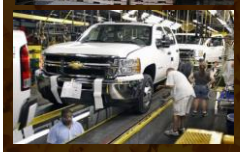
How do they get here?

Exotic insects may hitch a ride with…

- Wood packing material
- Nursery Stock
- Little old ladies
- People *who know better* e.g. firewood and collectors

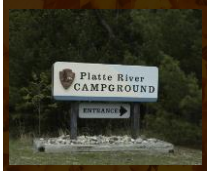
Foreign pathways: Wood crating, pallets and dunnage can introduce non-native phloem- and wood-borers into North America.


Container ship



Michigan is a major manufacturing center; import tons of materials.

Domestic pathways: Non-native woodborers and bark beetles established in other states or Canada can be accidentally introduced into Michigan via firewood, logs and nursery stock.



The Key Players: People

APHIS

U.S. Customs and Border Protection — U.S. Department of Homeland Security

Michigan Department of Agriculture & Rural Development

Our focus:
Other areas in Michigan at high risk for introductions and establishment of invasive forest insects (e.g. campgrounds and sawmills)

The Key Players: Insects

"Those who do not learn from history are doomed to repeat it." George Santayana

Subcortical Insects
Larvae live under the Bark

Phloem-borers

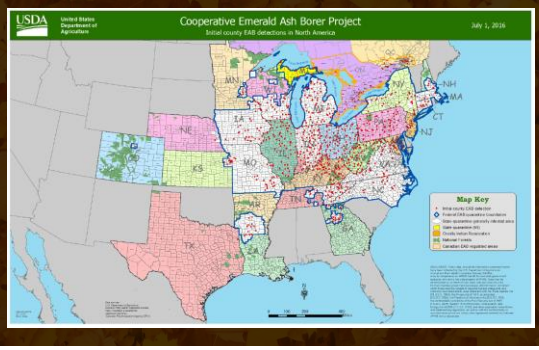
Subcortical Insects
Larvae live under the Bark

Wood-borers

Emerald Ash Borer - EAB
Agrilus planipennis Fairmaire

- Discovered in 2002, Michigan
- Native to Asia
- A specialist: attacks only ash trees
- Larvae - phloem-borers
- Most Destructive Exotic Forest Pest to Invade North America!

EAB Infestations in 27 States, Ontario and Quebec
July 1, 2016



Emerald Ash Borer

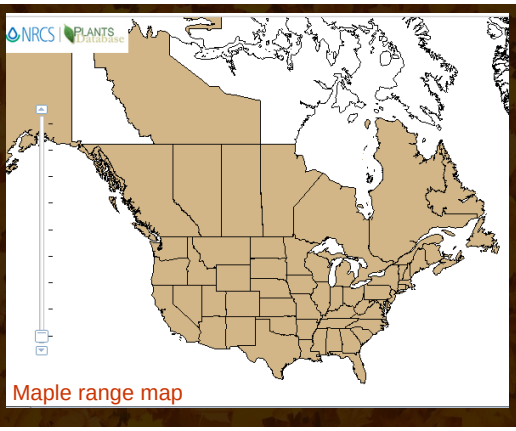
- 8 billion forest ash trees in the United States
- 37.9 million on suburban land
- Tens of millions of dead ash trees in Michigan
- $10.7 BILLION US – for tree removal, not replanting

What are we looking for??

1. Asian Longhorned Beetle - ALB

Anoplophora glabripennis Motschulsky

- Native to East Asia
- Arrived in New York - 1996
- A generalist:
  - Hosts: 12 genera, 50+ species
  - Major concern: Maple
    - Wood
    - Syrup
    - Ecosystem Services
- Current Infestations:
  - Massachusetts, New York, Ohio



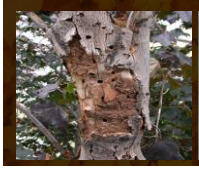
Maple range map

Current ALB distribution map

Massachusetts, New York, Ohio

Asian Longhorned Beetle

- Larvae are wood-borers
- Trees fall on houses, cars, people!
- If ALB "gets out" - $650 BILLION DOLLARS
  - Let me restate that… $650,000,000,000.00



Signs of ALB Infestation:

- Canopy dieback
- Dime sized exit holes
  - Don't be fooled by tap scars
- Oviposition scars

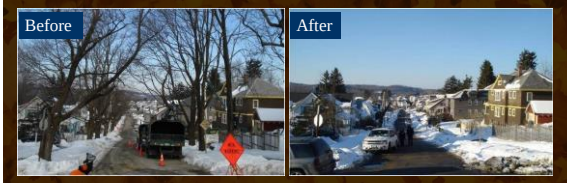
Asian Longhorned Beetle
What are we doing about it?

- Federal Quarantine
- Eradication
- Insecticide treatments
- Success
  - Chicago, New Jersey, Toronto?
- Surveys
  - New ALB pheromone lure
  - Forests and warehouses

ALB has been found in warehouses in ALL OF THESE STATES!!! California, Florida, Illinois, Indiana, Maine, Michigan, North Carolina, New Jersey, New York, Ohio, Pennsylvania, South Carolina, Texas, Washington and Wisconsin

Asian Longhorned Beetle Infestations

- Eradication (removal of infested trees) can be successful but it's painful for residents and landowners
- Early detection is critical for minimizing impacts of ALB and eradication efforts.



Worchester, MA residential neighborhood
before and after ALB eradication

2. Walnut twig beetle – WTB/TCD

Pityophthorus juglandis Blackman

- Native to Western North America
- 2010, Knoxville, TN – first time within the range of black walnut
- Insect/Disease complex, WTB vectors Thousand Canker Disease

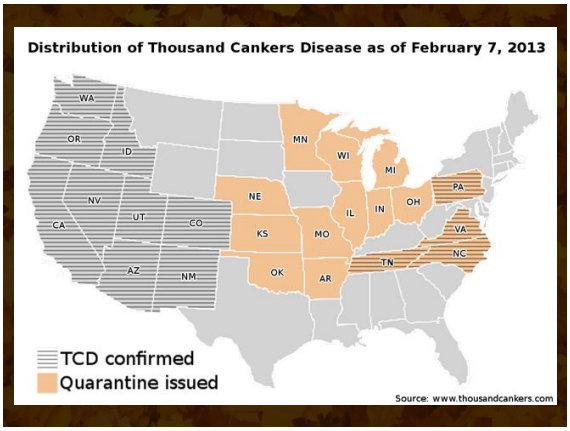
Walnut twig beetle – WTB/TCD

Economic loss:

- Landscape trees,
- Lumber – furniture, wood turning
- Nuts

Walnut twig beetle signs & symptoms

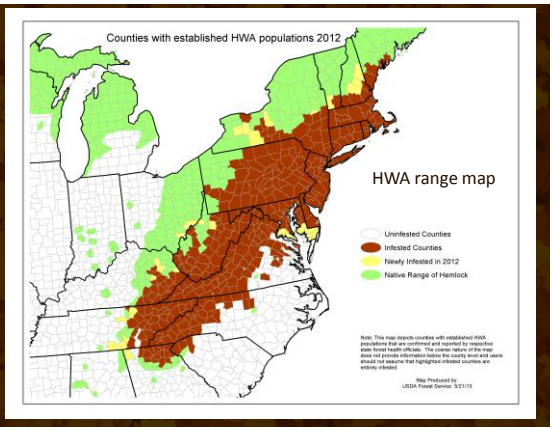
- Wilting branches
- Canopy dieback
- Cankers
- Exit holes



3. Hemlock Woolley Adelgid

Adelges tsugae Annand

- Native to Western North America and Asia
- Sap suckers
- Threaten Eastern Hemlock trees



May 12, 2015 – successful HWA eradication from Ottawa County – nursery stock planted in 2013

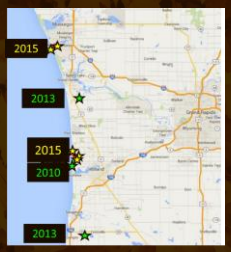
June 2015:
HWA infestations identified near Holland, MI on nursery trees planted in 2001 – further investigations discovered infestations on native hemlocks

Current Challenges

HWA detection and delineation - critical but difficult
- Where are the hemlocks?
- HWA distribution patchy and highly variable

Funding for surveys and treatment/eradication?
- USFS - "fire borrowing"
- State funding – questionable

Failure to eradicate new infestations provides HWA access to areas where hemlock is most abundant.

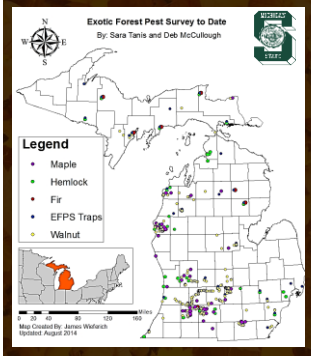


HWA infestations were reported by people who were paying attention!

Groundskeepers

Arborists

2013 Michigan State University Exotic Forest Pest Survey



Hemlock woolly adelgid

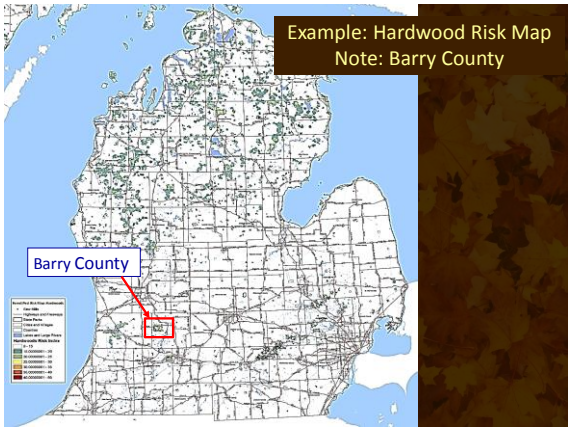
1000 canker disease

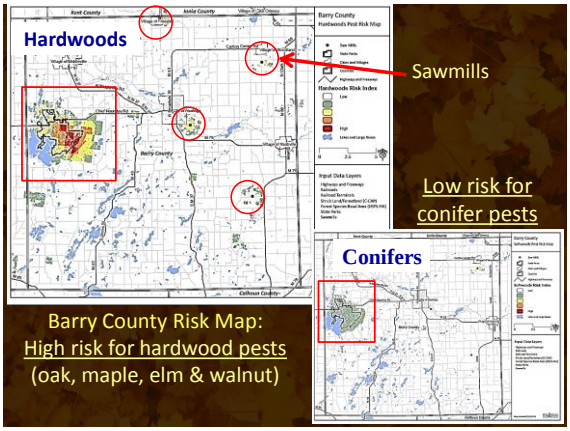
Asian Longhorned Beetle

Michigan is a big state… how did we pick our sites?

Risk Maps: developed for Hardwoods and Conifers using GIS and multiple data sources

Risk Factors taken into account:
- Forest cover type / dominant trees
- Campgrounds, recreation areas, attractions
- Number and origin of visitors
- Nurseries: import and export
- Sawmills (diverse species; high volume)
- Railroad switching yards and major highways





We focused specifically on:

1. Cerambycids = longhorned beetles
   ALB, Spruce LHB, etc.

Anoplophora glabripennis

We focused specifically on:

2. Buprestids = metallic woodborers
   Oak splendor beetle, gold spotted oak borer

Agrilus biguttatus

We focused specifically on:

3. Scolytinae = bark beetles and weevils
   Walnut twig beetle, European elm bark beetle, etc.

Pityophthorus juglandis

Focused specifically on:

4. Siricids = horntails

Sirex noctilio

How did we catch them?

- 101 Lindgren funnel traps
- 235 cross-vane panel traps

Funnel trap

WTB trap

Panel trap

Lures – we bait the traps with something that "smells" good – host volatiles, pheromones, ethanol

Therese Poland, USFS

Lures for Conifer sites (pine, spruce, fir)

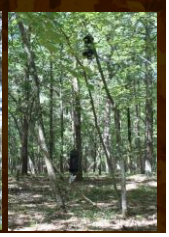
1. Ultra high release (UHR) a-pinene + ethanol + frontalin
2. 3R hydroxy hexane-2-one + 2R3R-hexanediol + UHR ethanol
3. Monochamol + UHR a-pinene + ipsenol
4. Fuscamol + a-pinene + ethanol
5. Ipsdienol + ipsenol + lanierone + methyl butanol + cis-verbenol
6. a-pinene + b-pinene + ethanol + lineatin + conophthorin

Lures for Hardwood sites (oaks, elm, maples, walnut)

1. UHR ethanol + conophthorin + Manuka oil
2. 3R hydroxy hexane-2-one + 2R3R-hexanediol + UHR ethanol
3. Fuscamol + fuscamol acetate + UHR ethanol
4. Heptanol, 2-methyl-3-buten-2-ol, multistriatin, a-cubebene (elms)
5. 4nheptyloxy butanol + 4nhepthyloxy butanal) + linalool + z-3-hexenol + beta-caryophyllen (maples)

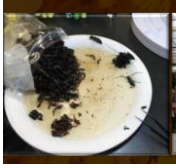
Trap placement is important: Ground or canopy traps, depending on target pests and site

- Ground: 214 traps hung on rebar
- Canopy: 122 traps (20 ALB traps)

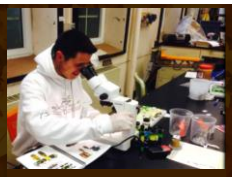


- Traps set May to September
- Checked every four weeks
- We covered >15,000+ miles during the 2013 summer

Insects were sorted in the lab. Each woodborer was then pinned for ID.



Species Identification:



Kyle Redilla, MSU

Gary Parsons, MSU Coleopterist

Mike Philip, MDARD, **King** of Bark Beetles!

Woodborer identification is rarely easy

Example: Longhorned Beetles

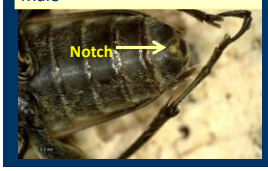
Trigonarthris minnesotana

Trigonarthris proxima

Trigonarthris minnesotana
Male

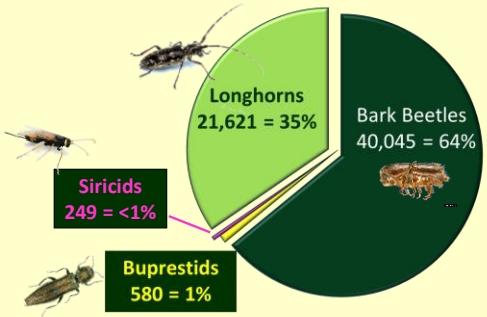
Trigonarthris minnesotana
Female

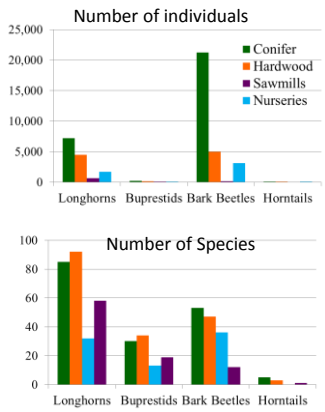
Trigonarthris proxima
Male



Trigonarthris proxima
Female

Captured and identified 62,495 bark beetles, woodborers and horntails from the 28 sites in 2013. No ALB!

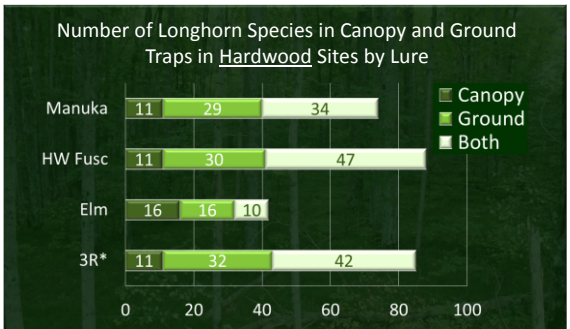




Lower Peninsula

Bark beetles were abundant in conifer sites. Buprestids and horntails were never captured in high numbers.

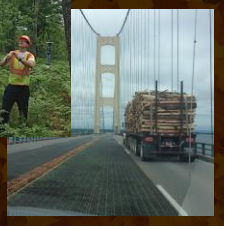
Species diversity was highest for longhorned beetles (267 species). Bark beetles (112 sp.) and buprestids (97 sp.) also diverse.



A different complex of species was active up in the canopy at hardwood sites, showing the importance of placing traps in the canopy, as well as on the ground.

It was so successful in 2013, we thought we should do it again

- Landfills
- Industrial sites
- Pallet yards
- Sawmills
- Recreation sites



We've Expanded Our Search

- 60 sites
- 15 lures
- Target insects:
  - ALB
  - Longhorns
  - Moths

August 2016

We found one walnut twig beetle in a trap in Southern Michigan

The Take Home Messages

- Don't Move Firewood
- Michigan forests are worth protecting
- Pests can be anywhere, anytime
- Forest pests can be EXPENSIVE!

- So I ask again, please – Don't move Firewood!