Development of novel ecosystems following simulated emerald ash borer outbreak in ash-dominated forests

Mark Norris & Rebecca Bernacki

- Paul Hess (INWR), Linda Ziemba (MNWR), Jim Eckler (NYS DEC)
- Mark Quinn (Monroe Co.), Emily Johnson (Genesee Land Trust)
- Catarina Torres, Samantha Paulus
- Bernacki family, Lynn Beeley, Jennalee Holzschuh, Erica Burgeson, Keith Abramo, Cara Norris
- Matt Mulvaney, Courtney Webster, MNWR
Exotic insect pests and pathogens pose the most serious current threat to the forests of eastern North America. The litany of pest and pathogen introductions is long;

Figure 1. Pathways of impact of pests and pathogens on forest ecosystem processes.

WNY

- EAB confirmed in
  - 2009 Cattaraugus Co.
  - 2010 Monroe Co.
  - 2011 Rochester

*Bedbugs? Other Strange Invaders Threaten Much Wider Damage*

*By PETER APPELBOIME  SEPTEMBER 5, 2010*

ACRA, N.Y.

You have perhaps heard about the bugs. In fact, it’s hard to turn on the television or read a newspaper without hearing more about *bedbugs*. In your mattress, at the office, the theater, the Brooklyn district attorney’s office, the Empire State Building — from New York to Portland, it’s the summer’s It bug.

But at the Cornell University Agroforestry Resource Center in the Catskills, they are more concerned with a less celebrated bug, the *emerald ash borer*. Native to China, it was first detected in the United States in Michigan in 2002 — perhaps arriving in packing material with shipments to auto plants. Since then it has spread across the upper Midwest and into Canada, killing tens of millions of ash trees. It was first reported in New York in June 2009 in Cattaraugus County in southwestern New York.

*The New York Times*
WNY

- Prevalent ash
- Regional analysis via USFS FIA
  - WNY & NWNY
  - Change over time
    - 2005-2009
    - 2010-2014
WNY: Tree composition (FIA: 2010-2014)

WNY

- Acer: 12.4%
- Fraxinus
- Tsuga
- Pinus
- Fagus
- Prunus
- Populus
- Quercus
- Betula
- Malus
- Ostrya
- Carya
- Other (21)

NWNY

- Acer: 19%
- Fraxinus
- Ostrya
- Crataegus
- Picea
- Malus
- Tsuga
- Tilia
- Ulmus
- Fagus
- Carya
- Quercus
- Populus
- Prunus

Other (17)

American

- American
  - Nigra
  - Pennsylvanica

WNY: Tree composition (FIA: 2010-2014)
WNY: Ash tree abundance (FIA: 2005-2009)

- NWNY: 32%
- WNY: 20%
No consistent pattern by county with respect to EAB-infestation
No broad EAB signature yet
ASH-DOMINATED FORESTS
ASH FORESTS

- Paired plots
  1. Control vs. girdled (2012), Non-ash control (2016)
  2. EAB-infested (2014), Non-ash (2016)

- Environment
  - Canopy cover (overstory, understory)
  - Microclimate

- Survey vegetation
  - Various strata

- Ecosystem functioning
  - Soil, Forest floor
  - Productivity
    - Trees, seedling photosynthesis
ASH FORESTS: SIMULATED EAB (2012)
ASH FORESTS: *EAB-INFESTED (2014)*

![Tree bark with holes caused by EAB larvae]

![Tree trunk with EAB damage]

![General view of infested forest]

![Close-up of EAB damage on tree trunk]
ASH FORESTS: Tree community composition (2013)

- Ash dominant, other species often understory trees (dogwood, buckthorn)
- Relatively undiverse, few stems of other canopy tree species to replace ash
- Exotic/invasive shrubs are present and most likely to fill niche voided by ash
ASH FORESTS: Tree community composition

### Basal area (m$^2$ per plot)

- **Girdled**
  - Ash
  - Non-ash

- **Control ('13)**
  - Ash
  - Non-ash

- **Non-Ash**
  - Ash
  - Non-ash

### Treatment
- Ash
- Non-ash

### Average Ash rating
- 2014: 3.0
- 2016: 4.3
ASH FORESTS: Understory cover

- Woody
- Grass
- Forbs
- Vines

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Total Invasive Cover (%):
- Girdled
- Non-Ash
ASH FORESTS: Ecosystem functioning – soil

Soil respiration
- 2012: Control 6, Girdled 5
- 2013: Control 7, Girdled 5
- 2014: Control 8, Girdled 5
- 2016: Control 9, Girdled 5

SOM %
- 2012: Girdled 20%, Control 18%
- 2013: Girdled 22%, Control 16%
- 2014: Girdled 24%, Control 14%
- 2016: Girdled 28%, Control 18%

Girdled, Control, Non-Ash treatments

Ash, Non-Ash plots
ASH FORESTS: Ecosystem functioning - productivity

- **WOOD**
  - CONTROL
  - GIRDLED

- **LITTER**
  - CONTROL
  - GIRDLED

- **Forest floor mass**
  - Girdled
  - Control
  - Non-Ash

- **Forest floor mass**
  - Ash
  - Non-Ash

- **Graphs**
  - Productivity (kg/ha/yr)
  - Forest floor mass

- **Legend**
  - CONTROL
  - GIRDLED
ASH FORESTS: Ecosystem functioning - photosynthesis

Photosynthesis (µmol CO₂/m²/sec)

- Ash Seedlings
- Non-Ash Seedlings

Control  Girdled
ASH FORESTS: Forest community beyond plants
ASH FORESTS: Restoration project (2016)
EAB in WNY: Conclusions

- Major disturbance
- Resilient ecosystem functioning
- Altered successional trajectory
- Novel ecosystems