

Big Changes from Little Bugs: Effects of Exotic Insects and Pathogens on Catskill Forest Ecosystems



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Many thanks to colleagues:

Mary Arthur, U. Kentucky

Kathie Weathers, Cary Institute

Lynn Christenson, Vassar College

Jake Griffin, U. Wisconsin

Matt Weand, U. Kentucky

And many others who helped in field and lab

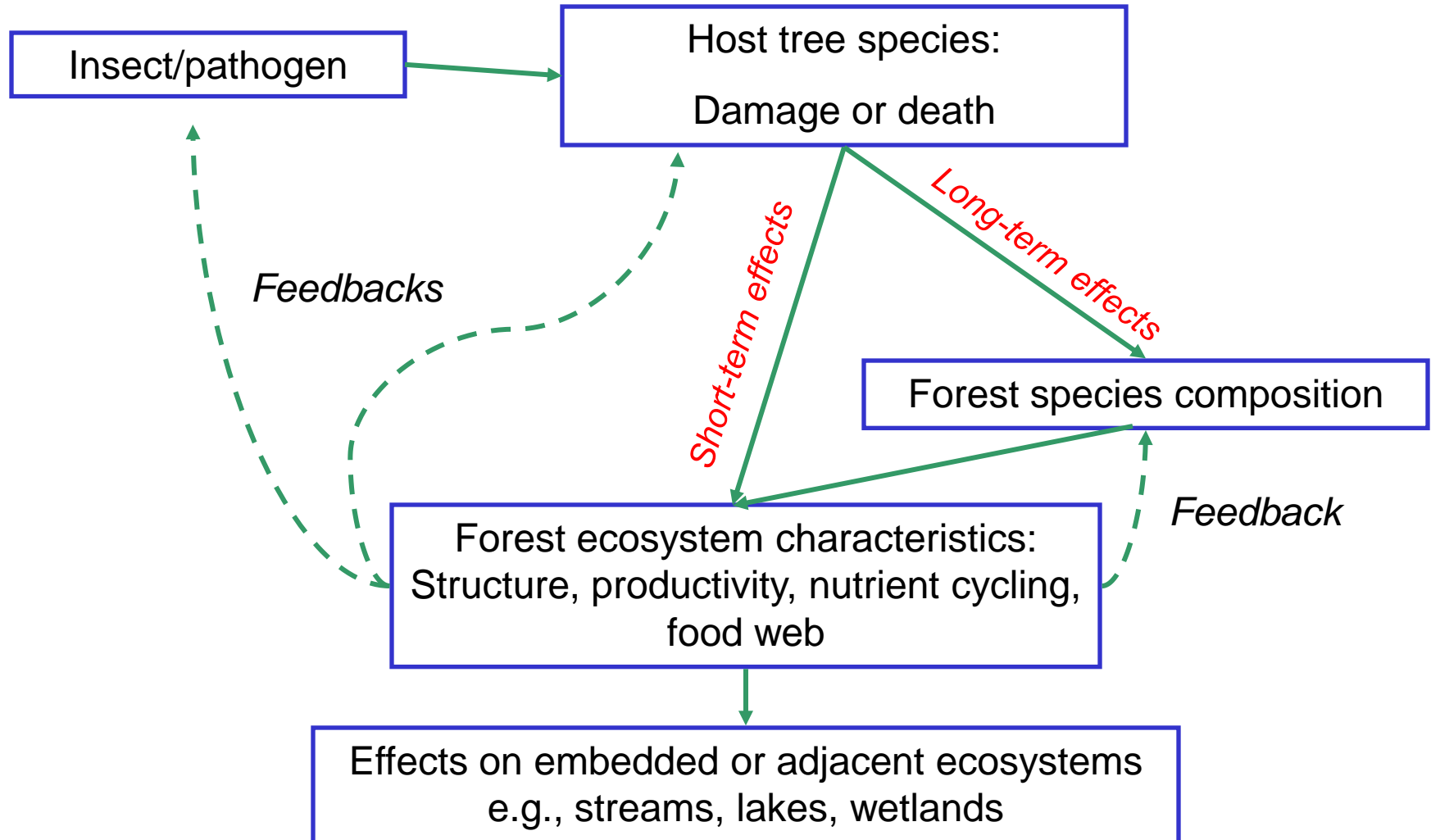


The Rogue's Gallery

(A Partial List)

- Gypsy moth
- Beech bark disease
- Hemlock woolly adelgid
- Emerald ash borer
- Chestnut blight
- Dutch elm disease
- Balsam woolly adelgid
- White pine blister rust
- Dogwood anthracnose
- Butternut canker
- And on and on.....
- *And waiting in the wings:*
 - Asian longhorned beetle
 - Sudden oak death (*Phytophthora ramorum*)
 - *Sirex* wood wasp

Short- and Long-Term Effects of Introduced Insects and Diseases



Gypsy Moth

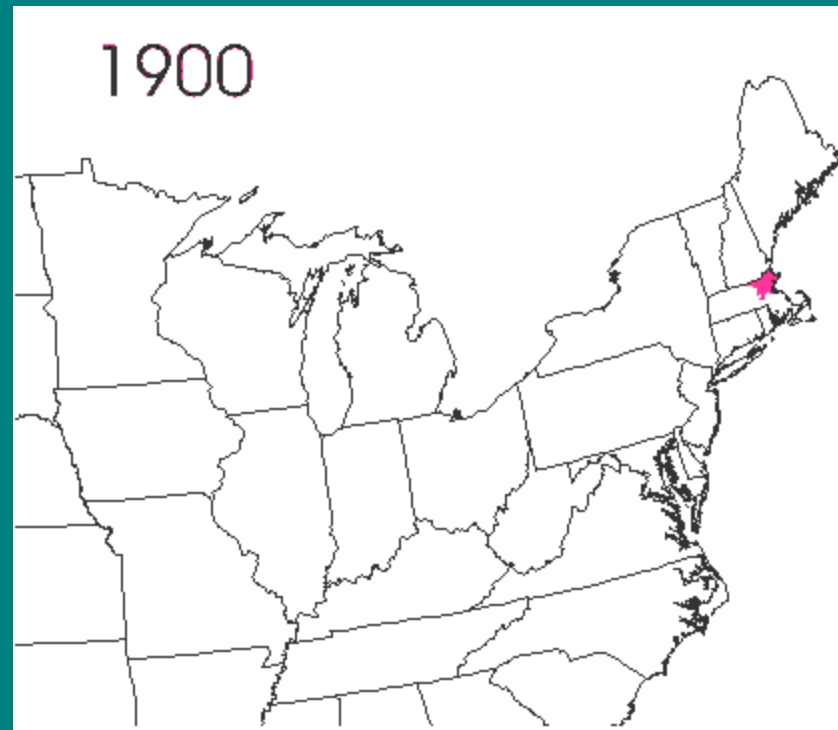
(*Lymantria dispar*)



E. Leopold
Trouvelot
(1827-1895)

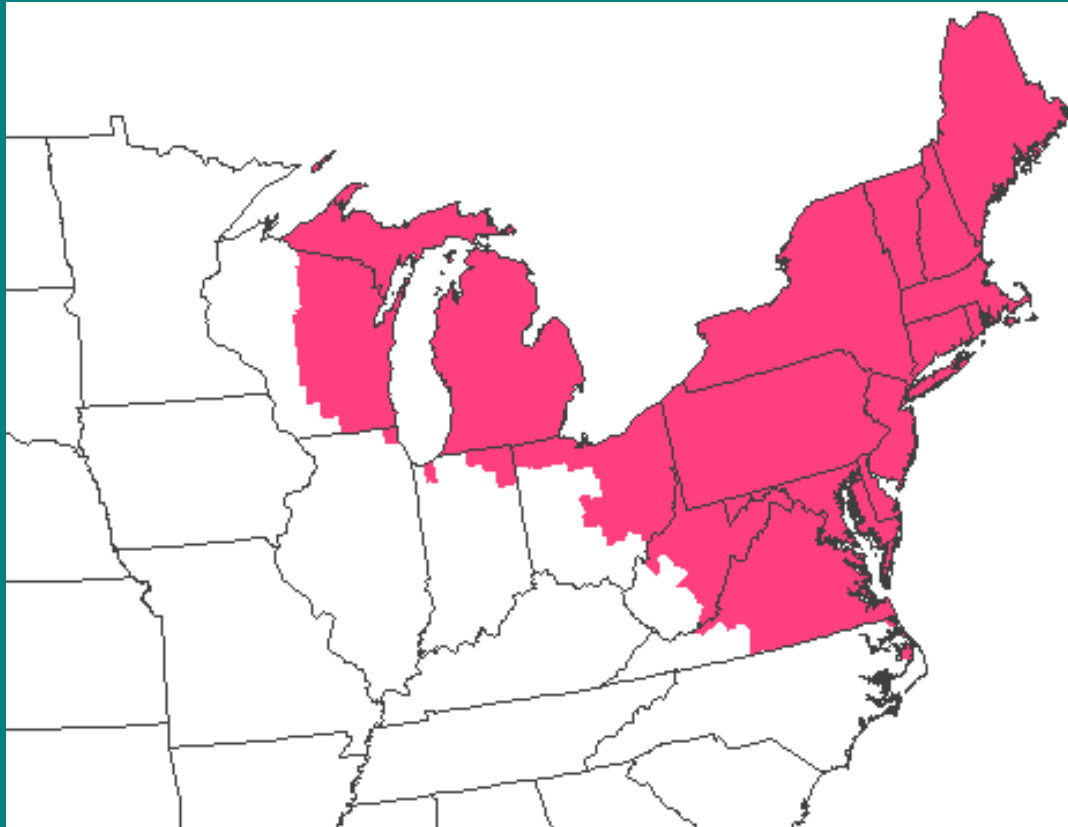
Trouvelot's home in Medford, Mass.

Spread of the Gypsy Moth 1900-2007



Map from USDA Forest Service

Distribution of the Gypsy Moth 2008



Map from USDA Forest Service

Effects of Gypsy Moth Defoliation



- Reduced tree growth
- Reduced seed crop
- Reduced transpiration, increased soil water
- Differential tree mortality
 - Conifers
 - Stressed trees
- Altered carbon and nitrogen cycling

Fate of Nitrogen in Gypsy Moth-Defoliated Forests

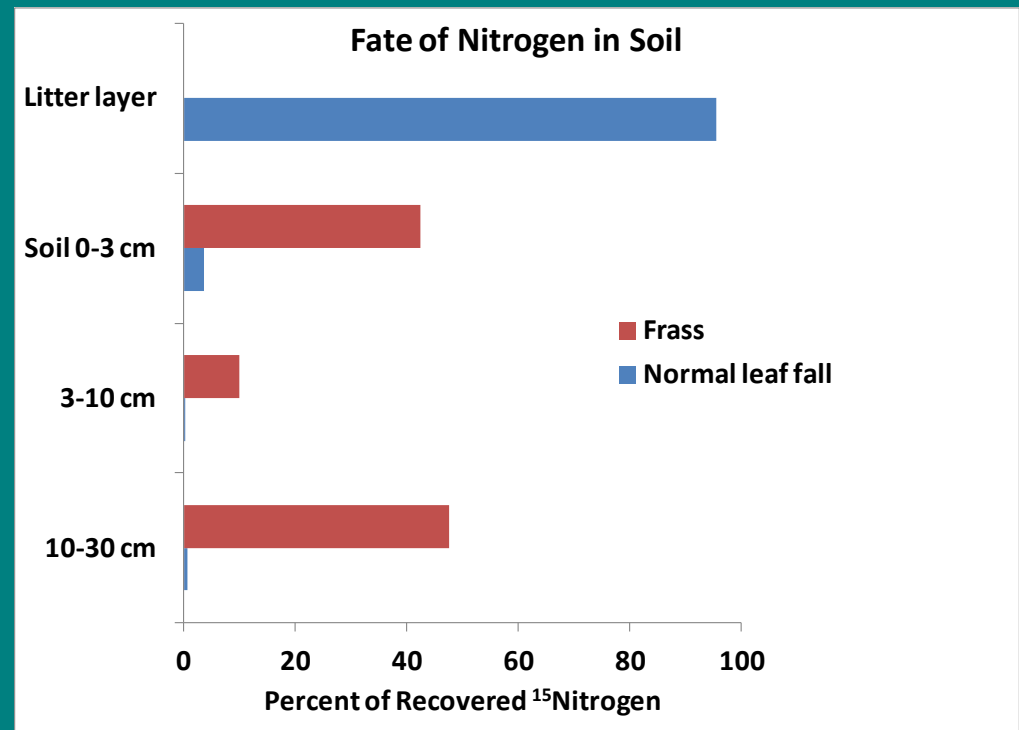
- Nitrogen that would normally be resorbed by the plant is transferred to the forest floor as frass, insect biomass, etc.
- Mobilized frass nitrogen is primarily redistributed in system rather than lost to leaching
- Much of the nitrogen in frass is moved to deeper layers of the soil

Labeling a tree with ^{15}N

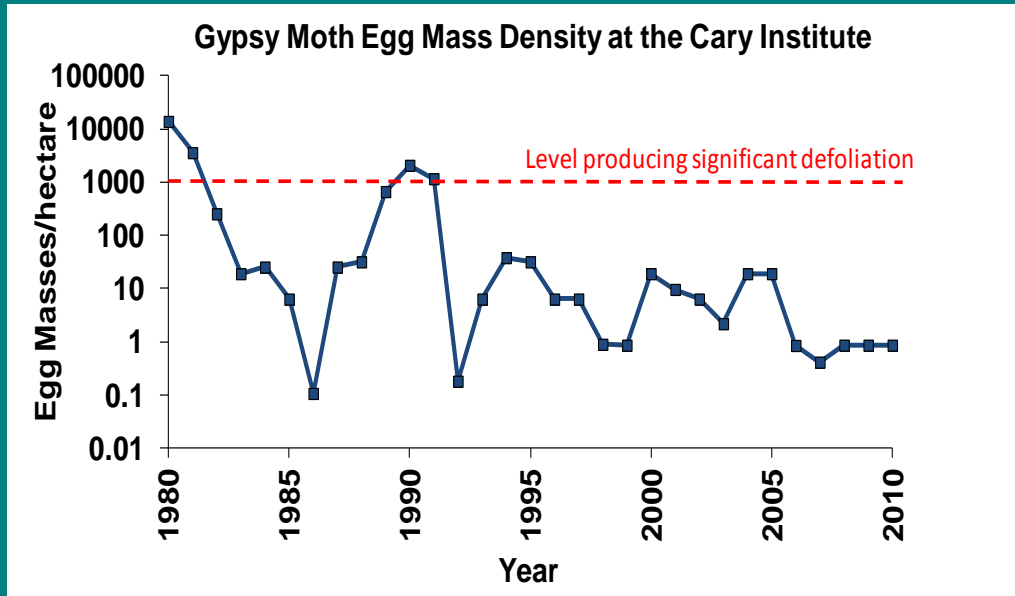


Lovett et al. 2002

Christenson et al. 2002



Decline of the Gypsy Moth?



Data from Clive Jones, Cary Inst.



Catskill Mts., summer 2005

Beech Bark Disease

Interaction of scale insect (*Cryptococcus fagisuga*) and fungi (*Neonectria* sp.)

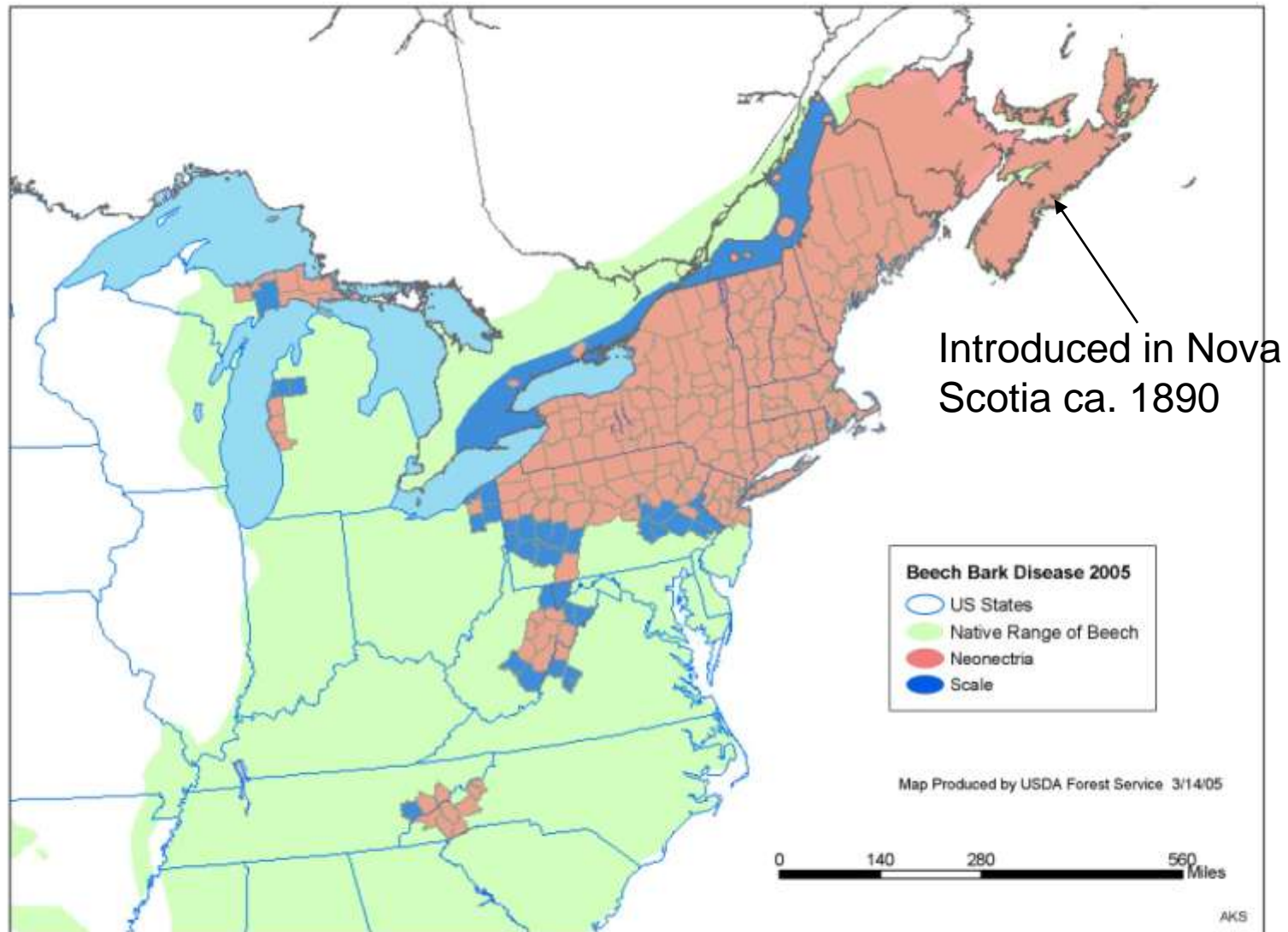


Beech scale adult
with outer
covering removed



Neonectria fruiting
bodies on beech bark

Beech Bark Disease



Effects of Beech Bark Disease



- Kills trees slowly over 10 years or more
- Shifts in forest composition and structure
- Interaction with nitrogen status
- Shifts in nitrogen cycling and retention
- Loss of food source for wildlife



Bear Attempts Candy Store Break-In in Old Forge

By [Matt Herkimer](#)
July 31, 2012



YouTube

“It wasn’t Yogi or Boo Boo but a real life bear with a sweet tooth that apparently tried to break into a candy store in Old Forge last week. WKTV reports that a black bear caused extensive damage to The Candy Cottage while attempting to get in for some goodies...”

Research on Beech Bark Disease in the Catskills

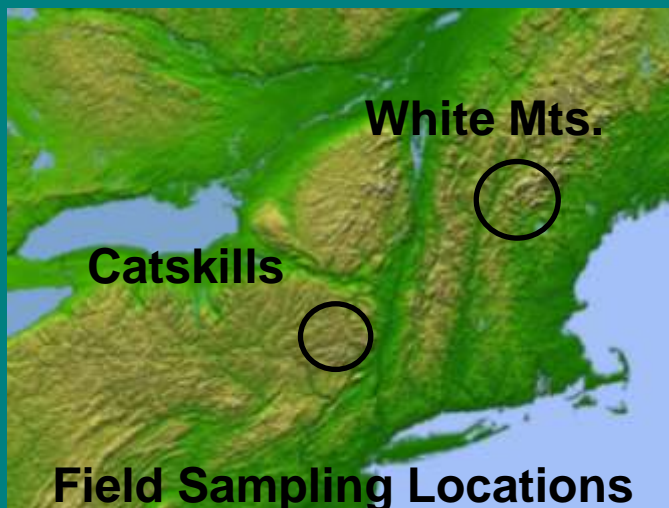
- BBD affects >99% of beech trees in the Catskills
- About 20% seem to be tolerant of the disease
- Most of the larger beech trees (>20 inches diameter) are gone
- Overall shift in species composition toward sugar maple



What Controls the Path of Vegetation Change After Beech Decline?

BBD plot study

- Plots centered on stump of former canopy beech tree, where canopy has closed the gap
 - Camera-based measurements of LAI by species
 - Soils: Organic, Surface Mineral and Deep Mineral
 - Vegetation



- Catskills: 186 plots
- White Mts.: 111 plots

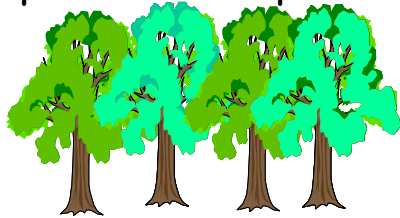
Lovett, Arthur and Weand in prep

Beech Bark Disease and Tree Species Change

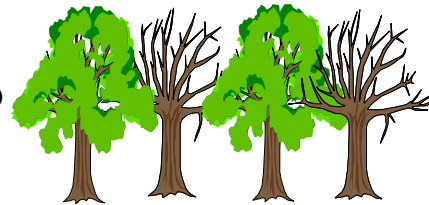
Gradient Study in Catskill Mountains

Maple Beech Maple Beech

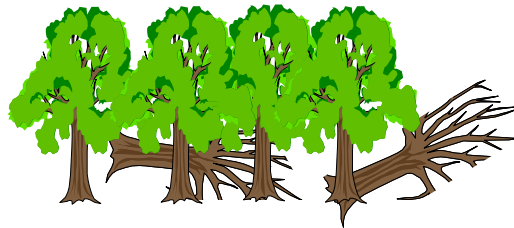
Mixed beech-maple



Beech die from BBD



Maple dominates

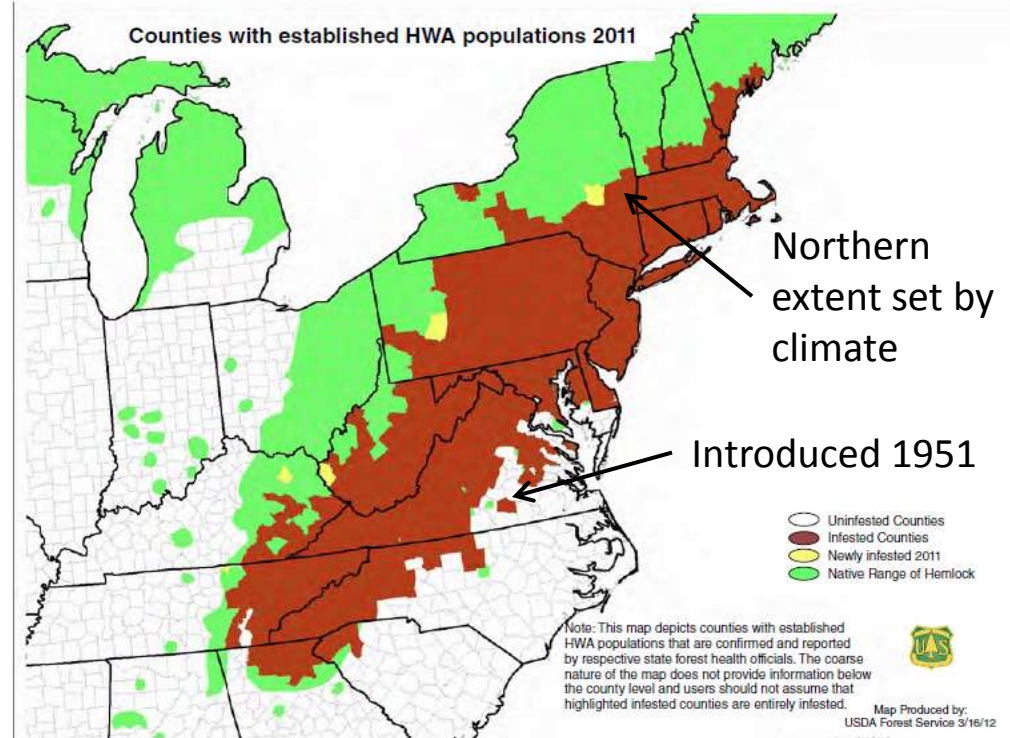


Measured 22 plots that span this gradient

Shift in species composition due to BBD

causes changes in ecosystem function such as increased rate of litter decomposition, decreased forest floor thickness and increased nitrate leaching to streams

Hemlock Woolly Adelgid (*Adelges tsugae*)

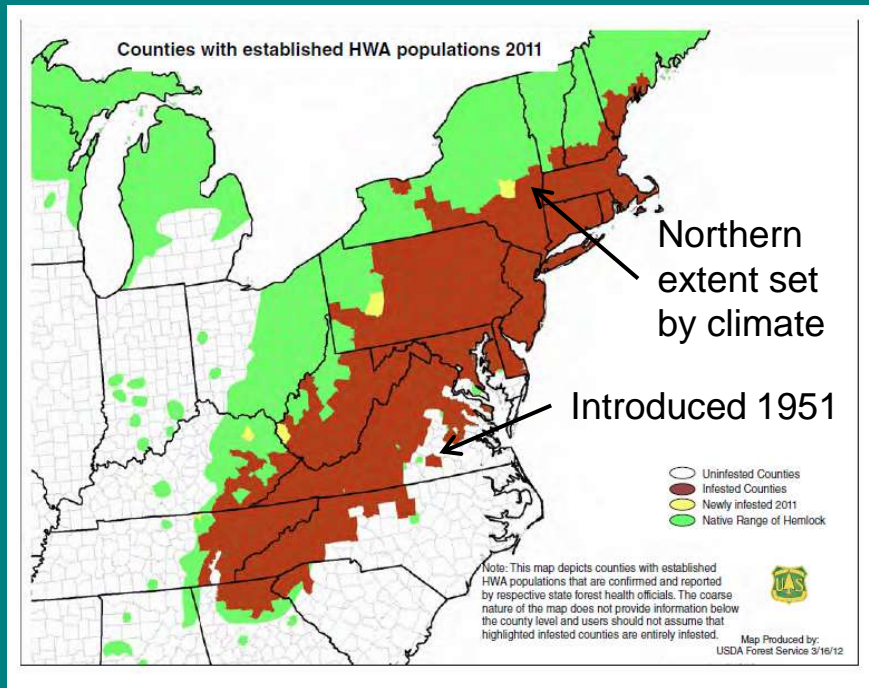




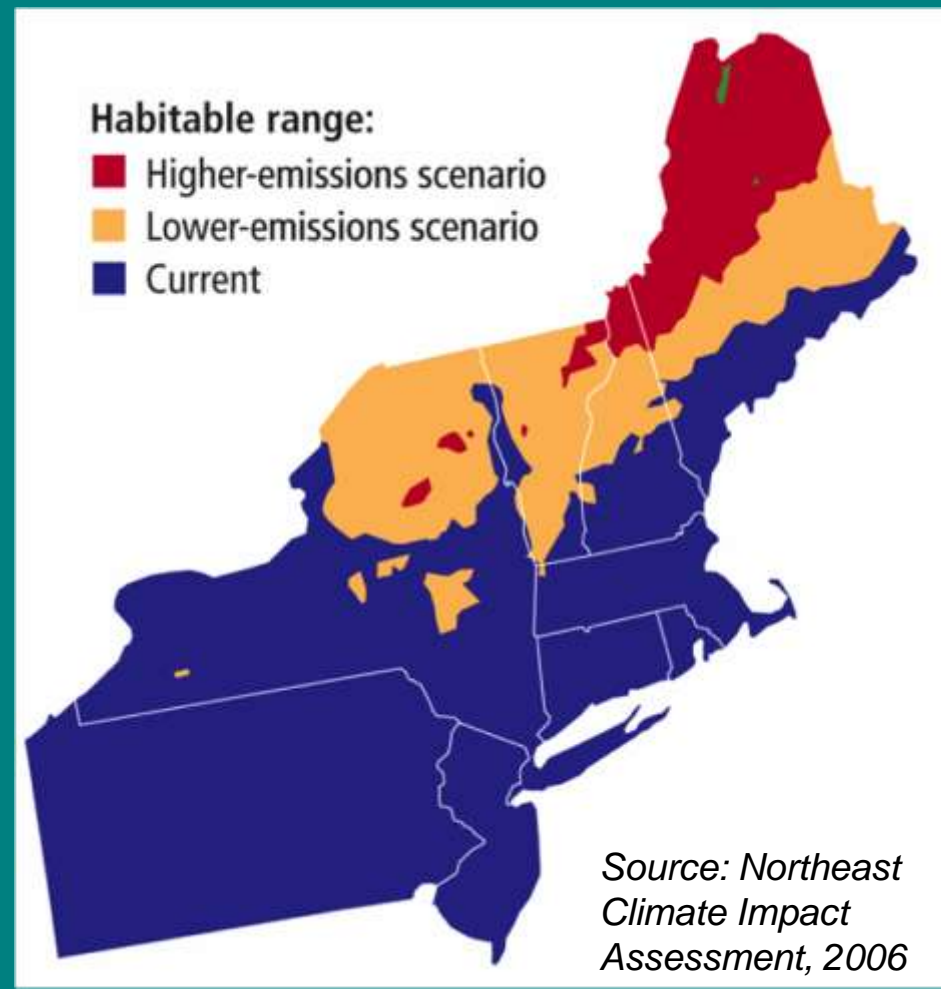
Effects of Hemlock Woolly Adelgid

- Tree mortality after 4-6 yrs.—very little resistance
- May set back succession
- Important coniferous habitat in deciduous dominated forests
- Increased light and temperature in streams
- Short-term: Disruption of production and nutrient cycles due to disturbance (e.g., Yorks et al., 2002)
- Long-term: Species change to deciduous trees is expected to cause increased nitrate leaching and reduced carbon storage

Range of Hemlock Woolly Adelgid Will Spread Northward as the Climate Warms



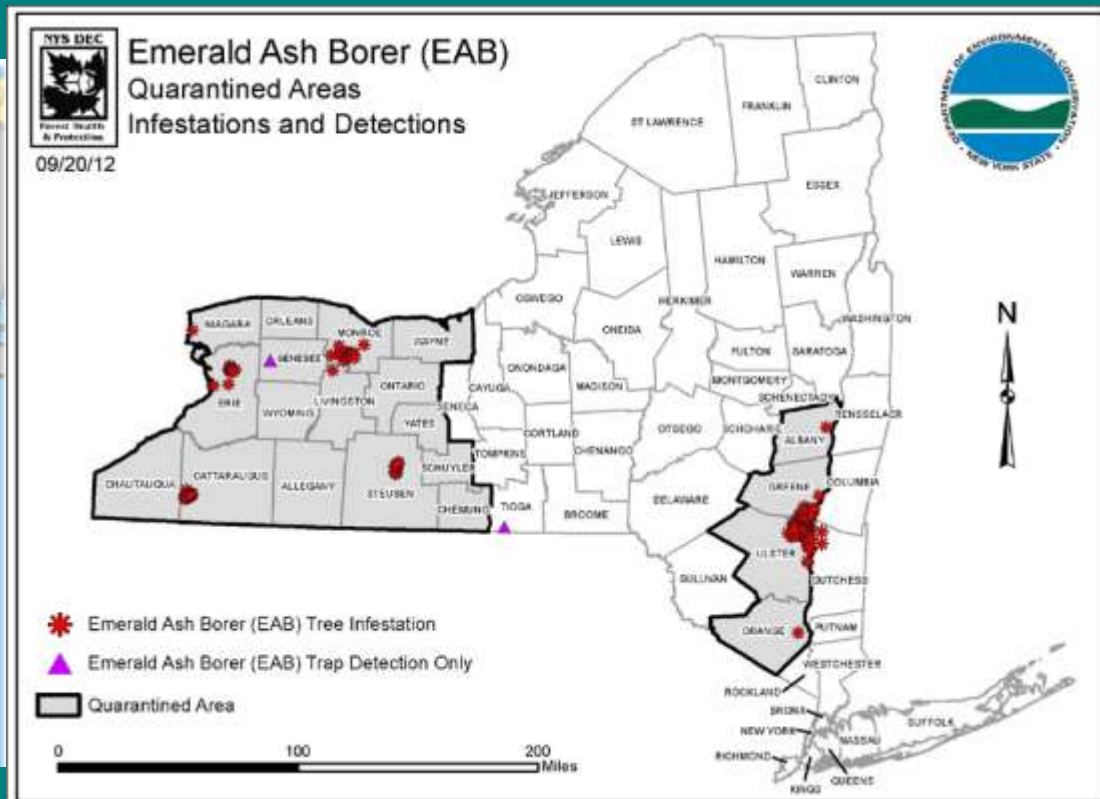
Area habitable by HWA in 2100 under different CO2 emissions scenarios



- Cold winter nights cause high mortality, but are becoming less frequent
- Ecosystem response is variable at northern end of range
- Evolution of adelgid population

Emerald Ash Borer

(*Agrilus planipennis*)



Impacts of Emerald Ash Borer

- Ash trees are 7% of trees in NY State
- Can be dominants in certain areas, particularly wetlands and successional forests
- Gradient of ash decline associated with forest structural changes that influence the bird community (Research of Larry Long, Ohio State University)

Preview of Coming Attractions



Asian Longhorned Beetle



Sudden Oak Death



Sirex Wood Wasp

Are All Pests Unique, or Can We Predict Ecosystem Responses to New Pests?

What Do We Need to Know?

- **Attributes of insect or pathogen**
 - Specificity
 - Lethality
 - Mode of action
- **Attributes of host tree**
 - Dominance
 - Uniqueness

Predictions will require close collaboration between forest ecologists and entomologists/pathologists

From Lovett et al. 2006

Other Data and Knowledge Gaps

- Broad-scale, long-term vegetation and soil monitoring
- Research on wildlife responses
- Research on interaction among stressors— pests, climate change, air pollution, land use
- Dedicated research watersheds for integrated analysis of forest response

Can This Problem be Solved?

- This is a multi-billion dollar economic problem as well as an ecological calamity
- Eradication of established pests is virtually impossible, but we can slow their spread and buy some time
- Biological control has much promise but is difficult and risky
- We should be focusing on how to prevent the next pest introduction
- Action is needed at the federal level to control the major vectors: *live plants for the nursery trade* and *wood packing material*



What can you do about this?

- Use native rather than imported plants in landscaping
- Don't move firewood
- Contact representatives in Congress

From Science to Policy Action

- The Cary Institute is leading an initiative to summarize scientific information on this issue and use it in an outreach campaign aimed at media and federal legislators