Climate Change and Invasive Pests and Pathogens

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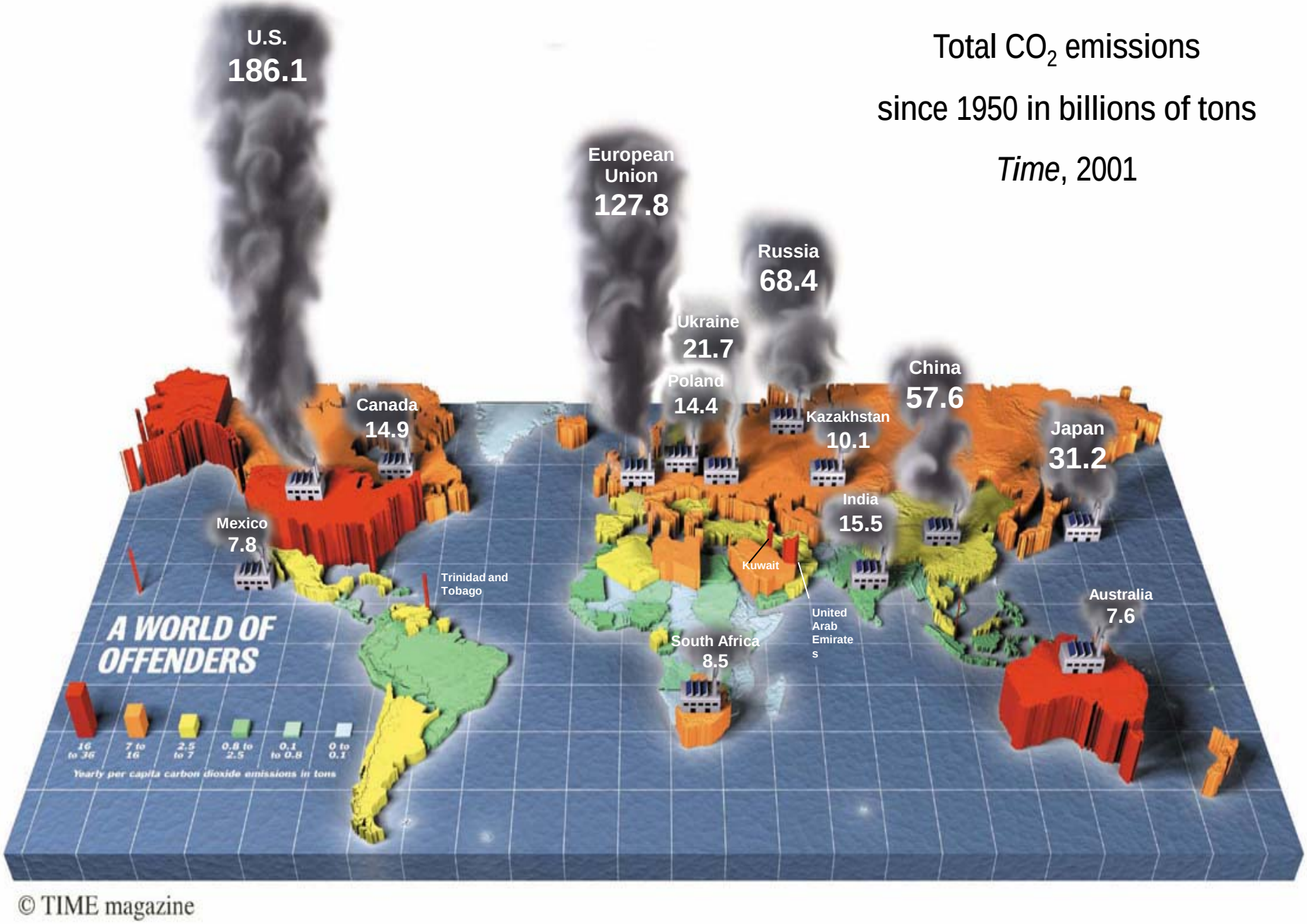
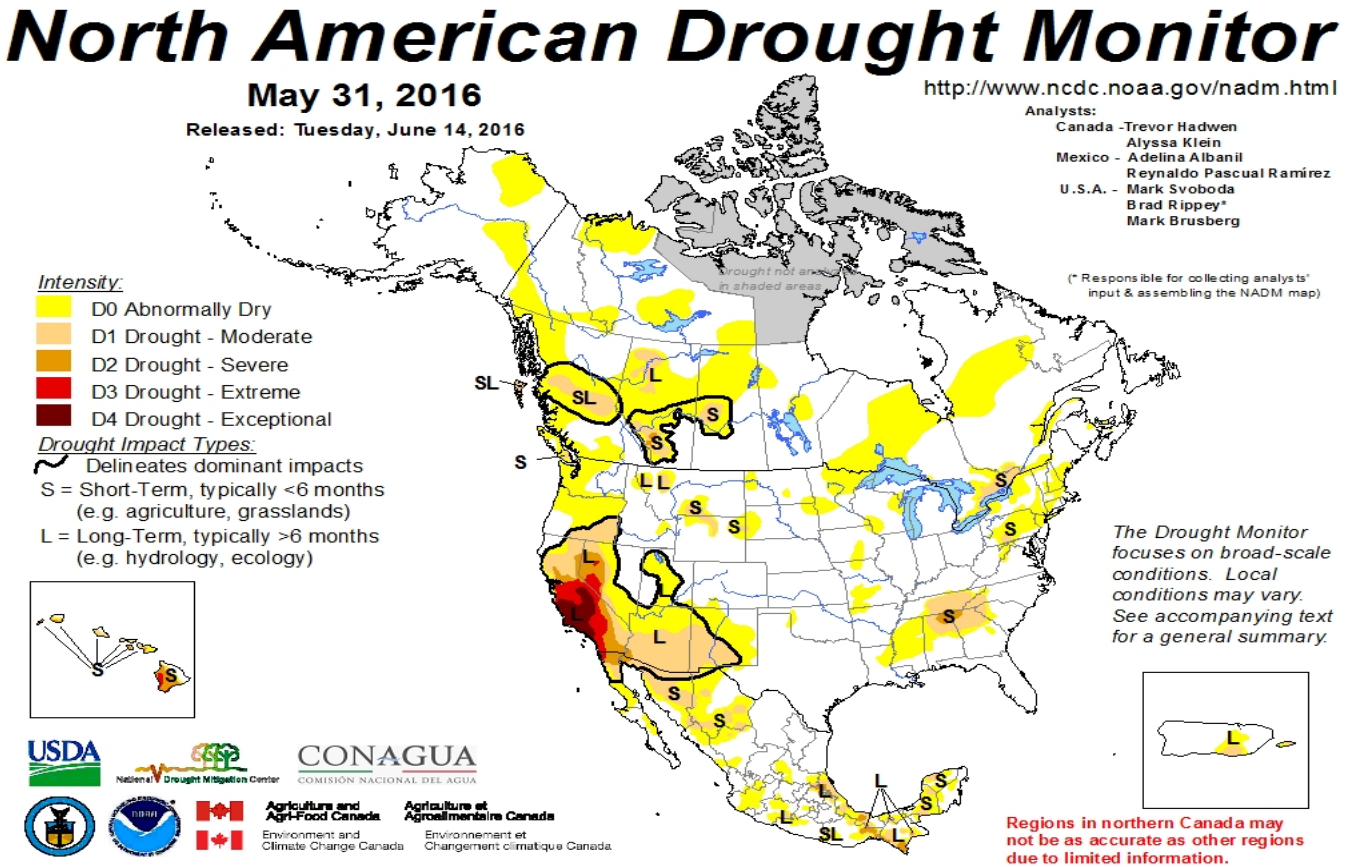

Total CO_2 emissions
since 1950 in billions of tons
Time, 2001
U.S.
186.1
European Union
127.8
Russia
68.4
Ukraine
21.7
Poland
14.4
China
57.6
Canada
14.9
Kazakhstan
10.1
Japan
31.2
India
15.5
Mexico
7.8
Trinidad and Tobago
Kuwait
United Arab Emirates
Australia
7.6
South Africa
8.5
A WORLD OF OFFENDERS
16 to 36
7 to 16
2.5 to 7
0.8 to 2.5
0.1 to 0.8
0 to 0.1
Yearly per capita carbon dioxide emissions in tons
© TIME magazine

Global Changes & Ecological Impacts
What's happening?

Weather trends



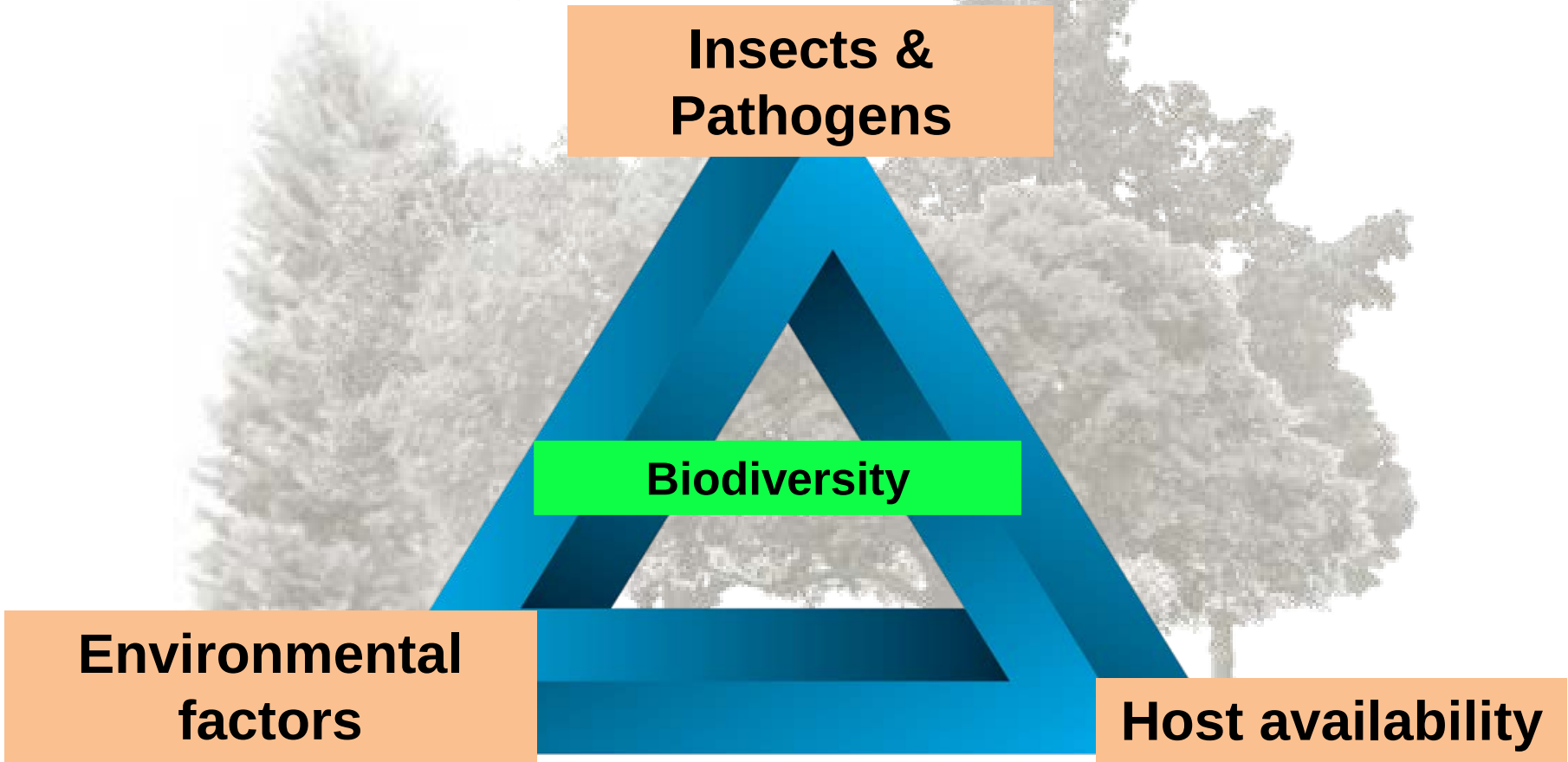
Global Changes & Ecological Impacts
What's happening?

Ecological impacts

- **Rainfall/moisture**
- **Temperature**
- **pH**
- **Salinity**
- **Activities & distribution of several sp**

2016 record of warmer summer. Temperatures 2 degrees higher than in the 20th century

Interaction Between Pests & Climatic Conditions



Global Changes and Local Impacts… What's Happening in your Backyard?

Warm temperature

Drought

Transpiration

Photosynthates

Carbon imbalance

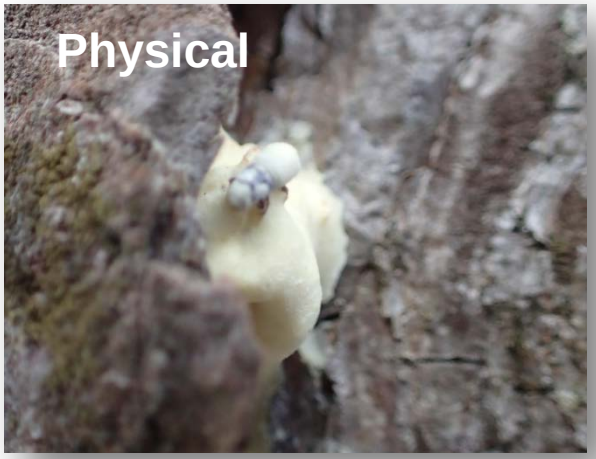
Secondary metabolites (defense)

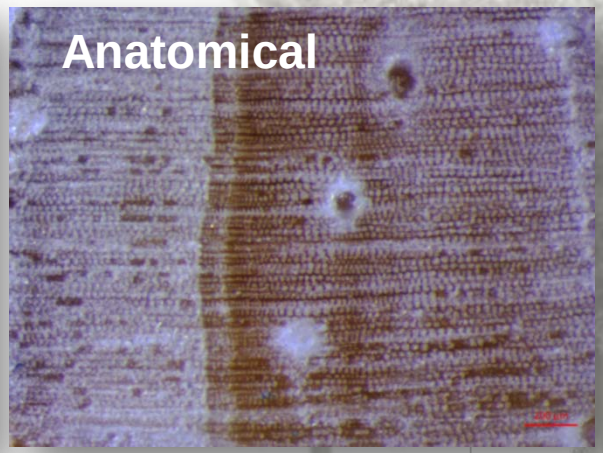
Global Changes and Local Impacts… What's Happening in your Backyard?

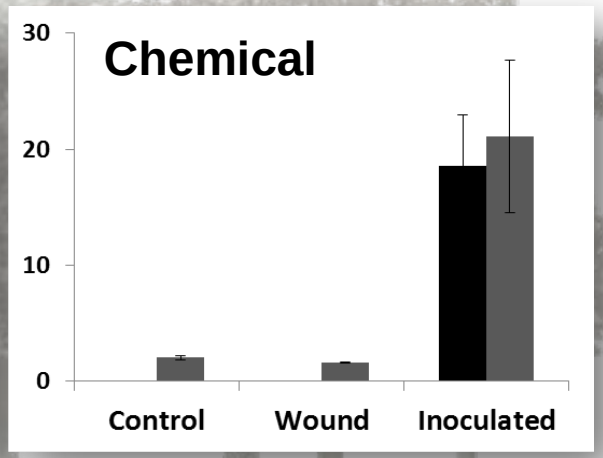
Warm temperature

Drought

Plant defense responses





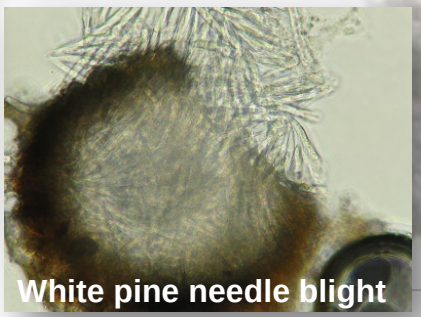


Global Changes and Local Impacts… What's Happening in your Backyard?

Warm temperature

Drought

Insect and pathogen reproductive rates



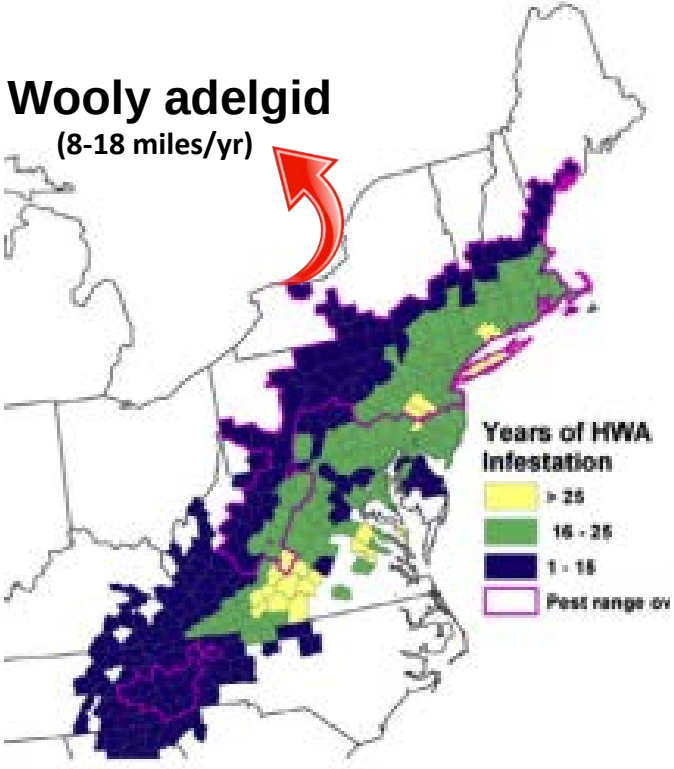
Unpredictable population eruption driven by threshold effects & triggered by abiotic factors, particularly **climate**

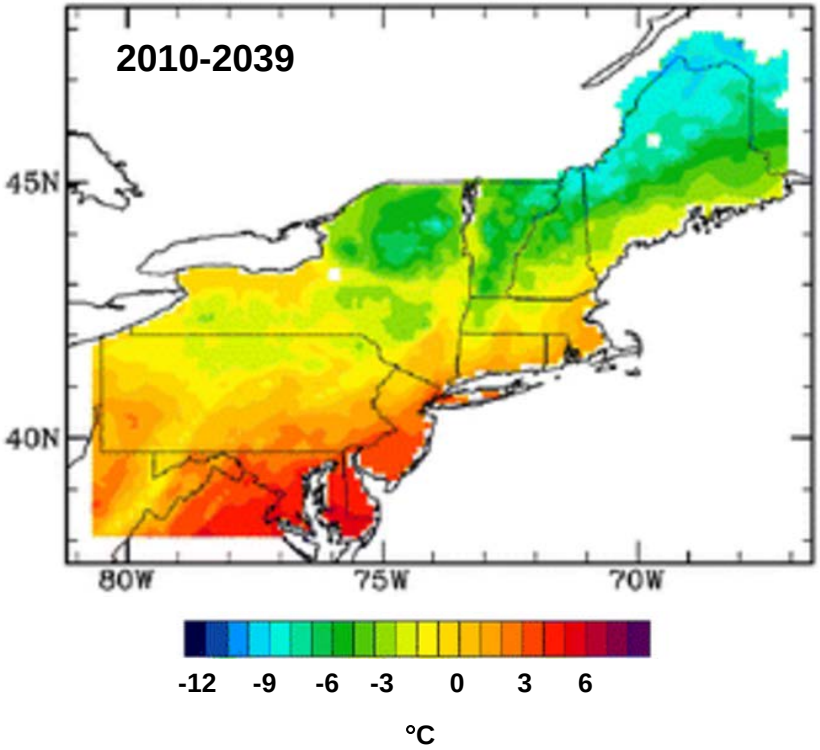
Continuing to expand into areas previously inhospitable

Increased winter minimum temperatures are expected to promote hemlock wooly adelgid (*Adelges tsugae*) expansion northward into the hemlock forests of Canada

Intolerant to cold temperatures

Wooly adelgid
(8-18 miles/yr)





Dr. Carole Cheah

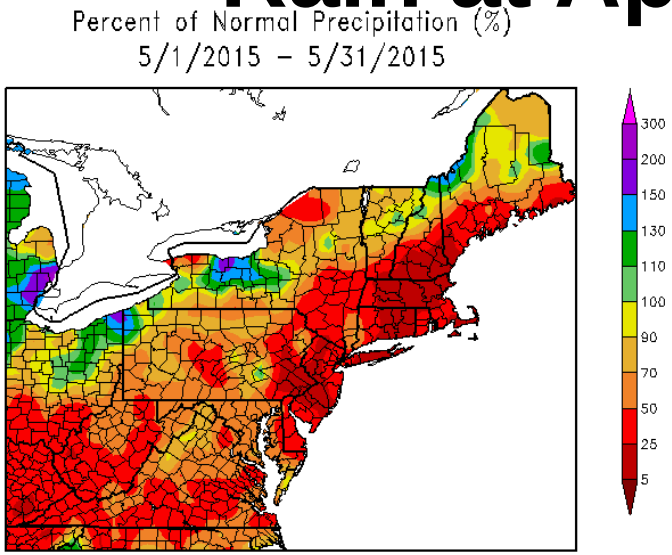
Morin & Liebhold, 2015
Paradis et al. 2007

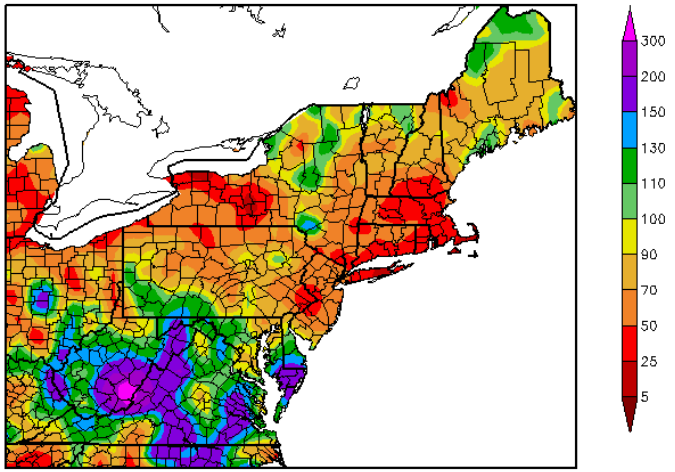
Gypsy Moth Outbreak 2015 & 2016

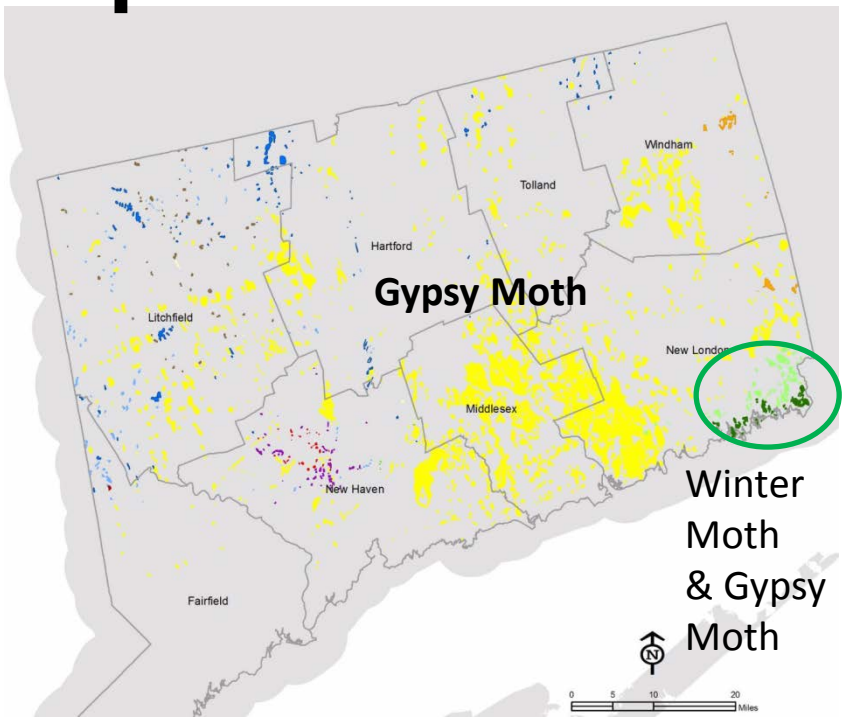
Gypsy moth fungus, largely responsible for controlling gypsy moth since discovery by CAES in 1989.

Fungus requires rain (moisture) in May and June for infection & propagation in the caterpillars

Gypsy Moth Outbreak Due to Lack of Rain at Appropriate Time



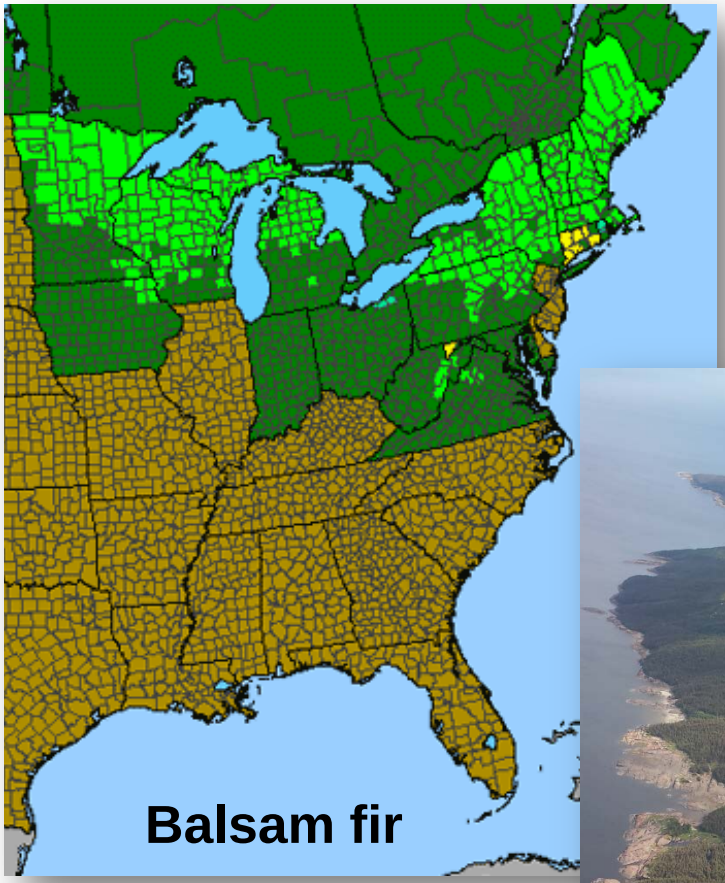




Aerial survey map (2015) showing defoliation; 175,273 acres impacted by gypsy moth (yellow), 4,166 acres combined winter moth and gypsy moth (light green). The 2016 aerial forest defoliation survey currently in progress.

CAES
The Connecticut Agricultural Experiment Station
Putting Science to Work for Society since 1875

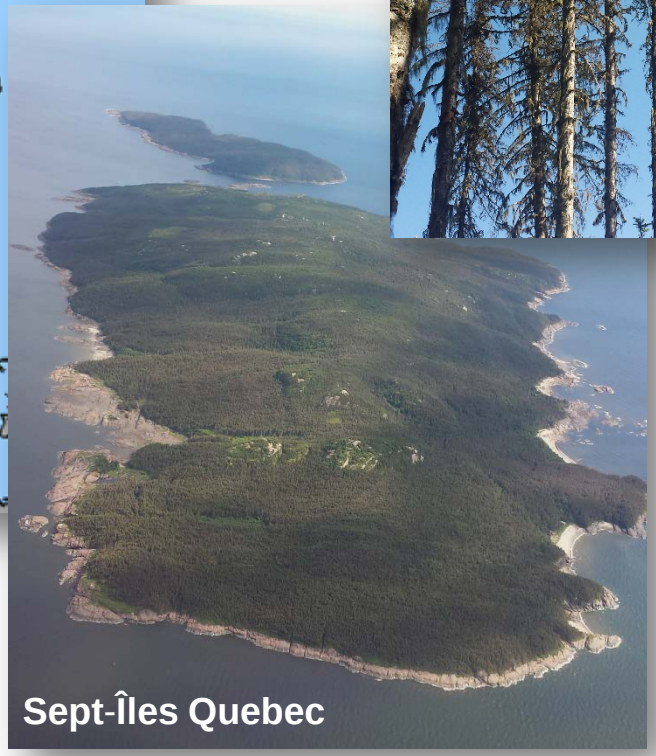
A Cold Temperate Insect Increasing Range Expansion in North America



Native

Present

Rare



Photos: Adriana Arango

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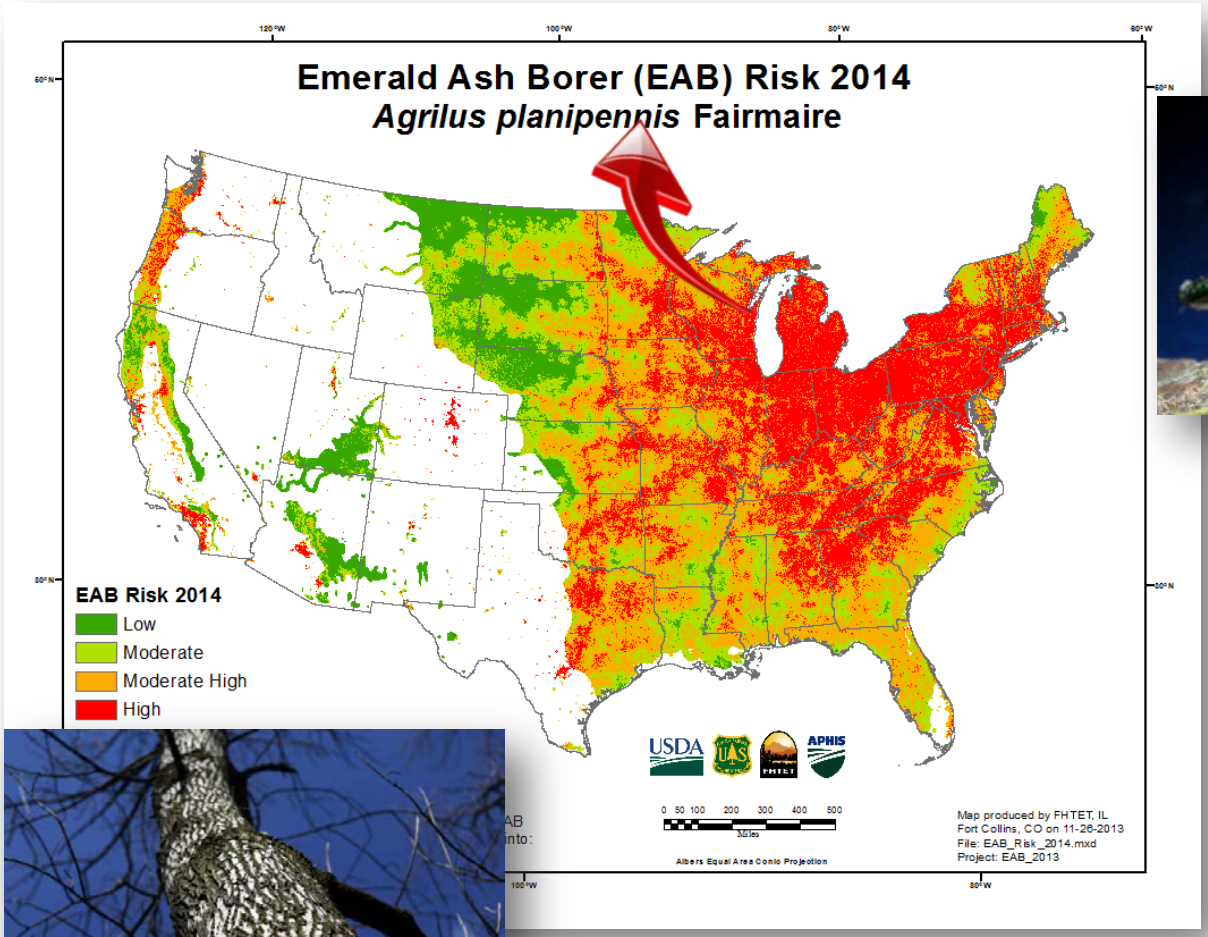
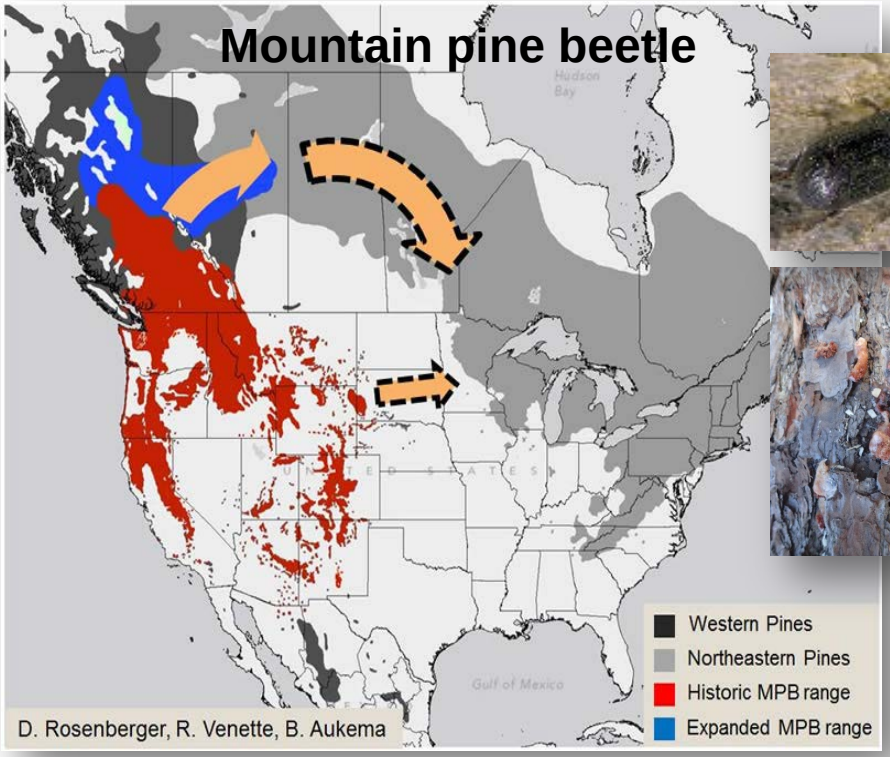
EAB Establishment Positively Affected by Temperature

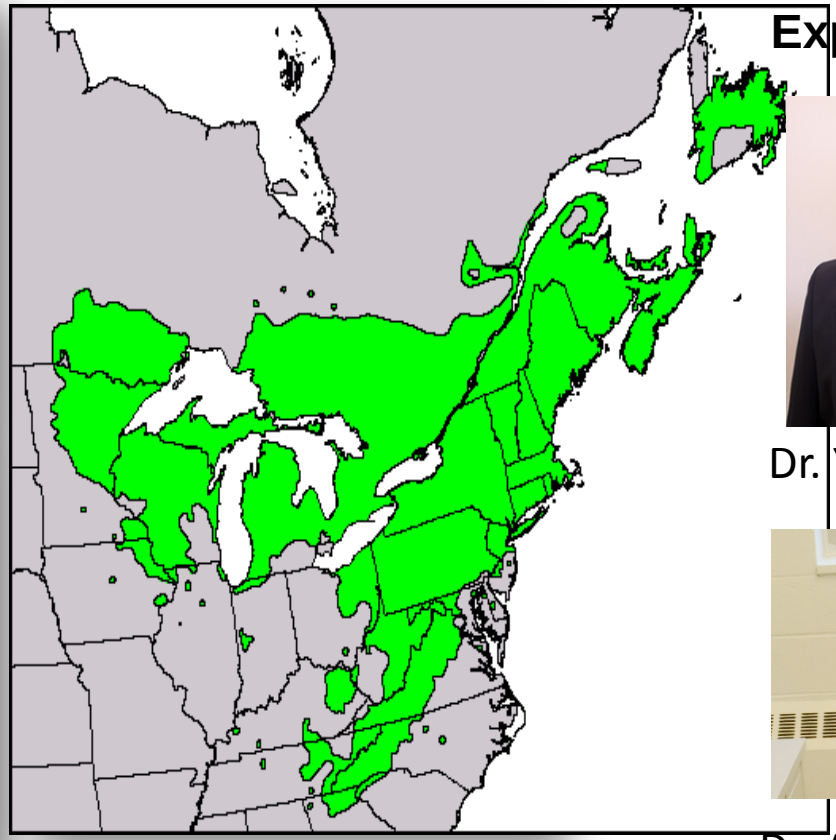


Dr. Claire Rutledge

Taking advantage of thermal increases, reaching news hosts and new areas



Increase in the frequency of weather events favorable to the disease

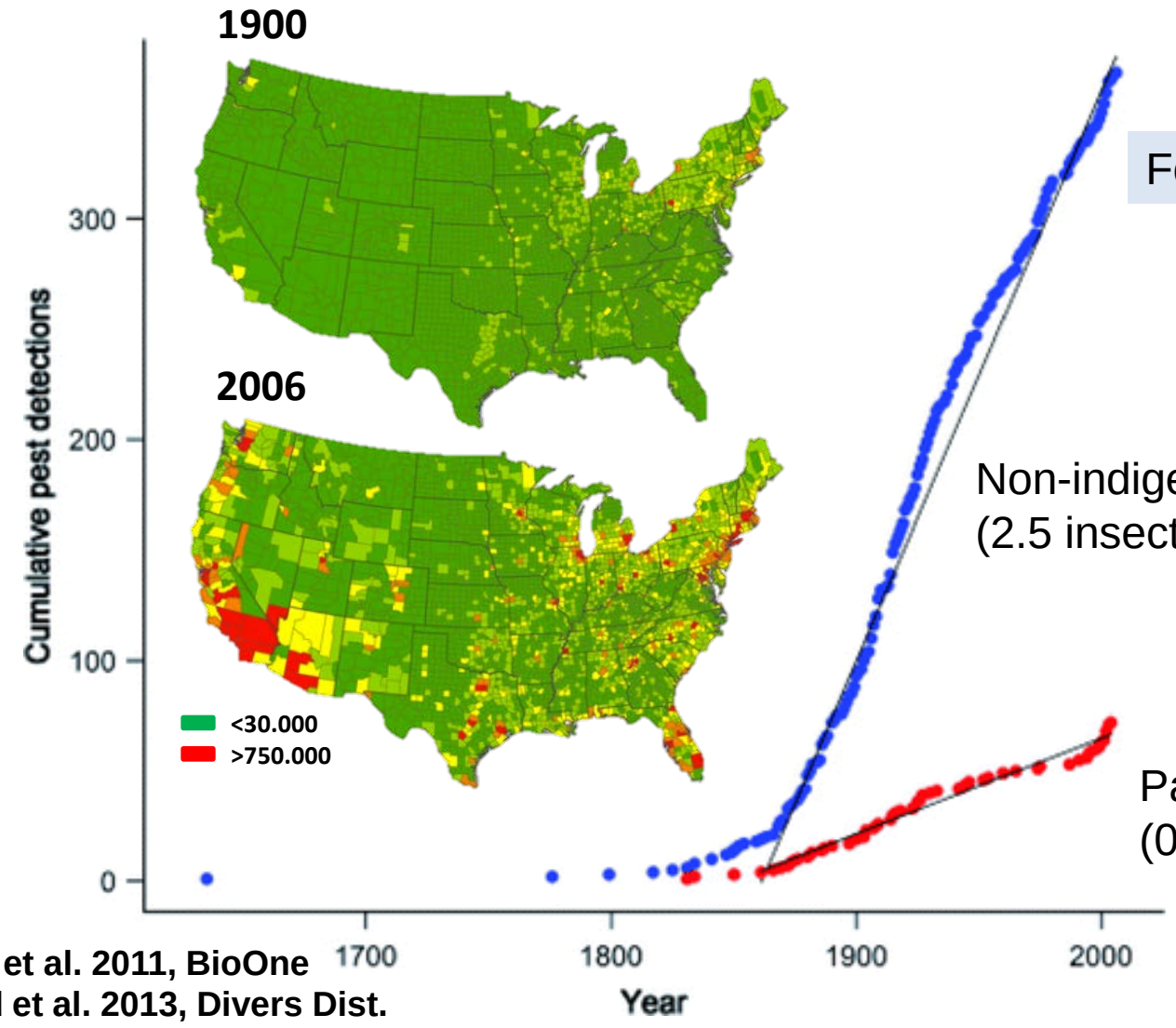


Identification & Expansion

Dr. Yonghao Li

Dr. Adriana A.

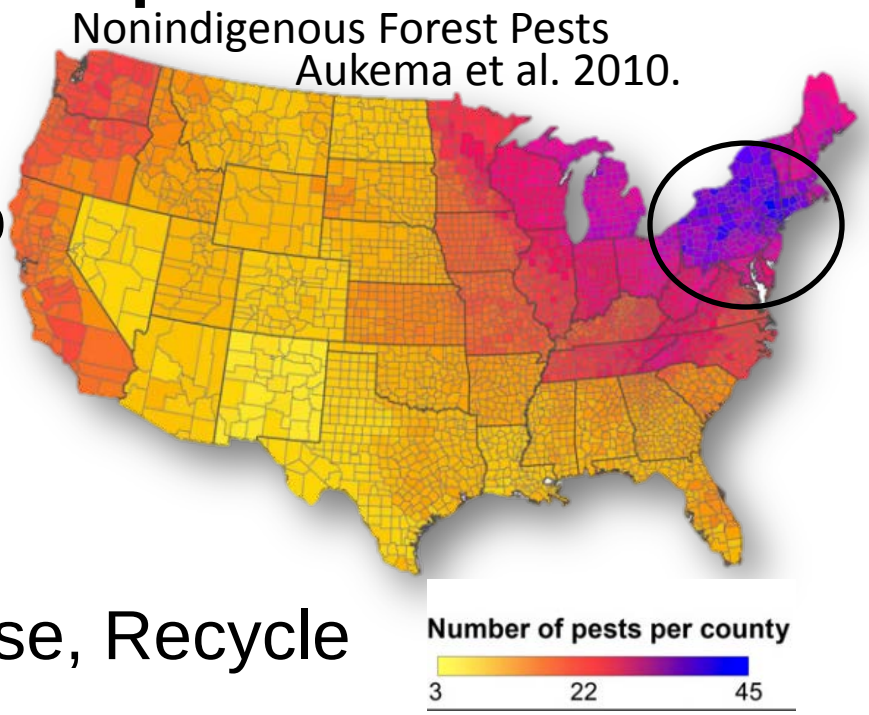
Pests Population on the Rise



Aukema et al. 2011, BioOne
Liebhold et al. 2013, Divers Dist.

Reacting to Climate Change

- Urban: Silvicultural - Increase landscape heterogeneity (i.e., altering **tree species** and **age diversity**)
- Forest: reduce tree density to decrease stand susceptibility
- Backyard: Early detection
- Home: Refuse, Reduce, Reuse, Recycle



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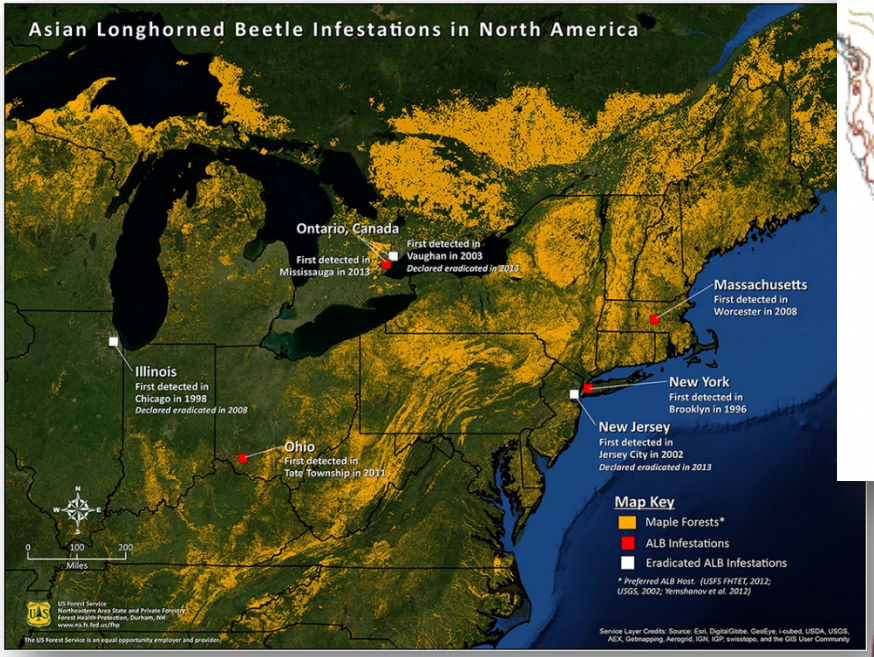
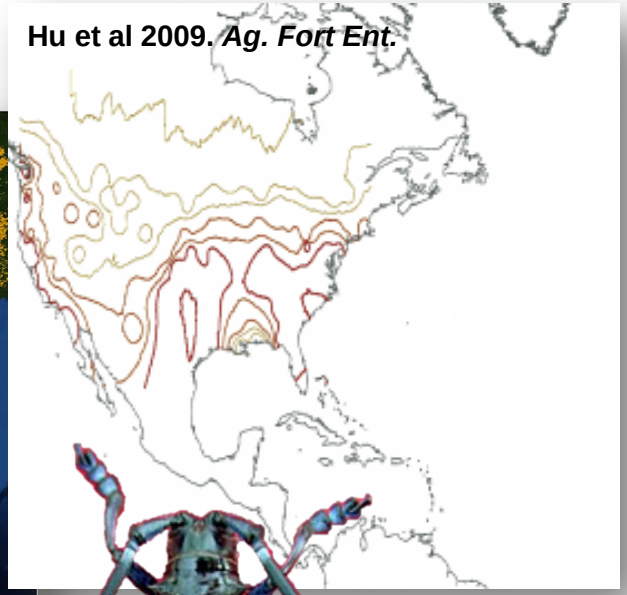
Not Here Yet, but Surrounding CT
Would we see it soon?



Courtesy: Kevin Dodds, USDA



Dr. Gale Ridge