The Hemlock Woolly Adelgid *Adelges tsugae* A formidable pest we *CAN* manage

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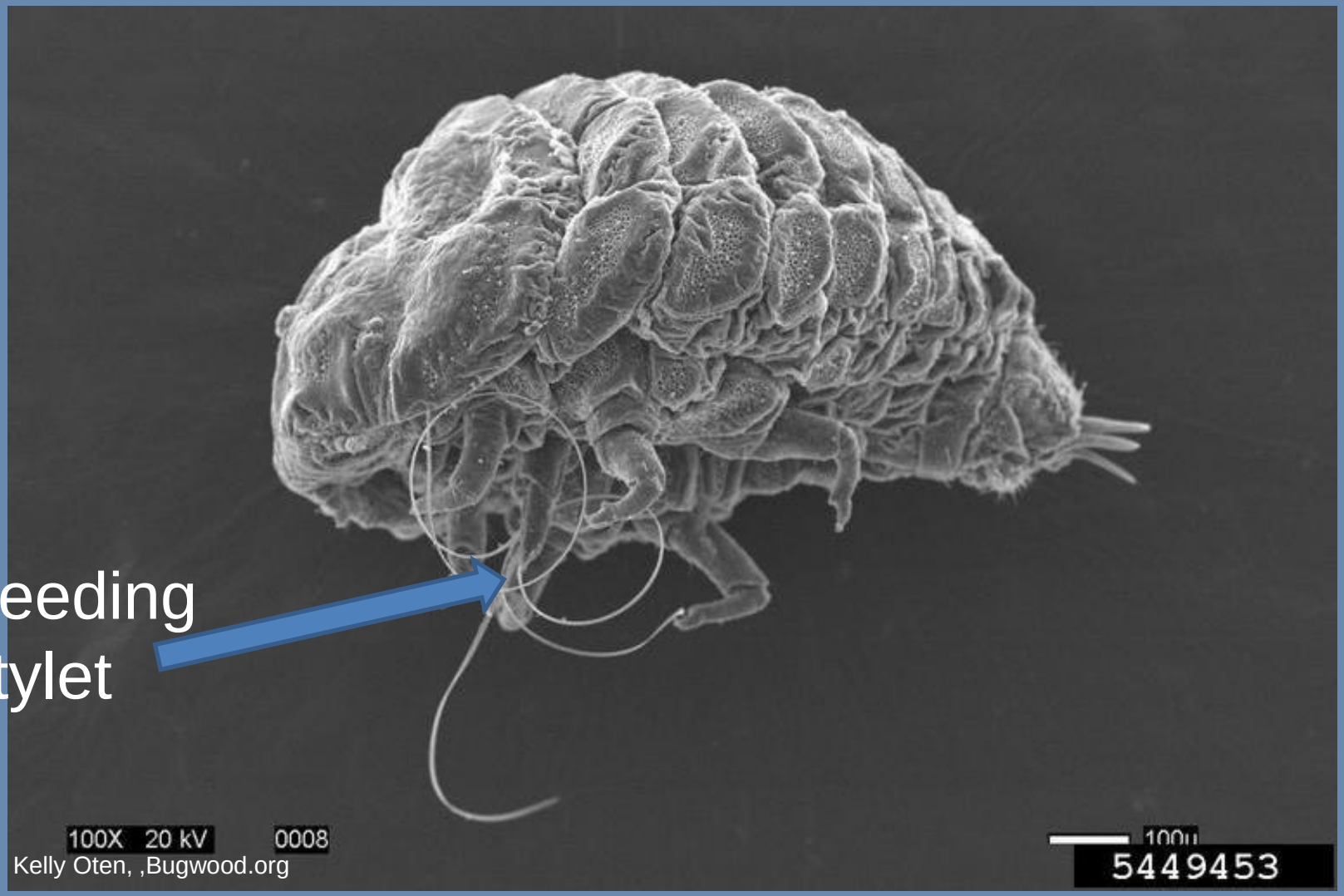
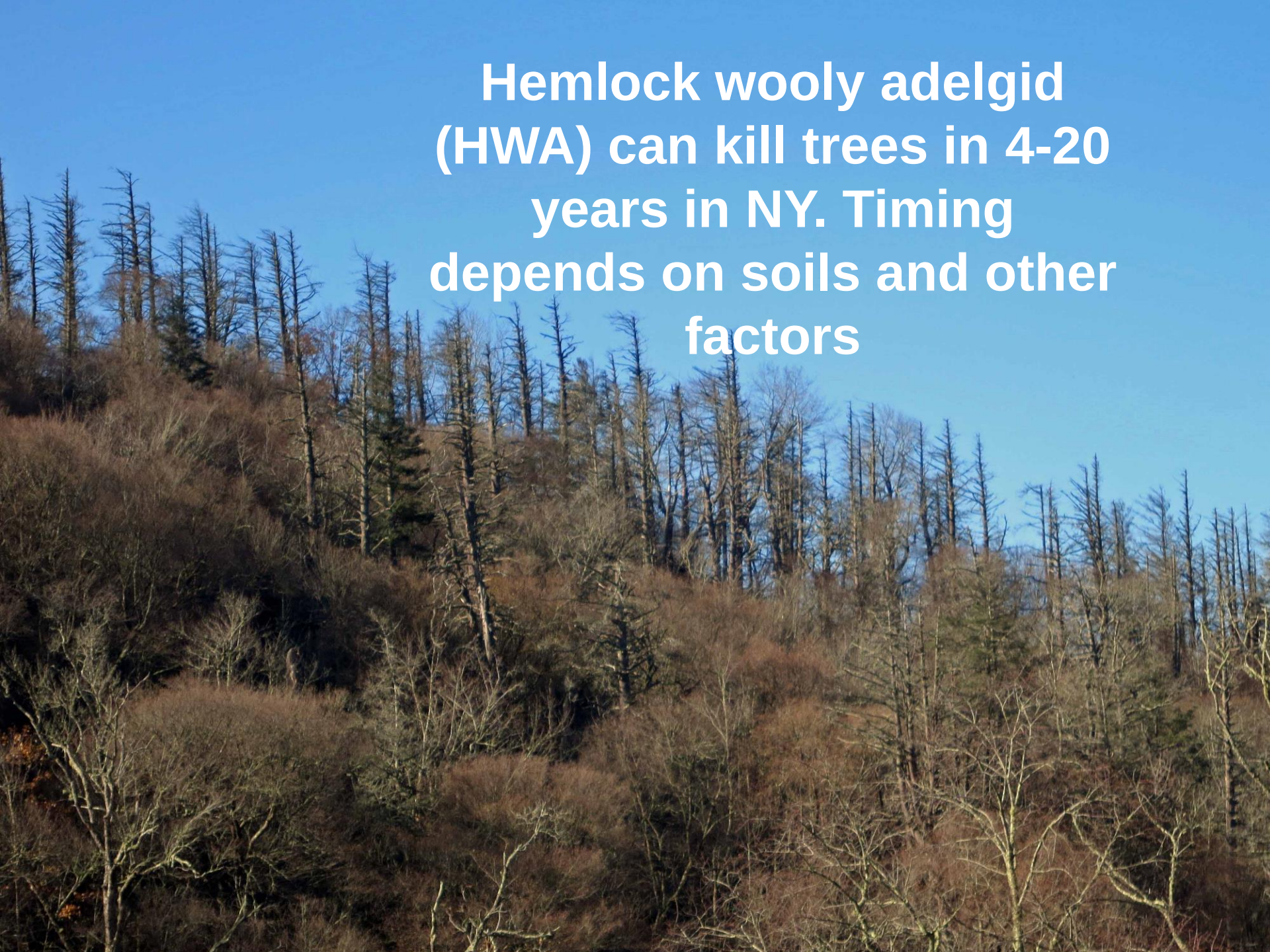
Hemlock woolly adelgids feed on twigs near the base of hemlock needles

Adelgids feed on the tree's stored nutrients, and the feeding damage leads the blocking of the flow of nutrients to the buds and needles



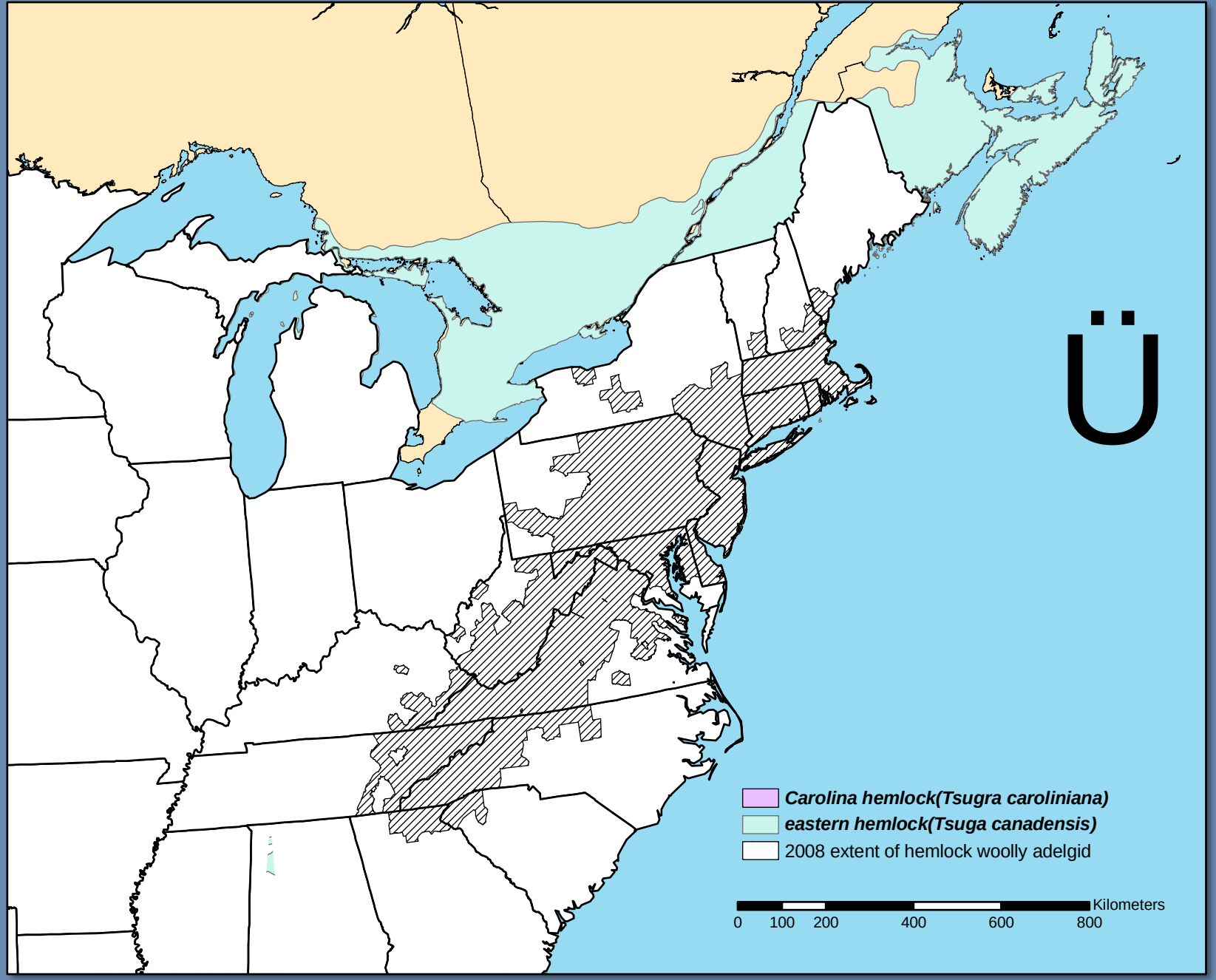

Hemlock wooly adelgid (HWA) can kill trees in 4-20 years in NY. Timing depends on soils and other factors

Host trees in North America

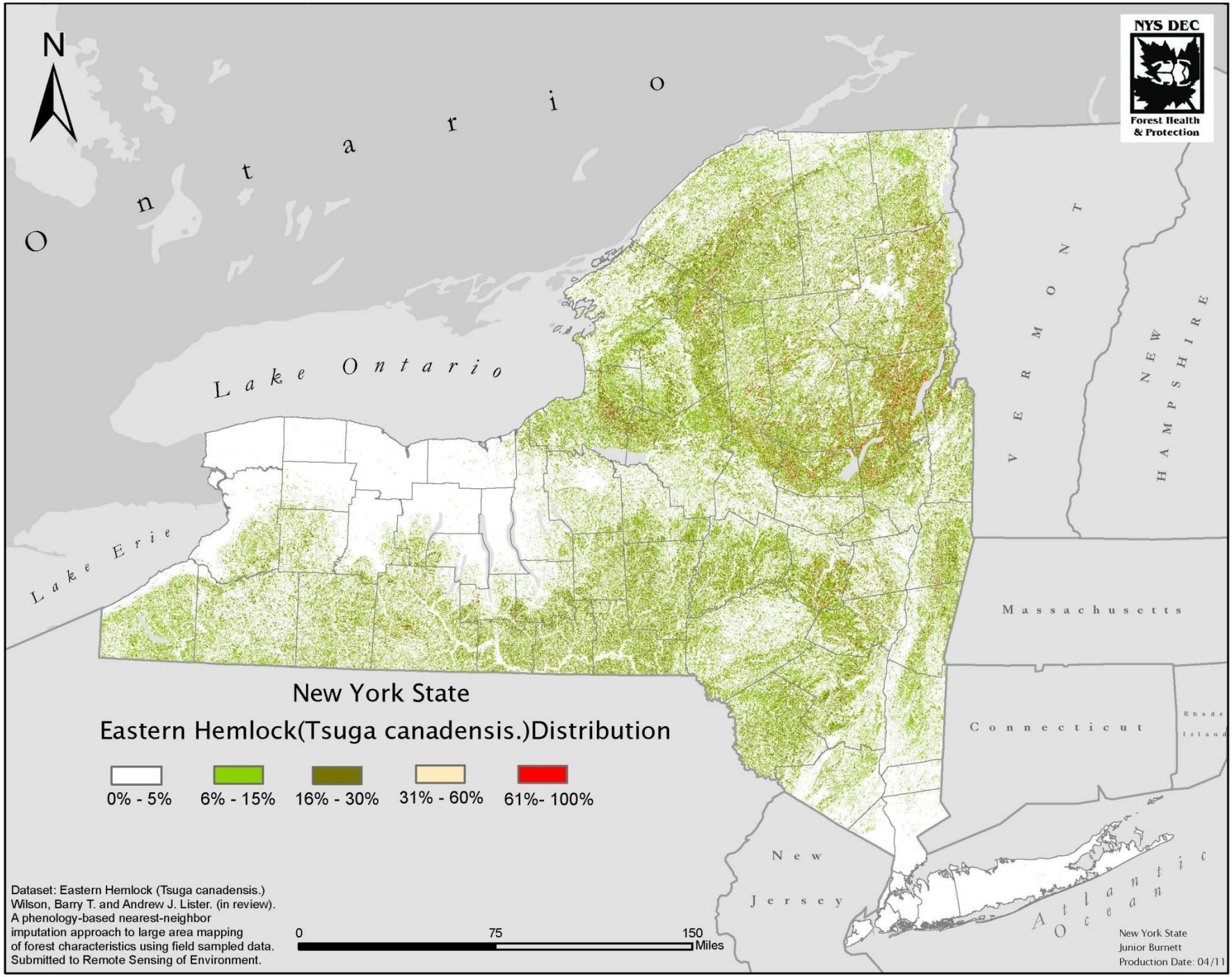
Eastern Hemlock
Tsuga canadensis

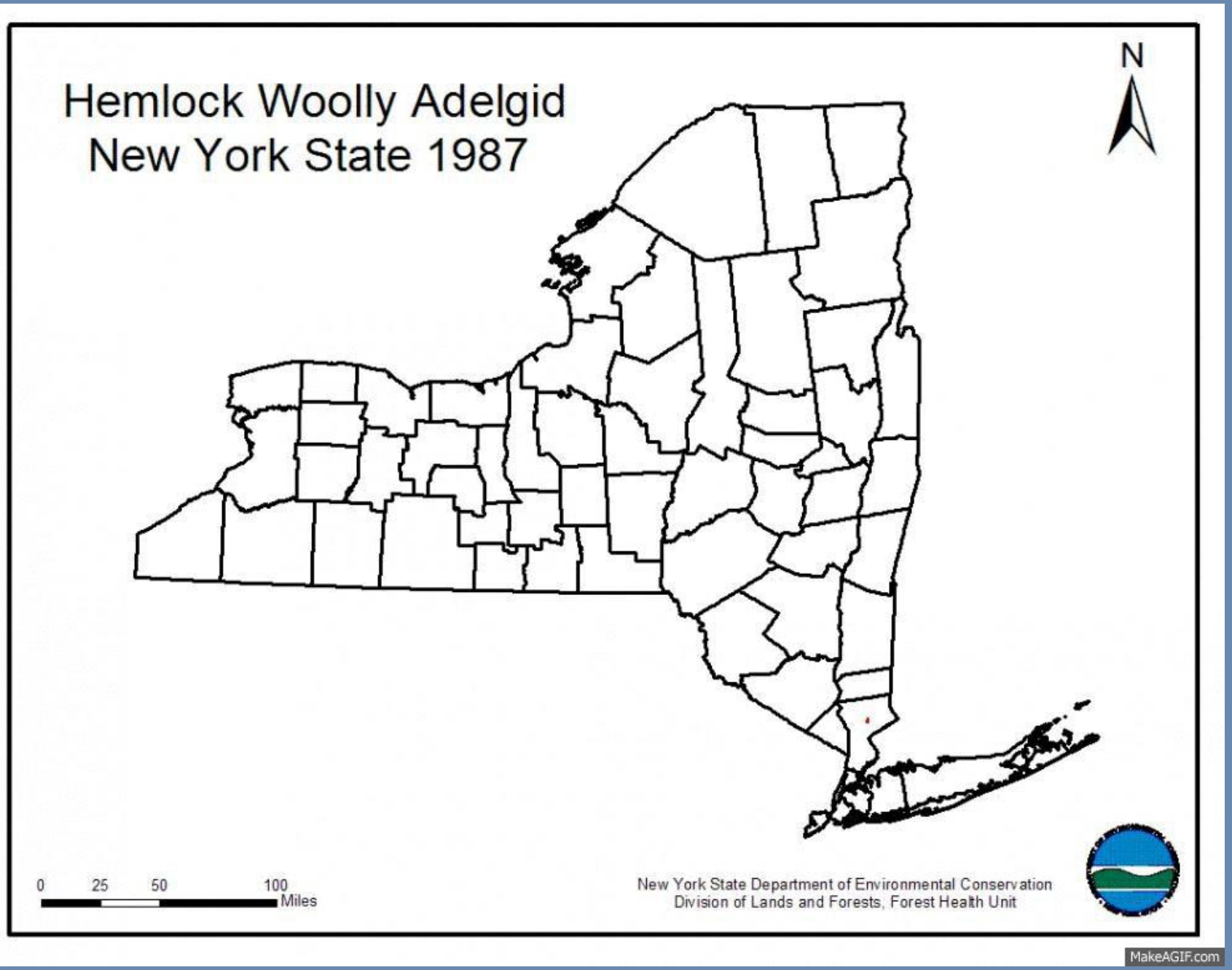
Carolina Hemlock
Tsuga caroliniana

Western Hemlock
Tsuga heterophylla



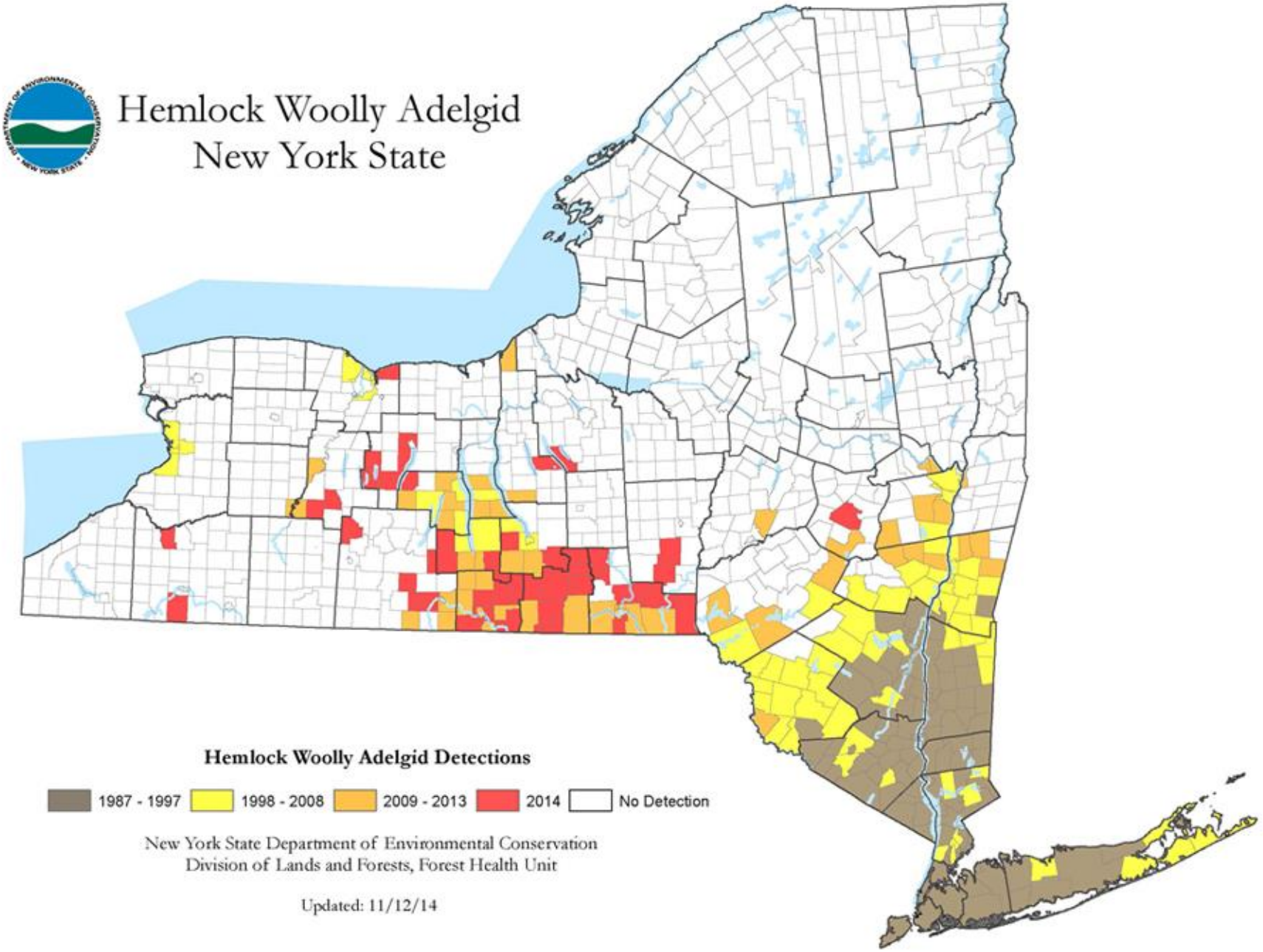
USFS, Northern Research Station, 2008


N
NYS DEC
Forest Health & Protection
Ontario
Lake Ontario
Lake Erie
VERMONT
NEW HAMPSHIRE
Massachusetts
Connecticut
Rhode Island
New Jersey
Atlantic Ocean
New York State
Eastern Hemlock(Tsuga canadensis.)Distribution
0% - 5%
6% - 15%
16% - 30%
31% - 60%
61%- 100%
Dataset: Eastern Hemlock (Tsuga canadensis.)
Wilson, Barry T. and Andrew J. Lister. (in review).
A phenology-based nearest-neighbor
imputation approach to large area mapping
of forest characteristics using field sampled data.
Submitted to Remote Sensing of Environment.
0
75
150
Miles
New York State
Junior Burnett
Production Date: 04/11



Scott McDonnell, NYSDEC. 2014.

Hemlock Woolly Adelgid
New York State

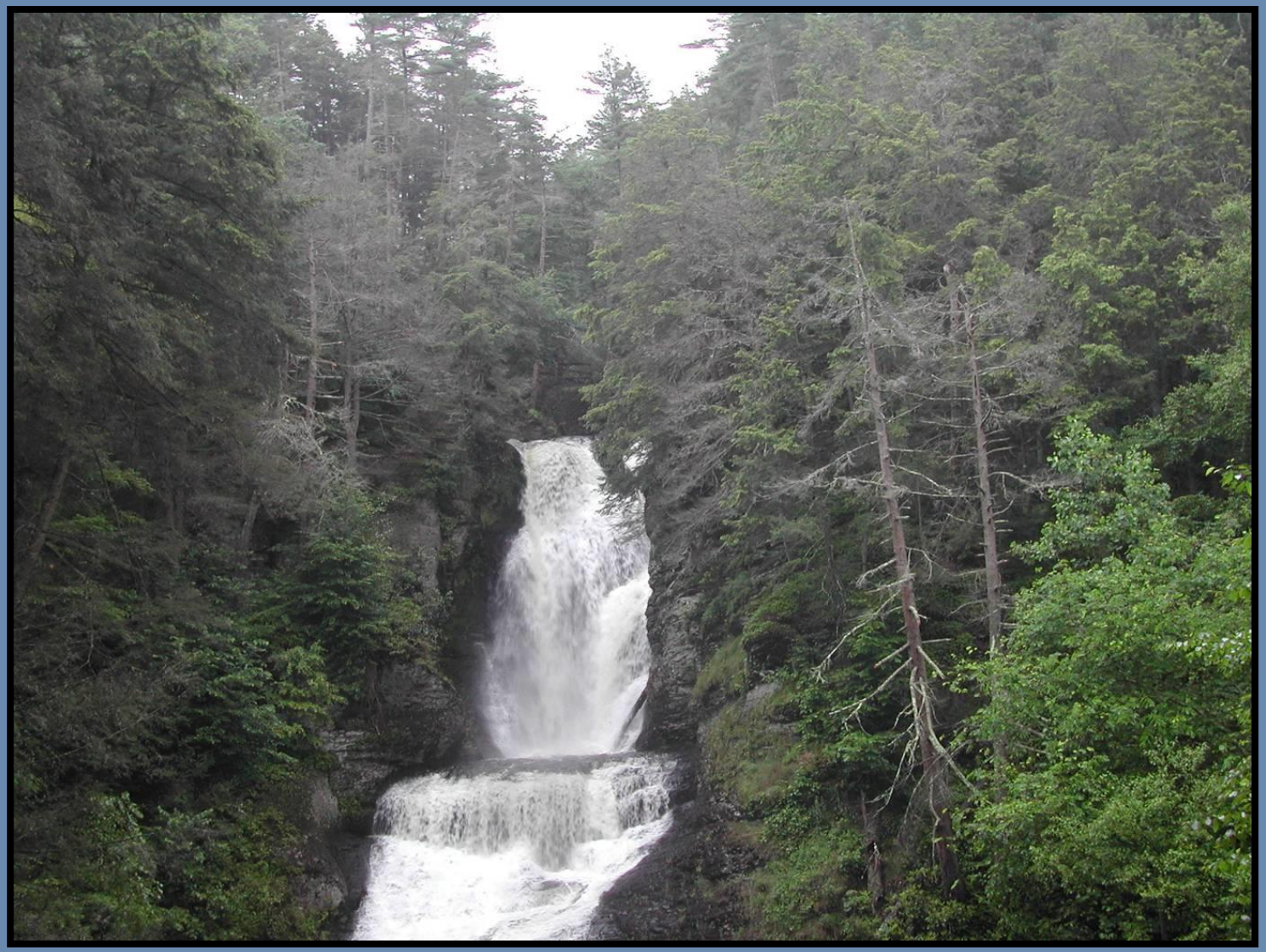


New York State Department of Environmental Conservation
Division of Lands and Forests, Forest Health Unit

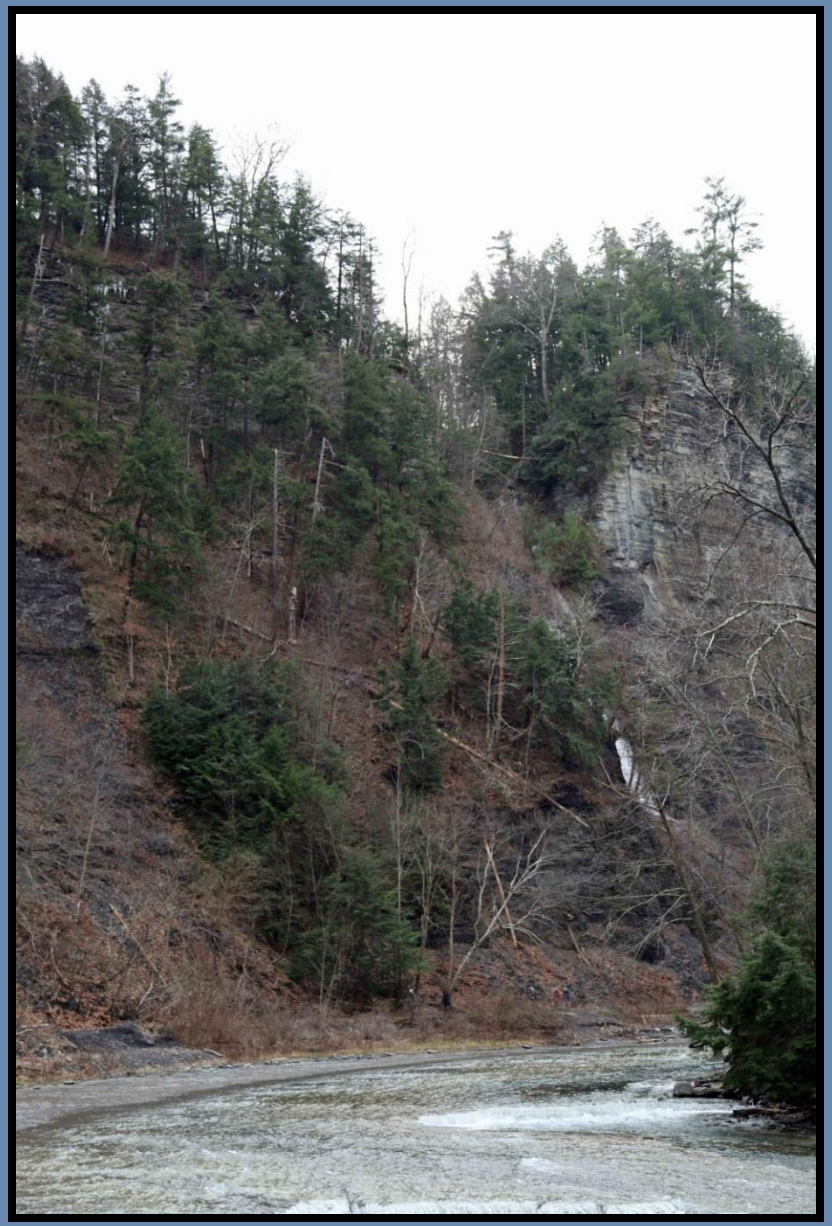
Updated: 11/12/14

Questions/Comments?

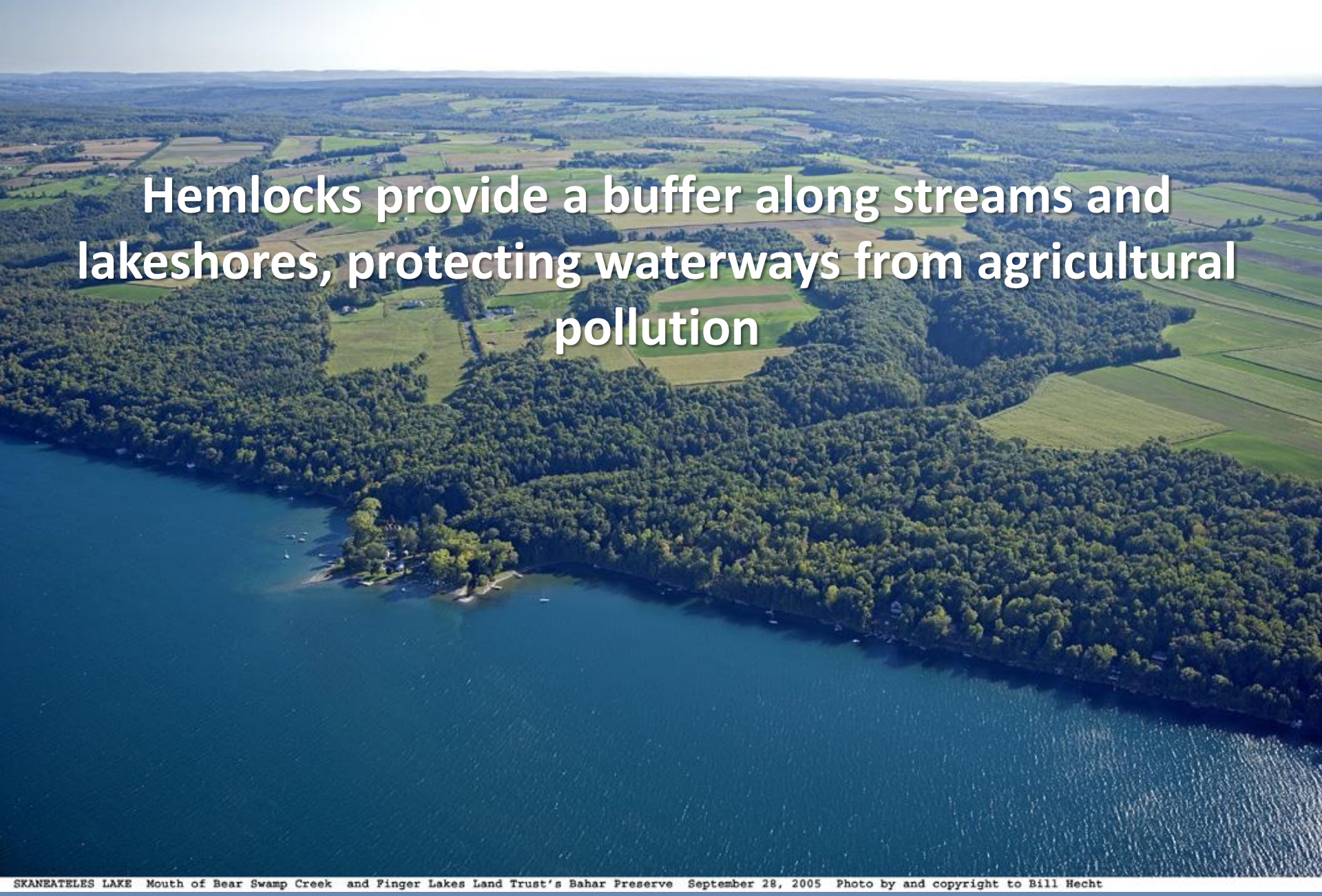
Hemlocks are foundation species in the forest: Frequently occur along gorges and waterways



Hemlocks are foundation species in the forest: Grow on Hillsides, Prevent Erosion



Shade steams, shelter animals & plants; Death can allow invasive plants to establish



Skaneateles Lake, a AA unfiltered source of water for Syracuse, NY

Photo Bill Hecht 2005

Watkins Glen State Park

HWA infestation detected in 2009

Tree had severe canopy decline after just **3 years!**

HWA on an infested tree: the white stuff is a waxy wool the adelgids produce to protect themselves

What impact do you think the hemlock woolly adelgid could have on your community or you personally?

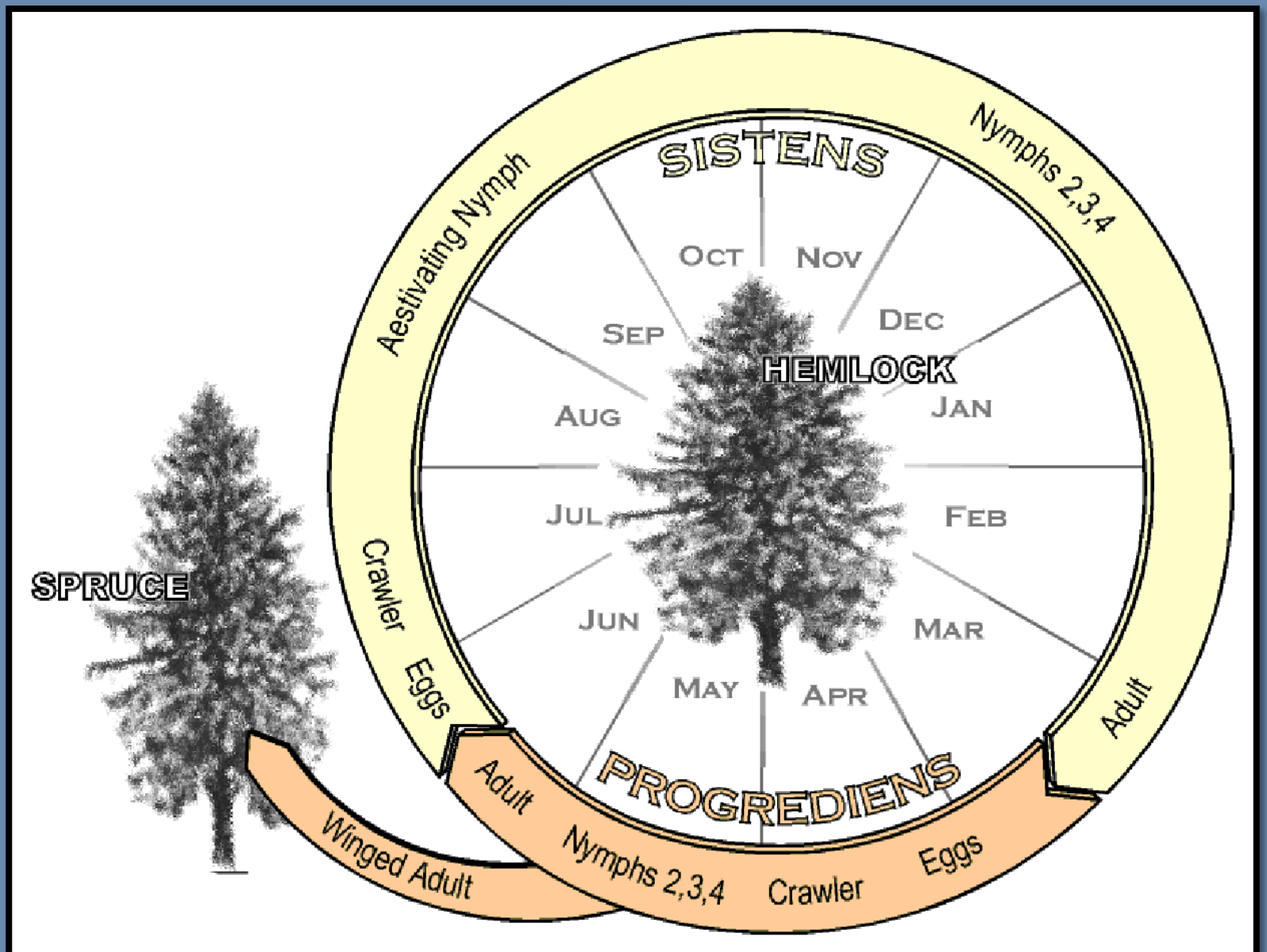
Now its time to learn some weird biology!

Life Cycle

HWA on the East coast is from Southern Japan, in Japan it has both sexual and asexual reproduction
In US only asexual Reproduction: No males needed!

Only 1 female is necessary to start an infestation!

2 Generations/ year; in US only feed on hemlock



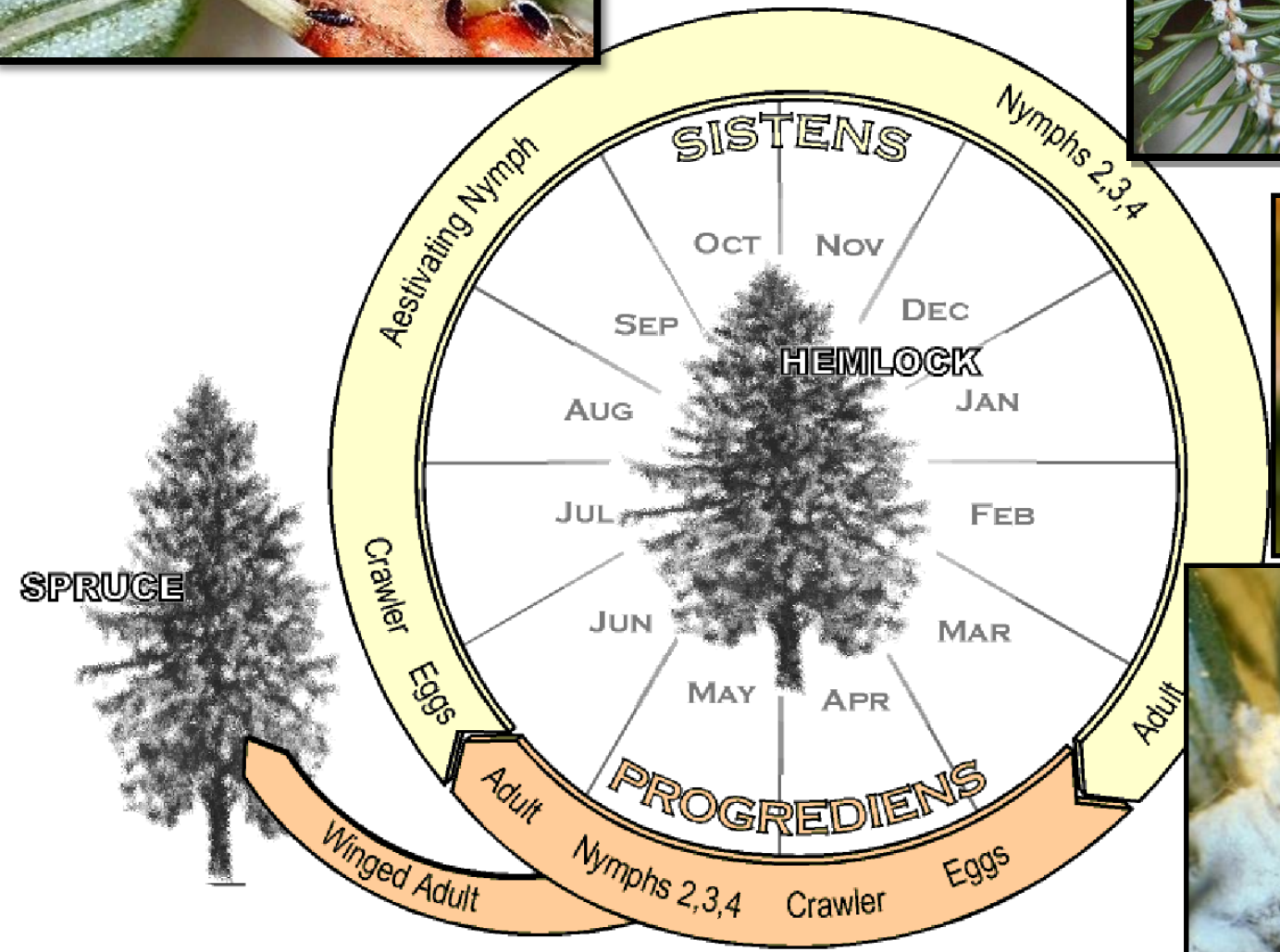
Vince D'Amico & Michael Montgomery

2 generations per year & 50-100 eggs/female 1 x 100 x 50 = 5,000 potential progeny from 1 female/yr.

Crawler is the ONLY stage which disperses! Wind is important for short dispersal, birds for long distances.

The *Crawler* will find a feeding location and insert it's mouthparts, staying in that spot for the rest of its life. With this change it is called a *Nymph*.

Life Cycle


SISTENS
PROGREDIENS
HEMLOCK
SPRUCE
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
Aestivating Nymph
Nymphs 2,3,4
Adult
Eggs
Crawler
Winged Adult
Adult
Nymphs 2,3,4
Crawler
Eggs


crawler
UGA5018073

Questions/Comments?

HWA Detection

Look for gray foliage tint from afar

HWA on the branches give trees gray tint

HWA Detection

Look for the bug itself on twigs

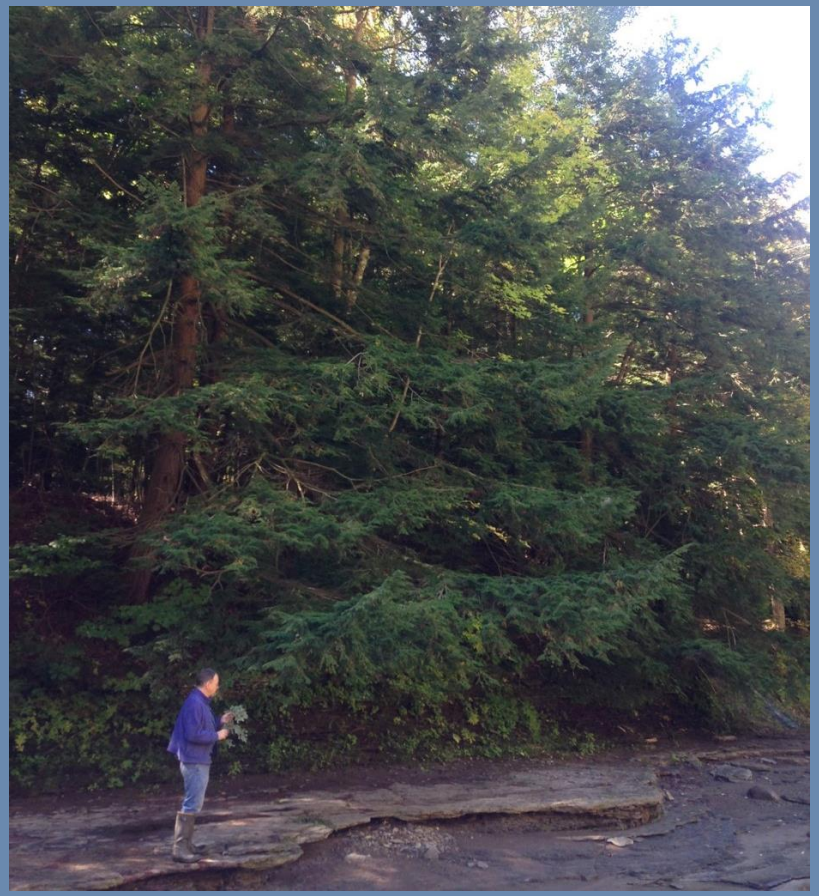
- Inspect branches near ground
- Don’t use binoculars! The glare from the shiny needles gives false positives!
- Examine twigs that fall to the ground after a storm. Infestations are frequently in the crown and fallen branches may have HWA

HWA Detection

- Examine bark of trees for tell-tale wisps of the waxy wool
- Woolly Wisps can also be seen on forest floor
- A squash ball with Velcro can be launched into the tree to detect adelgids in the crown

Be sure to check branches near water

Birds are implicated as good long distance vectors and frequently rest on hemlocks near water



Early infestations are frequently patchy

HWA may be hard to see in summer because they are dormant and very small.

Early infestation: Many HWA because tree is still a good quality food source

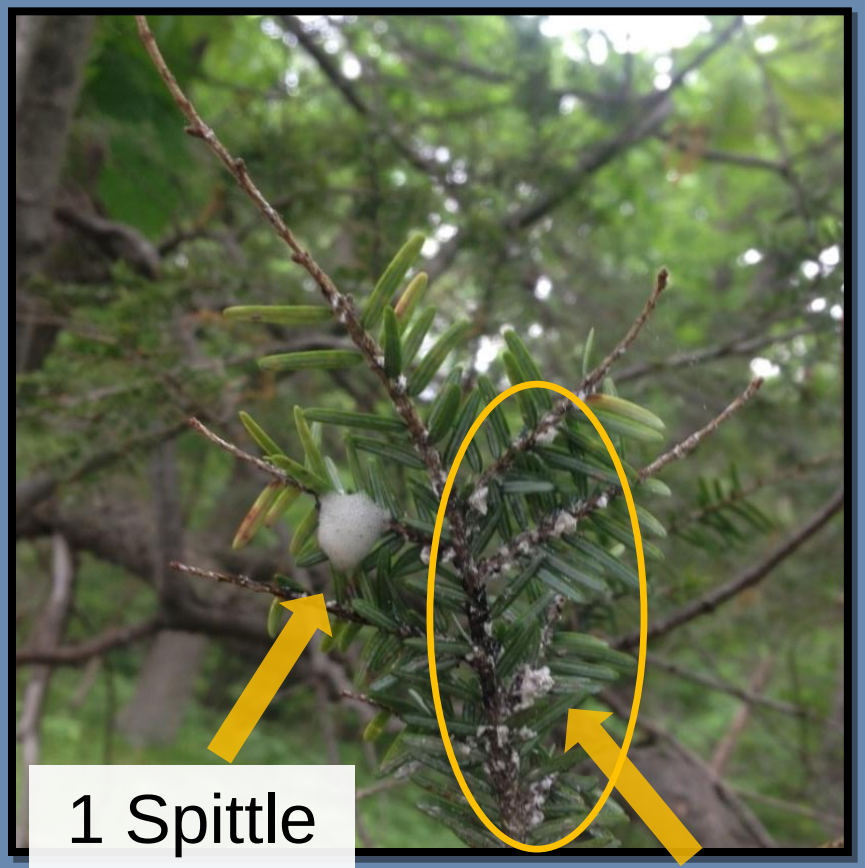
Late infestation

in Summer, new growth has been killed by HWA

Few HWA because HWA only feeds on new shoots

Which one is the adelgid?

Which one is the adelgid?



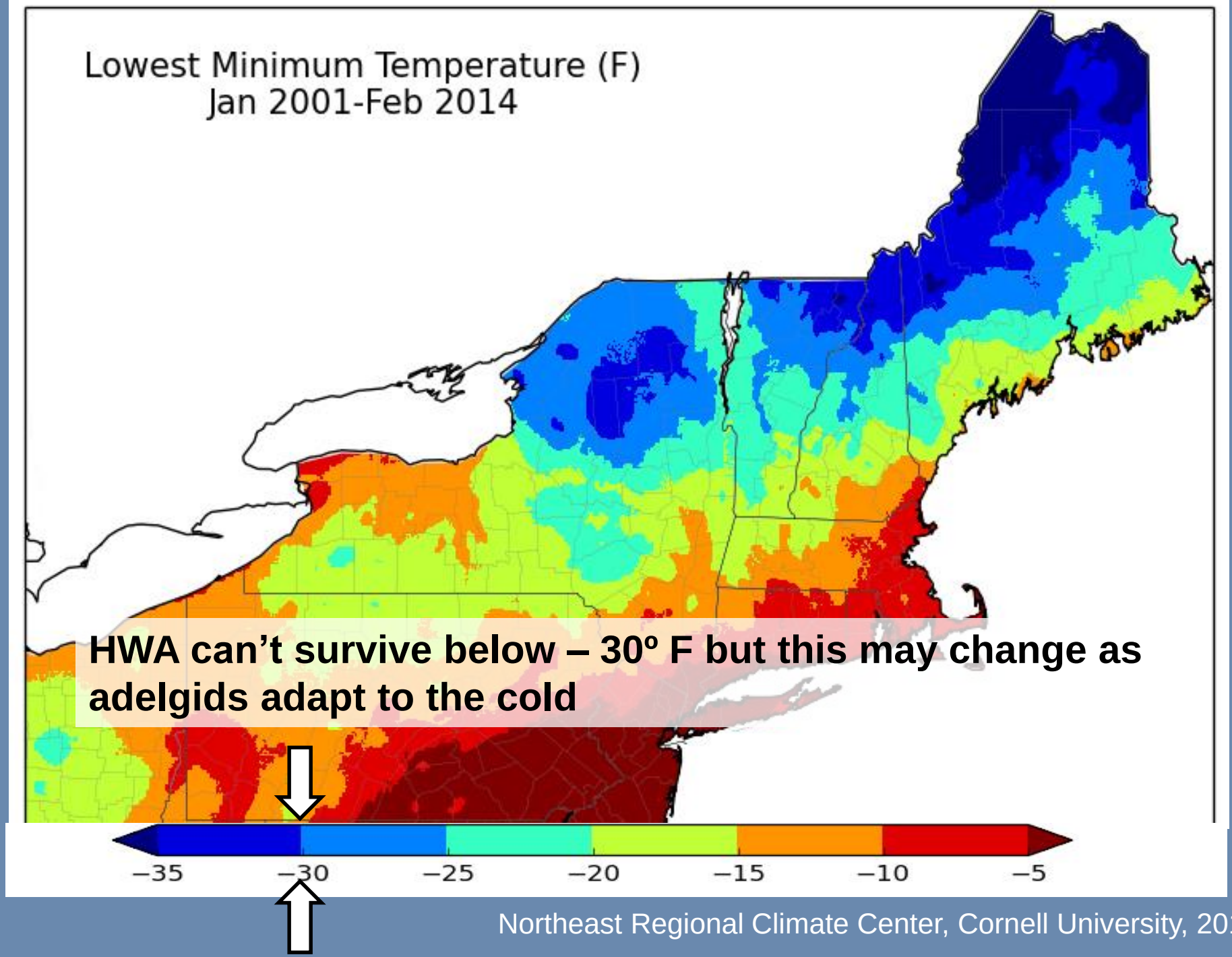
1 Spittle bug

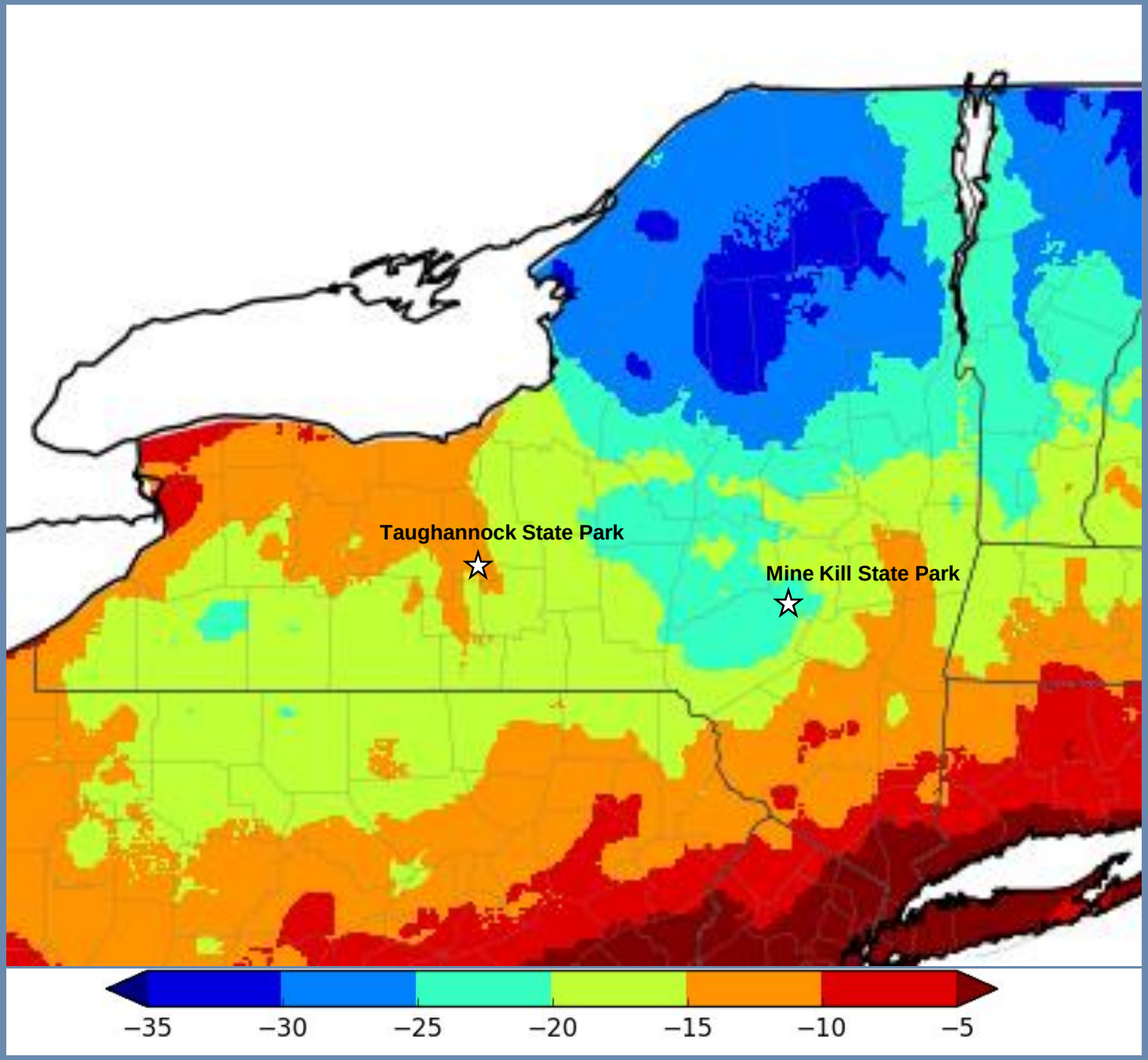
2 HWA

3 Hemlock elongate scale: on underside of needle not on twig

HWA and Cold Weather

- **HWA populations can be reduced by cold weather**
- **Severity and time of year are important.**
  Parker et al. 1999; Skinner et al. 2003
  - In January and February, 3% of HWA from Holyoke, MA survived -22F (-30C); none survived -31F (-35C).
  - Susceptibility increases later in the season (Feb – Mar)
- **Tolerance of low temperatures genetically linked.**
  - Common garden experiment in MA with HWA from Maryland and MA. Butin et al. 2005
  - Adelgids from colder areas were more cold tolerant!


Lowest Minimum Temperature (F)
Jan 2001-Feb 2014
HWA can’t survive below – 30º F but this may change as adelgids adapt to the cold
−35
−30
−25
−20
−15
−10
−5
Northeast Regional Climate Center, Cornell University, 2014



Northeast Regional Climate Center, Cornell University, 2014

HWA and Cold Weather

- Taughannock State Park
  - Lowest temperature -8F (-22C) on 4 Jan 2014
  - 91% mortality, n=3253
- Mine Kill State Park
  - Lowest temperature -24F (-31C) on 23 Jan 2014
  - 82% mortality, n=2936
- The colder location has less HWA mortality!
- It appears that HWA populations can adapt to the cold!

How do you identify hemlock trees?

Cone Bearing evergreens

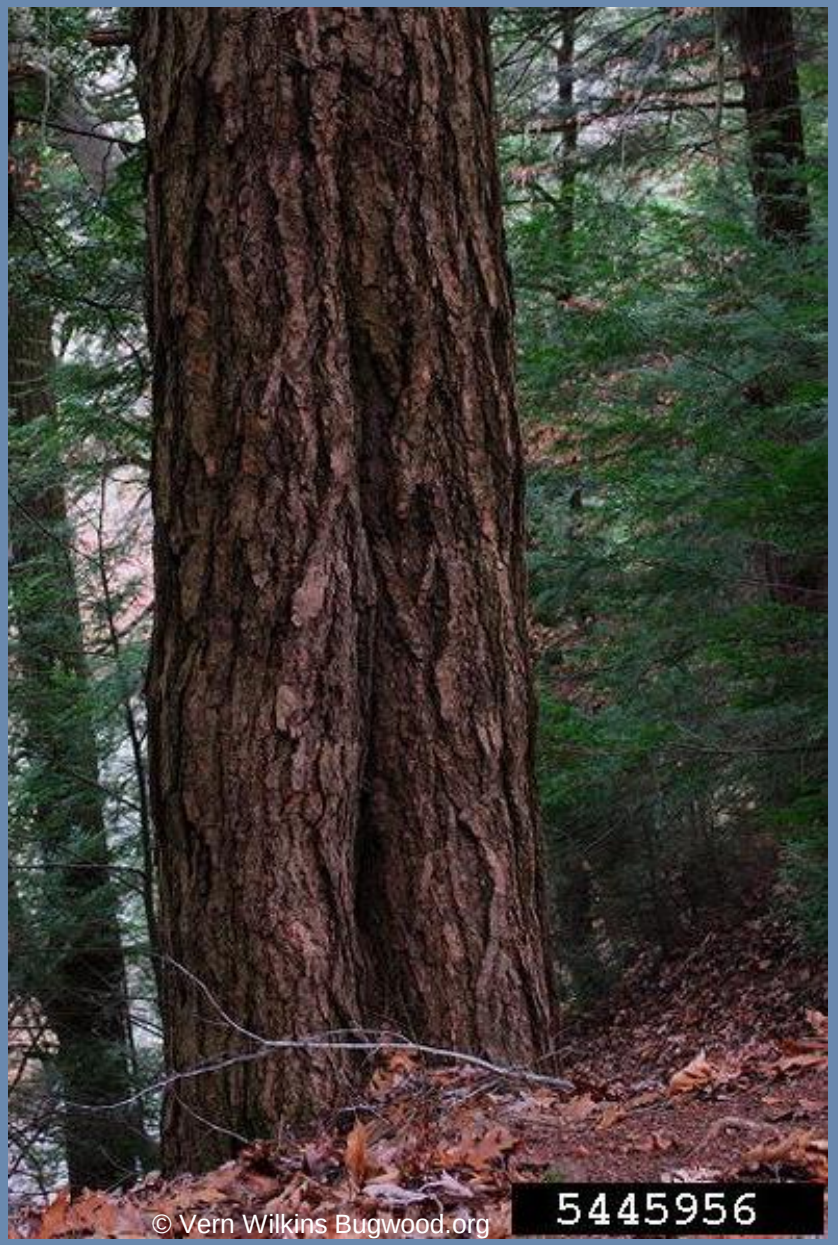
Short, soft, flat needles alternately arranged on twig

Dull green under with 2 white stripes

Shiny green top

Needles are attached individually and have a little stem at the base

Bark: Grayish black with red hues



Monitoring HWA

Time of year?

Trees most likely to be infested and/or die first?

Distribution (pattern) of infestation?

Monitoring HWA

Time of year?

- Anytime! January-May is best

Trees most likely to be infested and/or die first?

- Trees near water most likely to be infested
- Older trees likely to die first

Distribution (pattern) of infestation?

New: Patchy! Older: More uniform

What can reduce HWA populations?

Natural Control

i.e. bugs that eat bugs,

tough trees & nasty weather

Chemical controls:

i.e. pesticides

Natural Control of Insect Populations

- **Host Tree Resistance**
  - Many factors involved, most poorly understood for trees
- **Abiotic Factors**
  - Temperature, humidity
- **Biological Control**
  - Predators, Parasites, and Pathogens
- **Populations are kept under control through the additive effect of all these factors**
- **What is being done to control HWA?**

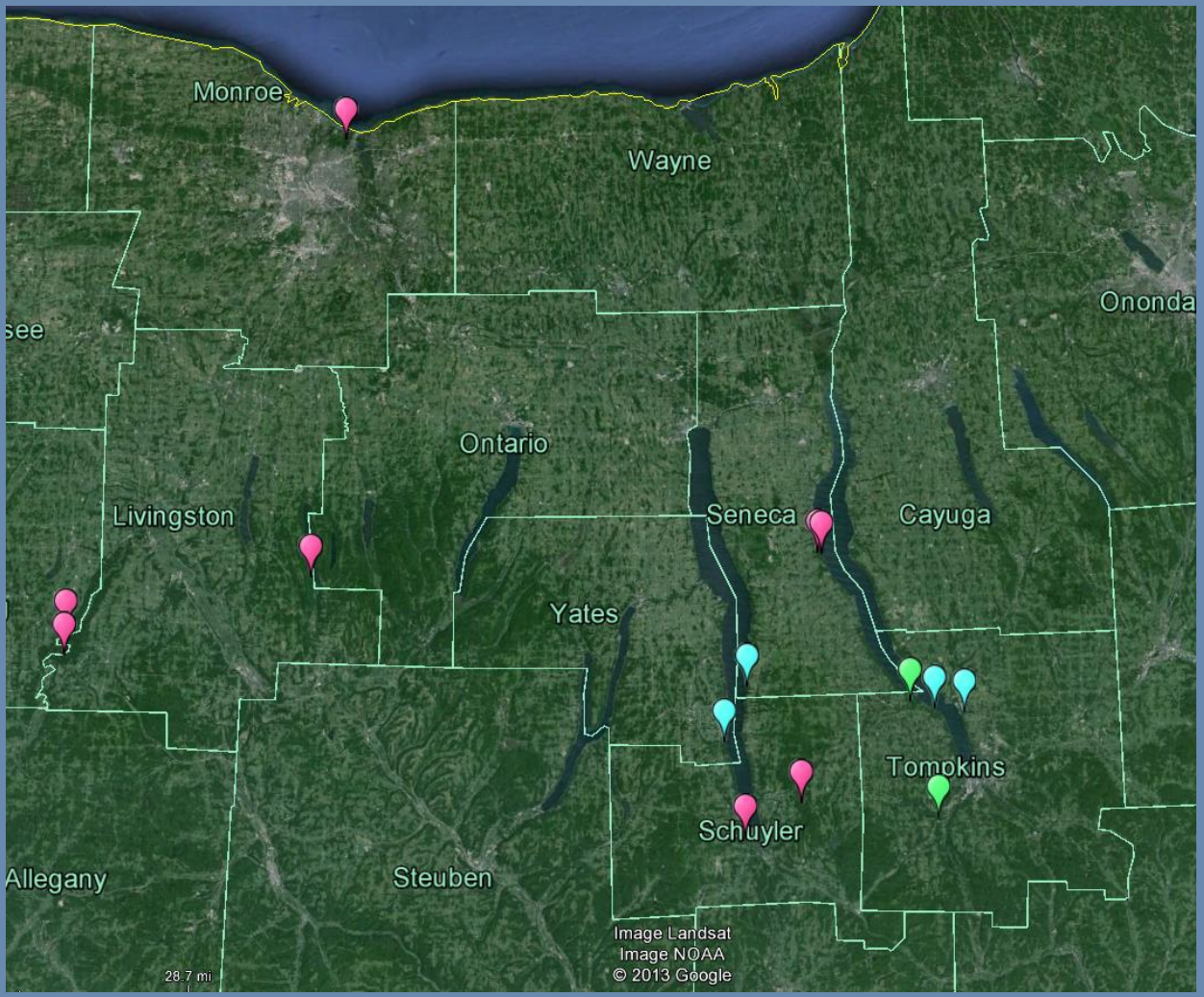
HWA Biological Control Program

- HWA detected in Eastern United States 1951?
- Classical Biological Control program initiated in 1993
- Work has focused on Coccinellid and Derodontid beetles from Eastern Asia and the Pacific Northwest.
  - Seven species have been released to date, two in NY
  - Only one species has become widely established: *Laricobius nigrinus* (Coleoptera: Derodontidae)

Laricobius nigrinus

- Native to Pacific Northwest: Feeds ONLY on Adelgids

Laricobius nigrinus releases in NY 2009 to 2013

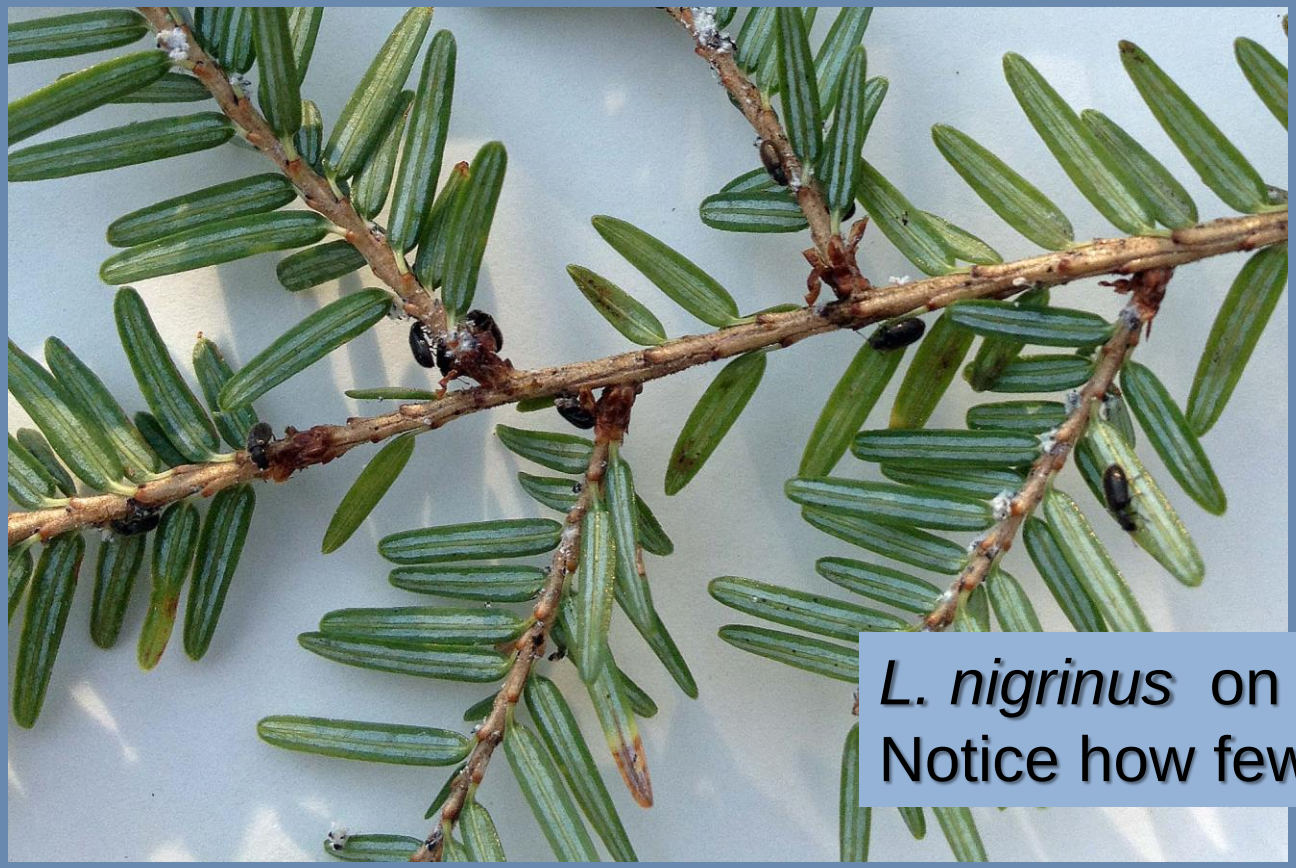


- 14 locations: 2009, 2012, 2013
- Two biotypes:
  - Puget Sound
  - Idaho
    - Established at two sites – F5 generations

Laricobius nigrinus releases

Laricobius nigrinus Production

- *Laricobius nigrinus* is very effective at killing HWA however it is expensive to rear!
- Laboratory production $8 per bug!
- Most releases are wild collected: Puget Sound and Idaho



L. nigrinus on an infested branch: Notice how few HWA there are!

Silver flies released for the 1st time in 2015!

- 2 species of *Leucopis* species from the Pacific NW
- Larvae feed on HWA eggs
- The goal is to establish a suite of predators that will fill all the potential niches occupied by HWA.

Natural Enemy Production

Current push is to create field insectaries:

- Planting hemlocks in convenient locations across the state
- Utilize established hemlock hedges

Biocontrol in North Carolina

Natural enemies were released too late to save most of these trees

Hemlock Hill, Banner Elk, NC – First release of Laricobius nigrinus 2003

Hemlock Recovery in North Carolina

This hillside wasn't as badly infested and more natural enemies were released so more trees survived

Chemical Control

Goal: protect hemlock gene pool!

Types of chemicals

- Mineral oil or soaps
- Systemic Insecticides

Recommendations: Mark Whitmore

Topical Chemical Control: Not recommended!

- Mineral oil or soaps
  - Thorough application required for adequate control
  - Potentially detrimental effects on non-target organisms

Mark Whitmore

Great Smoky Mountains National Park Resource Management Archive, USDI National Park Service, Bugwood.org

UGA1294055

Mineral oil or soaps: Not recommended!

Access is necessary for spray rigs: urban areas only

Mark Whitmore

Mineral oil or soaps

Impacts on non-target organisms is detrimental

Need to apply annually

Mark Whitmore

Systemic Insecticides

- Imidacloprid
  - Various formulations and application techniques:
    - **Core Tect** - time release tablets – NY restricted use
    - Stem injection – NY restricted use
    - Soil injection – NY restricted use
    - Soil drench – Only formulation available to homeowners
    - Basal bark spray – NY restricted use

Effective for 7 years or more

Problem: Slow movement through tree: up to 1 year

Recommendations: Mark Whitmore

Imidacloprid: Soil drench Available to homeowners

Mark Whitmore

Pesticides can kill aquatic insects!

Best Management Practices

Old tree in decline?

- Dinotefuran (Safari): Fast!
- + Imidacloprid: long-term protection

Young tree with good canopy?

- Imidacloprid only: Time not an issue

Recommendations: Mark Whitmore

Imidacloprid & Dinotefuran (Safari) Basal Bark Spray Tank Mix

Dinotefuran (Safari)

- Fast moving
- Effective 1-2 years

Imidacloprid

- Slow moving
- Effective up to 5 years

Mark Whitmore

Hemlock Recovery

No need to treat until HWA observed, but… don’t wait too long!

Time is not as much an issue for young trees as long the canopy is not showing symptoms

Mark Whitmore

Treatment Evaluation

Upper crown will respond first, then the lower crown

Look for new shoots to evaluate response to treatment

Mark Whitmore

Systemic insecticies + biological control

- Treat vulnerable large trees
- Leaving younger trees to harbor HWA & grow predators

+

Recommendations: Mark Whitmore

Next steps for Management

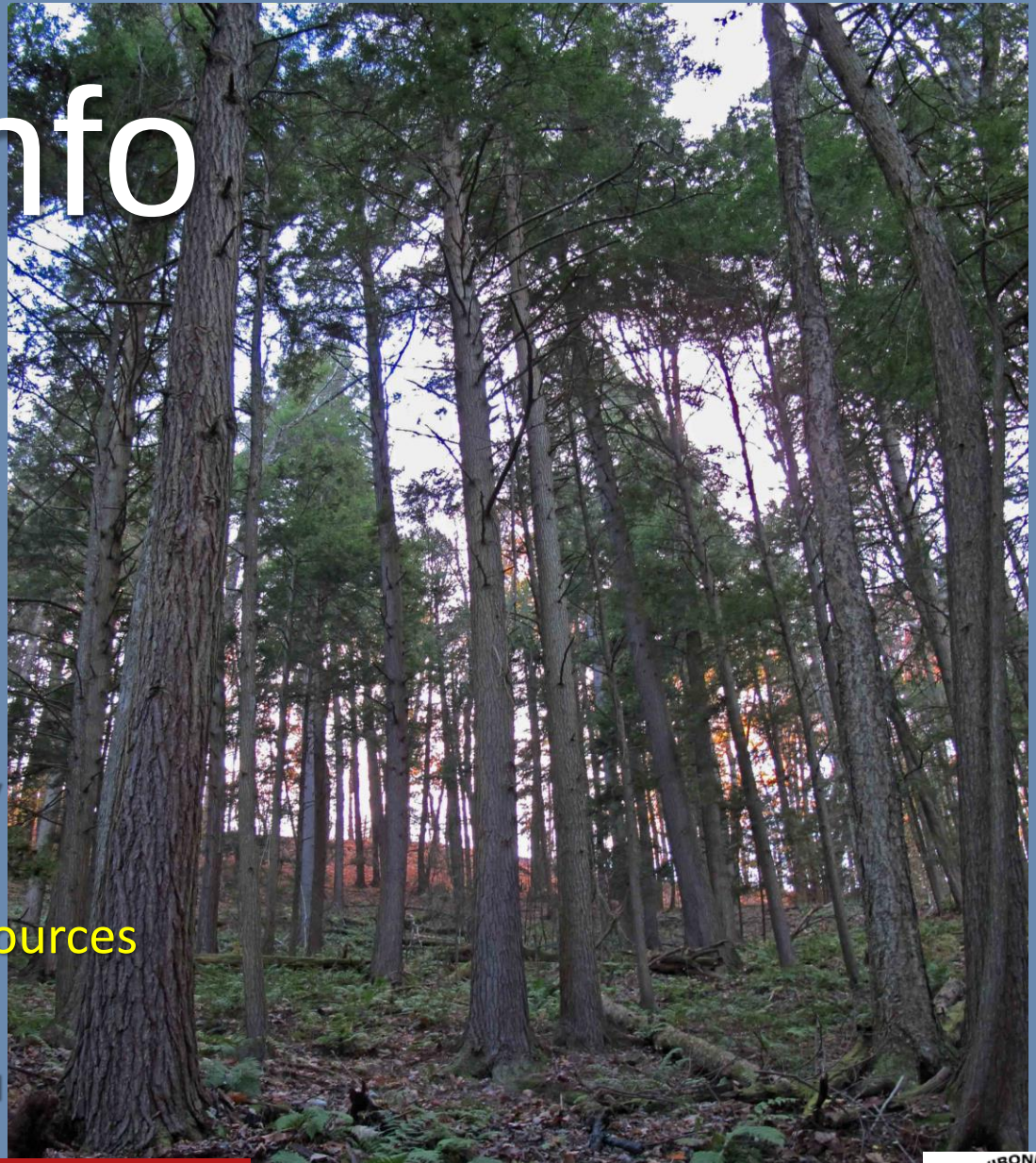
- Develop region wide priorities for managing specific stands
- Maintain genetic resources: **Protect Trees!**
- Early detection and monitoring: **Very important!**
- Rear and release predators

Mark Whitmore

Keep the legacy alive
Sign-up to Volunteer!

www.nyshemlockinitiative.info

nyis.info



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