Hemlock Wooly Adelgid

MEGAN MASSA MEES718I FALL 2021

Outline

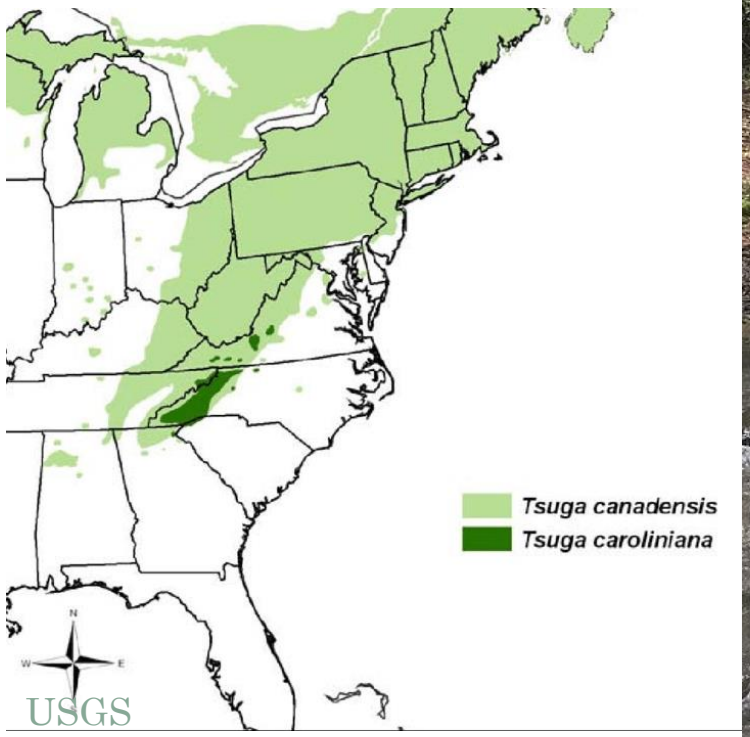
- Eastern hemlock
- Hemlock woolly adelgid (HWA) biology
- Invasion history
- Impacts
- Control efforts in MD
- Research gaps

Thanks to Biff Thompson, Maryland Department of Agriculture

USDA

Eastern hemlock (*Tsuga canadensis*)

- Foundational species
- IUCN Status: Near Threatened
- Cooler climate, elevation
- Pockets in eastern MD



HWA biology

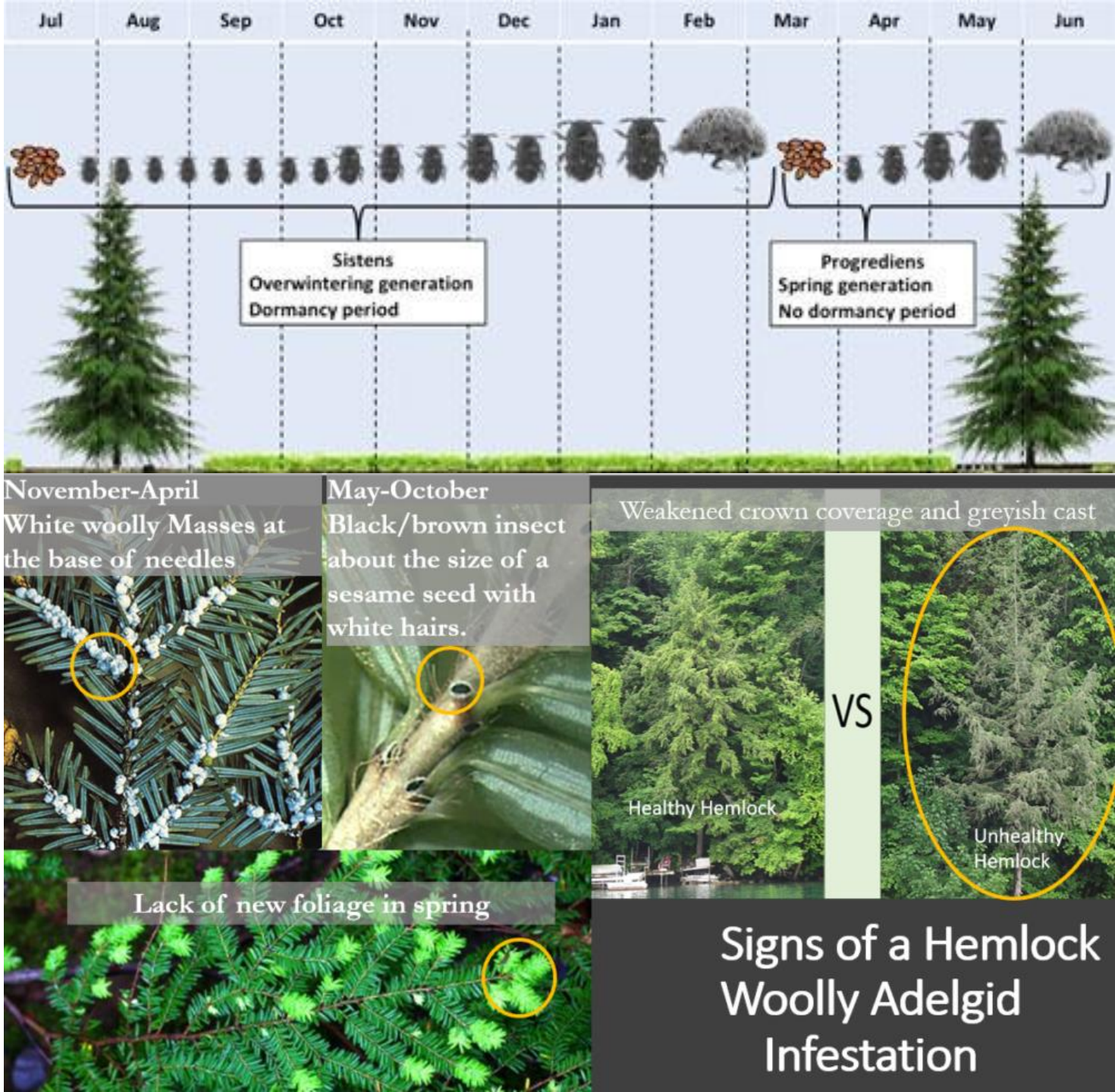
Hemlock woolly adelgid (Adelges tsugae) or HWA

Eastern hemlock has low resistance (Havill et al. 2011)

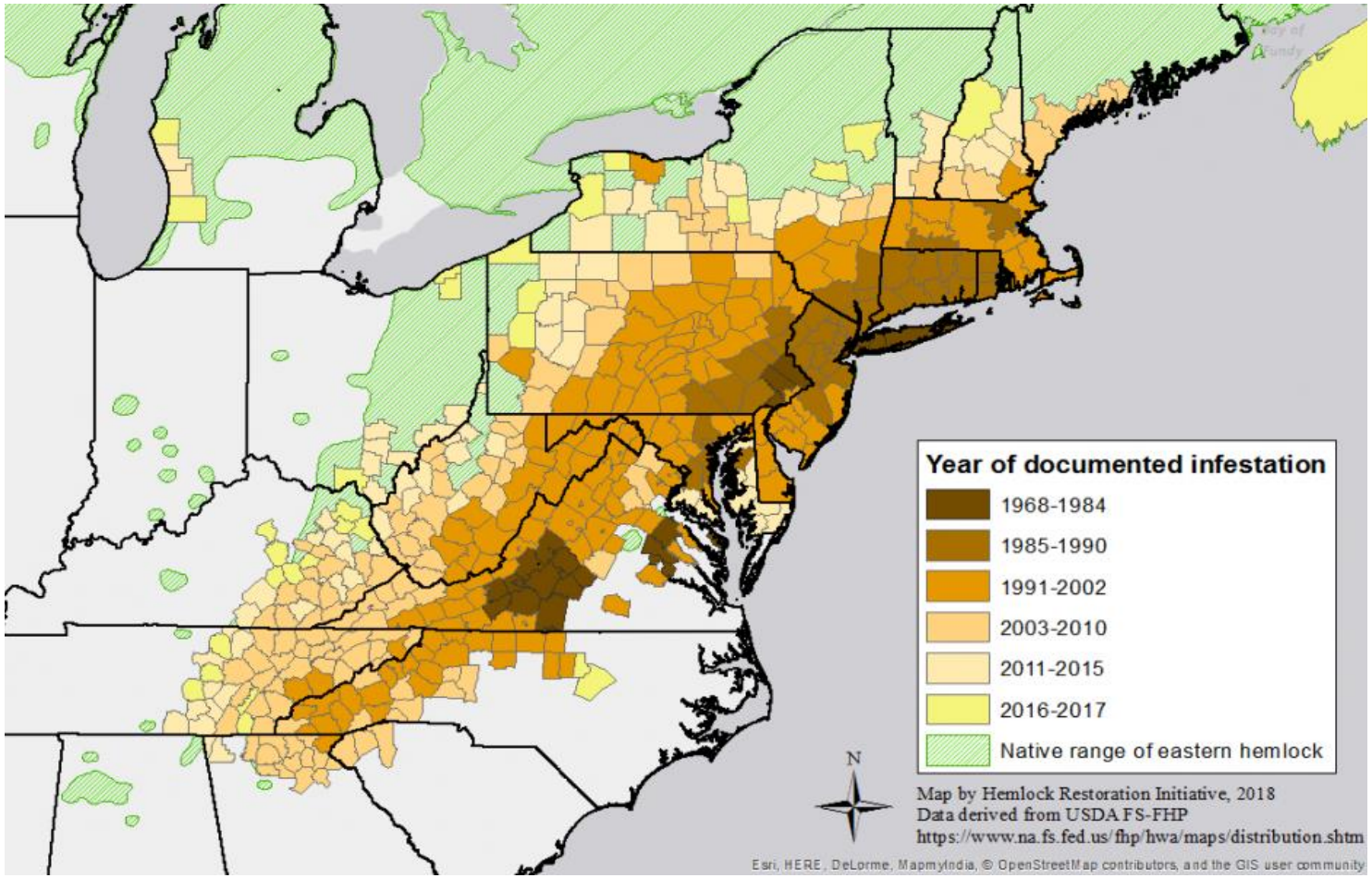
2 generations:

- Progrediens: spring
- Sistens: overwintering ovisacs

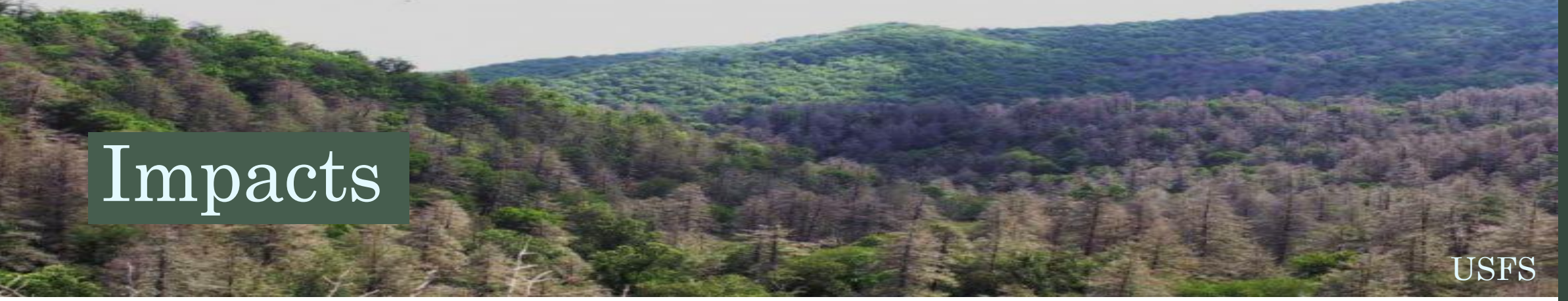
High reproductive potential (300 eggs per individual)



Invasion history



- Richmond, VA 1950
- Single introduction of a Japanese HWA lineage (Havill et al. 2011)
- Rapid southward spread 15.6 km/yr, slower spread northward at 8.1 km/yr (McAvoy et al. 2017)



Impacts

- Canopy thinning, stand death
- Carbon cycling (Nuckolls et al. 2009)
- Increased nitrogen in stream water (Cessna & Nielsen 2012)
- Shifts in benthic macroinvertebrates as community type changes to rhododendron or mixed hardwood (Diesburg et al. 2019)
- Facilitate secondary invasion with loss?
  - "Hemlock effect" (Long 2006)
  - Depends on invader, possibly prevented by soil chemistry
- Financial costs of lowered property values (Li et al. 2014)

Control efforts in MD

- Monitoring: MDA Forest Pest Management Section
  - Detection and impact surveys to ID priority stands
- Control efforts began in late 90s in Frederick Co
- 96-97: field trials with insecticide
- 2003 First biocontrol efforts
- US Forest Service HWA Initiative

Insecticide

- Foliar spray (insecticide or oil)
- Systemic treatment (imidacloprid)
  - Soil injection
  - Trunk injection
  - Soil drench

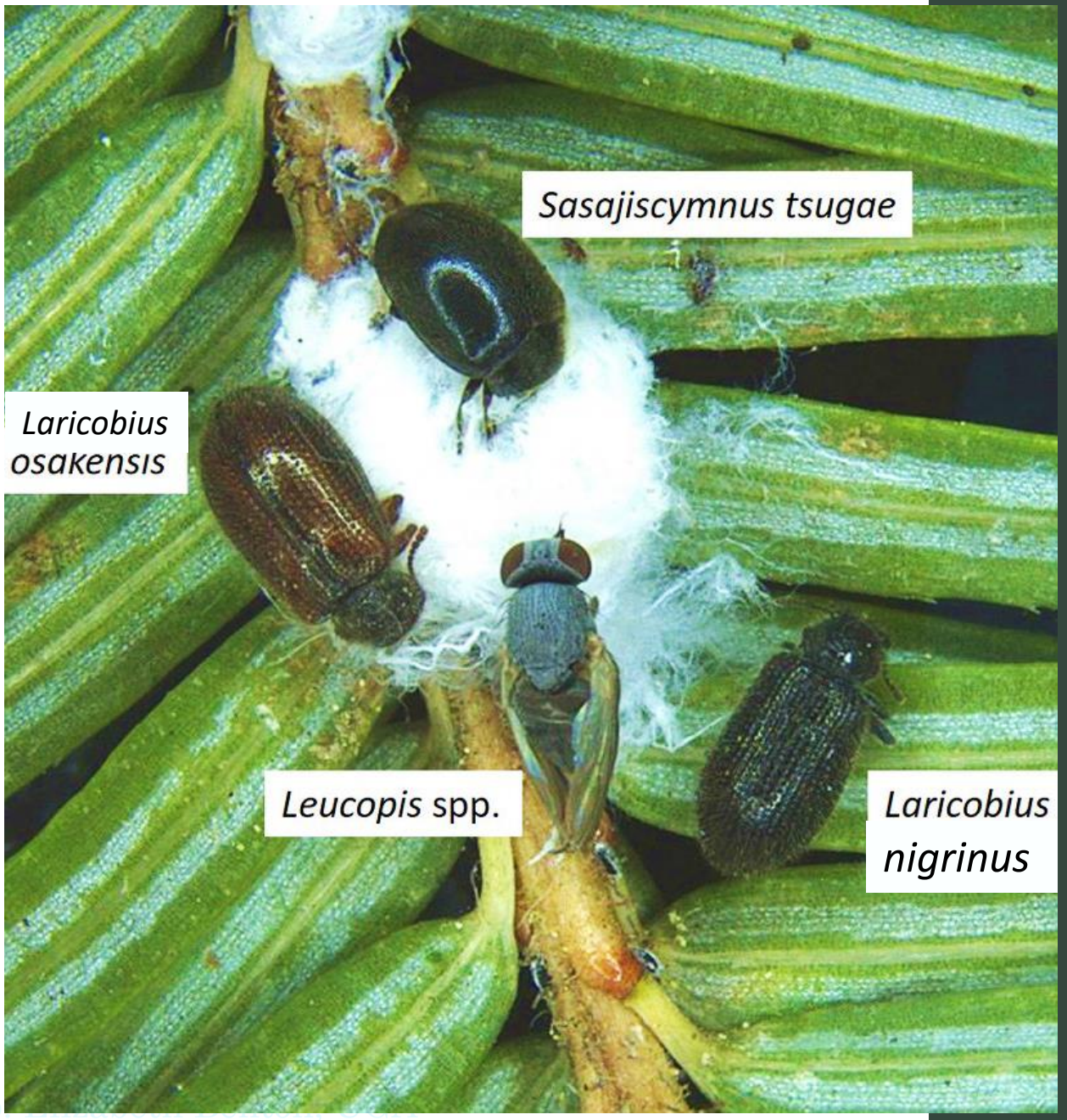
Soil injection / USDA

- Non-target impacts?
  - Imidacloprid detected (below EPA benchmarks) in streams associated with HWA treatment (Benton et al. 2016)
- Large-scale application difficult, especially in remote areas

Biocontrol

Laricobius nigrinus (from west coast)

- *L. nigrinus* can remove >50% of overwintering sistens ovisacs (Jubb et al. 2020)
- Small amount of hybridization with native *L. rubidus* (Jubb et al. 2020)
- Captive breeding program at Virginia Tech; collection from wild in Washington



Biocontrol

Rocky Gap State Park (photos) →

- Biocontrol only

Swallow Falls State Park

- Pesticide only
- Biocontrol release planned soon

Future of HWA

- Climate change, cold tolerance
- Asexual with low genetic diversity, but mutation possible
- Functional loss
- "Complete loss of the hemlock forest type within 20 years of adelgid establishment" (Spaulding & Rieske 2010)

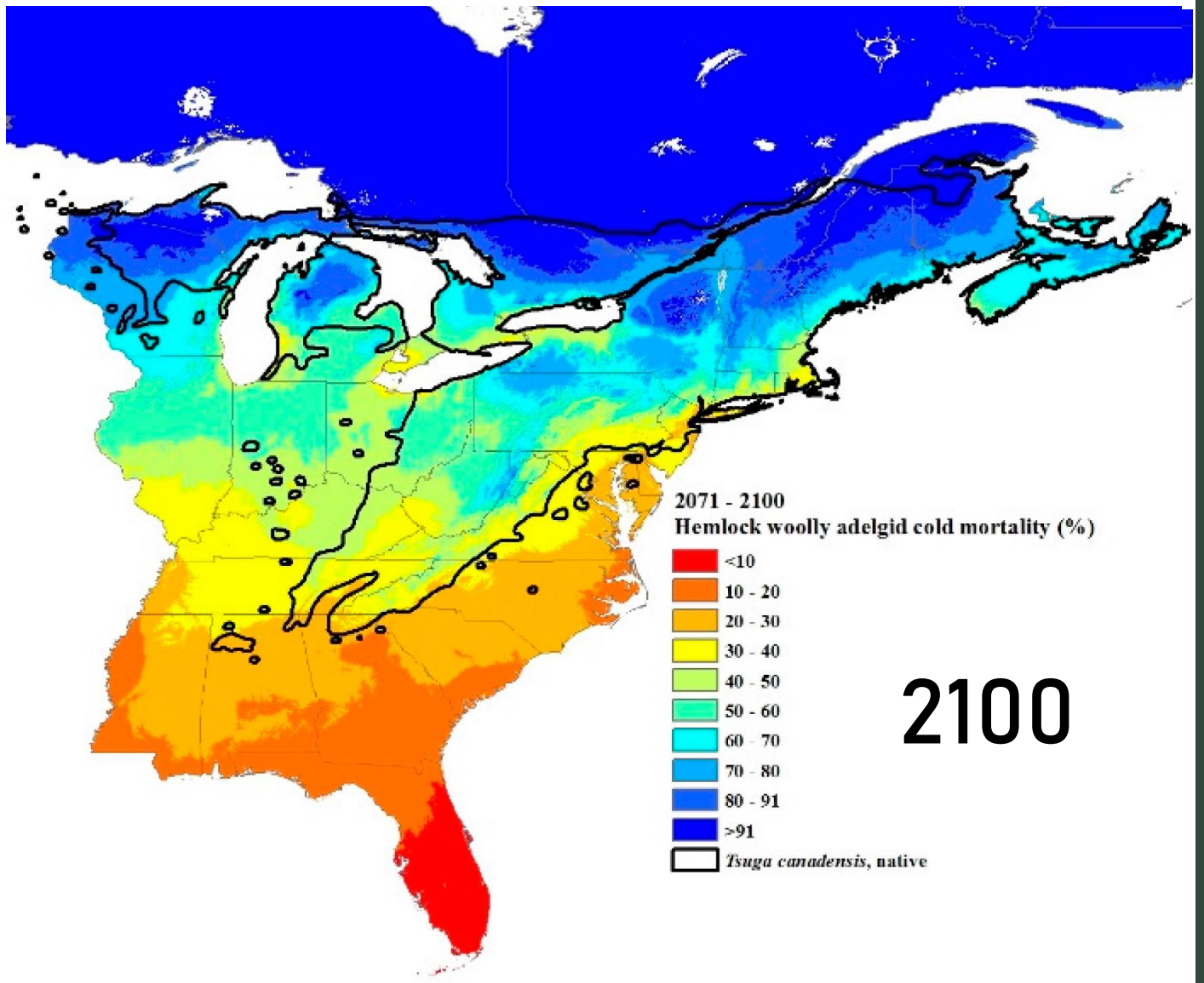


Figure from McAvot et al. (2017)

Research gaps

- Advances in biocontrol:
  - Leucopus flies: will they prefer HWA as a generalist predator?
  - Aerial spraying of fungal pathogen to HWA?

- Interactions with other stressors and invaders including elongate hemlock scale *Fiorinia extera*

- Role of private land as reservoir

- Role of volatile terpenes in chemical defense and attracting natural enemies (Havill et al. 2011)

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