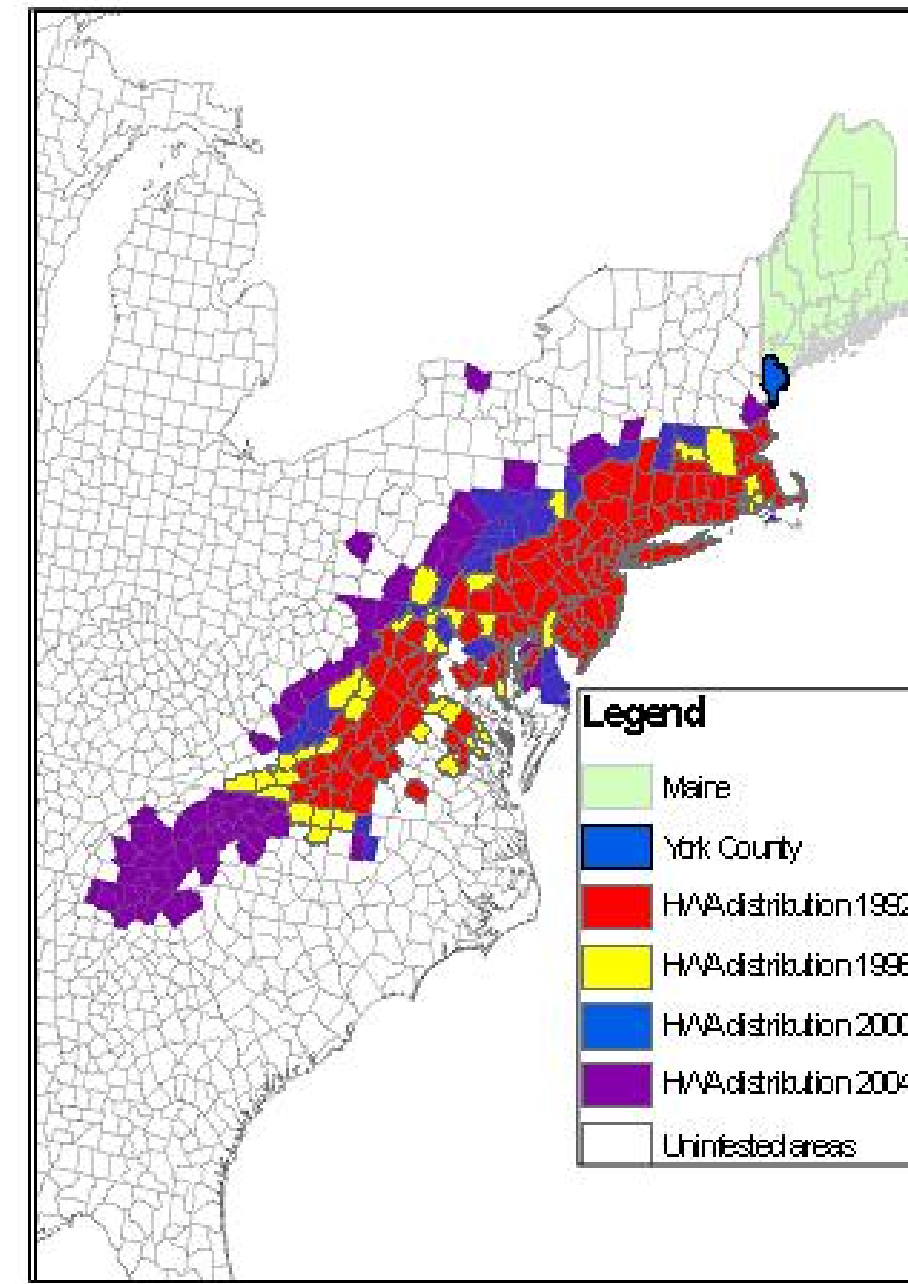


Comparing Site Characteristics and Eastern Hemlock Recovery Potential to a Model of Hemlock Decline at the Northern Range of the Hemlock Woolly Adelgid Infestation

HWA in the USA

- Introduced to North America in the 1920s
- Virginia-1951
- Southern New England-1985
- Causes damage and mortality to Carolina and eastern hemlock
- Extensive damage in southern New England, slower spread in northern New England



HWA in Maine

- External quarantine-1988
- Reported on nursery stock-1999
- Found on native forest hemlocks
- (Gerrish Island, Kittery, ME)-2003
- Found on hemlocks in four York County towns (Kittery, York, Wells and Eliot)-2005

Management Considerations

For hemlock conservation:

- Need to decide where to prioritize management
 - Cutting
 - Predator releases
 - Spraying
- Hemlock survival will depend on
 - Infestation level
 - Cold temperature limits on infestation
 - Tree's ability to recover from HWA feeding and drought

Healthy hemlock stand near Sebago Lake, ME



Sophia DeMaio

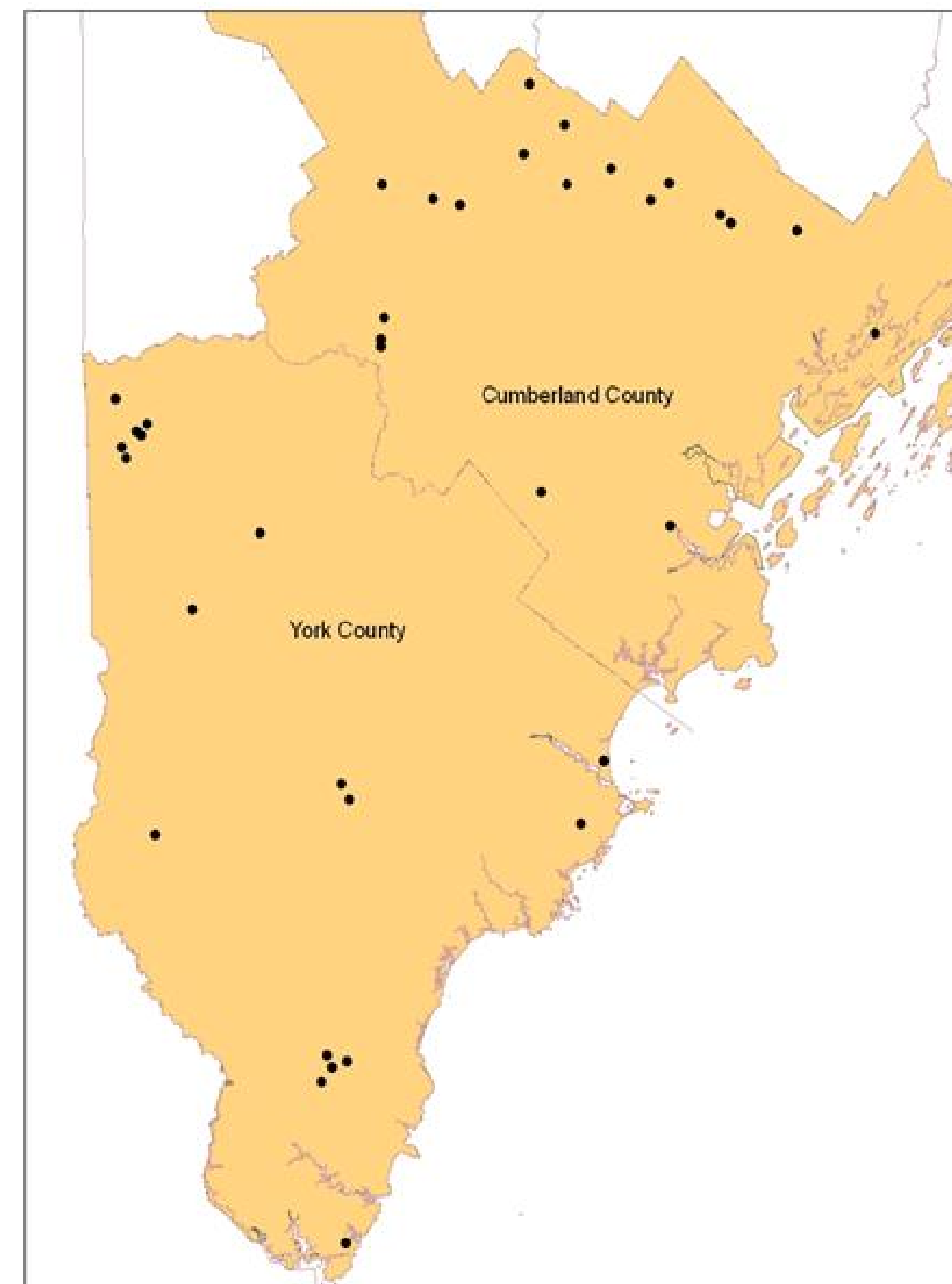
M.S. Student, University of Maine

Advisory Committee:

William Livingston (chair) & Jeremy Wilson
 School of Forest Resources, University of Maine
 Laura Kenefic & Jennifer Pontius
 Northern Experiment Station, US Forest Service



Plot Locations



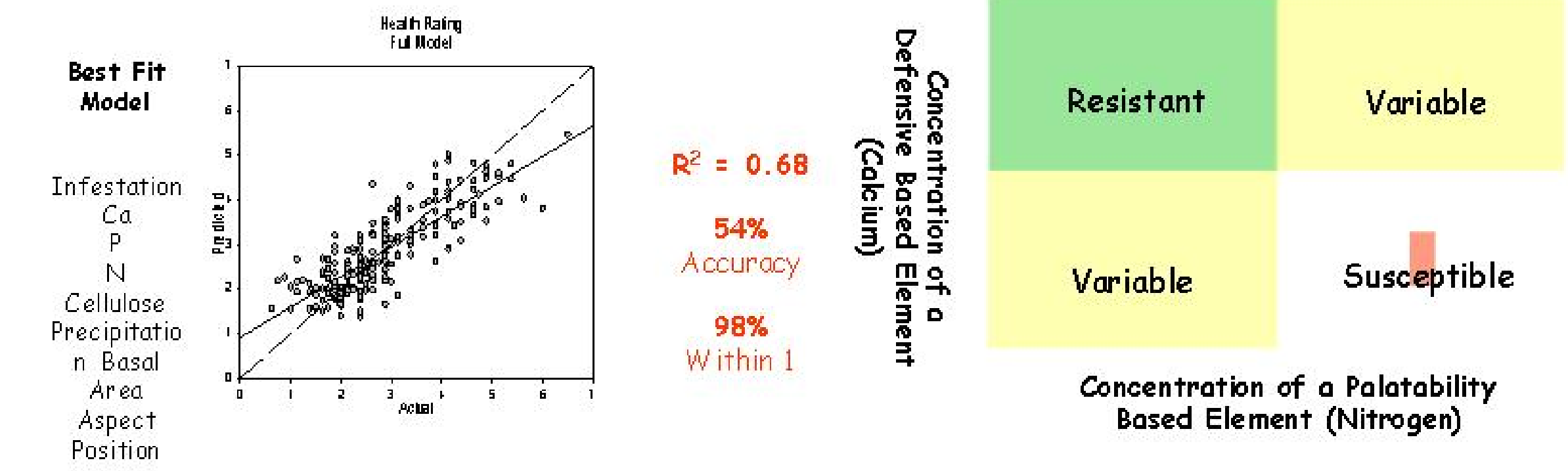
Approach

- Choose hemlock stand located closest to a randomly selected point on public and conservation easement lands
- Measure site and tree characteristics
 - 1/5th acre plot
 - Regeneration stocking & ground cover
 - Soil type, drainage, and chemistry
 - Slope and aspect
 - LCR, % dieback, density
- Core ≥12 dominant/co-dominant hemlock per site
- Apply predictive model (Jennifer Pontius)

Analysis

- Compare variation in recovery with:
 - Soil type, drainage, texture
 - Topographic features
 - Soil chemistry
 - Predictive model results of HWA decline
 - Measurements of tree vigor
- Do relationships indicate management priorities?
 - Example: Does a stand's ability to recover from stress also indicate decline likelihood when infested with HWA?

Predictive Model of Hemlock Decline



Pontius, Jennifer, and others. 2005. Environ. Entomol. 35:112-120

Develop GIS Model

- Quantify relationships between site variables and HWA infestation in New England (Pontius et al. 2005)
- Quantify a similar relationship with drought induced radial reductions in hemlock in Maine.
- Combine layers to show sites most vulnerable to drought and HWA stress

Conclusions

- There is time for proactive management of hemlock in Maine
- Research is needed to create guidelines for stand management based on likelihood of hemlock survival.
- Study will focus on finding site and tree factors that best indicate:
 - Good hemlock recovery from stress
 - Lowest risk for HWA incited decline

Hemlock Woolly Adelgid (white material) on hemlock



Lethal Temperatures in Maine

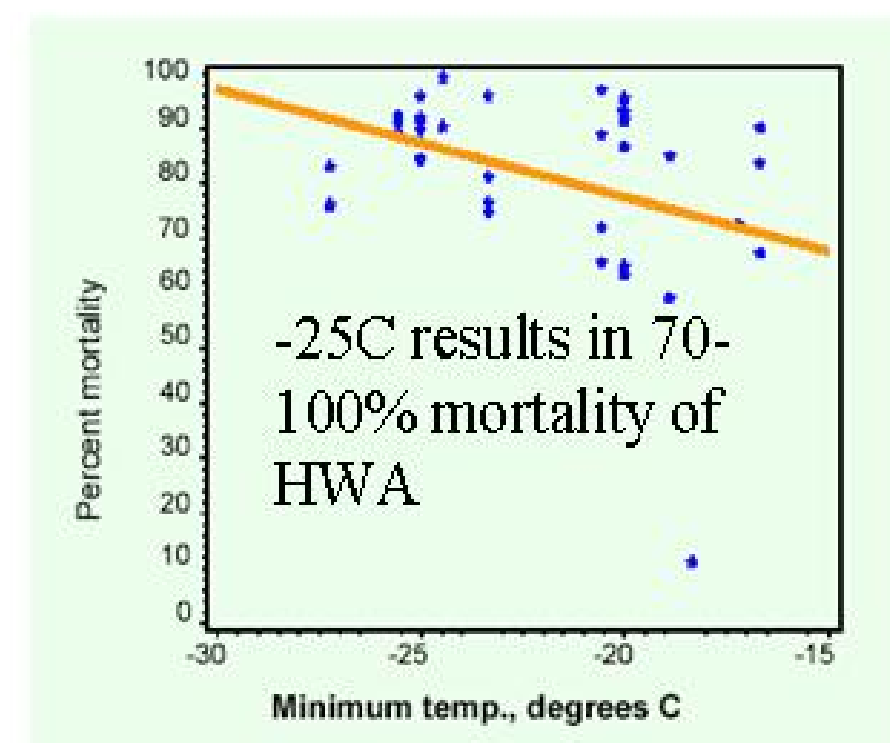
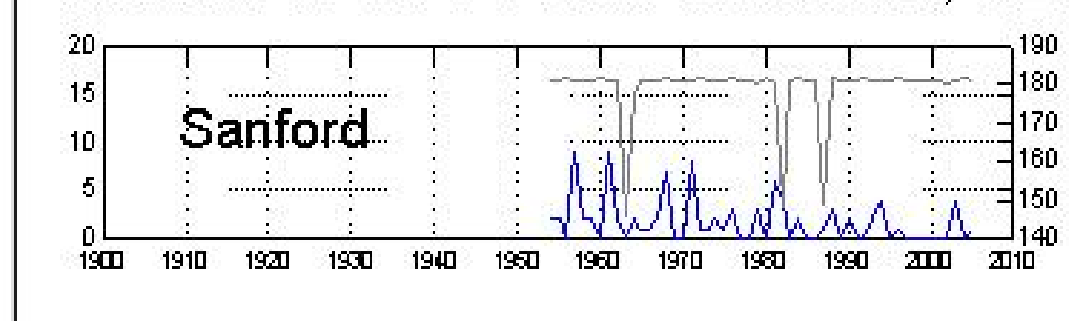


Figure 12. HWA mortality at minimum recorded temperature.

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Number of -25C events in Sanford, ME



Drought Associated with Mortality Spike in HWA Infested Stands

- Study in New Jersey found drought sensitive hemlock stands suffered mortality during the 1995 drought

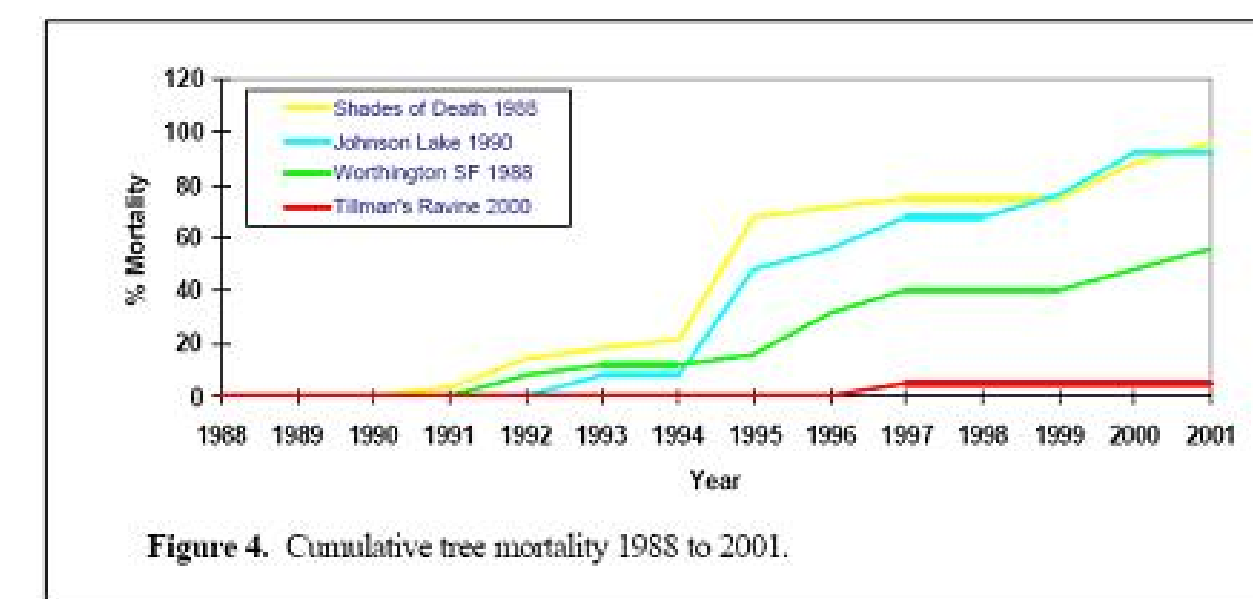
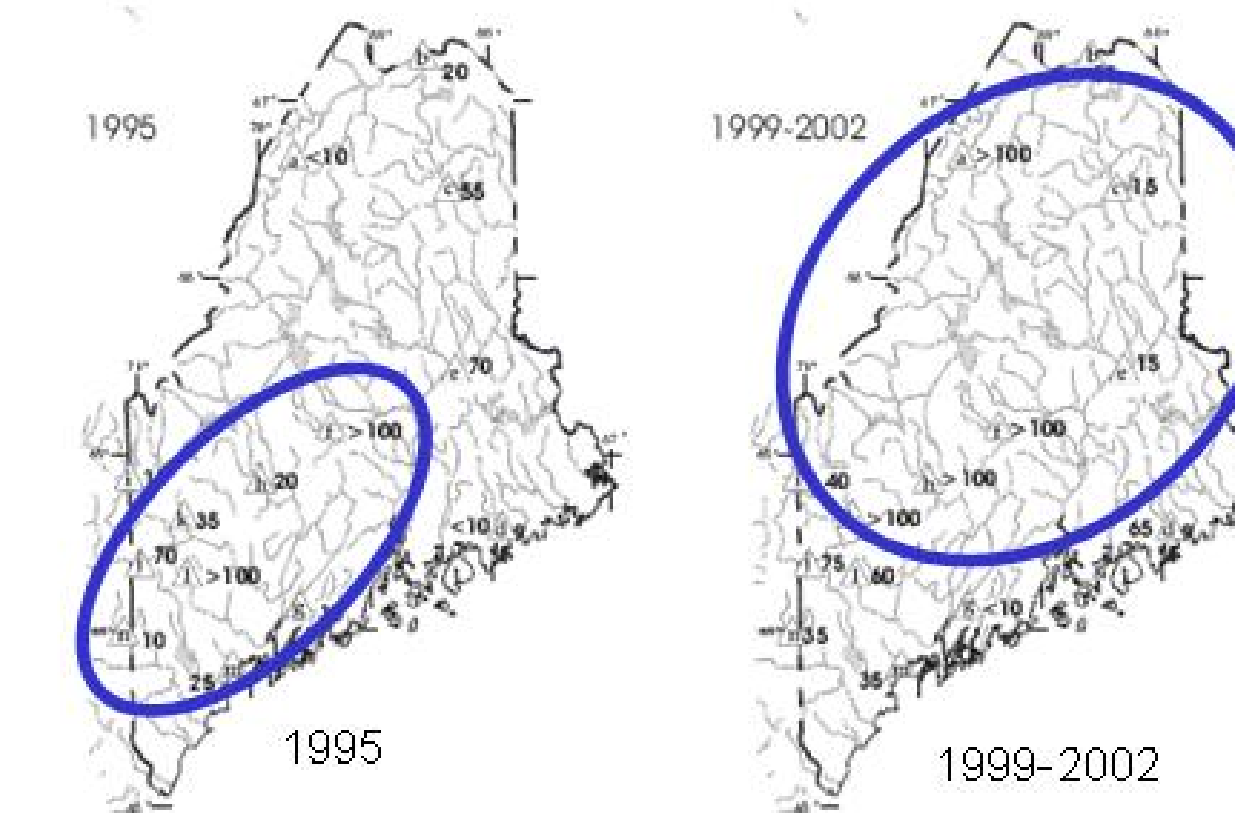


Figure 4. Cumulative tree mortality 1988 to 2001.

Mayer, Mark, and others. 2002. Thirteen Years of Monitoring the Hemlock Woolly Adelgid In New Jersey Forests. p. 50-60 in Symposium on the Hemlock Woolly Adelgid In Eastern North America, February 5-7, 2002, East Brunswick, New Jersey.

Drought and Dendrochronology



Severity of drought as indicated by frequency (>100 years) of likely occurrence (USGS)

- Maine droughts in 1995 and 2001
- Use dendrochronology to indicate drought year that affected tree growth
- Measure recovery: percent growth increase in tree rings after drought

