# Beech Mortality and Drought In Northern Maine

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![](_page_2_Figure_0.jpeg)

McWilliams et al. 2005. Forests of Maine. USDA Forest Service, Forest Inventory and Analysis, Newtown Square, PA

- FIA plots: beech mortality increase from 0.9% to 3.3% from 1995 to 2002.
- Aroostook County average cumulative mortality since 1995
  - 13% for plots measured 1999-2002
  - 44% for plots measured 2003-2004

# Drought

- Precipitation was half of normal in 2001.
- Driest areas correspond to areas with high beech mortality.

![](_page_3_Figure_3.jpeg)

# Hypotheses

- Drought incited mortality event(s)
  - Shallow, well drained soils predisposed trees to stress
  - BBD predisposed trees to drought stress damage
  - Neonectria fungus kills weakened beech
- Warmer winters favoring scale insect incited the decline and mortality

## **Beech Mortality Study Area**

![](_page_5_Figure_1.jpeg)

## Field Sampling

- 21 townships in four northern counties
- Paired 1/5 acre plots:
  - High mortality Sites ( $\geq$  20% mortality of beech) (x=43%)
  - Low mortality Sites (half the mortality of HMS) (x=12%)
- Soil pit drainage class, total depth, rooting depth
- Measure
  - Diameter of all trees > 5 in.
  - − Core  $\geq$ 12 beech and 12 from alternate species
    - dominant or co-dominant
- Beech
  - Abundance of Cryptococcus fagisuga (scale insect)
  - Area of bark with external BBD defects
  - Presence of Neonectria perithecia
  - % Crown dieback

- Use of dendrochronology to evaluate the relationship between
  - Drought
  - Onset of tree dieback and mortality
- Relate severity of mortality to:
  - Site factors
    - Soil & rooting depth
    - Tree age & density
    - Slope and aspect
  - Bark colonization by the Neonectria fungus.

# Analysis

![](_page_7_Picture_10.jpeg)

![](_page_7_Picture_11.jpeg)

# **Results to Date**

![](_page_8_Picture_1.jpeg)

![](_page_8_Picture_2.jpeg)

- Under-productive beech thickets
  - Vegetative sprouts & seed origin regen.
  - Higher stand densities
  - Typically pole size stems
  - Highly defective tree stems
  - Evidence of Harvesting
- BBD long associated with these stands
  - Well established scale insect pop.
  - Neonectria faginata dominant
  - Neonectria ditissima pop. scarce

## Stand Type I-"Aftermath" Forests

![](_page_9_Picture_11.jpeg)

![](_page_9_Picture_12.jpeg)

![](_page_9_Picture_13.jpeg)

## Stand Type II- Newly Affected Northern Forest

![](_page_10_Picture_1.jpeg)

![](_page_10_Picture_2.jpeg)

- Large beech with smooth bark (>200 yrs)
- Presumably unaffected by BBD
  - extreme winter temps– geographic isolation
- Trees now suffering substantial mortality and dieback
  - Scale insect present
  - Both Neonectria present
  - Tarry spot present

#### Stand Type Distribution

- Type 1 = "Aftermath" forests
- Type 2 = Newly affected forests

![](_page_11_Figure_3.jpeg)

# Comparison of tree diameter means for living and dead trees in 2 stand types

![](_page_12_Figure_1.jpeg)

#### • Two Neonectria species

- Exotic fungus- Neo. faginata
- Native fungus- Neo. ditissima
- Red perithecia collected
  - − Frozen to -20°C
  - Rehydrated in the lab to induce sporulation
- Ascospore measurements used to differentiate species
  - Length >14.3µm,
    Neo. ditissima
  - Length <13.3µm,</li>
    Neo. faginata
- Isolated cultures sent away for sequencing
  - Amy Rossman, Beltsville

## Neonectria Fungus Identification

![](_page_13_Picture_12.jpeg)

![](_page_13_Picture_13.jpeg)

### Fungal isolations confirm identifications

- From 27 trees over 3 townships
  - 3 populations per tree

![](_page_14_Figure_3.jpeg)

## **Revised Hypotheses**

- 1. Stand type I
  - Beech stands weakened by BBD for years.
  - Drought occurring in 2001 incited mortality
  - Existing Neonectria populations flourished on stressed trees
    - Neo. Faginata dominant

#### 2. Stand type II

- Beech stands historically unaffected by BBD.
- Warmer winter temperatures advantageous to scale insect.
  - Increasing populations stressed older large trees
- Drought occurring in 2001 incited mortality
- Existing Neonectria populations flourished on stressed trees.
  - Neo. Ditissima dominant

## **Future Studies**

- Sample more field locations to evaluate the revised hypotheses.
  - Sampling regions based on existing climate regions and biophysical regions
  - 10 plots per region (5 townships)
- Continue to characterize *Neonectria* species in each Stand Type in sub-sample of 2006 plots

![](_page_16_Picture_5.jpeg)

![](_page_17_Picture_0.jpeg)