

Using Silviculture as a Tool to Minimize Impacts of Invasive Species



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Beech Bark Disease Complex



Beech Shelterwood

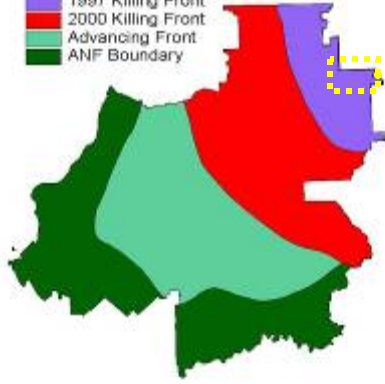


- **Objective:** To compare beech regeneration characteristics in shelterwood establishment cuts where resistant beech are retained as residuals. Associated offspring are either retained or killed with herbicide.

Cooperative Adventure with: ANF, NRS, NA-FHP

Allegheny National Forest Coverage of Beech Bark Disease

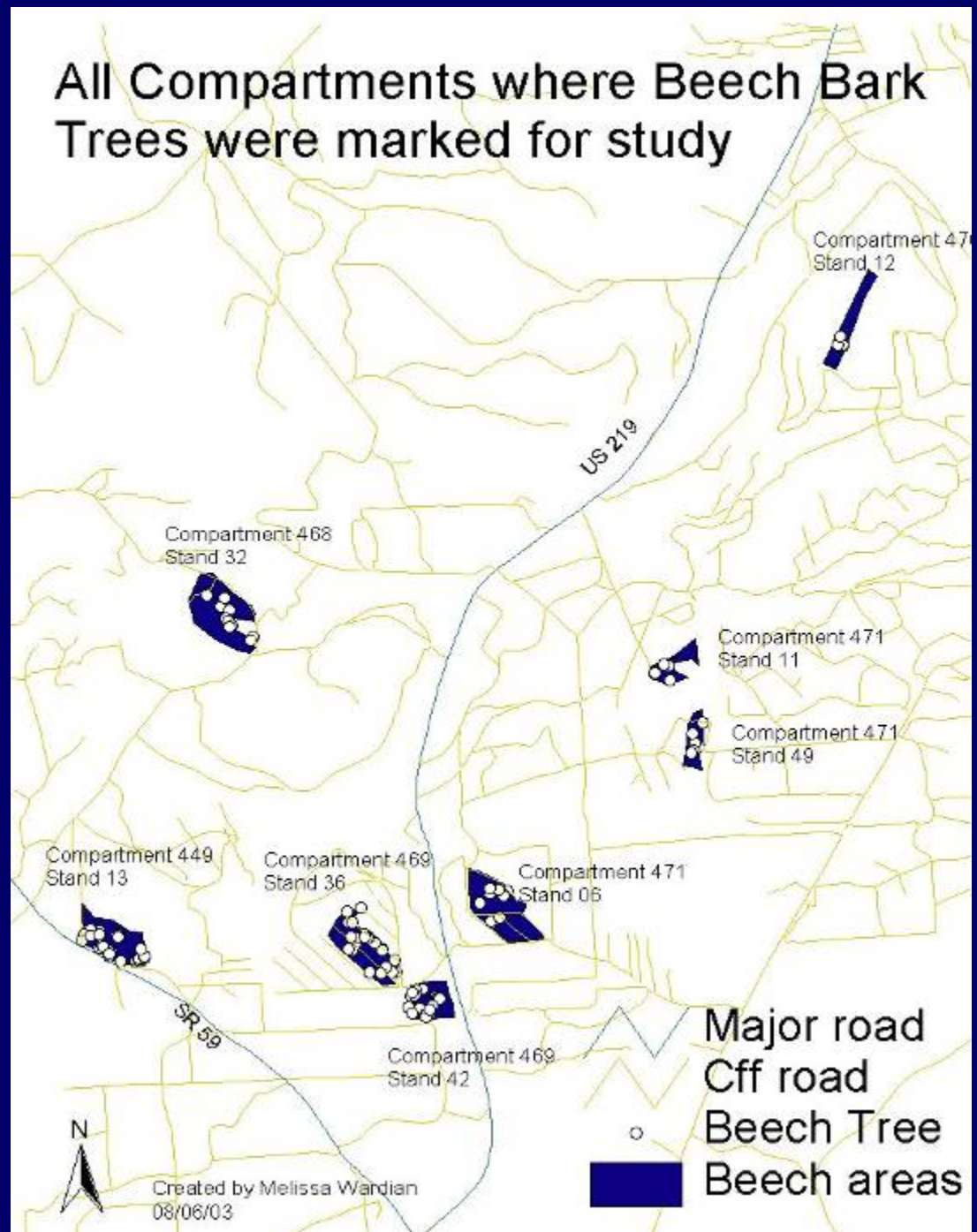
- 1997 Killing Front
- 2000 Killing Front
- Advancing Front
- ANF Boundary



Created by Melissa Wardian
08/06/03

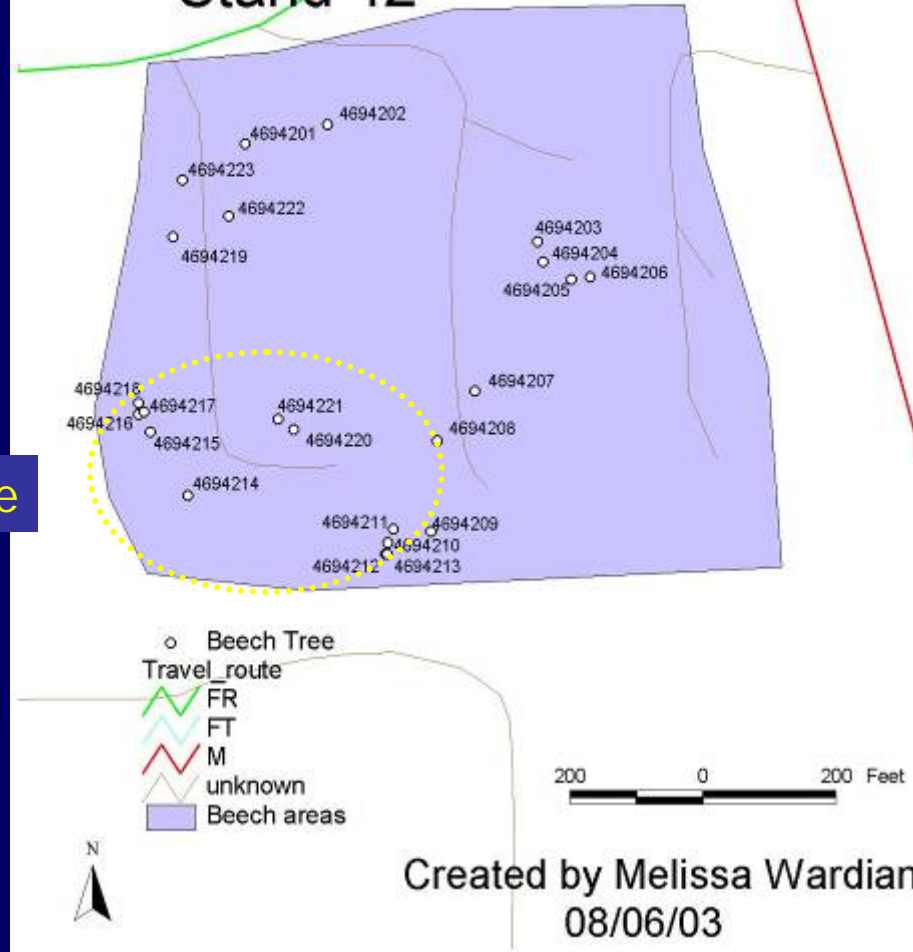
Stands 13, 36, 42 will be
used in study

All Compartments where Beech Bark Trees were marked for study



Created by Melissa Wardian
08/06/03

Beech Bark Disease Resistant Trees Compartment 469 Stand 42



No Spray Zone

Methods

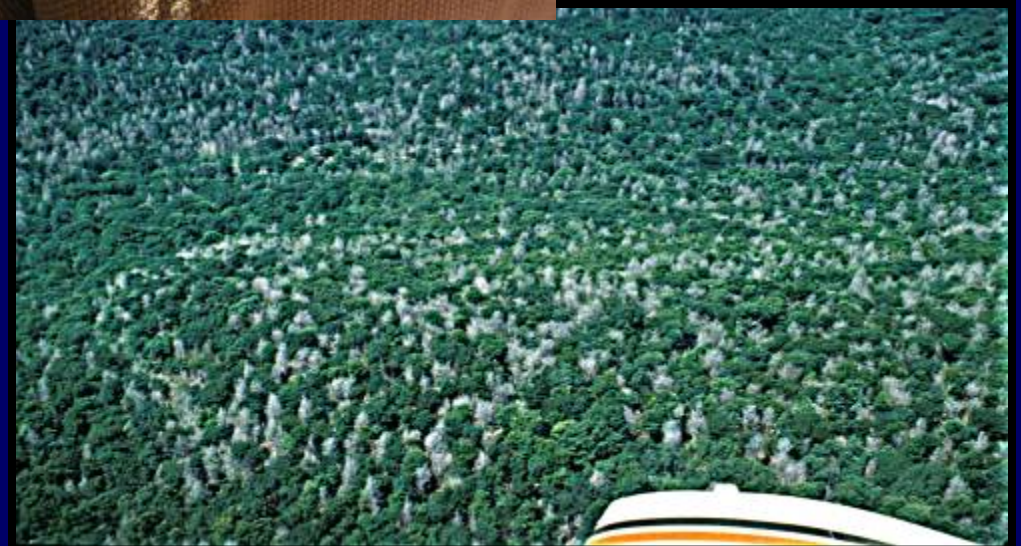


- Establishment Cuts: Winter 2005
- Vegetation measurements: Plots centered on resistant beech.
- Herbicide: Aug. 2005
- Monitor: Tree vigor, beech sprouting, regeneration growth

Resistant trees: Beech regeneration 2-years after shelterwood and herbicide



Hemlock woolly adelgid, *Adelges tsugae*



Thinning HWA-Threatened Stands

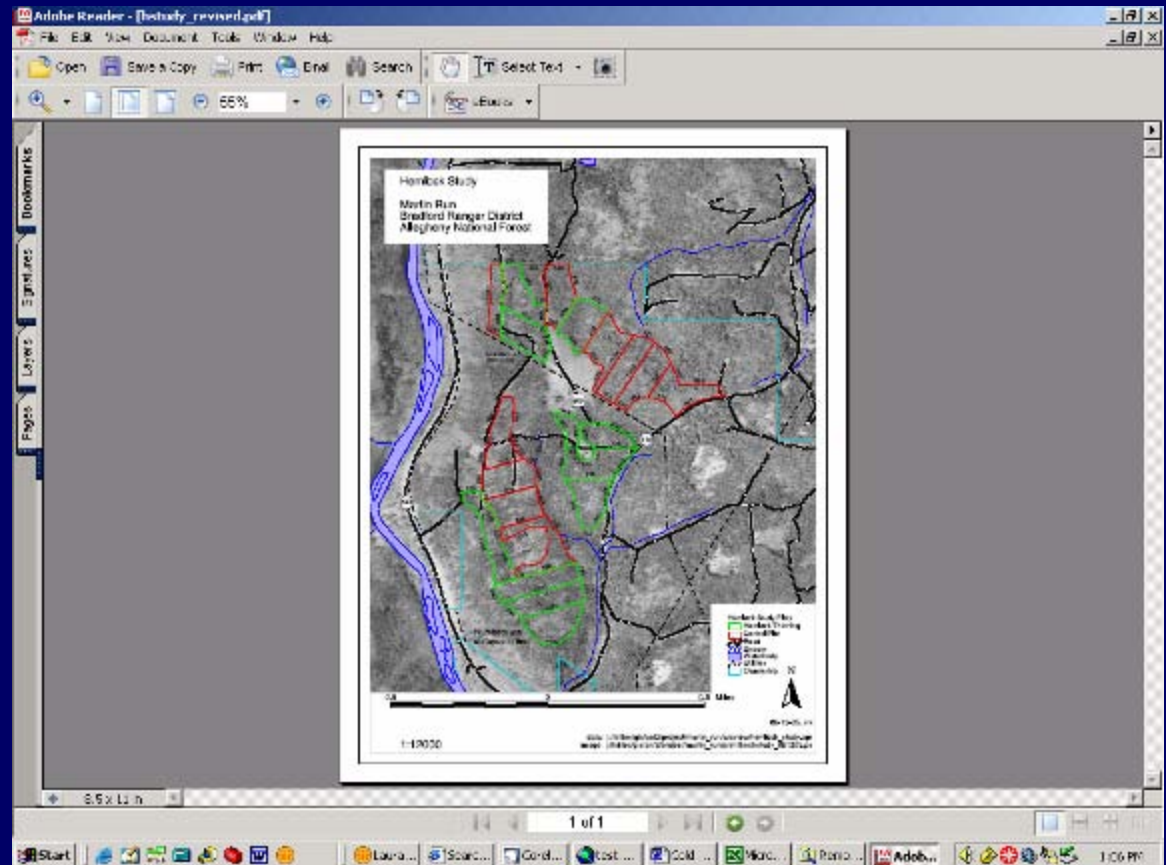


Objective: Develop silvicultural thinning guidelines to reduce decline and mortality of hemlocks from HWA in eastern forests representing a range of stand types and structures.

Cooperative Adventure with: ANF, NRS, NA-FHP

Methods

- Stand Selection Criteria:
 - ≥ 60 acres
 - ≥ 30 ft²/a hemlock
 - No site limitations for harvesting
 - > 5 years until infestation



Thinning for HWA in Massachusetts Proposed Study Areas: State DCR Land



Marking a Thinning

Guidelines:

- BA <150 reduce to 80
- BA 150-200 reduce to 100
- BA >200 reduce to 130



Training marking crew to release midstory and understory hemlock





Subject tree: Post-thinning



Control Plot: Subject Tree



European gypsy moth, *Lymantria dispar*

Introduced in 1869 by amateur scientist, escaped into yard and adjacent forest areas.

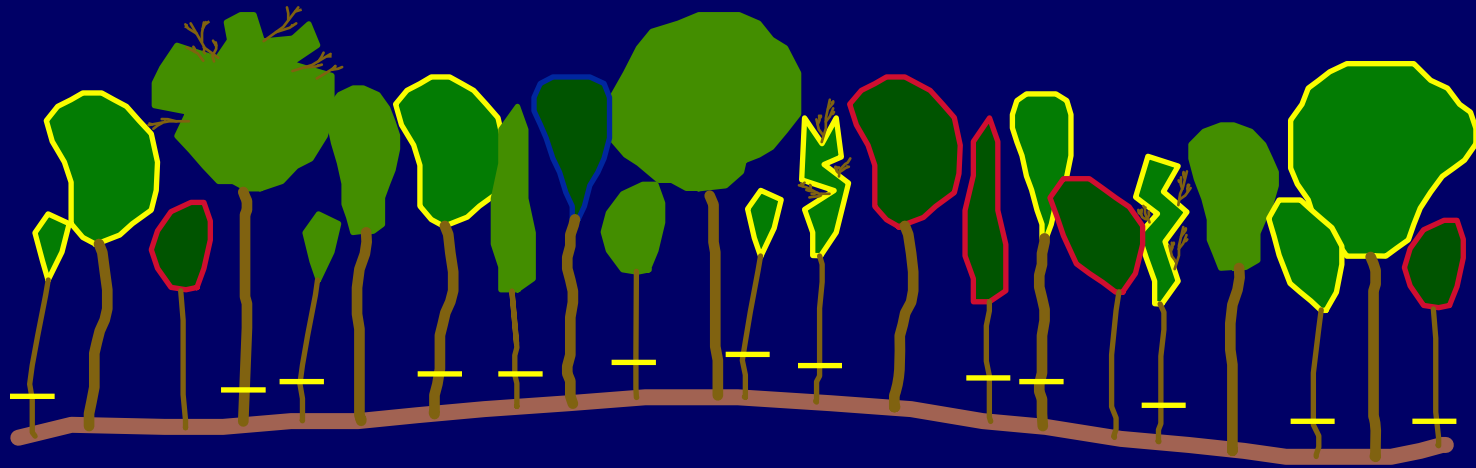


Presalvage Thinning

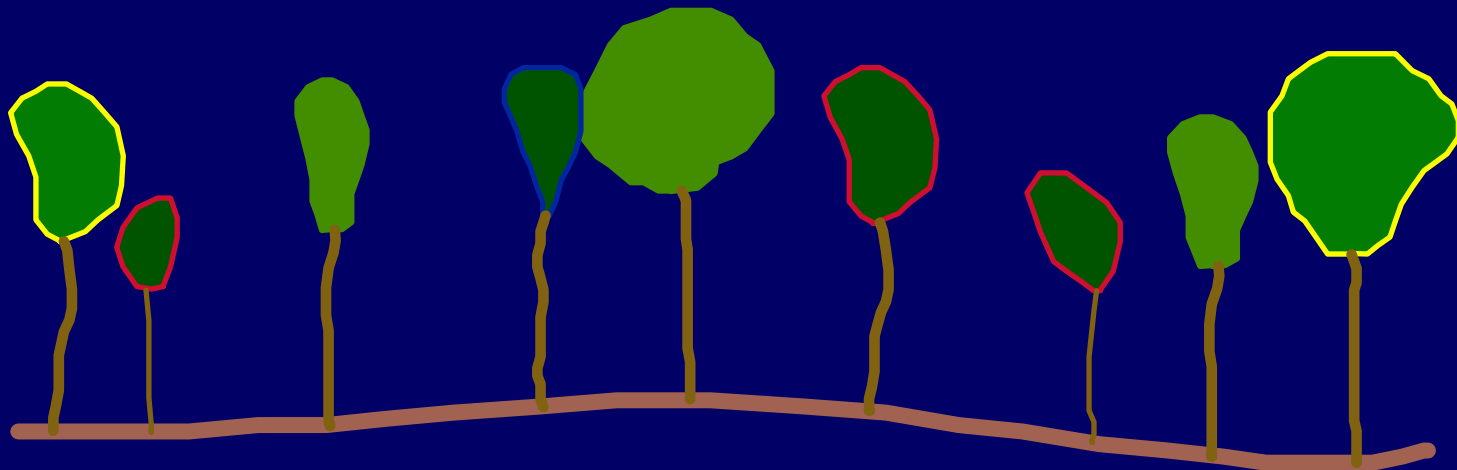
- stand characteristics
 - applied to susceptible stands (>50% BA/Ac in susceptible species)
 - > C - level stocking and 80% relative density
 - > 15 years from maturity
 - 1 - 3 years or more before gypsy moth defoliation
- priorities for removing trees
 - oaks with poor crowns
 - non - oaks with poor crowns
 - trees with abundant structural features
 - trees with fair crowns

Presalvage Thinning (Older Stand)

(Gottschalk 1993)



WO  HI  RO  RM 

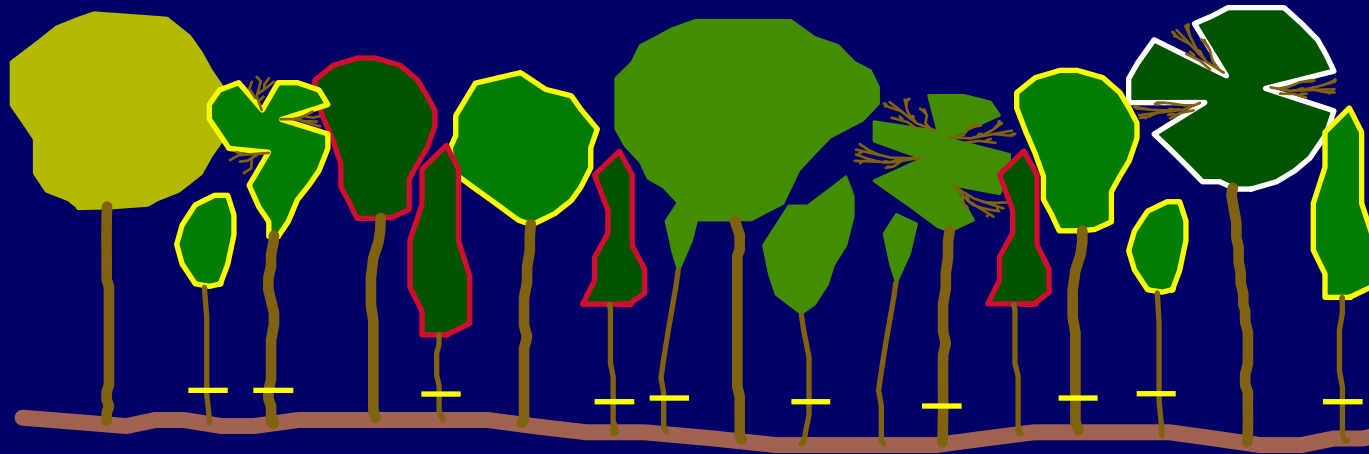


Sanitation Thinning

- stand characteristics
 - applied to resistant and immune stands (>50% BA/Ac in susceptible species)
 - > C - level stocking and >80% relative density
 - > 15 years from maturity
 - 1 - 3 years or more before gypsy moth arrival
- priorities for removing trees
 - preferred food species (susceptible species)
 - trees with abundant structural features or refuges
 - trees with poor crowns
 - trees with fair crowns

Sanitation Thinning (Older Stand)

(Gottschalk 1993)



YP  RO  WO 
WA  RM 



Feeding Preference Classes

Susceptible - white, black, red, scarlet, and chestnut oaks, serviceberry, basswood, bigtooth aspen, witch hazel, hawthorn

Resistant - red maple, sugar maple, black gum, hickory, sweet birch, black cherry, American beech, sassafras, slippery elm, hackberry, American chestnut, sourwood

Immune - yellow poplar, ash, cucumbertree, striped maple, dogwood, black locust, spicebush, rhododendron, mountain laurel

Defoliated Oaks

Yellow Poplar, No
Defoliation



Other Factors

- drought 1988, 1991
- defoliation by other insects
 - yellow poplar by *Odontopus calceatus* (yellow poplar weevil) 1992, 1993, 1994
 - red maple by *Itame pustularia* (lesser maple spanworm) 1995, 1996
- ice storm 1995

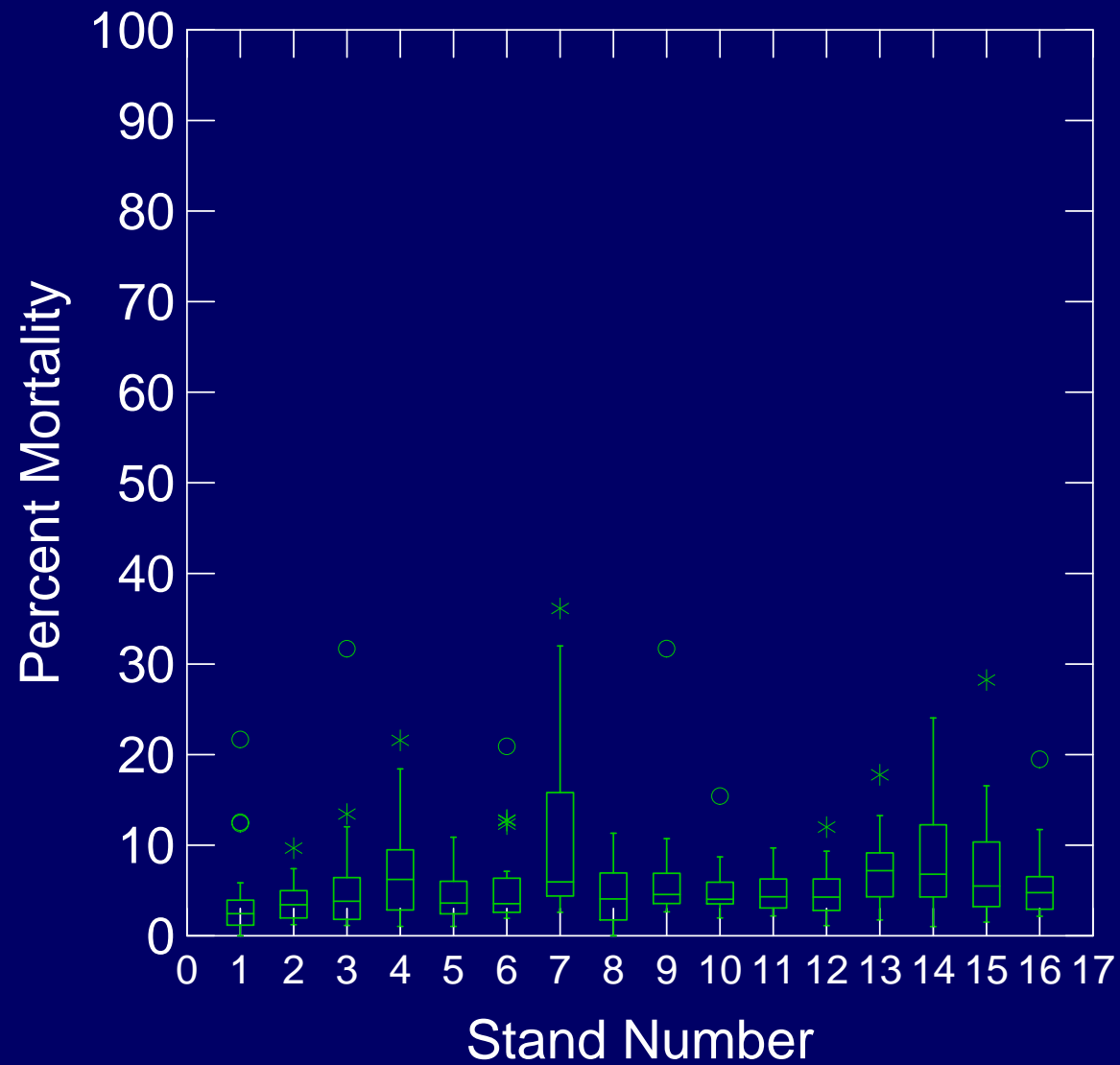


West Virginia University Forest

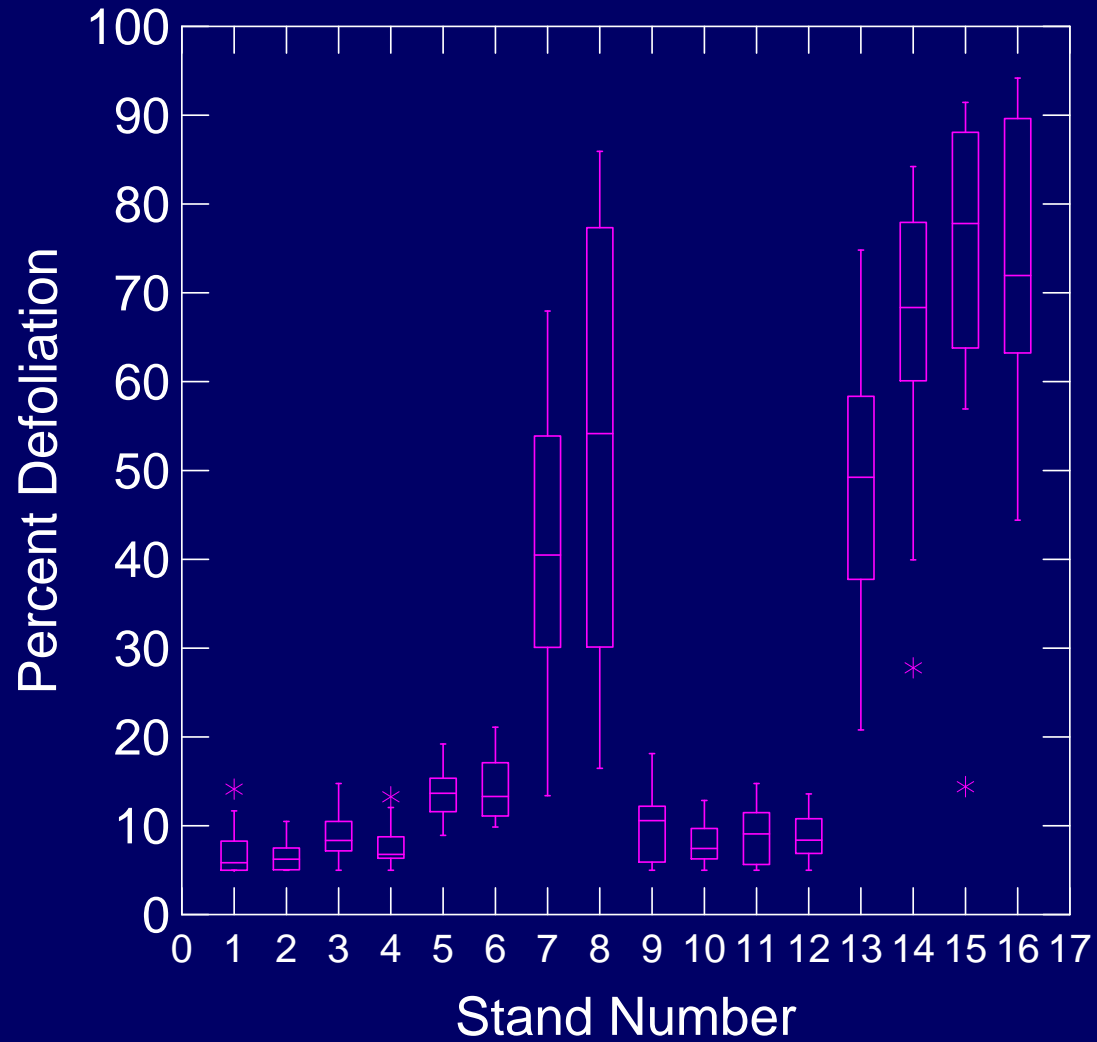
Treatments

- Four stands for each treatment, split into treated and untreated halves for a total of 16 stands
- Each stand was 20 – 30 acres in size

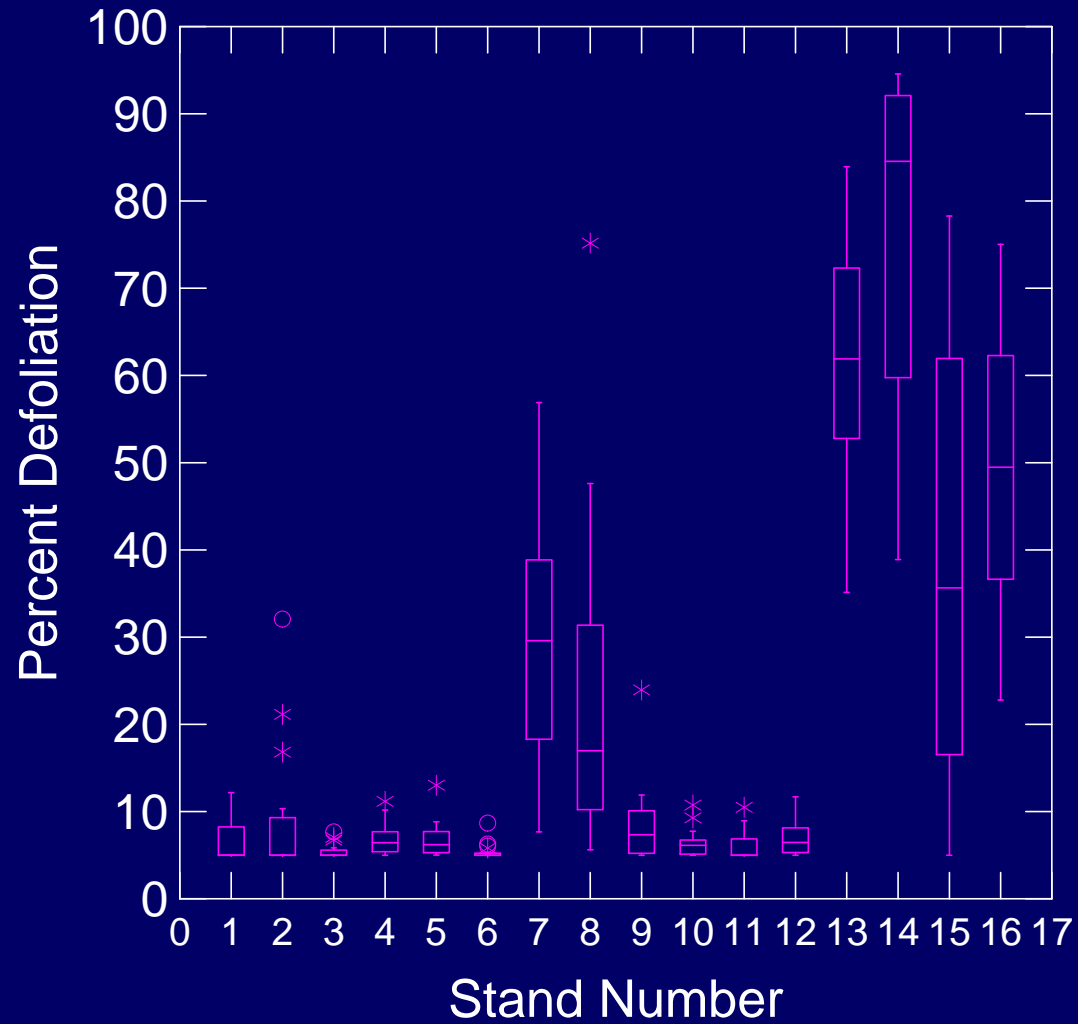
Pretreatment Mortality (1989)



Percent defoliation in 1990



Percent defoliation in 1991



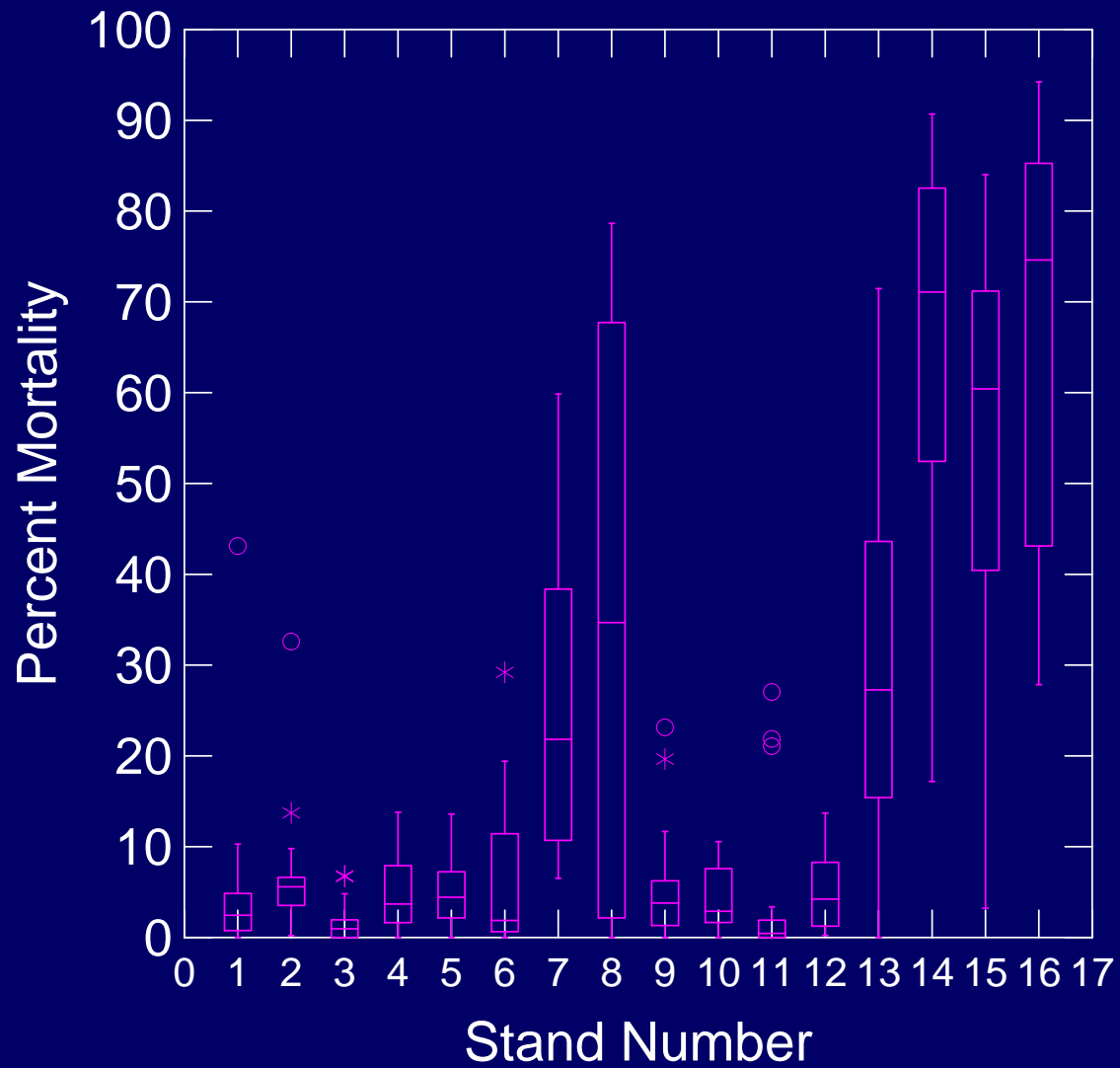
LS Means 1990 Defoliation

Preference Class	% Defoliation
Immune	7.678
Resistant	16.344
Susceptible	45.947

LS Means 1991 Defoliation

Preference Class	% Defoliation
Immune	7.559
Resistant	13.492
Susceptible	40.590

Mortality after 5 years in 1994



Mean Contrasts 1994 Mortality

Treatment Combinations	LS Mean	P
Unthinned, Undefoliated	5.107	0.000
Unthinned, Defoliated	51.394	
Thinned, Undefoliated	4.516	0.000
Thinned, Defoliated	34.791	
Unthinned, Undefoliated	5.107	0.891
Thinned, Undefoliated	4.516	
Unthinned, Defoliated	51.394	0.018
Thinned, Defoliated	34.791	

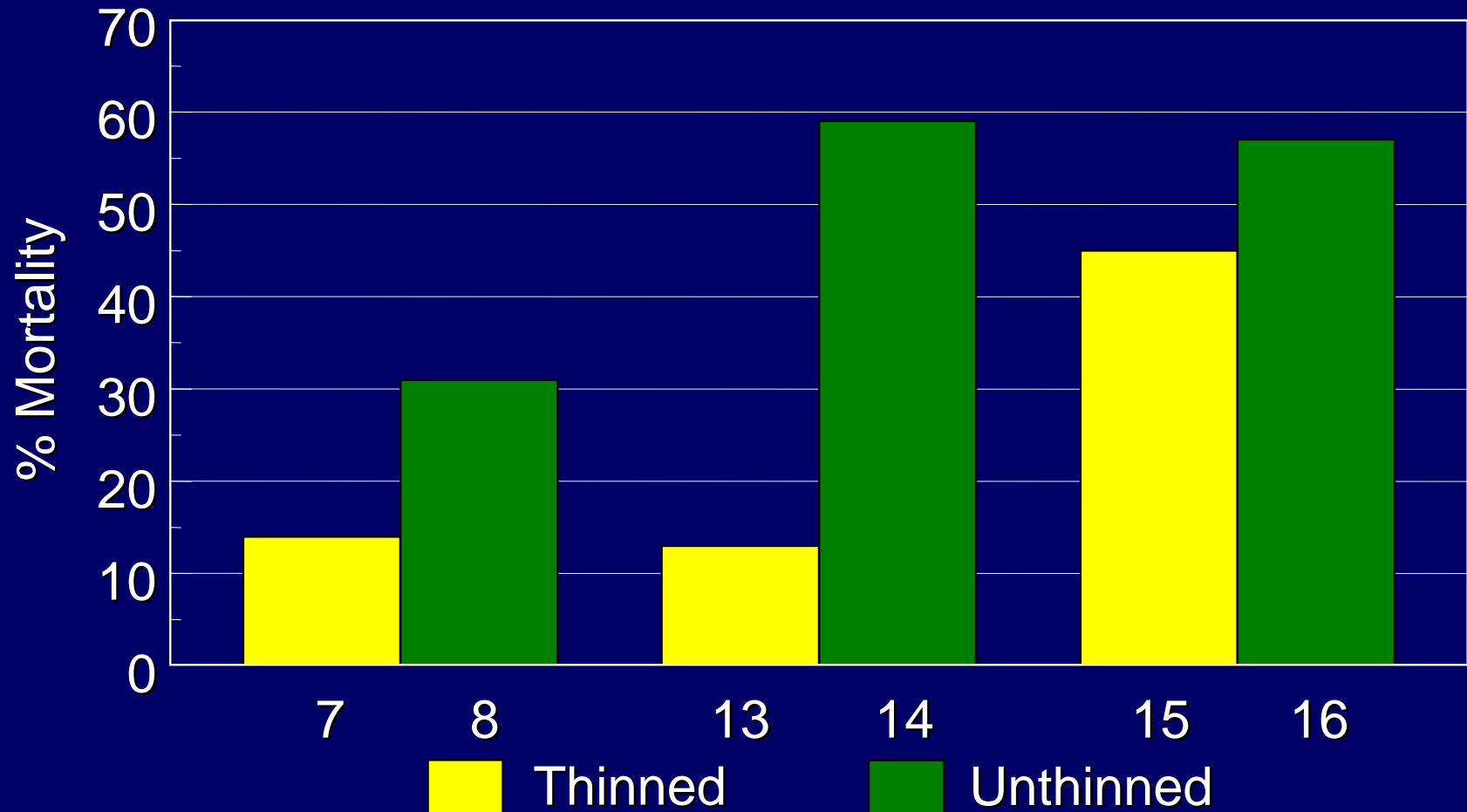
Mean Contrasts 1994 Mortality

Treatment Combinations	LS Mean	P
Sanitation, Undefoliated	4.908	0.964
Presalvage, Undefoliated	4.715	
Sanitation, Defoliated	31.871	0.004
Presalvage, Defoliated	54.315	
Sanitation, Undefoliated	4.908	0.001
Sanitation, Defoliated	31.871	
Presalvage, Undefoliated	4.715	0.000
Presalvage, Defoliated	54.315	

Mean Contrasts 1994 Mortality

Treatment Combinations	LS Mean	P
Defoliated, Unthinned, Sanitation	37.072	0.007
Defoliated, Unthinned, Presalvage	65.717	
Defoliated, Thinned, Sanitation	26.670	0.075
Defoliated, Thinned, Presalvage	42.912	
Defoliated, Unthinned, Sanitation	37.072	0.289
Defoliated, Thinned, Sanitation	26.670	
Defoliated, Unthinned, Presalvage	65.717	0.008
Defoliated, Thinned, Presalvage	42.912	

Mortality in Thinned & Unthinned Stands West Virginia University Forest



Mean Crown Diameter Change (CDC) for Red Maple (RM), Yellow Poplar (YP), Northern Red Oak (NRO), and All Trees (CDC) by Treatment

Treatment	YP	RM	NRO	<u>CDC (ft)</u>
Control	4.0 b	3.1 b	3.7 b	2.5 a
Control & Defoliation	5.5 ab	2.4 c	1.6 c	2.9 ab
Thinned	4.7 b	4.5 a	5.3 a	3.2 b
Thinned & Defoliation	7.8 a	2.1 c	2.6 bc	4.7 c

(Mean pairwise comparisons with Bonferroni adjustment)

Mean Basal Area Change (BAC) for Red Maple (RM),
Yellow Poplar (YP), Northern Red Oak (NRO), and All Trees
(BAC) by Treatment

Treatment	YP	RM	NRO	<u>BAC (ft²)</u>
Control	0.105 c	0.027 c	0.111 b	0.055 a
Control & Defoliation	0.197 b	0.077 a	0.074 c	0.073 b
Thinned	0.156 b	0.050 b	0.144 a	0.084 c
Thinned & Defoliation	0.349 a	0.074 a	0.089 bc	0.084 c

(Mean pairwise comparisons with Bonferroni adjustment)

