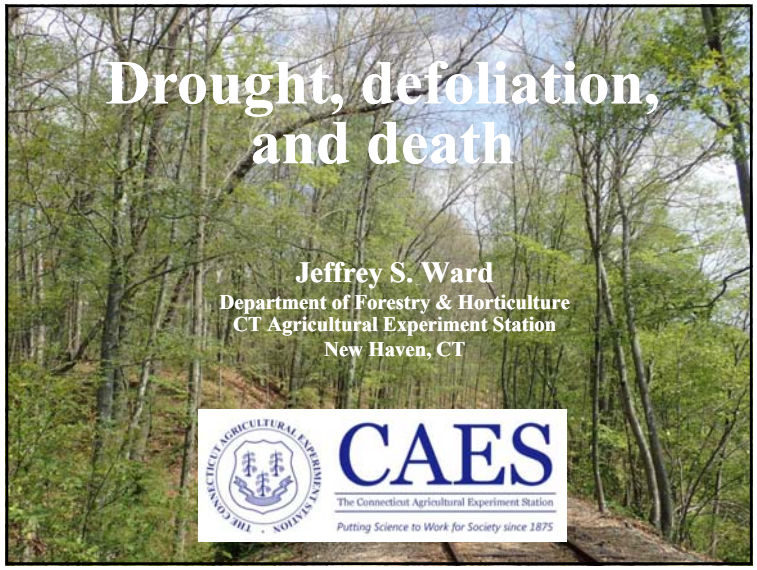
Drought, defoliation, and death
Jeffrey S. Ward
Department of Forestry & Horticulture
CT Agricultural Experiment Station
New Haven, CT
CAES
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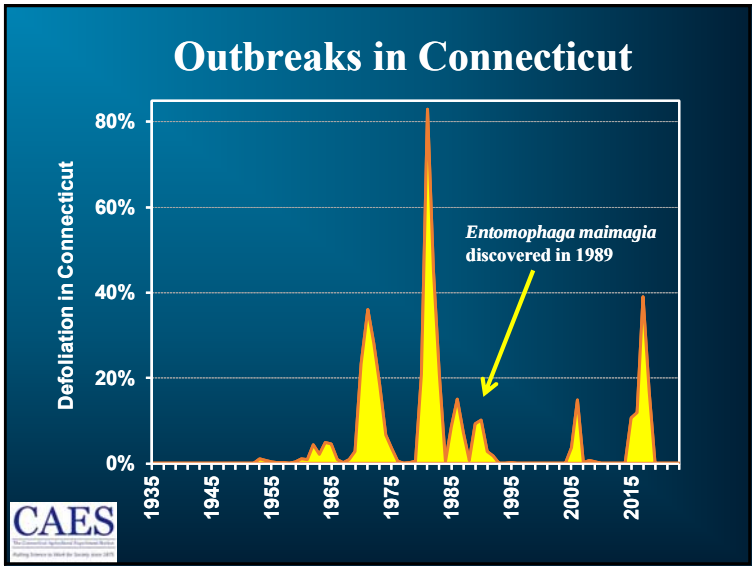
1


Outbreaks in Connecticut
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80%
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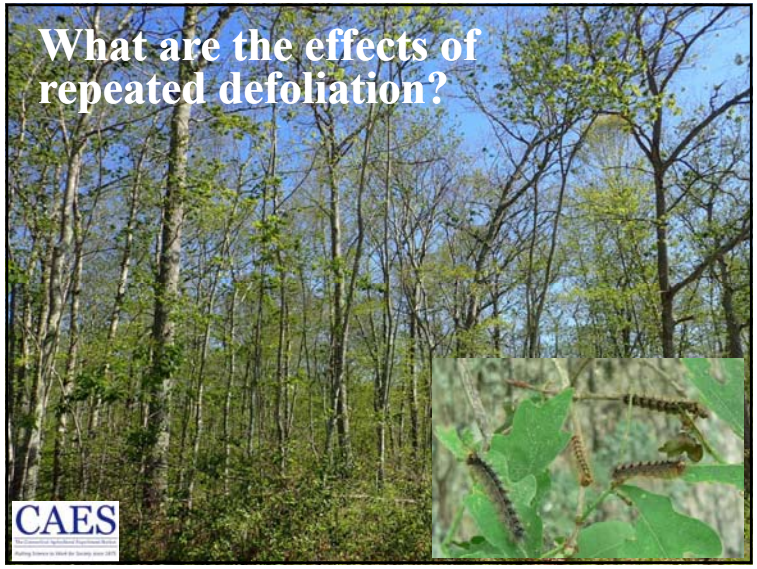
What are the effects of repeated defoliation?
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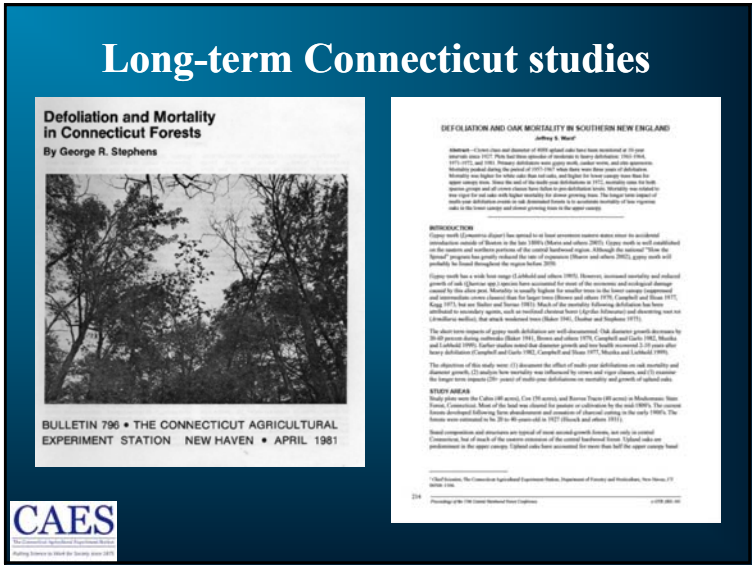
Long-term Connecticut studies
Defoliation and Mortality in Connecticut Forests
By George R. Stephens
BULLETIN 796 • THE CONNECTICUT AGRICULTURAL EXPERIMENT STATION NEW HAVEN • APRIL 1981
DEFOLIATION AND OAK MORTALITY IN SOUTHERN NEW ENGLAND
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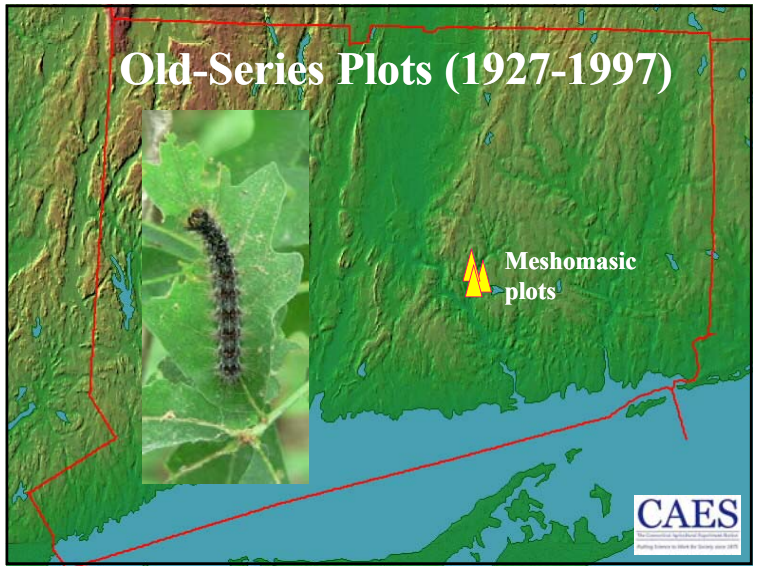

5

Tree measurements (≥ 0.5” dbh)

Diameter (inches) at 4.5 feet

Species

Crown class

Location

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Impact of defoliation

Multi-year events are important

Loss of lower canopy oaks

Loss of white oaks

Loss of low vigor red oaks

After defoliation

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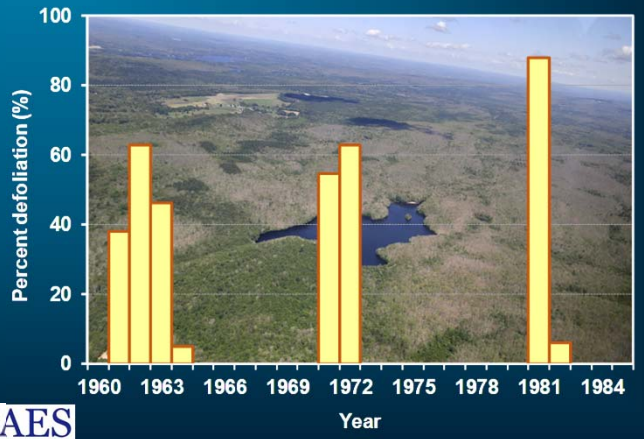
Old-Series defoliation



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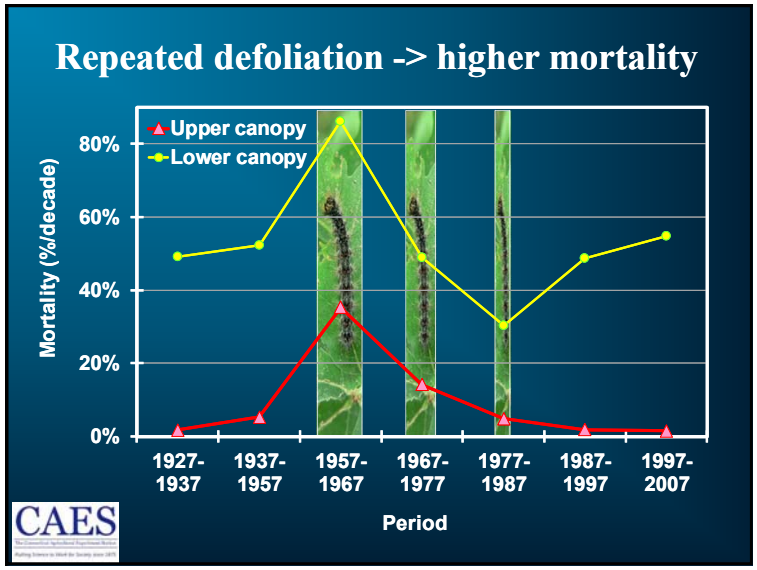

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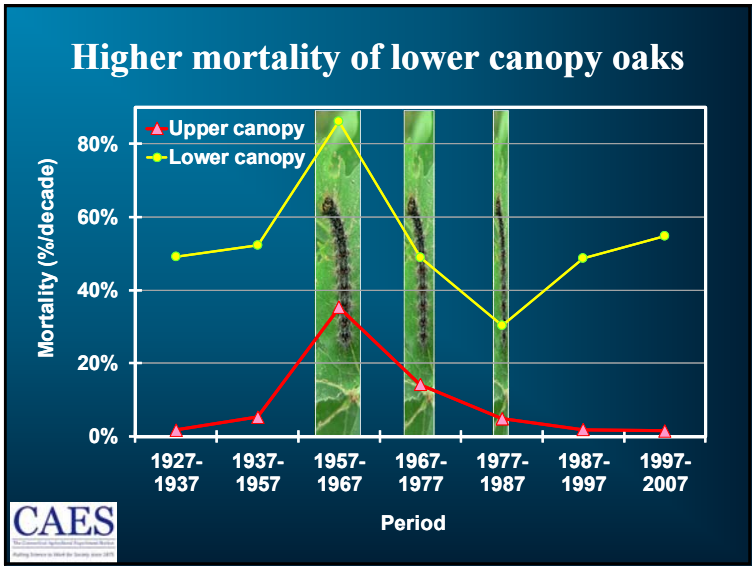

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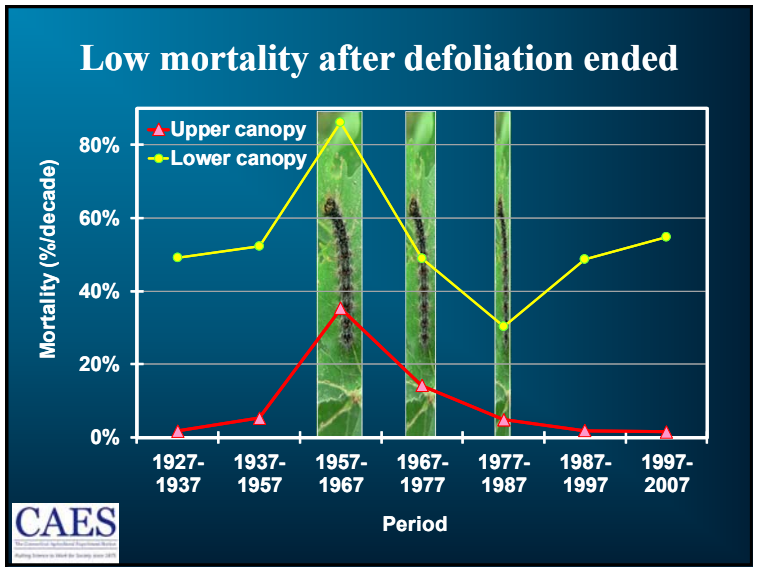

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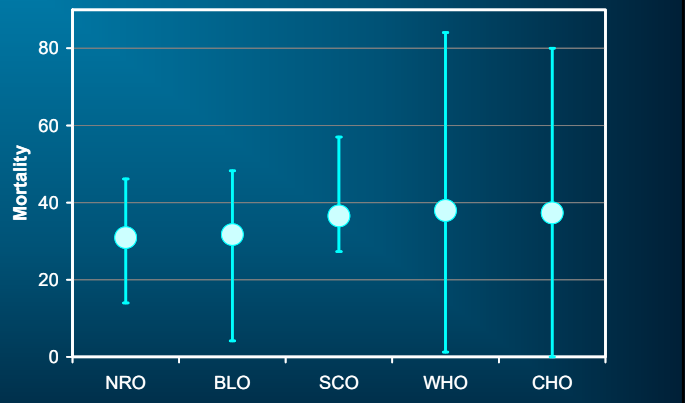
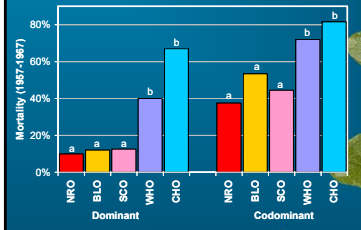
Literature estimates for species vary



Kegg 1971 Dunbar and Stephens 1975 Stalter and Serrao 1983 Fosbroke and Hicks 1989
Kegg 1973 Campbell and Sloan 1977 Herrick and Gansner 1987

13

White oak mortality higher than red oak



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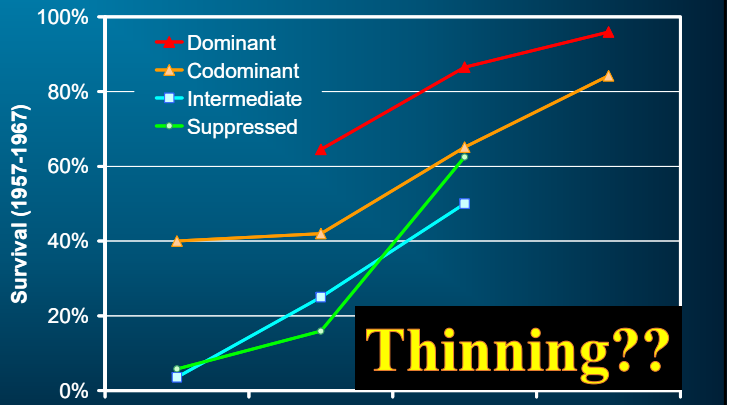
Survival high for fast growing red oaks



Thinning??

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Bottom line I

MULTI-YEAR defoliations removed less vigorous trees, lower canopy trees, and white oaks.

Surviving trees did recover and showed little longer-term (30+ year) effects.

However

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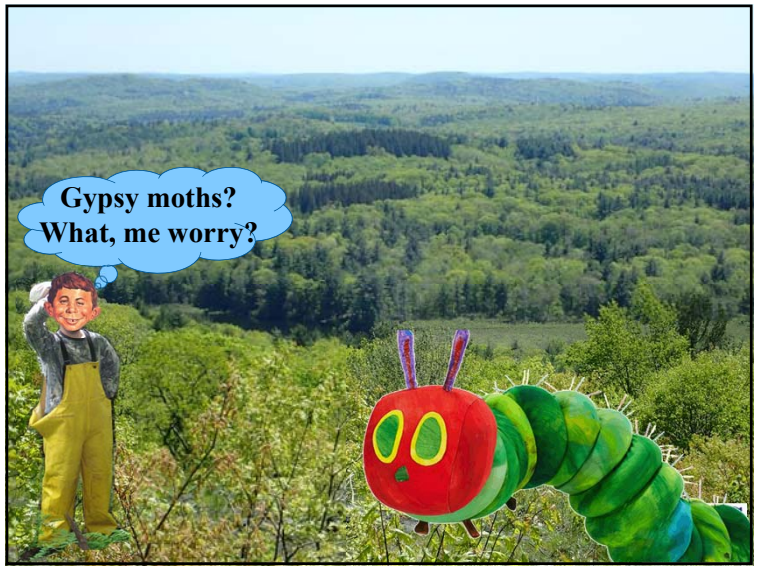
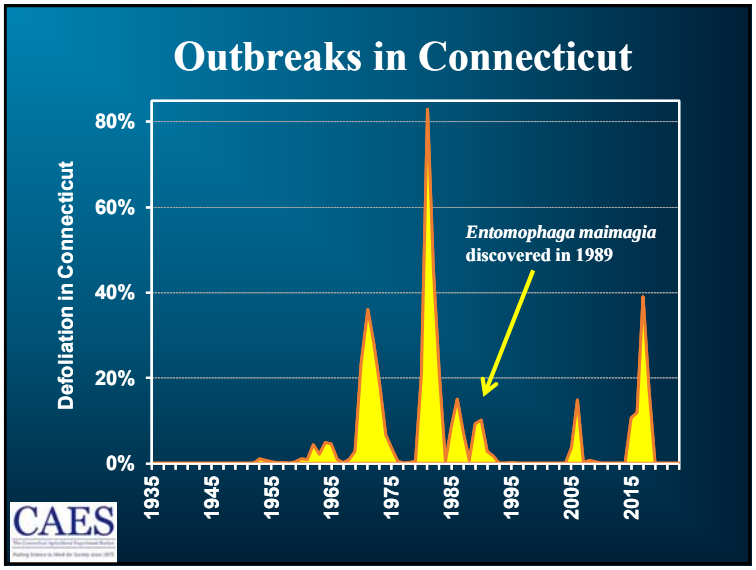

Gypsy moths?
What, me worry?

17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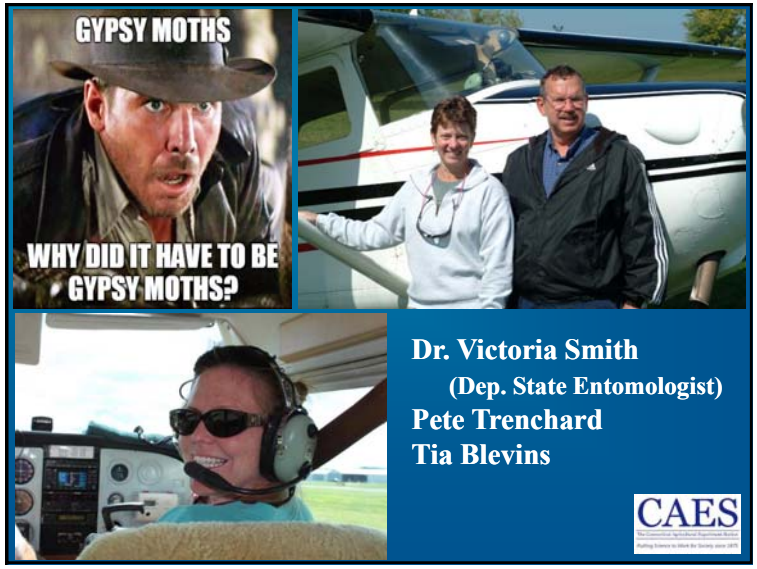
GYPSY MOTHS
WHY DID IT HAVE TO BE GYPSY MOTHS?
Dr. Victoria Smith
(Dep. State Entomologist)
Pete Trenchard
Tia Blevins
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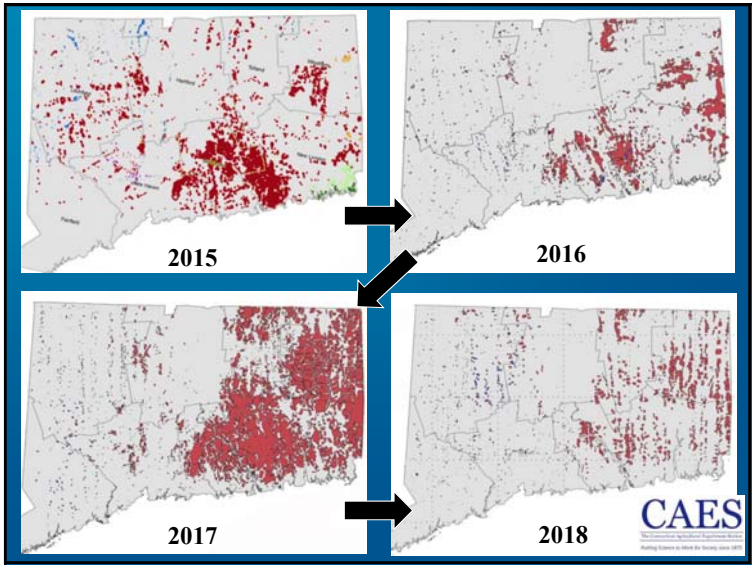
2015
2016
2017
2018
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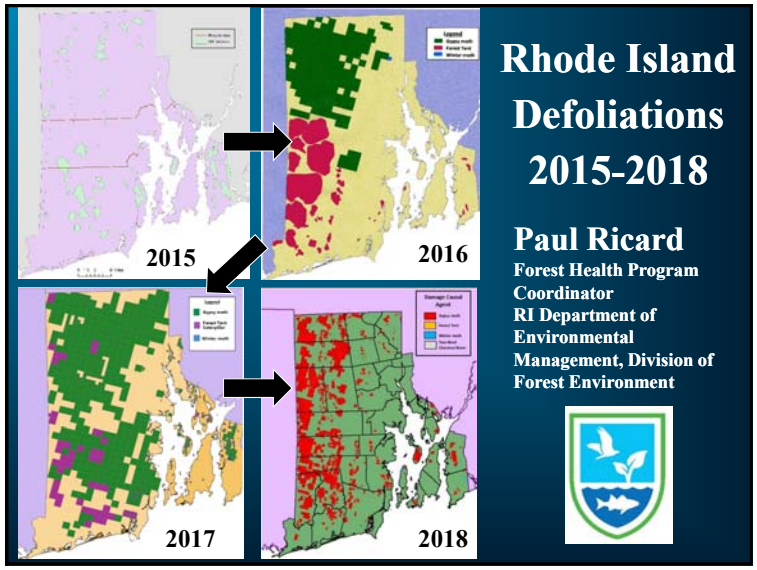
20


2015
2016
2017
2018
Rhode Island Defoliations 2015-2018
Paul Ricard
Forest Health Program Coordinator
RI Department of Environmental Management, Division of Forest Environment

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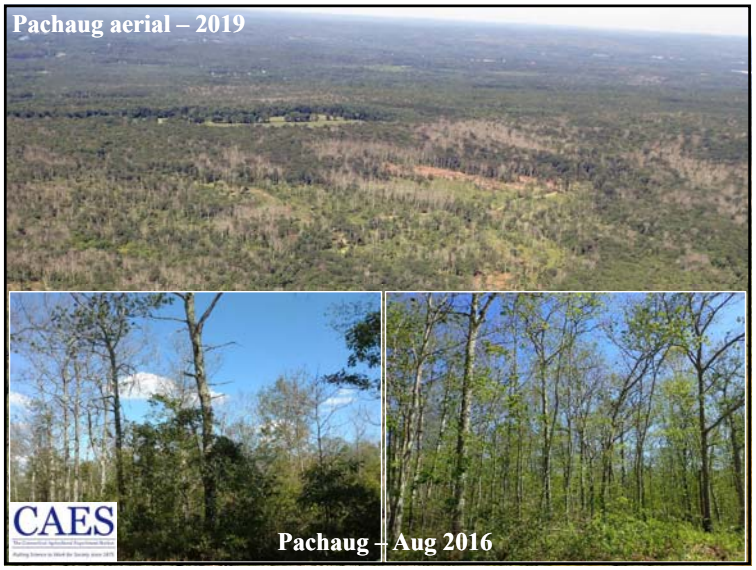
Pachaug aerial – 2019
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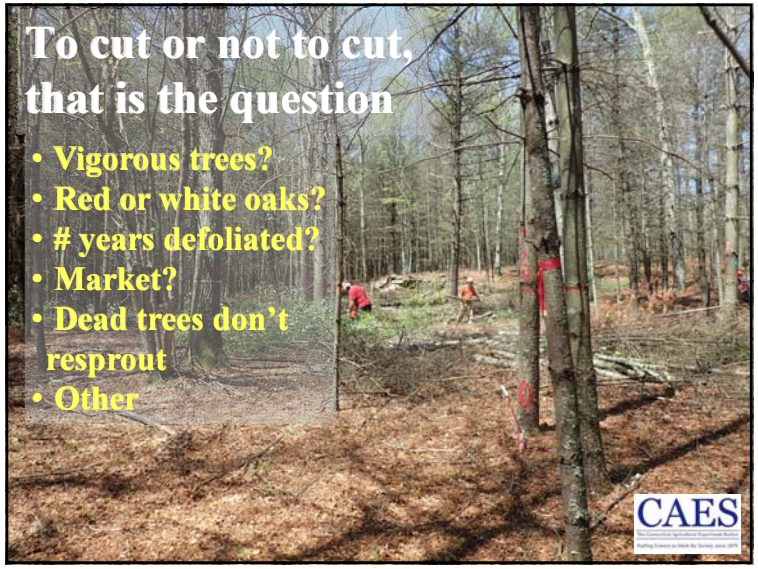
Pachaug – Aug 2016

22


To cut or not to cut, that is the question
• Vigorous trees?
• Red or white oaks?
• # years defoliated?
• Market?
• Dead trees don't resprout
• Other
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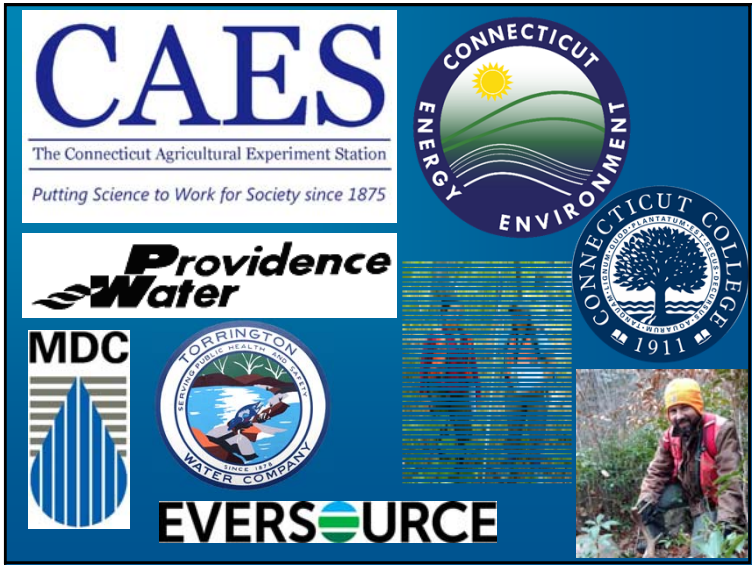
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Providence Water
CONNECTICUT COLLEGE 1911
MDC
TORRINGTON WATER COMPANY
EVERSOURCE

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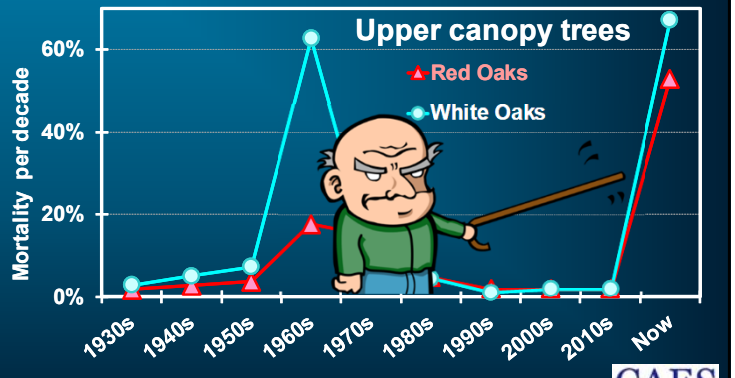
Red oaks are now dying – what's happening?



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What we examined

29 study areas (120+ acres*)
16 study areas had matched managed/unmanaged stands
15 study areas with severe defoliation, 7 with moderate, and 7 with minimal/none

3095 oaks examined (and countless others):
- NRO – northern red oak (n=1578)
- BLO – black oak (n=931)
- WHO – white oak (n=436)
- CHO – chestnut oak (n=150)

* Maromas study areas did not have fixed area plots

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For fellow geeks

Both
- Arcsine transformations of 3-yr mortality rates
- Model selected had lowest AIC and factors were significant ($p \leq 0.05$)

Stand level
- Linear mixed model analysis with study area as random factor

Tree level
- Binary logistic regression by species

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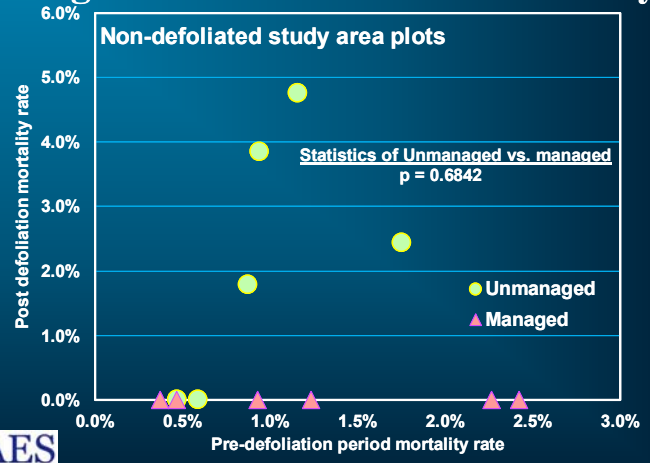
Drought – no effect on stand mortality



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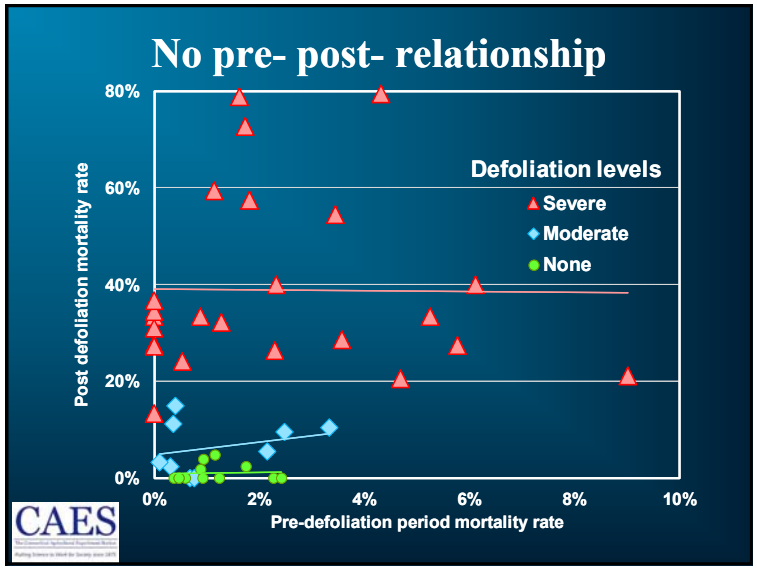

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Pre-defoliation oak mortality

Pre-defoliation stand level mortality did not differ by:

- Managed vs. unmanaged stands
- Stand oak basal area
- Stand oak density
- Did not examine soils, but saw high mortality on some moist soils (e.g., Pikes, Pine Acres)

High pre-defoliation stand level mortality did not predict high post-defoliation mortality

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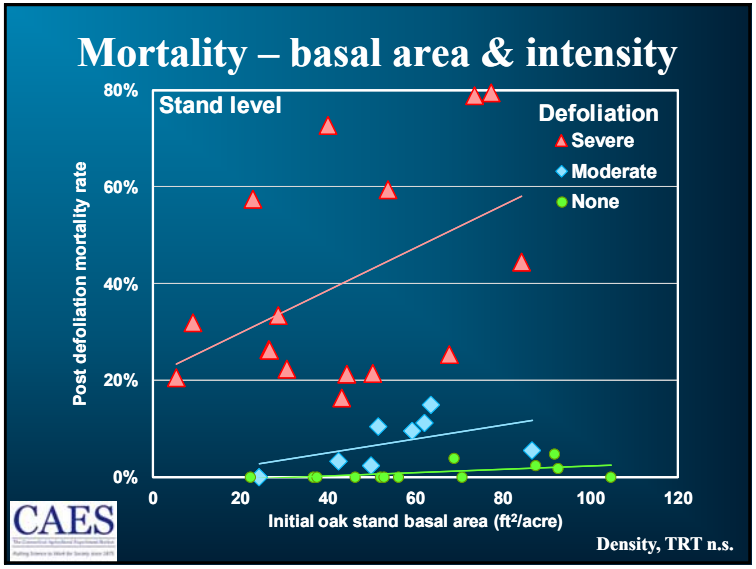

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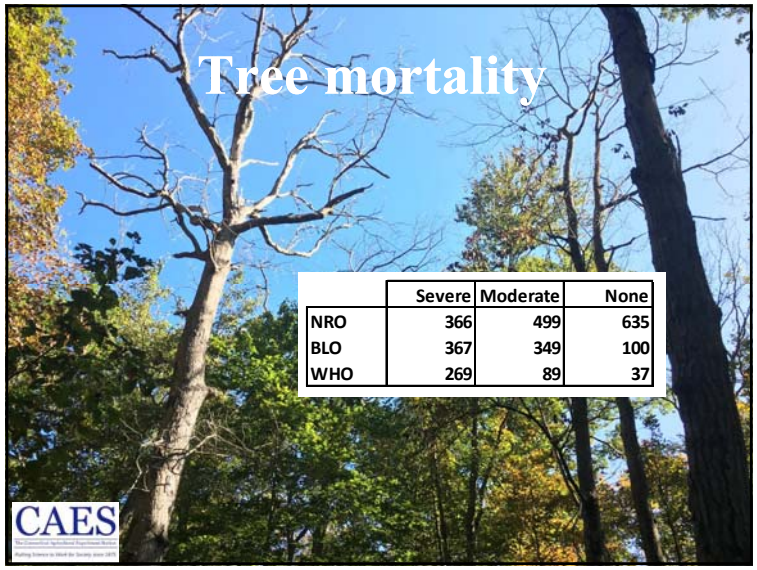
Tree mortality
Severe Moderate None
NRO 366 499 635
BLO 367 349 100
WHO 269 89 37
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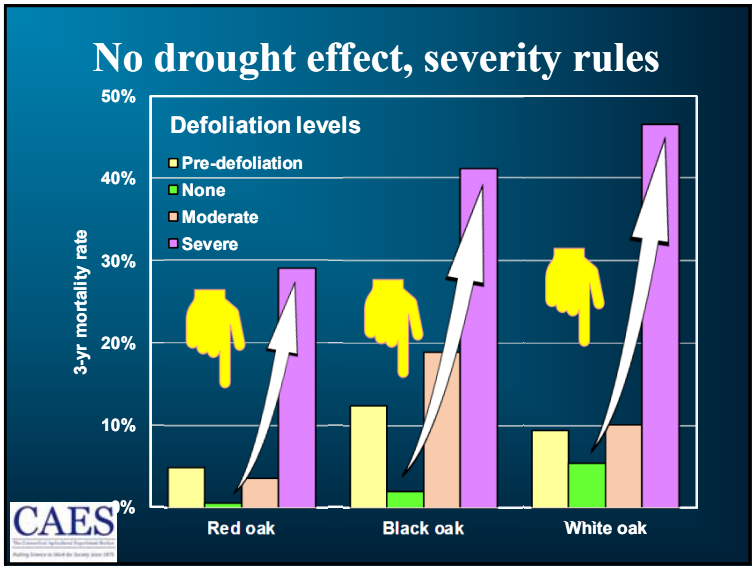
No drought effect, severity rules
Defoliation levels
Pre-defoliation
None
Moderate
Severe
3-yr mortality rate
50%
40%
30%
20%
10%
Red oak
Black oak
White oak
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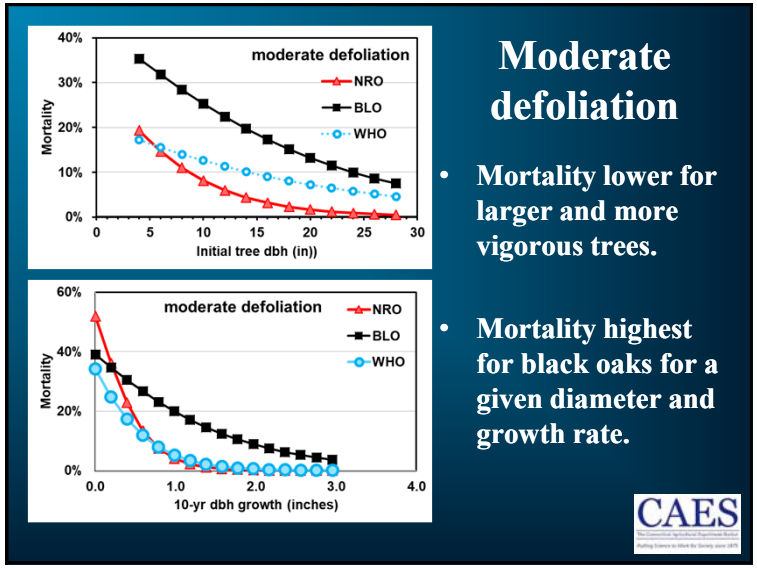
Moderate defoliation
moderate defoliation
NRO
BLO
WHO
Mortality
Initial tree dbh (in))
10-yr dbh growth (inches)
• Mortality lower for larger and more vigorous trees.
• Mortality highest for black oaks for a given diameter and growth rate.
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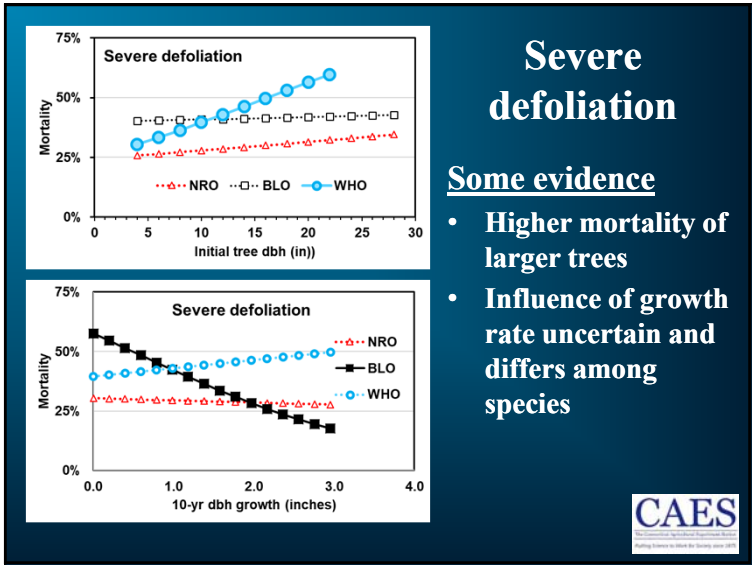
Severe defoliation
Severe defoliation
NRO
BLO
WHO
Mortality
Initial tree dbh (in))
10-yr dbh growth (inches)
Some evidence
• Higher mortality of larger trees
• Influence of growth rate uncertain and differs among species
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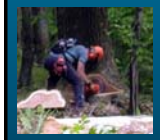
Other

Crown class not significant (but few lower canopy trees)



Thinning increased mortality of red and white oaks on severely defoliated plots

However, no link between mortality and stand oak density or basal area (?)

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Summary

No detectable effect of drought on stand or tree mortality rates

Reduce anticipated stand and tree mortality by:

- removing black oaks, and to a lesser extent removing white oak
- thinning effects are uncertain
- if severe (heavy, multi-year) defoliations occur, expect high mortality and can not predict which trees will die

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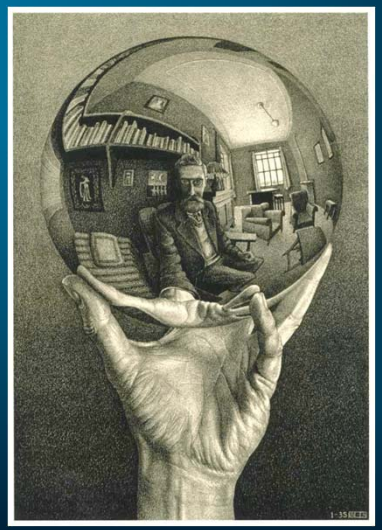

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But trees are older now,
so will they also recover?
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