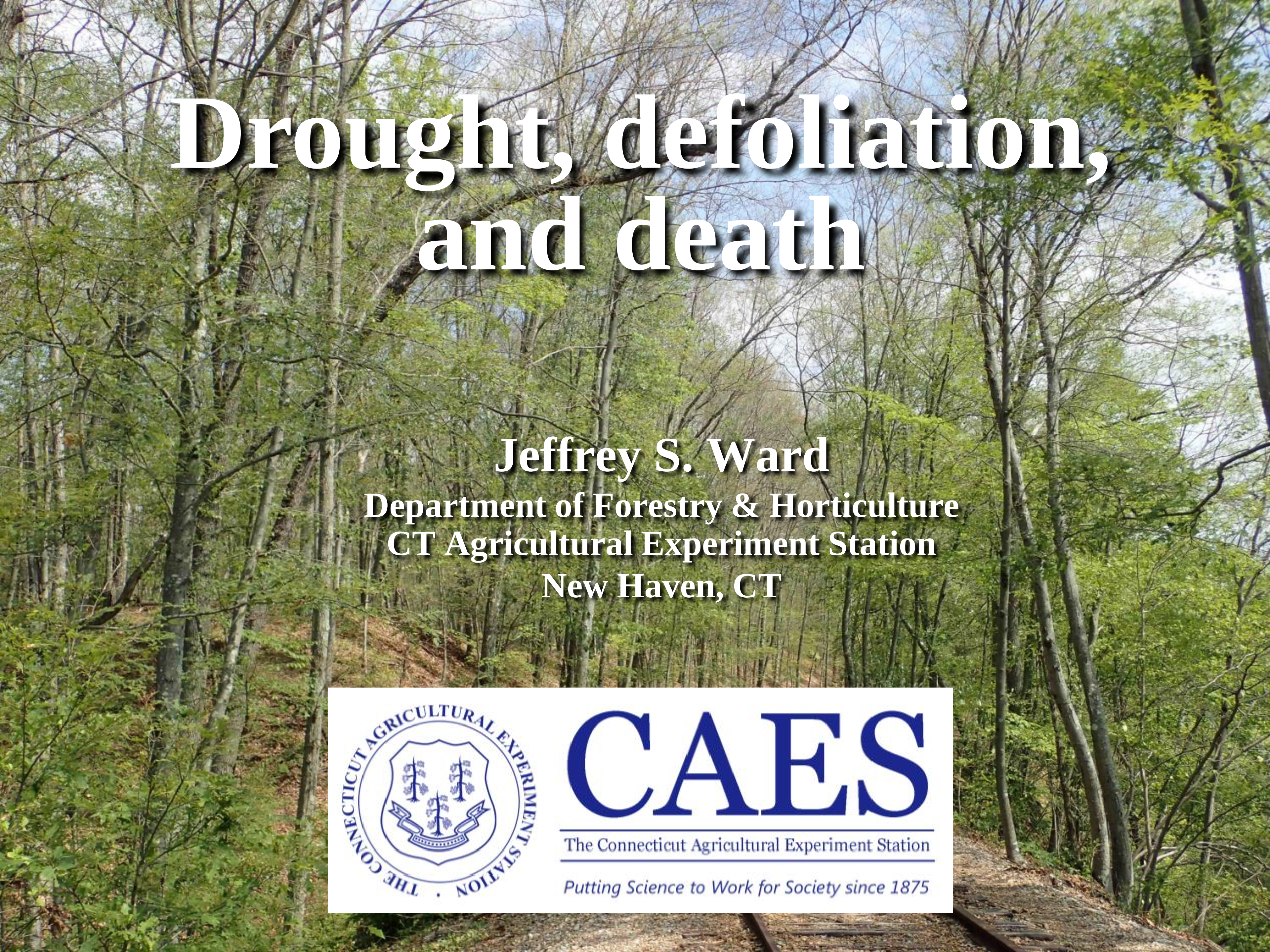

Drought, defoliation, and death

Jeffrey S. Ward
Department of Forestry & Horticulture
CT Agricultural Experiment Station
New Haven, CT

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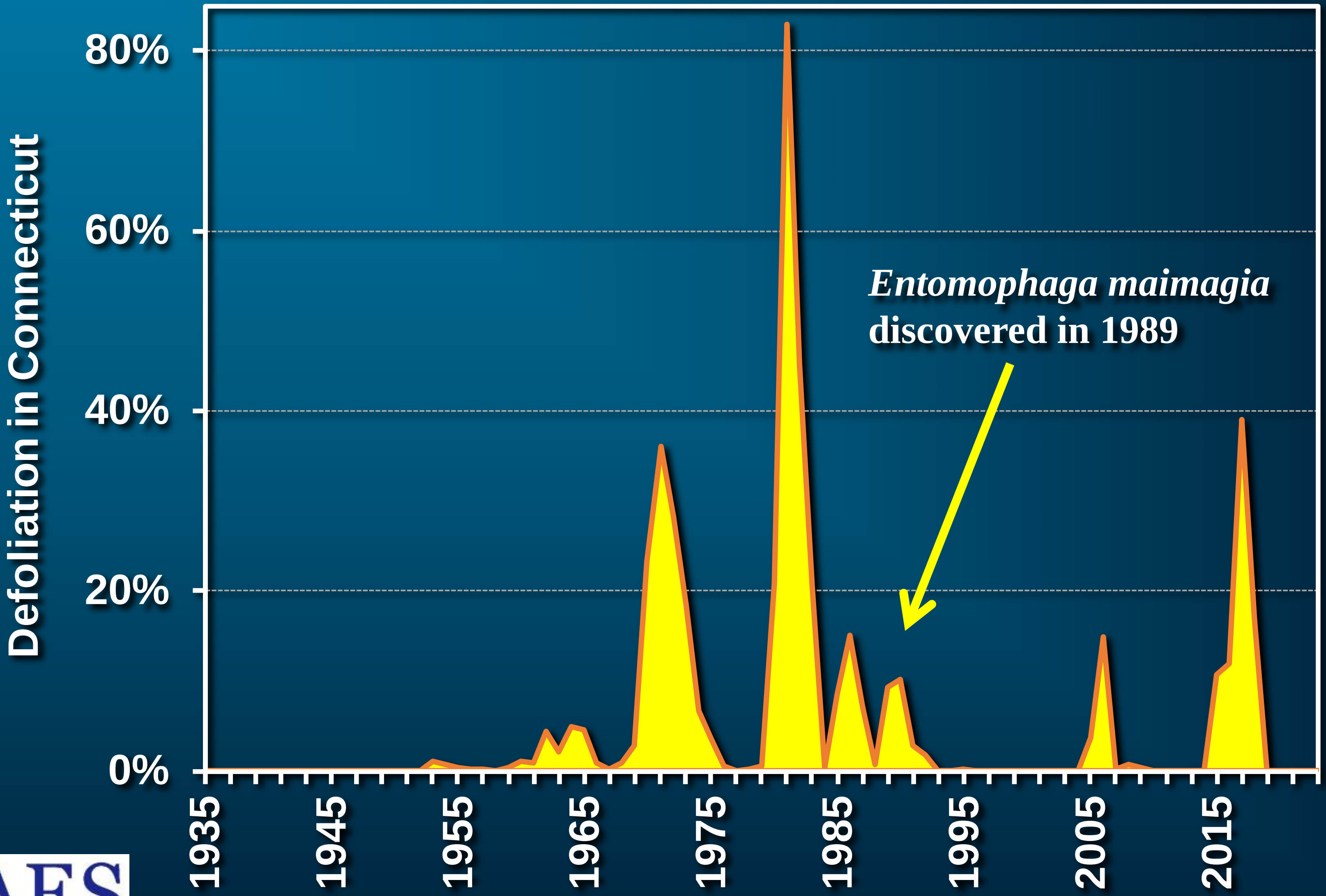
HOW CAN I TELL IF I GOT GYPSY MOTHS ?
LAWN AND GARDEN
© [illegible] CREATORS SYNDICATE INC
THE TINY CAMPFIRES AND THE ACCORDION MUSIC USUALLY GIVE THEM AWAY.
LAWN AND GARDEN
5-17

Outbreaks in Connecticut



Entomophaga maimagia
discovered in 1989

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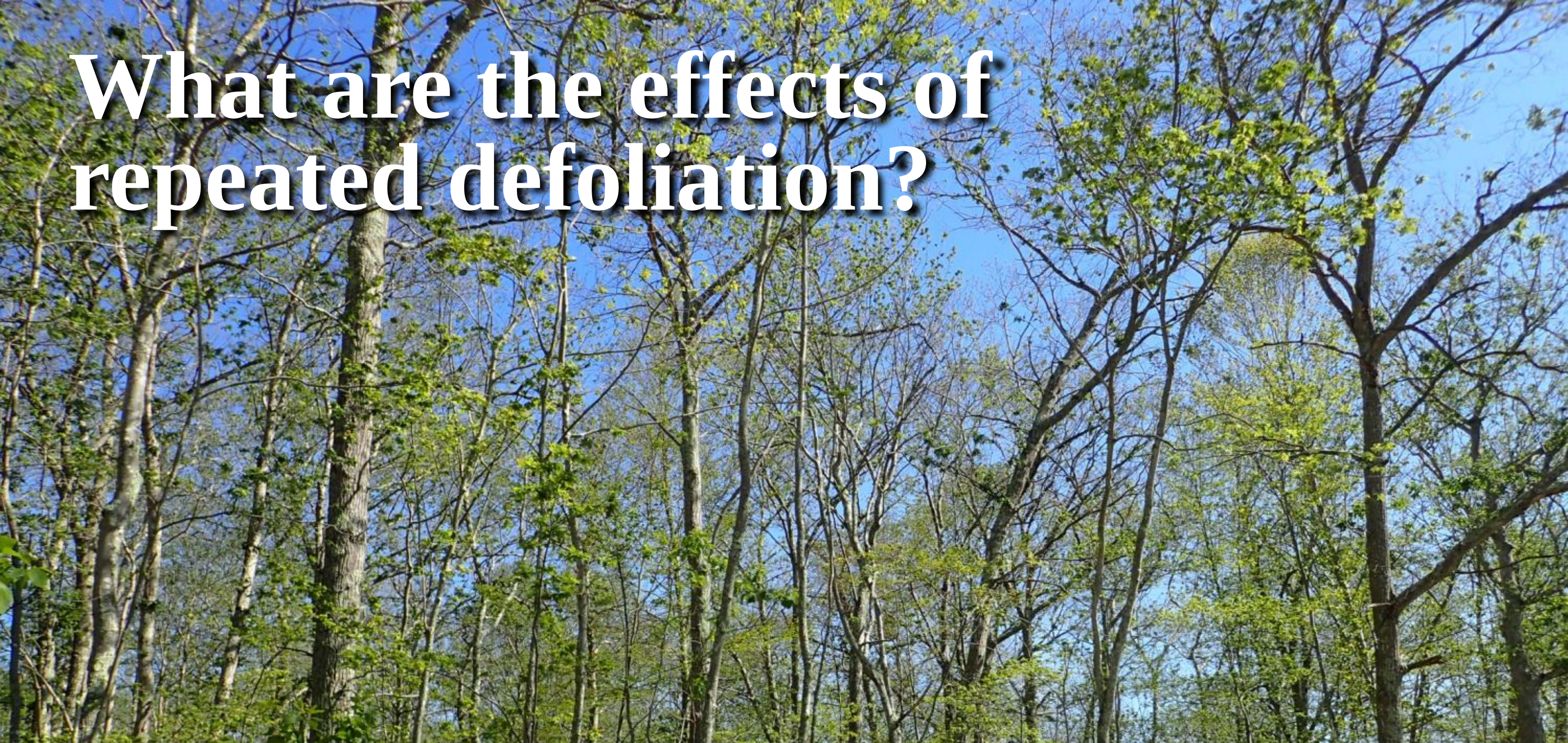
What are the effects of repeated defoliation?



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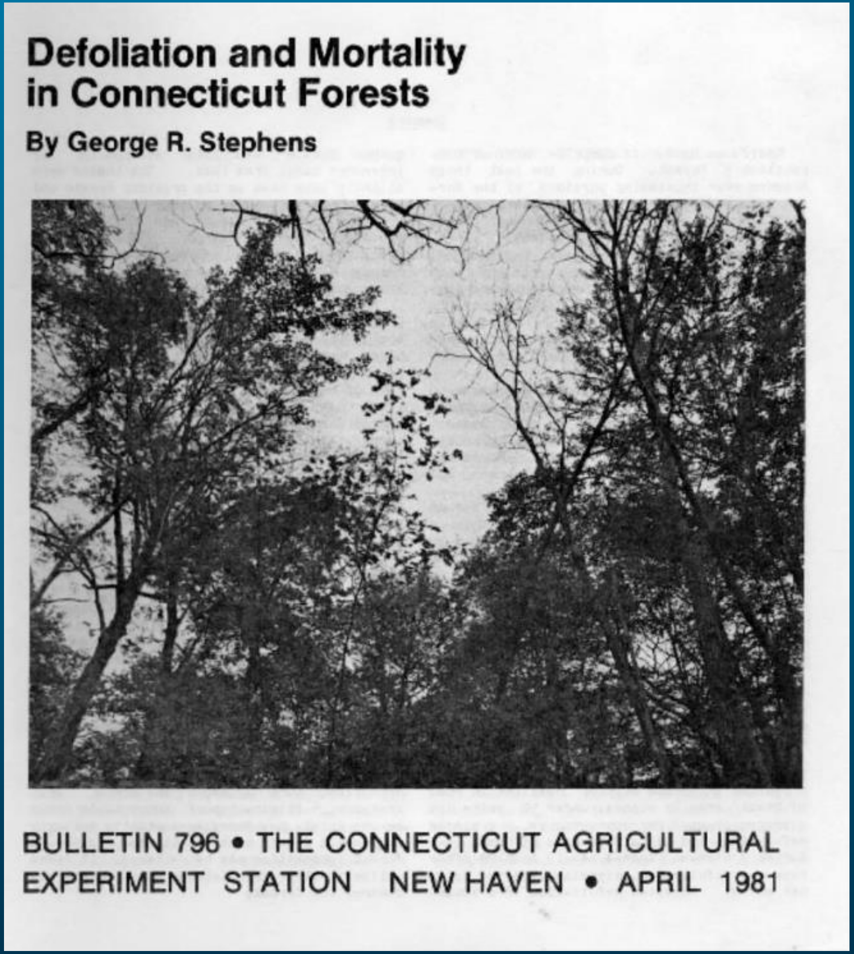
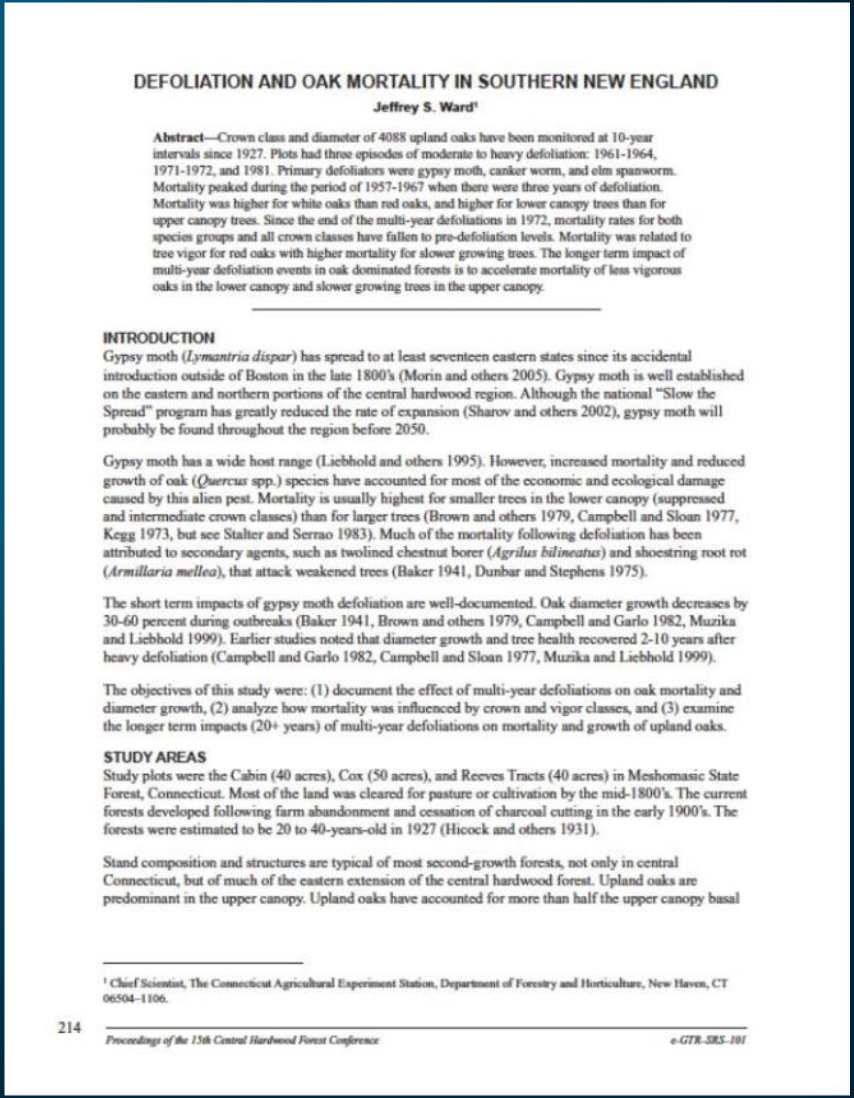
Long-term Connecticut studies



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

Jeffrey S. Ward[1]

Abstract—Crown class and diameter of 4088 upland oaks have been monitored at 10-year intervals since 1927. Plots had three episodes of moderate to heavy defoliation: 1961-1964, 1971-1972, and 1981. Primary defoliators were gypsy moth, canker worm, and elm spanworm. Mortality peaked during the period of 1957-1967 when there were three years of defoliation. Mortality was higher for white oaks than red oaks, and higher for lower canopy trees than for upper canopy trees. Since the end of the multi-year defoliations in 1972, mortality rates for both species groups and all crown classes have fallen to pre-defoliation levels. Mortality was related to tree vigor for red oaks with higher mortality for slower growing trees. The longer term impact of multi-year defoliation events in oak dominated forests is to accelerate mortality of less vigorous oaks in the lower canopy and slower growing trees in the upper canopy.

INTRODUCTION

Gypsy moth (*Lymantria dispar*) has spread to at least seventeen eastern states since its accidental introduction outside of Boston in the late 1800's (Morin and others 2005). Gypsy moth is well established on the eastern and northern portions of the central hardwood region. Although the national "Slow the Spread" program has greatly reduced the rate of expansion (Sharov and others 2002), gypsy moth will probably be found throughout the region before 2050.

Gypsy moth has a wide host range (Liebhold and others 1995). However, increased mortality and reduced growth of oak (*Quercus* spp.) species have accounted for most of the economic and ecological damage caused by this alien pest. Mortality is usually highest for smaller trees in the lower canopy (suppressed and intermediate crown classes) than for larger trees (Brown and others 1979, Campbell and Sloan 1977, Kegg 1973, but see Stalter and Serrao 1983). Much of the mortality following defoliation has been attributed to secondary agents, such as twolined chestnut borer (*Agrilus bilineatus*) and shoestring root rot (*Armillaria mellea*), that attack weakened trees (Baker 1941, Dunbar and Stephens 1975).

The short term impacts of gypsy moth defoliation are well-documented. Oak diameter growth decreases by 30-60 percent during outbreaks (Baker 1941, Brown and others 1979, Campbell and Garlo 1982, Muzika and Liebhold 1999). Earlier studies noted that diameter growth and tree health recovered 2-10 years after heavy defoliation (Campbell and Garlo 1982, Campbell and Sloan 1977, Muzika and Liebhold 1999).

The objectives of this study were: (1) document the effect of multi-year defoliations on oak mortality and diameter growth, (2) analyze how mortality was influenced by crown and vigor classes, and (3) examine the longer term impacts (20+ years) of multi-year defoliations on mortality and growth of upland oaks.

STUDY AREAS

Study plots were the Cabin (40 acres), Cox (50 acres), and Reeves Tracts (40 acres) in Meshomasic State Forest, Connecticut. Most of the land was cleared for pasture or cultivation by the mid-1800's. The current forests developed following farm abandonment and cessation of charcoal cutting in the early 1900's. The forests were estimated to be 20 to 40-years-old in 1927 (Hicock and others 1931).

Stand composition and structures are typical of most second-growth forests, not only in central Connecticut, but of much of the eastern extension of the central hardwood forest. Upland oaks are predominant in the upper canopy. Upland oaks have accounted for more than half the upper canopy basal

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Old-Series Plots (1927-1997)

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Tree measurements ($\geq$ 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

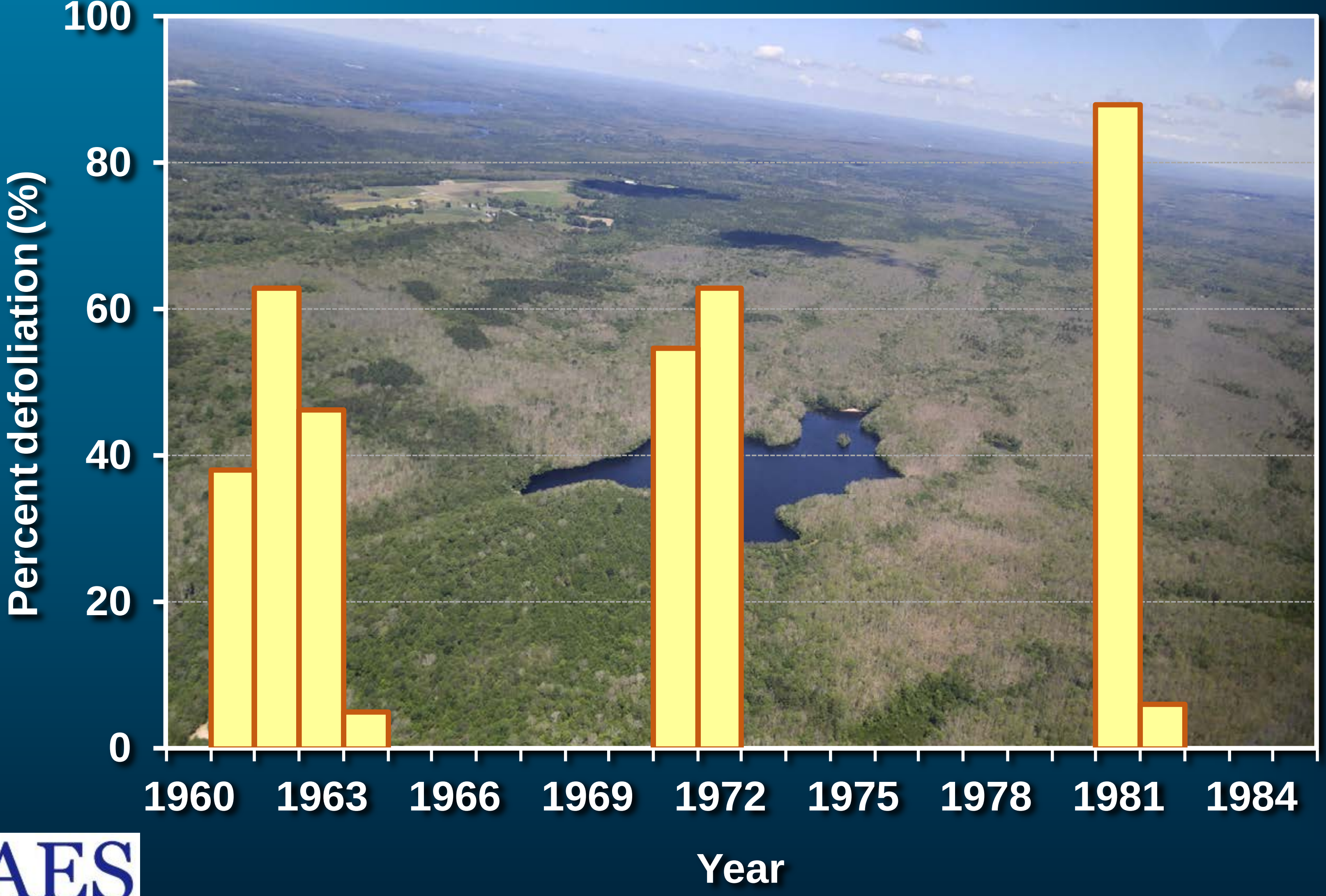
Loss of lower canopy oaks

Loss of white oaks

Loss of low vigor red oaks

After defoliation

Old-Series defoliation



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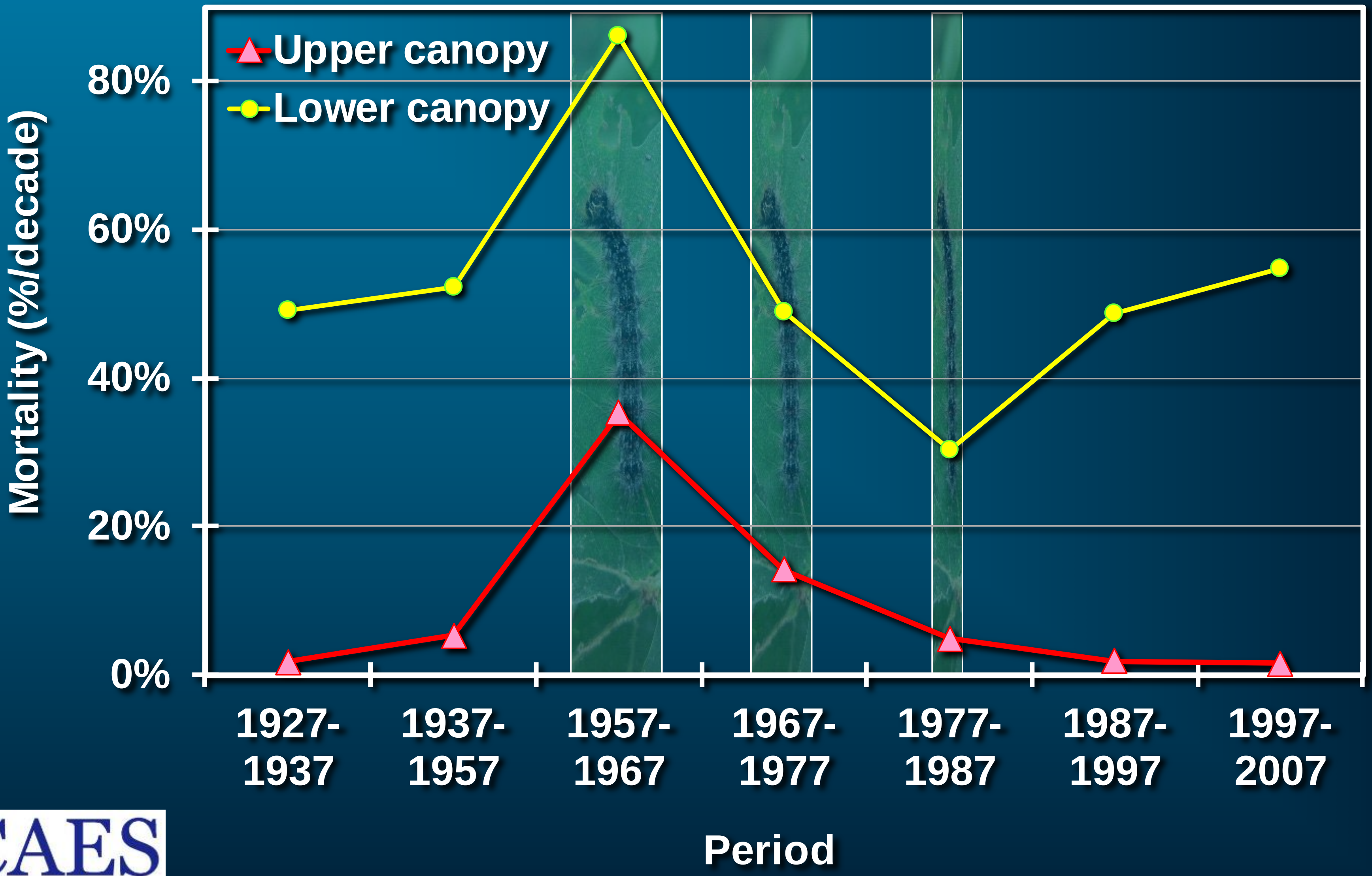
Repeated defoliation -> higher mortality



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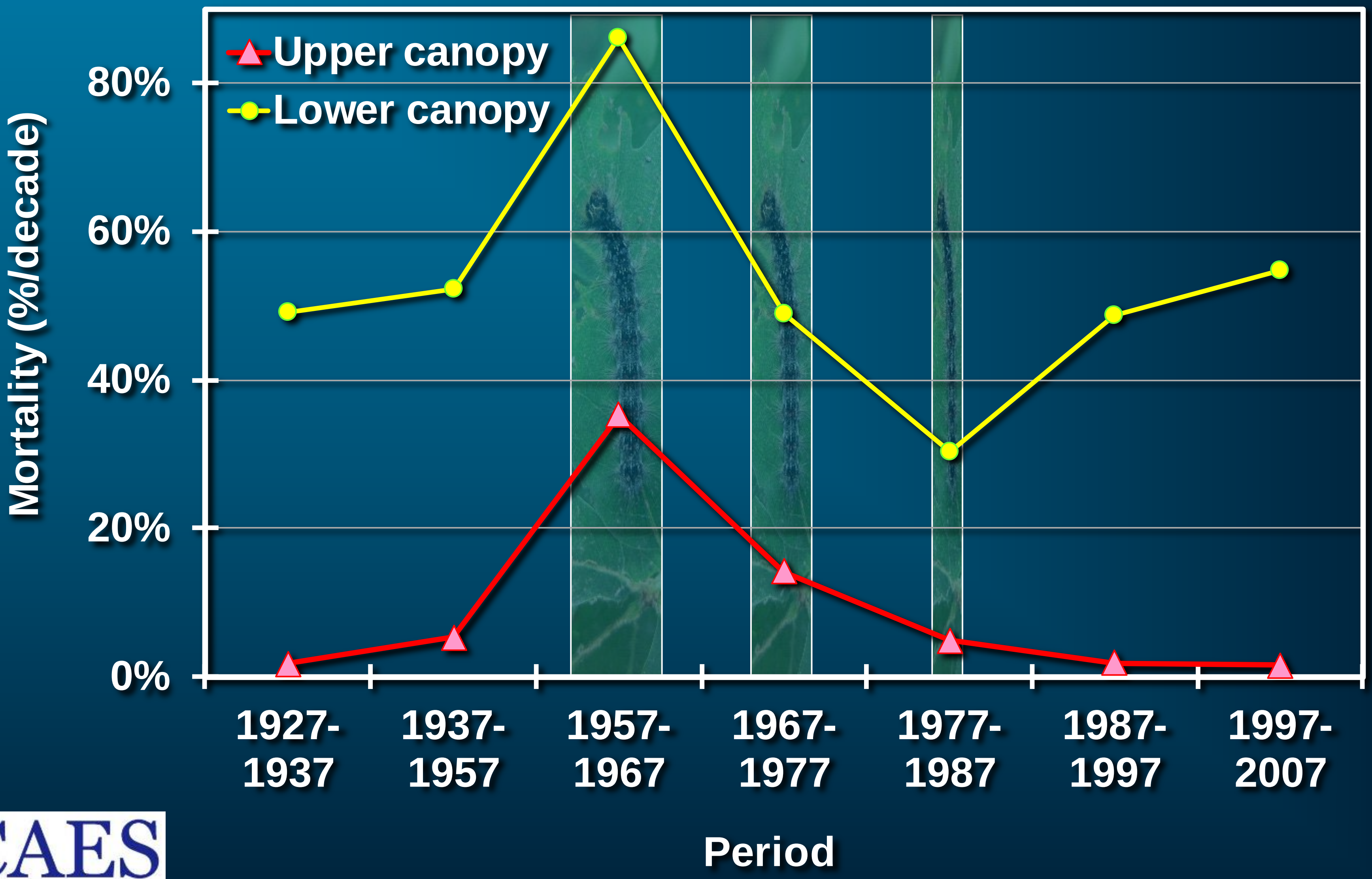
Higher mortality of lower canopy oaks



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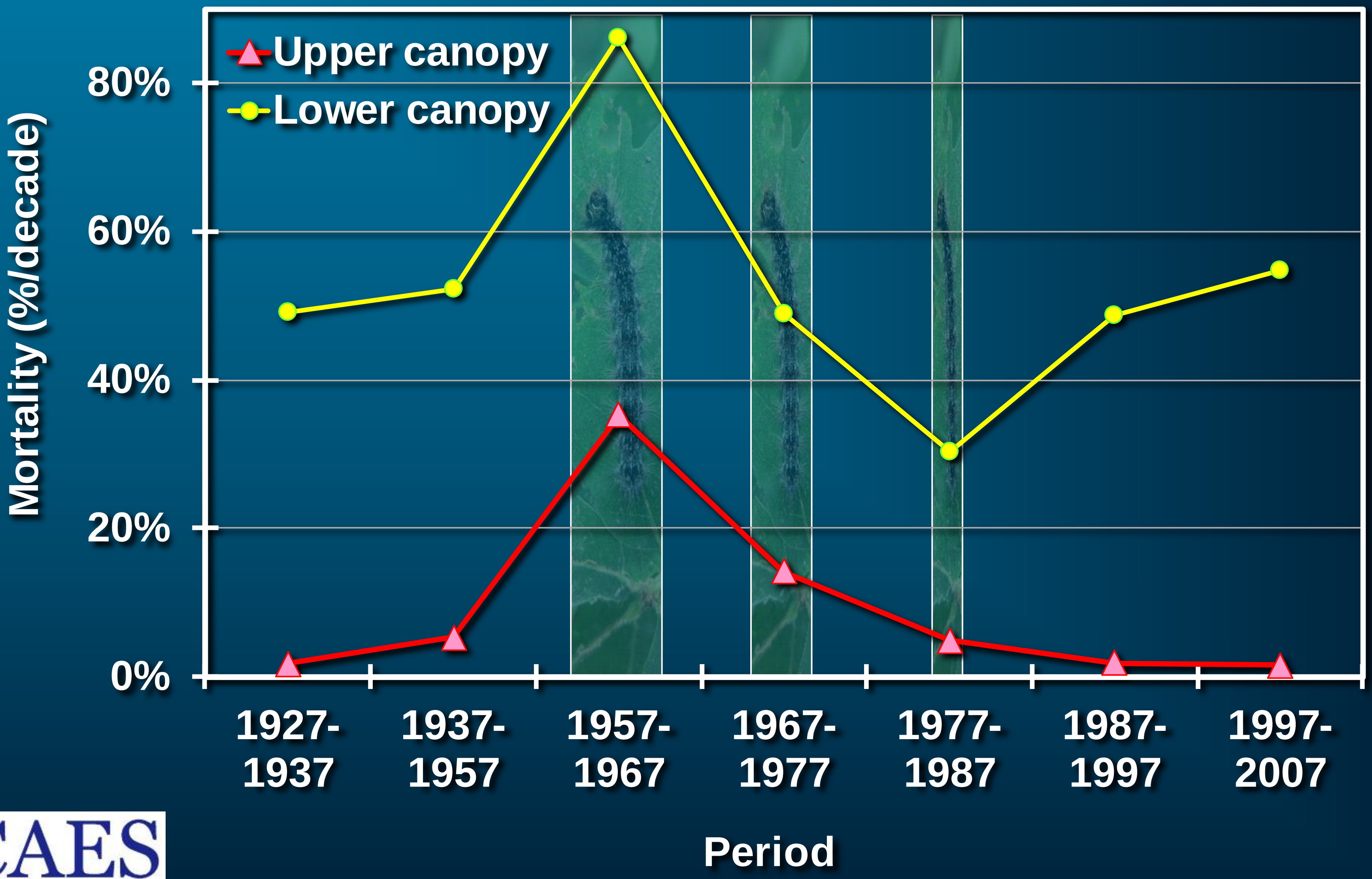
Low mortality after defoliation ended



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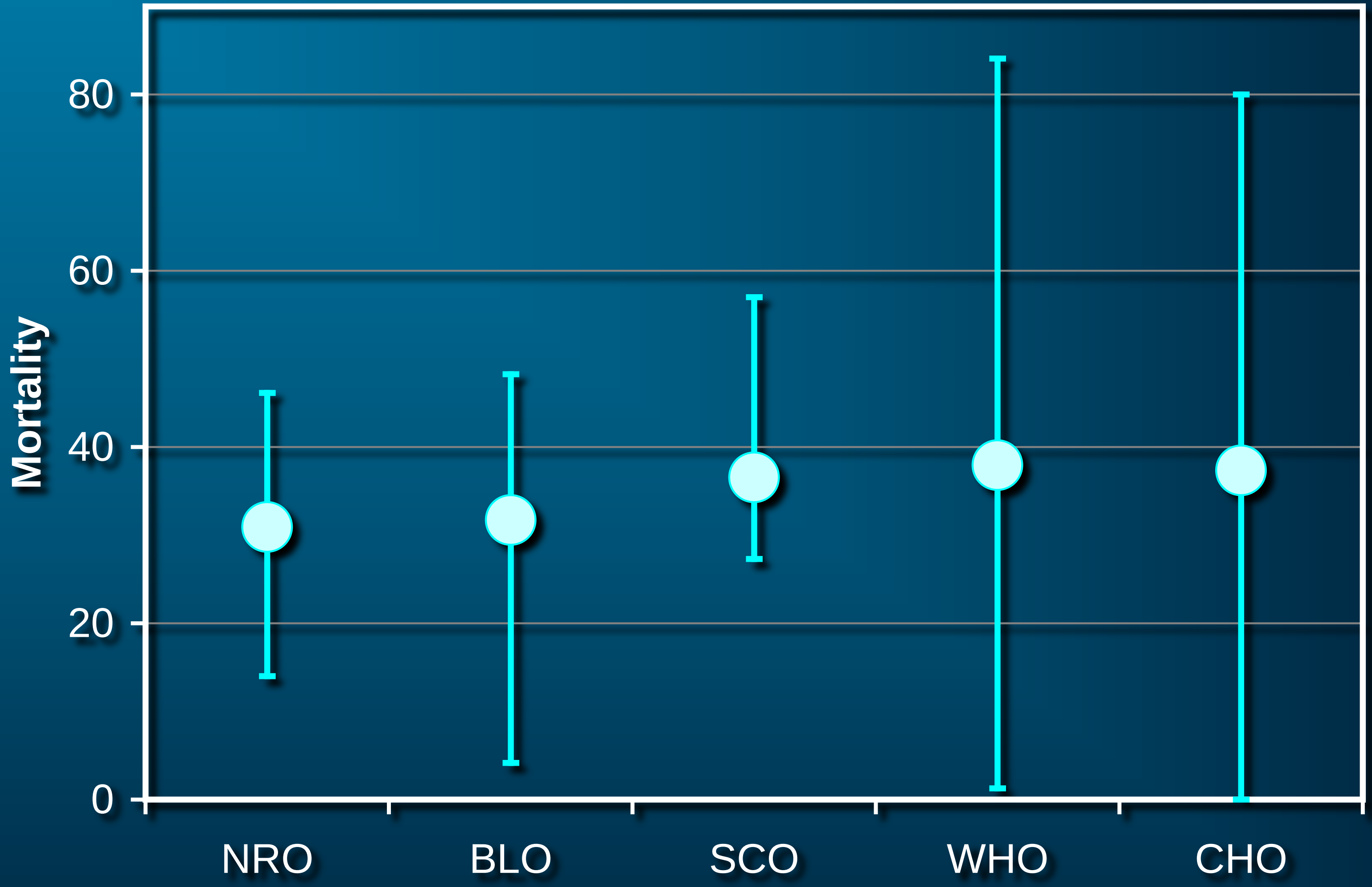
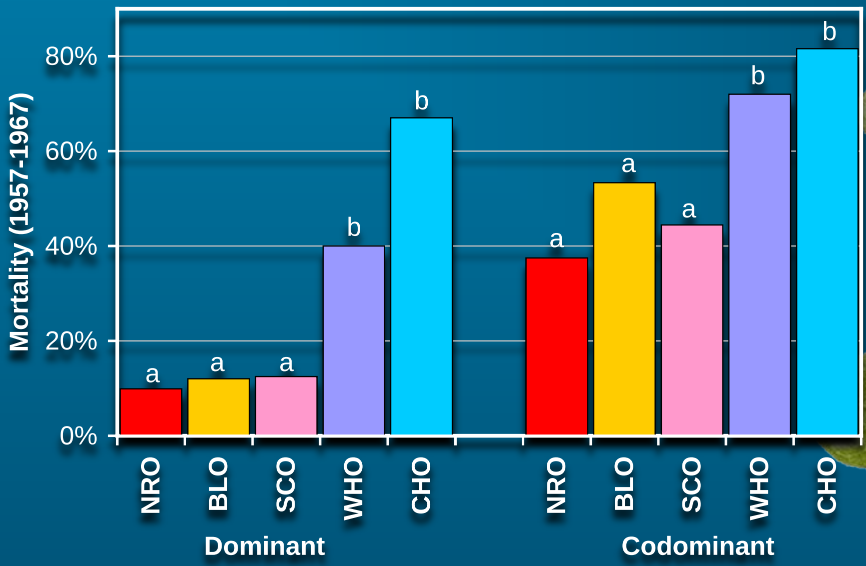
Literature estimates for species vary



Kegg 1971 Dunbar and Stephens 1975 Stalter and Serrao 1983 Fosbroke and Hicks 198
Kegg 1973 Campbell and Sloan 1977 Herrick and Gansner 1987

White oak mortality higher than red oak



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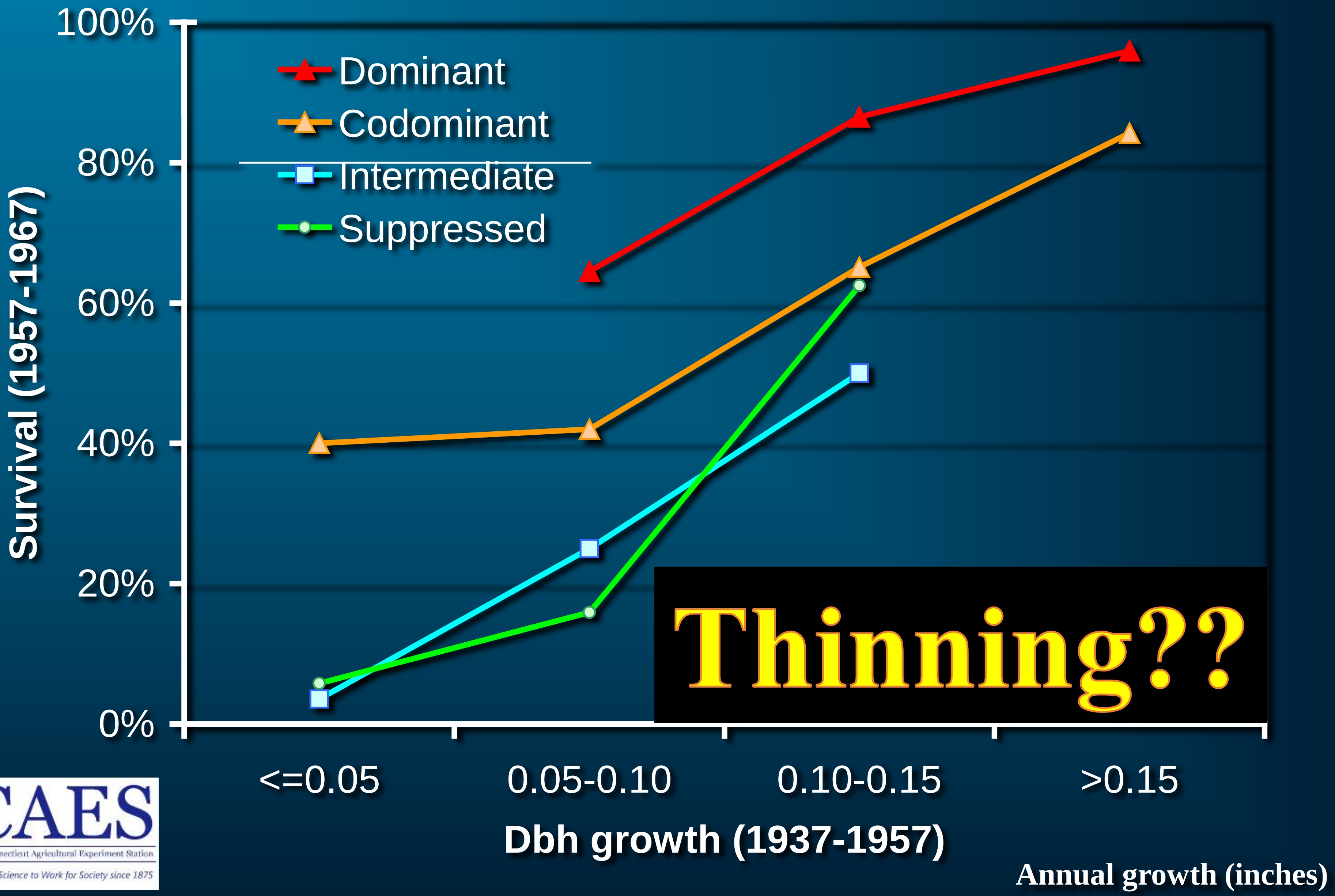
Survival high for fast growing red oaks



Thinning??

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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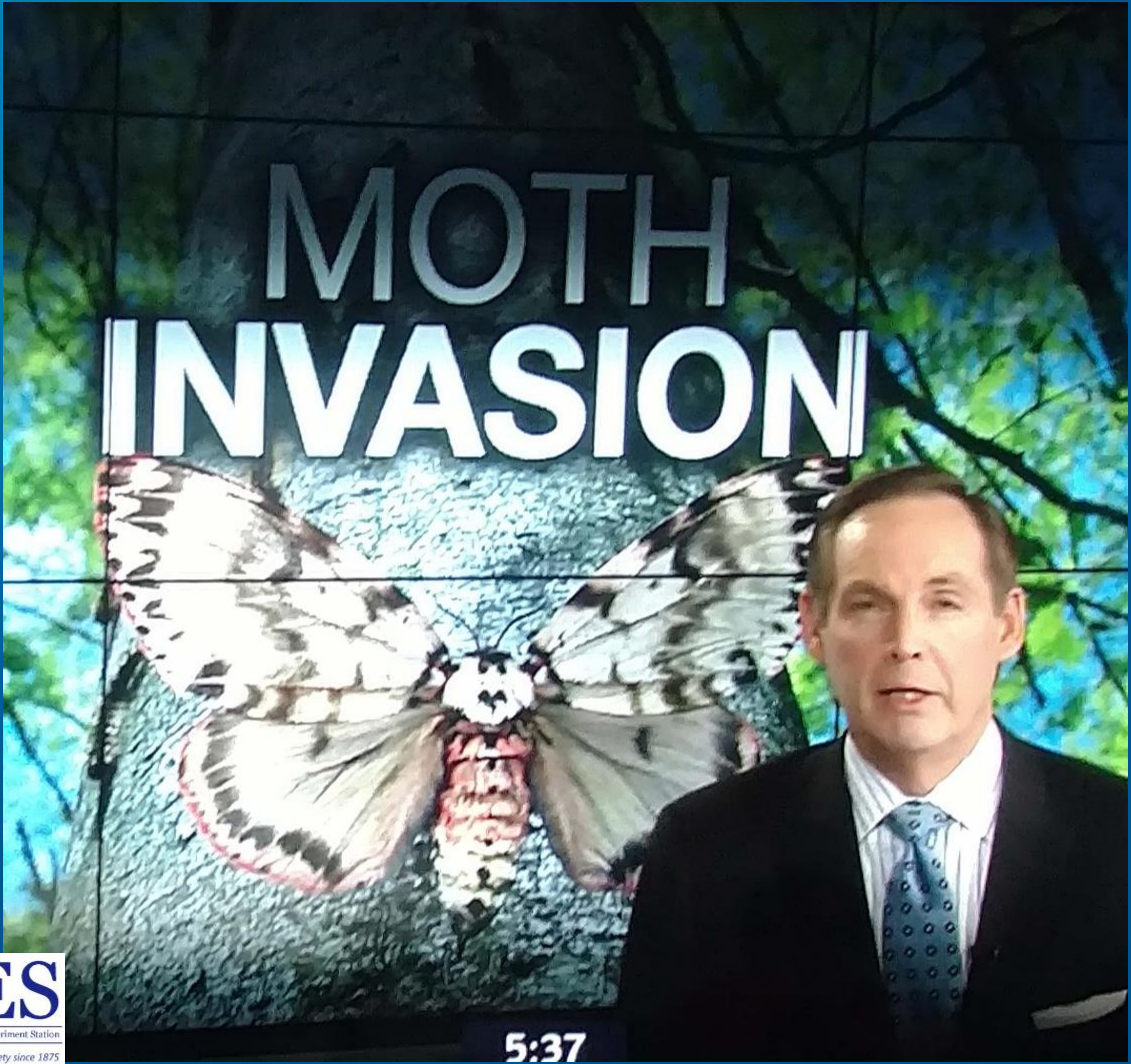
Gypsy moths? What, me worry?



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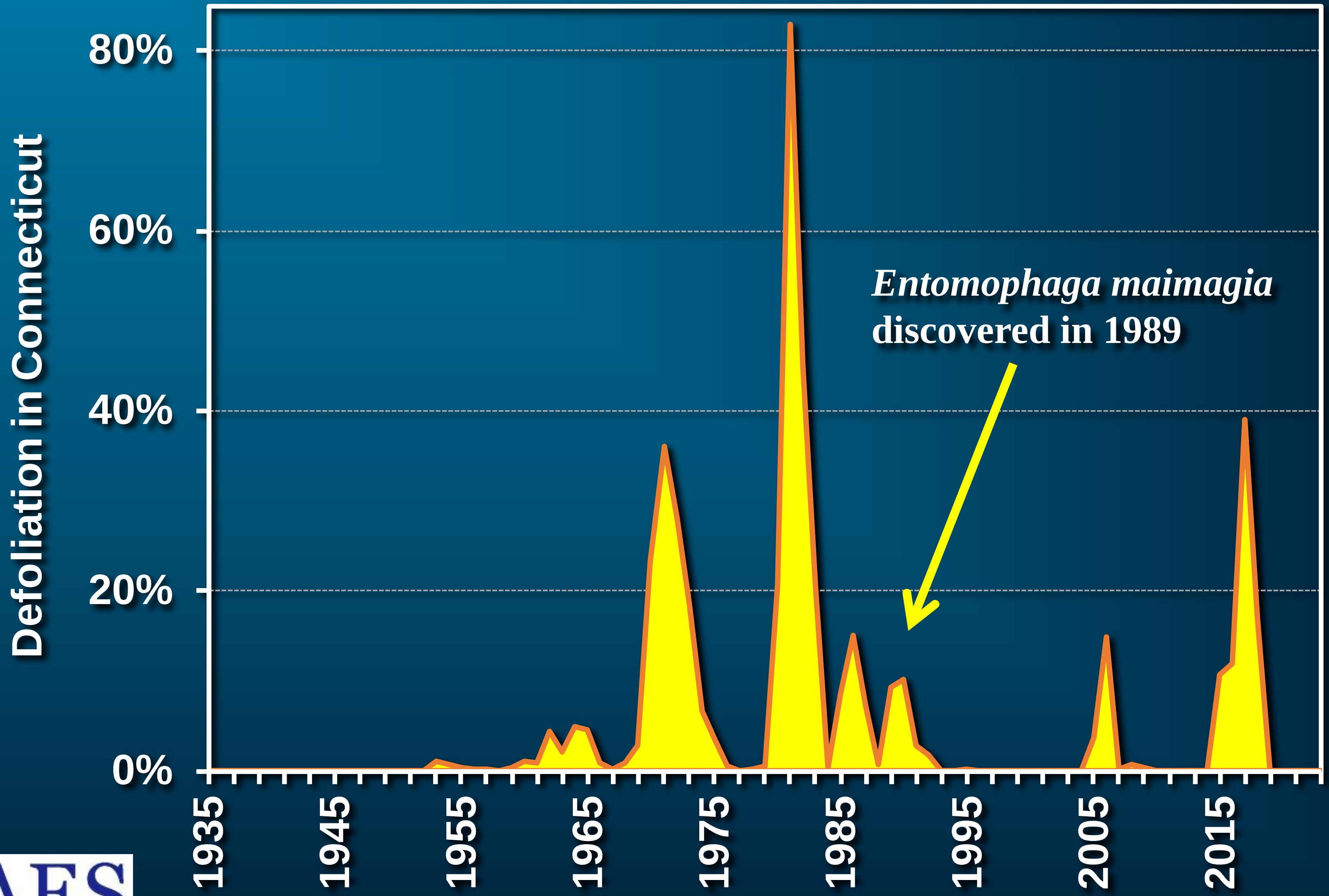
Outbreaks in Connecticut



Entomophaga maimagia
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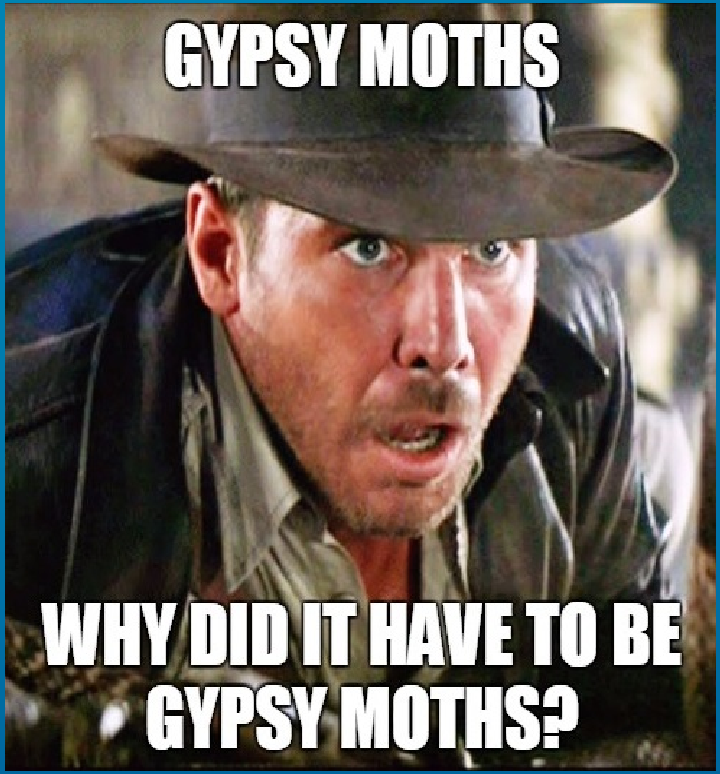

Dr. Victoria Smith

(Dep. State Entomologist)

Pete Trenchard

Tia Blevins

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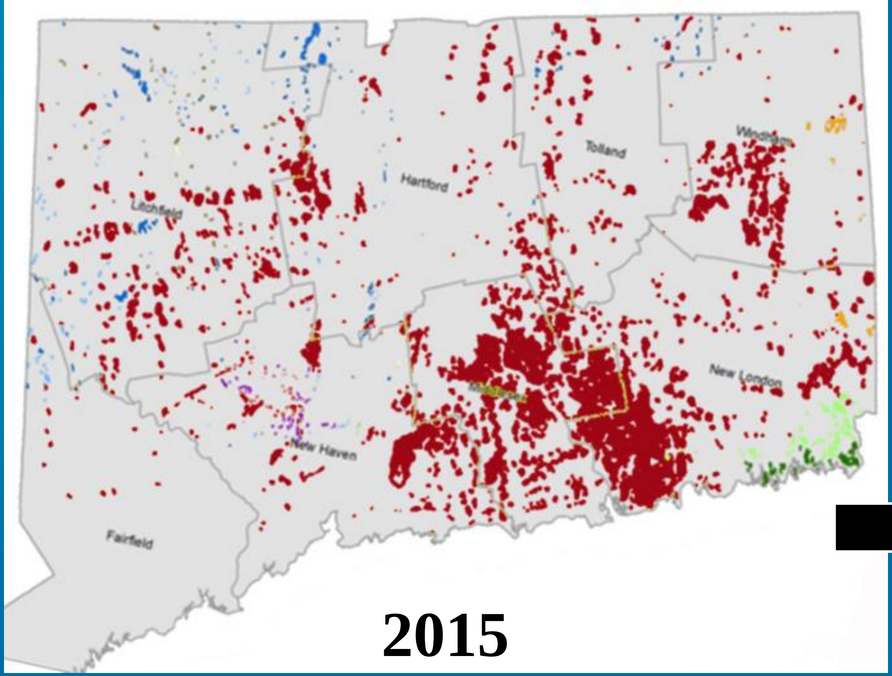
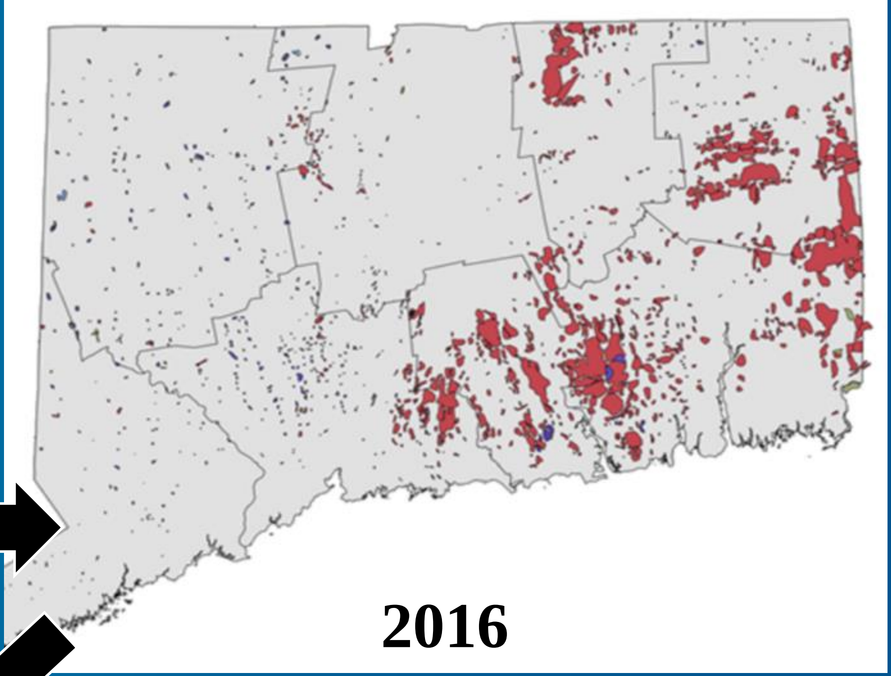
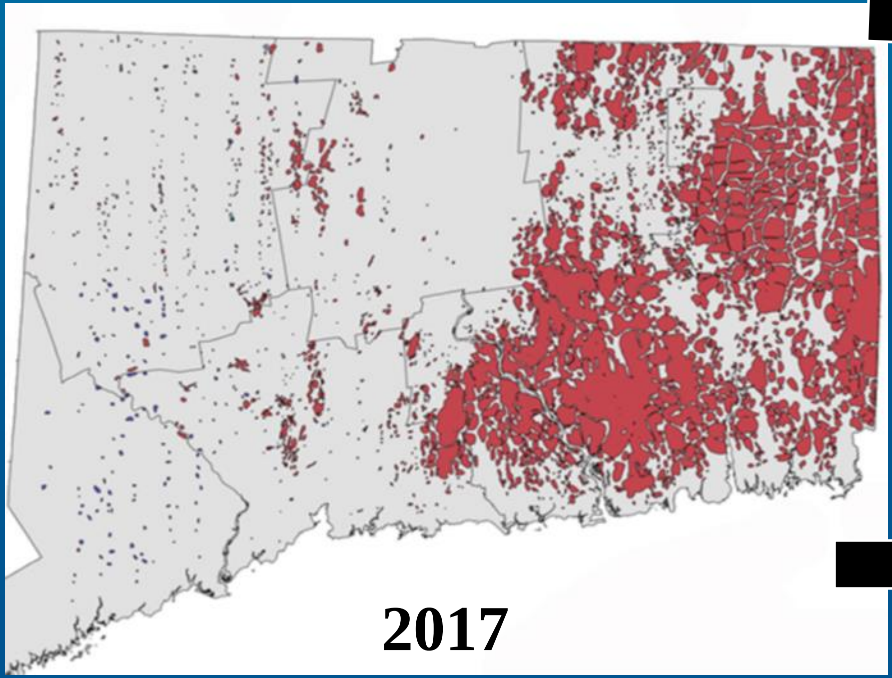


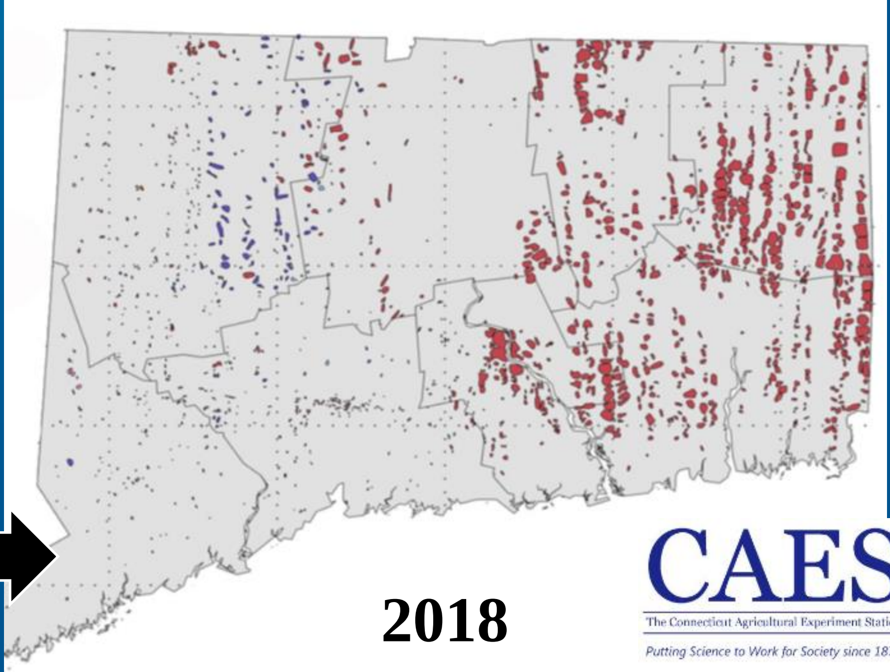
2015



2016



2017



2018

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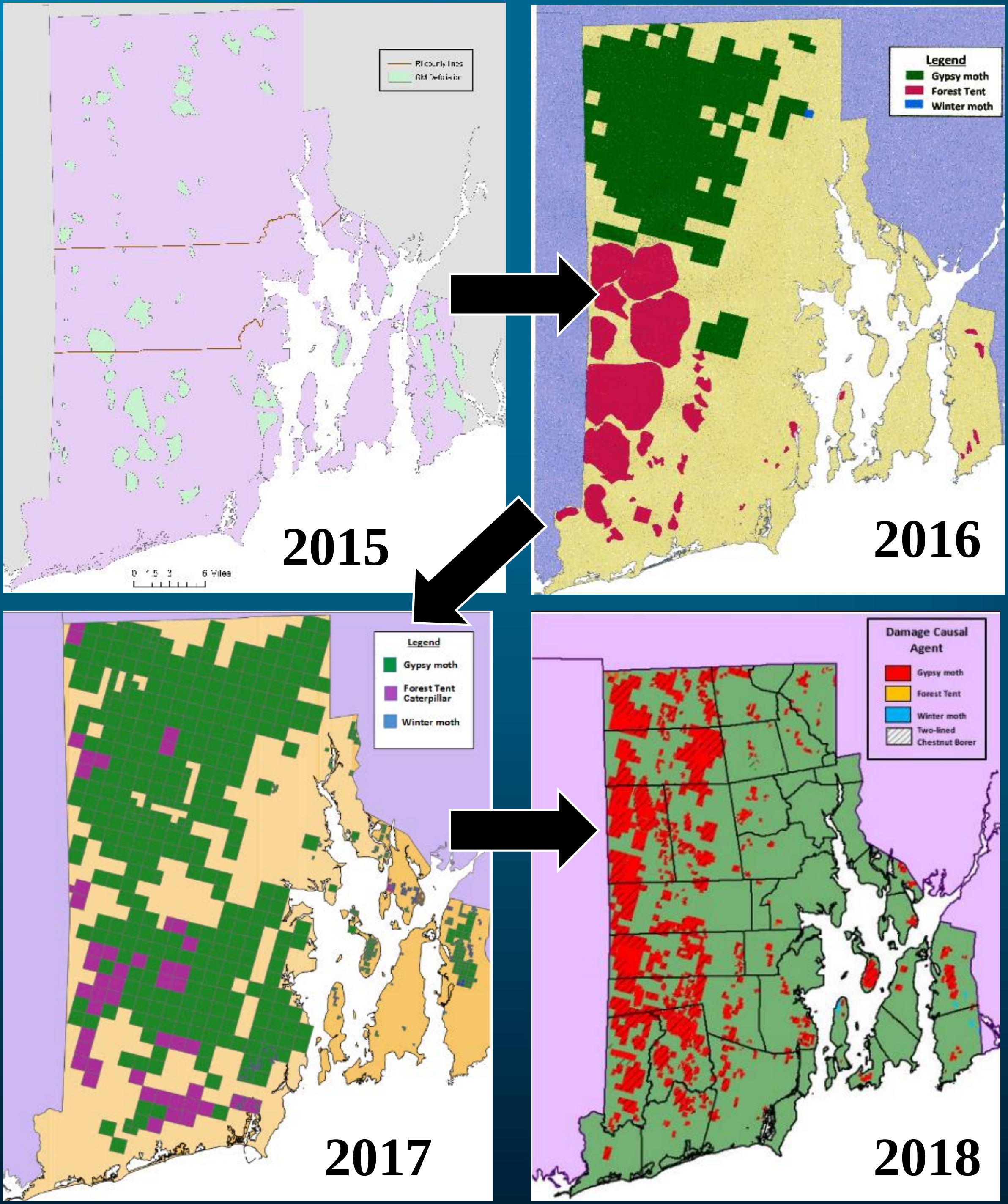
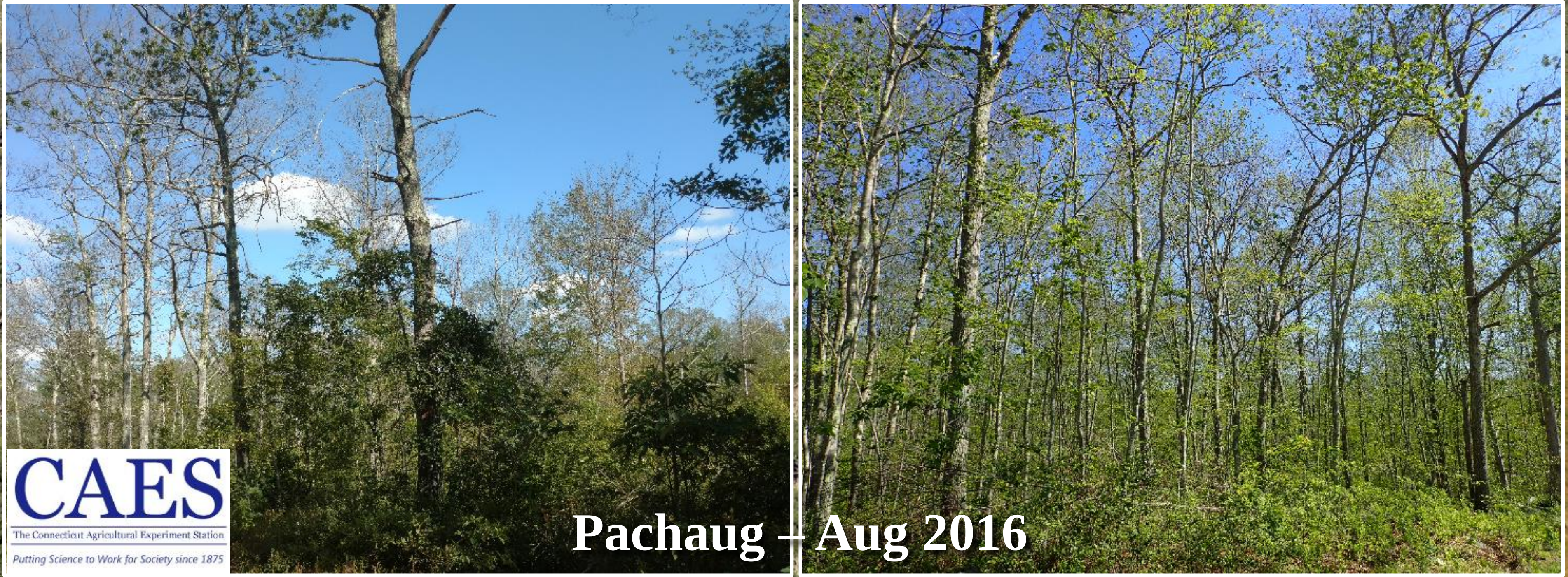
Rhode Island Defoliations 2015-2018



Paul Ricard

Forest Health Program Coordinator
RI Department of Environmental Management, Division of Forest Environment

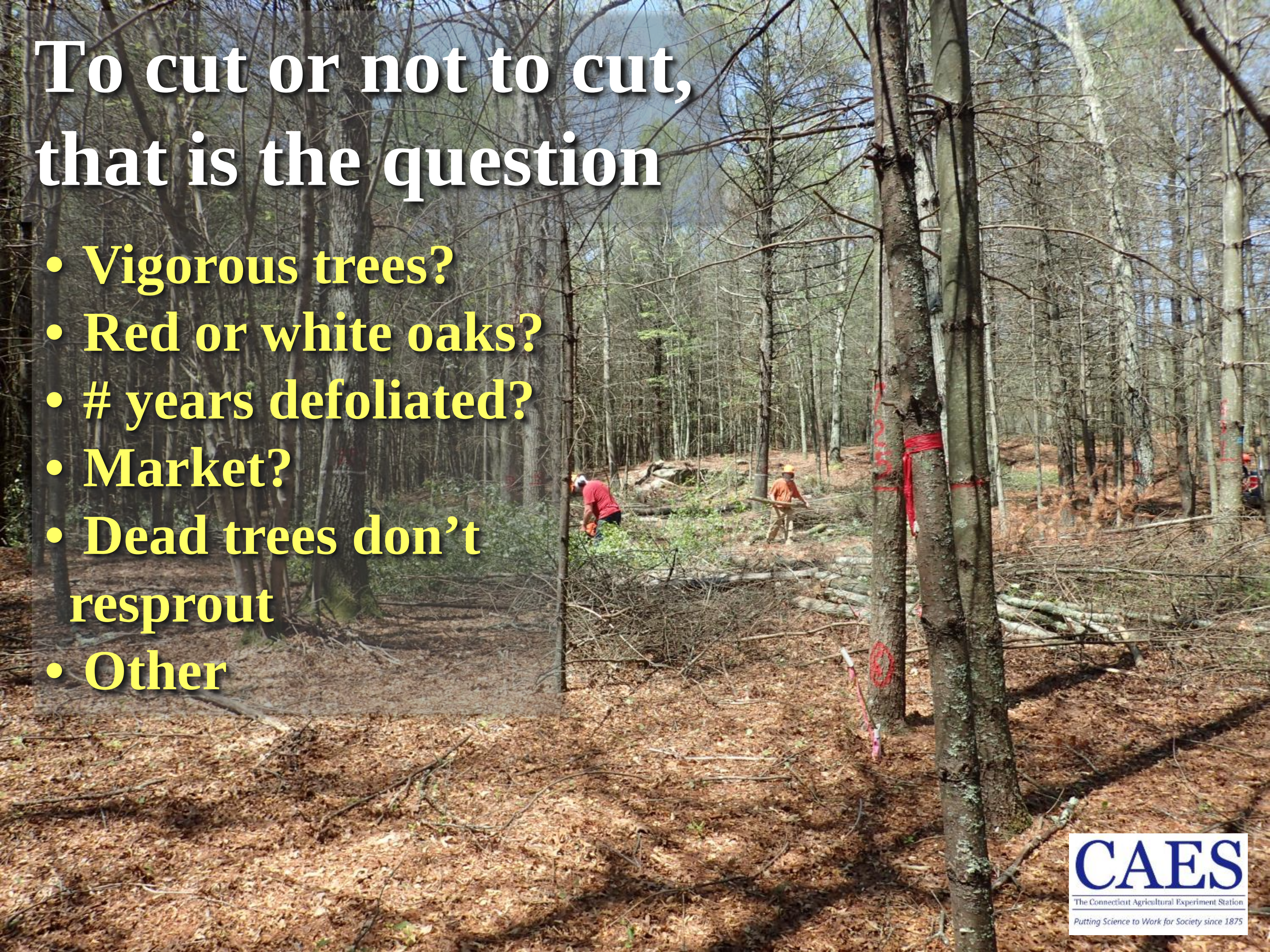
Pachaug aerial – 2019



Pachaug – Aug 2016

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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CONNECTICUT ENERGY ENVIRONMENT

Providence Water

CONNECTICUT COLLEGE 1911

TANQUAM LIGNUM QUOD PLANTATUM EST SECUS DECURSUS AQUARUM

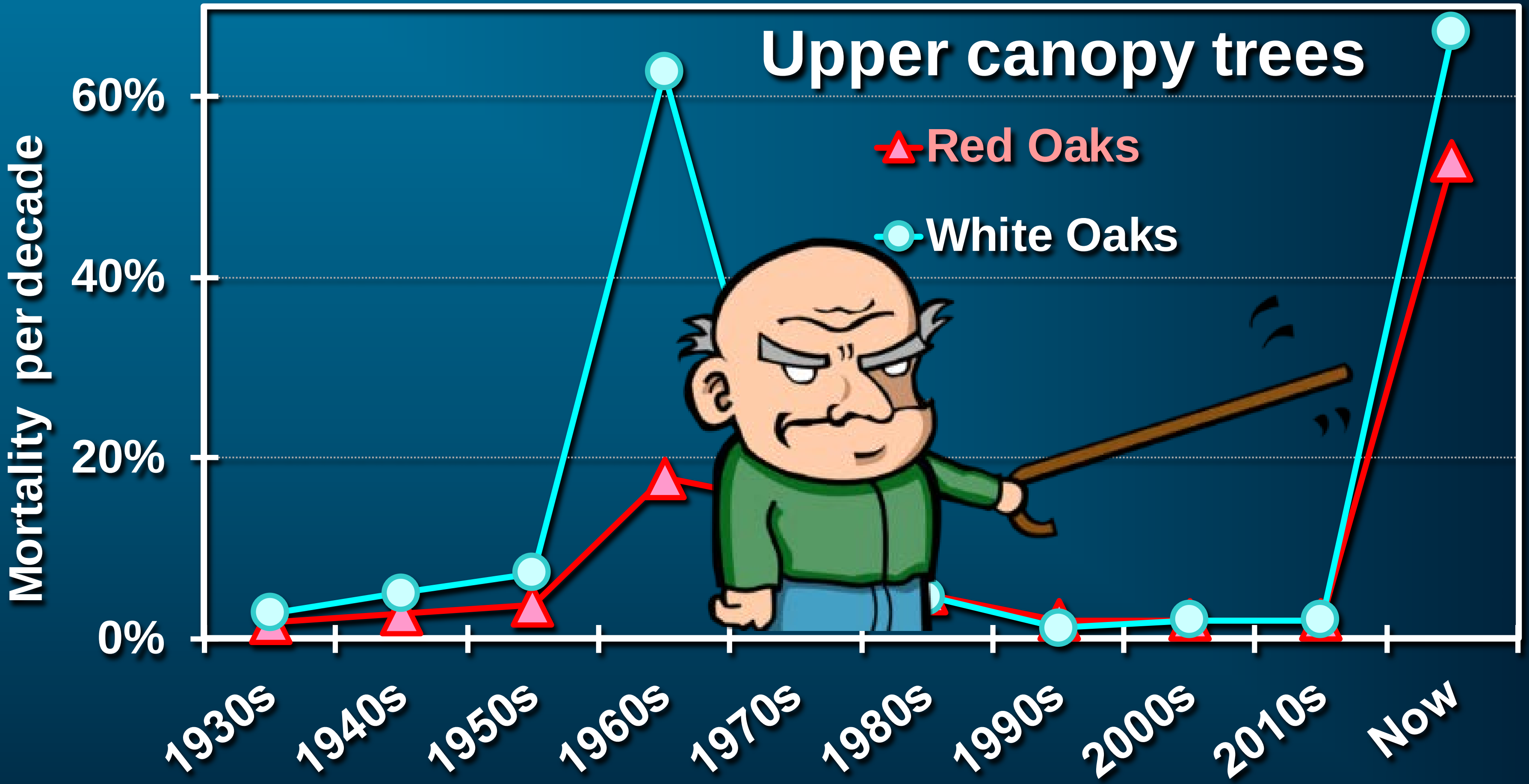
MDC

TORRINGTON WATER COMPANY

SERVING PUBLIC HEALTH AND SAFETY SINCE 1878

EVERSOURCE

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 ($p \leq 0.05$)

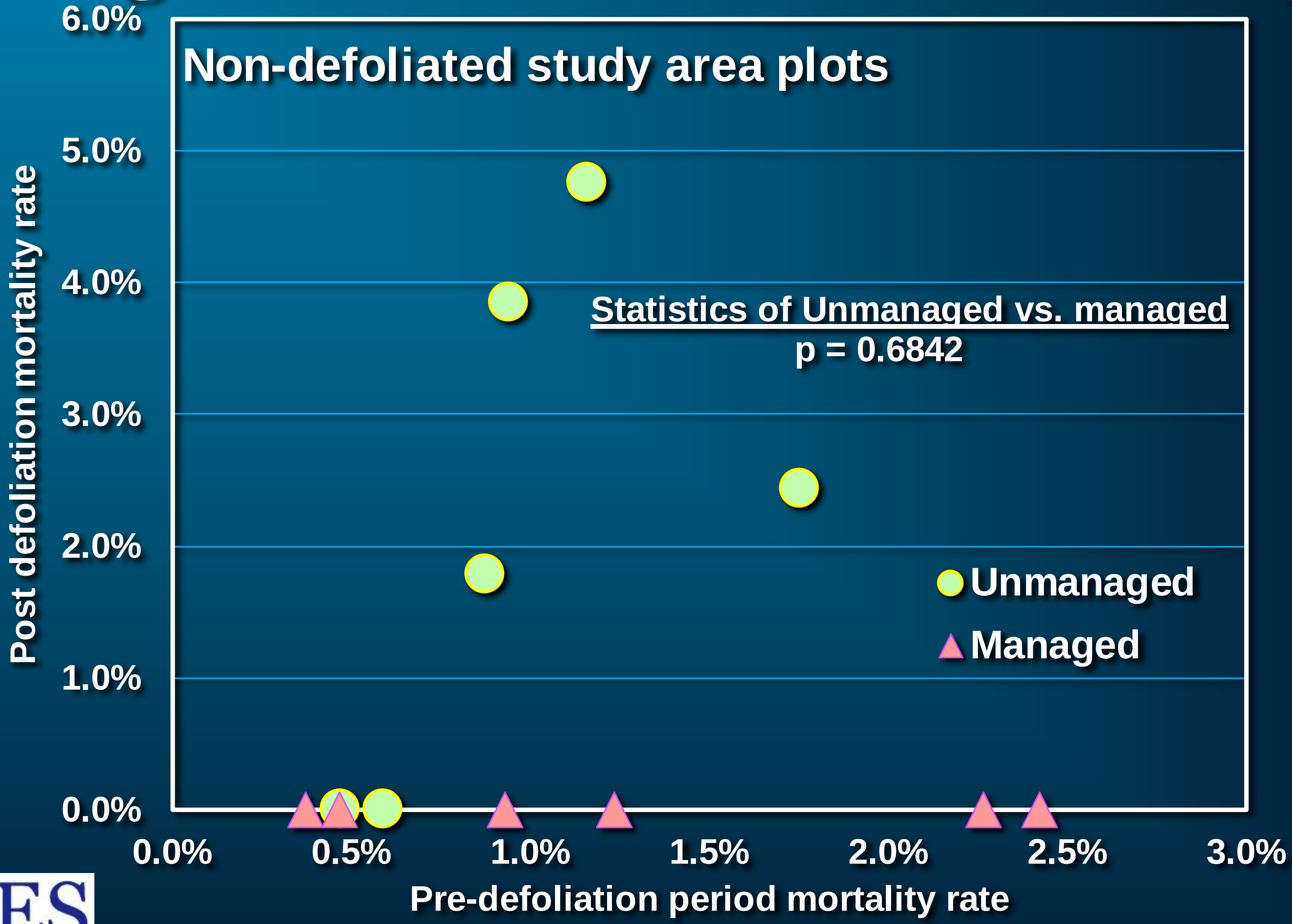
Stand level

- Linear mixed model analysis with study area as random factor

Tree level

- Binary logistic regression by species

Drought – no effect on stand mortality



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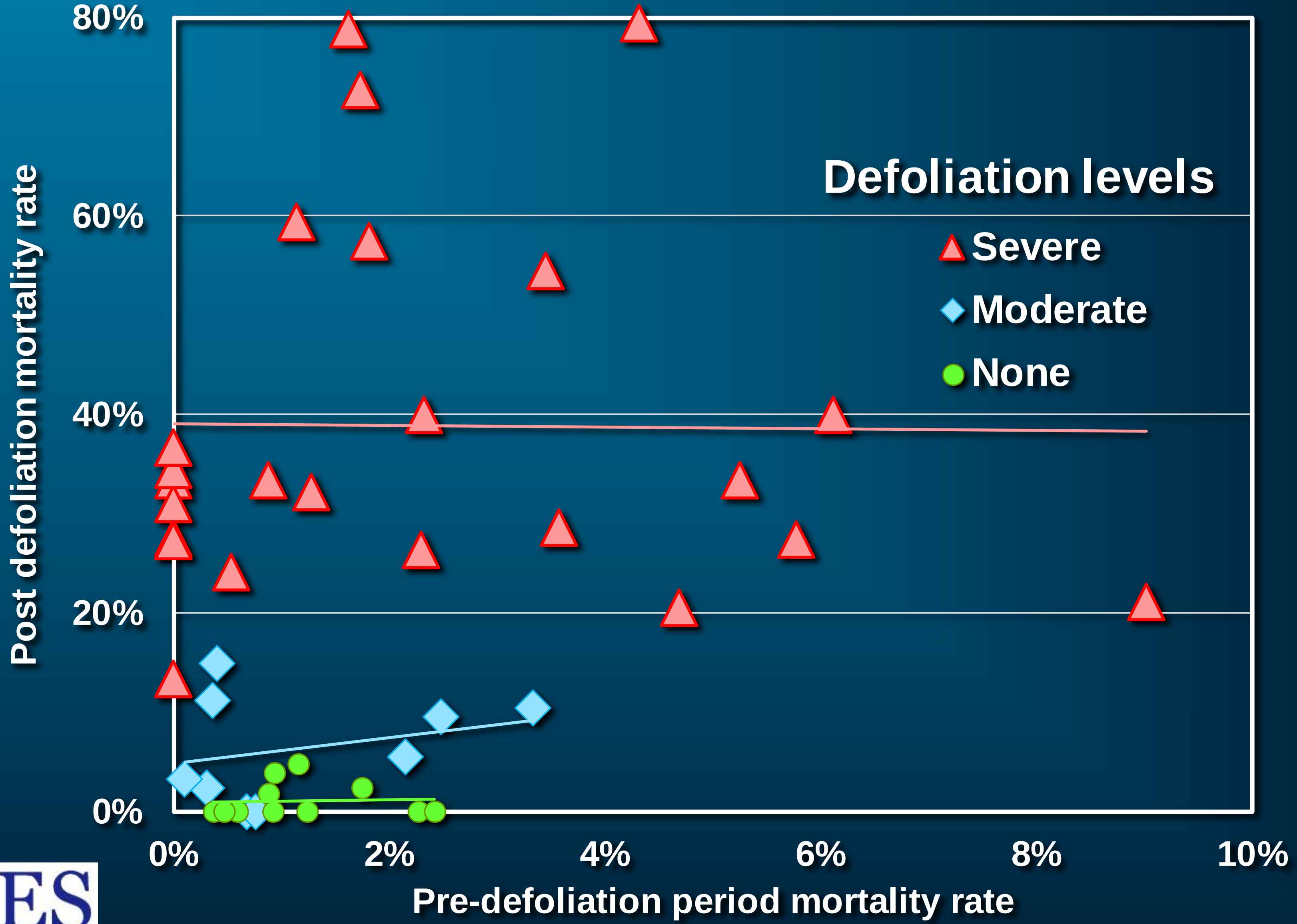
No pre- post- relationship



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Pre-defoliation oak mortality

Pre-defoliation stand level mortality did <u>not differ by</u>:

- 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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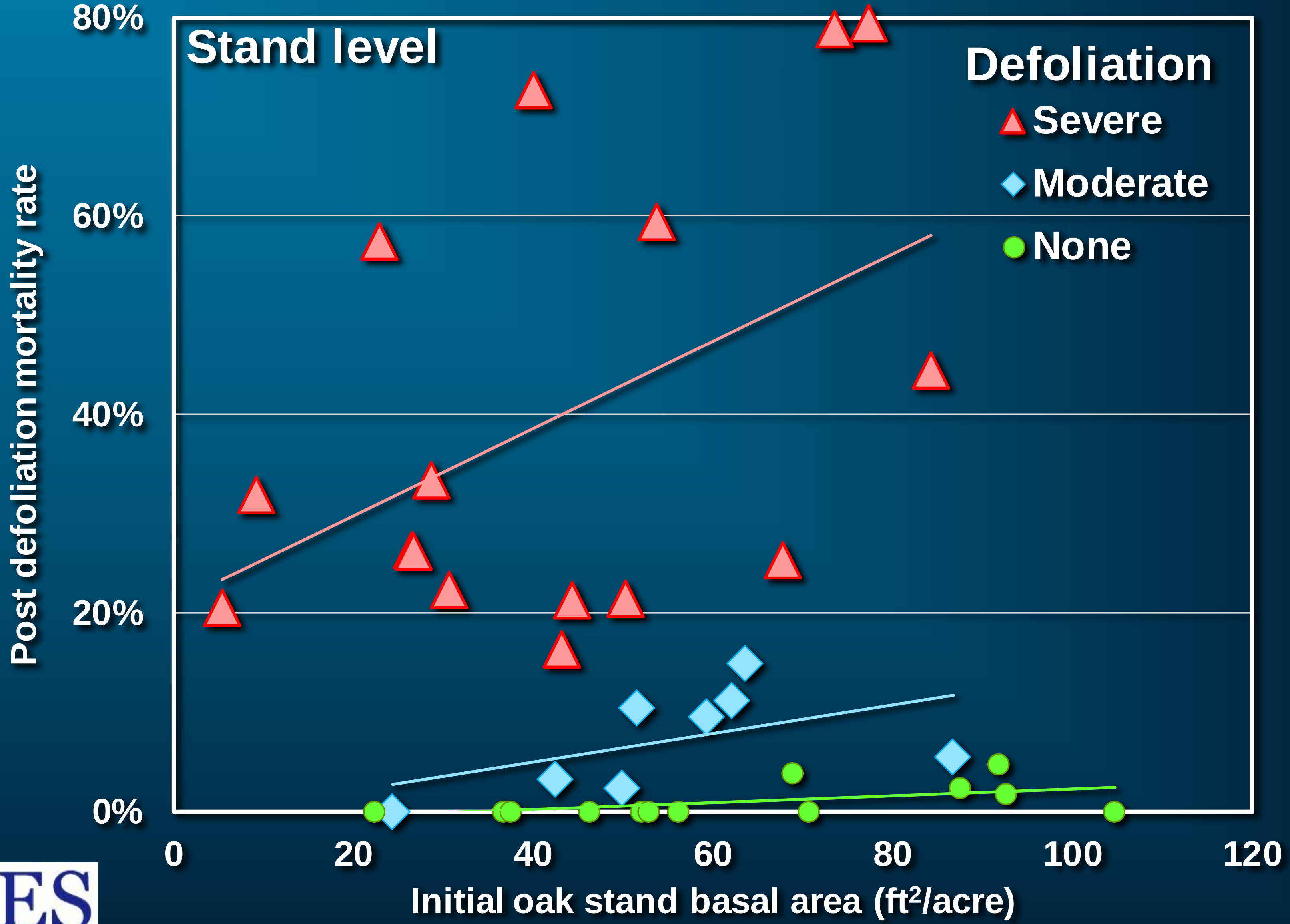
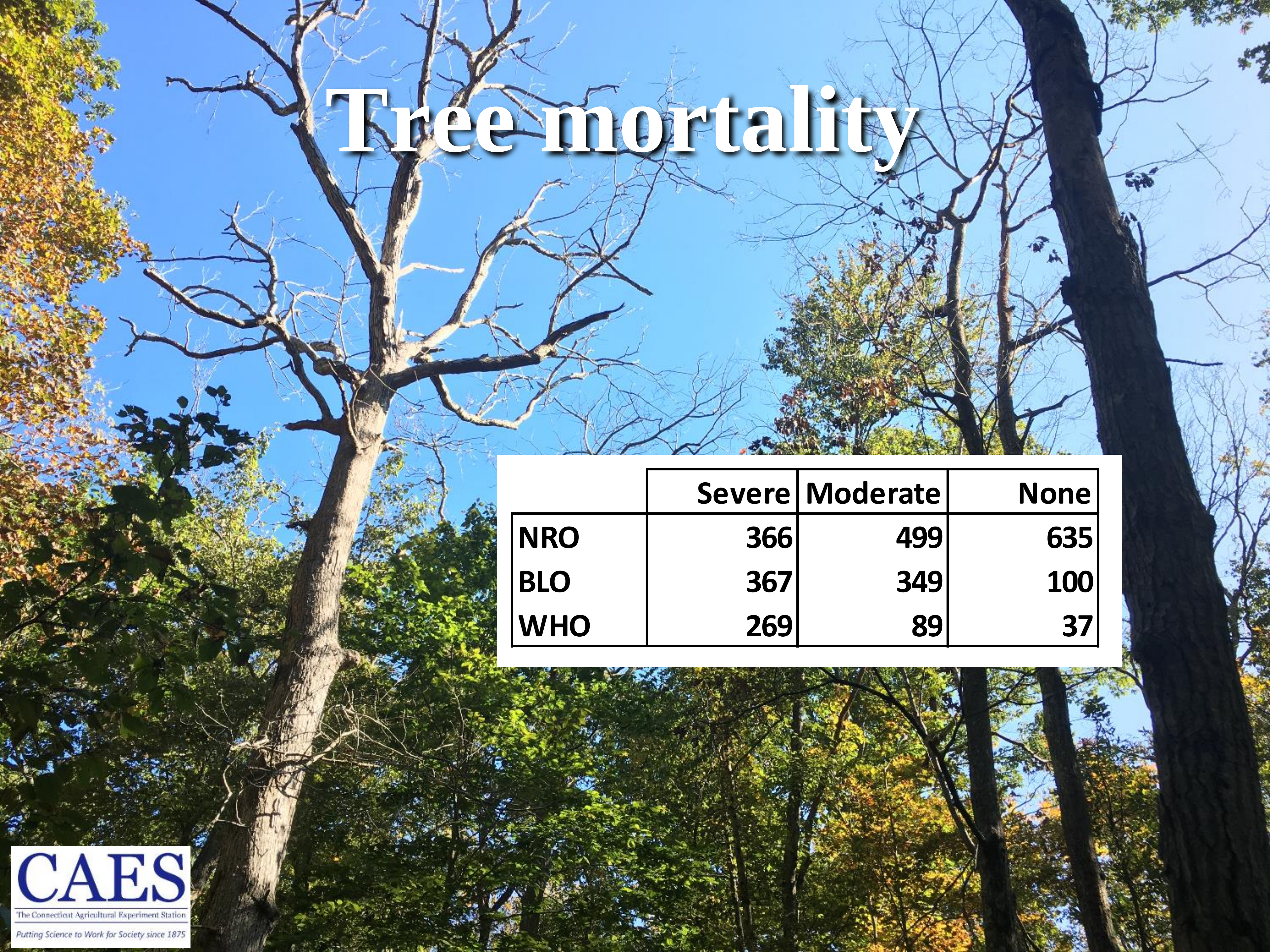
Mortality – basal area & intensity



Density, TRT n.s.

Tree mortality



	Severe	Moderate	None
NRO	366	499	635
BLO	367	349	100
WHO	269	89	37

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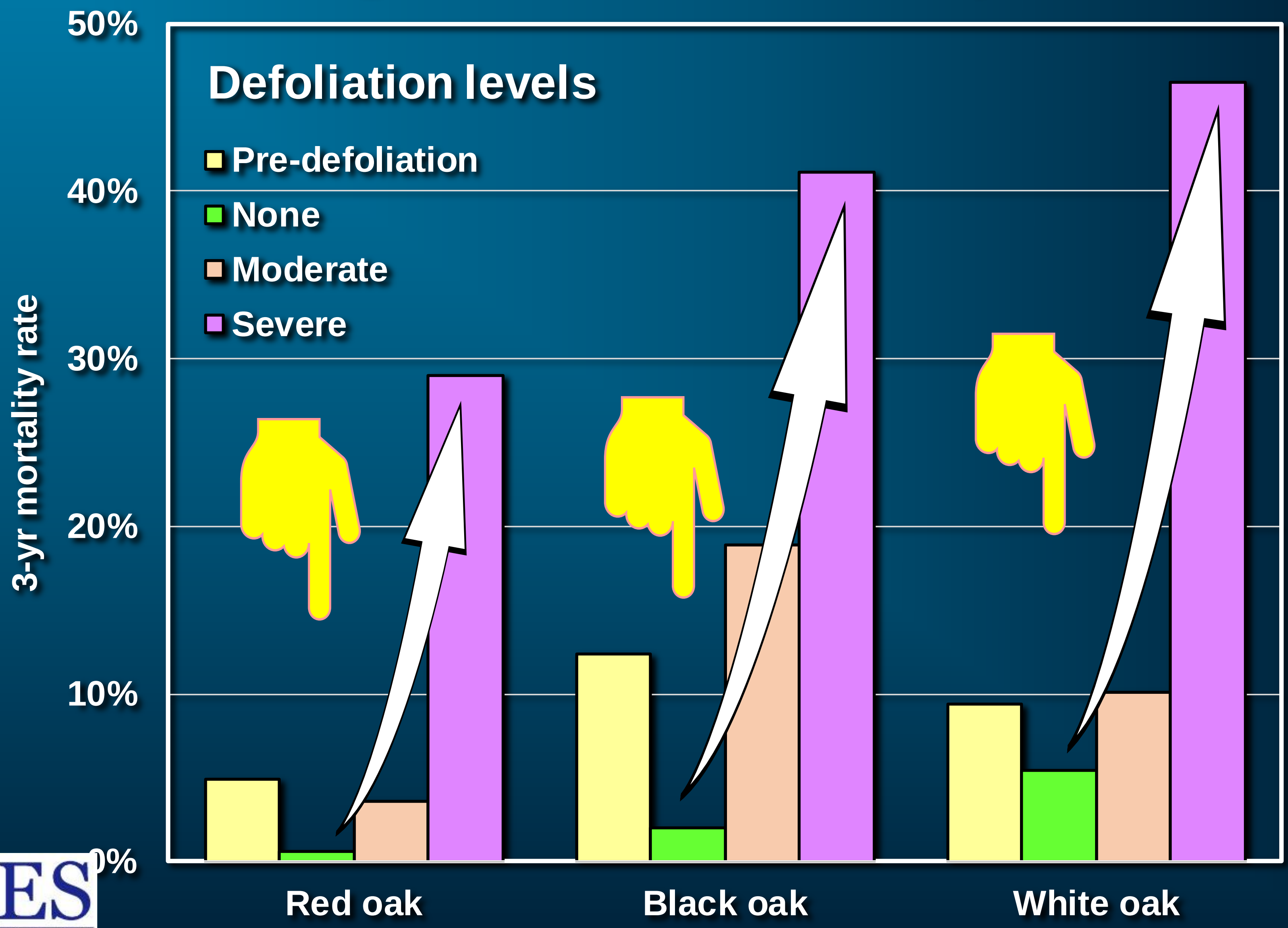
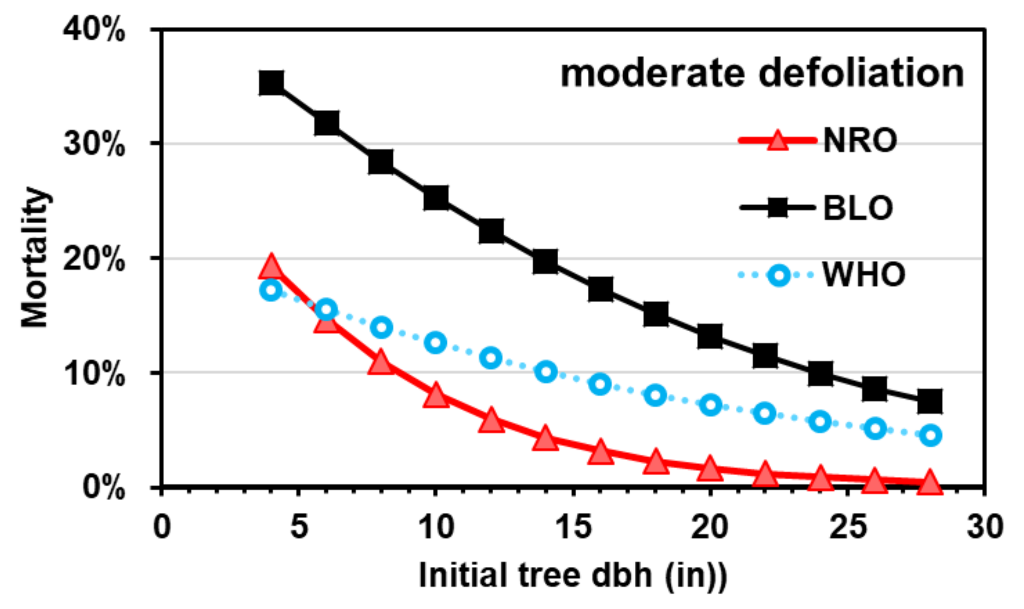
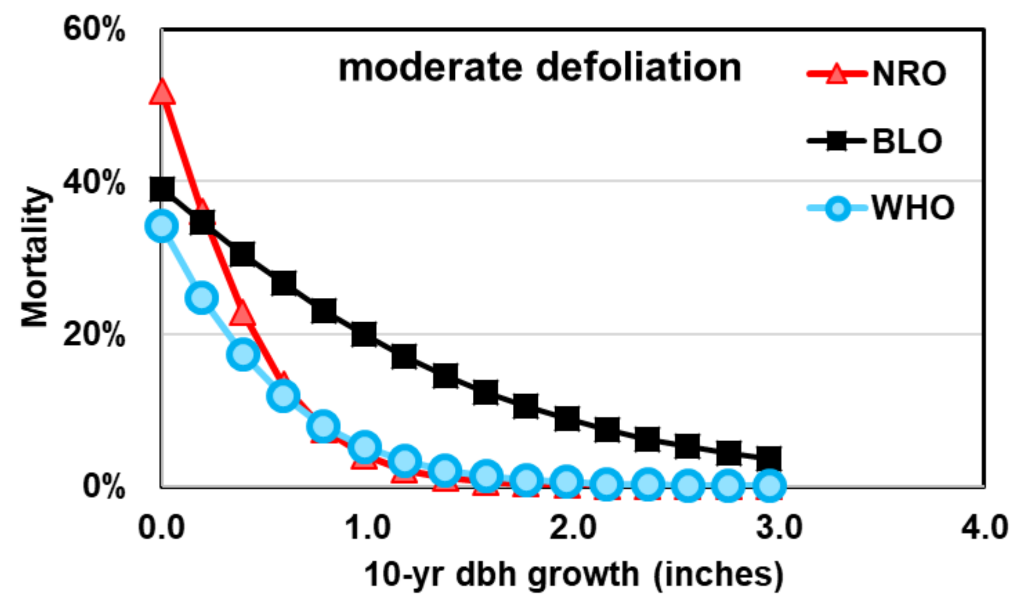
No drought effect, severity rules







Moderate defoliation

- Mortality lower for larger and more vigorous trees.
- Mortality highest for black oaks for a given diameter and growth rate.

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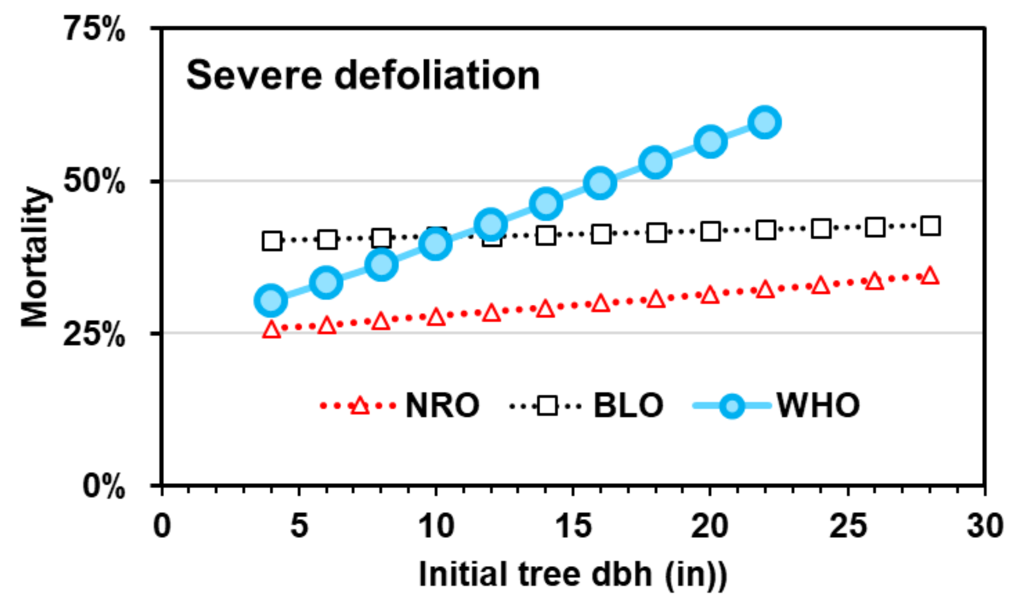

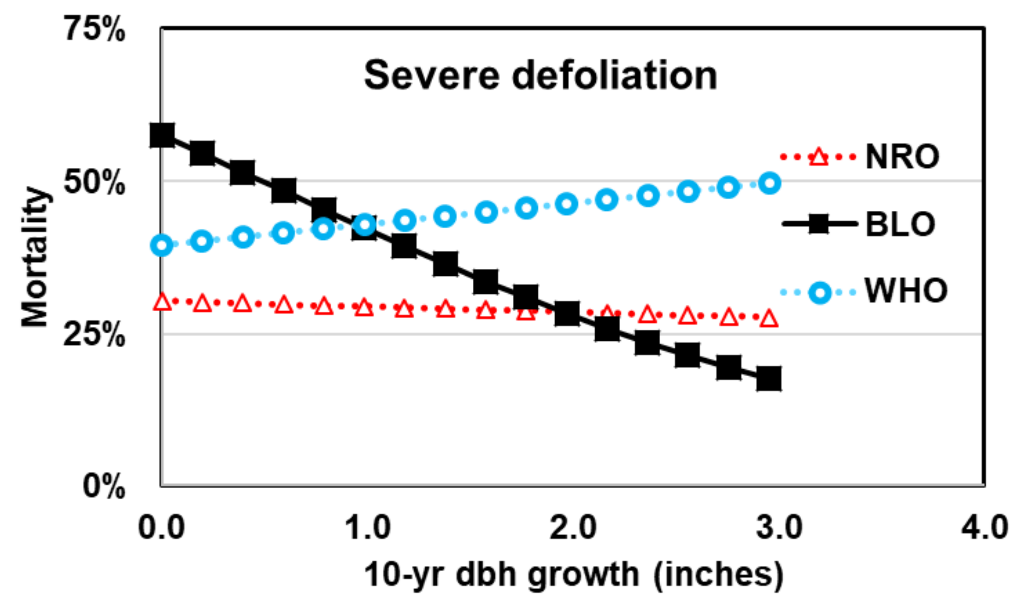

Severe defoliation

Some evidence

- Higher mortality of larger trees
- Influence of growth rate uncertain and differs among species

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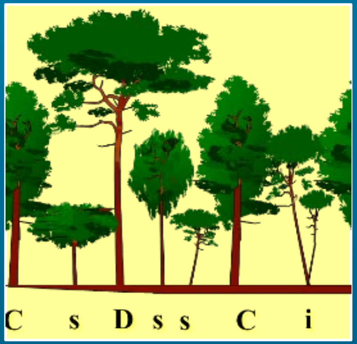
Other



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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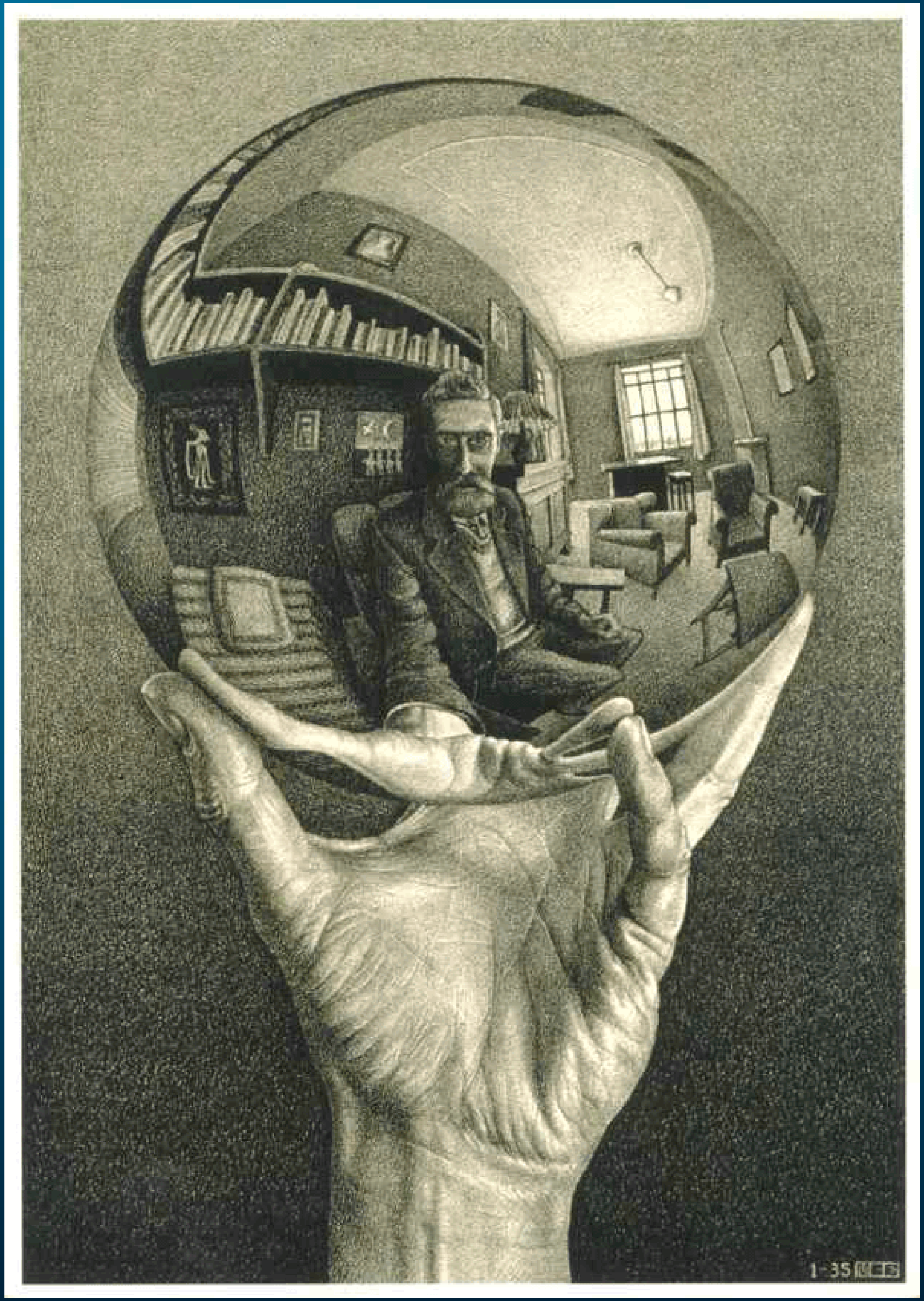
Summary

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

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Impacts to add

Watershed hydrology

Wildfire risk

Increased tick densities

Decreased mast

Tree falling on roads, trails, infrastructure