White Pine Decline in Maine

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What is Disease?

- Take moment to discuss and define this term with others.

Livingston et al. 2005

Some Definitions

- 1858 – Disturbances in the normal physiological activity (Julius Kuhn)
- 1900 – The disturbance threatens the life (Ward and Hartig)
- 1935 – Disturbance caused by continuous irritation of the primary causal factor (Whetzel)

Livingston et al. 2005

Definitions for Forest Health

- Disease: Persistent, detrimental functioning
  - A consequence of adverse conditions
- Cause of Disease: Disease Complex

  Adverse conditions resulting in disease
  - Predisposing: What's needed for disease
  - Inciting: Factors inciting disease state
  - Secondary: Factors affecting tree after becoming diseased

Livingston et al. 2005

What is White Pine Decline?

- Tree decline: Thinning and yellowing of crown
- Mortality from 1997-2000: >50% in stands
- Southern Maine
  - Scattered locations
  - Simultaneous appearance
- Dense, pole-size stands

Livingston et al. 2005

What Predisposed White Pine to Decline?

- White pine regenerated on sites to which is wasn't adapted
  - Rooting restrictions
  - High densities
- Unprecedented drought

Livingston et al. 2005

Land Use History

- Field abandonment
  - By 1940 total number of farms in Maine declined by 80 %
  - From 1872-1995 over 7 million acres converted back to forest
  - Today, 17.7 million acres of forest
- Consequences
  - Plow pans
  - Soil compaction
  - Old fields favored white pine
  - Rooting restrictions

Harvard Forest Diorama

Livingston et al. 2005

Decline Associated with Shallow Soil Restrictions

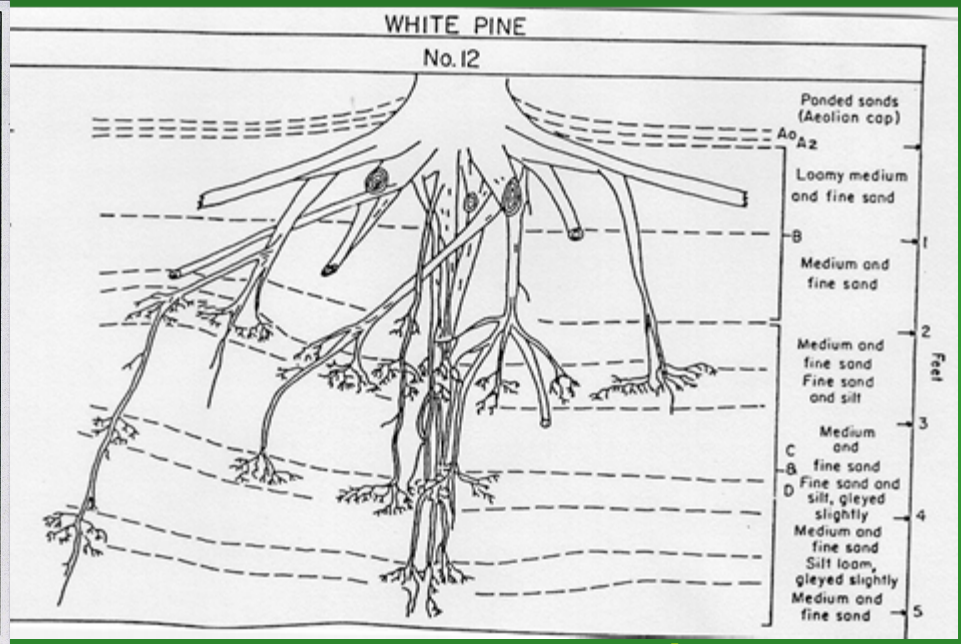
(<30cm)

- Plow pan
- Water table
- Bedrock
- Lithological discontinuity
  - Plow layer
  - Natural

Livingston et al. 2005

Rooting Habits of White Pine

Steve Howell, 2000



Brown and Lacate, 1961

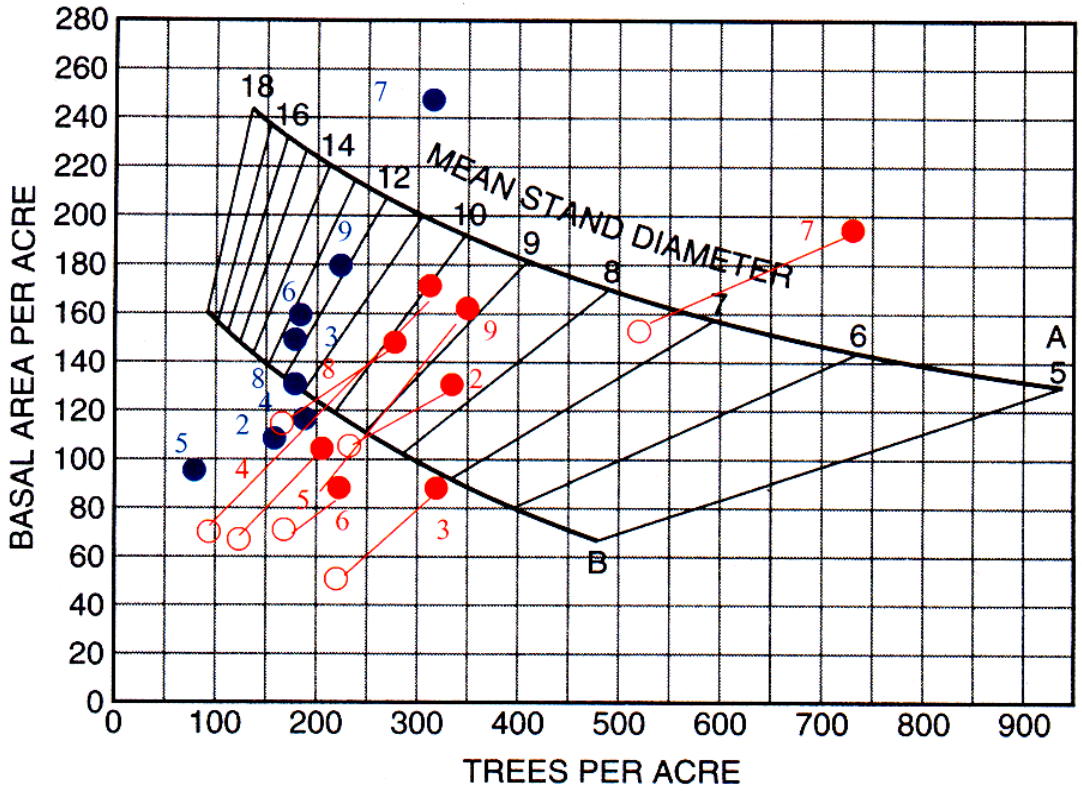
- Restricted white pine rooting depth
- White pine roots will grow deep if soil-structure inhibitors not present

Livingston et al. 2005

High Densities Associated with Decline

- Before mortality
  - Smaller DBH
  - More stems
  - Initial BA similar
- After mortality
  - understocked for size class
  - density similar to low mortality plots

Livingston et al. 2005



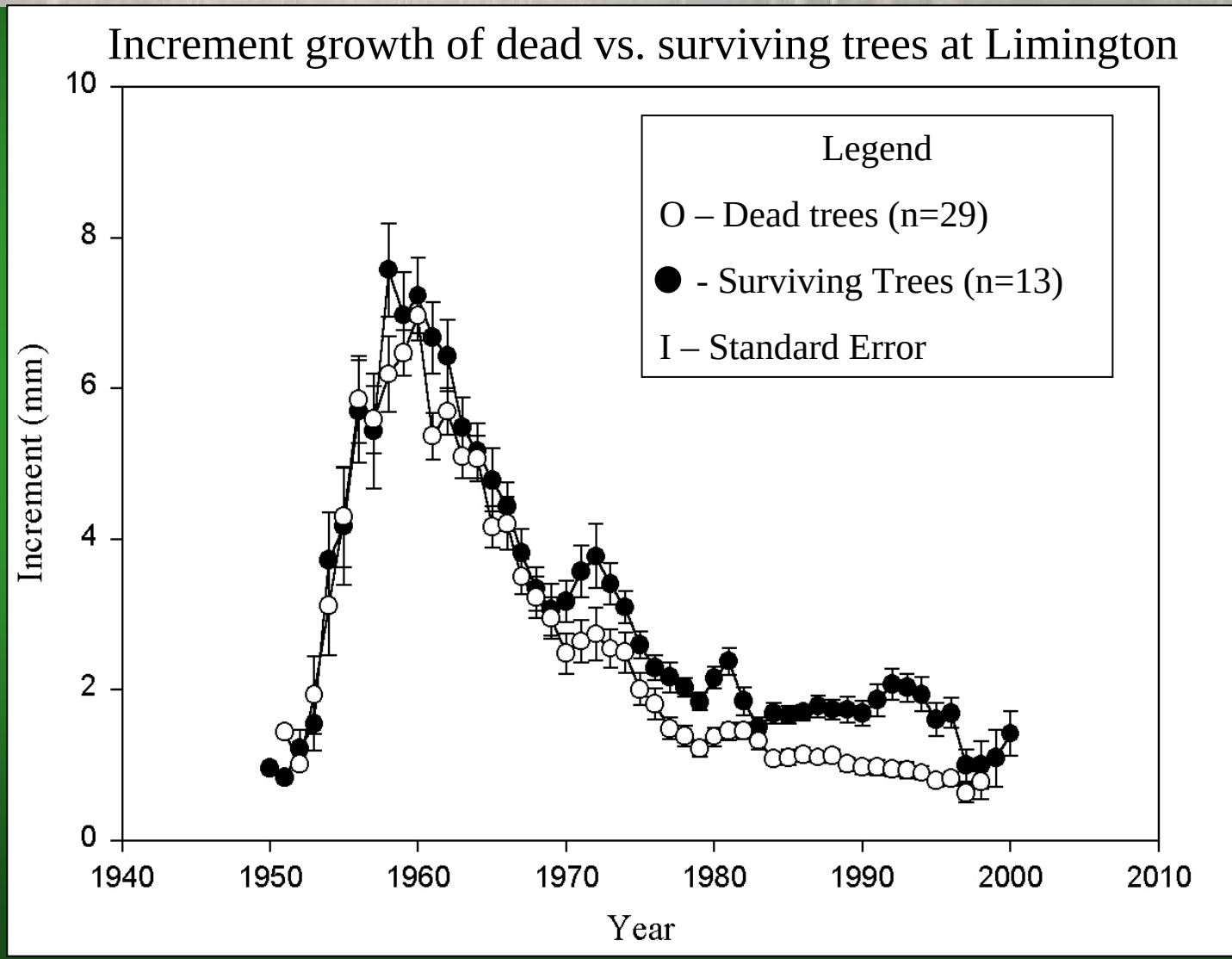
(Philbrook et al 1979)

High mortality prior to mortality
High mortality after mortality
Low mortality

Fries et al. 2002

Prior Growth of Declining White Pine

- Period of reduced growth >24 yrs (7 of 8 sites)
- Ages similar (43 vs 45 yrs)
- Smaller DBH (19 vs 25 cm)



Livingston et al. 2005

Fries et al. 2002

Year of Last Growth Increment

- Percent of dead trees sampled
- Peaked in 1996-97

Last year of growth	% dead trees high mortality	% dead trees low mortality
1990	1%	0%
1991	0%	0%
1992	0%	0%
1993	0%	0%
1994	1%	0%
1995	9%	0%
1996	31%	67%
1997	33%	33%
1998	19%	0%
1999	2%	0%
2000	1%	0%
2001	2%	0%

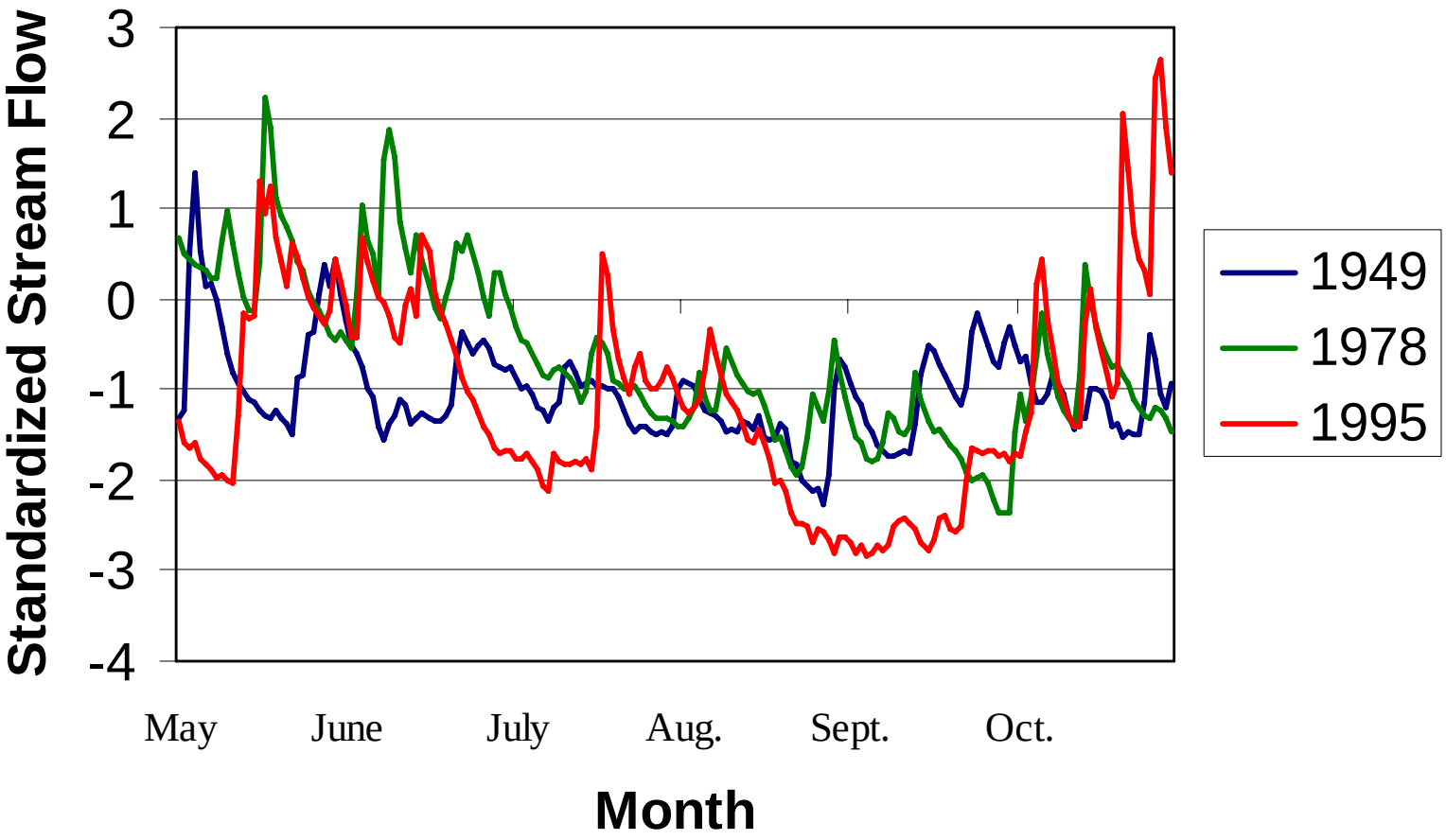
Livingston et al. 2005

Growth of Surviving Trees

- Number of years of declining growth, 1995-2000 in surviving trees did not differ between plot types
  - High mortality sites: 2.8
  - Low mortality sites: 2.4
- Growth trends in surviving trees in high and low mortality plots did not differ

Livingston et al. 2005

Prior to 1997, 1995 Worst Drought Year



Livingston et al. 2005

Secondary Factors
Biotic Stress

- 88 trees sampled at DBH and roots
  - Dominant
  - Few needles, red needles, no needles
- % of trees with pests
  - 63.6% Cerambycidae
  - 60.2% *Ips* spp.
  - 56.8% *Armillaria* spp.
- All secondary in nature

Ips bark beetle

Armillaria root rot

Livingston et al. 2005

White Pine Decline in Maine: Is it a Disease?

- Yellowing and thinning of crown
- Reduced growth
- >50% mortality on isolated sites

Livingston et al. 2005

White Pine Decline in Maine: What Caused the Disease?

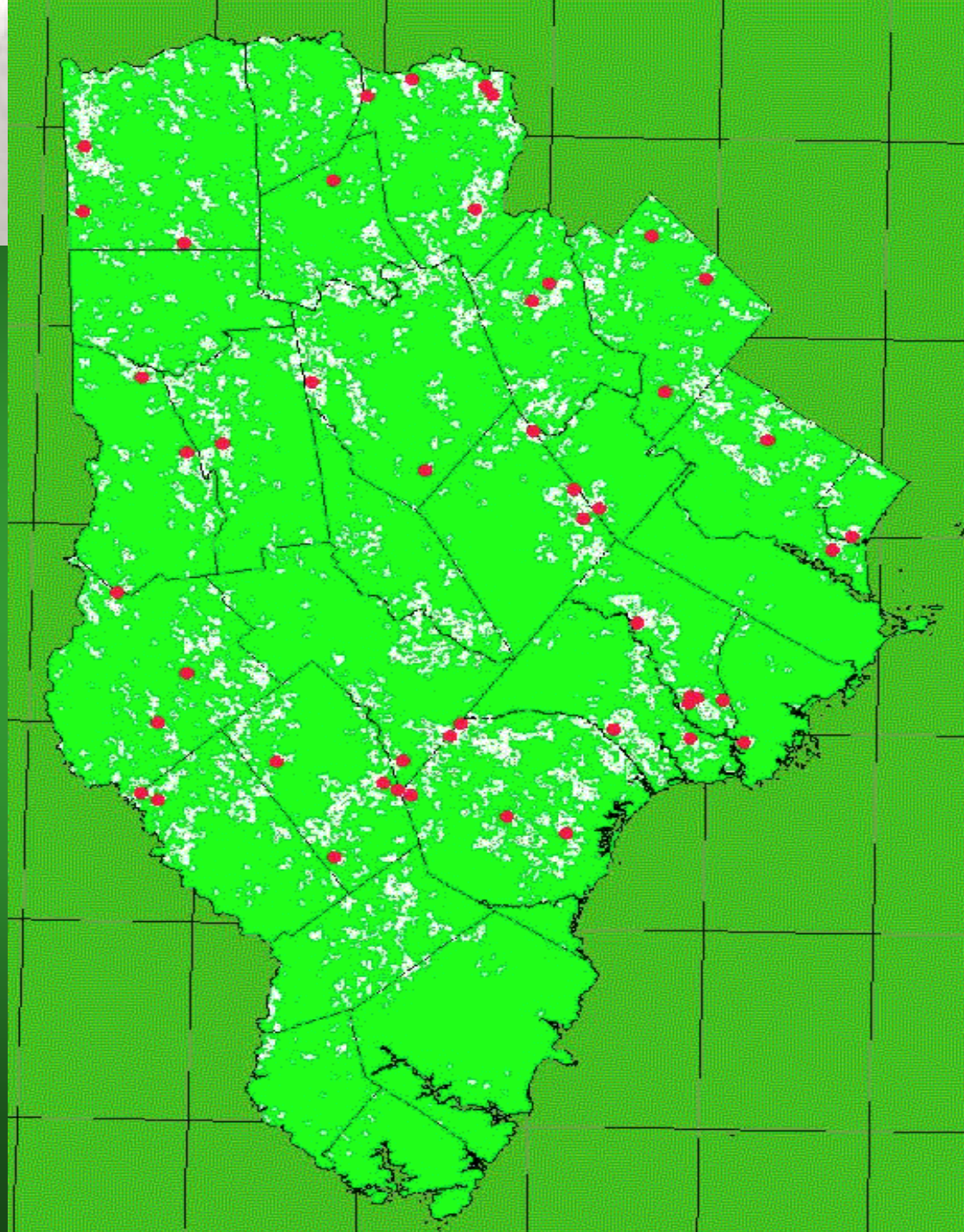
- Predisposing
  - Dense stands
  - Shallow rooting
- Inciting – drought
- Secondary
  - Bark beetles
  - *Armillaria* root disease
  - Stem canker fungi

Livingston et al. 2005

How Much Area is at Risk?

- About 10% of white pine stands
  - York County
  - Hazardous rooting restrictions of <30 cm)
- About 25% of stands
  - Rooting restrictions of <50 cm.
  - Trees about 2 inches smaller in DBH: 13 in vs. 15 in

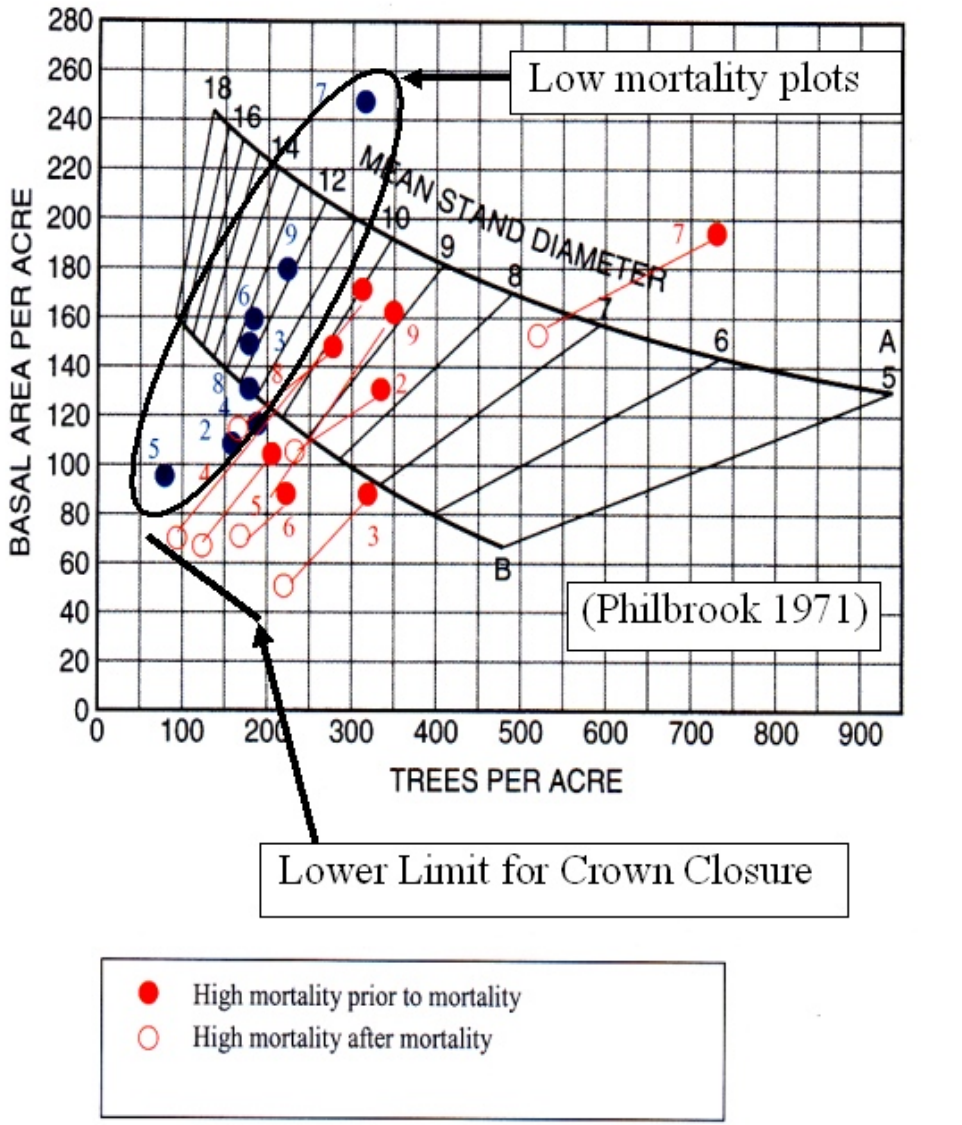
Livingston et al. 2005



What Should be Done?

- White pine can be grown on high hazard sites
  - Height growth same as other sites
  - Only smaller diameter trees at risk
- Maintain low densities
  - Thin out smaller trees
  - Maximize diameter growth

Livingston et al. 2005



Is White Pine Decline a Forest Disease?

Livingston et al. 2005

Managed Stands are Healthy Stands!

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