

# Completing the Life Cycle of Trees: Northern Forest Dead Wood and Tree Regeneration in the Context of Forest Resource Assessments

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# Outline



- Tree regeneration context
- Regional inventory
- Emerging results
- Next steps



# Tree Regeneration Context

- Future forest in context of global change
- Forest Stressors: insects/disease, loss of winter, episodic precipitation, urbanization, evolving forest product markets, browse
- Regeneration analysis implicitly requires a greater context



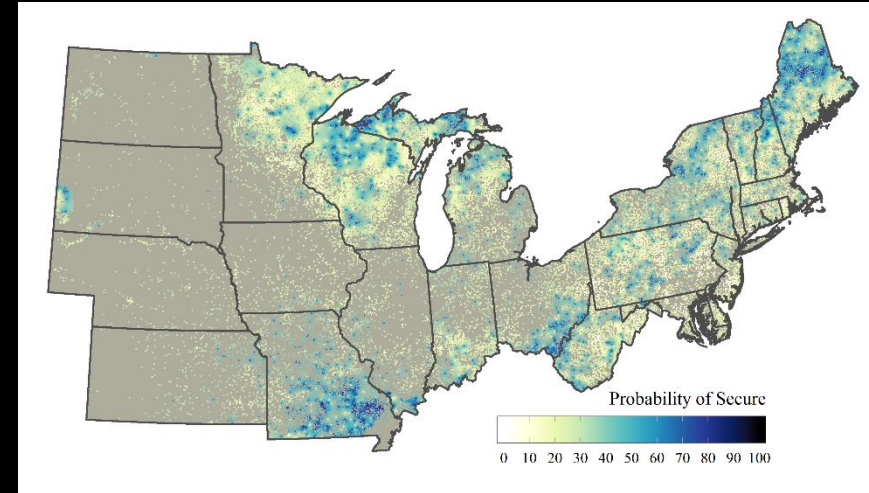
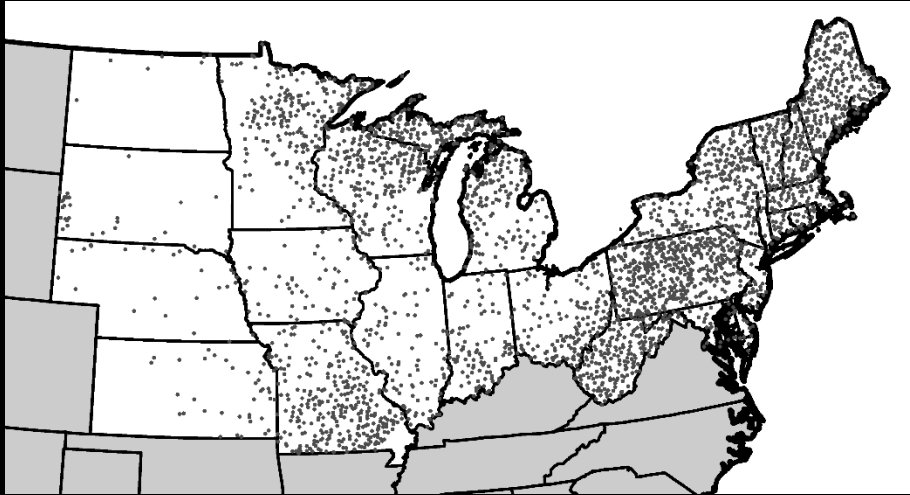
# Barriers to Native Species Regeneration

<b>Factor</b>	<b>Literature</b>
<b>Mesophication</b>	Nowacki and Adams 2008
<b>Forest conversion/development</b>	Drummond and Loveland 2010, Nowacki and Adams 2014
<b>Wildfire exclusion</b>	Abrams 1992, Brose 2014
<b>Soil chemistry</b>	Driscoll et al. 2001, Zaccherio and Finzia 2007
<b>Large-ungulate herbivory, deer</b>	Côté et al. 2004, Waller and Alverson 1997
<b>Changing climate</b>	Dukes et al. 2009, Iverson et al. 2008a
<b>Large-ungulate herbivory, moose</b>	Adreozzi et al. 2014, Faison et al. 2010, Kirkpatrick et al. 2003
<b>Native plant invasion</b>	Knight et al. 2009, Royo and Carson 2006
<b>Alien plant invasion</b>	Engleman and Nyland 2006, Hobbs 1995
<b>Native destructive pests and diseases</b>	Potter and Conkling, 2016, Jackson and Finley 2011
<b>Alien pests and diseases</b>	Lovett et al. 2016, Aukema et al. 2010
<b>Forest fragmentation</b>	Allen et al. 2013, Augustine and Frelich 1998
<b>High cost of regeneration management</b>	Kern 2016, Jackson et al. 2011
<b>Lack of resource management plan</b>	Butler 2006
<b>Lack of planning for regeneration</b>	Marquis 1994, Nyland 1998
<b>Poor cutting practices</b>	Deluca et al. 2009, Nyland 1992

**Numerous Barriers to Regeneration!**



# Context: Northern Forest Regeneration Following Stand Replacement

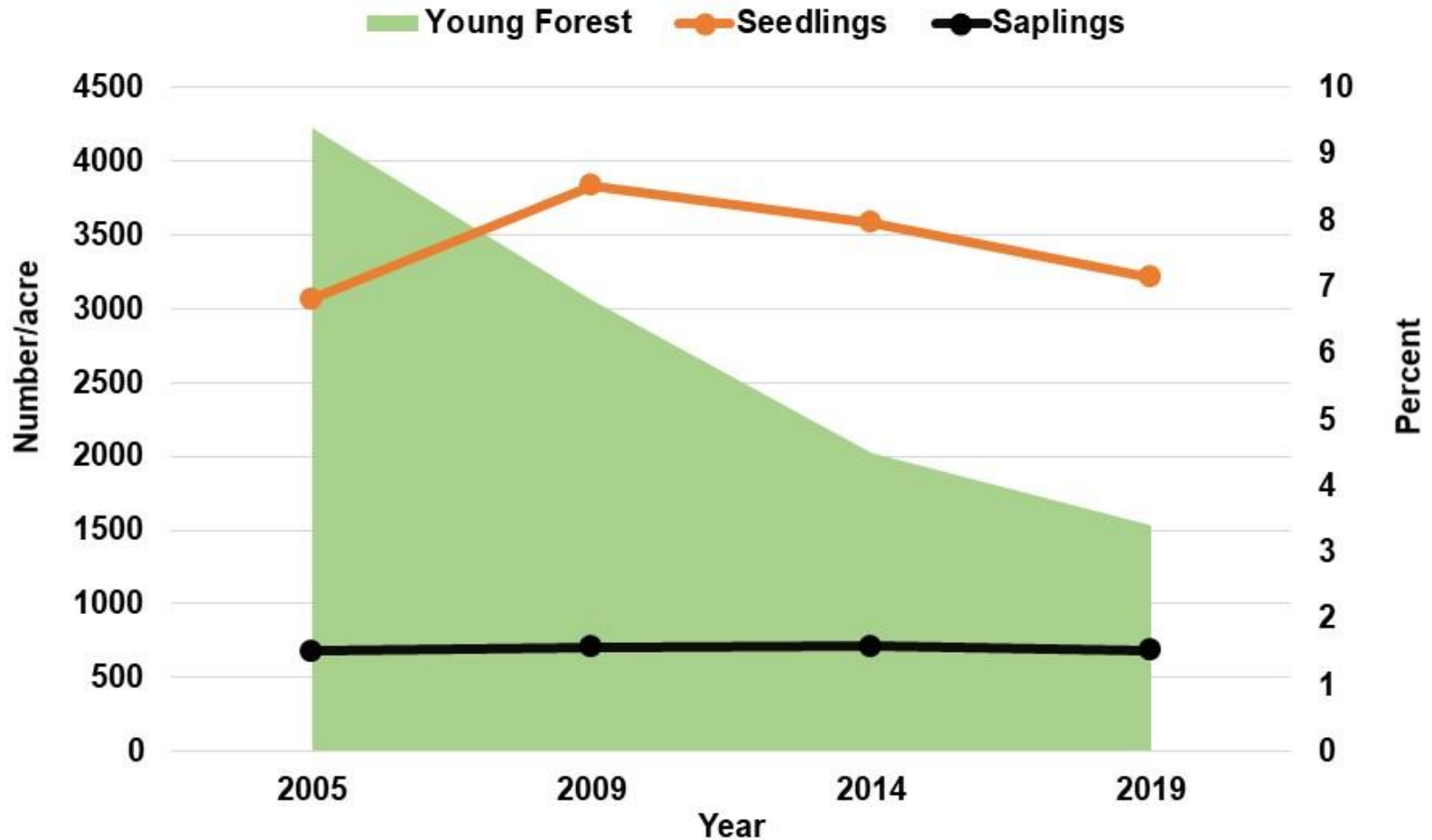


Half of plots lacked adequate seedlings to regenerate stand after canopy removal

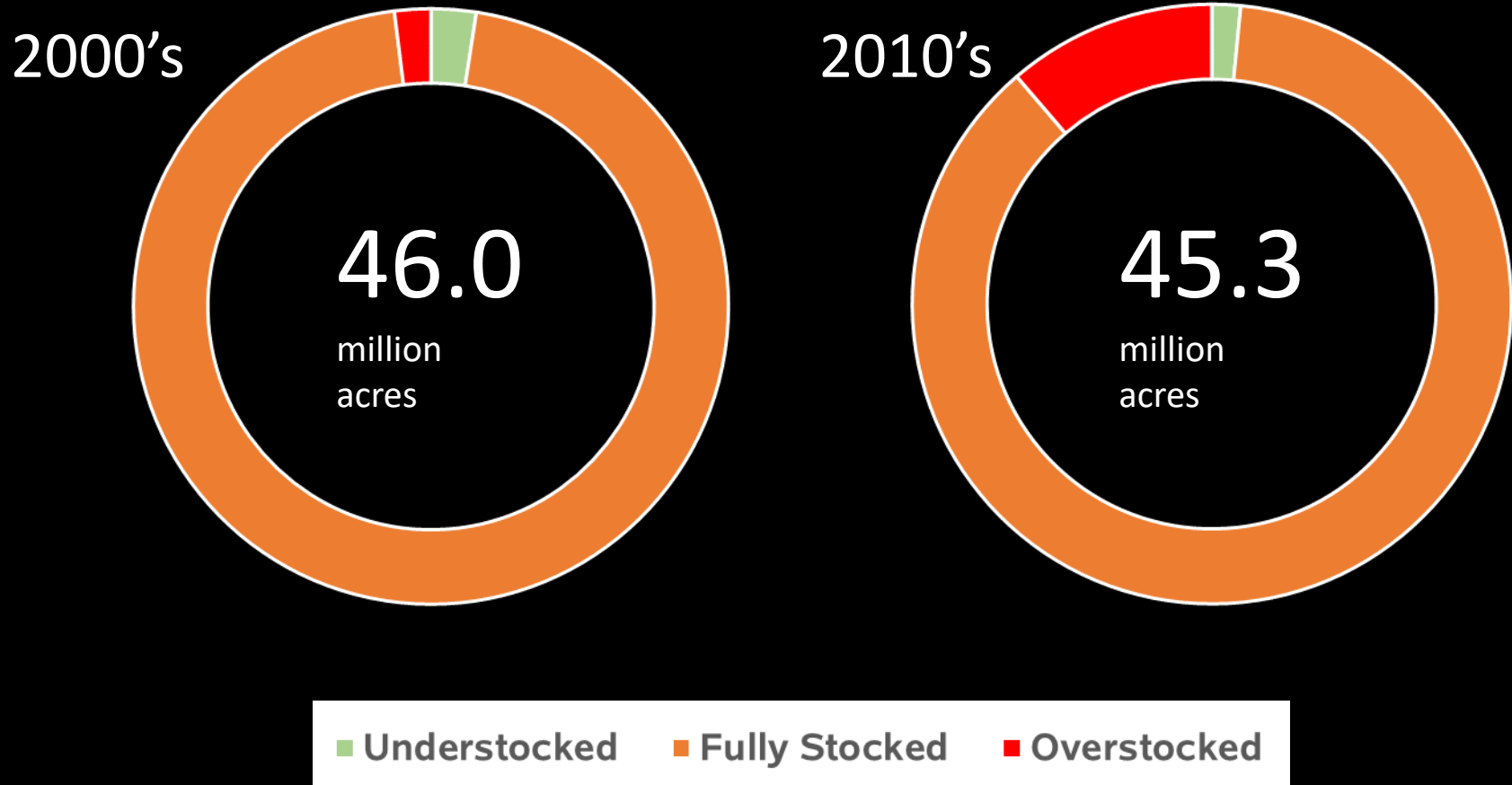
*Vickers, L.A., et al. 2019. Are current seedling demographics poised to regenerate northern US forests? J. For.*



# New England Context

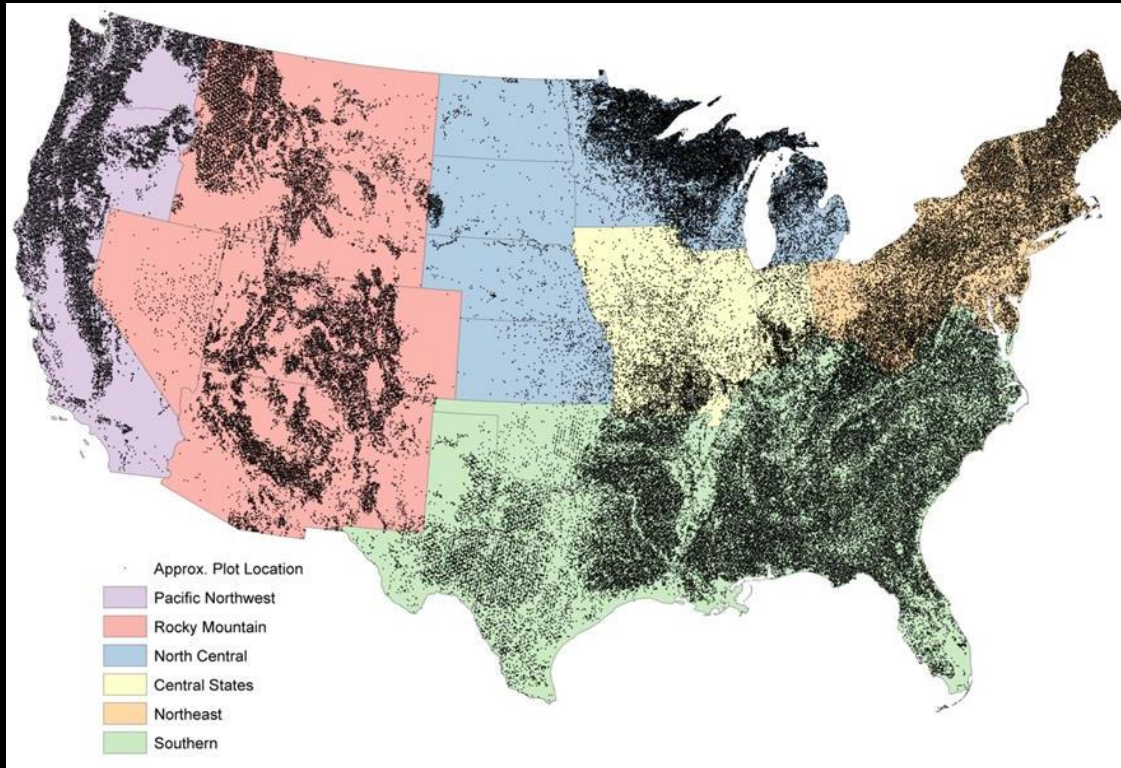


# New England Context: Relative Density



\* Weiskittel and Woodall. In Prep. United States forests are at critical densities...





# FIA

## US' Official Forest Inventory

- Field Data

- <https://apps.fs.usda.gov/fia/datamart/datamart.html>

- Population Estimates

- <http://apps.fs.fed.us/Evalidator/evalidator.jsp>

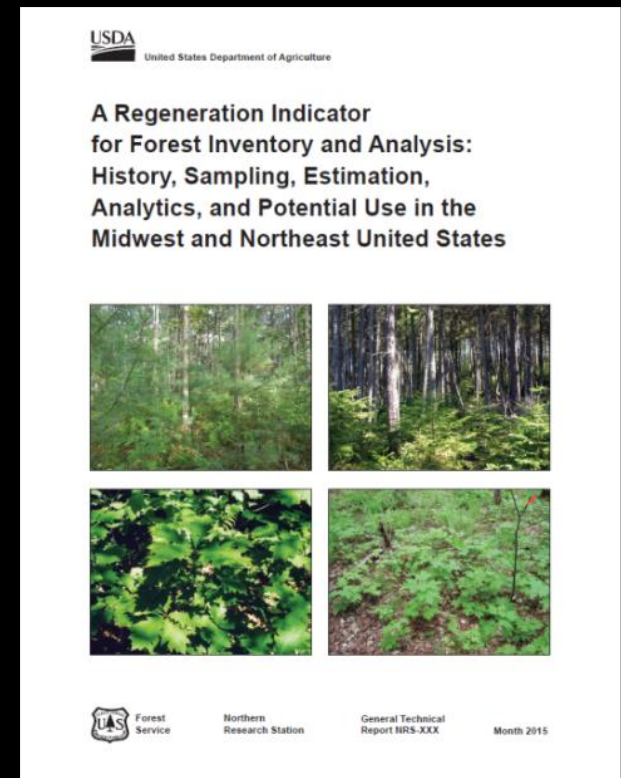




# Beginning in 2012: Length Classes

1. 2.0 inches to < 6.0 inches
2. 6.0 inches to < 1.0 foot
3. 1.0 foot to < 3.0 feet
4. 3 feet to < 5.0 feet
5. 5 feet to < 10.0 feet
6.  $\geq$  to 10.0 feet

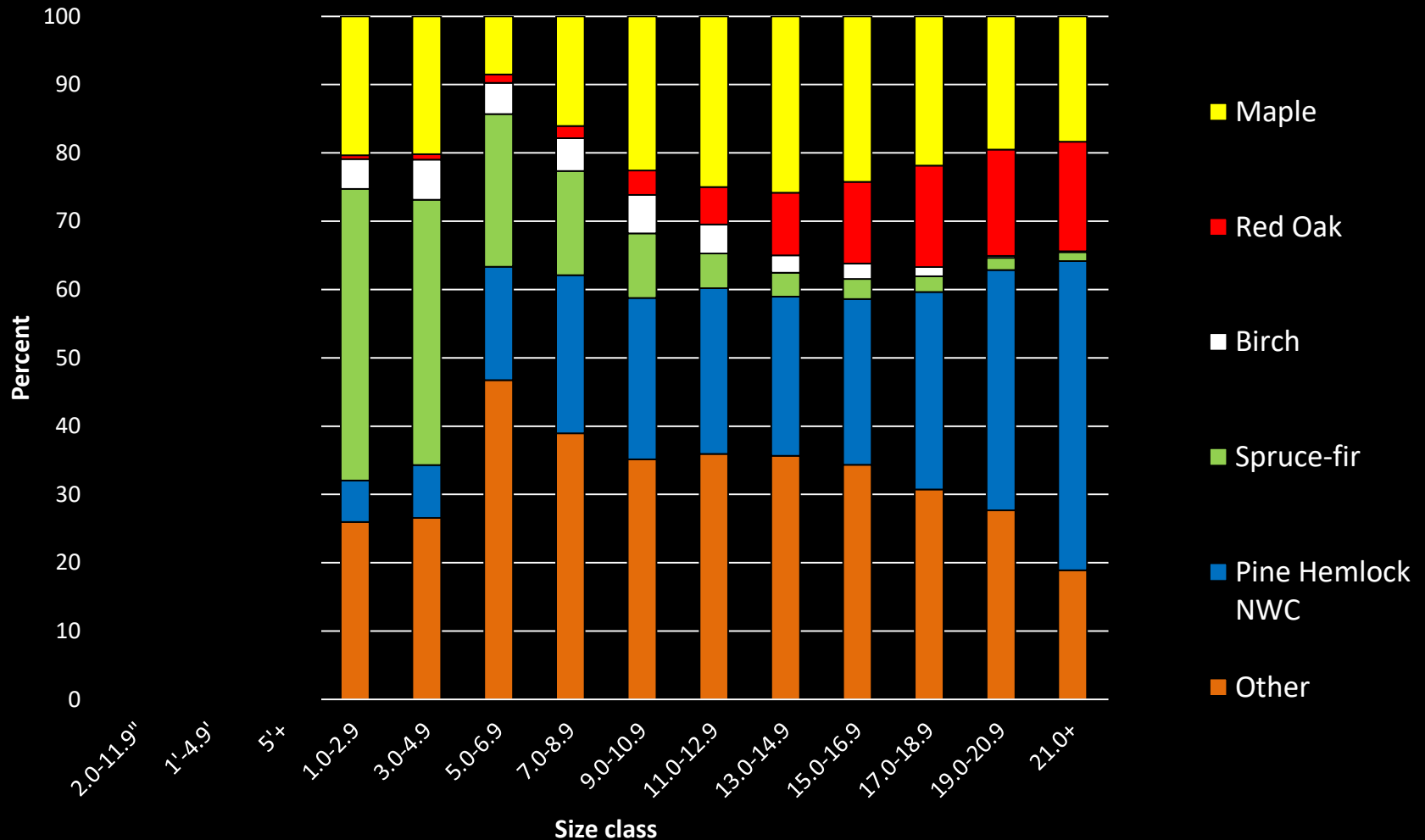
\* A seedling is measured from the base to the tip of the terminal bud



NRS-GTR-148



# All Taxa in Northeast



# Regeneration in Context of Live Trees

2-6 inches

Species	Seedlings/Acre
red maple	1,264
sugar maple	717
white ash	394
balsam fir	346
striped maple	167



> 5 ft and < 1 inch DBH

Species	Seedlings/Acre
American beech	31
red maple	18
sugar maple	15
striped maple	14
white ash	10



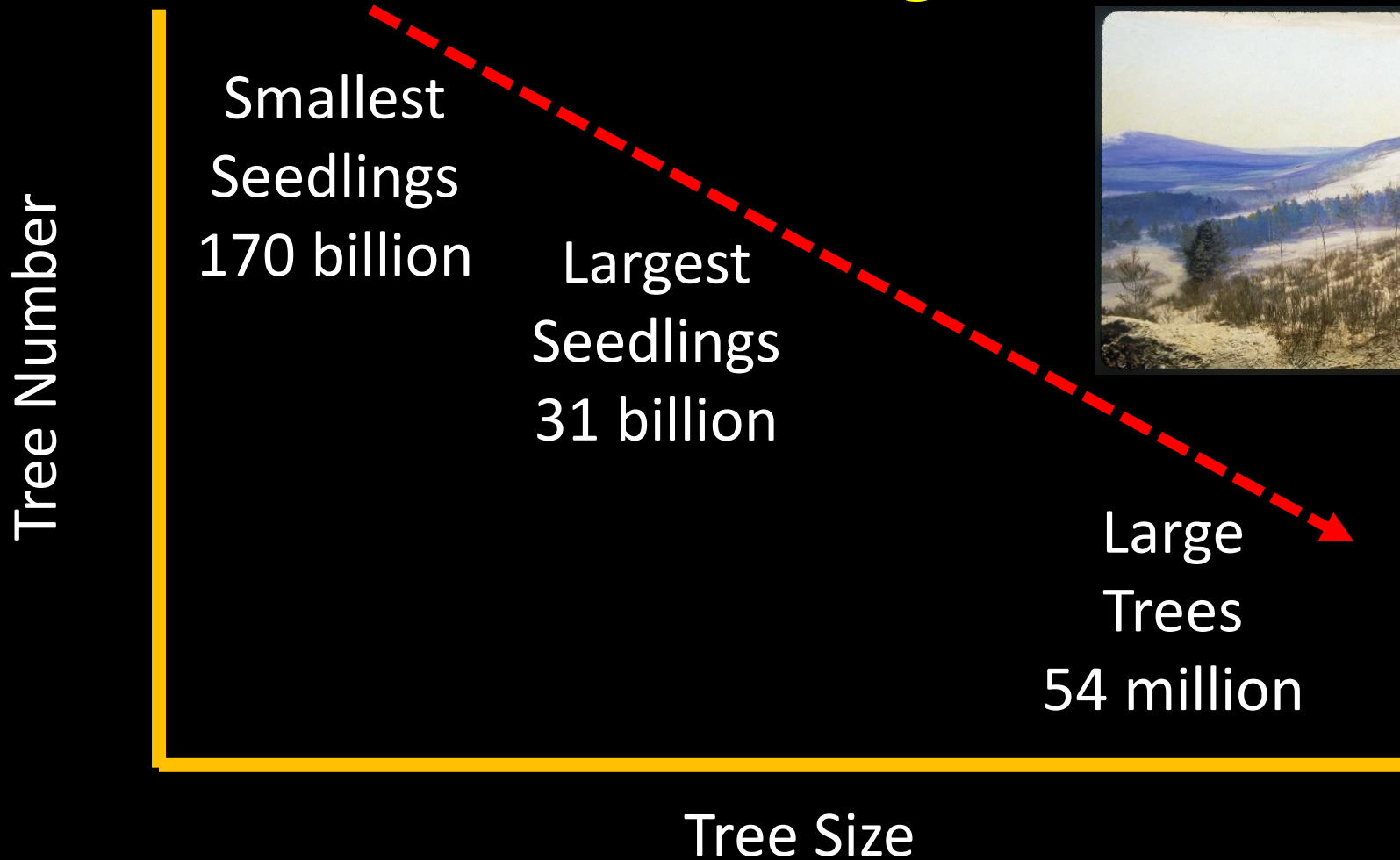
Species	Trees/Acre
eastern white pine	0.39
sugar maple	0.19
eastern hemlock	0.11
northern red oak	0.10
yellow birch	0.09

\* Maine, New Hampshire,  
New York, & Vermont

> 24 inches DBH



# Where Will Stand Development and Global Change take New England's Seedlings?



# Browse Impact Classes

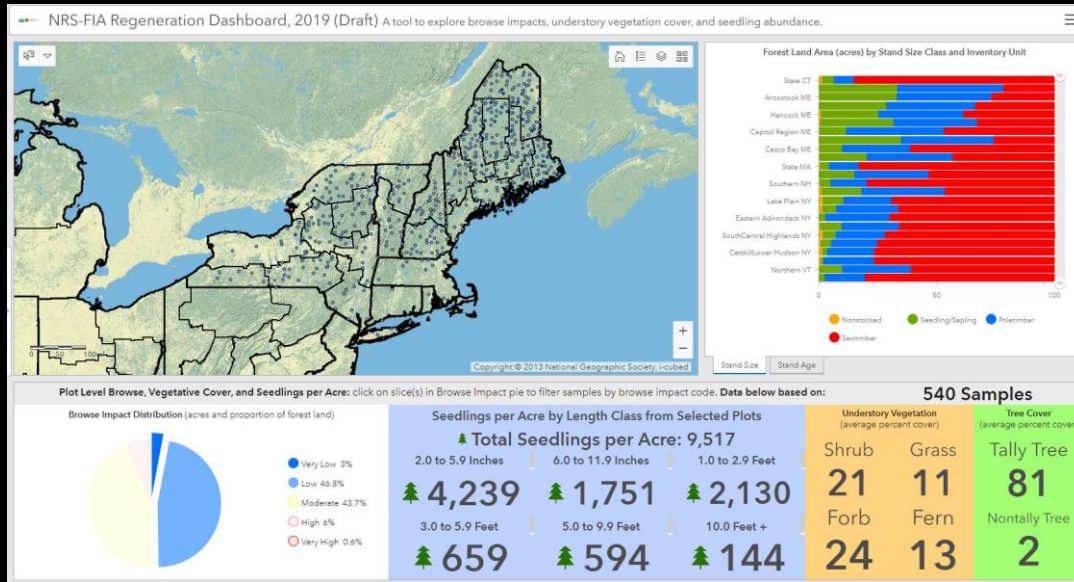


*Deer enclosure  
(Univ. Wisc.)*

1. Very low: Plot is inside a well-maintained enclosure
2. Low: Minimal browse and vigorous seedlings
3. Moderate: Browsing evident but not common
4. High: Browsing common on preferred vegetation
5. Very high: Heavy, repeated browsing on all species...visible browse line

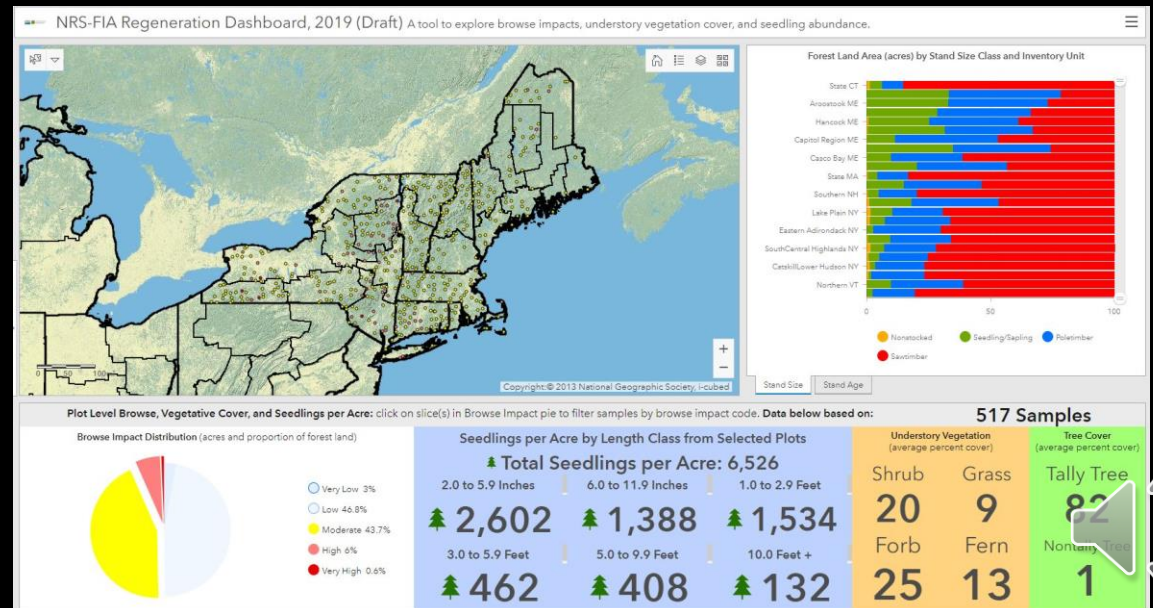


# Regeneration Dashboard



Low  
Browse  
Plots

Moderate  
/High  
Browse  
Plots



# Evolution of Tree Species Assessments via Large Scale Forest Inventories



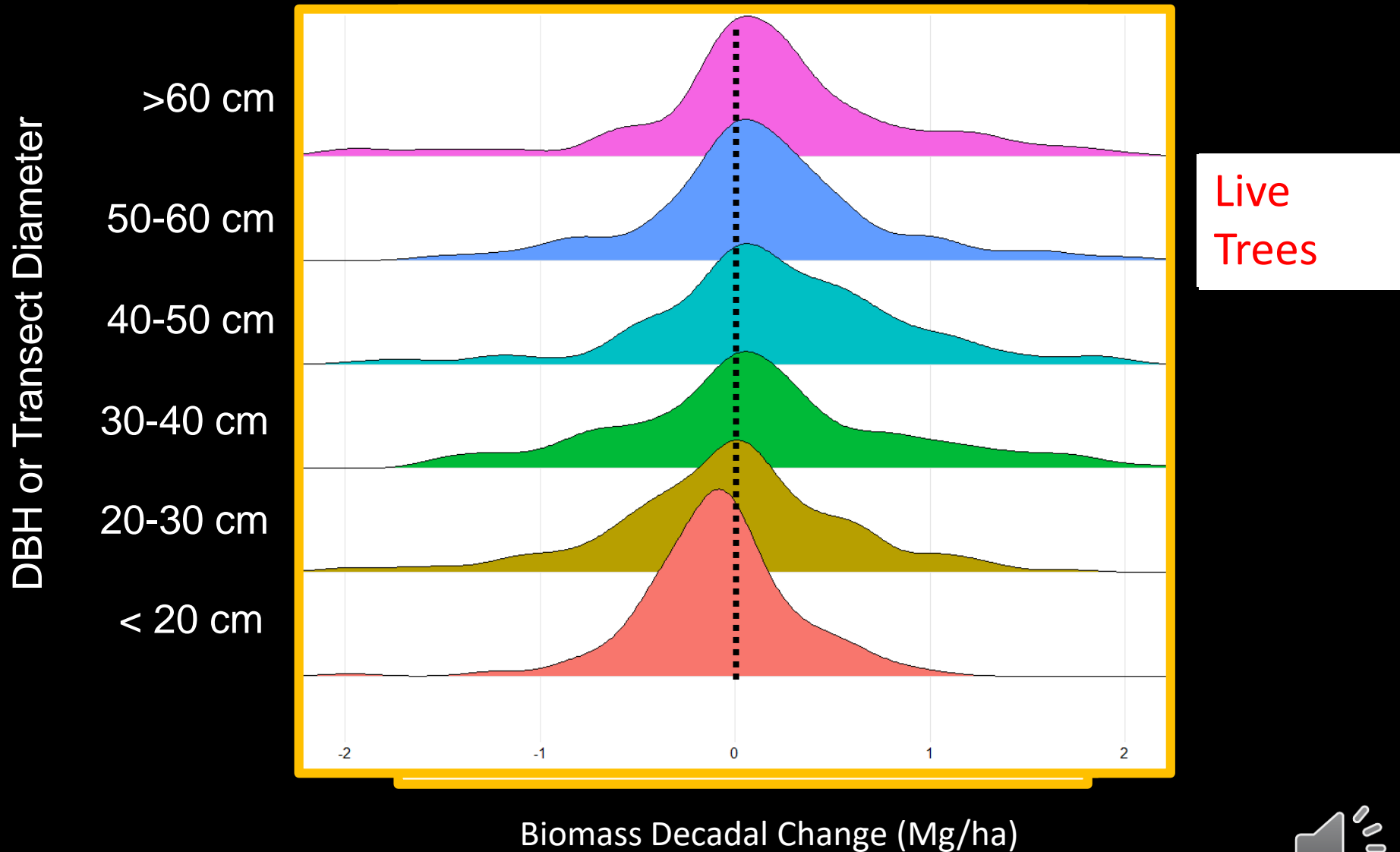
Forest Survey circa 1934

- Merchantable tree attributes
- Regeneration stocking
- Standing dead
- Downed dead
- Regeneration length distribution

Time

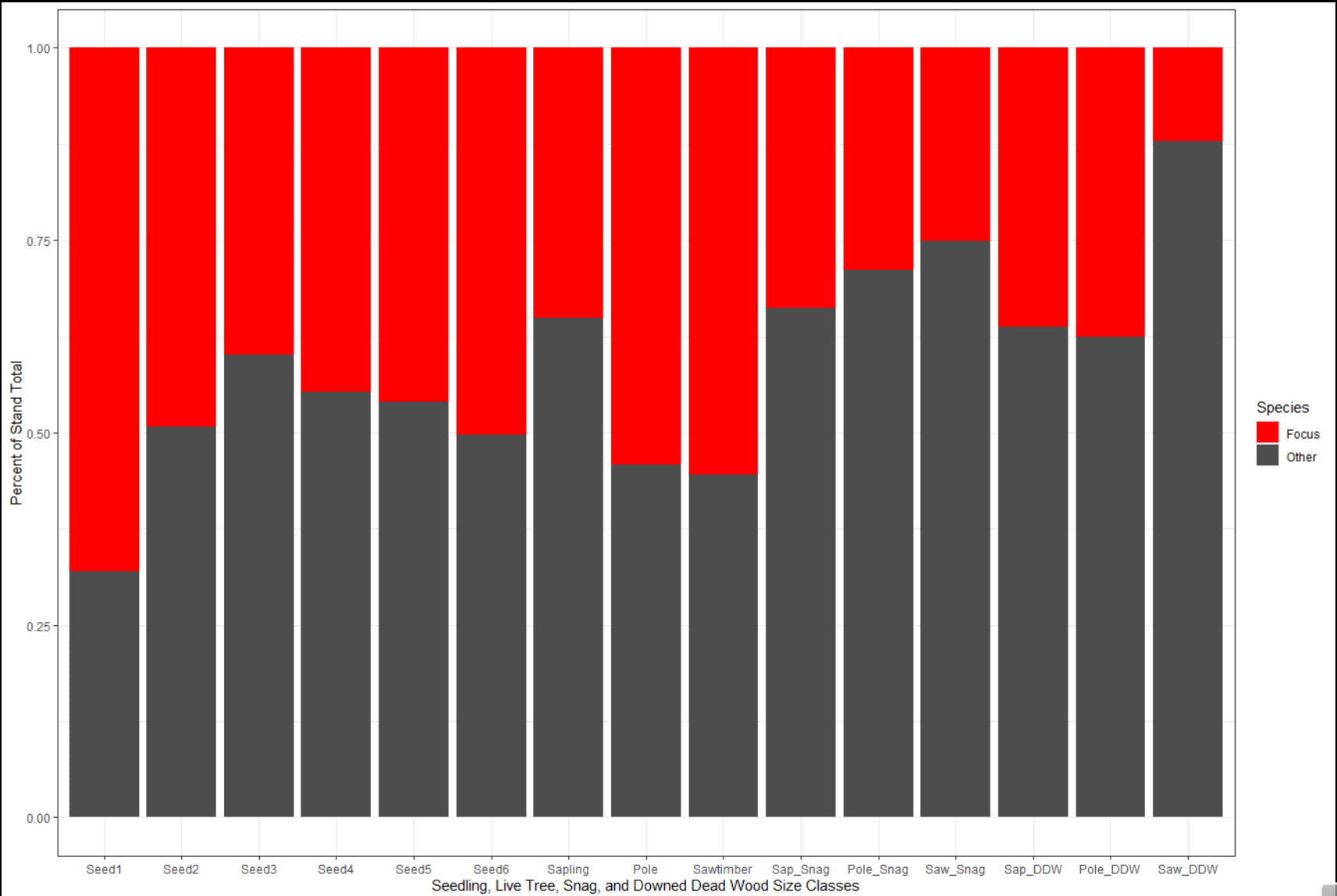


# US Standing Live/Dead + Downed Dead





# Sugar Maple vs all Other Tree Species



Seedlings



Live Trees



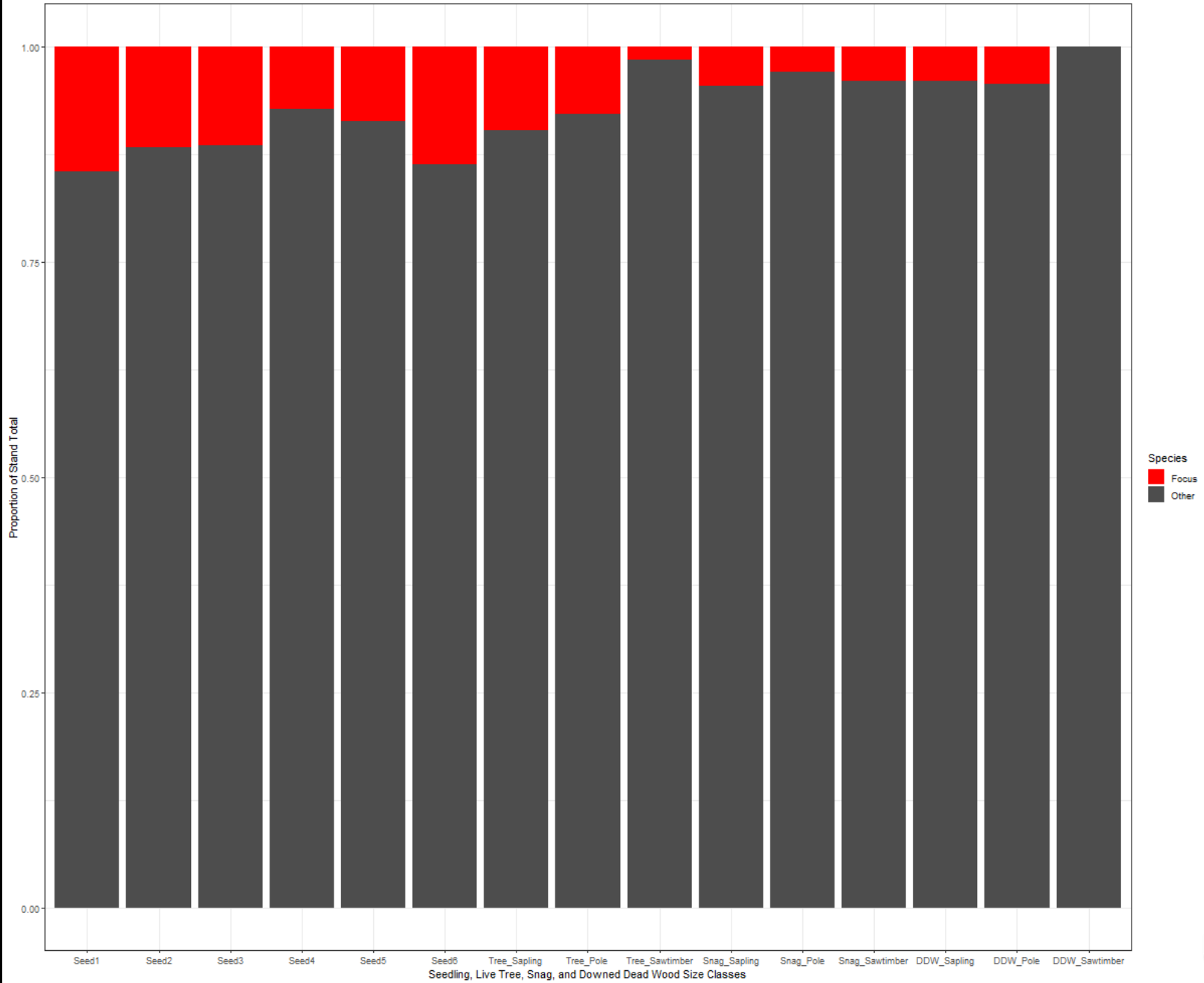
Snags



Downed Dead Wood



Sugar Maple Basal Area Occupancy (%):10



# Next Steps in Monitoring & Analysis

- Starting field **remeasurement** with adequate data for seedling change estimation in a few years
- Techniques for **quantifying the “profile”** of tree demography
- Regeneration **data distribution** and documentation
- Continued incorporation into **holistic resource analysis**



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