

# **Dynamics of institutional timberland ownership and its impact on forest management in Northern Forest Region, United States**

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- Change in aboveground biomass within Northeastern United States over the last five years based on FIA data showed distinct spatial patterns of increases and decreases, with predominantly decrease within the Northern Forest.

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<http://www.nsrcforest.org>

# Project Summary

Forest ownership patterns in the United States have changed dramatically over the past couple of decades. Traditional Vertically Integrated Forest Products Companies (VIFPCs) have sold their timberlands to institutional owners like Timber Investment Management Organization (TIMOs) and Real Estate Investment Trust (REITs). Several reasons have been identified for these ownership changes, including tax issues, international and domestic competition, realization of timber industry by outside financial investors. The Northern Forest region has not been immune to this trend.

Institutional owners are often perceived as being oriented towards maximizing profit, which influences their landholding objectives and time horizons, as compared to traditional VIFPCs. It is important to understand if these changes in timberland ownership have a role in affecting the species composition, biomass, and health of the forest. Few studies dealing with this topic have been made for the Northern Forest region. We attempted to conduct a detailed study to quantify the changes in forest composition and aboveground biomass across a wider spatial coverage and look for spatial patterns.

We used Forest Inventory and Analysis (FIA) data which are based on permanent remeasured plots. All FIA plots for nine states in the Northeast; CT, ME, MA, NH, NJ, NY, PA, RI, and VT, that were sampled twice from 2003 to 2012 were selected for analysis. Change in the aboveground biomass (lbs/ac/yr) for each plot was calculated based on measurements from individual trees. ArcGIS was used to conduct a spatial interpolation using Kriging, as well as compute distance from major roads and cities. ANOVA and regression were used to test for differences in change in aboveground biomass between different variables of interest.

There was an overall decrease in aboveground biomass across the study area based on the last two forest inventories. Spatial patterns in biomass change showed that southern areas tended to have positive changes compared to rest of the study area. Differences in biomass change among States was significant. Moreover, biomass change was significantly different for different forest types. However, no distinct relationship of biomass changes was observed with respect to land ownership or proximity to road and cities. Results from this study will help provide inputs in decision making for timberland management and carbon sequestration in this region.

# Background and Justification

- Over the past couple of decades, we have observed a dramatic trend where traditional Vertically Integrated Forest Products Companies (VIFPCs) have sold their timberlands to institutional owners like Timber Investment Management Organization (TIMOs) and Real Estate Investment Trust (REITs).
- In the last two decades, holdings of TIMOs and REITs grew from almost nothing to more than 25 million acres in 2005. In financial terms, investment in timberland by TIMOs and REITs increased from less than \$ 1 billion in 1985 to \$25 billion in 2005.<sup>[1]</sup>
- Literature suggests that this trend was the result of the pursuit for tax efficient ownership, international and domestic competition in global forest products, and a realization by the timber industry that it was not strategically necessary to own both timberland and manufacture units since market source of raw material was sometimes better than owning forest lands.<sup>[1]</sup>

[1] Hickman C. 2007. TIMOs and REITS. Paper prepared for Forester, R & D. [http://www.fs.fed.us/spf/coop/library/timo\\_reit.pdf](http://www.fs.fed.us/spf/coop/library/timo_reit.pdf)

# Background and Justification

- The Northern Forest region is no less affected by this trend where the tendency is more towards mixed softwoods and hardwood stands.
- Timberland ownership plays a crucial role in forest management since it is ultimately the owners who make every decision on their land which could in some way be constrained by the societal values.<sup>[2]</sup>
- Institutional owners are often perceived as being oriented towards maximizing profit, while also being different in their landholding objectives, time horizons and management capacities, as compared to traditional VIFPCs. Such decisions not only impact the structure and conduct of timber industry but also affect the characteristics of forest ecosystems.<sup>[3]</sup>

[2] Butler, BJ. 2008. Forest ownership patterns are changing. National Woodlands. Spring 2008. pp. 8-9.

[3] Bliss, JC, Kelly EC and Abram J. 2008. Disintegration of the Industrial Forest Estate and the Future of Small-Scale Forestry in the United States. Working Paper Series, RSP 08-03, Rural Studies Program.

# Background and Justification

- It is important to understand if these kinds of ownership changes have a role in affecting the species composition, biomass, and health of the forest and in land fragmentation.
- In addition, these changes could influence the role played by these landscapes towards the benefit of society such as recreation, biodiversity and water conservation.
- Few studies related to this theme have been done in the Northern Forest region but a detailed spatial study quantifying the changes in forest composition and aboveground biomass in relation to the types of different timberland ownerships across a wider spatial coverage, looking for spatial patterns.

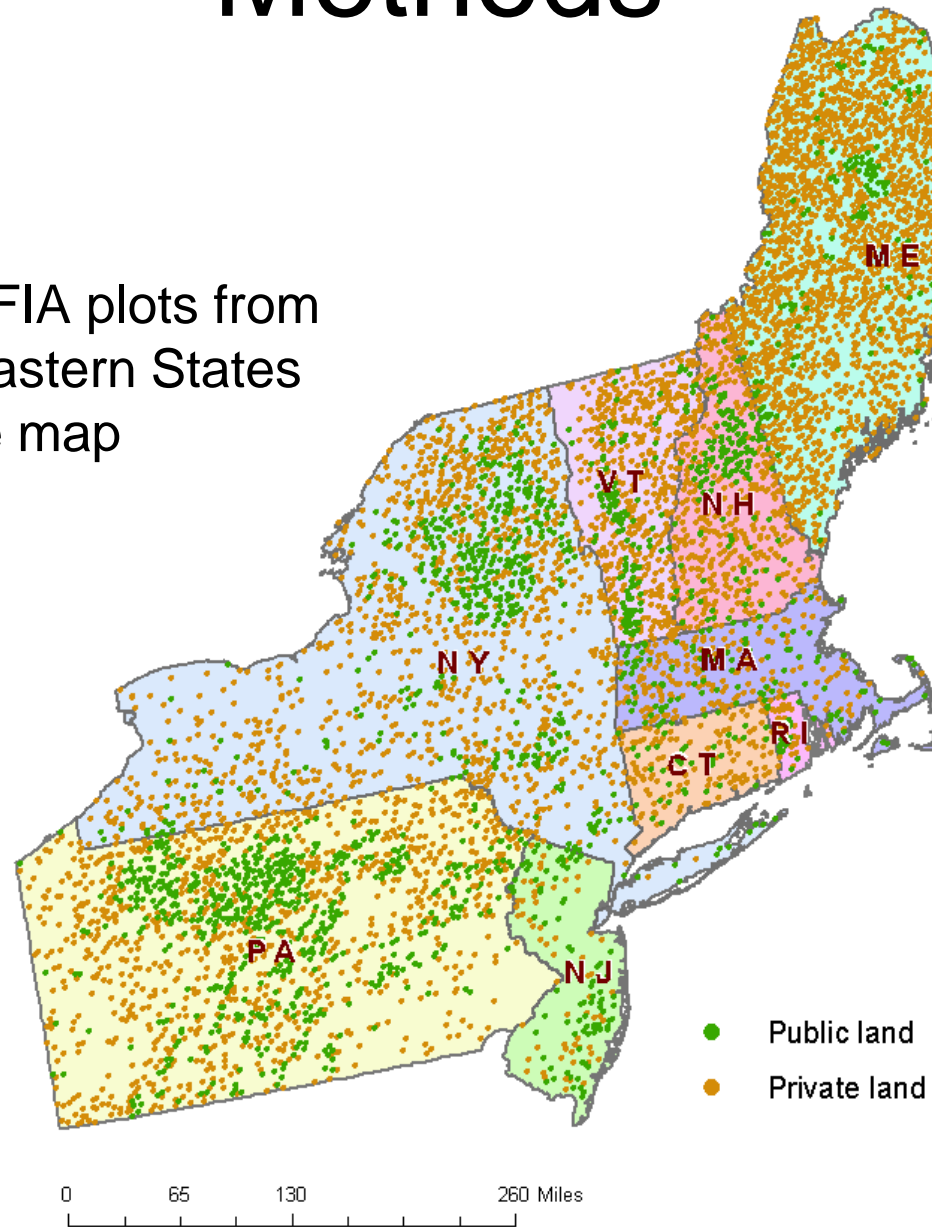
# Methods

- Forest Inventory and Analysis (FIA) data were used in the analysis
- Data from year 2003 to 2012 were used, excluding plots containing more than one condition
- GIS data were downloaded from different government agencies' website
- Point data for plot locations were created using Latitude and Longitude coordinates from FIA data

# Methods

## Study Area

Selected 6843 FIA plots from nine (9) Northeastern States as shown in the map



# Methods

## Analysis

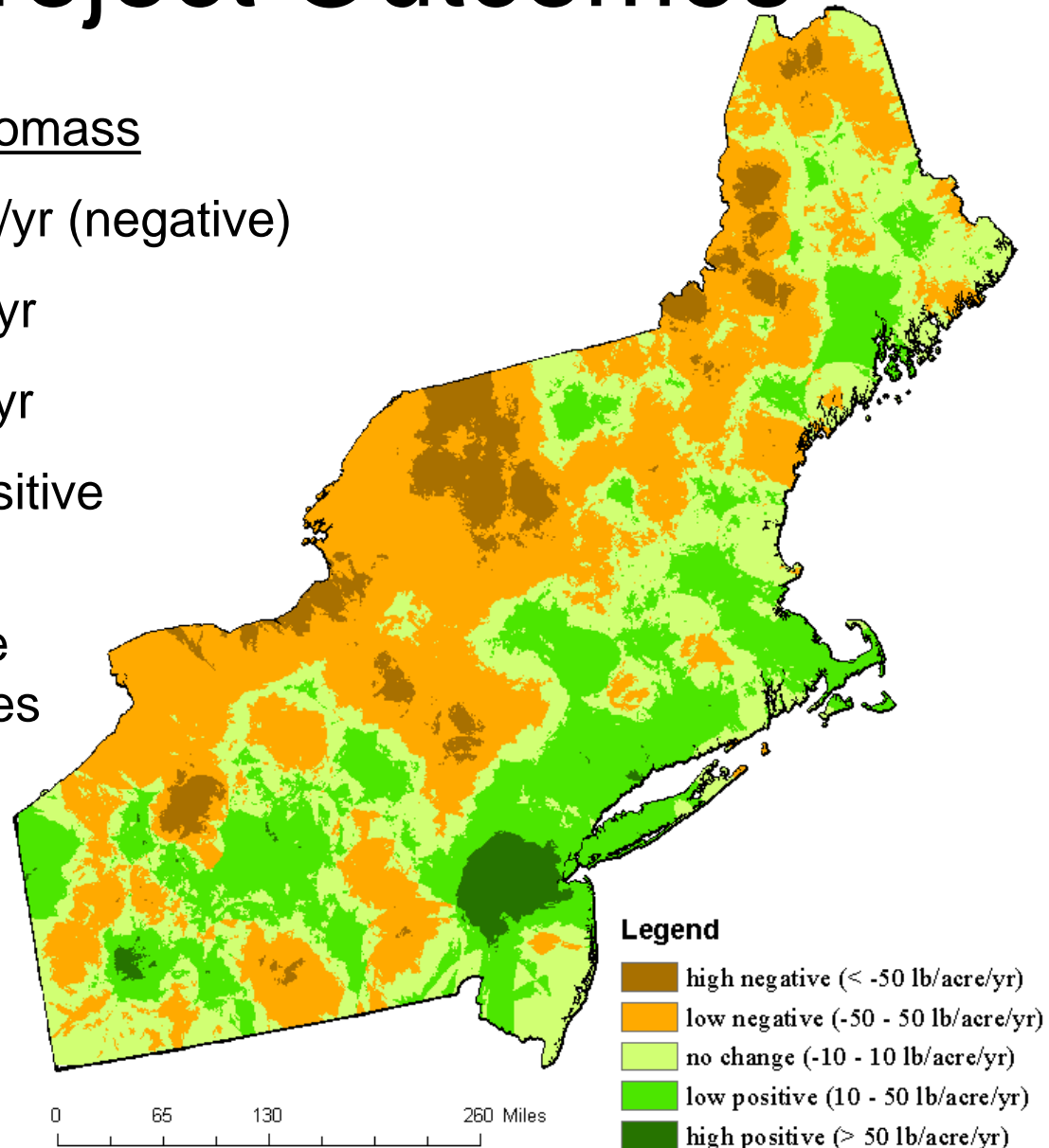
- Aboveground biomass for each tree in the plot was calculated by
  - i) using designated expansion factors and
  - ii) summing biomass for bole, foliage, stump and saplings
- Average biomass per acre for each plot was then derived by summing the biomass over all trees in the plot
- Change in biomass was calculated by looking at biomass for two different time periods and dividing the difference by respective number of years
- Kriging was done to interpolate biomass using ArcGIS
- ANOVA and Regression were done to observe relationship among different variables of interest



# Results/Project Outcomes

## Change in Aboveground Biomass

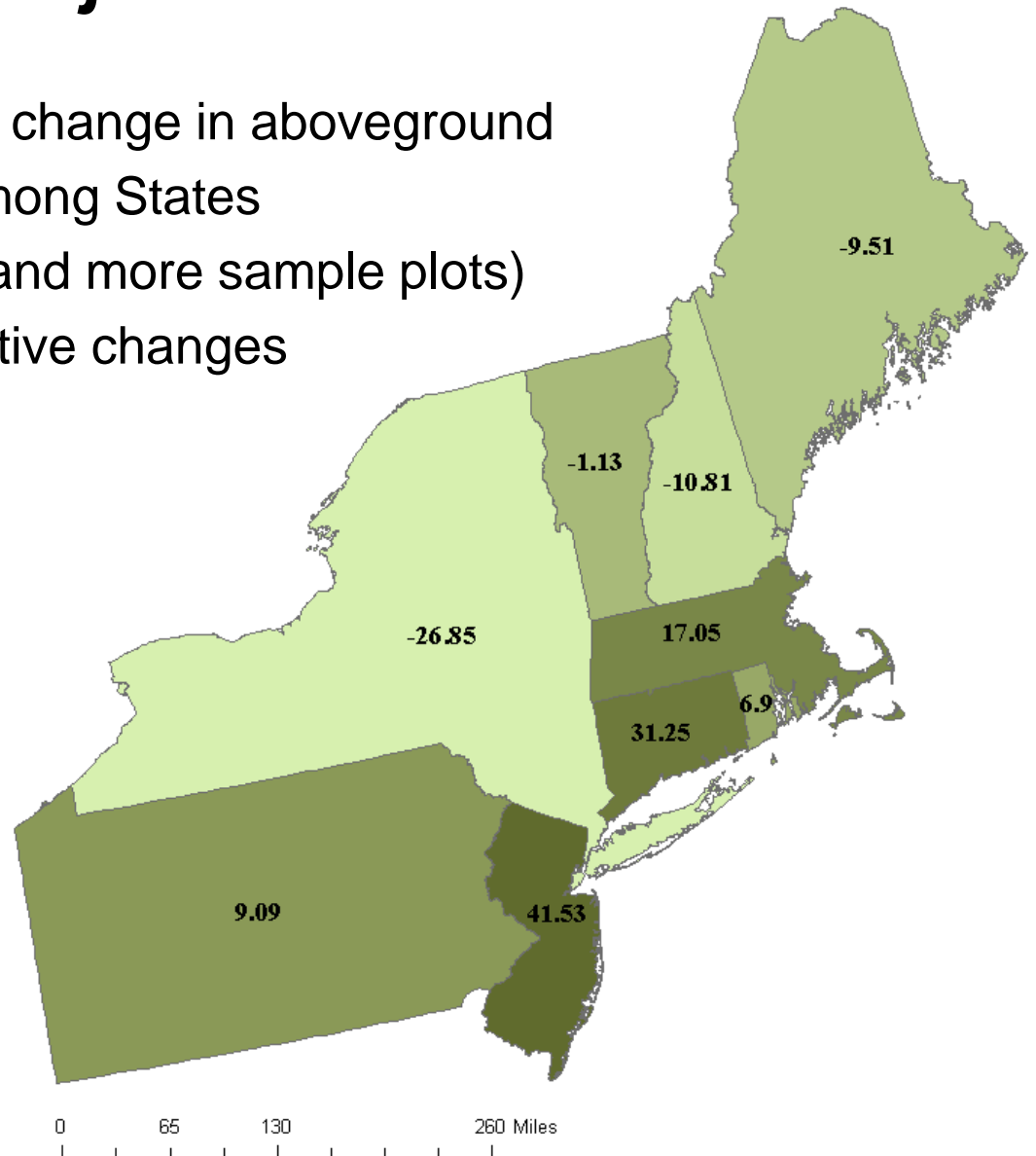
- Mean change: -5.2 lb/ac/yr (negative)
- Minimum: -1507.7 lb/ac/yr
- Maximum: 1060.0 lb/ac/yr
- Southern parts show positive changes
- Patches of high negative and high positive changes observed



# Results/Project Outcomes

- Significant differences in change in aboveground biomass (lbs/ac/year) among States
- States with larger area (and more sample plots) tend to have larger negative changes

State	n	Mean	SE
NY	1423	-26.8	2.8
NH	477	-10.8	5.4
ME	2246	-9.5	2.4
VT	547	-1.1	4.6
RI	54	6.9	10.8
PA	1514	9.1	4.7
MA	284	17.1	6.8
CT	156	31.3	9.7
NJ	142	41.6	10.9
<b>Total</b>	<b>6843</b>	<b>-5.2</b>	<b>1.6</b>



# Results/Project Outcomes

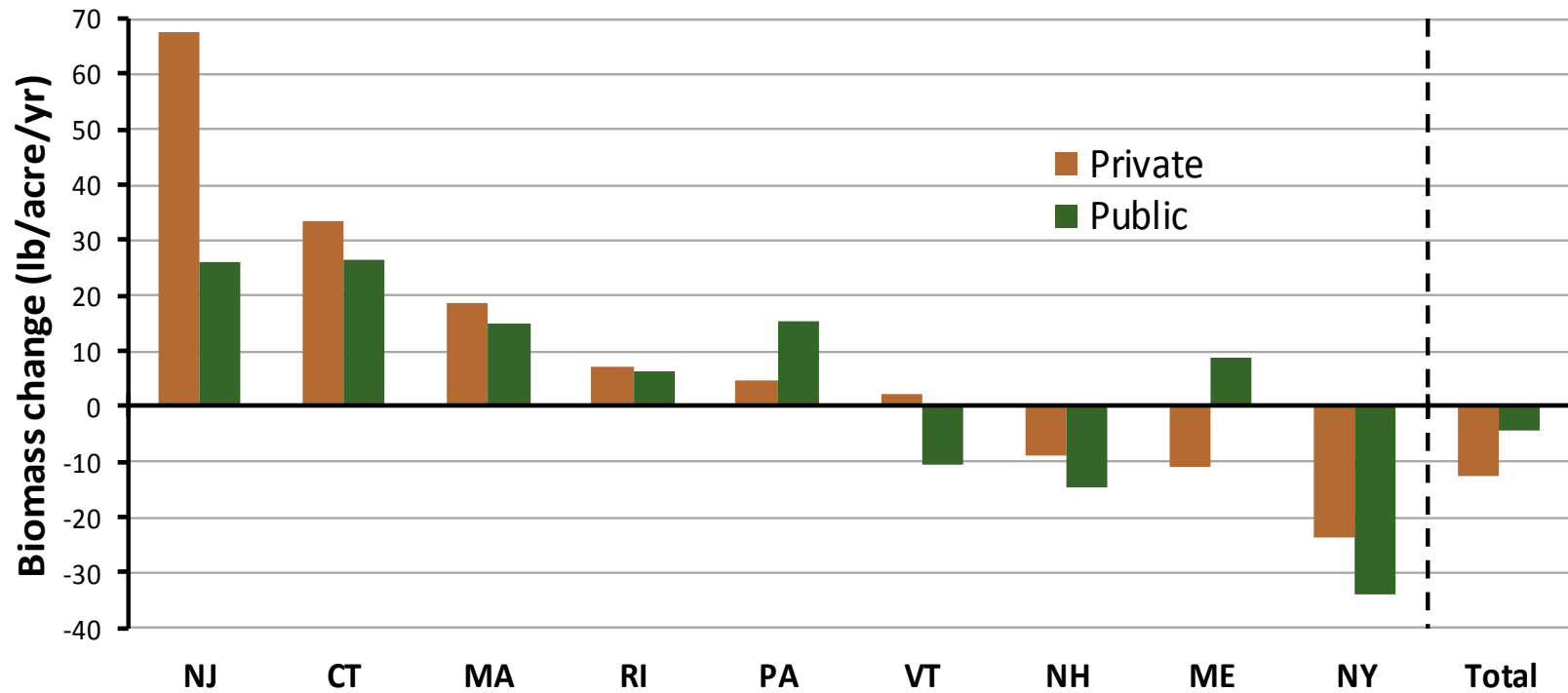
## Factorial Analysis

- 2 levels of ownership (private and public)
- 9 levels of State
- No interaction effect between **Ownership** and **State**
- Main effect due to **Ownership** is not significant
- Main effect due to **State** is significant

Ownership	n	Mean	SE
Public	1826	-1.19	3.11
Private	5017	-6.66	1.87

# Results/Project Outcomes

Change in aboveground biomass between Private vs Public Land by State



Private land

positive – NJ

negative – NY

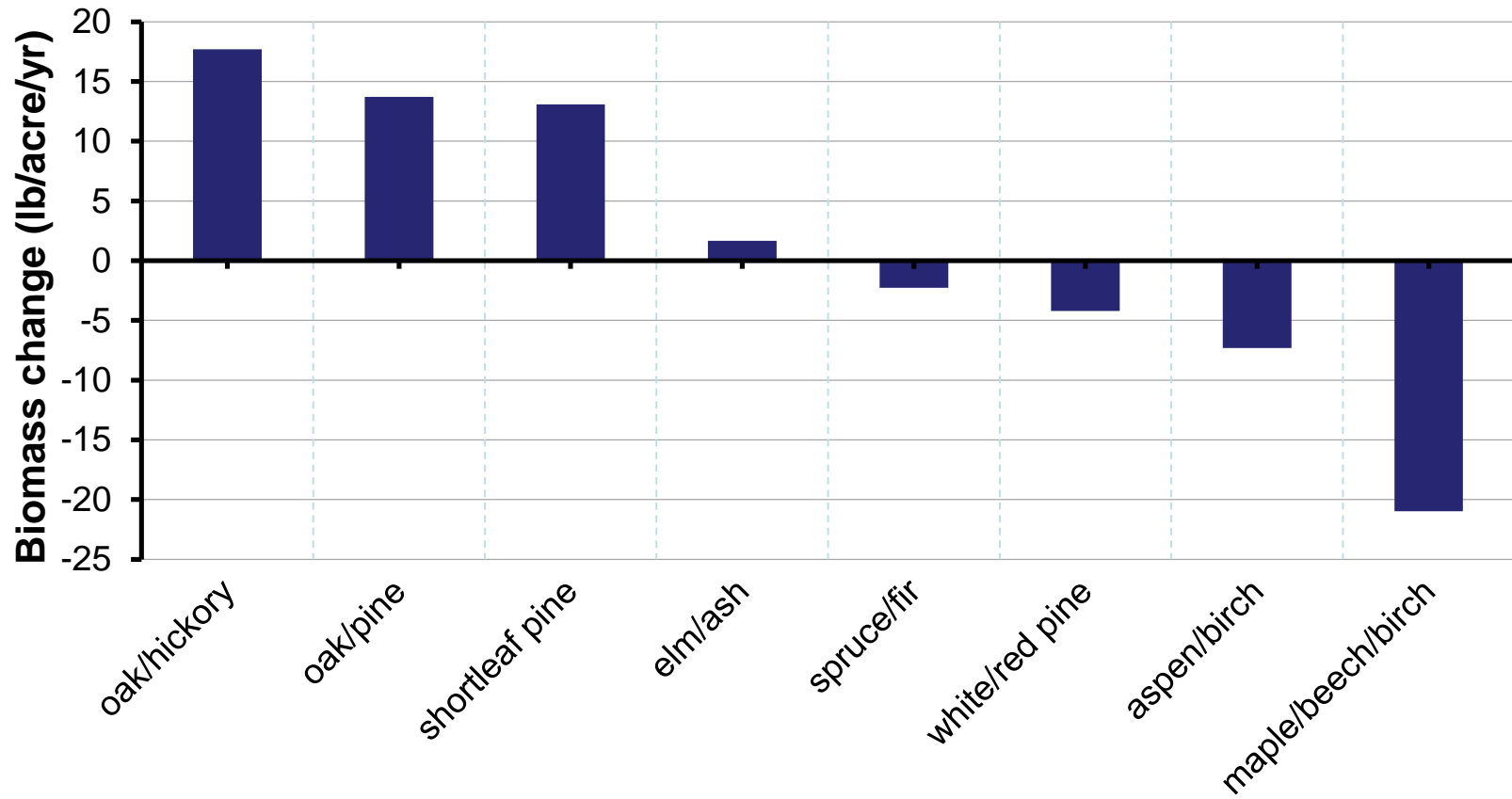
Public land

positive - CT

negative - NY

# Results/Project Outcomes

Change in aboveground biomass among different forest types



Significant differences among forest types was observed ( $p < 0.0001$ )

# Results/Project Outcomes

## Outreach Efforts

- Map showing above ground biomass change within 5 years time in Northeastern States of US was prepared
- Results would be incorporated as a chapter in PhD Dissertation
- Presentation of the work presented at two different meetings
  - i) Northeastern Mensurationists Organaziation meeting 2013
  - ii) Graduate Symposium at Virginia Tech, 2014

# Implications and applications in the Northern Forest region

- Results from this study will be useful in identifying the impact of different forest ownerships on forest management
- Understanding the changes in aboveground biomass in different types of timberland ownerships, different forest types for nine different states in Northern region will help develop appropriate forest management strategies to maintain healthy forest in the study area.
- Graphical results from the study could be useful in recognizing possible linkages of forest biomass change with other relevant factors.

# Future directions

- Further differentiation in biomass change among different types of private timberland ownership could be analyzed as future work
- Further research on relationship between sawmill locations and biomass changes looks like a promising issue.



# List of products

- Quantification of aboveground forest biomass in relation to forest land characteristics using Forest Inventory and Analysis Data. Paper presented at 17<sup>th</sup> annual Northeastern Mensurationists Organization (NEMO) meeting. York Harbor, Maine. November 4-5, 2013.
- Spatial factors affecting aboveground biomass across Northeastern Region US. Paper presented at Sixth Annual Graduate Symposium. Virginia Tech. Blacksburg, VA. April 1, 2014.
- Spatial dynamics of timberland ownership and impact on forest attributes. Chapter in PhD dissertation. Expected Date 30 May 2015.