

# Sawmill Wood Procurement in the Northern Forest

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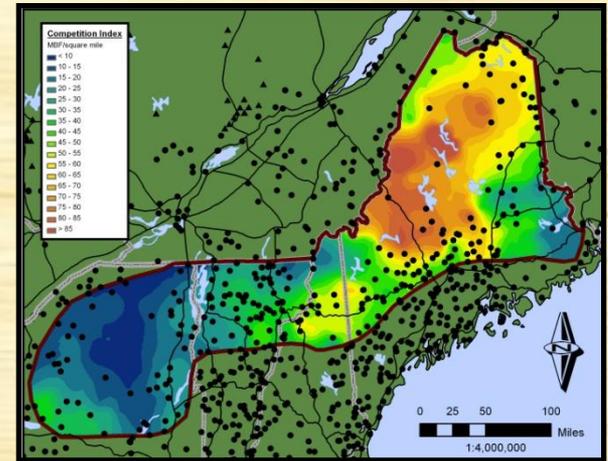
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The Northern Forest is a critical source of sawlogs for hundreds of sawmills in the United States and Canada. A number of factors, including land use change associated with development and urbanization, pose significant challenges to the long-term wood supply for mills in this region.

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<http://www.nsrcforest.org>

# Project Summary

Most sawmills in the Northern Forest region depend on local wood supply to meet production requirements. Unfortunately, few data are available to characterize wood procurement by the industry on a regional scale. Without reliable procurement data it is difficult to anticipate the effects that socioeconomic and land use changes will have on the wood supply and profitability of the primary forest products industry. This study used a mail survey of 783 sawmills in the United States and Canada to gather information about the procurement operations of sawmills within 100 miles of the Northern Forest. The objectives of the study were to:

- 1) characterize the wood procurement activities of mills in this region;
- 2) provide estimates for the geographic range of procurement operations;
- 3) examine the relative importance of specific sawlog sources,
- 4) compare perceptions of changes in log supply over a ten year period from 1994 to 2005,
- 5) map competition for sawlogs based on a geospatial analysis of woodshed maps provided by survey respondents;
- 6) predict how changes in land use will affect the wood supply.

American mills procured 90% of their total 2005 roundwood supply from within 30 to 70 miles of the mill, but often ranged 200 miles or more to meet requirements. Of the 1.2 billion board feet of log procurement reported by U.S. mills in the survey, gatewood was the most dominant log source (54%), followed by roadside sources (23%) and stumpage (16%). Over one third of the 1.1 billion board feet of procurement reported by Canadian mills in the survey originated in the United States. On average, Canadian mills that have little or no procurement from Provincial Crown lands routinely range 150 miles or more to meet procurement requirements, predominantly from roadside sources in the United States. A majority of mills in both countries reported that the quality of logs available for purchase and the average volume per log within their woodshed declined between 1994 and 2005. Furthermore, 64% of respondents reported a decline in the average parcel size of forest ownerships within their woodshed over that period. These results may indicate that the sawlog resource is in decline in the region and will be further impacted by development trends.

# Background and Justification

- Forest products industry is important to the communities of the Northern Forest and has been a central component of traditional patterns of land ownership and use.

## Northeast Forests

- 4.56m ac. forestland
- 4.23m ac. timberland
- 90% private forest
- \$557 million in stumpage earned by landowners
- Ecosystem services
- Non-market values



## Northeast Forest Industry

- \$14.4 billion in manufacturing shipments
- 7.3% of manufacturing sales
- 92,000 jobs
- \$3.4 billion in payroll
- Strong solid wood products sector
- Declining pulp and paper sector
- Growing woody bioenergy sector

# Background and Justification

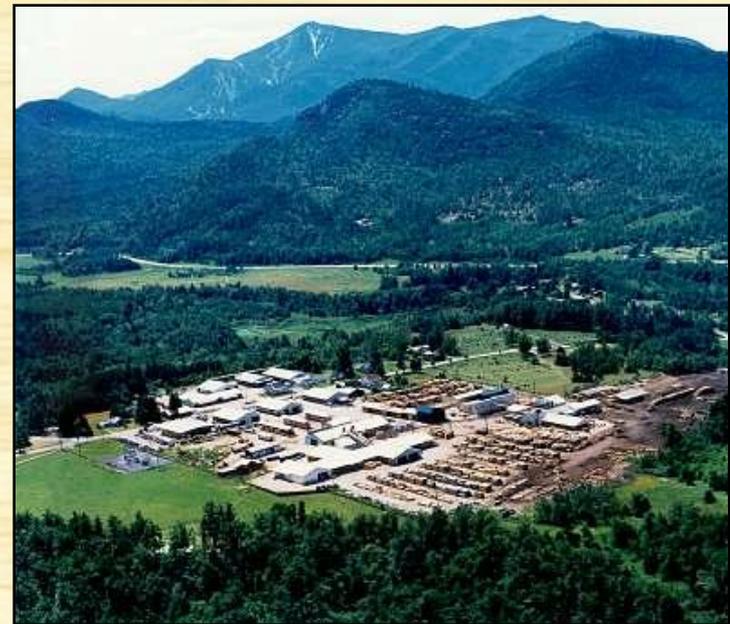
- The region is experiencing changes that may negatively affect wood supply for the forest products industry.

## Northeast Forests

- Urbanization
- Parcelization
- Fragmentation
- Changing ownership objectives
- Globalization
- Exploitation



## Northeast Forest Products Industry

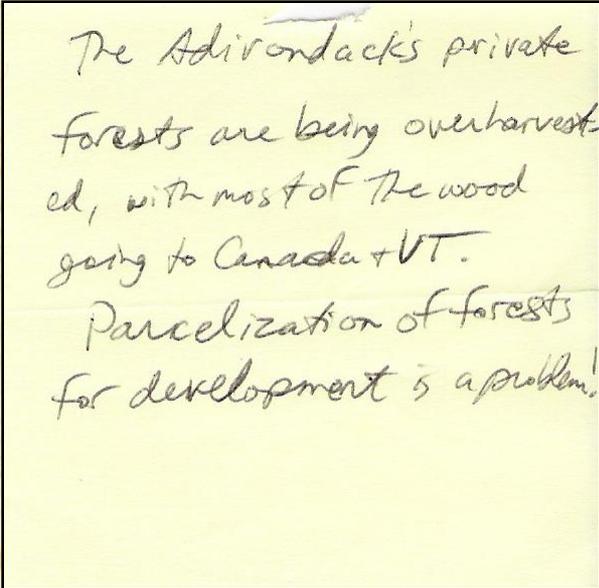


Ward Lumber, Jay, NY

Photo: [www.wardlumber.com](http://www.wardlumber.com)

# Background and Justification

- A lack of adequate regional procurement data makes it difficult to anticipate how these trends will affect the wood supply and the future of the industry.
- Research questions:
  - How are these trends affecting sawmills?
  - Can we characterize wood procurement for sawmills in the Northern Forest?
  - What trends do sawmill managers perceive?
  - Can we identify and quantify wood procurement trends spatially?
  - Can we predict where effects will be most intense in the future based on spatial analysis?



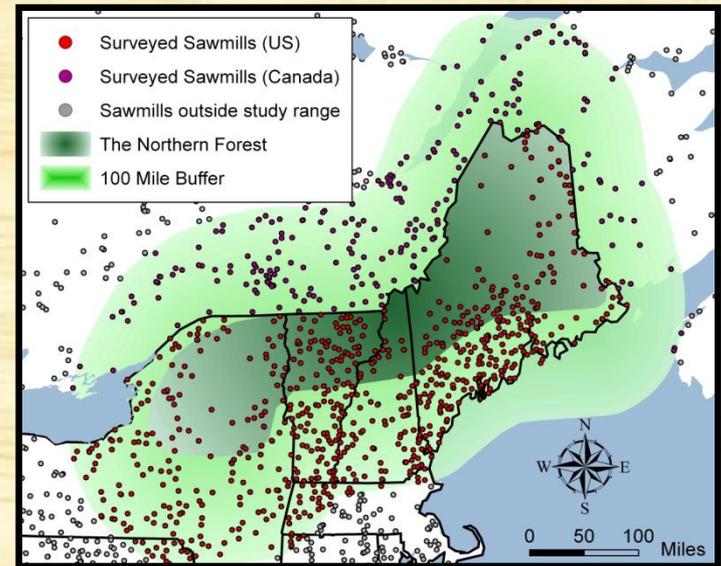
The Adirondack's private forests are being overharvested, with most of the wood going to Canada + VT.  
Parcelization of forests for development is a problem!

A handwritten note attached to a returned questionnaire from the sawmill survey.

# Methods

## The Sawmill Survey

- Objectives of the mail survey
  - Quantify the size of wood procurement regions (“woodsheds”)
  - Quantify the relative importance of different sawlog sources
  - Evaluate variation in wood procurement operations
  - Evaluate changes in log quality and availability between 1994 and 2005
  - Map sawmill woodsheds and link maps to procurement data
- We used Dillman’s Tailored Design Method (2000)
- The sample frame included all sawmills within 100 mi of the Northern Forest and was developed using:
  - Government directories
  - Industry Association directories
  - NGO listing of sawmills
  - Internet business directories
  - Company websites
- We included all year-round mills
- Respondents included:
  - 211 mills in the United States
  - 76 mills in Canada
  - 2.3 billion bf of sawlogs

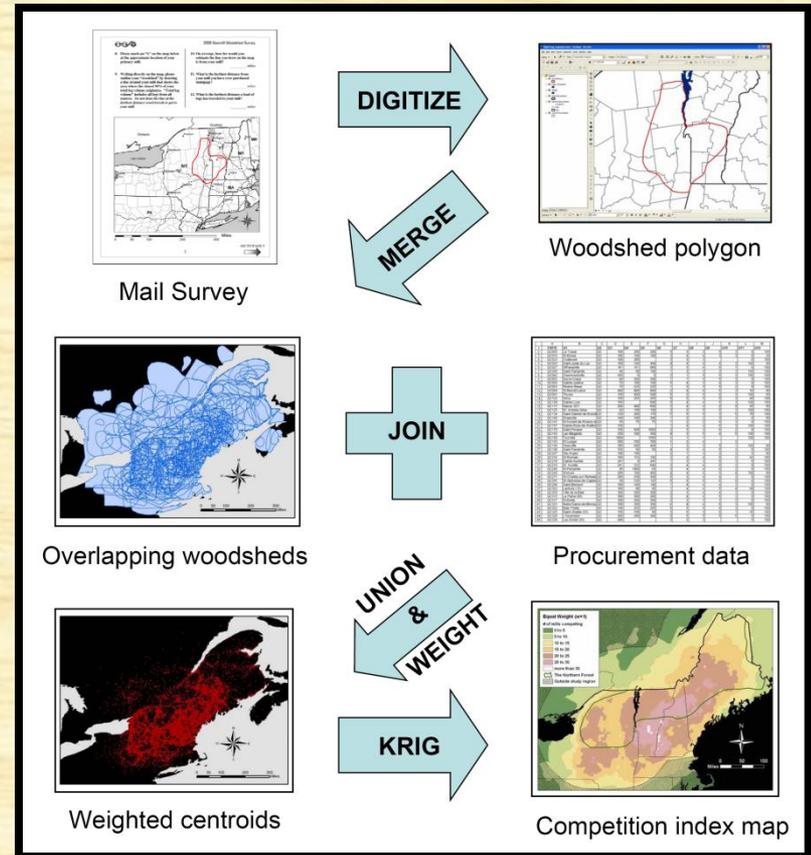


Map of the sample frame for the mail survey.

# Methods

## Mapping Sawmill Woodsheds

- As a component for the sawmill survey, 228 sawmills in the U.S. and Canada provided detailed maps of their wood procurement regions, also known as a woodsheds.
- Individual woodshed maps were digitized in ArcGIS and joined to procurement data from the survey and other sources. This allowed each woodshed to be weighted based on many different combinations of procurement variables.
- Once the individual woodsheds were digitize and weighted, they were converted to rasters and summed in groups to visualize different variables. For example, weighting the woodsheds of hardwood mills by annual procurement volume and summing them provides a spatial visualization for the demand for hardwood sawlogs
- Kriging was used to interpolate predicted values of variables across the study region.
- We also used a variety of remote sensing data to characterize each woodshed with regards to land cover and land use variables such as percent forest cover, percent impervious surface, road density and other variables correlated with development and parcelization.



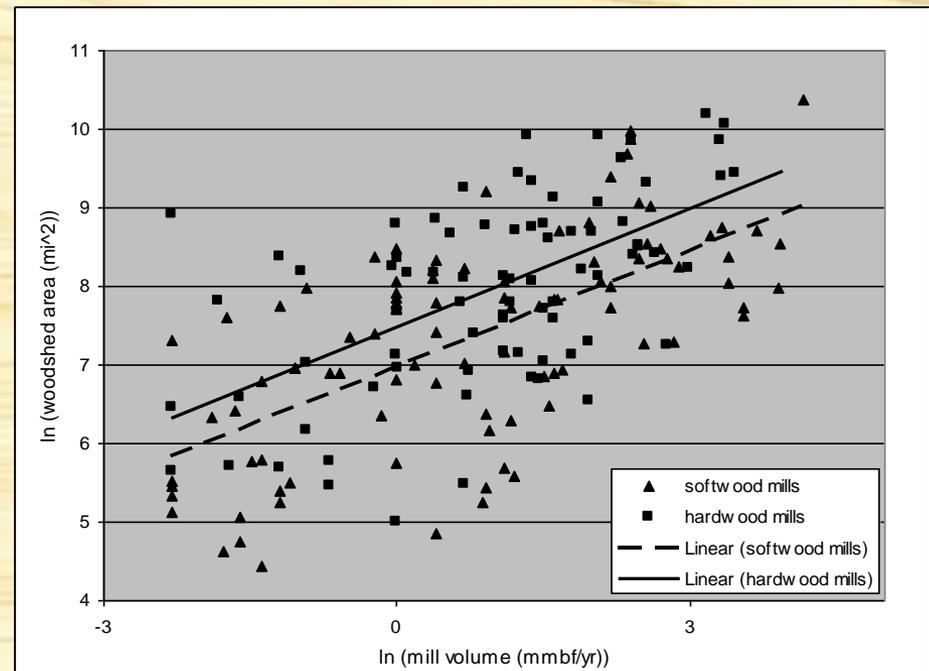
Schematic for GIS methods used to produce procurement maps.

# Methods

## Predicting Non-Respondent Woodsheds

Though 228 mills provided woodshed maps, approximately 280 mills in the U.S. and Canada did not respond to the survey. In order to account for these mills in mapping wood procurement in the Northern Forest, we developed multiple regression models to predict the woodshed area of non-respondent mills based on mill attributes and landscape variables.

- We hypothesized that mill characteristics such as annual production volume and mill type would impact woodshed area.
- We were also interested in the effects of land use and cover variables on woodshed area. For example, we hypothesized that mills in more urbanized areas would have larger woodsheds than those in less urbanized areas.
- Fourteen variables were included in this analysis.

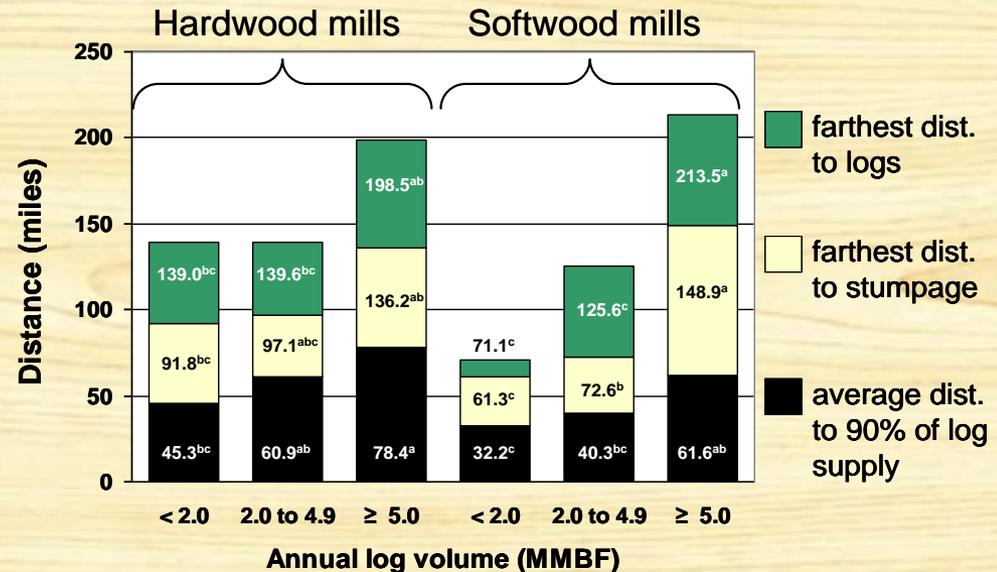


Plot showing the relationship between two mill characteristics and woodshed area.

# Results/Project Outcomes

## Procurement by U.S. Mills

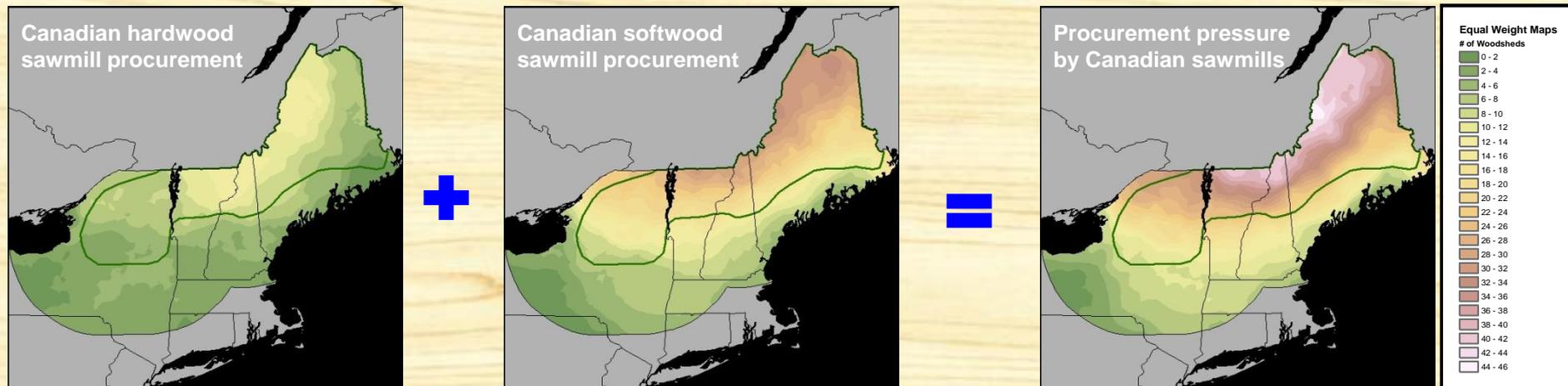
- Larger mills range farther for sawlogs than smaller mills.
- Hardwood mills have larger woodsheds on average, but softwood mills can range over 200 miles to procure logs.
- Hardwood mills get roughly equal procurement from stumpage, roadside and gatewood, while softwood mills are more heavily dependent on gatewood.
- Overall, gatewood represented the largest single source of logs.
- See Anderson and Germain (2007) for more details.



# Results/Project Outcomes

## Procurement by Canadian Mills

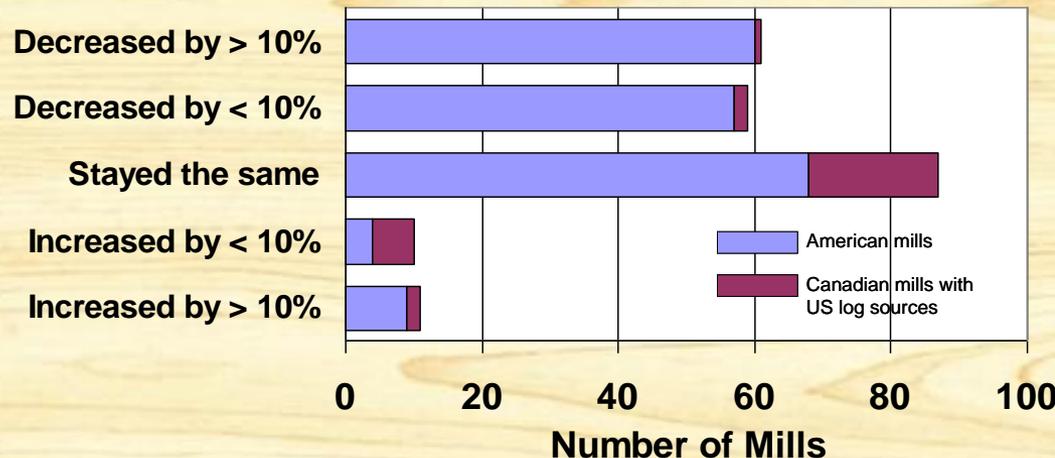
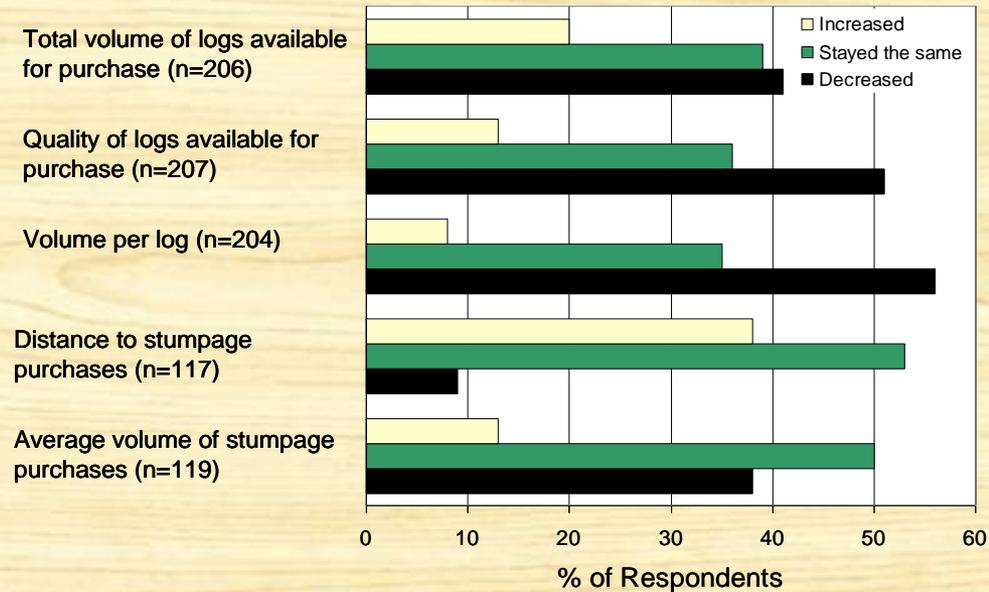
- Provincial Crown lands accounted for 43% of the 5.2 million m<sup>3</sup> of log procurement reported by Canadian mills, with 34% from the U.S.
- Nearly half of the Canadian mills reported procuring at least some of their supply from the United States and over half of those mills procured of 50% of their supply from the U.S.
- Mills with U.S. procurement relied most heavily on roadside sources, procuring around 32% of supply from bid or direct sale from log landings, concentration yards and other roadside sources
- 51% of Canadian mills reported a decline in the quality of logs and 60% reported a decline in the average volume per log
- See Anderson et al. (in press) for more details.



# Results/Project Outcomes

## Changes in Wood Supply

- 57% of U.S. hardwood mills and 48% of U.S. softwood mills reported that the quality of sawlogs available for purchase declined between 1994 and 2005.
- 66% of hardwood mills and 49% of softwood mills reported that the average volume per log declined over that period.
- 64% of respondents reported a decline in the average parcel size of forest ownerships within their woodshed over that period.
- See Anderson and Germain (2007) for more details.



# Results/Project Outcomes

## Land Cover/Use and Procurement Range

- Annual procurement volume was the strongest predictor of woodshed area. Other variables related to mill attributes, including % of procurement in hardwoods and mill density within the woodshed were also significant variables in the model.

Model variable	Parameter estimate	Standardized par. estimate	t - value	p - value
Intercept	1.4787	0	0.52	0.6044
ln(mill volume)	0.3579	0.4340	8.45	<.0001
ln(% farmland)	0.4721	0.4206	4.76	<.0001
ln(mill density)	-98.1498	-0.3119	-5.34	<.0001
ln(% water)	0.4539	0.2457	4.30	<.0001
ln(% forest)	2.6179	0.4128	3.68	0.0003
ln(% state land)	0.2795	0.1836	2.60	0.0103
ln(% hardwood)	0.0711	0.1082	2.16	0.0323
ln(% fed. land)	0.1309	0.1052	1.99	0.0482
ln(% urban)	0.4670	0.1593	1.63	0.1060
ln(% canopy)	-1.4304	-0.1729	-1.48	0.1421
ln(% ISA)	0.5197	0.3525	1.44	0.1525
ln(% roads)	-0.4615	-0.1481	-1.43	0.1552
ln(% developed)	-0.7024	-0.3614	-1.37	0.1740
ln(pop. density)	-0.0815	-0.0560	-0.61	0.5445

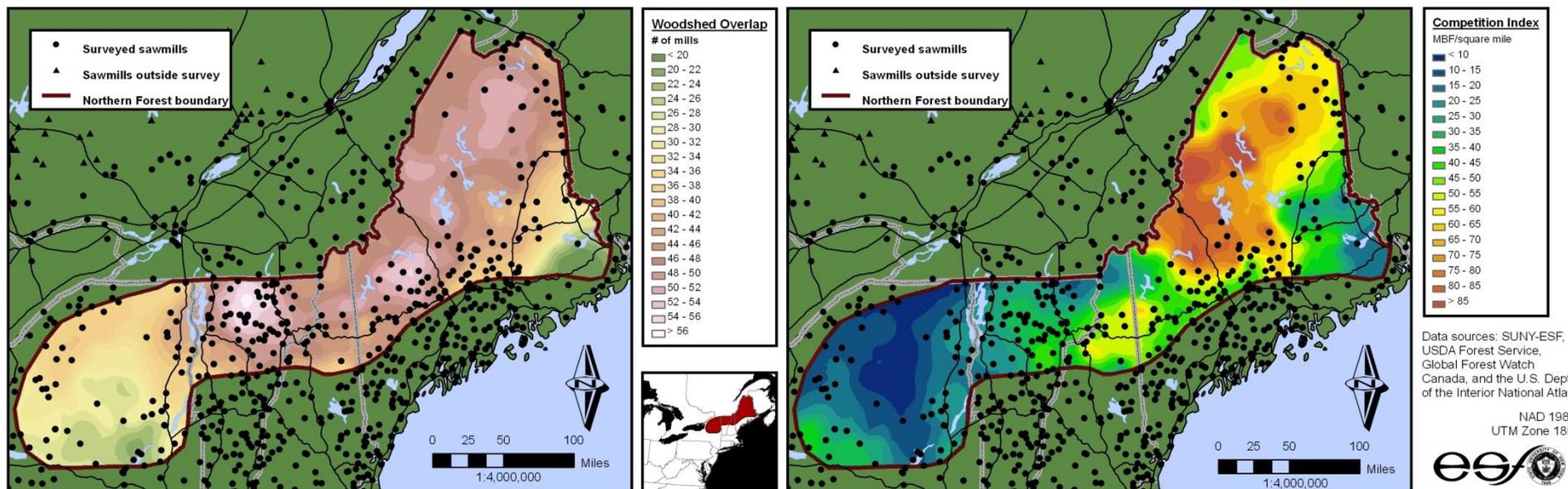
Table showing parameters of a multiple regression model predicting woodshed area (mi<sup>2</sup>) based on woodshed attributes and mill characteristics.

- Mills in areas with more farmland and open water tended to have larger woodsheds.
- Mills with more state and federal land within their woodsheds tend to have larger woodsheds.
- In general, land cover variables related to development, such as impervious surface area and population density, were poor predictors of woodshed area.
- It does not appear that sawmills expand their woodsheds in response to development at the intensity experienced in this region.

# Results/Project Outcomes

## Mapping Wood Procurement

- Spatial analysis of sawmill woodsheds provided by mill managers and modeled for nonrespondents shows the highest intensity of woodshed overlap (most mills competing for roundwood) in the Northern Forest to be in northern Vermont and southern Maine.
- If woodsheds are weighted by annual procurement volume (mbf/mi), analysis shows areas of western and northern Maine to have the highest procurement pressure. The Maine hotspots are attributable to a combination of high softwood lumber production in Maine and exports of logs to Canadian mills.
- The Adirondack region of New York and far eastern Maine have both the lowest woodshed overlap and the lowest procurement pressure.



# Results/Project Outcomes

## Outreach

- **Completed**
  - 7 oral presentations
  - 4 poster presentations
  - 1 facilitated discussion session
  - 3 publications
  - Mailed survey results, including a copy of Anderson and Germain (2007) to all participating sawmills.
- **Planned**
  - 3 more publications, including one *The Northern Logger and Timber Processor*

# Implications and Applications for Sawmills

- Manufacturers can assess market growth potential based on the competition for sawlogs
- Manufacturers can better plan for capital improvements given the declines in log quality and volume per log
- Results improve understanding of Canadian wood procurement pressure

# Implications and Applications for Policy Makers

- Current wood procurement pressure, particularly in “hot spots”, may point to measures to better maintain the forested working landscape.
- Shifts in land use, whether urbanization or preservation, need to consider long-term wood supply.
- Measures may be necessary to curb exploitative harvesting.
- As competition increases, special consideration may be required to support smaller family-owned sawmills, an important component of the Northern Forest landscape.

# Future Directions

- How will the burgeoning woody biomass markets impact wood procurement for sawmills?
- Will declines in log volume and quality require sawmills to change product mix or manufacturing processes?
- What are the forest conditions in those wood procurement “hot spots”?
- How will energy costs influence sawmill woodsheds?
- How will increasing wood procurement pressure affect specific tree species (i.e., sugar maple, white pine) that are both economically and ecologically important to the Northern Forest?

# Products

## Presentations and Outreach

- Anderson, N., R. Germain and E. Bevilacqua. 2008. Quantifying Competition for Sawlogs and Stumpage Based on Geospatial Analysis of Sawmill Woodsheds. Presentation at the joint annual meeting of the New York and New England Society of American Foresters, Saratoga, NY.
- Anderson, N., R. Germain and E. Bevilacqua. 2007. Trends in Private Forest Ownership and Potential Impacts on Sawmill Wood Supply in the U.S. and Canada. Forests in Settled Landscapes Conference, Toronto, ON.
- Anderson, N., R. Germain and E. Bevilacqua. 2007. Trends in Sawmill Wood Procurement in the Northeast: Implications for New York. Presentation at the winter meeting of the New York Society of American Foresters, Liverpool, NY.
- Anderson, N., R. Germain and E. Bevilacqua. 2007. The Impacts of Urbanizing Woodsheds on the Sawmill Industry in the Northeast. Presentation at Emerging Issues Along Urban/Rural Gradients, Atlanta, GA.
- Anderson, N., R. Germain and E. Bevilacqua. 2006. Sawmill Wood Procurement in the Northeast: Links to Forest Ownership. Presentation at the Eastern CANUSA Forest Science Conference, Quebec City, Quebec.
- Anderson, N. and R. Germain. 2006. Potential effects of parcelization on foresters, loggers and sawmills in New England. Facilitated an open discussion session at the annual meeting of the New England Society of American Foresters, Nashua, NH.
- Bevilacqua, E., N. Anderson, and R. Germain (Bevilacqua presented). 2007. Quantifying sawmill competition based on a geospatial analysis of individual sawmill woodsheds. New York State GIS Conference, Albany, NY.

# Products

## Refereed Publications

- Anderson, N., R. Germain and E. Bevilacqua. 2008. Characteristics of transborder wood flow to sawmills in eastern Canada. *Forestry Chronicle*. (in press)
- Anderson, N., R. Germain and E. Bevilacqua. 2008. Competition for Sawlogs in the Northern Forest: An Analysis of Overlapping Sawmill Woodsheds. In *Mapping Forestry*, Environmental Systems Research Institute (ESRI), Redlands, CA. (in press)
- Anderson, N. and R. Germain. 2007. Variation and trends in sawmill wood procurement in the Northeastern United States. *Forest Products Journal* 57(10): 36-44.

# Products

## Publications in Preparation

- Anderson, N. Sawmill wood procurement in the Northeast United States. PhD Dissertation. (December 2008.)
- Anderson, N., R. Germain and E. Bevilacqua. Predicting the range of sawmill wood procurement operations based on land use and land cover variables. In preparation for submission to the Northern Journal of Applied Forestry.
- Anderson, N., R. Germain and E. Bevilacqua. A geospatial analysis of sawmill wood procurement in the northeast United States. In preparation for submission to the Journal of Forestry.
- Anderson, N., R. Germain and E. Bevilacqua. Sawmill wood procurement operations in the Adirondacks: A case study. In preparation for submission to the Northern Journal of Applied Forestry.
- Anderson, N., R. Germain and E. Bevilacqua. Hotspots of competition for sawlogs. In preparation for submission to The Northern Logger and Timber Processor.