Analysis of Wood Resource Availability in the Northeastern United States

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- A series of consistent, documented spatial datasets were created that capture several real-world factors affecting the relative accessibility of standing timber, which is a critical input for accurate regional wood supply analyses.
- A quantitative assessment suggests that the average portion of the land base with reduced harvest accessibility as a result of one or more potential barriers (e.g. steep slopes, riparian buffers, poor access to low-grade wood markets, etc.) is 41% across ME, NH, VT, NY, MA, and PA.

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Project Summary

Forests are an important part of the cultural and economic fabric of the Northern Forest region, but demand for wood-use within the renewable energy sector has occasionally raised concerns about the sustainability of the forest resource in the face of new and existing demand. Accurate estimates of available wood supply are a critical starting point for decision-making and evaluations of sustainability, but these analyses must also accommodate the fact that not all forested acres are accessible and available for harvesting. This involves answering questions such as: How many acres of forested land are unavailable for harvesting because they are within recommended riparian buffer areas? How many acres of forestland are on slopes that are too steep to harvest as a result of equipment limitations or soil erosion concerns? The datasets generated through this analysis are an attempt to answer these types of questions quantitatively.

The analysis was carried out using a Geographic Information System (ArcGIS 10.2.2) to create spatial datasets that represent real-world factors affecting accessibility of standing timber, such as distance from roads, protected areas, stream buffers, existing harvest demand, and others, within a six-state study area encompassing the Northern Forest region and adjacent states. Relevant input datasets were obtained from state-level GIS resources and a suite of terrain, logistic, and market access variables were subsequently derived. Each data layer was converted into a binary format representing the presence or absence of a potential barrier to harvesting, where a 'barrier' is a condition that increases the environmental, social, or financial cost of harvest operations (e.g. areas within stream buffers are a barrier with a higher 'cost' than areas without). Combining all binary datasets produced a cumulative map of all potential harvest limitations, highlighting the locations with the highest number of co-occurring barriers and, consequently, the highest potential for reduced timber accessibility.

Results revealed that, on average, 41% of the relevant land base in each state has one or more barriers that may reduce the accessibility of standing timber. All datasets generated through this analysis are available for download in both spatial and tabular formats, along with comprehensive documentation. In addition to a synoptic report, the results were also integrated into an existing wood supply modeling tool. By quantifying common assumptions, these datasets will improve the accuracy of wood supply analyses in the region and increase the utility of the assessment tools that require these types of user inputs.

Background and Justification

- Assessment of regional wood supply has been a longstanding area of research, but analyses often vary in their scope, scale, methodology, and underlying assumptions, particularly in terms of the assumptions used to discount available wood volume due to accessibility limitations. <u>We lack</u> <u>region-wide, consistent datasets that quantify the relative accessibility of wood</u> <u>supply in terms of physical, environmental, legal, social, or logistical</u> <u>constraints to harvesting</u>. The lack of consistent, quantitative data to inform these assumptions leads to widely varying estimates of the sustainable wood supply in an area, which risks over or underestimating the availability of this important social and economic resource.
- Related efforts have focused on modeling tools with interfaces that allow users to examine the wood supply in a chosen area. The Northern Forest Biomass Project Evaluator (NFBPE) – developed by the North East *State* Foresters Association (NEFA) – is one example of a user-friendly tool for project-level assessments of the volume of all grades of wood available, under different scenarios, including low-grade wood for energy. However, a series of NFBPE training workshops held throughout the Northern Forest region in September 2012 also identified a need for real data to inform the selection of model assumptions.

Background and Justification

- Through this project, we developed a series of well-documented, consistent, region-wide spatial and tabular datasets related to the landscape, infrastructure, and market variables that affect the availability of forested acres. These can serve as standard and consistent inputs for any typical wood supply analysis, as well as direct inputs to the NFBPE tool. This required compiling existing data, creating several new datasets, analyzing the compiled or created datasets for applicability, and identifying any gaps in the existing data to inform the direction of future research.
- The goal of this project was to provide quantitative data on potential harvest limitations, which would improve existing methods of wood supply prediction in the Northern Forest region. These data will also allow us to better understand the real, quantitative impacts of external factors, such as suburban development and road infrastructure, on the accessibility of the wood resource. In addition, rendering this data in a spatially explicit manner helps identify forested acres or specific regions that are particularly wellsuited to act as a reliable source of wood, as well as areas that may be less favorable for harvesting. All of this information can help decision-makers make better-informed choices regarding how best to utilize the forest resource.

Methods

Data Layer	Description	Methodology/Criteria
Riparian Buffers	Riparian buffers do not necessarily represent an absolute barrier to timber harvest, however the accessibility of standing timber can be relatively reduced in these areas.	Variable buffers were generated for all water features (streams, wetlands, waterbodies) based on terrain steepness adjacent to the stream channel, shoreline, etc., as recommended by state-specific BMPs for buffer distances based on % slope.
High Elevation	Harvest is generally restricted in high elevation areas.	Areas over 2,700ft elevation.
Steep Slopes	Steep slopes present equipment limitations and soil erosion concerns that limit accessibility.	Areas with slope greater than 50%.
Road Access	Areas beyond a typical maximum skidding distance require additional costs and inputs that can reduce accessibility.	Areas more than 0.5 miles from a road.
Low-Weight Bridges	Bridges with maximum loads below the weight of a typical fully-loaded log or chip truck can act as a logistical constraint.	Areas in closest proximity to a bridge with a max load weight limit of less than 80,000lbs.
Access to Low-Grade Wood Markets	The absence of strong markets for low- grade wood can be a barrier to timber harvesting because those conditions reduce the economic viability of forestry operations, especially on marginal sites with lower quality timber.	Areas outside the primary or secondary drive-time area of existing facilities consuming low-grade wood (pellet mills, biomass power plants, pulp & paper mills).
Protected Areas/Management Limitations	Land under certain categories of ownership may have limited harvesting accessibility due to biodiversity and conservation considerations or management limitations.	Areas from the National Conservation Easement Database and Protected Areas Database with GAP Status Code 1 or 2.

Methods (Cont'd)

Complete documentation of data sources and details of the methodology used to derive each data layer is available as a pdf at: <u>http://nefainfo.org/</u> <u>wood-resourceavailability.html</u>

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Methods

- An additional barrier to harvesting is *parcelization*, the subdivision of forested lands into small ownerships
- Individual parcel data from towns in ME, NH, and VT, and sub-county areas in NY, were overlaid on NLCD forest cover and PAD protection status
- The fraction of forest area in individual parcels of at least 10 acres (minimum harvestable area), and at least 50 acres (ownership manageable as a sustained-yield unit), were determined
- Results were regressed on land cover and US Census variables to develop a predictive model

A note about interpreting these results:

- None of the variables examined in this analysis should be considered absolute barriers to timber harvest; rather, they represent conditions that can increase the environmental, social, or financial *costs* of forestry operations—potentially reducing timber accessibility.
- These barriers can be overcome under the right circumstances, such as the presence of highquality timber, strong timber prices, and/or sufficient resources to invest in logging infrastructure. (Northern Maine is a prime example of a region with a robust forest products industry that was highlighted in this analysis as having relatively reduced accessibility)

Percentage of the land base* in each state that was identified as having possible timber harvesting constraints.

	Riparian Buffers	Limited Access to Low-Grade Markets	Protected/ Mgmt Limits	High Elevation	Steep Slopes	Limited Road Access	Proximity to Low-Weight Bridges	All Potential Barriers**
Maine	1.2%	24.5%	2.1%	0.6%	0.2%	32.5%	20.0%	47.0%
New								
Hampshire	5.3%	4.1%	7.8%	3.8%	0.9%	21.7%	30.0%	47.6%
Vermont	7.3%	13.2%	4.3%	1.6%	0.9%	9.8%	21.8%	42.1%
New York	5.5%	20.0%	8.0%	0.9%	0.5%	9.8%	8.7%	32.7%
Massachusetts	5.1%	26.4%	2.3%	0.0%	0.2%	1.4%	9.0%	29.3%
Pennsylvania	3.8%	32.6%	1.8%	0.2%	1.3%	6.2%	14.6%	45.0%

* The land base considered here includes all forested land, as well as areas categorized as scrub/scrub or agriculture in the National Land Cover Dataset (2011) because these areas currently have timber resources or have the potential to be converted to a forested state in the future.

** The total value for "All Potential Barriers" is not necessarily equal to the sum of all individual values because certain lands may fall into more than one category, e.g. an area may be far from roads AND protected.



Integration of Results into the Northern Forest Biomass Project Evaluator

?

90.0%

50.0%

70.0%

Slope

Elevation

Wetlands

Data developed through this project can now be accessed from within the NFBPE tool and used to inform the selection of key model assumptions relevant to the selected study area.

Inaccessible Acres

The values below indicate the percentage of acres in each county that may be inaccessible for harvesting timber, as a result of each physical or environmental contraint. You can use these values to guide your selection of Key Assumptions in Part D.

	<u>State</u>	<u>County</u>	<u>Steep</u> <u>Slopes</u>	<u>High</u> <u>Elevation</u>	<u>Wetlands</u>	<u>Far from</u> <u>Roads</u>	<u>Stream</u> Buffers	<u>Restrictive</u> <u>Conservation</u> <u>Easements</u>	Total ?
Þ	Massachusetts	Franklin	0.93%	0.02%	4.37%	3.25%	9.94%	3.23%	18.99%
	Massachusetts	Berkshire	1.38%	0.32%	8.22%	7.54%	9.34%	9.17%	29.64%
	New Hampshire	Cheshire	0.22%	0.05%	6.83%	8.64%	6.45%	3.70%	22.10%
	New York	Columbia	0.25%	0.00%	7.13%	1.44%	7.49%	0.37%	15.21%
	New York	Rensselaer	0.63%	0.01%	5.51%	3.69%	6.40%	0.10%	14.68%
	Vermont	Windham	0.57%	1.57%	3.08%	7.16%	7.41%	1.33%	18.54%
	Vermont	Bennington	2.61%	6.01%	4.97%	19.08%	7.95%	12.65%	39.65%

Biomass Project Evaluator

Federal

Municipal

State

Farmer

C. Percentage of Acres in Different Ownership

Corporate

Private Parcels 1-50 acres

Private Parcels 50+ acres

Categories that are Accessible for Harvesting

15.0%

30.0%

10.0%

50.0%

Selected Counties:	<u>Steep</u> Stopes 0.94%	<u>High</u> <u>Elevation</u> 1.14%	<u>Wetlands</u> 5.73%	<u>Far from</u> <u>Roads</u> 7.26%	<u>Stream</u> <u>Buffers</u> 7.85%	Restrictive Conservation Easements 4.37%	<u>Total</u> 23%
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Degree of Parcelization

Fraction of Unprotected Forest in Parcels of <10 Acres

Fraction of Unprotected Forest in Parcels of <50 Acres

- Outreach efforts
 - NFBPE users will be notified about the new version of the modeling tool that incorporates the results of this analysis (via an announcement in the INRS newsletter)
 - An NFBPE video tutorial is available to instruct users on how to interpret and utilize these results.
 - 3-page synopsis of project results
 - Presentation at ECANUSA

Implications and applications in the Northern Forest region

- Integration of these results with the NFBPE tool will improve the model results by more accurately constraining accessible timberland acreage.
- The strength of these datasets is their consistency across all the states in the region.
- The results put real data behind common qualitative assumptions used in wood supply modeling.
- The states in this analysis have between 29 and 48% of their relevant land base affected by one or more potential harvest barriers. In addition, the results of the parcelization analysis reveal that even those areas that have few (or no) barriers often have a high degree of parcelization (i.e., a large fraction of forest in parcels <10acres), which reduces harvest likelihood. This suggests that the overall level of timber accessibility is actually lower than the harvest barrier analysis suggests.
- While these data do not necessarily indicate the absence of harvesting in areas with many potential accessibility barriers, the relatively large percentage of land with at least one possible barrier or a high degree of parcelization, should serve to temper future wood supply estimates.

Future directions

- This analysis only derived a handful of variables that affect the accessibility of standing timber. There are other important factors, such as sensitive habitat areas, that we were unable to address in this analysis due to a lack of data at the necessary resolution or a lack of consistency/availability of data across states. Future work may help to fill these data gaps and expand the scope of accessibility variables considered.
- There is a significant body of literature assessing how landowner attitudes can affect the likelihood of harvesting and a future analysis would be improved by incorporating this type of information about social constraints into the spatial analysis approach utilized here.

List of Products

Peer-reviewed publications:

 Manuscript in preparation describing parcelization impact on forest land availability for harvest

Conference presentations:

 Hushaw, J. and M.J. Ducey. 2014. Spatial data for modeling wood resource availability in the northeastern United States. 7th Eastern CANUSA Forest Science Conference, Rimouski, Quebec, October 16-18, 2014.

Other tangible products:

(all available for download at <u>http://nefainfo.org/wood-resource-availability.html</u>)

- Binary GIS data layers
- GIS data layers summarized by town
- Tabular data summarized by town and county
- Detailed documentation of data sources & methodology
- 3-page synopsis of results
- New version of the Northern Forest Biomass Project Evaluator (NFBPE) tool with integration of these results.
- Recorded video tutorial to inform NFBPE users about the new feature and how to interpret the accessibility data.