Productivity standards for cut-to-length and whole-tree systems in Maine

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- **Harvester productvity in PCT stands as predicted**
- **Small feller-buncher tested was not suitable for non-PCT harvest**

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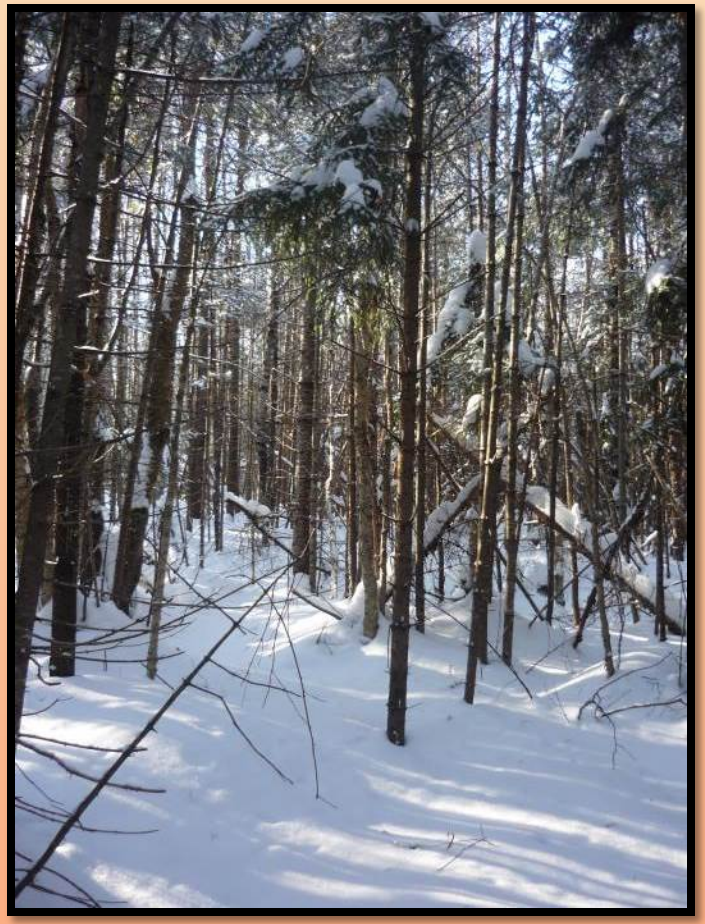
http://www.nsrcforest.org

Project Summary

There are over 11 million acres of small diameter forests in Maine that are in need of thinning in order to maximize tree growth. This project is an assessment of harvest productivity in small diameter stands, both pre-commercially thinned (PCT) and non-PCT, since limited research of this type has been conducted in Maine over the last 25 years. The goal of this project was to evaluate the productivity of logging equipment harvesting 40-year old stands: a harvester in PCT stands and a small custom-built feller-buncher in non-PCT stands. (The feller-buncher was originally designed to clear residential house lots and powerlines.) Further, this project was also used to assess stand damage caused by the logging equipment. The results of this phase were presented at the 2013 Council on Forest Engineering Meeting in Missoula, MT. A time and motion study was conducted with the harvester and results validated productivity equations previously developed for similar equipment in Maine. The feller-buncher time and motion study was cancelled as it became evident after several weeks of harvesting a small clear-cut that the machine was not well-suited to the terrain and stem size. Stress on the machine caused frequent breakdowns, and it was determined that the use of this machine in forest settings is not applicable. The implications for the Northern Forest region are that harvester productivity equations are now validated and available to the public. Further, we have shown that a particular promising feller-buncher was not suitable for the work at hand which implies that the forest industry must continue to search for equipment combinations that can profitably harvest non-PCT stands with small diameter trees.

Background and Justification

- Maine has over 11 million acres of small diameter tree stands (dbh < 12 in.).
- In the past 25 years, limited logging equipment productivity research has been conducted.
- Managing small diameter forest stands is a topic of growing interest and necessity.



Small diameter tree stand at the Austin Pond harvest site.

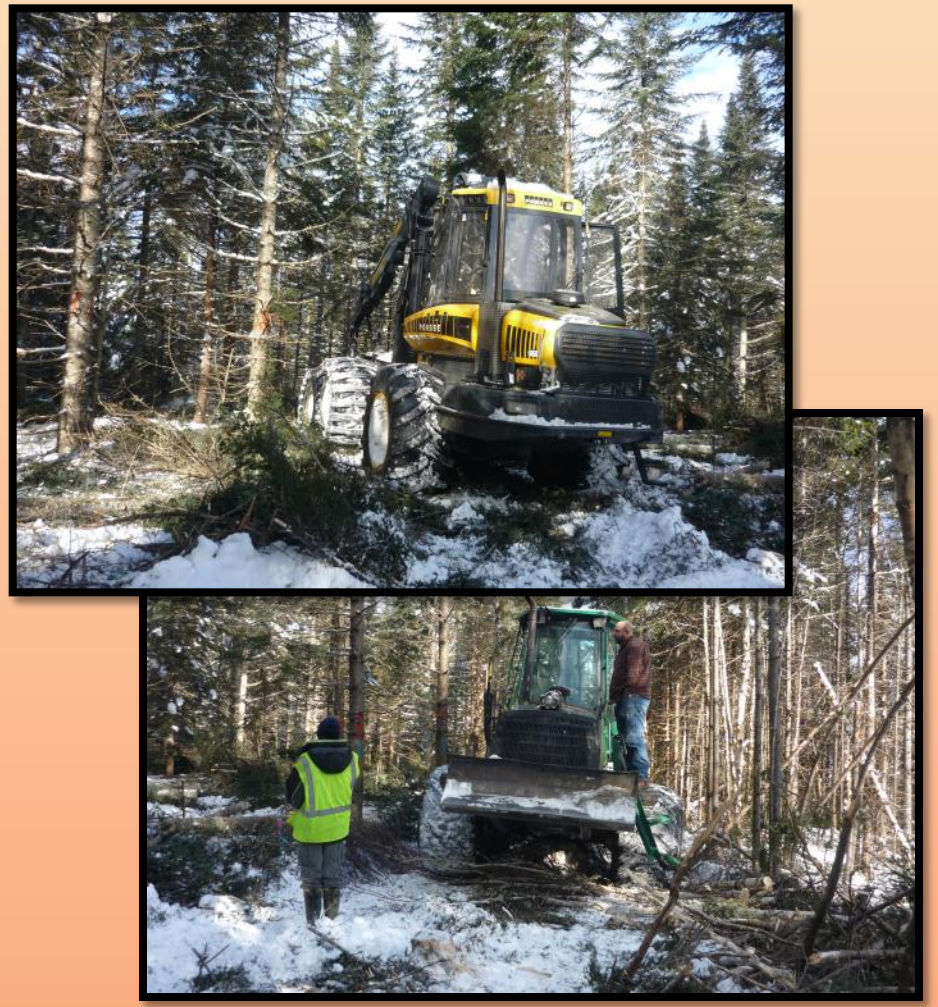
Background and Justification

- Machine productivity data is important in order to calculate the cost of harvesting small diameter trees.
- Studying two different machines is one step forward to find a machine that can operate cost efficiently in small diameter stands.

TOP: Ponsse Ergo harvester.
BOTTOM: Custom made feller-buncher.

Methods (Harvester)

- Paint 1-inch dbh class on trees in three harvest blocks for detailed harvester time study.
- Conduct time study using handheld computer by recording cutting and processing time for each tree.



TOP: Harvester in painted harvest block.
BOTTOM: Researcher discusses forwarding options with machine operator.

Methods (Harvester)

- Separate wood from each harvest block by product.
- Mark each pile of wood with the harvest block number.
- Measure each pile and record volume.
- Keep track of tonnage delivered to mills and compare volume measured to estimate total removal per harvest block.

TOP: Shortwood pile at roadside with block ID.
BOTTOM: Log truck loading studwood.

Methods (Feller-Buncher)

- Start machine in 5-ac clear cut.
- Pile biomass along roadside and separate biomass from different harvest blocks.
- Measure volume of biomass pile.
- Keep track of tonnage delivered to mill and compare volume measured to estimate total removal per harvest block.

Biomass pile from clear cut harvest block cut by feller-buncher.

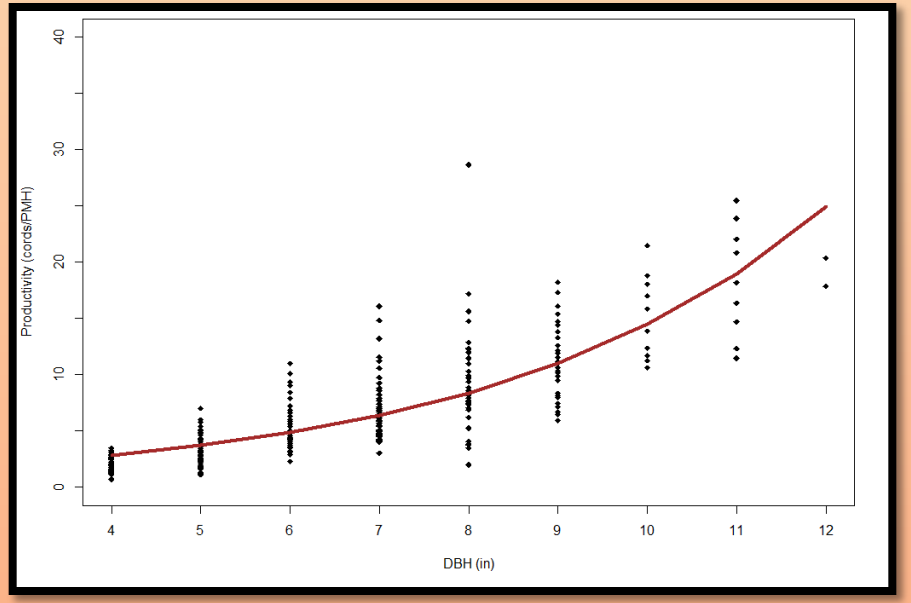
Results/Project Outcomes

- During the clear cut harvest, it was evident that the feller-buncher was not suited for harvesting the present tree size.
- Significant time consumption and mechanical stresses led to the early stoppage of the trial.
- The conclusion is that the machine was underpowered for the task at hand.

Machine operator getting ready to start up feller-buncher after fixing a broken hydraulic hose.

Results/Project Outcomes

- Harvester data was used to successfully validate harvester cycle time and productivity models developed by Hiesl (2013 MS Thesis).
- Harvester productivity information for four different treatment intensities in a randomized block design is now available

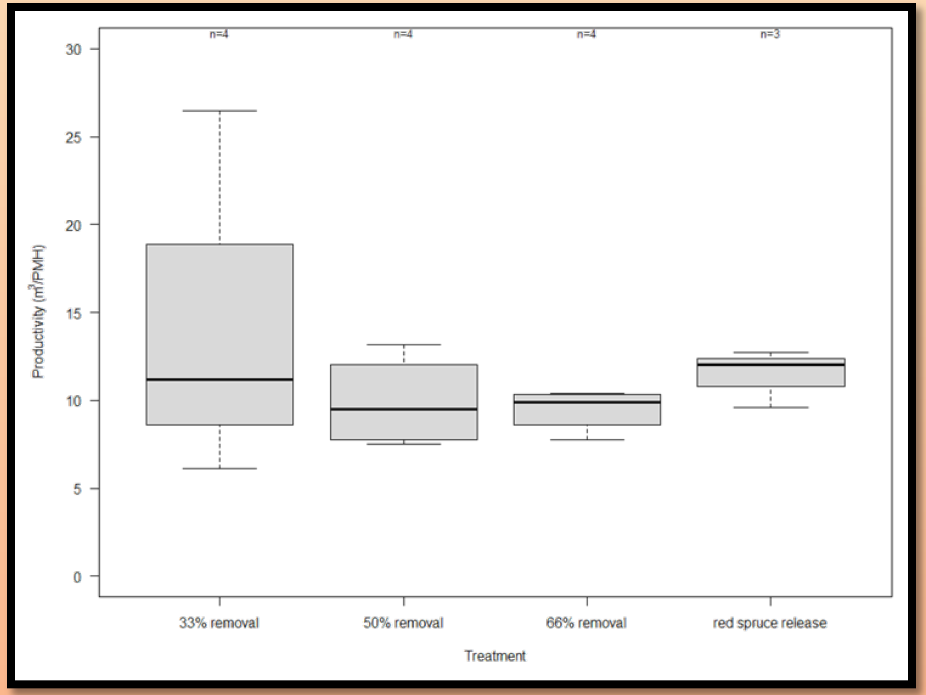


Validation of harvester productivity with data collected at research site. Red line shows estimated harvester productivity based on equations developed by Hiesl (2013). Black dots represent the measured productivity during the harvester time study of this project.

Results/Project Outcomes

Plot	Harvest Time (min)	Volume Removed (m^3)	Productivity (m^3/PMH)
1T	468	58	7.5
2T	395	63	9.6
3T	290	53	11.0
4T	375	50	8.1
7T	370	58	9.4
8T	458	92	12.0
9T	366	77	12.7
10T	117	52	26.5
11T	160	30	11.3
12T	185	34	11.1
15T	313	69	13.1
17T	370	64	10.4
21T	427	44	6.1
23T	356	46	7.8
27T	361	62	10.3

Harvester time consumption and productivity in each harvest block.



Range of harvester productivity with four different treatment intensities.

Results/Project Outcomes

- Harvest site was visited by Plum Creek Timber Co. employees during the harvest.
- Groups of loggers and land managers have visited the harvest site for discussion of small diameter stand management.
- During the harvest an update was given to the Cooperative Forestry Research Unit (CFRU).
- A final report of this project has been submitted to the CFRU.

Post harvest stand conditions of a harvest block cut by the harvester.

Implications and applications in the Northern Forest Region

Harvest productivity literature describes harvest intensity as one factor influencing machine productivity. Our research showed, however, that in a small diameter stand the range of harvester productivity is not different between four treatment intensities. It also shows that a small feller-buncher of the size tested does not have enough power to conduct the operation. For the Northern Forest Region this means that a harvester works well in stands with tree diameter of four inches or above. The productivity is high enough to achieve positive returns.

One truck load of shortwood cut and processed by the Ponsse Ergo harvester.

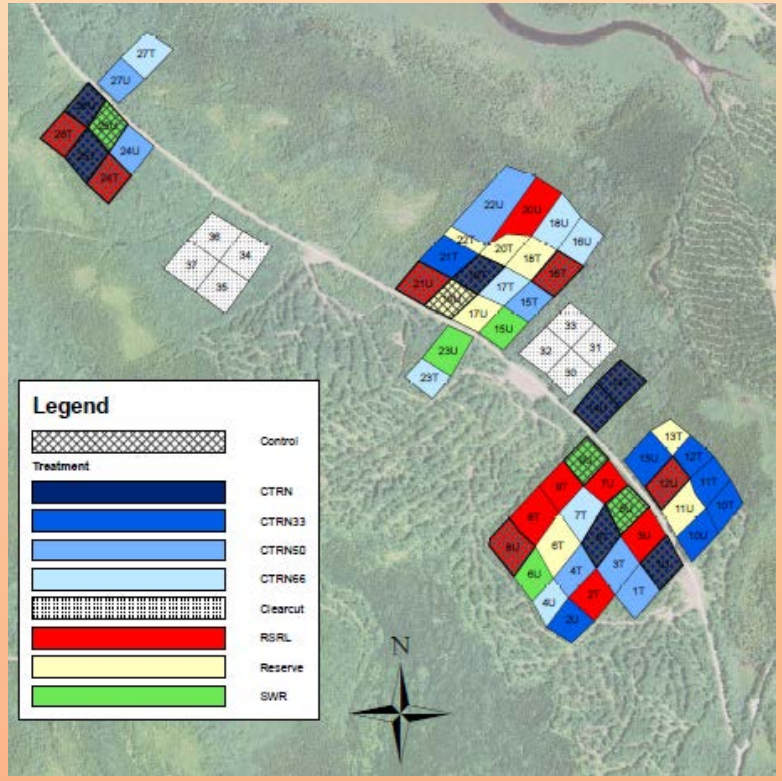
Implications and applications in the Northern Forest Region

The issue of finding suitable logging equipment for non-PCT stands is still uncertain. We know from previous studies that a standard feller-buncher is too large and too expensive, and this study showed that a small feller-buncher is not powerful enough and takes too much time. We still need to find a machine that is cost efficient and productive. Such a machine might be the CAT 501 feller-buncher which will be tested next at the Austin Pond harvest site. This research is important since delaying the management of these small diameter tree stands results in lost tree growth and lost value.

Non-precommercially thinned stand with one trail cut by the feller-buncher.

Future Directions

- Conduct time and motion study on larger feller-buncher such as CAT 501 operating in non-PCT stands.
- Analyze range of costs for harvesting small diameter stands.
- Study new equipment not yet used in the Northern Forest Region



Map of research area, including several different treatment intensities and replicates.

List of Products

Other Publications

Hiesl, P. and Benjamin, J.G. 2014. Harvester and Feller-Buncher Productivity and Cost in Small Diameter Timber Stands in Central Maine, USA (in preparation). In: Proceedings of the 37th Council on Forest Engineering: Global Harvesting Technology. Moline, IL, USA: June 22-25, 2014.

Hiesl, P., Roth, B. and Benjamin, J.G. 2014. Harvester Productivity in a Commercial Thinning with Four Treatment Intensities in west-central Maine, USA (in press). In: Roth, B. ed. Cooperative Forestry Research Unit 2013 Annual Report. Orono, ME, USA: University of Maine.

Hiesl, P. and Benjamin, J.G. 2013. Assessment of feller-buncher and harvester caused stand damage in partial harvests in Maine. In: Proceedings of the 36th Council on Forest Engineering: Forest Operations for a Changing Landscape. Missoula, MT: July 7-10, 2013.

List of Products

Presentations

Hiesl, P., 2013. Productivity Standards for Whole-Tree and Cut-To-Length Harvesting Systems in Maine. Master of Science thesis defense presentation. April 5, 2013. Orono, ME, USA: University of Maine.

Hiesl, P. 2013. Productivity standards for whole-tree and cut-to-length harvesting systems in Maine. Presentation for the College of Natural Sciences, Forestry, and Agriculture Graduate Student Research Award Competition. University of Maine, Orono, ME: February 21, 2013.

Brockmann, D. and Hiesl, P. 2013. Austin Pond Study - Silviculture Progress Report. Cooperative Forestry Research Unit Advisory Committee Meeting. University of Maine, Orono, ME: January 23, 2013