Gentle Logging System Evaluation

(OBSERVERS' REPORT)

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Abstract

Five observers (a forest engineer, a forester, a soils specialist, a logger, a forest landowner, and a sustainable forestry expert) evaluated five modern harvesting systems during a two-day thinning in a productive hardwood stand on a site with a high water table. Operations were conducted in early May, when the soils were wet, near Munising, Michigan.

The observers felt that all five systems adhered closely to the thinning prescription and that damage to the residual stand and disturbance of the soil was minimal. Operator skill seemed to be more important than equipment design in producing acceptable results. Although there will still be times of the year when logging on wet sites is not possible, these newer harvesting systems can be safely operated for more of the year than traditional systems.

Introduction

A significant portion of the northern hardwood forest in Upper Michigan grows on productive sites where seasonally moist soils are subject to damage from mechanized harvesting equipment. Management of these sites is severely limited without a viable harvesting option. Recent advances in harvesting equipment designs have produced machines that may be able to operate on these sites without causing as much damage as traditional systems. This project was designed to evaluate several types of newer harvesting systems on a typical, sensitive site in Upper Michigan.

A forest in north-central Alger County near Munising, Michigan was chosen for the evaluation. The land is managed by Shelter Bay Forests and supports a productive hardwood forest on seasonally moist soils. It was also easily accessible for both equipment and visitors.

The soils on the site are of loamy glacial till origin and are deep and moderately well drained. Typically, these soils have a firm, dense fragipan layer about two feet below the surface that restricts vertical water movement and creates a perched water table in the early spring. Areas near the bottom of slopes and in depressions can stay excessively wet well into the growing season. We chose to conduct our evaluation in early spring, shortly after snowmelt, to ensure that the water table would be high.

The fragipan and perched water table in sites like this forces trees to develop shallow root systems. This leaves the trees vulnerable to windthrow, which in turn produces typical pit and mound microrelief. Although there were few downed trees on the site at the time of our thinning, windthrows in the distant past had left many pits and mounds. The mounds provide drier microsites on their tops while wetter microsites are found in the adjacent pits. Forwarders that pitch around while moving over mounds and into pits often cause injuries high on standing trees where their bunk stakes scrape the bark. This microrelief challenged equipment operators to both avoid disturbing the wetter depressions and avoid injuring residual trees in the stand.

The study forest is dominated by second growth, pole-sized sugar and red maple with black cherry, American beech, and yellow birch associates. There are conifers (eastern hemlock, balsam fir, and white spruce) scattered sparsely throughout the stand. A preliminary inventory showed that: the average basal area was 135 sq. ft., there were an average of 325 trees per acre with an average diameter of 10" DBH, and the average volume was 37 cords per acre.

The first day of this two-day demonstration exhibited the harvesting systems to a broad audience of professionals. On the second day we evaluated the systems in some detail. Three separate reports provide the basis for evaluating the harvest systems:

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- Loggers, foresters, landowners, resource specialists, and others who attended the first day's operations were given a questionnaire and asked to share their impressions. More than 200 of these questionnaires were summarized and discussed in the ***Participant's Questionnaire Report***.
- Forest scientists made a series of measurements in the areas harvested during the second day's operation. Summaries of these data were made to describe the stand before and after harvesting as well as to assess the harvesting equipment itself. Those summaries are presented in the ***Quantitative Measurements Report***.
- A diverse group of observers was selected to watch the systems and interact with the manufacturers and operators during both days of harvesting. A summary of their impressions and conclusions is presented in this report, the ***Observer Report***.

The study forest was divided into ten harvesting areas of roughly equal size – about 2.5 acres each. Five of these areas were used on the first day (May 9, 2001) for visitors to observe the harvesting systems in operation and to allow the operators to become familiar with stand conditions. The remaining areas were harvested on the second day (May 10, 2001). Comments in this report from the observer team are based on observations they made during both days.

Trees to be cut were marked by a crew from the Michigan Department of Natural Resources several weeks prior to harvesting. Trees were painted so that the marks were visible from all sides. An attempt was made to leave a uniformly stocked stand (a basal area of about 80 sq. ft. per acre), but allowances were made for the natural variability throughout the site.

Five harvesting systems were chosen to represent a range of equipment types. A summary of this equipment appears in Table 1. Two systems employed large, tracked, skid-steer harvesters, two employed rubber-tired, articulated harvesters, and one employed a small, tracked, skid-steer harvester. All harvesting was "cut-to-length" but with a variety of booms and harvesting heads. All forwarding was done with either six-tired or eight-tired articulated machinery. All rubber-tired machines were equipped with steel Olofsfors Eco-Tracks over their tandem tires. No forwarding was done in the area harvested by the small "Harvest Systems" machine because the unit scheduled for that area was withdrawn at the last minute. Harvesting systems were randomly assigned to five of the harvesting areas on the first day and to different harvest areas on the second day. The smallest system did not completely cut the first day's harvest area and so remained in that area for the second day.

A team of six observers was assembled to evaluate the harvesting systems based on observations and interactions with equipment operators and manufacturers. This group included people with diverse backgrounds and interests:

- An engineer: Robert Rummer (Project Leader, Forest Operations and Engineering Research Unit, USDA Forest Service, Southern Research Station)
- A forester: Paul Pierce (Timber Management Specialist, Michigan Department of Natural Resources – Paul marked the stand for thinning)
- A soil scientist: Dwight Jerome (Resource Soil Scientist, USDA Natural Resource Conservation Service)
- A logger: Warren Suchovsky (Owner of Suchovsky Logging)
- A landowner: Russel Weisinger (Director of Forestry Operations for Shelter Bay Forests – the landowner)

Table 1. Harvesting system components used for Gentle Logging System Evaluation.

System Description	Manufacturer	Harvester	Forwarder*
Tracked harvester and 6-wheeled forwarder	Timberjack	608s, 25' articulated boom	1010, 6-wheeled
Tracked harvester and 6-wheeled forwarder	Fabtek	FT133, 21' articulated boom	FT346B, 6-wheeled
6-wheeled harvester and 8-wheeled forwarder	Ponsse	Ergo, 33' telescopic boom	Caribou, 8-wheeled
	Valmet	911.1, 32' telescopic boom	840, 8-wheeled
Small, tracked harvester with no forwarding	"Harvest Systems"	Link-Belt LS1600, 21' articulated boom,	NONE

* - all forwarders were equipped with Olofsfors Eco-tracks.

- A sustainable forestry expert: Mark Sherman (Sustainable Forestry Initiative Coordinator for Michigan and Northwest District Procurement Manager for Mead Corporation)

The site was fairly dry for the first day's harvesting but a heavy rain on the evening of May 9, 2001 created the type of wet conditions we had anticipated for the second day. As a result, observers had a chance to witness the systems operating under both dry and wet conditions at this site. Even so, the reader should remember that this evaluation took place at a single site under a unique set of conditions. Results may have been different on another site, with different operators, or at a different time.

I have attempted to group and paraphrase the comments made by the observers into a narrative. Particular points of view may be either overstated or understated as a result. The observers will have a chance to speak for themselves during the videoconference that will conclude the evaluation phase of the project. Observer comments have been grouped into the following general categories to match those used in the Quantitative Measurements Report:

(1) Stand assessment,
(2) Compliance with the harvesting prescription,
(3) Damage to residual trees,
(4) Machine productivity,
(5) Ground disturbance and the extent of rutting, and
(6) General comments.

1. Stand Assessment

Observers felt that this stand was typical of many productive northern hardwood stands of the region. Although it was composed mainly of pole-sized trees, there were areas with sawtimber-size trees as well. Stand density varied from place to place but not to an uncommon extent. Although the ground surface was uneven as a result of old windthrows, there were few downed trees and observers did not feel that this microrelief caused undue disruption of the systems' operations. In general, equipment was able to operate unobstructed throughout the site.

Tree marking on this site was better than average, according to the logger on our team. He pointed out that the paint marks were visible from all sides of the tree and sufficient room was left for equipment to maneuver. These factors combined to make the processor operators' job easier than it might be on other jobs.

Ground conditions were not as wet as might be found on some sites in the region but definitely on the wet end of the spectrum. This was particularly true on the second day of the evaluation, when it became difficult to even walk down the main access road due to a heavy rain during the preceding evening.

2. Compliance With Harvest Prescription

The intensity of cutting varied through the stand as a direct result of natural stand variability but operators were able to adjust well to this. The processors did not cut some larger or heavily branched trees that were marked. In a normal operation these would have been felled by chainsaw, but that was not done here. In fact, felling more of the difficult-to-process trees by hand may reduce site disturbance by eliminating some of the awkward maneuvering of the larger processors.

The small Harvest Systems unit was slower than the larger equipment and unable to handle some of the bigger trees in its area. As a result, it did not complete the thinning in the area where it operated. This result was anticipated because this machine was designed to be small and light, not for maximum productivity.

Most were pleased with the condition of the stand after harvest. Slash was distributed well throughout the site, stumps were cut low, and large undesirable stem parts were scattered throughout the stand rather than concentrated at landings. Differences among system performance seemed to be more with stand conditions and the operators than with the equipment.

We told operators that they could deviate from cutting only marked trees if doing so would reduce the damage to the site. Observers agreed that allowing operators to have flexibility was critical to minimizing site damage. This means that the foresters will need to trust their operators and the operators will need to understand why the stand was marked in a particular way.

3. Damage to Residual Stand

In general, most observers agreed that there was less damage to residual trees in all of the harvest plots here than on the average logging job with which they were acquainted. Operators were skilled with their machines and had a number of techniques to minimize damage to both the residual trees and to the soil.

Very few trees were left leaning or otherwise damaged. One observer commended the operators for cutting smaller whips rather than just driving over them. This improved the appearance of the cut stand. Other observers noticed this practice and were concerned that it reduced the amount of sapling-sized regeneration on the site. We did not inventory advanced regeneration before the cutting and so can't be sure how much was lost on this site. Neither did we issue instructions to the operators to avoid damaging these smaller trees. Had we done so, the result may have been quite different.

Despite the shallow root systems on this site, very few exposed roots were noticed in the harvested areas. Although stem injuries were infrequent, skid-steer machines seemed to produce slightly more lower stem injuries as they turned and the largest forwarders seemed to produce the most high scrape injuries as they pitched over the hummocks. One observer felt that the fixed-head processors had better control over the felling direction of cut trees than the dangle-head machines. This in turn may have reduced limb and top injuries to residuals.

Every logging operation causes some damage to residual trees. Allowing operators to leave an undamaged, marked tree and cut a damaged, unmarked tree instead could promote long-term stand health. Here is the flexibility that was discussed above being suggested as a way to improve the overall quality of the job. As before, it would require an increased level of trust on the part of the forester and an increased level of sophistication on the part of the operator to be successful.

4. Machine Productivity

Productivity of the larger systems was remarkably similar. Expensive systems do not necessarily mean expensive logging when all factors are considered. The small system, despite its low cost, was less productive than the larger, more expensive systems. Its advantages lay elsewhere.

Observers were impressed with the ability of these systems to produce clean material with well-trimmed limbs. Even crooked or heavily limbed stems were handled well by these systems. The potential of cut-to-length systems, like these, to improve high-value product utilization over conventional systems was also mentioned as a factor adding to their productivity.

Maintenance costs, reliability, and repair costs were noted as being critical to the productivity of any harvesting system. They are certainly included when decisions are made to purchase new or used equipment. Observers felt that manufacturers are paying attention to these costs and working to keep them as low as possible. Although not specifically evaluated here, these newer machines provide a range of productivity enhancing features including: excellent lighting for extending operation into the night, higher comfort for the operator for greater alertness and endurance, maintainability improvements (like automated greasing systems) to reduce down-time, and ruggedness of design to extend intervals between major repairs.

Machine productivity is calculated as the ratio of production cost to product value. The definitions of "cost" and "value" are evolving today. New factors must be placed into this simple equation that were never there before. Social and environmental costs and values have not been traditional economic variables in the calculation of machine productivity but are rapidly becoming as important as the price of fuel or labor. The cost to the environment of a badly rutted site or the value to society of an undamaged and healthy forest are concepts that are easy to understand but difficult to quantify. These uncertain new factors may be the ones that direct logging away from the old chainsaw and Iron Mule operations toward these new technologically advanced systems.

5. Extent of Ground Disturbance and Rutting

Although there was significant disturbance around decking areas and on the main access road, the harvest areas had very little disturbance. The turning of equipment, particularly forwarders and skid-steer harvesters, caused most of this. The crawler-type machines tended to scrape-off the tops of hummocks and scuff the areas where they turned. Articulated machines with bogey axles tended to do much less disturbance of this type. Disturbance was minimized most when both the processor and the forwarder drove over the slash created by the processor. This required close coordination between both operators. Systems with longer booms had the advantage of being able to reach more of the stand from fewer access paths, thereby further reducing disturbance.

The sandy texture of the soil here provided a better base of support for the machines than finer-textured soils might have done. This in turn helped minimize compaction and rutting. Compaction and rutting did not appear to be a problem as long as the machines did not make numerous passes over the same spot and stayed away from the wetter areas of the site. When unacceptable rutting was noticed, it was always in areas where these two conditions had not been met. Forwarders caused most of the disturbance and rutting as they shuttled in and out of the stand. Processors, on the other hand, had very little impact. The small Harvest Systems machine left practically no evidence of its passing.

There was disagreement among the observers about the solution to the disturbance caused by the forwarders. One observer felt that smaller machines with only two axles would be better because they would carry less weight and be more maneuverable. Others, however, felt that the larger machines had the advantages of both distributing the load over more wheels and an extended reach with their longer booms. Long booms, as previously stated, reduce the number of trips through the stand. One observer made the point that the largest forwarders were the only ones that could operate on wet clay and organic soils because of their superior floatation.

Figure 1. Olofsfors Tracks.

All of the wheeled machines in this evaluation had Olofsfors tracks on at least one set of bogey axles (Figure 1). These tracks improved floatation but also had the effect of "churning" the surface soil as they passed. This was true of the skid-steer tracked harvesters as well. Chunks of surface soil were picked up in the tracks, carried for a short distance, and then deposited in a new spot as they fell off of the tracks. The effect of this was to expose mineral soil in many places where machinery passed. This was noted as a desirable situation by several observers. By exposing mineral soil, the machinery was providing an improved seed bed for species like birch, basswood, and cherry.

6. General Observations

Observers felt that, although there were still times when harvesting operations should be restricted, these larger systems did provide an effective way to conduct thinnings on sensitive sites like this one. Site and stand impacts were minimal under the conditions of this test. All the systems, with the exception of the smallest processor, worked well in this type of thinning. Despite these favorable impressions, some observers still remain a little uneasy that these machines may be too bulky for jobs like this.

All agreed that successful gentle logging depends on combining the right harvesting prescription, equipment, and operator. Improvements to any one of these three factors will result in an incremental gain but increasing the integration among them can radically reduce site impacts and improve operation productivity. Selecting the right cutting head, wheel or track system, residual basal area, access paths, and operator training are certainly all important but getting the landowner, forester, equipment manufacturer, and logger to work as a single team is far more critical for success.