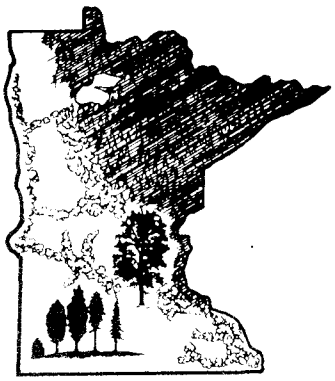

Minnesota Forestry Research Notes

No. 205
July 15, 1969

Full-Tree Harvesting System Aids Forest Management[1/]

Z. A. Zasada and J. C. Tappeiner[2/]

Mechanized timber harvesting systems were designed for efficient timber extraction, and their use in improving forest management practices is currently under study at the University of Minnesota's Cloquet Forest Research Center. A study of the full-tree harvesting system in a 40 acre tract of quaking aspen (Populus tremuloides Michx.) indicated that this system can accomplish the site preparation necessary for conversion to red pine by planting.

Study Area

The study was located in northern Itasca County in 40 acres of high site (site index 80) 48-year old aspen. The stand had 250 merchantable trees per acre, consisting of 25 cords of aspen and one cord each of balsam fir and paper birch per acre. The merchantable trees ranged from 6-12 inches in diameter. Advanced reproduction in the understory occurred on about 40% of the area. It consisted of about 450 trees per acre (1-5 inches dbh) of which 55% were balsam fir, 35% paper birch and 10% maple, elm or basswood. Also, there was a light understory of hazel and dogwood shrubs, 1-5 feet high, averaging about 4000 stems per acre. Soils of the Taylor silty clay loam and Warba fine sandy loam each occurred on about half the area.

Study Methods

Before and after logging, conditions of the overstory and understory were estimated on 146 randomly located mil-acre plots. Disturbance to the soil and amount of slash was estimated on randomly located line intercepts. Careful observations were made during the harvesting operation to determine how the machines were being used, the pattern of skidding, average size of the load, and problems of skidding loads of entire trees.

1/ In the Full-Tree Harvesting System a minimum of work is done at the stump, usually only felling the tree. The unlimbed or full-tree is forwarded from the stump to the roadside or landing for limbing and bucking into logs.

2/ Research Associate and Assistant Professor, respectively, Cloquet Forest Research Center, School of Forestry, University of Minnesota.

Published by the School of Forestry, University of Minnesota, St. Paul, Minnesota 55101, cooperating with the Division of Forestry, Minnesota Conservation Department, and Forest Industries of Minnesota

Figure 1. Skidding full trees into limbing landing. Load at top is being delimbed by 2 man limbing and topping crew. Slash from limbs and tops are concentrated in pile to right of skidders.

Logging Operation

This was a summer operation to test the feasibility of producing aspen pulp chips in the woods with a Mor-Bark Chipharvester Machine.

The fellers and skidders were told not to favor any of the residual trees or advanced reproduction in their work. Where trees interferred with the work, they could be removed or otherwise destroyed.

Cutters were required only to fell trees. All trees were felled in one direction. About 750 cords were felled manually and 200 cords with a tree-shear mounted on the front of a rubber-tire skidder.

Four skidders were used in this operation. Each skidder was equipped with six chokers. The usual load was five or six trees. The skidder operators indicated no difference in loads or speed in comparing full tree and tree length skidding. The full volume of the 40 acres was skidded to one chipping site, and all topping was done at the one site. Maximum skidding distance was about 1500 feet. Two main haul skid trails were made on the logged area with a bulldozer. The skidding was from the stump to a limbing and topping area and then to the chipper.

The limbing-topping area was about 250 feet from the machine and located on a slight slope so that slash could easily be pushed into a pile. The skidders cleared the site on their return trip to the woods after slash from four or five loads had accumulated. A two man crew limbed for four skidders and was not fully occupied.

The Mor-Bark Chipharvester debarked the tree length log and converted it to chips. Truck vans hauled chips to the mill. The bark was kept clear of the machine by the skidders. Occasionally a crawler tractor available on the site was used to push away the bark. Skidding and chipping production was approximately 90 cords per eight hour day barring breakdowns.

Figure 2. Aspen area after harvesting by the full-tree system. Ninety-four percent of the area was slash-free. Mineral soil was exposed on 29% of the area.

The Residual Stand

The residual stand was largely eliminated during the operation because the cutters and skidder operators were told not to favor non-merchantable trees or advanced reproduction. About 85% of these trees were eliminated on the area where chain saw felling was used; 95% were removed from the tree-shear felling area. The removal of the additional trees was required to maneuver the tree-shear to merchantable aspen. Approximately 90% of the understory shrubs were damaged or uprooted.

Ground Disturbance

Mineral soil was exposed on 29% of the area, with 1/3 of this (or 10% of the whole area) heavily disturbed by deep rutting from the skidders. About 32% of the area was lightly disturbed with the shrubs broken or uprooted, but no mineral soil was exposed. The remaining 39% was not disturbed by logging.

Slash Conditions

Approximately 94% of the area was slash-free after logging. At the limbing and topping site slash was concentrated in three piles which together occupied 1 1/4 acres and which could easily be burned. Peeled bark made a pile three feet high over 1/3 acre. The light slash on the remaining area consisted of debris on the ground before logging and non-merchantable trees which were knocked down during or windthrown after logging.

Silvicultural Interpretation

The harvesting of this stand met most of the conditions recommended for good aspen management. The overstory was removed from most of the area and, therefore, will not interfere with aspen sprouting. Since few residual trees remain, the next stand will be nearly pure aspen, ideal for future highly mechanized logging. About 15% of the area had a partial overstory of non-merchantable trees. This overstory will have little effect on the establishment of aspen sprouting. However, where present, it may reduce the yield of aspen and hinder efficient future mechanized logging.

Past research indicates that understory shrubs retard the establishment of aspen suckers, particularly following summer logging (1). Full-tree skidding on this operation damaged or uprooted 90% of the hazel and dogwood stems and thereby favored aspen sprouting.

Full-tree timber harvesting may permit a cost reduction in the conversion of aspen lands to conifers. Complete clear cutting with full-tree skidding can leave an area essentially free of slash and shrub vegetation and ready for conversion planting. In this case 85% of the area was free of overstory and 90% of the brush cover was broken down or uprooted. Foresters experienced in conversion planting examined this area and concluded that it could be hand planted without further site preparation and future brush competition could be sprayed. If so, the following savings may be possible:

Present Practice		Full-Tree Harvesting	
Site preparation by shearing and windrowing	$35.00 per acre	Site preparation - part of logging job-cost	none
Machine planting	$15.00	Hand planting	$30.00 per acre
Release by spraying 2nd season	$ 5.00	Release by spraying 2nd season	$ 5.00
Cost of stock	$25.00	Cost of stock	$25.00
Total	$80.00 per acre	Total	$60.00 per acre

Other possible advantages of full-tree harvesting over shearing:

A. Site preparation by shearing and windrowing leaves 10-15% of the area occupied by windrows of slash and debris and not plantable. Full-tree harvesting left only 3-6% of the area not plantable.

B. In shearing and windrowing operations, the humus layer is usually removed from the entire planted area, but with full-tree harvesting only about 1/3 of the area had the humus layer removed.

The main implications of this study are:

(1) Aspen management can be aided by mechanized full-tree harvesting because this system results in removal of nearly all over and understory vegetation, a condition which favors the establishment of pure, full-stocked stands of aspen.

(2) The full-tree harvesting system will allow the site preparation necessary for the conversion of aspen stands to conifers to be done during harvesting without affecting harvesting production and with considerable savings in cost of regeneration.

---

(1) Zengraff, P. J. 1946. Season of Cutting Affects Aspen Resprouting. Technical Note No. 250. Lake States Forest Experiment Station. 1 pp. mimeo.

Published as Sci. Jour. Ser. Paper No. 6986 of the Univ. of Minn. Agr. Expt. Sta.