1043 Thinning in an Ozark Forest, MO

Thinning in an Ozark Forest Wayne County, Missouri
Case study based on work by Peter Becker, Research Coordinator, Eastern Ozarks Forestry Council, Jason Jensen, Resource Forester, Missouri Department of Conservation, and Dennis Meinert, Soil Scientist, Missouri Department of Natural Resources.

Project ID: 1043

1. Name - Thinning in an Ozark Forest

Context | Objectives | Treatment Specifics | Utilization | Targets | Pre Treatment Data | Post Treatment Data | Links   This study focused on crop tree management, which leaves the best trees and opens their crowns so they can grow better, instead the more common, but detrimental practice of highgrading. Crop tree management requires removal of pole-sized trees, which currently have little commercial value. The markets for this material is as pulp wood, however the viability of this market is limited by transportation costs and low mill density. One way to make crop tree management economically feasible is to subsidize pole wood harvests with sawtimber removal. This combination produces imediate income for the landowner, reduces the number of stand entries, and ensures complete stand treatment. Due to the presence of red oak borer and the general poor health of the red oaks, the availability of suitable leave trees was quite low, and substantially larger amounts of timber were removed. The crowns of nearly all leave trees were opened on four sides, and the resulting stand resembled a shelterwood cut. A decision on whether to continue crop tree management or complete the shelterwood cut will be made on the next entry in 15 years.

Ponsse 1998 Buffalo eight-wheel forwarder

This study compares this conventional operation with (i) chainsaw felling and extraction by skidder was compared with (ii) hotsaw (feller-buncher) felling with mini-crawler extraction and (iii) harvester felling and forwarder extraction.examines the possibility of using a mechanized harvesting approach instead. The larger payload and longer reach of a forwarder compared with a skidder means fewer trips from woods to deck, and thus increased efficiency and decreased rutting and soil compaction. Mechanized (feller-buncher) harvesting has one-third the injury rate of chainsaw felling, which makes it attractive from the standpoint of operator safety and reduced insurance rates. The authors note that the attitude, skills, and performance of the person operating logging equipment, and not the equipment, are the primary determinants of “good” versus “bad” logging. In the hands of exceptionally skilled operators, all of the logging technologies tested proved capable of thinning Ozark forests satisfactorily so the selection of an appropriate system boils down to issues of productivity, economics, safety, and environmental impact.

The study site was a 70-year old, overstocked upland oak forest in Coldwater Conservation Area in southeastern Missouri. The stand was dominated by black oak,white oak, post oak, hickory species,and shortleaf pine. The red oak species had been stressed by a three-year drought, and stems with oak borer and decay fungi were evident, with some mortality. The slopes of the study site ranged from 3 to 60%, with an average slope of 30%. The topsoil was 3 to 6 inches deep, and soils were moderately to well drained.

A crop tree management system was applied by marking leave trees selected on the basis of expected longevity, quality, overall health, and potential for growth response. Due to the declining condition of the red oak species, shortleaf pine and white oak species were favored in all plots. The authors strongly recommend marking leave trees, rather than allowing the operator to decide what trees to harvest, especially for mechanized harvesting.

Three logging technologies were used on the site: (i) Husqvarna 372XP chainsaws and a 1977 John Deere 540B grapple skidder (18,100 operation hours), (ii) 2004 ASV Posi-Track RC-100 mini-crawler (tracked skid steer; 100 hours), 1999 Davco QC1200 hotsaw (feller-buncher; 1,500 hours), and Implemax Pro grapple 4836LW, and (iii) Ponsee 2001 Ergo six-wheel, cut-to-length harvester (4,000 operation hours) with 2002 H73501 head (2,000 hours) able to handle stem diameters up to 27 inches and a Ponsse 1998 Buffalo eight-wheel forwarder (10,000 hours) with K75 crane and 15-ton capacity. Both the harvester and forwarder operated with tracks during most of the trial due to wet conditions.

ASV Posi-Track RC-100 mini-crawler

Comparable volumes of timber were harvested by the different technologies. Although saw logs are larger than poles and thus should require less handling to make up the same volume, the relative volume of saw logs was not obviously associated with production rates for any operation or technology. The crawler/hotsaw was not cost effective, while the harvester/forwarder was at least as cost effective as the conventional chainsaw/skidder technology. The high productivity and utilization of the harvester/forwarder compensated for its high capital cost. The harvester/forwarder required the least time, and the crawler/hotsaw the most time for all operations, and this was reflected in the corresponding production rates (Figure 1).

Figure 1. Total productive machine time and volume of timber harvested per acre for chainsaw/skidder (Conventional), crawler/hotsaw (ASV+Davco), and harvester/forwarder (Ponsse) technologies. Production time would be reduced by simultaneous operations. cbf = 100 board feet.

The crawler/hotsaw was the only logging technology for which production cost exceeded revenue (Figure 2). The operators in this system were very experienced and motivated so its relatively low productivity likely reflects real limitations of the equipment operating in saw log-sized hardwood stands. Production rates for harvesting and extraction increased over time for the harvester/forwarder. This was because the harvester head did not operate properly until servicing was completed when the second plot was started. The harvester operator also gradually became accustomed to cutting timber harder than previously experienced, and the hauling service became better synchronized with the forwarder operations. Average total machine production costs per ton did not differ significantly between chainsaw/skidder and harvester/forwarder. However, results from the final plot are likely more representative of harvester/forwarder capability, and the lowest production cost of this technology was 14% less than that for chainsaw/skidder. It should be noted that the productivity, cost, and revenue estimates based on the results of this study are only crudely indicative of the logging technologies tested.

Figure 2. Machine production cost of operations for chainsaw/skidder (Conventional), crawler/hotsaw (ASV+Davco), and harvester/forwarder (Ponsse) technologies. The dashed line shows the overall revenue ($32/t) from timber harvested in the study.

Industry observers readily acknowledged the high productivity of the harvester/forwarder, but presumed that its high capital cost would make it cost ineffective, even for commercial logging operations not involving pole wood removal. However mechanized equipment was able to operate during riany conditions without rutting, had a higher utilization rate, and the repair and maintenance costs of the mechanized equipment are relatively low. Total hourly costs of the harvester and forwarder could be further reduced by working multiple shifts, which is not a safe option for the other equipment.

The harvest removed an average of 40 tons of pole wood per acre. Grade oak saw logs sold for $451-511 per thousand board feet (MBF), non-grade oak for $250-262 per MBF, oak pole wood for $25 per ton delivered, and pine pole wood for $15 per ton during the period from October 2004 to January 2005. Revenue for oak pole wood was net of transportation charges of $250 per load (about 25 tons).

Impacts

Biologically and economically significant damage to the boles of residual trees was low and comparable among technologies, as were soil disturbance and compaction. Crown damage was significantly greater for the harvester/forwarder, but still acceptable. Following harvest, tree density was reduced to 6-17%, and saw log volume to 43-56% of initial values by the three treatments. Unmarked trees that should have been felled accounted for 2% of the leave trees in chainsaw/skidder plots, 7% in crawler/hotsaw, and 13% in harvester/forwarder. As intended, the percentage of pine and white oak and the size of trees in the residual stands were increased relative to pre-harvest conditions.

Differences in exposed soil among logging technologies in the study were not significant, but the crawler/hotsaw exposed relatively more soil than the other technologies. Soil compaction sufficient to impede rooting was rare because the heavy equipment travelled over felled tree tops.

Working pulpwood with conventional equipment is always going to be somewhat inefficient and costly. Directional felling with chainsaws in hardwood was challenging but worked well with the spacing of leave trees in this crop tree management system. Skidding with the grapple helped with sorting before the wood hit the yard, allowing the knuckleboom loader to operate more efficiently." Joe Glenn, logging contractor.

Links

- Thinning study page—Eastern Ozarks Forestry Council
- Conventional and Mechanized Logging Compared for Ozark Hardwood Forest Thinning: Productivity, Economics, and Environmental Impact - The full version of this case study published in the Northern Journal of Applied Forestry

- Missouri's Biomass Harvesting Guidelines

2Land Ownership

State

3Location

Coldwater Conservation Area, MO

4Forest Type

Ozarks Oak-Hickory
Context 5Is this project a part of a landscape plan?
No
6In a Wildland Urban Interface (WUI)?
No
7Acreage treated
36 ac
8Type of contract
Contract
9Funding source
Missouri Department of Conservation and the Eastern Ozarks Forestry Council
10Collaborators and partners
Missouri Department of Conservation, Eastern Ozarks Forestry Council, DNR Soil & Water Conservation Program 11Project start date
2004
12Project completion date
2005 Treatment Goals 13Restoration, watershed or habitat improvement

14

15

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17Forest Stand Improvement

Treatment Specifics 18Primary treatment objective
Research; Crop tree thinning
19How does biomass removal fit with other objectives?
Well. Must remove small diameter trees
20Treatment description
Crop tree management - low thinning 21Description of contractors
Local loggers 22Travel distance for contractors

23Type of equipment used
(i) Husqvarna 372XP chainsaws and John Deere 540B grapple skidder,
(ii) ASV Posi-Track RC-100 mini-crawler, Davco QC1200 hotsaw feller-buncher, and Implemax Pro grapple 4836LW,
(iii) Ponsee Ergo six-wheel, cut-to-length harvester with H73501 head, and a Ponsse Buffalo eight-wheel forwarder.
24Treatment of residual slash if any

25Treatment cost per acre

26Trucking costs
$250 per load (about $10/ton)
Utilization 27Products from project
sawtimber, pole wood
28Price for products
oak sawtimber $451-511/mbf, non-grade oak $250-262/mbf, oak pole wood for $25/t delivered, and pine pole wood for $15/t delivered 29Date of Sale
Fall 2004 to winter 2005
30Did biomass markets exist previous to project?
Yes
31Type of utilization

32How well did the woody biomass match the utilization options?

33Distance to utilization

Treatment guidelines, targets, limitations 34Diameter limit

35Basal area reduction
Basal area was reduced to 29–47%
36Crown coverage

37Fuel loading

38Retention guidelines

39Treatment of snags and downed logs

40Soil impacts
Mineral soil was exposed on 13 to 45% of plot areas. Biologically significant soil compaction during timber extraction generally did not occur.
41Other ecological impacts monitored

Pre Treatment 42Fuel load

43Stem density (stems/ac)
480 to 680
44Basal area (ft2/ac)
111 to 117
45Canopy closure (%)

46Height to live crown base

47Snags and downed woody material

48Size class distribution
Quadratic Mean Diamter 5.6 to 7"
49Tree species composition
Black oak,white oak, post oak, hickory species,and shortleaf pine
50Presence/absence of invasive species

51Soil and other ecological data

Post Treatment 52Fuel load

53Stem density (stems/ac)
39 to 73
54Basal area (ft2/ac)
32 to 52 55Canopy closure (%)

56Height to live crown base

57Snags and downed woody material

58Size class distribution
Quadratic Mean Diamter 11.4 to 13.5"
59Tree species composition
Increase of pine and white oak, as intended
60Presence/absence of invasive species

61Soil and other ecological data