

HARVESTING COSTS AND ENVIRONMENTAL IMPACTS ASSOCIATED WITH SKYLINE YARDING SHELTERWOOD HARVESTS AND THINNING IN APPALACHIAN HARDWOODS¹

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ABSTRACT: To evaluate the potential for moderating the visual impact and soil disturbance associated with timber harvesting on steep-slope hardwood sites, thinning and shelterwood harvests were conducted with a skyline yarding system. Operations were monitored to document harvesting production, residual stand damage, soil disturbance, and visual quality. Yarding costs for thinning, removing 1,310 ft³/acre, were 30 percent higher than those for the conventional shelterwood (2,060 ft³/acre), and 33 percent higher than those for the irregular shelterwood (2,290 ft³/acre). Ninety percent of the harvested area on all sites showed little or no soil disturbance. On the two shelterwood units, 28 percent of residual trees were heavily damaged or destroyed compared with 6 percent on the thinning unit. A case study and aerial photos provide information that can help forest managers plan harvesting operations on environmentally or aesthetically sensitive sites.

INTRODUCTION

The controversy over clearcutting has caused managers of public lands to implement alternative silvicultural practices such as shelterwood harvests and thinnings, leaving residual trees to improve the visual quality of harvested areas. Although skyline yarding often is used on National Forests in the southern Appalachians to minimize soil disturbance, this technology generally is applied on clearcut units. To evaluate applications of cable-yarding technology to shelterwood harvests and thinnings on steep-slope hardwood sites, a case study was conducted on the Nantahala National Forest near Franklin, North Carolina.

METHODS AND RESULTS

Three harvest units were located in the yellow-poplar, white oak, and red oak forest type (site index of 80 for red oak and slopes of 30 to 50 percent). The silvicultural treatments included conventional shelterwood (removing 68 percent of the basal area and 2,060 ft³/acre); an irregular shelterwood to implement two-age management (removing 84 percent of the basal area and 2,290 ft³/acre); and thinning from above (removing 40 percent of the basal area and 1,310 ft³/acre). Units averaged 7.0 acres with maximum yarding distances of 550 to 990 feet. One-fifth-acre plots were installed to sample residual stand damage after felling and after yarding. Soil disturbance was sampled at intervals of 5 feet along random azimuth transects. Aerial photographs were taken before and after harvesting. A time and motion study of yarder operations recorded turn attributes, cycle times, delay time, and delay cause. The shop-built yarder was rigged with a 30-foot tower and gravity outhaul carriage.

Damage to residual trees in thinning was comparable to that reported for harvesting partial cuts in hardwoods with skidders (Lamson and others 1985) or a cable yarder (Fairweather 1991). Less than 6 percent of trees ≥ 7.5 inches in d.b.h were destroyed or received major damage (bark wounds ≥ 100 inch²). Twenty-eight percent of residual

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trees in the shelterwood units were destroyed or received major damage, similar to the damage reported for skyline yarding shelterwood harvests in western softwoods (Benson and Gonsior 1981). Most of the destroyed trees were bent or broken during felling operations. Bark wounds generally were caused by yarding and most often occurred along yarding corridors. On-site observations and results of other studies indicate that the stand damage in the shelterwood units could have been reduced by directional felling, more careful yarding, harvesting during the dormant season, and use of alternative skyline carriages. The percentage of harvest area by soil-disturbance class (Dyrness 1965) was similar on all three sites; 6 percent of the area was deeply disturbed (surface soil removed and subsoil exposed), and 4 percent was deeply disturbed and compacted. This is less disturbance than was reported for ground-based systems (Dyrness 1965; Hatchell and others 1970), and much less than reported for mechanized whole-tree harvesting (Martin 1988). Most of the deep disturbance and compaction occurred in the yarding corridors, where observation indicated that rigging the skyline for greater lift could further reduce soil disturbance.

Yarding costs per 100 ft³ removed for each treatment were \$9.72 for the conventional shelterwood, \$9.54 for the irregular shelterwood, and \$12.65 for the thinning. The differences reflect the larger turn volumes and higher machine utilization rates on the shelterwood units, and a small increase in yarding delays on the thinning unit. The shelterwood cuts were readily visible on the photos. However, there was much less contrast between the cut stand and the adjacent uncut areas than would result from clearcutting. The thinning unit could not readily be distinguished from the adjacent uncut stand.

SUMMARY

The results of this and other case studies indicate that thinning and shelterwood harvests can be conducted economically and environmental impacts of harvesting hardwoods on steep slopes can be moderated with skyline yarding. The successful application of these harvesting and silvicultural systems demands intensive planning and effective control of harvesting operations. To efficiently harvest timber and effectively protect the environment requires timber sale layout and contract administration skills, and a well-trained logging crew. When timber sales are required to yield a positive cash flow, the additional planning and operational costs could potentially limit low-impact harvesting to high-volume and/or high-value timber stands.

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