A Second Look At Cable Logging In The Appalachians

Figure 1. Steam-powered cable system logging hardwoods in West Virginia—the type of system used extensively in early 1900's.

Harry G. Gibson and Cleveland J. Biller

ABSTRACT—Cable logging, once used extensively in the Appalachians, is being re-examined to see if smaller, more mobile systems can help solve some of the timber-management problems on steep slopes. A small Austrian skyline was tested in West Virginia to determine its feasibility for harvesting eastern hardwoods. The short-term test included both selection and clearcut harvesting. Both yarding costs and environmental effects were analyzed.

Around the turn of the century, cable logging was used extensively in the East, along with the logging railroad (*Figure 1.*) As cheaper equipment became available, especially the diesel tractor and the heavy-duty truck, cable logging slowly passed out of the scene. By the 1950's, it was a rarity, but now loggers are taking a second look at cable logging. One reason is concern about damage done to the land resources by logging. Cable logging promises to do less damage than systems that require heavy tractors and a network of logging roads.

Our forest-engineering research unit has been testing a small European skyline cable yarding system in the forested steep mountainous areas of West Virginia. (Yarding here is defined as moving logs from stump to landing by an overhead cable system.) These first tests show that this kind of logging may be beneficial to the environment and the logger.

Why Cable Logging?

Logging by overhead cable systems generally requires fewer miles of road per unit area. The numerous skidroads that tractor logging requires on steep slopes would be reduced, thus removing a major source of stream sedimentation (*3,4*). Also, skidroads are a very visible disturbance on steep slopes, and if cable logging could replace conventional tractor systems, the appearance of the land after logging would be improved. In short, cable logging would have less temporary and permanent detrimental impacts on the forest environment.

Cable logging is not considered a cure-all for Appalachian harvesting and forest management. Best suited for steep slopes, it may be the only way to harvest (and thus manage) timber on some sites. In this respect, it seems to fit Appalachia quite well. Even in this rugged area, however, there are ridge tops, flats, and mild slopes that are not suited for cable. Here the conventional tractor system would complement the cable system.

Cable systems require advance planning. The terrain must be evaluated to determine whether cable machines should be used. Then the few haul roads required must be situated for the most efficient operation of the equipment. The location for each set-up of the equipment (called "sets") must be determined before moving the equipment from its prior set. Waiting until the last minute usually results in a poor location of the yarder.

Setting up, operating, and moving the cable machinery require a properly trained and motivated crew, one that is willing to work a cable system to its fullest. This is an extremely important factor. Supervision and management are important, too. These skills were plentiful in Appalachia at the turn of the century, but

Figure 2. URUS 1000-3 yarder mounted on Mercedes-Benz Unimog truck as tested in this study.

were lost as the old cable systems were phased out. Successful introduction of modern cable systems, we found, hinges on relearning these lost skills.

Goals and Equipment Tested

The size of Appalachian timber has changed drastically since the turn of the century. Second- and third-growth timber has replaced the virgin stands of the earlier period. The timber tracts are smaller; and, for the most part, the logging companies are smaller and have less capital to invest in equipment. Therefore, cable equipment does not need to be so large.

With these changes in mind, we selected a small yarder built in Austria for tests with three objectives—to determine: Whether this size machine was suitable for harvesting present-day Appalachian timber and at what approximate cost; whether this cable system could harvest selectively marked hardwood trees without excessive damage to the residual stand; and the degree of environmental impact when this type of logging system was used.

The skyline cable system tested was manufactured in Austria by the Reinhold Hinteregger Company.[1] It is mounted on a four-wheel-drive, heavy-duty truck unit (*Figure 2*). The skyline unit is the URUS Model 1000-3; the carriage used was the Gravimat automatic clamping unit.

This system is basically a modified shotgun system as defined by Studier and Binkley (*5*). In uphill yarding, the carriage returns downslope by gravity as a standard shotgun system does; but the carriage clamps to the skyline, and the skyline is fixed (not lowered or raised) during yarding. Although provisions are made

Table 1. URUS 1000-3 specifications.

Item	Specification
Drum storage capacity:	
Skyline drum	1,100 ft of 7/8-inch line (335 m of 22 mm)
Haulback line drum	2,100 ft of 1/2-inch line (640 m of 12 mm)
Mainline drum	1,100 ft of 1/2-inch line (335 m of 12 mm)
Strawline drum	2,100 ft of 7/32-inch line (640 m of 5.2 mm)
Standard tower height	28 ft (8.7 m)
Carriage capacity	2.75 tons (2.5 metric tons)
Total weight of yarder	14,630 lb (with Unimog truck) (6,650 Kg)
Power available:	
Mercedes-Benz Unimog four-wheel-drive	100 hp gross (80 hp DIN)

for downhill yarding, it has not been tested. The carriage has no mechanical slack-pulling (mainline feed-out to choker setters) capability other than gravity feed.

The yarder holds 1,100 feet of ⅞-inch skyline, permitting a reach of about 1,000 feet. Besides the skyline winch drum, three other drums are provided—one for the mainline, one for the strawline, and a rehaul line drum. (Specifications are given in *Table 1*.) The tower height of 28 feet can be augmented on convex slopes by the use of an intermediate support or shoe, which holds the skyline above high portions of ground. This is especially advantageous when used near the yarder (*Figure 3*) when the slope is not ideally concave.

The Test

The test area was on the Fernow Experimental Forest near Parsons, West Virginia, next to the

[1]*Mention of a particular brand name or product is for information only and does not imply endorsement by the U.S. Department of Agriculture or the Forest Service.*

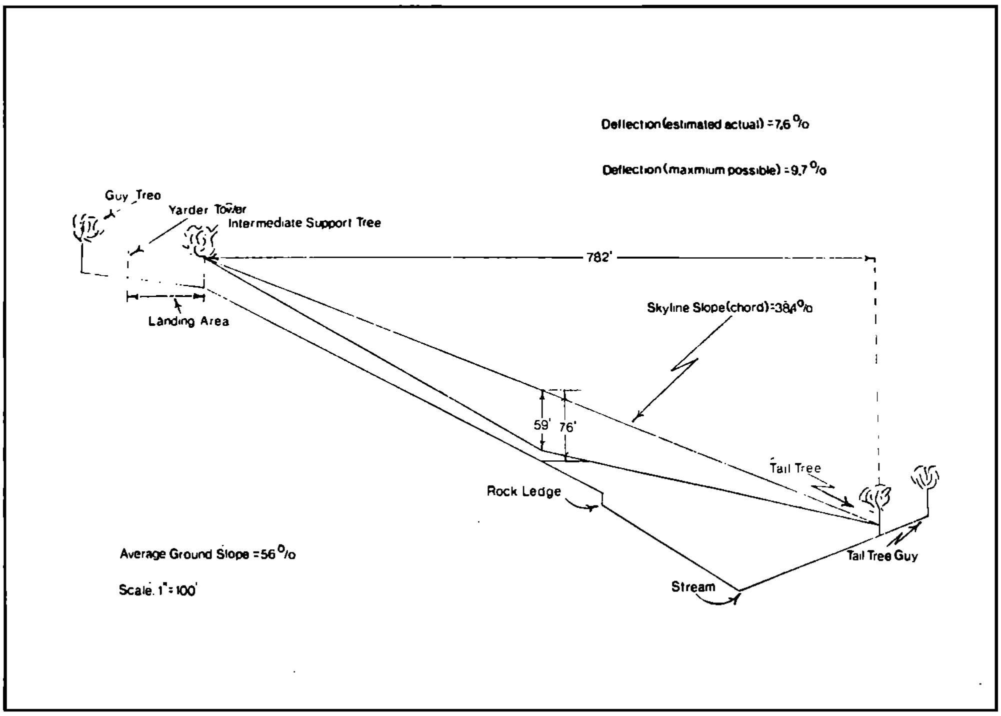

Figure 3. Sketch of one set-up of skyline on Fernow Experimental Forest.

Monongahela National Forest. The terrain is considered typical of the Appalachians (*Figure 4.*).

An 8.5-acre study area with slopes averaging 48 percent (with segments exceeding 60 percent) was chosen for the skyline operation. Selection harvesting was established for 4.4 acres, and clearcutting for 4.1 acres. This area included a rock outcropping two-thirds of the way down the slope with a stream at the bottom of the slope. The harvesting area extended across the stream, requiring logs to be yarded across the stream. One of the yarding sets is depicted in *Figure 3*.

The crew consisted of two choker setters, one yarder operator, and one chaser (who unhooked logs at the landing). Rigging was done by members of the logging crew. The crew was experienced in logging but had not worked on a skyline before.Therefore, it was oriented to the equipment and operations with photographic slides and video tape in a classroom. After the classroom session, the crew set up the yarder and skyline for dry-run training on a cleared area where they could see both ends (yarder and choker setting) of the opera-

Figure 4. Forested terrain in West Virginia, which is considered typical of Appalachian mountains.

THE AUTHORS—Harry G. Gibson and Cleveland J. Biller are research mechanical engineers, USDA Forest Service, Northeastern Forest Experiment Station, Forestry Sciences Laboratory, Morgantown, West Virginia.

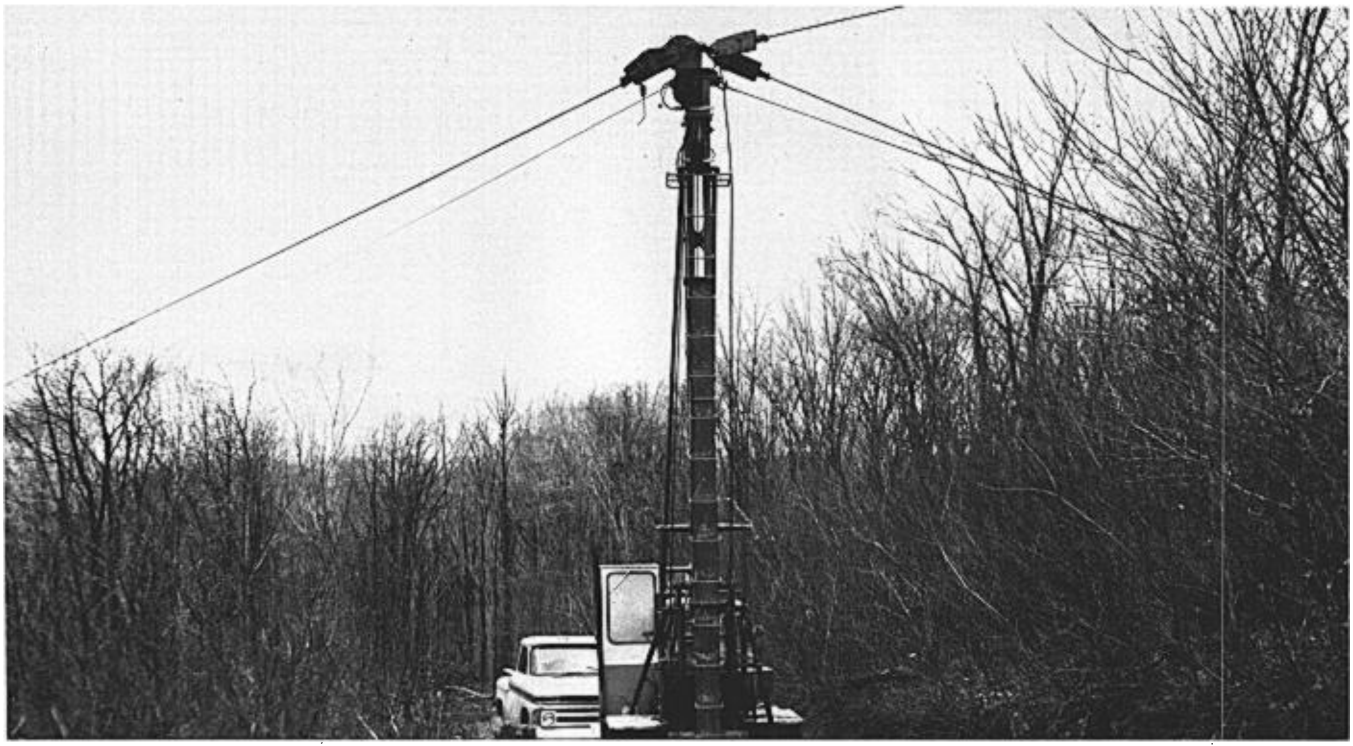

Figure 5. Yarder located on narrow road. Cables running to the right are guys. Large cable running to left is the skyline, and the smaller cable is the mainline. Logs were dropped below a second road 30 feet down the hill to the left.

tion. Actual logging started only after the crew had become familiar with the equipment (*Figure 5*).

Production Procedures

The clearcut area was logged first because we felt that this would be the easiest and safest place for the crew to begin. Logs were yarded random long length (down to 4 inches at the top diameter outside bark). Choker setting, yarding, and unhooking were timed, while the number of logs yarded per cycle and their volume were recorded. Three skyline sets of 803,768 and 692 feet were required. Only two complete yarder set-ups were needed because the skyline and yarder were rotated about 27 degrees for the second set.

Damage to residual trees in the selection area was marked to separate yarding damage from felling damage.

The logging site consisted of medium-to high-quality hardwood sawtimber. Average dbh was 16 inches; average tree volume, 285 board feet by ¼-inch International rule. A typical acre had a little over 20,000 board feet, predominantly yellow-poplar, hard maple, beech, and red oak. The oak site index was 80.

On the selection area, the stand was marked on a 4-percent financial maturity as outlined by Trimble et al. (6) (*Table 2*). Cutting included the removal of near culls, trees with significant butt rot, vigor-four trees, and short-lived species such as black locust, sassafras, and butternut.

Table 2. Minimum size of trees marked on the selectively cut area, by species.

Species	Minimum dbh (inches)
Yellow-poplar	20
Beech	20
Black cherry	22
Red maple	22
White ash	22
Sugar maple	22
Red oak	22
Basswood	20

Outcomes and Significance

Because only 8.5 acres were logged, the results must be considered as indicators. Nevertheless, short-term tests did establish a number of facts: First, this size of skyline equipment is capable of yarding hardwood logs of up to 30 inches butt diameter if the larger tree lengths are bucked. Second, this system can reach out to 700 to 800 feet in both clearcuts and selection cuts. Third, residual tree damage in selection cutting was not excessive.

Yarding costs (not including felling, loading, trucking, or moving logs out from under the skyline) were $13.48 per thousand board feet for an 800-foot clearcut set. This cost incorporates set-up and dismantle times, equipment, and labor. Of course, it would vary depending on terrain, crew, set distance, volume per acre, average volume per tree, and many other variables from one logging site to another.

The production cycle was slowed somewhat by having a crawler tractor pulling the logs out from under the skyline at the yarder. Delays occurred periodically at that point. Eliminating such delays is important to the success of any skyline system.

Yarding costs were lower in the selection cutting operation: $8.64 per thousand board feet. We believe that selection cutting costs would be higher than for clearcut yarding in most cases. Costs were lower, in this case, because: (1) on the selection area, the trees were marked on a financial maturity basis so that only larger trees were removed; (2) the short-term test may have resulted in an anomaly that could not be duplicated over long-term logging. We do believe that choker setting is easier in selection cuts because there is less slash to impede this operation (*Figure 6*).

On the selectively cut area, 40 residual trees or about 9 per acre received some kind of injury from yarding. Twenty-three percent of the injuries were in class 1 (bark abrasion) (*2, 1*); 60 percent were in class 2 (bark skinned off); 12 percent were in class 4 (broken stems); and 5 percent were in class 5 (bent stems). No root damage was found.

Logs were lifted over the stream depicted in *Figure 3*, and no debris was dragged into the stream.

Production and cost data seem to be competitive with that of tractor systems on steep sites, but this test was of very limited scale and scope. Whether this type and size of cable system can operate under many diverse timber, terrain, crew, and weather conditions in the Appalachian area has not been established.

Although this system was capable of handling the largest long log encountered, calculations indicate that the system was overloaded when it was flying the larger logs. One possible solution is to equip the yarder with stronger cable, which we believe should be done. (The ⅞-inch skyline breaking strength for the improved plow steel cable provided is 69,200 pounds, but cable with a strength of 83,250 pounds—a 20 percent increase—is commercially available). In addition, load indicators should be mounted on the yarder to warn the operator when he is approaching overload conditions. Logs that overload the system should be bucked.

Many more terrain, timber volume, and logging conditions need to be studied with light skyline logging equipment before much can be concluded about the applicability of this equipment to Appalachia. Stands with lower volumes should be logged and cost records should be kept. Additional studies should indicate ways that the equipment and operational techniques can be modified to best suit hardwood logging. The trade-offs between tractor systems and skylines should be identified and compared. The environmental savings of using skyline logging systems as opposed to tractor systems on steep slopes should be quantified if possible, and the environmental factors that dictate skyline use should be identified. Additional work with cable logging systems in the Appalachians is planned. ■

Literature Cited

1. HESTERBERG, GENE A. 1957. Deterioration of sugar maple following logging damage. USDA Forest Serv. Lake States Exp. Stn. Pap. No. 51, 58 pp.
2. NYLAND, R. D., AND W. S. GABRIEL. 1971. Logging damage to partially cut hardwood stands in New York State. AFRI Rep. No. 5, 38 pp., Syracuse Univ.
3. PACKER, P. E. 1967. Forest treatment effects on water quality. Penn State Int. Symp. on Forest Hydrol., Pergamon Press, London. pp. 687-699.
4. REINHART, K. G., A. R. ESCHNER, AND G. R. TRIMBLE, JR. 1963. Effect on streamflow of our forest practices in the mountains of West Virginia. USDA Forest Serv. Res. Pap. NE-1, 79 pp., illus.
5. STUDIER, DONALD D., AND VIRGIL W. BINKLEY. 1974. Cable logging systems. USDA Forest Serv. Pac. Northwest Reg., Portland, Oregon. 205 pp., illus.
6. TRIMBLE, GEORGE R., JR., JOSEPH J. MENDEL, AND RICHARD A. KENNEL. 1974. A procedure for selection marking in hardwoods. USDA Forest Serv. Res. Pap. NE-292, 13 pp.

Figure 6. Log is hooked to carriage and ready to be pulled up the narrow 15-foot corridor cut in selection area. Tail tree is in foreground. →