FOR180

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Mechanical Vegetative Management[1]

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Vegetation is manipulated in interface forests to generate income, increase visual quality, create recreation opportunities, promote or control wildlife habitat, create privacy, improve forest health, reduce fire fuels, and so on. Using the phrase "vegetative management" rather than "harvesting" may help people think more broadly about how interface forests are managed. The removal and selling of trees is not always the primary goal of management and trees are not the only vegetation manipulated. That said, most of this document focuses on felling and removal of trees because money from timber sales, even if not the primary landowner goal, often pays for or defrays the cost of management for other goals.

There are various means to manipulate vegetation: mechanical, chemical, fire, fertilization, and grazing. This fact sheet discusses the mechanical means to manage vegetation in interface forests and reviews available technologies that may be most useful in small, visible, and sensitive forests that are typical of the interface. Traditional rural mechanical systems are appropriate on some interface forests, but some practices need to be modified for interface forests.

There are three primary challenges to manipulating vegetation in interface forests: (1) removing vegetation without disrupting amenity and ecological conditions; (2) conducting a cost-effective operation as economies of scale are less available on small tracts; and (3) maintaining worker safety with small-scale equipment.

Figure 1. Manual felling to release crop trees is expensive and potentially dangerous. Credits: Kris Jensen

It is imperative to find the right system for a given site. From an environmental protection and legal perspective, it is important that soil and water quality are protected during the operation. Most state forestry agencies will have a section in their Best

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Management Practices guidelines that will aid minimizing impacts as well as providing information on appropriate equipment selection. From a financial perspective, it is critical to make the operations profitable for the operator and affordable for the landowner. From a liability perspective it is critical to recognize and minimize risks to worker safety.

Removal and control of understory brush is critical in order to manage for scenery and wildlife, and mitigate wildfire risk. Completing this task manually is labor intensive and hence devices drawn by either a skid-steer or a tractor are most common. The attachments typically use a drum chopper to chip and mulch small trees.

Timber removal practices involve the felling, bunching, skidding or forwarding, loading, and hauling of trees (Conway 1982). Felling can be done by chainsaw or by a machine such as a feller-buncher or harvester. The bunching of the felled trees in preparation for extraction can be done by hand for small or short logs, or by a machine with a grapple attachment. Extraction of the trees out of the forest can also be done by hand for very small material. Other extraction options include animal power such as horse or oxen teams, a forwarder that lifts the logs onto a trailer, or an agricultural tractor or a forest skidder that drags the trees out of the forest. If the material is small and of no monetary value, it is also possible to leave it in the forest for natural decay or to use a chipping/mulching machine to reduce its size. Finally, a grapple loader can be used to load merchantable logs onto trucks. For smaller operations, a truck fitted with its own small crane is common.

Increased productivity, improved safety, and greater cost effectiveness are reasons why harvesting for profit on large landholdings is predominantly carried out by large machines and systems. A feller-buncher, grapple skidder, and trailer-mounted loader system, used primarily for timber production on larger tracts of timber, are by far the most common system available in the Southeast, accounting for an estimated 80 percent of timber harvest.

Figure 2. Machines like this Gyro-Track are used in interface neighborhoods to reduce understory vegetation. Credits: Larry Korhnak

In many cases these large machines and systems may not be suitable for working in interface forests for reasons of high capital costs (new purchase price is up to $200,000 per machine), high moving costs (up to $2,500 for relocating the system), and the consequent need to harvest larger volumes of timber to remain cost effective (up to 2,000 tons per tract) (Shaffer 1992; Jensen and Visser 2004).

These larger systems, designed primarily for timber harvesting, may be less appropriate in interface forests where other outcomes such as amenities, property value, and forest health are desired. Landowners may be more tolerant of smaller equipment because they perceive it to be less detrimental to the land, even though evidence is mixed about the actual ecological effects of small-scale equipment (Marui, Kittredge, and McGuire 1995; Updegraff and Blinn 2000). Landowners may be willing to accept lower prices for their timber or even pay for services that produce ecological health, amenity value, or other landownership objectives, thus creating a special niche market for forestry operations of this type. However, vegetative management practices that reduce residual slash, minimize exposed dirt, reconvert roads, and reduce noise levels not only add operational costs and time, they also require operator skills that may be difficult to find or finance (Updegraff and Blinn 2000).

Small-Scale Harvesting Systems

A recent study published by the Minnesota Agricultural Experiment Station (Updegraff and Blinn 2000) defined small-scale harvesting systems as single or two-machine systems with base machines meeting the following criteria: weight less than or equal to 9,525 kg (21,000 lb), width less than or equal to 2.4 m (8 ft), engine power less than or equal to 60 kW (80 hp) and, in the case of cable yarder towers, height less than or equal to 15.3 m (50 ft).

Small, tracked skid-steers or excavators, small agriculture tractors, small cable-yarding systems, all-terrain vehicles (ATVs), and horse logging are possible small-scale systems for interface forest management. Generally, smallscale systems have lower capital investment costs than that of larger, more traditional harvesting systems designed entirely to maximize profit from timber harvests. For example, small tractors usually cost between $15,000 and $40,000, with modifications for forestry running between $4,000 and $20,000. Small-scale systems also have lower operating costs. With both lower capital and operating costs, small-scale systems working on smaller tracts or partial cuts can compensate for lower productivity, thus becoming more economically feasible for both harvesting contractor and landowner. Perhaps most important to interface landowners, small-scale harvesting systems tend to leave less residual stand damage because they are more maneuverable and can be more selective. However, as Table 1 illustrates, not all small systems are environmentally benign. The following are some of the harvesting systems that may be appropriate for interface forests.

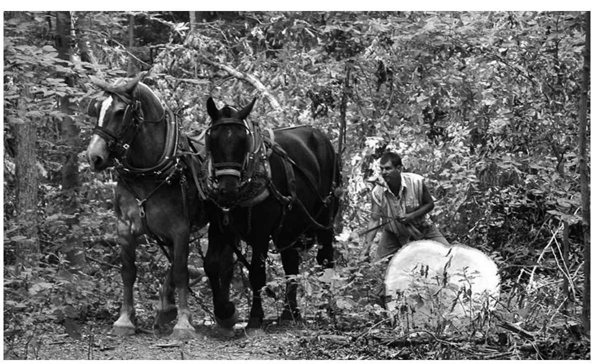

Figure 4. Using horses and other animals to haul logs can allow for small-scale and economical logging in the interface. Credits: Photo courtesy of Virginia Tech

Horse Logging

Manually felled logs are hauled to a relatively small deck by horses harnessed to modern horse buggies. Generally low in productivity, horse logging is primarily suitable for landowners with small, specialized objectives (e.g., single tree selection) and for those who place significant value in their forests' noncommercial value. Currently, there are more than 50 horse loggers in the central Southeast.

Small Agriculture Tractor

Agricultural tractors with 80 horsepower or less can be modified to perform either skidding or forwarding functions. When skidding, trees are felled manually then attached to the tractor with a chain or cable choker. The logs are then winched onto a modified skid plate, powered by the tractor's power takeoff (PTO), where their front ends are raised off the ground. The tractor then skids the load to a nearby landing. When forwarding, the tractor is used to pull a logging trailer, loading the manually felled trees using a grapple loader attachment. Small agriculture tractors are fairly inexpensive, maneuverable, light, reliable, and have low maintenance schedules. They are used very successfully in Europe and a number of manufacturers make farm tractors specially modified for logging operations. Farm tractors used in forestry operations do require compliance with Occupational Safety and Health Administration (OSHA) safety standards.

Small Excavators/Skid-Steers

Small excavators and tracked skid-steers, can be modified to perform felling, bunching, skidding, forwarding, and loading. With grapple loader attachments, these systems work much like the agriculture tractor. They are light, maneuverable, and relatively inexpensive. Small excavators and skid-steers used in forestry operations require compliance with OSHA safety standards.

Small Cable-Yarding System

These systems can move logs over steep or difficult terrain which is not suitable for other small-scale equipment. Generally, small cable-yarders are two- or three-drum systems, either trailer- or truck-mounted. The more modern yarders can be radio-controlled. Small cable-yarders are excellent for minimizing soil disturbance but specialized training is required to make sure the crew is efficient and safe.

All-Terrain Vehicles

Although not commonly practiced in the United States, ATVs can be modified for skidding and hauling over relatively short distances. ATVs performing forestry operations need four-wheel-drive with a minimum 300-cubic-centimeter engine capacity. Other common attributes are chains on the rear tires, weighted rear wheels, counterweight on the front, front bumpers, and a protective belly pan under the engine. It is important to note the use of ATVs in forestry operations can be dangerous.

Cut-to-Length

These systems are successfully used in Europe as well as the New England area, the Lake States, and parts of the South. Cut-to-length consists of a forwarder and harvester, and appears to be at the forefront of low-impact or environmentally sensitive harvesting. This two-person, two-machine system is considered low impact for several reasons: machine weight is distributed over six wheels rather than the traditional four wheels of a skidder; felling, limbing, and bucking are carried out at the stump, producing a slash mat that reduces soil compaction and recycles the nutrients; and logs are carried off the ground rather than dragged. While this system may address the ecological and social concerns of interface landowners, it faces the same economic constraints as conventional methods. This equipment is both expensive to purchase and maintain and therefore is less suitable for small woodlots or partial cuts.

It is important to note that because a system is small-scale does not necessarily mean it is low-impact; in some cases smaller systems require increased passes through the forest, which contribute to soil compaction. However, some small-scale systems are lighter, more maneuverable, and reduce residual stand damage. Table 1 provides a comparison of impacts and productivity (Jensen and Visser 2004).

The current reality is that there are very few harvesting contractors geared to meeting the needs of interface forestry and thus harvesting options may be limited to what is available in the local area. The local state forestry representative and or a local forestry consultant should have lists of available harvesting contractors.

Figure 5. Tractors can be modified to include a loading arm on a forwarder. Credits: Photo courtesy of Virginia Tech

Figure 6. Modifications to small excavators, like the addition of this feller to cut trees, make them useful in interface forest harvesting. Credits: Photo courtesy of Virginia Tech

Figure 7. Small cable-yarding systems are not common in the South but have been used elsewhere in steep terrain. Credits: Rien Visser

Figure 8. ATV's, modified to pull this wheeled trailer, can be used to move logs a short distance. Credits: Photo courtesy of Virginia Tech

Figure 9. Modern telescoping boom harvester, with a processing head. Note tire chains for wet weather and soil protection. Credits: Photo courtesy of Virginia Tech.

Costing an Operation

Accurately costing a forest operation is always difficult. Few harvesting contractors actively pursue work in interface forests because of small stand size, smaller diameter material, greater degree of difficulty (e.g., houses, power lines, public roads, noise restrictions), and the lack of higher value material. Professional arboricultural companies, lawn and garden companies, and boutique loggers are more likely to be service-oriented, but also must charge higher prices to cover their operation costs (Davies 1998; Lansky 2005).

On company-owned forest lands, a harvesting contractor is typically paid a rate per ton or per 1,000 board feet (MBF) harvested. Most timber sales on private land involve the transfer of ownership of the trees to be harvested to the contractor, either based on a lump-sum price or a stumpage rate. The harvester's profit is determined by the difference between what they pay the landowner, the price they get at the mill, and the cost of harvesting and transporting logs.

Harvest contracts that pay a rate per ton or transfer ownership to the contractor encourage high production of higher value material. That is, the most profitable and convenient logs are harvested first. Site work that does not produce high value timber at a rapid rate is less profitable and therefore less likely under this fee structure. This practice can be counterproductive to amenities and forest health objectives that are favored by interface landowners. In the worst cases, this fee structure encourages “high grading,” which over time creates genetically inferior forests because all the best trees have been removed.

Work charged at an hourly rate is probably a more appropriate alternative costing scheme for smaller woodlot operations. This provides the most control over the actual tasks the harvesting contractor should perform to meet the objectives set out by the landowner.

Safety

Timber harvesting is second only to deep sea fishing for causing work-related fatalities. And home use of chain saws is exceedingly risky too. Even for seasoned professionals it is a dangerous line of work. During the last two decades, the safety record has improved considerably through the use of mechanization, which has taken chain saws away from the forest workers and enclosed the workers in fully protected cabs. While such machines have proven to be safe and economically efficient for large-scale harvesting operations, both the size and their up-front capital cost (up to $200,000 per machine) make them less suitable for working in smaller stands or with smaller timber volumes.

Felling and transporting small wood volume in interface forests requires smaller crews with smaller equipment, and currently in the South very few safe options exist. As natural resource professionals begin to encourage people to do this type of work, they need to be careful that consideration is given to safety. For example, machinery that extracts trees from the forest should have both roll-over as well as falling object protection (ROPS and FOPS), a standard designed to protect the operator should the machine roll on rough or steep terrain or a large tree fall on the machine (see web.cocc.edu/logging/lrlinks/ropsfops.html). While all larger machines have such ROPS and FOPS, farm tractors only have ROPS and four-wheelers typically have neither.

Currently, the federal law, administered through the U.S. Department of Labor, Occupational Safety and Health Administration (OSHA) has only three requirements (U.S. Department of Labor 2005).

- All forestry workers must wear the following personal protective equipment (PPE): hardhat, hearing protection, eye protection, cut-resistant trousers, steel capped boots.
- There must be a standard first-aid kit on site.
- The crew must have a safety plan with regular safety meetings.

The Forest Resources Association's South-wide Safety Committee has developed a guide to safety and has general information on accident prevention in timber harvesting with ground-based logging systems. OSHA organizations in western states such as Oregon and Washington have developed very comprehensive rules and regulations for safety, especially for more specialized harvesting systems such as cable logging (U.S. Department of Labor 2005).

In addition, nearly every state requires timber harvesting contractors to purchase workers compensation insurance. Some states have mandatory programs run through the state; others allow contractors to obtain this insurance through private insurers. These private insurers often charge safety conscious contractors considerably lower rates. Thus, financial pressures from insurance companies encourage contractors to keep workers inside protected cabs and off the ground so they are less likely to be injured with chainsaws or other small equipment.

While there can be no definitive guideline for safety standards for contractors, the landowner and consulting forester should at least ensure that the intended contractor has liability as well as workers compensation insurance, is part of the state's professional forestry program, and abides by the OSHA rules and regulations.

Suggested Readings

Sloan, Hank. *2001*. Appalachian hardwood logging systems: Managing change for effective BMP implementations. In *Proceedings of the 24th Meeting of the Council on Forest Engineering*. Corvallis, Oregon: Council on Forest Engineering.

National Timber Harvesting and Transportation Safety Foundation. 1998. *Timber Harvesting Safety Manual* http://www.loggingsafety.com/thsm.htm.

Virginia Department of Forestry. 2002. *Timber Harvesting Best Management Practices*, *Virginia's Forestry Best Management Practices for Water Quality 4th Edition*, 41-50. http://www.dof.virginia.gov/wq/resources/BMP-Chapter-5B.pdf. Charlottesville, Virginia.

Visser, Rien. *Virginia Tech Logging Cost Analyses.* http://www.cnr.vt.edu/harvestingsystems/Costing.htm. Blacksburg, Virginia: Virginia Polytechnic Institute and State University, Department of Forestry.

References

Conway, S. 1982. *Logging Practices: Principles of Timber Harvesting*. San Francisco CA: Miller Freeman Publications Inc.

Davies, K. 1998. *Harvesting Systems.* Northampton MA: Davies and Company, http://www.daviesand.com/Choices/Harvesting_Systems/ (accessed July 8, 2005).

Jensen, K. and R. Visser. 2004. Low impact forest harvesting at the urban interface. In *Proceedings of the 27th Meeting of the Council on Forest Engineering.*

Lansky, M. ed. 2005. *Logging Cost Calculating for Low-Impact Forestry*. http://www.meepi.org/lif/costs.doc (accessed August 10, 2005).

Marui, M. J.; D. B. Kittredge; and E. J. McGuire. 1995. Massachusetts loggers: Carving a future for smaller woodlots. *Northern Logger and Timber Processor* 44(9): 40-41.

Shaffer, R. M. 1992. *Farm Tractor Logging for Woodlot Owners* (Publication 420-090). Blacksburg VA: Virginia Cooperative Extension.

Updegraff, K. and C. R. Blinn. 2000. *Applications of Small-Scale Forest Harvesting Equipment in the United States and Canada (Staff Paper Series No. 143)*. St. Paul MN: University of Minnesota, Minnesota Agricultural Experiment Station and College of Natural Resources.

U.S. Department of Labor. 2005. *Safety and Health Topics: Logging.* Washington DC: U.S.

Department of Labor, Occupational Safety and Health Administration, http://www.osha.gov/SLTC/logging (accessed July 29, 2005).

Wenger, K. ed. 1984. *Forestry Handbook,* 2nd edition. Hoboken NJ: John Wiley & Sons, Inc.

Definitions for Table 1:

Wet Weather – The sensitivity of equipment to wet terrain. Heavier ground-based equipment can rut up the site and affect water quality.

Slope – The steepness that each system tolerates. On sites with additional difficulties, such as rocky outcrops, these values will be higher.

Extraction Distance – The economically feasible distance to haul logs.

Tree Size & Log Length – The size of timber typically extracted by each system. Small is <15 inch DBH and large > 25 inch DBH. Short logs are 8-12 feet; long are >16 feet.

Moving Cost – The costs of the system and moving the equipment mean that larger and more expensive systems require greater harvest volume.

Road – The standard required for durable roads to ensure continued operation.

Tree Size – The weight of logs extracted by each system, in tons.

Log Weight – The weight capability for the system, where very small is less than 0.5 tons and large is 3 tons.

Table 1. Small-scale and conventional systems summary

Logging System	Wet Weather	Slope	Extraction Distance	Tree Size & Log Length	Moving Cost	Road	Log Weight (tons)	Log Length
Animal	Moderate	<20%	<500 ft.	Small, short	$	Low	.5	Short
Tractor	Moderate	<25%	<800 ft.	Medium, short	$	Low	1	Short
Small Excavators/ Skid-steers	Moderate	<40%	<800 ft.	Small, short	$	Low	1	Short
Skidder	High	<35%	<1500 ft.	Medium to large	$$	Med	2.5	Medium - long
Forwarder	High	<30%	<2500 ft.	Medium, long	$$$	High	1.5	Short - medium
Cable	Low	Any or concave	<1500 ft.	Small to medium long	$$	High	2.5	Long
ATV	Moderate	<10%	<500 ft.	Small, short	$	Low	1	Short
Helicopter	Low	Any	<6000	Large, any	$$$	High	3	Long

Source: Jensen and Visser 2004.