

3.1 TIMBER HARVESTING SYSTEMS

BACKGROUND

Choosing the most appropriate timber harvesting system can meet management objectives and minimize environmental impact.

A timber harvesting system is one of several combinations of equipment used for felling and extracting timber. Every system requires (1) a mechanism for felling trees and (2) a mechanism for removing felled trees or portions of felled trees to a roadside log landing for transportation to a mill. Matching the equipment to the site, implementing proper harvest layout, and hiring a skilled operator all contribute to successful logging. A licensed forester and a certified logger can help choose the right system. Landowners choosing to harvest timber on their own must decide if they have the time, skill, equipment, and knowledge to do so or if they wish to contract the services.

OBJECTIVE

Select a timber harvesting system appropriate to the site and landowner objectives.

CONSIDERATIONS

- Financial return is often a factor when considering which harvesting system to use. Costs associated with different logging methods vary and may affect the income received.
- Time of year can influence equipment choice. Frozen winter conditions may be suitable to almost any system, while a summer or fall harvest may limit use of some equipment, particularly on sites with wet soils.
- Ground conditions such as wet sites, rocky terrain, or steep slopes may limit use of the equipment.
- The size of the harvest area, tree density, and the size and value of the timber may limit the practicality of using some harvest systems. Equipment should be able to fell and move timber efficiently to the landing. Equipment that is too small may struggle handling large timber and damage the remaining trees. Skidding distances longer than half a mile may limit the feasibility of some equipment. Using equipment that is too large may result in higher levels of residual damage in tight stands of small timber. It may be inefficient to use large machines on lots smaller than 10 acres.
- The quality and quantity of the timber and the expected products help determine the feasibility of a method. Are there more high-quality sawlogs or more pulpwood? Will the tops be chipped? In a woodlot growing small, scattered, low-value trees, the cost of logging may be higher than the financial return. The ability to sort for multiple markets depends on the right mix of equipment, as well as the experience and skill of the operator.
- Systems using the entire tree may result in an aesthetically pleasing appearance and may be desirable on highly visible sites.
- Layout of truck roads, landings and skid trails affects efficiency and differs for each harvesting system. Long skidding distances and limited landing size may also limit the choice of equipment. Mechanized systems tend towards high production, covering more ground more quickly than conventional systems, making presale layout and sale supervision important.

3.1: Timber Harvesting Systems

- Operator skill plays the greatest role in determining success, regardless of the equipment chosen. A skilled operator reduces equipment impact, while an inexperienced one can do damage in a short time.
- The environmental sensitivity of a woodlot may dictate which logging equipment is most suitable. Crossing wetlands, logging near cultural artifacts and threatened and endangered plants, scarifying soil to promote regeneration, or minimizing disturbance to advanced regeneration may be some of the factors to consider. Implementing best management practices (BMPs), silvicultural prescriptions, and job layout for the equipment, then carefully closing out the sale will go a long way to achieving a successful timber harvest.
- Safety is integral to all decision-making including who operates in the woodlot, what equipment they bring, and what steps they take to ensure safe operating procedures. Some equipment provides a much greater level of safety and control, allowing work to be conducted in hazardous conditions. Operators must take responsibility for ensuring that everyone in and around the logging operation is safe at all times.

Commonly Used Timber Harvesting Systems

The following descriptions represent commonly used systems (but don't represent every possible combination).

- Conventional logging—uses a chainsaw and cable skidder.
- Mechanized logging—uses a feller-buncher, grapple skidder or other auxiliary equipment such as a loader, delimber, slasher, and chipper. Whole-tree (biomass) harvesting is a form of mechanized logging that typically adds a chipper for processing whole trees into chips at the landing, a loader to feed the chipper, and a trailer into which the chips are blown.
- Cut-to-length system—mechanized logging using a processor and forwarder combination.
- Other systems include draft animals, tractors, and other machines

Conventional Logging

- **Felling System - Chainsaw**

The chainsaw is the most common method for manually felling trees. A skilled chainsaw operator can fell trees directionally. Training in chainsaw use and maintenance is critical for safely felling trees.

- **Extraction System - Cable Skidder**

A cable skidder uses a winch, cable and chokers (chain) to gather and drag a load (hitch) of trees or logs. A cable skidder allows the operator to pull the cable to the trees rather than driving the machine to each tree. This allows for flexibility on uneven terrain. The cable-skidder operator must exit the machine to attach each tree to the cable. The winch pulls the trees, butt first, to the skidder by reeling the cable over an arch. The arch raises the hitch off the ground, reducing the friction and impact to the ground during the course of the skid.



Cable Skidder

- **Pros:**

- Allows large, valuable trees to be felled without damage.
- Allows trees to be removed from sensitive and difficult locations.
- Because trees are topped and limbed in the woods, reduces the size of the hitch, which in turn may reduce residual stand damage. Tops left in the woods may reduce nutrient depletion on poor sites.
- May prove cost-effective, especially on small jobs.

- **Cons:**

- Requires extreme physical exertion and exposure to adverse environmental conditions.
- Leaves the chainsaw operator vulnerable to falling debris and chainsaw injury.
- Is typically slower than a mechanized system.
- May damage advanced regeneration more than mechanized systems.

Mechanized Logging

- **Felling System**

Feller-bunchers

A feller-buncher, or harvester, describes any number of machines that cut (fell) and gather and pile (bunch) trees. The machine either drives to the base of the tree or reaches to the tree with a boom (extending arm). It severs the tree, using either a circular saw or a chainsaw-type head which cuts the tree, or a shear which pinches the tree off. Shears have fallen out of favor for use in high-quality timber because they crush the tree's fiber when the tree is severed.

After felling, trees are piled into hitches in or along skid trails for removal to the landing by a skidder. Mechanized operations tend to be whole-tree operations, which remove the entire tree from the forest for processing at the landing. This requires the support of several pieces of auxiliary equipment such as a loader, delimeter, slasher and chipper. The loader moves products around the landing as trees are processed into logs and chips. The delimeter removes branches, and the slasher cuts logs to length. Poor-quality stems and tops are run through the chipper to create biomass.

3-wheeled Harvesters

The 3-wheeled harvesters are rubber tired and highly maneuverable and designed for smaller-diameter trees. Typically configured with a fixed shear head, they work well in tight stands and on even terrain.

4- and 6-wheeled Harvesters

A felling machine with a fixed head mounted (typically) on a rubber-tired machine. The fixed-head harvester requires the operator to drive to the tree base to fell the tree.

Tracked Harvester

These tracked felling machines feature a cutting head mounted on a boom which reaches up to 20 feet. This reach aids harvesting on rough and steep terrain. The boom also allows the machine to harvest and carry large-diameter trees, as well as to direct the felling, which protects the residual stand.

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- **Extraction System - Grapple Skidder**

A grapple skidder uses a grapple to bunch, hold and drag a load of trees or logs. The operator doesn't get out of the machine to assemble a load, improving efficiency and operator safety. The grapple raises the hitch off the ground, reducing the friction and impact to the ground during the skid. Because the grapple skidder requires the operator to drive to the felled trees, some machines also have a cable with which to pull trees.

- **Pros:**

- The feller-buncher is able to carefully cut trees and lay them down where desired, protecting advanced regeneration, residual trees, cultural resources, and sensitive sites.
- Tracked machines may reduce soil compaction.
- Self-leveling, track-mounted feller-bunchers aid harvesting on steep slopes.
- Small feller-bunchers are maneuverable in tight stands.
- Mechanized logging offers high production.
- The operator remains in the cab of the machine.

- **Cons:**

- May result in residual stand damage, as well as greater soil disturbance or compaction.
- Smaller feller-bunchers may not be able to handle large trees.
- Mechanized logging, particularly a whole-tree operation, requires larger landings and skid trails.
- Logs may be damaged from multiple handling, improper machine adjustment, or operator inexperience.
- Whole-tree harvesting may deplete soil nutrient levels on poor sites over time.

- **Auxiliary Harvesting Equipment**

Delimber

The delimber takes the limbs off of the tree either by dragging the stem horizontally through a metal frame or by passing a metal arm down the length of the stem. The delimber is also an integral part of the processing head on a cut-to-length processor.

Slasher

A slasher is a circular saw or chainsaw mounted on a steel frame. The stem is placed in the frame horizontally by a loader and cross-cut or bucked to length. The slasher allows for high-volume processing of stems while protecting the operator in a cab.

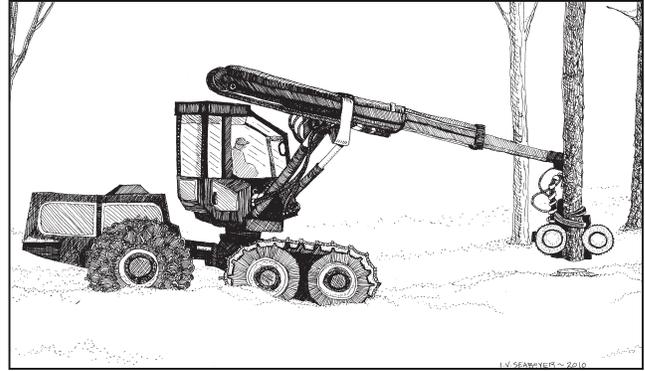
Chipper

The chipper used on a logging operation is capable of processing large, low-quality stems and branches into chips. The resulting whole-tree chips (biomass) are used as fuel at wood-to-energy power plants. A flail chipper (chipper which removes the bark from the stem before chipping), can produce pulp-quality (clean) chips used in paper or wood-pellet manufacturing. The bark and other flail material can be used as fuel, mulch or matting on sensitive logging areas. Chips are blown into tractor-trailer vans for transport.

Cut-to-Length System

- **Felling System - Processor**

A tracked or rubber-tired machine with a computerized cutting head used to fell, delimb, and buck (cut into smaller lengths) trees at the stump. A processor combined with a forwarder is referred to as a cut-to-length system. The cut-to-length system is often used on sensitive sites. The operator doesn't have to exit the machine to harvest and process trees. Limbs and tops are typically left in skid trails.



Cut-to-Length Processor

- **Extraction System - Forwarder**

A self-loading machine designed to carry trees or parts of trees. The forwarder, when combined with a processor forms a cut-to-length system. The forwarder may be used in combination with a feller-buncher and/or a chainsaw. A forwarder is often preferred on sensitive sites, because it carries rather than drags the wood.



Forwarder

- **Pros:**

- The processor head allows the operator to make decisions about the entire stem at the stump.
- The forwarder reduces ground impact because it carries logs rather than drags them.
- The increased surface area of the forwarder's wheels running over a mat of tree tops deposited on the trails protects the ground and distributes the weight of the loaded machine.
- The logs may be cleaner, which some mills prefer.
- The system allows for smaller landing sizes.
- Processing tops and limbs in the forest may reduce nutrient depletion.
- The operator remains in the cab of the machine.

- **Cons:**

- A cut-to-length system is expensive.
- The processor may have difficulty with larger trees.
- The processor head (rollers) can damage sawlogs.
- Hand felling and delimiting may be required, especially with larger hardwood.
- The system isn't usually as productive as traditional mechanized logging and has a higher overhead for equipment, which may result in slightly reduced stumpage prices.

Other Skidding Systems

Horses, oxen and mules can be used to skid trees, though logging with animals is slow and not common. Operators need training and care to ensure the safety of the animals as well as the logger. Draft animal loggers have the option of drawing stems and loads on the ground or raising them with an arch, sled or forwarder. Stems or logs are often bunched on the ground by a single animal and then forwarded by a team on an arch, sled or forwarder to minimize ground disturbance and residual stand damage. Draft animal logging creates narrow skid trails and may be a feasible system for removing small volumes of high-value trees from visually sensitive areas.

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Farm tractors equipped with specifically designed winches may be used to skid smaller trees. Operators must not exceed the limitations of the machine.

Other machines used to skid logs included all-terrain vehicles (ATV), bulldozers and trucks. Each machine has its benefits and limitations. Care is needed with any non-traditional logging machine to ensure the safety of the operators as well as those working in the vicinity.

RECOMMENDED PRACTICES

- ✓ Get professional help. (See below for listings of licensed foresters and certified loggers).
- ✓ Choose an experienced logger. Visit several completed harvests to see what different equipment and operators can do before making a final selection. Check references.
- ✓ Clarify expectations and objectives, and use a written contract.
- ✓ Lay out truck roads, landings and skid trails, and designate trees to cut (or leave) in advance. Tailor the layout to the harvest system selected (1) to reduce residual stand damage, soil compaction and erosion, and (2) to preserve advanced regeneration, unique species and cultural artifacts.
- ✓ Time the harvest (1) to avoid wet or poor logging conditions and conflicting uses, and (2) to optimize market conditions.
- ✓ Use BMPs for erosion control and to prevent sediment from entering streams or wetlands. You can find these guidelines in *Best Management Practices for Erosion Control on Timber Harvesting Operations in New Hampshire*, published by the N.H. Dept. of Resources and Economic Development, Division of Forests and Lands. Consult the latest version of this publication before harvesting timber.

CROSS REFERENCES

1.1 First Steps in Forest Management; 1.5 Staying Safe Working in the Woods; 2.3 Regeneration Methods; 3.2 Logging Aesthetics; 3.3 Aesthetics of Skid Trails, Truck Roads and Landings; 3.4 Harvesting in High-Use Recreation Areas; 3.5 Soil Productivity; 4.1 Water Quality; 4.2 Wetlands; 4.3 Forest Management in Riparian Areas; 4.4 Stream Crossings and Habitat; 5.4 Logging Damage; 6.3 Dead and Down Woody Debris; 7.7 Steep Slopes and other chapters in the Sensitive Areas section; 8.1 Timber Products.

ADDITIONAL INFORMATION

Bennett, K. P. 2010. *Directory of Licensed Foresters Providing Service to Forest Landowners in New Hampshire*. UNH Cooperative Extension, Durham, N.H. <http://extension.unh.edu/fwt/dir/index.cfm> Accessed on August 2, 2010.

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