



**ABOVE** A small rubber-tired harvester thinning a stand in north Idaho.

# New Technology in Forest Operations

*Bob Rummer, Research Engineer*

*U.S. Forest Service*

## Small-Scale Operations

Many forest landowners are looking for forest operations that are low impact or that will work on smaller forest tracts. In general, these objectives lend themselves toward smaller or low-ground pressure equipment and systems. Landowners cannot afford to bring a whole high-production mechanized crew onto a 10-acre parcel unless they plan to cut everything. Low impact or small-scale crews are specialized operations found in a wide range of system configurations.

The manufacturing trend has been the development of smaller mechanized equipment: small skidders, forwarders, harvesters, and feller-bunchers. One Canadian manufacturer, for example, is marketing a 50-hp rubber-tired skidder. It weighs in at 9,200 pounds and is just over six feet wide. A complete small-scale harvesting system with mini-skidder, mini-harvester, and a small chipper is currently being tested at Auburn University to determine productivity and costs. Landowners can find contractors across the country who have other types of small specialized machines for working in the woods.

Small-scale equipment offers the potential benefit of lower disturbance, lower capital cost, and lower operating costs. It can work in more selective prescriptions or in wildland-urban areas. However, there are several factors to examine for a small-scale operation. Although the equipment costs less than larger machines, the cost per ton or cost per acre may actually be higher. This is because the productivity of

equipment generally goes up faster than price with increases in size. Small-scale operations have to be well managed to keep costs in line. In addition, operator safety must be considered. Not all modified equipment or specialized machinery is designed to meet accepted forest machine safety standards. It is important to check equipment specifications to make sure that the operator is protected from rollover, falling objects, and poking hazards. Some manufacturers offer special “forestry packages” that will make the appropriate modifications to a base machine like a skid steer.

## Specialized Tools

Other new developments in forest operations include tools for specialized tasks like mulching and biomass recovery.

### Mulching

Mulching is a treatment used to address fire hazard—it lowers fuel bed depth, raises crown base height, and increases fuel-ground contact to promote decomposition. Increasingly, mulching is used instead of prescribed fire, particularly where there is risk of escaped fire, smoke concerns, or other management constraints. Mulching is also used to knock back excessive growth of invasive shrubs and to control vegetative competition. This is a good treatment for small stands or forests in the wildland-urban interface.

Mulching machines are probably the fastest growing segment of forest equipment in recent years. Mulching attachments have been developed for

small skid steer machines, for excavators, and for farm tractors. There are even purpose-built mulchers that have 500 hp and can shred a 30-inch diameter tree. The challenge for a land manager who wants to use mulching is to find the right type of machine for the terrain and forest condition. Matching equipment and operational needs is critical for the landowner to get the best outcome at the lowest cost. There are a few key things to keep in mind with mulching treatments:

Make sure that the basic machine can handle the slopes and soils. Rubber-tired equipment is generally faster and cheaper, but is limited by steep terrain or soft soils. Tracked machines generally have lower ground pressure and better stability on slopes, but they are slower and more expensive to operate. The most common problem occurs when trying to use wheeled machines on soft soils, with resulting ruts and disturbance.

The type of cutter head is also key. Vertical shaft cutters work like a lawnmower, with a disk or blade rotating on a vertical shaft and the cutting teeth arranged around the edge of the disk. Generally these cutters are limited to smaller trees and brush and produce a “chunkier” residue, with ragged stobs and stumps and debris scattered over the site. Horizontal shaft cutters, on the other hand, have cutting teeth attached to a spinning drum and are less constrained by stem size. Horizontal shaft cutters produce a finer residue with a cleaner cut at the stump.

The final result of mulching can be

adjusted based on a landowner's specifications. If the primary objective is understory vegetation control, a single pass with a vertical shaft cutter may be the least expensive approach. However, if the landowner wants to have a clean site with everything reduced to small pieces, it will likely take multiple passes with a horizontal shaft machine. Remember, if the operator has to make multiple passes over an area to achieve the desired condition, the costs escalate.

A mulching treatment, while immediate, is also temporary. Many hardwood and shrub species will re-sprout and quickly re-occupy the site. In a test conducted by the U.S. Forest Service near Athens, Georgia, a dense privet understory was mulched, and followed with foliar application of herbicide when the stumps resprouted. Mulching brought the vegetation lower and made it easier to apply chemicals. Mulching treatments can also be combined with prescribed fire to achieve longer-term results.

#### Biomass Recovery

Mulching leaves the shredded material to decompose in the stand. People often say, "Wouldn't it be great to be able to use that material for something?" New developments in woody biomass utilization may make that a possibility in the near future. Right now, about one-third of the renewable energy production in the U.S. comes from wood. That number is projected to rise as we find new ways to convert woody biomass into liquid fuels. In November 2007, there was a groundbreaking for a new commercial cellulosic ethanol plant in Georgia that should be operational by 2010. Scientists around the country are working to find the best processes to reduce wood to liquid fuels, including a new system that will convert wood chips into "bio-oil" in the woods. There are also new biomass power plants that will burn wood fuels and new pellet fuel factories that are supplying wood fuels to customers around the world. These new markets provide opportunities to collect woody biomass



**ABOVE** A biomass harvester that cuts, shreds, and bales understory material.

**LEFT** A rubber-tired mulching machine thinning dense pine regeneration.

from thinnings and understory treatments as a saleable commodity.

The challenge for forest operations is to find a way to economically collect residues. The most cost-effective operation is to add roadside chipping to thinning or other harvest operations. This captures limbs and tops, as well as some non-merchantable trees. A study in Georgia found that if you can get about one load of chips for every 10 loads of product (sawlogs or pulpwood), then residue recovery can be

justified with current prices for hog fuel. Recovering logging residues also helps reduce site preparation costs for the landowner.

It is harder to find cost-effective ways to pick up residues that are left scattered in the stand after a treatment. Several equipment manufacturers have developed biomass bundling machines. Like a giant hay baler mounted on a logging machine, a biomass bundler can travel through the woods picking up residues and com-



**Forest Resource Consultants, Inc.**

Providing comprehensive forest management, appraisal, consultation and real estate services since 1970

717 North Avenue  
Macon, GA 31211

Tel. (478) 745-4910  
www.frc.us.com

**FIELD OFFICES**

Lumpkin, GA  
Tel. (229) 838-4418

Townsend, GA (Eulonia)  
Tel. (912) 832-6470

Waycross, GA  
Tel. (912) 283-4878

Picayune, MS  
Tel. (601) 749-9969

Quitman, MS  
Tel. (601) 776-6772

Camden, AR  
Tel. (870) 836-5150

EXPERIENCE — STABILITY — KNOWLEDGE — RELIABILITY

pressing them into log-shaped bundles. The bundles can then be collected with regular logging equipment and trucked to power plants. Operating costs are marginal given current wood fuel prices. However, if the landowner considers other benefits such as fire risk reduction or site prep savings, bundling can be cost effective. These machines are continuing to evolve, with prototype models that may be less expensive.

Another new approach to collecting forest residues is understory harvesting. Several new machines have been designed that combine a mulching cutter with some mechanism to collect the shredded material. One prototype machine being developed at North Carolina State University blows shredded material from the mulcher into a chip trailer that is towed through the woods. Another design that has just reached the market puts a mulching cutter on the front of an agricultural

round baler. Shredded material gets rolled into 1,000-pound bales tied with regular baling twine. The bales or chips from these systems can be used for boiler fuel.

Collecting forest residues has the potential to generate additional revenue from forest management. It can also help achieve some management goals and desired conditions. However, there are concerns about the effect of residue collection on site productivity. Obviously, removing limbs and tops takes away some of the nutrient capital that is normally recycled through the stand. Minnesota has developed statewide biomass harvesting guidelines that address these concerns. Other states are using the Minnesota document as a guide to developing their own direction. This is an area of ongoing research as scientists try to develop guidelines for sustainable recovery rates.

## Conclusion

Forest managers face constantly evolving challenges. The markets and values for forest products are always changing, the natural threats to our forests vary over time, and the things that society and landowners want from forestlands are changing. As new needs are identified, innovators and engineers start working on new equipment. Through the process of research and development, some of these new tools will be coming soon to forests near you.

## About the Author

Bob Rummer is the Project Leader for the Forest Operations Research Unit, U.S. Forest Service, Southern Research Station, located in Auburn, Alabama. His team studies tools for working the woods across the country. You can learn more about their work at [www.srs.fs.usda.gov/forestops](http://www.srs.fs.usda.gov/forestops). ♦

# TENNESSEE TIMBERLAND AUCTION

5,905 Contiguous Acres in Cumberland County

**GREAT INVESTMENT OPPORTUNITY!**

Tuesday, April 7, 2009 • 10:00AM  
Cumberland County Community Complex  
Crossville, TN

- Close to I-40 & Crossville
- Mature Timber
- Offered in Multiple Tracts
- Deer & Turkey Hunting



**Westchester Auctions** LLC  
THE LAND MARKETING AUTHORITY

800-607-6888 • 217-352-6000  
[www.westchester-auctions.com](http://www.westchester-auctions.com)



TN Lic. #4119  
Rex Schrader  
Auctioneer Lic. #4989