Forest Harvesting in Virginia

Characteristics of Virginia's Logging Operations

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Introduction

Virginia's forests are a vital resource, providing multiple benefits for the commonwealth's citizens, forest landowners, and the forest industry. More than 15 million acres, nearly two thirds of the state is forested. These forests provide an estimated $23 billion in total economic output, annually, and provide forestry related jobs to nearly 145,000 (Rephann 2008). Forest harvesting is often a critical component of forest management[1]. Logging operations are essential to implementing forest management plans and providing income to forest landowners. In 2011, more than 5,900 timber harvests occurred on more than 248,000 acres of Virginia's forested land, and net growth continues to exceed the volume harvested (VDOF 2011).

Virginia's forest industry produces a broad array of products to meet the needs of consumers. These diverse products include paper, packaging, corrugated containers, specialty chemicals, structural lumber for home construction, and solid hardwood or veneers used for furniture, flooring, and paneling. Virginia's forests also provide a source of renewable energy for producing electricity, heating homes and businesses, and providing power to manufacturing facilities. The forest industry depends on a supply chain, which includes forest landowners who grow timber, logging businesses that harvest and transport timber, and mills that produce the forest products we use. Each link is critical and, without all the links in the supply chain, Virginia's multi-billion dollar forest industry could not continue to operate.

There are an estimated 900 logging businesses in Virginia that harvest and transport timber to wood processing facilities. Logging businesses are primarily small, family owned and operated, and provide the link between Virginia's forest landowners and the manufacturers who produce forest products. Logging businesses operate in a challenging and often dangerous environment where they deal with constantly changing weather conditions, fluctuating prices and markets for forest products, and work with equipment and systems, which require substantial amounts of capital to operate.

Most people have a general idea of what they think a logging operation looks like. However, logging systems can vary significantly among loggers and across regions. Loggers in one part of the state may not be aware of what loggers in another part of the state are doing. Understanding logging systems, and the equipment utilized, can help everyone involved in the wood supply chain make good decisions related to forest harvesting.

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This publication is based on a 2009 survey of Virginia loggers[2] and provides a snapshot of logging operations across the state. The goal is to provide insight into the basic functions of a forest harvesting operation in Virginia, and to provide specific operational details related to the characteristics and production levels of Virginia's logging businesses. It provides introductory information for those not familiar with forest harvesting operations, as well as specific results of the logger survey and more detailed comparisons of logging across the Commonwealth.

Overview of Forest Harvesting Operations

Virginia is diverse in terms of its markets for forest products, physiographic regions, topography, and forest types. This diversity leads to a wide range of forest harvesting operations in Virginia, from the steep mountains in the west to the flatter Coastal Plain in the east. Without ever leaving Virginia, it is possible to see swamp loggers, cable yarding operations, helicopter logging, horse and mule logging, as well as almost any possible combination of conventional harvesting machinery. While there can be diverse operations such as cable yarding or horse logging in Virginia, the vast majority of all harvesting occurs with conventional harvesting systems. This publication focuses on the variety of conventional harvesting systems typically found on harvesting operations in Virginia.

To compare logging businesses across the state we grouped them into regions based upon the three main physiographic regions in Virginia (Figure 1). Despite the variety of harvesting systems and equipment you may encounter, there are five common forest harvesting functions you will find in one form or another on almost all operations. These harvesting functions include felling, skidding, processing, loading, and trucking.

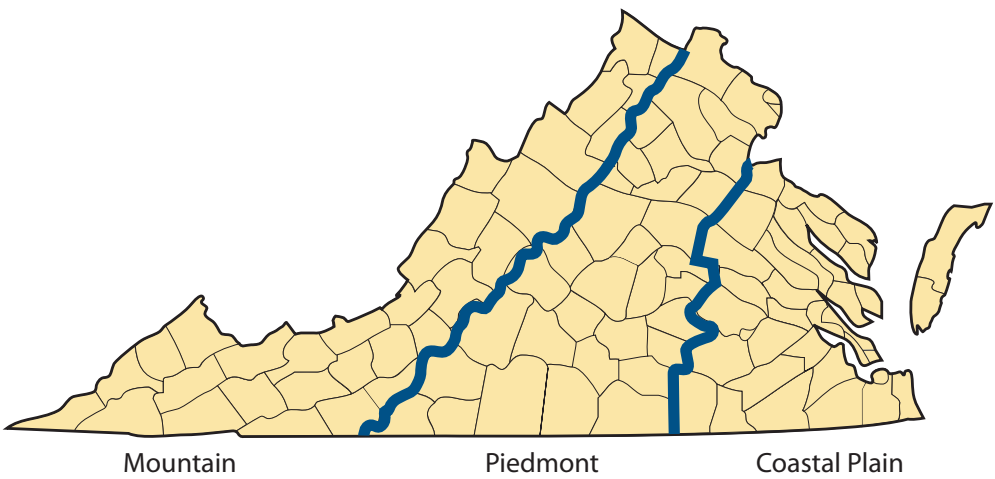

Figure 1. Physiographic regions of Virginia used to categorize logging operations.

Figure 2. Manual felling, using a chainsaw.

Figure 3. Mechanized felling with a rubber tire feller buncher.

Felling

Felling is the process of severing the tree stem from the stump so it can be moved and further processed. Manual and mechanized felling are the two general methods for felling trees. Manual felling involves an operator on the ground, using a chainsaw (Figure 2) to cut the tree. Mechanized felling utilizes a machine to cut the tree. There are several types of machines used for mechanized felling. The most common in Virginia are rubber-tired feller-bunchers (Figure 3), which are driven to each tree, and generally use a rotating disc saw head to cut the tree. These machines can accumulate several small trees before laying them down in a bunch to help facilitate skidding. Some operations also utilize tracked feller-bunchers that are mounted on a tracked machine similar to an excavator, and have a feller-buncher head mounted on a boom. The boom allows the feller-buncher to reach out and harvest multiple trees without moving the machine. Although not common in Virginia, a cut-to-length harvester is another type of mechanized harvesting machine which not only cuts the tree down, but also removes the limbs, and cuts the stem to merchantable lengths.

Skidding

Skidding is the process of moving felled trees from the stump to a centralized location, often called a landing, where they can be further processed and loaded onto trucks. Skidders generally use either a mechanical grapple or a system with

cables to grasp the stems, and lift one end of the logs off the ground as they transport them back to the landing. Cable skidders (Figure 4) require the operator to pull the cable out to each felled tree, and manually hook a choker to each log. A choker is a short cable or chain similar to a noose that goes around each log, and is attached to the cable. Cable skidders enable the operator to winch logs back to the skidder without having to drive to the log. This is particularly helpful on steep terrain. Grapple skidders (Figure 5) are driven to each stem or bunch of stems, and use a hydraulically powered grapple (similar to large tongs), which can be operated from the cab to grab and lift one end of the stems before moving them. Two other less common methods include using a bulldozer with an attached cable and winch system, or using a forwarder. Bulldozers are generally used in very steep terrain. A forwarder is typically used in combination with a cut-to-length harvester, and transports cut-to-length logs in a bunk (similar to a log truck) rather than skidding them on the ground.

Figure 4. Cable skidder

Figure 5. Grapple Skidder

Figure 6. Logging activities at a centralized landing (also referred to as a deck).

Processing

In mechanized harvesting operations, whole trees are typically skidded to the landing for additional processing to meet the specific length, or quality specifications for the mill where they will be delivered. The landing (also called a deck) is where most aspects of forest harvesting come together (Figure 6). The landing will have road access, and typically utilizes a knuckleboom loader (Figure 7) to handle and process trees and logs. The landing will be set up to facilitate the movement of wood skidded from the harvest site, allow for processing, the temporary storage of wood, and the loading of the wood onto trucks for transportation to a mill. Processing, which can occur at the landing, includes delimbing, bucking, and chipping or grinding.

Delimbing is the process of removing limbs from the tree stem, and utilizes either a chainsaw or one of several mechanized delimbing methods. On mechanized felling operations, delimbing is typically performed at the landing. On manual felling operations, delimbing is often performed with a chainsaw

Figure 7. Knuckle Boom Loader

prior to skidding. A common mechanized delimbing method utilizes a pull through delimber (Figure 8) where the loader pulls the stem through a set of knives to break off branches. Other less common methods of delimbing include chain flail delimbers, delimbing gates, and stroke delimbers. A chain flail delimber uses rotating chains to break off limbs. Delimbing gates are used by some operations harvesting southern pines, and involve attaching a delimbing gate to two trees or tall stumps. The skidder operator backs the trees into the delimbing gate, which breaks the limbs off as the trees are pushed through. A stroke delimber is a machine that pulls the tree stem through a set of knives, which break the branches off as the tree stem passes through.

While manual delimbing typically leaves the limbs distributed across the harvest site, mechanized delimbing operations typically leave the limbs concentrated at the landing. The limbs are then piled on the landing, carried back into the harvest site, or utilized for fuel.

Bucking is the process of cutting the tree into shorter lengths to meet the specifications for length, diameter, or other quality criteria required by the market(s) where the tree will be sold. Bucking is generally accomplished with chainsaws or

Figure 8. Knuckle boom loader delimbing at the landing using a pull-through delimber.

Figure 9. Buck saw, also referred to as slasher saw.

a hydraulically powered buck saw (Figure 9) (also called a slasher saw), which resembles a large chainsaw bar. While not common in Virginia, bucking can also be accomplished with a swing boom processor, a machine that has an attached processing head designed to accurately measure and buck logs to specified lengths. In some cases, no bucking is required with smaller trees, and the entire tree is loaded onto the truck after delimbing.

Chipping (Figure 10) and grinding are other forms of processing, which can occur at the landing on some operations.

Figure 10. Whole tree chipper, producing dirty chips from logging residue.

Loading

Loading, or the process of putting logs onto trucks, generally occurs at the landing and is normally handled by a knuckleboom loader. The loader is a key piece of equipment on the landing, and is typically involved in all the other processing steps. Knuckleboom loaders are often mounted on a stationary trailer, but can also be mobile if they are mounted on a tracked carrier or a truck. Other less common methods of loading include farm tractors, front-end loaders, or self-loading log trucks that have a knuckle boom loader attached to the truck. In the case of chipping operations, the chipper normally discharges directly into a trailer, often referred to as a chip van, so it chips and loads at the same time.

Trucking

Once the logs are processed, they are transported to a mill. Specific truck and trailer combinations for transporting logs to market can vary by region. The configuration can vary based on operating conditions, including type of access roads, the type of timber harvested, and the travel distances to mills. The most common log truck configuration is a tractor and trailer combination with a log trailer frame and attached bolsters (uprights) to hold logs in place (Figure 11). Other trucking configurations can include small single axle trucks, tandem or tri-axle trucks or tandem or tri-axle trucks with a pup trailer. The pup trailer holds an additional stack of logs and is towed behind the truck.

While average payloads will vary by trucking configurations, the rule of thumb for a tractor-trailer log trucking combination is about 25 tons of wood per load.

Logging business owners were asked to report the single most common method they normally use to perform each of these harvesting functions at their operations. The methods reported by logging businesses (Table 1) show considerable differences by region.

Figure 11. Common tractor trailer configuration with a 4-bolster log trailer.

Table 1. Percentage of responses received from logging businesses when asked to indicate the most common method used to perform each harvesting function on their operations.

Harvesting Function	Method / Machinery Used	Mountains (141 responses)	Piedmont (239 responses)	Coastal Plain (83 responses)
Felling	Chainsaw	91	36	9
	Rubber-tired feller-buncher	6	54	80
	Tracked feller-buncher	2	1	6
	Cut-to-length harvester	0	1	2
Skidding	Cable skidder	57	19	7
	Grapple skidder	20	64	90
	Forwarder	0	1	0
	Bulldozer	7	1	0
Delimbing	Chainsaw	88	40	21
	Pull-through delimber	8	45	65
	Chainflail delimber	0	4	3
	Delimbing gate	0	5	9
	Stroke delimber	1	1	0
Bucking	Buck or slasher saw	60	72	87
	Chainsaw	36	24	8
	Swing boom processor	0	1	0
	No bucking	1	1	4
Chipping	Whole tree (dirty/fuel) chipper	1	16	4
	Chipper with flail (clean chips)	1	1	2
	Grinder	0	0	4
Loading	Trailer mounted knuckleboom	50	76	95
	Mobile knuckleboom	37	10	3
	Self-loading trucks	3	1	0
	Front-end loader	6	8	1
Trucking	Tractor trailer	20	62	93
	Single axle	14	11	0
	Tandem axle	9	12	2
	Tandem with pup trailer	12	2	0
	Tri-axle	12	5	0
	Tri-axle with pup trailer	22	2	0

** Note that percentages do not always total to 100%. Some responses were missing, or included multiple responses, and it was not possible to determine the single most common method utilized.*

Products Produced on Logging Operations

The products produced by a logging operation will depend on the type of stand harvested and the type of harvest performed. Harvest types were grouped into four categories:

- Pine clearcut: A regeneration harvest where all merchantable trees are removed.
- Pine thinning: An intermediate treatment where some of the trees are removed to improve the growth of the remaining trees.
- Hardwood clearcut: A regeneration harvest in hardwood stands where all merchantable trees are harvested.
- Hardwood select cut or partial cut: A partial harvest in a hardwood stand. This is not a specific silvicultural treatment, and could include a number of different types of harvesting/management activities in hardwood stands.

Table 2. Percentage of harvest type reported by region.

Harvest Type	Mountains	Piedmont	Coastal Plain	Statewide Average
Pine Clear Cut	15.66	28.06	28.25	24.4
Pine Thinning	7.57	12.57	37.15	15.1
Hardwood Clear Cut	25.88	32.98	27.17	29.2
Hardwood Select Cut	50.27	26.39	7.24	31.1

The value of any individual tree depends on the price received when it is delivered to a mill as well as the cost of producing and delivering that product to the mill. Given that many mills buy wood for different purposes, different trees will have different values depending on their size, quality, species, accessibility and available markets. Loggers work to optimize the value of trees harvested based on current market conditions as well as distance and access to different markets. While markets can be complex, larger trees of satisfactory quality are more valuable and are typically sold as sawtimber and used to produce solid wood products. Smaller diameter trees and trees of lower quality are generally sold as pulpwood, and have a lower value.

The categories for products produced included the following:

- Hardwood sawtimber – Generally larger diameter and higher quality trees that are sawn into lumber for manufacturing flooring, furniture, pallets, and many other products.
- Hardwood pulpwood – Typically smaller or low quality hardwood trees that are chipped and used to make paper or other products, including oriented strand board (OSB), which utilizes small flakes of wood.
- Pine sawtimber – Generally larger diameter pine trees used for producing lumber, which is often used for construction.
- Pine pulpwood – Typically smaller or low quality pine trees that are chipped and used to make paper or other products such as oriented strand board (OSB), which utilizes small flakes of wood.
- Clean chips – Chips produced by harvesting operations in the woods, using a chain flail to remove most of the bark, limbs and foliage prior to chipping. Clean chips are used for making paper and, generally, require no further processing prior to being used for papermaking.
- Dirty chips – Produced by chipping logging residues such as limbs and tops, or by chipping whole trees, including bark, branches, and foliage. Dirty chips are also referred to as fuel chips, whole tree chips, wood fuel, or biomass, and are generally burned as boiler fuel to produce energy.

The percentages of each type of these products produced across Virginia, as reported by logging businesses, are shown in Table 3.

Table 3. Products produced in woods reported as a percentage of loggers' total production.

Products Produced	Mountains	Piedmont	Coastal Plain	Statewide Average
Hardwood Sawtimber	46.12	35.35	18.68	36.11
Hardwood Pulpwood	30.56	20.49	17.22	22.86
Pine Sawtimber	7.57	16.1	17.91	13.73
Pine Pulpwood	12.18	21.49	38.81	21.57
Clean Chips	0.35	1.81	4.53	1.76
Dirty (fuel) chips	1	4.02	1.48	2.65

Forest Harvesting Operations Across Virginia

Logging operations range from high production mechanized crews, producing more than one hundred loads per week harvesting planted pines, to smaller operations harvesting high quality hardwoods in the mountains, and some part-time operations, producing a few loads per week. While some operational differences, such as the type of equipment used and the size of operation, are based on the owner's preferences. Other factors also influence harvesting operations. Harvesting operations differ based on the topography in the area, the timber being harvested, the type of harvests performed, and the predominant markets in the region. While it is possible to see almost any type of forest harvesting operation within a given region, this section highlights the general characteristics of logging operations across the three main physiographic regions of Virginia.

Logging businesses often refer to their level of production in terms of the number of loads a crew produces in a week. Regional differences in terrain, the type of harvesting system, and the type of harvest will impact the logging crews' average weekly production. Because of the wide variety of logging operations, production levels range from one half to 100 loads or more per week, per crew. Statewide, the average production level for a logging crew is 20.4 loads per week (Figure 12). The majority of logging operations report that their average harvest size is between 20

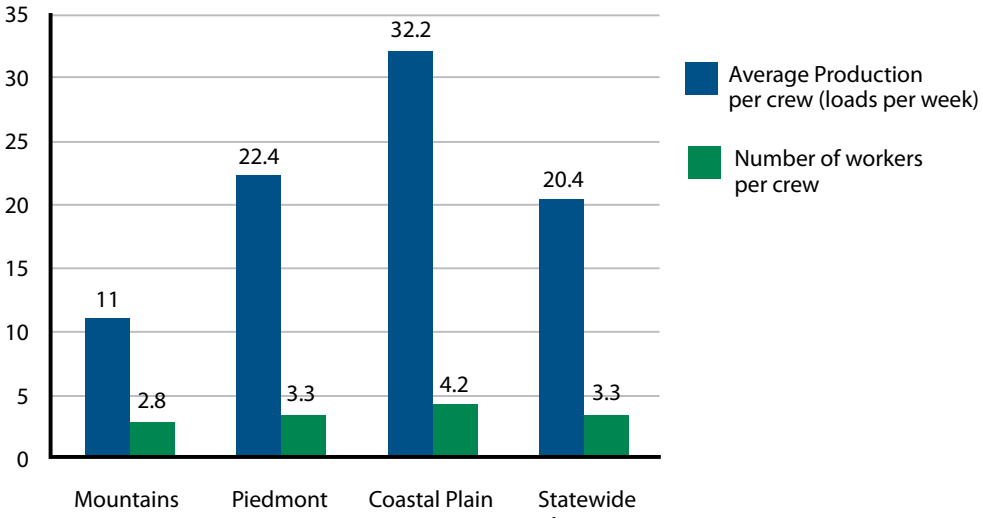

Figure 12. Average logging business production in loads per crew, per week.

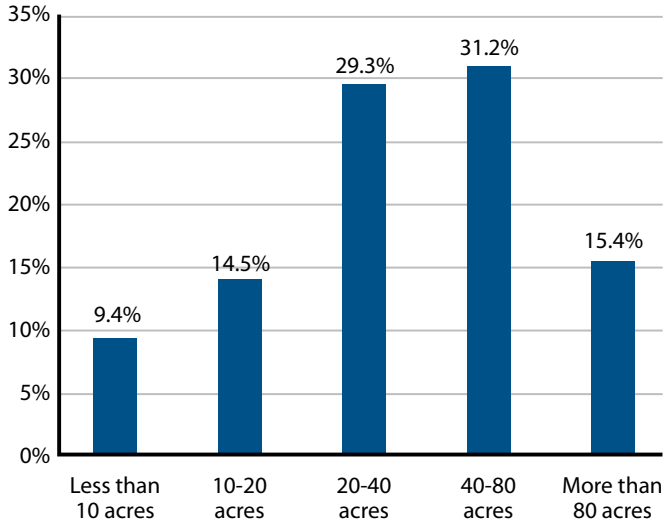

Figure 13. Average harvest size reported by logging businesses across Virginia.

and 80 acres (Figure 13). While most logging operations are generally unable to make a profit harvesting smaller tracts, close to 10 percent of loggers still report that the average tract size they harvested was 10 acres or less.

Mountains

Logging businesses in the mountains tend to be smaller than in other regions and harvests are primarily in hardwood stands. The single most common type of harvest reported by loggers in this area is a hardwood select cut. Mountain loggers have an average production rate of 11 truck loads per crew, per week, have fewer workers per crew, and are less likely to have multiple crews than in other regions of the state. The steep terrain influences harvesting systems in the mountains, and manual felling using chainsaws is the primary felling method. Cable skidders are the most common type of skidders utilized in the mountains. Hardwood sawtimber and pulpwood account for more than 75 percent of production as reported by logging businesses in the mountains. Chainsaws dominate the felling operations and are frequently used for delimbing and topping trees. However, the majority of logging operations utilize a hydraulically powered buck saw at the landing for bucking logs. Mountain logging operations have the most diversity in trucking configurations of any region. Smaller trucks, or truck and trailer combinations, are often necessary to access steep sites with narrow roads and tight turns that cannot be accessed with standard tractor-trailer combinations.

Piedmont

In terms of terrain and forest harvesting operations, the Piedmont is a transitional area between the steeper mountains to the west and the flatter Coastal Plain to the east. The Piedmont has some characteristics of operations to the east and west, but in general, the logging operations are more like those in the Coastal Plain. The majority of Piedmont operations utilize mechanized harvesting with rubber tired feller bunchers and grapple skidders, and often skid whole trees to the landing where delimbing and bucking are performed. These operations also tend to be more productive. Production rates are more than twice what they are for mountain logging operations; on average, they produce 22.4 loads per crew, per week. While hardwood harvests still represent slightly more than half the harvest types reported by piedmont loggers, hardwood clearcuts are more common than select cuts, and the amount of pine harvested increased substantially when compared to the mountains. Pine thinning and clearcuts represent more than a third of the total harvests reported by Piedmont loggers. The Piedmont also has several markets for dirty chips or biomass to produce energy and, as a result, it is much more common to find chippers on Piedmont logging operations. Throughout the entire Piedmont region, 16 percent of loggers indicated they had a chipper, and produced dirty (fuel) chips from logging residues. In some areas of the southern Piedmont, it is even more common to find loggers with chippers at their operations. Across all logging operations in the Piedmont, dirty (fuel) chips represent nearly 4 percent of all production reported by logging businesses.

Coastal Plain

In general, the Coastal Plain has the most mechanized and highest production logging operations in the state. These businesses have an average production rate of 32.2 loads per crew, per week. They are also more likely to have multiple logging crews per business owner, with an average of 1.43 crews per business. Coastal Plain operations also tend to have the highest number of workers per crew with an average of 4.2 workers per crew working in the woods. Coastal Plain logging is predominantly oriented toward pine harvesting with pine pulpwood and sawtimber, representing nearly 57 percent of the total products produced. The single most common type of harvest reported was a pine thinning operation. Chipping operations are more common in the Coastal Plain than in other regions. Although they make up a relatively small percentage of all operations, whole tree chippers with a chain flail produce clean chips, which represent about four percent of the total production reported. The most common type of harvesting equipment utilized in the Coastal Plain is a rubber-tired feller-buncher with grapple skidders and a trailer-mounted knuckle boom loader, utilizing a pull through delimber.

Summary

Virginia's logging businesses are as diverse as the state itself; however, some generalizations can be made about the characteristics of logging operations by region. Logging operations tend to increase their level of mechanization and productivity as you go from the mountains in the west to the Piedmont, then to the Coastal Plain in the east. The amount of pine harvested also tends to increase along with the size of logging crews and logging businesses as you go from west to east. Regardless of their location within the state, Virginia's logging businesses adapt their operations to utilize the resources available to them. They meet the challenges of the forests and markets, enabling forest landowners to generate income from their forests, and provide the raw material needed to run a multibillion-dollar forest industry.

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[1] Additional information on harvesting as a forest management tool can be found in other publications from Virginia Cooperative Extension at www.ext.vt.edu.

- Principles of Regeneration Silviculture in Virginia – Publication # 420-405
- An Overview of Forest Ecology and Management in Virginia – Publication # 465-315
- Sustainable Forestry: A Guide for Virginia Forest Landowners Publication – # 420-139

[2] The data on characteristics of Virginia logging businesses comes from a mail survey of participants in the Virginia SHARP logger program. The SHARP Logger program includes most Virginia logging businesses. This mail survey, based on 488 business owner responses, had an overall 59 percent rate. Data is based on information provided by individual businesses and represents small, part time logging operations as well as high production logging businesses. The averages of responses received provide a good representation of the logging workforce, but are not necessarily actual harvest and production data.


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