

# Characteristics of Virginia's Logging Businesses in a Changing Timber Market

M. Chad Bolding  
Scott M. Barrett  
John F. Munsell  
Miles C. Groover

---

## Abstract

The forest products industry is a vital component of Virginia's economy, and logging businesses, as the suppliers of raw material, are an extremely important part of this industry. How they operate, their challenges, and their ability to adapt to changing economic conditions are of interest to the entire forest products industry. To further our understanding of how Virginia loggers operate their businesses, we developed and mailed a repeatable survey instrument during the summer of 2009 to participants currently enrolled in the Virginia Sustainable Harvesting and Resource Professional logger program. Due to Virginia's distinct geographic makeup and its impact on logging system design and characteristics, results were segmented by three physiographic regions: mountains, piedmont, and coastal plain. Ninety-eight percent of respondents were men, 94 percent were Caucasian, and 49 years was the average age. Logging businesses operated with an average of 1.2 crews and 3.3 workers per crew, which varied across each region of the state. The type of harvesting system used also varied between regions as did the products harvested, production levels, use of technology, and time spent planning harvests and implementing best management practices. Business owners also indicated that their greatest challenges were finding markets for their products, the increasing costs of fuel and operation, and the prospect of fewer markets in the future. Survey results provided further insight into the characteristics of Virginia logging businesses and the challenges they face, while establishing a baseline dataset for future comparison.

---

Virginia has over 15.7 million acres of forested land, which constitutes approximately 62 percent of the total land area. Of this, 61 percent is considered commercially productive, and although forests are dominated by hardwoods, softwoods make up a large portion of harvests (Cooper and Becker 2009). Forestry is a large part of Virginia's economy. In 2006, it created over \$23 billion in total industry output and employed almost 145,000 people (Rephann 2008). There are, however, concerns for the future of forestry in the state. Continued population growth has fragmented forests in some areas, while downturns in the housing market and an economic recession have currently decreased the demand for wood. These changes have affected all components of the wood supply chain, specifically those that harvest and transport raw material. Similar challenges are being felt nationwide as logging firms cope with dynamic business models, a changing marketplace, and industry realignment.

A 2008 survey of South Carolina loggers (Moldenhauer and Bolding 2009) found that nearly half of the respondents

had modified their harvesting systems to cope with reduced tract sizes, and they expected to face continued challenges in the future with rising fuel costs, rising fixed costs, and less abundant timber. Similar concerns have been seen in other areas as well. Many logging businesses in the North Central region of the United States have faced decreasing profit margins and do not expect to be in the business in the next 5 years as a result of profitability issues (Allred 2009). Independent logging firms in Virginia, as the main suppliers

---

The authors are, respectively, Assistant Professor, Forest Operations/Engineering; Extension Associate and Virginia SHARP Logger Program Coordinator; Assistant Professor and Forest Management Extension Specialist; and Graduate Research Assistant, Forest Operations and Business, all in the Virginia Tech Dept. of Forest Resources and Environmental Conservation, Blacksburg (bolding@vt.edu, sbarrett@vt.edu, jfmunsell@vt.edu, mgroover@vt.edu). This article was received for publication in January 2010. Article no. 10720.

©Forest Products Society 2010.

Forest Prod. J. 60(1):86-93.

of raw material to manufacturing facilities, are an extremely important part of the state's forest products wood supply chain. Their ability to adapt to these growing concerns as well as to increased regulation and training requirements is important to the future of the entire forest products industry.

### **Virginia's Logging Sector**

Despite the importance of timber harvesting in the state, there have been few attempts to formally characterize Virginia's logging workforce. Although a 1993 survey conducted by the American Pulpwood Association looked at loggers across the southeastern United States, it only identified them within Virginia and did not provide information regarding demographics, production levels, or the types of systems used (Munn et al. 1998). Greene et al. (1988) were among the first to survey loggers at a statewide level and publish the results. Their first survey, conducted in 1987, established a baseline with which to compare future surveys and also provided information about the current logging community in Georgia. Most recently, Baker and Greene (2008) reported on the results of surveys conducted in 2002 and 2007. They also compared these results with those found from surveys completed in 1987, 1992, and 1997.

Similar surveys have been performed in West Virginia (Milauskas and Wang 2006), the Maine–Quebec border region (Egan and Taggart 2004), and New York (Egan 2009). These studies, as well as those performed in Georgia, have successfully described the logging communities in specific areas or documented significant changes or trends that highlight the importance of time-series research in the logging sector. They have identified factors that influence profitability and the overall health of logging businesses. Surveys have also helped to identify factors that could influence business owners in the future such as their ability to adjust to changing markets. This information is crucial to understanding how logging businesses cope with volatile markets and protracted economic downturns.

As in most states with a major forest products industry, Virginia has a logger training program that meets the requirements of the Sustainable Forestry Initiative (SFI). Virginia's Sustainable Harvesting and Resource Professional (SHARP) logger program is designed to train loggers and foresters in the state about the principles of sustainable forestry, environmental protection, and workplace safety. Instruction is provided by the Virginia Tech Department of Forest Resources and Environmental Conservation, Virginia Cooperative Extension Service, and Virginia Department of Forestry among others. Since 1996, more than 3,000 loggers, foresters, and others have received training through this program, representing the majority of logging firms that operate in Virginia. Virginia Tech Forestry Extension maintains a database of those who have completed the program. However, this database does not specify which participants are logging employees or logging business owners nor does it describe the characteristics of their logging firms.

Currently, there is little information in the literature about Virginia logging businesses. How they operate, their challenges, and their ability to adapt to changing economic conditions are of interest not only to researchers but are vital to the entire forest products industry. The objective of this study was to characterize Virginia logging businesses while establishing a time-series baseline to which future surveys

may be compared. In addition, we wanted to explain differences, if any, between loggers in the mountain, piedmont, and coastal plain regions of Virginia. This information will provide educators, professionals, and researchers the necessary tools for focusing on areas that can help the logging industry as well as serving as a reference point for identifying trends related to the state's logging community and forest products industry.

### **Methods**

To gather information about logging businesses in Virginia, a survey was constructed and a mailing list developed using the SHARP logger database during the summer of 2009. All 1,590 current SHARP loggers were included. We used a modified Dillman method that consisted of four mailings and a token of appreciation in an effort to improve the response rate (Dillman 2000). The first mailing consisted of a prenotice letter informing recipients that a survey would be mailed to them. The second mailing included a 30-question survey and letter informing the recipients they would receive 1 hour of continuing education credit for returning a completed survey. The third mailing contained a thank you letter for those who returned the survey and a reminder for those that had not. In the fourth and final mailing an additional survey was sent to nonrespondents.

The questionnaire was designed to obtain information on business owner and firm demographics, use of technology and planning, and involvement in professional associations. While no distinction was made between logging business owners and other SHARP logger participants during the mailing process, they were asked to categorize their occupation or job function on the survey. Questions about firms and their owners made up a large portion of the survey and focused on general characteristics of the owners including age, race, education level, years in the business, and area of operation. Loggers were also asked to describe their business in relation to harvesting system, products harvested, size, and use of contract trucking. Pertaining to technology and planning, there was a series of questions about what types of technology were used and how much time was spent on preharvest planning and Best Management Practice (BMP) implementation. Questions about the loggers' methods for gathering information on current events in the logging industry as well as their knowledge about the Virginia Loggers Association (VLA) and the Virginia Forestry Association (VFA) helped determine their involvement in professional organizations. They were also given an opportunity to explain the biggest problem they faced in their business using an open-ended format.

Responses were entered into a spreadsheet and numerical representations were assigned to the answers, which allowed for calculating descriptive statistics. Additionally, survey data were grouped according to the physiographic region where the respondent primarily worked. We divided the state into three distinct regions—mountains, piedmont, and coastal plain—based on the United States Forest Service's definition of Virginia's physiographic regions (Fig. 1) (Cooper and Becker 2009). Analysis of variance and the Tukey test were used to detect significant differences between responses from each region, and the chi-squared test of independence was used to analyze nominal survey data. Statistical analysis was performed using Predictive

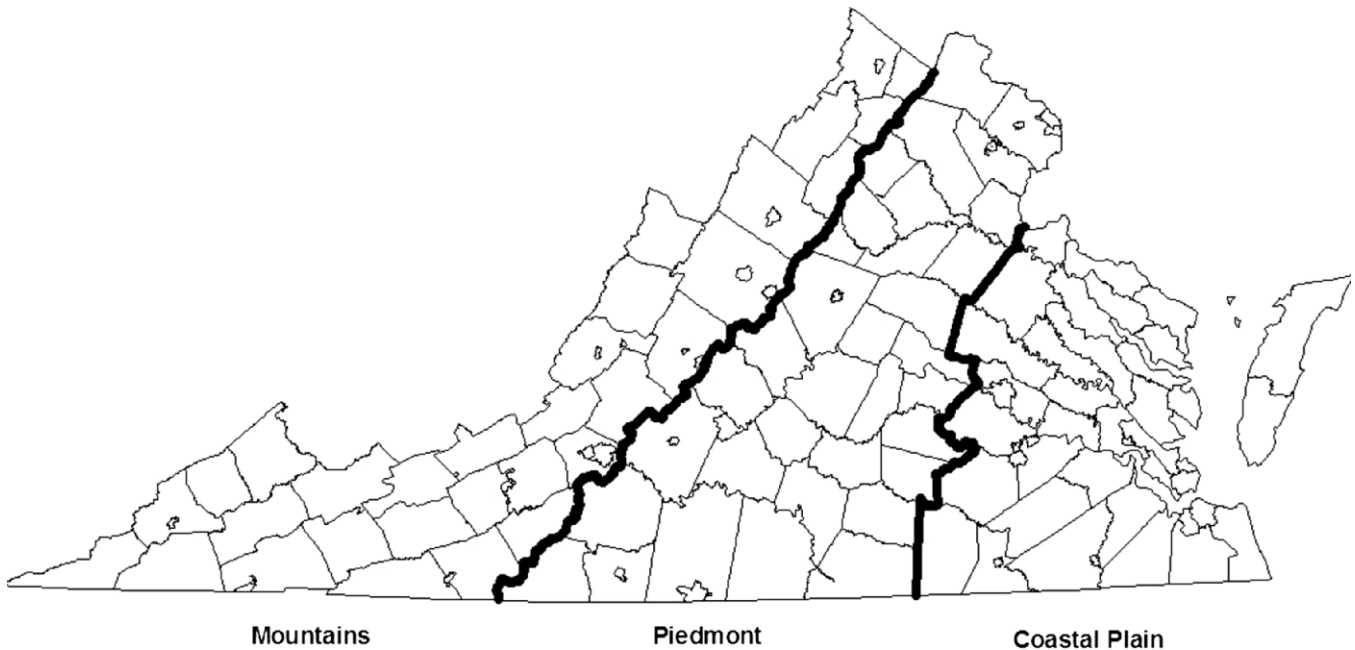


Figure 1.—Three physiographic regions of Virginia used for comparison as defined by the USFS (Cooper and Becker 2009).

Analytics Software (PASW 2009) and all tests were performed using an alpha of 0.05.

### Results and Discussion

Of the 1,590 surveys mailed, 21 were undeliverable and those loggers were removed, resulting in a population of 1,569. Nine hundred twenty-two surveys were completed and returned for an overall response rate of 58.8 percent. Of the 922 returned surveys, 488 respondents identified themselves as logging business owners. Each logging business was asked to respond only once so that firms with more than one owner would not be counted multiple times. This response rate was consistent with similar surveys (Greene et al. 1988, 1998, 2001; Egan and Taggart 2004; Milauskas and Wang 2006; Baker and Greene 2008; Egan 2009; Moldenhauer and Bolding 2009). One hundred forty-one logging business owners indicated they operated primarily in the mountains, 240 in the piedmont, and 82 in the coastal plain region of Virginia. Another 14 operated out of state while 11 did not indicate where they operated.

### Firm demographics

Because there were no significant differences in basic demographics between logging business owners in different regions, descriptive statistics were calculated for the entire group. Ninety-eight percent of respondents were male and 94.2 percent were Caucasian, 5.3 percent were African American, and less than 1 percent were Native American. They had an average age of 48.6 years and a median age of 49, which is nearly identical to the average age of 50 years reported by Baker and Greene (2008) in a survey of Georgia loggers. Comparatively, in a 2002 survey of West Virginia loggers, Milauskas and Wang (2006) found that the average logging business owner was 48 years old. In addition, Egan (2009) surveyed New York loggers and found an average age of 46.5 years. Regarding education, only 23 percent of Virginia loggers indicated that they had graduated or had

some college, while 49 percent reported they had graduated from high school. The remaining 28 percent responded that they only had some high school. As expected, younger logging business owners (age 18–34 y) were more likely to be college graduates (15.8%) versus 9.4 percent for owners  $\geq 65$  years old (Table 1). Eighty-seven percent indicated that logging was their primary occupation and had been in business an average of 25.3 years. Fourteen percent only logged part-time and had been in business an average of 18.7 years. The average logging business owner had 1.2 crews and 3.3 workers per crew.

The types of harvesting systems varied greatly across the state (Table 2). In the mountains, almost all felling and delimiting were performed with chainsaws, and a large portion of respondents indicated that bucking was also done manually. The mountains also had the highest use of cable skidders, mobile knuckleboom loaders, and the most diverse truck use with tri-axle trucks with a pup trailer and tractor trailers making up the highest percentage of responses. This is not surprising since Milauskas and Wang (2006) found that loggers in West Virginia, where the terrain is similar, performed the majority of their felling manually and skidding was performed with cable skidders. Virginia's piedmont region has terrain characteristics similar to both the mountains and coastal plain regions and may be

Table 1.—Education level and age of logging business owners in Virginia.

Education level	% of respondents by age			
	18–34 y (n = 57)	35–49 y (n = 198)	50–64 y (n = 200)	$\geq 65$ y (n = 32)
Some high school	10.5	24.2	31.5	40.6
High school graduate	56.1	54.5	42.5	34.4
Some college	17.5	11.1	13	6.3
College graduate	15.8	9.1	10	9.4
No response	0	1	3	9.4

*Table 2.—Characteristics of harvesting equipment and processes used compared among Virginia’s distinct physiographic regions.*

	% responses		
	Mountains (n = 141)	Piedmont (n = 239)	Coastal plain (n = 83)
<b>Felling</b>			
Chainsaw	91	36	9
Rubber-tired feller-buncher	6	54	80
Tracked feller-buncher	2	1	6
Cut-to-length harvester	0	1	2
Multiple	1	8	3
<b>Skidding</b>			
Cable skidder	57	19	7
Grapple skidder	20	64	90
Forwarder	0	1	0
Bulldozer	7	1	0
Multiple	16	15	3
<b>Delimiting</b>			
Chainsaw	88	40	21
Delimiting gate	0	5	9
Pull-through delimiting	8	45	65
Chainflail delimiting	0	4	3
Stroke delimiting	1	1	0
Multiple	3	5	2
<b>Bucking</b>			
Chainsaw	36	24	8
Slasher Saw	60	72	87
Swing-boom processor	0	1	0
No Bucking	1	1	4
Multiple	3	2	1
<b>Loading</b>			
Trailer mounted knuckleboom	50	76	95
Mobile knuckleboom	37	10	3
Self-loading trucks	3	1	0
Front-end loader	6	8	1
Multiple	4	5	1
<b>Trucking</b>			
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
Multiple	11	6	5
<b>Chipping</b>			
Whole tree chipper (dirty chips)	1	16	4
Whole tree chipper with flail (clean chips)	1	1	2
Horizontal tub grinder	0	0	4
Multiple	0	2	4
No chipper	98	81	86

considered a transitional area regarding logging practices. In the piedmont, 53 percent of respondents indicated that they used rubber-tired feller-bunchers while 36 percent reported that they used chainsaws for felling. Skidding was performed with grapple skidders and delimiting was performed with either a chainsaw or a pull-through delimiting. Trucking was done mostly with tractor trailers, but some was performed with single or tandem axle trucks.

Of the 61 loggers that indicated they used a chipper in their operation, 46 of those came from the piedmont meaning that nearly 20 percent of respondents in the piedmont used a chipper. In the coastal plain, almost all felling was performed with rubber-tired feller-bunchers and almost all skidding was performed with grapple skidders. Pull-through delimiting and slasher saws were the most common forms of processing, and loading was performed almost exclusively by trailer-mounted knuckleboom loaders. Tractor trailers were used nearly exclusively for trucking, and 13 percent of respondents indicated that they used a chipper in their operation. While respondents were asked to indicate only their most common method of performing each task, many indicated that they used multiple types of equipment to perform each task.

### Harvest type and production

Each geographic region has a different forested landscape, and as a result, the types of harvests performed and the products harvested varied between regions. Loggers working in the mountains most often performed hardwood select cuts, while those in the coastal plain most often performed pine thinnings or clearcuts. Statewide, the average respondent indicated that 24 percent of the harvests they performed were pine clearcuts, 15 percent pine thinnings, 30 percent hardwood clearcuts, and 31 percent hardwood select cuts. In the mountains, 52 percent of harvests performed were hardwood select cuts with another 26 percent as hardwood clearcuts (Fig. 2), and nearly 50 percent of what was harvested was hardwood sawtimber while 31 percent was hardwood pulpwood (Fig. 3). Similarly, Milauskas and Wang (2006) found that the majority of West Virginia harvests (62%) were either thinnings or diameter limit cuts. In the Virginia piedmont, 28 percent of harvests were pine clearcuts, 33 percent were hardwood clearcuts, and 27 percent were hardwood select cuts. In conjunction with the large amount of hardwood harvested, 35 percent of the harvested product was hardwood sawtimber and 21 percent was hardwood pulpwood. Another 16 percent was pine sawtimber, 22 percent was pine pulpwood, 4 percent was dirty chips, and 2 percent was clean chips. In the coastal plain, 28 percent of harvests were pine clearcuts, 37 percent were pine thinnings, and 27 percent were hardwood clearcuts. This finding is similar to that of Baker and Greene (2008) who found that only 32 percent of Georgia’s 2007 harvests were clearcuts. Almost 40 percent of coastal plain timber production was pine pulpwood with the remainder composed primarily of pine sawtimber, hardwood sawtimber, and hardwood pulpwood. As in the piedmont, only 6 percent of the production in the coastal plain was either clean or dirty chips, with 5 percent consisting of clean chips.

Loggers were also asked to estimate their production in loads per week in addition to how many crews they had and how many workers were in each crew (Table 3). The average logging business in Virginia estimated that they produced 20 loads per week. Production also varied greatly among regions, with the lowest levels of production being in the mountains, at 11 loads per week. In the piedmont, business owners reported harvesting an average of 22 loads per week. Loggers in the coastal plain reported the highest production at 32 loads per week. These differences in production levels between regions were statistically significant ( $P < 0.001$ ). Similarly, there were differences in the

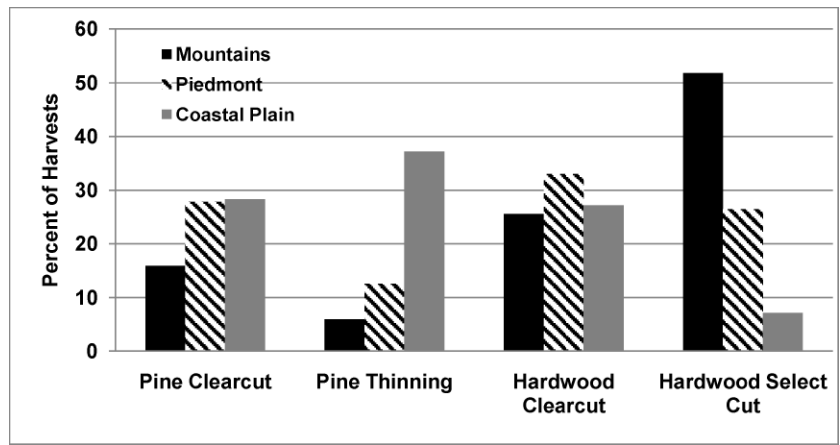


Figure 2.—Percentage of respondents indicating the type of harvest performed by physiographic region of Virginia.

number of crews per firm and workers per crew. Business owners in the mountains reported an average of 1.05 crews and 2.8 workers per crew. In the piedmont, owners had 1.12 crews and 3.26 workers per crew. In the coastal plain, however, loggers had highly mechanized operations and higher levels of production. In this region, business owners had significantly more crews ( $P < 0.001$ ) with an average of 1.43 and significantly more workers per crew ( $P < 0.001$ ) with 4.21. This is consistent with studies done in Georgia (Greene et al. 1988, 1998, 2001; Baker and Greene 2008) that found that loggers commonly used highly mechanized operations in coastal plain regions.

Statewide, Virginia loggers reported that 87 percent of their harvests were conducted on private land. In the mountains, loggers indicated that 3 percent of harvests were on United States Forest Service (USFS) land, which was significantly more than the other regions ( $P = 0.006$  and  $P = 0.022$ ), and 7 percent was on forest industry land. In the piedmont, less than 1 percent of harvesting was performed on USFS land, but nearly 3 percent was performed on Timberland Investment Management Organization (TIMO) or Real Estate Investment Trust (REIT) land. In the coastal plain, no harvesting was performed on USFS land, but 7 percent was performed on forest industry land, 12 percent

was performed on TIMO/REIT land, and 77 percent was on privately owned land. Respondents indicated that the average size of tracts harvested was between 20 and 80 acres. In the coastal plain, however, 45 percent of respondents indicated that the average tract size was between 40 and 80 acres. Distances between tracts were not significantly different by region ( $P = 0.112$ ) and 48 percent of all respondents indicated that they traveled 20 to 40 miles between tracts, while nearly 30 percent indicated they traveled less than 20 miles.

The study found that loggers' methods for acquiring timber varied by region. The mountains had the smallest percentage of logging business owners buying their timber at 23 percent, in the piedmont 33 percent purchased their own timber, and in the coastal plain 46 percent purchased their own timber. In the mountains and piedmont, a large percentage of the timber harvested was purchased by cutting on shares with the landowners (58% and 42%, respectively), but this was still a significant difference between the piedmont and mountains ( $P = 0.002$ ). In all three regions, about the same percentage reported that a company forester purchased their timber (14%), and in the coastal plain, significantly more timber (16%) was purchased by a wood dealer ( $P < 0.001$ ).

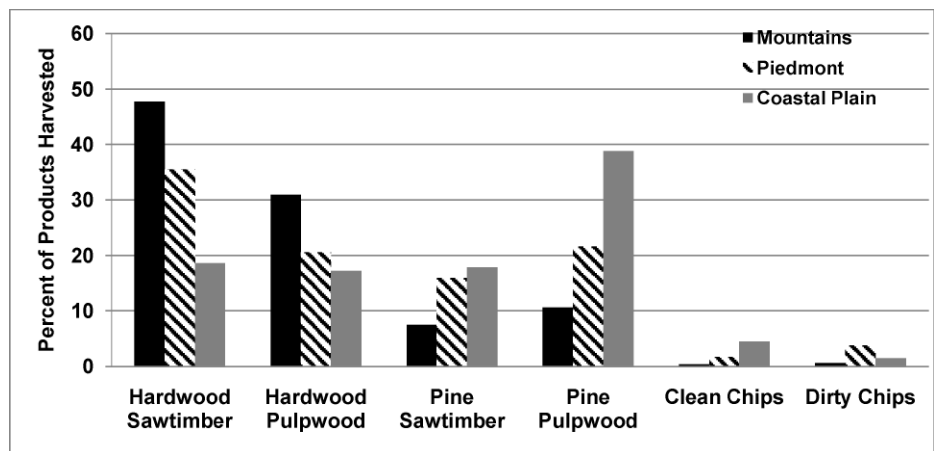


Figure 3.—Distribution of logging business owners' responses to the percentage of products harvested by physiographic region of Virginia.

**Table 3.—Descriptive statistics of logging business average production, number of crews, and crew size by physiographic region of Virginia.**

	<i>n</i>	Mean	Minimum	Maximum	SD
<b>Mountains</b>					
Loads per week	130	11.00	1	50	7.60
Crews owned	135	1.05	1	3	0.25
Workers per crew	135	2.80	1	10	1.58
<b>Piedmont</b>					
Loads per week	209	22.41	2	100	18.43
Crews owned	209	1.12	1	4	0.38
Workers per crew	207	3.31	1	10	1.63
<b>Coastal plain</b>					
Loads per week	72	32.20	3	80	16.70
Crews owned	76	1.43	1	5	0.93
Workers per crew	77	4.21	1	9	1.65
<b>Statewide</b>					
Loads per week	411	20.42	1	100	17.14
Crews owned	420	1.16	1	5	0.52
Workers per crew	419	3.28	1	10	1.66

**Table 4.—Percentage of logging firms using various types of technology in their businesses by physiographic region of Virginia.**

Type of technology	% who indicated that they used technology		
	Mountains ( <i>n</i> = 141)	Piedmont ( <i>n</i> = 239)	Coastal plain ( <i>n</i> = 83)
GPS	11	19	31
Computer mapping	9	13	20
Internet	35	37	67
E-mail	35	37	62

### Technology and professional involvement

Logging business owners were also asked if they used technologies such as GPS, computer mapping, the Internet, or e-mail (Table 4). Only 18 percent indicated that they used GPS and only 13 percent indicated they used computer mapping. Although statewide nearly 42 percent reported that they used Internet or e-mail, these percentages were lower in the mountains and piedmont at 35 and 37 percent,

respectively. However, in the coastal plain over 60 percent of respondents indicated that they used Internet or e-mail. Based on responses, a reasonable explanation for this may be the size of operations in the coastal plain. Because logging business owners have higher levels of production, more crews, and more workers per crew, it is reasonable to assume that they have more invested in their business and adapting technology for business management is warranted. The use of technology also increased with education level as college graduates were more likely to use the Internet (82%) than those with some high school (28%), a high school diploma (41%), and some college (43%; Table 5). Firms in the coastal plain also gathered information on current events from more diverse sources. Loggers were asked if they gathered information on current events from trade magazines, the Internet, associations, word of mouth, or company foresters, or if they did not look for information on current events. Nearly 65 percent of all respondents indicated that they gathered information through word of mouth, but there was a higher percentage of respondents in the coastal plain that gathered information from other sources.

Logging firms were also asked about their involvement in professional organizations. Specifically, we wanted to determine if they knew about and/or were members of the VLA and the VFA. Statewide, 89 percent indicated that they knew about the VLA and 32 percent reported that they were members. The VFA was slightly less known with 83 percent of respondents reporting that they knew about it and only 26 percent reporting they were members. The mountain respondents had the lowest percentage of respondents informed about (85%) and involved in (15%) both organizations, while those in the coastal plain had the highest percentage with 95 percent informed about the organizations and 50 percent involved. The piedmont respondents were only slightly less, with 90 percent informed about the organizations and 30 percent involved in them. Business owners' education level had little influence on whether loggers were aware of the VLA or VFA; however, the likelihood of membership substantially increased with education level (Table 5).

Business owners were asked to indicate how much time they spent planning harvests (Fig. 4) and implementing BMPs (Fig. 5). In the mountains and piedmont there were no significant differences between how much time was spent planning a harvest ( $P = 0.41$ ), but respondents from the mountains indicated that they spent more time implement-

**Table 5.—Education level of logging business owners in Virginia as an indicator of the type of technology used and their involvement in professional organizations.**

Type of technology	% who indicated they used technology or replied yes to involvement			
	Some high school ( <i>n</i> = 130)	High school graduate ( <i>n</i> = 237)	Some college ( <i>n</i> = 60)	College graduate ( <i>n</i> = 50)
GPS	12	13	28	46
Computer Mapping	8	11	23	30
Internet	28	41	43	82
E-mail	30	41	50	76
<b>Involvement</b>				
Aware of VLA	85	87	90	88
In VLA	29	28	30	40
Aware of VFA	80	81	88	84
In VFA	20	20	32	42

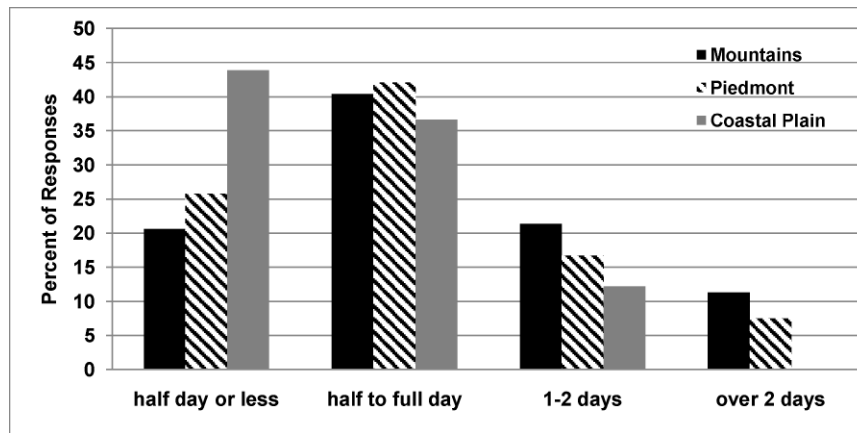


Figure 4.—The number of days spent planning harvests as indicated by logging business owners by physiographic region of Virginia.

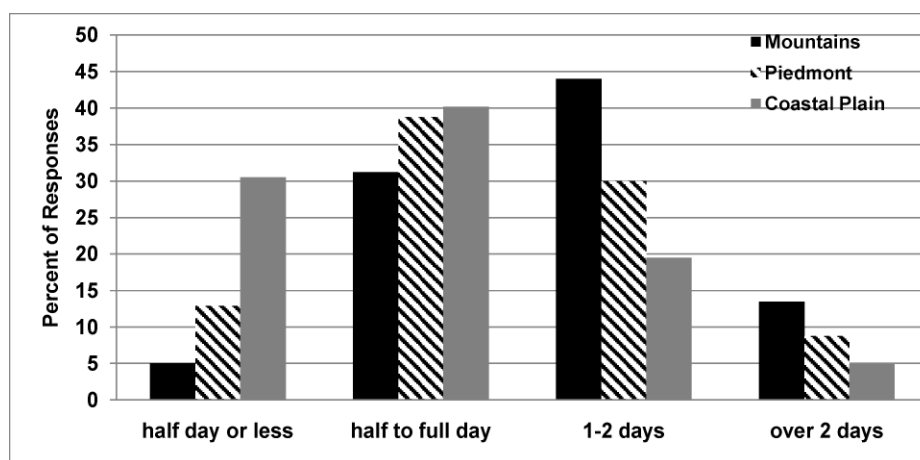


Figure 5.—The number of days spent implementing best management practices as indicated by logging business owners by physiographic region of Virginia.

ing BMPs ( $P < 0.001$ ). In the coastal plain, nearly all of the respondents spent a full day or less planning or implementing BMPs. This is likely a result of terrain differences between regions. More time is required to plan a harvest and implement BMPs in steep mountainous terrain compared with the coastal plain. A portion of the piedmont has terrain similar to that of the mountains and may account for the similarities in time spent planning and implementing BMPs. However, there was still a significant difference in the time spent implementing BMPs ( $P = 0.001$ ).

When logging business owners were asked to describe the biggest problem they faced in their business, there was a wide range of answers. Some of the most common responses were a lack of markets for their products or low prices, increasing operation costs, and declining wood markets in the future. There were also a large number of business owners that were concerned about fuel prices, the future of the profession, and recruiting qualified employees to sustain their businesses. This is similar to the findings of Egan and Taggart (2004) who performed a survey of loggers operating in the Maine–Quebec border region. They found the average age of loggers that expected to stay in the business was 43 years, while the average age of those that

did not expect to stay in the business was 51 years. They also found that those who intended to stay in the logging business were more educated and more often had relatives that were also in the logging business. In addition, Egan (2009) found that more than half of New York loggers indicated that the most common barriers to maintaining or expanding logging businesses were the high costs of fuel, insurance, and equipment.

## Conclusions

Virginia has a diverse logging community, and although logging business owners are similar in age and education, their operations are very different across the different regions of the state. Logging firms in the mountain region perform a larger percentage of their felling manually and have smaller crews and lower production. Mechanization, crew size, and production tend to increase from west to east, with the coastal plain region producing nearly 12 loads more per week than the statewide average. In addition to producing more volume, firms in the coastal plain are more likely to use technologies such as GPS, computer mapping, Internet, and e-mail, and are often involved in professional organizations.

Many logging businesses throughout Virginia expressed concerns about a lack of markets for their products and declining markets in the future. In light of recent mill closures and market volatility, further research is needed to understand how these difficult conditions are affecting the logging workforce and its capacity. This is a significant area of concern for many reasons, including recruiting the next generation of loggers. Other time-series survey studies have found an aging workforce that is having difficulty recruiting new workers and attracting them away from competing industries. Future studies that focus on recruitment and retention mechanisms as well as new market opportunities are warranted to maintain the viability of the forest operations workforce. Some business owners, especially in the piedmont region, are beginning to capitalize on the biomass wood-to-energy market throughout Virginia as shown by the number of respondents with a whole tree (dirty) chipper. However, this market is regional in nature and focused predominately around wood-burning power generation facilities. A more widespread and stable market is needed to have a substantial positive impact on Virginia's logging workforce.

### Acknowledgments

The authors thank Mr. Jim Mooney of the Virginia Logger's Association for his assistance. This study was supported by the Virginia Tech Forest Operations and Business Research Cooperative and the Virginia SHARP Logger Program, which is funded by the Virginia Sustainable Forestry Initiative Implementation Committee.

### Literature Cited

- Allred, S. B. 2009. Logging firm succession and retention. *Forest Prod. J.* 59(6):31–36.
- Baker, S. and W. D. Greene. 2008. Changes in Georgia's logging workforce, 1987–2007. *South. J. Appl. Forestry* 32(2):60–68.
- Cooper, J. A. and C. W. Becker. 2009. Virginia's timber industry—An assessment of timber product output and use, 2007. Resource Bulletin SRS-155. USDA Forest Service, Southern Research Station, Asheville, North Carolina. 33 pp.
- Dillman, D. A. 2000. *Mail and Internet Surveys: The Tailored Design Method*. John Wiley and Sons, New York. 480 pp.
- Egan, A. 2009. Characteristics of New York's logging businesses and logging business owners. *North. J. Appl. Forestry* 26(3):106–110.
- Egan, A. and D. Taggart. 2004. Who will log in Maine's north woods? A cross-cultural study of occupational choice and prestige. *North. J. Appl. Forestry* 21(4):200–208.
- Greene, W. D., F. Cabbage, and J. McNeel. 1988. Characteristics of independent loggers in Georgia. *Forest Prod. J.* 38(7/8):51–56.
- Greene, W. D., B. Jackson, and J. Culpepper. 2001. Georgia's logging businesses, 1987–1997. *Forest Prod. J.* 51(1):25–28.
- Greene, W. D., B. Jackson, and D. Woodruff. 1998. Characteristics of logging contractors and their employees in Georgia. *Forest Prod. J.* 48(1):47–53.
- Milauskas, S. and J. Wang. 2006. West Virginia logger characteristics. *Forest Prod. J.* 56(2):19–24.
- Moldenhauer, M. C. and M. C. Bolding. 2009. Parcelization of South Carolina's private forestland: Loggers' reactions to a growing threat. *Forest Prod. J.* 59(6):37–43.
- Munn, I. A., J. B. Cutshall, and D. G. Hodges. 1998. 1993 Pulpwood logging contractor survey. *Forest Prod. J.* 48(7/8):47–53.
- PASW. 2009. Predictive Analytics Software (PASW) Statistics 17.0.2. Release March 11, 2009. SPSS, Inc., Chicago, Illinois.
- Rephann, T. J. 2008. The economic impact of agriculture and forestry on the Commonwealth of Virginia. Weldon Cooper Center for Public Service, University of Virginia, Charlottesville. 56 pp.