

# **Minnesota Loggers and Invasive Forest Plants: Attitudes, Behaviors and Concerns<sup>1</sup>**

by

**Stephanie A. Snyder, Charles R. Blinn, and Rachel R. Peterson<sup>2</sup>**

**Staff Paper Series No. 257**

**Department of Forest Resources**

September 2019

College of Food, Agricultural and Natural Resource Sciences  
University of Minnesota  
St. Paul, MN

---

<sup>1</sup>This research was supported by the Minnesota SFI State Implementation Committee, the Minnesota Logger Education Program, Minnesota Forest Industries, the USDA Forest Service Northern Research Station, the University of Minnesota's Department of Forest Resources, and the Minnesota Agricultural Experiment Station under Projects MN 42-057 and MN 42-072. We are grateful to all of the logging business owners who participated in this study. The findings and conclusions in this publication are those of the author(s) and should not be construed to represent any official USDA or U.S. Government determination or policy.

<sup>2</sup>The authors are, respectively, Operations Research Analyst, USDA Forest Service, Northern Research Station, People and their Environments Unit, St. Paul, MN; Professor and Extension Specialist, Department of Forest Resources, University of Minnesota, St. Paul, MN; and Executive Director, Minnesota Logger Education Program, Cloquet, MN.

For more information about the Department of Forest Resources and its teaching, research, and outreach programs, contact the department at:

Department of Forest Resources  
University of Minnesota  
115 Green Hall  
1530 Cleveland Avenue North  
St. Paul, MN 55108-6112  
Phone: 612.624.3400  
Fax: 612.625.5212  
Email: [frweb@umn.edu](mailto:frweb@umn.edu)

Webpage: [www.forestry.umn.edu/publications/staff-paper-series](http://www.forestry.umn.edu/publications/staff-paper-series)

The University of Minnesota is committed to the policy that all persons shall have equal access to its programs, facilities, and employment without regard to race, color, creed, religion, national origin, sex, age, marital status, disability, public assistance status, veteran status, or sexual orientation.

## Table of Contents

List of Figures.....	ii
List of Tables.....	iii
Introduction.....	1
Methods.....	2
Analysis.....	5
Discussion.....	61
Conclusions.....	63
Bibliography.....	65
Appendices.....	67

## List of Figures

Figure 1. Distribution of respondents by timber volume size class (N=123).....	4
Figure 2. Distribution of respondents by Minnesota county and MnDNR forestry region.....	6
Figure 3. Summary of respondent’s business location by MnDNR forestry region (N=132; with percentages within each region) and the distribution of the MLEP entire logging business owner membership (N=367) during 2016.....	7
Figure 4. General level of knowledge about invasive forest plants by Minnesota logging business owners (Percent of respondents) (N=130).....	8
Figure 5. General level knowledge about invasive forest plants by Minnesota logging business owners and MnDNR forestry region (Percent of respondents) (N=130).....	9
Figure 6. General level knowledge about invasive forest plants by annual timber volume size class (Percent of respondents) (N=121).....	9
Figure 7. General level of knowledge about invasive forest plants by seasonality of operations (Percent of respondents) (N=126).....	10
Figure 8. Confidence in being able to identify specific invasive plants in the woods (Percent of respondents) (N=131).....	11
Figure 9. Percent of timber sales in the past 12 months in which invasive species were present (Percent of Respondents) (N=130).....	12
Figure 10. Percent of respondents noticing an increase in timber with invasive plants in the past three years (Percent of respondents) (N=130).....	13
Figure 11. Percent of respondents noticing an increase in timber sales with invasives in the past three years by MnDNR forestry region (Percent of respondents) (N=127).....	14
Figure 12. Percent of respondents noticing an increase in timber sales with invasives in the past three years by timber volume size class (Percent of respondents) (N=118).....	15
Figure 13. Sources consulted for information on invasive forest plants (Percent of respondents) (N=125).....	16
Figure 14. Rating of perceived degree of difficulty to implement potential invasive forest plant BMP practices (Percent of respondents).....	18
Figure 15. Perceived impact of invasive forest plant BMPs on logging business operations (Percent of respondents) (N=126).....	19

Figure 16. Perceived impact of invasive forest BMPs on logging business operations by MnDNR forestry region (Percent of respondents) (N=126).....	19
Figure 17. Perceived impact of invasive forest plant BMPs on logging business operations by timber volume size class (Percent of respondents) (N=119).....	20
Figure 18. Preference for voluntary versus regulatory invasive plant BMP program (Percent of respondents) (N=125).....	20
Figure 19. Development of invasive plant treatment and removal expertise (Percent of respondents) (N=125 and N=128).....	21
Figure 20. Degree of interest in developing invasive plant treatment and removal expertise (Percent of respondents) (N=119).....	22
Figure 21. Degree of interest in developing invasive plant treatment and removal expertise by MnDNR forestry region (Percent of respondents) (N=119).....	23
Figure 22. Degree of interest in developing invasive plant treatment and removal expertise by annual timber volume size class (Percent of respondents) (N=114).....	24
Figure 23. Percent of land owners/managers who had discussed invasive plants with logging business owners on their timber sales in the past twelve months (Percent of respondents) (N=100 for private lands and 97 for public lands).....	26
Figure 24. Activities contractually undertaken on public timber sales in the previous twelve months to avoid the introduction and spread of invasives by MnDNR forestry region (Percent of respondents) (N=117).....	29
Figure 25. Activities contractually undertaken on public timber sales in the previous twelve months to avoid the introduction and spread of invasives by timber volume size class (Percent of respondents) (N=111).....	30
Figure 26. Activities contractually undertaken on private timber sales in the previous twelve months to avoid the introduction and spread of invasives by MnDNR forestry region (Percent of respondents) (N=117).....	31
Figure 27. Activities contractually undertaken on private timber sales in the previous twelve months to avoid the introduction and spread of invasives by timber volume size class (Percent of respondents) (N=111).....	32
Figure 28. Activities voluntarily undertaken on public timber sales in the previous twelve months to avoid the introduction and spread of invasives by MnDNR forestry region (Percent of respondents) (N=119).....	34

Figure 29. Activities voluntarily undertaken on public timber sales in the previous twelve months to avoid the introduction and spread of invasives by timber volume size class (Percent of respondents) (N=113).....	35
Figure 30. Activities voluntarily undertaken on private timber sales in the previous twelve months to avoid the introduction and spread of invasives by MnDNR forestry region (Percent of respondents) (N=119).....	36
Figure 31. Activities voluntarily undertaken on private timber sales in the previous twelve months to avoid the introduction and spread of invasives by timber volume size class (Percent of respondents) (N=113).....	37
Figure 32. Reduced interest in purchasing a timber sale when invasive plants are present (N=122 for private land timber sales and N=116 for public land timber sales) (Percent of respondents). ....	39
Figure 33. Reduced interest in purchasing a public timber sale when invasive plants are present by MnDNR forestry region (N=116) (Percent of respondents).....	40
Figure 34. Reduced interest in purchasing a private timber sale when invasive plants are present by MnDNR forestry region (N=122) (Percent of respondents).....	40
Figure 35. Reduced interest in purchasing a public timber sale when invasive plants are present by timber volume size class (N=112) (Percent of respondents).....	41
Figure 36. Reduced interest in purchasing a private timber sale when invasive plants are present by timber volume size class (N=116) (Percent of respondents).....	41
Figure 37. Reduced interest in purchasing a timber sale if invasive plant BMPs were to be required (N=128 for private land and N=126 for public land timber sales) (Percent of respondents).....	42
Figure 38. Reduced interest in purchasing a public timber sale if invasive plant BMPs were to be required, by MnDNR forestry region (N=126) (Percent of respondents).....	43
Figure 39. Reduced interest in purchasing a private timber sale if invasive plant BMPs were to be required, by MNDNR forestry region (N=128) (Percent of respondents).....	43
Figure 40. Reduced interest in purchasing a public timber sale if invasive plant BMPs were to be required, by timber volume size class (N=120) (Percent of respondents).....	44
Figure 41. Reduced interest in purchasing a private timber sale if invasive plant BMPs were to be required, by timber volume size class (N=121) (Percent of respondents).....	44

Figure 42. Organizations that loggers would report invasives to if encountered on a timber sale (Percent of respondents) (N=125 private land timber sales and N=124 public land timber sales) (Respondents could indicate more than one organization).....	45
Figure 43. Percent of respondents ranking a training topic as most important (N=82).....	47
Figure 44. Preferred methods to learn about invasive forest plants (N=127).....	48
Figure 45. Distribution of logging businesses by timber volume harvested in the past twelve months (Percent of respondents (N=123).....	49
Figure 46. Distribution of logging businesses by MnDNR forestry region by timber volume in the past twelve months (Percent of respondents) (N=123).....	49
Figure 47. Distribution of logging businesses who produced 1,000 cords in the past twelve months (“Small Producers”) and logging businesses who produced more than 15,000 cords in the past twelve months (“Large Producers”) by MnDNR forestry region (Percent of respondents) (N=27 for “Large Producers” and N=32 for “Small Producers”).....	50
Figure 48. Seasonality of logging business operations (Percent of respondents) (N=128).....	51
Figure 49. Season of logging operation by MnDNR forestry region (Percent of respondents) (N=128).....	51
Figure 50. Seasons of logging operations by timber volume size class (Percent of respondents) (N=123).....	52
Figure 51. Distribution of businesses by season of operation and timber volume size class (Percent of respondents) (N=114).....	53
Figure 52. Harvests on SFI-certified lands in the past twelve months (Percent of respondents) (N=126).....	54
Figure 53. Average percent of timber sale volume by land ownership type (Percent of respondents) (N=123).....	55

## List of Tables

Table 1. Summary of questions examined using Fisher’s exact test of independence by MnDNR forestry region, annual timber volume size class, and season of operation.....	4
Table 2. Summary of number of respondents by MnDNR forestry region and county (n=132)....	4
Table 3. Degree of difficulty implementing invasive forest plant BMP business practices (Percent of respondents).....	17
Table 4. Percent of respondents who provided information or advice on various invasive plant topics to land owners/land managers on timber sales in the past twelve months.....	27
Table 5. Invasive plant control and treatment activities contractually and voluntarily undertaken on timber sales in the previous twelve months.....	28
Table 6. Chi-square tests of relationship between contractual and voluntary invasive plant control activities undertaken on timber sales in the previous twelve months (Percent of respondents).....	38
Table 7. Ranking of information needs (Percent of respondents) (N=82).....	46

## INTRODUCTION

Invasive plants are non-native species that are likely to cause economic or environmental damage, or harm to the health of other organisms (Beck et al. 2008). Invasive plants aggressively compete with native plant species and often displace them in forested ecosystems. They can greatly impact the health and regeneration of forest lands through reduced forest productivity, degraded soil and competition (Holmes et al. 2009). Additionally, invasive plants can adversely impact wildlife habitat and decrease suitability for a variety of recreational opportunities. In a survey of landowners and public land professionals in Minnesota, concerns were raised about the potential impact of invasive plants on conservation and ecological values, forest regeneration efforts, recreational activities, and game species (Reinhardt et al. 2019).

Invasive plants can be introduced into forested ecosystems through many mechanisms, including purposeful planting for landscaping, erosion control and wildlife habitat improvement (Reichard and White 2001); as well as floods, wind, animals and people that can spread seeds (Pickering et al. 2010; Rew et al. 2018). Invasive species can establish or spread during activities which disturb vegetative cover or expose soil, including grazing, road building, fire suppression activities, and recreation (Parks et al. 2005). Timber harvesting and associated road building and infrastructure, as one form of disturbance, can create opportunities for invasive plants to be introduced (Rauschert et al. 2017; Setterfield et al. 2005). Logging activities can contribute to the introduction and spread of invasives when seeds of invasive species become attached to logging and trucking equipment, employee or service vehicles driven to job sites, or boots. If the equipment isn't thoroughly cleaned when moving between harvesting sites, seeds can be spread and deposited as the equipment is moved (Veldman and Putz 2010). Higher concentrations of invasive plants have been correlated with proximity to infrastructure (i.e., roads, skid trails, landings) (Buckley et al. 2003; Wangen et al. 2006; Mortensen et al. 2009). However, while infrastructure is developed in order to access stands for harvesting, it is often used for other purposes (e.g., recreation corridors) after the harvest activity is complete (Anderson et al. 2015).

While best management practices (BMPs) for invasive forest plants have not been formally developed for loggers to follow when conducting harvest activities in Minnesota, timber sale contracts on public lands do typically require some efforts related to preventing the introduction and spread of invasive plants. On Forest Service land, timber sale contracts identify the location of known invasive plant infestations and outline conditions for cleaning logging equipment (USDA Forest Service, 2006). Specifically, logging equipment must be cleaned prior to moving into a cutting area of a Forest Service sale if it was last operating in an area known to contain invasive plants. Equipment must also be cleaned before moving between cutting units of the same sale if operations have occurred in an area with known invasives. Operators are instructed to clean their equipment of seeds, soil, vegetative matter, and other debris that could contain invasive forest plant material. On timber sales within Minnesota DNR-administered land, loggers are asked to voluntarily comply with guidelines designed to reduce the introduction and spread of invasive plants. These voluntary guidelines outline activities which include inspecting and cleaning equipment before entering and leaving a site

([http://files.dnr.state.mn.us/assistance/backyard/treecare/forest\\_health/timberInvasiveBrochure\\_web.pdf](http://files.dnr.state.mn.us/assistance/backyard/treecare/forest_health/timberInvasiveBrochure_web.pdf)). Few counties address forest invasive plants in their sale prospectus information they make available to potential buyers or in contract language.

Logging firms generally operate on multiple tracts across the landscape in a given year. For example, Minnesota logging businesses reported harvesting an average of 9.2 tracts (median of 6 tracts) in 2016 (Blinn et al. 2018). Due to this operational mobility they have the potential to recognize, come into contact with, and potentially introduce and spread invasive plants across the landscape. Loggers may play a key role as early detectors of invasive plants on family owned forests as they may be the only professionals with the opportunity to observe invasive plants and suggest activities to manage them on family owned lands. This is because, while timber sales on public lands are developed and administered by agency foresters, this is not necessarily the case with family owned forest land.

In spite of the role that loggers could play in helping to prevent the introduction and spread of invasives, we are not aware of any literature that has examined loggers' awareness, behaviors and information needs relative to invasive forest plants. To address this knowledge gap, logging business owners who were members of the Minnesota Logger Education Program (MLEP) were surveyed in Spring 2018 to gather baseline data regarding their: a) Awareness and knowledge of invasive plants, b) interactions with private landowners and public land managers with regard to invasive plants, c) business practices relative to invasive forest plants and what they may be doing to limit the introduction and spread of invasives when working in the woods, d) impact of controlling invasive plants on their business operations, e) interest in developing invasive plant expertise and services as an additional business offering, e) information and training needs regarding invasive plant identification and control, and f) company demographics. Learning more about these questions will provide Information to help inform logger training efforts for invasive forest plant management.

## **METHODS**

A mail survey was developed and administered to the logging business owners who were Minnesota Logger Education Program (MLEP) members as of spring 2018 (n=359). MLEP is a private non-profit educational corporation which provides professional development for Minnesota's logging industry. MLEP membership allows for training as required to meet program standards for agency land and industry certification. The MLEP defines a logging business as a sole-proprietorship, partnership or corporation that purchases stumpage and/or is an independent contract logger, controls timber harvesting and owns timber harvesting equipment ([mlep.org/membership.htm](http://mlep.org/membership.htm)). While a logging business may have multiple owners, the MLEP database has one key contact person per firm. The survey questions were worded to indicate that the respondent should consider actions of themselves and/or their employees. As each owner of the business was responding on behalf of themselves and their in-woods employees, the unit of analysis of our study was the logging business.

The draft survey was reviewed by the Minnesota SFI Implementation Committee, Minnesota Forest Industries, MLEP, Minnesota DNR (MnDNR), Minnesota Department of Agriculture, and the University of Minnesota for content and clarity. The survey was also pre-tested with two focus groups at the MLEP Logger Conferences during the spring of 2017 in northern Minnesota. Modifications to the survey instrument were made in response to comments received from those vetting steps to improve focus and

clarity. The final version of the survey contained 29 questions (A copy of the questionnaire is provided in Appendix 1). The survey was administered between March 14 and April 27, 2018 by the University of Minnesota in conjunction with MLEP and the Minnesota Sustainable Forestry Initiative Implementation Committee.

Following a modified tailored design method (Dillman 2000), a total of five contacts were made with potential respondents: a pre-notice postcard (Appendix 2), an initial full mailing (i.e., cover letter, questionnaire, postage-paid return envelope) (Appendix 3), a reminder postcard sent two weeks after the initial mailing (Appendix 4), a second full mailing sent to non-respondents four weeks after the initial full mailing (Appendix 5), and a final letter after the second full mailing to thank respondents and to encourage non-respondents to submit a completed survey (Appendix 6). The survey was designed as a double-blind study, where MLEP created a unique code with two letters and two numbers which was printed on each survey. Surveys were to be returned to the University of Minnesota where MLEP was notified of the codes as surveys were received. The survey documentation received an exemption from review through the Institutional Review Board at the University of Minnesota. The survey was administered between March 14 and April 27, 2018.

Of the 359 surveys that were mailed, responses were received from 135 individuals for an overall response rate of 38% and a useable response rate was 37%. To check for nonresponse bias, the initial quartile of respondents (based on when the completed survey was received) was compared to the last quartile following Armstrong and Overton (1977). Chi-square tests revealed that late responders were slightly more likely to be larger producers (e.g., had harvested at least 15,000 cords of timber volume in the past 12 months) ( $\chi^2(1, N=63) = 5.03, p=0.02$ ), and winter-only harvesting operations ( $\chi^2(1, N=63) = 4.00, p=0.05$ ). However, no significant differences were found between early and late responders relative to their general level of knowledge about invasive forest plants, perceived impacts of invasive plant best management practices (BMPs) on their business operations, level of interest in developing invasive plant treatment or removal expertise, or level of interest in purchasing a timber sale when invasive forest plants are known to be present.

Summary statistics and figures were prepared using Excel. After entry, error checking was conducted where all entries for every survey were reviewed. All identified errors were corrected during that process. Basic summary statistics and figures were calculated using Excel, and tests of difference were computed with SAS version 9.4. Eighty percent of the respondents provided responses to open-ended questions. These qualitative data were examined and grouped into major themes. Segmentations of some of the questions were examined by MnDNR forestry regions using Fisher's exact test of independence (Fisher 1992) to determine whether regional differences existed among respondents. Post-hoc tests were performed when the global test was significant through pairwise comparisons with Bonferroni corrections (Armstrong 2014).

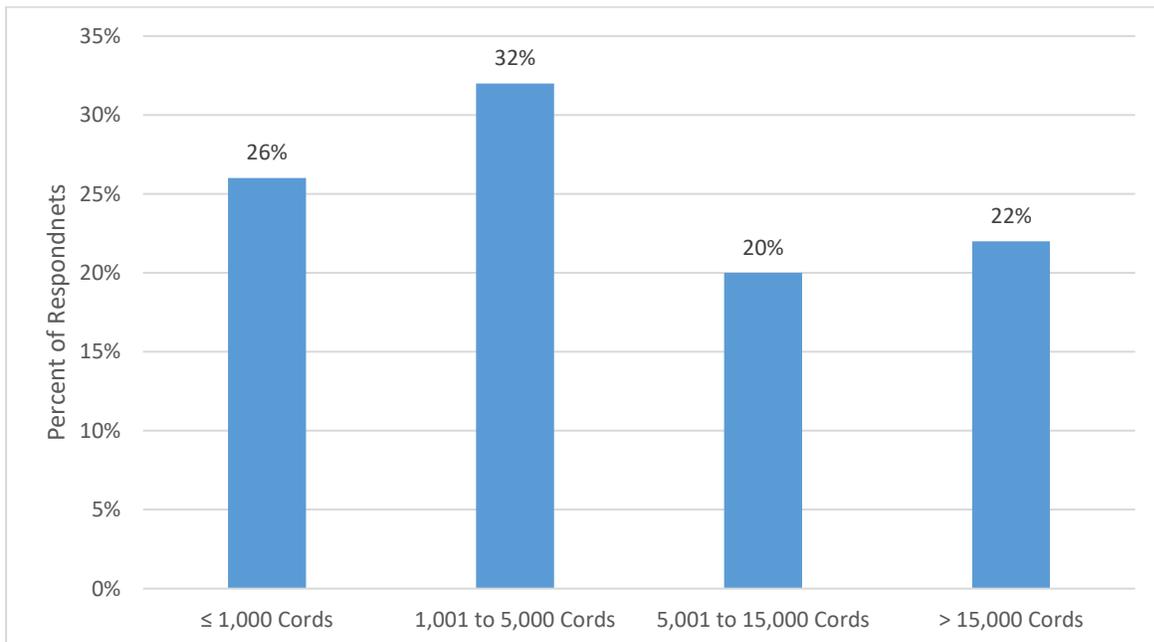
The questions that were evaluated by MnDNR forestry region are listed in Table 1:

**Table 1.** Summary of questions examined using Fisher’s exact text of independence by MnDNR forestry region, annual timber volume size class, and season of operation.

Question Number	Question Topic
1	General level of knowledge about invasive forest plants in Minnesota
4	Perceptions of an increase in the percentage of timber sales with invasive plants over the past three years
7	Perceived impact of a forest invasives BMP program
13	Interest in developing expertise in invasive forest plant treatment or removal
17	Contractually required invasive plant activities
18	Voluntary invasive plant activities undertaken
19	Reduced interest in purchasing a public land timber sale when invasive plants are present
20	Reduced interest in purchasing a public land timber sale when invasive plant BMPs must be followed
25	Amount of timber volume harvested in past twelve months
26	Seasons in which logging businesses operate

A second segmentation, of the same survey questions listed in Table 1, was done by annual timber volume size classes: 1,000 cords or less; 1,001 to 5,000 cords; 5,001-15,000 cords; and greater than 15,000 cords (Figure 1) to evaluate whether attitudes and activities related to invasive plants varied by business size.

**Figure 1.** Distribution of respondents by timber volume size class (N=123).



Finally, questions in Table 1 were segmented by whether a respondent’s business was a winter-only logging operation (24%), versus operation in other combinations of seasons (76%). These analyses were

motivated by the fact that winter-only logging businesses would be less likely to see invasive plants due to snow cover, plant dormancy, lack of leaves and flowers on plants, and winter die-back of vegetation.

## ANALYSIS

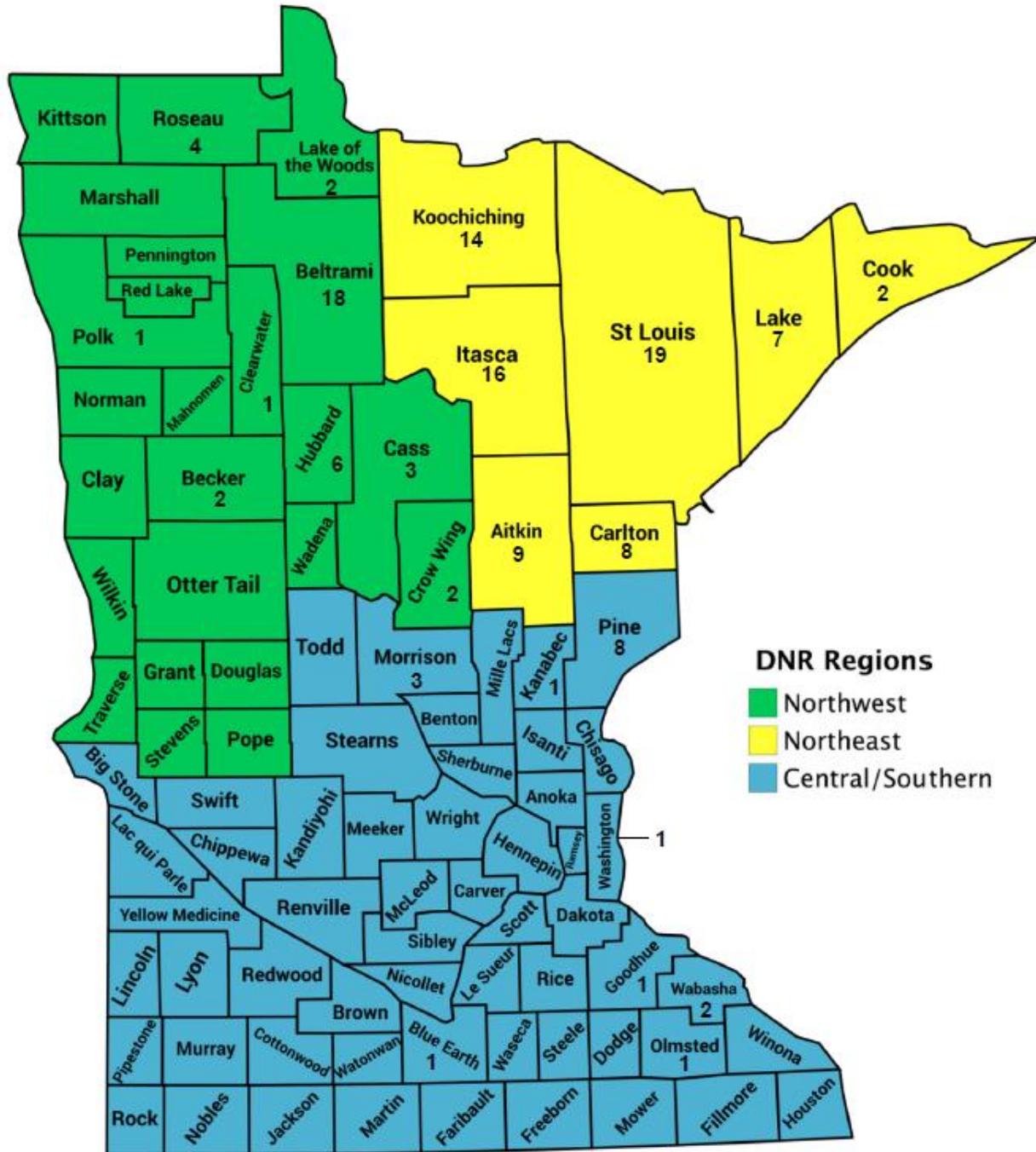
### Responses by County

The distribution of responses indicating where the respondent’s logging business was located (and not where their timber was harvested) by county and MnDNR forestry region is shown in Table 2 and Figure 2. Because of the relatively low number of MLEP members in the central and southern regions, data from those regions were combined for analysis and reporting purposes.

**Table 2.** Summary of number of respondents by MnDNR forestry region and county (n = 132).

County	Number of respondents
<b>DNR Northwest Region</b>	
Becker	2
Beltrami	18
Cass	3
Clearwater	1
Crow Wing	2
Hubbard	6
Lake of the Woods	2
Polk	1
Roseau	4
<b>DNR Northeast Region</b>	
Aitkin	9
Carlton	8
Cook	2
Itasca	16
Koochiching	14
Lake	7
St. Louis	19
<b>DNR Central/Southern Region</b>	
Blue Earth	1
Goodhue	1
Kanabec	1
Morrison	3
Olmsted	1
Pine	8
Wabasha	2
Washington	1

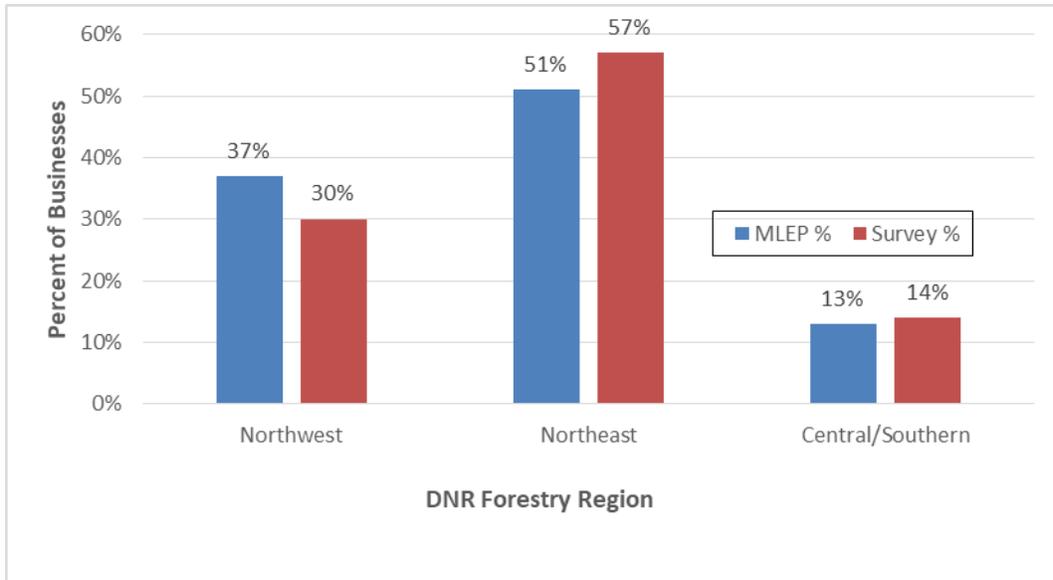
**Figure 2.** Distribution of respondents by Minnesota county and MnDNR forestry region



Created with Mapchart.net ©

The highest concentration of responses was from the northeast region (n = 75 respondents, 57 percent of respondents) and the least from the central/southern region (n = 18 respondents, 14 percent of respondents). The response rates across MnDNR Forestry regions are very similar to the distribution of MLEP’s logging business owner membership across Minnesota (Figure 3).

**Figure 3.** Summary of respondent’s business location by MnDNR forestry region (N=132; with percentages within each region) and the distribution of the MLEP entire logging business owner membership (N=367) during 2016.

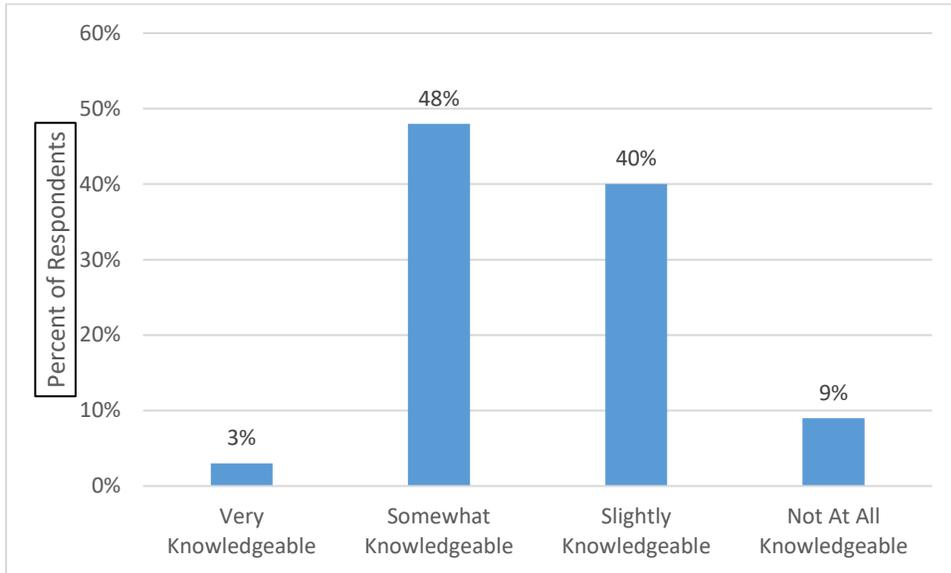


### **Survey Section I: Awareness of Minnesota Invasive Forest Plants**

#### **Question 1 (N=130)**

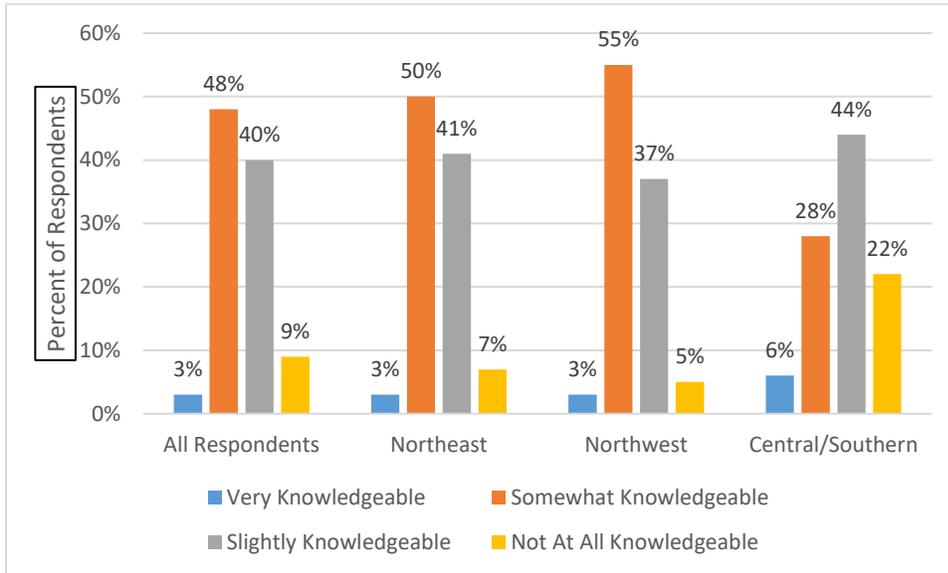
Respondents were asked about their general level of awareness regarding invasive forest plants in Minnesota. Response options, presented on a 4-point scale, ranged from Very Knowledgeable (1) to Not at All Knowledgeable (4). The most common response provided was Somewhat Knowledgeable (48%), followed by 40% of respondents indicating they were Slightly Knowledgeable (Figure 4). Only 3% of respondents reported being Very Knowledgeable.

**Figure 4.** General level of knowledge about invasive forest plants by Minnesota logging business owners (Percent of respondents) (N=130).



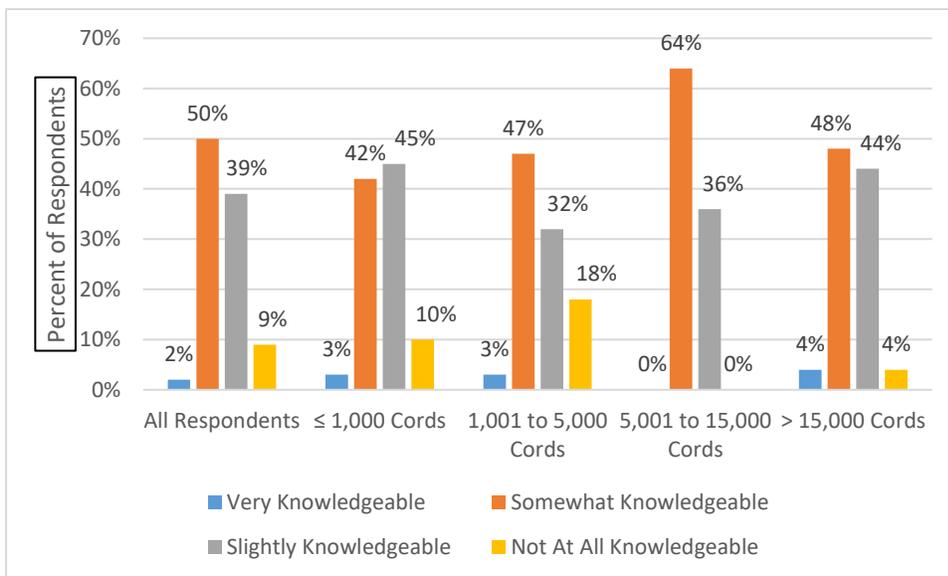
Given that invasive plant species are currently more prevalent in the southern part of the state (Kurtz 2013), we were interested in evaluating whether knowledge level of invasive forest plants differed regionally. We examined responses to the level of invasive forest plant knowledge question by the three MnDNR forestry regions to evaluate whether self-reported knowledge level varied regionally (Figure 5). A Fisher's exact test of independence was performed, and no association was found between the region in which the logging business is located and the self-reported level of knowledge regarding invasive plants ( $p=0.2551$ ).

**Figure 5.** General level of knowledge about invasive forest plants by Minnesota logging business owners and MnDNR forestry region (Percent of respondents) (N=130).



General knowledge about invasive forest plants was also evaluated by the four timber volume size classes in Figure 1 to determine whether knowledge level differed by producer size (Figure 6). A Fisher's exact test of independence was performed, and no association was found between the timber volume cut during the past twelve months and the self-reported level of knowledge regarding invasive plants ( $p=0.3009$ ).

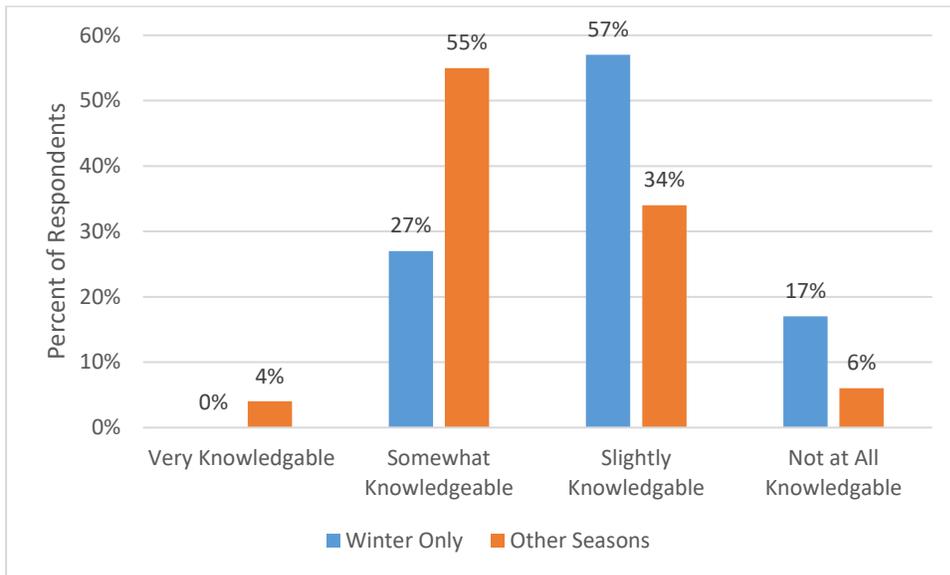
**Figure 6.** General level of knowledge about invasive forest plants by annual timber volume size class (Percent of respondents) (N=121).



Finally, the respondent's general level of invasive plant knowledge was examined by their seasonality of business operations to determine if it varied as a function of their business being a winter-only operation versus one that operates in other seasons. A Fisher's exact test of independence was

performed, and a significant association was found between seasonality of operations and their general knowledge about invasive forest plants ( $p=0.0118$ ) (Figure 7). Post-hoc pairwise tests with Bonferroni corrections (with a significance level of  $p=0.0083$ ) found that winter-only respondents expressed lower levels of knowledge than the other businesses. Specifically, higher percentages of winter-only respondents rated their knowledge level as Somewhat Knowledgeable and lower percentages of winter-only respondents rated their knowledge level as Slightly Knowledgeable, as compared to businesses operating in other seasons ( $p=0.0083$ ).

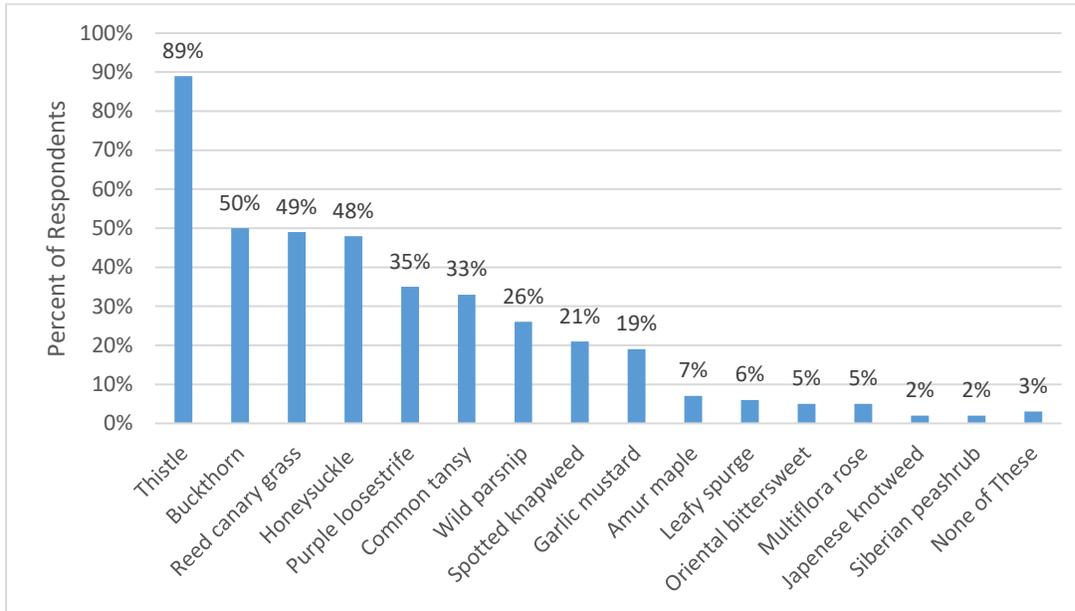
**Figure 7.** General level of knowledge about invasive forest plants by seasonality of operations (Percent of respondents) (N=126).



### Question 2 (N=126)

To gather information about their knowledge of specific plants, respondents were presented a list of 15 common invasive forest plants in Minnesota and asked whether they were confident they or their crew could correctly identify them in the woods. The 15 plants were derived from a management guide that was created using input from various invasive plant specialists within the state (Minnesota SFI Implementation Committee, 2015). Only 3% of respondents indicated they could not identify any of the 15 plants (Figure 8). The only plant that a majority of respondents (89%) were confident they could identify was thistle. Approximately half of the respondents could identify three of the plants: buckthorn (50%), reed canary grass (49%), and honeysuckle (48%). Two plants were identifiable by approximately one-third of respondents: purple loosestrife (35%) and common tansy (33%). The other plants were identifiable by considerably smaller percentages of the respondents. The average number of listed plants that the respondents stated they could identify was 4 ( $SD=2.22$ ), and the mode was 2.

**Figure 8.** Confidence in being able to identify specific invasive plants in the woods (Percent of respondents) (N=131).



ANOVA models were run to determine whether the average number of invasive plants that could be identified varied as a function of different factors. No significant relationship was found between the number of invasive plants that could be identified and the following factors: the MnDNR forestry region in which the respondent was located ( $F(2, 130) = 0.62, p=0.5396$ ), the annual timber volume size class of the respondent’s business ( $F(3, 121) = 0.04, p=0.9881$ ), their perception of the degree of impact that invasive plant BMPs might cause their business ( $F(3, 124) = 0.33, p=0.8038$ ), their level of interest in developing expertise in invasive plant treatment or removal ( $F(3, 118) = 0.96, p=0.4139$ ), level of interest in purchasing a public land timber sale when invasives are known to be present ( $F(2, 114) = 1.02, p=0.3649$ ), level of interest in purchasing a private land timber sale when invasives are known to be present ( $F(2, 120) = 0.92, p=0.4005$ ), level of interest in purchasing a public land timber sale if invasive BMPs were required ( $F(2, 124) = 0.71, p=0.4938$ ), or level of interest in purchasing a private land timber sale if invasive BMPs were required ( $F(2, 126) = 1.17, p=0.3144$ ).

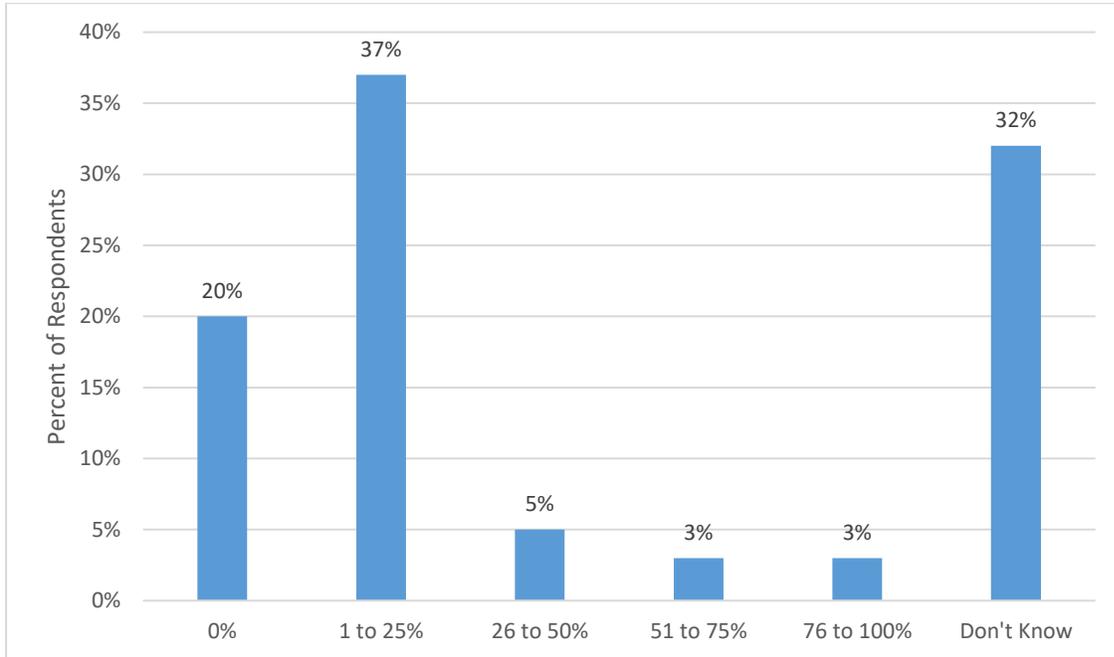
### Question 3 (N=130)

Respondents were asked to indicate the percentage of their timber sales in the past twelve months in which invasive forest plants were present<sup>3</sup>. Six response options were provided, ranging from 0% to Don’t Know. In general, respondents did not report high percentages of their sales having invasive forest plants, although almost one-third (32%) reported that they did not know (Figure 9). The most common response given (37% of respondents) was 1 to 25% of their sales in the past twelve months had invasive forest plants, with 20% reporting 0% of their sales. Only small percentages of respondents

<sup>3</sup> The question did not specify the basis a respondent was utilizing to report whether invasive plants were present. They could have responded in the affirmative to this question if invasive plants were mentioned in the timber sale contract or if they independently identified them on sale tracts.

reported more than 25% of their sales had invasive plants present: 26 to 50% of sales (5%), 51 to 75% of sales (3%), and 76 to 100% of sales (3%).

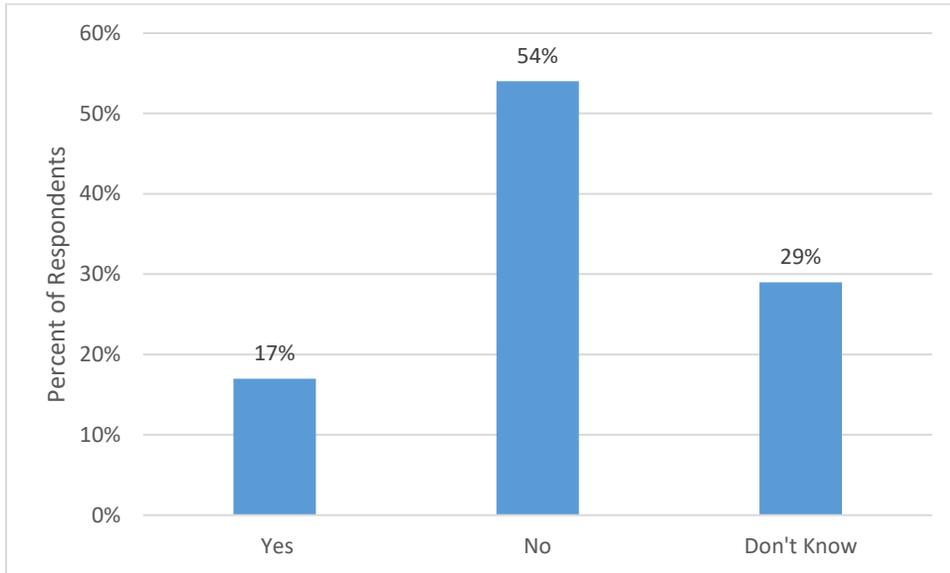
**Figure 9.** Percent of timber sales in the past 12 months in which invasive species were present (Percent of respondents) (N=130).



**Question 4 (N=130)**

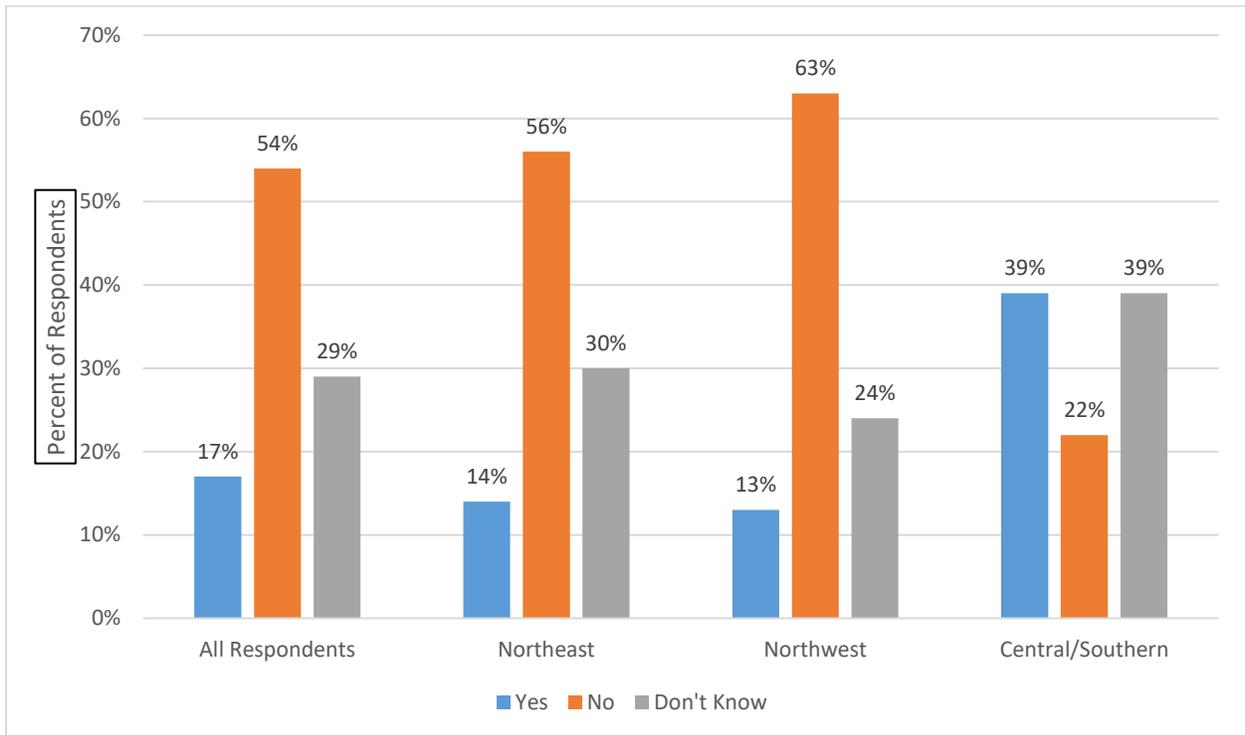
To get a sense of trends in frequency of sales with invasives, respondents were asked whether they or their crew(s) had noticed an increase in the percentage of their timber sales with invasive plants over the past three years. Respondents could respond Yes, No, Don't Know or that they've been in business less than three years. Three respondents who indicated they hadn't been in the business for three years were removed for analysis of this question. The majority of respondents (54%) indicated they had not noticed an increase of sales with invasives, while 29% reported not knowing (Figure 10). Only 17% had noticed an increase over the past three years of sales with invasive plants present.

**Figure 10.** Percent of respondents noticing an increase in timber with invasive plants in the past three years (Percent of respondents) (N=130).



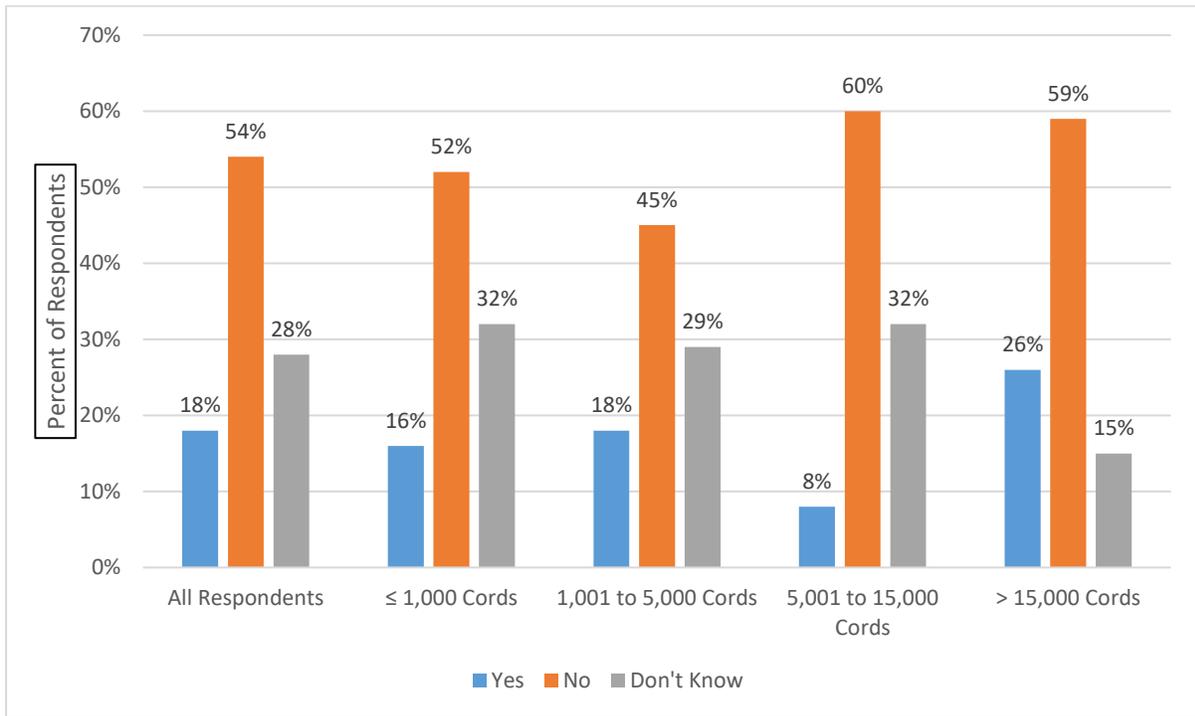
Responses to this question were evaluated by MnDNR forestry region. A Fisher's exact test of independence was performed, and a significant association was found between the region in which the logging business is located and their perspective on whether they have noticed an increase in the percentage of sales with invasive forest plants during the past three years ( $p=0.0319$ ) (Figure 11). Post-hoc pairwise tests with Bonferroni corrections (with a significance level of  $p=0.0167$ ) found responses in the Central/Southern region were statistically different than the Northeast region ( $p=0.0138$ ) and the Northwest region ( $p=0.0117$ ), but that responses did not differ between the Northeast and Northwest regions ( $p=0.8131$ ). Specifically, higher percentages of Central/Southern region respondents had noticed an increase in sales than the other regions, but higher percentages in the Central/Southern were uncertain of increases in invasives on sales as compared to the other two regions as well.

**Figure 11.** Percent of respondents noticing an increase in timber sales with invasives in the past three years by MnDNR forestry region (Percent of respondents) (N=127).



Responses to this question were examined by annual timber volume size class categories (Figure 12). A Fisher's exact test of independence was performed, and no association was found between annual timber volume size class and their perspective on whether they have noticed an increase in the percentage of sales with invasive forest plants during the past three years ( $p=0.4989$ ).

**Figures 12.** Percent of respondents noticing an increase in timber sales with invasives in the past three years by timber volume size class (Percent of respondents) (N=118).

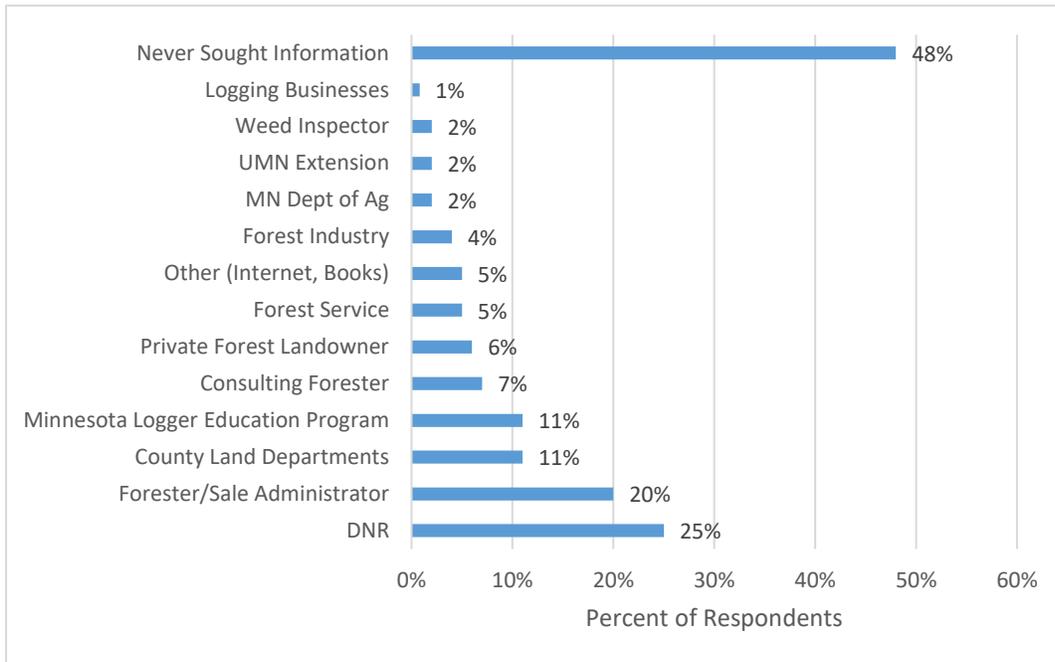


Responses were also evaluated by whether the respondent was a winter-only logging business versus one that operated in other seasons. A Fisher's exact test of independence was performed, and no association was found between seasonality of operations and their perspective on whether they have noticed an increase in the percentage of sales with invasive forest plants during the past three-year period ( $p=0.3746$ ).

#### Question 5 (N=125)

Respondents were presented a list of 12 organizations and asked whether they or their crew had contacted any of them when they needed general information about invasive forest plants. Almost half (48%) of respondents indicated they had never sought information about invasive forest plants (Figure 13). Of those that had, the organization with the highest percentage of contacts was the MnDNR (25%) followed by the forester/sale administrator (20%). Approximately 11% of respondents had contacted either MLEP or county land departments. All of the other sources were consulted by less than eight percent of respondents.

**Figure 13.** Sources consulted for information on invasive forest plants (Percent of respondents) (N=125).



## **Survey Section II: Business Practices**

### **Question 6 (N varies)**

Respondents were presented a list of 10 potential practices related to invasive forest plant control and asked to rate the difficulty of implementing each practice. The list of business practices was drawn from the literature (e.g., LeDoux and Martin, 2013) and requirements stipulated on some public land timber sales (e.g., USDA Forest Service, 2006). Response options ranged from Very Difficult (1) to Not at All Difficult (4) on a 4-point scale. When viewed by average values, the difficulty of all of the activities was rated below a 3, indicating each of the activities was more than Slightly Difficult to implement (Table 3 and Figure 14). The activity that was rated the least difficult to implement was learning to identify invasive plants, with an average value of 2.77, with 64% of respondents indicating this practice would either be Slightly to Not at All Difficult to implement. The practice rated with the greatest average difficulty was treatment of staging areas to remove invasive plants prior to bringing equipment in (1.52) with 59% of respondents indicating that would be a Very Difficult practice to implement. The second-most difficult rated activity was acquiring clean job-site construction materials (e.g., fill dirt, gravel, sand) (1.86), rated by 50% of respondents as Very Difficult.

**Table 3.** Degree of difficulty implementing invasive forest plant BMP business practices (Percent of respondents).

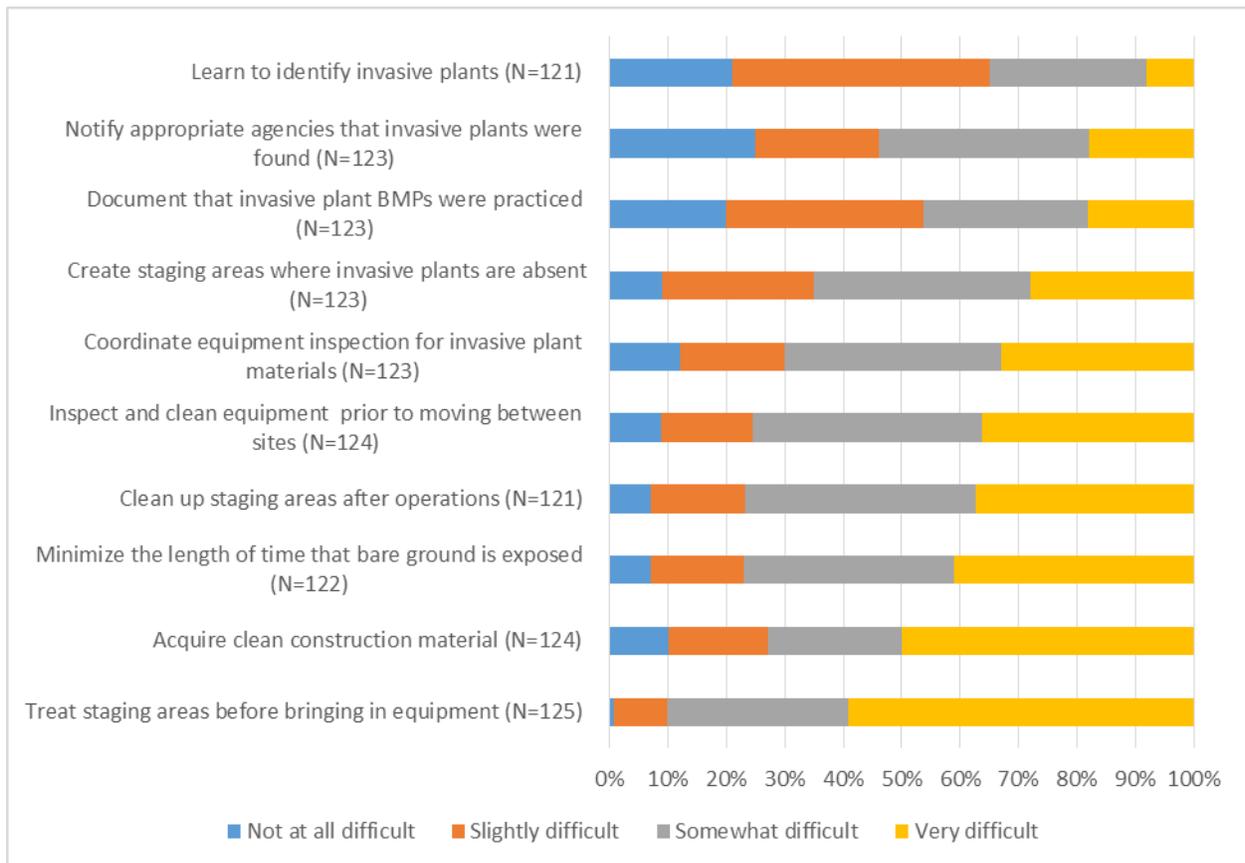
<b>Business Practice</b>	<b>Very Difficult (1)</b>	<b>Somewhat difficult (2)</b>	<b>Slightly difficult (3)</b>	<b>Not at all Difficult (4)</b>	<b>Average Value (Std Dev)</b>
Mow, spray or treat staging areas to remove invasive plants before bringing equipment in (N=125)	59%	32%	9%	1%	1.52 (0.6911)
Acquire clean construction materials, fill dirt, gravel, sand and/or mulch (N=124)	50%	23%	17%	10%	1.86 (1.0228)
Minimize the length of time that bare ground is exposed prior to re-seeding/re-vegetating (N=122)	41%	36%	17%	7%	1.89 (0.9109)
Clean up staging areas after operations (N=121)	37%	39%	17%	8%	1.95 (0.9156)
Inspect and clean equipment of soil, seeds and plants prior to moving between sites (N=124)	36%	39%	16%	9%	1.98 (0.9369)
Coordinate inspection of equipment for invasive plant materials (N=123)	32%	37%	18%	12%	2.10 (0.9917)
Create equipment staging areas where invasive plants are absent (N=123)	29%	36%	26%	9%	2.16 (0.9411)
Document that invasive plant BMPs were practiced in your operations (N=123)	20%	30%	27%	22%	2.51 (1.0509)
Document and notify appropriate agencies that invasive plants were found (N=123)	18%	36%	20%	25%	2.53 (1.0581)
Learn to identify invasive plants (N=121)	8%	28%	43%	21%	2.77 (0.8733)

To test for differences in average difficulty rating of the business practices in Table 3 by MnDNR Forestry region, ANOVA models were run. No statistically significant differences in average difficulty rating by region were found at the  $p=0.05$  significance level for any of the practices listed in Table 3.

ANOVA models were also run to determine whether average difficulty rating varied by timber volume size class. Average difficulty rating differed significantly by timber volume size class for two business practices: create equipment staging area without invasives [ $F(3, 116) = 3.27, p = 0.0237$ ] and inspect and clean equipment prior to moving between sites [ $F(3, 117) = 6.64, p = 0.0004$ ]. Post-hoc Tukey tests found that creating a clean equipment staging area was rated more difficult for volume size class 3 (5,001 – 15,000 cords) than 1 (1,000 cords or less). Timber volume size class 4 (greater than 15,000 cords) rated inspecting and cleaning equipment to be more difficult than either volume size class 1 (1,000 cords or less) or 2 (1,001 – 5,000 cords).

No statistically significant differences in average difficulty rating by timber volume size class were found for the following eight business practices identified in Table 3: treat staging area prior to bringing in equipment [F(3, 118) = 0.19, p = 0.9023], acquire clean fill materials [F(3, 117) = 0.31, p = 0.8177], minimize length of time bare ground is exposed [F(3, 115) = 0.27, p = 0.8458], clean staging areas after operations [F(3, 114) = 2.28, p = 0.2862], coordinate inspection of equipment operations [F(3, 117) = 2.20, p = 0.0916], document that invasive plant BMPs were practiced [F(3, 116) = 0.40, p = 0.7556], notify agencies that invasives were found [F(3, 116) = 0.96, p = 0.4121], and learn to identify invasives [F(3, 114) = 0.82, p = 0.4839].

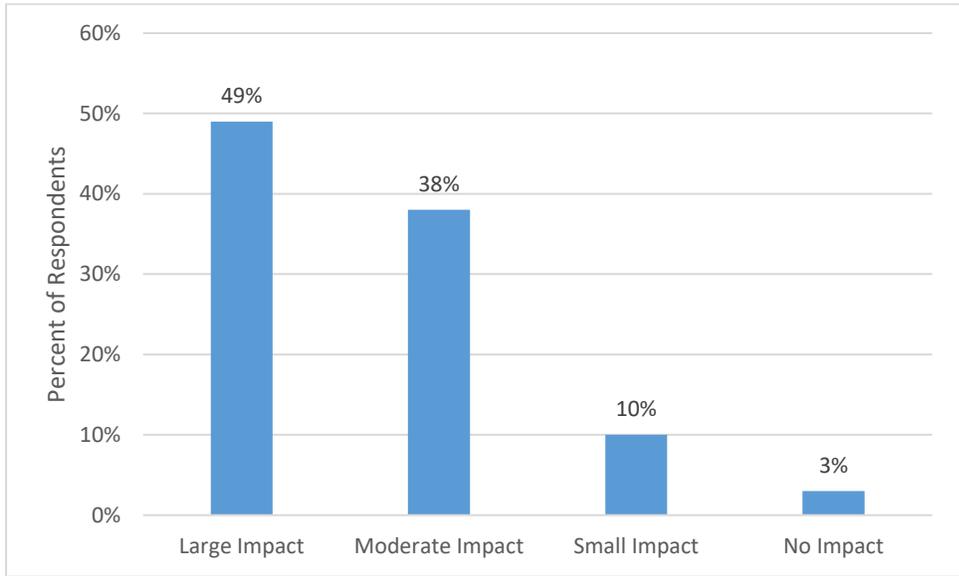
**Figure 14.** Rating of perceived degree of difficulty to implement potential invasive forest plant BMP practices (Percent of respondents).



**Question 7 (N=126)**

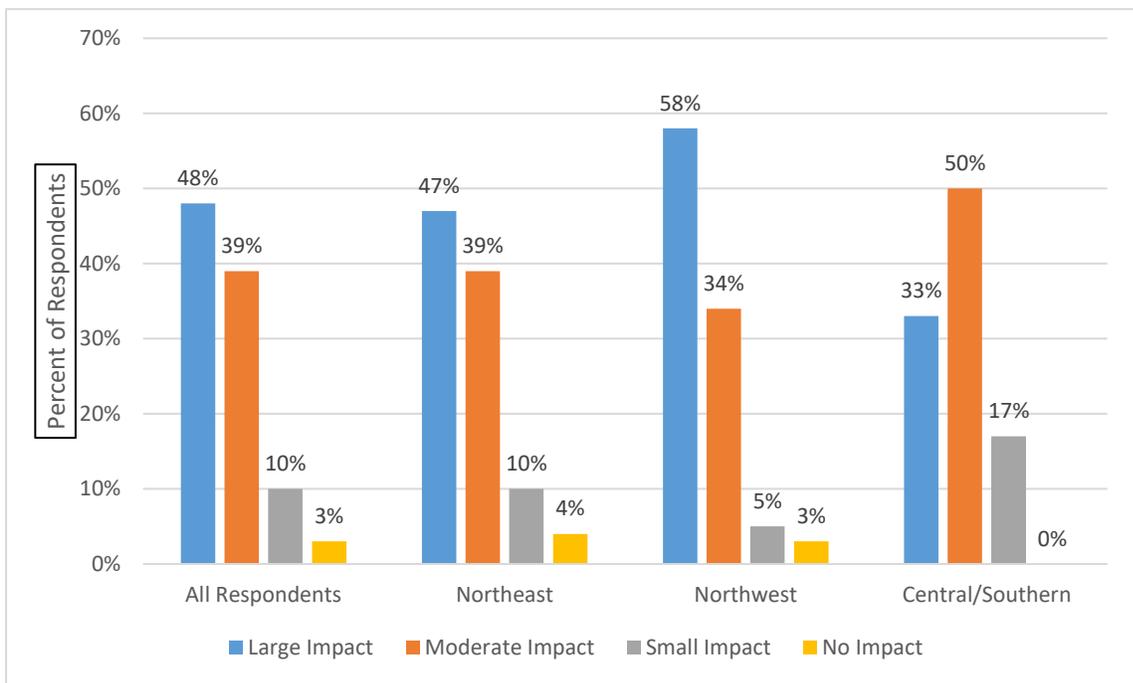
Respondents were asked to rate the perceived impact that a hypothetical statewide invasive forest plant BMP program for invasive forest plants that included the types of activities identified in Table 3 would have on their logging business, if one were to be developed. Response options were offered on a 4-point scale ranging from a Large Impact (1) to No Impact (4). Nearly half (49%) of respondents reported that a forest invasives BMP program would likely have a Large Impact on their business, with an additional 38% reported impacts would be Moderate (Figure 15).

**Figure 15.** Perceived impact of invasive forest plant BMPs on logging business operations (Percent of respondents) (N=126).

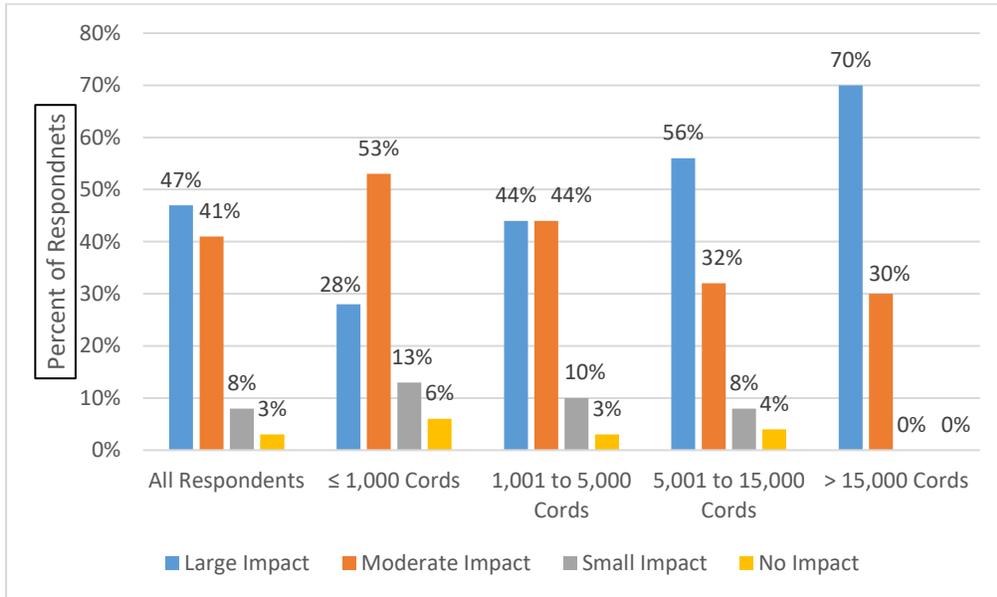


Responses to this question were examined as a function of the MnDNR Forestry region (Figure 16) and annual timber volume size class (Figure 17). Fisher’s exact tests of independence were performed. No association was found between the region in which the logging business is located ( $p=0.5816$ ), timber volume size class ( $p=0.1446$ ), or seasonality of operations ( $p=0.3260$ ) and the perceived impact of a forest invasives BMP program.

**Figure 16.** Perceived impact of invasive forest plant BMPs on logging business operations by MnDNR forestry region (Percent of respondents) (N=126).



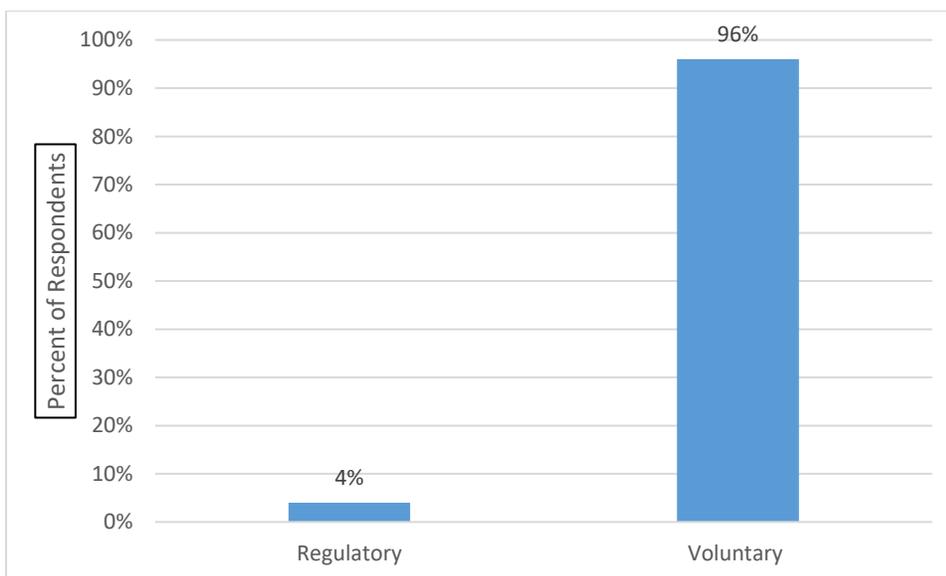
**Figure 17.** Perceived impact of invasive forest plant BMPs on logging business operations by timber volume size class (Percent of respondents) (N=119).



**Question 8 (N=125)**

Respondents were asked if a hypothetical statement invasive forest plant BMP program were to be developed and include the types of activities listed in Table 3, would they prefer such a program be implemented through regulatory or voluntary means. Respondents overwhelmingly preferred a voluntary program (96%, N=125) (Figure 18).

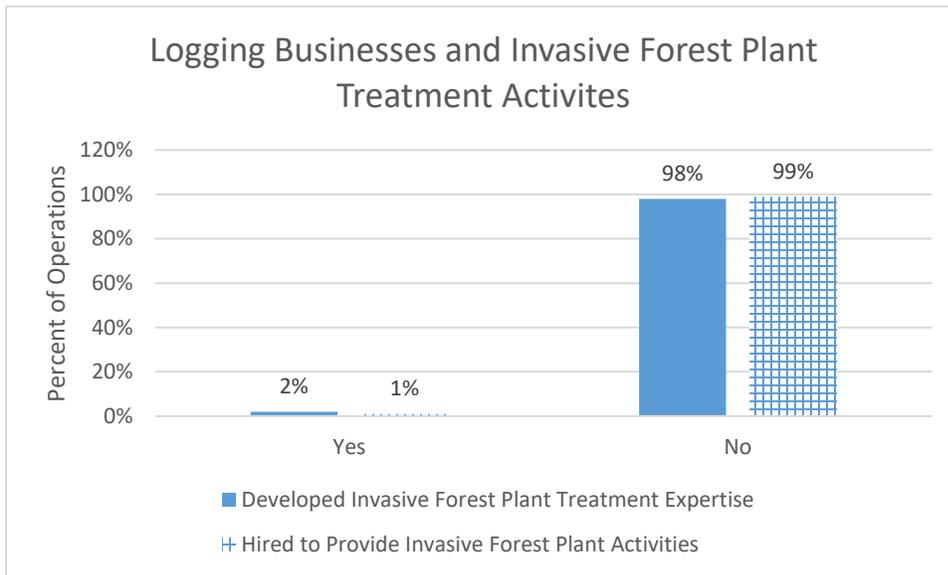
**Figure 18.** Preference for voluntary versus regulatory invasive plant BMP program (Percent of respondents) (N=125).



### Questions 10 and 11 (N=125 and N=128)

Respondents were asked whether their logging business has developed expertise in invasive forest plant treatment or removal as a way to diversity business operations and provide additional revenue streams. They were also asked whether they had been specifically hired, outside of a timber sale, to undertake invasive plant treatment or removal activities in the past 12 months. Only 2% of respondents reported that they have developed invasive forest plant treatment or removal services and only 1% have been hired to provide such services in the past twelve months (Figure 19).

**Figure 19.** Development of invasive plant treatment and removal expertise (Percent of respondents) (N=125 and N=128).



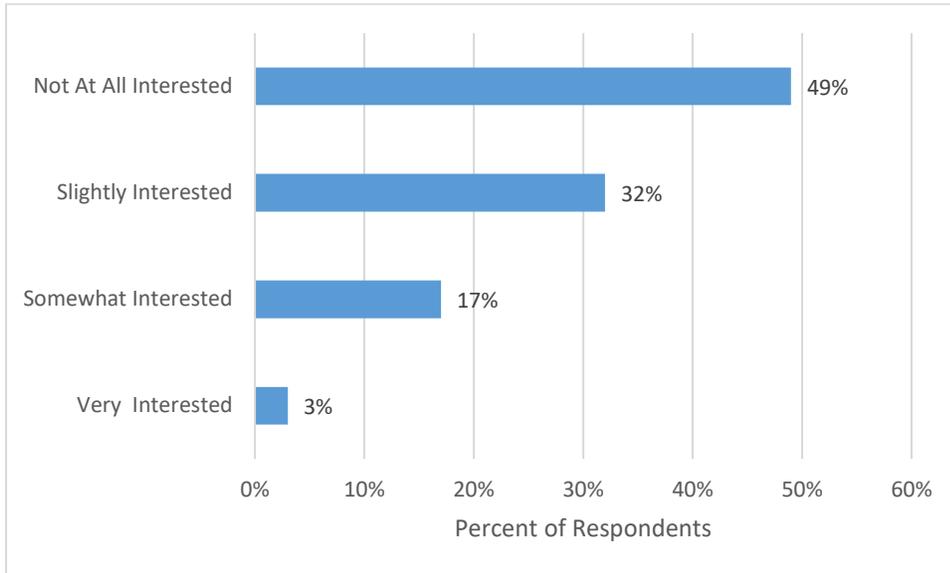
### Question 12

In this question, respondents were asked to indicate which invasive plant treatment activities they had been hired to perform, outside of a timber sale, in the past twelve months. Responses to this question aren't consistent. That is, the few respondents who indicated they had been hired to undertake any of invasive plant treatment activities (Q11) had also reported they had not developed such expertise (Q10).

### Question 13 (N=119)

Respondents were asked how interested they were in developing or expanding their expertise in invasive forest plant treatment or removal as a way to diversity their operations. Response options were offered on a 4-point scale ranging from Very Interested (1) to Not at All Interested (4). Almost half of the respondents (49%) indicated they were Not at All Interested in developing such expertise (Figure 20). Approximately one-third (32%) indicated Slight Interest. The average response value was 3.27 (SD = 0.8305), with a median rating of 3 and a mode of 4.

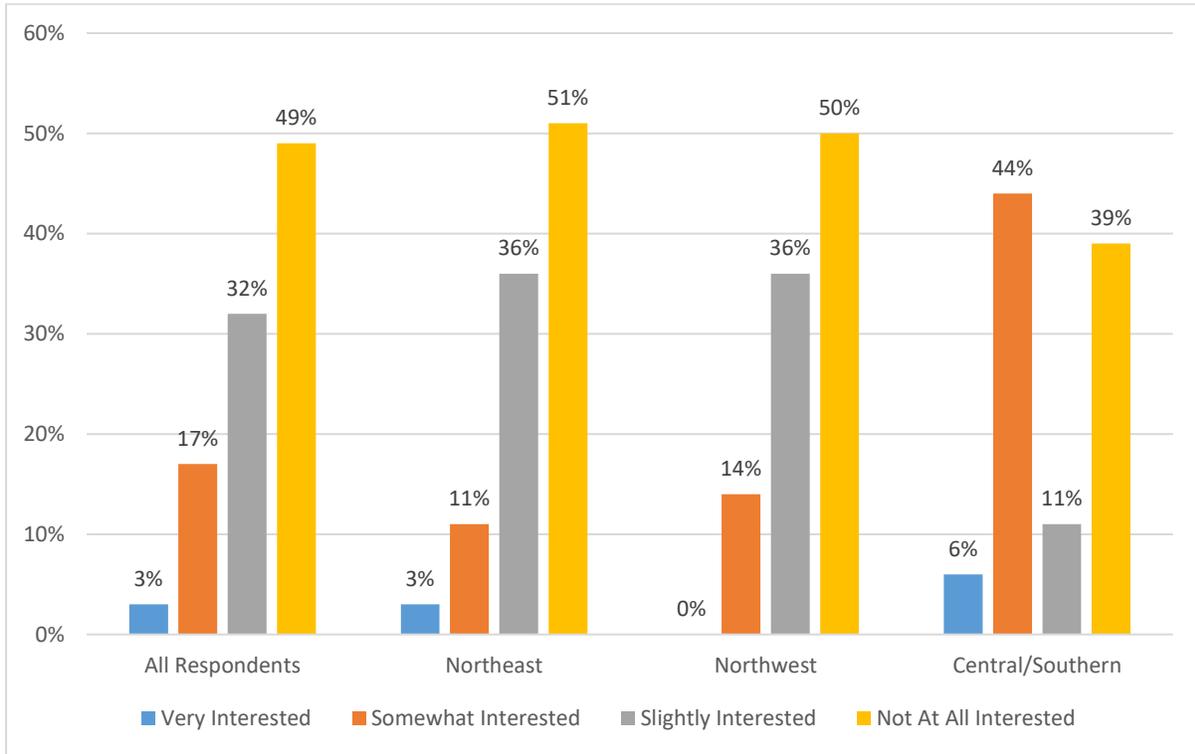
**Figure 20.** Degree of interest in developing invasive plant treatment and removal expertise (Percent of respondents) (N=119).



Treating the response scale as continuous, two ANOVA tests were run to evaluate whether level of interest in developing invasive plant expertise was associated with: a) the respondent's response to the survey question which asked whether they had noticed an increase in the percentage of sales with invasive plants over the past three years (Q4) and b) the respondent's general level of knowledge about invasive forest plants (Q1). The ANOVA tests indicated a significant effect associated with perceptions of increased number of sales having invasive plants on level of interest in developing invasive plant removal expertise ( $F(2, 113) = 5.23, p=0.0067$ ). Post-hoc Tukey tests indicated that respondents who had noticed an increase in sales with invasives over the past 3 years were more likely to express greater levels of interest in developing invasives treatment and removal expertise. However, no significant effect of the respondent's general level of knowledge about invasives was found related to their interest in developing invasive plant removal expertise ( $F(3, 116) = 0.78, p=0.5096$ ).

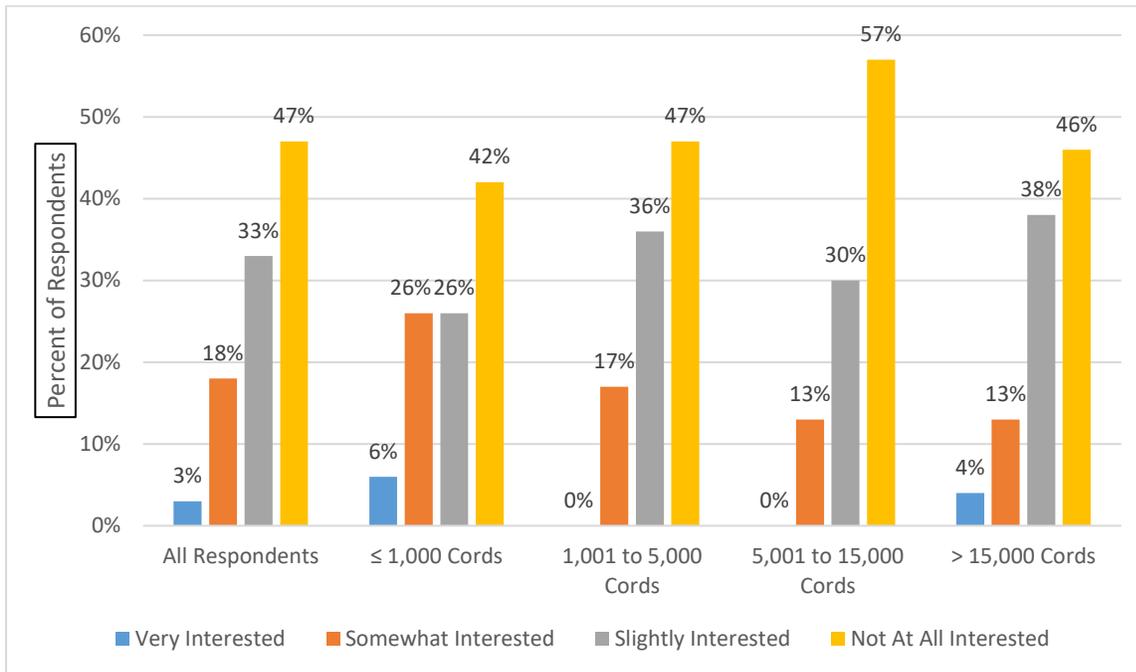
Interest in developing invasive plant treatment expertise was examined by MnDNR forestry region (Figure 21). A Fisher's exact test of independence was performed, and the degree of interest in developing invasive plant treatment expertise was found to differ by MnDNR forestry region ( $p=0.0264$ ). Post-hoc pairwise tests with Bonferroni corrections ( $p=0.0167$ ) found responses in the Central/Southern region were statistically different than the Northeast region ( $p=0.0067$ ) and the Northwest region ( $p=0.0156$ ), but that responses did not differ between the Northeast and Northwest regions ( $p=0.8709$ ). In general, interest in developing the expertise was higher in the Central/Southern region than the other two. Specifically, higher percentages of Central/Southern region respondents (44%) indicated they were Somewhat Interested in developing the expertise compared to 14% in the Northwest region and 11% in the Northeast region who were Somewhat Interested.

**Figure 21.** Degree of interest in developing invasive plant treatment and removal expertise by MnDNR forestry region (Percent of respondents) (N=119).



Interest in developing invasive plant treatment expertise was also examined by: a) annual timber volume size class (Figure 22) and b) seasonality of business operations (i.e., winter-only businesses versus one that operated in other seasons). Fisher’s exact tests of independence were performed, and degree of interest in developing invasive plant treatment expertise was not found to be statistically associated with either timber volume size class ( $p=0.7487$ ) or seasonality of operations ( $p=0.4168$ ).

**Figure 22.** Degree of interest in developing invasive plant treatment and removal expertise by annual timber volume size class (Percent of respondents) (N=114).



To better understand the segment of respondents who might be most interested in developing expertise in invasive plant treatment and removal activities, respondents were divided into two groups for further analysis. Specifically, a binary variable was created from responses to Question 13 which asked about their level of interest in developing invasive plant expertise. If a respondent indicated they were 'Very Interested' or 'Somewhat Interested' in their response to Question 13, they were assigned a value of 1 (N=23), while respondents who indicated they were 'Slightly Interested' to 'Not at All Interested' were assigned a value of 0 (N=96). Comparisons of these two groups, across different survey questions, was done to allow us to better understand what factors might be associated with whether a logging business was interested in developing this expertise which would help with targeting training and outreach.

Fisher's exact tests of independence were performed on categorical variables, and no association was found between interest in developing invasive plant treatment expertise and: a) general knowledge of invasive forest plants in Minnesota and ( $p=0.8051$ ), b) annual timber volume size class ( $p=0.3090$ ), c) whether one was a producer of more than 15,000 cords in the past twelve months ( $p=0.7787$ ), d) whether one was a producer of 1,000 or fewer cords in the past twelve months ( $p=0.0663$ ), e) whether one had contractually undertaken activities on private land ( $p=0.8059$ ) or public land ( $p=0.8057$ ) sales in the past twelve months to prevent the introduction or spread of invasive plants, f) whether one had voluntarily undertaken activities on private land ( $p=0.6334$ ) or public land ( $p=0.6272$ ) sales in the past twelve months to prevent the introduction or spread of invasive plants, or, g) whether one was a winter-only operator versus operations in other seasons ( $p=0.5875$ ).

Statistically significant differences were found between interest in developing invasive plant treatment expertise and: a) whether the respondent had noticed an increase in timber sales over the past three years with invasives ( $p=0.0006$ ), and b) the location of their logging business by MnDNR forestry region

( $p=0.0046$ ). Specifically, those business who had noticed an increase in the percentage of their timber sales with invasives over the past three years and those businesses located in the Central/Southern DNR region were both more likely to report interest in developing invasive plant treatment expertise.

In examining continuous variables, t-tests found no significant difference between interest in developing invasive plant treatment expertise and: a) the number of invasive forest plants the respondent indicated they were confident they could identify in the woods ( $t(117) = 0.51, p = 0.6086$ ), b) the percentage of the business's timber sale volume from private forest lands over the past twelve months ( $t(110) = -1.04, p = 0.2995$ ), c) the percentage of the business's timber sale volume from federal forest lands over the past twelve months ( $t(110) = 0.98, p = 0.3276$ ), or d) the percentage of the business's timber sale volume from industry/corporate lands over the past twelve months ( $t(67) = -1.48, p = 0.1443$ ).

Statistically significant differences were found between interest in developing invasive plant treatment expertise and: a) the percent of the business' timber sale volume from state forest lands over the past twelve months ( $t(110) = 3.00, p = 0.0034$ ) and b) the percent of the business' timber sale volume from county forest lands over the last twelve months ( $t(50) = -2.12, p = 0.0389$ ). Those with higher percentages of their timber volume from state land *more* likely to be interested in developing the invasives expertise, while those with higher percentages of their timber volume from county lands *less* likely to be interested.

In summary, the characteristics that are associated with logging businesses who have an interest in developing new invasive plant treatment and removal expertise are those who are located in the Central/Southern region of the state, who have noticed an increase in their timber sales with invasives over the past three years, and who derive higher percentages of their timber volume from state lands.

### **Survey Section III: Interactions on Timber Sales**

#### **Question 14 (N=121 for private lands and 122 for public lands)**

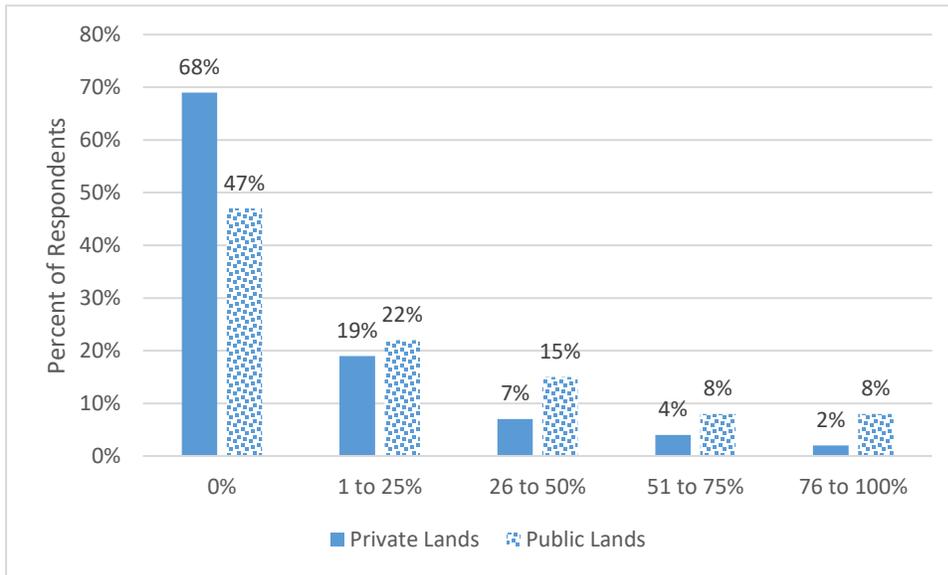
To assist in analyzing questions related to potential differences in invasive forest plant activities that logging businesses may have undertaken on private or public lands, respondents were asked whether they had undertaken any harvests on public or private lands during the past 12 months. Ninety-one percent of the 121 respondents to this question indicated they had harvested on private lands (N=110), while 84% of the 122 respondents to this question had harvested on public lands (N=103).

#### **Question 15 (N =100 for private lands and 97 for public lands)**

Respondents were asked to consider harvests they had conducted in the past twelve months and indicate the percentage of land owners/managers who had discussed invasive forest plants with them or their employees. Response options, on a 5-point scale, ranged from categories of 0% to 76-100%. Responses to this question were only retained for analysis if the respondent indicated in Q14 that they had harvested private and/or public land timber sales in the past twelve months. The most frequent response, for both land ownership types, was 0% of owners/managers discussing invasive plants with the logging business (68% of the responses for private land timber sales and 47% of the responses for public land timber sales) (Figure 23). A small percentage of respondents (6% of private land timber sales

and 16% of public land timber sales) reported that they had discussions regarding invasive plants on at least half of their sales.

**Figure 23.** Percent of land owners/managers who had discussed invasive plants with logging business owners on their timber sales in the past twelve months (Percent of respondents) (N=100 for private lands and 97 for public lands)



**Question 16 (N varies)**

Respondents were asked whether or what type of information or advice they provided land owners/land managers regarding invasive forest plants during the past twelve months on both private and public lands (Table 4). Only respondents who reported in Q14 that they had harvested any sales on public or private lands in the last twelve months were retained for this portion of the analysis. The majority of respondents indicated they had not provided any information or advice on invasive plant topics. Specifically, 76% of respondents indicated not providing any advice/information to public land managers, while 68% provided no information/advice to private landowners. Only three topics had been discussed or provided by 10% or more of respondents for either land type. That is, 14% of respondents had provided advice on identification of invasive forest plants for public lands, and 12% had provided this information to private landowners. Similarly, 15% of respondents had provided information to public land managers on who to contact for additional information about invasive plants, while 11% had provided this information to private landowners. Finally, 10% of respondents had provide information on impacts associated with invasive forest plants on private land timber sales.

**Table 4.** Percent of respondents who provided information or advice on various invasive plant topics to land owners/land managers on timber sales in the past twelve months.

Private Lands	N	Public Lands	N	Type of Information or Advice Provided by You or Your Crew
12%	97	14%	92	Identification of invasive forest plants
6%	98	1%	93	Information on invasive forest plant removal
3%	99	3%	93	Information on invasive forest plant prevention
10%	98	2%	92	Information on impacts associated with invasive forest plants
5%	98	2%	93	Information on logging BMPs associated with invasive forest plants
3%	98	1%	93	Information on services my logging business could provide to remove invasive forest plants
11%	98	15%	93	Advice about who to contact for additional information on invasive forest plants
68%	98	76%	93	None

**Question 17 (N=117)**

In order to better understand the types of activities that logging businesses are already undertaking to prevent the introduction and/or limit the spread of invasive forest plants, respondents were provided a list of activities and asked whether they had been contractually required to undertake any of them on timber sales in the past twelve months. The list of business practices was drawn from the literature (e.g., LeDoux and Martin, 2013) and requirements stipulated on some public land timber sales (e.g., USDA Forest Service, 2006). Only respondents who reported in Q14 that they had harvested any sales on private or public lands in the last twelve months were retained for this portion of the analysis. More than half of the respondents responded they had not contractually undertaken any of the activities on private land timber sales (61% of respondents) or public land timber sales (60% of respondents) (Table 5). For three of the activities, approximately one-quarter of the respondents had been contractually required to undertake them on public land timber sales: inspecting equipment for invasives prior to moving it to a different logging site (29%), inspecting equipment for invasives prior to removing it from the job site (26%), and cleaning/washing the equipment (26%). These same three activities were the only ones done contractually at any appreciable level on private land timber sales as well: a) inspecting equipment for invasives prior to moving it to a different logging site (21%), b) inspecting equipment for invasives prior to removing it from the job site (20%), and c) cleaning/washing the equipment (20%). Less than 7% of respondents for either land ownership type reported being contractually required to examine the harvest site for invasives. Of the invasive treatment activities (burning, herbicide application, manual treatment, or mechanical treatment), at most 4% of the respondents reported having to contractually undertake any of these activities on public land timber sales, while at most 6% of respondents reported contractually undertaking any of the treatment activities on private land timber sales.

**Table 5.** Invasive plant control and treatment activities contractually and voluntarily undertaken on timber sales in the previous twelve months (Percent of respondents).

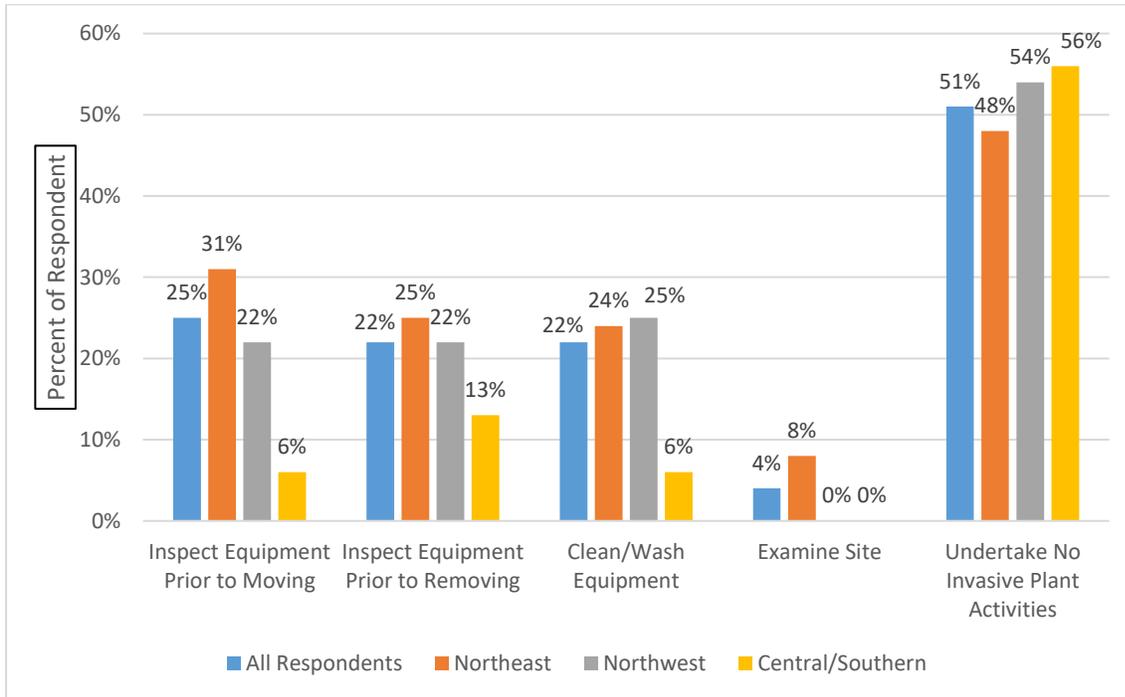
Activity	Contractual Activities		Voluntary Activities	
	Public Sales (N=95)	Private Sales (N=101)	Public Sales (N=96)	Private Sales (N=103)
Clean/Wash equipment	26%	20%	33%	29%
Inspect equipment prior to removing from job site	26%	20%	35%	32%
Inspect equipment prior to moving to job site	29%	21%	40%	32%
Examine site for invasives	4%	6%	13%	17%
Treat invasives via burning	0%	2%	0%	2%
Treat invasives via herbicide	0%	2%	0%	4%
Manually treat invasives	0%	1%	0%	3%
Mechanically treat invasives	0%	0%	1%	4%
None of the above	61%	60%	45%	47%

**A. Q17 Segmentation Analyses on Public Land Timber Sales**

**i. MnDNR Forestry Region**

The responses to Q17 were analyzed by MnDNR forestry region for public land timber sales. Fisher’s exact tests of independence found no statistically significant relationship between region and respondents who were contractually required to clean/wash their equipment ( $p=0.2726$ ), inspect equipment prior to removing it from a job site ( $p=0.6722$ ), inspect equipment prior to moving to a job site ( $p=0.1032$ ), examining the site for invasives ( $p=0.1636$ ), or having been contractually required to undertake none of the listed activities ( $p=0.8127$ ) on public land timber sales (Figure 24). The other activities weren’t segmented by MnDNR forestry region due to the small percentage of respondents who reported contractually undertaking those activities.

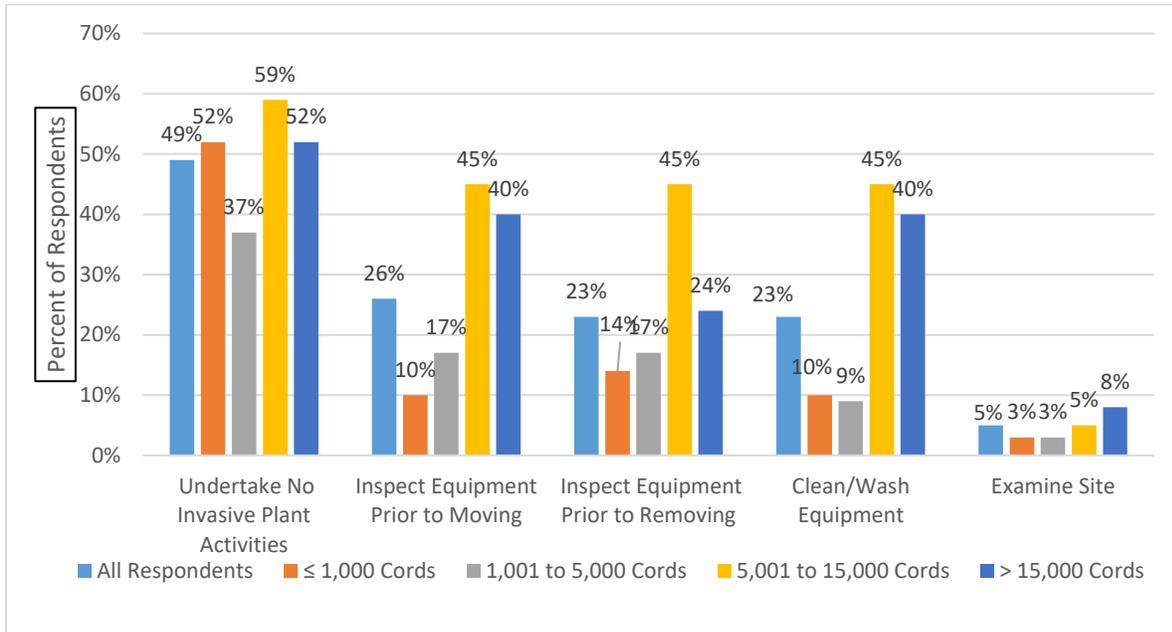
**Figure 24.** Activities contractually undertaken on public timber sales in the previous twelve months to avoid the introduction and spread of invasives by MnDNR forestry region (Percent of respondents) (N=117).



## ii. Timber Volume Size Class

The responses to Q17 were analyzed by annual timber volume size class categories. Fisher's exact tests of independence found statistically significant relationships between timber volume size class and respondents who were contractually required to clean/wash their equipment ( $p=0.0007$ ) and inspect equipment prior to moving to a job site ( $p=0.0073$ ) (Figure 25). Post-hoc pairwise tests with Bonferroni corrections (with a significance level of  $p=0.0083$ ) found respondents in the 1,000 cords or less volume category ( $p=0.0081$ ) and the 1,001 to 5,000 cord categories ( $p=0.0025$ ) were less likely than respondents in the 5,001 to 15,000 cord category to have contractually cleaned/washed their equipment prior to moving to a job site on public land timber sales. Ten percent of the 1,000 cords or less businesses and 9% of the 1,001 to 5,000 cord businesses contractually cleaned/washed their equipment versus 45% in the 5,001 to 15,000 cord category. Post-hoc pairwise tests with Bonferroni corrections (with a significance level of  $p=0.0083$ ) found respondents in the 1,000 cords or less volume category were less likely than respondents in the 5,001 to 15,000 cord category to contractually inspect their equipment prior to moving to a job site on public land timber sales ( $p=0.0081$ ), with 10% of the 1,000 cords or less businesses required to inspect equipment versus 45% in the 5,001 to 15,000 cord category.

**Figure 25.** Activities contractually undertaken on public timber sales in the previous twelve months to avoid the introduction and spread of invasives by timber volume size class (Percent of respondents) (N=111).



Fisher’s exact tests of independence did not find a statistically significant relationship between timber volume size class and contractual requirements to inspect equipment prior to removing it from a job site ( $p=0.0559$ ), examine site for invasives ( $p=0.8650$ ), or not being contractually required to undertake any of the listed activities ( $p=0.3931$ ) on public land timber sales. The other activities weren’t segmented by timber volume size class due to the small percentage of respondents who reported contractually undertaking those activities.

### iii. Seasonality of Operations

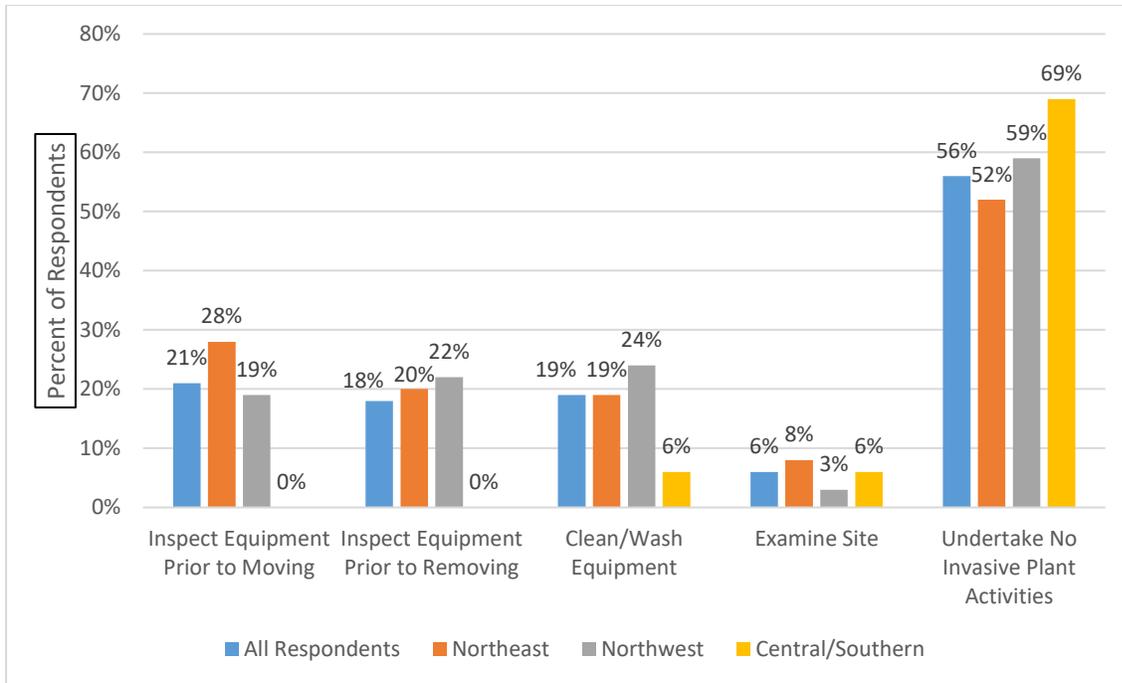
The responses to Q17 were analyzed by seasonality of operations (i.e., whether a respondent was a winter-only business versus a business operating in other seasons). Fisher’s exact tests of independence found no statistically significant relationship between seasonality of operations and respondents who were contractually required to clean/wash their equipment ( $p=0.3024$ ), inspect equipment prior to removing it from a job site ( $p=0.3024$ ), inspect equipment prior to moving to a job site ( $p=0.8029$ ), examining the site for invasives ( $p=0.5939$ ), or not having been contractually required to undertake any of the listed activities ( $p=0.5156$ ) on public land timber sales. The other activities weren’t segmented by seasonality due to the small percentage of respondents who reported contractually undertaking those activities.

## B. Q17 Segmentation Analyses on Private Land Timber Sales

### i. MnDNR Forestry Region

The responses to Q17 were analyzed by MnDNR forestry region for private land timber sales. Fisher’s exact tests of independence found a statistically significant relationship between the region and respondents who were contractually required to inspect their equipment prior to moving to a job site ( $p=0.0305$ ) (Figure 26). Post-hoc pairwise tests with Bonferroni corrections (with a significance level of  $p=0.0083$ ) found responses in the Central/Southern region were statistically different than the Northeast region ( $p=0.0166$ ), with 0% of Central/Southern respondents contractually required to inspect equipment versus 28% in the Northeast region.

**Figure 26.** Activities contractually undertaken on private timber sales in the previous twelve months to avoid the introduction and spread of invasives by MnDNR forestry region (Percent of respondents) (N=117).



Fisher’s exact tests of independence did not find a statistically significant relationship between region and contractual requirements to inspect their equipment prior to removing it from a job site ( $p=0.1159$ ), clean/wash their equipment prior to removing it from a job site ( $p=0.3629$ ), examining site for invasives ( $p=0.5571$ ), or not being contractually required to undertake any of the listed activities ( $p=0.4130$ ) on private land timber sales. The other activities weren’t segmented by region due to the small percentage of respondents who reported contractually undertaking those activities.

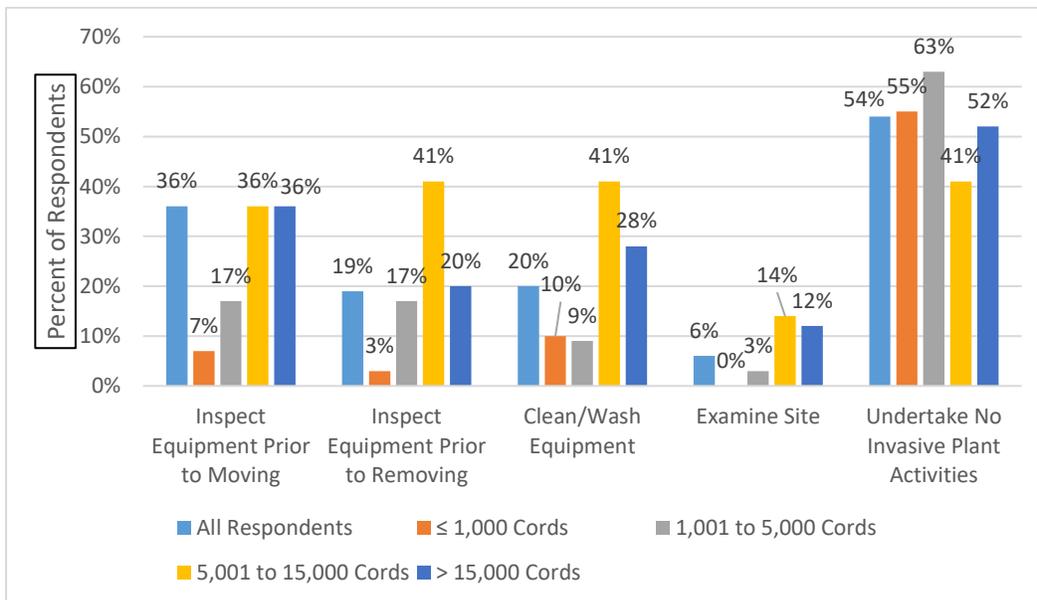
### ii. Timber Volume Size Class

The responses to Q17 were analyzed by annual timber volume size class categories on private land timber sales (Figure 27). Fisher’s exact tests of independence found a statistically significant relationship

between the timber volume size class and respondents who were contractually required to inspect their equipment prior to moving to a job site ( $p=0.0189$ ), inspect their equipment prior to removing it from a job site ( $p=0.0082$ ), and clean/wash their equipment ( $p=0.0100$ ). Fisher’s exact tests of independence did not find a statistically significant relationship between timber volume size class and contractual requirements to examine site for invasives ( $p=0.0749$ ) or not being contractually required to undertake any of the listed activities ( $p=0.4615$ ) on private land timber sales. The other activities weren’t segmented by timber volume size class due to the small percentage of respondents who reported contractually undertaking those activities.

Post-hoc pairwise tests with Bonferroni corrections (with a significance level of  $p=0.0083$ ) found respondents in the 1,000 cords or less volume category ( $p=0.0081$ ) were less likely than respondents in the greater than 15,000 cord category to have contractually been required to inspect their equipment prior to moving to a job site on private land timber sales. Respondents in the 1,000 cords or less volume category were also less likely to have to contractually inspect their equipment prior to removing it from a job site on private land timber sales than the 5,001 to 15,000 cord producers ( $p=0.0012$ ). Finally, respondents in the 1,001 to 5,000 cord volume category were less likely than respondents in the 5,001 to 15,000 cord category to have contractually been required ( $p=0.0064$ ) to clean/wash their equipment on private land timber sales.

**Figure 27.** Activities contractually undertaken on private timber sales in the previous twelve months to avoid the introduction and spread of invasives by timber volume size class (Percent of respondents) (N=111).



### iii. Seasonality of Operations

The responses to Q17 were analyzed by seasonality of operations (i.e., whether a respondent was a winter-only business versus a business operating in other seasons) on private land timber sales. Fisher’s

exact tests of independence found no statistically significant relationship between seasonality of operations and respondents who were contractually required to clean/wash their equipment ( $p=0.5855$ ), inspect equipment prior to removing it from a job site ( $p=0.7789$ ), inspect equipment prior to moving to a job site ( $p=0.7926$ ), examining the site for invasives ( $p=0.6773$ ), or having been contractually required to undertake none of the listed activities ( $p=0.8926$ ) on public land timber sales. The other activities weren't segmented by seasonality due to the small percentage of respondents who reported contractually undertaking those activities.

### **Question 18 (N=119)**

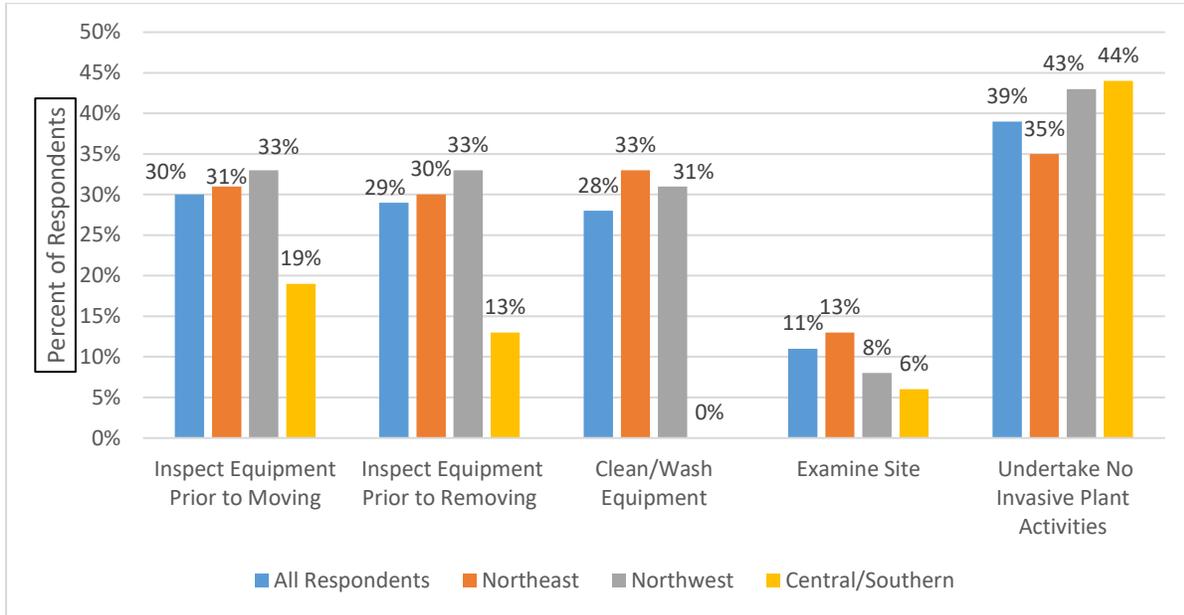
Respondents were asked to indicate which of the same eight invasive plant control and treatment activities (Table 5) they had voluntarily undertaken in the past twelve months in order to prevent the introduction and/or limit the spread of invasive forest plants. Forty-five percent of the respondents indicated they had not voluntarily undertaken any of the activities on public land timber sales, while 47% indicated none of the activities had been voluntarily undertaken on private land timber sales (Table 5). The same three activities undertaken by the greatest percentage of respondents under contractual requirements were also the highest implemented voluntary activities: a) inspecting equipment for invasives prior to moving it to a different logging site (40% public sales and 32% private sales), b) inspecting equipment for invasives prior to removing it from the job site (35% public sales and 32% private sales), and c) cleaning/washing equipment (33% public sales and 29% private sales). The percentage of respondents voluntarily inspecting job sites for invasives was almost triple the percentage doing so out of contractual requirements for each land ownership type. As with the contractual requirements, fewer than 4% of the respondents reported voluntarily undertaking any of the invasives treatment activities (burning, herbicide application, manual treatment, or mechanical treatment).

#### A. Q18 Segmentation Analyses on Public Land Timber Sales

##### i. MnDNR Forestry Region

The responses to Q18 were analyzed by MnDNR forestry region for public land timber sales. Fisher's exact tests of independence found no statistically significant relationship between region and respondents who voluntarily inspect equipment prior to moving to a job site ( $p=0.5650$ ), inspect equipment prior to removing it from a job site ( $p=0.3192$ ), examined site for invasives ( $p=0.7039$ ), or not having voluntarily undertaken any of the listed activities ( $p=0.6887$ ). The Fisher's exact test of independence did find a statistically significant relationship between region and respondents who voluntarily cleaned/washed their equipment ( $p=0.0130$ ). Post-hoc pairwise tests with Bonferroni corrections (with a significance level of  $p=0.0167$ ) found respondents in the Central/Southern region were statistically different than the Northwest region ( $p=0.0166$ ) and the Northeast region ( $p=0.0047$ ). Specifically, respondents in the Central/Southern region were significantly less likely to voluntarily clean/wash their equipment on public land timber sales (0%) versus 33% in the Northeast region and 31% in the Northwest region doing so (Figure 28). The other activities weren't segmented by region due to the small sample size.

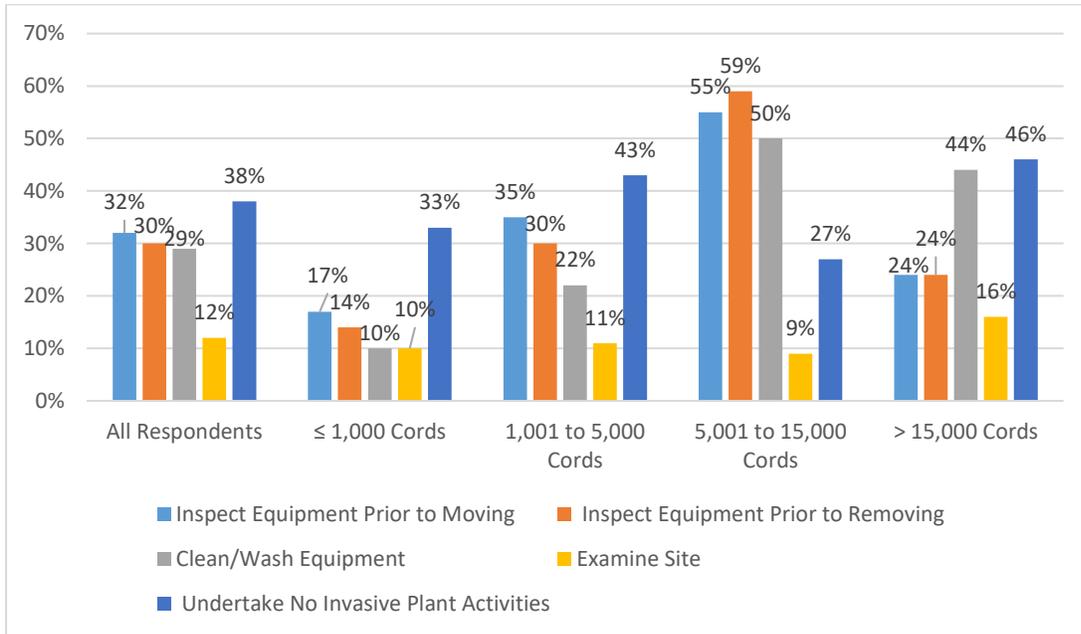
**Figure 28.** Activities voluntarily undertaken on public timber sales in the previous twelve months to avoid the introduction and spread of invasives by MnDNR forestry region (Percent of respondents) (N=119).



## ii. Timber Volume Size Class

The responses to Q18 were analyzed by annual timber volume size class categories (Figure 29). Fisher’s exact tests of independence found statistically significant relationships between timber volume size class and respondents who voluntarily clean/wash their equipment ( $p=0.0036$ ), inspect equipment prior to moving to a job site ( $p=0.0334$ ), and inspect equipment prior to removing it from a job site ( $p=0.0064$ ) on public land timber sales. Post-hoc pairwise tests with Bonferroni corrections (with a significance level of  $p=0.0083$ ) found respondents in the 1,000 cords or less group were statistically different than the 5,001 to 15,000 cord group for each of these activities. Specifically, loggers in the 5,001 to 15,000 cord volume group were significantly more likely to voluntarily inspect their equipment prior to moving it to a job site ( $p=0.0074$ ), inspect their equipment prior to removing it from a job site ( $p=0.0010$ ), and clean/wash their equipment ( $p=0.0034$ ) than the 1,000 cords or less group on public land timber sales. Fisher’s exact tests of independence did not find a statistically significant relationship between timber volume size class and voluntary actions to examining the site for invasives ( $p=0.8773$ ), or not voluntarily undertaking any of the listed activities ( $p=0.5105$ ) on public land timber sales. The other activities weren’t segmented by timber volume size classes due to the small number of respondents who reported undertaking those activities.

**Figure 29.** Activities voluntarily undertaken on public timber sales in the previous twelve months to avoid the introduction and spread of invasives by timber volume size class (Percent of respondents) (N=113).



### iii. Seasonality of Operations

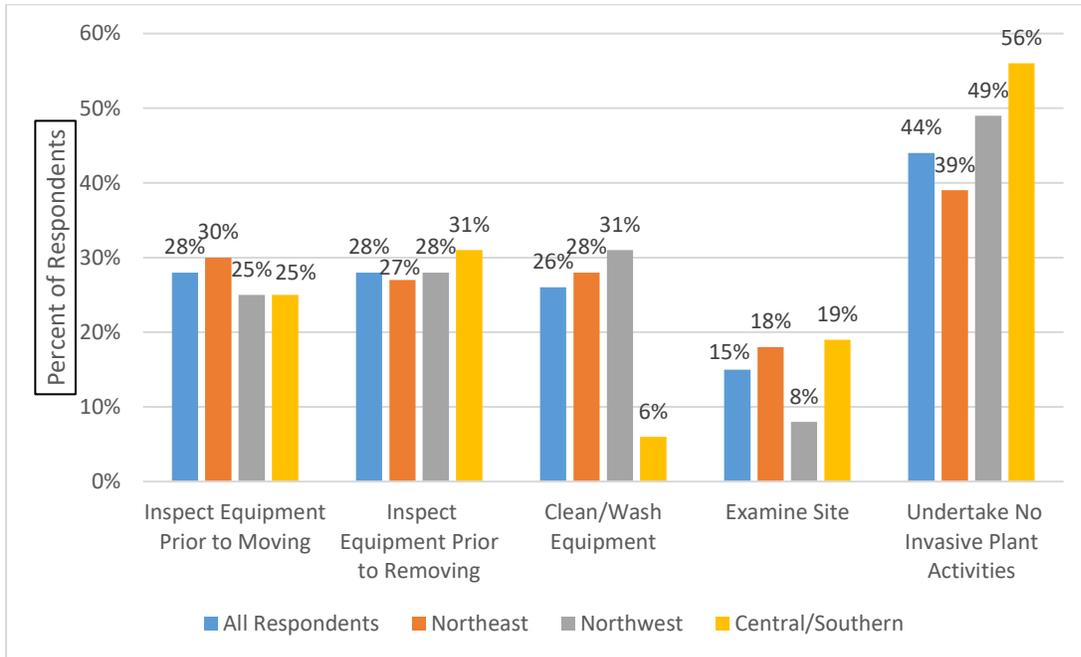
The responses to Q18 were analyzed by seasonality of operations. Fisher’s exact tests of independence found no statistically significant relationship between seasonality of operations and respondents who voluntarily cleaned/washed their equipment ( $p=0.2327$ ), inspected their equipment prior to removing it from a job site ( $p=0.2285$ ), inspected their equipment prior to moving to a job site ( $p=0.3453$ ), examined the site for invasives ( $p=0.7297$ ), or having voluntarily undertaken none of the listed activities ( $p=0.2565$ ) on public land timber sales. The other activities weren’t segmented by region due to the small number of respondents who reported voluntarily undertaking those activities.

## B. Q18 Segmentation Analyses on Private Land Timber Sales

### i. MnDNR Forestry Region

The responses to Q18 were analyzed by MnDNR forestry region. Fisher’s exact tests of independence found no statistically significant relationship between MnDNR forestry region and voluntarily inspecting equipment prior to moving to a site ( $p=0.880$ ), inspecting equipment prior to removing it from a site ( $p=0.9578$ ), cleaning/washing equipment ( $p=0.1410$ ), examining the site for invasives ( $p=0.4171$ ) or not voluntarily undertaking any of the invasives activities ( $p=0.3524$ ) (Figure 30). The other activities weren’t segmented by MnDNR forestry region due to the small number of respondents who reported undertaking those activities.

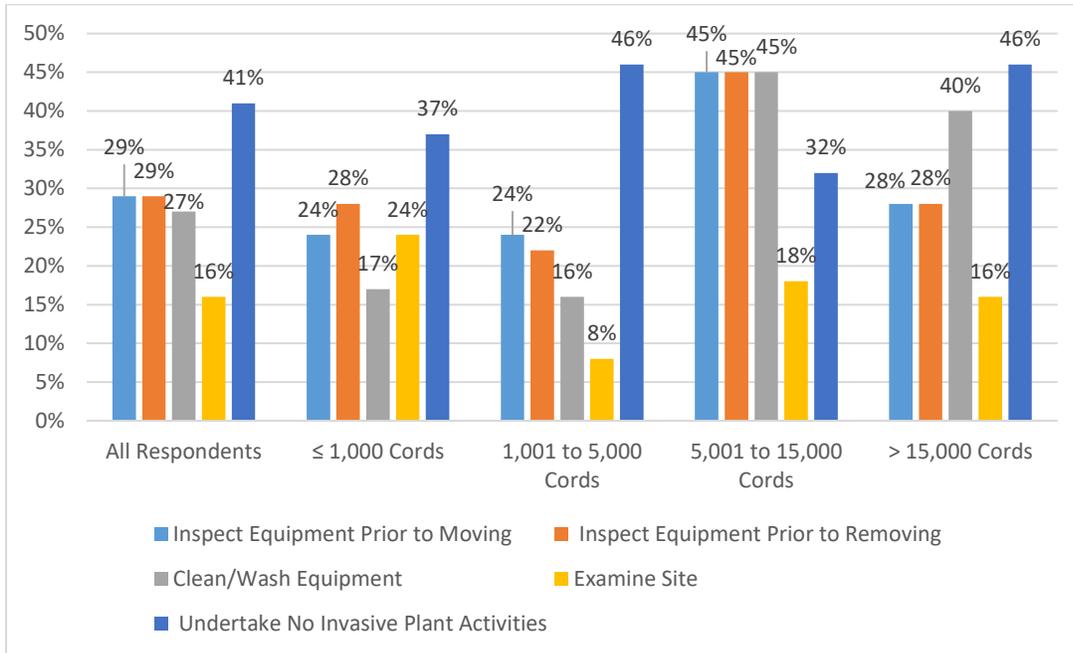
**Figure 30:** Activities voluntarily undertaken on private timber sales in the previous twelve months to avoid the introduction and spread of invasives by MnDNR forestry region (Percent of respondents) (N=119).



## ii. Timber Volume Size Class

The responses to Q18 were analyzed by annual timber volume size class categories. Fisher’s exact tests of independence found a statistically significant relationship between timber volume size class and voluntarily cleaning/washing equipment ( $p=0.0259$ ). Post-hoc pairwise tests with Bonferroni corrections (with a significance level of  $p=0.0083$ ) did not find any significant pairwise associations at the specified significance level. However, Figure 31 illustrates higher percentages of respondents in the 5,001 to 15,000 cord groups voluntarily undertook several of the activities than respondents in the other volume size classes. No statistically significant associations were found between timber volume size class and voluntarily inspecting equipment prior to moving to a site ( $p=0.3339$ ), inspecting equipment prior to removing it from a site ( $p=0.2867$ ), examining the site for invasives ( $p=0.3324$ ) or not voluntarily undertaking any of the invasives activities ( $p=0.6866$ ) (Figure 31). The other activities weren’t segmented by MnDNR forestry region due to the small number of respondents who reported undertaking those activities.

**Figure 31.** Activities voluntarily undertaken on private timber sales in the previous twelve months to avoid the introduction and spread of invasives by timber volume size class (Percent of respondents) (N=113).



### iii. Seasonality of Operations

The responses to Q18 were analyzed by seasonality of logging operations. Fisher’s exact tests of independence found no statistically significant relationship between seasonality of operations and respondents who voluntarily cleaned/washed their equipment ( $p=0.3306$ ), inspected equipment prior to removing it from a job site ( $p=0.0917$ ), inspected equipment prior to moving to a job site ( $p=0.2327$ ), examined the site for invasives ( $p=0.2379$ ), or having voluntarily undertaken none of the listed activities ( $p=0.6570$ ) on private land timber sales. The other activities weren’t segmented by seasonality of operations due to the small number of respondents who reported undertaking those activities.

### Question 17 and Question 18 Comparisons (N varies)

We were interested in examining whether there were relationships between contractual and voluntary implementation of invasive plants by logging businesses. Chi-squared tests indicated statistically significant relationships at the  $p=0.05$  level between the implementation of voluntary and contractual invasive control activities on both public and private timber land sales (Table 6). For example, 100% of the respondents who examined their public land timber sale sites for invasives out of contractual requirements also voluntarily examined their other public land timber sale sites which did not have contractual requirements. Conversely, 92% of respondents who were not contractually obligated to examine their public land timber sale sites for invasives also did not voluntarily examine their public land timber sites for invasives. Similarly, 90% of respondents who cleaned/washed their equipment on

private land timber sales due to contractual requirements also voluntarily cleaned/washed their equipment on their other private land sales. Conversely, 88% of the respondents who did not clean/wash their equipment on private land timber sales because they weren't contractually obligated to do so also did not voluntarily clean/wash their equipment on private land timber sales. In summary, respondents tend to either undertake the invasive plant inspection and cleaning activities explored in Table 6 either *both* voluntarily and contractually or not at all.

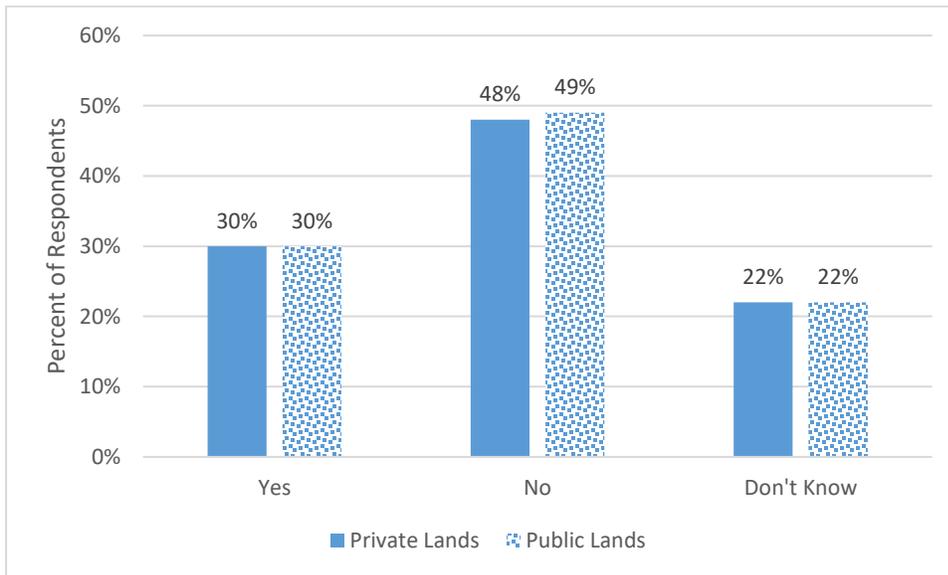
**Table 6.** Chi-square tests of relationship between contractual and voluntary invasive plant control activities undertaken on timber sales in the previous twelve months (Percent of respondents).

	<b>Examine Site for Invasives on Public Land Timber Sales</b>		<b>Examine Site for Invasives on Private Land Timber Sales</b>	
	Voluntarily Examine - No	Voluntarily Examine - Yes	Voluntarily Examine - No	Voluntarily Examine - Yes
Contractually Examine – No	92%	8%	89%	11%
Contractually Examine – Yes	0%	100%	83%	17%
	$\chi^2(1, N=94)=31.52, p<0.0001$		$\chi^2(1, N=101)=23.66, p<0.0001$	
	<b>Inspect Equipment Prior to Moving to Different Logging Site on Public Land Timber Sales</b>		<b>Inspect Equipment Prior to Moving to Different Logging Site on Private Land Timber Sales</b>	
	Voluntarily Inspect - No	Voluntarily Inspect - Yes	Voluntarily Inspect - No	Voluntarily Inspect - Yes
Contractually Inspect – No	83%	17%	86%	14%
Contractually Inspect – Yes	18%	82%	12%	88%
	$\chi^2(1, N=94)=36.51, p<0.0001$		$\chi^2(1, N=101)=45.31, p<0.0001$	
	<b>Inspect Equipment Prior to Removing it from the Logging Site on Public Land Timber Sales</b>		<b>Inspect Equipment Prior to Removing it from the Logging Site on Private Land Timber Sales</b>	
	Voluntarily Inspect - No	Voluntarily Inspect - Yes	Voluntarily Inspect - No	Voluntarily Inspect - Yes
Contractually Inspect – No	84%	16%	84%	16%
Contractually Inspect – Yes	16%	84%	5%	95%
	$\chi^2(1, N=94)=37.86, p<0.0001$		$\chi^2(1, N=101)=46.19, p<0.0001$	
	<b>Clean/Wash Equipment on Public Land Timber Sales</b>		<b>Clean/Wash Equipment on Private Land Timber Sales</b>	
	Voluntarily Clean/Wash - No	Voluntarily Clean/Wash - Yes	Voluntarily Clean/Wash - No	Voluntarily Clean/Wash - Yes
Contractually Clean/Wash – No	88%	12%	88%	12%
Contractually Clean/Wash – Yes	12%	88%	10%	90%
	$\chi^2(1, N=94)=49.30, p<0.0001$		$\chi^2(1, N=101)=49.41, p<0.0001$	

### Question 19 (N varies)

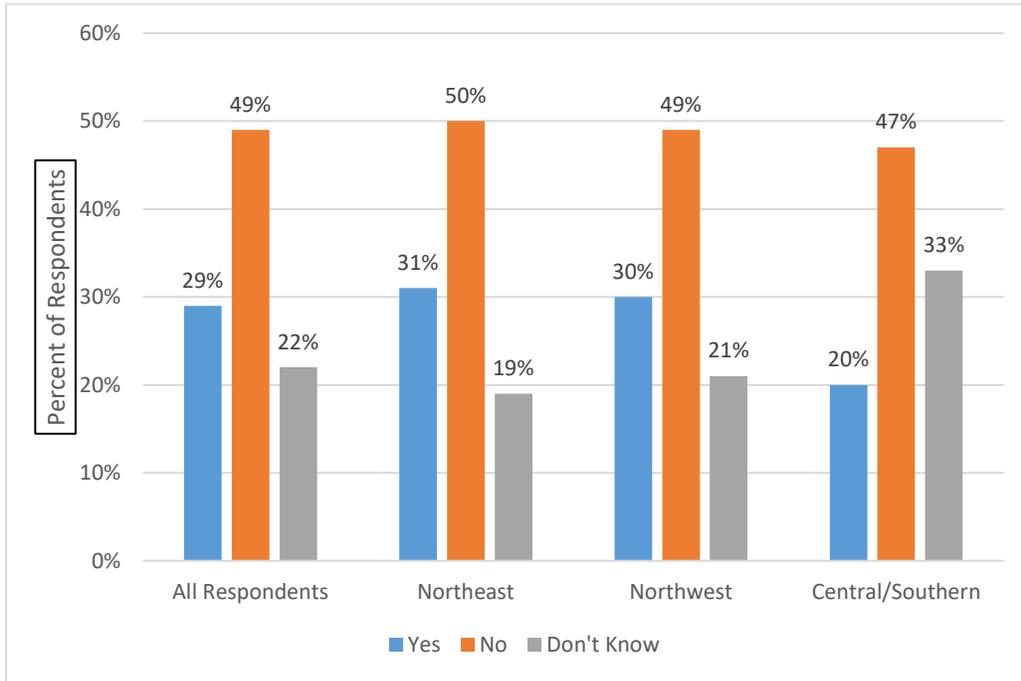
To gauge the impact that invasive plants might have on a logging business owner's interest in purchasing a timber sale, respondents were asked whether they would be less interested in a timber sale if they knew invasive forest plants are present. Responses were similar across both land ownership types (Figure 32). Approximately half of respondents indicated the presence of invasive species would not impact their interest in purchasing a timber sale (private or public sales), while 30% said that they would impact their interest and 22% were uncertain.

**Figure 32.** Reduced interest in purchasing a timber sale when invasive plants are present (N=122 for private land timber sales and N=116 for public land timber sales) (Percent of respondents).

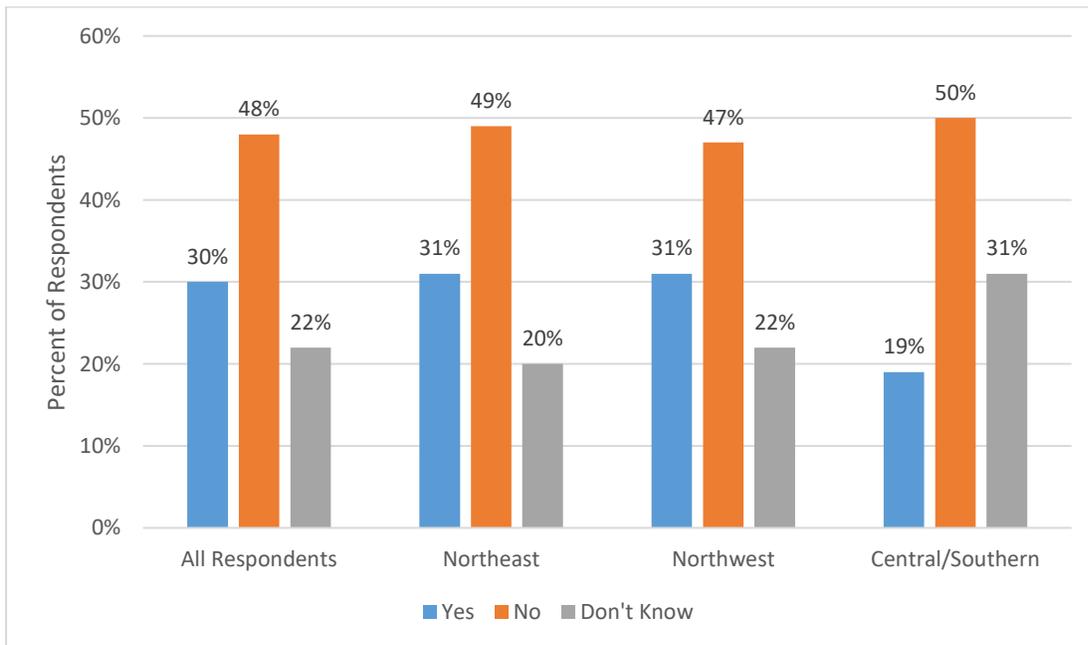


Responses to this question were examined by the three MnDNR forestry regions. Fisher's exact test of independence found no statistical relationship between region and reduced interest in purchasing either a public land timber sale ( $p=0.7978$ ) or a private land timber sale ( $p=0.8255$ ) when invasive plants are known to be present (Figures 33 and 34).

**Figure 33.** Reduced interest in purchasing a public timber sale when invasive plants are present by MnDNR forestry region (N=116) (Percent of respondents).



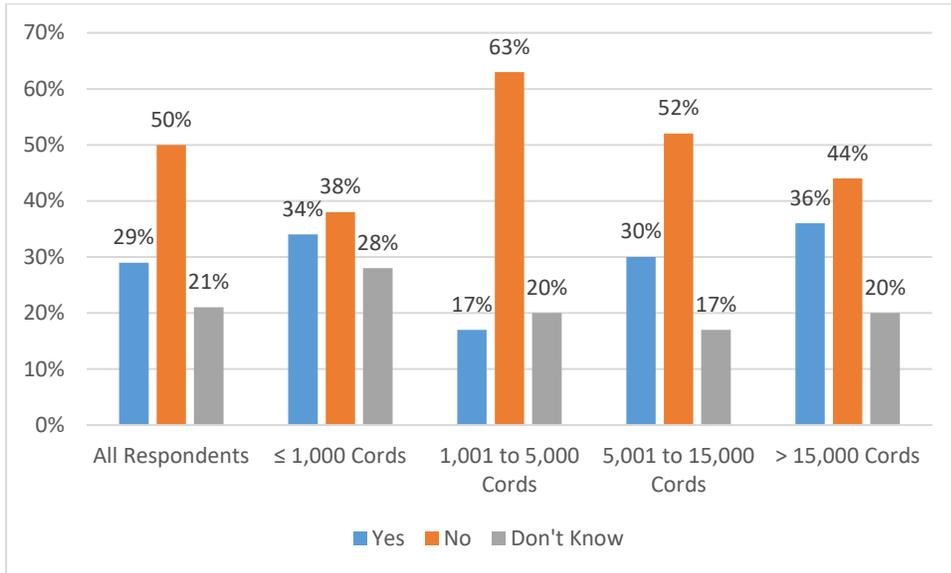
**Figure 34.** Reduced interest in purchasing a private timber sale when invasive plants are present by MnDNR forestry region (N=122) (Percent of respondents).



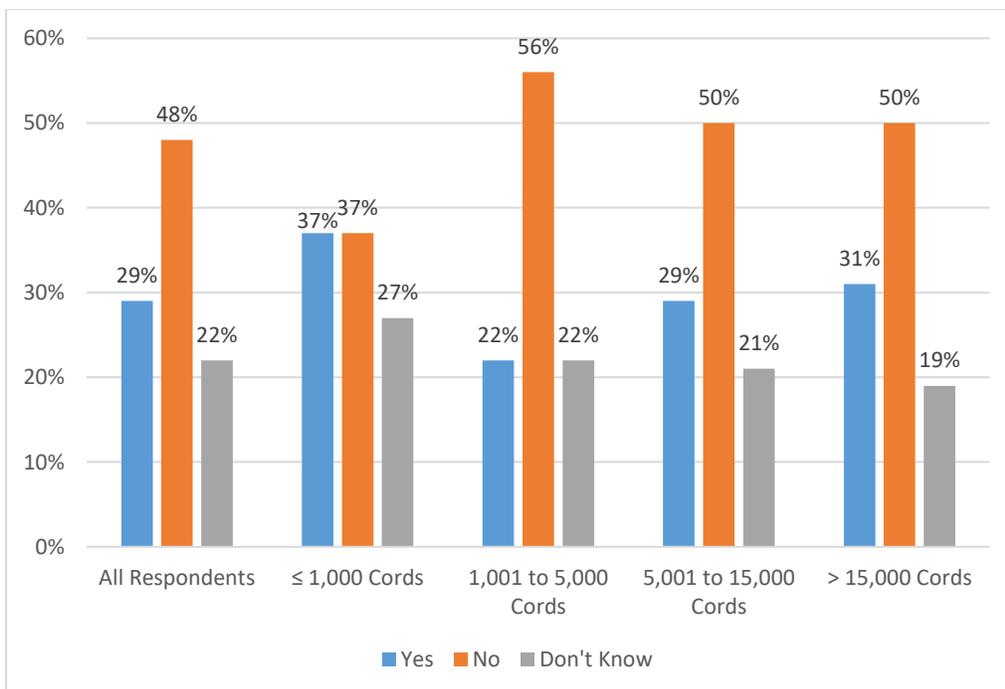
Responses to this survey question were examined by the timber volume size class categories. Fisher's exact test of independence found no statistical relationship between region and reduced interest in

purchasing either a public land timber sale ( $p=0.4793$ ) or a private land timber sale ( $p=0.8722$ ) when invasive plants are known to be present (Figures 35 and 36).

**Figure 35.** Reduced interest in purchasing a public timber sale when invasive plants are present by timber volume size class (N=112) (Percent of respondents).



**Figure 36.** Reduced interest in purchasing a private timber sale when invasive plants are present by timber volume size class (N=116) (Percent of respondents).

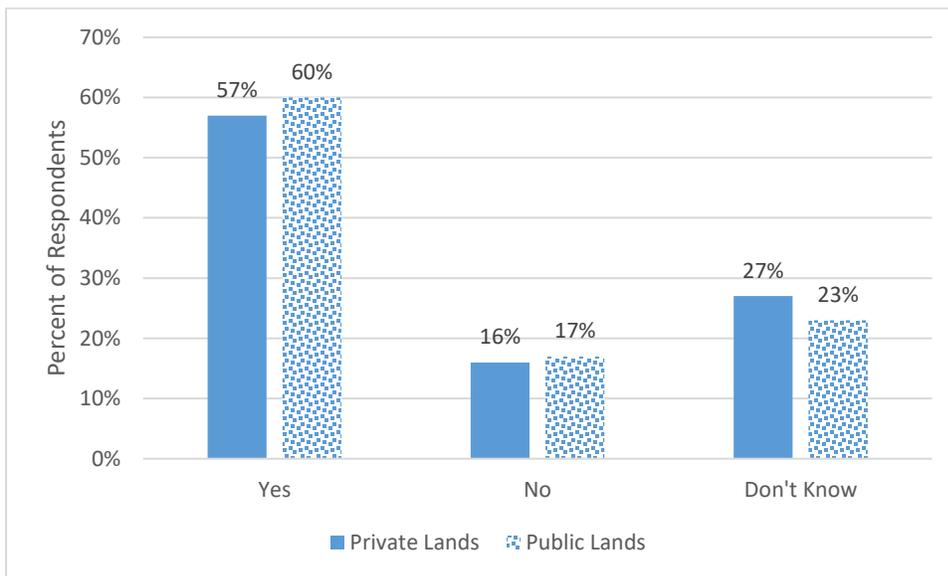


Finally, responses were examined by seasonality of business operations. Fisher’s exact tests of independence were performed, and no association was found between seasonality of operations and reduced interest in bidding on a public land timber sale ( $p=0.4509$ ) or a private land timber sale ( $p=0.3679$ ).

### Question 20 (N varies)

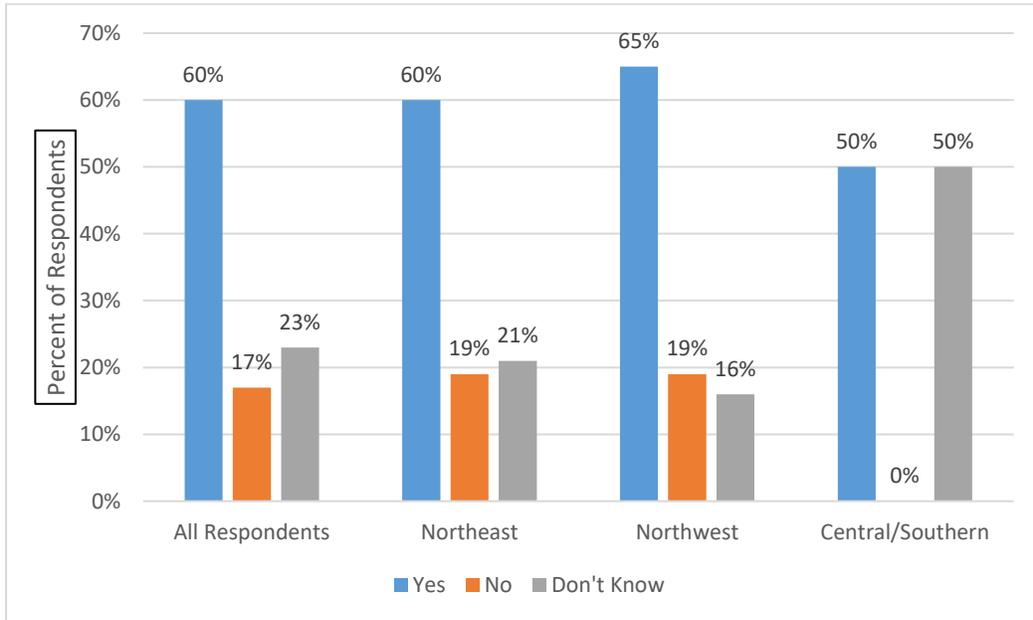
As a follow-up to the previous question, respondents were also asked whether they would be less interested in purchasing a timber sale if they knew BMPs related to invasive forest plants were required to be followed. Responses were very similar across both land ownership types (Figure 37). More than half of the respondents indicated the requirement to undertake invasive plant BMPs would reduce their interest in a timber sale (57% of respondents for private land timber sales and 60% for public sales). Approximately 16% said invasive plant BMP requirements would not impact their interest in purchasing a timber sale, while approximately one-quarter were uncertain. In comparison to Question 19, the possibility of having to implement invasive plant BMPs has a greater negative influence on interest in a given timber sale than does the presence of invasive plants on the sale site.

**Figure 37.** Reduced interest in purchasing a timber sale if invasive plant BMPs were to be required (N=128 for private land and N=126 for public land timber sales) (Percent of respondents).

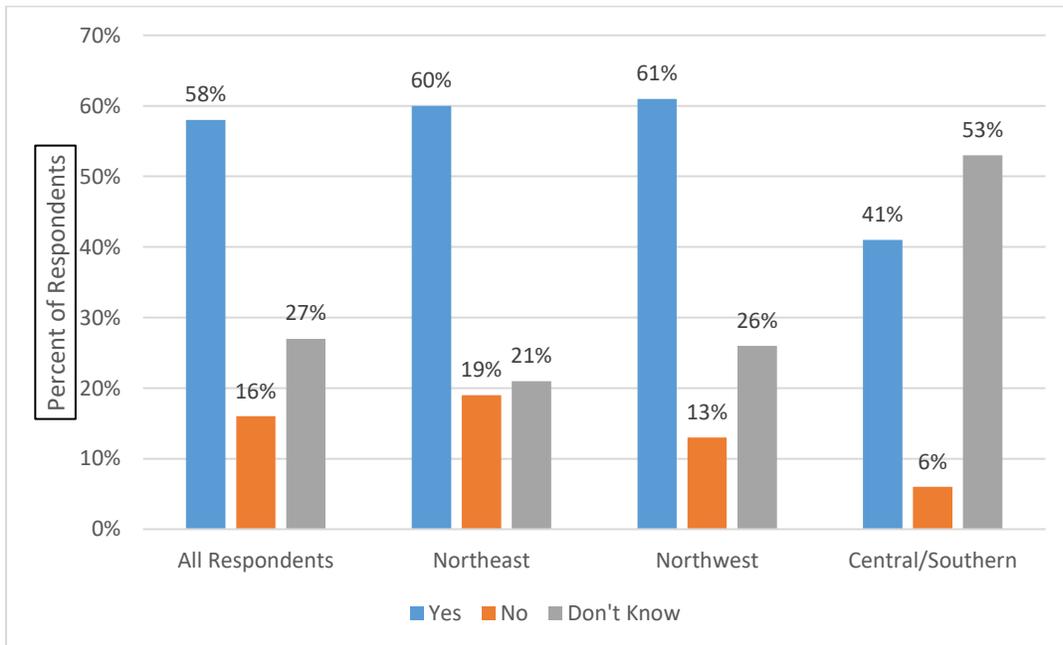


Responses to this question were examined by MnDNR forestry regions. Fisher’s exact test of independence found no statistical relationship between region and reduced interest in purchasing either a public land timber sale ( $p=0.0619$ ) or a private land timber sale ( $p=0.1209$ ) if invasive forest plant BMPs were to be required (Figures 38 and 39).

**Figure 38.** Reduced interest in purchasing a public timber sale if invasive plant BMPs were to be required, by MnDNR forestry region (N=126) (Percent of respondents).



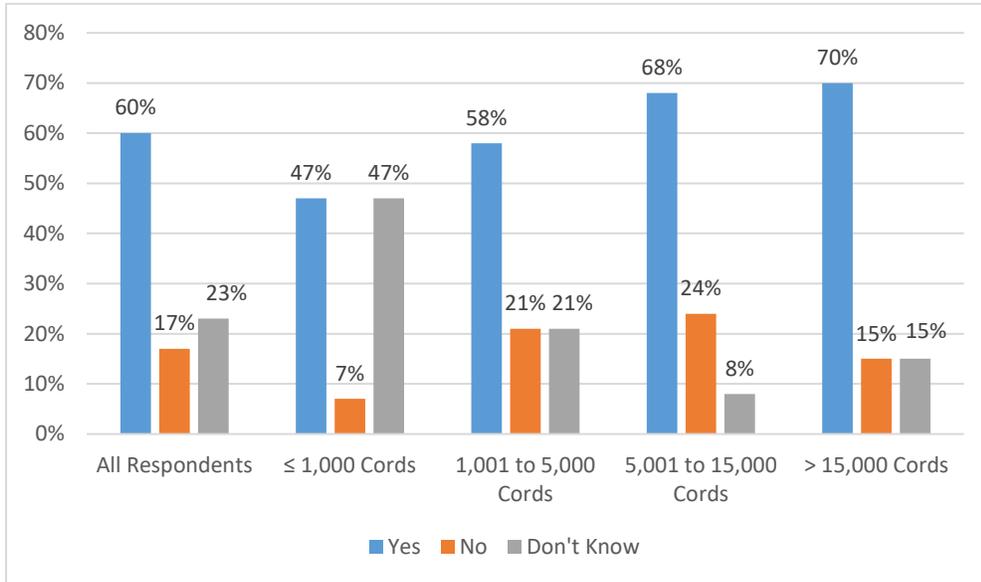
**Figure 39.** Reduced interest in purchasing a private timber sale if invasive plant BMPs were to be required, by MnDNR forestry region (N=128) (Percent of respondents).



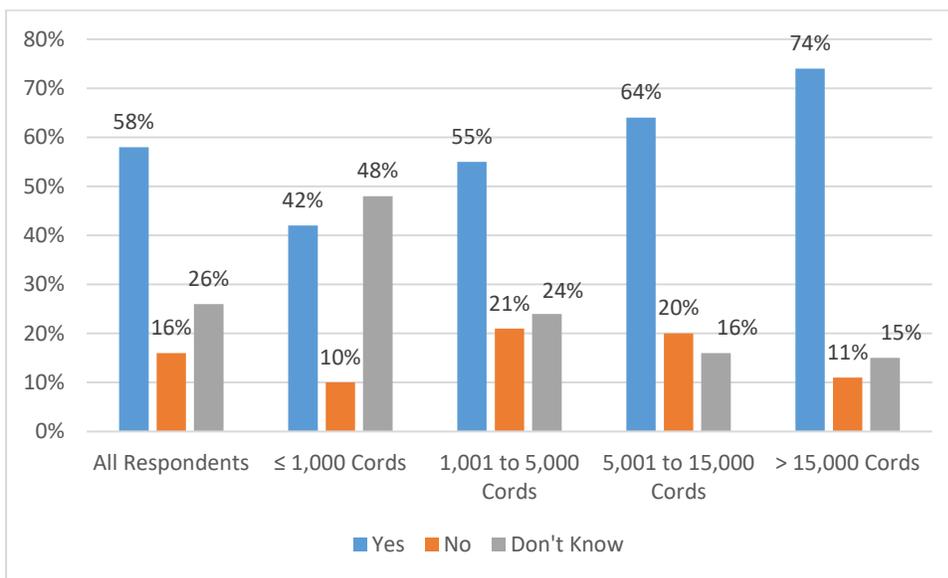
Responses to this question were examined by annual timber volume size class. Fisher's exact test of independence found a statistical relationship between annual timber volume size class and reduced

interest in purchasing a public land timber sale ( $p=0.0254$ ), but no statistical relationship when purchasing a private land timber sale ( $p=0.0602$ ) if invasive forest plant BMPs were to be required (Figures 40 and 41). Post-hoc pairwise tests with Bonferroni corrections (with a significance level of  $p=0.0083$ ) found a significant difference in responses between the 1,000 cords or less group and the 5,001 to 15,000 cord group ( $p=0.0033$ ), with the 5,001 to 15,000 cord group more certain to have a reduced interest in purchasing a public land timber sale if invasive BMPs were to be required.

**Figure 40.** Reduced interest in purchasing a public timber sale if invasive plant BMPs were to be required, by timber volume size class (N=120) (Percent of respondents).



**Figure 41.** Reduced interest in purchasing a private timber sale if invasive plant BMPs were to be required, by timber volume size class (N=121) (Percent of respondents).

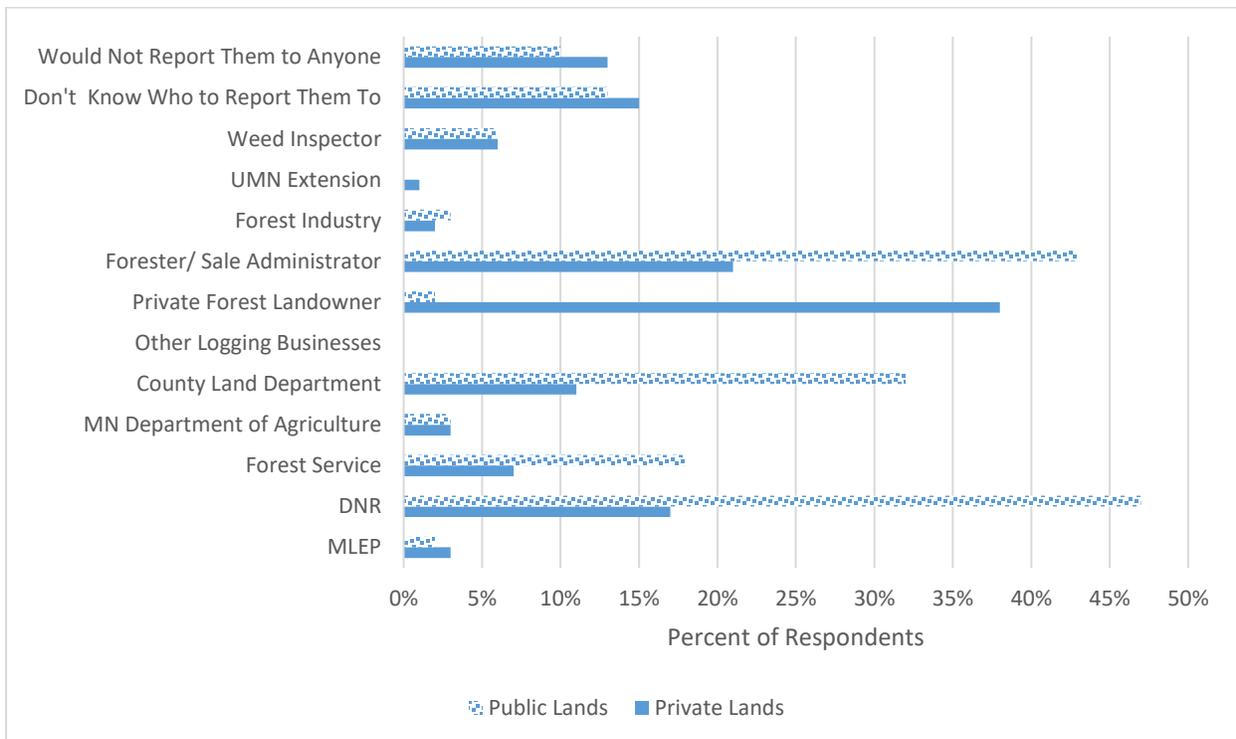


Finally, responses to this survey question were segmented by seasonality of logging operations. Fisher’s exact tests of independence were performed and no association was found between seasonality of operations and reduced interest in bidding on a public land timber sale ( $p=0.4586$ ) or a private land timber sale ( $p=0.2871$ ) if invasive forest plant BMPs were to be required.

### Question 21

Respondents were provided a list of eleven organizations and asked which they would report invasive plants to if they were to encounter them on a timber sale. Respondents could indicate more than one organization. A small percentage of respondents indicated they would not report invasive to anyone (13% of respondents on private land timber sales and 10% on public land timber sales) (Figure 42). Similar percentages indicated they do not know who to report invasives to (15% on private land timber sales and 13% on public land timber sales). Reporting sources vary depending upon whether the sale occurs on private or public land. For public land timber sales, the two entities most likely to report to are the DNR (47%) and the forester/sale administrator (43%). Approximately one-third of respondents would report invasives on public land timber sales to county land departments. For private sales, the most commonly selected reporting entity was the private forest landowner (38%), followed in smaller percentages by reporting to the forester/sale administrator (21%) and the DNR (17%).

**Figure 42.** Organizations that loggers would report invasives to if encountered on a timber sale (Percent of respondents) (N=125 private land timber sales and N=124 public land timber sales) (Respondents could indicate more than one organization).



**Survey Section IV: Information Needs**

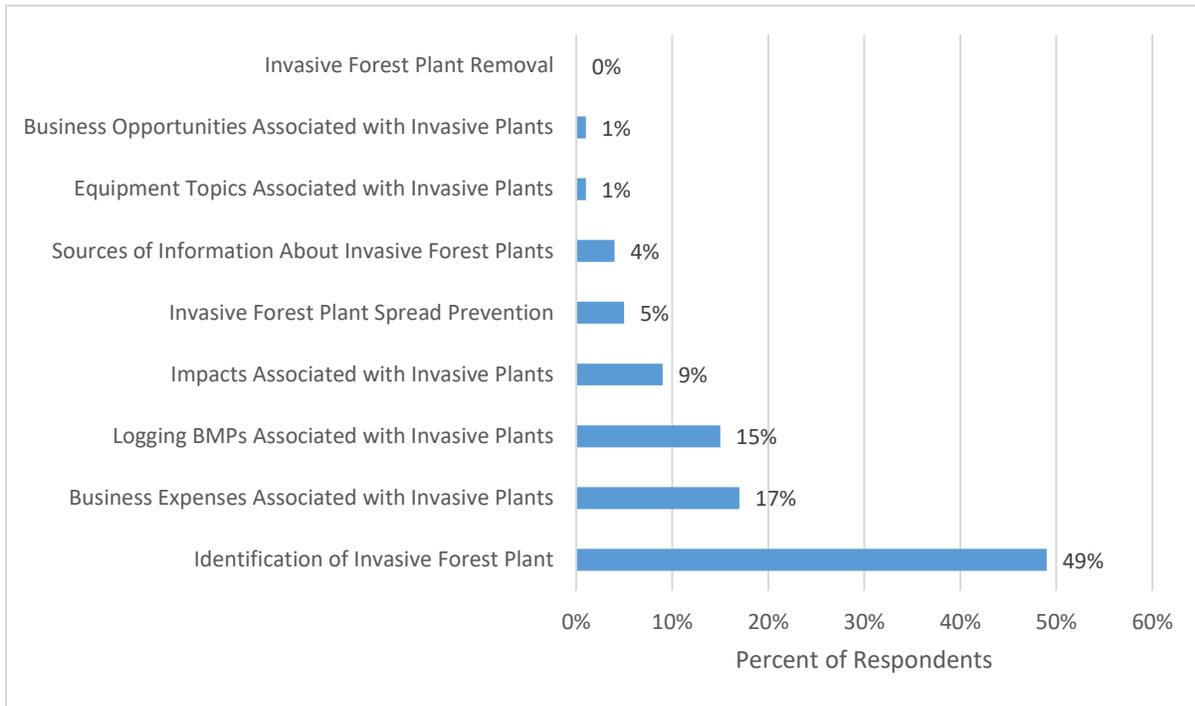
**Question 22 (N=114)**

Respondents were presented with nine education/information/training topics and asked to rank their top three needs relative to invasive forest plants or whether they had no information needs relative to invasive forest plants. Of the 114 respondents to this question, only 82 provided 1<sup>st</sup> through 3<sup>rd</sup> rankings. Some respondents checked multiple topics, but did not provide rankings, or provided the same rank to multiple topics; these responses were not included in the tally of ranking in Table 7 or Figure 43. Identification of invasive forest plants was the most frequently cited information need and was rated as the most important training topic by 49% of the respondents. Business expenses associated with invasive forest plants and logging BMPs associated with invasive plants were cited second and third most frequently, respectively. Only a very small percentage (3%) of the respondents indicated they had no information needs.

**Table 7.** Ranking of information needs (Percent of respondents) (N=82).

Information Topic	Percent 1 <sup>st</sup> Rank	Percent 2 <sup>nd</sup> Rank	Percent 3 <sup>rd</sup> Rank	Percent ranked either 1 <sup>st</sup> , 2 <sup>nd</sup> or 3 <sup>rd</sup>
Identification of Invasive Forest Plants	49	17	7	73
Business Expenses Associated with Invasive Forest Plants	17	13	13	43
Logging BMPs Associated with Invasive Plants	15	10	13	38
Impacts Associated with Invasive Forest Plants	9	15	10	34
Invasive Forest Plant Spread Prevention	5	18	22	45
Sources of Information About Invasive Forest Plants	4	9	6	19
Equipment Requirements Associated with Managing Invasive Forest Plants	1	11	11	23
Business Opportunities Associated with Invasive Forest Plants	1	2	11	14
Invasive Forest Plant Removal	0	5	6	11

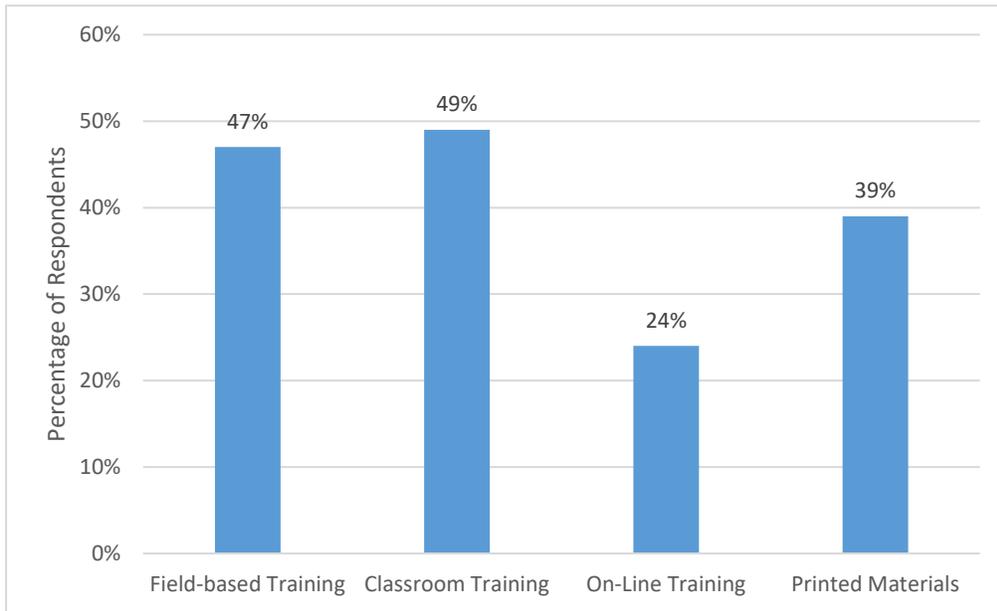
**Figure 43.** Percent of respondents ranking a training topic as most important (N=82).



**Question 23 (N=127)**

Respondents were asked how their logging business would prefer to learn about invasive forest plants, and provided a list with four options to choose from. While 20% of respondents indicated they have no interest in learning about invasive forest plants, the remaining 80% of respondents selected one or more learning modes (Figure 44). No single method was preferred by a majority of respondents. However, classroom training and field-based training were more preferred than the other two methods with almost half of the respondents indicating a preference for those two types of learning. On-line training was the least preferred learning format.

**Figure 44.** Preferred methods to learn about invasive forest plants (N=127).



## Section VI – Company Demographics

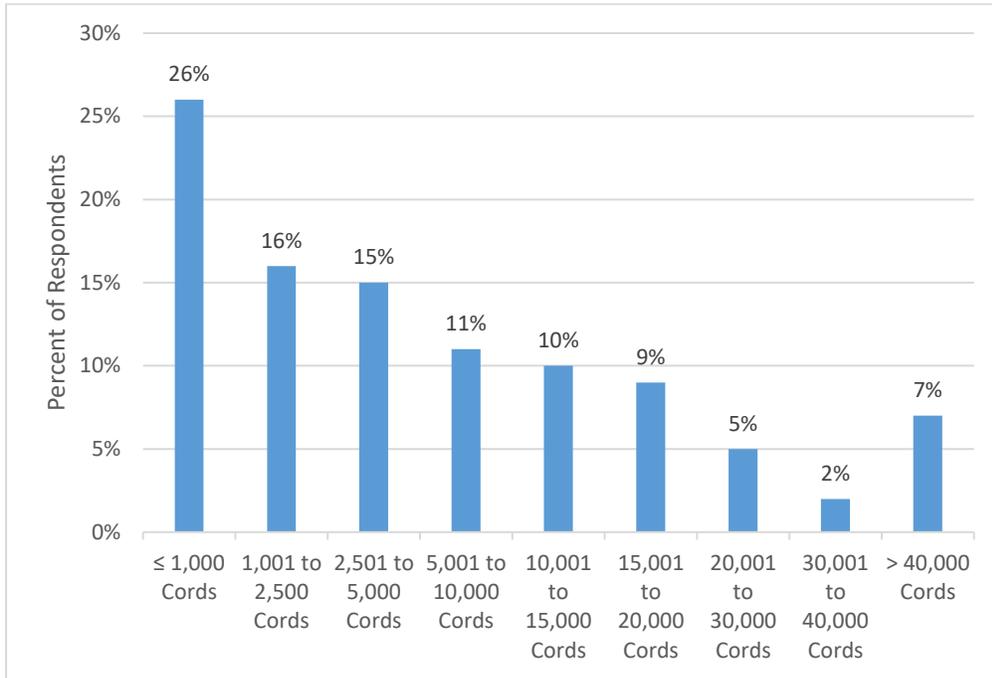
### Question 24 (N=132)

Respondents were asked to indicate the county in which their business is located (See Table 2).

### Question 25 (N=123)

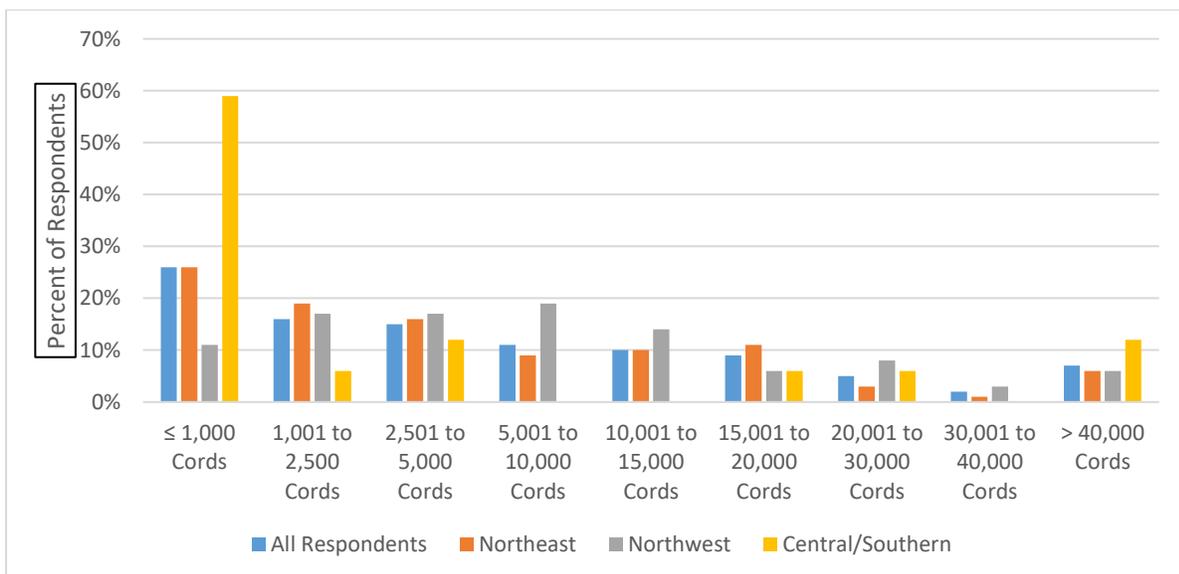
Respondents were asked how much timber volume they had harvested in the past twelve months and instructed to select a volume from nine options ranging from 1,000 cords or less to greater than 40,000 cords. The highest percentage of respondents (26%) were in the smallest harvest volume category of 1,000 cords or less (Figure 45). More than half of the respondents (57%) harvested 5,000 cords or less, while only 9% harvested more than 30,000 cords. Thus, our respondents are dominated by small to mid-size logging firms. Within MLEP, 67% of members reported producing 5,000 cords or less and 13% more than 15,000 cords (Rachel Peterson, personal communication).

**Figure 45.** Distribution of logging businesses by timber volume harvested in the past twelve months (Percent of respondents) (N=123).



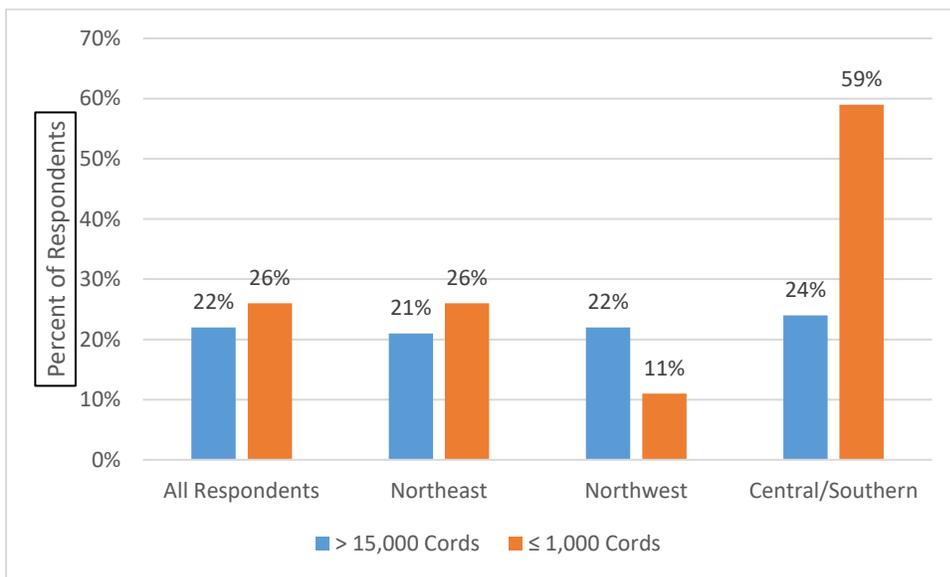
Respondents were segmented by MnDNR forestry region and the annual timber volume categories (Figure 46). A Fisher's exact test of independence was performed, and no association was found between the region in which the logging business is located and the harvest volume timber category ( $p=0.1207$ ).

**Figure 46.** Distribution of logging businesses by MnDNR forestry region by timber volume in the past twelve months (Percent of respondents) (N=123)



The timber harvest volume data were also parsed to examine the percentage of respondents who might be considered large producers (e.g., producing more than 15,000 cords) as well as the percentage of respondents considered small producers (e.g., producing 1,000 cords or less) by MnDNR forestry region. Overall, 22% of respondents produced more than 15,000 cords (n=27). A Fisher’s exact test of independence found no statistical association between MnDNR forestry region and likelihood of producing at least 15,000 cords ( $p=0.999$ ) (Figure 47). On the other end of the harvest volume distribution spectrum, 26% of respondents (n=32) produced 1,000 cords or less in the past twelve months. A Fisher’s exact test of independence found a statistical association between MnDNR forestry region and being a ‘small producer’ (e.g., producing 1,000 cords or less) ( $p=0.0015$ ), with a higher percentage of ‘small’ producers found in the Central/Southern region.

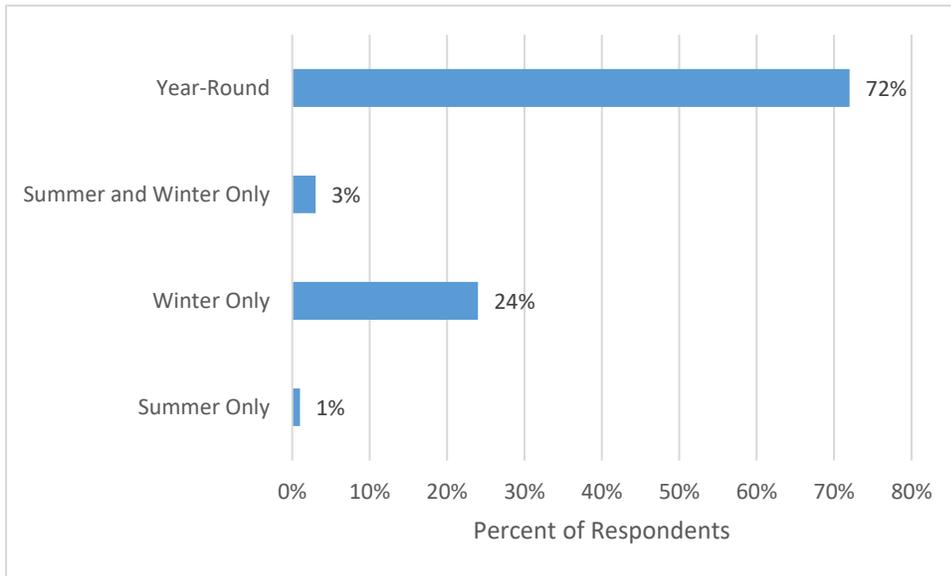
**Figure 47.** Distribution of logging businesses who produced 1,000 cords in the past twelve months (“Small Producers”) and logging businesses who produced more than 15,000 cords in the past twelve months (“Large Producers”) by MnDNR forestry region (Percent of respondents) (N=27 for “Large Producers” and N=32 for “Small Producers”).



**Question 26 (N=128)**

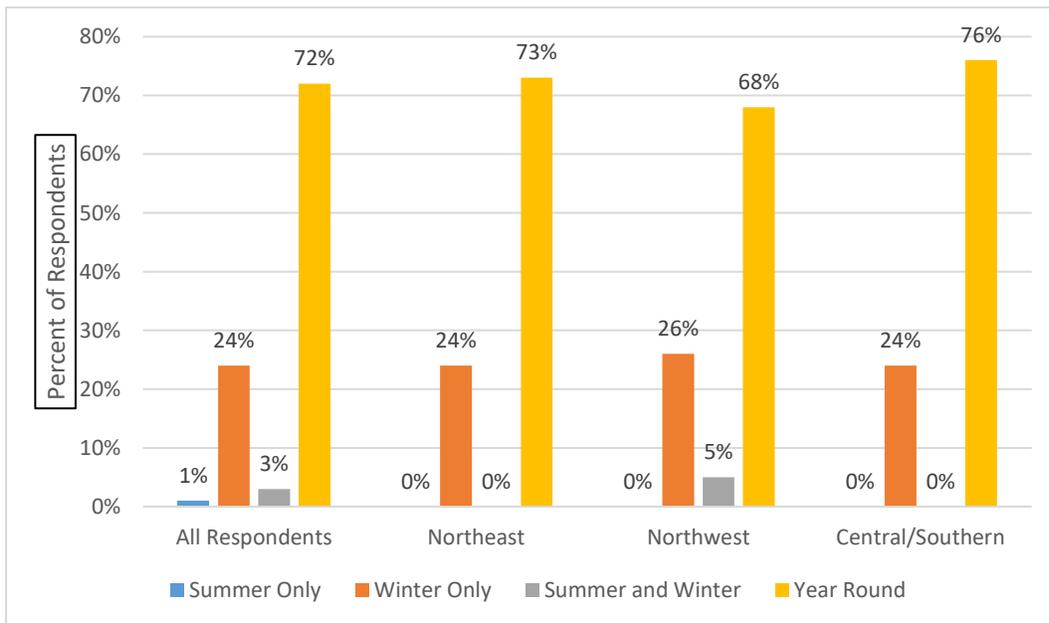
Respondents were asked to report the season(s) in which their logging business typically operates. The majority of respondents (72%) are year-round logging businesses (Figure 48). Approximately one-fourth of the respondents only operate in the winter, and the remaining 4% operate either only in the summer (1%) or in the summer and winter (3%).

**Figure 48.** Seasonality of logging business operations (Percent of respondents) (N=128).



Focusing on the winter only respondents, a Fisher’s exact test of independence found no statistical relationship between MnDNR forestry region and likelihood of being a winter-only business ( $p=0.9562$ ). Further, looking across all seasons, a Fisher’s exact test of independence found no significant relationship between MnDNR forestry region and season of operation ( $p=0.9505$ ) (Figure 49).

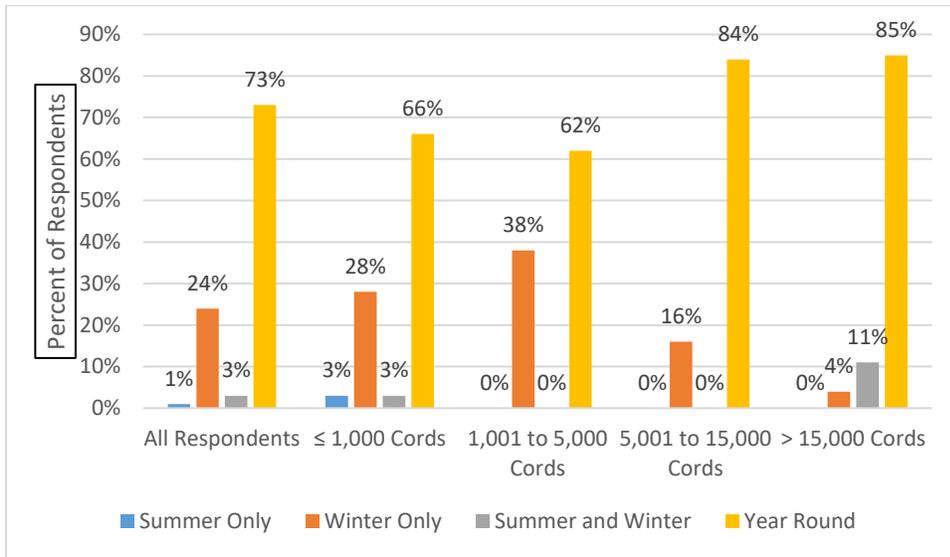
**Figure 49.** Season of logging operation by MnDNR forestry region (Percent of respondents) (N=128).



Seasonality of operations was evaluated by timber volume size class to determine if certain size operations might be more likely to be winter-only operations, and as a result, have lower chances of encountering invasive plant species during the course of their operations (Figure 50). A Fisher’s exact

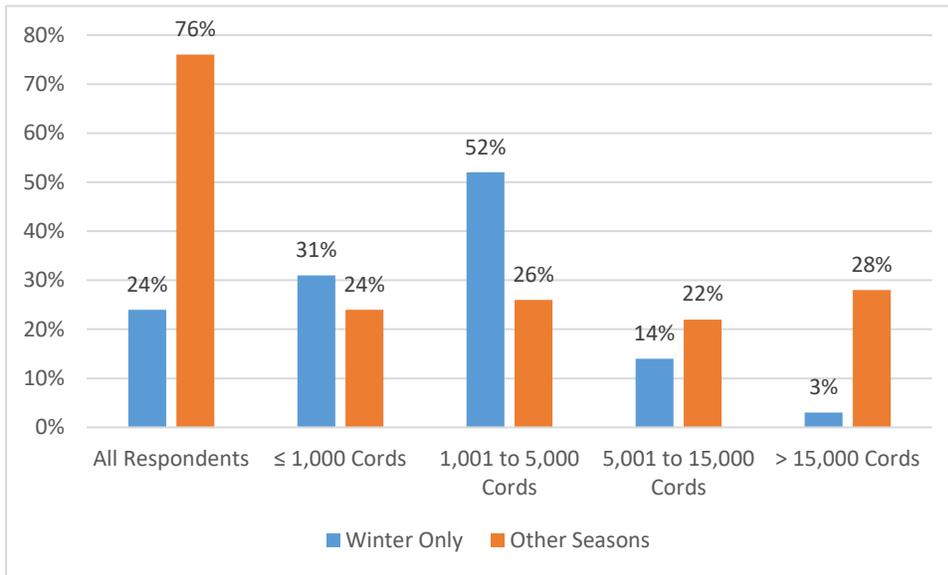
test of independence found a statistically significant relationship between annual timber volume size class and seasonality of timber operations ( $p=0.0032$ ). Post-hoc pairwise tests with Bonferroni corrections (with a significance level of  $p=0.0083$ ) found a significant difference in responses between the 1,001-5,000 cord group and the greater than 15,000 cord group ( $p=0.0005$ ). Specifically, the greater than 15,000 cord group is dominated by year-round operations, while the 1,001 to 5,000 cord group have the highest percentage of winter-only firms among respondents.

**Figure 50.** Seasons of logging operations by timber volume size class (Percent of respondents) (N=123).



Seasonality of respondent operations (e.g., winter-only business versus those operating in other seasons) was examined by the four timber volume size classes utilized above (Figure 50). A Fisher’s exact test of independence found a statistically significant relationship between annual timber volume size class and winter-only operations ( $p=0.0051$ ) (Figure 51). Post-hoc pairwise tests with Bonferroni corrections (with a significance level of  $p=0.0083$ ) found a significant difference in responses between winter-only businesses for the 1,001 to 5,000 cord businesses and the greater than 15,000 cord businesses. Specifically, higher percentages of the winter-only businesses were in the 1,001 to 5,000 cord group ( $p=0.0011$ ) and lower percentages were in the greater than 15,000 cord group ( $p=0.0018$ ) than businesses with other seasons of operations.

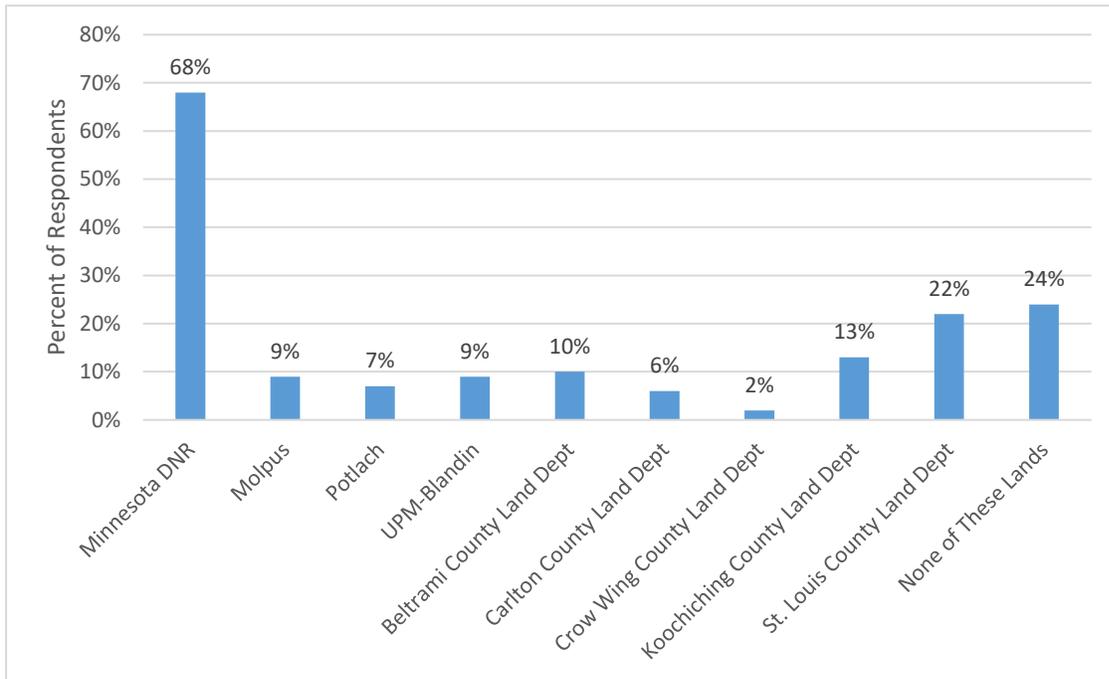
**Figure 51.** Distribution of businesses by season of operation and timber volume size class (Percent of respondents) (N=114).



**Question 27 (N=126)**

Respondents were presented a list of SFI-certified land ownerships in Minnesota and asked whether they had conducted any harvests on those lands in the past twelve months. The majority of respondents had conducted at least one harvest on one of these ownerships, with only 24% indicating they had not (Figure 52). The most commonly harvested SFI-certified land ownership was MnDNR lands, with 68% of respondents having conducted at least one harvest on these lands. The only other certified ownership on which at least 20% of respondents had harvested was from St. Louis County Land Department. Harvests on all of the other SFI-certified land ownerships were conducted by considerably smaller percentages of respondents.

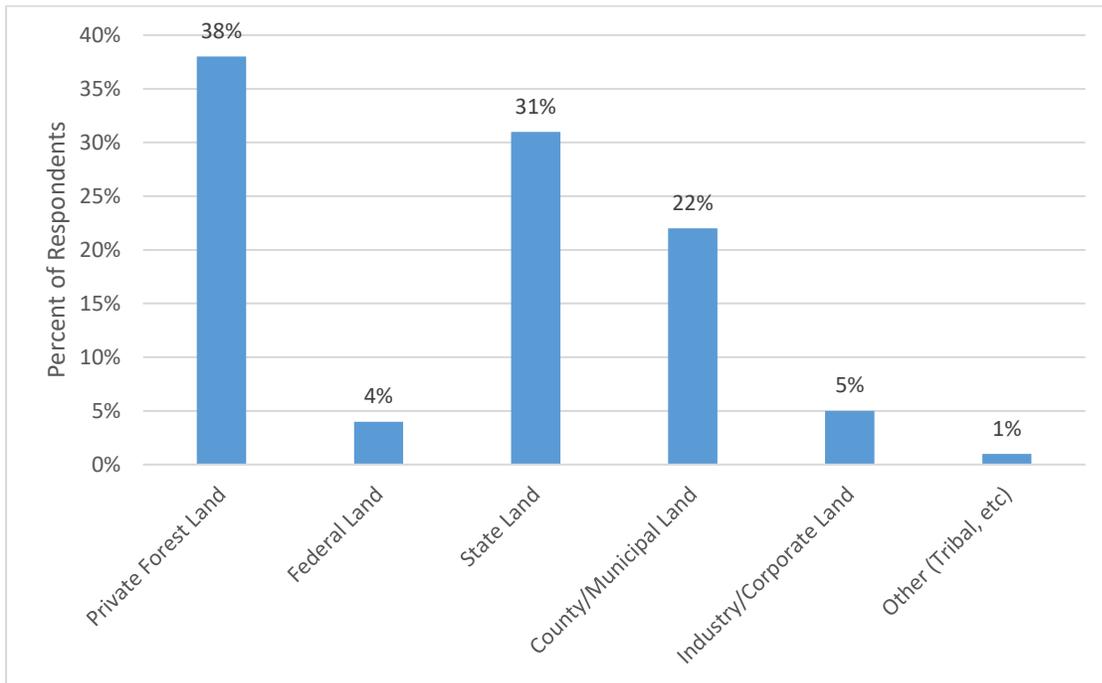
**Figure 52.** Harvests on SFI-certified lands in the past twelve months (Percent of respondents) (N=126).



**Question 28 (N=123)**

Respondents were asked to indicate the percentage of their harvested timber volume over the past twelve months that was derived from six different land sources (Private forest land, federal land, state land, county/municipal land, industry/corporate land, and other). On average, the largest percentage of timber volume for our respondents was derived from private forest land (38%), followed by approximately one-third from state lands (31%) and one-quarter (22%) from county or municipal lands (Figure 53). Those percentages are fairly comparable to the 2014 contribution to estimated harvest in Minnesota by owner (MnDNR 2017).

**Figure 53.** Average percent of timber sale volume by land ownership type (Percent of respondents) (N=123).



### Summary of Analyses by MnDNR Forestry Regions

We examined some of the survey questions by MnDNR forestry region (Table 2, Figure 2) to evaluate whether regional differences exist in terms of practices or attitudes given that some invasive plants are more prevalent in portions of the state than others (Center for Invasive Species and Ecosystem Health 2018).

No statistical difference in MnDNR forestry region and the following variables were found: general level of knowledge about invasive forest plants, perceived impact of an invasive forest plant BMP program, contractual invasive plant activities on public land timber sales, voluntary invasive plant activities on private land timber sales, reduced interest in public or private land timber sales when invasives are known to be present, reduced interested in public or private land timber sales if invasive BMPs were to be required, or season of logging operations.

A few factors did vary statistically by MnDNR forestry region. In general, when factors were found to vary, the differences were associated with the Central/Southern region versus the other two. Specifically, higher percentages of respondents in the Central/Southern regions reported noticing an increase in timber sales with invasives over the past three years than the other two regions. Respondents in the Central/Southern region also reported greater interest in developing invasive plant removal or treatment expertise than the other two regions. In terms of invasive plant activities being conducted on timber sales either contractually or voluntarily, when there were statistical differences, respondents in the Central/Southern region were less likely to be undertaking them, although most of the activities did not have regional variation. Specifically, Central/Southern respondents were less likely

than Northeast respondents to have been contractually required to inspect their equipment prior to moving it to private land timber sales. On public land timber sales, Central/Southern respondents were less likely than loggers in the other two regions to have voluntarily cleaned their equipment on public land timber sales. 'Small producers' (e.g., 1,000 cords or less) were more commonly found in the Central/Southern region. Thus, some of the differences in the Central/Southern respondents may be more of a function of being a small producer (e.g., perhaps less mechanized with lower levels of production and more time spent on-the-ground with a chainsaw and/or cable skidder), more than specifically related to a producer being located in the central or southern part of the state.

### **Summary of Analyses by Timber Volume Size Categories**

We examined some of the questions by annual timber volume size classes (1,000 cords or less; 1,001 to 5,000 cords; 5,001-15,000 cords; and greater than 15,000 cords) to evaluate whether producer size is associated with differences in practices or attitudes due to potential differences in equipment, types of sales, etc.

No statistical difference between timber volume class and the following variables were found: general level of knowledge about invasive forest plants, perception of an increase in sales with invasives over the past three years, perceived impact of an invasive forest plant BMP program, interest in developing invasive plant treatment expertise, reduced interest in public or private land timber sales when invasives are known to be present, reduced interested in private land timber sales if invasive BMPs were to be required.

A few of the factors did vary statistically by timber volume size class. In general, when factors were found to vary, the smaller cord businesses tended to be less active relative to invasive activities in comparisons to larger volume businesses. Specifically, on public land timber sales, the 1,000 cord or less companies and the 1,001-5,000 cord companies were less likely than the 5,001-15,000 cord companies to clean their equipment prior to moving it due to contractual obligations. Similarly, the 1,000 cords or less companies were also less likely to have been contractually required to inspect their equipment prior to moving it than the 5,001 to 15,000 cord companies. In terms of contractual requirements on private land sale land timber sales, the 1,000 cords or less companies were less likely to inspect their equipment than the greater than 15,000 cords before moving it to a sale and less likely than the 5,001-15,000 cord companies to inspect prior to removing it from a job site. Further, the 1,001-5,000 cord businesses were less likely to have been required to clean/wash their equipment than the 5,001-15,000 cord companies. Differences were also found in the voluntary activities companies had undertaken on their sales, and exclusively when comparing the 1,000 cords or less companies to the 5,001-15,000 cord companies. That is, the 1,000 cords or less companies were less likely to have voluntarily inspected their equipment prior to moving it, inspected equipment prior to removing it and clean/wash their equipment than the 5,001-15,000 cord companies. When it comes to perceptions about how potential invasive plant BMPs on public land timber sales might impact their interest in a sale, the 5,001-15,000 cord group were more certain in a reduced interest in timber sales than the 1,000 cords or less group. Finally, the 1,001-5,000 cord group had a higher percentage of winter only operations as compared to the greater than 15,000 cord companies.

The differences we found by timber volume size class are likely influenced in part by the type of sales different sized businesses bid on. For example, the smaller volume companies may be purchasing more private land timber sales which may be less likely to have contractual requirements to undertake invasive plant activities. Moreover, since the smallest-volume producers were more likely to be winter-only businesses, they are less likely to encounter invasive plants during their operations. The implications for these differences by timber volume size class is that greater training and assistance may be needed for the smaller volume operators if invasive plant BMP practices were to be required given less experience in dealing with invasive plant practices.

### **Summary of Analyses by Seasonality of Business Operations**

We examined some of the questions by seasonality of business operations (winter-only logging operation versus operation in other combinations of seasons) to evaluate whether differences exist in terms of practices or attitudes given that logging firms operating solely in the winter would have less likelihood of seeing invasive plants during the course of their operations. Of the factors examined, only two statistically significant differences were found: a) winter-only respondents reported lower general levels of knowledge of invasive forest plants in Minnesota, and b) higher percentages of winter-only businesses were in the 1,001-5,000 cord annual timber volume size classes. The implications of these findings is that winter-only businesses may be in greater need of training and assistance to deal with invasive plant control activities.

### **Summary of Open-Ended Comments on Invasive Logger Survey**

Question 9 and Question 29 provided opportunities for each respondent to provide open-ended comments. Themes and illustrative quotes from these open-ended comments are detailed below. The full set of comments are contained in Appendix 7.

#### A. Question 9 Open-Ended Comments

Respondents were asked if a BMP program for invasive forest plants were to be developed, whether they would prefer that a program be implemented through a regulatory or voluntary program. As a follow-up to this question, respondents were asked to explain why they would prefer a regulatory or voluntary program in an open-ended question. Themes that emerged from these comments are summarized below:

##### 1) Preference for Voluntary BMPs

Given that 96% of respondents indicated in the preceding question that they would be interested in a voluntary program, many of the comments focused on the loggers' perspectives on why a voluntary program would be preferred. Responses tended to focus on the flexibility that a voluntary program might offer:

"A voluntary (program) would be cheaper. Logger can find ways to comply with regulations."

"You would get better participation and more reporting through voluntary because loggers in a regulatory program would be afraid of fines."

“Every government program creates a huge level of bureaucracy and lots of expense and mess for everyone involved and brings a bunch of people with no common sense into the mix.”

There were a couple of comments in favor of a regulatory program, however, they were in the minority:

“If it were voluntary, the practice would only be performed by a few and our lands would continue to spread invasive species. Regulated is a must, requiring people to use BMPs under some type of supervision that will help in keeping invasive species from spreading a greater amount.”

“Regulatory = the only way it would be effective. I wouldn’t prefer a regulatory program, but I think it is the only way such a program would be effective.”

Several respondents indicated if BMPs were to be created that it would make sense to try them out as voluntary and then move to a regulatory approach if necessary:

“I would like to see how a voluntary program might work before going to a regulatory program.”

“I feel a voluntary program would be preferred to start with, and have monitoring of compliance through U of MN and MLEP be done periodically to see how good compliance is being done.”

Finally, comments by several respondents indicated they wouldn’t prefer either invasive plant BMP option (e.g., voluntary or regulatory):

“Neither. It would cut out a lot more logging businesses”

“We would not prefer either regulatory or voluntary. Employees turn-over too often to train. Plants are the job of the Forest Service, not the logger.”

## 2) Too Many Regulations

A common theme in the comments is that the logging industry is over-regulated, and as such, adding more regulations associated with invasive plant control would be burdensome:

“The more rules and regulations that are applied just mean less younger adults will be going into the logging industry.”

“I feel logging is already over-regulated. A regulatory program would only put more financial burden on loggers.”

“We don’t need any more regulations.” It’s hard enough to make a living in the logging business.”

## 3) Whose Responsibility?

In explaining their choice of a voluntary over a regulatory program, several respondents commented on the fact that they thought invasive plant identification, treatment or removal should be the responsibility or purview of organizations other than logging businesses:

“The logger should not have to do the job for the Forest Service.”

“The foresters are setting up the timber sales. I know they can’t find everything, but I shouldn’t be.”

“Seems to me it should be up to the land owner/agency.”

“I figure if the state or county is selling/setting up timber sales with invasive species on the land, then they should help out with things, maybe spraying or killing off before logging starts. Foresters should watch for and note species as they are cruising and setting up the sale.”

“When the DNR sets up a timber sale they should be identifying invasive plants in that area.”

#### 4) Assistance Needs

Other comments described information, assistance or training needs that loggers would need to undertake invasive plant BMP activities:

“First we need to learn what they all are and their impact on the forest.”

“It will take time for logger and crews to get knowledge levels developed sufficiently to be better at invasive species and management of these.”

The need for financial assistance or questions about who would pay for the additional expense associated with invasive plant prevention or treatment were pervasive in the comments:

“If we could get paid for identifying and removing invasive plants, I might be more receptive.”

“I have no idea what the cost would be or how I would be compensated.”

“The cost of doing business will go up if either program is implemented. I hope there is support for it.”

#### 5) Identity as a Logger

A couple of comments focused on the identity that respondents had of themselves as a logger, and the implications this had on their interest or ability in dealing with invasive plants in the woods:

“I am a logger not an invasive plant professional.”

“I own a logging company, not a weed finding and killing company.”

### B) Question 29 - End of Survey Written in Comment Themes

At the end of the survey, respondents were asked to provide any additional thoughts they might have concerning invasive forest plants that were not addressed in the survey (37% of respondents offered written comments). Themes from these comments are summarized below. The comments and themes tended to mirror those offered in the open-ended question earlier in the survey which asked them to explain why they would prefer either a regulatory or voluntary BMP program (Q29). The themes and illustrative quotes are detailed below.

#### 1) Responsibility

One theme that emerged was who should be responsible for addressing invasive plants in the Minnesota’s forests? Comments were made that public land managers, timber sale administrators, foresters, or landowners should be responsible for undertaking invasive plant treatment and removal activities prior to loggers harvesting on a tract rather than logger. Moreover, others suggested that a lack of earlier activity by other entities (state and county) has allowed the proliferation and spread of invasives. This comment was amplified by several respondents who mentioned that public entities should focus attention on spraying and mowing ditches and right-of-ways as a means of preventing

spread of invasive plants. Respondents expressed frustration and concern that they might have to bear the brunt of responsibility for dealing with invasives, while they believe the responsibility and action should rest with others:

“I strongly believe this is someone other than the logger’s problem. Federal, state and county should have to do some work when invasives are around.”

“Wondering why ditches and road right-of-ways are generally not mowed or taken care of until a lot of weeds have gone to seed...allowing birds, animals and the wind to spread the seeds far and wide?”

## 2) Economic impact of dealing with invasives

A common concern expressed by respondents was that potential requirements to address invasive plant introduction and spread would have a significant economic impact to logging businesses operations. Because of this, respondents felt that financial assistance or compensation should be made available for them to deal with invasives on timber sales. Moreover, they voiced concern that they were going to bear the economic brunt of more rules and regulations related to invasive plants when they don’t feel that they are the major reason for invasives being in the forest:

“I fear the bulk of the cost will fall on the logging industry, when in fact we are a small part of the problem.”

“Any downtime costs money. If markets don’t pay for this, then logger will have to. Loggers cannot carry the burden.”

## 3) Source of invasive introduction and spread

Although the survey didn’t include any statements or ask any questions about whether loggers were a cause of invasive plant introduction and spread in Minnesota’s forests, many respondents wrote comments at the end of the survey indicating that they shouldn’t be the focus of an invasive species problem. A statement that was made many times in the comments is that other entities and vectors are the major source of invasive plant introduction and spread (i.e., ATV riders, hunters, hikers, birds, wind, flooding, or wildlife) rather than loggers. Further, because the respondents don’t feel that they are the primary reason for invasive plants increasing across the landscape, they expressed frustration that they might be singled out to undertake costly measures to further prevent the introduction and spread of invasives versus other potential sources which are more diffuse and difficult to regulate:

“Regulate all parties involved in preventing the spread of invasives such as ATV riders, off-road pickups and outdoorsmen.”

“Public, ATV’s, dogs, etc. are a much bigger problems than loggers,”

## 4) Futility of actions

Comments were shared about the perceived futility of requiring loggers to undertake actions to limit the spread of invasive plants. Comments were made that once invasive get introduced into the forest, requiring loggers to undertake a variety of cleaning and treatment activities relative to invasive plants will be futile and just cost their businesses money and time:

“It is highly improbable that forest practices will make any difference except putting extra burdens on everyone involved.”

“It would hurt small businesses while achieving minimal success.”

#### 5) Too many regulations

Another emergent theme was that the logging industry is over-regulated and that adding additional regulations and requirements related to invasive plant control would be a burden making it harder for them to turn a profit and remain in business:

“The industry needs requirements, but when does it stop!”

“Mandatory regulations would hurt the bottom line of an industry that already has a tight profit margin.”

## DISCUSSION

### Are loggers serving as early detectors of invasive plants?

While respondents reported a fair amount of knowledge about invasive plants, it does not appear that they are currently actively serving as early detectors. Approximately 15% of respondents indicated they were voluntarily examining their sites for invasives. In the written comments, a common sentiment expressed was that a logger’s role should not be identifying and dealing with invasives. Instead, respondents indicated this should be the role of foresters and timber sale administrators when sales are set up. However, a problem with this viewpoint is that foresters and timber sale administrators may not be involved with all timber sales, especially those on private forest lands. In a recent study of Minnesota private landowners and public land managers, a majority of respondents indicated they were likely to survey their lands for invasives (Reinhardt et al. 2019). Thus, it may be common for private landowners to at least be aware of certain invasive forest plants like buckthorn on their property, and that this awareness could influence the activities that loggers are asked to undertake when logging on private sales. Some of the impetus for landowners to monitor for invasive forest plants and/or require invasive plant control activities during logging operations is likely due to the Minnesota Noxious Weed Law (MN State Statute ch. 18, § 18.75 – 18.91) that requires landowners to control and prevent spread of certain listed plant plants (e.g., common tansy, wild parsnip, spotted knapweed, leafy spurge, purple loosestrife).

Our results suggest that unless loggers receive some additional compensation for treating invasives or financial assistance in undertaking BMPs to prevent further spread, there may be little incentive for them to actively seek out invasive forest plants and report or treat them. While loggers may care about the health of the forest, the reality is that having to deal with invasive plants makes their job more difficult and costly. The question remains, would loggers proactively seek to identify invasives if such activity is not built into the contractual requirements of the timber sale they purchased or assistance was not available to offset the cost of the activity?

### What are Minnesota loggers currently doing regarding invasive plants?

Some Minnesota logging businesses are undertaking actions as part of their business operations to prevent the introduction and spread of invasive forest plants. Approximately 40% of the respondents report that they have contractually undertaken at least one activity to limit the introduction and spread of invasive plant in the past year, while 50% report having undertaken at least one activity voluntarily. Approximately one-quarter of respondents reported either inspecting their equipment prior to moving in or out of logging sites or cleaning/washing equipment out of contractual obligations. These modest percentages are somewhat surprising given that the MnDNR and the U.S. Forest Service stipulate the need to inspect and clean equipment (MnDNR 2008, USDA Forest Service 2006). However, if only small percentages of timber sales in the past twelve months have contained (or identified) invasive plants as indicated by the data in Figure 9, perhaps because of how timber sales have been designed to avoid areas with invasive plants, due to control activities where the area was pretreated by the landowner prior to logging, or the lack of treatment in areas where the invasive plants are already so widespread, then limited control practices would be contractually required. Moreover, if harvesting activities occurred during winter months with snow cover when invasive plants might not be visible, loggers may be less motivated or have fewer requirements to undertake invasive plant control actions. Also, loggers may have institutionalized equipment inspection and cleaning into their normal business practices and don't think of that work as being a contractual requirement.

While our data do not provide evidence of causality or sequencing of activities, they show a relationship between the incidence of contractual and voluntary activities by a logging business to prevent the introduction and spread of invasives. That is, logging businesses either tend to undertake activities like inspecting their equipment for invasive plants prior to moving it *both* voluntarily and contractually or not at all. Several explanations are possible. Some logging businesses may view invasive plant control activities as good business practices that are beneficial for forest health and may undertake them on all timber sales, regardless of whether the activities are contractually required or not. Another potential explanation is that once businesses are contractually required to undertake invasives activities, their level of awareness of invasive plants is increased and they in turn could be incorporating such activities as routine business practices and undertaking them voluntarily on other timber sales. Either way, it shows there are some logging businesses who are voluntarily undertaking activities to prevent the introduction and spread of invasives. It would be important to learn more about what is needed to encourage and assist logging businesses to undertake practices to prevent the introduction and spread of invasive plants, particularly if they are operating in areas with a known risk of infestations.

One factor that may impede a logging business' willingness to voluntarily undertake activities to limit the introduction and spread of invasives may be a perception of futility. Comments were shared in the open-ended questions about the perceived futility of requiring loggers to undertake actions to limit the spread of invasive plants. Specifically, respondents felt that once invasive plants are present, requiring them to undertake equipment cleaning and treatment activities relative to invasive plants will be futile and just cost them money and time. Thus, training, information and outreach to encourage logging businesses to undertake invasive plant control activities might benefit from the recognition of this perception and its role as a potential impediment.

## Are Minnesota logging businesses interested in developing new business offerings around invasive plant treatment?

We wanted to gauge potential interest in developing new expertise in invasive treatment which might be marketable as additional services logging businesses could provide. While few logging businesses had already developed invasive treatment expertise, there was some amount of interest in developing these skills among approximately half of the respondents. A training program for logging businesses could be developed which presents and uses results from this survey to focus on key local topics such as the rationale for increasing awareness of forest invasive plants, plant identification, invasive forest plant spread prevention practices and associated expenses, agency requirements and restrictions and potential future plans to address the spread of these plants. Based upon preferences expressed in the survey, training would likely be best received as classroom and field based learning and utilize a field guide containing information about invasive forest plants.

## Potential impact of invasives and invasive plant BMPs on timber supply

Logging business owners are worried about potential impacts that future BMPs for invasive plants might have on the cost of their operations. They are concerned that there are already too many regulations and wonder who would bear the cost of a BMP program. Given that some respondents indicated they would be less interested in bidding on sales with invasives and even more would be less interested in bidding on sales with required invasive BMPs, it raises the question as to whether sales with known invasives will be avoided in the future, and if so, whether that would have an impact on timber supply in the state in the future.

## **Conclusions**

Since invasive plants pose a landscape-scale problem, multi-actor approaches are needed to develop effective solutions. Logging businesses, as well as other groups who work and recreate in forested landscapes, have roles to play in limiting the introduction and spread of invasive forest plants. At the same time, logging business owners raised concerns about the impact of having to adopt new business practices related to invasive plant control and suggested the need for compensation or cost-share assistance to enhance the feasibility and cost-effectiveness for them to adopt those practices. One of the keys to a rapid response to invasive plants is the early identification and reporting of new occurrences. Logging business owners may be concerned that if they learn to identify invasive plants and report their presence to a public entity, timber supply may be negatively impacted or the business will be required to perform costly treatments. Thus, disincentives may exist for logging businesses to be pro-active relative to invasive forest plants.

Respondents reported that it is not common for them to have discussions with land managers or forest owners about invasive forest plants on timber sales on which they are operating. Having a dialogue about invasive plants be a more standard part of timber sale preparation and operations could be an important preliminary step in ensuring that parties are better aware of invasive plants in the area and considering steps that could be taken to minimize their introduction and spread.

Logging business owners in our study did not perceive large percentages of their timber sales in the past twelve months to have invasive plants present, nor to have noticed significant increases in sales with

invasives over a three-year period. On one hand, this could be an encouraging sign that invasive forest plants aren't yet pervasive on the landscape. Alternatively, it could suggest that Minnesota loggers are not familiar enough with invasive plants to identify them in the woods or that timber sale administrators are strategically avoiding offering sales in areas with known infestations. It would be useful to explore this question further to determine whether, with training in invasive plant identification, loggers report higher instances of sales with invasive plants, and if so, whether this leads to increased concern, control activity, or information-seeking behavior about invasive plants. Further, it would be useful to understand if timber sale administrators are purposefully avoiding stands with infestations currently, what happens to these avoided stands over time in terms of ecological condition, level of infestation, and timber quality. Our results suggest that coordinated efforts to implement invasive plant control activities between public managers who prepare timber sales and logging businesses is important and in need of more attention and future research.

## Bibliography

- Anderson LG, Rocliffe S, Haddaway NR, Dunn AM (2015) The role of tourism and recreation in the spread of non-native species: a systematic review and meta-analysis. *PLoS One* 10(10), e0140833.
- Armstrong, R.A. 2014. When to use the Bonferroni correction. *Ophthalmic Physiol Opt.* 34: 502-508. doi: 10.1111/opo.12131
- Armstrong, J.S., and T. Overton. 1977. Estimating nonresponse bias in mail surveys. *Journal of Marketing Research.* 14(3): 396-402.
- Beck KG, Zimmerman K, Schardt JD, Stone J, Lukens RR, Reichard D, Randall J, Cangelosi AA, Cooper D, Thompson JP. 2008. Invasive species defined in a policy context: Recommendations from the Federal Invasive Species Advisory Committee. *Invasive Plant Science and Management*, 1: 414-421.
- Blinn, C.R., O'Hara, T., Chura, D.T., and M.B. Russell. 2015. Minnesota's logging businesses: A survey to determine the health and viability of the logging sector. *Forest Science.* 61(2): 381-387. <http://dx.doi.org/10.5849/forsci.14-013>
- Blinn, C.R., Snyder, S.A., Russell, M.B., and R.R. Peterson. 2018. Status of the Minnesota Logging Sector in 2016. University of Minnesota, Department of Forest Resources, Staff Series Paper XXX.
- Buckley DS, Crow TR, Nauertz EA, Schulz KE (2003) Influence of skid trails and haul roads on understory plant richness and composition in managed forest landscapes in Upper Michigan, USA. *Forest Ecology and Management*, 175: 509-520.
- Center for Invasive Species and Ecosystem Health. 2018. University of Georgia, Center for Invasive Species and Ecosystem Health. (<http://www.eddmaps.org/distribution/>)
- Dillman, D.A. 2000. *Mail and internet surveys: The tailored design method.* New York: John Wiley & Sons, Inc. 464 p.
- Dodet, M., and C. Collet. 2012. When should exotic forest plantation tree species be considered as an invasive threat and how should we treat them? *Biological Invasions* 14: 1765-1778. DOI 10.1007/s10530-012-0202-4
- Fisher, R.A. 1922. On the interpretation of  $\chi^2$  from contingency tables, and the calculation of P". *Journal of the Royal Statistical Society.* 85(1): 87-94.
- Gavier-Pizarro, G.I., Radeloff, V.C., Stewart, S.I., Huebner, C.D., and N.S. Keuler. 2010. Rural housing is related to plant invasions in forests of southern Wisconsin, USA. *Landscape Ecology*, 25: 1505-1518.
- Holmes, T.P., Aukema, J.E., Von Holle, B., Liebhold, A., and E. Sills. 2009. Economic impacts of invasive species in forests. *The Year in Ecology and Conservation Biology.* 1162: 18-38.
- Kurtz, C.M. 2013. An assessment of invasive plant species monitored by the Northern Research Station Forest Inventory and Analysis Program, 2005 through 2010. Gen. Tech. Rep. NRS-109. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station. 70 p.

LeDoux, C.B., and D. Martin, 2013. Proposed BMPs for invasive plant mitigation during timber harvesting operations. Gen. Tech. Rep. NRS-118. Newtown Square, PA: USDA, Forest Service, Northern Research Station. 12 p.

MnDNR. 2017. Minnesota's forest resources 2016. St. Paul, MN: Minnesota Department of Natural Resources, Division of Forestry. (<http://files.dnr.state.mn.us/forestry/um/forest-resources-report-2016.pdf>)

Minnesota SFI Implementation Committee. 2015. A management guide for private forest landowners. Fourth Edition. 42 p.

Mortensen, D.A., Rauschert, E.S.J., Nord, A.N., and B.P. Jones. 2009. Forest roads facilitate the spread of invasive plants. *Invasive Plant Science and Management*, 2: 191-199.

Parks CG, Rodosevich SR, Endress BA, Naylor BJ, Anzinger D, Rew LJ, Maxwell BD, Dwire KA (2005) Natural and land-use history of Northwest mountain ecoregions (USA) in relation to patterns of plant invasions. *Perspectives in Plant Ecology, Evolution and Systematics* 7: 137-158.

Pickering CM, Hill W, Newsome D, Leung YF (2010) Comparing hiking, mountain biking, and horse riding impacts on vegetation and soils in Australia and the United States of America. *Journal of Environmental Management* 91(3): 551-562.

Reichard SH, White P (2001) Horticulture as a pathway of invasive plant introductions in the United States. *Bioscience* 51: 103-113.

Reinhardt J., Russell M, Lazarus W, Chandler M, Senay S (2019) Status of invasive plants and management techniques in Minnesota: Results from a 2018 Survey. UMN Dept. of Forest Resources, Staff Paper Series No. 253.

[https://www.forestry.umn.edu/sites/forestry.umn.edu/files/russell\\_survey\\_staffpaper\\_final.pdf](https://www.forestry.umn.edu/sites/forestry.umn.edu/files/russell_survey_staffpaper_final.pdf)

Rew LJ, Brummer TJ, Pollnac FW, Larson CD, Taylor KT, Taper ML, Fleming JD, Balbach HE (2018) Hitching a ride: seed accrual rates on different types of vehicles. *Journal of Environmental Management* 206: 547-555.

Setterfield, S.A., Douglas, M.M., Hutley, L.B., and M.A. Welch. 2005. Effects of canopy cover and ground disturbance on establishment of an invasive grass in an Australia savanna. *Biotropica*, 37: 25-31.

USDA Forest Service. 2006. Timber Sale Contract Division BT. Standard provisions for timber sales to be measured before felling. ([https://www.fs.fed.us/forestmanagement/documents/contracts/!FS-2400-6T\\_Division\\_BT\\_6-06.pdf](https://www.fs.fed.us/forestmanagement/documents/contracts/!FS-2400-6T_Division_BT_6-06.pdf))

Veldman, J.W., and F.E. Putz. 2010. Long-distance dispersal of invasive grasses by logging vehicles in tropical dry forests. *Biotropica* 42(6): 697-703.

Wangen, S.R., Webster, C.R., and J.A. Griggs. 2006. Spatial characteristics of the invasion of *Acer platanoides* on a temperate forested island. *Biological Invasions* 8: 1001-1012.

**Appendix 1.** Minnesota logging business owners invasives forest plant survey.

**Survey to Minnesota Logging Business Owners on Terrestrial Invasive Forest Plants**

Thank you for participating in our study. This survey is designed to obtain information which will help to direct logger training efforts for invasive forest plant management in Minnesota. Your participation provides important input which may help support efforts to keep potential invasive forest plant BMPs voluntary, much like our current Forest Management Guidelines. This survey, as supported by the Minnesota Sustainable Forestry Initiative® (SFI®) Implementation Committee, will also be used for research purposes that support the 2015-2019 SFI Forest Management and Fiber Sourcing Standard objectives for Forest Research, Science and Technology as well as Training and Education.

You may decline to answer any question. If you wish to comment on any questions or expand on your responses, please feel free to use the space in the margins or on the last page. Your responses will be kept confidential.

If you have any questions about this study, please contact me at (612) 624-3788 or [cblinn@umn.edu](mailto:cblinn@umn.edu)

Thank you in advance for your assistance!



Please return your completed survey as soon as possible in the enclosed postage paid envelope to the address below.

Charlie Blinn  
Department of Forest Resources  
University of Minnesota  
1530 Cleveland Avenue North  
St. Paul, MN 55108-1027

I. AWARENESS OF MINNESOTA INVASIVE FOREST PLANTS

1. Within your logging business, what is your general level of knowledge about invasive forest plant species in Minnesota? *(Check one option)*

Very knowledgeable

Somewhat knowledgeable

Slightly knowledgeable

Not at all knowledgeable

2. Which of the following invasive forest plant species are you confident that you or your crew can correctly identify in the woods? *(Check all that apply)*

Buckthorn

Japanese knotweed

Honeysuckle

Wild parsnip

Spotted knapweed

Multiflora rose

Leafy spurge

Garlic mustard

Oriental bittersweet

Reed canary grass

Siberian peashrub

Thistle

Common tansy

Amur maple

Purple loosestrife

None of these

3. During the past twelve months, on what percentage of your timber sales were invasive forest plants present? *(Check one option)*

0%

1 to 25%

26 to 50%

51 to 75%

76 to 100%

DON'T KNOW

4. Have you or your crew noticed an increase in the percentage of your timber sales with invasive forest plants over the past three years? *(Check one option)*

YES

NO

DON'T KNOW

Have been in business less than 3 years

5. Who have you or someone within your crew contacted when you needed general information about invasive forest plants? *(Check all that apply)*

MLEP

Forest Service

MN Department of Agriculture

DNR

County land departments

Other logging businesses

Private forest landowners

Consulting foresters

Forest industry

UMN Extension

Forester/Sale Administrator

Weed Inspector or Cooperative Weed/Invasive Species Management Areas

Have never sought information

Other (please specify): \_\_\_\_\_

**II. BUSINESS PRACTICES**

6. If Minnesota were to develop an invasive forest plants Best Management Practices (BMP) program, how difficult would it be for your logging business to implement the following practices? *(Check one option for each row)*

<b>Business Practice</b>	<b>Very difficult</b>	<b>Somewhat difficult</b>	<b>Slightly difficult</b>	<b>Not at all difficult</b>
Learn to identify invasive plants				
Create equipment staging areas where invasive plants are absent				
Mow, spray or treat staging areas to remove invasive plants before bringing equipment in				
Clean up staging areas after operations				
Inspect and clean equipment of soil, seeds and plants prior to moving between sites				
Coordinate inspection of equipment for invasive plant materials				
Acquire clean construction materials, fill dirt, gravel, sand and/or mulch				
Minimize the length of time that bare ground is exposed prior to re-seeding/re-vegetating				
Document and notify appropriate agencies that invasive plants were found				
Document that invasive plant BMPs were practiced in your operations				

7. If a BMP program for invasive forest plants were to be developed and included the types of activities identified in Question 6 above, what do you think would be the overall impact on your logging business? *(Check one option)*

- Large impact 
                 
 Moderate impact 
                 
 Small impact 
                 
 No impact

8. If a BMP program for invasive forest plants were to be developed and included the types of activities identified in Question 6 above, would you prefer that the program be implemented through a regulatory or a voluntary program? *(Check one option)*

- Regulatory 
                 
 Voluntary

9. Please tell us why you would prefer either a regulatory or voluntary program.

---



---



---



---



---



---

10. Has your logging business developed expertise in invasive forest plant treatment or removal as a way to diversify its operations? *(Check one option)*

YES       NO

11. Outside of a timber sale, was your logging business hired to provide invasive forest plant treatment or removal activities in the past twelve months? *(Check one option)*

YES       NO

If NO, skip to question 13.

12. Following up from question 11, which of the following activities was your logging business hired to undertake in order to prevent the introduction and/or limit the spread of invasive forest plants? *(Check all that apply)*

Hired?	Activities to Prevent Introduction and/or Limit Spread of Invasive Forest Plants
<input type="checkbox"/>	Examine site for invasive plants
<input type="checkbox"/>	Mechanically treat invasives
<input type="checkbox"/>	Manually treat invasives
<input type="checkbox"/>	Treat invasives using herbicides
<input type="checkbox"/>	Treat invasives using burning
<input type="checkbox"/>	Inspect equipment for invasive plants prior to moving it to a different logging site
<input type="checkbox"/>	Inspect equipment for invasive plants prior to removing it from logging site
<input type="checkbox"/>	Clean/wash equipment
<input type="checkbox"/>	Other (please specify):

13. How interested is your logging business in developing or expanding your current expertise in invasive forest plant treatment or removal as a way to diversify its operations? *(Check one option)*

Very interested      Somewhat interested      Slightly interested      Not at all interested

### III. INTERACTIONS ON TIMBER SALES

14. Did your logging business have any harvests on public or private lands during the past twelve months? (*Check one option each for Private Lands and Public Lands*).

LAND TYPE	YES	NO
Private Lands		
Public Lands		

If YES to either land type, proceed to question 15. If NO to BOTH land types, skip to question 19.

15. On harvests your logging business conducted on either public or private lands in the past twelve months, approximately what percentage of those land owners/managers discussed invasive forest plants with you or your crew? (*Check one option each for Private Lands and Public Lands*).

LAND TYPE	0%	1 to 25%	26 to 50%	51 to 75%	76 to 100%
Private Lands					
Public Lands					

16. During the past twelve months, what information or advice did you or your crew provide to private land owners and/or public land managers about invasive forest plants? (*Check all that apply*)

Private Lands	Public Lands	Information or Advice Provided by You or Your Crew
		Identification of invasive forest plants
		Information on invasive forest plant removal
		Information on invasive forest plant prevention
		Information on impacts associated with invasive forest plants
		Information on logging BMPs associated with invasive forest plants
		Information on services my logging business could provide to remove invasive forest plants
		Advice about who to contact for additional information on invasive forest plants
		None
		Other (please specify): _____

17. During the past twelve months, which of the following activities did your logging business **contractually** undertake on your private or public land timber sales in order to prevent the introduction and/or limit the spread of invasive forest plants? *(Check all that apply)*

Private Lands	Public Lands	Contractually Required Activities Undertaken
		Examine site for invasive plants
		Mechanically treat invasives
		Manually treat invasives
		Treat invasives using herbicides
		Treat invasives using burning
		Inspect equipment for invasive plants prior to moving it to a different logging site
		Inspect equipment for invasive plants prior to removing it from logging site
		Clean/wash equipment
		None of these activities
		Other (please specify): _____

18. During the past twelve months, which of the following activities did your logging business **voluntarily** undertake without being required to do so on your private or public land timber sales in order to prevent the introduction and/or limit the spread of invasive forest plants? *(Check all that apply)*

Private Lands	Public Lands	Voluntary Activities Undertaken
		Examine site for invasive plants
		Mechanically treat invasives
		Manually treat invasives
		Treat invasives using herbicides
		Treat invasives using burning
		Inspect equipment for invasive plants prior to moving it to a different logging site
		Inspect equipment for invasive plants prior to removing it from logging site
		Clean/wash equipment
		None of these activities
		Other (please specify): _____

19. If you are aware that invasive forest plants are present, are you less interested in purchasing a private or public land timber sale? *(Check one option for each land type)*

LAND TYPE	YES	NO	DON'T KNOW
Private Lands			
Public Lands			

20. If you knew a public or private land timber sale required you to implement BMP's related to invasive plants, would you be less interested in purchasing that sale? (Check one option for each land type)

LAND TYPE	YES	NO	DON'T KNOW
Private Lands			
Public Lands			

21. If you or your crew were to encounter invasive plants within your timber harvest operations on either private or public land timber sales, to whom would you report them? (Check all that apply for each land type)

Private Lands	Public Lands	Entities to Whom My Logging Business Would Report Invasives
		MLEP
		DNR
		Forest Service
		MN Department of Agriculture
		County land departments
		Other logging businesses
		Private forest landowners
		Forester/Sale Administrator
		Forest industry
		UMN Extension
		Weed Inspector or Cooperative Weed/Invasive Species Management Areas
		Don't know who to report them to
		Would not report them to anyone
		Other (please specify): _____

#### IV. INFORMATION NEEDS

22. Rank (1, 2, or 3) your logging business's **top three** education/information needs relative to invasive forest plants. (Please rank only three information needs).

- \_\_\_\_\_ Logging BMPs associated with invasive forest plants
- \_\_\_\_\_ Invasive forest plant removal
- \_\_\_\_\_ Invasive forest plant spread prevention
- \_\_\_\_\_ Impacts associated with invasive forest plants
- \_\_\_\_\_ Identification of invasive forest plants
- \_\_\_\_\_ Business expenses associated with invasive forest plants
- \_\_\_\_\_ Business opportunities associated with invasive forest plants
- \_\_\_\_\_ Equipment requirements associated with managing invasive forest plants
- \_\_\_\_\_ Sources of information about invasive forest plants
- \_\_\_\_\_ Have no information needs relative to invasive forest plants
- \_\_\_\_\_ Other (please specify): \_\_\_\_\_

23. How would your logging business prefer to learn about invasive forest plants? *(Check all that apply)*

\_\_\_\_\_ Field-based training

\_\_\_\_\_ Classroom training

\_\_\_\_\_ On-line training

\_\_\_\_\_ Printed materials

\_\_\_\_\_ Have no interest in learning about invasive forest plants

\_\_\_\_\_ Other (please specify): \_\_\_\_\_

#### VI. COMPANY DEMOGRAPHICS

24. In what Minnesota county is your business located? \_\_\_\_\_

25. In the past twelve months, what was your logging business's approximate timber volume (in cords) harvested? *(Check one option)*

≤ 1,000 cords

1,001 to 2,500 cords

2,501 to 5,000 cords

5,001 to 10,000 cords

10,001 to 15,000 cords

15,001 to 20,000 cords

20,001 to 30,000 cords

30,001 to 40,000 cords

> 40,000 cords

26. In which season(s) does your logging business typically operate? *(Check one option)*

Summer only

Winter only

Year-round

27. In the past twelve months, did your logging business conduct harvests on any of these SFI-certified lands? *(Check all that apply)*

- Minnesota DNR
- Molpus
- Potlatch
- UPM-Blandin
- Beltrami County Land Department
- Carlton County Land Department
- Crow Wing County Land Department
- Koochiching County Land Department
- St. Louis County Land Department
- None

28. In the past twelve months, approximately what percentage of your logging business's timber sales volume came from the following sources? *(Write in approximate percentages that total to 100%.)*

Source	Percentage (%)
Private forest lands	
Federal lands	
State lands	
County/municipal lands	
Industry/Corporate lands	
Other (please specify):	
<b>TOTAL</b>	<b>100%</b>

29. Please provide any additional thoughts you have concerning invasive forest plants that we did not address in the survey.

---



---



---



---



---



---

Thank you for your participation in this study! Please return your survey in the enclosed envelope.

**Appendix 2.** Survey pre-mailing postcard sent to all logging business owners.

March 14, 2018

Dear MLEP Member:

In a couple of weeks, you will receive a survey that is being conducted in an effort to better understand your knowledge about and activities related to invasive forest plants. Your input is vital and will be used to help develop a baseline understanding of industry knowledge of invasive forest plants so that MLEP can better develop training to assist you in combating that threat in our forests. I strongly encourage you to complete and return the survey.

**Please be assured that all survey information will be kept confidential, and no information will be released that can be linked to you.** The survey is being conducted by the University of Minnesota in conjunction with MLEP and the Minnesota SFI State Implementation Committee. A “double-blind” process will be used to ensure respondents are only known by survey code.

Your participation in this survey is highly encouraged. When complete, a report summarizing the results of the study will be available at [www.mlep.org](http://www.mlep.org).

If you have any questions about this study, please contact me.

Sincerely,

A handwritten signature in black ink, appearing to read 'Rachel Peterson', written in a cursive style.

Rachel Peterson  
Executive Director

**Appendix 3.** Correspondence printed on University of Minnesota letterhead for the initial mailing of the survey.

«F\_Name» «L\_Name»

March 21, 2018

«Company»

«ADDRESS\_1»

«ADDRESS\_2»

«City», «ST» «ZIP»

Dear «F\_Name» «L\_Name»:

A healthy forest is critical to Minnesota's logging and forest industry. With the increasing number of invasive species affecting our forests, it is important to understand the role our logging professionals play in mitigating the ravages of these species. Many of our native species and forested communities are at risk or currently being impacted by a variety of invasive plant species. For these reasons, we would like your assistance in understanding your knowledge about and activities related to invasive forest plants, so we can better assist you through training and information to combat the invasive threats in our forests.

As a logging business owner who is a member of the Minnesota Logger Education Program (MLEP), you have been chosen to participate in a research study being conducted by the University of Minnesota through a partnership with the Minnesota SFI State Implementation Committee and other partners. In the enclosed survey we ask you a variety of questions about your knowledge, understanding and activities related to invasive plant species. The survey should take about 20 minutes to complete. Please return your completed survey using the enclosed postage paid envelope.

Please be assured that all survey information will be kept confidential, and no information will be released that can be linked to you. The code number on your survey will only be used to ensure you don't receive reminders once you have returned your completed questionnaire. Your participation in this survey is voluntary and you do not have to answer all the questions. However, you can help us by sharing the information about your business. When complete, a report summarizing the results of the study will be available on the MLEP website, [www.mlep.org](http://www.mlep.org).

If you have any questions about this study, please contact me at [cblinn@umn.edu](mailto:cblinn@umn.edu).

Thank you very much for taking the time to complete this survey!

Sincerely,



Charlie Blinn  
Professor and Extension Specialist

Enc.

**Appendix 4.** Follow-up postcard sent to all logging business owners one week after the initial mailing of the survey.

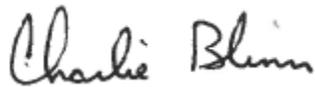
April 4, 2018

Dear Logging Business Owner:

Last week, I mailed you a survey asking for information about invasive forest plants. If you have already completed and returned it – thank you! Your response is appreciated and will provide us with a baseline understanding of industry knowledge of invasive forest plants so that MLEP can better develop training to assist you in combating that threat in our forests.

If you have not yet completed the survey, I encourage you to do so as soon as you are able. Your response is crucial to helping build a useful approach to addressing the threat to our forests. If you have any questions, please contact me at [cblinn@umn.edu](mailto:cblinn@umn.edu).

Thank you for your help!

A handwritten signature in black ink that reads "Charlie Blinn". The signature is written in a cursive, slightly slanted style.

Charlie Blinn

**Appendix 5.** Correspondence printed on University of Minnesota letterhead for the second mailing of the survey to nonrespondents.

«F\_Name» «L\_Name»

April 20, 2018

«Company»

«ADDRESS\_1»

«ADDRESS\_2»

«City», «ST» «ZIP»

Dear «F\_Name» «L\_Name»:

About three weeks ago, a survey was sent to you asking for information about invasive forest plants. As of today, we have not received your questionnaire. If you have already completed the survey, please let us know so that we can double-check our records.

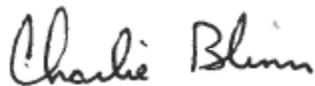
The University of Minnesota is conducting this survey in conjunction with the Minnesota Logger Education Program and the Minnesota SFI State Implementation Committee to understand your knowledge about and activities related to invasive forest plants. In order for the results to truly reflect the status of the industry, it is very important that we receive your completed questionnaire. The survey should take about 20 minutes to complete. Please return your completed survey using the enclosed postage paid envelope.

All responses will be kept confidential. The code number on your survey is used only to make sure that you don't receive reminders once you have returned your completed questionnaire to us. Your participation in this survey is voluntary and you do not have to answer all the questions. However, your input is important. When complete, a report summarizing the results of the study will be available on the internet at [www.mlep.org](http://www.mlep.org).

If you have any questions about this study, please contact me at [cblinn@umn.edu](mailto:cblinn@umn.edu).

Your participation is greatly appreciated!

Sincerely,



Charlie Blinn  
Professor and Extension Specialist

Enc.

**Appendix 6.** Final letter printed on Minnesota Logger Education Program letterhead sent to all logging business owners.

«F\_Name» «L\_Name»

April 27, 2018

«Company»

«ADDRESS\_1»

«ADDRESS\_2»

«City», «ST» «ZIP»

Dear «F\_Name» «L\_Name»:

I am writing to you about the survey on invasive forest plants which you should have received several weeks ago. If you have already returned your questionnaire – **thank you!** If you have not yet completed the survey, please do so today. If you need a replacement questionnaire, please contact Rachel Peterson at MLEP at (218) 879-5633 or [rachel.peterson@mlep.org](mailto:rachel.peterson@mlep.org). Your response will provide us with a baseline understanding of industry knowledge of invasive forest plants so that MLEP can better develop training to assist you in combating that threat in our forests.

Although we have received a large number of completed questionnaires, our understanding improves with each response. Therefore, your completed questionnaire is very important to the success of this survey.

The survey is being conducted by the University of Minnesota in conjunction with the Minnesota Logger Education Program and the Minnesota SFI State Implementation Committee to understand your knowledge about and activities related to invasive forest plants. The survey should take about 20 minutes to complete.

All responses will be kept confidential. Your participation in this survey is voluntary and you do not have to answer all the questions. However, your input is important. When complete, a report summarizing the results of the study will be available on the internet at [www.mlep.org](http://www.mlep.org).

If you have any questions about this study, please contact me at [cblinn@umn.edu](mailto:cblinn@umn.edu)

Your participation is greatly appreciated!

Sincerely,



Charlie Blinn  
Professor and Extension Specialist

Enc.

## Appendix 7 Open-Ended Comments:

### Question 6 Comments:

Q6 looking at equipment will not find most invasives. Reviewing past sites will. Perfect equipment cleaning is impossible.

Q6 All time we are not compensated for (business practices 2 - 10).

### Question 7 Comments:

Q7 this depends how in-depth the process is. Could be a large impact

### Question 8 Comments:

Q8 As if there is NOT enough to worry about.

Q8 It will be voluntary until someone objects and then we will be pressure washing between every job. Those portable washers are \$10,000! Not to mention the chemicals we will have to buy to kill all those Invasives.

Q8 All of these steps and procedures will / would affect logging operation time, overhead and overall production. Why not regulate the people that are actually spreading the invasives in our state? (ATV clubs, weekend cabins / homes, hunters, campers, etc.). Answer: Because loggers are easy to set regulations on, there is big money in all recreational uses, and it would upset political agendas and bad PR with the public & political officials.

Q8 Neither

Q8 NOT AT ALL. Plants are the job of the Forest Service, not the logger.

Q8 Regulatory only way it would be effective

### Question 9 Comments:

Q9 get the logger to do your job for nothing!! Why Not!!

Q9 My thoughts are the foresters are setting up the timber sales. I know they can't find everything but I shouldn't be.

Q9 Voluntary is much easier than regulatory. Regulatory is black and white and leaves no options or leniency. The cost of doing business will go up if either program is implemented. I hope there is support for it.

Q9 Voluntary because all regions, timber sales and invasive species vary across the state. It would be almost impossible to set one hard line rules for all situations.

Q9 it would cut out a lot more logging businesses

Q9 We would not prefer either regulatory or voluntary. Employees turn-over too often to train. Plants are the job of the forest service not the logger. The logger should not have to do the job for the forest service.

Question 13 Comments:

Q13 for pay yes, for free NO.

Q13 if it's a feasible way to diversify.

Question 19 Comments:

Q19 Depends if the loggers have to take action on knowing the invasive species or if it will be the forester's job.

Q19 Public lands - depends on season

End of Survey Comments:

A Better chance of being done

A voluntary would be cheaper Logger can find ways to comply with regulations

Already too many regulations

Another dead end job and more red tape that will not make a difference anyway.

At this stage in the game: I would need help

Because it does not apply to loggers who only operate in winter

Because there are too many regulations already

Better Voluntary Once people start regulations they just keep adding more & more

Birds are the biggest spread of invasive plant seeds. Not Logging

Could take class when we had time

Different levels of authority with regulatory

Does logging industry need more regulations?

Does Not Matter if Minnesota Statutes SFRA89A.05 is followed and we are paid

Don't like regulations

Every government program creates a huge level of bureaucracy and lots of expense and mess for everyone involved and brings a bunch of people with no common sense into the mix. For example on oil spill that was required to be spread on the road (next to a lake) instead of left where it was a long way from the lake.

First we need to learn what they all are and their impact on the forest.

I cut under 100 cord's a year. Because the people who care would do it. I am just one person that does all the work. Just for firewood. Small sales

I don't want either

I feel like we face enough unnecessary regulations. Seems to me it should be up to land owner / agency.

I feel logging is already over regulated. A regulatory program would only put more financial burden on loggers. If we could get paid for identifying and removing the invasive plants, I might be more receptive

I feel voluntary program would be preferred to start with and have monitoring of compliance through U of M and MLEP be done periodically to see how good compliance is being done. It will take time for logger and crews to get knowledge levels developed sufficiently to be better at invasive species and management of these

I feel voluntary to start with and monitoring through U of M - MLEP periodically to see how good is compliance? It will take time for loggers & crews to get knowledge levels developed sufficiently to be better at invasive species & management of those.

I figure if the state or county is selling/setting up Timber sales with invasive species on the land then they should help out with things, maybe spraying or killing off before logging starts. Foresters should watch for and note species as they are cruising and setting up the sale, as to they cover the sale first.

I have enough people telling me what to do already. The enforcing entity would more than likely have no common sense. It would be another opportunity to "play favorites" and decide whose life to make miserable.

I work totally on private land often that land is agricultural where the landowner is actively doing things that would create difficulty in dealing with invasive plants and would make responsibility unclear. For that reason I favor a voluntary program.

I would like to see how a voluntary program might work before going to a regulatory program. It seems that we have a lot of mandatory programs and regulations already.

I would prefer voluntary because I am a LOGGER not an invasive plant professional. The logging industry does not need any more programs for the loggers to complete so they can resume being loggers. Make your local state or county forest rangers carry the program requirements and let them be the judge how to handle the issue. The DNR regulates zebra mussels not the fishermen!

I would think the probability of a practical common sense program would be higher with a voluntary program

If everybody would have done something 20 years ago, then we would have a handle on it.

If it is voluntary I do not have to participate in a lost cause program

If it was regulatory I have no good idea what the cost would be or how I would be compensated

If it was regulatory the government would start requiring more from us to handle their problem

If it were voluntary the practice would only be performed by a few and our lands would continue to spread invasive species. Regulated is a must requiring people to use BMP'S under some type of supervision that will help in keeping invasive species from spreading a greater amount.

If there is too much hassle the agencies should pay us to cut those sales. Depends on what needs to be done.

If we have to go to class and learn about it we don't need someone else to tell us how to do it again.

Knowledge of appropriate practices

Less of a push back voluntary

Let's create jobs for more government while the logging industry is losing ours!

Let's honestly call it what it is the "voluntary" programs are not voluntary in practice. I own a logging company, not a weed finding & Killing company

Might get too much variation if it was regulatory

More regulations are always problematic

More time to learn the plants

None

Not to make it mandatory

Paper Work Involved

Regulatory =only way it would be effective. I wouldn't prefer a regulatory program, but I think it is the only way such a program would be effective

Regulatory programs can get out of hand when a forester takes total control

Regulatory would discourage participation and or inevitably involve fines and liquidated damages

Should start with Voluntary program or guys won't work well if made to do it

So I don't have to talk to someone

Stress

The logging industry has enough regulations already. The cost to implement most of the regulations is always expected to be paid for by the logging operation.

There are too many companies now that don't follow regulations so why put a company under another financial constraints when competing against other companies that don't follow and seem to get all the jobs.

Think logger would do a good job voluntary. Regulatory agencies are usually rigid and over the top.

Time element

Timing

Too many regs now!

Too many regs already

Voluntary because I would probably snake out of doing it

Voluntary because if someone wants to go through the extra expenses for no return they can do so

Voluntary because we have plenty to deal with now.

Voluntary doesn't seem as intrusive or heavy handed as regulatory

Voluntary first, if it doesn't work then go to regulatory

Voluntary is better

voluntary program probably more workable involving private landowners

Voluntary- we don't need anybody telling us how to clean our equipment. Most equipment is moved after or before State employ's work days begin or on weekends. The more rules and regulations that are applied just mean less younger adults will be going into the logging industry.

Voluntary works a lot better

Voluntary works with other BMP practices

Voluntary would be easier to implement & control & work with

Voluntary would incur less cost to the tax payer

Voluntary, because some landowners would not want to have the added cost.

Voluntary. We wouldn't have to wait for DNR longer than we do now if we need something or ask them to come to site.

Voluntary: we have limited summer operation, if there are invasive plants present there is already a seed source in the ground, when moving to a different site most plants only produce seed late summer, early fall so the window for carrying seed is small. We already clean soil and debris from equipment (hard to get it all)

Voluntary-most young forestry officials can't tell the difference in tree species. Now you want the+K50m to look at our equipment. HA!HA! Most of them don't have a clue!

We as a logging business have enough regulations to be concerned with as is.

We don't need any extra laws. Although I believe, even voluntary guidelines eventually turn into laws (Unfortunately)

We don't need any more regulations -voluntary programs will be more likely to be followed

We don't need any more regulations. It's hard enough to make a living in the logging business and besides I brought attention to county weed dept. in Pine County & Aitkin County on spotted knapweed back in the early 90's. Nobody acknowledged a problem back then. I sprayed 1,000's of acres for US Fish & wildlife service out west and told them of this serious problem. There was no response. So I don't believe we need it to be regulatory.

We have enough regs

We have enough regulations in the woods

We have enough regulatory rules now!!!

We live in northern MN and we are good stewards of the land I don't think we go out of our way to do damage.

When regulated it always turns in to a financial burden

When the DNR sets up a timber sale they should be identifying invasive plants in that area. Should be voluntary for us to deal with the issue

Who pays for the cost of all of this?

You would get better participation and more reporting through voluntary because loggers in a regulatory program would be afraid of fines.

Q20 depends on what would be required to be done and the cost.

Q20 Get the government off their seats and do it themselves. Why does the logger have to do it?

Q20 Any downtime costs money. If markets don't pay for this, then loggers will need to. Loggers cannot carry the burden.

Get crews to take care of the problem instead of everybody pointing the finger at it. Get off your seats

As of lately most public agencies have made us aware of invasives on-site. Please be aware, if anything gets implemented by regulators for us to follow, it will cost time and money. If the markets can't absorb higher fiber costs then the only place to get money from is the stumpage source. Most roadside/landing invasives are either a vehicle or recreational vehicle issue- not caused by equipment. I believe more money should be spent on spraying ditch sides and planting noninvasive plants. Stop the spread at the source.

why should I do your job for free somewhere in MLEP regs I need to cut wood!! Apparently MLEP thinks that we need more shit to do instead of making money

I understand loggers need to know RMZ, first aid & CPR and the correct training classes to fulfill requirements. To make a logger know all the different types of invasive plants and the requirements with each plant is ridiculous. It seems to be a push back and forth, seems like the state officials don't want to deal with it so it will get pushed to a requirement of the logger, and that's not RIGHT. The industry needs requirements, but when does it stop!

Another survey should be initiated that targets the recreation groups who use the forests in Minnesota clubs- organization and maybe deer hunter association off road vehicle users do spread a lot of invasive material

Another survey should be initiated that targets the recreational users of the forests in the state - recreation groups - clubs

ATV's spread more invasive species than all MN Loggers combined. Mandatory regulations would hurt the bottom line of an industry that already has tight profit margins. It would hurt small business while achieving minimal success.

Be realistic about what loggers can do. Public, ATV's, dogs, etc. are a much bigger problem than loggers.

Before you think about putting regulations on timber sales for logging- what are your regulations for the spread of the invasives by recreational vehicles and off road ATVs!!!

Birds and animals have a large part in the transportation of invasive plants

Charlie this does not pertain to me. I don't need these forms

Concerning tansy: It's like well we lost the battle when you ask for help! I would think if a person asked and was willing to help you would get some. Hello; Charlie;

Cost of everything is going up and is driving a lot of people out of the business, who pays for this consuming stuff or ideas but the logger?

Cost to logger

Equipment& Herbicide-does the same gear work for all invasives?

Expense

Focus needs to be on TSA training cannot be costly/ Restrictive on loggers must not be focused statewide on loggers, many other spread risks (hikers, gravel, wildlife)

Have not seen any difference in 40 years so why now?

Hi Charlie, Just once; Before I die I would like to see the loggers get some compensation for the BMP's we do. It's in the statute 89A.05

How much extra time will be required to deal with invasive plants

I do believe it would be a good idea to have the logger given the option to treat the invasive plants

I do think our industry is a little late to the party on this issue and though I don't know a good way to implement a good policy on it, it should be done

I fear the bulk of the cost will fall on the logging industry- (Timber Industry) when in fact we are a small part of the problem.

I guess I need to get better educated about the extent of the problem with invasive plants and also the impact or lack of impact they may have on forest health.

I know this may be a concern, but I believe Charlie is getting paid and is addressing something here that we would not be getting paid for and is going to cost us.

I realize this can be an issue. I wonder if you think logging causes it or not.

I strongly believe this is someone other than the logger's problem. Federal, State and county should have to do any work when invasives are around. This would just be another way to create needless jobs.

I think that all the ATV trails and activities need to be addressed to atv clubs. I do believe they are some of the ways noxious weeds are moved from spot to spot. I don't believe more regulations on loggers is a way to go. Have to inform all the groups and people who use our forest. Hunters, Atv's, Etc!!

Invasive plant class at MLEP training would be helpful.

It is highly improbable that forest practices will make any difference except putting extra burdens on everyone involved. Wind Etc. (Nature) spreads most of these and 95% of the forest in the state are never seen by anyone. It's like spitting at a forest fire.

It seems this is just another way to create jobs in the public work force. Or to create more funding to state agencies. Wildlife-flooding and wind move more seeds than loggers ever will. Let it rest.

Loggers can't absorb any added expense

None

Not totally sure what impact they have on the forest. Need better education on identifying them. Curious to know what dealing with them consists of.

Orange Hawk Weed is also invasive

Regulate all parties involved in preventing the spread of invasives such as ATV riders / clubs, off-road pickups, and outdoorsman. Try setting up a heated pressure washing system at all entrances and exits for all public lands and see who steps up to pay for that. That's what you'll ask loggers to do!

The cost of doing this would be enormous. We cannot be responsible for landowner's or manager's jobs

There are so many of them to know all!

There has been an invasive species of plant or animal on every single site I have cut last year. You are wasting everyone's time and money on this.

This can work but cannot go overboard. It is a time and money process

We try to clean equipment from job to job. Most of us do our part. Wind and animals spread more to area's than loggers ever will.

What about all the 4 wheelers & pickups that tear everything up? Invasive plants line the DNR county & state roads here for years and they do nothing! Let's spray herbicides and pollute everything. I know you want contribute some of your wages to fight this. Take it out of ours?

While good for our forests there is getting to be many regulations and paper work when dealing with the DNR. So this would only add more paperwork at state level.

Why such a concern now?

Wondering why the State and County have not been more aggressive in attacking the spread of poison parsnip. We use to see an odd plant. Now it has really taken over ditches and road right-a-ways. Also wondering why ditches and road right-a-ways are generally not mowed or taken care of until a lot of the weeds have gone to seed, especially the thistle has gone to seed allowing birds, animals and wind to spread the seeds far and wide.

You can't stop the invasive spread