Forestry Education Attitudes and Teaching Practices Among High School Science Teachers in the Southern Piedmont

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ABSTRACT

Forestry education in high schools can be an effective method for introducing students to forest management. To study its use and purpose, we conducted a web-based survey of high school science teachers in the Southern Piedmont region of the United States investigating their forestry education attitudes and teaching practices. A total of 1024 surveys were delivered and 324 returned for an adjusted response rate of 32%. Results indicate that most teachers (82%) agree forestry should be taught in high schools and do so most frequently by presenting forestry concepts in the context of ecosystem services, followed by physical and physiological characteristics of trees. Concepts related to products, uses, and management are taught least frequently. Variables that predict teaching frequencies for each of these three concept groups include classes taught in the last 5 years, environmental education program training, and childhood location in addition to attitudes toward and knowledge of forest management. Also, it was found that over half (57%) of the teachers surveyed do not take field trips to forests and less than 25% do so multiple times per year. Variables that predict whether or not teachers take field trips to forests include confidence in teaching forestry concepts, involvement in school natural resources related extra-curricular activities such as 4-H and Envirothon, and the presence of a forest within walking distance of the school. The most widely reported constraints to teaching forestry concepts and taking field trips to forests are mandated standards or curriculum (60%), money (40%), time (32%), mandated testing (19%), and training, interest, and infrastructure (19%).

Acknowledgements and Dedication

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Chapter 1 – Introduction

Due to numerous environmental challenges faced by the United States and world, the need for well-trained environmental and natural resources managers is increasingly critical (Ko and Lee 2003, Rey 2003, Sharik and Frisk 2011). At the same time, changing demographics and diverse attitudes and behaviors of the public spark need for public involvement in natural resource management (Tarrant et al. 2003, Thompson et al. 2005, Schaaf et al. 2006). Whether and what types of forestry information are presented is of importance. Forestry education is defined in this paper as education about "the profession embracing the science, art, and practice of creating, managing, using, and conserving forests and associated resources for human benefit and in a sustainable manner to meet desired goals, needs, and values" (SAF 2008). The phrase forestry concepts refers to concepts taught in science classes that relate to any aspect of the above definition. For example, forestry concepts include ecosystem services such as water quality and wildlife habitat in addition to products and uses such as timber production because these are desired goals, needs and values. Additionally, tree characteristics such as tree identification and tree growth are forestry concepts as they are involved in the science of managing forests.

The lack of forestry and natural resources information being taught by teachers has many disadvantages. In his book, *Last Child in the Woods*, Richard Louv points out that a lack of knowledge about and experiences in the outdoors lead children to suffer major disadvantages and names the public school system as one culprit (Louv 2005). In 1985, a survey of college bound high school seniors was conducted. Thirty one percent of the students surveyed knew nothing about forestry careers and only one percent considered themselves to be well informed regarding forestry (Wellman 1987). A more recent study has shown that much remains the same. In 2006, a survey found that teenagers do not recognize professional career opportunities in forestry and that forestry is the least popular of the natural resource fields (Hagar et al. 2007). After observing widespread misconceptions about forests among Minnesota high school students, Bowyer (2000) studied formal forest education in the state. Findings showed that inconsistent and incomplete information presented by teachers are one reason (Bowyer 2000).

Lack of knowledge about forestry and forestry careers has been speculated as one reason that enrollment is declining at National Association of University Forest Resource Programs (Shairk and Frisk 2011). The argument is that increased education and marketing of the forestry profession at the high school level will improve understanding of the field and profession (Sharik and Frisk 2011). Results from the current study not only provide insight into teachers' attitudes toward forestry and the content they teach but may also help to justify this speculation.

Similar enrollment trends are occurring internationally causing researchers in other countries to examine possible reasons behind the declines. A 2000 Australian university study surveyed forestry students and asked what would improve recruitment into forestry (Searle and Bryant 2009). Most student responses focused on increasing the availability information about forestry more available to high school students with the most frequently reported suggestion being for graduates and professionals in the field to visit schools and speak about careers.

The idea that exposure to forestry in high school is important to the future of the profession is not new. In 1988, an article detailing recruitment and retention of forestry students, points out that efforts should be taken to make sure high school students in particular are aware of the forestry profession because this is when many students make career choices (Schlosser, 1988). A similar article published the same year echoes the importance of providing forestry education to high school students (Egan, 1988). Even a century ago, the importance of forestry education was discussed in the *Journal of Education* where various authors discussed the importance of teaching this "new study" and getting children outside (Rane 1906; "Forestry in the schools 1909; "Forestry in schools" 1911). In 1914, then Chief of the Forest Service Don Carlos Ellis is described in the Journal of Education as being aware of the attitudes of teachers regarding implementing an addition to the school curriculum "But he is so certain that the salvation of our forests rests with the training children get in conservation in the public schools that he comes before a body of education with enthusiasm and determination" ("Shall forestry," 1914 pg. 628).

Few studies have been conducted to explain the types of forestry concepts taught in schools, the extent to which forestry career opportunities are being discussed, or the relationship of attitudes toward forestry and forestry education. Recently, Wilent (2011) describes the lack of information on the types of forestry information being distributed to high school students and urges researchers to investigate these questions. In an article published in *Virginia Forests*, David Wm. Smith describes his opinion that children should learn about forests in public and private schools and goes on to ask the question, "Are our children really learning enough about forest resources to ask the right questions and make informed decisions about these resources when they become decision makers in the future?" (Smith 2011 pg. 19). Cleary there is a need for research in this area.

In light of this need, the intent of this study is to research forestry education in secondary science courses using a regional perspective based on the relevance of forestry and associated career opportunities. We measured the field and classroom forestry teaching practices among high school science teachers in the Southern Piedmont region of the United States to determine the extent to which they teach forestry and why. Variables measured included situational, attitudinal, knowledge-based, educational and demographics. In addition, this study examined teacher beliefs about what constrains forestry instruction.

The next chapter of this document provides a review of the literature as a framework for the study. It contains descriptions of similar forestry education and attitudes studies, as well as agriculture, natural resources, and environmental education studies. A summary of literature illustrating the benefits of field trips and analyzing field trip use is also included. Chapters three and four describe analyses of classroom and field forestry teaching practices and detail the results of regression models used to predict these teaching practices. Chapter five explains an analysis of open-ended qualitative data in the form of open ended comments from survey respondents about constraints to forestry instruction. Finally, chapter six provides a summary of key findings for the study and describes their importance.

Chapter 2 - Literature Review

Knowledge, Attitudes, and Teaching Practices Related to Forestry and Forestry Education

Few studies exist that examine teaching practices relative to forestry specifically; however, several exist where knowledge of and attitudes toward forestry and forestry education were measured. One of the most frequently cited studies researched Mississippi teachers' values, attitudes, and educational needs towards forestry and forest industry (Measells et al. 2003). Overall, teachers in the study had positive attitudes toward the forest industry and almost all (97%) believed that forestry education would benefit students. At the same time, teachers reported that school visits, educational materials, partnerships with schools, educational programs and materials, and industrial tours or field trips would be most useful in improving their forestry knowledge.

Groves (1977) investigated which variables related to teacher knowledge and opinion of natural resources and how they go about teaching a forestry unit using a sample of Virginia teachers. Results showed that type of undergraduate or graduate school attended and specialization as well as type of community lived in during youth were related to natural resource knowledge. The frequency of participation in conservation or outdoor recreation activities at the time of the study and during youth, and the subjects they taught were also important. Teachers reported that their primary purpose for teaching a forestry unit would be to guide attitudinal development and that they would use environmental materials and county facilities, with the discovery method being the primary teaching approach.

A survey of agricultural education teachers in West Virginia was conducted to determine their knowledge of and attitude towards forestry and forestry education and to evaluate how attitude and knowledge differed among demographic characteristics (Friend 2008). This study focused somewhat differently on forestry skills and techniques. Respondents were most confident teaching about tree parts, forestry careers, chainsaw use, tree growth, and reproduction. Almost all (95%) agreed or strongly agreed that forestry should be a class taught by agricultural education teachers. Additionally, almost all agreed or strongly agreed that forestry should be a topic in agri-science classes. When asked about their ability to teach the subject, 60% of respondents agreed or strongly agreed that they feel qualified to teach forestry but nearly all also agreed or strongly agreed that agricultural education teachers need more training in the subject matter. With regard to constraints, almost 60% reported inadequate tools as limiting factors, followed by a lack of knowledge on the part of the educator. With regard to challenges they face in teaching forestry, most frequently reported was a lack of knowledge followed by lack of resources, lack of time, and lack of student knowledge.

The Friend (2008) study also examined the frequency of forestry techniques and skills being presented by teachers. Calculating timber volume, pacing to determine a linear distance, measuring standing trees, and identifying tree species by leaves were most often presented. Topics taught least included chainsaw maintenance techniques, identification of forest fire fighting tools, professional and technical employment in forestry, and identifying potential den and mast trees.

Public Attitudes toward Forests and Forestry

Researchers have also attempted to measure attitudes among the general public toward forests. Many of the variables in these studies are similar to those focused on teachers. For example, the forest management values among the public in Oregon were compared to those across the nation. Both groups were biocentric in value orientation, “favoring the extension of ethical consideration to all parts of forests, including birds, mammals, plants, insects, and such elements as forest streams and soils," with the national group possessing stronger values (Steel et al. 1994 pg. 138). They also found that women, young people, liberals, postmaterialists, and those in environmental organizations were the most likely to have biocentric values. Also, those with biocentric values are far more likely than those without to oppose traditional forest management practices. However, even those with anthropocentric leanings, advocating "the wise use of forests for the betterment of humankind," preferred policies and practices more gearing more toward preservation (Steel et al. 1994 pg. 38). Cordell and Tarrant (2002) also report that public attitudes toward forest management have been shifting away from anthropocentric objectives.

Vining (2003) conducted a public survey in Illinois and three surrounding states to compare attitudes toward forest management in Shawnee National Forest. Overall, surveyed groups trust forest managers but also desire more public involvement in natural resource management. Like Steel et al. (1994), Vining (2003) also found that respondents favored protection more than resource-use activities, and rated those associated with commodity extraction as least acceptable.

Wagner et al. (1998) conducted a study in which they compared the attitudes of the public and forestry professionals as they relate to forestry practices. Wagner et al. (1998) found substantial differences between the public and forestry professionals with regard to attitudes toward forestry goals. Also, forestry professionals were more supportive than the public of nearly all management practices listed.

Knowledge and Attitudes Related to Agriculture and Natural Resources Education

Teachers' knowledge and attitudes toward agriculture and use of natural resources curricula have also been studied. Agriculture education is defined by the National Future

Farmers of America Organization (2012) as "a systematic program of instruction available to students desiring to learn about the science, business, technology of plant and animal production and/or about the environmental and natural resources systems." Perry (1998) surveyed K-12 teachers in Oregon to measure their knowledge of and attitudes toward agriculture and natural resources issues and curriculums. Findings indicate that science teachers and teachers from rural areas are more likely to be aware of agricultural and natural resources curricula such as FFA, 4H, and Project Learning Tree. While teachers reported that they had a positive attitude toward these programs, only a small percentage of teachers had actually received program training. Results also suggest that teachers realize the importance of teaching agriculture and natural resources concepts but that pressure to align with state benchmarks limits their ability to teach these concepts. Also, teachers reported that they are always in search of materials to aid them in their efforts. Finally, teachers reported having mostly positive attitudes toward agriculture and natural resources professions which leads researchers to believe that if able, they would present unbiased information about these topics to their classes.

More recently, a study was conducted in Iowa to explore factors related to elementary school teachers' beliefs about incorporating food, agricultural, and natural resources topics and activities into their classrooms (Knobloch 2008). Results suggest that teachers believed that these topics would enhance their curriculum and that they could be taught in any subject matter.

Knowledge, Attitudes and Teaching Practices Related to Environmental Education

Several studies have been conducted related to teacher attitudes about environmental education. According to the North American Association for Environmental Education (2011) "Environmental education (EE) teaches children and adults how to learn about and investigate their environment, and to make intelligent, informed decisions about how they can take care of it." In one study, Wisconsin teachers from twelve disciplines related to environmental education were surveyed to determine their perceptions and attitudes about environmental education and class time devoted to teaching (Lane and Wilke 1994). Following the recommendation made by Lane and Wilke (1994), a study of University of Illinois Cooperative Extension Service Educators was conducted (Sebasto 1998). In each study teachers mostly believed that environmental education is very important but that they incorporate very little of it into their classrooms (Lane and Wilke 1994, Sebasto 1998). One additional similarity among both studies was that a lack of background in environmental education among teachers was noted as a primary inhibitor.

There are notable differences as well. While Lane and Wilke (1994) found the beliefs that environmental education is unrelated to their subject matter as one of the most commonly reported barriers, Sebasto's (1998) findings show only a small percentage of teachers feel this way. What Sebasto (1998) found was that a lack of sufficient time to prepare and deliver programs related to the environment was the primary hurdle.

A survey of secondary science teachers in Ohio examined teacher attitudes toward environmental issues curriculum and teaching environmental issues in secondary science classes along with perceived barriers to teaching environmental issues (Kim and Fortner 2006). Like other studies, teachers were found to have favorable attitudes toward environmental education. Teachers also believe that they have the ability and knowledge to teach about environmental issues, but current abilities were less than preferred abilities. Teachers reported that they were better able to teach environmental issues and the impacts of humans on the environment rather than draw upon and communicate actual experience in resolving these issues. Also, current levels were significantly lower than what is preferred. Finally, lack of time and curriculum standards were reported as major barriers, whereas personal interest and relation to the course disciplines were not.

Outside of the United States, Ko and Lee (2003) found similar results in a study about perceptions and practices among secondary school teachers in Hong Kong. On average, teachers' attitudes toward environmental education were favorable, teachers' perceived efficacy in teaching environmental education was moderate and both attitudes and self-efficacy were significantly correlated with the intention to teach environmental education concepts (Ko and Lee 2003). Results show that intention to teach environmental education scored significantly higher when compared to actual practice. Respondents reported that external barriers to teaching environmental education were more constraining than personal barriers and the most common external barriers reported were large class size and lack of class time.

A survey of science teachers in Pennsylvania was used to determine which variables affect teacher use of watershed curricula (Gruver and Luloff 2008). Results showed that teachers' self-efficacy, the belief that students gain the required competences outlined in standards, and the belief that they understood watershed concepts well enough to effectively communicate them to students affected a teacher's use of the curricula. Sociodemographic variables, on the other hand, did not seem to be related to teachers' use of curricula.

In 2009, teachers from Australia were interviewed to determine their perceptions of a new course titled Earth and Environmental Science (EES). When asked about their reasons for introducing the course at their schools, the most common reason was that the teacher had an educational background, employment history or personal interest in geology or environmental science (Dawson and Moore 2011). When asked about difficulties in implementing EES, teachers pointed to the syllabus, a lack of resources including a textbook and lab materials, and background knowledge among students and teachers.

Findings from a survey of American middle school teachers found that decisions to implement environment based education (EBE) were influenced by environmental attitudes, environmental sensitivity, receptiveness to EBE, teaching context, awareness of evidence of positive outcomes, and environmental literacy, knowledge and skills (Ernst 2009). In terms of barriers, respondents did not believe that any barriers listed on the survey were strong or very strong. However, the barriers perceived as strongest were lack of funding, lack of transportation, state standardized testing, state standards, and lack of planning time.

Teaching Behavior Predictors and Constraints to Teaching Other Concepts

A survey of members of the National Association of Agricultural Educators was conducted to study the relationship between teacher characteristics and attitudes and teaching with regard to reading in agricultural science (Park and Osborne 2007). The researchers found that a teacher's personal value of reading, general approach to reading, years of teaching experience, and knowledge of content area strategies predict their attitudes toward reading in agricultural science. Another regression analysis showed that frequency of content strategies, attitude towards reading in agriscience, and intensity of text use predict teachers' general approach to reading in agricultural science. Knowledge of content area reading strategies, total time and text use, general approach to using reading in agricultural science, confidence in content area reading strategy use, and intensity of text use were found to predict the frequency of content area reading strategy use. Finally, frequency of text use, intensity of text use, and licensure predicted cumulative use of text in agricultural science courses.

While not specific to environmental education, during interviews with high school social studies teachers in Chicago, Journell (2010) found that though teachers were interested in current events such as an election occurring at the time of the study, they did not implement information about the election into their classes and cited anxiety surrounding an end of course test as a reason. Journell (2010) argued that the pressure to achieve high scores on state assessments and resulting lack of "open space" in the curriculum leads to refrained or no emphasis on current events. In a review of literature regarding factors that prevent teachers from using technology, Mumtaz (2006) created a list of inhibitors found in several studies which included a lack of teaching experience with information and communications technology (ICT), support for teachers using technology, help with children supervision when using computers, specialist teachers who could teach computer skills, computer availability, time to implement computer technology into the curriculum, and financial support.

Benefits of Field Trips

Several publications demonstrate the benefits of field trips, particularly outdoor field trips, for students in terms of increasing awareness of the natural environment (Palmberg and Kuru 2000; Rudman 1994; Knapp and Barrie 2001). Evidence also exists for the relationship between environmental education and academic gains in areas other than environmental education. A study of high school students in California compared students from schools that focus on the environment surrounding the school through techniques such as field trips to students from schools that do not (SEER 2000). Researchers found that students in the former group scored higher in 72% of academic assessments which included math, science, reading, attendance rates and grade point averages than those in the latter group.

While many of the studies in the literature focus on the short term benefits of field trips, interviews of elementary school students one year after an environmental education field trip to Great Smokey Mountains National Park found that students "retained long-term environmental and ecological content and evidenced a potentially perceived increase in proenvironmental attitude" (Farmer et al. 2007 pg. 40). In addition, researchers note that field trips can encourage students to address and study environmental issues during their college educations as to pursue science related careers (Rudman 1994; Poudel et al. 2005).

A study of high school students in Israel attempted to determine which factors influence learning during a geologic field trip (Orion and Hofstein 1994). It was found that variables such as class size, grade level, and previous attitudes toward the subject had only limited effects on the students' field trip performance. Variables that were most influential on student performance were preparation for the trip and placement of the field trip within the curriculum trajectory.

While most studies regarding field trips in the literature focus on trips to locations outside of the schoolyard, one study of Florida elementary school students focused on the benefits of using the schoolyard as a site for education (Cronin 2000). Results showed that those students who were taught through outdoor schoolyard experiences learned significantly more about ecological science than those who did not (Cronin 2000). The results of a study examining the effects of a summer ecology program in the Baltimore-Annapolis area suggest that abilities to learn are improved in familiar areas such as schoolyards when compared to new or novel places (Martin et al. 1981).

Field Trip Use and Constraints to Taking Field Trips

Various studies have examined perceived constraints among teachers regarding student field trips. In interviews with teachers and heads of schools in Australia, researchers found that it was difficult for teachers to take field trips because of concerns regarding the interruption of school timetables, students missing other classes, and cost (Dawson and Moore 2011). With regard to outdoor field trips specifically, Orion (1993) constructed a list of the most common explanations found in the literature for teachers not taking outdoor field trips. Reasons include logistic limitations within the school system such as cost, safety, and time concerns as well as organizational difficulties, a lack of teaching and learning materials, and limited familiarity with the outdoors as a learning environment.

Simmons (1998) conducted a study in which elementary school teachers were interviewed to determine which of four outdoor settings were most appropriate for field trips, as well as the perceived benefits and barriers of field trips. Teachers believed that deep woods and rivers/ponds/marshes were more appropriate than urban nature, but that these areas presented significantly more hazards. With regard to deep woods explicitly, teachers believed that they were a useful educational setting but concerns about getting lost would need to be offset by maps and other resources. In general, teachers believed that field trips to natural areas were an important part of the curriculum, that students would enjoy the experience, and that the field trips held educational value. However, they did not feel comfortable teaching in natural settings, did not believe they had adequate training or the necessary background to do so, and were concerned about student safety and large class sizes.

In focus group discussions with educators from the Northern Kentucky Environmental Education Coalition, Miechtry and Harrell (2002) found that teachers desired low-cost, nearby field trips. Teachers also reported that obstacles to taking field trips include transportation issues such as bus schedules and funding, time constraints, school scheduling, and coordination between classes because of teachers and students missing other classes. An earlier study involving interviews of high school science teachers in Australia yielded similar results (Mitchie 1998). Factors that teachers listed that affect whether or not they take field trips included the issues of transportation, funding and large class sizes as related factors, safety of students, timetable inflexibility, required time and effort on the part of the teacher, and the availability of resources and people to assist (Mitchie 1998).

Ritchie and Coughlan (2004) found that financial constraints were the primary barriers for teachers when it comes to undertaking school field trips. In a survey of Texas elementary school teachers, Kaspar (1998) found that teachers go on field trips because they believed that outdoor field trips should be part of the curriculum and that trips promoted learning, they had a supportive administrator, they enjoyed an alternative method of teaching, they felt it was a good use of resources, they believed the extra work it took to schedule was more than offset by the benefits, money was available, the trip promoted good student behavior, someone else planned the trip, and they did not have to teach on the day of the trip. Barriers to taking field trips were cost of transportation, lack of chaperones, lack of time to plan the trip, needing more information, being in conflict with other classes, not being aware of programs, misbehavior on the trip, and the school district not allowing field trips.

In a paper comparing teachers in the United States, Canada, and Germany, researchers found that in all three countries teachers believed that field trips are valuable educational experiences (Anderson et al. 2006). With regard to constraints, in the United States and Canada, cost was a common factor, and in the United States and Germany, time was a common factor. Also, in the United States and Germany, curriculum demands in terms of testing schedules, over-crowded curriculums, and lack of teaching materials were identified as constraints.

Summary

Several common findings emerge from the literature review. Teachers believe forestry education would benefit students and should be taught. They also see the importance in teaching broader concepts of natural resources and environmental education. However, the literature also suggests that while they would like to do more, teachers are incorporating little environmental education into their curriculum. Teacher background, previous knowledge, and attitudes are factors that influence whether they incorporate these concepts and the extent to which they do.

With regard to constraints, lack of time to plan or present these concepts is frequently a limiting factor as is a lack of background knowledge about the subject. Curriculum standards are another frequently reported constraint and lack of funding or other resources have also been found as prohibitive. Finally, the lack of student background knowledge in these subjects has also been found as a hurdle.

Teachers believe field trips are valuable yet many are constrained especially in terms of outdoor field trips. Many studies have found that costs associated with the trip including transportation such as bus availability and schedules are hard to overcome. Other transportation issues are also important, as are conflicts with other classes due to the teacher or students being absent. Curriculum standards resulting in a lack of open class time is another frequent challenge. Finally, safety concerns as well as lack of resources and unfamiliarity with the outdoors are also important issues.

CHAPTER 3 – Forestry Education by High School Science Teachers in the Southern Piedmont

ABSTRACT

Forestry education in high schools introduces students to information about forests and their management. Three hundred twenty eight high school science teachers in the Southern Piedmont region of the United States were surveyed about their attitudes toward forestry and forestry education in addition to the frequency that they present forestry concepts in class. Results show that teachers present ecosystem services concepts most frequently, followed by tree characteristics. Least frequently taught are concepts related to products, uses, and management. Variables that were hypothesized to predict teaching frequencies were modeled for each concept. Significant predictors include classes taught in the last 5years, environmental education program training, and childhood location in addition to attitudes toward and knowledge of forest management.

INTRODUCTION

The need for environmental and natural resources managers is becoming increasingly critical given environmental challenges (Ko and Lee 2003, Rey 2003, Sharik and Frisk 2011). In light of changing demographics, attitudes, and behaviors of the general public, the need for public engagement regarding natural resources management is also increasing (Tarrant et al. 2003; Thompson et al. 2005; Schaaf et al. 2006). Studying if and what types of forestry education are being provided to future generations of potential managers and citizens could provide useful information to those seeking to advance forestry education in secondary schools. Forestry education is defined in this paper as education about "the profession embracing the science, art, and practice of creating, managing, using, and conserving forests and associated resources for human benefit and in a sustainable manner to meet desired goals, needs, and values" (Society of American Foresters 2008). The phrase forestry concepts refers to concepts taught in science classes that relate to any aspect of the above definition. For example, forestry concepts include ecosystem services such as water quality and wildlife habitat because these are desired goals needs and values. Additionally, tree characteristics such as tree identification and tree growth are forestry concepts as they are involved in the science of managing forests. This research measured the forestry teaching practices of high school science teachers and studied the variables that predict practices. Limited forestry education in secondary schools could have disadvantages for students. For instance, some name this as the reason that many young people hold misconceptions about the subject (Bowyer 2000). In 1985, survey research on college bound high school seniors found that 31% knew nothing about forestry careers (Wellman 1987). Moreover, only 1% considered themselves to be well informed about forestry (1987). A recent study demonstrates more of the same. Using survey research, Hagar et al. (2007) found that teenagers do not recognize professional career opportunities in forestry and that forestry is the least popular of the natural resource fields. Sharik and Frisk (2011) cite lack of knowledge about forestry and forestry careers as a reason that enrollment in university forestry programs is declining. To address this, some believe that increasing education about forestry in high schools will improve interest and growth.

Knowledge, Attitudes, and Teaching Practices

One of the most frequently cited studies was conducted to determine the values, attitudes, and education needs of public school teachers in Mississippi (Measells et al. 2003). Results indicated that teachers had an overall positive attitude toward the forest industry and almost all believed that forestry education would benefit students. Teachers reported that school visits, educational materials, partnerships with schools, educational programs and materials, and industrial tours or field trips would help.

Twenty five years earlier, Groves (1977) investigated variables related to a teacher's knowledge and opinion of natural resources and their methods for teaching a forestry unit. Results show that graduate school type, area of study, type of community lived in as a youth, and type of undergraduate school related to their natural resource knowledge. Teacher opinions about natural resources were related to the number of conservation or outdoor recreational activities they participated in, both at the time of study and during their youth. The subjects they taught also mattered. Teachers reported that guiding attitudinal development would be their primary objective in teaching a forestry unit. They also reported that they would use environmental materials and county facilities to teach the unit, and discovery method would be their primary approach.

More recently, agricultural education teachers in West Virginia were surveyed to determine their knowledge of and attitude towards forestry and forestry education and to evaluate how these characteristics varied by demographics (Friend 2008). Ninety five percent agreed or strongly agreed that forestry should be a class taught by agricultural education teachers and the same amount agreed or strongly agreed that forestry should be taught in agri-science classes. When asked about their ability to teach the subject, 60% agreed or strongly agreed that they feel qualified, but 98% also agreed or strongly agreed that agricultural education teachers need more training in forestry. Fifty seven percent of respondents reported that inadequate tools were a constraint followed by a lack of knowledge.

Knowledge and attitudes toward agriculture and natural resources and the inclusion of these topics into curricula have also been researched. Perry (1998) surveyed K-12 teachers in

Oregon about their knowledge of and attitude toward agriculture and natural resources issues and curricula. Teachers from rural areas were more likely to be aware of curricula such as FFA, 4H, and Project Learning Tree. Though most teachers had positive attitudes, very few had actually received program training (Perry 1998). Results also suggest that teachers realize the importance of teaching agriculture and natural resources concepts, but that the pressure to align with state benchmarks for education limits their ability to teach these concepts. A study conducted more recently highlights teacher beliefs about incorporating food, agricultural, and natural resources topics and activities into their classrooms (Knobloch 2008). Teachers in this study believed that these topics would enhance curriculum and could be taught in any subject matter (Knobloch 2008).

Several studies have also researched teacher attitudes toward environmental education. In one study, Wisconsin teachers were surveyed to determine their perceptions of environmental education (Lane and Wilke 1994). A study of University of Illinois Cooperative Extension Service Educators was conducted with similar objectives (Sebasto 1998). Both found that teachers believe environmental education is very important but they actually incorporate very little (Lane and Wilke 1994, Sebasto 1998). Each also found limited backgrounds in environmental education were a primary reason for low integration levels. On the other hand, Lane and Wilke (1994) found that teachers are less likely to incorporate environmental education when they believe it is unrelated to their subject matter. Yet, Sebasto (1998) found that more important was time to prepare and deliver programs related to the environment.

Similarly, Kim and Fortner (2006) found that teachers also have positive attitudes and believe they have the capability and knowledge to teach these issues but current abilities were less than preferred. Teachers reported that they were better able to teach the issues rather than communicating actual experience in resolving them. Also, levels of teaching were significantly lower than what is preferred. Finally, lack of time and curriculum standards were reported as major barriers whereas personal interest and relation to classes were not.

In summary, teachers believe forestry lessons would benefit students and should be taught as is also the case with broader concepts of natural resources and environmental education. However, while they would like to do more, teachers are not incorporating a great deal of environmental education into their classes. Factors that influence whether teachers present these concepts include their background, previous knowledge and attitudes toward them. Factors limiting forestry, natural resources, or environmental education are lack of time, lack of background knowledge, curriculum standards, lack of funding or other resources and background knowledge.

Further research in the area of forestry education specifically is useful for educators and forestry outreach specialists that aim to advance availability and quality of forestry education in secondary schools. In addition, most studies in the literature were conducted at the state level or smaller. This study contributes useful insights to this topic by assessing relevant factors on a multi-state scale. Specific objectives for the study were to determine the extent to which high school science teachers in the Southern Piedmont region of the United States are teaching forestry concepts in the classroom as well as the variables that predict forestry concept teaching frequency.

METHODS

Data for this study were collected using a web-based survey of high school science teachers in the Southern Piedmont region of the United States. Web surveys have significant advantages over other survey methods in terms of response rate, cost, and researcher time and resources (Cobanoglu et al. 2001). Electronic surveys can also be completed quicker than mail surveys, data from the surveys are received much sooner, and information about respondent's survey completion process can be obtained (Griffis et al. 2003).

Biological, environmental, earth, agricultural, and other related science teachers at public high schools in the Southern Piedmont were the target population. The study region extends from northeast Virginia to east-central Alabama and includes parts of North Carolina, South Carolina, and Georgia (Figure 1). This area is one of the major land resource areas as defined by the United States Department of Agriculture Natural Resources Conservation Service (USDA NRCS).

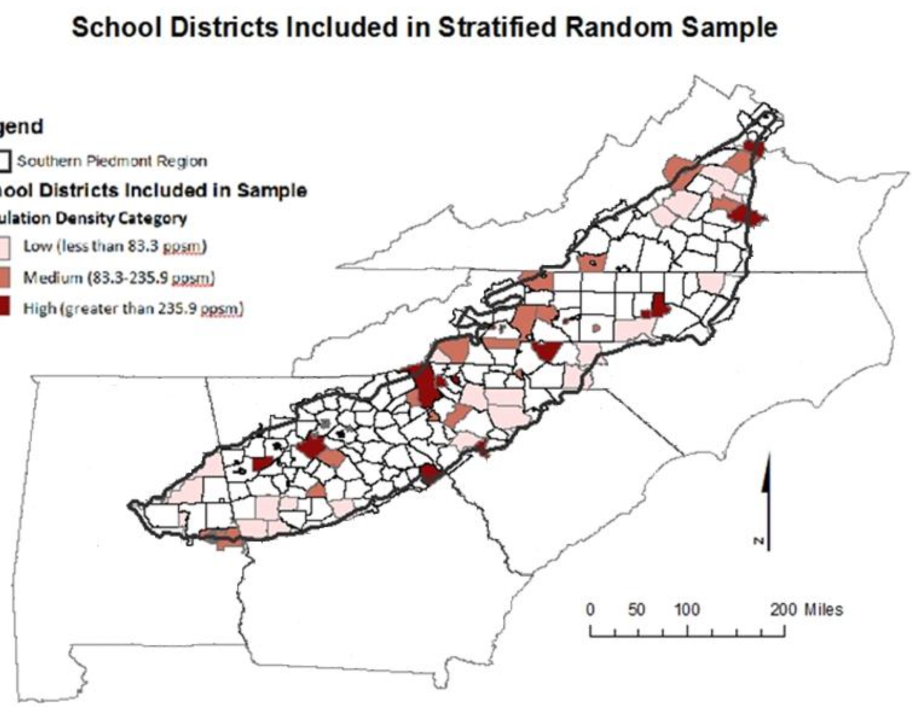

Figure 1. School districts in the Southern Piedmont included in stratified random sample.

The study region was selected because it is defined based on physiographic rather than socioeconomic characteristics. Also, it includes a variety of population densities ranging from very rural areas to large cities such as Atlanta, Georgia, Columbia, South Carolina, Charlotte, North Carolina, and Richmond, Virginia. Private forests make up the largest portion (58%) of land use and it also includes federal and state managed forests (USDA NRCS). Finally, forest management is prominent in the region (Conroy et al. 2003).

We focused on public school teachers because they are organized systematically into districts. Biological, environmental, earth, natural resources, and other related high school science teachers were the unit of analysis since they were considered most likely to introduce concepts of interest. Cluster sampling was used since it was not possible or practical to sample the population as a whole (McMillan 2008). Typically cluster sampling involves sampling naturally occurring clusters followed by a sampling of units of analysis within these clusters. For this study, we randomly selected school district clusters and included every applicable science teacher within them.

Double stratified random sampling was used to select school district clusters. School districts were stratified based on the state in which they are located and three population density categories (less than 83.2 people per square mile (ppsm), 83.2-235.8 ppsm and greater than 235.8 ppsm). We stratified to ensure proportional representation among states and to capture teachers from each population density category. A sample frame of teacher names and e-mail addresses was developed using information on websites for each school or by contacting administrative assistants when necessary.

Survey constructs were developed based on previous studies as well as study objectives. Comments and suggestions offered by a panel of experts were used to refine the instrument. The survey was pilot tested with a convenience sample of teachers in Virginia. Quantitative analysis of pilot data was used to further adjust the survey instrument.

Closed ended questions and question grids with Likert type response scales were used to measure most variables followed by space for open ended comments. Respondents were asked to report which of a list of science courses they had taught within the last five years in addition to their years of teaching experience and demographic information such as sex, age, race, and political orientation. Other items asked respondents to report whether or not they had environmental education program training such as Project Learning Tree or Project Wild, the extent of their involvement in school natural resources organizations such as 4H or Envirothon, and the type of location in which they spent the majority of their childhood. Respondents were asked to report the extent to which they feel informed about forestry using a 1 (not at all informed) to 5 (highly informed) scale. Using a 5 point response scale of strongly disagree (1) to strongly agree (5), respondents were asked to report the extent to which they agreed or disagreed with a list of statements about forestry being a large part of the economy in their area, whether forestry should be taught in high schools, their confidence to teach forestry concepts, whether they would like more training in forestry, and the constraints that limit them from teaching forestry concepts.

Several items attempted to measure respondent attitudes toward forest management. One question grid presented respondents with a list of management practices and asked them to report whether they believe the practice should or should not be used. Respondents could also report that they were not familiar with the management practices. Respondents were asked to report the importance level they placed on a list of forest management goals or objectives using a 5 point scale from less important (1) to more important (5). Using a 3 point scale of not at all beneficial, somewhat beneficial, and very beneficial, respondents were asked to report how beneficial forest management is to a list of characteristics. Finally, respondents were presented with a list of forestry concepts and asked to report the frequency that they teach each of them using a scale of never, sometimes, or often. Question items were distributed over several web pages and average survey completion time was fifteen minutes.

We used Apian SurveyPro 5 and Netcollect software to develop and publish the survey. It was implemented using a modified Tailored Design Method (Dillman 2000). An invitation to participate in the study including a link to the survey and a unique password for each potential respondent was distributed via email to teachers in the sample. Three reminder e-mails including one describing a gift card incentive to participate were sent over a one month period following initial distribution. To test for non-response bias, we distributed a shortened version of the survey to non-respondents. Responses were combined with those received after the incentive offer and compared to all other responses. There were no significant ($p < .05$) differences found between the two groups of respondents.

Data were organized and analyzed using SPSS PASW Statistics 18. Descriptive statistics were used to characterize the data. To identify underlying latent groupings in the data, we used Principal Components Analysis (PCA). Factors with eigenvalues greater than 1 were retained and varimax rotation with Kaiser Normalization was used. We labeled each factor using phrases that make sense conceptually and calculated summated means for each. Responses to 26 attitudinal questions about the goals and impacts of forest management were analyzed in one Principal Components Analysis so that factored measurements could be included as potential predictors in regression analysis. Five items were omitted due to cross-loading. Responses for frequencies that forestry concepts are presented were analyzed in a second PCA so that each factor could serve as a dependent variable for regression analysis and because this scale measured practice while the former focused on respondent attitudes. Twenty four concepts were initially included in the PCA and 4 were omitted due to cross-loading.

Three stepwise multiple linear regression models were used to predict the frequency that groups of forestry concepts are taught. The models were cross-validated according to Field (2009). We chose stepwise regression because this method is appropriate for exploratory model building and selected backward as opposed to forward stepwise regression as it is less likely to exclude predictors involved in suppressor effects (Field 2009). The same set of variables was initially included in each regression model. This allowed us to not only assess the characteristics and attitudes that relate to forestry education in general but also to illustrate differences in the roles of attitudes and characteristics for each concept group. Included variables were measurements of attitudes toward goals and impacts of forest management, knowledge of forestry and forest management practices, attitudes toward forestry education, teaching experience and classes taught, environmental education training, involvement in extra-curricular activities, forestry backgrounds, and demographic variables including sex, race, age, and political orientation.

RESULTS

An e-mail invitation containing a link to the survey was sent to 1095 teachers. Seventy-one of these e-mails were not delivered due to invalid e-mail addresses. Of the 1024 that were delivered, 324 respondents completed the survey for a response rate of 32%.

Teacher respondents were from 55 districts in the study area (Table 1). The percentage of teachers from each state closely matched its percentage of area in the Southern Piedmont region and corresponded to teacher numbers across population densities. More females (62%)

than males responded. A vast majority were Caucasian (92%) and ages ranged from 23 to 68, with most between 31-40 years (39%) and a mean age of 42. Forty percent of respondents consider themselves to be politically moderate and a higher percentage of respondents reported being conservative (37%) when compared to those that are liberal. About half of the respondents reported spending the majority of their childhood in rural areas (49%), while the other half spent their childhood in suburban or urban areas.

Respondents' teaching experience varied from less than 1 year to 44, with over half having 10 years or less (54%). Average teaching experience was 12 years. General, honors, AP/IB, and gifted biology courses were taught most frequently (73%). Other classes taught by respondents include environmental science, earth science, physical science, general science, agriculture, horticulture, ecology, and botany. Just under half of the respondents reported that they have received some form of training on environmental education programs such as Project Learning Tree or Project Wild (47%). When asked about their involvement in extra-curricular activities such as 4H or Envirothon, over 60% reported that they were not at all involved.

Table 1. Characteristics of high school science teacher respondents from the 5 state Southern Piedmont of the U.S. Total sample size 328.

Respondent Characteristic	Percent	Respondent Characteristic	Percent
Demographics/Personal Background		Teaching Characteristics	
State		Years Teaching	
Virginia	25%	1-10 years	54%
North Carolina	26%	11-20 years	28%
South Carolina	17%	21-30 years	12%
Georgia	27%	31-40 years	5%
Alabama	5%	41-50 years	1%
Population Density Category		Classes Taught within Last Five Years	
Low	11%	Any Biology	73%
Medium	28%	Any Environmental Science	33%
High	61%	Any Earth Science	34%
Sex		Any Physical Science	37%
Male	38%	Agriculture	4%
Female	62%	Horticulture	4%
Race		Ecology	9%
White	92%	Botany	1%
Black	5%	General Science	5%
Other	3%	Environmental Education Program Training	
Age		Yes	47%
21-30 years	22%	No	53%
31-40 years	39%	Involvement in School Natural Resources Organizations (1-5 scale)	
41-50 years	28%		
51-60 years	4%	1 - Not at all involved	63%
61-70 years	7%	2	17%
Political Orientation		3	10%
Very liberal	9%	4	4%
Liberal	14%	5 - Highly involved	6%
Moderate	40%		
Conservative	22%		
Very conservative	15%		
Childhood Location			
Rural farm	23%		
Rural non-farm	26%		
Suburban	46%		
Urban	5%		

Knowledge and Attitudes

Forty percent of respondents were neutral when asked about the level to which they feel informed of forestry. Close to half (48%) agreed or strongly agreed that forestry is a large part of the economy in their area. When asked how beneficial they believed the impacts of forest management are relative to a list of potential outcomes (1 = not at all beneficial to 3 = very beneficial), respondents on average reported that forest management is beneficial (2.64). They reported believing it is most beneficial to wildlife habitat (2.81), forest health (2.77), air quality (2.76), water quality (2.75), and biodiversity (2.69) and least beneficial to property value (2.46), climate change prevention (2.5), carbon storage (2.5), human well-being (2.54), though mean responses are still above the midpoint for each of these. Respondents reported water quality (mean = 4.37), air quality (4.36), biodiversity (4.31), wildlife habitat (4.11), and endangered species (4.02) as being the most important goals or objectives for forest management (1 = less important to 5 = more important).

The Principal Components Analysis used to identify groupings of attitudinal variables yielded five favors including: 1) goals related to products and uses; 2) goals related to ecosystem services; 3) goals related to wildlife; 4) impacts to forest; and 5) impacts to humans (Table 2). The Principal Components Analysis solution explained 65% of the variance among all items with factors 1 (23%) and 2 (15%) explaining the highest amounts. Cronbach's alpha values were highest for factors 1, 2, and 3 and moderate for factors 4 and 5.

Table 2. Rotated component matrix with factor loadings for attitudes toward forest management of science teachers in the Southern Piedmont region.

	Factors				
Survey Items	**Impacts to Forest**	**Goals Related to Products and Uses**	**Goals Related to Wildlife**	**Goals Related to Ecosystem Services**	**Impacts to Humans**
Impact – Air quality	**.859**	.050	.018	-.062	.016
Impact – Water quality	**.842**	.047	-.065	.027	-.069
Impact – Biodiversity	**.832**	-.007	.179	.073	.106
Impact – Wildlife habitat	**.825**	.031	.012	-.019	.105
Impact – Soil quality	**.776**	.002	-.009	.061	.224
Impact – Scenic beauty	**.676**	.112	-.109	-.099	.223
Impact – Forest health	**.627**	-.009	.081	.114	.435
Impact – Carbon storage	**.579**	.039	.144	.070	.382
Goal – Scenic beauty	-.010	**.808**	.076	.025	-.035
Goal – Outdoor recreation	.032	**.760**	.135	.084	-.068
Goal – Fire prevention	-.006	**.744**	.260	.109	.197
Goal – Non-timber forest products	.118	**.714**	.175	.205	-.014
Goal - Timber	.070	**.705**	.028	.209	.082
Goal - Biodiversity	.031	.082	**.840**	.130	-.017
Goal – Endangered species	.057	.212	**.785**	.188	-.004
Goal – Wildlife habitat	-.013	.399	**.700**	-.012	.057
Goal – Water quality	-.021	.197	.023	**.852**	-.021
Goal – Air quality	-.079	.156	.082	**.850**	.076
Goal - Bioenergy	.117	.126	.179	**.535**	-.037
Impact – Fire prevention	.214	-.015	.082	-.008	**.855**
Impact – Property value	.313	.103	-.116	-.022	**.660**
Variance explained by each factor	22%	15%	10%	9%	8%
Chronbach's alpha	.897	.839	.756	.676	.614
Total variance explained			65%		

Survey item and response scale for impacts:
"Please select the response that best represents how beneficial you believe the impacts of forest management are for each of the following characteristics"
1 = not at all beneficial to 3 = very beneficial

Survey item and response scale for goals:
"Please select the response that best represents the level of importance you place on each of the following forest management goals."
1 = less important to 3 = more important

When asked about various forest management practices, high percentages of respondents reported that they were not familiar with some practices rather than weighing in on whether or not they should be used. Least recognized by respondents are growing non-timber forest products, slash burning, planting on streamside zones, reforestation with tree clones, habitat improvement cuts, and pine plantations. We calculated the total number of practices recognized by respondents to assess a respondent's knowledge in general.

Attitudes and Teaching Practices

Eighty two percent of respondents agreed or strongly agreed that forestry concepts should be taught in schools. However, only 34% agreed or strongly agreed that they feel confident to teach forestry concepts. Fifty eight percent of respondents agreed or strongly agreed that they would like to receive more training in forestry. When asked about constraints that limit them from teaching forestry concepts, 80% agreed or strongly agreed that curriculum standards limit them and 78% agreed or strongly agreed that time constraints are restrictive.

Over half of the respondents report often teaching air quality, endangered species, wildlife habitat, biodiversity, nutrient cycling, and climate change. At the same time, over half respond that they never teach tree measurement, wood products, forestry career opportunities, non-timber forest products, and timber harvesting. Three forestry concept factors were identified using Principal Components Analysis (PCA) and labeled using the conceptual nature of grouped items. The factors include: 1) ecosystem services concepts; 2) tree characteristics concepts; and 3) products, uses, and management concepts and each had a Cronbach's alpha value greater than 0.80 (Table 3). The PCA solution explained 58% of the variance among all items with factors 1 (21%) and 2 (20%) explaining the highest amounts. Using a scale of 1 = never to 3 = often, teachers present concepts related to ecosystem services most frequently (2.38), followed by those related to tree characteristics (1.67). Least frequently taught are concepts related to products, uses and management (1.55). Factor means for all groups are significantly different (p < .001).

Table 3. Rotated component matrix with factor loadings for frequency that forestry concepts are taught by science teachers in the Southern Piedmont region.

	Factors		
Survey Items	**Concepts Related to Ecosystem Services**	**Concepts Related to Products, Uses and Management**	**Concepts Related to Tree Characteristics**
Concept – Biodiversity	**.806**	-.025	.186
Concept – Climate change	**.751**	.065	-.140
Concept – Endangered species	**.739**	.131	.253
Concept – Nutrient cycling	**.736**	-.001	.170
Concept – Sustainability	**.712**	.240	.063
Concept – Wildlife habitat	**.668**	.302	.315
Concept - Carbon storage	**.637**	.138	.049
Concept – Air quality	**.600**	.332	-.047
Concept – Timber harvesting	.171	**.764**	.258
Concept – Wood Products	.072	**.759**	.277
Concept – Timber production	.180	**.754**	.154
Concept – Outdoor recreation	.161	**.698**	.135
Concept – Non-timber forest products	.188	**.669**	.147
Concept – Forestry career opportunities	-.011	**.626**	.306
Concept – Fire as a management practice	.208	**.554**	.344
Concept – Tree physiology	.132	.102	**.788**
Concept – Tree growth	.126	.244	**.787**
Concept – Tree identification	.076	.300	**.721**
Concept – Tree measurement	.015	.348	**.687**
Concept – Tree pests/diseases	.186	.357	**.608**
Variance explained by each factor	21%	20%	16%
Chronbach's alpha	.875	.867	.841
Total variance explained		58%	

Survey item and response scale:
"Listed below are concepts that may be presented in science classes. For each of the following concepts, please select the response that best represents the frequency that you present the concept in your classes."
1 = never; 2 = sometimes; 3 = often

Frequency of Teaching Forestry Concepts

Eleven variables predict the frequency that respondents present forestry concepts related to ecosystem services (Table 4). The stepwise model accounts for 54% of the variance in the frequency that concepts are taught. Attitudinal variables in this model having positive relationships with ecosystem services teaching frequency are importance placed on wildlife and ecosystem services management goals and how beneficial respondents believe forest management is to forests. Importance placed on products and uses management goals has a negative relationship with ecosystem services teaching frequency. With regard to respondent knowledge of and connection to forestry, the number of management practices recognized by respondents and extent of agreement that forestry is a large part of the economy in their area have positive relationships with the frequency ecosystem services are taught. Classes taught in the last 5 years play a role in predicting this teaching frequency with teachers of biology and environmental science classes teaching more and physical science teaching less. Finally, having environmental education training such as Project Learning Tree or Project Wild and increasing confidence to teach forestry concepts have positive relationships with ecosystem services teaching frequency.

Table 4. Parameters, slope estimates, and p-values for variables predicting the frequency that concepts related to ecosystem services are taught by science teachers in the Southern Piedmont region.

Parameter	Slope estimate	P-value
Increasing importance placed on forest management goals related to wildlife	.337	< .001
Teaching any Biology classes in the last five years versus not	.309	< .001
Teaching any Environmental Science classes in the last five years versus not	.264	< .001
Increasing importance placed on forest management goals related to products and uses	-.169	.004
Having had some form of environmental education program training versus not	.130	.010
Increasing agreement that forestry is a large part of the economy in respondents' area	.129	.012
Increasing importance placed on forest management goals related to ecosystem services	.121	.026
Increasing belief that the impacts of forest management are beneficial to forests	.111	.028
Increasing number of forest management practices recognized	.102	.043
Teaching any Physical Science classes in the last five years versus not	-.090	.067
Increasing agreement with feeling confident to teach forestry concepts	.096	.079
F		22.329
Significance level		< .001
Adjusted R^2		.540

The frequency that teachers present forestry concepts related to tree characteristics included 7 variables which overall explained 30% of the variance (Table 5). In this model, several teaching characteristics were found to have positive relationships with the frequency tree characteristics are taught such as teaching biology, agriculture, or horticulture in the last 5 years. In addition, confidence to teach forestry concepts and involvement in natural resources extra-curricular activities have positive relationships with this teaching frequency. Recognition of forest management practices has a positive relationship with tree characteristic teaching frequency. Finally, teacher age was found to have a positive relationship with this teaching frequency.

Table 5. Parameters, slope estimates, and p-values for variables predicting the frequency that concepts related to tree characteristics are taught by science teachers in the Southern Piedmont region.

Parameter	Slope estimate	P-value.
Teaching any Biology classes in the last five years versus not	.236	< .001
Increasing agreement with feeling confident to teach forestry concepts	.204	.001
Teaching any Agricultural Science classes in the last five years versus not	.212	.007
Increasing involvement in school natural resources related extra-curricular activities	.182	.009
Increasing age	.137	.025
Increasing number of forest management practices recognized	.128	.039
Teaching any Horticulture Science classes in the last five years versus not	.133	.077
F		13.445
Significance level		< .001
Adjusted R^2		.303

The frequency that teachers present forestry concepts related to products, uses, and management of forests included 7 variables that account for 42% of the variance (Table 6). Attitudinal variables were once again found to be significant predictors in this model. Positive relationships with teaching frequency exist for importance placed on management goals related to forest products and uses as well as how beneficial respondents believe forest management is to humans. Recognition of forest management practices and extent of feeling informed about forestry have positive relationships with this teaching frequency. A respondent spending the majority of his or her childhood in a rural farm location was also found to have a positive relationship with products, uses, and management teaching frequency. Classes taught in the last 5 years play a role in predicting this teaching frequency with teachers of environmental and agricultural science classes teaching more frequently. Finally, extent of agreement that curriculum standards limit teaching forestry concepts has a negative relationship with products, uses, and management teaching frequency.

Table 6. Parameters slope estimates, and p-values for variables predicting the frequency that concepts related to forest products, uses and management are taught by science teachers in the Southern Piedmont region.

Parameter	Slope estimate	P-value
Increasing importance placed on forest management goals related to products and uses	.282	< .001
Teaching any Environmental Science classes in the last five years versus not	.211	< .001
Teaching any Agricultural Science classes in the last five years versus not	.236	< .001
Increasing extent to which respondents feel informed of forestry	.188	.002
Increasing belief that forest management is beneficial to human needs	.132	.016
Increasing number of forest management practices recognized	.136	.017
Increasing agreement that curriculum standards limit respondents from teaching forestry concepts	-.118	.038
Reporting spending the majority of their childhood in a rural farm location versus a suburban one	.092	.095
F		19.033
Significance level		< .001
Adjusted R^2		.419

DISCUSSION

Results support literature showing teachers believe forestry concepts should be taught in high schools (Measells et al. 2003; Friend 2008). However, even with demonstrated importance of forestry education, many forestry concepts are taught infrequently or never. This could be due to a high percentage of teachers reporting low confidence when it comes to teaching forestry concepts. Over half report that they would like more training thus demonstrating an interest in the topic yet high percentages agree that curriculum standards and time are constraining.

The summated mean values for each forestry concept groups show an imbalance in the teaching frequencies for each group. Concepts related to forest products, uses and management are taught least frequently when compared to ecosystem services or tree characteristics. This is important because it suggests that students may be receiving incomplete information about forests and their management. No related studies were found in the literature describing the specific types of forestry education occurring in high schools.

The influence of classes taught in the last 5 years on the extent to which teachers present each of the three concept groups could show that topics are more conducive to being covered in certain science classes than others. Model results reiterate that knowledge of forestry predicts the frequency that a teacher covers forestry concepts (Friend 2008; Dawson and Moore 2011). It is mostly to be expected that characteristics such as training and confidence relate to teaching frequency (Friend 2008). Increasing involvement in school natural resources organizations leading to an increase in teaching frequency in one of the models is also not surprising given that teachers may feel more comfortable with forestry concepts after being exposed to them through these organizations. Additionally spending childhood in a rural farm location may show that childhood exposure to forestry concepts leads to the knowledge and desire to teach about them.

Perhaps most noteworthy is the relationship between attitudes and behavior. Ideally, attitudes should not affect teaching practices as to eliminate bias in education. However, two of the three models indicate that attitudes toward goals and impacts of forest management influence the extent to which teachers present certain concepts. For example, those that place importance on forest management goals related to ecosystem services teach about ecosystem services more often while those placing importance on products and uses goals teach about forest products and uses more often. Some evidence exists regarding the influence of teacher attitudes (Park and Osborne 2007; Ernst 2009). In addition, there is a literature base supporting the idea that teacher beliefs influence teaching practices (Parajes 1992; Richardson 1996; Bryan and Abell 1999). Attitudes were not significant in the model related to tree characteristics, which seems logical given tree structure and function remains the same regardless of attitudes.

Some interesting variables were found to not be significant predictors of the frequency of teaching forestry concepts. For example, as in other studies, high percentages of teachers reported agreeing with statements about time and curriculum standards limiting the amount of forestry concepts they present but these variables were found to be significant predictors in only one model (Perry 1998; Kim and Fortner 2006). Also, previous employment in forestry, outdoor recreation habits, and years of teaching experience were found to influence teaching practices in other studies but these variables were not found to be predictors in the current study (Groves 1977; Park and Osborne 2007; Dawson and Moore 2011).

A major implication of this study is the limited and in some cases incomplete or unbalanced forestry education occurring in high school science classes. Results of this study should encourage the forestry education proponents to promote education about forestry concepts in high school science classes. Forestry education proponents should support existing and develop additional forestry training programs and professional development opportunities for teachers as suggested in other studies (Lane and Wilke 1994; Sebasto 1998; Dawson and Moore 2011). These programs should provide information on all types of forestry concepts and address teacher concerns regarding implementation therefore increasing teacher knowledge and confidence. Additionally, programs should provide examples of ways to align concepts with state standards. Project Learning Tree is one example of a well-known program that provides teachers with information about forestry education and suggests ways that activities can be used to meet mandated standards, thereby mitigating the challenges faced by them. Finally, programs should address the concepts least taught currently and provide ways that teachers can integrate these concepts into their classrooms. For example, since forest products concepts are infrequently taught, activities and lessons that relate these products to aspects of forests covered by teachers such as wildlife habitat or spark teacher and student interest in other ways such as discussing forest products used every day.

Forestry professionals and others involved in the field could also work to promote the profession by visiting schools and providing information about forest management and the career. Local chapters of professional organizations, government agencies, forest products businesses, college forestry departments, and other groups could develop outreach programs and partnerships through which they support local schools in their area by providing this information. These groups should be open to and willing to meet teacher desires and needs with regard to teaching about forests and their management.

Additionally, because of the demonstrated importance of attitudes, forestry professionals and other stakeholders should work to promote positive attitudes toward forest management. Materials or outreach events highlighting sustainable forestry are possible strategies. These include providing forestry materials or training to teachers or efforts to improve attitudes toward forestry.

CONCLUSION

In this study, we aimed to determine the extent to which high school science teachers are teaching forestry concepts in the classroom as well as the variables that predict forestry concept teaching frequency. We have presented the characteristics, attitudes, and teaching practices of 324 biological, environmental, earth, and other related science teachers at public high schools in the Southern Piedmont region of the United States. Respondents present forestry concepts regarding ecosystem services most frequently, followed by concepts related to tree characteristics. They teach concepts related to products, uses, and management least frequently. Variables that predict teaching frequencies for each of these groups of concepts include but are not limited to teaching characteristics in addition to attitudes toward and knowledge of forestry. The study not only identifies specific areas of forestry education that are lacking but also challenges faced by teachers interested in presenting forestry concepts in their classrooms. Suggestions for improving forestry education in high schools were also presented including teacher training programs as well as other outreach and partnerships between forestry education stakeholders and schools.

CHAPTER 4 – High School Science Teacher Field Trips to Forests in the Southern Piedmont

ABSTRACT

Field trips to forests are useful for teaching students about forests and natural resources management. We studied high school science teachers in the Southern Piedmont of the United States. We administered an online survey to collect information about teaching characteristics and field trip frequency. Over half of the 328 teachers that responded never take field trips to forests and very few do so multiple times per year. We used binary logistic regression to identify significant predictors of field trip behavior. Variables that best predict whether or not teachers take students to forests include confidence to teach forestry, involvement in school natural resources extra-curricular activities such as 4H and the presence of a forest within walking distance of the school.

INTRODUCTION

Class field trips are one method of introducing students to forests, the goods and services they provide, and how to manage them sustainably. Rudman (1994) suggests that outdoor field trips add relevance to science classroom learning, encourage science interests, and increase aspirations for science careers. Palmberg and Kuru (2000) point out that field trips are a type of environmental education program that helps students develop relationships with the natural world as well as increasing their environmental sensitivity, outdoor recreation, and social relationships. This study aimed to evaluate forest field trip use in one region of the United States.

Forest Field Trips

Outdoor field trips can substantially increase student awareness and understanding of environmental management (Rudman 1994; Palmberg and Kuru 2000; Knapp and Barrie 2001). Evidence also exists for academic gains in other content areas. A study of high school students in California compared students at schools with curriculum focused on the surrounding environment with schools that do not. Students in the former group scored higher in 72% of their academic assessments which included math, science, reading, attendance rates, and grade point averages than those in the latter (SEER 2000). A study employing interviews of elementary school students one year after an environmental education field trip to Great Smokey Mountains National Park found that students were able to recall environmental and ecological content over the long-term and showed increases in proenvironmental attitude (Farmer et al. 2007). Field trips can also lead to increased interest in environmental issues and science during college and steer students toward science related careers (Rudman 1994; Poudel et al. 2005).

Most field trip research focuses on trips to locations outside of the schoolyard. However, one study in Florida focused on the effects of using schoolyards for environmental education (Cronin 2000). Results showed that elementary students taught through schoolyard experiences learned significantly more about ecological science than those who did not. Similarly, a study examining the effects of a Summer Ecology Program in the Baltimore-Annapolis area suggests that students' learning is heightened in familiar areas such as schoolyards when compared to new or novel places (Martin et al. 1981). Each of these studies shows that outdoor areas on or convenient to school properties are effective field trip sites.

Constraints that influence a teacher's ability to take field trips have also been studied. Teachers and heads of schools in Australia noted that it was difficult to take field trips because they interrupt school timetables, students miss other classes, and can have substantial costs (Dawson and Moore 2011). Orion (1993) constructed a list of the most common explanations for limiting outdoor field trips. Reasons include logistical limitations such as cost, safety, and time as well as organizational concerns, lack of teaching and learning materials, and unfamiliarity with the outdoors as a learning environment (1993). Many of these could be mitigated by using a convenient field trip site as described above.

Simmons (1998) interviewed elementary school teachers to determine which of four outdoor settings were most appropriate for field trips as well as the perceived benefits of and barriers to field trips. With regard to deep woods explicitly, teachers believed that they could be a very useful setting but fears of getting lost cause hesitancy. In general, they believed that field trips to natural areas are important, students would enjoy the experiences, and outdoor field trips held educational value. However, they did not feel comfortable teaching in natural settings, did not believe they had adequate training or the necessary background to do so, and were concerned about students' safety and managing large class sizes.

Miechtry and Harrell (2002) found that teachers desired low-cost, nearby field trips because such trips avoid transportation costs and reduced time commitments avoid scheduling and coordination challenges between classes. A study in Australia yielded similar results (Mitchie 1998). Ritchie and Coughlan (2004) found that financial constraints were the primary barriers for school field trips and in a survey of Texas elementary school teachers, Kaspar (1998) found much of the same but that the school district also prohibited field trips. Curriculum demands in terms of testing schedules, over-crowded curriculums, and lack of teaching materials have also been noted as constraints (Anderson et al. 2006).

In summary, teachers believe field trips are valuable (Simmons 1998; Anderson et al. 2006). Additionally, convenient sites such as schoolyards are appropriate and beneficial field trip sites (Martin et al. 1991;Cronin 2000). Many constraints limit teachers from taking field trips, especially outdoor field trips. Costs, transportation issues, curriculum standards, lack of open class time, safety concerns, lack of resources, and unfamiliarity with the outdoors are all common commonly reported constraints. To determine the extent of field trip implementation using a regional context, we asked science teachers in the Southern Piedmont about how often they take their classes on forest field trips and whether there is a forest convenient to their school that can be used for field trips. Additionally, we measured variables that we hypothesized would predict whether or not they take field trips to forests for educational purposes.

METHODS

Data for this study was collected using a web based survey of high school science teachers in the Southern Piedmont Region of the United States. Web surveys have significant advantages over other survey methods in terms of response rate, cost, and researcher time and resources (Cobanoglu et al. 2001). Findings of this study also suggest that web-based surveys can be used to effectively survey educators because most have access to the web and e-mail. Electronic surveys can also be completed more rapidly than conventional mail surveys, data are received much sooner, and information about survey completion can be obtained (Griffis et al. 2003).

We targeted biological, environmental, earth, agricultural, and other related science teachers at public high schools in the Southern Piedmont. The five-state Southern Piedmont region extends from northeast Virginia to east-central Alabama, stretching across parts of North Carolina, South Carolina, and Georgia (Figure 2). The area is a Major Land Resource Area defined by the United States Department of Agriculture Natural Resources Conservation Service (USDA NRCS).

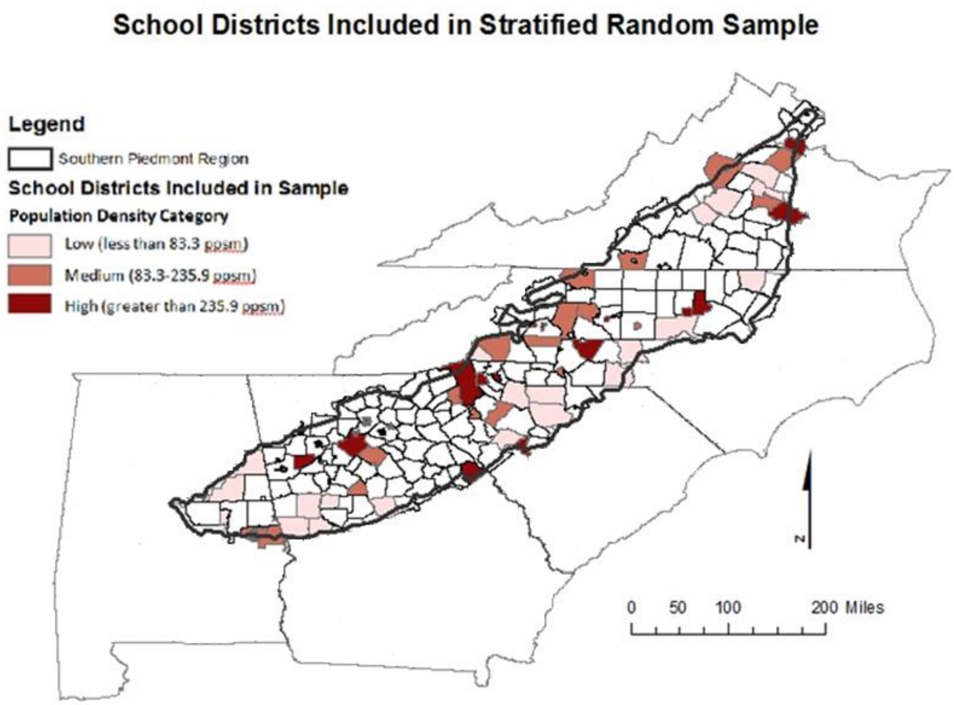

Figure 2. School districts in the Southern Piedmont included in stratified random sample.

The study region was selected because it is defined based on physiographic rather than socioeconomic characteristics and includes a variety of population densities ranging from rural areas to large cities such as Atlanta, Georgia and Richmond, Virginia (USDA NRCS). Private forests make up the largest portion (58%) of the land use in this region (USDA NRCS). It also includes many federally and state managed forests (USDA NRCS). Finally, intensive forest management is prominent in the region (Conroy et al. 2003).

We limited our study to public school teachers because they are organized systematically into districts. We also focused on high school teachers because many of the research concepts are not generally taught until students reach the high school level. Biological, environmental, earth, natural resources, and other related science teachers were surveyed because they were considered most likely to incorporate field trips to study natural areas.

A cluster method was used to draw the sample. This sampling technique can be employed when it is not possible or practical to sample individuals as a whole such as when there is no list of all of the individuals in the population or gathering such a list is impractical (McMillan 2008). Cluster sampling typically involves selecting naturally occurring clusters followed by a second round where units of analysis within these clusters are sampled. For this study, we randomly selected school district clusters and included every applicable science teacher within them.

Double stratified random sampling was used to select school district clusters. To do this, school districts were stratified based on state and three population density categories (less than 83.2 people per square mile (ppsm), 83.2-235.8 ppsm and greater than 235.8 ppsm). Stratification was used to ensure proportional sampling of each state in the region and that teachers from various population densities are represented. A proportional approach was used when stratifying by state so that the percentage of districts in the sample would be the same as the percentage of the region made up by that state. Equal weighting was used to stratify by population density.

Teacher names and email addresses were compiled using school websites and administrative assistance. Survey constructs were based on previous studies as well as unique study objectives. The instrument was tested by a panel of experts and pilot tested with a convenience sample of teachers in Virginia. Closed ended questions and question grids with Likert type response scales were used to measure variables and open ended comments allowed free input. Respondents were asked to report which of a list of science courses they had taught within the last 5 years in addition to their years of teaching experience and demographic information such as sex, age, and race. Other items asked respondents to report whether or not they had environmental education program training such as Project Learning Tree or Project Wild, involvement in school natural resources organizations such as 4H or Envirothon, and confidence to teach forestry concepts. In addition, respondents were asked to report whether or not there is a forest within walking distance of their school that could be used for educational purposes, the extent to which they agreed or disagreed that time and money are constraints to field trip use, and how often they take field trips to any forest for educational purposes.

The survey was developed using Apian SurveyPro 5 software and published using Apian NetCollect software. The survey was implemented using a modified Tailored Design Method (Dillman 2000). An invitation to participate in the study including a link to the survey and a unique password for each potential respondent was distributed via email to each sampled teacher. Three reminder e-mails including one describing a gift card incentive to participate were sent over a one month period. To test for non-response bias, we distributed a shortened version of the survey to non-responders. We combined their responses with those received after the incentive was offered and compared them to earlier responses to the original survey. No significant differences ($p < .05$) were observed between the two data sets. Data from the study was analyzed using SPSS PASW Statistics 18 software. Descriptive statistics were calculated to describe respondents and their attitudes toward field trip use. We used binary logistic regression to identify characteristics among science teachers that predict whether they take field trips to forests for educational purposes. We chose stepwise regression because this method is appropriate for exploratory model building and selected backward as opposed to forward stepwise regression as backward selection is less likely to exclude predictors involved in suppressor effects (Field 2009). Eight school and teaching characteristics were initially included in this model including years of teaching experience, subjects taught, confidence to teach forestry concepts, environmental education program training, involvement in school natural resources organizations, presence of a forest within walking distance of the school, and agreement with statements regarding time and money as field trip constraints.

RESULTS

An e-mail invitation containing a link to the survey was sent to 1095 teachers. One thousand twenty four were successfully delivered. Three hundred twenty four respondents completed the survey for an adjusted response rate of 32%.

Responses were received from teachers in 55 school districts. Percentage of teacher responses in each state closely matched the percentage of the Southern Piedmont region constituted by each state. Not surprisingly, most respondents taught at schools in the high population density category (61%). Twenty eight percent were from medium population density areas and 11% from areas with low population densities. Sixty two percent were female, 92% were white and range in age from 23 to 68 years with a mean of 42.

Respondents teach various courses including biology, environmental science, earth science, physical science, and agriculture science. Teaching experience varied from less than one year to 44 years with a mean of 12. Just over half of the respondents (53%) reported that they had some form of environmental education program training such as Project Learning Tree or Project Wild. A high percentage of teachers (63%) reported that they were not at all involved in school natural resources related extra-curricular activities such as 4H or Envirothon. Fifty six percent of teachers reported that there is a forest within walking distance of their school.

Confidence in teaching forestry concepts varies. Thirty four percent agreed or strongly agreed that they feel confident to teach forestry concepts, 36% disagreed or strongly disagreed and 30% were neutral. A high number of respondents (80%) agreed or strongly agreed that time and money limit field trip use. Fifty seven percent reported never taking field trips to forests while 43% reported doing so at least once per year.

Eight school and teaching variables were initially included in the backward logistic regression model. The final model is significant and includes 3 predictors (Table 7). Predictor variables are confidence to teach forestry related concepts, involvement in school natural resources related extra-curricular activities, and presence of a forest within walking distance of the school. A unit increase in the level of agreement with the statement "I feel confident to teach forestry concepts" leads to teachers being 2.2 times as likely to take field trips to a forest, whereas involvement in school natural resources related extra-curricular activities increases odds 1.6 times. Teachers who reported that there is a forest within walking distance of the school are over 11 times more likely to take a field trip to a forest. The final model correctly predicts field trip use for 75% of respondents, a substantial increase from 58% as predicted by chance. A non-significant P-value for the Hosmer and Lemeshow goodness-of-fit test shows that the model is a good fit and Nagelkerke R^2 is .477.

Table 7. Results of a stepwise binary logistic regression to predict log odds that science teachers from the Southern Piedmont region of the U.S. take field trips to any forest for educational purposes.

Variables Included in Model	B (S.E.)	Wald	Odds Ratio Exp (B)	Sig.
Confidence to teach forestry concepts	0.797 (.176)	20.446	2.218	< .001
Involvement in school natural resources related extra-curricular activities	0.439 (.152)	8.317	1.551	.004
Presence of a forest within walking distance of the school	2.435 (.362)	45.358	11.413	< .001
Constant	-4.993 (.687)	52.843	.007	< .001
Nagelkerke R^2		0.477		
Correctly Predicted Cases		75%		
Hosmer and Lemeshow		p = .174		

DISCUSSION

Given the number of science topics focused on forests and the additional benefits of outdoor field trips, the limited number of teachers that take field trips was unexpected. It seems that many students are not given opportunities for academic and other gains shown to be provided by outdoor field trips. A high number reported that time and money constraints limit forestry related field trips, which corresponds to previous findings (Orion 1993; Kaspar 1998; Mitchie 1998; Ritchie and Coughlan 2004; Anderson et al. 2006; Miechtry and Harrell 2002; Dawson and Moore 2011). It is interesting to note, however, that constraints were not found to be significant predictors of whether or not teachers take field trips to forests in the regression model. It was the presence of a forest within walking distance of the school that dramatically increases the odds that teachers take field trips to forests. This is probably because a forest within walking distance eliminates significant transportation and scheduling costs found as primary constraints in other studies (Kasper 1998; Miechtry and Harrell 2002). In addition, field trip sites on or convenient to school grounds can be taken within class periods thereby mitigating the time constraints found in other studies. A surprisingly high number of teachers reported the existence of a forest within walking distance of their school that could be used for field trips. This is especially important given our finding that it substantially increases the odds that a teacher will take forest field trips and the student gains provided by activities in schoolyards and other areas in close proximity presented in the literature (Martin et al. 1981; Cronin 2000).

The relationship between a teacher's level of involvement in school extra-curricular natural resources activities and field trips to forests suggests program involvement may prompt them to take their students outdoors. It may also be that involvement in these activities increases their comfort in visiting forests or allows them to discover innovative ways to implement field trips to forests. The role of confidence in teaching forestry concepts is also not surprising, given that those feeling more confident would be better positioned to teach a lesson. It is possible that a lack of confidence could be related to a lack of background or training in forest education which are frequently found as limiting factors (Orion 1993; Simmons 1998).

Neither the classes teacher respondents have taught in the last 5 years nor whether they have had environmental education program training relate to whether they take field trips to forests. We hypothesized that subject taught and environmental education program training would affect the likelihood of taking field trips to forests. The insignificance of subject taught may show that teachers' motivations for taking field trips or perceived constraining factors are similar across subjects. The insignificance of environmental education program training in the model could mean that these trainings are not sufficiently encouraging field trips. However, this may also be due to teachers perceiving the same field trip constraints such as time and money regardless of training. Finally it is interesting to note that teaching experience was not found to predict field trip use. This may show that regardless of experience, teachers face the same challenges.

The implication of this study that a percentage of science teachers do not take field trips to forests should encourage proponents of forest field trips to develop teacher training programs that both promote field trip use and provide solutions for overcoming challenges. Since an increase in confidence to teach forestry concepts increases the odds that teachers take field trips to forests, resources should be made available to teachers so that they are able to learn more about forests and forest management. Teacher training programs and professional development opportunities addressing these topics should be utilized. Many such programs such as Project Learning Tree exist and should be supported and when necessary, new programs should be developed. Additionally, networks of forestry professionals, college forestry departments, and other groups could provide materials and information to teachers as well as assist with field trips.

Additionally, results indicate that having a forest within walking distance of the school dramatically increases the odds that teachers take their classes to visit forests. To this end, efforts should be made to create new and preserve existing forests in close proximity to schools as well as making forests easily accessible to teachers to use as a learning tool. In the absence of a school or other forest within walking distance, nearby forest landowners including businesses and government agencies could sponsor field trips to their land. While providing this access and funding may help, it is important to note, however, that this would not address time and scheduling conflicts. An alternative would be to develop an indoor or other innovative "green" space where trees could be planted and used as learning tools.

CONCLUSION

In the current study, we sought to determine the frequency that teachers take field trips to any forest for educational purposes and the variables that predict whether or not they take field trips to forests. We have presented the characteristics and beliefs of and field trip frequency for

324 biological, environmental, earth, and other related science teachers at public high schools in the Southern Piedmont region of the United States. In addition, we determined the school and teaching characteristics that predict whether teachers take field trips to forests. It was found that over half of the teachers surveyed never take field trips to forests and variables predicting the odds of taking forest field trips include confidence to teach forestry concepts, involvement in extra-curricular activities and the presence of a forest within walking distance of the school. Finally, we offered suggestions to encourage use of field trips to forests in science education including teacher training programs, field trip assistance from forestry professionals, preserving forests near schools, and improving access to local forests.

Chapter 5 – Constraints to Teaching Forestry Concepts and Taking Forest Field Trips in the Southern Piedmont

ABSTRACT

Teaching forestry concepts in high school science classes and field trips to forests can be beneficial to secondary students. We analyzed open ended comments from high school science teachers in the Southern Piedmont region of the United States about the factors that influence their ability to teach forestry concepts and take field trips to forests. Comments from 136 teachers were grouped and counted according to theme. Five key thematic categories emerged and these categories related to constraints reported by respondents included mandated standards/curriculum (60%), money (40%), time (32%), mandated testing (19%), and training, interest, and infrastructure (19%). Proposed methods for overcoming constraints are also discussed.

INTRODUCTION

Teachers have the opportunity to teach forestry and associated careers both in the classroom and by taking field trips to forests. However, studies have shown that there are many constraints that often prevent them from doing so (e.g. Lane and Wilke 1994; Kaspar 1998; Mitchie 1998; Friend 2008; Ernst 2009; Dawson and Moore 2011). This study builds on this pool by analyzing comments from 136 high school science teachers in one region of the United States about their perceptions regarding what constrains them from providing forestry education and taking field trips to forests. Forestry education is defined in this paper as education about "the profession embracing the science, art, and practice of creating, managing, using, and conserving forests and associated resources for human benefit and in a sustainable manner to meet desired goals, needs, and values" (SAF 2008).

Teacher Constraints

Several studies have found that teachers believe forestry education would benefit students and should be taught (Measells et al. 2003; Friend 2008). Teachers also see the importance in teaching the broader concepts of natural resources and environmental education (Lane and Wilke 1994; Perry 1998; Sebasto 1998; Ko and Lee 2003 Kim and Fortner 2006; Knoblock 2008). Nevertheless, several studies have found that while they would like to do more, teachers are incorporating little environmental education into their classes (Lane and Wilke 1994; Sebasto 1998; Ko and Lee 2003). Factors that influence whether teachers incorporate these or other concepts or the extent to which they do include their background and previous knowledge of the concept and attitudes toward them (Park and Osborne 2007; Ernst 2009; Dawson and Moore 2011).

Lack of time to plan or present forestry concepts is often noted as a limiting factor (Sebasto 1998; Ko and Lee 2003; Kim and Fortner 2006; Friend 2008; Ernst 2009). Lack of background knowledge about the subject also constrains teacher delivery (Lane and Wilke 1994; Sebasto 1998; Friend 2008; Dawson and Moore 2011). Curriculum standards are another frequently reported limitation (Perry 1998; Kim and Fortner 2006; Ernst 2009). Lack of funding or other resources have also been found to be limiting (Friend 2008; Ernst 2009; Dawson and Moore 2011). Finally, lack of students' background knowledge in these subjects has also been found to be a constraint (Friend 2008; Dawson and Moore 2011).

Teachers believe field trips are valuable (Simmons 1998; Anderson et al. 2006). However, there are many constraints that limit them from taking field trips, especially outdoor field trips. Costs associated with the trip are often prohibitive (Orion 1993; Mitchie 1998; Kaspar 1998; Ritchie and Coughlan 2004; Anderson et al. 2006; Dawson and Moore 2011).

Other transportation issues have also been reported and conflicts with class schedules are another commonly reported constraint (Orion 1993; Mitchie 1998; Kaspar 1998; Miechtry and Harrell 2002; Dawson and Moore 2011). Curriculum standards and the lack of open class time are others as is safety (Orion 1993; Kaspar 1998; Mitchie 1998; Simmons 1998; Miechtry and Harrell 2002; Anderson et al. 2006). A lack of resources and unfamiliarity with the outdoors can also limit participation (Orion 1993; Mitchie 1998; Kaspar 1998; Simmons 1998).

We asked science teachers in the Southern Piedmont to comment on the constraints that limit them in order to assess forestry education and forest field trip challenges from a regional context. Specific objectives for the study were to determine the constraints most frequently experienced by respondents and identify their needs in terms of providing forestry education and taking field trips to forests.

METHODS

Data for this study was collected from open-ended comments obtained from a web-based survey of high school science teachers in the Southern Piedmont region of the United States. Web-based surveys have significant advantages over other survey methods in terms of response rate, cost, and researcher time and resources (Cobanoglu et al. 2001). Electronic surveys can also be completed quicker than conventional mail surveys, data are received much sooner, and information about survey completion can be easily obtained (Griffis et al. 2003).

Respondents in this study include biological, environmental, earth, agricultural, and other related science teachers at public high schools in the Southern Piedmont Region of the United States (Figure 3). The region covers five states and extends from northeast Virginia to east-central Alabama, and across parts of North Carolina, South Carolina, and Georgia. It is one of the Major Land Resource Areas defined by the United States Department of Agriculture Natural Resources Conservation Service (USDA NRCS).

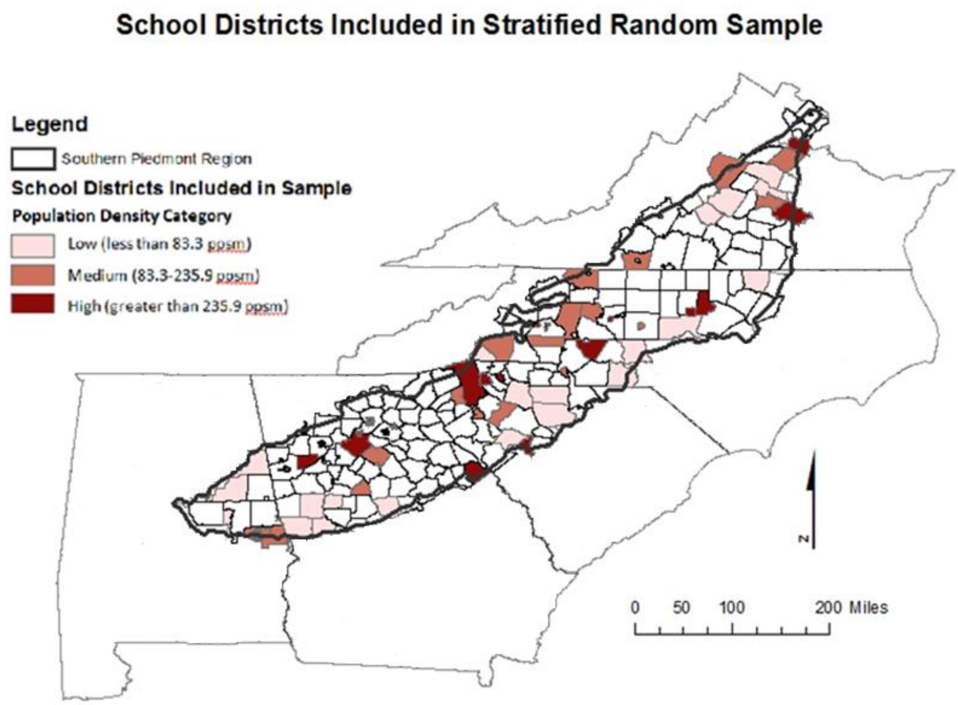

Figure 3. School districts in the Southern Piedmont included in stratified random sample.

The Southern Piedmont region was selected because it is defined based on physiographic rather than socioeconomic characteristics. Also, it includes a variety of population densities ranging from very rural to large cities including but not limited to Atlanta, Georgia and Richmond, Virginia. Private forests make up the largest portion (58%) of land use in this region and it also includes many federally and state managed forests (USDA NRCS). Finally, forest management is a prominent economic activity in the region (Conroy et al. 2003).

We focused on teachers in public schools because they are organized systematically into districts. The sample consists of biological, environmental, earth, natural resources, and other related science teachers because they were considered most likely to introduce relevant concepts and grasp the challenges of doing so.

Cluster sampling was used to draw the sample. This sampling technique can be employed when it is not possible or practical to sample individuals as a whole such as when there is no list of all of the individuals in the population or gathering such a list is impractical (McMillan 2008). Cluster sampling typically involves the selection of naturally occurring clusters followed by a second round of unit analysis selection within these clusters. For this study, we randomly selected school district clusters and included every applicable science teacher within them.

Double stratified random sampling was used to select school district clusters. School districts were first stratified based on the state in which they are located and then according to population density category (less than 83.2 people per square mile (ppsm), 83.2-235.8 ppsm and greater than 235.8 ppsm). This strategy was employed to ensure proportional sampling by state and that each population density category was represented. Proportions were used when stratifying by state to mirror area represented. Population density was equally stratified.

Teacher names and e-mail addresses were compiled using website information provided by each sample school or by contacting administrative assistants when necessary to obtain missing information. The web-based survey contained multiple web pages of closed-ended questions and question grids, and concluded with a space for open-ended comments. The open ended comment box used the text prompt “Please use the following space to describe any constraints that limit you from teaching forestry concepts or taking forestry related field trips, or to elaborate on any of the answers you provided, or to describe any additional comments.” Descriptive data about the respondents were also gathered via the survey instrument.

The survey was developed using Apian SurveyPro 5 software and published using Apian NetCollect software. It was implemented using a modified Tailored Design Method (Dillman 2000). An invitation to participate in the study including a link to the survey was distributed via email to each sampled teacher. Three reminder e-mails including one describing a gift card incentive to participate were sent over a one month period.

We used thematic analysis, a process used to translate qualitative information into quantitative data for statistical procedures (Boyatzis 1998). Open ended coding techniques described in Babbie (2010) were used, which involved repetitive coding to identify emerging themes within the data. In some cases themes were explicitly stated and in other cases, they were interpreted from information in sentences or paragraphs. In addition, some comments contained multiple themes and were coded as such. Thematic frequency was then calculated.

RESULTS

Response

An e-mail invitation containing a link to the survey was sent to 1095 teachers. Seventy one were not delivered due to invalid e-mail addresses, resulting in an effective sample of 1024. Three hundred twenty four teachers responded for an adjusted response rate of 32%. A total of 136 teachers provided comments.

Respondent Characteristics

Respondent characteristics are presented in Table 8. The percentage of teachers at schools in each state in the sample closely matched the percentage of the Southern Piedmont region made up of by each state. Respondents were more often females and predominantly white. Ages ranged from 23 to 68, averaged 42 years, with most falling between 31-40. Most respondents consider themselves to be politically moderate, but a higher percentage of respondents reported being conservative rather than liberal.

Teaching experience varied from less than 1 year to 44 years, averaged 12 years, with over half falling into the 1-10 years category. Biology classes including all levels such as general, honors, AP/IB, and gifted were most frequently taught by respondents within the last five years. Other classes taught by respondents include environmental science, earth science, physical science, general science, agriculture, horticulture, ecology, and botany.

Table 8. Characteristics of high school science teacher respondents from the Southern Piedmont. Total sample size 136.

Respondent Characteristic	Percent
Demographics/Personal Background	
State	
Virginia	25%
North Carolina	25%
South Carolina	21%
Georgia	24%
Alabama	5%
Population Density Category	
Low	12%
Medium	24%
High	65%
Sex	
Male	34%
Female	66%
Race	
White	90%
Black	6%
Other	4%
Age	
21-30 years	17%
31-40 years	31%
41-50 years	21%
51-60 years	24%
61-70 years	7%
Political Orientation	
Very liberal	10%
Very liberal	10%
Liberal	14%
Moderate	44%
Conservative	17%
Very conservative	17%

Respondent Characteristic	Percent
Teaching Characteristics	
Years Teaching	
1-10 years	47%
11-20 years	33%
21-30 years	12%
31-40 years	7%
41-50 years	2%
Classes Taught within Last Five Years	
Any Biology	68%
Any Environmental Science	32%
Any Earth Science	36%
Any Physical Science	36%
Agriculture	5%
Horticulture	4%
Ecology	10%
Botany	2%
General Science	5%

Forestry Education and Forest Field Trip Constraints

A range of constraints were identified across respondent comments, and fell into five key thematic categories (Table 9). Thematic constraints include: mandated standards or curriculum; money; time; mandated testing; and training, interest, and infrastructure. Themes are defined below and examples of data supporting each are offered. Ways to address these constraints, both previously mentioned in the literature and new ideas, will be discussed.

Table 9. Thematic categories identified in open ended comments from 136 Southern Piedmont teachers.

Theme	**Number of Respondents**	**Percent of Respondents**
Mandated standards or curriculum	82	60
Money	54	40
Time	43	32
Mandated testing	26	19
Training, interest, and infrastructure	26	19

Mandated Standards and Curriculum

Many respondents specifically mentioned state or locally mandated standards and curriculum as constraining factors. One reported simply:

> *State standards dictate what we teach- and most standards do not incorporate forestry concepts.*

With regard to a specific curriculum, another explained:

> *I would very much like to spend more time teaching about forestry, conservation, etc., but the Earth Science curriculum pacing (along with locally issued benchmark exams) prevent me from teaching things that are not specifically part of the curriculum.*

Similarly, another explained:

> *Forestry concepts are not included in the VA Biology SOL requirements and the curriculum is already packed so it is difficult to make space for it at the biology level.*

Money

Many respondents indicated that money is a constraint when it comes to teaching about forestry or taking field trips to forests. One simply exclaimed:

> *Budget, budget, budget!!!!!*

Others described the financial constraints at their school in further detail. For example, one respondent stated:

> *Our school system has a lack of money- there have been job cuts for 3 years now, so field trip money was cut out. Any field trip money now comes from grants.*

Another described:

> *In this economy the name of the game is money. School systems are hanging on by a thread. Furloughs have cut teacher pay and increased class size. We are asked to make do with available resources or less.*

Time

A number of respondents cited time as a major challenge to teaching forestry concepts or taking field trips to forests. In some cases, respondents explained the reasons behind feeling as though they have limited time for these activities. For example, one respondent described:

> *The biggest reason I don't teach more on forestry is the lack of time. Our class blueprint covers so many different areas that it is hard to focus on [one] area.*

Others, however, were less descriptive. For example:

> *Biggest thing is time….wish I had more!*

In either case, and whether they were referring to time for implementing forestry education or taking field trips to forests or time for planning to do so, it is obvious that teachers feel constrained by time.

Mandated Testing

Some teachers specifically mentioned mandated tests as a constraint. These were identified by various names throughout comments. Regardless, it is evident that teachers place priority on teaching concepts that will be covered on these exams. One respondent described:

> *I am the only Biology teacher at my high school and Biology is a state-tested subject. Unfortunately, test scores are of extreme importance at my school due to pressures from the state.*

Another simply described:

> *Standardized testing allows for very little time to do anything "extra."*

Training, Interest, and Infrastructure

A range of other constraints were reported by respondents in their comments. Those reported more than once include a lack of background or training in forestry, perceiving students to be uninterested in forestry, student behavior, lack of resources or materials, the lack of a nearby forest, and large class sizes. One respondent described:

> *I know almost nothing about forestry, because it wasn't one of my primary interests and was not any part of my training.*

Another asserted:

> *Students don't care about forestry. My perception is that it's a low-paying profession, which the students don't like.*

In terms of infrastructure, one noted:

> *Lack of forested area within walking distance of the school keeps me from taking my students on daily field trips.*

Additionally, one respondent described:

> *Textbooks also do not include adequate chapters on forestry.*

It is evident that a range of training, interest, and infrastructure issues constrain teachers from teaching about forestry or taking field trips to forests.

DISCUSSION

Teachers feel constrained by several important factors when it comes to providing forestry education or taking field trips to forests. Results in this study correspond to many of the findings in previous studies. For example, mandated standards and curriculum as a constraint have often been reported (Orion 1993; Kaspar 1998; Perry 1998; Miechtry and Harrell 2002; Anderson et al. 2006; Kim and Fortner 2006; Ernst 2009). When mandated standards and curriculum that do not contain forestry concepts are required, they are not seen as important concepts to cover. Financial constraints were also frequently noted (Orion 1993; Mitchie 1998; Kaspar 1998; Ritchie and Coughlan 2004; Anderson et al. 2006; Friend 2008; Ernst 2009; Dawson and Moore 2011). Strict and limited school budgets do not allow for teachers to spend money to buy forestry education materials or take field trips to forests if transportation is required.

Lack of time was another frequently reported constraint (Sebasto 1998; Ko and Lee 2003; Kim and Fortner 2006; Friend 2008; Ernst 2009). When faced with many topics that must be presented in one school period, day, or year, teachers do not have time to implement forestry education or take field trips to forests. While other studies do not explicitly mention end of course tests as a constraint, it can be assumed that these were included in descriptions of constraining curriculum standards. Because of the pressure placed on teachers to cover topics on these mandated tests, other concepts such as forestry are not seen as important parts of their classes. It is interesting to note that concern regarding safety was found as a constraint in several previous studies, but not in our study (Orion 1993; Mitchie 1998; Simmons 1998). In addition, conflicts with other classes due to the teacher or students being absent was commonly reported in other studies but not at all in our study (Orion 1993; Kaspar 1998; Miechtry and Harrell 2002; Dawson and Moore 2011).

Some previous studies have mentioned recommendations for helping teachers to overcome the constraints limiting them from teaching forestry concepts and taking forestry related field trips. Professional development and training opportunities for teachers were often suggested (Lane and Wilke 1994; Mitchie 1998; Sebasto 1998; Simmons 1998; Miechtry and Harrell 2002; Dawson and Moore 2011). Lane and Wilke (1994) suggested that teacher education courses need to specifically address relating environmental topics into respective teaching areas and Dawson and Moore (2011) mentioned the importance of providing innovative ideas for doing so. Miechtry and Harrell (2002) explained that environmental education programs must be aligned with state standards and ideas for doing so should be discussed. This suggestion is further supported by our findings, especially due to the number of respondents reporting standards as constraining, and we assert that similar programs should be developed to train teachers on forestry education. Project Learning Tree (PLT) is an example of a successful training program that provides teachers with information about forestry education and suggests ways that activities can be used to meet mandated standards, thereby mitigating the challenges faced by them. The community of forestry professionals and all of those with an interest in forestry education should continue to promote PLT and similar programs.

Simmons (1998) explained training program planners need to try to better understand teachers concerns and fears and focus on addressing these as part of training programs. Our results indicate that this understanding is necessary and support the notion that similar assessments of teacher concerns be conducted in other areas and programs developed to address them. Mitchie (1998) and Dawson and Moore (2011) noted the importance in bringing teachers face-to-face with local experts providing advice during training programs. Forestry professionals could become active in developing and participating in teacher training programs and provide valuable support by visiting schools more regularly and speaking directly to students about forestry. Professional forestry organizations could develop outreach programs in which their members "adopt" a local school and provide support.

Miechtry and Harrell (2002) and Dawson and Moore (2011) also suggested that field site visits in addition to development of outdoor education sites should be included. We agree that this is a crucial step due to illustrated benefits of field trips and suggest that school systems actively assess the availability of nearby forests that can be used for field trips and encourage their use. Programs could be developed to illustrate techniques for teaching in forests, specifically and forestry professionals and other proponents of forestry education, again, could provide support for these activities. Finally, Lane and Wilke (1994) and Mitchie (1998) suggested that teachers be encouraged to participate in these training opportunities, particularly by school administration officials. In light of our results, we assert that proponents of forestry education contact these individuals and urge support of teacher attendance at these programs as well as forestry education in general, especially because of evidence of administrative discouragement.

Development of resources and materials for teachers was also recommended by several researchers (Dawson and Moore 2011; Simmons 1998; Miechtry and Harrell 2002). Dawson and Moore (2011) noted that field guides, specifically, are valuable resources that would encourage field trips when provided to teachers. We agree that resources should be provided to teachers and suggest both development of new and distribution of already available materials such as tree identification books and descriptions of forestry related activities. Because money was frequently mentioned as a constraint, these materials should be provided at little or no cost. Sponsorship and funding could be provided by professional forestry organizations, state and local agencies, university forestry programs, or forest products corporations.

Since money for field trip transportation is often limited or non-existent, the groups mentioned above could also provide funding for transportation to forests if one does not exist near the school. While time may remain an issue, financial support could help overcome this issue by increasing appeal among administrators. We also stress the importance of preserving and or planting of forests within walking distance of schools or on school grounds that can be used for field trips. School systems who own these forests should recognize their importance and work to maintain them. Those with open space could work to establish a convenient outdoor classroom. Private individuals or organizations that own forest land in close proximity to schools should also be encouraged to offer their land as a school field trip site.

CONCLUSION

In the current study, we sought to determine the challenges faced by science teachers when it comes to teaching about forestry or taking field trips to forests. We have presented the constraints most frequently mentioned in the qualitative section of an online survey by biological, environmental, earth, agricultural, and other related science teachers at high schools in the Southern Piedmont. We then compared these findings and our ideas for overcoming the challenges with those presented in previous studies. A major implication of this study is that it highlights the constraints that prevent or limit teachers from adding forestry concepts into their class curricula. The results should encourage proponents of forestry education to find ways to mitigate these constraints as described above.

Chapter 6 – Conclusion and Recommendations

Results of this survey indicate that teachers believe forestry should be taught in high schools. Respondents present forestry concepts regarding ecosystem services most frequently, followed by concepts related to tree characteristics. They teach concepts related to products, uses, and management least frequently. Variables that predict teaching frequencies for each of these groups of concepts include but are not limited to teaching characteristics in addition to attitudes toward and knowledge of forestry. It was also found that half of the teachers surveyed never take field trips to forests. Variables that predict the odds of taking forest field trips include confidence to teach forestry concepts, involvement in extra-curricular activities and the presence of a forest within walking distance of the school. The most widely experienced constraints to teaching forestry concepts and taking field trips to forests are a lack of time due to crowded curriculums and state testing , lack of money to take field trips, lack of background or training in forestry, school administration discouraging field trips, and lack of materials or resources.

Major implications of this study include identification of areas of forestry education that require attention in order to improve forestry education in high schools as well as creating a baseline of the status of forestry education in high schools, particularly from a regional perspective. Results should encourage proponents of forestry education to support measures that will help to mitigate the challenges faced by teachers with regard to teaching forestry concepts and taking forestry field trips. Examples of support that could be provided include the development and sponsorship of teacher training programs and forestry education materials as well as financial assistance. Partnerships between groups of forestry professionals and schools should be developed and maintained as a pathway for the spread of information about forestry and assistance with providing forestry education and taking field trips to forests. Additionally, outreach programs should be developed to address teacher concerns regarding forest management since attitudes were found to influence the concepts teachers present. Finally, forests on or near school grounds should be created or preserved for educational use.

One limitation of this study is that it only included teachers from one geographic region. Results may differ in other parts of the United States. Another limitation could be the relatively low response rate, though a non-response bias check found early and late/non-responders to be statistically similar. Finally, the study was exploratory and focused on general aspects of teacher attitudes and teaching practices related to forestry instead of focusing on any one or several specifically. Since forestry is prominent in other areas of the country, similar research elsewhere could further determine the extent to which teachers present forestry concepts in their classes and utilize field trips to forests for educational purposes and the challenges they face in doing so.

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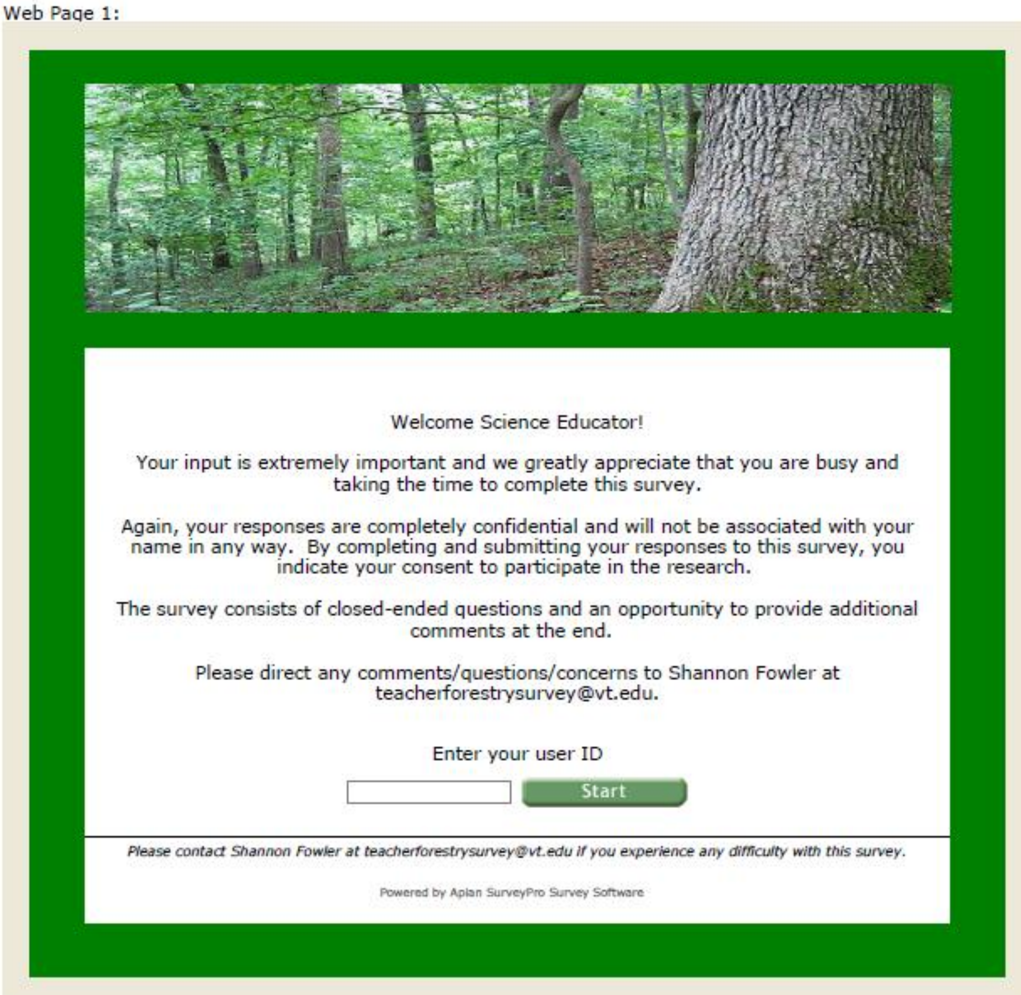
Appendix A – Survey Instrument

Web Page 1:



Welcome Science Educator!

Your input is extremely important and we greatly appreciate that you are busy and taking the time to complete this survey.

Again, your responses are completely confidential and will not be associated with your name in any way. By completing and submitting your responses to this survey, you indicate your consent to participate in the research.

The survey consists of closed-ended questions and an opportunity to provide additional comments at the end.

Please direct any comments/questions/concerns to Shannon Fowler at teacherforestrysurvey@vt.edu.

Enter your user ID

Start

Please contact Shannon Fowler at teacherforestrysurvey@vt.edu if you experience any difficulty with this survey.

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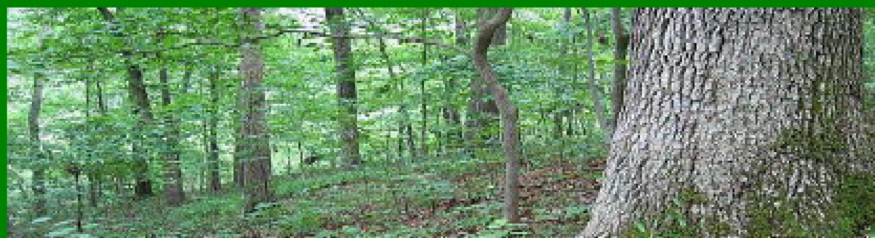
Web Page 2:



Completed

For how many years have you been teaching?

Which of the following biological, environmental, natural resources, agricultural, or other related science classes have you taught within the last five years? (Select all that apply)

General Biology	AP/IB Biology	Agriculture Science
General Environmental Science	AP/IB Environmental Science	Natural Resources Science
General Earth Science	AP/IB Earth Science	Botany
General Physical Science	AP/IB Physical Science	Horticulture
Honors Biology	Gifted Biology	General Science
Honors Environmental Science	Gifted Environmental Science	Other 1 (Please list below)
Honors Earth Science	Gifted Earth Science	Other 2 (Please list below)
Honors Physical Science	Gifted Physical Science	Other 3 (Please list below)

Other 1:

Other 2:

Other 3:

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Please contact Shannon Fowler at teacherforestrysurvey@vt.edu if you experience any difficulty with this survey.

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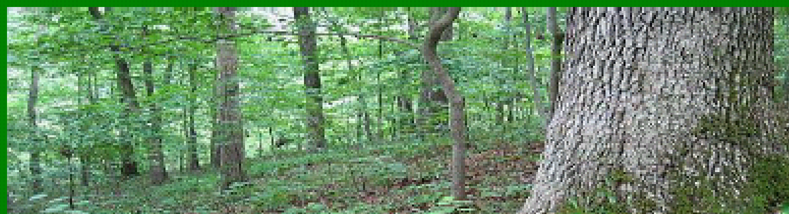
Web Page 3:



Completed

Please select the response that best represents the level of importance you place on each of the following forest management **goals**.

	Less Important	-----	-----	---->	More Important
Carbon storage					
Timber					
Water quality					
Air quality					
Bioenergy					
Endangered species					
Outdoor recreation					
Wildlife habitat					
Fire prevention					
Biodiversity					
Non-timber forest products					
Scenic beauty					
Climate change prevention					

We're also interested in your **perceptions** of what forestry professionals think of these management goals. For each of the following, please select the response that best represents the level of importance you believe **forestry professionals** place on the following goals.

	Less Important	-----	-----	---->	More Important
Carbon storage					
Timber					
Water quality					
Air quality					
Bioenergy					
Endangered species					
Outdoor recreation					
Wildlife habitat					
Fire prevention					
Biodiversity					
Non-timber forest products					
Scenic beauty					
Climate change prevention					

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Please contact Shannon Fowler at teacherforestrysurvey@vt.edu if you experience any difficulty with this survey.

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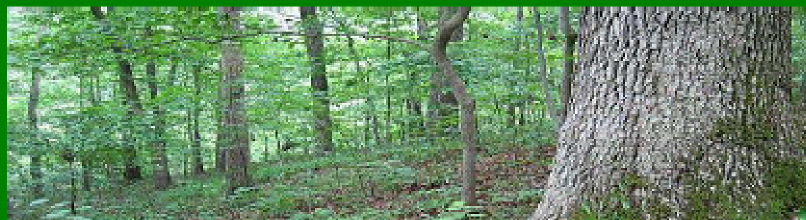
Web Page 4:



Completed

Listed below are concepts that may be presented in science classes. For each of the following concepts, please select the response that best represents the frequency that you present the concept in your classes.

	Never	Sometimes	Often
Carbon storage			
Timber production			
Air quality			
Bioenergy			
Endangered species			
Outdoor recreation			
Wildlife habitat			
Biodiversity			
Forest structure			
Forest regions of the U.S.			
Tree pests/diseases			
Tree identification			
Tree growth			
Tree measurement			
Tree physiology			
Wood products			
Forestry career opportunities			
Fire as a management practice			
Non-timber forest products			
Timber harvesting			
Soil science			
Nutrient cycling			
Climate change			
Sustainability			
Other 1 (Please list below)			
Other 2 (Please list below)			
Other 3 (Please list below)			

Other 1:

Other 2:

Other 3:

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Please contact Shannon Fowler at teacherforestrysurvey@vt.edu if you experience any difficulty with this survey.

Web Page 5:

Completed

Please select the response that best represents the extent to which you believe the following statements about the forestry profession. (Select one response for each statement concluding the following sentence)

The forestry profession:

	Do not believe	------	------	----->	Strongly believe
is a rewarding career.					
is ethical.					
does not manage land sustainably.					
serves society by taking care of the world's forests.					
provides for future generations.					
does not have high environmental standards.					
is based on sound science.					
does not have sound policies.					
is completely open and honest.					
does not respect a diversity of viewpoints.					
is not trustworthy.					

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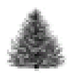
Web Page 6:

Completed

Please select the response that best represents how beneficial you believe the **impacts** of forest management are for each of the following characteristics.

Web Page 6 -- continued:

	Not at all beneficial	Somewhat beneficial	Very beneficial
Water quality			
Scenic beauty			
Wildlife habitat			
Property value			
Air quality			
Outdoor recreation			
Biodiversity			
Soil quality			
Fire prevention			
Forest health			
Carbon storage			
Human well-being			
Climate change prevention			



For each of the following management practices, please indicate whether you believe the **practice** should or should not be used when managing forests.

	Should not	Should	I am not familiar with this practice.
Prescribed fire			
Pesticides			
Clearcuts			
Partial harvests (thinning)			
Pine plantations			
Fertilizers			
Natural reforestation			
Artificial reforestation (planting)			
Slash burning			
Road construction			
Habitat improvement cuts			
Genetic improvement of trees			
Planting on streamside zones			
Planting on abandoned agriculture land			
Reforestation with tree clones			
Growing non-timber forest products			

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Web Page 7:

Completed

Please rank the following based on your attitude toward the term with 1 being the term you have the most positive attitude toward and 6 being the term you have the least positive attitude toward. (Use the drop-down lists to select a number for each term)

Ecosystem management	
Environmental conservation	
Forest ecology	
Forest Industry	
Forestry	
Natural resources management	

Please rank the following professions based on your willingness to recommend the profession to your students with 1 being the profession you would be most willing to recommend and 5 being the profession you would be least willing to recommend. (Use the drop down lists to select a number for each profession)

Arborist	
Biologist	
Ecologist	
Environmental stewardship manager	
Forester	

On a scale of 1 to 5, to what extent do you feel informed about forestry?

1 (Not at all informed)
2
3
4
5 (Highly informed)

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Web Page 8:

Completed

Please select the response that represents the extent to which you agree or disagree with each of the following statements.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
My values influence my students' values.					
My vlaues influence my students' career choices.					
My teachings influence my students' values.					
My teachings influence my students' career choices.					
Forestry is a large part of the economy in my area.					
Forestry concepts should be taught in schools.					
I would like to receive more training in forestry.					
Time constraints limit me from teaching forestry concepts.					
Money constraints limit me from teaching forestry concepts.					
Curriculum standards limit me from teaching forestry concepts.					
I feel confident to teach forestry concepts.					

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Web Page 9:

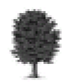
Completed

To what extent do you agree or disagree with the following statements regarding forests?

Web Page 9 -- continued:

To what extent do you agree or disagree with the following statements regarding forests?

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
The primary use of forests should be for products that are useful to humans.	○	○	○	○	○
Humans should have more love, respect, and admiration for forests.	○	○	○	○	○
Forest resources can be improved through human management	○	○	○	○	○
Forests have a right to exist for their own sake, regardless of human concerns and uses.	○	○	○	○	○
Forests should be used primarily for timber and wood products.	○	○	○	○	○
Plants and animals exist primarily for human use.	○	○	○	○	○
We should actively harvest more trees to meet the needs of a much larger population.	○	○	○	○	○
Wildlife, plants, and humans have equal rights to live and develop.	○	○	○	○	○



Which term best describes the area in which you spent the majority of your childhood?

- ○ Rural farm
- ○ Rural non-farm
- ○ Suburban
- ○ Urban

On a scale of 1 to 5, to what extent were you exposed to forestry as a child?

- ○ 1 (Not at all exposed)
- ○ 2
- ○ 3
- ○ 4
- ○ 5 (Highly exposed)

Have you or has any member of your family worked in forestry?

- ○ Yes
- ○ No

Have you ever owned more than 10 acres of forested land?

- ○ Yes
- ○ No

On average, how often do you participate in outdoor recreation activities?

- ○ Rarely
- ○ Once per month
- ○ Once per week
- ○ Multiple times per week
- ○ Every day

Have you received any environmental education program training such as Project Learning Tree, Project Wild, etc.?

- ○ Yes
- ○ No

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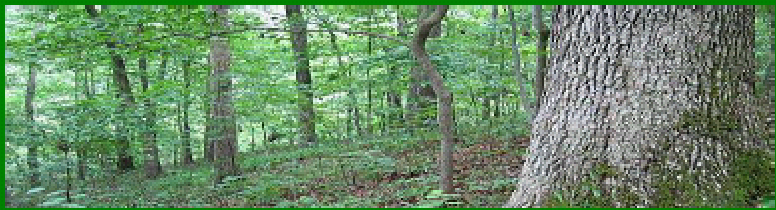
Web Page 10:

Web Page 10 -- continued:



Completed

Which of the following college degrees have you earned? For each that you select, please state the college/university from which you received the degree and your major.

	Degree earned	College/University (please list full name)	Major
Bachelor's			
Master's			
Doctorate			

Is there a forest that you can visit for educational purposes within walking distance of your school?

- Yes
- No

How often do you take field trips to any forest for educational purposes?

- Never
- Once per year
- 2-3 times per year
- 4 or more times per year

On a scale of 1 to 5, to what extent are you involved in natural resources related extra-curricular activities such as FFA, 4H, Envirothon, etc. at your school?

- 1 (Not at all involved)
- 2
- 3
- 4
- 5 (Highly involved)

How often do you gather information about forestry from each of the following sources?

	Never	Sometimes	Often
Workshops/trainings			
Environmental/conservation groups			
Television			
Periodicals			
Internet			
Family members			
Government agencies			
Other (Please list below)			

Other:

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Please contact Shannon Fowler at teacherforestrysurvey@vt.edu if you experience any difficulty with this survey.

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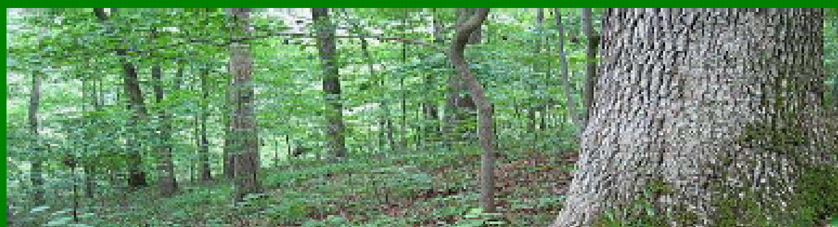
Web Page 11:



What year were you born?

[ ]

What is your sex?

- Male
- Female

Are you Spanish/Hispanic/Latino?

- Yes
- No

What is your race?

- American Indian
- Asian
- Black or African-American
- Native Hawaiian or other Pacific Islander
- White
- Other

On a scale of 1 to 5, how would you describe your political orientation?

- 1 (Liberal)
- 2
- 3 (Moderate)
- 4
- 5 (Conservative)

Please use the following space to describe any constraints that limit you from teaching forestry concepts or taking forestry related field trips, to elaborate on any of the answers you provided, or to describe any additional comments.

<< Last | Pause | Send Answers

Please contact Shannon Fowler at teacherforestrysurvey@vt.edu if you experience any difficulty with this survey.

Powered by Apian SurveyPro Survey Software

Web Page 12:

Thank you for taking the time to complete this survey!

Please contact Shannon Fowler at teacherforestrysurvey@vt.edu with any feedback you wish to provide.

Please contact Shannon Fowler at teacherforestrysurvey@vt.edu if you experience any difficulty with this survey.

Powered by Apian SurveyPro Survey Software

Appendix B – Survey Invitation and Reminder E-mails

Dear Science Educator,

Hello, I am a graduate student at Virginia Tech and contacting you to ask for your help in a study of high school science teachers. My project aims to learn about how forestry and natural resource management relates to the science courses you teach. Please know that you do not need any expertise in these areas to participate. You are receiving this invitation because you are a science teacher at a school within the study area, which extends from Northeast Virginia southward to Eastern Alabama. To participate, all you need to do is complete a short online questionnaire, which is described below. Participation is entirely voluntary and responses completely confidential. Results will be used to illustrate the compatibility of topics related to forests and their management with the interests, needs, and practices of science teachers. A summary of the results will be sent to all participating teachers.

The survey should take **no longer** than 15 minutes and can be accessed by clicking on the web-address below or copying and pasting the address into your web browser. You will be required to enter a password which can be found below the web address. The number is for tracking and processing purposes only. Your name will never be associated with the study or any of the responses and the survey can be completed at a time most convenient for you.

Please access the survey at:

https://www.web2.cnre.vt.edu/nccontent/teacherforestry/

Password:

****

Thank you so much for your time and assistance. I look forward to hearing from you!

Sincerely,

Shannon Fowler
M.S. Candidate
Department of Forest Resources and Environmental Conservation
Virginia Polytechnic Institute and State University
teacherforestrysurvey@vt.edu

Dear Science Educator,

Last week I contacted you requesting your help in a study of high school science teachers regarding forestry and natural resource management and how these topics relate to the courses you teach. I realize that you are busy but I'd like to remind you that your response is extremely important and the survey takes **no longer** than 15 minutes to complete. Please remember that you do not need any expertise in these areas to participate. Again, the survey can be accessed using the web address and password below and can be completed even if you have opened it previously. Thank you and I look forward to your responses!

Please access the survey at:

https://www.web2.cnre.vt.edu/nccontent/teacherforestry/

Password:
****

Thank you so much for your time!

Sincerely,

Shannon Fowler
M.S. Candidate
Department of Forest Resources and Environmental Conservation
Virginia Polytechnic Institute and State University

Dear Educator,

Hello, we are contacting you again to ask for your help in a study of high school science and agriculture teachers. You may recall that the project aims to learn about how forestry and natural resource management relates to the courses you teach and that you are receiving this invitation because you are a science or agriculture teacher at a school within the study area, which extends from Northeast Virginia southward to Eastern Alabama. The survey is still open and we know it is a busy time for you but we would be extremely grateful for your participation. Please know that participation is entirely voluntary and confidential, and you do not need any expertise in forestry and natural resource management. A summary of the results will be sent to all participating teachers.

The survey should take **no longer** than 15 minutes and can be accessed by clicking on the web-address below or copying and pasting the address into your web browser. You will be required to enter a password which can be found below the web address. The number is for tracking and processing purposes only. Your name will never be associated with the study or any of the responses and the survey can be completed at a time most convenient for you.

Please access the survey at:

https://www.web2.cnre.vt.edu/nccontent/teacherforestry/

Password:

****

Thank you so much for your time and assistance. I look forward to hearing from you!

Sincerely,

Shannon Fowler
M.S. Candidate
Department of Forest Resources and Environmental Conservation
Virginia Polytechnic Institute and State University
teacherforestrysurvey@vt.edu

Dear Educator,

Over the last several weeks, we have contacted you requesting your help in a study of high school science and agriculture teachers that aims to learn about how forestry and natural resources management relates to the courses you teach. We wish to let respondents know that upon completion of the survey they will be enrolled in a lottery to receive one of four $50 Amazon.com gift cards in appreciation for participation. Those who have already completed the survey have already been enrolled. If you have not yet completed the survey, please do so by this Friday, May 27, 2011 in order to be entered into the drawing. Remember, if you have previously opened and only partially completed the survey you can return to and complete it at any time. Also please remember that you do not need any expertise in these areas to participate. The survey can be accessed using the web address and password below. The drawing will take place shortly after the survey has closed and winners will be contacted by e-mail. Odds of winning are based on the number of survey respondents from the 1000 contacted. We truly appreciate your time and assistance with this study and we wish you the best with the end of your school year!

Please access the survey at:

https://www.web2.cnre.vt.edu/nccontent/teacherforestry/

Password:

****

Thank you again!

Sincerely,

Shannon Fowler
M.S. Candidate
Department of Forest Resources and Environmental Conservation
Virginia Polytechnic Institute and State University

Appendix C – IRB Approval Letters

VirginiaTech

Office of Research Compliance
Institutional Review Board
2000 Kraft Drive, Suite 2000 (0497)
Blacksburg, Virginia 24060
540/231-4606 Fax 540/231-0959
e-mail irb@vt.edu
Website: www.irb.vt.edu

MEMORANDUM

DATE: March 22, 2011

TO: John Seiler, Shannon Fowler, John Munsell

FROM: Virginia Tech Institutional Review Board (FWA00000572, expires October 26, 2013)

PROTOCOL TITLE: Teachers Survey of Forestry

IRB NUMBER: 11-249

Effective March 22, 2011, the Virginia Tech IRB Administrator, Carmen T. Green, approved the new protocol for the above-mentioned research protocol.

This approval provides permission to begin the human subject activities outlined in the IRB-approved protocol and supporting documents.

Plans to deviate from the approved protocol and/or supporting documents must be submitted to the IRB as an amendment request and approved by the IRB prior to the implementation of any changes, regardless of how minor, except where necessary to eliminate apparent immediate hazards to the subjects. Report promptly to the IRB any injuries or other unanticipated or adverse events involving risks or harms to human research subjects or others.

All investigators (listed above) are required to comply with the researcher requirements outlined at http://www.irb.vt.edu/pages/responsibilities.htm (please review before the commencement of your research).

PROTOCOL INFORMATION:
Approved as: **Exempt, under 45 CFR 46.101(b) category(ies) 2**
Protocol Approval Date: **3/22/2011**
Protocol Expiration Date: **NA**
Continuing Review Due Date*: **NA**
*Date a Continuing Review application is due to the IRB office if human subject activities covered under this protocol, including data analysis, are to continue beyond the Protocol Expiration Date.

FEDERALLY FUNDED RESEARCH REQUIREMENTS:
Per federally regulations, 45 CFR 46.103(f), the IRB is required to compare all federally funded grant proposals / work statements to the IRB protocol(s) which cover the human research activities included in the proposal / work statement before funds are released. Note that this requirement does not apply to Exempt and Interim IRB protocols, or grants for which VT is not the primary awardee.

The table on the following page indicates whether grant proposals are related to this IRB protocol, and which of the listed proposals, if any, have been compared to this IRB protocol, if required.

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VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY

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Date*	OSP Number	Sponsor	Grant Comparison Conducted?
3/20/2011	09152101	University of Georgia	Not Required (exempt protocol)

*Date this proposal number was compared, assessed as not requiring comparison, or comparison information was revised.

If this IRB protocol is to cover any other grant proposals, please contact the IRB office (irbadmin@vt.edu) immediately.

cc: File

VirginiaTech

Office of Research Compliance
Institutional Review Board
2000 Kraft Drive, Suite 2000 (0497)
Blacksburg, Virginia 24060
540/231-4606 Fax 540/231-0959
e-mail irb@vt.edu
Website: www.irb.vt.edu

MEMORANDUM

DATE: April 28, 2011

TO: John Seiler, Shannon Fowler, John Munsell

FROM: Virginia Tech Institutional Review Board (FWA00000572, expires October 26, 2013)

PROTOCOL TITLE: Teachers Survey of Forestry

IRB NUMBER: 11-249

Effective April 27, 2011, the Virginia Tech IRB PAM, Andrea Nash, approved the amendment request for the above-mentioned research protocol.

This approval provides permission to begin the human subject activities outlined in the IRB-approved protocol and supporting documents.

Plans to deviate from the approved protocol and/or supporting documents must be submitted to the IRB as an amendment request and approved by the IRB prior to the implementation of any changes, regardless of how minor, except where necessary to eliminate apparent immediate hazards to the subjects. Report promptly to the IRB any injuries or other unanticipated or adverse events involving risks or harms to human research subjects or others.

All investigators (listed above) are required to comply with the researcher requirements outlined at http://www.irb.vt.edu/pages/responsibilities.htm (please review before the commencement of your research).

PROTOCOL INFORMATION:
Approved as: **Exempt, under 45 CFR 46.101(b) category(ies) 2**
Protocol Approval Date: **3/22/2011**
Protocol Expiration Date: **NA**
Continuing Review Due Date*: **NA**
*Date a Continuing Review application is due to the IRB office if human subject activities covered under this protocol, including data analysis, are to continue beyond the Protocol Expiration Date.

FEDERALLY FUNDED RESEARCH REQUIREMENTS:
Per federally regulations, 45 CFR 46.103(f), the IRB is required to compare all federally funded grant proposals / work statements to the IRB protocol(s) which cover the human research activities included in the proposal / work statement before funds are released. Note that this requirement does not apply to Exempt and Interim IRB protocols, or grants for which VT is not the primary awardee.

The table on the following page indicates whether grant proposals are related to this IRB protocol, and which of the listed proposals, if any, have been compared to this IRB protocol, if required.

Date*	OSP Number	Sponsor	Grant Comparison Conducted?
3/20/2011	09152101	University of Georgia	Not Required (exempt protocol)

*Date this proposal number was compared, assessed as not requiring comparison, or comparison information was revised.

If this IRB protocol is to cover any other grant proposals, please contact the IRB office (irbadmin@vt.edu) immediately.

cc: File

Office of Research Compliance
Institutional Review Board
2000 Kraft Drive, Suite 2000 (0497)
Blacksburg, Virginia 24060
540/231-4606 Fax 540/231-0959
e-mail irb@vt.edu
Website: www.irb.vt.edu

MEMORANDUM

DATE: May 23, 2011

TO: John Seiler, Shannon Fowler, John Munsell

FROM: Virginia Tech Institutional Review Board (FWA00000572, expires October 26, 2013)

PROTOCOL TITLE: Teachers Survey of Forestry

IRB NUMBER: **11-249**

Effective May 20, 2011, the Virginia Tech IRB PAM, Andrea Nash, approved the amendment request for the above-mentioned research protocol.

This approval provides permission to begin the human subject activities outlined in the IRB-approved protocol and supporting documents.

Plans to deviate from the approved protocol and/or supporting documents must be submitted to the IRB as an amendment request and approved by the IRB prior to the implementation of any changes, regardless of how minor, except where necessary to eliminate apparent immediate hazards to the subjects. Report promptly to the IRB any injuries or other unanticipated or adverse events involving risks or harms to human research subjects or others.

All investigators (listed above) are required to comply with the researcher requirements outlined at http://www.irb.vt.edu/pages/responsibilities.htm (please review before the commencement of your research).

PROTOCOL INFORMATION:
Approved as: **Exempt, under 45 CFR 46.101(b) category(ies) 2**
Protocol Approval Date: **3/22/2011**
Protocol Expiration Date: **NA**
Continuing Review Due Date*: **NA**
*Date a Continuing Review application is due to the IRB office if human subject activities covered under this protocol, including data analysis, are to continue beyond the Protocol Expiration Date.

FEDERALLY FUNDED RESEARCH REQUIREMENTS:
Per federally regulations, 45 CFR 46.103(f), the IRB is required to compare all federally funded grant proposals / work statements to the IRB protocol(s) which cover the human research activities included in the proposal / work statement before funds are released. Note that this requirement does not apply to Exempt and Interim IRB protocols, or grants for which VT is not the primary awardee.

The table on the following page indicates whether grant proposals are related to this IRB protocol, and which of the listed proposals, if any, have been compared to this IRB protocol, if required.

Date*	OSP Number	Sponsor	Grant Comparison Conducted?
3/20/2011	09152101	University of Georgia	Not Required (exempt protocol)

*Date this proposal number was compared, assessed as not requiring comparison, or comparison information was revised.

If this IRB protocol is to cover any other grant proposals, please contact the IRB office (irbadmin@vt.edu) immediately.

cc: File

Office of Research Compliance
Institutional Review Board
2000 Kraft Drive, Suite 2000 (0497)
Blacksburg, Virginia 24060
540/231-4606 Fax 540/231-0959
e-mail irb@vt.edu
Website: www.irb.vt.edu

MEMORANDUM

DATE: October 3, 2011

TO: John Seiler, Shannon Fowler, John Munsell

FROM: Virginia Tech Institutional Review Board (FWA00000572, expires May 31, 2014)

PROTOCOL TITLE: Teachers Survey of Forestry

IRB NUMBER: 11-249

Effective October 3, 2011, the Virginia Tech IRB PAM, Andrea Nash, approved the amendment request for the above-mentioned research protocol.

This approval provides permission to begin the human subject activities outlined in the IRB-approved protocol and supporting documents.

Plans to deviate from the approved protocol and/or supporting documents must be submitted to the IRB as an amendment request and approved by the IRB prior to the implementation of any changes, regardless of how minor, except where necessary to eliminate apparent immediate hazards to the subjects. Report promptly to the IRB any injuries or other unanticipated or adverse events involving risks or harms to human research subjects or others.

All investigators (listed above) are required to comply with the researcher requirements outlined at http://www.irb.vt.edu/pages/responsibilities.htm (please review before the commencement of your research).

PROTOCOL INFORMATION:
Approved as: **Exempt, under 45 CFR 46.101(b) category(ies) 2**
Protocol Approval Date: **3/22/2011**
Protocol Expiration Date: **NA**
Continuing Review Due Date*: **NA**
*Date a Continuing Review application is due to the IRB office if human subject activities covered under this protocol, including data analysis, are to continue beyond the Protocol Expiration Date.

FEDERALLY FUNDED RESEARCH REQUIREMENTS:
Per federally regulations, 45 CFR 46.103(f), the IRB is required to compare all federally funded grant proposals / work statements to the IRB protocol(s) which cover the human research activities included in the proposal / work statement before funds are released. Note that this requirement does not apply to Exempt and Interim IRB protocols, or grants for which VT is not the primary awardee.

The table on the following page indicates whether grant proposals are related to this IRB protocol, and which of the listed proposals, if any, have been compared to this IRB protocol, if required.

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Date*	OSP Number	Sponsor	Grant Comparison Conducted?
3/20/2011	09152101	University of Georgia	Not Required (exempt protocol)

*Date this proposal number was compared, assessed as not requiring comparison, or comparison information was revised.

If this IRB protocol is to cover any other grant proposals, please contact the IRB office (irbadmin@vt.edu) immediately.

cc: File