Using Forest Ecology Exercises in Science Fairs to Increase Interest in Forest Resources Education: An Example From A Stand Development Study

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Abstract

Undergraduate enrollment in forest resource programs has been declining for the past 10 to 15 years, with enrollment in some programs nearing critical levels. Efforts to increase enrollment include broadening program offerings, creating new majors (especially in spatial information systems), and increasing recruiting efforts. A potential recruiting approach is working directly with junior and senior high school students (grades 7 through 12) interested in natural sciences on forest resource specific science fair projects. Greater involvement from forest resource professionals in encouraging and developing science fair projects could help reverse the declining undergraduate enrollment trend.

We present an example of a stand development study presented by the junior author during a series of science fair contests. The study was conducted in northeastern Oklahoma, and utilized the stem reconstruction technique for determining age distribution and height development patterns of several hardwood species in a single plot. Hypotheses included "The larger the tree diameter the older the tree", and "The tallest tree was always the tallest tree". We discuss implications of using this study in science fairs, along with opportunities and limitations for other forest-based ecological studies, and how they can lead to increased interest in forest resources as a career.

Introduction

Undergraduate student enrollment in forest resource programs has been declining for the past 10 to 15 years, especially in the forestry major (MacLean 2002, Anonymous 2004a, 2004b, FAEIS 2008, Nyland 2008, Sharik and Frisk 2008). At some schools, enrollment is nearing critical levels making it difficult to justify offering the forestry major. For example, Washington State University is considering terminating its forestry program (Geranios 2008, Jones 2008). Reasons for declining enrollments in forest resource programs include a lack of interest among high school students, perceived poor job prospects following graduation, low starting salaries, normal enrollment cycle of peaks and valleys (Anonymous 2004b), and a math and science "phobia" by students (Sharik and Frisk 2008).

Another reason for declining enrollment is the perception that forestry and timber harvesting are synonymous. For example, the recent History Channel series *Ax Men* followed several logging crews working in the Pacific Northwest forests. The series showed the tough working conditions and hazards that loggers face on a daily basis. *Ax Men* was an interesting show, but could hurt future forestry enrollment as prospective students equate logging with forest management. Forestry professionals know that logging is an integral part of the forest management process, but foresters and loggers are usually not the same people.

Increasing enrollment is a primary goal at many forest resource programs. One way to increase enrollment is to diversify program offerings. For example, spatial information system programs have been initiated with the advent of GIS and GPS technology. Unfortunately, such programs require increased resources, both monetary and faculty. Another option to increase enrollment involves joint program offerings between departments, schools, or universities. This option requires less investment since much of the infrastructure is already in place, but issues such as coordination, credit, and faculty burden must be taken into account.

The most used option to increase undergraduate enrollment in forest resource programs is recruitment. Many forest resource programs have as a component of their strategic plan an increase in recruitment activities. As with the other options, however, recruitment activities require funding, and administration, faculty, and staff are asked to participate in recruiting efforts. Larger forest resource programs may even have a recruitment coordinator.

Recruitment efforts usually involve meeting prospective students on the university campus, at high schools, or at career days. Recruiters meet with students individually, or in groups, or may present a video or slide show describing the university and forest resource programs. It is unknown how many students are actually 'hooked' with these types of recruitment activities. It would seem that activities that get the students into the forest where students can touch trees, hear sounds, and recruiters can point out "neat ecological features" to spark student interest would be more effective. An example used by one forest resources program is their work with local Future Farmers of America (FFA) forestry teams preparing for local and regional competitions. These competitions include tree identification, equipment identification, sawlog and pulpwood estimation, map interpretation, and timber stand improvement (silviculture). Another possibility, the one explored in this report, is to work with individual students on science fair projects.

Science Fairs

Science fairs are a collection of scientific projects developed by elementary, junior high school and senior high school students. Students are supposed to design projects based on personal interests, utilize standard methods of scientific inquiry, develop the display, and present their results initially at a local school fair, and possibly move on to compete at state, regional, national, and international contests (SRSF 2008a).

Additionally, science fairs provide students with opportunities to conduct themselves in a professional environment while promoting the spirit of competition. They allow students to pursue interests that may lead to careers in their chosen field. Science fairs can also be fun for the students (SRSF 2008b).

Science fairs represent an excellent recruitment opportunity. Students get to work with experts in the field on projects of interest. A mentoring environment is created that can lead, not only to increased enrollment in forest resource programs, but also to long-term career pathways. The key is to connect students with experts. A recruiter or faculty member may have to provide initial advertising at local schools to generate interests and contacts. Below, we described a science fair project developed by the junior author while in the 8th grade, with some guidance by the senior author and the junior author's parents.

Stand Development Science Fair Project

The authors of this paper are cousins. One day, the junior author expressed an interest in studying trees for a science fair project. The senior author was a faculty member in the School of Forest Resources at the University of Arkansas - Monticello, and had research interests in mixed-species stand development. Therefore, a project was developed to study the age structure and height development of a mixed-species upland hardwood stand near the junior author's home in Delaware County, Oklahoma. The junior author titled this project "Reconstruction of Tree Growth".

Two hypotheses were developed after discussion with the junior author while walking through the family forest. These hypotheses were based on previous research by the senior author in bottomland hardwoods and his knowledge of the stand development literature. To enhance the learning experience, the senior author helped guide the junior author to these hypotheses by asking a series of questions, including "Does tree size reflect tree age" and "Has the tallest tree always been the tallest tree?". The hypotheses were (1) "The larger the tree diameter the older the tree" and (2) "The tallest tree was always the tallest tree".

This study utilized the stem reconstruction technique for determining tree height development (Oliver 1982). A sample plot was located by finding a medium-sized northern red oak tree (*Quercus rubra* L.) that was in the upper canopy. This tree served as plot center. Four additional trees located near the northern red oak were also used in the study. Diameter-at-breast height (d.b.h., 4.5 feet from the ground) was measured, then each tree was felled and tree discs cut at 3-foot intervals along the main stem to the top of the tree beginning with a disc near the base of each tree. The senior author and the junior author's father did all chainsaw work for safety reasons. Tree discs were aged by the junior author using a hand-held magnifying glass. The senior author provided the junior author several literature articles to help with data interpretation.

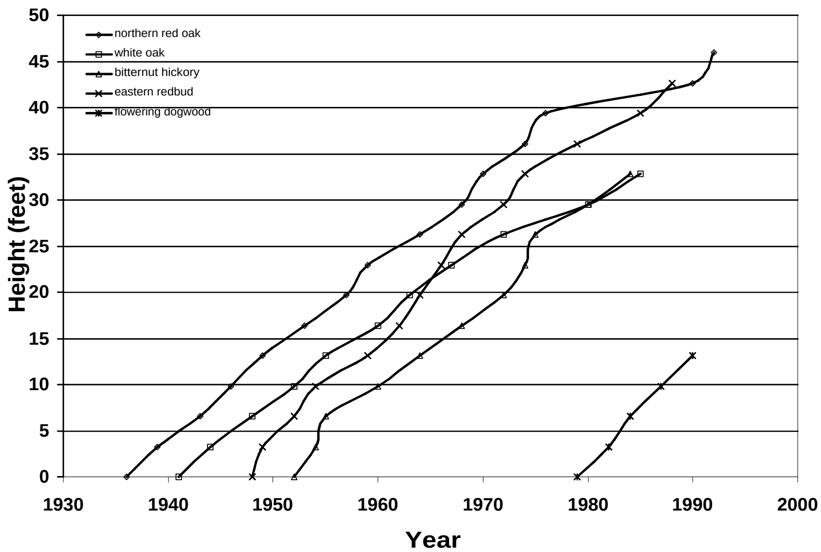
Tables and graphs were prepared by the junior author showing size-age relationships and height development. Table 1 shows that the largest tree was indeed the oldest tree. Three other trees, the white oak (*Q. alba* L.), bitternut hickory (*Carya cordiformis* (Wangenh.) K. Koch) and eastern redbud (*Cercis canadensis* L.), were only 5 to 16 years younger. The flowering dogwood (*Cornus florida* L.) was clearly the youngest tree of the five trees in the plot.

Table 1. Tree species, d.b.h, and age from a single plot in Delaware County, Oklahoma.

Species	D.B.H. (inches)	Age
northern red oak	13.3	61
white oak	5.8	56
bitternut hickory	5.3	45
eastern redbud	4.5	49
flowering dogwood	1.5	18

The northern red oak was also the tallest tree in the plot, and had always been the tallest (Figure 1). Each tree shows a somewhat linear height development pattern. Noteworthy is the eastern redbud. Tree disc were cut at 3-foot intervals, regardless of tree shape. The eastern redbud was leaning considerably away from the northern red oak. Its true height was less than that depicted in Figure 1.

Figure 1. Height development for 5 trees from a single plot in Delaware County, Oklahoma.



Specific stand development conclusions cannot be stated from this study. Only one plot of 5 trees and remedial aging techniques were utilized. Still, it does appear that a stratified stand exists with 4 of the 5 trees similar in age, yet occupying different canopy layers.

Regarding the hypotheses statements, both hypotheses were accepted. The hypothesis “the larger the tree diameter the older the tree” was accepted based on Table 1. Also, the hypothesis “the tallest tree was always the tallest tree” was also accepted based on Figure 1. In even-aged, mixed-species bottomland hardwood stands, both of these hypotheses are usually rejected (Clatterbuck and Hodges 1988, Johnson and Krinard 1988, Lockhart et al. 2006). The junior author was aware of results found in the literature, and potential issues with results based on only one sample plot. Of greater importance though was the knowledge the junior author gained on the use of the scientific method to develop a research question, generate hypotheses, and test hypotheses.

An example of the science fair display is shown in Figure 2. The project was entered in four science fairs over a one year period. The junior author earned first place at two of these contests. Unfortunately, the project was disqualified at the Oklahoma State Science Fair because real biological samples were used in the display (note the tree discs on the display in Figure 2). The use of real biological samples in displays was a violation of the science fair rules. We were unaware of this rule. Further, we did not think wood samples were dangerous since many science fair project displays contained plywood (which we later found were acceptable since plywood is a processed wood). The science fair rules were very clear on this issue.

Figure 2. "Reconstruction of Tree Growth" science fair display with junior author.

While the state science fair contest results were disappointing, the project was still considered a success. Much knowledge was gained during the conduct of this tree reconstruction project. The junior author was knowledgeable about tree rings, but not about how different tree species grow when competing with each other. He was very proud of his science fair project, and particularly proud of the attention it received at science fair contests. Judges commented on the uniqueness of the project, particularly the methods, and the presentation of the results. Several judges and science fair contestants further commented about the knowledge they gained through the reconstruction of tree growth, including the older ages of the smaller trees. This science fair project did spark interest in the junior author about forestry and forest-related professions. Unfortunately, he eventually chose another career pathway when he enrolled in college. Still, the uniqueness of forest ecology exercises in science fairs, such as reconstruction of tree growth, may spark others to purse careers in forest resources. A purview of past science fair projects on the World Wide Web show that few projects involve forest ecology questions. The uniqueness of such projects can be used to further student interests in forest resources, while concurrently produce desired results at science fair contests.

Conclusions

Science fairs may be an effective tool to increase enrollment in forest resource programs. Potential recruits can be identified early, while concurrently giving students hands-on experience with the scientific method. Working with students in science fair projects will require considerable time commitments. If university faculty are involved, then adjustments may be needed to fulfill tenure-track obligations.

Science fair mentors must be familiar with science fair contest operations. It is also useful to keep scientific questions at a level appropriate for the student's age, and remember that science fair judges may be unfamiliar with forest ecology questions and the scientific inquiry and methods involved to test these hypotheses. The presentation display written contents must be informative, yet concise. Avoid excessive use of technical terms. Finally, remember to follow the science fair rules. It is tempting to place samples from the forest, such as tree discs, into the display as this will make the display unique among displays from other scientific disciplines. Photographs will suffice, but ensure they convey the intent of the display. For example, a series of pictures showing the forest with the trees to be harvested marked with flagging, followed by a picture of stacked tree discs, and then a picture showing a closeup of a tree disc including periodically marked tree rings (every 5 or 10 years). Sharp, contrasting photographs will still make the display unique.

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