1. **Project Number**: LNE93-37
Grant Number: 99 Coop-1-7191
Funding Period: Funding Period 6/1/93-3/31/97

2. **Project Title**: Integrating Stewardship Forestry into Total Farm Management

3. **Project Coordinator**:
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4. **Type of Report**: Final

5. **Date of Report**: December 3, 1998

6. **Reporting Period**: December 9, 1996 to December 3, 1998

7. **Major Participants**:
James C. Finley (Penn State University), Stephen B. Jones (Formerly Penn State University, Currently Auburn University), James R. Grace (Pennsylvania Bureau of Forestry), Roger Fickes (Pennsylvania Bureau of State Parks), James Redding (United States Forest Service), George Freeman (Freeman's Tree Farm)

8. **Cooperators**: No new information.

9. **Project Status**:
Please check one of the following. The project is:

X **New**: received SARE/ACE funding for the first time
__ **Continuation**: a previously approved project, following revision and competitive review.

10. **Statement of Expenditures**

Final Report

Objectives:

1. Establish six timber harvesting demonstration/study replicates distributed in different timber types in Pennsylvania.
2. Enhance the adoption of a forest stewardship ethic by farmers, timber harvesters, other landowners, and extension agents, by demonstrating the impacts of various silvicultural options.
3. Develop baseline data for monitoring forest growth and changes in species diversity.
4. Determine the economics of sustainable forestry practices and potential contributions to the whole farm budget.

Abstract:

Well-managed forests product many environmental and economic benefits, such as improved air and water quality, wood products, recreational opportunities, and wildlife habitat. Farmers are one of the largest groups of forest landowners in the United States. For this and future generations, it is essential that farmers wisely use and manage their forests.

This project established seven demonstration/research replicates to examine the economic and environmental benefits of proper farm woodlot management as well as to demonstrate various management practices. Each 12-acre replicate consists of six two-acre treatments: a control and five timber harvesting practices. Three of the seven replicates are on state forest land, and the remaining four are on private, state parks, state game lands, and university properties. Remeasurements to gauge growth response to various treatment are complete and should show changing stand structure and species composition shifts.

The installations demonstrate the benefits and consequences of timber harvesting to farm woodlot owners and others. The completed demonstrations have been used as part of extension workshops for landowners, foresters, and timber harvesters. The plots prove that this type of outdoor classroom is very useful for conveying forest stewardship concepts. The plots provide important baseline data for long-term monitoring of forest growth and value, and changes in species composition with resulting changes in wildlife habitat and biodiversity.

Specific Project Results

Objective 1. Ultimately we established seven demonstration/research replicates. These included the six proposed in this project and another developed as part of the farmer grant program on the Freeman Tree Farm. Three of the seven replicates are on state forest land, and the remaining four are on private, state parks, state game lands, and university properties (See Map in Appendix A). Two additional demonstrations are now available on state forest lands and a second one on state park lands is marked and ready for harvest. The Bureau of Forestry plans to establish at least one demonstration following the model established for this project in each of the state's 67 counties.

Objective 2. The demonstration sites have served as focal points for many tours in the past four years. It is difficult to document all the tours; however, Appendix B displays listing of some known tours. Survey results indicate that these sites are effective educational tools for introducing participants to basic forest ecology and management principles. In addition, the comparison of various treatments suggests that sustainable forestry can meet a variety of landowner objectives including economic feasibility. Knowledgeable landowners are better stewards (See Appendix C for Journal of Forestry article).

Objective 3. Field crews collected preharvest and postharvest data at all seven sites in 1993 and 1994. Data collected included overstory tree species, diameters, and merchantable heights. In addition, they measured and described regeneration and herbaceous plant communities and established photo points to document stand development. Overstory remeasurements were completed in December 1997; however, comparison of this data with the initial inventory is incomplete. In a cooperative effort with the United States Forest Service the Habitat Assessment Model developed under another SARE project was "run" in 1996 on each site and compared across treatments to demonstrate how harvesting affects wildlife use.
Objective 4. Initial data served to develop the total economic value before harvesting and the value realized from harvesting the blocks. Simulations of value change over time, although planned, remain undone. A new graduate student, entering the program this winter, may choose to complete this phase of the project.

Dissemination of Findings

All of the sites continue to host tours, although use varies by location. The replicates on the Freeman Farm, Stone Valley Experimental Forest, French Creek State Park, and State Game Lands 211 are the most frequently used. This most certainly relates to their location and the commitment of their "hosts" to the maintenance and use of the sites to influence forest management. The other three sites are more isolated and are thus difficult to reach. Nonetheless all seven sites contribute to the objective to reach specific audiences.

Handouts and brochures in Appendix D convey the nature of materials developed to reach target audiences using the sites. The replicate was a featured element in the Fiftieth Anniversary of the Tree Farm Program hosted at the Farm. Last year on that one day alone more than 300 landowners and interested citizens visited the site. As an aside, The Freeman Farm received the 1998 National Tree Farm of the Year Award from the American Forest Foundation. This the first time that the National winner has come from Pennsylvania and we are confident that the structure plots played an important role in their receiving this recognition. The Stone Valley site has hosted the 60 students participating the Pennsylvania Governor's School for each of the past three years. That same site also played a prominent role in a day-long program for 50 teachers participating in the Pennsylvania Alliance of Environmental Educators workshop this fall.

State Game Lands 211, only 10 miles north of the Harrisburg, the state's capital, receives untold numbers of visitors. For the past three falls, volunteers with the state's Forest Stewardship Program has hosted tours as local residents travel through the state game land. Normally the road just beyond the replicate is closed, but on one Saturday each fall the commission opens the road for people to enjoy the area's scenic beauty. The local extension agent works with the volunteers to maintain the trail through the site and the signs along the route. This summer the Pennsylvania Game Commission chose to develop a thirteen part public television series on the state's forest and wildlife resources. This replicate played a prominent role in one of these segments addressing the role of white-tailed deer and forest renewal.

The French Creek State Park replicate is uniquely located for use by schools in and near Philadelphia. In 1997 a graduate student at Penn State working with a the Bertram Cluster in Philadelphia used this site to evaluate the role of demonstrations in helping center-city youth understand forest management. See Appendix E for a copy of this study.

The Sustainable Forestry Initiative of Pennsylvania, part of American Forest and Paper Association effort to ensure sustainable forestry practices, is using the replicates in various ways. All of the loggers participating in the first level Sustainable Forestry Course visit through slides one of the sites. During the "visit" they have the opportunity to compare various cutting practices, including high-grading. To date more than 800 Pennsylvania timber harvesters have completed this course. During the second level course the timber harvesters will actually visit one of the sites and collect data on forest regeneration. Interestingly two of the sites are now part of another demonstration project showing the impact of water quality Best Management Practices (BMPs) funded by a grant from the Pennsylvania Department of Environmental Protection.

Site Information:

The sites are located in each of seven Pennsylvania counties, evenly distributed across the state. Three are on State Forests including Lackawanna, Lackawanna County; Tiadaghton, Lycoming County; and Forbes, Somerset County. One is on State Game Lands 211 in Dauphin County. One is located on French Creek State Park in Berks County. The only privately owned site is on the Freeman Tree Farm in Clarion County. The seventh is on Penn State's Stone Valley Experimental Forest in Huntingdon County. For a map displaying all seven sites refer to Appendix A.

The Stone Valley and SGL 211 sites are oak-hickory forest type dominated by white oak, yellow poplar, red oak, and red maple. The Freeman Tree Farm, Lackawanna, French Creek, and Forbes are all mixed species or transition types dominated by mixed oaks, red maple, black birch, and other commercial species. The Tiadaghton site is the only replicate dominated by Allegheny hardwoods including yellow poplar, sugar maple, basswood, cucumber, red maple, and black birch.

The Tiadaghton and Stone Valley Sites were both selected, because of steepness or drainage problems to become part of the water quality BMP project mentioned above. Ensuring that timber harvesting practices are sustainable is the intent of this new effort and coupling water quality protection with harvesting approaches provides and excellent opportunity to work with loggers and others managing forest resources.

Economic Analysis:

As stated previously, a control and five different harvesting treatments occur on each replicate. Installed harvest treatments include:

- Control—no harvesting
- Thinning from below—removing small trees first
- Thinning from above—removing the largest trees first, representing a diameter limit controlled harvest
- Improvement—cutting through the diameter distribution, removing 1/3 of the trees from above and 2/3 from below the average stand diameter
- Shelterwood regeneration cut—retaining 40 percent of the trees in larger size class
- Clearcut regeneration cut—removing all trees one inch in diameter and larger

For a presentation of the economic data derived from the initial data refer to Appendix F.

Potential Contributions and Practical Applications

Farm woodlots are typically a source of quick cash, and are too frequently harvested without regard for future income and productivity. Woodlots managed with this approach cannot sustainably produce high quality products. What many farmers and other landowners do not realize is those woodlots are an asset. An asset which if managed in a more sustainable fashion can produce reliable periodic returns. In Pennsylvania, "high-grading," or taking the best and leaving the rest, is a widely employed harvesting practice on private forest lands. It provides immediate large financial returns, but ruins the resource for future years and perhaps future generations. The treatment which demonstrates high-grading has proven useful in conveying the consequences of such a practice. An improvement thinning, again one of the practices demonstrated, serves as an investment in the future forest by increasing residual tree vigor and productivity, while at the same time providing some immediate financial return. Workshop participants see the differences between sustainable forestry and unsustainable forestry firsthand.

Perhaps one of the unanticipated and yet very valuable benefits of this project has been the variety of audiences who use the sites and the number of messages that the sites convey to the users. The Bertram Cluster project with an inner-city Philadelphia school showed that providing examples of various harvesting practices in close proximity helps students understand the environmental effects of timber harvesting. Working with diverse audiences, we learned that demonstration projects can change knowledge and attitudes within groups. Most specifically we have shown that participants in education programs more readily understand and accept clearcutting as a management tool after viewing the demonstration areas.

After viewing the sites, timber harvesters often express changes in their understanding of timber harvesting impacts. Most specifically they recognize the potential to cause adverse shifts in species composition, stand structure, and rotation length through the application of diameter-limit harvests. This revelation has particular application as the Sustainable Forestry Initiative of the American Forest and Paper Association continues to expand across the country.

New Hypotheses:

Evaluation results from workshops indicate that participants acquire useful information. Outdoor demonstrations enhance learning in the areas of forest ecology and management. Future research might include determining how long knowledge stays with a person, and how often reinforcement is necessary. In addition, what does this knowledge have on future woodlot management practices? Will fewer landowners "high-grade" because of what they have learned? Does the impact of the harvest demonstrations change as the immediate visual impact of harvest declines? Can timber harvesters and professional foresters use the sites to change client notions about the merits of harvesting "large, old trees" to benefit "small, young trees?" Will the demonstrations serve to show the combined effects of timber harvesting, tree and plant regeneration, and white-tailed deer feeding?

Farmer Adoption and Direct Impact

Change in Practice:
Research to determine whether visiting the demonstration areas causes farmers or other landowners to change their management practices was not a formal part of this project. However, it is safe to say that many landowners seemed enlightened about the consequences of "high-grading" versus more sustainable methods of timber harvesting. Research did show that the sites were effective in changing attitudes toward clearcutting as a viable management tool. There is also evidence that the exclosures on each of the six treatments at each of the seven replicates are useful in convincing visitors of the negative changes that high white-tailed deer populations cause in forest systems.

Farmer Evaluations:

Participants in seven workshops at the demonstration areas were asked to complete a questionnaire (Appendix G). The first part of the questionnaire asked them to rank their agreement with various statements about forest management practices, forest stewardship, and land ownership. Part two consisted of multiple choice questions designed to test landowner knowledge of basic forest ecology and management practices. Part three collected general demographic information, and asked respondents to provide comments. Overall, "test" scores improved after participants walked through the demonstration area (See Appendix C).

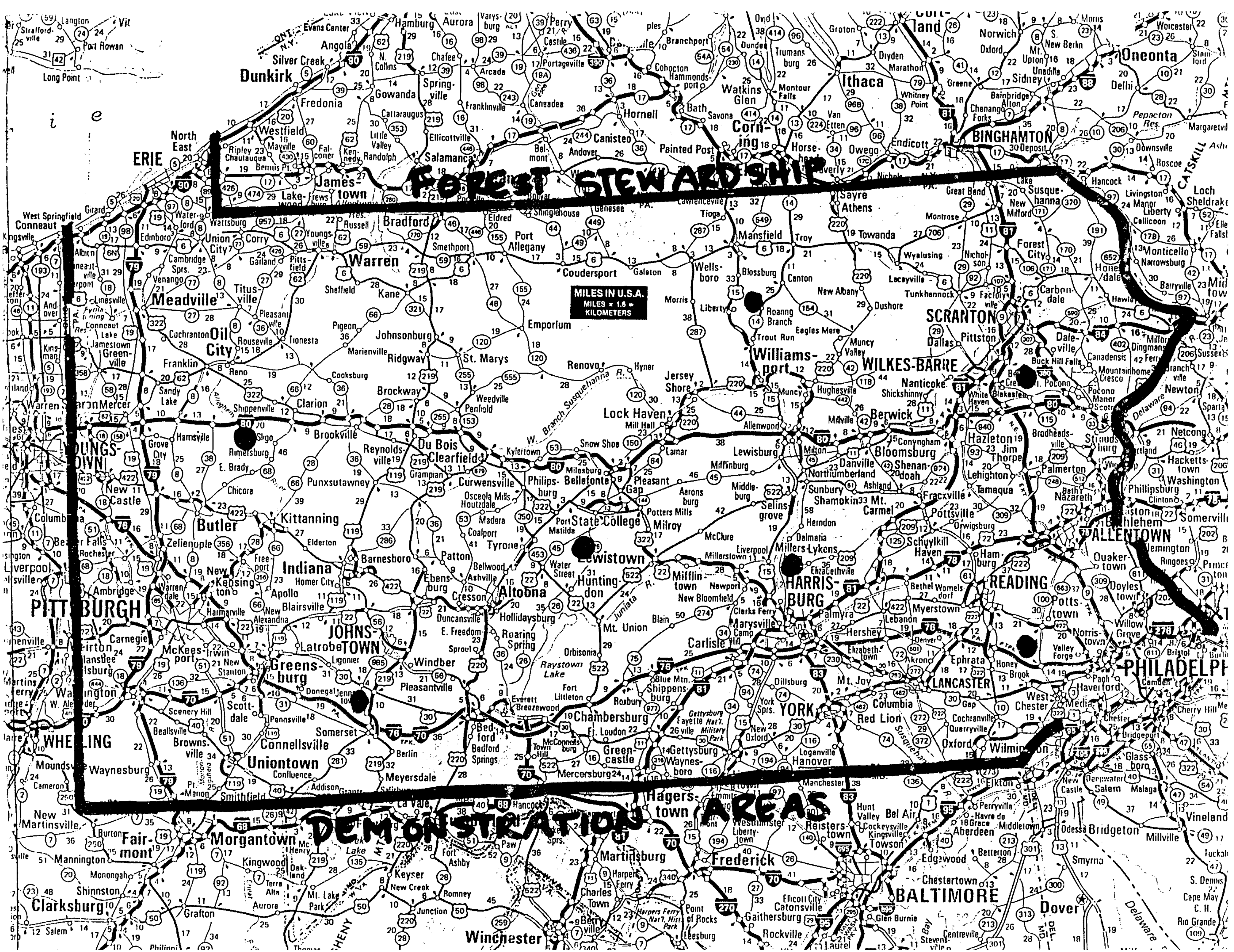
Producer Involvement:

Number of growers/producers in attendance at:
900 Workshops
300 Conferences
550 Field Days
Other Events:
180 Pennsylvania Governor's School
100 Teacher Workshops
600 Logger Education
50 Government and Agency Personnel
1 Video Segment

Areas Needing Additional Study:
While this project is nearly five years in development it may take again that long or longer to realize its effect. For example, the biological monitoring of plant diversity will not likely show results in the near future. Although we are witnessing some responses, especially inside and outside deer exclosures on each replicate, quantitative differences are uncertain. Also, we would like to monitor the educational value of self-guided trails at each of the sites.

Appendix A

Site Maps and Location Descriptions



FOREST STEWARDSHIP
DEMONSTRATION AREAS
MILES IN U.S.A.
MILES × 1.6 = KILOMETERS
ERIE
PITTSBURGH
HARRISBURG
PHILADELPHIA
SCRANTON
WILKES-BARRE
ALLENTOWN
READING
LANCASTER
YORK
JOHNSTOWN
Altoona
State College
Williamsport
BALTIMORE
BINGHAMTON

FOREST STEWARDSHIP DEMONSTRATION AREAS

General Information

More than half of Pennsylvania is covered by forests. Most of these are "working" forests, continuously supplying the people of Pennsylvania and people all over the world with essential natural resource amenities and forest products. Because Pennsylvania's extensive forests contain high quality hardwoods, timber harvesting is an important reality and a significant part of our state's economy. Most everyone depends on the forest for wood products, and many people depend on the forest for their livelihood. Others simply enjoy the many forms of recreation and natural beauty the forest provides.

This intensive use of Pennsylvania's woodlands, particularly timber harvesting, can have a large impact on the sustainability of the forest and its resources. However, with proper planning and careful management, timber harvesting can be beneficial, helping maintain vigorous, healthy, and productive forests. Therefore, it is essential that timber harvesting be employed as part of a professionally prepared management plan that recognizes potential consequences and avoids resulting negative impacts, including erosion and sedimentation, soil compaction, and damage to residual trees.

The forest provides many different benefits, and the preference for how it should be used or not used varies from person to person. For this reason, timber harvesting is frequently a controversial issue. Because most people (forest landowners and the general public) know so little about timber harvesting and its role in maintaining sustainable forests, the controversy is often magnified. To reduce the potential for conflict, we have developed these sites to demonstrate alternative methods of timber harvesting along with both their benefits and consequences. With responsible forestry, which may include timber harvesting, we can ensure that biodiversity, wildlife habitat, and aesthetics are maintained.

There are eight demonstration areas established across the state to demonstrate and study alternative timber harvesting practices.

- Lackawanna State Forest, Lackawanna County
- Tiadaghton State Forest, Lycoming County
- Forbes State Forest, Westmoreland County
- State Game Lands 211, Dauphin County
- Freeman Tree Farm, Clarion County
- French Creek State Park, Berks County
- Stone Valley Experimental Forest, Huntington County

One of the primary objectives of this project is to encourage responsible forest resource management. We want all visitors to embrace the forest stewardship ethic.

FORESTRY TERMINOLOGY:

In order to facilitate understanding of the project, the treatments, and the considerations involved, we offer the following definitions of some of the terms frequently used in forestry:

- ***Forestry*** : the art and science of establishing and managing forests and their associated resources for a variety of benefits and values.
- ***Regeneration*** : the replacement of one forest stand by another as a result of natural seeding, sprouting, planting, or other methods.
- ***Residual stand*** : trees that remain following any cutting operation.
- ***Silviculture*** : the art, science, and practice of establishing, tending, and reproducing forest stands with desired characteristics. **Cutting** is the primary tool of silviculture and can either promote growth of desirable species or the establishment of new trees.
- ***Stand*** : a grouping of forest vegetation sufficiently uniform in species composition, age, and condition to be distinguished from surrounding vegetation types and managed as a single unit.
- ***Stewardship*** : the wise management and use of forest resources to ensure their health and productivity today with regard for generations to come.

The Treatments

Each site demonstrates five different harvesting treatments: a diameter-limit cut aimed at removing the smallest trees, a diameter-limit cut removing the largest trees, a thinning of averaged-sized trees (replaced by a shelterwood on three sites), an improvement thinning, and a clearcut. The treatment blocks are two acres each including an interior .6 acre measurement plot.

NO HARVEST

The major objective of this project is to encourage the responsible management of forests by showing the results of alternative timber harvesting treatments. However, our demonstration would be incomplete without first permitting you to see how the forest would appear without a treatment. In many circumstances no cutting may be a preferred alternative. Please keep in mind though, that forests, even without cutting, are dynamic, and ever-changing.

Treatment 1. Control... For comparison, nothing is removed from this plot.

THINNINGS

Tree mortality (death) is a natural, ongoing process in the forest. Young forests with small trees support many thousands of individual trees per acre. As the forest matures and individual trees become larger, many of those thousands of trees are crowded (by faster growing neighbors) and die.

Thinning is a forestry technique used to "capture" some of the potential mortality by harvesting selected trees. Thinning reduces crowding and, by redistributing the growth potential to the most desirable trees on the site, the overall health, vigor, and growth of the remaining stand is increased. Those "residuals" or remaining trees may have been selected for one of many reasons, including wildlife habitat (a "cavity" tree), timber, or aesthetics. Thinning also provides some intermediate return on a landowner's long-term forest investment.

Three or four of the treatments demonstrated at each site are thinnings. These sites were fully stocked before harvesting. That is, there were no openings in the forest. Viewed from above, the crowns or branches of the trees seemed to touch one another in a continuous, green carpet. There was no room for individual crowns to grow and expand. The purpose of our thinning treatments was to reduce the stocking or density to 60 percent to give the residual trees additional room to reach out, thus increasing their rate of growth.

Treatment 2. Diameter-Limit from Below... A diameter-based thinning-from-below reduces the stocking (to 60 percent) by removing all trees smaller than a calculated diameter. Because the decisions about which individuals to remove are driven by diameter alone, there is no opportunity to deliberately allocate growing space to meet objectives. For instance, if all the trees on the site are of approximately the same age, a common condition in Pennsylvania, the smaller ones are growing slowly and competing poorly with their larger neighbors. Removing them typically provides little additional growing space to the larger ones. Also, by removing all the trees of similar size, we may actually eliminate one or more tree species that happen to grow and develop naturally at a slower rate. Although the resulting forest can look almost park-like, which is pleasing to many people, the treatment can have important negative effects. Small trees and shrubs provide food, homes and hiding places for wildlife, and their removal may significantly reduce wildlife use of the area. Also, a diameter-based cut from below will likely not be an economically viable option, in terms of both immediate cash flow and ultimate financial return.

Treatment 3. Diameter-Limit from Above... A diameter-based thinning-from-above reduces the stocking (again, to 60 percent in this case) by removing all trees larger than a calculated diameter. Those largest trees are selected on the basis of diameter alone, regardless of their location with respect to other trees. Neither of the diameter-based thinnings shown in this demonstration is rooted in sound forestry. The results are generally undesirable. Once again, when all similarly sized trees are removed, certain tree species can be completely eliminated from the remaining stand, and in an even-aged stand (most in Pennsylvania are), the burden of ultimately regenerating the forest falls on the smaller and possibly genetically inferior residual trees. Because the remaining trees are not younger, but instead are slower-growing, damaged, diseased or less vigorous species, they may not be able to respond to the increased growing space made available to them by the thinning. This is a negative impact on long-term forest health and diversity. In addition, this treatment allows no consideration for wildlife habitat. A diameter-based cut from above probably yields the highest immediate cash return of any thinning, but the long-term financial yield is drastically reduced. The residual stand, dominated by low value and poor quality trees, is simply unable to generate much future income potential.

Treatment 4. Diameter-Limit from the Middle... In this treatment, the stocking was reduced to 60 percent by removing all trees between two calculated diameters. In other words, the medium-sized trees were removed, leaving the largest dominant trees and the smallest trees. The result is what <u>appears</u> to be a two-aged stand of maturing sawtimber and younger saplings. In fact, the trees that are left may be very similar in age. Overall, the average tree diameter in the stand has been reduced, and the composition of species has been shifted towards those that are more tolerant of shade. Additional growing space has been made available for the sapling-sized trees. The trees that were removed were merchantable, providing some financial return.

Treatment 5. Improvement Thinning... An improvement thinning represents the professional forester-recommended silvicultural treatment for this forest stand. It was designed to meet a set of specified objectives, including production of timber for income, maintenance of wildlife habitat, and protection of the soils and related resources. In an improvement thinning, the resource professional balances the landowner's management objectives with forest conditions the site and markets, and then selects individual trees to cut or to leave on the basis of species, spacing, and tree quality. The result is that trees of many sizes are removed and growth is redistributed by making growing space available to desired trees. In this way, the overall quality of the forest is improved for whatever objectives were chosen. Typically, the immediate cash return from this type of thinning does little more than cover its costs, but the treatment serves as an investment in the future of that particular forest.

REGENERATION HARVESTS

Forests are a renewable natural resource. Forests left completely undisturbed do not live forever. Once a tree becomes "mature," growth slows, resistance to insects and disease is reduced, and its ability to respond to injuries diminishes. Old trees are eventually harvested naturally, dying and then crumbling or crashing to the forest floor to donate their nutrients to the soil where they can be used by other living organisms and new seedlings. In a **regeneration harvest** we are mimicking this slow natural process to ensure long-term forest sustainability. Old trees are removed as efficiently as possible in order to supply the space and access to resources (light, moisture and nutrients) needed for the establishment of a new crop. When making decisions regarding a regeneration harvest one must consider the characteristics of the site, including soil and topography, the species of trees in the forest and their specific regeneration requirements, as well as possible impacts on wildlife and water resources.

Treatment 6. Clearcut... A **clearcut**, as defined by foresters, removes all the trees in one cutting, mimicking a natural disturbance like a fire or windthrow. In our hardwood forests, care must be exercised to make sure that naturally occurring regeneration is adequate **before** the cut is made. Otherwise, establishment of the new forest can be delayed significantly, and the site may become occupied by grasses and ferns or trees that do not meet the landowner's objectives. When applied appropriately, this treatment will lead to a forest of similarly aged trees, the most abundant being those that grow best in high levels of sunlight. The financial returns associated with this treatment can be high, but the aesthetic value of the forest for most observers is diminished until the new forest becomes established. Although the term "clearcut" imparts a very negative image to most people, harvesting a mature forest may be a good option for a landowner, depending upon the growth patterns of involved species, the timber market, and the conditions of the site.

Treatment 7. Shelterwood... A shelterwood cut removes both small trees and some large trees, the exact treatment varying from site to site. This regeneration treatment, which is less visually disruptive than the clearcut, favors tree species that require less than full sunlight to regenerate or trees that grow best under the shade or ***shelter*** of other trees. In addition to their sheltering function, the trees left after the first cut serve as seed sources for the new forest. Therefore, a shelterwood cut has the added benefit of allowing new tree seedlings to become established over time, reducing the risk of having no new growth. The first cut of the shelterwood treatment offers only limited initial cash flow. Much higher returns are realized when the new stand is established and the larger, residual trees are removed. This treatment will be re-evaluated in 10 years and if sufficient regeneration is present it will be harvested, if not, a second cut may be applied to stimulate additional regeneration establishment and growth.

The Impact of Whitetail Deer

The whitetail deer was hunted nearly to extinction around the turn of the century. Their remarkable recovery since that time can be attributed to factors including the elimination of natural predators (mountain lions and wolves) by early settlers, abundance of favorable habitat provided by young forests and agricultural fields, and protective game laws. But the resulting overpopulation of deer has negative consequences for our forest resources. The diversity of woody and herbaceous ground cover is reduced as is the diversity of forest songbirds and other wildlife. There is a delayed recovery of forests after disturbance due to deer overbrowsing. Often, commercially valuable tree species have failed to regenerate.

Many differing perspectives and opinions surround the issue of deer overpopulation. Whitetails certainly are beautiful animals, and a park-like forest that is easy to walk through results from their browsing of shrubs and seedlings. Therefore, actions to reduce the deer herd in Pennsylvania will only by taken when landowners, hunters, legislators and the general public understand the negative consequences of overpopulation.

Within all the demonstration areas, deer are expected to have a large impact on the growth of new seedlings and other vegetation after harvesting. We also anticipate tree regeneration under different harvesting treatments to vary. To demonstrate the effect of different light levels in combination with deer populations, paired fenced and unfenced regeneration plots have been established in each of the six treatment blocks. Differences in plant species abundance and composition will be monitored.

Summary

Each research plot will be remeasured three years and ten years after harvesting. We will monitor factors related to plant and animal species diversity, residual and new growth, mortality, and economic value of each treatment. Additional harvests may be conducted in the future to maintain density at 60 percent within the thinned treatment areas.

As we've pointed out, the timber harvesting alternatives presented do not all represent good forestry, but regardless, they are all used in Pennsylvania. The diameter-based thin-from-above treatment, also called "high-grading" because it removes the best or highest grade trees and leaves the rest, is particularly common on private, individual properties in the state. The purpose of this demonstration is to provide landowners, timber harvesters, foresters, and concerned citizens with some harvesting options, displaying both their positive and negative consequences. In addition, we hope to make you aware of some of the many considerations that should be a part of harvesting decisions. After all, our actions today have a great deal of bearing on the future sustainability of Pennsylvania's forests. As a result, we hope that forest landowners who visit the site will use the knowledge gained and, with the help of professional forest managers, incorporate their own objectives into a forest management plan. We believe all visitors can learn enough about responsible forest management to help form educated opinions about important forestry issues. Finally, we encourage you to embrace the forest stewardship ethic and share the spirit of responsibility for our renewable natural resources.

Please remember that all of us use, in fact depend on, forest products. Timber harvesting is an essential practice that can serve as an effective, environmentally sensitive tool of forest management. Join us in encouraging responsible management of all forests, public and private.

FOREST STEWARDSHIP DEMONSTRATION AREAS

Progress Report *updated 4/10/95*

Lackawanna State Forest, Lackawanna County

Contact:

Tony Santoli, B.O.F, (717) 963-4561
Walt Fayocavitz, B.O.F. District 11, Forester, (717) 963-4561

Progress:

- pre-harvest photos (8/93)
- harvest completed (8/93)
- post-harvest photos (11/93)
- deer exclosures installed (12/93)
- first year data collection completed (6/94)

Educational Use:

Forest Stewardship, A Workshop for Landowners (7/94), *canceled*

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State Game Lands 211, Dauphin County

Contact:

Dave Henry, Game Commission, (215) 926-3136
Paul Craig, Extension, (717) 921-8803
Paul Troutman, B.O.F, (717) 326-8875

Progress:

- pre-harvest photos (8/93)
- harvest completed (10/93)
- post-harvest photos (5/94)
- deer exclosures installed (5/94)
- first year data collection completed (7/94)
- data reconciled (1/95)
- trail constructed (3/95)
- signs

Educational Use:

- A Stewardship Approach to Selling Timber from Your Woodland (10/93) - 25
- L.E.A.P. silvicultural field exercise (6/94) - 10
- Capital Region Forest Stewardship Conference (9/94) - 25

****

Freeman Tree Farm, Clarion County

Contact:

George Freeman, Tree Farmer, (814) 797-5198 home, (412) 659-4061 farm

Progress:

- pre-harvest photos (9/93)
- harvest completed (1/94)
- deer exclosures installed (5/94)
- post-harvest photos (5/94)
- first year data collection completed (8/94)
- trail installed (5/94)
- interpretive signs made (10/94)
- data reconciled (4/95)
- boundaries painted (4/95)

Educational Use:

- Forest Stewardship Committee Meeting Tour (7/94) - 25
- Woodland Management Workshop (10/94) - 150

Stone Valley Experimental Forest, Huntingdon County

Contact:

Joe Harding, Forest Manager, (814) 865-6272

Progress:

- pre-harvest photos (8/93)
- harvest complete (7/94)
- deer exclosures installed (6/94)
- first year data collection completed (6/94)
- post-harvest photos (6/94)
- trail installed (7/94)
- signs made (4/95)
- data reconciled (1/95)
- boundaries painted (4/95)

Educational Use:

- PFA Meeting (5/94) - 10
- Conservation Leadership School (7/94) - 12
- Forest Stewardship VIP Annual Meeting (7/94) - 60
- Woodland Owners of Centre County (8/94) - 16
- PA Forest Issues Committee (10/94) - 10

****

French Creek State Park, Berks County

Contact:

Jeff Stuffle, B.O.F., (215) 469-6217

Progress:

- pre-harvest photos (11/94)
- harvesting completion expected (8/95)

Educational Use:

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Forbes State Forest, Somerset County

Contact:

Dave Williams, B.O.F., (412) 238-9533
Don Stiffler, B.O.F., (412) 238-9533

Progress:

- pre-harvest photos (8/93)
- harvest complete (12/94)
- post-harvest photos (4/95)
- fences installed (4/95)
- first year data collection (5/95)

Educational Use:

- L.E.A.P. silviculture field exercise (5/94) - 30
- Forest Stewardship VIP workshop (10/94) - 30

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Tiadaghton State Forest, Lycoming County

Contact:

Bill Miller, B.O.F., (717) 327-3450

Progress:

- pre-harvest photos (11/93)
- harvesting completion expected (12/95)

Educational Use:

Forest Stewardship Demonstration Areas
Locations and Contacts

Lackawanna State Forest, Lackawanna County
Contact:
Tony Santoli, B.O.F, (717) 963-4561
Walt Fayocavitz, B.O.F. District 11, Forester, (717) 963-4561

State Game Lands 211, Dauphin County
Contact:
Dave Henry, Game Commission, (215) 926-3136
Paul Craig, Extension, (717) 921-8803
Paul Troutman, B.O.F, (717) 326-8875

Freeman Tree Farm, Clarion County
Contact:
George Freeman, Tree Farmer, (814) 797-5198 home, (412) 659-4061 farm

Stone Valley Experimental Forest, Huntingdon County
Contact:
Joe Harding, Forest Manager, (814) 865-6272

French Creek State Park, Berks County
Contact:
Jeff Stuffle, B.O.F., (610) 469-6217
Randy Frey, Park Manager (610) 582-9680
Matt Marcineck, Park Officer (610) 582-9680

Forbes State Forest, Somerset County
Contact:
Dave Williams, B.O.F., (412) 238-9533
Don Stiffler, B.O.F., (412) 238-9533

Tiadaghton State Forest, Lycoming County
Contact:
Bill Miller, B.O.F., (717) 327-3450

Directions to Forest Stewardship Demonstration Areas:

1. To Stone Valley Experimental Forest Site, Huntingdon County (from P.S.U.)
Take Rt. 26 South from State College.
You must make a right turn in Pine Grove Mills (stay on Rt. 26).
Pass the sign for Shaver's Creek Environmental Center.
Turn right just beyond the Whipple Dam Store.
Follow this winding dirt road for a couple mile, going straight through the "X-shaped" intersection (do not veer left).
At the stop sign turn right.
The plots will be on the right side of the road.
You may turn right at the parking sign and park next to the trail head.
Travel time from State College is 30 min.

2. To State Game Lands 211 Site, Dauphin County (from Penn State):
Take US 322 East from State College.
Pass through Clarks Ferry.
There will be a Hardees Restaurant on the right and a "GAS & DIESEL" sign on the left. Veer left here and drive into Dauphin.
There are other, more difficult left turns closer to Dauphin if you miss this one. Look for signs that say "To 225."
Going south on Rt. 225, turn left onto Stony Creek Road.
Drive for approximately 4 miles.
Plots will be on left side of road adjacent to the power line.
There is space for parking on the right hand side of the road.
The trail begins on the road, across from the parking area.
Travel time from State College is 1 3/4 hours.

3. To Tiadaghton State Forest Site, Lycoming County (from Penn State):
Take Rt. 26 North from State College to Rt. 64 North to I80 East to US 220 North.
Follow US 220 to Williamsport.
Turn onto US 15 North.
Turn right onto Rt. 14.
Follow this road along a river, passing a bridge on the right hand side of the road.
The plots will be on the right side of the road, shortly after the bridge.
There is a place to park on the left hand side of the road.
The plots are situated on the side of the slope.
Travel time from State College is 1 1/2 hours.

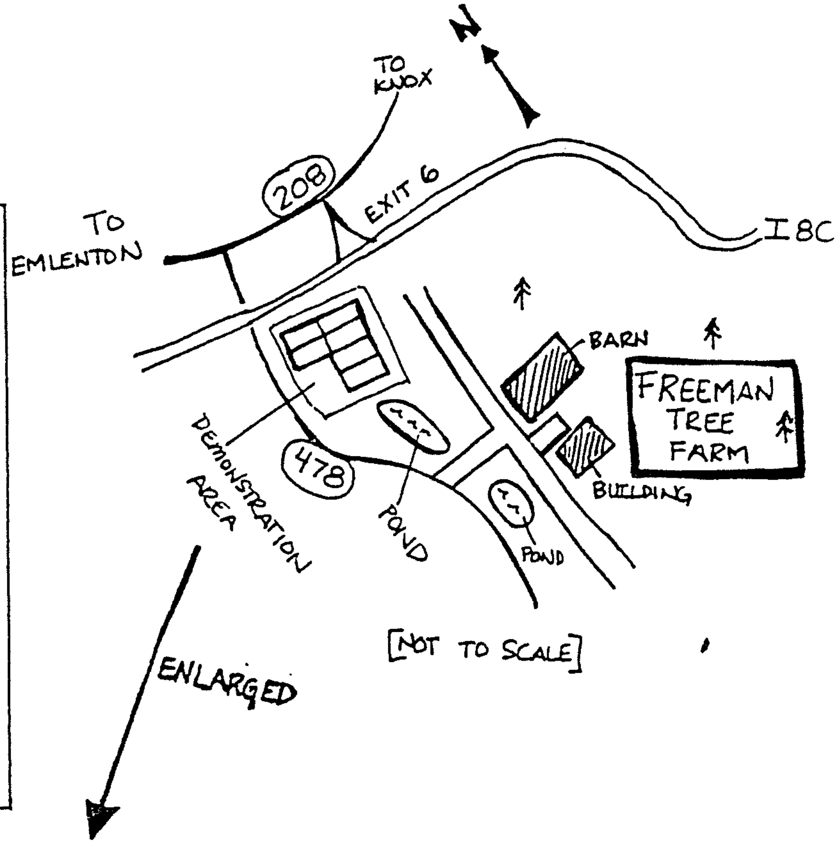
4. To Lackawanna State Forest Site, Lackawanna County (from Penn State):
Take Rt. 26 North from State College to Rt. 64 North to I80 East.
Exit at Blakeslee (exit 43), and go north on Rt. 155.
Turn right at the sign that says "Thornhurst 5 miles."
Drive to Thornhurst and make a left turn at the intersection after the firehouse (to Wilkes Barre).
Pass the Bureau of Forestry Headquarters on the right.
Turn right into Lackawanna State Forest on Pottstown Road (this turn is easy to miss).
The plots are approximately 2 miles down this dirt road.
On the right side of the road there is a place to pull over and park.
Walk from the road on skid trail, pass the log landing, and cross over a bridge to find the first plot.
Travel time from State College is 3 hours.

5. To Freeman Tree Farm Site, Clarion County (from Penn State):
Take US 322 West from State College to I80 West.
Take Exit 6.
Turn left on Rt. 208, then make a left turn onto Rt. 478 (this road will take you under I80).
Follow Rt. 478 for a couple miles and make a left turn into Freeman Farm (there is a conspicuous sign at the gate).
You will be driving toward a barn. Make a left turn when you get there.
The plots are on the left hand side of this dirt road.
There is a easily walkable skid trail down to the demonstration.
This is actually the end of the trail that begins down from the road on which you entered the property.
The trail head is in front of the lower man-made pond.
Travel time from State College is 2 1/2 hours.

6. To Forbes State Forest Site, Somerset County (from Penn State):
Take US 322 West from State College to US 220 South.
South of Altoona, turn onto US 22 West.
Turn onto US 219 South towards Johnstown.
Turn onto US 30 West.
Make a left turn onto Laurel Summit Road.
This will turn into a dirt road. Turn right when the road you are on dead ends.
Veer left onto Hickory Flats Road.
The plots are a one mile further; four on the left side of this road, and two on the right.
You can park on the side of the road.
Travel time from State College is 2 1/2 hours.

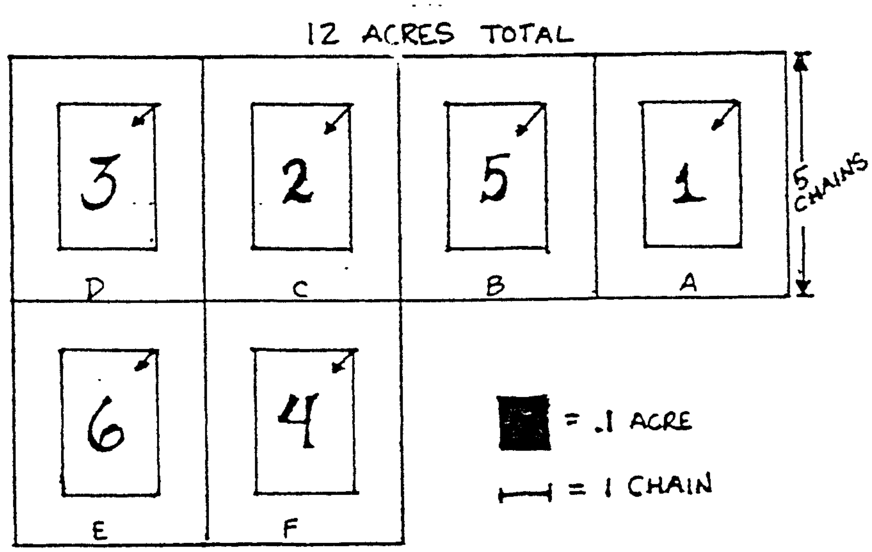
7. To French Creek State Park Site, Berks County (from Penn State):
Take US 322 East from State College to Harrisburg.
Turn onto I81 North (East) and then I83 South to I76 East (PA turnpike).
Take Exit 22 off I76 and turn onto Rt. 23 East.
Take Rt. 345 North to French Creek State Park.
Turn left at the Park sign (3rd entrance).
Take the first right, then a left and another left onto Firetower Rd. **
There is parking lot just inside the gate on the right side of this road.
The plots are up this road about a half mile on the right hand side.
Three of the plots are on the left hand side of the Red Trail and the other three are on the right side.
**Follow map closely on the dirt roads.
Travel time from State College is 3 1/2 hours.

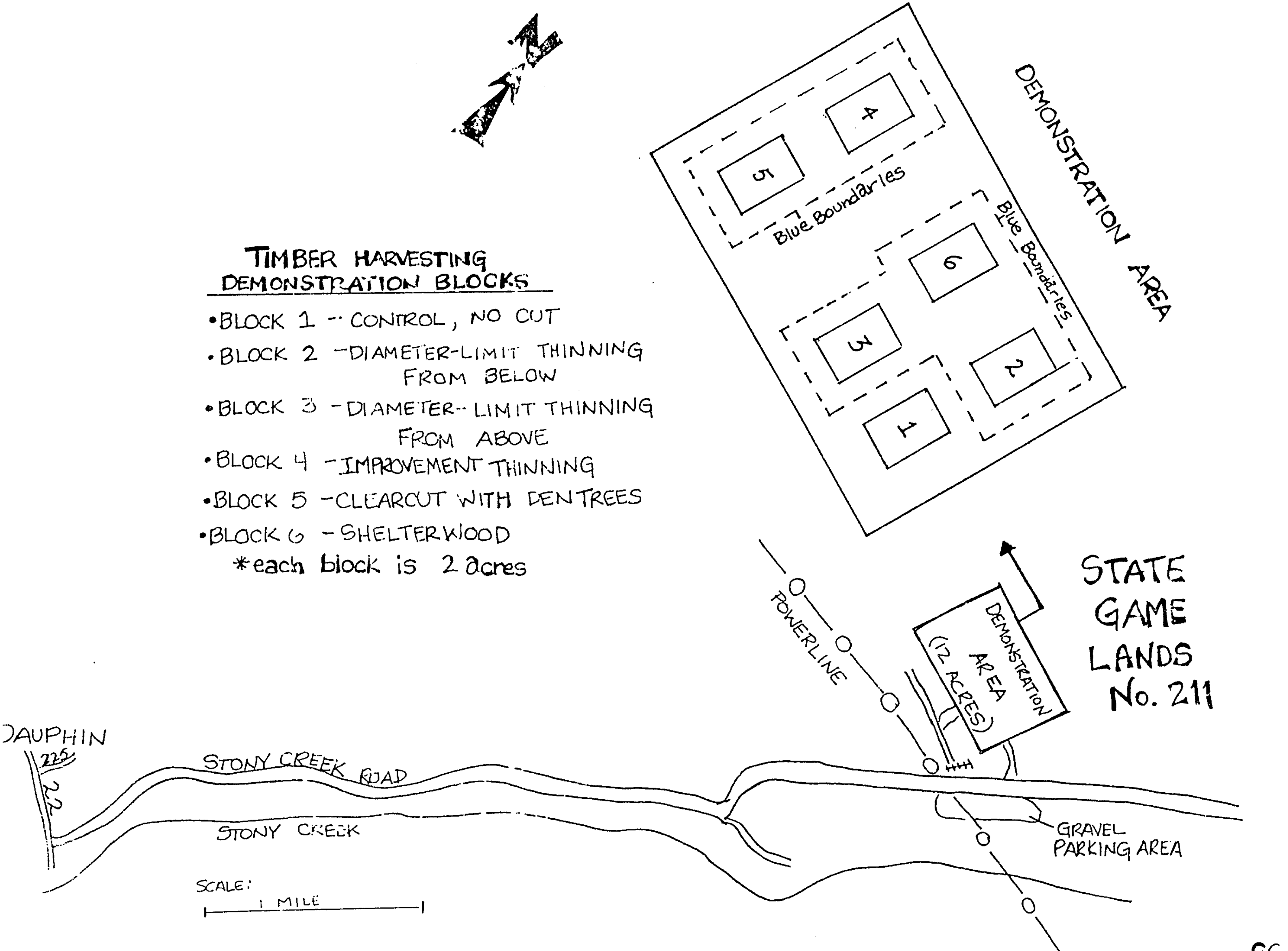
FOREST STEWARDSHIP DEMONSTRATION AREA AT FREEMAN TREE FARM



TREATMENT BLOCKS
(2 ACRES EACH)

1 CONTROL
2 THINNING FROM BELOW
3 THINNING FROM MIDDLE
4 THINNING FROM ABOVE
5 IMPROVEMENT THINNING
6 CLEARCUT

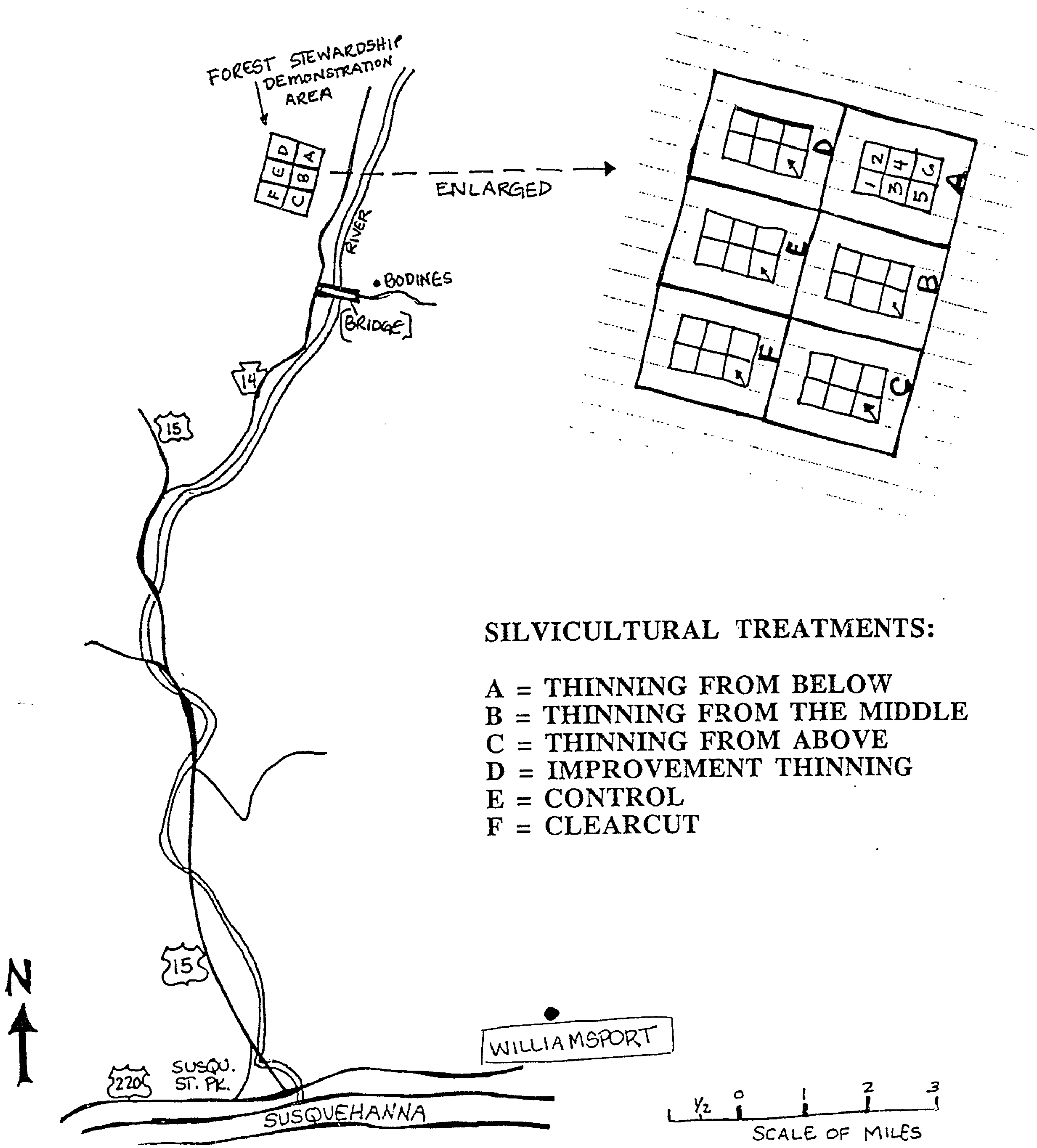




MAP for PA FOREST STEWARDSHIP FOREST MANAGEMENT DEMONSTRATION SITE

SG 211

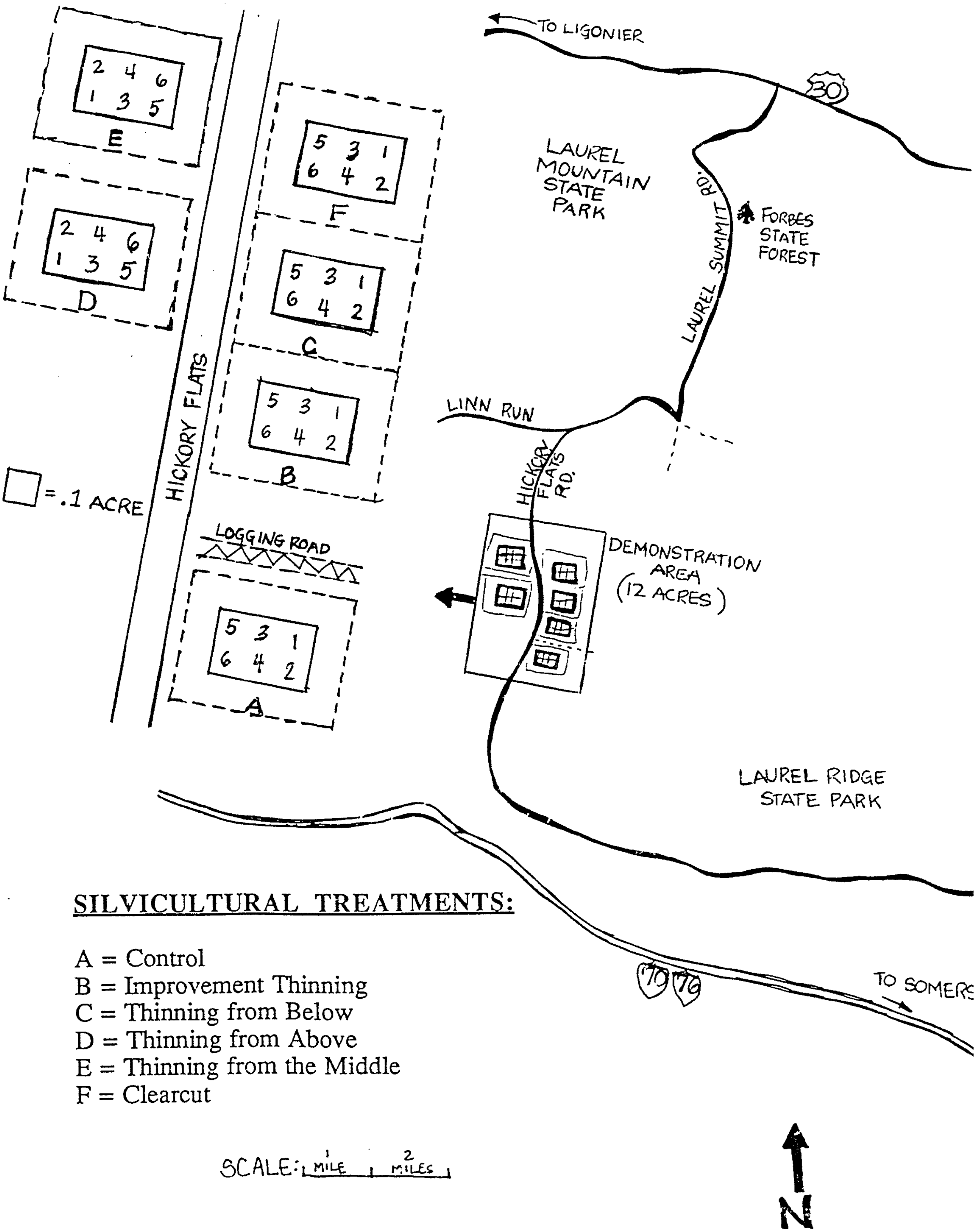
FOREST STEWARDSHIP DEMONSTRATION AREA AT TIADAGHTON STATE FOREST



SILVICULTURAL TREATMENTS:

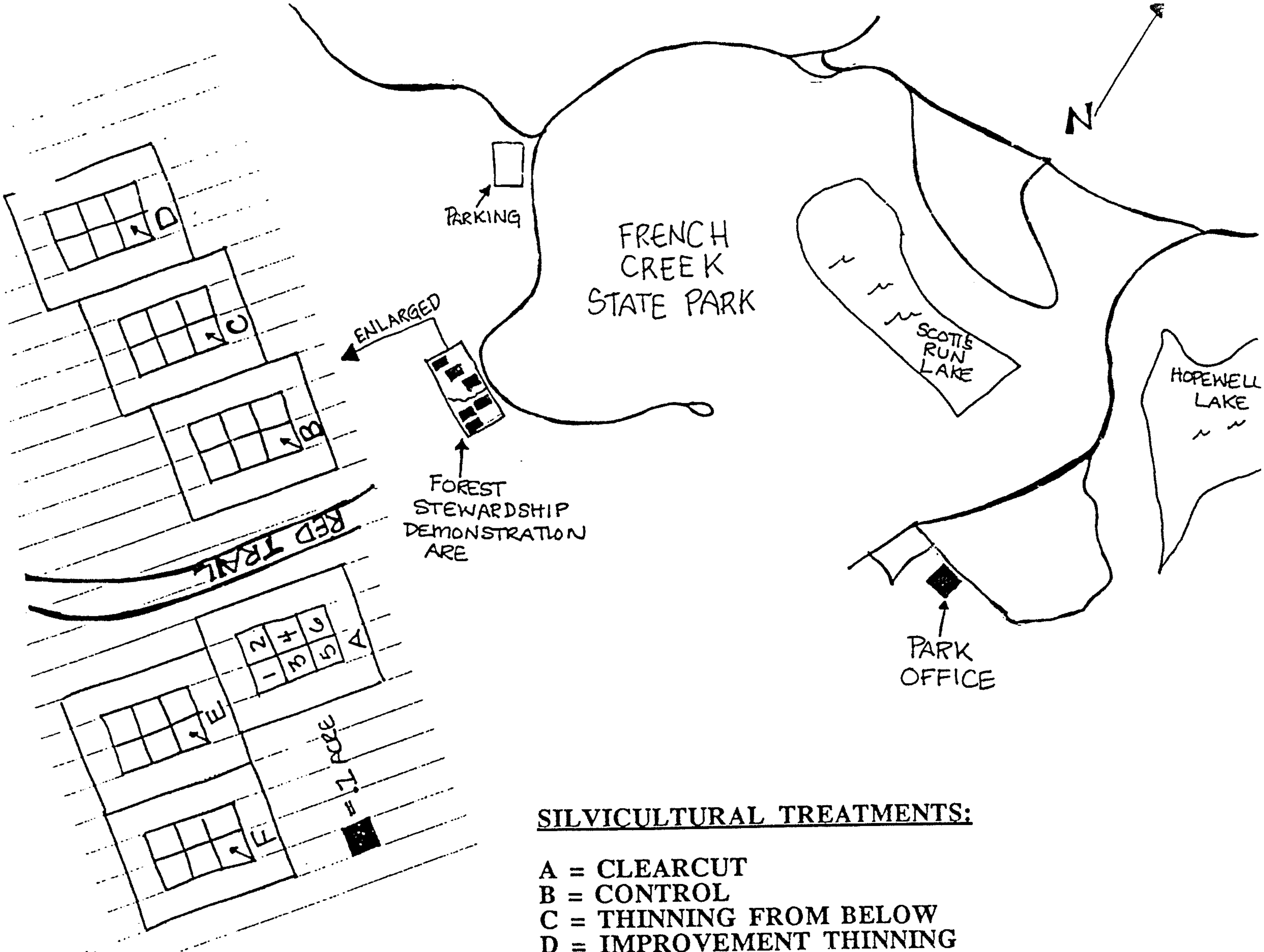
A = THINNING FROM BELOW
B = THINNING FROM THE MIDDLE
C = THINNING FROM ABOVE
D = IMPROVEMENT THINNING
E = CONTROL
F = CLEARCUT

FOREST STEWARDSHIP DEMONSTRATION AREA IN FORBES STATE FOREST



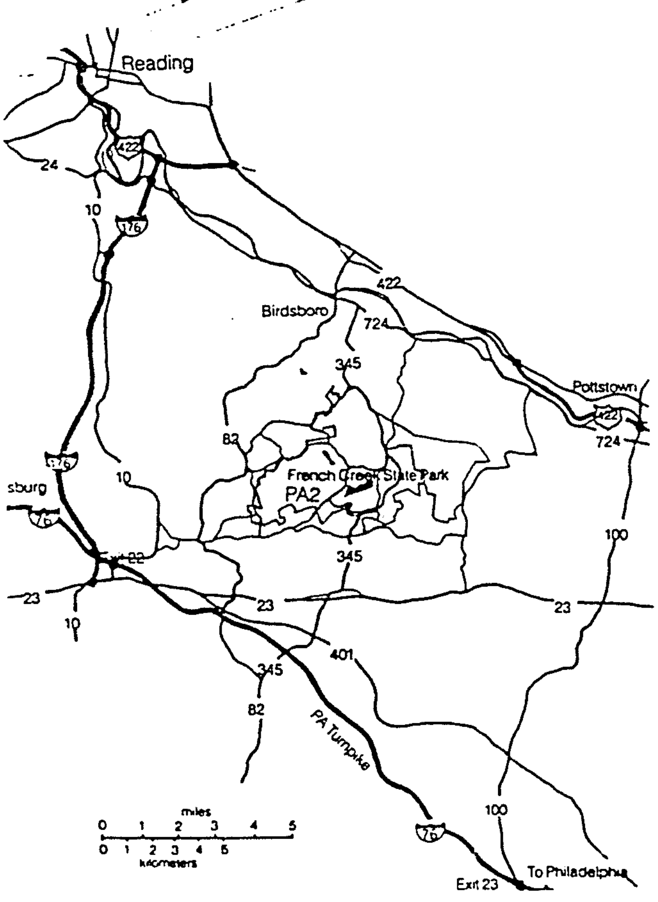
SILVICULTURAL TREATMENTS:

A = Control
B = Improvement Thinning
C = Thinning from Below
D = Thinning from Above
E = Thinning from the Middle
F = Clearcut



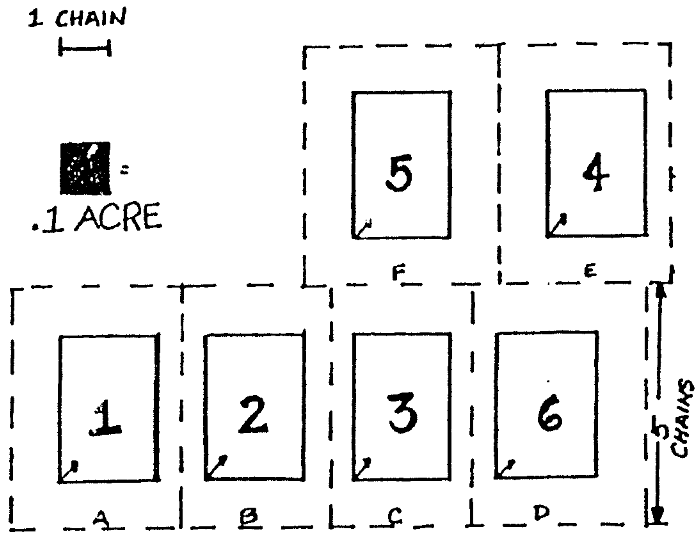
SILVICULTURAL TREATMENTS:

A = CLEARCUT
B = CONTROL
C = THINNING FROM BELOW
D = IMPROVEMENT THINNING
E = SHELTERWOOD
F = THINNING FROM ABOVE



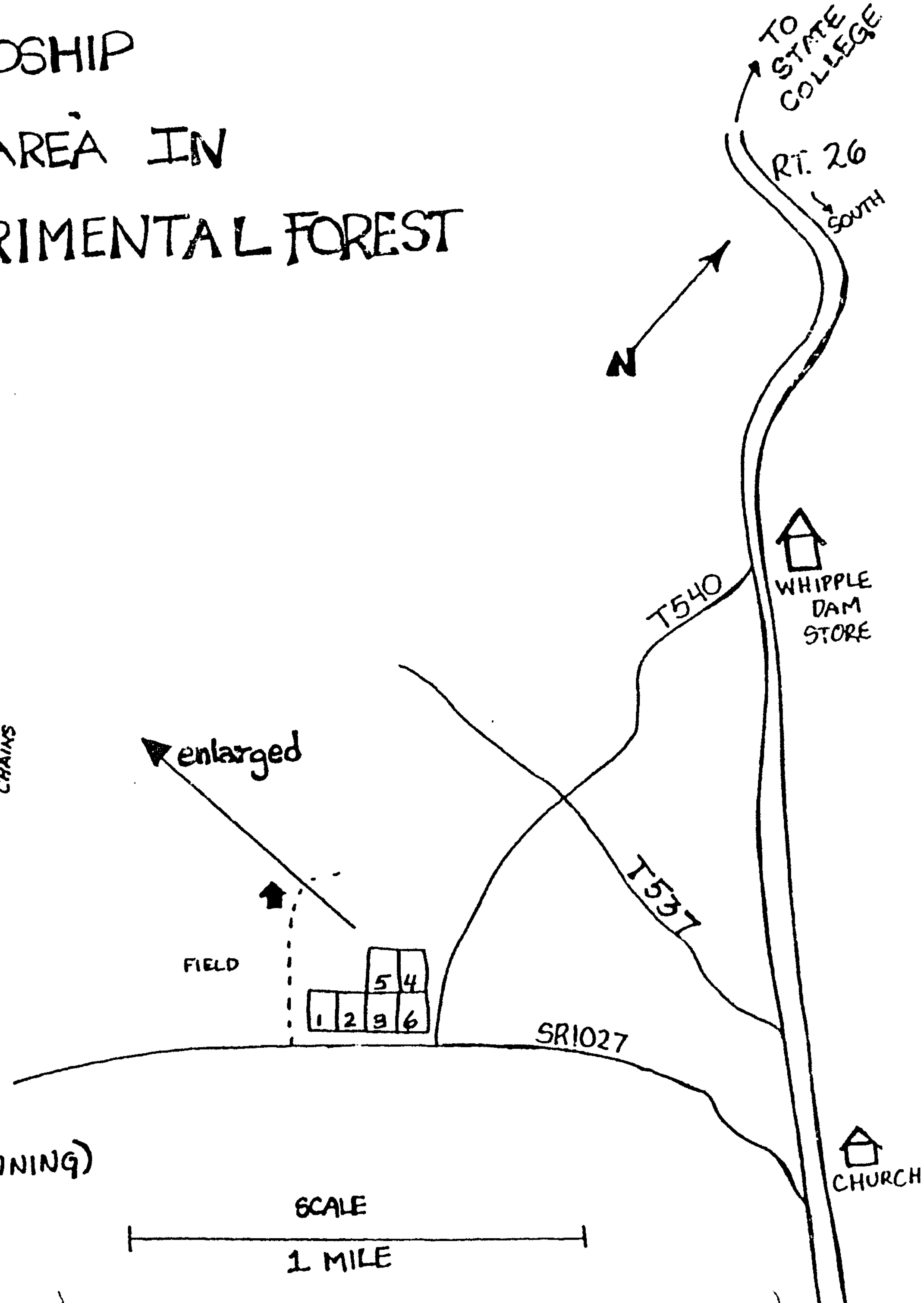
Forest Stewardship Demonstration Area at French Creek State Park

FOREST STEWARDSHIP DEMONSTRATION AREA IN STONE VALLEY EXPERIMENTAL FOREST

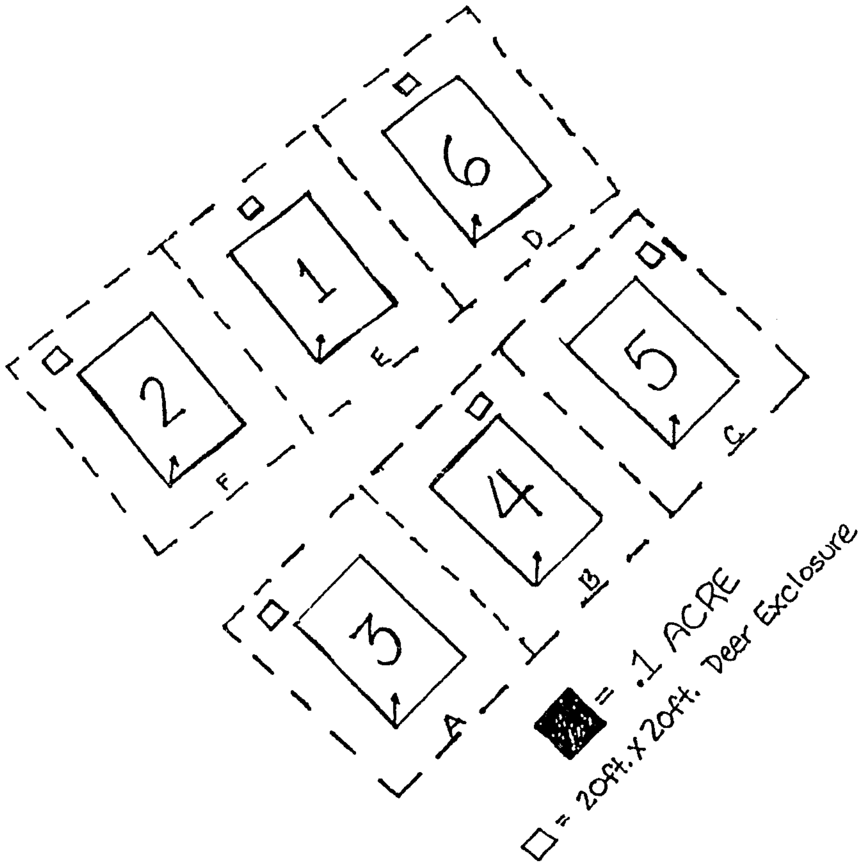


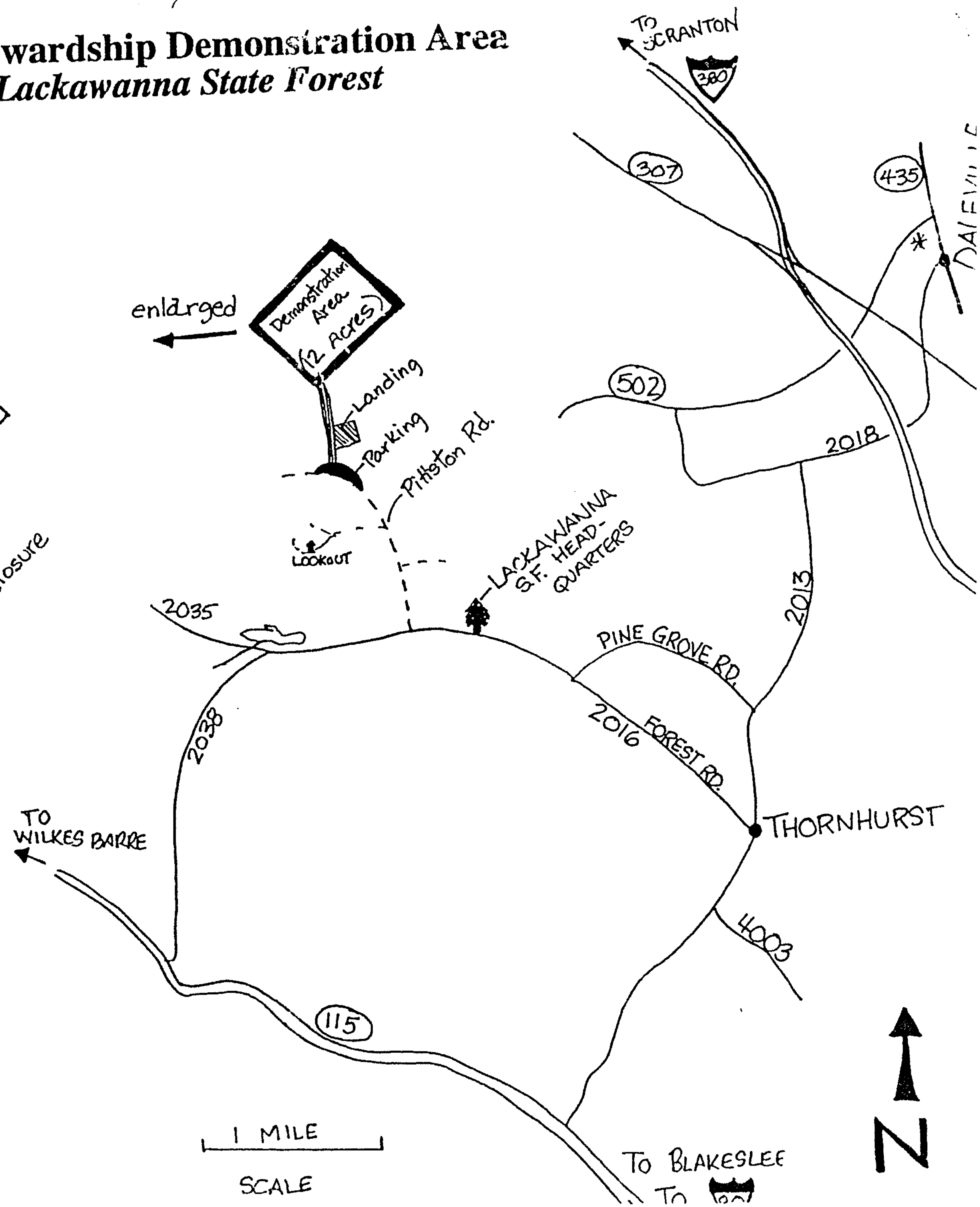
TREATMENT BLOCKS:

1 = CONTROL
2 = THINNING FROM BELOW
3 = THINNING FROM ABOVE
4 = SILVAH (IMPROVEMENT THINNING)
5 = CLEARCUT
6 = SHELTERWOOD



Forest Stewardship Demonstration Area
at Lackawanna State Forest





TREATMENT BLOCKS
(two acres each)

1 = Control
2 = Thinning from Below
3 = Thinning from Above
4= Thinning from Middle to Above
5 = Improvement Thinning (SILVAH)
6 = Clearcut

FOREST STEWARDSHIP
TIMBER HARVEST
DEMONSTRATION AREA
Freeman Tree Farm

More than half of Pennsylvania is covered by forests. Most of these are "working" forests, continuously supplying the people of Pennsylvania and people all over the world with essential natural resource amenities and forest products. Because Pennsylvania's extensive forests contain high quality hardwoods, timber harvesting is an important reality and a significant part of our state's economy. Most everyone depends on the forest for wood products, and many people depend on the forest for their livelihood. Others simply enjoy the many forms of recreation and natural beauty the forest provides.

All this "taking" from Pennsylvania's woodlands, particularly timber harvesting, can have a large impact on the sustainability of the forest and its resources. However, with proper planning and careful management, timber harvesting can be beneficial, helping maintain vigorous, healthy, and productive forests. Therefore, it is essential that timber harvesting be employed as part of a professionally prepared management plan that recognizes potential consequences and avoids resulting negative impacts, including erosion and sedimentation, soil compaction, and damage to residual trees.

The forest provides many different benefits, and the preference for how it should be used or not used varies from person to person. For this reason, timber harvesting is frequently a controversial issue. Because most people (forest landowners and the general public) know so little about timber harvesting and its role in maintaining sustainable forests, the controversy is often magnified. To reduce the potential for conflict, we have developed this site to demonstrate alternative methods of timber harvesting along with both their benefits and consequences. With responsible forestry, which may include timber harvesting, we can ensure that biodiversity, wildlife habitat, and aesthetics are maintained.

This site on the Freeman Tree Farm is one of eight areas established across the state to demonstrate and study alternative timber harvesting practices. One of the primary objectives of this project is to encourage responsible forest resource management. We want all visitors to embrace the forest stewardship ethic. Because many people have the opportunity to visit the Freeman Tree Farm, this site provides us access to a large number of people who care deeply about forests and who want to form educated opinions about natural resource management.

FORESTRY TERMINOLOGY:

In order to facilitate understanding of the project, the treatments, and the considerations involved, we offer the following definitions of some of the terms frequently used in forestry.

- ***Forestry*** : the art and science of establishing and managing forests and their associated resources for a variety of benefits and values.
- ***Regeneration*** : the replacement of one forest stand by another as a result of natural seeding, sprouting, planting, or other methods.
- ***Residual stand*** : trees that remain following any cutting operation.
- ***Silviculture*** : the art, science, and practice of establishing, tending, and reproducing forest stands with desired characteristics. **Cutting** is the primary tool of silviculture and can either promote growth of desirable species or the establishment of new trees.
- ***Stand*** : a grouping of forest vegetation sufficiently uniform in species composition, age, and condition to be distinguished from surrounding vegetation types and managed as a single unit.
- ***Stewardship*** : the wise management and use of forest resources to ensure their health and productivity today with regard for generations to come.

The Treatments

Each of the six treatment blocks is two acres. The treatments include various types of thinnings and a regeneration harvest.

NO HARVEST

The major objective of this project is to encourage the responsible management of forests by showing the results of alternative timber harvesting treatments. However, our demonstration would be incomplete without first permitting you to see how the forest would appear without a treatment. In many circumstances no cutting may be a preferred alternative. Please keep in mind though, that forests, even without cutting, are dynamic, and ever-changing.

Block 1. Control... For comparison, nothing is removed from this plot.

THINNINGS

Tree mortality (death) is a natural, ongoing process in the forest. Young forests with small trees support many thousands of individual trees per acre. As the forest matures and individual trees become larger, many of those thousands of trees are crowded (by faster growing neighbors) and die. The trees in this forest began to grow around the turn of the century, and there were nearly 500 per acre before treatments were applied.

Thinning is a forestry technique used to "capture" some of the potential mortality by harvesting selected trees. Thinning reduces crowding and, by redistributing the growth potential to the most desirable trees on the site, the overall health, vigor, and growth of the remaining stand is increased. Those "residuals" or remaining trees may have been selected for one of many reasons, including wildlife habitat (a "cavity" tree), timber, or aesthetics. Thinning also provides some intermediate return on a landowner's long-term forest investment.

Four of the treatments are thinnings. These sites were fully stocked before harvesting. That is, there were no openings in the forest. Viewed from above, the crowns or branches of the trees seemed to touch one another in a continuous, green carpet. There was no room for individual crowns to grow and expand. The purpose of our thinning treatments was to reduce the stocking or density to 60 percent to give the residual trees additional room to reach out, thus increasing their rate of growth.

Block 2. Diameter-Limit from Below... A diameter-based thinning-from-below reduces the stocking (to 60 percent) by removing all trees smaller than a calculated diameter. Because the decisions about which individuals to remove are driven by diameter alone, there is no opportunity to deliberately allocate growing space to meet objectives. For instance, if all the trees on the site are of approximately the same age, a common condition in Pennsylvania, the smaller ones are growing slowly and competing poorly with their larger neighbors. Removing them typically provides little additional growing space to the larger ones. Also, by removing all the trees of similar size, we may actually eliminate one or more tree species that happen to grow and develop naturally at a slower rate. Although the resulting forest can look almost park-like, which is pleasing to many people, the treatment can have important negative effects. Small trees and shrubs provide food, homes and hiding places for wildlife, and their removal may significantly reduce wildlife use of the area. Also, a diameter-based cut from below will likely not be an economically viable option, in terms of both immediate cash flow and ultimate financial return.

Block 3. Diameter-Limit from the Middle... In this treatment, the stocking was reduced to 60 percent by removing all trees between two calculated diameters. In other words, the medium-sized trees were removed, leaving the largest dominant trees and the smallest trees. The result is what appears to be a two-aged stand of maturing sawtimber and younger saplings. In fact, the trees that are left may be very similar in age. Overall, the average tree diameter in the stand has been reduced, and the composition of species has been shifted towards those that are more tolerant of shade. Additional growing space has been made available for the sapling-sized trees. The trees that were removed were merchantable, providing some financial return.

Block 4. Diameter-Limit from Above... A diameter-based thinning-from-above reduces the stocking (again, to 60 percent in this case) by removing all trees larger than a calculated diameter. Those largest trees are selected on the basis of diameter alone, regardless of their location with respect to other trees. None of the diameter-based thinnings shown in this demonstration is rooted in sound forestry. The results are generally undesirable. Once again, when all similarly sized trees are removed, certain tree species can be completely eliminated from the remaining stand, and in an even-aged stand (most in Pennsylvania are), the burden of ultimately regenerating the forest falls on the smaller and possibly genetically inferior residual trees. Because the remaining trees are not younger, but instead are slower-growing, damaged, diseased or less vigorous species, they may not be able to respond to the increased growing space made available to them by the thinning. This is a negative impact on long-term forest health and diversity. In addition, this treatment allows no consideration for wildlife habitat. A diameter-based cut from above probably yields the highest immediate cash return of any thinning, but the long-term financial yield is drastically reduced. The residual stand, dominated by low value and poor quality trees, is simply unable to generate much future income potential.

Block 5. Improvement Thinning... An improvement thinning represents the professional forester-recommended silvicultural treatment for this forest stand. It was designed to meet a set of specified objectives, including production of timber for income, maintenance of wildlife habitat, and protection of the soils and related resources. In an improvement thinning, the resource professional balances the landowner's management objectives with forest conditions the site and markets, and then selects individual trees to cut or to leave on the basis of species, spacing, and tree quality. The result is that trees of many sizes are removed and growth is redistributed by making growing space available to desired trees. In this way, the overall quality of the forest is improved for whatever objectives were chosen. Typically, the immediate cash return from this type of thinning does little more than cover its costs, but the treatment serves as an investment in the future of that particular forest.

REGENERATION HARVESTS

Forests are a renewable natural resource. Forests left completely undisturbed do not live forever. Once a tree becomes "mature," growth slows, resistance to insects and disease is reduced, and its ability to respond to injuries diminishes. Old trees are eventually harvested naturally, dying and then crumbling or crashing to the forest floor to donate their nutrients to the soil where they can be used by other living organisms and new seedlings. In a **regeneration harvest** we are mimicking this slow natural process to ensure long-term forest sustainability. Old trees are removed as efficiently as possible in order to supply the space and access to resources (light, moisture and nutrients) needed for the establishment of a new crop. When making decisions regarding a regeneration harvest one must consider the characteristics of the site, including soil and topography, the species of trees in the forest and their specific regeneration requirements, as well as possible impacts on wildlife and water resources.

Block 6. Clearcut... A **clearcut**, as defined by foresters, removes all the trees in one cutting, mimicking a natural disturbance like a fire or windthrow. In our hardwood forests, care must be exercised to make sure that naturally occurring regeneration is adequate **before** the cut is made. Otherwise, establishment of the new forest can be delayed significantly, and the site may become occupied by grasses and ferns or trees that do not meet the landowner's objectives. When applied appropriately, this treatment will lead to a forest of similarly aged trees, the most abundant being those that grow best in high levels of sunlight. The financial returns associated with this treatment can be high, but the aesthetic value of the forest for most observers is diminished until the new forest becomes established. Although the term "clearcut" imparts a very negative image to most people, harvesting a mature forest may be a good option for a landowner, depending upon the growth patterns of involved species, the timber market, and the conditions of the site.

Shelterwood... An alternative to a clearcut is a shelterwood cut. A shelterwood cut removes both small trees and some large trees, the exact treatment varying from site to site. This regeneration treatment, which is less visually disruptive than the clearcut, favors tree species that require less than full sunlight to regenerate or trees that grow best under the shade or ***shelter*** of other trees. In addition to their sheltering function, the trees left after the first cut serve as seed sources for the new forest. Therefore, a shelterwood cut has the added benefit of allowing new tree seedlings to become established over time, reducing the risk of having no new growth. The first cut of the shelterwood treatment offers only limited initial cash flow. Much higher returns are realized when the new stand is established and the larger, residual trees are removed.

The Impact of Whitetail Deer

The whitetail deer was hunted nearly to extinction around the turn of the century. Their remarkable recovery since that time can be attributed to factors including the elimination of natural predators (mountain lions and wolves) by early settlers, abundance of favorable habitat provided by young forests and agricultural fields, and protective game laws. But the resulting overpopulation of deer has negative consequences for our forest resources. The diversity of woody and herbaceous ground cover is reduced as is the diversity of forest songbirds and other wildlife. There is a delayed recovery of forests after disturbance due to deer overbrowsing. Often, commercially valuable tree species have failed to regenerate.

Many differing perspectives and opinions surround the issue of deer overpopulation. Whitetails certainly are beautiful animals, and a park-like forest that is easy to walk through results from their browsing of shrubs and seedlings. Therefore, actions to reduce the deer herd in Pennsylvania will only be taken when landowners, hunters, legislators and the general public understand that there are negative consequences of overpopulation.

At the Freeman Tree Farm, deer may have a large impact on the growth of new seedlings and other vegetation after harvesting. We also anticipate tree regeneration under different harvesting treatments to vary. To demonstrate the effect of different light levels in combination with deer populations, paired fenced and unfenced regeneration plots have been established in each of the six treatment blocks. Differences in plant species abundance and composition will be monitored.

Summary

Each research plot will be remeasured three years and ten years after harvesting. We will monitor factors related to plant and animal species diversity, residual and new growth, mortality, and economic value of each treatment. Additional harvests may be conducted in the future to maintain density at 60 percent within the thinned treatment areas.

As we've pointed out, the timber harvesting alternatives presented do not all represent good forestry, but regardless, they are all used in Pennsylvania. The diameter-based thin-from-above treatment, also called "high-grading" because it removes the best or highest grade trees and leaves the rest, is particularly common on private, individual properties in the state. The purpose of this demonstration is to provide landowners, timber harvesters, foresters, and concerned citizens with some harvesting options, displaying both their positive and negative consequences. In addition, we hope to make you aware of some of the many considerations that should be a part of harvesting decisions. After all, our actions today have a great deal of bearing on the future sustainability of Pennsylvania's forests. As a result, we hope that forest landowners who visit the site will use the knowledge gained and, with the help of professional forest managers, incorporate their own objectives into a forest management plan. We believe all visitors can learn enough about responsible forest management to help form educated opinions about important forestry issues. Finally, we encourage you to embrace the forest stewardship ethic and share the spirit of responsibility for our renewable natural resources.

Please remember that all of us use, in fact depend on, forest products. Timber harvesting is an essential practice that can serve as an effective, environmentally sensitive tool of forest management. Join us in encouraging responsible management of all forests, public and private.

Appendix B

Partial
Program Listings
January 1997 through November 1998

Date/Location	Event	Number of Persons	Comments
March 5, 1997 Thornhurst	New Jersey / Pennsylvania Logger Training	14	Joint meeting between states, funded by US Forest Service
April 19, 1997 Stone Valley	International Conference on Indigenous Knowledge	12	Tour designed for people conveying knowledge about resource management and sustainability
May 12, 1997 (Kane Exp. Forest)	US Forest Service National Silviculturalist Tour	110	Using the original site and design, explained to silviculturalist from across the nation the merit of using demonstrations to reach audiences.
May 21, 1997 (Kane Exp. Forest)	Eco-weekend	30	Teachers introduced to using demonstrations in classroom teaching on the environment
July 28, 1997 Stone Valley	Pennsylvania Governor's School	32	Outstanding high school students considering agricultural careers
July 29, 1997 Stone Valley	Pennsylvania Governor's School	30	Outstanding high school students considering agricultural careers
September 10, 1997 Forbes State Forest	Environmental Logging, Sustainable Forestry Initiative	13	Sustainable Forestry Initiative Programs use the sites to emphasize harvesting practice impacts
September 13, 1997 Freeman Farm	50th Tree Farm Anniversary Celebration	300	Hosted by the Clarion County Stewardship Committee and the American Tree Farm System
September 20, 1997 Game Lands 211	Dauphin Co. Forest Owners Workshop	45	Annual meeting held by county agent
November 20, 1997 Baltimore Maryland	Working Toward Common Goals Workshop	85	Regional meeting sponsored by NRCS to explore farmer outreach programs. One of three case studies for Northeast presented.
June 24, 1997 Game Lands 211	Pennsylvania Game Commission Deer Management Committee	14	Video tape of this tour became a feature segment of a 13 part video program aired on the Public Broadcasting System statewide
July 27, 1998 Stone Valley	Pennsylvania Governor's School	30	Outstanding high school students considering agricultural careers
July 28, 1998 Stone Valley	Pennsylvania Governor's School	33	Outstanding high school students considering agricultural careers
November 20, 1997 Baltimore Maryland	Working Toward Common Goals Workshop	85	Regional meeting sponsored by NRCS to explore farmer outreach programs. One of three case studies for Northeast presented.
June 13, 1998 Game Lands 211	Center Region VIPs/Covert Summer Meeting	20	VIPs work with service foresters and peer landowners
September 12, 1998 Game Lands 211	Dauphin Co. Forest Owners Workshop	28	Annual meeting held by county agent
September 29, 1998	University of	45	Many favorable complements and

Stone Valley	Freiberg Student Exchange		interest in developing similar demonstrations near Freiberg in the Black Forest
November 9, 1998	State College High School Enviro Class	42	Part of a lesson section on sustainable forestry

Appendix C

Journal of Forestry Article

Stephen B. Jones

PEER REVIEWED

Encouraging Private Forest Stewardship through Demonstration

By Alison H. Harmon, Stephen B. Jones, and James C. Finley

On their field tour of the Freeman Tree Farm, Pennsylvania landowners saw the benefits and consequences of clearcutting, a forest management practice often met with public opposition. Such demonstrations of harvesting outcomes proved more effective in educating NIPFs than slide shows and lectures.

Forestry researchers and sociologists alike have devoted much study to private forest landowners. What are their beliefs? What motivates them to own and manage forestland? What can the forestry profession do to encourage private forest stewardship?

There is a general absence of science-based forest management on Pennsylvania's private, nonindustrial forests. This ownership class, which comprises half a million individuals, accounts for more than 70 percent of the state's forests and supplies 80 percent of the raw materials for the largest hardwood industry in the nation (Jones and Finley 1993). Yet only 3 percent of these owners have written forest management plans (Birch and Stelter 1993), and if Pennsylvania is like other eastern states, only 20 percent of all timber harvests involve a forester (Nyland 1992). In practice, private forest landowners make decisions that affect not only the long-term viability of the hardwood industry but also the sustainability of the broader set of values that society expects from even private forests.

Jones et al. (1995) suggested that a major obstacle to communicating with private forest owners has been the forestry community's adherence to myths that mischaracterize landowners. Private forest owners are much less connected to their land than in the past, and they are more like the general public than professional foresters with regard to environmental, timber, and private property issues (Luloff et al. 1993; Bliss et al. 1994; Bourke and Luloff 1994).

Egan and Jones (1993) found that most landowners already embrace a land ethic. Without knowledge and assistance, however, wanting to do the right thing is not enough. Landowners who are more informed about forests and forestry have more favorable harvesting outcomes: less erosion and sedimentation, better-quality roads, better residual stand quality, and less damage to residual trees. They found an even stronger relationship between forester assistance and harvesting outcome.

Landowners agree that they need more information to make responsible forest management decisions (Luloff et al. 1993). Interestingly, they prefer technical assistance and education over cost sharing (Bliss and Martin 1990; Jones et al. 1995). If education can ensure private forest sustainability, how can foresters best educate landowners?

A Penn State Cooperative Extension project, "Integrating Sustainable Forestry into Total Farm Management," funded by the USDA Sustainable Agriculture Research and Education Program, introduces landowners, the general public, foresters, and loggers to the role of timber harvesting in sustaining forests. Cooperators include the USDA Forest Service, the Pennsylvania Bureau of Forestry, the Pennsylvania Game Commission, the Pennsylvania Bureau of State Parks, and tree farmer George Freeman.

There are seven project sites across Pennsylvania: each demonstrates six timber-harvesting treatments in 2-acre blocks, including no cutting and a clearcut. The four intermediate treatments reduced relative density to 60 percent: a diameter-based thinning that removed the smallest trees, a diameter-limit cut that removed only the largest trees ("high-grading"), a thinning of trees evenly distributed above and below the mean tree diameter (replaced by a shelterwood, relative density to 50 percent, on three sites), and an improvement thinning using SILVAH prescriptions (Marquis and Ernst 1992). The demonstration design is modeled after an installation at the Kane Experimental Forest in northwestern Pennsylvania.

Project participants were shown the various benefits and consequences associated with the cutting alternatives. Discussion topics included the appropriateness of each treatment for meeting specific landowner objectives, the complex nature of forestry, the need for making long-term management plans, and the role of the professional forester in decisions about how and when to harvest. We sought to assess the effectiveness of the demonstration areas in increasing landowners' knowledge and awareness of forests and timber harvesting, as measured by an objective test. A secondary purpose was to evaluate whether a tour through a demonstration area had any effect on the attitudes and beliefs of the participants.

Table 1. Mean objective knowledge scores, by experimental group.*

Experimental group	n	Mean scores (correct responses)	S.D.
Control	63	8.76 a	3.20
Slides only	77	10.38 b	3.33
Slides plus field tour	56	12.14 c	3.28

Mean scores not followed by the same letter are significantly different at the $p < 0.05$ level. The score is the number of multiple-choice questions answered correctly; perfect score = 17.

Table 2. The effect of prior workshop attendance on the objective knowledge score.

	Attended prior workshops		First workshop		
Experimental group	Mean	n	Mean	n	*p*-value
Control	10.18	33	7.24	29	.000*
Slides only	11.17	40	9.58	36	.036*
Slides plus field tour	12.69	36	11.11	18	.099

Indicates a significant difference in objective scores between those who had attended previous workshops and those who had not; perfect score = 17.

Methods

The Penn State Cooperative Extension Service hosted five forest stewardship workshops and meetings during the summer and fall of 1994 at two demonstration sites. Workshop and meeting participants served as the sample for this study. Foresters, forest landowners, timber harvesters, timber buyers, and some nonlandowners constituted the audiences. The program had two parts: a scripted slide presentation and a walking tour of the field demonstrations. The slide presentation covered forest history, ecology, timber-harvesting alternatives, and threats to the sustainability of Pennsylvania's forests. Participants viewed photographs of each cutting alternative as it was discussed. During the walking tour that followed, the purposes of the various cutting treatments were reiterated and the benefits and consequences of each were explored.

We randomly divided each workshop audience into three experimental groups. Group assignment determined when participants would complete a questionnaire: on arrival (control group), following the indoor segment (slides-only group), or at the end of the demonstration tour (slides-plus-field-tour group). The questionnaire, which was standard for all groups, contained objective knowledge questions about forests and forest management and a subjective section asking the degree to which (on a five-point scale) respondents agreed with statements about forest management practices. The objective, multiple-choice questions came from an established instrument used in logger educational programs (LEAP). The subjective, attitude-belief questions came from a previous survey (Luloff et al. 1993). We also asked respondents for demographic and landownership information.

We expected that objective test scores would increase once respondents had seen the slides, but we wanted to know whether the field demonstration would improve them further. We were also interested in how the slides and field tour would affect respondents' beliefs about timber harvesting and clearcutting, and the relationship between objective test score and acceptance (based on subjective responses) of various cutting practices. We focused on clearcutting not because our goal was to "improve" attitudes toward clearcutting but because this harvesting method is typically met with considerably more opposition than are intermediate treatments, such as those in the demonstration (Ribe 1989; Brunson and Shelby 1992).

Results and Discussion

The number of people in the study sample was 197. The range of ages was nine to 80 years. About one fourth were women (28 percent). The respondents were distributed across all levels of education, annual household income, and occupational categories (white collar, blue collar, student, retired, and other). Sixteen percent of respondents' occupations were classified as forest-resource dependent (i.e., foresters, timber harvesters, woodsworkers, etc.). More than half had previously attended at least one workshop on forest management (57 percent). Most were landowners (72 percent), and about one third said they had written forest management plans (36 percent).

We derived for each respondent an objective knowledge score, that is, the total number of multiple-choice questions answered correctly; the highest possible score was 17. Factor analysis of the subjective items identified two unique factors. Items concerning the consequences of cutting trees or harvesting timber composed one factor (timber harvest acceptance); the second factor (clearcut acceptance) included items concerning clearcutting and replanting after trees are cut. We derived respondent scores for each factor by summing the five-point scales for the applicable subjective items.

Objective knowledge. Analysis of variance indicated that knowledge score was influenced by experimental group ($p = .000$). Scheffe's test indicated that the slides-only group scored significantly higher than the control group, and the slides-plus-field-tour group scored significantly higher than the slides-only group *(table 1).*

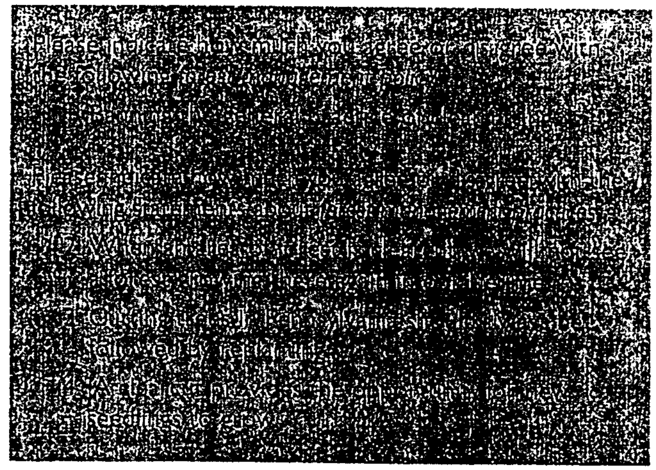
A multiple analysis of variance showed that two other variables were important sources of variation in knowledge score: respondents' education level ($f = 7.59$, $p = .000$) and whether a respondent had previously attended a forest management meeting or workshop ($f = 16.48$, $p = .000$).

A closer examination of the effect of previous workshop attendance on knowledge score revealed that as our workshop progressed, the effect of attendance at prior workshops diminished *(table 2).*

The significant increases in mean knowledge score attributable to the slide show and field tour suggest that both can be valuable and effective teaching tools. However, participants appear to learn most when a traditional classroom experience (using slides) is followed by an experience in the field, where concepts are witnessed.

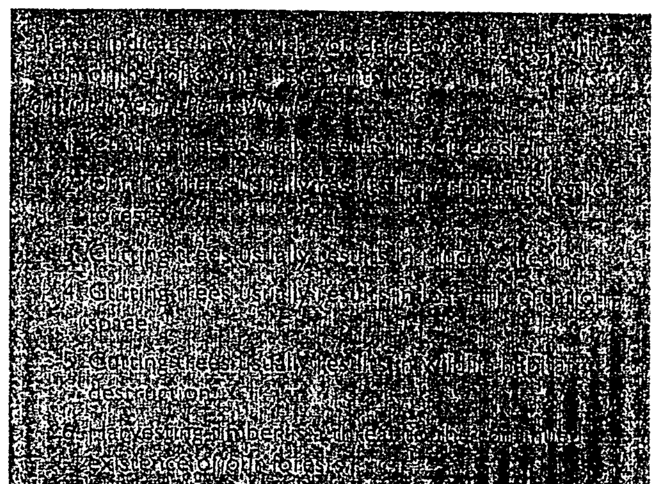
The importance of previous workshop attendance suggests that repeated exposure to information about forests and timber harvesting may help increase knowledge. Although scores increased over the course of this workshop for all participants, the tour of the demonstration area nearly closed the gap between first-time and veteran workshop participants (no significant difference within the slides-plus-field-tour group). Although repeated exposure to forest management information may be important, then, any exposure to an outdoor demonstration appears to be especially valuable.

Subjective responses. The clearcut acceptance score summed all the items concerning clearcutting and one concerning replanting trees after cutting. These statements were included in the clearcut scale:



Respondents could score from one to five points for each statement, the total being the clearcut acceptance score. Each item was coded so that a higher score reflected an acceptance of clearcutting and relying on natural regeneration instead of planting. The highest possible score was 20 and the lowest, four.

The timber harvest acceptance score summed all the items concerning the results of cutting trees or harvesting timber:



Once again, higher scores reflect a greater acceptance of using timber harvesting as a forest management tool. The highest possible timber harvest acceptance score was 35 and the lowest was seven.

A one-way analysis of variance and Scheffe's test indicated that clearcut acceptance scores were significantly higher for the slides-plus-field-tour group than for the other two groups. The slides-only group scores were not higher than the control scores. Experimental group was not a significant source of variation in timber harvest acceptance scores *(table 3).*

Workshop participants who had walked through a recent clearcut were less likely to think clearcutting should be banned, less likely to think replanting was necessary, and more likely to see clearcutting as an opportunity for new seedlings to grow. The same difference is not apparent for timber harvest acceptance scores, most likely because participants were generally favorable toward timber harvesting when they came to the workshop.

The association between knowledge and acceptance. The significant change in attitudes and beliefs about clearcutting interested us, and we decided to explore two more specific associations. A one-way analysis of variance of clearcut acceptance score by possible answer choices for the two objective questions on clearcutting showed that knowledge of clearcutting is related to acceptance of clearcutting. For example, the first asked,

When applied appropriately, a clearcut [illegible]
a. removes all the most valuable trees [illegible]
smaller ones [illegible]
b. generally converts a forest into a meadow [illegible]
c. results in [illegible] forest [illegible]
[illegible]
d. removes all the vegetation from the site.
e. I don't know for sure.

A Scheffe's test indicated that respondents who chose *c* — the correct answer—had higher clearcut acceptance scores and significantly higher scores than respondents who chose *a* or *b* (p = .000).

The second question was,

The forests [illegible] Pennsylvania [illegible]
the result of [illegible]
a. widespread [illegible] and burning [illegible]
[illegible]
[illegible]
[illegible] settlers.
[illegible] experimentation by early foresters with different [illegible] methods of harvesting.
e. I don't know for sure.

A Scheffe's test indicated that respondents who knew that *a* was correct had higher clearcut acceptance scores than other respondents and significantly higher scores than respondents who chose *e* (p = .003). Workshop participants who know the silvicultural purpose of clearcutting and are more familiar with Pennsylvania forest history thus seem to be more accepting of clearcutting.

Conclusions

The respondents in our sample were clearly not typical of Pennsylvania's 500,000 private forest landowners, as evidenced by the high proportion (one third) who had written forest management plans. These are landowners who are interested enough in forest management to attend forest stewardship workshops, some of them repeatedly. Results, then, can be generalized only to landowners with this degree of motivation.

This study is not unique in finding significant gains in knowledge as the result of an educational experience. In addition, there was a shift in attitude: participants became more accepting of the practice of clearcutting. Although they viewed slides of clearcuts along with slides of other cutting alternatives, their attitude did not change until they had seen and walked through the clearcut site. It should be noted however, that this was a very small clearcut, and size may have been an important factor in making it acceptable.

There are a few examples in the literature of studies that link forestry knowledge with attitudes toward timber harvesting and clearcutting (Willhite et al. 1973; Becker 1983). Findings from this study are consistent with these and another previous study in which attitudes about timber harvesting were modified when information was provided (Brunson and Reiter 1996).

We conclude that the forest stewardship demonstration areas are a valuable educational tool that can contribute to landowners' knowledge and understanding of forests and timber harvesting beyond that achieved by an indoor experience alone. In addition, the field demonstration provides landowners and others with the opportunity to see alternative timber-harvesting practices and reevaluate their views about them. Changes in attitudes about various forest management practices resulting from educational programming that includes a field demonstration may be worthy of further exploration.

Landowners must be more knowledgeable about forest ecology and silviculture if Pennsylvania's forests are to be managed in a sustainable manner. Timber harvesting is part of sustainable forest management, and if the forest stewardship demonstration areas serve as effective tools in communicating the benefits and consequences of various timber-harvesting methods, such demonstrations should be incorporated into educational programming as often as possible. Demonstrating harvesting options can help landowners understand the complexities of natural forest processes and may encourage them both to manage for long-term goals and to involve a professional forester in management decisions.

The general public should be included as well, not only because all citizens are potential landowners but also because they are increasingly involved in determining the management of public lands and influencing decisions on private lands. Many participants who had been opposed to clearcutting had misconceptions—for example, that "a clearcut removes all vegetation from the site"—and were confused about forest regeneration and growth. If public opposition to clearcutting, and more generally to timber harvesting, is going to affect natural resource policy, then it should be based on informed judgment.

A logical next step would be to conduct training sessions for service foresters, consulting foresters, and extension agents on how to establish and use a demonstration area to teach and encourage stewardship. In addition, forestry volunteers might find the demonstrations valuable tools for outreach efforts. Eventually, establishing a network of forestry demonstration sites, exemplary tree farms, and model stewardship forests might prove useful. A variety of audiences stand to gain from the learning experience we believe a field demonstration can provide. JOF

Table 3. One-way analysis of variance of acceptance scores by experimental group.

	Control	Slides only	Slides plus field tour	F-statistic	p-value
Clearcut acceptance					
n	63	78	55		
mean	13.70	13.87	15.62*	6.33	.0022
s.d.	3.07	3.75	2.56		
Timber harvest acceptance					
n	62	76	55		
mean	25.61	25.34	26.4	.6144	.5420
s.d.	5.44	5.97	4.78		

*Acceptance scores are significantly different between groups at the $p \leq 0.05$ level (Scheffe's test).

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This study was supported in part by the funds of USDA Cooperative Agreement 92 COOP-1-7191.

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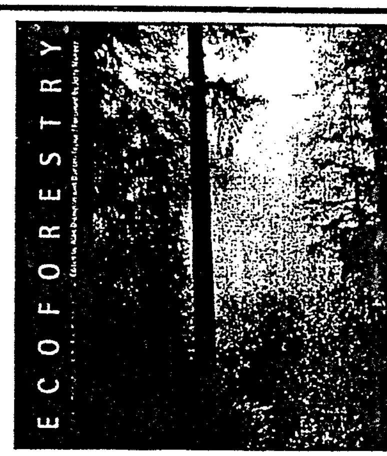

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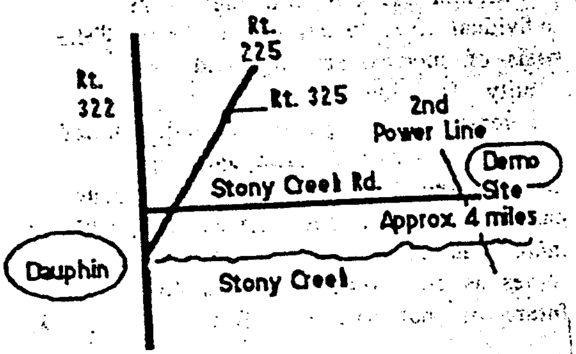
Appendix D

Site Brochures and Samples Educational Materials

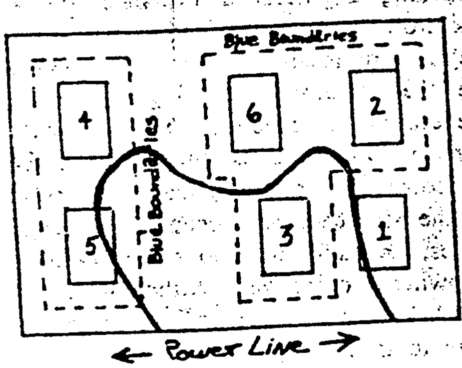
Appendix E

Master's Thesis
Shorna Broushard

Directions to Forest Management Demonstration Site Stony Creek Valley Dauphin, PA



Trail Map



- BLOCK 1 – CONTROL, NO CUT
- BLOCK 2 – DIAMETER-LIMIT THINNING FROM BELOW
- BLOCK 3 – DIAMETER-LIMIT THINNING FROM ABOVE
- BLOCK 4 – IMPROVEMENT THINNING
- BLOCK 5 – CLEARCUT WITH DENTREES
- BLOCK 6 – SHELTERWOOD

Forest Management Demonstration Area Trail Guide

State Game Lands No. 211 Stony Creek Valley Dauphin, PA

In cooperation with
Penn State University
School of Forest Resources
Dauphin County Cooperative Extension
Pennsylvania Game Commission
Pennsylvania Department of Conservation and Natural Resources
Bureau of Forestry

Forestry Today

More than half of Pennsylvania is covered by forests. Most of these are "working" forests that continuously supply Pennsylvanians and people from all over the world with essential natural resource amenities and forest and paper products. Because Pennsylvania's extensive forests contain high quality hardwoods, timber harvesting is an important part of the state's economy. We all depend on the forest for wood and paper products. Many others rely on the forests for their livelihood. Others simply enjoy the many forms of recreation and the natural beauty the forest provides.

Timber harvesting is frequently a controversial issue. A forest provides many different benefits, and the preference for how it should be used or not used varies from person to person. The controversy about timber harvest is often magnified by the fact that most people(forest landowners and the general public) know little about timber harvest and it's role in maintaining sustainable forests.

With proper planning and careful management, timber harvesting can be beneficial by helping to maintain a vigorous, healthy, and productive forest. However, it is essential that any timber harvest be carefully planned to consider potential consequences and avoid negative impacts like erosion and sediments.

Site Introduction

This site is one of seven timber harvest demonstration areas across PA. This particular site was established in 1993 The purpose of this area is to demonstrate alternative methods of timber harvesting along with both their benefits and consequences to individua and groups interested in forestry. Each site will be re-evaluated three years an ten years after harvest to monitor facto related to plant and animal species diversity, residual and new growth, mortality, and economic value of each treatment.

Deer Exclusions

In each of the treatment areas a deer exclusion fence has been constructed. This 20 ft. by 20 ft. area is designed to demonstrate the effect of uncontrolled feeding by the whitetailed deer on fore: regrowth. These fences were installed immediately after harvest and will be maintained during the trial.

Definitions

Silviculture: the art, science, and practice of establishing, tending, and reproducing forest stands with desired characteristics.
Cutting is the primary tool of silviculture and can either promote growth of desireable species or the establishment of new trees.
Stewardship: the wise management a use of forest resources to ensure their health and productivity today with regard for generations to come.

The History of This Forest

This is a mixed species, hardwood forest, that probably began growing after the turn of the century. At that time the previous stands had been cut twice before for the production of charcoal for iron production and also for coal mine timbers.

About the Demonstration Trail

There are six harvesting treatments demonstrated at the Stony Creek Valley, State Game Lands No. 211 site. Each treatment is two acres and marked by signs and orange painted boundaries. The treatments include various types of thinning and regeneration harvests.

Each plot has been measured and harvest selections made based on five timber harvesting methods. The timber harvesting alternatives demonstrated do not all represent good forestry; however: they are all used in Pennsylvania. Each plot will be remeasured three and ten years after harvesting. Plant and animal species diversity, residual and new growth, mortality, and economic value of each treatment will be monitored throughout the project. Additional harvests may be conducted in the future to maintain density at 60% within the thinned treatment areas.

Block 1 - Control, No Harvest

This stand allows you to observe how the forest would appear without any timber harvest. In many forest situations no cutting may be a preferred alternative. Remember though that forests, even without cutting, are dynamic and ever-changing.

Look up into the forest canopy and notice that some tree crowns are larger than others. Some trees are dominant, having large crowns that receive the most sunlight. Others are called co-dominant, and receive sunlight on at least two sides of the crown. Intermediate trees receive sunlight from the top only, and a suppressed tree receives no direct sunlight. One important thing to realize is that even though you are seeing trees of different sizes, they are still, approximately, the same age. Tree diameter and height do not necessarily indicate age.

Blk. 2- Diameter Limit from Below

A diameter limit from below thinning cut reduces the density of a forest to a set percentage (60% in this study) by removing all trees smaller than a calculated diameter. Because the decisions of which individual trees to remove are made by diameter alone, there is no opportunity to allocate growing space to meet future objectives. Although the resulting forest can look almost park-like, which is pleasing to many people, this treatment can have important negative effects, especially to wildlife. Small trees and shrubs provide food, homes, and hiding places for wildlife.

Block 6 - Shelterwood Cut

A shelterwood harvest is a type of regeneration harvest. There are two regeneration cuts in this demonstration. In a regeneration harvest, older trees are removed as efficiently as possible in order to supply the space and access to light, moisture, and nutrients needed for the establishment of a new crop.

A shelterwood cut removes both small and some large trees, varying from site to site. The trees left after the first cut serve as seed sources for the new forest. This allows a new forest to become established over time, reducing the risk of having no new growth. When the new stand is established, in 10 to 15 years, the residual seed trees are removed.

Blk. 3-Diameter Limit from Above

A diameter limit thinning from above is a second type of thinning cut designed to reduce stand density to 60% like block # 2. However; in this instance, the largest trees are selected first for removal on the basis of their diameter regardless of their location. This harvest is often called "high grading" and is typical of most unplanned timber harvests. This type of harvest probably yields the highest immediate cash return of any thinning harvest, but the long term financial yield is drastically reduced. Because the remaining trees are not younger but instead are slower growing, damaged, and diseased, they may not respond to the increased growing space made available to them by thinning. The residual stand becomes dominated by low value and poor quality trees.

Block 4 - Improvement Thinning

An improvement thinning represents the professional forester's recommended forest treatment. It has been designed to meet a set of specified objectives, including production of timber for income and/or wildlife habitat. In an improvement thinning, the resource professional balances the landowner's objectives to forest conditions, the site, and timber markets and then selects individual trees to cut or to leave on the basis of species, spacing, and tree quality. Individual trees of many sizes are removed and growth is redistributed by making growing space available to desired trees. Typically, the immediate cash return from this harvest does little more than cover costs, but the treatment serves as an investment in the long term future of that particular forest site.

Block 5 - Clearcut

A clearcut is a regeneration harvest that removes all the trees in one cutting, mimicking a natural disturbance like a windthrow or a fire. In our hardwood forests, care must be exercised to make sure that naturally occuring regeneration is adequate **before** the cut is made. Otherwise establishment of the new forest can be significantly delayed and the site becomes occupied by ferns, grasses, and trees that do not meet the landowner's objectives. Although the term "clearcut" imparts a very negative image to most people, harvesting a mature forest may be a good option for a landowner, depending upon the growth patterns of involved species, the timber market, and the conditions of the site.

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School of Forest Resources

TEACHING FOREST STEWARDSHIP TO URBAN YOUTH

A Thesis in

Forest Resources

by

Shorna Renell Broussard

Submitted in Partial Fulfillment

of the Requirements

for the Degree of

Master of Science

August 1997

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ABSTRACT

Forests are a critical component of Pennsylvania's landscape, even in the urbanizing southeast quadrant. If we are to sustain these forests that furnish wood products to a vital local industry and contribute to the regional quality of life, we must make all citizens, young and old, aware of the realities of forests and forestry. The extension project titled "Teaching Forest Stewardship to Urban Youth" examined whether and to what extent exposure to classroom and outdoor activities in the city and a forestry demonstration site at French Creek State Park effect a change in urban youths' knowledge and attitudes toward sustainable forestry.

After conducting forestry-related instructional activities with 182 middle-school students in Philadelphia, I found that outdoor demonstrations do effect changes in youths' attitudes and knowledge about forestry. There were three stages to the instruction: classroom activities, forestry activities in an urban outdoor setting, and forestry activities in a rural outdoor setting. I obtained data about student attitudes and knowledge about forestry by administering a questionnaire to the students before and after the treatments.

I used two knowledge measures in this study: Forest Practices, Ecology, and Facts (FPEF) and Forest Ecology and History (FEH). When compared to the control/placebo group on the FPEF knowledge measure, the three treatment groups of 8th grade students gained knowledge while only the French Creek treatment group of 7th grade students gained knowledge. The 6th graders experienced no knowledge gain on this particular measure. When compared to the control/placebo group on the FEH knowledge measure the 8th graders did not experience any knowledge gain but for the 7th graders the French Creek treatment group gained knowledge and for the 6th graders the Cobbs Creek group gained knowledge.

I also measured attitude change in this study as measured by five scales: Pro and Anti-Timber Harvest, Forest Preservation, Conditional Pro Timber Harvest, and Permanent Destruction Timber Harvest Attitudes. When compared to the control/ placebo group, after touring the French Creek Demonstration Forest, students felt more favorable about timber harvesting and about utilizing harvesting as a management tool as long as ecological impacts are taken into consideration. Also, after seeing the silvilcultural practices at French Creek the students no longer felt that timber harvesting results in a permanent destruction of forests. After the French Creek treatment, knowledge level was negatively correlated with negative attitudes about timber harvesting and positively correlated with positive attitudes about harvesting as a forest management tool.

The educational program I conducted was designed to foster informed young citizens with a proper knowledge base to guide future decisions. I found that the youth learned more about forestry, shed their negative views about forestry, and adopted attitudes in favor of harvesting sustainably. Based on these findings, I concluded that classroom exercises, urban forestry activities, and demonstration forests are valuable components of an educational program that contribute to participant knowledge gain and attitude change. Future studies should continue to encourage children to think about natural resource issues and the role forests play in their lives.

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ABSTRACT

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LIST OF TABLES

ACKNOWLEDGMENTS

This project was funded by grants from the USDA Cooperative States Research, Extension, and Education Service; the PA Department of Education; the USDA Forest Service; and Penn States' College of Health and Human Development and School of Forest Resources. I am thankful for these partners that provided funding to carry out the research.

I would like to thank all the project partners who greatly enhanced this study through their guidance, patience, and advice: Southeast Regional Director for Cooperative Extension Gary San Julian, Leisure Studies Professor Alan Graefe, PA Department of Education Environmental Education Coordinator Patti Vathis, Cobbs Creek Community Environmental Education Center Directors Carole-Chew Williams and Bob Harmon, Bartram Cluster Leader Ricardo Curry, Associate Director for Project Learning Tree Sheri Sykes, and Instructor and Urban and Community Forestry Coordinator at Penn State, Bill Elmendorf. I would not have been able to do the project without the bright perspectives, direction, and support from the teachers in Philadelphia. Of course none of this research would have been possible without the children who were wonderful to work with. Special thanks goes to my advisor Stephen B. Jones and my committee members Connie Flannagan and Larry A. Nielsen for all their guidance and support and all the insight and wisdom they shared with me during my graduate program. I would also like to thank my family and James M. Mote for the assistance they provided during my graduate career at Penn State.

Chapter 1
INTRODUCTION

Forests have an essential role in the ecological balance of life on earth. In Pennsylvania. There are approximately 17 million acres of commercial forestland. While some of this forestland is owned by state and federal government, most of it is privately owned. The management of forestland is a controversial and much debated topic. Conflicts exist over managing forests for lumber, recreation, wildlife, and other competing uses. Debate also surrounds topics like forest fires, endangered species habitat, and soil erosion. To be informed citizens, children need to think about these issues. They need to understand the role forests play in their lives. Too often youth, especially those living in urban areas, have little understanding of issues that relate to the sustainability of their communities and the broader natural environment. As a result, tremendous need exists to involve this segment of society in addressing issues that relate to their communities, lifestyles, and natural environment--especially since today we place unprecedented demands on forests for wood products and environmental, recreational, and aesthetic benefits. If we are to sustain these forests that enhance regional quality of life, we must make all citizens, young and old, aware of the realities of forests and forestry so that individual decisions collectively bode well for our forests and consequently our future.

Project Information

Luloff et al. (1993) found that citizens and forest landowners alike know little about the realities of forests and forestry. The researchers found that people believe cutting trees usually results in unpleasant aesthetics, permanent loss of forest cover, wildlife habitat destruction, soil erosion, muddy streams, and commercial or residential development. The lack of understanding regarding proper forest management manifests itself in a proliferation of local forestry ordinances and other harmful actions and perceptions. This process hastens forest conversions to commercial, residential, or other non-forest land uses. Seventy-two percent of Pennsylvania's 17 million acres of forests are privately owned by over one-half million individuals. This ownership pattern, characterized by a mosaic of farms, forests, and small (but growing) communities, predominates throughout the urbanizing landscapes of the northeastern and Mid-Atlantic United States. Southeastern Pennsylvania is no different where the trend of urban pressure is also increasing.

Citizens who are knowledgeable of the benefits derived from properly maintaining a "working" forest within the rural/urban zone are more likely to advocate forest sustainability. Ongoing outreach efforts by Cooperative Extension and the Forest Stewardship Program target forest landowners across the state encouraging responsible forest management. This project, however, represented a new thrust: the young urban decision makers of tomorrow. Toady's youth represent future stewards of the earths' precious natural resources. The information absorbed by these youths' during their early years will shape their thinking, perceptions, and attitudes that will influence their future decisions.

Research Objectives

1) To compare knowledge of forest ecology, state forestry facts, and timber harvesting among five experimental groups: a control group, a placebo group, a group that received classroom instruction and slide show, a group that went to Cobbs Creek and did forestry activities outdoors, and a group that went to the French Creek Demonstration Forest.

2) To compare degrees of acceptance of timber harvesting and clearcutting as forest management tools among the five groups.

3) To examine the relationship between knowledge of forestry and acceptance of timber harvesting and clearcutting.

Hypotheses

1. Knowledge scores will be significantly higher for the classroom, Cobbs Creek, and French Creek groups when compared to the control and placebo groups.
2. Knowledge scores will be significantly higher for the Cobbs Creek and French Creek groups when compared to the classroom instruction group. This tests the hypothesis that outdoor instruction should produce higher gains in knowledge when compared to indoor instruction.
3. After viewing the silvicultural treatments at the French Creek Demonstration Forest, this treatment group should exhibit significant attitude changes in regard to timber harvesting. Specifically, scores for Pro-Timber Harvest Attitude and Conditional Pro-Timber Harvest Attitude will be significantly higher for the French Creek group when compared to the control, placebo, classroom, and Cobbs Creek groups while the Forest Preservation, Permanent Destruction Timber Harvest Attitude, and Anti-Timber Harvest Attitudes scores will be significantly lower.
4. The correlation between knowledge score and acceptance score will be a direct positive one for the classroom, Cobbs Creek, and French Creek groups. I hypothesize that the students that are more knowledgeable about forest ecology, practices, history, and facts will also be less likely to possess negative attitudes toward cutting as a forest management tool.

Chapter 2
LITERATURE REVIEW

This chapter includes a review of the literature relating to minority and urban youth environmental education and the evaluation of these educational programs. I also examine literature about the roles that school, outdoor experiences, indoor experiences, natural resources, demonstrations, and Project Learning Tree have in environmental education. I conclude the chapter by discussing how the literature review shaped my study design.

Environmental Education Importance to Minorities

It is widely believed that environmental concerns are important to Caucasian, economically privileged people, and that people of color, especially in inner-cities, have little interest in such matters. But in fact Sheppard (1995) looked at the black-white environmental concern gap and found that the differences between the races are actually very small. Although there is little research on Black children's relationship with nature, those studies that have addressed this topic show that children's diverse and rich appreciation for nature and their moral responsiveness to its preservation are not suppressed by the serious constraints of living in an economically impoverished inner-city (Kahn 1993).

The National Environmental Education and Training Programs' 1994 study measuring environmental attitudes and behaviors of American youth from disadvantaged areas in Chicago, Los Angeles, and New York was commissioned to identify critical gaps in environmental education so that resources could be targeted more effectively. This was the first comprehensive survey on environmental views and educational needs to focus on disadvantaged youth. The authors thought is was important to study students living in disadvantaged socioeconomic circumstances due to their higher exposure to environmental hazards, their often limited opportunities to experience nature, and many other critical concerns in their lives relative to environmental issues. The researchers found that, while these youth have other issues weighing heavily on their mind, they have strong perceptions about environmental issues and problems. Although it may not be the highest priority in their lives, students from disadvantaged areas do care about the natural environment.

Similarly, Kahn and Freidmans' (1995) results showed that the serious constraints of living in an economically impoverished inner-city community cannot easily dampen childrens' diverse and rich appreciation for nature, and moral responsibility to its preservation. Kahn and Freidman interviewed children across grades 1, 3, and 5 from an economically impoverished inner-city Black community. The children were asked about their views and values about the natural environment and whether they were aware of environmental problems. The authors found that the children demonstrated a sensitivity toward nature and an awareness of environmental problems. Later, Kahn, Howe, and Friedman (1995) used the same methodology to look at the environmental views and values of rural and urban Brazilian children and found striking similarities between this Brazilian population and the African-American children looked at in Kahn and Friedman's 1995 study.

Importance of School in Environmental Education

Empirical work points to the importance of the school in environmental education and the need for new opportunities for involvement of disadvantaged youth in environmental education. Bringing environmental education into the inner-city is a curricular method receiving serious attention from environmental educators (Running-

Grass 1994). Smith, Hill, Matranga, and Good (1995) stated that public schools are centers of youth activity and represent an ideal setting for collaborative youth-at-risk programming. The National Environmental Education and Training Programs' 1994 study also recognized the key role of school in environmental education.

If these schools are in urban areas, researchers stressed the need to value the urban environment as well. Lutz (1995) saw the city as an intricate and positive part of the environment and believed that children should appreciate cities' built and green aspects. Similarly, Stranix (1975) recommended using the urban environment as a learning resource for school students.

Some researchers discuss the ease with which environmental education can be incorporated into existing curricula. Environmental topics overlap with many subjects that are traditionally being taught in school. Schwartz (1987) concluded that environmental education instruction can be successfully implemented into the school curriculum that already exits. She also found that environmental education instruction can improve the attitudes of students toward the subject areas of social studies and science. When Tipton (1992) measured the perceptions and values of 400 Oregon professional foresters he found consensus on the need for forestry education, including environmental education, to be fused into existing school curricula. When Hind (1988) looked at public elementary schools in the Commonwealth of Pennsylvania, she found that a majority of the school districts in the state had some type of environmental education program and that it was perceived as important by the instructional staff and the school district administration. Hinds' findings in Pennsylvania mirror the national trend where 30 states have formal environmental education programs in place.

Successful Environmental Education Programs

Various kinds of environmental education programs have been successful. These programs have taken place in many different settings--from indoor to residential. The following is an examination of the wide range of environmental education settings and how participants have changed as a result of the programs. Newhouse (1990) stated that it is crucial that attitude and behavior research be applied in the design of educational programs. In some cases attitude and knowledge shifts were measured and reported, providing evidence for their effectiveness as models for environmental education programming. Educational programs need to be evaluated to demonstrate effectiveness and to allow educators to choose among alternative teaching tools.

Outdoor Residential Education Programs

Bennett and Padalino (1989) examined the role of environmental education in programs for youth-at-risk by conducting and evaluating a week-long residential camp experience for 160 New York city youth. Since these youth lacked firsthand knowledge of the world beyond their immediate environment, one of the more promising means of improving the achievement and facilitating the development of at-risk youth is the use of field experiences to provide experiential learning. The students participated in total education in a total environment where basic skills instruction was incorporated into an environmental studies theme. The authors concluded that residential environmental education programs appear to provide a real opportunity for building strength of character, human relationships, and environmental connections which reduce the risk of failure in school.

Bowman and Shepard (1985) worked with minority students from Columbus where they participated in a three-day resident program with natural resource-related field experience. The activities consisted of hikes, looking at demonstration plots, collecting data, entering data, and discussing career opportunities. Whereas most of these inner-city youth had not been in the forest before they felt more comfortable as a result of the program. Bowman and Shepard also demonstrated that participation in hands-on experiences was an effective way to increase interest in natural resources.

Carlson and Baumgartner (1974) showed that a week-long natural resource camp experience produced a positive change in campers' attitudes toward natural resource management for multiple uses. No control group was used in this pretest/posttest design. The two camps used in the study were sponsored by a variety of natural resource agencies whose objectives included developing leaders with an understanding of natural resource values and the ability to make responsible decisions concerning resource management and use.

School-Based Programs

The effectiveness of school-based programming depends on the target age. Because many attitudes are established and fixed by the time a student reaches high school, Knapp (1972) proposed that instruction in environmental education take place in the elementary or middle school. Based on that premise, Mabie and Baker (1996) collected data from students at two urban, inner-city Los Angeles elementary schools. They worked with 5th and 6th graders who knew very little about the food and fiber system before completing a 10-week series of experiential activities. The students were unfamiliar with the definition of agriculture, California crops, agriculture careers, and the related agriculture terminology. Their knowledge of the previous subjects increased through participation in the activities. Mabie and Baker (1996) concluded their study by stating that "people should be capable of making educated decisions on issues in the voting booth as well as their personal lives (p. 4)."

Stranix (1975), also working in the most effective age range, conducted a study of attitudinal changes in 7th and 8th grade inner-city students as a result of constructive participation in an urban environmental studies program. He hypothesized that students' participation in observing and solving real-life environmental problems produces positive changes in their attitudes towards school. Two methods of teaching urban environmental studies were used: an experimental community action approach using cameras, and a traditional classroom instruction using the latest films, film strips, multimedia kits, records, texts, and pamphlets dealing with urban environmental problems. Results of the testing show that significant gains are attained by the experimental group in the attitudinal areas tested. Also, inner-city students' attitudes toward school improve when they participate in urban action projects.

Outdoor Education Programs

There has been a considerable amount of research into the effectiveness of outdoor learning experiences. Outdoor experiential learning activities have the potential to enlighten those inner-city youth to natural resources. Urban students' environmental excursions can be beneficial, but can prove uncomfortable as demonstrated by Bixler, Carlise, Hammitt, and Floyd (1994). The authors surveyed interpreters at urban nature centers and found that urban students expressed a wide range of fearful responses to natural environments, which pose barriers to enjoying and learning about wildlands. However, the authors concluded that whether learning opportunities were formative or corrective, urban students still needed to have frequent and direct experiences with the wildland environment.

Metro, Dwyer, and Dreschler (1981) presented similar conclusions. They surveyed students about trips to forests and found that 87% of Whites and 69% of Blacks had visited a forest and Whites indicated greater frequency of visits than Blacks. The authors also found that the highest frequency of negative comments about learning experiences and enjoyment of their visit were reported by Black females. They concluded that this, plus the negative expectation of Black females who had not visited a forest, suggests that special consideration be given to this group in environmental education.

Importance of Natural Resources in Outdoor Education

Few studies on environmental education are concerned with conservation of natural resources. After doing an extensive review of natural resource education materials, Pomerantz (1991) concluded that the materials mainly emphasized basic knowledge of ecological principles. The author stressed that in order for young people to apply their knowledge of ecological principles to resource management problems, educators and resource managers need to expose students to natural resource management issues.

Importance of Demonstrations in Outdoor Education

While the use of demonstrations has been documented in adult natural resource and agricultural education, the same was not available for the youth population. Results of the literature review illustrate the effectiveness of demonstrations in various education programs and the need for their continued and expanded use. The lack of information on the effectiveness of demonstrations in youth environmental education confirms the need to use demonstration areas with this population as well. While attempting to find examples specific to forestry and youth, the information was not documented. To illustrate the effectiveness and utilize all information available on demonstration areas, many of the examples refer to agriculture and farmers.

Using demonstration plots have been a common practice since the beginning of organized extension efforts (Nafziger 1984). These plots provide an excellent opportunity for teaching scientific principles while allowing farmers to view improvements personally and possibly adapt them for use on their own farms.

The Ohio Agriculture Research and Development Center sponsored a study to evaluate the effectiveness of the Ohio Rapid Adjustment Farms (test demonstration farms). Cunningham and Simmeral (1977) found that in order for the test demonstration to be most effective in transferring technology and management practices to other farmers in the community, interaction between the demonstration farmer and other farmers in the community were essential.

Similarly, Daigger, Siffring, and O'Dea (1975) found that the demonstrations were effective in encouraging farmers to learn and adopt new agricultural practices. One farmer concluded "I'd rather see a story than hear one any day (p. 122)." By observing the fertilization practices over time the farmers were able to see the benefits over time as opposed to simply hearing about it.

Shifting to a different focus, the goal of the Durgan, Schmitt, and Holder (1991) study was to have an in-field program that integrated research and teaching methods in an interactive environment. The authors educated participants in crop production and management decisions via plot demonstrations. While 71% of the participants rated the overall program as excellent, the field sessions were rated higher than indoor ones.

The following study examined the effectiveness of demonstration forests in effecting attitude and knowledge changes. Hiller (1995) tested whether outdoor demonstrations can increase landowner knowledge of forest ecology and silviculture. She conducted five workshops for various audiences on three completed forest stewardship demonstration sites during 1994. Results from a comparison of pre and post-workshop questionnaires indicated that the outdoor demonstration enhanced learning. Test scores were significantly higher for respondents who saw an introductory slide show when compared to a control group, and even higher for respondents who toured the demonstration site. Also, participants who had higher test scores tended to be more accepting of using timber harvesting as a forest management tool.

Indoor/Classroom Environmental Education

Some environmental education studies have focused on the classroom as a setting. Jaus (1982) designed a study to determine the effectiveness of ten hours of classroom environmental education instruction on fifth graders' attitudes toward the environment. He found that the students in the experimental groups exhibited significantly more positive attitudes toward the environment. However, the students in the control group also had favorable attitudes toward the environment. He concluded that providing ten hours of environmental education to fifth graders can change their slightly positive attitudes toward the environment to strongly positive ones. Therefore, devoting even ten hours of this type of instruction appears to be worth the time invested. Janus (1982) also found similar results when he exposed elementary school students to only two hours of environmental education instruction.

The next study compares two forms of indoor instruction. Houghton, Arrignton, and Bradshaw (1994) evaluated the educational effectiveness of correspondence instruction in an extension program on vegetable gardening. The authors compared the effectiveness of two program delivery methods: an illustrated lecture and correspondence instruction. Effectiveness was measured by knowledge gain. A pretest/posttest (multiple-choice) was used, and two treatment groups were formed via self-selection. Although both methods of program delivery resulted in higher post-test scores, changes in scores were significantly higher for the illustrated lecture group.

Not all studies produce attitude changes due to factors that are beyond the researchers' control. Armstrong and Impara (1990) evaluated the impact of the environmental education program *NatureScope* in classrooms where it was used as a curriculum supplement. A pretest/posttest design produced few significant differences. Results indicated that only one issue of *NatureScope* was effective in imparting knowledge. The authors attributed the results to teacher attrition during the study, and the introduction of nonresponse bias. Quinn (1976) used value sheets (short lessons on environmental problems accompanied by a series of personally involving questions) to effect change in high school students' environmental attitudes. He found that there was a significant learning experience for the experimental group and the control group in 10 out of 32 items on the survey. Since the control group exhibited the same learning characteristics as the experimental group, Quinn could not attribute the learning to the treatment.

Project Learning Tree

When looking at environmental education curricula, one stellar program is continually recognized because it is widely used, well evaluated, and covers a broad subject area. Project Learning Tree (PLT) is a popular environmental education program used in all 50 of the United States, U.S. territories, Canada, Mexico, Brazil, Japan, Finland, and Sweden (American Forest Foundation 1993). PLT examines the relationship between humans and forest resources. Both formative and summative evaluations of PLT were conducted by Marcinknowski and Iozzi (1994). They found that the PLT program was an effective program for increasing environmental knowledge and effecting positive attitudinal growth in students in grades Pre K-8, and particularly in Grades 2-8. In addition, teachers who have completed at least one PLT Teacher Workshop, and who implement the new PLT activities as intended, were more likely to observe knowledge gains and attitudinal change in their students. This was found to be particularly true when students were exposed to a series of PLT activities over a relatively short time.

Chunko (1994) sought to improve the teaching effectiveness of PLT by developing a PLT Lifestyles Handbook. The handbook, written for K-8 teachers, was intended to present sociological, economic, cultural, and social aspects of forest resource management in ways that would 1) increase awareness among the students, 2) stimulate students' critical thinking in and out of the classroom, and 3) enable teachers to incorporate issues contained in the handbook into classroom instruction. Most teachers, because of lack of specialized training and awareness, had not previously covered in-depth subject areas as connecting human attitudes and behaviors with forest resources to explore sustainability. However, Chunko found that teachers who used the handbook were more inclined to use PLT Lifestyles learning activities in the classroom since they were now equipped with the background and materials.

Justification

The literature review demonstrates that designing a successful inner-city environmental education project requires certain key elements. First, the literature showed that the urban environment is a comfortable, practical, and ideal place for environmental education to take place. It is for these reasons that an urban forestry treatment (Cobbs Creek) was included in the educational program. This treatment served as not only a forestry education component but also a introductory procedure to help students 1) become more familiar with being outdoors and examining trees, and 2) address any fears or discomforts associated with learning in a forested environment. The Cobbs Creek treatment was also the bridge between the classroom exercises and the trip to the rural forest that is sometimes quite foreboding in the mind of young city dwellers. Cobbs Creek is unique in that it is the U.S.'s largest urban park with many riparian areas, creeks, and trees to examine. It is also a place that is familiar to the students--many of whom visited the park regularly.

The literature review also revealed that the school system is a center of student activity and a good avenue into the urban environment. It is for this reason that public schools in the Philadelphia School District were targeted. Because it has been shown that many attitudes are formed by the time a student reaches high school, younger, more impressionable middle school aged students were chosen for this study. The science class context was chosen because the students are developing a science literacy and a way of thinking that leads to informed decisions. Also, at the middle school age, students are still learning, evaluating, and determining how we manage our shared resources such as air, water, land, and forests. A science-based forestry education program fits well with the existing curriculum dealing with space, earth, and all its resources.

The evidence favors outdoor education as an effective teaching environment when covering natural resources education. Two outdoor treatments were used in this study. Outdoor field demonstrations were also found to be effective in transferring knowledge about natural resource management. French Creek Demonstration forest with all the timber harvesting demonstrations was an ideal place to conduct the final treatment.

These demonstrations were also found to produce changes in attitudes when compared with audio-visual techniques conveying the same information. An indoor treatment was included for comparison. Project Learning Tree is a widely used forestry-based environmental education curricula that was found to be effective in increasing knowledge and changing attitudes, particularly in 2nd to 8th grade children. An activity from the PLT curriculum was used as part of the indoor education.

Since reinforcement is more likely to enhance attitude changes, three cumulative treatments were used with each building upon the knowledge gained previously while introducing new topics at the same time.

Lastly, some students may tend to perform and behave differently when a guest is present. This is known as the Hawthorn effect. To determine if the students performed better on the questionnaires simply because there was a speaker and not because of the treatment, I included a placebo group as well. These students received a college preparation talk and I did not cover any topics that would produce any knowledge or attitude gain for the measures in this study.

For comparison a control group was also included. This group received no treatment whatsoever.

Chapter 3
METHODS

This chapter details the procedures I used to assess the educational effectiveness of the classroom activities, French Creek Demonstration Forest, and Cobbs Creek Community Environmental Education Center. I will explain sampling procedures and the experimental design. I will include details of the treatment given to experimental groups complete with educational objectives of the field tour and classroom exercises. The measurement instrument I used for the study was a questionnaire. I will end with a discussion of the variables in the questionnaire, my hypotheses, and how I tested those hypotheses using standard statistical methods.

Study Sites

The indoor study sites used were classrooms in the Hamilton, Sayre, and Turner Middle Schools in Philadelphia, PA. One site used for this study is located at French Creek State Park in Reading, PA. This demonstration forest is the closest to Philadelphia. The site is a 70-80 year old mixed species hardwood forest dominated by mixed oaks, red maple, and other commercial species. A complete description of the Forest Stewardship Demonstration Area is in Appendix A.

This study also involved activities at Cobbs Creek Community Environmental Education Center in Philadelphia, PA. Cobbs Creek is part of Fairmount Park which, at 8700 acres, is the largest landscaped urban park in the United States. The park has miles of riparian areas, creeks, and streams. The heterogeneous landscape attracts a variety of urban wildlife.

Study Sample

There are 22 clusters in the Philadelphia School District. Each cluster consists of a high school and all the middle and elementary schools that feed into it. I worked with the Bartram cluster for this project. In cooperation with Rick Curry, Bartram Cluster leader; Carole Chew-Williams, former Science Curriculum Supervisor for the Phila. School District and current Director of Cobbs Creek Community Environmental Education Center; and Bob Harmon, Science Department Head for Roxborough High School, we selected willing science teachers to participate in the study.

I limited the number of schools to three. We wanted to evenly distribute the treatments across all middle-school grade levels so I worked 6th, 7th, and 8th grade classes at Turner, Sayre, and Hamilton, respectively. One teacher from each school was selected to participate in the study. Each teacher had two science classes, so two science classes (about 30 students per class) from each of the three middle schools were included. In addition one control or placebo classroom was used in each school for comparison to treatment groups.

Sample Description

The study population contained 182 middle schools students in the Philadelphia School District. Demographic and other information about the study sample are listed in Table 1. About 46% of the students were male and 54% were female. The students were in grades 6, 7, and 8 with ages ranging from 9 to 14. About 84% of the students classified themselves as African-American, 4% as American Indian, 1% as Asian-American, 0.5% as Latin-Hispanic, and 1% as Caucasian.

Table 1. Demographic characteristics of the study population.

	HAMILTON Middle School n=78		SAYRE Middle School n=57		TURNER Middle School n=47	
VARIABLE	**Male** $n_1=36$	**Female** $n_2=42$	**Male** $n_1=27$	**Female** $n_2=30$	**Male** $n_1=21$	**Female** $n_2=26$
Grade	8	8	7	7	6	6
Age	10-13	10-14	11-14	11-14	10-13	9-12
Black	30	35	23	24	19	22
Asian	1	0	1	0	0	0
White	0	0	0	0	0	2
Amer. Indian	0	1	0	6	1	0
Hispanic	0	0	1	0	0	0
Left blank/ Not listed	5	6	2	3	1	2

Summary of Procedures

There were three parts to the treatment. I wanted to compare the educational gains and attitudinal changes after each of the three cumulative treatments. The first treatment was an indoor classroom session consisting of a slide presentation on the history of Pennsylvania's forests and a Project Learning Tree activity. The second treatment was an outdoor urban forestry activity at Cobbs Creek in Philadelphia. The third treatment was a guided tour of the French Creek Forest Stewardship Demonstration Area in Reading. The classroom activities covered the topics of forest history, natural forest processes, silviculture, threats to forest sustainability, importance of trees, and tree facts. The Cobbs Creek activities included topics of tree measurement, ecology, and reiteration of tree facts presented in the classroom. Activities at French Creek centered around timber harvesting and how harvesting affects forest sustainability and how it is used as a management tool. We also covered forest facts and ecology.

I worked with three middle schools in the Philadelphia School District. One teacher was chosen from each of the schools on the basis of the their school involvement, motivation, and willingness to participate in the study. Each teacher had two of their classes participate in the research project. In addition one control or placebo classroom was used in each school. These nine classrooms made up the sample for the study.

I randomly divided the 182 students into five experimental groups. The control group received no treatment, the placebo group received a college preparation presentation, the classroom group received the slide show and PLT activity, the Cobbs Creek group received the urban forestry outdoor activity, and the French Creek group received the guided tour at the demonstration forest. The last three treatments were cumulative.

Students were given a pretest prior to the treatment and a posttest at different times depending on which treatment group they were assigned to. The questionnaire was split into three sections. The first had 27 subjective questions regarding forest resource extraction, management, and use. The students responded to the questions on a Likert scale of one to five with one being strongly disagree and five being strongly agree. There were also nine multiple-choice questions designed to measure the students knowledge of forest ecology, silvicultural concepts, and forest facts. The last part of the questionnaire consisted of sociodemographic questions asking students' ages, gender, grade in school, and race.

I visited each of the nine classes twice during the study (Table 2). The first day all treatment, control, and placebo groups completed a pretest. Then everyone except those in the control or placebo groups participated in classroom exercises including a slide presentation on the history of Pennsylvania's forests and a Project Learning Tree activity. In the afternoon we (all groups except control and placebo) walked to Cobbs Creek to do outdoor activities. The second day occurred within the following two weeks. Students in the posttested treatment group were taken to French Creek Demonstration Forest to tour the plots. The students in the control and placebo groups took their second posttest while the others were gone. The treatments were cumulative so that all students in the posttested treatment group received all three treatments. They were, however, tested at different times depending on which of the three posttest treatment groups they were assigned to (classroom, Cobbs Creek, French Creek).

Table 2. Schedule of classroom, Cobbs Creek, and French Creek activities.

SCHOOL and CLASSROOM	LOCATION	DATE
Hamilton 2 classes	Classroom and Cobbs Creek	10-11-96 and 10-16-96
	French Creek Demonstration Forest	10-23-96 and 10-24-96
Sayre 2 classes	Classroom and Cobbs Creek	10-17-96 and 10-18-96
	French Creek Demonstration Forest	10-30-96 and 10-31-96
Turner 2 classes	Classroom and Cobbs Creek	10/15/96
	French Creek Demonstration Forest	10-29-96

Measurement Instrument: Questionnaire

The questionnaire I used (Appendix F) was based on one tested by Hiller (1994) in a similar study using Forest Stewardship Demonstration areas. It consisted of attitudinal questions, a multiple-choice knowledge test, and a section asking for sociodemographic information. The attitudinal portion was given prior to the multiple-choice knowledge questions so as not to influence the attitudinal questions (Armstrong and Impara 1990).

Some of the attitudinal questions were worded in either a positive and negative manner. For the purposes of coding, I reversed the scale for negative statements so that all the questions could be interpreted in the same direction.

Likert Scale Questions

The first part of the questionnaire was a set of 27 questions. There were six questions measuring the Anti-Timber Harvest Attitude, three questions measuring the Pro-Timber Harvest Attitude, three questions measuring the Forest Preservation Attitude, three questions measuring the Conditional Pro-Timber Harvest Attitude, two questions measuring the Permanent Destruction Timber Harvest Attitude, six knowledge questions, one question on wildlife, one question on air pollution, and two placebo questions unrelated to the study (Table 3). The attitude scales were derived through a factor analysis of all the attitudinal questions. The items on the questionnaire were measured using Likert scales asking the students the degree to which they agree or disagree with each statement. The choices were strongly disagree, disagree, neutral, agree, and strongly disagree. The variables were recoded such that higher scores reflect a stronger attitude. Nine of the questions were previously validated by Luloff et al. (1993). Two items were taken from Chunko's (1994) study of teachers, five questions from Hiller's (1995) study measuring the attitudes of private landowners, and I developed the other 11 questions.

Table 3. Individual items from questionnaire that measure five attitude types as indicated by the factor analysis.

Anti-Timber Harvest Attitude
9. Cutting trees makes the soil wash away (soil erosion).
11. When we cut trees in Pennsylvania, we must always replant.
14. Cutting trees destroys animal habitat or homes in the forest.
18. Cutting trees causes losses of places where people enjoy nature.
21. Cutting trees threatens the forest.
27. Cutting trees makes streams muddy.

Pro-Timber Harvest Attitude
3. People who own forests should be encouraged to cut trees to make lumber and paper products.
7. We should use our forests for furniture, paper, and other wood products.
8. Forests should be mainly used for products that humans use.

Forest Preservation Attitude
2. Forests should be used to get underground minerals like copper, gold, zinc, and others. (-)
4. Forests should be untouched and left alone.
5. Forests have a right to remain that way, regardless of human wants or needs.

Conditional Pro-Timber Harvest Attitude
13. Cutting trees can sometimes be good for the forest.
12. Clearcutting is a good way to help certain trees grow.

Permanent Destruction Timber Harvest Attitude
16. Once trees are cut, they will never grow back again.
24. When a forest is clearcut, trees will not grow back in our lifetime.

There were also six knowledge questions placed in this section to measure students' grasping of certain definitions and concepts. These questions were placed in the attitudinal portion of the questionnaire so that all knowledge questions were not limited to the multiple-choice format. The six knowledge questions measured the students' knowledge of forest ecology and history (Table 4).

Table 4. Individual items from questionnaire that measure the FEH knowledge score.

Forest Ecology and History Knowledge
10. Trees are a non-renewable resource.
15. Pennsylvania's forest recovered from widespread clearcutting and fires about 100 years ago.
17. Trees can help reduce harmful pollutants in the air.
20. Tennis shoes, gasoline, lipstick, and ink are all products made from natural resources.
23. Trees in the forest compete for food, light, and space.
26. Most of Pennsylvania's forest are 60-80 years old.

Multiple-Choice Questions

The second part of the questionnaire was a multiple choice knowledge test of basic forest ecology, silviculture, and facts. Four questions were taken from Hiller's (1995) landowner study, and the other five were basic definition and factual questions. I had to modify some of the questions to make them appropriate for a younger audience. The material I tested the students on was knowledge of the state bird, state tree, and valuable tree in the state. I also included definitions of canopy, photosynthesis, and tree rings. Lastly, I also asked the students how slash, clearcutting, and high-grading affect the forest. The number of correct answers on this part of the questionnaire measure the students knowledge of forest practices, ecology, and facts. The ecology questions in this section were different than the ecology questions in the attitudinal part of the questionnaire. Both knowledge measures are discussed in detail later in the chapter.

Demographics

The last portion of the questionnaire contained items asking students for demographic information including gender, age, grade in school, academic grades, race, and parental land ownership. Because the students did not consistently report their academic grades from pretest to posttest, I did not use that variable in my analyses. Also, since only 5% of the students reported any parental forestland ownership, I excluded this variable from analysis as well.

Variables

Knowledge Scores

A student's forest practices, ecology, and facts (FPEF) knowledge score was the number of questions answered correctly on the multiple choice part of the test. High scores reflect more correct answers. A student's forest ecology and history (FEH) knowledge score was the mean score of their answers to a set of questions used to measure knowledge of certain concepts and definitions regarding forest ecology and history. High scores indicate more correct answers. Although the FPEF and FEH knowledge measures both had questions about forest ecology, each contained a different set of questions measuring forest ecology.

Attitudinal Scores

I also measured attitudes toward timber harvesting and forest management. Attitude scores were the mean scores of the student's answers to subjective questions about timber harvesting and clearcutting. Higher scores reflect a stronger attitude. Scores were calculated for each student on the following attitude scales: Anti-Timber Harvesting, Pro-Timber Harvesting, Forest Preservation, Conditional Pro-Timber Harvest, and Permanent Destruction Timber Harvest.

Data Reduction

For the purposes of tracking in this short-term longitudinal design, each student in the study was assigned an ID number that I used for pretest/posttest tracking. The ID number corresponded to the experimental group and school the student attended. Scales were created by taking the mean scores on a particular set of questions measuring the attitudes and knowledge discussed previously. The students had to have answered at least half of the questions on a particular measure to be included. A higher mean reflects a strong opinion about the particular attitude type being measured. The mean was also taken of the six knowledge questions that were included in the attitudinal portion of the questionnaire. A higher mean reflects more correct answers on this part of the test.

On the multiple-choice part of the questionnaire students answered nine multiple-choice questions. The total of correct answers to these questions constitute the student's knowledge score.

For the demographic questions there were two levels of gender and six for race. Age, and grade in school were fill-in-the-blank questions.

Hypothesis Testing: Hypotheses 1 and 2

1) Knowledge scores will be significantly higher for the classroom, Cobbs Creek, and French Creek groups when compared to the control and placebo groups.
2) Knowledge scores will be significantly higher for the Cobbs Creek and French Creek groups when compared to the classroom instruction group. This tests the hypothesis that outdoor instruction should produce higher gains in knowledge when compared to indoor instruction.

Forest Practices, Ecology, and Facts Knowledge Score (FPEF)

For each of these questions a student was given a "1" for a correct answer and a "0" for an incorrect answer. The sum of these scores was the student's FPEF knowledge score.

I ran a repeated measures ANOVA of the FPEF knowledge score by group to test the effect of the treatment over time for each of the five groups. To test the hypothesis that knowledge scores will be higher for the Cobbs Creek and French Creek groups when compared to the classroom only, control, and placebo groups I performed a one-way ANOVA of knowledge score by experimental group. Where the ANOVA's indicated a relationship between an independent variable and a score, I used a Scheffe's test to identify significant between-group differences.

Forest Ecology and History Knowledge Score (FEH)

For this set of questions a student's forest ecology and history (FEH) knowledge score was the mean score of their answers to a set of questions used to measure knowledge of certain concepts and definitions regarding forest ecology and history. I ran a repeated measures ANOVA by experimental to test the effect of the treatment over time. To test the hypothesis that knowledge scores will be higher for the Cobbs Creek and French Creek groups when compared to the classroom only, control, and placebo groups I performed a one-way ANOVA of knowledge score by experimental group. Where the ANOVA's indicated a relationship between an independent variable and a score, I used a Scheffe test to identify significant between-group differences.

Hypothesis Testing: Hypotheses 3 and 4

3. After viewing the silvicultural treatments at the French Creek Demonstration Forest, this treatment group should exhibit significant attitude changes in regard to timber harvesting. Specifically, scores for Pro-Timber Harvest Attitude and Conditional Pro-Timber Harvest Attitude will be significantly higher for the French Creek group when compared to the control, placebo, classroom, and Cobbs Creek groups while the Forest Preservation, Permanent Destruction Timber Harvest Attitude, and Anti-Timber Harvest Attitudes scores will be significantly lower.

4. The correlation between knowledge score and acceptance score will be a direct positive one for the classroom, Cobbs Creek, and French Creek groups. I hypothesize that the students that are more knowledgeable about forest ecology, practices, history, and facts will also be less likely to possess negative attitudes toward cutting as a forest management tool.

To test the hypothesis that attitude change would be prevalent for the classroom, Cobbs Creek and French Creek groups when compared to the control and placebo, I performed a repeated measures analysis of variance (ANOVA) with time as the repeated measure for each attitude type. I then performed one-way ANOVA's for each attitude type to compare the means of the five groups (control, placebo, classroom, Cobbs Creek, and French Creek). Similar procedures were followed for the knowledge questions also. Where the ANOVAs indicated a relationship between an independent variable and a score, I used a Scheffe's test to identify significant between-group differences.

Association of Knowledge and Attitude Scores

To determine the nature of the relationship between knowledge and attitude scores I tested the hypothesis that there should be a direct positive correlation between these two measures. I looked at the bivariate correlation coefficients within each of the five groups to evaluate the nature of the relationship.

Impact of School and Grade in School

Although this was not part of the original research design or hypotheses, I looked at the grade level of the students. To examine potential effects of grade level on students' scores I performed two-way ANOVAs (grade by treatment) of scores by grade by treatment. Where significance was indicated, I also performed one-way ANOVAs of scores by all five treatments separately for each grade.

Statistical Analysis

All statistical analyses were done using the Statistical Package for Social Science (SPSS).

Experimental Design

The selected design is classified as a nonequivalent control group design according to Campbell and Stanley (1963). I controlled for the non-random effects by randomly and equally distributing treatments across all classes. There were also control groups at two schools and a placebo group at one school. This experimental design minimized the testing effect by assuring that each student only took the survey twice.

Of the nine classrooms used in Bartrum cluster middle schools, one classroom from each of the three schools (71 students) were assigned to the control and placebo groups.

The 111 experimental group students were randomly assigned to three experimental sub-groups. The testing instrument I used was a questionnaire I discussed in detail earlier in the chapter. Each student completed the questionnaire twice at different times. Everyone received one pretest and one posttest taken at a certain time depending on which experimental group the student was assigned to. I was the sole presenter on the field trips and in the classroom. I also issued the questionnaires. I pretested the students to assess baseline knowledge, attitudes, and values in the area of forestry, forest management and the environment. I then issued posttests (Table 5) to the students after the three treatments: the classroom exercise (X_1), the Cobbs Creek Environmental Education Center (X_2), and the field exercises at French Creek (X_3). The posttest was given immediately after the classroom exercises and 7 to 10 days after the Cobbs Creek and French Creek treatments. I could not wait 7 days to administer the posttest to the classroom treatment group because the classroom and Cobbs Creek treatments were given on the same day (Table 2).

There was, of course, some attrition in the study due to absences. This longitudinal study only used results from those students who had taken both the pretest and posttest. Those students in the experimental groups received all three treatments.

Table 5. Nonequivalent Control Group Design.

PRETEST	Slides & PLT	POST TEST 1	Cobbs Creek	POST TEST 2	French Creek	POST TEST 3
Experimental O_1 n=111	X_1	O_2 n=39	X_2	O_3 n=36	X_3	O_4 n=36
PRETEST	No Trtmnt.					POST TEST 1
Control O_5 n=49						O_6 n=49
PRETEST	PSU Placebo Presen.					POST TEST 1
Placebo O_7 n=22	X_4					O_8 n=22

O=observations (pretests/posttests)

X=treatments

Table 6. Number of students tested after each treatment.

	Hamilton		Sayre		Turner	
Grade	8	8	7	7	6	6
Control	14	14	-	-	8	13
Placebo	-	-	9	13	-	-
Slides/ PLT	13	5	7	3	7	4
Cobbs Creek	5	12	3	8	3	5
French Creek	4	11	8	6	3	4

Limitations

I attempted to offer the same amount of information at all of the different classroom visits. However, the grade of the students affected how much material I was able to present (Table 7). I was only able to complete the entire slide show only with the 8th grade classrooms. I had to go considerably slower with the younger 6th grade students because they had more questions and required more time to grasp certain topics. The teaching pace was much slower with this group. I was able to complete the entire slide show with the 8th grade students and about half with the 7th graders, and one-fourth with the 6th graders. In this research study all analyses were done based on the information that was presented to all three grade levels.

Table 7. Amount of slide show presented for each grade level.

Slide Segments	6th Grade	7th Grade	8th Grade
Original Forests of PA (1-9)	X	X	X
Today's Forests (10-16)	X	X	X
Dynamic Forests (17-24)	X (Slide 22)	X	X
Silvics (25-27)		X	X
Tolerance (28-41)		X (Slide 30)	X
Thinning (42-45)			X (Slide 45)

Also, while trying to provide a natural resource education program to middle-school students at an impressionable age, it is understandable that some of the urban youths might have been apathetic or uninterested in natural resources. Also, some middle-school teachers might have had deeply engrained attitudes about timber harvesting and other forest management activities that could have had a stronger influence on the students than the educational experience at the demonstration site. The proposed methodology identified and controlled for these possible pitfalls.

Treatments

The treatments, as mentioned earlier, were the classroom exercises, and the field tours and exercises at Cobbs Creek and French Creek. Specific educational objectives include the following:

1) Students will understand that today's forests are the result of widespread clearcutting and burning at the turn of the century. (Classroom)

2) Students will understand that forest ecosystems are dynamic and change even without human intervention. (Classroom and French Creek)

3) Students will learn the purpose of a variety of silvicultural practices including thinning and regenerating (i.e. clearcutting and shelterwood) (Classroom and French Creek)

4) Students will understand the connection between the trees in their neighborhood and beyond, and the clean air, water, and aesthetics that they provide. (Cobbs Creek)

5) Students will be able to identify common forest products that they use everyday. (Classroom)

Classroom Exercises

The classroom exercises consisted of a slide presentation on the history of Pennsylvania's forests and an activity adapted from the Project Learning Tree curriculum.

The slide show adapted for use in this study was created by Alison Hiller (1995) and used when she tested the educational effectiveness of demonstration forest tours with private landowners. The entire slide set includes forest history, forest ecology, slivics, silviculture/intermediate treatments and even-aged management, regenerating Pennsylvania's forests, growth and development of forest stands, and threats to sustainability. I used the following segments when presenting to the schools: original forests of PA, today's forests, dynamic forests, silvics, tolerance, and thinning. The complete slide set begins with scenes of logged over and in some cases burned over areas of Pennsylvania around the turn of the century. The program continues by describing with tables and photos the contrasting nature of Pennsylvania's forests today. The slides that follow show different examples of forest change like the ongoing forest change demonstrated by stand mortality and growth, and the rapid change resulting from a clearcut and a tornado. The slides then show the individual species characteristics of black cherry , including size, fruit, shade tolerance. Concepts including tolerance, succession, crown classes, competition, and mortality are illustrated with a group of slides taken of a single northern hardwood stand after a clearcut, over the course of 60 years. Next, the purposes of silvicultural thinning and regeneration are discussed. A script of the slide show is in Appendix B.

After the slide presentation, I led the students through the Project Learning Tree Activity titled "We All Need Trees." The purpose of this activity was to realize that many tree products are not obvious. Through the activity the students discover the diversity and multitude of products that are in some form derived from trees. A complete listing of the activity is in Appendix C. The activity was structured as follows.

<u>Objectives</u>

1. Students will examine various products and determine which ones are made from trees
2. Students will describe ways that trees are used to make products and ways that these products can be conserved
3. Students will explore the concept that successful technologies are those that are efficient and promote the sustainable use of our tree resources

Procedure

1. I placed the following items on a table in classroom and labeled each with a number: magazine, toothpick, cardboard box, shampoo, sponge (synthetic, not natural), rayon shirt, bottle of vanilla flavoring, rubber gloves, plastic comb, tissue, make-up, aspirin.
2. I divided the student into groups of four.
3. The various groups moved around the classroom and examined the products. They determined as a group which of the products were made from trees.
4. The groups reported their results to the class.
5. I handed an informational article to each of the groups detailing the many uses of trees.
6. The students then re-evaluated the list of products and added or deleted items from one list to another.
7. The groups shared their new lists with the class and we discussed the diversity of products we get from trees. The students' realized through the discussion that all the products I placed around the room are made from trees in some way.

Cobbs Creek

Urban forestry exercises at Cobbs Creek aimed to help students make the link to an important natural resource in their community. This activity further enforces the role forests play in their everyday lives. A full description of the activity is in Appendix D.

Objectives

1. Students will develop an appreciation for the world's largest living plants--trees.
2. Students will size trees using standard units of measurement.
3. Students will learn three aspects of trees when determining a tree's size: height, DBH, and crown spread.
4. Students will work in pairs cooperatively and practice their math and science process skills.
5. Students will become amateur foresters as they apply real-world applications for science and math skills.
6. Students will discover that trees are both interesting and enjoyable.

Procedure

1. Walk to Cobbs Creek to examine trees.
2. I divided the students into groups of two. Each group chose one tree to measure at Cobbs Creek.
3. Students used diameter tapes, calipers, clinometers, and 100-ft tapes to measure DBH, tree height, and crown width.
4. One student in the group recorded the measurements.
5. Students were given extra credit if they could identify the state tree that was introduced

during the slide show earlier.

6. We walked back to the school and had each group report their data on the chalkboard.

The students recorded all the data and created a graph of the tree characteristics for the section of Cobbs Creek visited.

French Creek Demonstration Forest

The tour at French Creek Demonstration Forest (FCDF) revisited issues that were presented in the classroom and at Cobbs Creek. A full description of the French Creek tour is located in Appendix E.

Objectives

1. Students will objectively examine five different timber harvesting treatments.
2. Students will observe and compare tree growth, size, structure, crown class, wildlife, and temperature in the different plots.
3. Students will examine the treatments based on wildlife, monetary income, recreation, aesthetics, forest ecology.
4. Students will understand the impact deer have on forests.
5. Students will learn the Pennsylvania state bird.
6. Students will learn what one of Pennsylvania's most valuable trees for wood products is.
7. Students will learn what slash is and how it can be beneficial to forests and wildlife.

Procedure

1. I led students through a tour and discussion of the demonstration forest.
2. The students were broken into groups of four and collected the following in their assigned plots: crown class, species, and DBH of trees. They also measure the plot temperature and looked for signs of wildlife.
3. Students reported their findings and we discussed, compared, and contrasted everyone's results.

Chapter 4
RESULTS

I will present results from the statistical analyses I used to test my hypotheses. I will go on to discuss how the treatments affected the population according to my hypothesis testing.

My first hypothesis was that knowledge scores will be significantly higher for the classroom, Cobbs Creek, and French Creek groups when compared to the control and placebo groups. The second hypothesis stated that knowledge scores will be significantly higher for the Cobbs Creek and French Creek groups when compared to the classroom instruction group. The next hypotheses deal with the variables causing variance in Pro and Anti-Timber Harvest, Forest Preservation, Conditional Pro-Timber Harvest, and Permanent Destruction Timber Harvest Attitudes. I hypothesized that mean scores for the Pro-timber Harvest and Conditional Pro-Timber Harvest attitudes will be significantly higher for the French Creek group when compared to the control, classroom, and Cobbs Creek groups. The final relationship I tested was that between knowledge score and positive attitudes toward timber harvesting. I anticipated a significant positive association.

Test Results

A dependent set of variables were measured at the pretest and posttest. The variables are as follows. As indicated in the methods chapter, for the slide presentation each grade level was presented a different set of information. Therefore when analyzing the effect of the classroom treatment, I based it on the information presented to all grade levels.

I ran a repeated measures ANOVA with grade, gender, and group as the between subject factor and time (pre and post) as the repeated measure for the FEH and FPEF knowledge measures and the five attitude types. If the repeated measures ANOVA indicated a grade effect, then the results were further analyzed by grade.

Gender was not found to be significant in any of the tests I performed for this study and will not be included in further discussion. I used the Scheffe's test to identify differences among the five groups used in this study. The Scheffe's test is a multiple range test that measures the difference between two group means at the 0.05 significance level. Along with the Scheffe's test, the F-statistic is also used to measure significance. The F-statistic significance levels used throughout the study are set at the 0.005 and 0.05 levels as indicated by the asterisks in the tables.

Hypotheses 1 and 2

1) Knowledge scores will be significantly higher for the classroom, Cobbs Creek, and French Creek groups when compared to the control and placebo groups.

2) Knowledge scores will be significantly higher for the Cobbs Creek and French Creek groups when compared to the classroom instruction group. This tests the hypothesis that

outdoor instruction should produce higher gains in knowledge when compared to indoor instruction.

Analyzed by Grade in School

I ran a repeated measures ANOVA with grade, and treatment group as the between subject factor and time (pre and post) as the repeated measure for the FEH and FPEF knowledge measures.

FPEF Knowledge Score

The results of the repeated measures ANOVA showed a main effect of time $F(1, 159)=56.57$ $p<.001$. Treatment had an effect over time $F(4, 159)=2.37$ $p<.05$, and treatment was found to have an effect by grade over time $F(2, 159)=2.59$ $p<.05$.

Hypothesis 1 Test

Since grade was found to have an effect on the treatment over time, I took a closer look at the FPEF knowledge measure pre and post test by grade for the control/placebo group and the treatments groups. I ran one-way ANOVA's for each grade to find out if there was a pattern. The results in Table 8 show that the both the 6th and 8th graders in the three treatment groups demonstrated significant gains in knowledge on this particular measure when compared to the control and placebo groups. However, the three treatments as a whole had no effect on the 7th graders knowledge level in this subject area.

Table 8. One-way ANOVA of FPEF knowledge score by grade level and treatment.

	Control and Placebo Groups		Treatment Groups (Classroom, Cobbs Creek, French Creek)		F Statistic
Grade in School	**Mean**	**S.D.**	**Mean**	**S.D.**	**F**
8th	0.25	.52	1.44	0.64	70.07*
7th	0.89	0.58	0.94	0.84	0.60
6th	0.26	0.45	0.73	0.45	11.73*

***indicates significance at the .005 level**
****indicates significance at the .05**

Hypothesis 2 Test

I analyzed the same knowledge measure by all five treatment groups separately to find out which group(s) experienced the most knowledge gain. I report the results in Table 9. The 8th-graders in all treatment groups experienced significant gains in FPEF knowledge when compared to the control group as indicated by the Scheffe's test. The hypothesis for outdoor instruction producing a more significant knowledge gain did not hold for the 8th grade students since both the indoor and outdoor treatment groups exhibited knowledge gain.

Table 9. One-way ANOVA's of FPEF Knowledge Score (posttest) by treatment for the 8th grade students.

	MEAN	S.D.	F-RATIO
1 control	0.25	0.52	23.10*
3 slide show/PLT	1.50	0.62	
4 Cobbs Creek	1.35	0.70	
5 French Creek	1.47	0.64	

***indicates significance at the .005 level**
****indicates significance at the .05**

For the 7th grade students the French Creek group experienced the most in knowledge gain when compared to the Cobbs Creek group (Table 10). There is no apparent pattern and the outdoor instruction hypothesis does not hold for this group either.

No significant knowledge gains were experienced by the 6th graders on this measure.

Table 10. One-way ANOVA's of FPEF Knowledge Score (posttest) by treatment for the 7th grade students.

	MEAN	S.D.	F-RATIO
2 Placebo	0.89	0.58	3.37**
3 Slide show/PLT	0.90	0.52	
4 Cobbs Creek	0.45	0.69	
5 French Creek	1.36	0.84	

***indicates significance at the .005 level**
****indicates significance at the .05**

Summary for FPEF Knowledge Score

For the 8th graders all treatment groups combined experienced significantly more knowledge gain when compared to the control/placebo group, whereas for the 7th grade students combined this did not occur. The 7th grade did not show this because only the French Creek group experienced significant knowledge gain when compared to control/placebo group. Therefore the French Creek treatment was the most effective treatment with the 7th grade students for increasing FPEF knowledge while all treatments produced significant knowledge gain with the 8th grade students. No significant knowledge gains were made by the 6th graders on this measure. However, on this knowledge measure, the mode of instruction--whether indoor or outdoor--did not affect the amount of knowledge gained for the 8th grade students. Therefore, for the 8th grade students, the results supported hypothesis 1 but not hypothesis 2. Neither hypotheses were supported by the results of the 6th and 7th graders.

FEH Knowledge Score

The results of the repeated measures ANOVA show that treatment had an effect over time $F(1, 160)=3.83$ $p<.10$, and treatment was found to have an effect by grade over time $F(5, 160)=4.58$ $p<.10$.

Hypothesis 1 Test

Since grade was found to have an effect on the treatment over time, I took a closer look at the FEH knowledge measure pre and post test by grade. I ran one-way ANOVA's for each grade to find out if there was a pattern. The results in Table 11 show that the 7th graders in all treatment groups combined demonstrated significant gains in knowledge on this particular measure when compared to the control and placebo groups. When looking at the three treatment groups together, they had no effect on the 6th and 8th graders knowledge level in this subject area.

Table 11. One-way ANOVA of FEH knowledge score by grade level and treatment.

	Control and Placebo Groups		Treatment Groups (Classroom, Cobbs Creek, French Creek)		F Statistic
Grade in School	Mean	S.D.	Mean	S.D.	F
8th	3.61	.48	3.90	.71	3.78
7th	3.36	.70	3.85	.92	4.42**
6th	2.99	.48	3.43	.74	3.76

*indicates significance at the .005 level
**indicates significance at the .05

Hypothesis 2 Test

I analyzed the FEH knowledge measure by all five treatment groups to find out which group(s) experienced the most knowledge gain (Table 12). The 8th graders experienced no significant gains in FEH knowledge.

Table 12. One-way ANOVA's of FEH Knowledge Score (posttest) by treatment for the 8th grade students.

	MEAN	S.D.	F-RATIO
1 control	3.61	0.48	1.74
3 slide show/PLT	3.98	0.78	
4 Cobbs Creek	3.96	0.74	
5 French Creek	3.73	0.59	

***indicates significance at the .005 level**
****indicates significance at the .05**

For the 7th grade students the French Creek group experienced the most in FEH knowledge gain when compared to the placebo and Cobbs Creek groups (Table 13).

Table 13. One-way ANOVA's of FEH Knowledge Score (posttest) by treatment for the 7th grade students.

	MEAN	S.D.	F-RATIO
2 Placebo	3.36	0.70	5.44*
3 Slide show/PLT	3.60	1.02	
4 Cobbs Creek	3.39	.71	
5 French Creek	4.38	.77	

***indicates significance at the .005 level**
****indicates significance at the .05**

For the 6th grade students the Cobbs Creek group experienced the most significant knowledge gain when compared to the control group (Table 14). This significant gain was not picked up by the one-way ANOVA in which all three treatment groups where lumped together.

Table 14. One-way ANOVA's of FEH Knowledge Score (posttest) by treatment for the 6th grade students.

	MEAN	S.D.	F-RATIO
2 Control	2.99	0.70	2.97**
3 Slide show/PLT	3.27	1.02	
4 Cobbs Creek	3.83	.71	
5 French Creek	3.19	.77	

***indicates significance at the .005 level**
****indicates significance at the .05**

Summary for FEH Knowledge Measure

For the 8th grade none of the treatment groups experienced significant knowledge gained when compared to the other groups whereas for the 7th grade students only the French Creek group experienced significant knowledge gained when compared the control/placebo and Cobbs Creek groups. For the 6th grade students the Cobbs Creek group experienced the significant knowledge gain when compared to the control/placebo. Therefore the French Creek treatment was the most effective treatment with the 7th grade students and Cobbs Creek was the most effective treatment for the 6th grade students for increasing FEH knowledge. For the 6th and 7th graders on this knowledge measure the outdoor instruction hypothesis holds since the Cobbs Creek and French Creek groups experienced the most knowledge gain when compared to control/placebo. The results also illustrate the significant knowledge gain in the treatments groups when compared to the control and placebo groups. For the 8th graders, the results do not support either of the hypotheses. The 6th and 7th graders' results, while only partially supporting hypothesis 2, illustrated that outdoor instruction did produce significant knowledge gains when compared to the control/placebo group whereas the classroom instruction treatment did not.

Hypothesis 3

3) After viewing the silvicultural treatments at the French Creek Demonstration Forest, this treatment group should exhibit significant attitude changes in regard to timber harvesting. Specifically, scores for Pro-Timber Harvest Attitude and Conditional Pro-Timber Harvest Attitude will be significantly higher for the French Creek group when compared to the control, placebo, classroom, and Cobbs Creek groups while the Forest Preservation,

Permanent Destruction Timber Harvest Attitude, and Anti-Timber Harvest Attitudes scores will be significantly lower.

Pro-Timber Harvest Attitude

The results of the repeated measures ANOVA show a main effect of time F(1, 162)=54.16 p<.005. Grade did not have an effect over time nor did treatment have an effect by grade over time, so the results were not analyzed by grade. Treatment had an effect over time F(4, 162)=2.98 p<.07.

To find out what effect treatment had over time I ran a One-way ANOVA of the Pro-Timber Harvest Attitude scores by treatment group for all the students (Table 15). The results of the Scheffe's test indicate that the French Creek treatment group experienced a significant positive change in their attitudes toward timber harvesting when compared to the control/placebo group. This supports hypothesis 3 that states that the French Creek treatment group should produce the attitude changes about timber harvesting.

Table 15. One-way ANOVA's of Pro-Timber Harvest Attitude Score (posttest) by treatment for the 6th, 7th, and 8th grade students.

	MEAN	S.D.	F-RATIO
1 Control/Placebo	2.45	0.90	3.27*
3 slide show/PLT	2.71	1.00	
4 Cobbs Creek	2.68	0.83	
5 French Creek	2.75	0.77	

*indicates significance at the .005 level
**indicates significance at the .05

Conditional Pro-Timber Harvest Attitude

The results of the repeated measures ANOVA show a main effect of time F(1, 161)=8.64 p<.001. Grade did not have an effect over time nor did treatment have an effect by grade over time, so the results were not analyzed by grade. Treatment had an effect over time F(4, 161)=11.70, p<.001.

To find out what effect the treatment had over time, I analyzed the Conditional Pro-Timber Harvest Attitude scores by treatment group for all the students. The results of the Scheffe's test indicate that the French Creek treatment group experienced significant knowledge gain when compared to the control/placebo, classroom instruction, and Cobbs Creek groups (Table 16). This evidence strongly supports hypothesis 3 that states that the French Creek group will be the most efficacious in effecting attitude changes about timber harvesting.

Table 16. One-way ANOVA's of Conditional Pro-Timber Harvest Attitude Score (posttest) by treatment for the 6th, 7th, and 8th grade students.

	MEAN	S.D.	F-RATIO
1/2 Control/Placebo	2.69	0.82	13.74*
3 slide show/PLT	2.87	0.70	
4 Cobbs Creek	3.11	0.89	
5 French Creek	4.06	0.84	

*indicates significance at the .005 level
**indicates significance at the .05

Anti-Timber Harvest Attitude

The results of the repeated measures ANOVA show a main effect of time $F(1, 162)=.71$ $p<.05$. Grade had an effect over time $F(2, 162)=1.57$, $p<.008$. Treatment was found to have an effect over time $F(4, 162)=6.03$ $p<.001$ and treatment had an effect by grade over time $F(5, 162)=7.12$, $p<.001$.

I analyzed the anti-timber harvesting attitude measure by all five treatment groups to find out which group(s) experienced the attitude changes. Since grade was found to have an effect, the results were further analyzed by grade. I report the results in Table 17. When looking at the 8th graders, the Scheffe's test indicated that the Cobbs Creek group experienced significant attitude changes against timber harvesting when compared to the control/placebo group. The classroom instruction and French Creek treatments did not affect the 8th grade students' attitudes toward timber harvesting. These results do not support the hypothesis.

Table 17. One-way ANOVA's of Anti-Timber Harvest Attitude Score (posttest) by treatment for the 8th grade students.

	MEAN	S.D.	F-RATIO
1 control	4.02	0.45	3.35*
3 slide show/PLT	3.81	0.48	
4 Cobbs Creek	3.55	0.54	
5 French Creek	3.68	0.61	

*indicates significance at the .005 level
**indicates significance at the .05

For the 7th grade students only the French Creek group experienced attitudinal changes away from an anti-timber harvesting point-of-view when compared to all other groups (Table 18). The French Creek treatment was the most effective treatment with the 7th grade students for decreasing their Anti-Timber Harvest Attitudes. This supports the hypothesis that the French Creek treatment will be most efficacious in changing attitudes about harvesting. No significant attitude changes were experienced by any of the 6th graders on this measure.

Table 18. One-way ANOVA's of Anti-Timber Harvest Attitude Score (posttest) by treatment for the 7th grade students.

	MEAN	S.D.	F-RATIO
2 Placebo	3.76	0.51	14.27*
3 Slide show/PLT	3.55	0.53	
4 Cobbs Creek	3.65	0.69	
5 French Creek	2.29	1.00	

***indicates significance at the .005 level**
****indicates significance at the .05**

Forest Preservation Attitude

The results of the repeated measures ANOVA do not show a main effect of time $F(1, 162)=1.35$ $p<.08$. The effect of the treatment did not differ by grade over time nor did the treatment have an effect over time. Since the treatment did not affect this attitude for the students I did not further analyze this variable.

Permanent Destruction Timber Harvest Attitude

The results of the repeated measures ANOVA show a main effect of time F(1, 159)=5.08 p<.001. The effect of the treatment did not differ by grade over time nor did the treatment have an effect over time, so the results were not further analyzed by grade. Also, treatment had an effect over time F(5, 159)=11.21 p<.001.

According to the Scheffe's test the French Creek group exhibited significant attitude change when compared to the control/placebo group (Table 19). After the French Creek treatment students disagreed with the idea that timber harvesting results in permanent destruction of the land as indicated by their 2.17 score (2=disagree).

Table 19. One-way ANOVA's of Permanent Destruction Timber-Harvest Attitude Score (posttest) by treatment for the 6th, 7th, and 8th grade students.

	MEAN	S.D.	F-RATIO
2 Control/Placebo	2.92	0.79	4.29**
3 Slide show/PLT	2.43	0.99	
4 Cobbs Creek	2.56	1.14	
5 French Creek	2.17	0.92	

***indicates significance at the .005 level**
****indicates significance at the .05**

Hypothesis 4: Correlation Between Knowledge Scores and Attitude Scores

4) The correlation between knowledge score and acceptance score will be a direct positive one for the classroom, Cobbs Creek, and French Creek groups. I hypothesize that the

students that are more knowledgeable about forest ecology, practices, and history will also be less likely to possess negative attitudes toward cutting as a forest management tool.

To determine if a relationship existed between higher knowledge scores and a higher acceptance of timber harvesting and clearcutting as indicated by the pro and conditional timber harvest attitude scales, I obtained bivariate correlation coefficients for each attitude paired with the two knowledge scores at post test. The results are shown in Table 20. No significant correlations were found between the FPEF knowledge score and Anti-Timber Harvest Attitudes, Pro-Timber Harvest Attitudes, or Conditional Pro-Timber Harvest Attitudes. No significant correlations were found with the FEH knowledge scores and the Pro-Timber Harvest and Forest Preservation. I only reported the significant relationships.

The Anti-Timber Harvest Attitude was positively correlated with FEH knowledge for the control, placebo, and classroom groups and negatively correlated with the French Creek group (placebo group exhibited marginal significance). After the French Creek treatment as FEH knowledge score increased the Anti-Timber Harvest Attitude score decreased. That is a lower level of knowledge about forest ecology and history coincides with a stronger attitude against timber harvesting. The correlation between these two knowledge and attitude scales did not switch from positive to negative until the French Creek treatment.

The Forest Preservation Attitude and FPEF knowledge were significantly and negatively correlated after the classroom treatment. After the classroom treatment students that were more knowledgeable about forest practices, ecology, and facts were more apt to have strong forest preservation attitudes.

The Conditional Pro-Timber Harvest Attitude and FEH knowledge were positively and significantly correlated after the French Creek treatment. After seeing the timber harvesting demonstration students who knew more about forest ecology and history were more inclined to favor timber harvesting under the proper conditions.

Lastly, the Permanent Destruction Timber Harvest Attitude was negatively and significantly correlated to both the FPEF and FEH knowledge scores. Students that knew more about forestry were less likely to possess attitudes that presume timber harvesting results in permanent destruction of forests.

Table 20. Bivariate correlation coefficients for timber harvesting acceptance scores by knowledge scores at the posttest.

	1 Control		2 Placebo		3 Classroom		4 Cobbs Creek		5 French Creek	
Anti-Timb. Harvesting Attitude	coef.	p	coef.	p	coef.	p	coef.	p	coef.	p
by FEH Knowledge Score	**.39**	**.01**	.41	.06	**.61**	**.00**	.23	.18	**-.65**	**.00**
Forest Preservtn. Attitude	coef.	p	coef.	p	coef.	p	coef.	p	coef.	p
by FPEF Knowledge Score	-.00	.10	.03	.90	**-.38**	**.02**	-.20	.25	.09	.62
Cond. Pro-Tmb. Harv. Attitude	coef.	p	coef.	p	coef.	p	coef.	p	coef.	p
by FEH Knowledge Score	-.01	.97	-.11	.62	.27	.10	.22	.19	**.41**	**.01**
Perm.Dest. Tmb. Harv. Attitude	coef.	p	coef.	p	coef.	p	coef.	p	coef.	p
by FPEF Knowledge Score	-.23	.16	-.17	.50	-.16	.33	**-.40**	**.02**	**-.43**	**.01**
by FEH Knowledge Score	.14	.37	-.05	.81	-.28	.09	**-.33**	**.05**	**-.37**	**.03**

Chapter 5
DISCUSSION

Summary of Results

Knowledge gain is often the goal of environmental and natural resource education programs. My findings mirror those of many other programs in that the educational experience produced significant gains in knowledge among the participants. However, this study was unique because it studied the cumulative effect of program components with an audience that has never been the subject of forestry demonstration plot research.

There were two previous studies that these results resembled in terms of attitude change. In this study the children exhibited positive attitude changes toward timber harvesting after the Cobbs Creek and French Creek treatments. This attitude change did not occur after the slide show and classroom exercises but when the students went outdoors and viewed trees and harvesting. Morgan and Gramann (1989) found an affective attitude change where students had more positive attitudes toward snakes after the snake was taken from the aquarium and handled by the instructor. By becoming physically closer to the snake and seeing firsthand that the instructor was not harmed by the snake, the students felt more positive about the experience. Similarly in this study, the students did not change their attitudes about harvesting until they became involved with touching, measuring, and learning about trees firsthand. They realized that just as snakes are not always aggressive, cutting trees is not always bad. Hiller (1995) conducted a study where only after touring a demonstration forest and seeing a clearcut did private forest landowners become more accepting of timber harvesting and clearcutting. Hiller also found that those landowners that knew more about forestry were also more accepting of timber harvesting and clearcutting. These results reflect those of her study in that the students that had a high knowledge about forestry also had a positive attitude toward harvesting and did not think that cutting trees permanently destroys the forest. This was the only study in the literature that linked forest management knowledge and attitudes toward harvesting. However forest management knowledge has been positively correlated to acceptance of other forest management activities including the use of herbicides (McNabb and Bliss 1994) and the use of prescribed burning (Cortner, Zwolinski, Carpenter, and Talyor 1984; Carpenter, Taylor, Cortner, Gardner, Zwolinski, and Daniel 1985; Manfredo, Fishbein, Haas, and Watson 1990).

Tabular Summary of Results

Table 21. Summary of Knowledge Score results as indicated by significant between group differences for 6th, 7th, and 8th graders.

	FPEF Knowledge	FEH Knowledge
6th Grade	none	Cobbs Creek vs. control placebo
7th Grade	French Creek vs. Cobbs Creek	French Creek vs. control placebo Cobbs Creek
8th Grade	All treatment groups vs. control placebo	none

Table 22. Summary of Pro-Timber Harvesting Attitude and Conditional Pro-Timber Harvest Attitude results as indicated by significant between group differences for all grades.

	PTHA Attitude	CPTHA Attitude
All Grades	French Creek vs. control placebo	French Creek vs. control placebo classroom Cobbs Creek

Table 23. Summary of Anti-Timber Harvesting Attitude and Permanent Destruction Timber Harvest Attitude results as indicated by significant between group differences for all grades.

	ATHA Attitude	PDTHA Attitude
All Grades		French Creek vs. control placebo
6th Grade	none	
7th Grade	French Creek vs. control placebo classroom Cobbs Creek	
8th Grade	Cobbs Creek vs. control placebo	

Table 24. Summary of correlations between variables for all treatment groups and the control and placebo.

	Control	Placebo	Classrm.	Cobbs Creek	French Creek
FEH & ATHA	+	+			-
FEH & CPTHA					+
PDTHA & FEH FPEH					–

Discussion of Results

Urban Youth Environmental Education

With the majority of the United States population residing in urban areas, the decisions that affect the nation and the management of its natural resources are made by those urban residents. With this amount of potential future influence in mind, I targeted the young decision makers of tomorrow in Philadelphia. Youth have environmental messages aimed at them daily from a variety of sources: television programs, comics, kids books, teachers, etc. Yet despite the prevalence of environmental messages aimed at them, increasing evidence shows that they are not learning much about the environment except for simple platitudes and blind faith about environmental causes (Adler 1993). Many children develop attitudes that are based on emotion, incomplete, or inaccurate information. I designed an environmental education program that moved beyond the pro-environmentalist attitude and provided the children with an understanding of how they impact and are affected by the common environment. With the negative views of the forestry profession that are often portrayed in the media, I wanted to give the students complete, objective, and relevant information about timber harvesting and how it affects the land, the people, and the economy. Youth can only be expected to make informed decisions when they have all the components necessary, like proper facts, knowledge, and complete accurate information. By providing all these components in this environmental education program, the youth I worked with became more knowledgeable and accepting of timber harvesting as a forest management tool (Table 21).

The literature review showed that children growing up in urban areas do care about the environment and their usually limited exposure to nature experiences does not extinguish their environmental concern. Also, while Black children may generally have a lower overall familiarity with environmental or natural resource topics, they learn just as well as their White counterparts when given the same educational experience (Higginbotham 1996). While I was not able to make racial comparisons in this study, I found that when Black urban schoolchildren are given a quality environmental education they experience significant knowledge gains and attitude changes. By utilizing the urban environment in this study, the children were able to make a connection with the natural resources in their own communities. This created a sense of relevance in terms of the importance of trees. Valuing the urban environment and using it as a learning resource was a key component of this environmental education study. Translating the educational experience into something the children could relate to in their own neighborhood was very important.

Outdoor Education

In terms of knowledge gain the outdoor treatments produced significant gain for 6th, 7th, and 8th graders when compared to the control and placebo groups (Table 21). However, for the 8th graders both the indoor classroom instruction and outdoor instruction caused the students to exhibit significant gains in knowledge. As stated earlier, since the amount of exposure varied by grade I based the knowledge scores on what information all three grade levels were exposed to. While the treatment effectiveness varied for the 6th and 7th graders, the students in the outdoor treatment groups consistently knew more about forestry than the control/placebo group. These results support the body of literature that says people learn better by doing and seeing. Although outdoor education should be the mode of choice, especially for natural resources education, the classroom treatment worked for the 8th grade students. Studies have also shown that while outdoor experiences produce knowledge gain, indoor experiences can also be effective. The ideal combination would incorporate both indoor and outdoor sessions. Indoor sessions are useful for orientation and introductory exercises or when outdoor experiences are not possible. While outdoor education has unique benefits that cannot be realized indoors, indoor instruction should not be discounted, especially since the later is more attractive to schoolteachers because of ease.

Potential Uses: School as an Avenue for Environmental Education

Because schools can be effective avenues for environmental education, they should continue to be utilized. Pennsylvania has K-12 environment and ecology requirements handed down from the Pennsylvania Department of Education. Since this is fairly new legislation, many teachers are looking for ways to incorporate environmental studies into their curricula. When approaching schools with an environmental education program, it is best to present a program that can easily be incorporated into what the teacher are already doing in the classroom. For teachers, ease of use is an important characteristic of any educational program they are considering using. It is for this reason that I used the Project Learning Tree curricula which has activities classified by grade level, subject in school, indoor or outdoor, and time required. Many of the materials used in the PLT are readily available in the school and the activities are planned in 50-minute sessions, just as classes are. Since there are quality low-cost easy to use programs available, if any program requires substantial time or money, it is not likely that the teacher will use it. For this project the first two treatments required no additional resources from the teachers and could easily be done again at a later date or with another class with the teacher instructing instead of me. I gave the teachers complete copies of the activities and other educational resources so that they could do the activity on their own. The trip to the French Creek Demonstration Forest did require buses and travel time, but the School District provides funds for off-campus field trips.

Effectiveness of French Creek Demonstration Forest

I conclude that Forest Stewardship Demonstration Area was a valuable educational tool that contributed to youths' knowledge and understanding of forest ecology and silviculture concepts beyond that achieved by an indoor experience alone. The field demonstration provided youth an opportunity to familiarize themselves with alternative timber harvesting practices and evaluate or re-evaluate their views of these practices. Only after seeing the timber harvesting demonstrations did the students adopt attitudes in favor of harvesting. They felt that if done properly, cutting trees is necessary and is sometimes useful for the residual trees. Also, after seeing French Creek they believed that cutting trees does not result in permanent destruction of forests and that trees do grow back. All grades experienced this attitude change (Tables 22, 23). However, seeing the demonstration forest did not change the 6th graders anti-timber harvesting attitude. These youngsters possessed a dichotomous attitude where they were against harvesting but at the same time believed that cutting trees in certain situations is acceptable. Because they were the youngest grade that I worked with, they probably have difficulty forming concepts about sustainable forestry at such a young developmental age.

Before the students toured the demonstration forest their low knowledge about forestry was positively correlated with an attitude against timber harvesting. However after seeing the various ways a forest can be managed at French Creek the students who learned about forestry did not possess negative attitudes toward cutting trees but agreed that harvesting is necessary at times (Table 24). These students also believed that harvesting trees does not result in permanent destruction of the forest and that the trees grow back.

The results demonstrate that while knowledge of forestry can be gained from classroom or urban forestry activities, the only way that attitudes change is by actually seeing the direct results of various harvesting treatments. With all the competing negative images of timber harvesting that are portrayed by the media, attitude changes should be a goal of any natural resource education program. These negative images translate into opposition against the forest industry that often manifests itself in unsound policies. Youth should be given the proper information so that when they need to make decisions on managing our shared resources, they can do so in an informed fashion. Therefore if a goal is to change youths' attitudes about forestry, showing is the most effective way, especially with younger children.

Which Treatments Worked Best for Whom: Effect of Grade in School

Table 25. Summary of which grades experienced attitude change and/or knowledge gain as a result of the treatments.

	Control	Placebo	Classroom	Cobbs Creek	French Creek
FEH Knowledge				6th	7th
FPEF Knowledge			8th	8th	8th 7th
Pro-Timb. Harvest					all grades
Cond. Pro Timb. Harv.					all grades
Perm. Destr. Timb. Harv.					all grades
Anti-Timb. Harvest				8th	7th

While this study was not adequately designed to test grade effect since the amount of information varied by grade and each grade level was taught by a different teacher, some conclusions are possible. When looking at the information that all grades were exposed to at French Creek, the 7th graders learned the most (Table 25). For the 7th graders French Creek was the only treatment that produced attitude changes as well. For this grade level, French Creek was the most effective treatment. Because the treatments were cumulative, so was some of the information presented. The 7th graders in this study performed best when they were exposed to the same information in different settings. This kind of multiple exposure to information made a big difference for the 7th graders and was effective in producing desired attitude changes and knowledge gain. For the 6th graders, French Creek was also the most effective treatment with the exception of Cobbs Creek on one particular knowledge measure. I attempted to present the same information to all three grade levels in this study. However, because the 6th graders were at such a young developmental stage I was unable to get through all the information with them. Therefore I analyzed the results based on the information that everyone was exposed to. Yet the 6th graders still did not exhibit the same gains as their older counterparts. This educational program was not ideal for the 6th graders. A more basic forestry education program would be more appropriate for this grade level than one that explores advanced concepts like forest management and how it related to sustainable forestry. The 8th grade students benefited from the three cumulative treatments like the 7th graders, but experienced knowledge gain and attitude changes before the French Creek treatment. The repetition of information in different settings was not as important for the 8th grade since they absorbed the information faster. Since the 7th graders were behind the 8th graders by one developmental year, it would be expected that the younger the children the longer it will take for them to learn the same amount of information as their older schoolmates. Although age and child development were not part of the original hypotheses or research design, these variables should be taken into account in future studies involving children of different ages.

Conclusions and Implications

If Pennsylvania's forests are to be managed sustainably more of the population needs to know what that entails. One way to accomplish this is by reaching youth since as they age they will become increasingly more involved in decisions concerning the management of public and private lands. In the educational program that I conducted as the youth learned more about forestry they shed their negative views about forestry and adopted attitudes in favor of harvesting trees sustainably.

Forest resource management and use is something that every student in Philadelphia takes part in every day. When choosing between "paper or plastic" at the grocery store youths are making a choice to use a renewable resource that comes from our forests or a depletable petroleum product. The water they drink everyday comes from a water body in which temperature is regulated by the trees that surround it and those same trees stabilize the soil and keep it from washing into the water. If youth understand the connection and influence that they have on natural resources then they will be more likely to be advocates of natural resources in the future. Also if youth understand the necessity of forests in terms of the benefits they provide like wood products, aesthetics, and recreation then they will be more apt to have a sustainable forestry management perspective.

Based on the findings of this study, I conclude that classroom exercises, urban forestry activities, and demonstration forests are valuable components of an educational program and that they contribute to participant knowledge gain and attitude change. For 7th graders cumulative treatments re-emphasizing the same information was key, the 8th graders picked up the information more readily, and the 6th graders would have benefited from a program that was more aligned with their younger developmental stage. Touring the French Creek Demonstration Forest was the most efficacious treatment in terms of producing attitude changes about forestry. Demonstration forests are an effective arena for future successful forestry education programs. However, the indoor and Cobbs Creek exercises were effective in 1) producing knowledge gains about forestry with the older students, 2) getting all the students acclimated to forestry, and 3) addressing any fears or discomforts associated with learning in a forested environment.

These implications are particularly of value because this type of educational program could be implemented in any of the other 21 clusters in the Philadelphia School District. The program is also adaptable for use at any of the other six demonstration forests around the state.

Recommendations for Future Research

This educational program was found to be effective in changing attitudes and producing knowledge gains with 6th, 7th, and 8th grade middle school students in inner-city Philadelphia. Since the treatments were not as effective with the younger group, perhaps a more basic module needs to be tested that can have more efficacy. Also, this was a short-term longitudinal study. A study that measures the long-term effects of the treatment would be useful. In addition, it would be helpful to know if these treatments affect the students behavior over time. It would be useful to study the long-term effects of the study to determine if attitude changes that I witnessed really translate into future behavioral changes.

This study could also be repeated with different audiences to compare its effectiveness among different groups. Would this program be as effective with a group of suburban students or rural students? Another perspective is that of cumulative treatments. A study where the students received one, and only one, treatment could compare the effects of repetition on knowledge and attitude changes.

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APPENDIX A

General Description of Forest Stewardship Demonstration Area

General Description of the French Creek Forest Stewardship Demonstration Area

"Integrating Sustainable Forestry into Total Farm Management," funded by the United States Department of Agriculture's Sustainable Agriculture Research and Education Program (SARE), enabled Penn State to establish seven Forest Stewardship Demonstration Areas across Pennsylvania to encourage responsible forest resource management through education. There are six 2-acre harvesting treatments demonstrated on each site. Each 2-acre treatment block includes a fenced 20' by 20' deer exclosure. The 12-acre site used in this study is located at French Creek State Park near Reading, PA.

The trees in this forest began to grow around the turn of the century, and there were nearly 500 trees per acre before treatments were applied. When all the trees on the site are of approximately the same age, a common condition in Pennsylvania, the stand is said to be even-aged. French Creek Demonstration site is even-aged.

The Treatments

Six treatments, two acres each, are demonstrated along Fire Tower Road with three on each side of the Red Trail. The treatments include various types of thinnings and regeneration harvests. The following is a description of each treatment, the reason for including it in the demonstration, and a diagram that illustrates the portion of the diameter distribution that was removed in each treatment.

In the diagrams that follow each description, DBH refers to the tree diameter measured at breast height, which is a standard four and a half feet above the ground (uphill side).

NO HARVEST

For comparison, nothing is removed from this block. The major objective of this project is to encourage the responsible management of forests by showing the results of alternative timber harvesting treatments. However, the demonstration would be incomplete without first being able to compare how the forest appears without cutting. In many circumstances, no cutting may be a preferred alternative.

Block 1. Control... For comparison, nothing is removed from this plot.

THINNINGS

Tree mortality is a natural and ongoing forest process. Young forests with small trees support many thousands of trees per acre. As the forest matures and individual trees become larger, many of those thousands of trees are crowded and suppressed (by faster growing neighbors) then die. In this way, the forest naturally "thins" itself.

Thinning a forest stand anticipates natural mortality. Thinning reduces crowding and, by redistributing the growth potential to the most desirable trees on the site, increases the overall health, vigor, and growth of the remaining stand. Those "residuals" or remaining trees may have been selected for one of many reasons, including wildlife habitat (a "cavity" tree), timber, or aesthetics. Thinning can provide some intermediate return on a landowner's long-term forest investment.

Three of the treatments along Fire Tower Road are thinnings. Before harvesting, there were no openings in the forest (the forest was "fully stocked"). There was no room for individual crowns to grow and expand. The purpose of our thinning treatments was to reduce the stocking or density to 60 percent to give the remaining trees additional room to reach out, thus increasing their growth rate.

Block 2. Diameter-Limit from Below... A diameter-based thinning-from-below removes all trees smaller than a calculated diameter. Again, since this is an even-aged stand, the smaller slower growing trees were simply poorer competitors than their now larger neighbors. Removing them provides little additional growing space to the larger ones. Also, by removing all the small trees, we may eliminate one or more tree species that happen to develop naturally at a slower rate. Although the resulting forest can look almost park-like, which can be aesthetically pleasing, small trees and shrubs provide food, homes and hiding places for wildlife. Their removal may significantly reduce wildlife use of the area. A diameter-based cut from below will likely not be an economically viable option, in terms of both immediate cash flow and ultimate financial return.

Block 3. Improvement Thinning... An improvement thinning represents the professional forester-recommended treatment for this forest stand. It was designed to meet a set of specified objectives, including production of timber for income, maintenance of wildlife habitat, and protection of the soil and related resources. A resource professional balances the landowner's management objectives with forest conditions, the site, and timber markets, and then selects individual trees to cut or to leave on the basis of species, spacing, and tree quality. The result is that trees of many sizes are removed and additional growing space is made available to desired trees. The overall quality of the forest is improved for whatever objectives were chosen. Typically, the immediate cash return from this type of thinning is relatively small, perhaps just covering its costs, but an investment has been made in the future of the forest.

Block 5. Diameter-Limit from Above... A diameter-based thinning-from-above removes all trees larger than a calculated diameter. Those largest trees are selected on the basis of diameter alone, regardless of their location with respect to other trees. Neither of the diameter-based thinnings shown in this demonstration is rooted in sound forestry. The results are generally undesirable. Once again, when all similarly sized trees are removed, certain tree species can be completely eliminated from the remaining stand, and in an even-aged, the burden of regenerating the forest falls on the smaller and possibly genetically inferior trees that are left. Because the remaining trees are not younger, but instead are slower-growing, damaged, diseased, or less vigorous species, they may not be able to respond to the increased light and growing space made available to them by the thinning. In addition, this treatment allows no consideration for wildlife habitat implications. A diameter-based cut from above yields the highest immediate cash return of any thinning, but the long-term financial yield is drastically reduced. The remaining low value trees are unable to generate much future income potential. This type of thinning, also called "high-grading" because it removes the best or highest grade trees and leaves the poorer quality trees, is a common practice on private individual properties throughout the temperate hardwood forests of the eastern United States.

REGENERATION HARVESTS

Forests are a renewable natural resource. Trees in forests left completely undisturbed, do not live forever. Once a tree becomes mature, growth slows, resistance to insects and disease is reduced, and its ability to respond to injuries diminishes. Old trees are eventually "harvested" naturally, dying and then crumbling or crashing to the forest floor to donate their nutrients to the soil where they can be used by other living organisms and new seedlings. In a **regeneration harvest** we are mimicking this natural process to ensure long-term forest sustainability. Not all in nature is a gradual death--one regeneration harvest on the site mimics catastrophic effects that wind, fire, disease, and other natural disasters can cause.

Old trees are removed as efficiently as possible in order to supply the space and access to resources (light, moisture and nutrients) needed for the establishment of new trees. When making decisions regarding a regeneration harvest one must consider the characteristics of the site, the silvics of tree species, as well as possible impacts on wildlife and water resources.

Block 4. Shelterwood... A shelterwood cut removes both small trees and some large trees, the exact treatment varying from site to site. This regeneration treatment, which is less visually disruptive than the clearcut, favors tree species that grow best under the shade or ***shelter*** of other trees. Some mature trees are left to provide this shelter and to serve as seed sources for the new forest. The first cut of the shelterwood treatment offers only limited initial cash flow. Much higher returns are realized when the new stand is established and the larger, residual trees are removed.

Block 6. Clearcut... A **clearcut**, as defined by foresters, removes all the trees in one cutting, mimicking a natural disturbance like a fire or large-scale blowdown. In our hardwood forests, care must be exercised to make sure that naturally occurring regeneration is adequate **before** the cut is made. Otherwise, establishment of the new forest can be delayed significantly, and the site may become occupied by grasses and ferns or trees that do not meet the landowner's objectives. When applied appropriately, this treatment will lead to a forest of similarly aged trees, the most abundant being those that grow best in high levels of sunlight. The financial returns associated with this treatment can be high, but the aesthetic value of the forest for most observers is diminished until the new forest becomes established.

The Impact of White-tailed Deer

At French Creek State Park deer have a large impact on seedlings and other vegetation. The fenced exclosure in each of the blocks demonstrate the effect of deer browsing.

As pointed out, the timber harvesting alternatives presented do not all represent good forestry, but regardless, they are all used in Pennsylvania. The purpose of the demonstration forest is to provide landowners, timber harvesters, foresters, and the public a comparison of some harvesting options, displaying both their positive and negative consequences. Many considerations should be a part of harvesting decisions. Our actions today have a great deal of bearing on the sustainability of Pennsylvania's forests. As a result, we hope that the demonstration site will shape the knowledge gained and help form objectives, ideas, and attitudes about forest management. All visitors to the demonstration site can learn enough about responsible forest management to help form informed opinions about important forestry issues.

APPENDIX B

Slide Show Script

FOREST STEWARDSHIP FOR LANDOWNERS
Slide Show Script

Slide 1 (FH1)

Title Slide: The Changing Nature of Pennsylvania's Forests

• I would like to start by talking about how the forests of PA have changed since European settlement.
• I'll describe the **forests that exist in Pennsylvania today,**
• and then discuss some of the **change that occurs** as forests grow and develop and the methods used in **forestry to control that change.**
• I'll finish by discussing some of the **challenges facing forest managers** today, and the **role that landowners can play** in forest stewardship.

Slide 2 (FH6)

The Original Forests of Pennsylvania

• The species composition of PA's forests has changed significantly over the last 200 years.
• <u>First</u>, Pennsylvania was nearly all forests and the early forests contained many more conifers than they do today, primarily white pine and hemlock. • <u>Second</u>, important species such as chestnut (which made up more than 1/4 of the growing stock of the central Appalachian forest) elm, and beech have been reduced in importance because of man's unintentional introduction of exotic pests.
• What were the causes of these changes? (People)
• Land clearing, logging and fire contributed to the removal of the best representatives of the primeval forest.

Slide 3 (FH17)

Log Drive on the Susquehanna

• This is the Susquehanna River in the 1850s. In the 1860s, Williamsport was regarded as the timber capital of the world.
• Most of the large white pine was cut out by the late 1870s.
• Lumber was not the only forest product from Pennsylvania's woodlands. The iron, leather and steam industries that fueled the industrial revolution were based on wood. Charcoal was particularly important in the southern and central parts of the state. At the height of charcoal production there were close to five hundred furnaces in the state.
• Why use a river to transport logs?
• Because there were no roads in the wilderness, rivers, and rafting were the first method of choice in moving forest products.

Slide 4 (FH20)

Wood Workers Harvesting Hemlock Bark

• What is the state tree of PA? (eastern hemlock)
• As white pine was being harvested extensively for lumber, hemlock was used exclusively for the bark which was rich in tannins and used by the many tanneries that operated in northern Pennsylvania.
• But, when the white pine growing stock ran out, hemlock logs were no longer left behind in the woods but were skidded out as sawlogs.
• As late as the early part of the 19th century, Pennsylvania had the greatest reserves of eastern hemlock timber in the world.

Slide 5 (FH23)

Logging Railroad, Horse Team and Hemlock Bark Chute

- Steam power was the last phase in harvesting Pennsylvania's virgin forests.
- Steam was used to power the mills.
- Locomotives allowed the logging of the ridges and upland terrain that was previously inaccessible to river transport.
- Railroads moved loggers, horses and feed to remote areas to cut timber.
- Railroads made logging a year-long activity and no area of the state was left untouched. Railroads not only transported the logs to the mill, but also served as access to the "outside world."

Slide 6 (FH22)

Horse Logging Hardwoods

- It still took a lot of manpower and horsepower to fell the trees and bring them to the landing.
- The last operating railroad was closed in 1941.

Slide 7 (FH25)

Cutover Hillside in North Central Pennsylvania

- Note the skid trails left from horse-dragged logs en route to the landing.
- Lumberjacks initially cut only the biggest and best logs along the rivers and larger streams. Oxen and later horses were used to skid the logs to the landing.
- Due to strong markets for so called "chemical wood" (used for potash, acetate of lime and wood alcohol production), every stick of timber was merchantable and could be sold somewhere. [wood chemicals]

Slide 8 (FH29)

Burnt out Hillsides in Late 19th Century PA

• This led to extensive clearcutting, and uncontrolled fires burned through the slash (remaining branches).
• Fire had virtually eliminated the conifers from PA's forests. Hardwoods, able to sprout after fire, sprung up in their place.

Slide 9 (FH28)

Early Conservationist Joseph Rothrock

• Seeing the impacts of unbridled timber exploitation, early conservationists like Gifford Pinchot, America's first forester, and Dr. Joseph Rothrock, (Professor of Botany at the University of Pennsylvania), helped spark the conservation movement in Pennsylvania that we have today.
• In 1886, the Pennsylvania Forestry Association, one of the country's oldest conservation organizations, was formed.

Slide 10 (FH30)

Today's Forests

• With increasing farm abandonment and protection from fire, more and more land reverted to young forests.
• As the young hardwoods grew, one of the most productive temperate hardwood forests in the world developed.
• Let's take a look at what Penn's Woods look like today.

Slide 11 (TS4)

Commercial forestland

Where is all the forestland in PA?
• Pennsylvania is most heavily forested in the northern and central parts of the state. As you can see from this slide, a half-dozen counties along the northern tier of the state have more than 80% of land area in forest.
• Timberland or commercial forestland is forestland that is capable of producing crops of timber (20 cubic feet per acre per year), and is able to be harvested without constraints, i.e. not a park or nature preserve.

Slide 12 (TS5)

Major Forest Types in PA (2/3 oak-hickory)

• Forest type is a descriptive classification of the existing forest cover.
• Forest types may be composed of single species or an association of many species.
• The two main forest type in PA are the Northern Hardwoods (Blue) and Oak-Hickory types (Tan).
• Where are we on this map? What forest type would we expect to find on our field tour? We shall see what trees make up that forest type.

Slide 13 (ES21)

Bar Graph: Top Ten Tree Species in PA

• In 1989, ten species accounted for 77% of the total PA volume of timber.
• As you can see from the graph, the area occupied by red maple is increasing dramatically. This is not just happening in PA, but throughout the northeast.
• Why? Because it can grow on a variety of sites, without much direct sunlight, and because it is not very valuable and therefore is not harvested as much as other species. Also, it is not being browsed by herbivores as much as other species, like Red Oak.

Slide 14 (FH31)

Table: Pennsylvania is indeed Penn's Woods

58% of PA is forested
94% of that forestland is commercial forestland
• Overall, Pennsylvania is growing more than twice what is being removed. Note the expanding role of red maple, which is growing **four** times as fast as it is being cut.

Slide 15 (FG1)

Title Slide: Growth and Development of Forest Stands

Slide 16 (ES8)

Glaciated Allegheny Plateau - Forest Community

This slide illustrates what a forest community is.
• A forest community is an assemblage of plants and animals living in an environment of air, water, and soil. Each factor and each individual is conditioned by, and conditions the other factors comprising the complex.

Slide 17 (FG9)

Title Slide: Forests are Dynamic

Dynamic implies change, and change is happening constantly in the forest. (over time and over space)

Slide 18 (ES10)

Unglaciated Plateau Topography in Autumn

We are all familiar with the changes that happen in our forests on an annual basis, making autumn a brilliantly colorful season.

Slide 19 (FG11)

Conifer Stand

We may be less familiar with the ongoing changes that occur across the seasons and across the years. This forest, although it appears to be stable, is undergoing slow but constant change over time.

Slide 20 (FG10)

Aspen Cut

In this stand change is happening much more rapidly. There is a recently clearcut area, an area that was cut just five years before this picture was taken that now supports thousands of new aspen seedlings, and an area in the background that was probably cut decades ago where older and much larger trees continue to grow. Growth changes the appearance of the forest.

Slide 21 (FG15)

Hemlock Stump and Cherry

Often we can read the change that has happened over the course of history. The hemlock that once stood here was harvested near the turn of the century and cherry has since taken its place on this site.

Slide 22 (FG38)

Oak Seedling

Nature prepares for the inevitable change as young seedlings wait for an opening, ready to respond to a patch of sunlight with rapid growth.

Slide 23 (FG64)

Tornado Aftermath

Openings can be created by a variety of natural disturbances.
- This is the aftermath of a Tornado that struck Renova PA in 1985.
- But, nature is resilient and renewal of the forest does occur, most often without planting.

Slide 24 (FG20)

Cutter

• Change in the forest can also be human caused.
• Forest management is a method of controlling that change, using cutting as a tool to achieve the desired response from nature.

Slide 25 (FG21)

Title Slide: Silvics

• Very important in the science of forest management is **Silvics**.
• In order to understand and predict how a forest ecosystem will respond to change, we need to be familiar with the characteristics of the individual tree species within that ecosystem, and the requirements of each for growth and development
• **Silvics is therefore the study of individual tree species.**
• Let's briefly look at the silvics of one of the principal components of the Allegheny hardwoods forest-type - black cherry.

Slide 26 (ES26)

Black Cherry Sawtimber

• Black cherry is the tallest of the cherries and one of the most important and valuable species in PA.
• Throughout its range in eastern North America, black cherry grows well on a wide variety of soils.
• Nowhere in its range, however, does black cherry achieve the form, diameter, and outstanding quality that it does on the Allegheny Plateau.

Slide 27 (ES29)

Fruiting of Wild Black Cherry

• Black cherry provides an important food source for many wildlife species • In return, the birds and mammals that consume the fruit also serve as a means of seed dispersal for the tree.
• Otherwise, the fruits would mostly fall right under the parent, unable to be carried by the wind. Cherry cannot grow well in its own shade.

Slide 28 (FG23)

Title Slide: TOLERANCE

• Tolerance describes a species' ability to tolerate environmental extremes... one aspect of a species' ability to respond to change.
• Each species of trees has specific environmental conditions that they either require for growth or tolerate in order to out-compete other species.
• Trees can be tolerant to variety of environmental extremes including shade, temperature changes, and drought.
• Why is tolerance an advantage? What are the costs of having such an advantage. i.e. shade tolerance often means slow growth.

Slide 29 (FG28)

Canopy

Shade tolerance is simply the ability of a species to tolerate shade, or to continue growing in the shade by using low levels of light efficiently.

Slide 30 (FG29)

Hemlock Seedling

We have probably all been in a hemlock forest at one time or another. It is a nice place to visit in summer because it is so shady and cool. The hemlock is a very shade tolerant, slowly growing species.

Slide 31 (FG41)

Cherry Stand

• Unlike hemlock that can regenerate in its own shade, cherry trees need plenty of sunlight in order to develop. Many hemlock stands that were cut around the turn of the century developed into cherry stands. Because cherry does not reproduce well under its own shade, a more shade tolerant species eventually occupies the site. As this process continues, and without another disturbance, a cherry stand may become a hemlock stand once again.
• **Succession is the replacement of one species or association of species by another over time, without disturbance.**
• These next 6 slides depict the **natural succession** of species on the Allegheny Plateau. following a sawlog and chemical wood cut in 1927/28. • As a point of reference there is a white stake that is apparent in most of the series.
• When this picture was taken, the sawlogs had been removed from this forest stand.

Slide 32 (FG42)

Cherry stand after sawlogs and chemical wood removed

• The remaining wood in the stand was removed to be used in the manufacture of wood chemicals.
• A major opening has been created, and full sunlight is hitting the ground.
• Notice the advanced regeneration in the foreground of the picture. These cherry seedlings were probably there before the stand was harvested, but they could not grow and develop until more sunlight was reaching the ground.
• The change that has occurred we would call an unnatural **disturbance**.
• Watch what happens in 10 years.

Slide 33 (FG43)

Cherry stand 10 years later (seedlings and saplings)

• After 10 years...
• A young forest of thousands of rapidly growing black cherry seedlings is establishing itself.

Slide 34 (FG44)

Cherry stand 20 years later (large saplings)

• Notice what happened to the tree next to the white stake. So, obviously much growth has occurred in this period of ten years. What else has occurred?
• Notice what has happened to the number of trees in this stand. As trees grow larger, they require more resources for growth. This site cannot support as many pole-sized trees as it could small saplings.
• Individual trees that get out-competed eventually die, and the forest is naturally thinned out.

Slide 35 (FG45)

Cherry stand 41 years later (poles)

• Notice what happened again to the number of trees in this stand.
• Notice the presence of sugar maple. Sugar maple is a shade tolerant species, that grows at a much slower pace than black cherry.
• The sugar maples were present as small seedlings 40 years ago, but were quickly out-competed by fast growing black cherry seedlings.
• Because the maples are shade tolerant, they were able to grow underneath the crowns of the black cherry saplings.
• The trees in this slide are all the same age. This is what we call an even-aged stand. We have watched them all grow for the same amount of time - 41 years.

Slide 36 (FG46)

Cherry stand 51 years later (sawlogs and poles)

• The stand continues to be thinned out, and we are seeing that some larger trees have fallen to the ground, replenishing some of the nutrients in the soil.

Slide 37 (FG47)

Cherry stand 61 years later (sawlogs)

60 years after the removal of sawlogs, we have sawlogs once again.
• Although this stand of trees began to grow in the same year, we have many different sizes of trees not only differences between the principle species, cherry and maple, but within each species.
• Some cherry trees were better competitors than others for a variety of reasons including spacing, soil conditions, and varying genetic makeups.
• If this slide also showed the crowns of each of those trees, we would see that they also would differ in size, shape, and position in the canopy.

Slide 38 (FG50)

Crown Classes

crown class = is an evaluation of an individual trees' crown in relation to its position in the canopy and the amount of full sunlight it receives
The four categories we use to describe crown class include:
• Dominants = trees with crowns extending above the canopy and receiving light from all sides
• Co-dominants = trees with crowns in the general level of the canopy, receiving very little light from sides
• Intermediates = Shorter trees receiving only a little direct light from top, no light from sides
• Suppressed = crowns entirely below the level of the canopy and receiving no direct light either from above or sides.
• In the previous slide, most of the dominants and co-dominants were black cherry, while sugar maple made up the intermediate and suppressed crown classes. We will come back to this concept when we walk through the woods.

Slide 39 (FG51)

Canopy

Crown shapes and crown position.
• Dominant red oak about center of slide, Co-dominant to right of center, flattened on one side, Intermediate and suppressed trees are evident.
• Relating back to the series of slides we just saw, the poor competitors in this stand will eventually fall out of the picture while the crowns of other trees continue to expand.
• On average, 2% of the trees in the forests of PA die each year.
• Guess which in this picture will be the survivors in another ten years.
• Also keep in mind that competition is not only happening in the canopy of the forest. Underground roots are also competing, for other limited resources including moisture, nutrients, and growing space.

Slide 40 (FG59)

Big Tree

• The best competitors are certainly going to be there for the longest time, but as trees age, their growth usually slows, they become less efficient at transporting food, nutrients, and water.
• They are more susceptible to attacks by insects and fungi, and recover more slowly after damage.

Slide 41 (FG49)

Old Growth Mortality

• They too will eventually die and complete the continuing cycle of replacement, replenishing the soil with nutrients as they decompose.
• Landowners and resource managers can accept these slow natural processes, or capture some of the mortality by controlling that process of change and the results of the change.

Slide 42 (IT4)

Title Slide: Thinning

• A forestry technique called thinning is one way of doing that.
• Thinning is literally "thinning out" certain trees to allow other more resources.

Slide 43 (IT5)

Cross-sections of yellow pine logs
• One of the objectives of thinning is to control spacing and density
• Thinnings are used to reduce the number of trees per acre more rapidly that it would occur in naturally.
• The limited amount of resources on the site can be redistributed to the trees you select, maximizing the growth of these individuals.
• In this way, you control which trees survive and which are thinned out.

Slide 44 (IT13)

Defects in standing timber

• Thinning allows you to control the species composition of a stand as well as the quality of timber.
• If growing timber is one of your objectives, you may choose to remove damaged or poorly formed trees.

Slide 45 (IT14)

Den Tree

A timber buyer wouldn't care much for this tree. But, **cavity trees** provide high quality wildlife habitat, which may also be one of your objectives.

Slide 46 (SS4)

Title Slide: Forest Regeneration

• Silviculture is the entire cycle of establishment, tending, protecting and harvesting a stand of trees to meet the objectives of the landowner.
• Regeneration is the replacement of one forest stand by another as a result of natural or human caused disturbance.
• What is the difference between succession and regeneration. (Succession is the replacement of an association of species without disturbance, and regeneration is the replacement of a forest stand following a disturbance).
• I mentioned that in thinnings, we were redistributing resources to selected remaining trees. In a regeneration cut, we attempt to create the conditions that are necessary for the growth of new seedlings.

Slide 47 (SS5)

Types of Regeneration
There are three different types of regeneration:
• A = seedling (from a seed) - plus seedling sprouts.
• B = stump sprouts (from stump)
• C = root suckers (from roots)
• The type of regeneration can depend upon the species. Hardwoods typically re-sprout from the stump once they have been cut, (depends on the size of the stump).
• Sources and types of regeneration impact the silviculture and management decisions.
• Regeneration can occur naturally or artificially, with some human interference. The hardwood species that we have in PA are generally able to regenerate without replanting.

APPENDIX C

Project Learning Tree Activity

Overview
It is easy to see that items made of wood come from trees. However, many tree products are not obvious. In this activity your students will discover the diversity and multitude of products that are in some way derived from trees.

Background
Products are derived from all parts of a tree. Wood is the most obvious. It provides things such as lumber for houses, furniture, doors, picture frames, clocks, paintbrush handles, counters, cabinets, floors, spools for thread, etc. ***Cellulose*** is the major component of wood (and most other plant fiber). Paper is made from cellulose, and paper products include books, wrappers, cereal boxes, magazines, newspapers, food labels, etc. Besides being used to make paper, cellulose is an ingredient in many other products. (See student readings on pages 41-42.)

Getting Ready
1. Before doing this activity, collect as many of the following items as you can:

- Newspaper
- Toothpicks
- Candy bar with almonds
- Piece of lumber or plywood
- Tissue paper
- Sponge (synthetic, not natural)
- Article of rayon clothing or a piece of rayon cloth
- Baseball
- Wooden chopsticks or a wooden mixing or salad spoon
- Bottle of vanilla (flavoring)
- Book or magazine
- Cardboard box
- Can of paint thinner, turpentine, or mineral spirits
- Pack of chewing gum
- Can of paint
- Bottle cork
- Rubber gloves
- Apple or other piece of fruit that comes from trees
- Plastic comb or brush
- Piece of cellophane
- Wooden chair or other piece of furniture

Most of these items should be readily available around the house. Others may be available from your school's buildings and grounds department, shop, or art department. Scraps of plywood and lumber may also be available from a home improvement store.

2. You will be dividing your students into groups of four, so make enough copies of student pages 41-42 for each group of four students.

Doing the Activity
1. Place the items you collected around the room, and label each one with a number.

2. Divide the group into teams of four, and tell them that team members will work together to determine which of the products around the room are made from trees. All team members must agree with the team's decision about each product and must be able to explain why each product is on their team's list.

3. Have the students in each team number themselves from one to four. Tell all the "1's" that it's their responsibility to record the information that everyone on their team agrees on and that they'll have to report their group's findings to the rest of the class. Tell all the "2's" that they must make sure that everyone in the group has an opportunity to speak as the team tries

Grades 4-6

Social Studies, Science, Language Arts

Successful technologies are those that are appropriate to the efficient and sustainable use of resources, and to the preservation and enhancement of environmental quality. (2.3)

Natural beauty, as experienced in forests and other habitats, enhances the quality of human life by providing artistic and spiritual inspiration, as well as recreational and intellectual opportunities. (3.4)

Analyzing, Classifying and Categorizing, Interpreting

Students will ① examine various products and determine which ones are made from trees, ② describe ways that trees are used to make products and ways that these products can be conserved, and ③ explore methods for recycling and reusing products.

Various forest products (see Getting Ready Step 1) and copies of pages 41–42

Preparation: 30 minutes
Activity: Two 50-minute periods

to reach decisions. The "3's" must make sure the group stays on track and gets everything accomplished in the time allowed. And the "4's" are the only people who may leave the group to ask you questions.

4. Have the teams move around the room and examine the products. *(WARNING: Do not let them open any of the product containers.)* After they have decided if one item comes from trees in some way, they should record it on a list and move on to the next one.

5. Once teams have established their lists, give each team a set of the readings on pages 41–42. Each student should read the article that corresponds to his or her number. (Student pages can be cut in half).

6. After reading their articles, students should explain the contents to their team members. Each person is responsible for making sure everyone else in the group understands what his or her article says.

7. The teams should then re-evaluate the list of products they came up with in Step 4. Are there any products they want to add to or delete from their list? Once again, remind them that everyone on their team must agree with the changes and should be able to explain why each item is on their list.

8. Have the teams share their lists with the rest of the group. Discuss the diversity of products we get from trees. Check the students' understanding of the articles by asking them to explain why they included certain products. If they didn't realize it during the activity, they should realize by the end of the discussion that all the products you spread around the room came from trees in some way.

9. How will this new awareness of forest products affect student's lifestyles? Will they make any changes? Talk about conservation practices where their families use a forest product but could also ① recycle the product, ② reuse the product, or ③ reduce its use.

Enrichment

Have the students work in their groups to brainstorm a list of the ways they use paper. Then have them write down possible substitutes for the three or four items on the list that they think are the most important. Afterward have them compare the environmental and economic factors associated with these products and their possible substitutes by answering the following questions. (They will need to do research to answer some of the questions. Encourage them to divide the research among their group members.)

1. Would the substitute serve the same purpose as efficiently and cheaply as the tree product?

2. Is the substitute made from a renewable or nonrenewable resource?

3. Does the production of the substitute require more or less energy than the production of the original product? (They will need to research this.)

4. Is the substitute reusable or recyclable? Was the original forest product reusable?

5. What, if any, are the long-term implications for continuing to use the paper product or its substitutes?

END NOTES...

ASSESSMENT OPPORTUNITY

Wood furniture is an obvious tree product. But many common products such as toothpaste, which contains cellulose or wood fiber, are not. A scavenger hunt for tree products is a fun way to assess students' understanding of the concepts and information presented in this activity. The scavenger hunt can be done in school, outdoors, or in a supermarket or drug store.

1. Organize students into groups of three.

2. Provide each group with a list of items such as these to find:

- two products derived from the gum of trees (rubber products, chewing gum)
- two objects made directly from wood (furniture, toothpicks, spools)
- two products made from tree resin (violin rosin, soap, varnish)
- two products derived from fruits and nuts of trees (cider, dyes, spices)
- two products extracted from the leaves or bark of trees (astringent lotion, cork, honey)

3. Challenge your students to find items that are not obvious tree products.

4. After a fixed amount of time, have the students share their discoveries and explain which part each product is from.

RELATED ACTIVITIES

Tree Treasures, A Few Of My Favorite Things, Three Cheers for Trees, Resource-Go-Round, Renewable or Not?

REFERENCE

Wright, Helena. *300 Years of American Papermaking.* Washington, DC: Smithsonian Institution, 1991.

STUDENT PAGE©

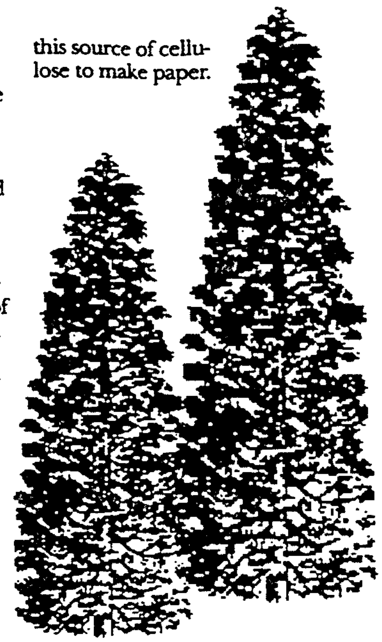
TREE READINGS

1 Look around you and chances are you'll see a lot of things made out of wood. People use wood to build houses and other buildings; to construct doors, floors, fences, and furniture; and to make many other products including bowls, boats, paddles, crates, baskets, and baseball bats.

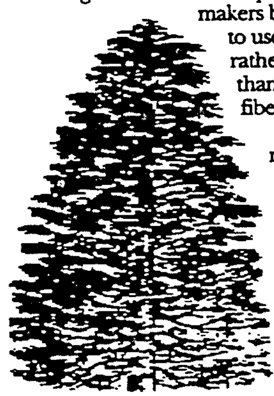
To make wood products, you must first harvest trees and process them into lumber. In sustaining a renewable supply of timber, forest managers practice silviculture—the management and cultivation of forests. Young trees are usually re-planted or naturally re-seeded on the land where they were harvested. Openings created by harvests often improve the habitat for certain wildlife species.

After the trees have been cut down, the branches are removed, and they are cut into logs. Then, the logs are loaded onto trucks and transported to a sawmill. The first machine at the sawmill strips off the bark. The logs are then measured and then cut into lumber. Depending on how the wood will be used (whether for buildings, furniture, baseball bats, etc.), the trees will be cut in different ways. What products a tree is used for depends on the type of tree it is. For example, hardwood trees such as oak and maple are often used for flooring and high-quality furniture, while softwood (coniferous) trees are usually used for papermaking, lower-quality furniture, houses, and crates.

Plants contain a compound called cellulose to give them rigidity and support. Cellulose is the main component in wood and, in most cases, people use this source of cellulose to make paper.



2 Paper was made by hand for nearly 17 centuries following its invention in China about 100 A.D. In the Orient, plant fibers were beaten into a pulp, suspended in water, and formed into sheets by draining the fibers through a screen. As knowledge of papermaking moved westward, papermakers began to use rags rather than plant fibers to furnish pulp.



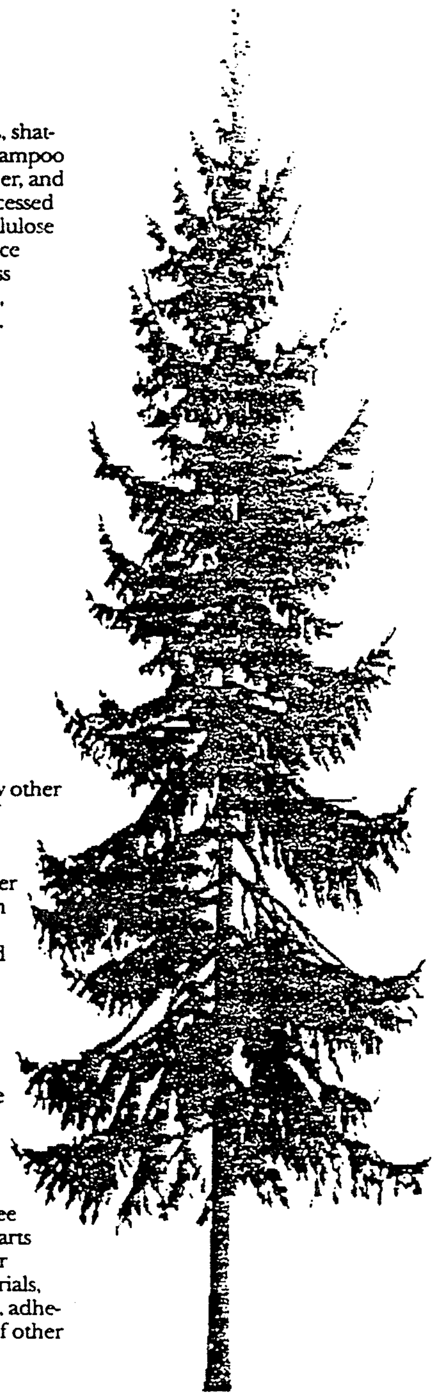
Papermaking spread to Europe through the Middle East, reaching Spain from North Africa by about 1200. From Spain, the craft eventually was brought to the New World. The Spanish established a European-style paper mill in Mexico in about 1580, but little is known of that endeavor, and it did not mark the beginning of continuous production.

Paper mills use cellulose from three sources: recycled paper, wood chips and sawdust leftover from making lumber, and raw logs. When raw logs arrive at the mill, machines strip the bark off and chop the trees into chips. Then the chips (and other sources of cellulose) are "cooked" with chemicals until the mixture becomes a thick pulp.

Next, the pulp is "washed." During the washing stage, dirt and other impurities are filtered out, producing clean pulp and, leftover waste and solids called sludge water. The sludge is separated from the water and either landfilled, burned, or applied to the land as fertilizer. The wash water goes into a waste water treatment system. The clean pulp then goes through a series of machines where the fibers get mashed apart so that the pulp will form smooth sheets when dried.

Eventually, the pulp is run onto screens where the water drains off, and the result is newly formed paper. The paper is compressed and dried. Depending on the chemical process used to refine the pulp and the amount of cleaning and flattening involved, people create different kinds of paper such as coffee filter paper, heavy writing paper, wrapping paper, and so on. They can also create cardboard, boxboard, paperboard, and other strong products.

TREE READINGS



3 All land plants contain a compound called cellulose, which provides them with rigidity and support—it's the number-one component in wood. People use cellulose from wood to make a variety of products besides paper. For example, cellulose can be mixed with certain chemicals and squeezed into fibers that are used to make carpets, wigs, and fabrics such as rayon for clothes and furniture. Cellulose is also used as a key ingredient in cellophane, sausage casings, explosives, shatterproof glass, sponges, shampoo thickeners, imitation leather, and many other products. Processed with certain chemicals, cellulose may also be used to produce molded plastics for eyeglass frames, hairbrush handles, steering wheels, and so on.

4 It would be hard—if not impossible—to find a part of a tree that people do not use in some way. The bark of many trees, for example, is used for many different products. Most bottle corks are made from the bark of cork oak trees, which grow in Europe and Africa near the Mediterranean Sea. The spongy bark of these trees is made into bulletin boards, the inner cores of baseballs, and many other products. Quinine, the drug used to cure and prevent malaria, comes from Peruvian bark and had been used by Native Americans long before the Europeans arrived. Some tree bark has an abundance of a chemical called tannin. People use tannin to process leather.

Some trees produce saps called gums and resins that are used to make paint thinner, chewing gum, medicines, and many other products. For hundreds of years, South American Indians have extracted the sap or latex from the rubber tree to make products such as rubber-soled shoes and containers. They processed it by heating the rubber and mixing it with sulfur to improve its strength. Maple trees produce a sap that people turn into maple syrup. Trees provide people with fruits and nuts such as apples, coconut, pecans, lemons, and olives, and spices such as allspice and nutmeg. Tree leaves, trunks, and other parts also provide ingredients for paints, road building materials, medicines, artificial vanilla, adhesives, inks, and hundreds of other products.

APPENDIX D

Cobbs Creek Activity

Sizing Up Trees

Let students search their environment for a champion tree.

By Don Nelson
Associate Professor of Elementary Education
at Western Illinois University in Macomb
(1995) Science and Children 32 (8), 16-18.

A Cruise Through the Forest

By Bruce G. Smith
Assistant Professor in the Center for Science Education
at Clarion University in Clarion, Pennsylvania
(1991) Science Scope 14 (7), 12-15

This is collaborative effort with Pampalena Watson /Andrew Hamilton School
Shoma Broussard/Penn State University

Middle/High School Level

Anticipated Learning Outcomes:

1) Students will develop an appreciation of the world's largest living plants___ trees.
2) Students will size trees using the standard units of measurement.
3) Students will learn the three aspects of trees when determining a tree's size; height, trunk circumference (girth), and the spread of branches (crown).
4) Students will discuss the variation in size of trees.
5) Students will identify the location of the trees.
6) Students will give the date the trees were measured and by whom.
7) Students will include clear photographs of the trees along with the date the photographs were taken.
8) Students will state the trees physical condition.
9) Students will work in pairs cooperatively and practice their math and science process skills.
10) Students will become amateur foresters as they apply real-world applications for science and math skills.
11) Students will discover that the 'big tree' investigations are both interesting and enjoyable.

Science Processes

a. Measuring
b. Estimating & Predicting
c. Recording Data
d. Interpreting Data

Mathematics Skills

a. Measuring
b. Addition
c. Subtraction
d. Multiplication
e. Circle/Diameter Concepts

Materials Needed: In Field

1) Wear long pants, boots or old tennis shoes.
2) garden gloves
3) pencils, paper
4) meter sticks

5) string
6) ziplock plastic bag
7) chalk
8) clinometer (constructed before going to the neighborhood forest/creek/park)
9) film (camera)
*10) **Caution:** Ask about known allergies and ask permission to spray children against poison ivy or poison oak. Tell children what these plants look like (three leaves: the central leaflet has a longer stem: sometimes the leaves are reddish and glossy: one poison ivy variety climbs trees, and another is on the ground; the big hairy vines seen climbing trees are the other variety). It has been discovered that the aluminum chlorhydrate in antiperspirants will stop poison ivy rash. Best use is to spray the antiperspirant on legs and rub between fingers. Have children wash their hands when they get back to school, and tell them to wash real well when they get home and to take their clothes off inside out so as not to infect the person who does the laundry.

Materials Needed: At School

11) graph paper
12) pencils

Procedures:

1) Take your class outside to examine trees in the surrounding neighborhood.
2) Challenge students to think of ways to determine which of the trees they see is the biggest.
3) Students will realize that there are three aspects to consider when determining a tree's size: 1. height
   2. trunk circumference (girth)
   3. the spread of branches (crown)
4) Students will measure trees and practice their science and math process skills.

* **To measure a tree's girth,** ask each pair of students to wrap a piece of string around the tree at approximately their chest level. If there are limbs below that height, students should measure below the bottommost branch. After measuring, they should place the length of the string that encircled the tree along a meter stick to determine the tree's circumference in centimeters.
* **To measure a tree's crown,** have one child act as the observer and the other as the measurer. The observer should stand far enough away to see the tree in its entirety. Then the measurer should move to the farthest tip of the outermost branch on one side of the tree and mark that spot on the ground. The measurer should then follow the observer's directions to the outermost branch on the **opposite** side of the tree and mark that spot on the ground. Students determine the size of the crown by measuring in meters the distance between the two marked locations.
* **To measure a tree's height,** have one student stand next to the trunk while the other child backs away from the tree, with arm outstretched and holding an unsharpened pencil perpendicular to the ground in his or her fist.

Sighting down the arm, the child should adjust the pencil's position so that the top of the pencil, and the base of the trunk appears to rest on top of the fist. **(see Figure 1)**. The child may need to move forward or backward and to adjust the length of the pencil to see this image.
Then the child should turn the pencil 90° to the left or right, making sure that the base of the tree is still aligned with the top of the fist, and direct his or her partner to walk away from the trunk in the direction the pencil points **(see Figure 2)**. The student should say "Stop!" when his or her partner appears to be at the end of the pencil. Then they can determine the tree's estimated height by measuring, in meters, the distance from the base of the tree to where the partner stands.
***To determine which of the trees** in the neighborhood **is the largest** overall. Students should combine the girth, crown, and height measurements for each tree. The resulting number represents the tree's "size points."
* When students return to the classroom, they can identify the largest tree by comparing size points and then graph the data.

Figure 1

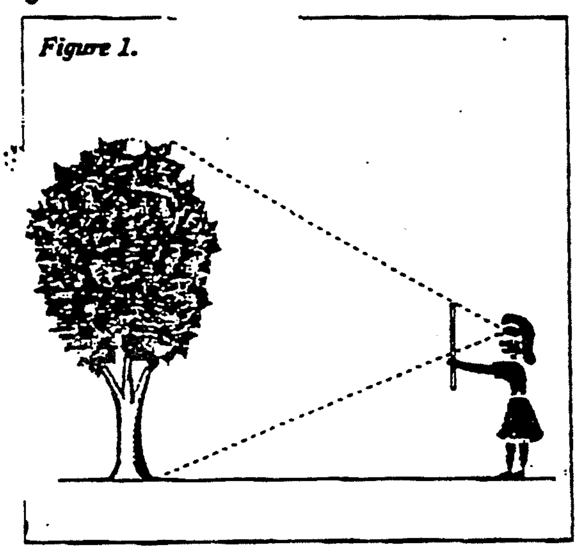
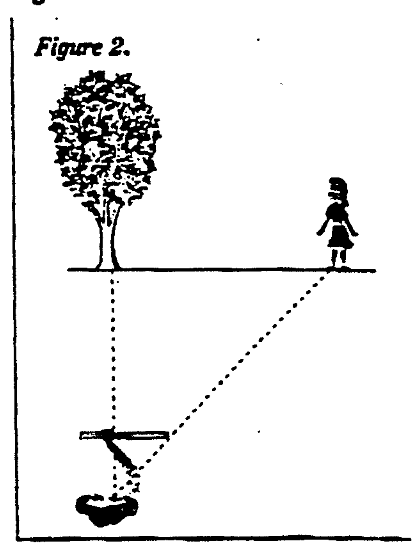


Figure 2



Resources: Introduce students to the following resources. American Forests. (1994) ***National register of big trees.*** Washington, DC: Author (A copy of the current register is available for $7.95, plus shipping and handling, from American Forests, P.O. Box 2000, Washington, DC 20013-2000; tel. 202-667-3300; fax 202-667-2407.)

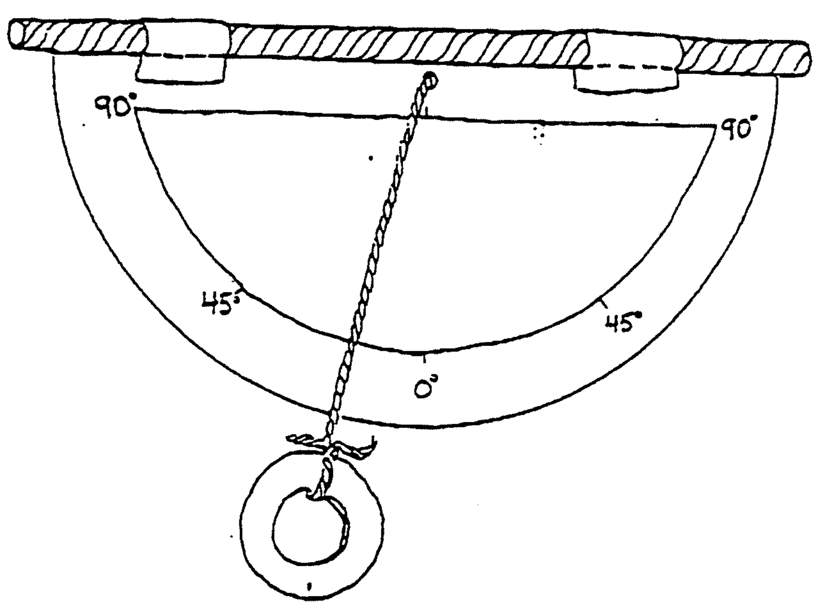
Watts, M (1991). ***Treefinder***. Rochester, NY: Nature Study Guild

Directions for constructing a clinometer:
Materials
(For each pair of students)
* Protractor photocopy
* Manila folder
* Glue
* Pin
* Straw
* 20 cm kite string
* Steel washer

Procedure
1. Place the protractor photocopy along the lengthwise edge of the manila folder and glue it to the folder.
2. Cut around the outside of the protractor.
3. Center the straw lengthwise along the straight side of the protractor and tape it securely.
4. Using a pin, poke a hole through the center of the protractor and push enough string through the hole to tie a knot in the string behind the protractor. Tie the knot large enough to keep the string from slipping back through the hole. Pull the knot against the back of the protractor so that the string swings freely in the front.
5. Take the string hanging from the front of the protractor, tie the washer on the end of the string.
6. Check to see that the string swings freely. If it doesn't, first check for rough edges that might interfere with the string, then try tilting the clinometer slightly until the string swings freely.

Figure 1.

Figure 1.



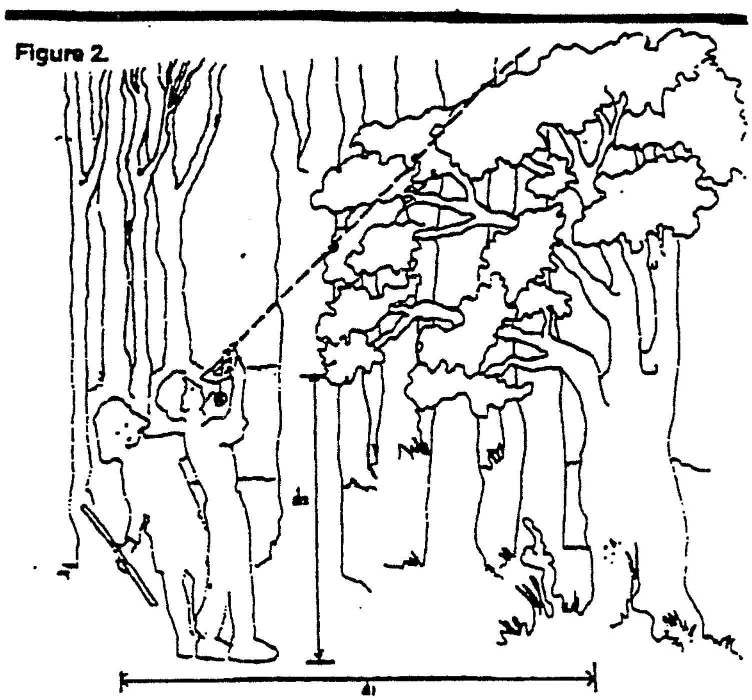
Using a clinometer

To measure the height of a tree, work in pairs, and then compute the height of the tree using geometry

Procedure

1. Select one tree in the area to measure.
2. One student begins by sighting the top of the tree through the straw and walking backwards from the tree.
3. The second student acts as an observer, watching for obstacles in the first student's path and observing the string on the clinometer. as the tilt of the clinometer changes, so does the location where the string crosses the protractor scale on the clinometer. When the string crosses the clinometer at the 45 % mark, the observer stops the other student. (See Figure 2)
4. When the observing partner calls for a halt, the first student remains at this point.
5. Using a yardstick, the observer measures the distance, in feet, from the base of the tree to the student's feet.
6. To this number, add the distance from the ground to the top of the student's eyes. Assuming that the tree is at a right angle to the ground, this is its height. (See figure 2)

Figure 2



APPENDIX E

French Creek Demonstration Forest
Field Tour Script

FIELD TOUR

Forest Stewardship Demonstration Area

revised 7/11/94

INTRODUCTION

The Project:

• 7 areas established across the state of Pennsylvania, modeled after a USFS Field Project at the Kane Experimental Forest, ANF.
• Each site is a complete demonstration on which 6 different harvesting treatments including a "control" have been applied in 2-acre blocks.
• In addition, a 20ft.X20ft. exclosure has been erected at the north end of each block.
• The objectives of the project include:
  • comparison of residual growth and mortality among treatments
  • comparison of regeneration of tree species, shrubs, and herbaceous species among treatments- controlling for deer.
  • comparison of economic potential of each treatment
  • evaluation the educational effectiveness of demonstrations in increasing knowledge of forests and forestry, and encouraging adoption of a forest stewardship ethic for a variety of audiences.
• The project has two main purposes: Forestry Research and Forest Stewardship Education. My own research is to evaluate the educational component, to see if this is a worthwhile demonstration and outdoor classroom.
• I will be conducting workshops for various audiences that include a slide show and a tour of the demonstration area. Questionnaires will be given to three randomly assigned groups at different points in the workshop, (i.e. in the beginning (control), after slides, and after tour).
• How does attending a half-day workshop affect an individual's knowledge of forest ecology and management, and how does that newly gained knowledge affect their attitude towards resource management and resource professionals?

Appearance of a recently harvested site:

• This site was recently harvested. You will notice skid trails, and probably a few damaged stems (this is inevitable). This may not be a pretty site, but it is the initial reality of timber harvesting. It is important that skid roads be stabilized. I some cases, they will require gradings, the construction of water control devices, and seeding to prevent any erosion or sedimentation into nearby streams.
• In your mind, compare the bare and muddy areas to the way a new house looks like when construction has just been completed. The area around the house is seeded quickly to improve the appearance of the yard. Usually this bare area is completely covered with vegetation well within a year.

• You will also see logging slash, or the unmerchantable branches and tops cut from the trees by the harvester. Slash should be spread across a harvested site to provide cover for wildlife, to protect new seedlings from both the elements and from herbivores, and to eventually add nutrients to the soil as these tops decompose.
• The higher the slash is piled, the more cover for small mammals, birds, and reptiles, and the more seedlings are protected from deer browsing.
• Slash that is scattered more evenly will decompose faster because it is closer to the ground. Think of a compost pile and the heat that is generated within the pile. Heat stimulates the microorganisms that are responsible for decomposition. The faster decomposition occurs, the

faster those nutrients will be added to the soil where they are required for growth by new seedlings and other vegetation.
• Branches and tops can also be used to make wood chips. But, the trade-off is less cover for wild-life, a greater chance of erosion, and less nutrients returned to the site after harvesting.
• An important thing to remember when seeing a recently harvested site, is that this is a temporary situation. When harvesting is planned and carried out carefully, vegetation quickly reclaims the harvested area. Special attention must be paid to wet areas and those areas near water-bodies. Forestry is a tool that can be used to **protect** our water and soil resources rather than negatively impact them.
• In Pennsylvania we are fortunate to have the kind of species that rarely require replanting. This is different from the conifer plantations and forests of the Southeast and Northwest. Northern hardwoods regenerate naturally renewing a healthy forest that is well-adapted to unique site conditions.

BLOCK 1

Treatment: CONTROL

• For comparison, nothing was removed from this block.
• This should give you an approximate picture of what this entire site would look like unmanaged.
• Also, the control serves to demonstrate that even an unmanaged forest is dynamic.
These natural forest processes are exactly what forestry attempts to imitate on a much shorter time scale in order to maintain:

productivity
vigor
forest health

While at the same time, allowing for human needs and wants by providing:

the raw materials for wood products
opportunities for recreation
protection for soil and water resources
important areas for wildlife habitat
maintaining the aesthetic value of one's property
meeting other landowner objectives.

** this list is just some of the many considerations for the landowner that are involved in designing a management plan.
• As we walk through the demonstration we will try to decide which objectives are met by each treatment and which are not met.

Concept: EVEN-AGED STANDS

• Guess the ages of two differently sized trees.
  • We will have the opportunity to prove this later, but I would be willing to bet that these two trees are close the same age. Age is not necessarily the reason for their size difference - genetics and micro-site conditions are. (like people).
  • This is an example of what we call an even-aged stand.
  • Pennsylvania's forests have a rich history that demonstrates the resilience and dynamics of the forest ecosystem.
  • Many forests in Pennsylvania are even-aged as a result of the type of management that was practiced around the turn of the century. (In fact, most in the forestry profession wouldn't call what was done "forest management").
  • That is, most forests in Pennsylvania were cleared and burned at least one time for the timber, for charcoal, or so the land could be used for agriculture from 1870 to about 1930.

• The result of a clearcut is typically an even-aged stand dominated by intolerants, with slower growing tolerants in the smaller crown classes.

Definitions:

even-aged stand = a group trees that do not differ in age by more that 10 to 20 years or 20% of the rotation age for the stand.
clearcut = removal of all trees in one cutting at one time.
tolerants = trees that can withstand shade or suppression, thriving at low light levels, although generally slow growers.
intolerants = requiring full or close to full sunlight to grow.
crown classes = an evaluation of an individual trees' crown in relation to its position in the canopy and the amount of full sunlight it needs (dominant, co-dominant, intermediate and suppressed or overtopped).

Concept: COMPETITION

• If these two trees are the same species and the same age then why aren't they the same size?

- One is a better competitor than the other for one reason or another :
  - Access to resources like sunlight, water, and nutrients
  - Browsing by herbivores
  - Attack by fungus or insects
  - Genetic variation
  - Damage from a storm or animal.
- The important point here is that smaller trees are not necessarily younger trees.
- Diameter does not equal age.

Concept: CROWN CLASS

- The result is several different layers in the canopy, that is, different crown classes:

  Dominant = the tallest trees, getting sunlight on several sides of their canopy
  Co-dominant = taller trees that get sunlight on the top of their canopy
  Intermediate = trees with canopies not reaching the top, getting some sunlight
  Suppressed (over-topped)= the shortest trees with small canopies that hardly get any sun at all except in flecks. Shade tolerant trees can withstand being suppressed for a longer time than intolerant species. They are naturally slower-growing.
  - What crown classification would you use to describe these two trees?

Concept: STOCKING

- Would you say that this stand has room for these trees to grow and expand much?
- When you look up, how much sky do you see?
- How much sunlight would you say gets down to the understory where we are standing?
- Compare the spacing of the trees to that of a pine plantation. What is the difference? These trees were not planted. They regenerated naturally. Do you think this was always a forest, or could it have been used for agriculture? Look for stone fences.
- Also remember that trees are only standing about waist deep. Just as their branches are up there in the canopy competing for sunlight, their roots are under the ground competing for water and nutrients.
- We would call this stand "fully stocked," or 100% stocked, meaning that all the resources available for growth are being used. Nothing is being wasted.
- As trees grow, they use more space and other resources. Therefore, young forests support many smaller trees, and as the forest matures, many are crowded out by faster growing neighbors and die. This forest stand has many fewer trees than it did 30 years ago. Trees that are tolerant of shade are more likely to survive in the understory than "intolerants."
- Find a patch of seedlings or saplings where enough sunlight has reached the forest floor to allow regeneration. What will this patch look like in 30 years?
- What had to happen in order for that much sunlight to hit the ground? Did a large tree die and fall or crumble to the ground? What caused that tree to die? Insects? Disease? Lightning? Wind? Or some other "natural disaster?" When you see the patch of regeneration - of new small trees, a few of which will eventually become mature trees - would you still call the disturbance that occurred a "disaster?"

BLOCK 2

Concept: THINNING

- Three out of the five remaining treatments are called "thinnings."
- Thinning is a forestry technique that is used to capture potential mortality by removing trees to reduce the crowding that would cause them to die before they were able to reach maturity. Thinning is what naturally occurs as a patch of many small trees becomes a few large trees. Using forestry, we speed up this slow natural process by choosing the trees we want to keep in the stand or choosing the trees we would like to harvest now.
- Faster growth can be redistributed to the trees that can best use the available resources - or to the most desirable trees for a variety of objectives. (see below).
- The trees that are removed can provide an intermediate financial return to the landowner on a long-term forest investment. (wood products, recreation, firewood).
- Criteria used to decide which trees to leave or which trees are most desirable depends upon the landowners objectives, but can include:

  wildlife habitat (den trees, or mast producing trees)

high timber value
high aesthetic value
important species or rare species
recreational value

• The purpose of our three thinning treatments was to reduce the stocking level (a measure of crowding or competition for resources) from 100% to 60%.

Treatment:
DIAMETER-LIMIT FROM BELOW

• The first thinning is called a diameter-based thinning from below in which the stocking was reduced to 60% by removing the smallest trees up to a calculated diameter. No other criteria were used (spacing, species, quality, wildlife value).

• WHAT HAS BEEN REMOVED?

Most of the suppressed and intermediates have been removed. Tolerant trees have been removed, as well as slow growers, and poor competitors.

• WHAT REMAINS?

Dominants and co-dominants remain to grow, but not much additional growing space has been made for them. They were already out-competing their smaller neighbors.

• AESTHETICALLY?

This treatments looks kind of park-like. Attractive to many.

• WILDLIFE?

Wildlife use of the area will probably be reduced as a result because much of what they use for shelter, food, and hiding places has been removed.

• $

Financially, there won't be much of a reward for removing unmerchantable trees, except for those that can be used for **firewood**. The investment in the larger trees may not have been necessary, they will probably reach the same size with or without the suppressed and intermediates. This was not a commercial thinning, and so did not provide a financial return to the landowner.

• FUTURE OF FOREST?

Some species, particularly shade tolerants, grow naturally at a slower rate, and they may be eliminated from the future stand. The growth of the residual stand may not have been hurt by the removal of the smaller trees, but it most likely was not helped either.

****At half of the demonstration areas, there are 4 thinnings instead of 3 and only one regeneration harvest. A "diameter-limit from the middle" replaces the shelterwood treatment. At these sites, the thinning from the middle is BLOCK 3, the thinning from above is BLOCK 4, the improvement thinning is BLOCK 5, and the clearcut is BLOCK 6.**

Treatment:
DIAMETER-LIMIT FROM THE MIDDLE

• This thinning is called a diameter-based thinning from the middle, in which the stocking was reduced to 60% by removing medium-sized trees between two calculated diameters. No other criteria were used (spacing, species, quality, wildlife value).

• WHAT HAS BEEN REMOVED?

Pole sized trees were removed (intermediates and co-dominansts). The average stand diameter has been reduced and the species composition has shifted toward more tolerant species.

• WHAT REMAINS?

What remains after this treatment is what appears to be a two-aged stand. We have removed the center of the distribution of diameters and are left with sawtimber and saplings.

• AESTHETICALLY?
Not unappealing.
• WILDLIFE?
Wildlife who depend upon mid-sized trees for food and shelter may be negatively impacted.
• $
The trees that were removed were merchantable, providing some financial return.
• FUTURE OF FOREST?
The younger looking tolerants were favored by this treatment, as more space has been provided for them to grow. The larger trees may also benefit from this thinning, relieved of the competition from the pole-sized intermediates and co-dominants.

BLOCK 3

Treatment:
DIAMETER-LIMIT FROM ABOVE

• In this second thinning, the diameter-based thinning from above, diameter was again the only criterion used. But, this time all trees above a calculated diameter were removed disregarding species, spacing, or quality.
• WHAT WAS REMOVED?
The largest most valuable trees were removed including dominants and many co-dominants. In other words, the best competitors were removed and the best seed sources, genetically speaking. Many resources are free to be used by residuals in comparison to the thinning from below.
• WHAT REMAINS?
The smaller, slower growing trees, generally of poor quality and poor competitive ability remain. Unfortunately, although many resources have been freed up, these individuals probably do not have the crowns or roots necessary to utilize them. The burden of ultimately regenerating a new forest rests almost entirely on these "genetic inferiors."

• AESTHETICALLY?
Not especially appealing. Looks like a hurricane hit it. But, there are still trees, which is important to many landowners.
• WILDLIFE?
No consideration was given to wildlife (den trees, food production etc.)
• $
The immediate financial return can be quite high, but the residual stand is unable to generate much future income potential. In fact, rehabilitating the stand later is likely to cost the landowner.
• FUTURE FOREST?
What remains probably won't be a very productive or healthy forest. In addition, fast growing tolerant species may be eliminated permanently from the stand, along with the future seedlings they could have produced.
Look for epicormic branches (small branches that come out of the main stem of the tree that lessen the value of the timber), defects, diseased and poorly-formed trees.

****Although I have not had many positive things to say about this treatment, it is important to note that this practice is widely employed on privately owned forest lands in Pennsylvania. It demonstrates the importance of not only consulting with a trained forester before harvesting trees, but identifying your objectives, and designing a long-term management plan. **Remember, diameter does not equal age.**

BLOCK 4

Treatment: IMPROVEMENT THINNING

• This treatment should look somewhat different from the previous thinnings because many more criteria than just size were used to determine which trees to remove.

• WHAT WAS REMOVED?

Trees from all size classes are removed to improve the spacing and re-allocate resources to the most desirable trees. Poor quality stems are removed to make room needed for high quality stems to maximize growth. Damaged or diseased trees are removed as are undesirable species. In addition, some larger valuable trees are cut to provide intermediate income to the landowner. This treatment might be compared to weeding a garden while at the same time, picking some of the vegetables for dinner.

• WHAT REMAINS?

The desirability of a tree wholly depends upon the objectives of the landowner. A stand can be improved for wildlife, recreation, aesthetics, timber production, etc. Trees that remain might provide food or shelter for wildlife, may be unique species, or are of the quality and species to maximize growth and productivity using the newly available resources.

AESTHETICALLY?

Visually, this stand is probably as appealing as the control block, because a variety of sizes were removed with some additional light getting to the forest floor.

• WILDLIFE?

There is plenty of room in this treatment to make provisions for wildlife.

• $

This treatment will not bring the highest immediate financial return, but the future income potential is quite high. An improvement thinning does not have to be pre-commercial. It might be necessary to remove dominants and co-dominants to make room for their neighbors to expand.

• FUTURE FOREST?

This treatment serves as an investment in the future forest by maintaining vigor, productivity, and forest health. Valuable trees left will become even more valuable in 10 or 15 years.

Concept: REGENERATION HARVESTS

• The 3 thinnings I have just shown you are concerned with concentrating growth on residual trees whereas the remaining two treatments focus on regenerating a new stand, that is removing all or nearly all trees and creating the conditions necessary for new seedlings to grow. Occasionally den trees seed trees or shelter trees are left for wildlife or to facilitate natural regeneration.

• What are the conditions necessary for new seedlings to grow?

• What is the difference between natural and artificial regeneration? Which is more common in Pennsylvania? Which is more common in Southeast and Northwest?

BLOCK 5

• As trees age, their growth slows, resistance to insects and disease is reduced, and the ability to recover from injuries is diminished. Old trees die and eventually donate their nutrients back to the soil. Refer back to the large dead tree in the **control**. When a managed even-aged stand that has been either naturally or artificially thinned reaches the end of a rotation, it is time to consider a regeneration cut.

Activity: TREE RINGS

• Look at the rings on a few of the stumps in Block 5 (clearcut). Count them to assess the approximate age of the stand. What determines the age or average diameter a stand can achieve? (soil conditions, species, spacing, climate, topography, elevation) Also notice the varying widths of the rings and discuss reasons for this. (suppression by shading, drought, lack of nutrients). Do you notice any stumps of trees whose growth rate had slowed before it was cut? Why would this be the case? (competition, slower growth with age, fungus, or insect infestation, larger trees are less efficient at transporting water, sugars, and nutrients)

• The aging and eventual death of mature trees is a slow natural process that a regeneration harvest attempts to mimic, resulting in what looks similar to a natural disturbance like a fire or a wind storm. There are many site condition considerations involved in planning a regeneration harvest including:

soil and topography
site moisture, proximity to wetlands
impacts on specific wildlife species (corridors may be important)
proximity to other water resources (streams and rivers may require buffers)

Treatment: CLEARCUT

• A consideration of particular importance when planning to do a clearcut is the presence of advance regeneration, or new seedlings that are ready to respond when the overstory is removed. Also, what is there that might hinder the growth of new seedlings? Ferns? Grasses? Deer? Undesirable or weedy species? (grapevines, striped maple)

• WHAT IS REMOVED?

In a clearcut, all trees are removed in one cutting (not just high value trees).

• WHAT REMAINS?

In many cases, snags or den trees are left to provide food and shelter for wildlife. Also, a great deal of slash remains. Why leave slash? Slash provides protection for new seedlings from the heat and from herbivores. The decomposing matter will also eventually donate nutrients to the soil.

• AESTHETICALLY?

Visually, the value of the stand is diminished for most until a new forest begins to establish itself. Although, an opening has the possibility of providing a view of the landscape, a possible plus.

• WILDLIFE?

The impact on wildlife can be significant. Some species are affected positively and some negatively. Den trees and slash provide some cover.

• $

The immediate financial return can be high, but future income potential is delayed for several decades.

• FUTURE FOREST?

The word clearcut imparts a very negative image to most people. It is often confused with land clearing for development. When applied appropriately, a clearcut results in an even-aged stand dominated by trees that grow best in full sunlight.

Issue: THE IMPACT OF WHITETAIL DEER

**See deer exclosure on block 5 (clearcut)

• Regeneration failure is just one of the negative consequences of deer overpopulation and over-browsing.

• Whitetail deer were hunted nearly to extirpation around the turn of the century, but have since made a remarkable recovery. (lack of natural predators, presence of young forests, abundance of agricultural fields, and protective game laws).

• Deer browsing currently is having a notable effect on forest diversity, including ground cover, songbirds and other wildlife. As well as delaying the recovery of a forest after disturbance.

• Are deer likely to be a problem here?

• There are many different perspectives on the deer issue and the problem won't begin to be solved until individuals become aware of the problems associated with deer overpopulation.

• These six fences will make a nice demonstration as the vegetation continues to grow and change.

The appearance of a clearcut:

A recent clearcut may not be particularly pretty to view from a distance. But, allow yourself to take a close look. Has all the vegetation been removed from the site? What do you see on the forest floor? (wildflowers, herbs, seedlings). What tree species are present? Are they tolerant or intolerant or both? Which type will dominate in just a few years? Which will dominate in 20 years? 50? 100? What will this site look like in 5 years? 20 years? 70? (See the **control**, because this is how that stand started out 60-70 years ago).

How does the appearance of this stand compare with that of the "**high-grade**?" and how do the futures of these two stands differ? Which harvesting treatment is better for the sustainability of Pennsylvania's forest resources?

BLOCK 6

Treatment: SHELTERWOOD

• A shelterwood is also a regeneration cut, but differs from a clearcut in that all trees are removed in 2 or 3 stages instead of just 1.

• WHAT WAS REMOVED?

All the understory trees are removed (suppressed and intermediates), as well as several co-dominants and dominants.

• WHAT REMAINS?

Dominant trees remain that have been chosen for their good form and ability to produce seed. * Note that the best seed producers need not always be the best timber trees. Choosing the trees to leave depends upon specific species requirements for regeneration, (shade, amount of seed required, type of seed dispersal, seed characteristics or requirements for germination, vulnerability of seeds and seedlings). This demonstrates the importance of knowing the silvics of the species you are trying to regenerate.

• AESTHETICALLY?

Visually, the shelterwood is somewhat less disruptive than the clearcut because of the large residuals.

• WILDLIFE?

The effect on wildlife will be similar to the clearcut, although the residual trees may provide some food additional food and shelter.

• $

The financial return following the initial cut may be limited, but considerably higher after shelter trees are removed.

• FUTURE FOREST?

The resulting stand is even-aged and dominated by trees not requiring full sunlight to germinate and grow! Leaving seed sources on the site allows regeneration to become established gradually - not a one shot deal like a clearcut. Re-entering the stand to remove residuals will require great skill to avoid excessive damage to new seedlings and saplings. (Many will quickly re-sprout if knocked over). Timing and planning are important. Deer still may present a problem. Fencing may be a good option as with the clearcut. Saplings knocked down during the removal of the seed trees may re-sprout.

SUMMARY

THOUGHT QUESTIONS:

What type or species of tree do you prefer most and why?
What would a timber harvester say? a wildlife enthusiast? a hunter? birder? hiker?
Which treatment is best for wildlife?
What are some of the commercial uses of the tree species present on this site?
How many ways do wood products affect our lives?
In what different ways do we consume the forest? How does the forest respond?
Would it be better to make these things out of other materials, so we do not have to cut down so many trees? What are the alternatives, and are they renewable resources?
What are some of the careers that the forest provides?
How can we help conserve Pennsylvania's forests?
Should we be preserving our forests?
What does forest sustainability mean?
What does **Forest Stewardship** mean and why is it important?

REVIEW KEY POINTS:

- Diameter- limit cutting or "high-grading" is widely employed in PA. This practice is not rooted in sound forestry.
- A clearcut is a silvicultural practice that does not have to be an "environmental nightmare." Most of today's forests are the result of widespread clearcutting.
- Most of the forests in Pennsylvania are "even-aged," remember diameter does not equal age.
- Pennsylvania's forests do not typically need to be re-planted after harvesting. They can regenerate naturally.
- Forest ecosystems are both resilient and dynamic.
- Change in our forests can happen both naturally and with human intervention.
- Some of the change caused by humans can threaten the sustainability of our forests.
- It is our responsibility to manage that change.

THE FUTURE OF THE DEMONSTRATION SITE

- Data will be collected this summer, 3 years, and 10 years from now in order to evaluate residual growth and mortality, regeneration - controlling for deer, the plant and animal diversity, and the economic potential of each treatment.
- I invite you to return to this site in the future to watch the changing story of this dynamic forest.

APPENDIX F

Questionnaire

STUDENTS' KNOWLEDGE AND ATTITUDES ABOUT FOREST MANAGEMENT, WILDLIFE, AND THE ENVIRONMENT

We are interested in what you know and think about forestry and related issues. Read each question carefully and place your answer in the space provided. If you have any questions, please ask.

Some of the questions ask you how much you agree or disagree with certain statements. You choose any number from a line like this and write it next to the statement to show how you feel.

	1	2	3	4	5
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	

Here's and example:

____________Bill Clinton is a good president.

If you **really dislike** Bill Clinton **a lot**, you would put a **1** on the line.

If you **really like** Bill Clinton **a lot**, you would put a **5** on the line.

If you think Bill Clinton is **okay**, but **don't like him all that much**, you would put a **4.**

If you **don't have an opinion** or **neither like nor dislike** Bill Clinton you would put a **3.**

Strongly Disagree	1 Disagree	2 Neutral	3 Agree	4 Strongly Agree	5

Please state how much you agree or disagree with these statements about how to manage forests.

______1. Clearcutting should not be allowed.

______2. Forests should be used to get underground minerals like copper, gold, zinc, and others

___3. People who own forests should be encouraged to cut trees to make lumber and paper produts.

___4. Forests should be untouched and left alone.

How much do you agree or disagree with these statements?

___5. Forests have a right to remain that way, regardless of human wants or needs.

___6. Forests should primarily be used as homes for different animals.

___7. We should use our forests for furniture, paper, and other wood products.

______8. Forests should be mainly used for products that humans use.

How much you disagree or agree with these statements?

______9. Cutting trees makes the soil wash away (soil erosion).

______10. Trees are a non-renewable resource.

______11. When we cut trees in Pennsylvania, we must always replant.

______12. Clearcutting is a good way to help certain trees grow.

______13. Cutting trees can is sometimes good for the forest.

______14. Cutting trees destroys animals habitat or homes in the forests.

	1	2	3	4	5
Strongly Disagree	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**	

How much you disagree or agree with these statements?

_______15. Pennsylvania's forest recovered from widespread clearcutting and fires about 100 years ago.

_______16. Once trees are cut they will never grow back again.

_______17. Trees can help reduce harmful pollutants in the air.

_______18. Cutting trees causes losses of places where people enjoy nature.

_______19. Cutting trees can make air pollution worse.

_______20. Tennis shoes, gasoline, and lipstick, and ink are all products made from natural resources

_______21. Cutting trees threatens forests.

_______22. Most of the earth's water is in a form that humans can readily use.

_______23. Trees in the forest compete for food, light, and space.

_______24. When a forest is clearcut, trees will not grow back in our lifetime.

_______25. The tropical rainforests are homes for many species that haven't even been discovered yet.

_______26. Most of Pennsylvania's forests are 60-80 years old.

_______27. Cutting trees makes streams muddy.

For the following questions select the best answer.

1. The state tree of Pennsylvania is the__________.
   a. eastern white pine.
   b. sugar maple.
   c. eastern hemlock.
   d. northern red oak.
   e. do not know

2. The________________is the top of the forest made up of branches and leaves from the tallest trees.

   a. canopy
   b. understory
   c. cambium
   d. ecosystem
   e. do not know

3. The conversion of water and carbon dioxide into a sugar by green leaves is called_____.

   a. photosynthesis.
   b. chlorophyll.
   c. phloem.
   d. germination.
   e. do not know

4. Pennsylvania's most valuable tree for wood products is a__________.

   a. white pine.
   b. eastern hemlock.
   c. black gum.
   d. black cherry.
   e. do not know

5. The state bird of Pennsylvania is the_____.

   a. red-eyed vereo.
   b. hummingbird.
   c. ruffed grouse.
   d. cardinal.
   e. do not know

6. "High-grading" in Pennsylvania's forests______.

   a. protects new trees that are growing.
   b. looks at only the size and value of trees.
   c. helps lots of different species of trees and animals.
   d. improves the quality of the forest after the trees are taken out.
   e. do not know

7. The rings of a cut tree indicate____.

    a. how much space the tree had to grow.
    b. which years were best for the tree.
    c. how old the tree is.
    d. all of the above
    e. do not know

8. When done correctly, a clear cut________.

    a. removes all the valuable trees but leaves smaller ones.
    b. converts a forest into a meadow.
    c. takes away all the vegetation forever.
    d. results in a forest with trees that are all the same age and like lots of sun.
    e. do not know

9. After a tree is cut down during a timber harvest, "slash" (branches and log debris) ____.

    a. provides cover and protection for animals.
    b. protects new tree seedlings from being eaten.
    c. donates nutrients to the soil.
    d. all of the above
    e. do not know

Please tell me a few things about yourself.

1. What is your gender? M F

2. How old were you on your last birthday?________

3. What grade are you in?__________

4. What was your cumulative grade point average at the end of last year?_________

5. If you don't know, which of the following is the best description of your grades last year?

    a. mostly A's
    b. A's and B's
    c. mostly B's
    d. B's and C's
    e. mostly C's
    f. C's and D's
    g. mostly D's
    h. D's and F's
    I. mostly F's

6. Which ethnic/racial groups do you belong to?

   a. African-American/Black
   b. Asian-American
   c. Latin-Hispanic
   d. Arab-American
   e. European-American/White
   f. American Indian

7. If your ethnic group is not listed, please list here_______________________________

8. Do your parents own any forestland? YES NO

Appendix F

Sample
Economic Analysis

State Game Lands 211

Treatment	Harvested Volume (Bd.Ft.)	Harvested Value (Bd.Ft. + Cu. Ft.)	Residual Volume	Net Present Value ($)	Residual + Growth (Bd.Ft.)	Total Value in 20 yrs. ($)
Control	-	-	16869	4227	19752	4227
Low Thin	1150	50	11342	4596	13180	4646
High Thin	12563	743	5152	3387	10230	4130
Improvement	3138	337	8532	3828	14580	4165
Shelterwood	2744	554	10843	3065	15156	3619
Clearcut	5861	802	0	-	-	-

Stone Valley

Treatment	Harvested Volume (Bd.Ft.)	Harvested Value (Bd.Ft. + Cu. Ft.)	Residual Volume	Net Present Value ($)	Residual + Growth (Bd.Ft.)	Total Value in 20 yrs. ($)
Control	-	-	8198	3254	11990	3254
Low Thin	6520	0	5896	3279	9323	3279
High Thin	6292	1004	761	663	3233	1667
Improvement	6881	1101	9825	3957	14748	5058
Shelterwood	3353	1160	5777	3171	8705	4331
Clearcut	11269	1806	0	-	-	-

The last column in each table depicts the expected net present value of each treatment after 20 years. For the Game Lands 211 site the value of $4130 for the high thinning, which is a euphemism for high-grading, shows that the effect of this non-silvicultural treatment is not that detrimental. However, two things come into play. First that treatment block contained extremely high volume, principally yellow poplar, before the harvest and as a result retained more volume than would normally have been the case in this type of harvest. Secondly, the residual volume was largely red oak that the growth model predicts will recover and yield considerable value. The values for Stone Valley are more typical of the expected and observed outcome with a "high-thin" harvest.

Appendix G

Workshop Questionnaires

FORESTMANAGEMENT QUESTIONNAIRE

for general audiences

The management of our forest resources has become a controversial issue in recent decades, resulting in conflicts among environmentalists, foresters, timber harvesters, and landowners. In order to begin resolving differences and to better understand each of our concerns and varying opinions, could you please take a moment to share your views?

For the following questions: SD = strongly disagree, D = disagree, N = neutral
SA = strongly agree, and A = agree

1. One controversial issue facing the country today concerns the management of forest lands. Please indicate how much you agree or disagree with each of the following forest management policies.

a. Banning the general practice of clearcutting..	SD	D	N	A	SA
b. Encouraging mineral exploration and extraction..	SD	D	N	A	SA
c. Promoting economic development through the forest products industry....................	SD	D	N	A	SA
d. Encouraging forest landowners to harvest timber..	SD	D	N	A	SA

2. Please indicate how much you agree or disagree with the following statements about the uses of forests.

a. Forests have a right to exist for their own sake, regardless of human concerns and uses...	SD	D	N	A	SA
b. The primary use of forests should be for products that are useful to humans............	SD	D	N	A	SA
c. Forests should be used primarily for timber and wood products..............................	SD	D	N	A	SA

3. Please indicate how much you agree or disagree with each of the following statements regarding the results of cutting trees in Pennsylvania.

a. Cutting trees usually results in soil erosion...	SD	D	N	A	SA
b. Cutting trees usually results in permanent loss of forests..................................	SD	D	N	A	SA
c. Cutting trees usually results in muddy streams..	SD	D	N	A	SA
d. Cutting trees usually results in loss of recreation space..................................	SD	D	N	A	SA
e. Cutting trees usually results in wildlife habitat destruction...............................	SD	D	N	A	SA

4. One tree can out-compete another because of:
   a. better access to resources like sunlight, water, and nutrients.
   b. less browsing from herbivores.
   c. varying genetic make-up.
   d. all of the above.
   e. I don't know for sure.

5. Removing all the smallest trees from an area of forest:
   a. provides more growing space for the largest trees.
   b. can provide a large profit for the landowner.
   c. improves the habitat for many wildlife species.
   d. none of the above.
   e. I don't know for sure.

6. What is <u>not</u> an example of a pioneer or intolerant species?
   a. yellow poplar
   b. aspen
   c. American beech
   d. black cherry
   e. I don't know for sure.

7. The practice of "high-grading" in Pennsylvania:
   a. protects regeneration.
   b. only considers the size and value of trees.
   c. enhances species composition.
   d. ensures the quality of the forest stand after harvesting.
   e. I don't know for sure.

8. In an improvement thinning:
   a. both small trees and large trees are removed.
   b. wildlife habitat cannot be considered.
   c. trees with obvious defects are usually left standing.
   d. the landowner cannot make any profit because not enough trees are removed.
   e. I don't know for sure.

9. The rings of a cut tree indicate:
   a. how much space the tree had to grow.
   b. which years were the best growing years for the tree.
   c. how old the tree is.
   d. all of the above.
   e. I don't know for sure.

10. When applied appropriately, a clearcut:
   a. removes all the most valuable trees, but leaves smaller ones.
   b. generally converts a forest into a meadow.
   c. results in an even-aged forest stand that is dominated by trees that grow best in full sunlight.
   d. removes all the vegetation from the site.
   e. I don't know for sure.

People of all ages and backgrounds are interested in Forest Stewardship. In order to help us better understand and serve our audience, please take a moment to share information about yourself. Your answers will remain anonymous.

1. Gender: ____ Male ____ Female

2. How old were you on your last birthday? _____

3. What was the highest level of education you completed?
   ____ grade school (grades 1-8)
   ____ some high school (grades 9-11)
   ____ completed high school (grade 12)
   ____ some college/ technical school beyond high school
   ____ bachelors degree
   ____ graduate or professional school after college

4. If you are currently employed, what is your occupation? ____________________

5. What is your annual household income?
   ____ less than $15,000
   ____ $15,000 - $30,000
   ____ $30,001 - $45,000
   ____ more than $45,000
   ____ I am not sure.

6. How would you describe your community?
   ____ A city
   ____ The suburbs of a city
   ____ A small town
   ____ A rural area

What is your zip code? __________

7. Have you ever attended a meeting on forest management before? ____ yes ____ no

8 Are you a forest landowner? ____ yes ____ no

   If yes,
   How many forested acres? _____ What county? ______________

   Do you have a <u>written</u> management plan for your woodland? ____ yes ____ no

   Do you live on your land? ____ yes ____ no

   If no, how far away from your land do you live? ______ miles

Any additional comments you make on the back of this page will help me improve future programs.

Thank you for your time!