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Northeastern Forest Experiment Station

General Technical Report NE-183

Quantitative Silviculture for Hardwood Forests of the Alleghenies

Dedication

This publication is dedicated to the memory of Roe S. (Sandy) Cochran, former Forest Resource Specialist with the Extension Service, The Pennsylvania State University. Sandy was a guiding light in the Allegheny Hardwood Silviculture Training Sessions on which this publication is based. He was instrumental in initiating, promoting, and conducting every session, from their inception in 1978 until his death in 1991. Sandy contributed to the technical and administrative aspects of the Training Sessions in many, many ways, but may best be remembered for his famous Wednesday night steak fry. It is to his untiring efforts to provide educational opportunities leading to good forestry practices in the Allegheny Region, his commitment to the forestry profession, and his exceptional drive and character that this publication is dedicated.

Cover Photo

The cover photograph was taken during one of the first Allegheny hardwood silviculture training sessions at the Kane Experimental Forest, sometime during 1976 or 1977. The individuals in the photograph represent the wide range of participants in the sessions, including University professors, consulting and industrial foresters, and foresters from public land management agencies. Among those in this photograph are several of the individuals who intiated the course, including Dave Marquis, at the left of the front row; Sandy Cochran, in the center in a light jacket; Ben Roach, on the right of the front row; and Rich Ernst, second from the left in the back row.

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Quantitative Silviculture for Hardwood Forests of the Alleghenies

David A. Marquis
Editor

A collection of lectures from the annual
Silviculture Training Sessions
conducted by the

USDA Forest Service
Northeastern Forest Experiment Station
Warren, Pennsylvania

and

The Pennsylvania State University
Cooperative Extension Service
University Park, Pennsylvania

Contents

Preface

Forest Service research on hardwood silviculture has been under way in northern Pennsylvania since the Kane Experimental Forest was established in 1929. Throughout the 1930's the Civilian Conservation Corp provided the manpower to initiate many long-term studies of ecology and forest growth. The experimental forest was closed during World War II, and after the war, a small silviculture research program was maintained at both the Kane Experimental Forest and the Pocono Experimental Forest. The Pocono forest was privately owned, but research was conducted there by Forest Service personnel. Many studies were maintained and remeasured by Ashbel Hough and others throughout the long period of reduced activity until the late 1960's.

In the 1960's, the program was revitalized by combining the minimal staffs of the Kane and Pocono Experimental Forests and establishing a new laboratory in Warren, Pennsylvania. The silviculture research staff at Warren was expanded in 1970, which led to a comprehensive research program on the forest management problems of the region.

The new program, combined with the reopening of the 1930 studies at Kane, provided for rapid accumulation of scientific knowledge on the ecology and management of Allegheny hardwoods. Special efforts were made to organize that knowledge into a coordinated set of management guidelines. Initial guidelines included procedures to obtain satisfactory regeneration after harvest cutting, and to control stand density and structure during thinning. These guidelines have since been expanded into a complete system of stand evaluation and silvicultural prescriptions that cover the full range of forest conditions and management alternatives in the region.

Much other research is also applicable to the Allegheny region. Oak silviculture research at the Central States Forest Experiment Station (later divided between the Northeastern and North Central Forest Experiment Stations) in Ohio, Kentucky, and other Central States has been used extensively, as has research of The Pennsylvania State University; West Virginia University; and the College of Environmental Science and Forestry, State University of New York at Syracuse. Research conducted or sponsored by the Hammermill Paper Company, Tg Forest Products (formerly Armstrong Forests), and Glatfelter Pulp Wood Company has been important also.

In 1976, the Northeastern Forest Experiment Station and the Cooperative Extension Service of The Pennsylvania State University organized several training sessions to explain and demonstrate the silvicultural prescription system to practicing foresters. Since then, two to four sessions have been held each year, with 20 to 30 participants at each session. The sessions are updated periodically as new research information becomes available. In 1985, a new classroom facility was built at Kane and in 1987 the sessions were lengthened from 3 to 4 days each. In addition, some supplementary 1-day sessions were added to provide in-depth coverage of techniques outlined in the basic sessions.

The sessions have been attended by representatives from nearly every forest management organization in the region: Allegheny National Forest, Monongahela National Forest, other Eastern Region national forests and headquarters offices, State and Private Forestry, Northeastern Forest Experiment Station, Pennsylvania Bureau of Forestry, Pennsylvania Game Commission, New York Department of Environmental Conservation, forestry faculty of eight or nine eastern universities, Hammermill Paper Co., International Paper Co., Tg Forest Products Inc., Kane Hardwoods Division of Collins Pine Co., National Fuel Gas, Westvaco, Charmin Paper Division of Proctor and Gamble, Glatfelter Pulp Wood Co., 15 to 20 forestry consulting firms and others. Ontario Ministry of Natural Resources has participated and others have come from as far away as Chile, Italy, Holland, and New Zealand.

The sessions provide excellent feedback on research needs. Some 60 to 80 participants each year provide candid evaluations on the applicability of the research, and help to identify areas needing further study or refinement. The result is an improved research product as well as an effective technology transfer process.

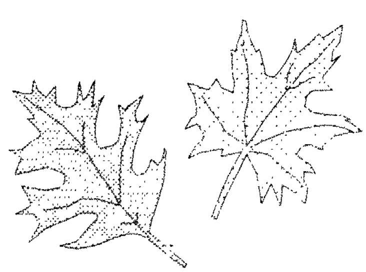
About half of the time in each training session is devoted to classroom lectures in which results of research and basic principles of silvicultural technique are presented. The remaining time is devoted to practical field exercises in which participants have an opportunity to apply the techniques under the guidance of course instructors. The sessions represent an exceptional collection of practical information on the systematic and scientific application of silviculture to a particular forest region.

Acknowledgments

Lectures presented here were prepared by scientists at the U. S. Department of Agriculture, Forest Service, Forestry Sciences Laboratory, Warren, Pennsylvania. A number of other scientists have contributed immeasurably to these lectures, or to the research leading to the silvicultural knowledge on which the guidelines are based. Some of these include: Ashbel F. Hough, Carl E. Ostrom, Thomas W. Church, Ted J. Grisez, Harold J. Huntzinger, Benjamin A. Roach, John C. Bjorkbom, Kurt W. Gottschalk, John A. Stanturf, David S. deCalesta, Coleman Holt, and Nancy G. Tilghman. For their contributions, we are especially grateful.

Ash Hough deserves special mention as a pioneer researcher who initiated -- and kept alive during nearly 30 years of official neglect -- the many long-term studies that have since helped tremendously to verify responses of forest stands to treatment. Likewise, Ben Roach deserves special mention for his early efforts in formulating systematic silvicultural prescription procedures in the Central States. His guide served as a model for the Allegheny system.

Special thanks also to the dedicated group of forest technicians of the Forestry Sciences Laboratory in Warren. Without these skilled assistants, the research leading to these guidelines could not have been completed: Virgil L. Flick, Vonley D. Brown, John A. Crossley, David L. Saf, and Harry S. Steele.



Pesticide Precautionary Statement

This publication reports research involving pesticides. It does not contain recommendations for their use, nor does it imply that the uses discussed here have been registered. All uses of pesticides must be registered by appropriate State and/or Federal agencies before they can be recommended.

CAUTION: Pesticides can be injurious to humans, domestic animals, desirable plants, and fish or other wildlife--if they are not handled or applied properly. Use all pesticides selectively and carefully. Follow recommended practices for the disposal of surplus pesticides and pesticide containers.

The computer program described in this publication is available on request with the understanding that the U.S. Department of Agriculture cannot assure its accuracy, completeness, reliability, or suitability for any other purpose than that reported. The recipient may not assert any proprietary rights thereto nor represent it to anyone as other than a Government-produced computer program.

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Introduction

David A. Marquis, Roe S. Cochran

Silviculture always has been a combination of art and science. Silvicultural systems and cutting methods are based upon scientific principles, but recognizing which technique will provide best results in any particular circumstance requires a great deal of experience and judgment -- the art side.

The person prescribing silvicultural treatments in any forest stand needs a thorough knowledge of present stand conditions, must be aware of the possible treatments and their many effects, and must juggle biological considerations with management objectives and costs. When management goals include the integration of several major resources, such as timber, wildlife, or aesthetics, the decisionmaking process can be very complex. Forest types that include variability in species composition and structure, such as the eastern mixed hardwoods, add further to that complexity.

In the past, we have depended upon the judgment of experienced silviculturists to weigh these many factors and determine the most appropriate treatment or course of action. And we have depended upon the skill of these same people to apply the prescribed treatments to the highly variable situations they encounter in each stand.

However, as our scientific knowledge grows and the range of disciplines needed to deal with multiple resources increases, we must have more objective ways to measure and evaluate forest stand conditions and to arrive at recommended treatments.

Much of our research in the hardwood forests of the Allegheny Region has been aimed at the development of a systematic and quantitative procedure for stand analysis and prescription. The articles that follow describe the continually evolving system that we have developed for hardwood forests of the Alleghenies.

Quantitative Silviculture for the Alleghenies

The stand analysis and prescription procedures described here are based on extensive research. Without such a foundation, no collection of guidelines can be very meaningful. This research included studies of important biological factors and investigations of the ways in which these factors regulate tree regeneration, tree and stand growth, or wildlife habitat. Guidelines based on research results provide a basis to decide how much is enough or too much in particular circumstances. For example, successful tree regeneration following harvest cutting is highly dependent upon the amount of advance reproduction, and that finding was used to develop specific guides on how many advance seedlings are needed, and how those numbers vary with species, seedling size, site, deer browsing pressure, cutting treatment, and other factors.

A complete series of guidelines of this type was developed and integrated into a stand analysis and prescription procedure. This system involves an inventory of basic overstory, understory, and site factors that are then summarized and analyzed in specific ways to evaluate the stand's potential for growth and regeneration. Then, a series of decision tables or charts is used to determine an appropriate prescription based upon critical levels of the various site and vegetation variables, in combination with specific landowner objectives.

All steps of this process are based upon stand and site variables that have been quantified. As a result, the entire process can be programmed, and the data analysis, report generation, and even the decisionmaking can be automated to a considerable degree. Our computer program has been named SILVAH, which stands for SILViculture of Allegheny Hardwoods. As a result, the system of stand inventory, analysis, and prescription is often referred to as the SILVAH stand analysis and prescription system.

Whether or not the SILVAH computer program is used to automate the process, the stand analysis and prescription technique provides a systematic and quantitative way to make silvicultural decisions in forest stands. It reduces the amount of subjectivity and judgment required, and ensures consistency across all stands and individual prescribers.

Assumptions and Applicability

The guidelines presented here were developed for and are applicable to the cherry-maple (Allegheny hardwoods), beech-birch-maple (northern hardwoods), oak-hickory, and oak-northern hardwood transition forest types growing on the Allegheny Plateau and Allegheny Mountain sections of Pennsylvania, New York, West Virginia, and Maryland. The guides to even-age intermediate culture are widely applicable, even outside the Allegheny Region. However, the guides to regeneration are more restricted to the region of applicability because of such local influences as deer populations, site characteristics, climate, and insect pests.

The basic procedures and framework of the decisionmaking process are universally applicable. If local silvical knowledge is sufficient to permit the needed modification in decision criteria, this system of stand inventory, analysis, and prescription can be adapted to most northeastern forests.

Management Goals

The silvicultural prescriptions currently incorporated into the SILVAH system assume that forest lands are being held and managed for multiple resource use, with timber production as one of the primary goals. Timber prescriptions may be modified to accommodate selected wildlife and aesthetic goals as well.

The SILVAH system further assumes that:

1. all resources are being managed on a sustained-yield basis;

2. emphasis in timber management is on sawlog and veneer production of black cherry, sugar maple, red maple, white ash, northern red oak, white oak, and other valuable species where they occur;

3. both even-age and uneven-age silvicultural systems will be used, each where it is most appropriate for the management objectives;

4. even-age silviculture will be applied to grow a full yield of high-value products as quickly as is economically feasible without losing total wood production in the meantime, and then reproduce the stand when it is mature by a means that will provide full stocking of mixed species composition in the next stand, including a substantial proportion of valuable intolerants such as black cherry, white ash, northern red oak, and red maple; and

5. uneven-age silviculture will be applied to obtain a substantial yield of timber products while maintaining a continuous forest cover at all times, for areas where aesthetics, recreation, and late-successional wildlife species are of special importance.

A Word of Caution

You must realize that our research is not completed. What we describe must not be considered the final, ultimate, everlasting, universal answer. Instead, this research represents the best information that we currently have. The guides have been tested extensively, and the system works consistently well in most common situations. But undoubtedly there will be modifications as we learn more from research still under way. Furthermore, guidelines cannot account for all the many variations that one encounters in the natural world.

Therefore, apply the guidelines critically. You cannot abdicate your responsibility to exercise professional judgment. The guides must be used as an aid to professional judgment, not as a substitute.

Always watch for situations in which the answer you get from the guidelines does not jibe with your professional experience. For example, if you inventory a stand and work up the data to find that the stocking guide indicates the stand to be fully stocked, you must not accept that as gospel and forget everything else you have ever learned. You should look at the stand and ask yourself some questions. The guide says this stand is fully stocked. Is it? Does it look fully stocked? If it is, there must be a lot of small dead trees in the stand. Are they there? The stand should look crowded. Does it? There should be relatively little understory except in open places, and reproduction should be scarce and small. Is that so?

If your answers to such questions conform to what the guides imply, you can feel reasonably confident that both you and the guides are on safe ground. If your answers do not fit, then something is wrong, and you need to find out what is wrong before you proceed. Maybe your inventory was sloppy or you did not take enough plots to get accurate data. Maybe you made some mistakes in arithmetic, or gave the computer improper processing instructions. Maybe the composition of the stand is outside the range of the guides. Or maybe the guides are wrong. So, the answer the guides provide must not be accepted on blind faith.

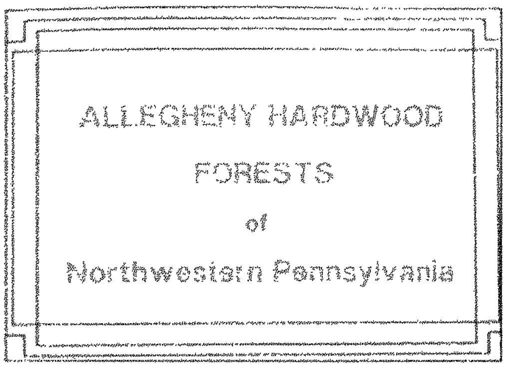
The guides are intended to assign some mathematical quantities to things we guessed at in the past. They are intended to reduce the amount of subjectivity and seat-of-the-pants forestry that was used in the past in stand prescription and marking. They are intended to provide an objective, measurable, and remeasurable basis for judgment. But that does not mean that the numbers generated are invariably right, and everything else is wrong.

If that limitation is recognized, and the guideliness are used in combination with a full measure of professional judgment, they provide a powerful tool to make stand analysis and prescription more accurate and consistent. This quantitative approach to silviculture combines more science than before, but does not obviate the need for the continuation of art.

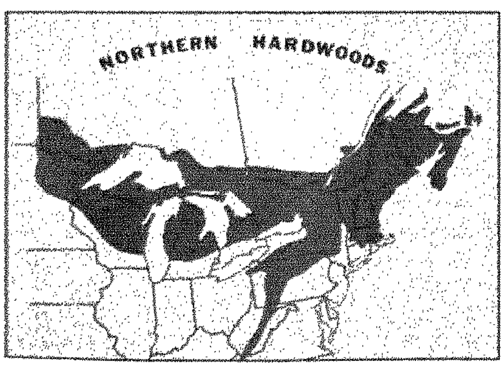
The articles that follow illustrate how the art and science of quantitative silviculture is being applied in the Allegheny forest region.

History & Origin of Allegheny Hardwoods

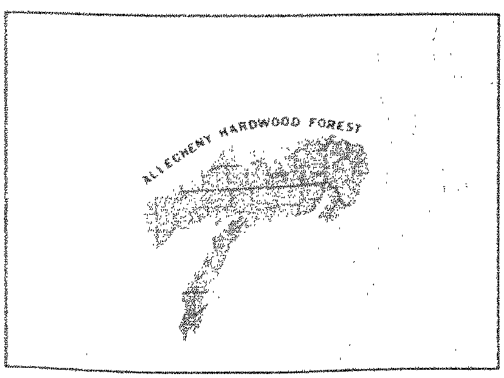
David A. Marquis



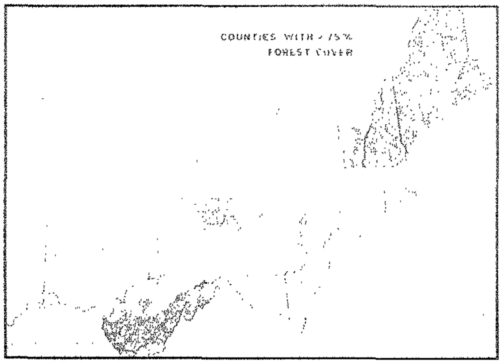
1. The Allegheny hardwood--or cherry-maple--fo



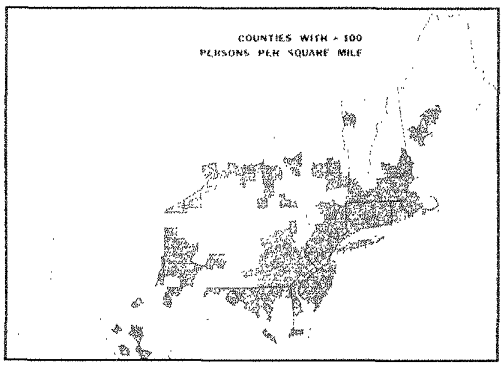
2. is a subtype of the northern hardwood or be
forest that spans the northern portion of the
States from New England to the Lake States.



3. Allegheny hardwoods occur on approximately
of the Allegheny Plateau and Allegheny Mour
Pennsylvania, New York, Maryland, West Virg

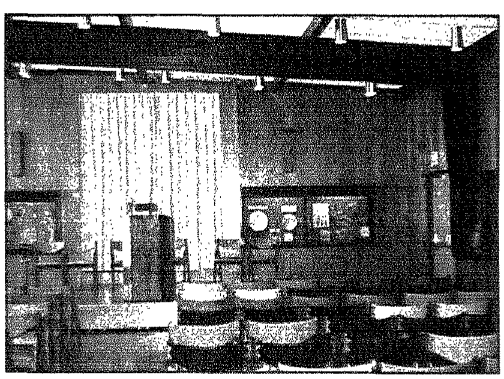


4. The area occupied by Allegheny hardwoods is a heavily forested region. It is one of the major contiguous blocks of commercial forest land in the Northeast, and wood-using industries play an important role in the rural economy of the region.

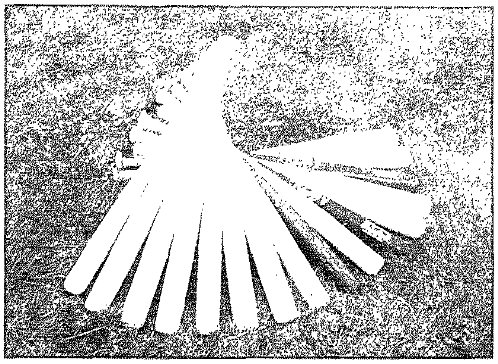


5. Yet these forests are surrounded on all sides by the eastern megalopolis; nearly one-third of the U.S. population lives within a day's drive of the region, providing a large and nearby market for forest products and a demand for many other uses of the forest land.

6. Allegheny hardwood or cherry-maple forests are unique in that they produce nearly all of the world's supply of commercial black cherry timber.



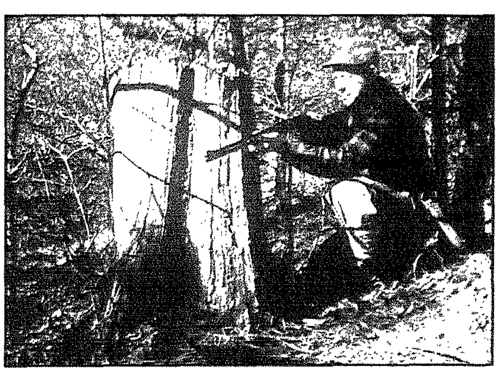
7. Cherry is a wood of exceptional beauty used in the production of fine furniture and veneer for cabinets and panelling.



8. No less important are the other hardwood species that grow in Allegheny forests--such as white ash--the long-time favorite wood for tool handles and baseball bats

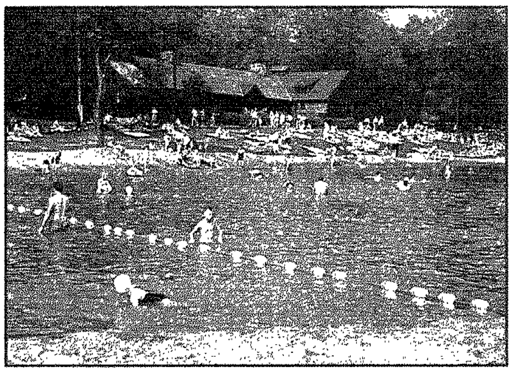
9. and the maples, well-known as sources of lumber for furniture and specialty products, for maple syrup,

10. and for their spectacular orange-red fall foliage.

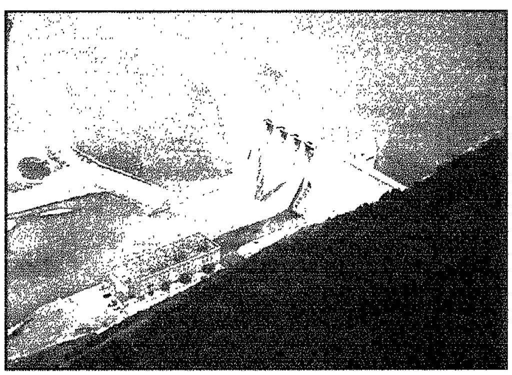


11. Allegheny forests yield many social and economic benefits other than timber products. Hunting is one major example. Pennsylvania ranks first in the nation in the sale of hunting licenses, with big-game animals such as deer a leading attraction.

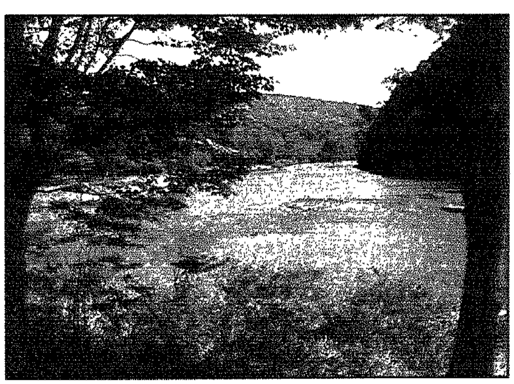
12. More than 400,000 deer are harvested annually in Plateau forests along with bear, turkey, and many kinds of small game.



13. Fishing, hiking, camping, birdwatching, water sports, snowmobiling and other forms of outdoor recreation,



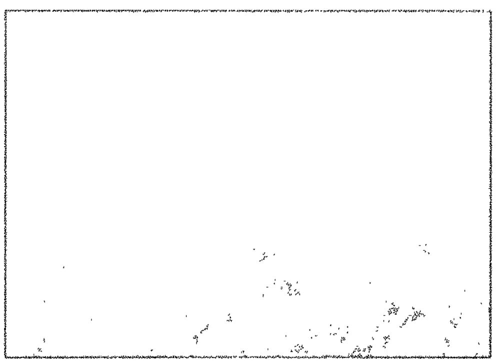
14. water resources for home and industry,



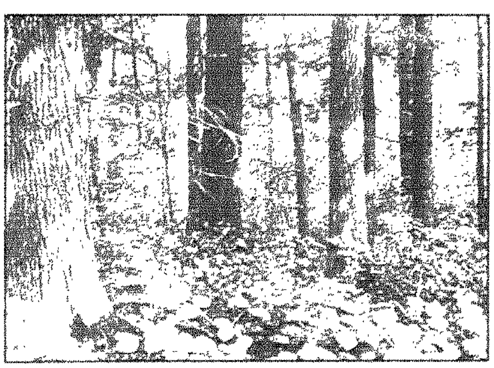
15. and scenic beauty must be added to the list of benefits derived from Allegheny hardwood forests.

16. It is easy to expect these benefits will continue indefinitely, however, we must understand that these forests are changing. At present, they are largely second growth, representing an intermediate stage in the ecological succession for this region. The capability exists to delay or hasten this natural process and to alter the level of benefits obtained from the various resources

17. To fully understand the range of options available and the ecological basis for silvicultural treatments in Allegheny hardwoods, it is important to know something of the history and origin of present stands.

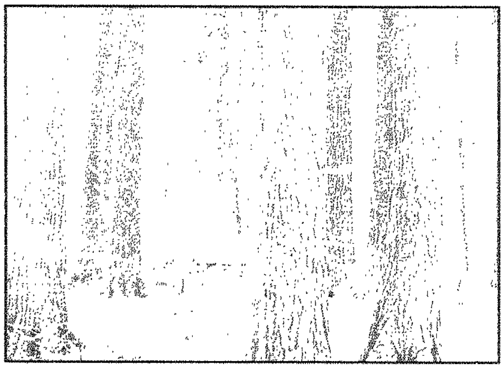


18. When white settlers first came to northern Pennsylvania, they found vast expanses of forest land stretching as far as the eye could see.



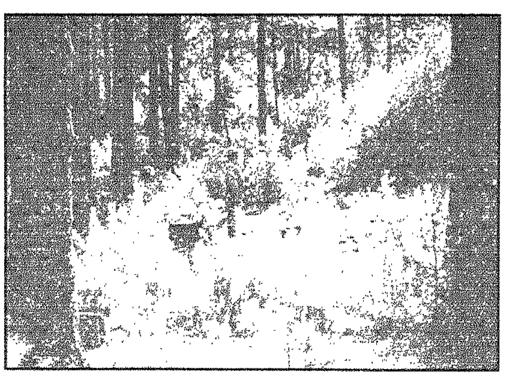
19. Many of these original forests were mature and overmature, and they contained very large trees of species like white pine, eastern hemlock, American beech, and sugar maple.

20. Beech-hemlock and beech-maple stands were by far the most prevalent. Beech, hemlock, and maple represented more than 70 percent of all trees observed during early land surveys on what is now the Allegheny National Forest.

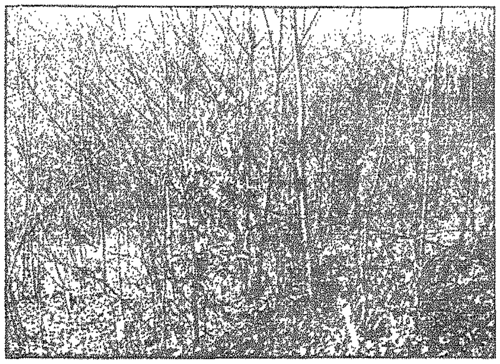


21. Hemlock was most abundant on moist sites along stream valleys and poorly drained upland areas.

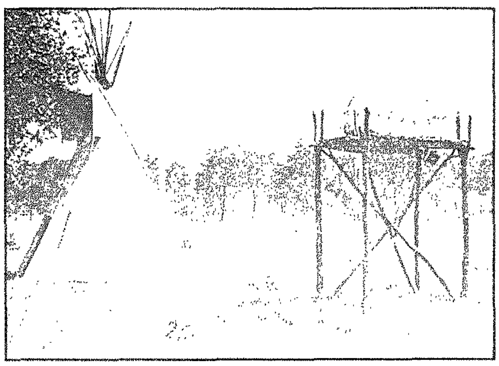
22. Beech, maple, and other hardwoods were more abundant on better drained sites.



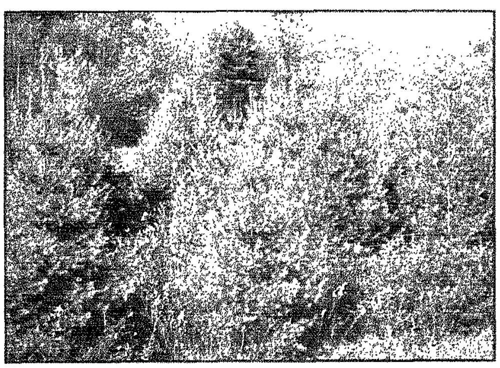
23. White pine was also a common and extremely important species in the original forests. But stands containing large proportions of white pine were small, occurring primarily on river flats and lower slopes.



24. Not all stands were primeval in character. Disturbance such as wildfires and windthrow were common, resulting in the presence of stands of varying ages and sizes. These stands represent various stages of recovery from natural disturbances.

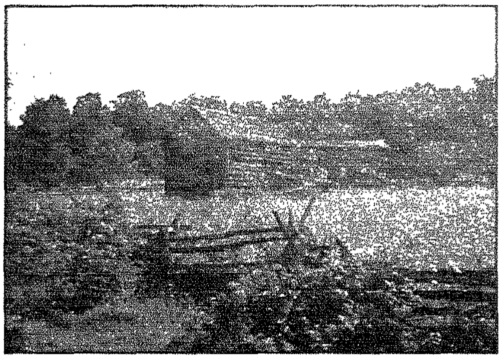


25. Indians were also responsible for many forest disturbances. All northeastern Indians lived in villages; they cleared land for agriculture, and often burned the woods to improve berry production, hunting, and facilitate travel. Indian villages were relocated rather frequently as soil and firewood were depleted, so the total acreage affected was considerably larger than that actually occupied at any one time.

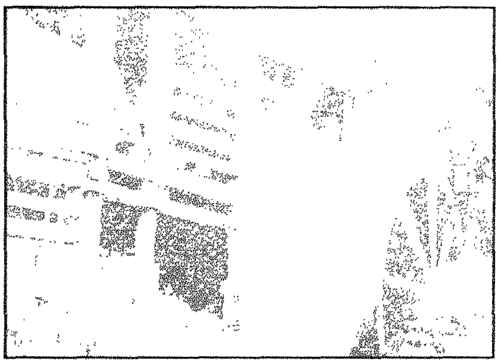


26. Many white pine stands are thought to have originated on the sites of abandoned Indian villages or on areas burned by Indians.

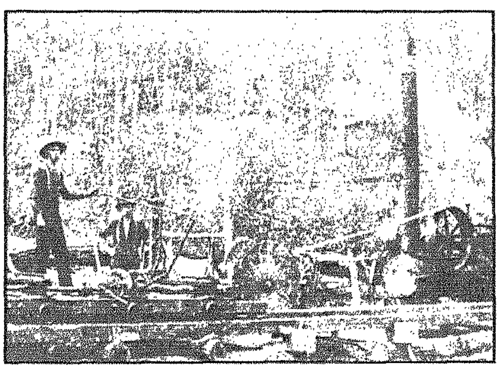
27. The presence of oak along the Allegheny River and its tributaries is probably also the result of fires started by Indians who lived, hunted, and travelled along the river. The oaks are more likely to resprout after repeated fires than most other species. Under current fire protection programs, these oak stands are gradually reverting to northern hardwoods.



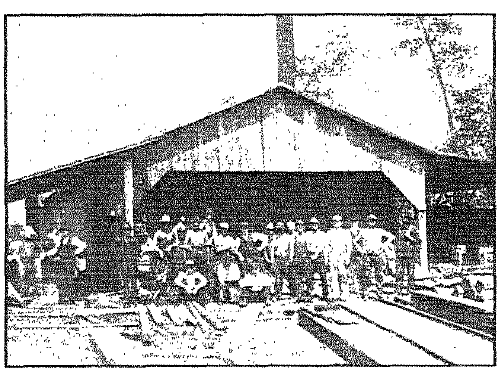
28. Europeans began to settle northwestern Pennsylvania in the mid-1700's. Early settlers cleared some land for agriculture and cut some timber for their cabins and barns. But settlement proceeded slowly until the early 1800's. For example, in 1810 the population of Warren County was 26 and that of McKean County was 142.



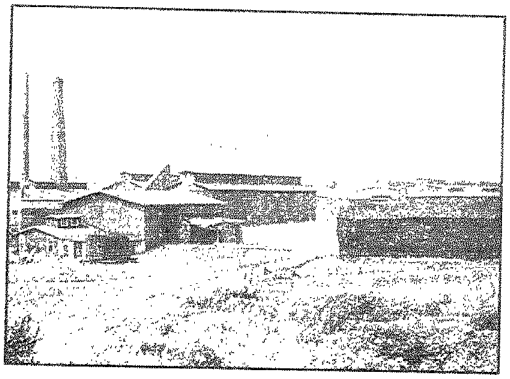
29. Even the earliest settlers did some timber cutting for market. The first sawmill in Warren County was a water-powered mill built in 1800; a raft of pine timbers from this mill was floated down the Allegheny River to Pittsburgh in 1801. Despite this early start, timber cutting remained limited during the early 1800's.



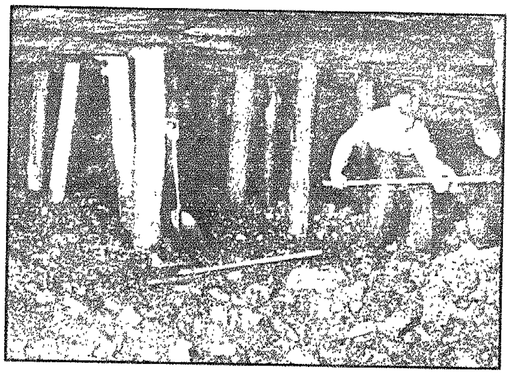
30. Cutting began to accelerate after 1840 when portable steam power plants became available, making circular sawmills practical.



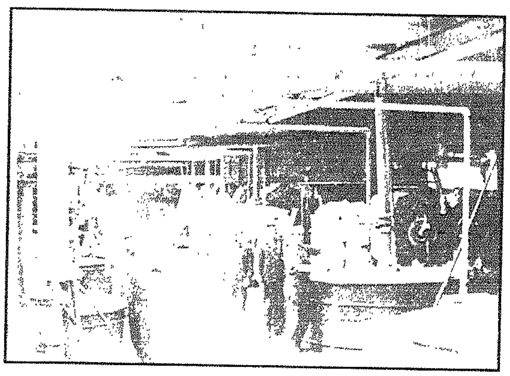
31. Mills that could cut 10,000 board feet of lumber per day became common, and much larger circular mills were built toward the end of the century.



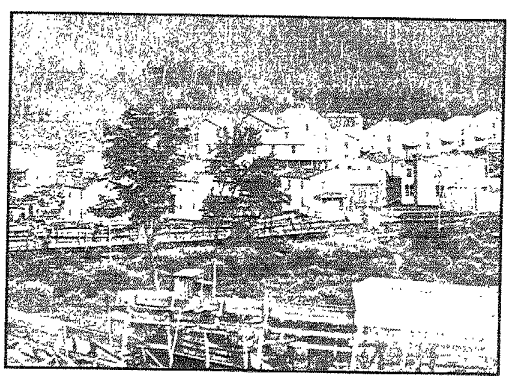
32. Tanneries that used hemlock bark as their source of tannin for curing leather began to appear in the late 1850's. This infant industry received a great boost in the 1860's by the demand for harness, military equipment, and industrial belting occasioned by the Civil War. Tanneries continued to increase in importance through the turn of the century.



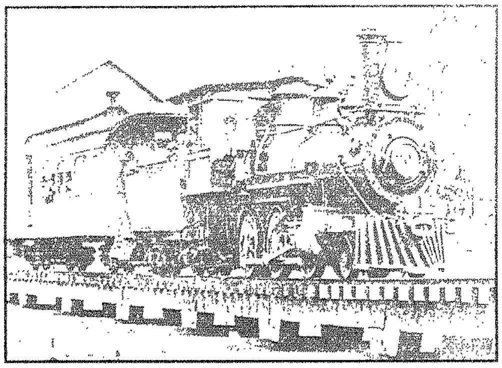
33. An eighty-fold increase in coal production between 1850 and 1900, and an equivalent increase in the demand for mine props, timbers, planks, and railroad ties, contributed to expanded timber cutting



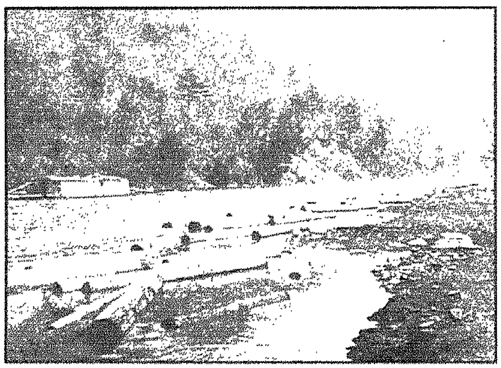
34. as did the demand for paper and other wood pulp products.



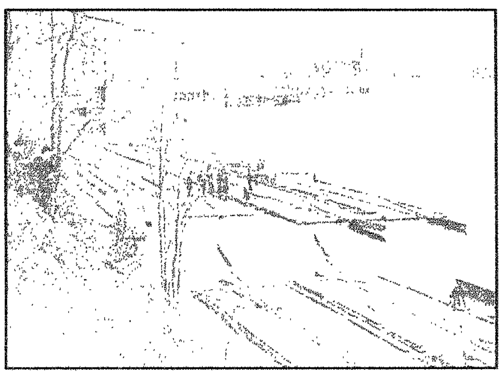
35. Settlement was proceeding more rapidly by 1850, and the demand for lumber to build houses, stores, and furniture increased markedly.



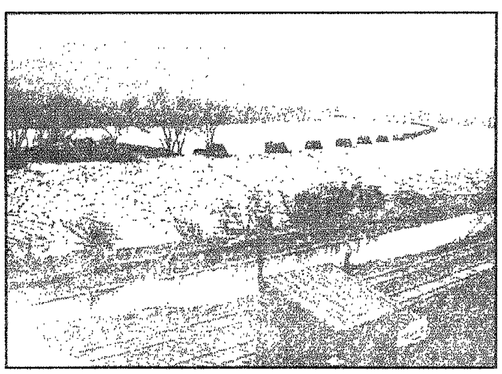
36. Major railroads began to reach the Allegheny hardwood area about this time. Railroads opened extensive and previously inaccessible areas of timber and provided convenient transportation for further development. The first railroad reached Warren in 1859, and two others followed within the next 10 years.



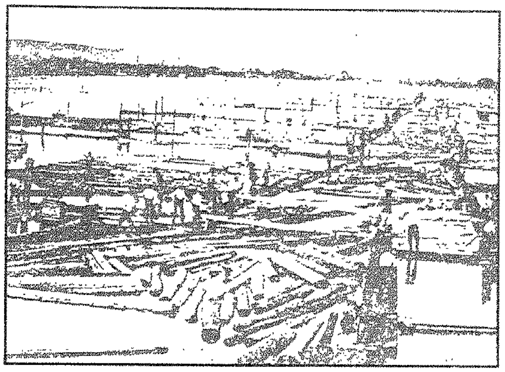
37. During early years of this period, white pine was the major species cut, mainly along the drainages. It was floated down secondary streams to mills, and floated,



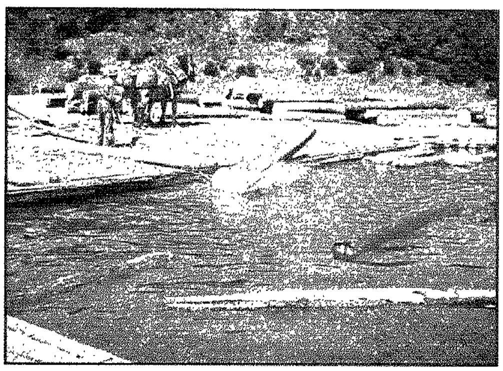
38. rafted, or barged down the Susquehanna and Allegheny Rivers to major markets in Williamsport, Harrisburg, Philadelphia, Pittsburgh, and Cincinnati.



39. As late as 1875, pine was the predominant species passing through the big boom at Williamsport. But as limited supplies of pine were depleted and demands for construction lumber increased, more and more hemlock was cut.

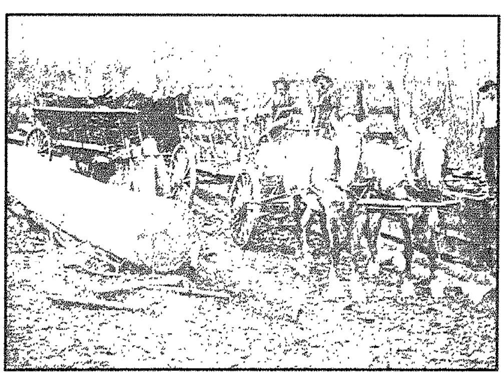


40. By 1890, nearly 8 times as much hemlock was passing through the Williamsport boom as pine--a complete reversal within 15 years.

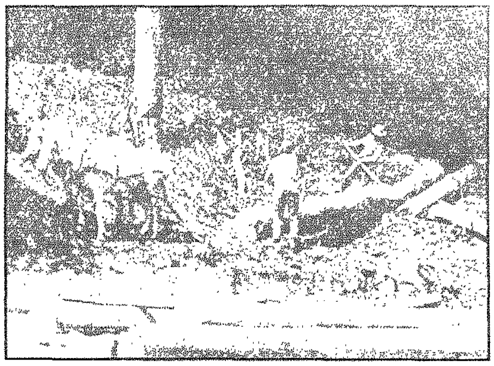


41. Also, during this period, some large and especially valuable hardwoods were removed--for furniture, panelling and interior trim. Red oak and white ash were cut near the mills, whereas species such as yellow-poplar, cherry, chestnut, and basswood were cut elsewhere because they float well and could be transported by stream.

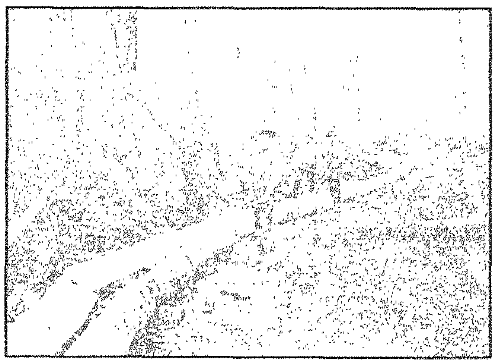
42. These early cuttings for white pine, hemlock, and selected hardwoods did not result in extensive clearcutting. Hardwoods and hemlock of the quality desired were scattered. And white pine rarely grew in pure stands over extensive areas; it typically grew as small groups of trees intermingled in stands of other species.



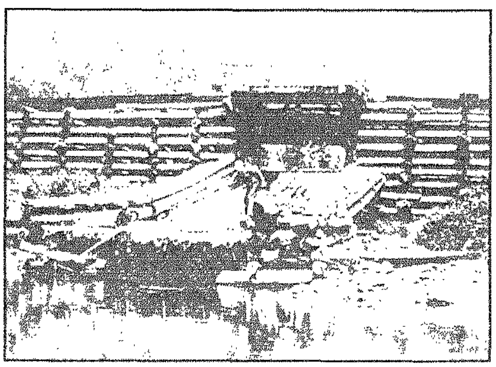
43. Furthermore, the technology required to move large volumes of logs was not well advanced enough to permit clearcutting of major portions of the virgin forest. Most of the cutting was still confined to areas where streams could be used to transport logs to the mill.



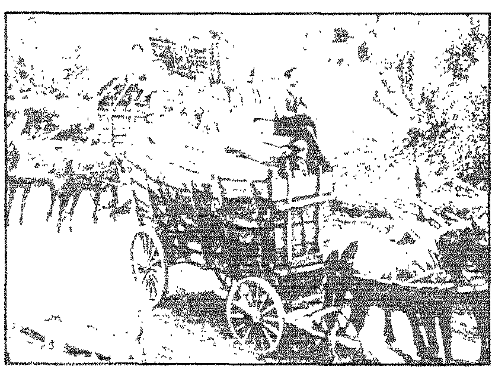
44. In typical operations of the day trees were felled in the winter and skidded to streams with horses in preparation for the spring thaw.



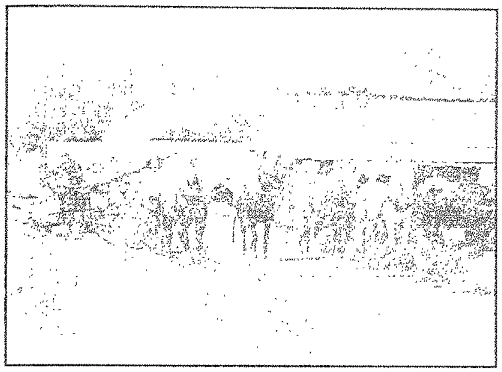
45. Log slides were often built to extend the distance that logs could be moved.



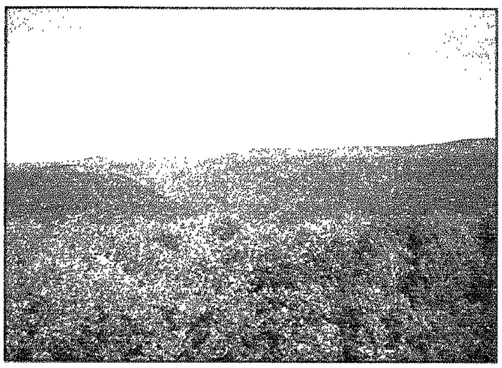
46. Splash dams permitted logs to be driven down very small streams. With high water during the spring run-off, these dams filled up quickly. When the gates were opened, a rush of water carried the logs down otherwise shallow streambeds.



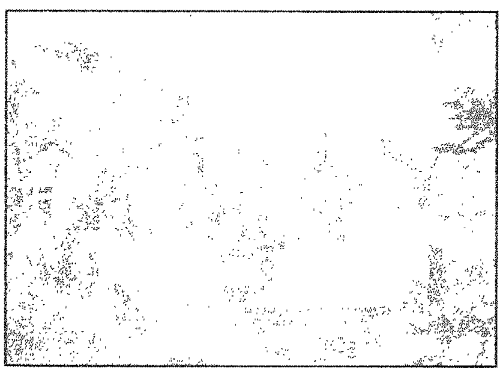
47. Many attempts were made to tap the timber resources more distant from streams. Horse-pulled wagons were used to haul both bark and logs over dirt or even plank roads. But road construction was difficult and expensive and hence little used.



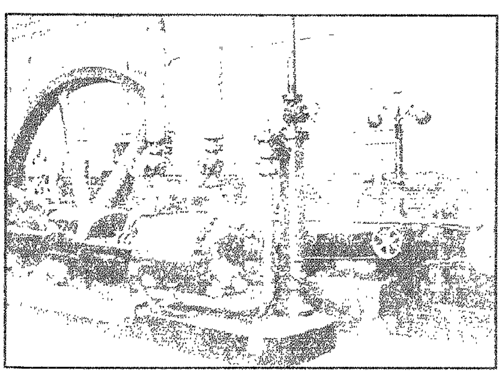
48. Some ambitious loggers built tram roads--the forerunners of logging railroads. Tracks were built of heavy timber on which wheeled log carts could be moved.



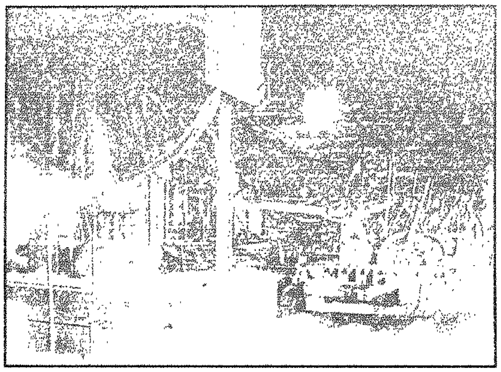
49. Because of the dependence on water transport, and markets limited to only the larger trees of selected species, the major portion of the virgin forest--lying on the uplands--remained fairly much intact through about 1880. The cuttings for pine, hemlock, and selected hardwoods were to be scattered and patchy partial ones that left considerable amounts of residual overstory in most places.



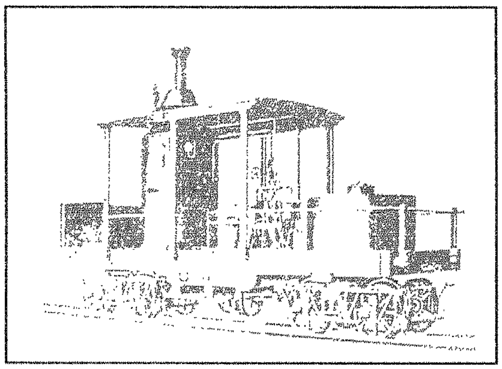
50. But these cuttings did create openings in the extensive forests and resulted in considerable amounts of advance hardwood reproduction.



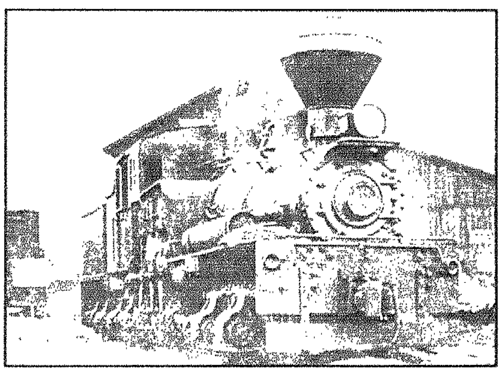
51. During the last half of the 19th century, the industrial revolution had begun to change the methods used to accomplish nearly everything, everywhere. By about 1880, major advances in logging, transportation, and milling methods combined to create dramatic changes in timber harvesting on the Allegheny Plateau.



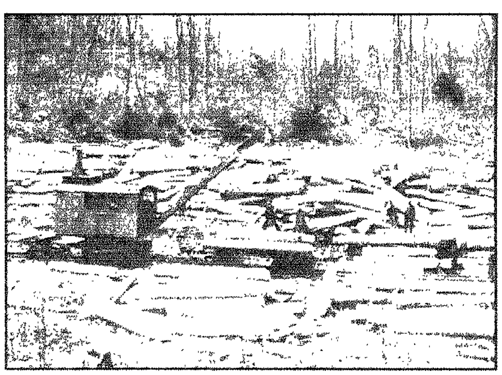
52. Band saws came into use after 1880, making possible the construction of huge mills capable of sawing 100,000 feet or more of lumber per day.



53. The most important change affecting timber production was the development of railroad locomotives designed especially for logging. Originally they were handmade and were little more than a boiler mounted on a flat car with a specially-designed means of transmitting power to the driving wheels.

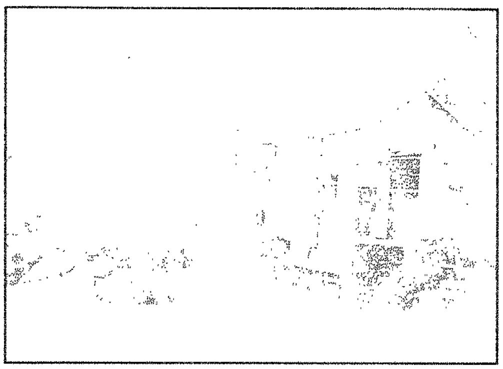


54. Logging engines were powered by a crankshaft geared to each axle. This model of the Shay was first of several logging engine designs. These geared engines, although slow, were capable of traversing very steep grades and they could negotiate very uneven tracks and sharp curves.

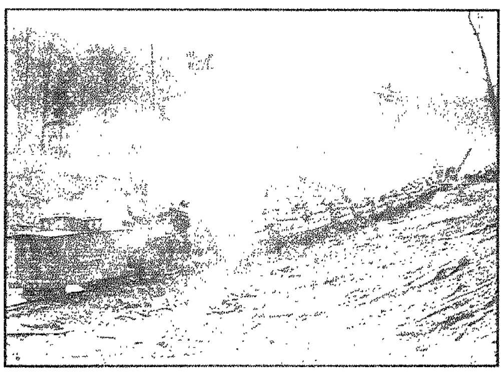


55. Other steam-powered equipment that added greatly to the ability to move large volumes of timber included steam tower skidders and log loaders like this American loader.

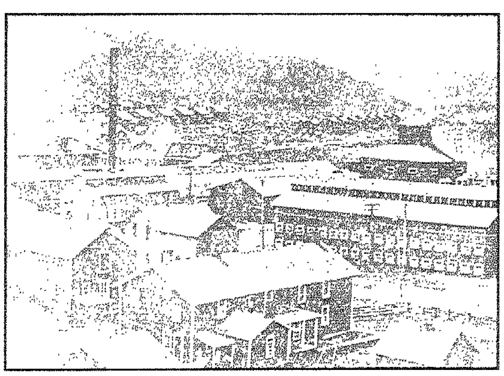
56. Before long, logging railroads had been built up nearly every valley to reach the timber on the high ground above,



57. and daily log trains delivered previously undreamed of quantities of logs to the mills on a year-round basis. It was not necessary to rely on access to streams; railroads could reach anywhere and they did.



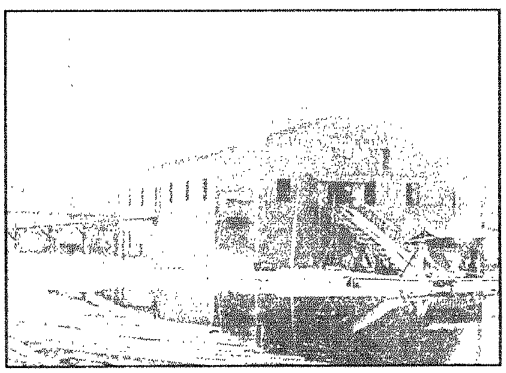
58. By 1890 the stage was set for a dramatic change in forest cutting operations. Logging railroads had solved the problem of transporting logs from rugged mountain areas.



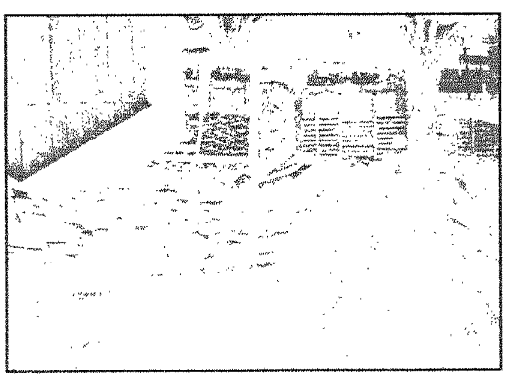
59. A major driving force behind the ensuing forest exploitation was the tanning industry, which by the early 1900's had become not only the major forest industry in northern Pennsylvania, but--as represented by the U.S. Leather Company--the largest single industry in the United States.

60. Tanneries used tremendous quantities of hemlock bark from which they extracted the tannin used to cure leather. These huge piles of hemlock bark were photographed at the Ludlow Tannery of the Curtis Leather Company.

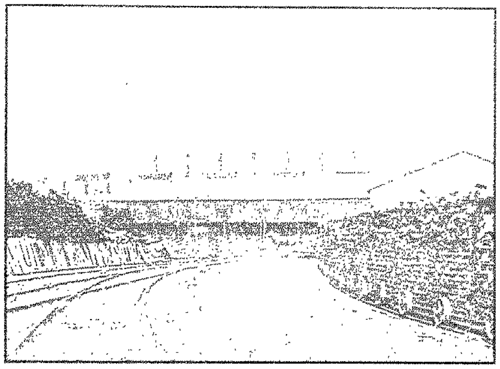
61. Contrary to popular opinion, hemlock logs were seldom left in the woods to rot after the bark had been removed. This belief apparently was perpetuated because the logs were often left for several months during the bark peeling season while all available labor was used to peel the bark. Those logs were usually retrieved later and cut for construction lumber.



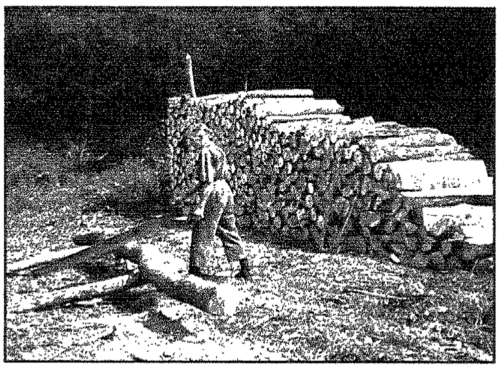
62. The ready and dependable supply of logs and markets and the development of the band saw led to a large sawmill industry, which was often associated with the tanning industry.



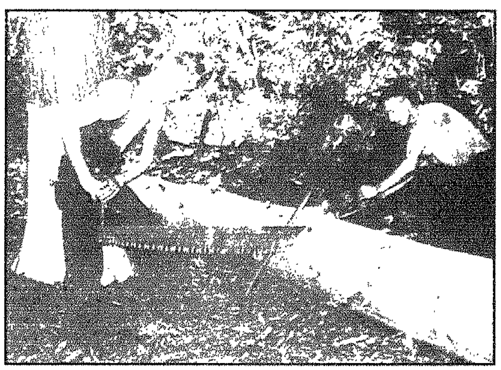
63. The combination of the two products, bark and sawlogs, made it possible to finance the expense of building railroads to reach the timber while providing good profits besides.



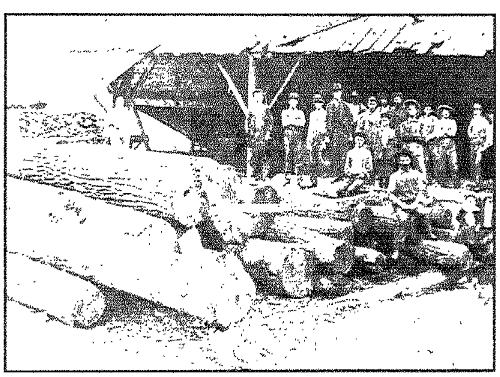
64. This same combination also led to a third major forest industry: wood chemical plants that produced charcoal, wood alcohol, acetic acid, acetate of lime, and similar products. Tanneries provided dependable markets for many of the chemicals produced, whereas the established logging railroads made transport economical enough to permit bulk recovery of these small wood products.



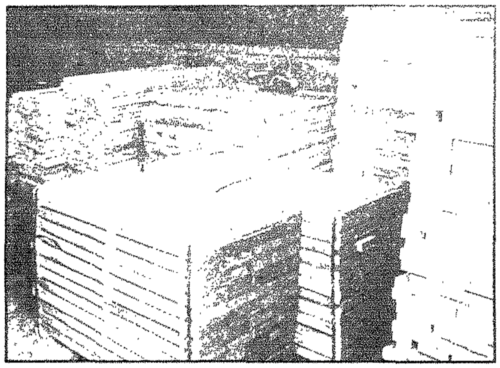
65. Chemical wood plants provided a market for virtually every size and species of tree growing on the Plateau.



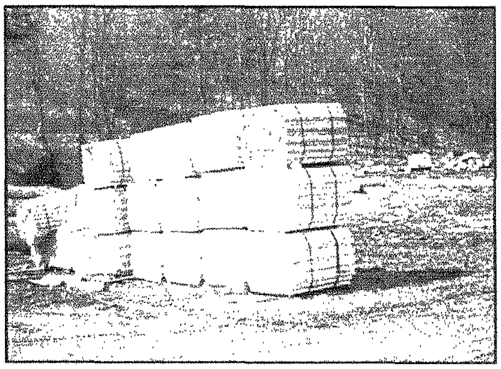
66. Nearly everything was useable. Bark was peeled from the hemlock to use for tanning leather, and the logs were cut for construction lumber.



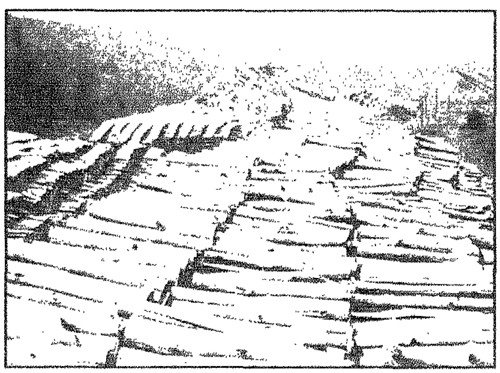
67. Hardwood logs were also used for construction lumber and for railroad ties, barrel staves, lath,



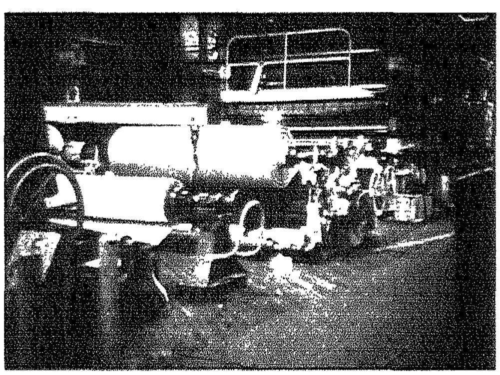
68. and high quality furniture, like this black cherry dimension stock,



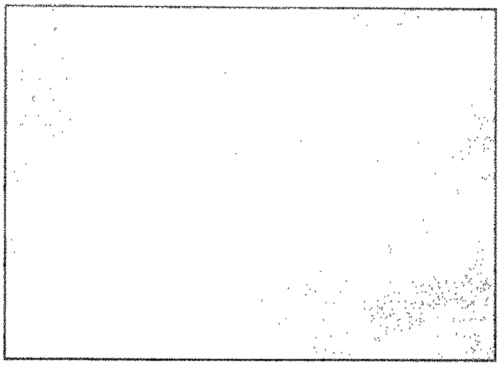
69. tool handles, baseball bats from these white ash rounds.



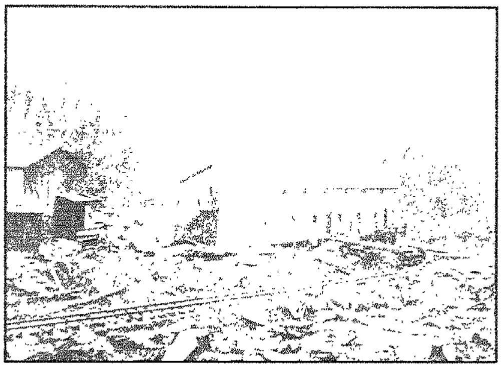
70. Boltwood was used for charcoal and wood chemicals



71. or for pulp and paper products.

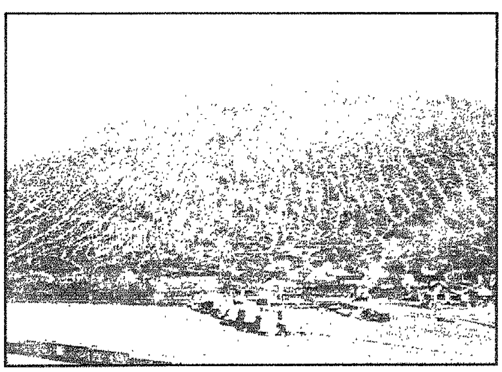


72. Scrap pieces were made into clothes pins or other small products, or were cut and bundled for kindling wood for use in the many stoves of that era.

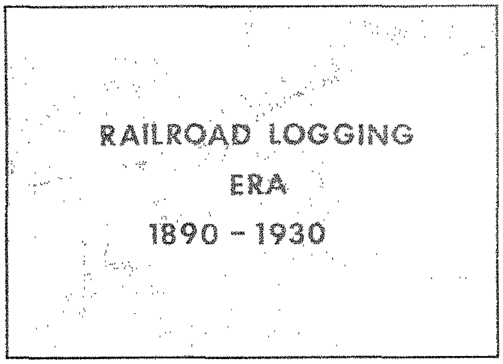


73. Logging camps sprang up everywhere to accommodate the multitude of loggers required to cut and skid the timber.

74. During this era, deer were hunted and sold on the open market to supply the camps with venison and hides. As a result of excessive deer harvests, the deer herd in Pennsylvania was nearly eliminated by the turn of the century.

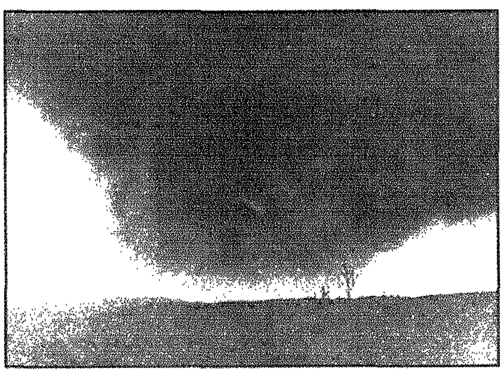


75. During the railroad era between 1890 and 1930, the virgin and partially cut forests of the Allegheny Plateau were almost completely removed.



76. The period of heavy cutting--the railroad logging era--began about 1890, reached a peak about 1910, and ended about 1930, at which time the forests of the Allegheny Plateau had been completely liquidated.

77. In a few areas, the heavy coniferous slash left after railroad logging



78. resulted in severe forest fires. When this occurred on poorly drained soils, especially in areas where deer browsing or frost damage was heavy,

79. orchard or open stands resulted that have persisted without much tree cover to the present time. Typically, these areas are located in the valley bottoms or occasionally on the poorly drained soils of the broad, flat plateau tops.

80. These areas are now dominated by such plants as aster, goldenrod, grass, and fern with only a few widely spaced trees of black cherry or red maple.

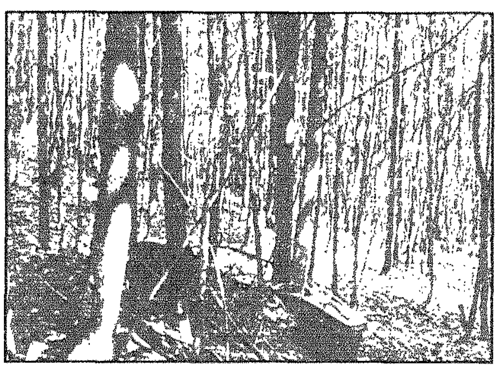
81. On most of the Allegheny Plateau on areas that were not burned severely, fine new second-growth stands containing valuable species such as black cherry, white ash, yellow-poplar, red maple, and sugar maple have developed.

82. This stand on Little Arnot Creek is typical. It had been partially cut in 1868 for hemlock. In 1927, the stand became part of the first commercial timber sale on the newly formed Allegheny National Forest.

83. All hemlock and hardwood sawlogs were removed during the winter of 1927-28

84. and the remaining trees were clearcut for chemical wood about a year later.

85. Ten years after clearcutting, a new forest of saplings was established.



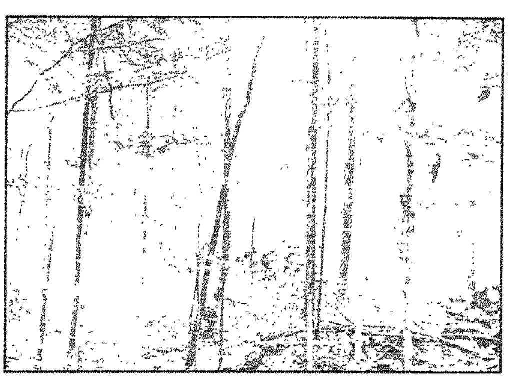
86. Twenty years after cutting, the stand had grown into the small pole stage.

87. By age 30, several dominant black cherry stems in the foreground provide a reference that can be used to watch the stand develop

88. through age 40

89. to age 50

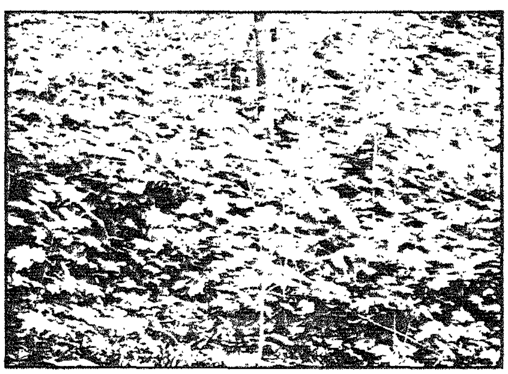
90. and up to age 60 in 1988. This stand exhibits all the characteristics of a typical Allegheny hardwood stand that resulted from the railroad era clearcuttings.



91. Within the general pattern of cutting described, great variation occurred from place to place. The number of partial cuts made in an individual stand during the 1850 to 1890 period ranged from none to several; the severity ranged from light to heavy. Each of these partial cuts was followed by a surge of advance reproduction that influenced the composition and character of the next stand after the railroad era clearcuttings removed the remainder of the overstory.

92. Although the chemical wood clearcuts were about as complete as a commercial clearcut can be, some residuals were left in most stands. The number, size, and distribution of the residuals had an important influence on the character of the next stand. Many stands never received a chemical wood clearcut, whereas others were clearcut several times. Some examples of the major stand types that originated from these different patterns of cutting follow.

93. The first example is a stand of mature and overmature northern hardwoods that had been cut over lightly about 1900 for hemlock logs. In 1935, it contained about 106 square feet of basal area per acre almost entirely in beech and sugar maple. The canopy had been opened appreciably by the hemlock cutting and by natural mortality of the old-growth trees, many of which were overmature.

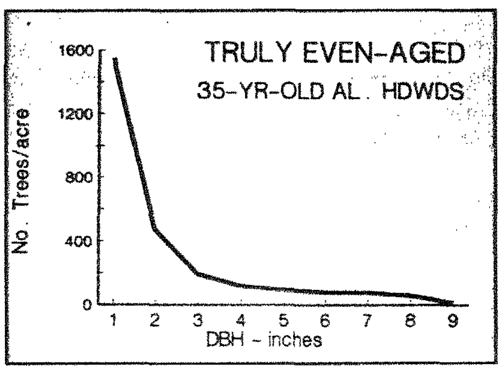


94. As a result, there was a dense understory of sugar maple and beech advance seedlings throughout the stand

95. and in areas where the hemlock cutting had been heavy, there were some pole-size trees of a new age class.

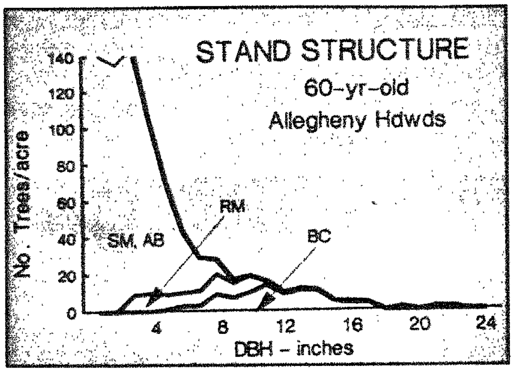
96. A cut to remove the balance of the sawtimber combined with a chemical wood clearcut, was completed in 1935. Tallies made after cutting revealed that about 180 stems per acre 1- to 8-inches in diameter were left standing after the chemical wood cut. The stems represented 10 square feet of basal area.

97. As part of an experiment, eight 1/4-acre plots were established in this stand to determine the influence of those small residual trees. All stems larger than 0.5-inch dbh were mowed down on two of these plots immediately after commercial logging was complete, thus creating a truly even-aged stand. However, 5,000 to 6,000 stems of sugar maple and beech advance reproduction less than 0.5-inch d.b.h. that were not mowed. There were no significant number of black cherry advance seedlings.

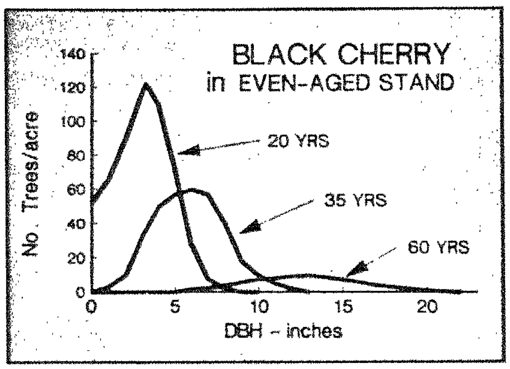


98. Data from the mowed plots 35 years after clearcutting illustrate the composition and structure of truly even-aged stands in the cherry-maple type. When the number of trees in this stand is plotted over diameter class, the diameter distribution for the stand forms an inverse J-shaped curve. This type of diameter distribution is traditionally associated with all-aged stands. Even-aged stands are assumed to follow a bell-shaped or normal curve. This apparent discrepancy in stand structure has led to many erroneous conclusions about the age arrangement and proper management of northern hardwood forests. Some have assumed that because a stand exhibits a typical all-age diameter distribution, it must be all-aged. But nothing is further from the truth, as illustrated by this truly even-aged stand.

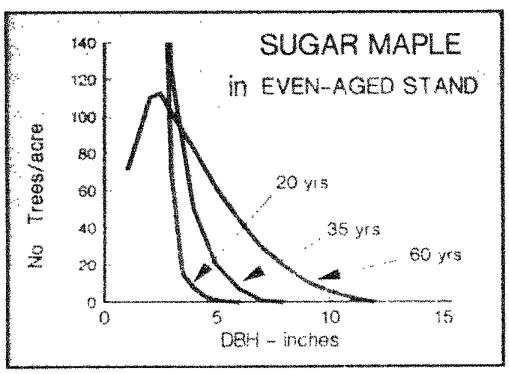
99. The inverse-J distribution occurs in even-aged stands because the tolerant species such as sugar maple and beech are capable of surviving for many years without growing much when they are crowded or overtopped. In dense young stands, a few individuals emerge into dominant crown positions and grow rapidly. The remaining tolerant stems are overtopped but survive leaving a large number of trees in the small diameter classes. This is the inverse-J curve.



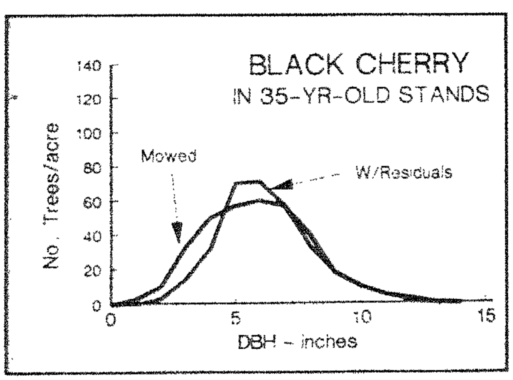
100. When such stands contain a mixture of species of widely different tolerances and growth rates, the diameter distribution and crown canopy is stratified by species groups. The intolerants grow better than other species and capture dominant crown positions and larger diameters. The intolerants that do not maintain dominance quickly die and are absent from the smaller size classes. But the tolerants survive in the lower crown layers and smaller sizes and create a highly stratified, even-aged mixture. Even-aged Allegheny hardwoods usually contain black cherry in the dominant position, sugar maple and beech in the suppressed position, and red maple in an intermediate strata between the two extremes.



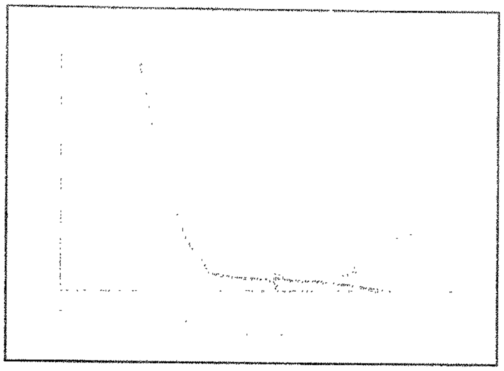
101. The diameter distribution of the intolerant cherry does form a bell-shaped curve even though that of the entire stand as a whole does not. The distribution for black cherry is a bell-shaped curve that moves to the right and becomes increasingly flatter as the stand matures. Note that the largest cherry in this stand are 13 inches d.b.h. at age 35.



102. By contrast, the distribution for sugar maple is a very steep inverse-J curve with the largest sugar maple much smaller than the largest black cherry at the same age. In this stand, the largest sugar maple were only 7 inches d.b.h. at age 35.



103. Leaving a small number of residual trees during the final chemical wood clearcut resulted in slightly larger diameter distributions from the unmowed plots. The general form of the diameter distribution for black cherry remains the same--bell-shaped with little difference between mowed and unmowed plots.



104. The maples in both plots have steep inverse-J curves, but the unmowed plots contain a few maples of larger diameters that cause the tail of the inverse-J curve to extend much farther than would be expected in a truly even-aged stand. The trees in this extended tail are the residual stems of a distinctly older age class. These residuals have a place in the main crown canopy, and the diameters are approximately the same as those of the larger black cherry. Although the slight difference in the diameter distribution of sugar maple in the two stands may appear inconsequential, the residual trees have had a major impact on stand development.

180 residual trees (10 sq. ft. of BA)
at time of cutting

represent

40 % of BA at age 35

105. The relatively small number of residuals left after chemical wood cutting (180 stems per acre representing 10 square feet of basal area) constitute about 47 square feet or 40 percent of the total stand basal area at age 35.

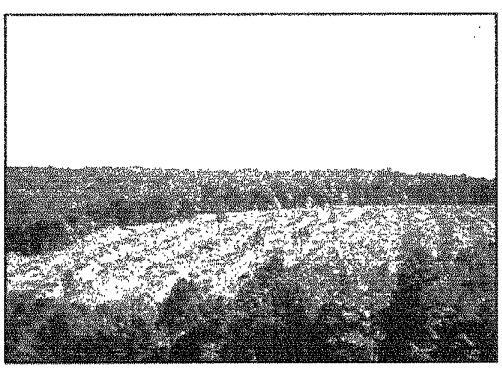
AT AGE 35

	Mowed	W/Residuals
% Cherry	65	35
Dia. (QSD)	2.8	4.4
Eff. Age	24	42
Tol. BA › 6"	0	35
Largest BC	13	15
Largest Maple	6	14

106. Leaving a few tolerant residual saplings and poles had these effects: A lower proportion of black cherry (35 versus 65 percent of the basal area) and correspondingly higher proportions of sugar maple and beech than that on the mowed plots; a larger quadratic stand diameter (4.4 versus 2.8 inches); faster stand development producing an effective age of 42 years versus 24 years; presence of tolerant species in the main crown canopy and merchantable size classes -- 35 square feet of sugar maple and beech versus none in the mowed plots. The largest sugar maple in the mowed stand was 6 inches, whereas in the unmowed plots they were as large as 14 inches. Even the cherry were slightly larger in the plots with residuals, suggesting that cherry grows faster when in mixture with maple than it does in pure stands.

107. Examination of numerous other stands that were clearcut for chemical wood and known to contain small residual trees has revealed the same pattern consistently Where sugar maple and beech are present in the main crown canopy in diameters comparable to the largest black cherry, the sugar maple and beech are invariably residual stems of an older age. They are in the main crown layer because they received a head start on the faster growing intolerants.

108. The second example is a stand that received two chemical wood cuts. The original stand on this site had been clearcut about 1895, resulting in a 42-year-old second-growth stand when this photo was taken in 1937. The second-growth contained a considerable number of black cherry stems that had originated after the first clearcut, along with the usual sugar maple and beech. There was little advance regeneration, such as found in the old-growth stands of that era. Because the stand was young, there were few sawlogs and the second clearcut in 1937 was for chemical wood only.

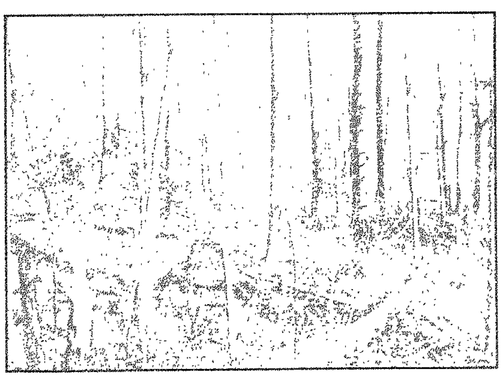


109. Strip-wise fashion was the usual practice when cutting for chemical wood only. This usualy was not feasible in a cutting where sawlogs were removed first (the usual practice) because of the slash and skid trails caused by the sawlog harvest. Two cutters were typically assigned to a strip about 60 feet wide. They felled the trees from the center of the strip and cut the center line very clean to facilitate skidding with horses. Slash was allowed to accumulate along the edges of the strip. Although trees as small as 2 or 3 inches d.b.h. were utilized for chemical wood, the cutters seldom bothered to cut such small stems when they were located in the windrows of slash along the strip edge.

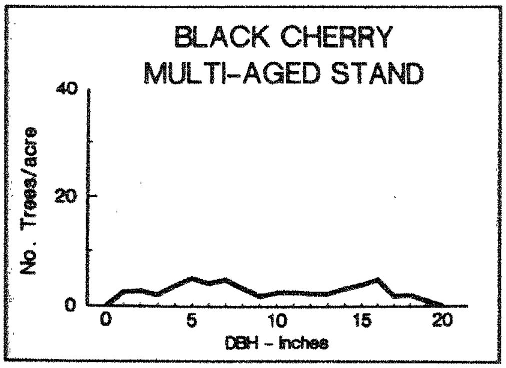
110. Evidence of this type of cutting is plainly visible today if you know what to look for. Such stands contain lines of shade-tolerant residuals in the main crown about 60 feet apart.

111. The shade tolerant species in areas between the lines have small diameters and suppressed crown positions. The large trees in the areas between the lines are fast-growing intolerants. Because stumps of young trees sprout vigorously, these third-growth stands that resulted from clearcutting of young second-growth typically have a very high percentage of sprout origin stems.

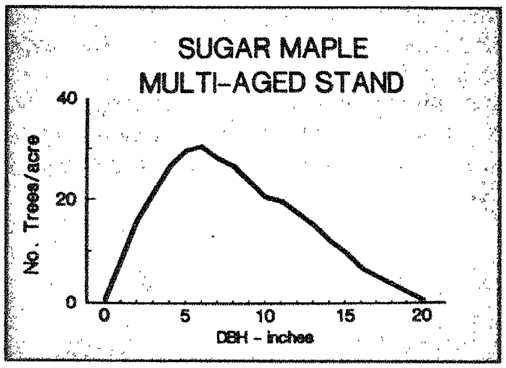
112. This aerial photograph shows clearly the strip-wise pattern of cutting and windrows of slash that were common in the chemical-wood-only cuts.



113. For our third and final example, here is a stand that never received a chemical wood clearcut. This stand was partially cut for hemlock sawlogs in 1888, and then cut again for the remaining hemlock and hardwood sawlogs in 1900. Because the stand was never cut for chemical wood it never received a complete clearcut, though the final sawlog cut was quite heavy. A surge of reproduction developed after each of the two partial cuts, and this reproduction, together with some residuals from the original stand, provides three distinct age classes in the present stand.



114. Because basal area was not reduced below about 40 square feet per acre, the proportion of shade-intolerant species tends to be low in these multi-age stands that were never clearcut. The black cherry diameter distribution in this stand is broad and irregular. This is typical of older stands with a low percentage of cherry. Several closely spaced age classes of cherry cause the curve to show several slight peaks.



115. The sugar maple distribution in multi-aged stands may depart dramatically from the inverse-J form. The intermingling of several age classes, and death of the very small maples in this older stand produce a nearly bell-shaped curve. So, shade tolerant species often exhibit diameter distributions exactly opposite of what you would expect. If the sugar maple exhibits a steep J-shaped curve, it is probably an even-aged stand. If it exhibits a bell-shaped curve, it is often a multi-aged stand.

MAJOR TYPES OF

ALLEGHENY HARDWOOD STANDS

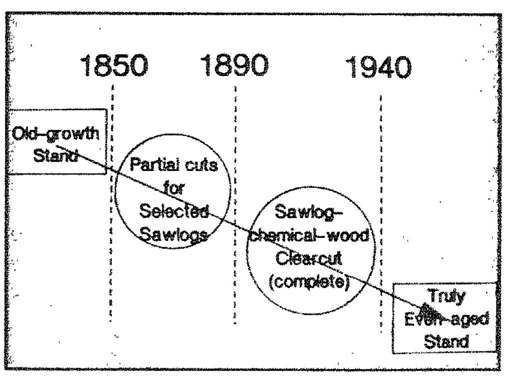
Truly Even-aged

Even-aged Third growth

Even-aged Second growth

Multi-aged

116. Most Allegheny hardwood stands can be grouped into four major types on the basis of past cutting history: truly even-aged stands, third-growth even-aged stands with residuals, second-growth even-aged stands with residuals, and multi-aged stands.



117. Truly even-aged stands are rare and limited to research plots and small portions of stands where the final cutting was usually complete. The previous hemlock-beech old-growth stands may or may not have had partial cuts during the 1850-1900 era. To be truly even-aged, the final cut must be complete leaving no residual stems larger than seedling size.

TRULY EVEN-AGED

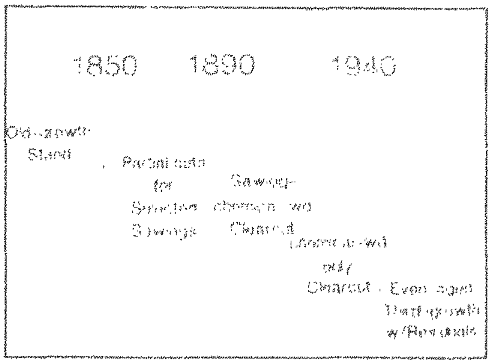
60 to 90 years old

High % Cherry

Highly stratified

No Residuals

118. The crown canopy of truly even-aged stands is highly stratified by species. Black cherry is usually abundant and occupies the dominant crown positions and larger diameters. There are few, if any, tolerant species in the upper canopy or larger diameters because there were no residuals.



119. Third-growth, even-aged stands resulted from two clearcuts over a short period of time. Usually, the first was a combined sawlog-chemical wood clearcut in the 1880-1920 era, followed by a second clearcut for chemical wood only in the 1920-40 era.

EVEN-AGED THIRD GROWTH

(with Residuals)

50 to 70 years old

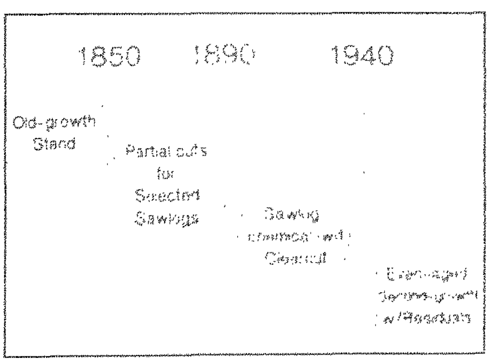
High % Cherry

Stratified Canopy

Residual Tolerants in Lines

High % Sprouts

120. These third-growth stands typically have a high percentage of cherry usually regenerated after the first clearcut, providing a source of cherry sprouts in addition to new seedlings following the second clearcut. Third-growth stands usually have a very high percentage of sprout-origin stems because young trees tend to sprout prolifically when cut. The canopy is stratified with tolerant residuals in the main canopy arranged in parallel lines as a result of the strip-wise pattern of cutting. These stands tend to be our youngest because this type of cutting occurred toward the end of the railroad logging era, after the old-growth stands were gone. Quality of third-growth often seems poor, because of the young age and the high proportion of sprouts.



121. Second-growth, even-aged stands are perhaps our most common type. They originated from the most typical pattern of cutting--one or two partial cuts in the 1850-1910 era, followed by a clearcut for sawlogs and chemical wood in the 1900-30 era.

EVEN-AGED SECOND-GROWTH
(with Residuals)

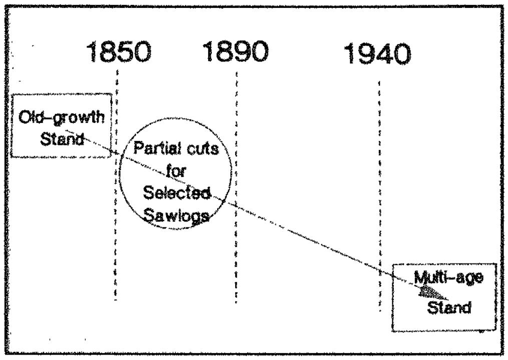
60 to 90 years old

Moderate % Cherry

Stratified Canopy

Residual at Random

122. Most of the original old-growth stands on these sites had one or more partial cuts before the final clearcut, and this encouraged in large amounts of tolerant advance regeneration. Much of this tolerant advance growth was too small to harvest at the time of the final clearcut, and some of these stems were left as residuals. So these second-growth, even-age stands often have a fair proportion of tolerant residuals in the main crown canopy, distributed at random through the stand. Most second-growth stands are slightly older than the third-growth discussed previously because final harvests of this type occurred earlier, while some old growth was in existence.



123. Multi-age stands never had a complete clearcut. The final partial cut usually was confined to sawlog trees. This partial cut may have been heavy and was often called a commercial clearcut. But considerable quantities of pole- and sapling-size trees were left as residuals. Often, this type of cutting occurred in areas where there was no chemical wood markets, or where the final cut occurred before the chemical wood plants were built.

MULTI-AGED

90 plus years old

Low % Cherry

Crown not Stratified

Residual Tolerants in all Sizes

124. Multi-age stands are our oldest stands because they originate from the cutting that occurred in the 1880-1910 era before chemical wood plants were widely distributed. Shade-tolerant species are usually well represented in the main crown canopy, so the distinct stratification evident in even-aged stands is absent. The tolerant residuals often dominate the stand, and it is common for some of them to exceed several hundred years of age. Cherry percentages are usually low, because of the incomplete cutting and high density of residuals.

These stands are often classified as northern hardwoods rather than Allegheny hardwoods. These type differences, of course, are simply the opposite ends of a continuum that forms the northern hardwood ecosystem. Many of the differences we observe in present day stands on the Allegheny Plateau are the result of differences in their past cutting history. This is true of such characteristics as species composition, age, amount of sprouting, and crown stratification.

PAST CUTTING HISTORY

DETERMINES PRESENT

FOREST CONDITIONS

125. Understanding how the present forests originated and developed, should enable you to determine proper forest management and provide insight into cutting techniques that will produce desired regeneration today.

Several lessons can be learned from our examination of past history. Although we tend to think of our present second-growth stands as even-aged stands resulting from complete clearcutting at the turn of the century, this is an oversimplification. The present stands are not completely even-aged. They were created by a sequence of cuts that resembled shelterwood or diameter-limit cuttings more than clearcutting. A close look at these stands reveals that their age arrangement is complex and that regeneration did not always originate in one fell swoop.

Cherry seedlings (and red maple) can start at the time of clearcutting and outgrow already established seedling-sapling advance reproduction of sugar maple and beech. Because present stands lack tolerant advance reproduction and may contain small cherry advance seedlings, it is no wonder that clearcutting today tends to create nearly pure cherry third-growth. Deer browsing, of course, may limit any kind of reproduction today.

If stands with a mixture of tolerants and intolerants are desired, it probably will be necessary to retain sapling- and pole-size stems of the tolerant species at the final harvest so that a new stand containing both species groups in the main canopy will result. In other words, creation of stands that can be managed by even-age techniques sometimes requires creating several age classes on purpose.

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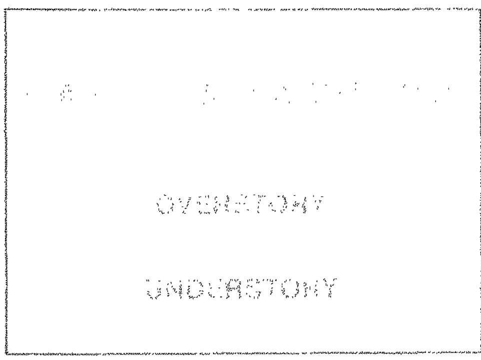
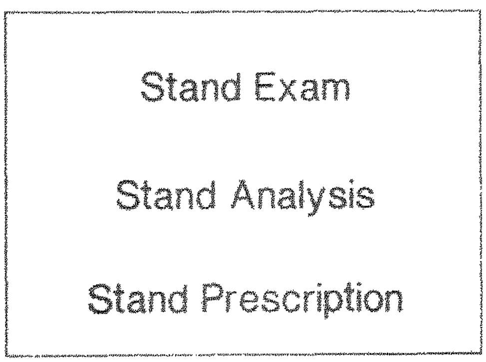
Stand Examination Procedures

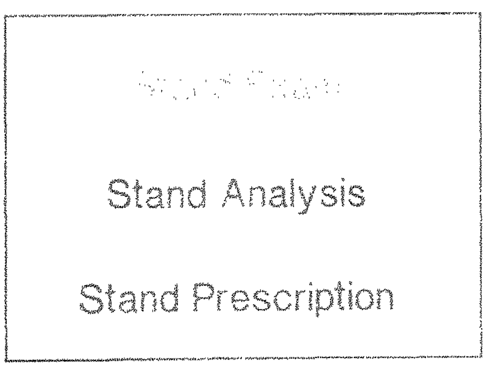
James C. Redding



1. The SILVAH (SILViculture of Allegheny Hardwoods) stand analysis and prescription procedure provides a systematic way to evaluate forest stands and make silvicultural decisions,



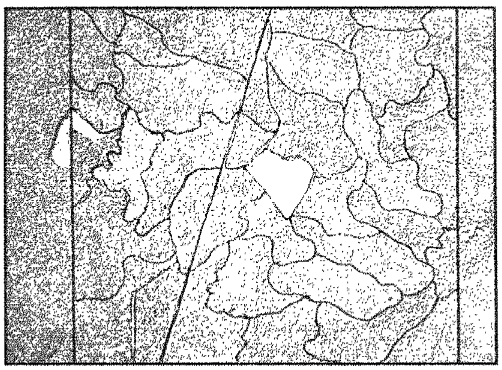
2. and consists of three steps: (a) stand examination, (b) stand analysis, and (c) stand prescription.



3. The stand examination or inventory described here provides the basic data needed to determine the stand's density, species composition, structure, stage of maturity, and potential for future growth or regeneration. Silvicultural treatments can be based on these measured facts rather than subjective judgments. Inventory data collected in this manner tells you not only how much you can cut, but also precisely where the cut is located.

DELINEATE STAND BOUNDARIES

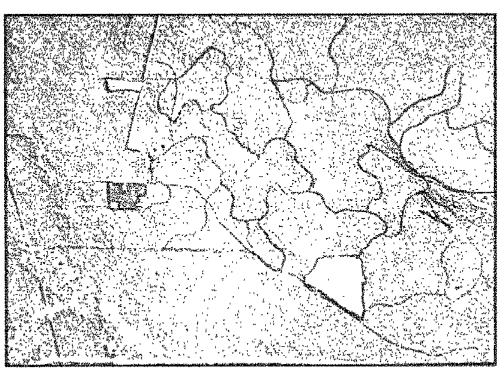
4. The first step in examining a stand is to determine the stand boundaries.



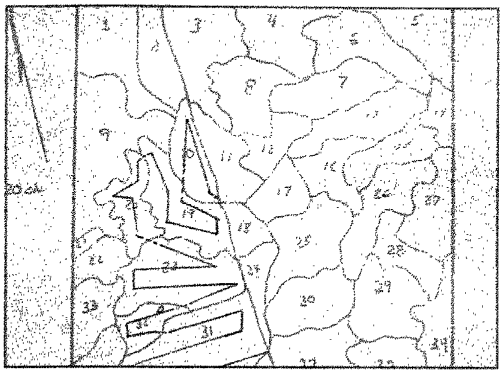
5. Stand units usually are identified from aerial photographs first and later checked and adjusted on the ground as needed.

Stand boundaries should be set to keep the stand as uniform as possible in composition, age, structure, and site quality. However, consideration also should be given to the ease of management. Boundaries that coincide with easily recognized features of the terrain such as roads or streams allow for more efficient field work and stands that can be reidentified readily.

6. Stand area is dictated largely by stand conditions--the amount of uniform conditions available in one block. Stand area should be large enough to provide a reasonably efficient field operation which varies with size of ownership. On large ownerships, stands less than 10 acres may prove inefficient, but stands as small as 3 to 5 acres may be practical on small properties. Areas of uniform stand condition usually do not cover more than 50 to 100 acres, and stands larger than this may be undesirable under even-age management since very large reproduction cuts are undesirable for visual reasons.



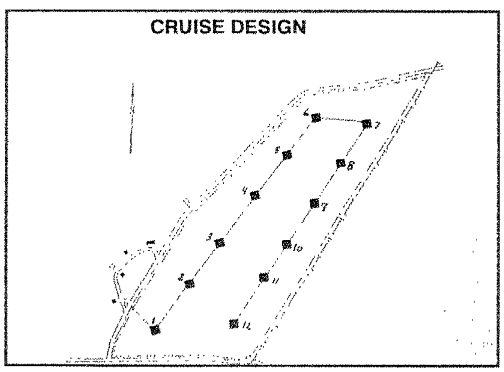
7. In areas of heavy deer browsing, avoid very small stands and long narrow ones such as those indicated by arrows.



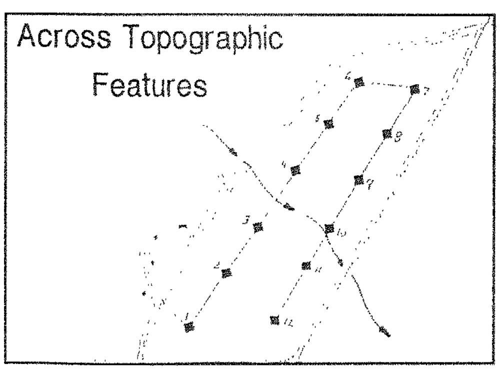
8. An acetate overlay on the aerial photo with each stand numbered provides a useful method of keeping track of stands, cruise lines, and plot locations as well as a place to record field notes on changes in stand condition.

ESTABLISH CRUISE LINES

9. The next step is to devise a sampling scheme that ensures the plots are well distributed throughout the stand and that plot locations are set without bias.

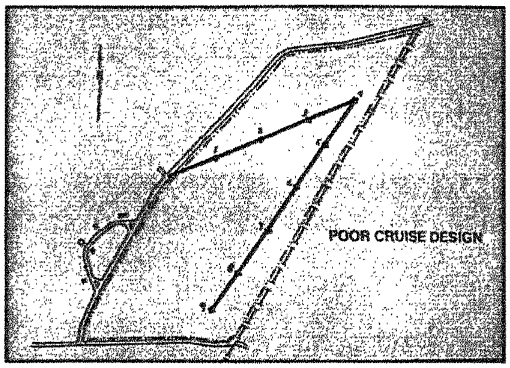


10. A systematic sample using predetermined cruise lines with sample plots at fixed intervals along the lines is usually easiest.

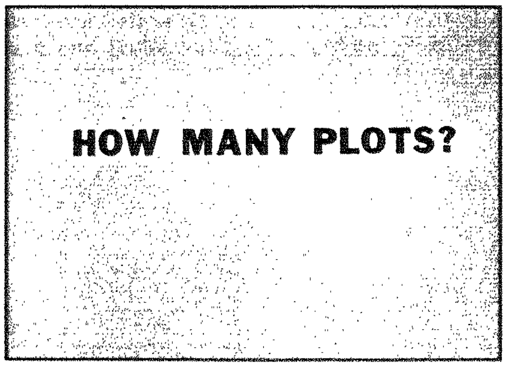


11. Cruise lines should be laid out across topographic features rather than parallel to them. A single cruise line through a stand seldom provides adequate coverage; two or more lines are usually required to ensure a representative sample. Cruise lines should be kept at least 75 feet from open boundaries like roads and powerlines, and overstory plots should be at least 100 feet apart to avoid overlap.

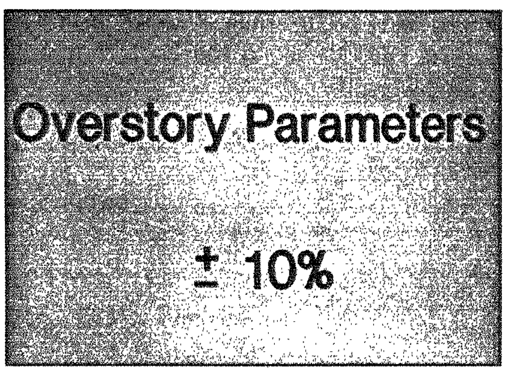
The number of cruise lines, the spacing between them, and the spacing between plots on a line must be set to obtain enough well-distributed sample points to provide accurate estimates for the stand. The number of plots required to keep standard error within any desired limits can be calculated if data on variances are available.



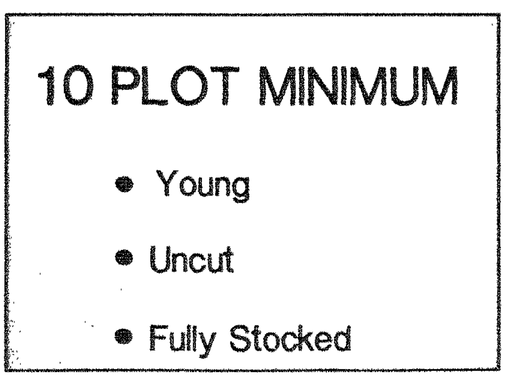
12. Avoid laying out cruise lines that miss significant portions of the stand. Even if the overstory is uniform, understory conditions can be quite variable.



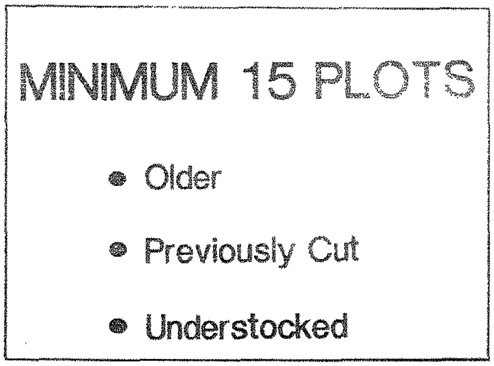
13. The number of plots needed to obtain an adequate sample depends on stand conditions.



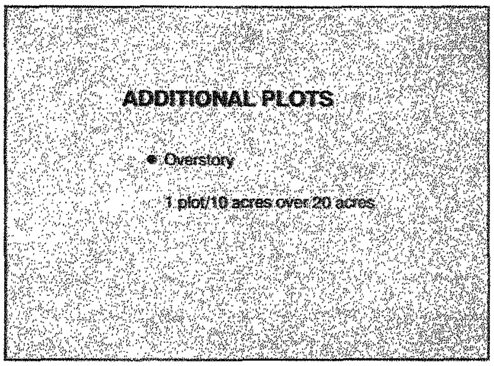
14. Critical overstory parameters (total basal area, species composition, stand diameter, relative density) usually can be estimated plus or minus 10 percent (at a 95% confidence level) with a sample of 10 to 25 plots, depending on variability in the stand and stand size.



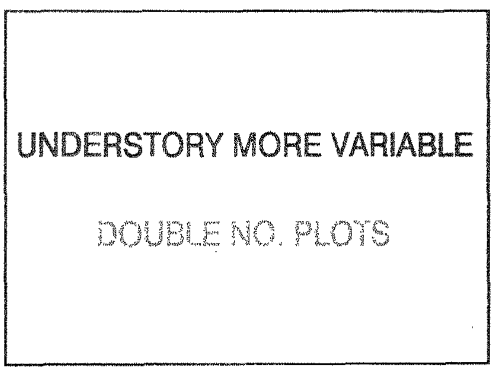
15. As a rule of thumb, we suggest a minimum of 10 overstory plots in stands that have relatively uniform conditions (such as young, previously uncut, and fully stocked stands).



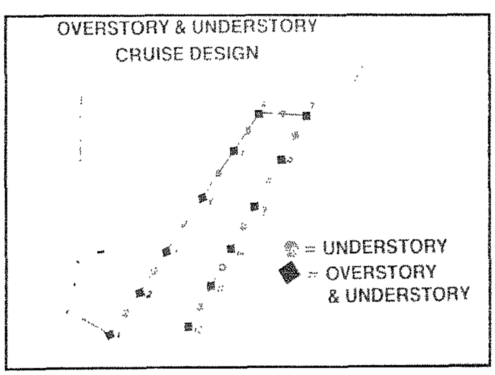
16. and a minimum of 15 overstory plots in stands that have less uniform conditions (such as previously cut, older, or understocked stands).



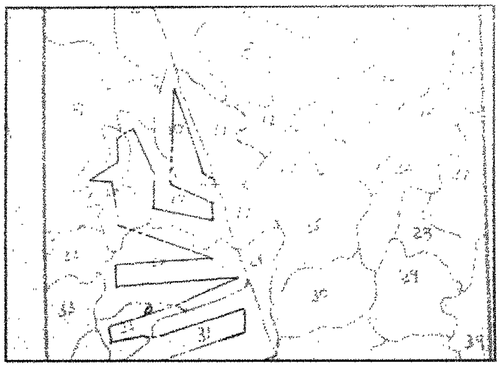
17. For stands greater than 20 acres in size, take an additional overstory plot for every 8 to 10 acres over 20 acres.



18. Because of the variability in numbers of desirable advance seedlings and amount of undesirable herbaceous cover, more regeneration plots than overstory plots are required for an adequate assessment. We recommend two regeneration plots for every overstory plot.



19. To obtain the desired number of understory plots, locate the cruise lines and overstory plot centers first. Each overstory plot center also will be an understory plot center. In addition, take an extra understory plot halfway between each of the combined overstory-understory plot locations.

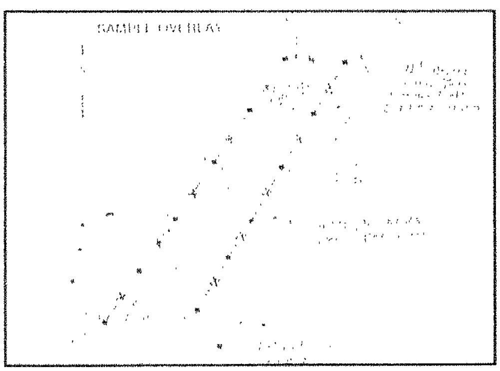


20. An hour spent in the office laying out cruise lines on a map or aerial photograph of the property will often save time and many miles of unproductive walking.

Attempt to select a stand or group of stands that can be examined in a day and lay out the cruise lines so that the end point of one stand corresponds as closely as possible to the beginning point of the next stand. Also, if possible lay out the entire day's work in a circular route so that you finish the day near the starting point and your vehicle.

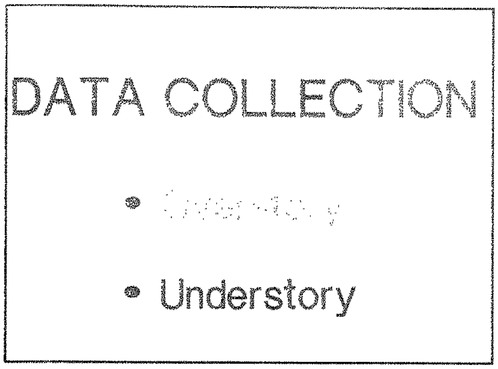
Do not assume that the top of the aerial photo is north when determining the bearings of your cruise lines. Some photos are as much as 15° to 18° off. Use a U. S. Geological Survey sheet or a known straight feature on the ground to orient your photo.

In laying out cruise lines, look for checkpoints such as road intersections, well openings, and other features that can be used to verify your location. Try to begin each cruise line from such a checkpoint that is easily identifiable both on the ground and on the photo or map. Avoid extremely long cruise lines that cannot be tied into checkpoints of some type every 15 to 20 chains (1,000 to 1,500 feet). You may wander far off course if you do not plan your cruise and check yourself carefully.



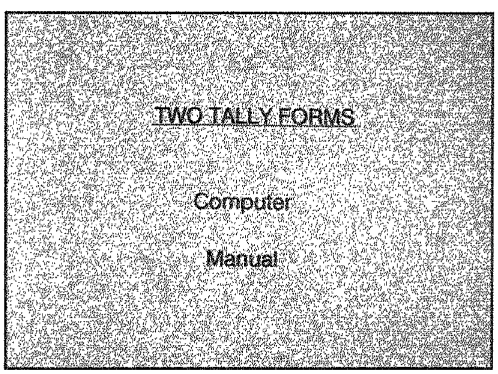
21. Use the acetate overlay you made as a working field map. Record bearings of cruise lines, intervals between plots, and connecting lines between stands on the overlay. These overlays are also a useful place to record changes in understory conditions, such as wet areas, or in overstory conditions that may lead to breaking the stand into two stands or changing the typed stand boundaries. Good field notes on the overlay make data summarization easier.

22. After the cruise lines and plots have been drawn on a map or photo of the stand, the field work can begin. A hand compass and pacing are all that are needed to locate the actual on-the-ground plots. Be sure to take the plot wherever it falls--do not move plot locations to avoid thick patches of beech brush, slash piles, or other unpleasant conditions as this will bias the data. Do not move it into areas of good timber either.

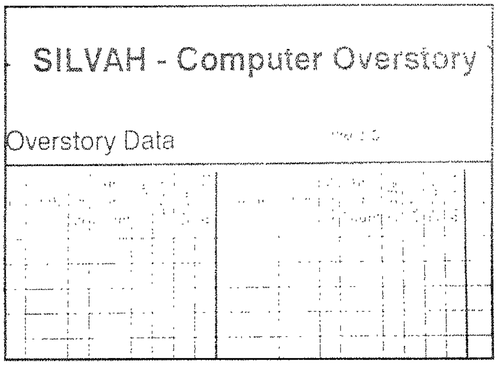


23. Data on overstory and understory conditions plus information on site limitations are collected and recorded during the course of the stand inventory. First we discuss overstory data collection.

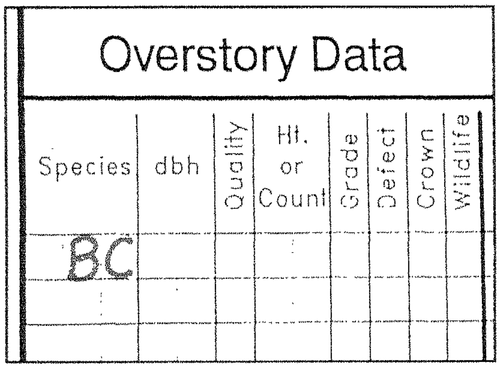
24. The recommended sampling procedure for the overstory is a variable radius plot using a ten-factor prism to obtain a basal area tally of all trees 1.0-inch d.b.h. or larger. Trees intercepted by the prism are recorded by species, diameter, and quality. If accurate sawlog volume estimates are desired and if data are being summarized by computer, you may also record merchantable sawlog height, grade, and defect for sawtimber-size trees. Other prism factors, or fixed-area plots, also may be used if desired.



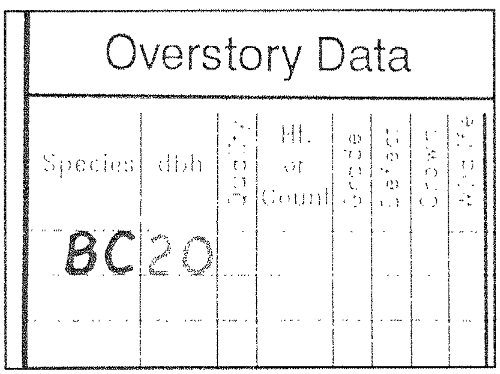
25. We have designed two overstory tally forms for entering all overstory data collected during stand inventory (Appendix 2 and 3).



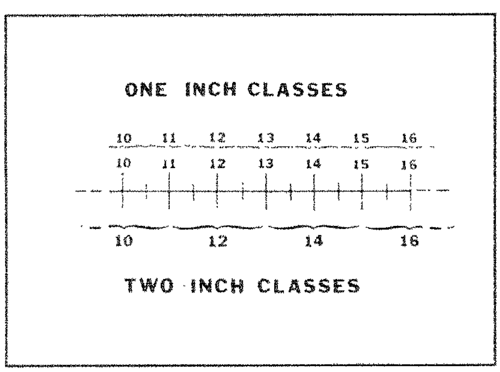
26. The Computer Overstory Tally form (Appendix 2) is used when the data analysis will be performed by computer. Each tree sampled in the overstory is recorded on a separate line.



27. For example, suppose we intercepted a 20-inch black cherry with the prism. From the mnemonic species code list (Appendix 1), we find the species code for black cherry (BC) and record it on the tally form in the first column. The SILVAH program recognizes three different types of species code (Appendix 1): forest survey, mnemonic, or user defined.



28. Diameter breast high (d.b.h) should be estimated and recorded to the nearest 1- or 2-inch class. Estimating d.b.h requires practice--inexperienced workers often find it necessary to measure diameters for a day or two. Thereafter, occasional checks should suffice except for large trees, which are difficult to estimate accurately. In this example, we record the tree as 20 inches d.b.h.



29. Caution--breaking points for trees recorded by 1-inch size classes fall on the half inch, and breaking points for trees recorded by 2-inch size classes fall on the whole inch. For example, when using 2-inch diameter classes, the 14-inch class extends from 13.01 to 15.00; and for 1-inch classes, it extends from 13.51 to 14.50. Be consistent when recording trees, and use either 1-inch classes or 2-inch classes but not both.

QUALITY CLASSES

Code	Class
1	AGS
2	UGS
3	Dead

30. Three quality classes are recognized and are recorded as coded values.

AGS (Code 1)

- Sawlog Now
- Sawlog Potential
- Acceptable Species
- Will Survive 15 Years

31. Acceptable growing stock trees (AGS, code 1) are trees that either now contain sawlog material or have the potential in the future to contain sawlog material anywhere in the tree, are of an acceptable commercial species and will survive until your next entry. Do not discriminate because of size; assume that every tree will grow to sawtimber size and judge quality on that basis.

UGS (Code 2)

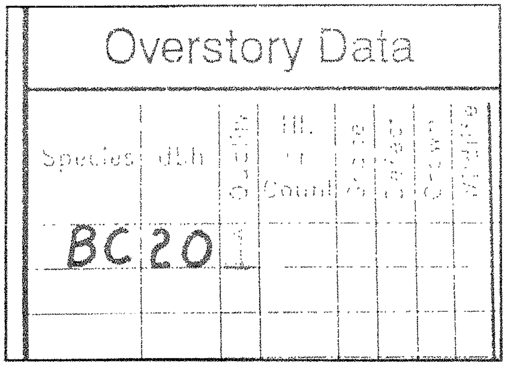
- Will Never Contain Sawlog
- Will Not Survive 15 Years
- Unacceptable Species

32. Unacceptable growing stock trees (UGS, code 2) are trees that do not presently contain sawlog material or do not have the potential for sawlog material, are of an unacceptable species or in your judgment will not survive until your next entry. All noncommercial species are considered unacceptable growing stock.

DEAD (Code 3)

- Salvage sales
- Optional (wildlife)

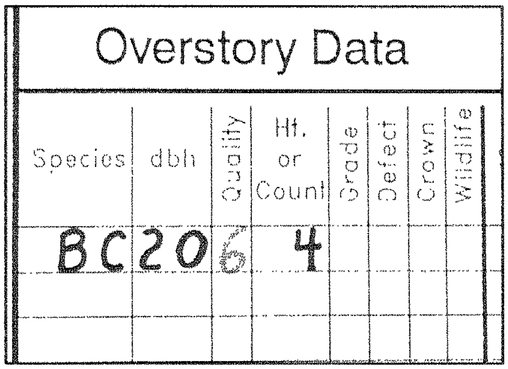
33. The third quality code is for recording dead trees (code 3). This coding is designed to give volume estimates from dead trees if a salvage cut is prescribed. Tallying dead trees is optional. This quality class also can be used to tally non-salvageable material that has benefit for wildlife.



Overstory Data

Species	dbh	Quality	Ht. or Count	Grade	Defect	Crown	Wildlife
BC	20	1					

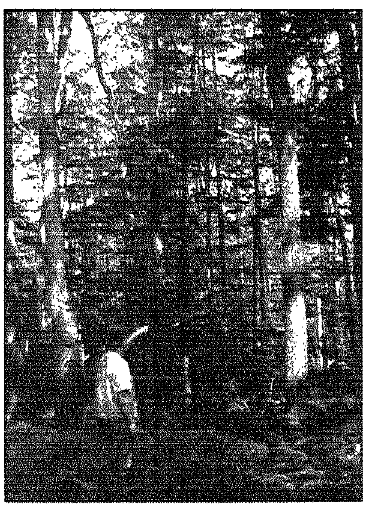
34. In our example, the tree is acceptable growing stock or quality Code 1.



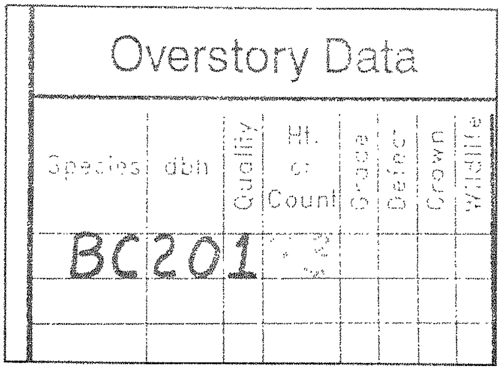
Overstory Data

Species	dbh	Quality	Ht. or Count	Grade	Defect	Crown	Wildlife
BC	20	6	4				

35. If accurate sawlog volumes are to be calculated from the inventory data, merchantable sawlog heights (in numbers of 8-foot bolts) should also be recorded for each tree that contains a sawlog. These merchantable heights will be used in sawlog volume calculations. If no heights are recorded for sawlog trees, SILVAH will estimate merchantable heights from equations of average heights encountered in stands in northwestern Pennsylvania. In the example, there are four 8-foot bolts or 32 feet of clear bole.



36. Estimates of merchantable sawlog height should be to a point where diameter drops below the minimum inside bark diameter for sawtimber or the height at which the bole breaks up. We recommend a minimum diameter inside bark (d.i.b) of 10.5 inches for hardwoods.



37. If heights are not recorded on the form, the height column may be used to record tree count. The number of trees with the same species, diameter, quality, and other attributes is entered into the column--the example shows three. You must record the proper code in the overstory cruise type field as described later.

1 - Grade 1
2 - Grade 2   7 - Fuelwood
3 - Grade 3
4 - Construction   9 - Veneer
5 - Local

38. SILVAH gives you several options for recording tree grade depending on the accuracy you desire and the time and money you are willing to spend on an inventory. These options are coded values entered on the header sheet and are clearly defined in Appendix A of the User's Guide to SILVAH. If you choose not to grade trees, SILVAH will estimate grade based upon equations of average grade recovery by species and d.b.h., including a percentage for culls and sawtimber-size trees containing only pulpwood. If either all trees or no trees are graded (with prism cruise), the appropriate cruise type (in the stand ID data block) is 1. If you use a fixed area cruise, the code is 4.

One option that adds very little time to an inventory but increases accuracy is to code in the grade column only those trees that are culls or sawtimber size trees containing only pulpwood volume. If you choose this option, use a cruise type 7 for prism cruise or 8 for fixed area cruise in the stand ID data block.

GRADE

CRUISE TYPE

Prism	Fixed	
1	4	Grade All or None
7	8	Grade Only Codes 6 and 8

39. It is very important to enter the proper code for cruise type on the header sheet to allow SILVAH to properly analyze your cruise data.

Overstory Data

Species	dbh	Quality	Ht. or Count	Grade	Defect	Crown	Wildlife
BC	20	1	4				
SM	14	2		6			

40. For example, if you intercept a 14-inch sugar maple that contains only pulpwood material and code the grade as 6, the program will assign only pulpwood volume to this tree.

Overstory Data

Species	dbh	Quality	Ht. or Count	Grade	Defect	Crown	Wildlife
BC	20	1	4				
RM	16	2		8			

41. Likewise, if you intercept a 16-inch cull red maple, you would code it 8 in the grade column. The program will not include this tree in volume estimates.

Crown condition if oaks is the single most important factor in predicting mortality due to gypsy moth defoliation-induced stress. Three classes are recognized. Crowns in good condition (code 1) have less than 25 percent dead branches, little or no epicormics, and healthy foliage. Crowns in poor condition (code 3) have one or more of the following conditions: 50 percent or more of the branches are dead; foliage density size and coloration are abnormal; or epicormic sprouting is heavy. Trees whose crowns fall between these extremes are rates as fair (code 3).

DEFECT

Code 0 - 9

0 = 0%

2 = 20%

4 = 40%

ETC

42. If accurate timber values and net volumes are to be calculated from the inventory data, percent defect also may be recorded. Enter a value from 0 to 9 representing the percentage (to the nearest 10 percent) of the merchantable tree volume that is unmerchantable due to decay, sweep, crook, or other defect. Thus, a 1 equals 10 percent, 9 equals 90 percent and so on. If you choose not to collect and record defect, deductions will be made based on averages of defect by species and diameter from a sample of trees in northwestern Pennsylvania.

WILDLIFE

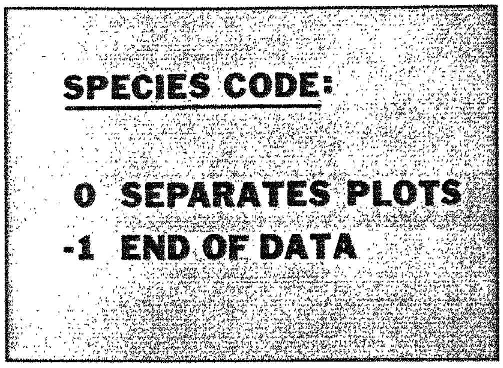
1 Den - Potential

2 Den - Existing

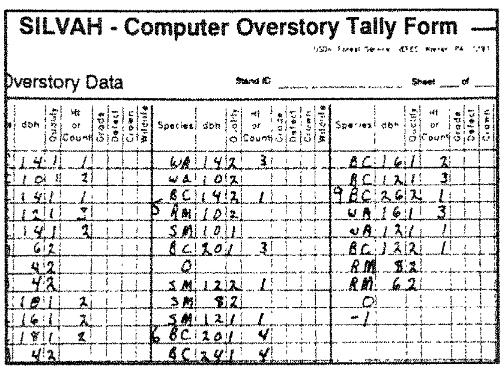
3 Snag - Potential

4 Snag - Existing

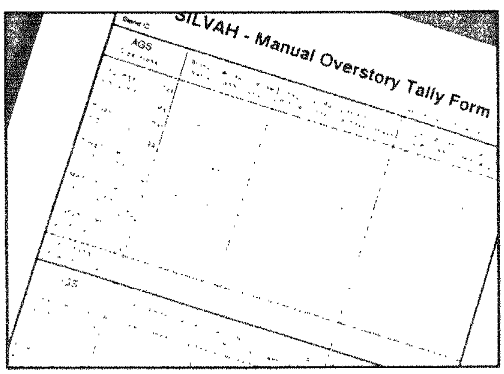
43. If information is desired on wildlife habitat, overstory trees with value as den trees or snags may be recorded. Care should be taken to mark dead trees using a code 3 in the quality column. Both potential and actual den trees and snags are recorded using the codes shown here.



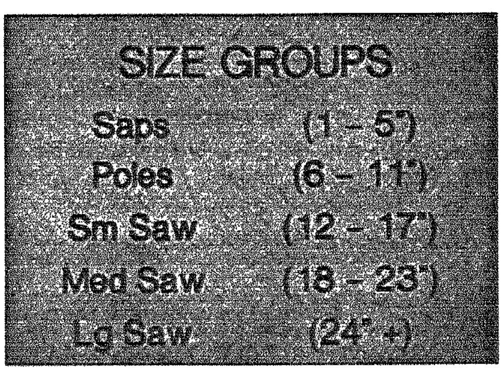
44. A zero entered in the species column of the tally form separates one plot from the next; a -1 in the species column after the zero indicates the last plot in the stand.



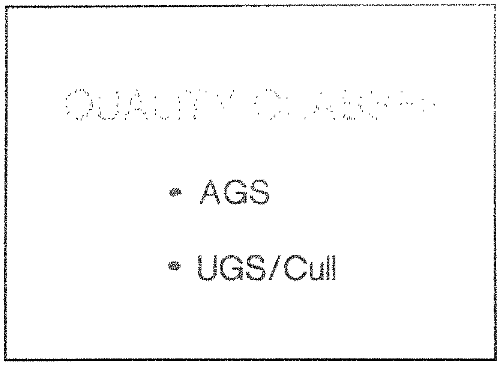
45. The completed overstory tally form should look like this. By maintaining each plot separately in this way, it is possible to calculate plot to plot variances and estimate sampling accuracy.



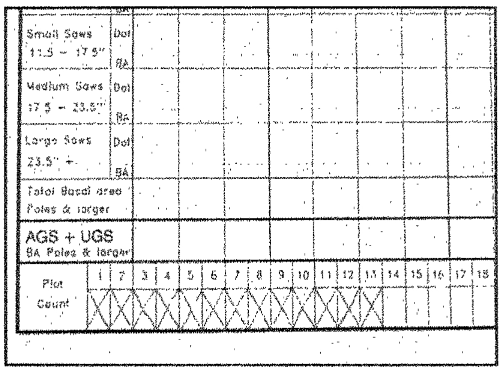
46. If you intend to calculate the stand summary and prescription by hand, the alternate manual tally form may be used (Appendix 3). Instead of recording each tree, a dot tally of the entire stand is made. Trees intercepted by the prism are dot tallied by species, size class, and quality class.



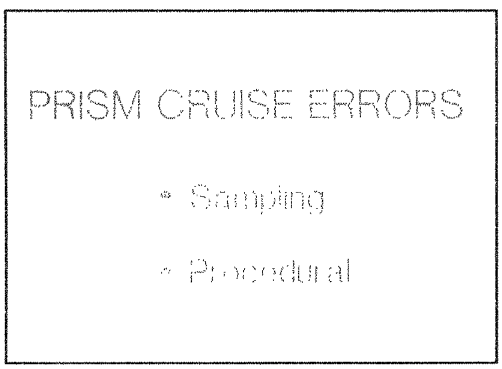
47. Five size classes are recognized on the manual tally form. When using this form, we recommend using size class breaking points that correspond to 1-inch diameter classes. Thus, saplings are 1.0 inch to 5.5 inches d.b.h. (1- through 5-inch classes). Poles are 5.6 to 11.5 inches d.b.h. (6- through 11-inch classes). Small sawtimber is 11.6 to 17.5 inches d.b.h. (12- through 17-inch classes). Medium sawtimber is 17.6 to 23.5 inches d.b.h. (18- through 23-inch classes). Large sawtimber is 23.5 inches d.b.h. and larger (24-inch class and larger). When these size classes are entered into the computer, use the following diameter midpoints: 3", 8", 14", 20", 26", respectively.



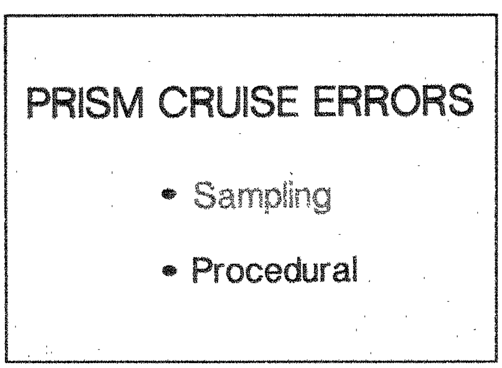
48. Two quality classes are recognized on the manual tally sheet: acceptable growing-stock (AGS) trees are unacceptable growing-stock trees (UGS). Dead trees are not tallied but could be tallied on a separate sheet if merchantable volume of dead material is wanted as described before.



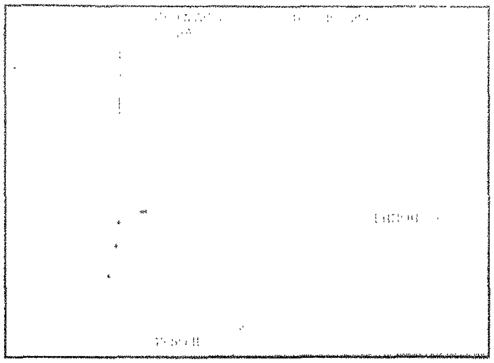
49. No provision is made for separating plots on the manual tally form--data from all plots are combined in the dot tally. But the number of plots sampled must be recorded. Make an "X" (or record total number of trees intercepted by the prism) in the boxes provided for this purpose. If numbers of trees per plot are recorded rather than an "X", sampling error for total basal area can be calculated.



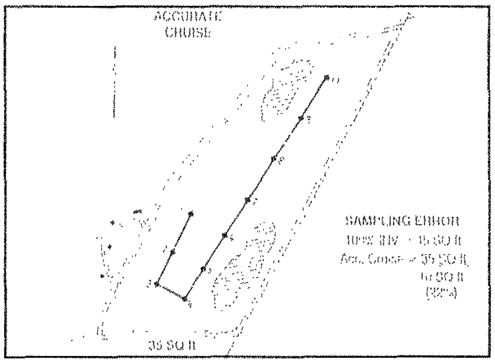
50. That completes the review of the tally forms; next we discuss inventory procedures. As with any prism cruise, two sources of error should be avoided: sampling and procedural.



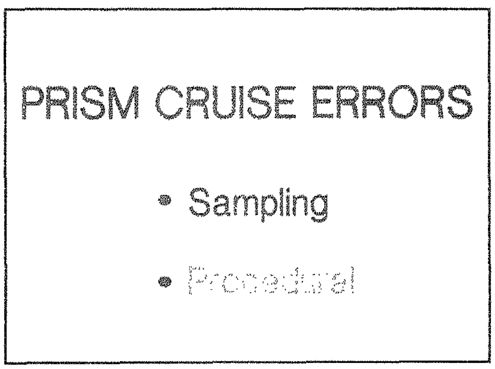
51. First we look at sampling errors that are caused by variability within a stand. Some portions of a stand may differ from other portions in species composition, density, tree size, and so on. To get an accurate stand average, plots must be located so as to sample the various conditions. Sampling error can be kept to acceptable limits by sampling enough evenly distributed plots to adequately cover the entire stand.



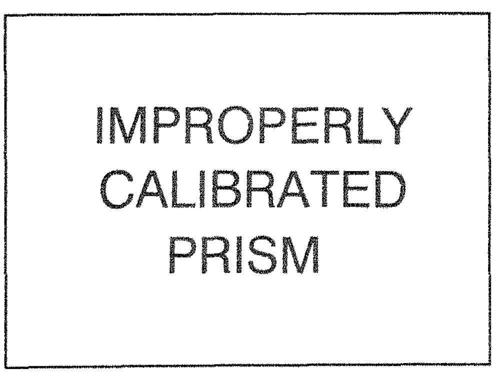
52. By analyzing the cruise of a stand used in a field exercise, I will illustrate what a poorly laid out cruise can do to sampling error. It is a 32-acre stand on which we have a 100 percent inventory of all trees 1.0 inch and larger, so we know exactly what is there. For red maple, we know there are 45 square feet of basal area per acre.



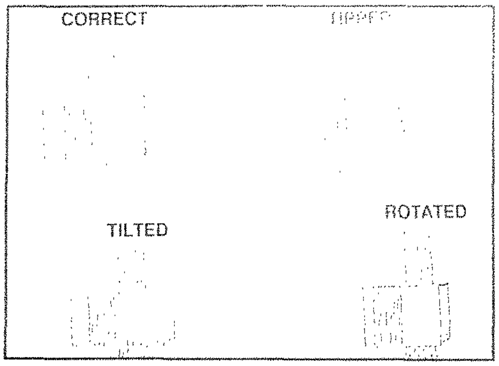
53. For an exercise, we laid out 10 variable radius prism plots that were not evenly distributed throughout the stand. These plots were carefully measured to eliminate any error in procedure producing what we call an "accurate cruise." As you can see, the poorly distributed plots missed the areas with a higher basal area of red maple (the shaded areas) resulting in a 22 percent error due to an inadequate sample. We can minimize, but not eliminate, sampling error by sampling enough well-distributed plots to thoroughly cover the stand.



54. The second type of error found in prism cruising is error in procedure. With care, this source of error can be eliminated.

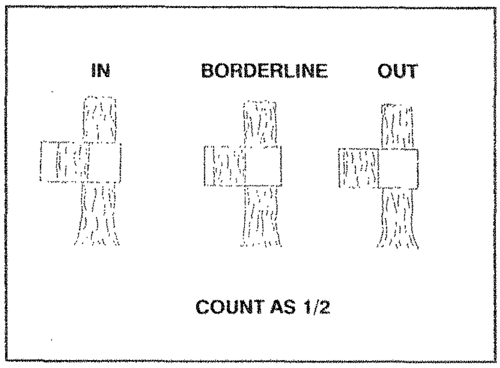


55. Inaccurate prisms are one source of procedural error. Many nominal 10-factor prisms, especially less expensive ones, are not actually 10 factor. Some are off by more than a whole factor, so check yours for accuracy and do not use one that has not been calibrated. You can check a 10-factor prism quickly by sighting on a target that is exactly 12 inches wide--the target should look like a borderline tree at exactly 33 feet.

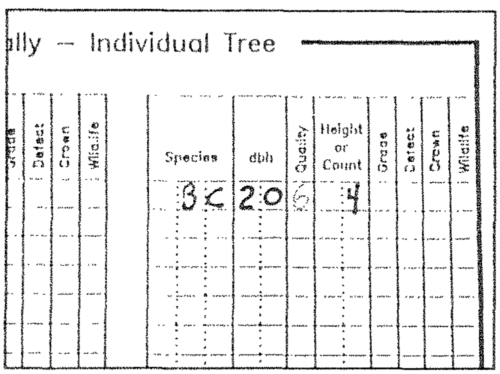


56. Another error is sloppy procedure. The prism and not the observer must be kept over the center of the plot. It usually helps to rest the prism on a plot center pole and rotate around it. The prism must also be held level and vertical (except where tilted purposely to compensate for slope or leaning trees). If the prism is tilted side to side or front to back on level ground, horizontal deflection is altered and a cumulative error is introduced.

Overfamiliarity also can cause problems. Experienced foresters sometimes go through the motions of making a prism count without ever actually looking through the prism. Avoid subconsciously deciding whether the tree is in or out until you have checked it with the prism



57. Borderline trees present another problem. Improper classification of borderline trees (trees that you can not positively identify as in or out through the prism) has been a source of error in past tallies. If pressures to get the job done preclude checking borderline trees, we recommend counting each one as a 1/2 tree as opposed to counting every other one. Total basal area will be no different, but composition and distribution will be. For example, counting the first borderline tree, which may be a pole sugar maple, while ignoring the second, which may be a black cherry small saw, would affect both composition and distribution.



58. Half-trees may be recorded on the computer tally form by adding a 5 to the quality class. Thus, an acceptable growing stock borderline tree is tallied as 6 (1 + 5) in the quality column. The computer summarization program will interpret this as a half-tree. If you are recording data on the manual form, use an "X" rather than a dot, or keep them separate.

FOR BAF 10:

DISTANCE (FT) = 2.75 • DIA (IN)

59. The most accurate procedure is to measure the distance to the tree centerline and its d.b.h. If the distance in feet is more than 2.75 times the diameter in inches, the tree is out of range for a 10-factor prism. Otherwise it is in. A 75-foot, automatic return tape that can be clipped to the belt will facilitate such checks.

1 - Small Trees (count)

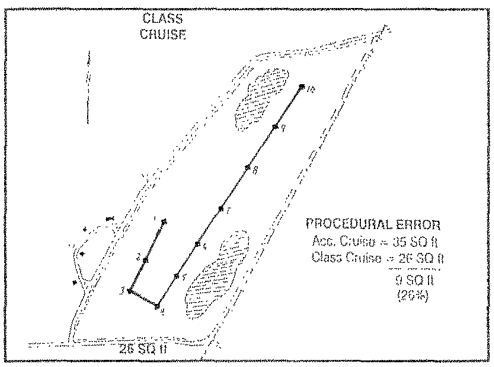
2 - Noncommercial (count)

3 - Dead (don't count)

60. Small trees present another problem. In tallying the basal area, one precaution is especially important: do not overlook the small trees. The overstory density guide is based on all trees 1.0 inch d.b.h. or larger. Decisions on appropriate thinning procedures and evaluations of selection cutting require knowledge of the proportion of the stand in this size class. If the small trees are overlooked or deliberately ignored, the guides will give you the wrong answer.

Including these small trees does not add appreciably to the time required for the overstory tally, because relatively few of these trees are picked up in the 10-factor prism cruise in older stands. At the other sampling extreme, many of the small trees and even some larger trees will be dead when stands are very dense; be sure not to include these in the tally unless they are coded as dead trees. Dead trees should not be counted unless you plan to salvage merchantable volume from these stems or want to record them for wildlife purposes.

Be sure to include all live noncommercial species in your tally as they are taking up growing space and are part of the growing stock.



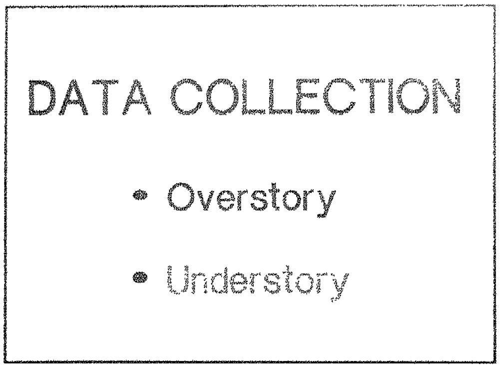
61. With data from the field exercise we also were able to demonstrate procedural error. On those 10 plots for which we had an "accurate" prism cruise, we had students from previous training sessions take those plots using the exact same plot center. The results of 10 years of data from student inventories show that their average estimate of red maple basal area was 26 percent too low due to improper procedure in using the prism.

Sampling Errors = 10 SQ ft (22%)

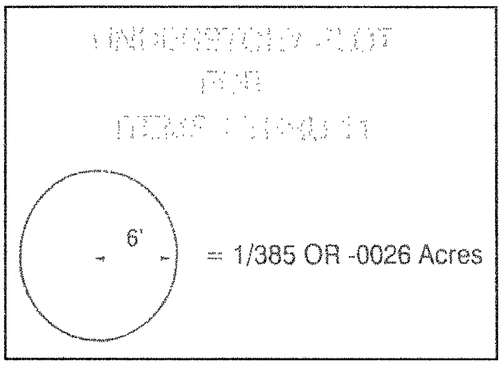
Procedural Errors = 9 SQ ft (26%)

Total Error = 19 SQ ft (42%)

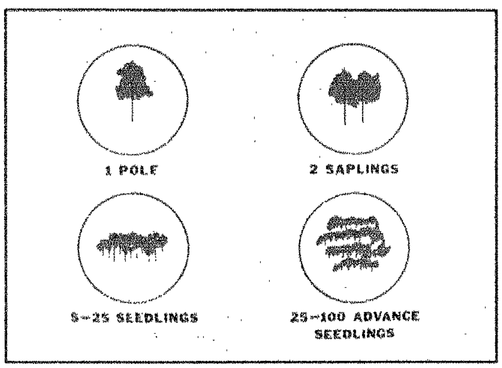
62. Combining the sampling error caused by poor cruise design with improper procedure in using the prism gives us a total cruise error of 42 percent. If you are going to invest time and money to conduct an inventory, it is imperative that you control these important but often overlooked sources of error.



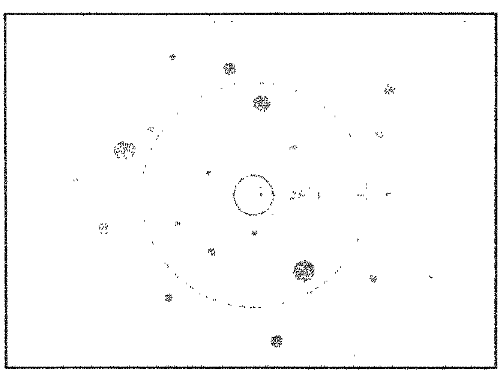
63. At the same time the overstory data are collected, regeneration (understory) data also are collected using the same plot centers as those for the overstory survey. Additional plots located between the overstory plots will also be needed to obtain an adequate sample. At locations where both overstory and understory data are collected, tally the understory data first to avoid estimating errors due to trampled vegetation.



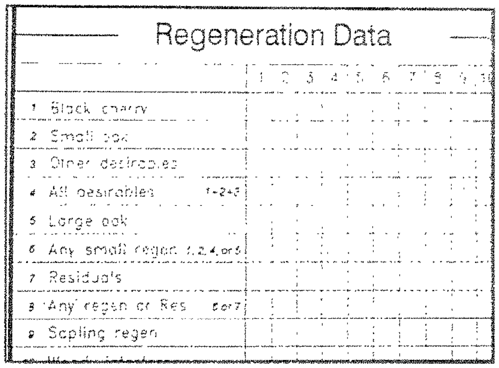
64. Most of the understory data will be collected on a 6-foot radius plot. This size was selected because it approximates the ground area occupied by a single tree when the tree first reaches merchantable (pulpwood) size.



65. Guides to the numbers of seedlings required per 6-foot plot at various times in the regeneration process have been developed by Marquis and others. These guidelines assure that there is at least one stem per 6-foot plot when the stand first reaches merchantable size--thus assuring full stocking.



66. Because fern and grass coverage is often spotty and evidence of site limiting factors is not always obvious it is best to use a larger plot size for evaluations of these items. A plot size of one-twentieth of an acre (26.4-foot radius) is recommended.

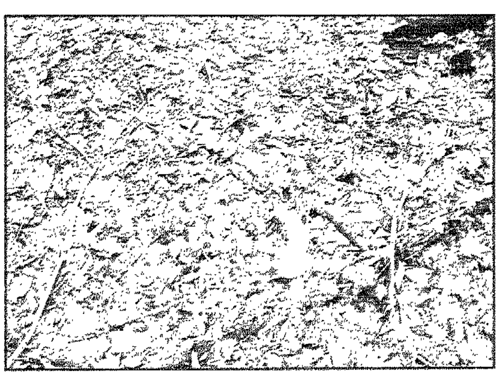


Regeneration Data	1	2	3	4	5	6	7	8	9	10
1 Black cherry										
2 Small oak										
3 Other desirables										
4 All desirables 1+2+3										
5 Large oak										
6 Any small regen 1,2,4,or 5										
7 Residuals										
8 Any regen or Res 6 or 7										
9 Sapling regen										

67. Understory data are recorded on a separate tally form (Appendix 4).

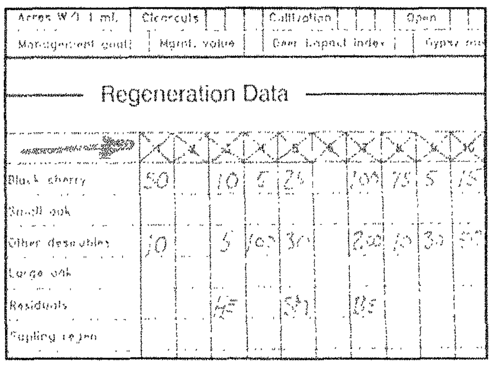
68. Although it may seem necessary at first to make a time-consuming count to determine whether a plot has the required number of appropriate-size seedlings, this is seldom necessary. With a little experience, the determination can be made on most plots without any counting.

69. Most plots will be abundantly stocked or

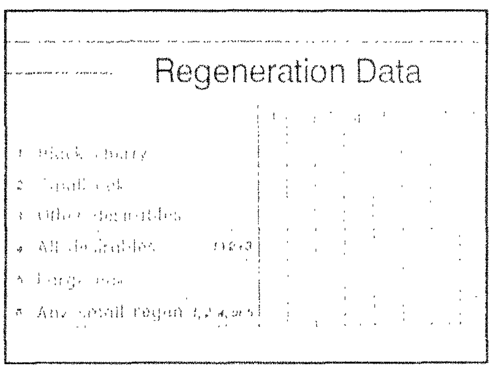


70. sparsely stocked, and seedlings that are large enough to count will be readily visible from a standing position.

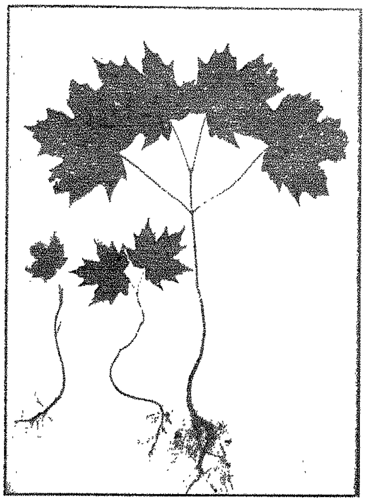
71. Those that you must kneel down to find are generally too small to count anyway. We suggest that you strive to estimate and record to the following numbers: 5, 10, 15, 20, 25, 30, 40, 50, 60, 75, 100, 200, 200+.



72. You must keep an accurate record of the number of understory plots examined. Some plots may have no data in any of the 16 factors, so, indicate each plot tallied by placing an "X" through the plot number at the top of the regeneration block on the tally form. After the cruise is completed, count the number of plots taken and enter this value in the box for # plots (regen).



73. In completing the Regeneration tally form (Appendix 4), the first step is to assess the amount of desirable advance regeneration on the 6-foot radius plot. Black cherry and oak are tallied separately from other desirable species. Desirable species may vary from location to location or ownership to ownership, but a list should be developed and applied consistently so results are comparable from stand to stand.



74. Advance seedlings are weighted by height and vigor. Seedlings such as the sugar maple on the right should not be counted. Any seedling that is less than 2 inches tall, has fewer that two normal-size leaves or still bears cotyledons has a poor chance of survival and should not be counted. Seedlings between 2 inches and 1 foot tall such as the one in the middle are counted as one seedling, and those of good vigor over 1 foot tall as on the left are counted as two seedlings.

DESIRABLE SPECIES

Black Cherry	Yellow-Poplar
Red Maple	Cucumber
Sugar Maple	(Basswood)
White Ash	(Hemlock)
Red Oak	

75. Desirable timber species usually include black cherry, sugar maple, red maple, white ash, yellow-poplar, cucumbertree, red oak, white oak, and basswood. In some localities, beech, birch (yellow and sweet), oaks other than red or white, hickory, hemlock, and white pine also may be considered as desirable. Count these species as desirable only if they fully meet the management objectives for the property.

LARGE OAK REGEN

4.5 FEET TALL +

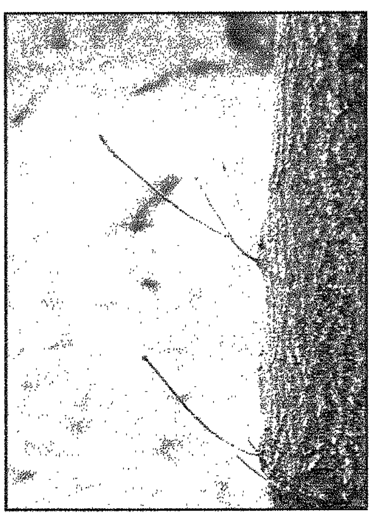
76. Large oak regeneration is based on guides from the Central States where only seedlings 4.5 feet tall or taller are counted as advance seedlings. Count each such stem as one seedling.

RESIDUALS

Sugar maple, beech, hemlock
3"=10" DBH of good form
and quality
Record Species Code

77. If there is a sugar maple, beech, or hemlock 3 to 10 inches d.b.h. on the 6-foot radius plot of acceptable quality to leave as a residual tree, record the species code of that tree in the residual box.

78. Desirable residual trees have at least moderately good crowns and clear straight boles free of branches, epicormic branches, or other defects for at least the first 17 feet. Remember that residual trees are very large advance regeneration. They will be left after the final harvest cut to form a part of the new stand. Because they will be essentially open-grown for 30 to 40 years (until the fast-growing intolerant seedlings catch up to them), bole quality will not improve. Therefore, residuals must be free of branches or defects initially. If your organization does not retain residuals after harvest cutting, do not record in this row.



79. Particular attention should be given to epicormic branches. Stems with more than one or two epicormics on the butt log should not be considered acceptable residual trees.

2 Stems 0.5" to 2.0"

1 Stem 2.0" to 6.0"

Acceptable Species and Quality

80. For sapling regen, if there are at least two stems of commercial species 0.5 inch to 2 inches d.b.h., or at least one stem 2 to 6 inches d.b.h. on the 6-foot radius plot, record the species code of the dominant stem. Do not count stems of species that would be considered woody interference such as beech-root suckers.

81. Saplings should be stems of a distinctly different age than those in the overstory--usually ones that originated after a heavy cutting within the past 25 years or so. Sapling regen is an entire new age class that is already well established and growing vigorously, under the present canopy, and that needs only to be released to form the next stand.

WOODY INTERFERENCE

Record Number of Stems

< or equal 1' = 1 stem

> 1' = 2 stems

82. Stems of beech, striped maple, sourwood, blackgum, elm, hophornbeam, and blue beech on the 6-foot radius plot should be counted as woody interference. Count all stems less than 1 foot tall as one stem, and all stems over 1 foot tall as two stems.

83. Count clumps of beech root suckers that originate from the same spot as one stem.

LAUREL AND RHOD

Coded Value - 6' Plot

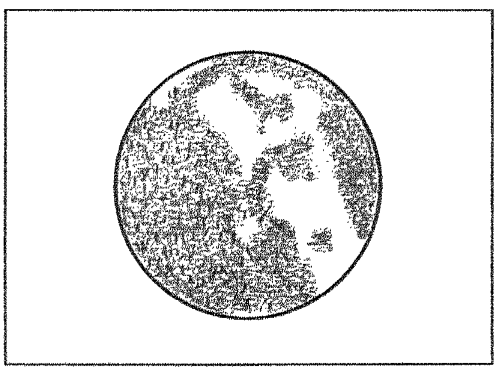
1 = <1' and <50% of plot

2 = >1' and <50% of plot

3 = <1' and >50% of plot

4 = >1' and >50% of plot

84. Record the presence of laurel and rhododendron on the 6-foot radius plot in one of four categories: (1) laurel or rhododendron present, but less than 1 foot high and covering less that half of the plot area; (2) present on less than half the plot area, but more than 1 foot tall; (3) present on more than half of the plot area, but less than 1 foot tall; (4) present on more than half of the plot and more than 1 foot tall.



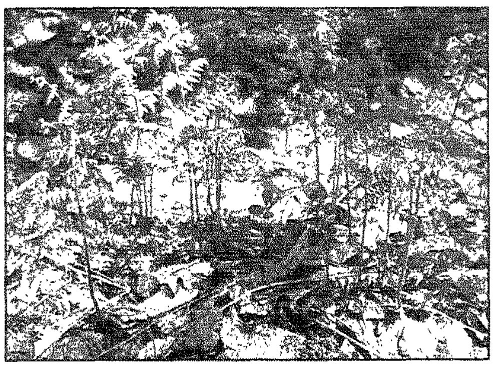
85. Because the remaining undesirable understory attributes tend to be more variable, we will assess them on the larger 26-foot radius plot. Record an ocular estimate of the percentage of the larger plot surface area covered by fern or grass foliage, when viewed from directly above the plot.

FERNS

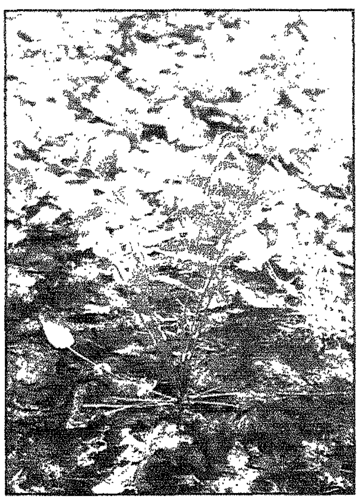
Percent Coverage on

1/20 Acre

86 Count any fern that grows as individual fronds from the ground level. These ferns reproduce through underground rhizomes and spread very rapidly under light conditions created by partial cutting.



87. Ferns that grow in clumps, tend not to spread rapidly after thinning, so we estimate their percent coverage and record a number equal to one-half our estimate.



88. Record the weighted average percentages of the plot covered by fern foliage.

GRASSES

Percent Coverage on

1/20 Acre

89. For grass and sedge, record an ocular estimate of the percentage of the plot surface covered by foliage of any grass or sedge.

FERN AND GRASS

ASSESS SEPARATELY

90. If grass and fern are found together on the same plot, do not add percentages together as the rate of spread of one species is independent of the amount of the other species.

GRAPEVINE

Number in Crowns on

26' plot

(1 or more)

91. Record the number of grapevines in the crowns of any tree on the 1/20-acre plot.

SITE LIMITS

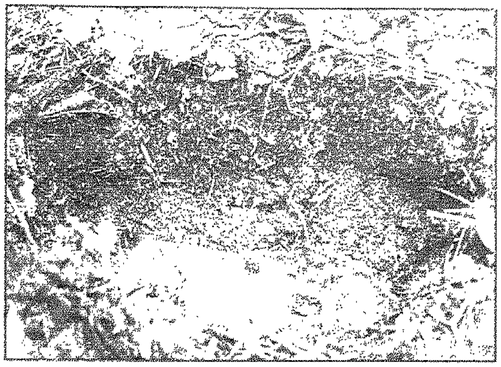
Evidence of Poor Drainage

or Rock anywhere on 26' plot

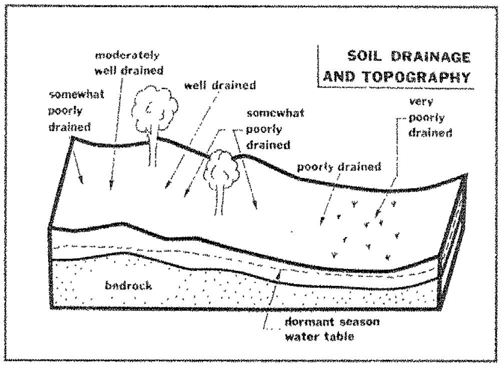
1 = Poor drainage

2 = Rock

92. Record the coded value in the site limits row for each 1/20-acre plot on which there is any evidence of either poor soil drainage or high stone content in the surface soil. Use a code of 1 for poor drainage, 2 for rocky surface. A blank or zero indicates that there are no site limits on that plot.



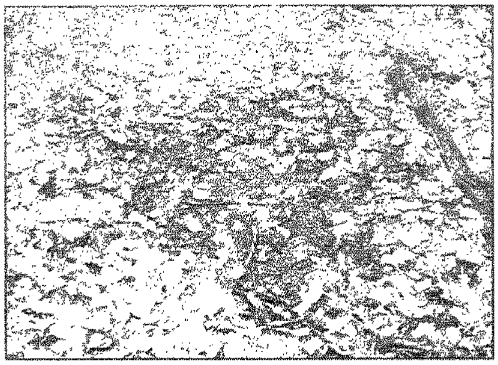
93. Taking soil samples or digging soil pits is neither feasible nor necessary to determine site limitation. They should be evaluated on the basis of surface conditions.



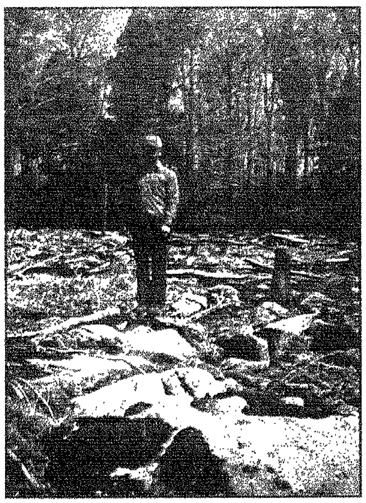
94. On the Allegheny Plateau, look for poor soil drainage in concave positions of broad flat ridge tops, in upland bottoms, and at the base of slopes. Low topography is more likely to be poorly drained than is high topography. Convex topographic configuration generally indicates well-drained or moderately well-drained soils. In valley bottoms, soil drainage becomes poorer from the stream channel toward the base of slopes. Concave and low-lying areas in bottoms are especially likely to be poorly drained, as are toes of slopes with many seeps.

95. Other indicators of poor soil drainage include: standing water in depressions or wet surface soils that persist during the dormant season and during periods of normal rainfall in the summer and early fall;

96. presence of wet-site plants such as sedges, rushes, sphagnum moss, sensitive fern, interrupted fern, cinnamon fern, skunk cabbage, false hellebore, and marsh marigold;



97. and very deep spongy humus layers at the soil surface.



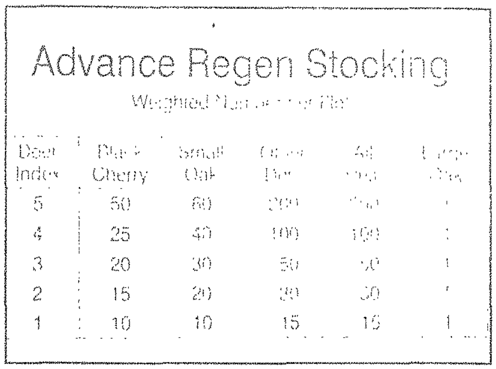
98. Stony areas can be recognized after a little experience. Look for the stone layer beneath the forest floor in road cuts. Large sandstone outcrops generally will be present somewhere upslope as well. The hard and uneven feel of the soil surface when walked upon is a sure indicator of many surface stones.

EXPANDED TALLY

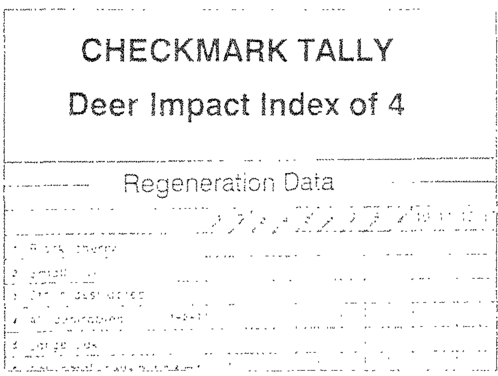
Regeneration Data

	1	2	3	4	5	6	7	8	9
1 Black cherry	[illegible]	[illegible]		[illegible]		[illegible]	[illegible]	[illegible]	[illegible]
2 Small oak									
3 Other desirables	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]
4 All desirables 1+2+3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

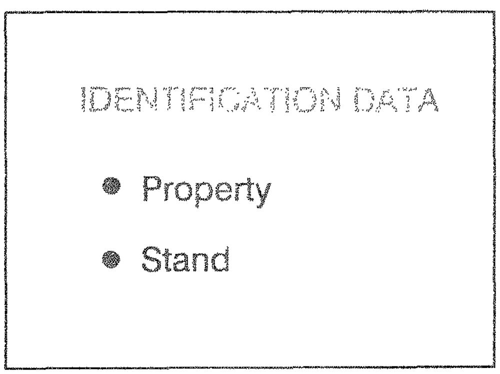
99. When complete, the expanded regeneration tally sheet will look like this.



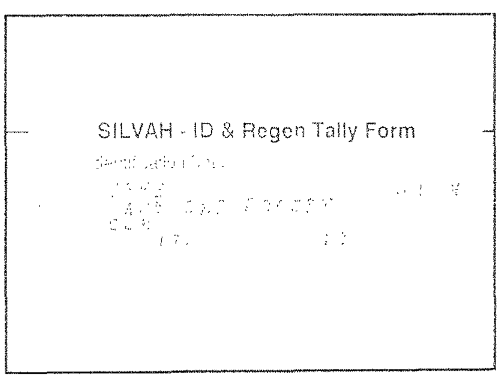
100. An alternative method for assessing the understory condition is to determine at each plot if the criteria for your appropriate deer density is met or not. The amount of advanced seedlings for a plot to be stocked varies tremendously with the deer impact index. In this example, use a deer impact index of 4, which requires that a plot contain at least 25 black cherry, 40 small oak, or 100 other desirables for a plot to be considered stocked.



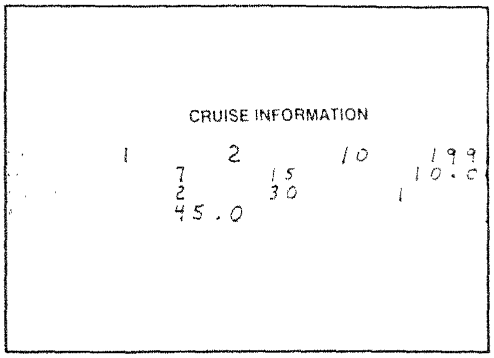
101. You just make a checkmark if the stocking criteria for your deer impact index is met. A completed checkmark tally would look like this.



102. The identification data block contains information needed to identify the stand, information on the cruise procedures used, and basic data on stand and site factors and management goals. Some of these items come from other sources, such as management plans, soil-site maps, aerial photographs, and wildlife agency reports.



103. The information requested at the beginning of this block identifies the particular stand by ownership and location.



104. The middle section requests specific information on the type of cruise used. It is important to fill out this section very carefully. The most important coded values in this section are reviewed here.

SPECIES CODES

1 = Mnemonic

2 = User-Defined

3 = Forest Survey

105. Species codes are coded values telling the computer which particular system you used.

DBH CLASSES

1 = 1" Class

2 = 2" Class

3 = 5 Major Classes

106. Likewise, record a coded value for the d.b.h. class.

	Cruise Type	
	Prism	Fixed
Individual Tree All/None Graded	1	4
Grade 6, 8 Only	7	8
Counts Col 4	2	5
Dot Tally	3	6

107. The coded value for the type of overstory cruise is necessary for the computer to know how you used the various fields on the tally form so the data can be properly summarized.

REGEN CRUISE TYPE

0 = None

1 = Condensed (checkmark)

2 = Standard (counts) Default

108. Code the appropriate value for the type of regeneration cruise.

PLOT SIZE

1 = 6' Radius (default)

2 = Milacre

109. Finally, record the coded value for the size of plot used to assess advanced seedling stocking.

SITE AND MANAGEMENT GOALS

110. The final portion of the identification block describes particular site factors and management goals that may influence the final prescription. If you are in an oak stand, it is necessary to take site index.

HEIGHT ADJUSTMENT

1.50 = High

1.00 = Medium (Default)

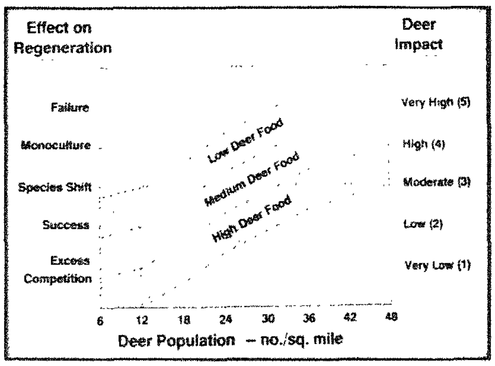
0.50 = Low

111. If you did not record actual heights, you may make an adjustment in the local heights used in SILVAH.

MANAGEMENT GOALS

Code	
1	No Restrictions (Default)
2	Even/Uneven Age - No Clearcut
3	Uneven-Age - Maximize for Timber
4	Uneven-Age - Large Trees

112. The final prescription that SILVAH will generate is dictated by your specific management goals. Codes 2, 3, and 4 indicate restrictions that visual or wildlife goals for this stand may impose on timber cutting methods.

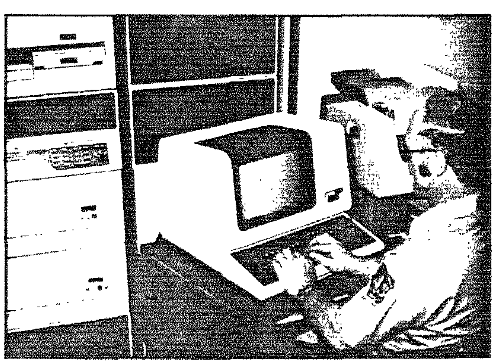


113. Deer impact index is a function of deer density and the amount of alternative food available within a 1-mile radius of the stand. Deer population can be estimated using pellet group counts or from your State Game agency's estimate for your area. Using this chart, determine the deer impact index for your stand.

DEER IMPACT INDEX

Code	Rating
1	Very Low
2	Low
3	Moderate
4	High (Default)
5	Very High

114. Then, enter the appropriate coded value on the tally form.



115. You have completed the first step in the three-step process--the stand inventory. You are now ready to enter the data into the computer to begin the second step--stand analysis.

Selected References

Beers, T. W.; Miller, C. I. 1964. Point sampling: research results theory and applications. Res. Bull. 786. Lafayette, IN: Purdue University. 56 p.

Marquis, David A. 1981. Survival, growth, and quality of residual trees following clearcutting in Allegheny hardwood forests. Res. Pap. NE-477. Broomall, PA: U. S. Department of Agriculture, Forest Service. Northeastern Forest Experiment Station. 9 p.

Marquis, David A. 1982. Effect of advance seedling size and vigor on survival after clearcutting. Res. Pap. NE-498. Broomall, PA: U. S. Department of Agriculture, Forest Service. Northeastern Forest Experimant Station. 7 p.

Marquis, David A.; Bjorkbom, John C. 1982. Guidelines for evaluating regeneration before and after clearcutting Allegheny hardwoods. Res. Note NE-307. Broomall, PA: U. S. Department of Agriculture, Forest Service. Northeastern Forest Experiment Station. 4 p.

Marquis, David A.; Ernst, Richard L.; Stout, Susan L. 1992. Prescribing silvicultural treatments in hardwood stands of the Alleghenies (Revised). Gen. Tech. Rep. NE-96. Radnor, PA: U. S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 101 p.

APPENDIX 1

Species	Forest survey	Mnemonic	User-defined
Other Softwoods	1	OSW	0
Other Hardwoods	4	OHW	88
Balsam Fir	12	BF	0
E. Red Cedar	68	ERC	0
Larch	70	L	0
Tamarack	71	TAM	0
Spruce	90	S	0
Norway Spruce	91	NS	0
White Spruce	94	WS	0
Black Spruce	95	BS	0
Red Spruce	97	RS	0
Pine	100	P	0
Jack Pine	105	JP	0
Red Pine	125	RP	0
Pitch Pine	126	PP	0
White Pine	129	WP	1
Virginia Pine	132	VP	0
Southern Pine	170	SP	0
N. White Cedar	241	NWC	0
Eastern Hemlock	261	EH	6
Maple	310	M	0
Red Maple	316	RM	21
Silver Maple	317	SVM	0
Sugar Maple	318	SM	20
Buckeye	330	BUC	0
Birch	370	B	50
Yellow Birch	371	YB	0
Sweet Birch	372	SB	0
Paper Birch	375	PB	0
Hickories	400	H	60
Bitternut Hickory	402	BH	0
Pignut Hickory	403	PH	0
Pecan	404	PCN	0
Shellbark Hickory	405	SLH	0
Shagbark Hickory	407	SGH	0
Mockernut Hickory	409	MH	0
Hackberry	460	HAC	0
Yellowwood	481	YW	0
Persimmon	521	PER	0
American Beech	531	AB	54
Ash	540	A	0
White Ash	541	WA	55
Black Ash	543	BA	0
Green Ash	544	GA	0
Honey Locust	552	HL	0
Butternut	601	BUT	71
Black Walnut	602	BW	0
Sweetgum	611	SG	0
Yellow-Poplar	621	YP	59
Cucumbertree	651	CUC	84
Mountain Magnolia	654	MM	0
Tupelo	690	T	0
Water Tupelo	691	WT	0
Black Gum	693	BG	66
American Sycamore	731	AS	0
Aspen	740	ASP	63
Balsam Poplar	741	BP	0
E. Cottonwood	742	EC	0
Bigtooth Aspen	743	BTA	0
Quaking Aspen	746	QA	0
Black Cherry	762	BC	76
Oak	800	O	0
White Oak	802	WO	40
Swamp White Oak	804	SWO	0
Scarlet Oak	806	SO	32
N. Pin Oak	809	NPO	0
S. Red Oak	812	SRO	0
Cherrybark Oak	813	CBO	0
Overcup Oak	822	OO	0
Burr Oak	823	BRO	0
Blackjack Oak	824	BJO	0
Swamp Chestnut Oak	825	SCO	0
Chinkapin Oak	826	CKO	0
Pin Oak	830	PNO	0
Chestnut Oak	832	CO	48
N. Red Oak	833	NRO	30
Shumard Oak	834	SHO	0
Post Oak	835	PO	0
Black Oak	837	BO	31
Black Locust	901	BL	0
Willow	920	W	0
American Basswood	951	BAS	58
Elm	970	E	61
American Elm	972	AE	0
Slippery Elm	975	SE	0
Rock Elm	977	RE	0
Boxelder Maple	313	BEM	0
Striped Maple	315	STM	99
Devils Walkng. Stick	353	DWS	89
Serviceberry	355	SVB	91
Blue Beech	391	BB	90
Dogwood	491	DOG	81
Hawthorn	500	HAW	94
Ironwood	701	OST	92
Pin Cherry	761	PC	95
Choke Cherry	763	CC	0
Sassafras	931	SAS	96
Mountain Ash	935	MTA	97
Ailanthus	999	ONC	98
Other Non-Comm	998	AIL	0

SILVAH - Computer Overstory Tally Form

USDA, Forest Service, NEFES, Warren, PA 1/91

Overstory Data

Stand ID ____________________ Sheet ____ of ____

Species	dbh	Quality	Ht. or Count	Grade	Defect	Crown	Wildlife	Species	dbh	Quality	Ht. or Count	Grade	Defect	Crown	Wildlife	Species	dbh	Quality	Ht. or Count	Grade	Defect	Crown	Wildlife

SILVAH - Manual Overstory Tally Form

Stand ID

USDA, Forest Service, NEFES, Warren, PA 1/91

AGS Size class		Black cherry	White ash	Yellow poplar	Red maple	N. Red oak	Eastern hemlock	All others	Sugar maple	Amer. beech	Striped maple	Other oaks, hickory
Saplings 1.0 – 5.5"	Dot											
	BA											
Poles 5.5 – 11.5"	Dot											
	BA											
Small Saws 11.5 – 17.5"	Dot											
	BA											
Medium Saws 17.5 – 23.5"	Dot											
	BA											
Large Saws 23.5" +	Dot											
	BA											
Total Basal area Poles & larger												

UGS Size class		Black cherry	White ash	Yellow poplar	Red maple	N. Red oak	Eastern hemlock	All others	Sugar maple	Amer. beech	Striped maple	Other oaks, hickory
Saplings 1.0 – 5.5"	Dot											
	BA											
Poles 5.5 – 11.5"	Dot											
	BA											
Small Saws 11.5 – 17.5"	Dot											
	BA											
Medium Saws 17.5 – 23.5"	Dot											
	BA											
Large Saws 23.5" +	Dot											
	BA											
Total Basal area Poles & larger												
AGS + UGS BA Poles & larger												

Plot	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Conversion factor
Count																					BAF/# plots

*BA = Dots * Conversion factor*

SILVAH - ID & Regen Tally Form

Identification Data

USDA, Forest Service, NEFES, Warren, PA 1/91

Sheet ___ of ___

Owner/Agency
Forest/Property
County/District
Compartment/Unit — Stand No.
Remarks
Species Codes — dbh classes — Tally month — Year
Overstory Cruise — Type — # plots — BAF/plot size
Regen Cruise — Type — # plots — Plot size
Acreage in stand — Stand age
Cover Type — Habitat type — Soil type — Site class
Site species — Site Index — Height adjustment
Elevation — Aspect — Slope % — Topo. position
Operability — Access — Water code — Water code
Acres W/I 1 mi. — Clearcuts — Cultivation — Open — Water code
Management goal — Mgmt. value — Deer impact index — Gypsy moth — Stress

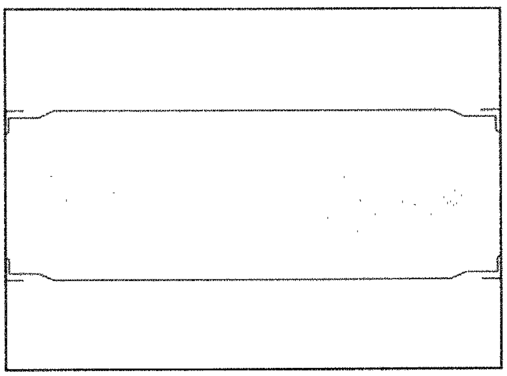
Notes

Regeneration Data

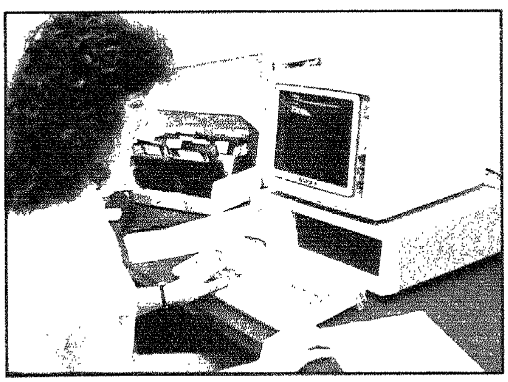
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	#	%
1 Black cherry																						
2 Small oak																						
3 Other desirables																						
4 All desirables 1+2+3																						
5 Large oak																						
6 Any small regen 1, 2, 4, or 5																						
7 Residuals																						
8 Any regen or Res. 6 or 7																						
9 Sapling regen																						
10 Woody interference																						
11 Laurel & Rhododendron																						
12 Ferns																						
13 Grasses																						
14 Any intrfr. 10, 11, 12, or 13																						
15 Grapevines																						
16 Site limitations																						

Stand Data Summary and Analysis

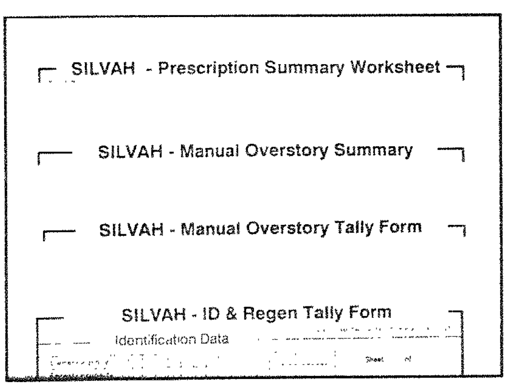
Susan L. Stout



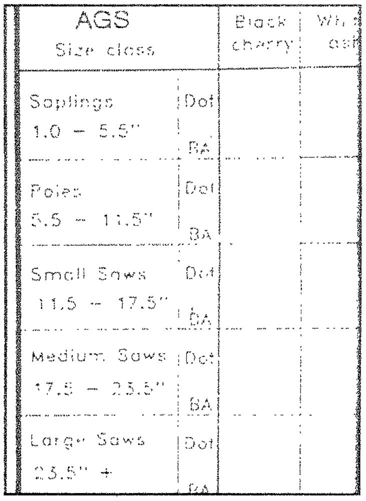
1. The second step in the SILVAH process is to summarize and analyze inventory data from forest stands.



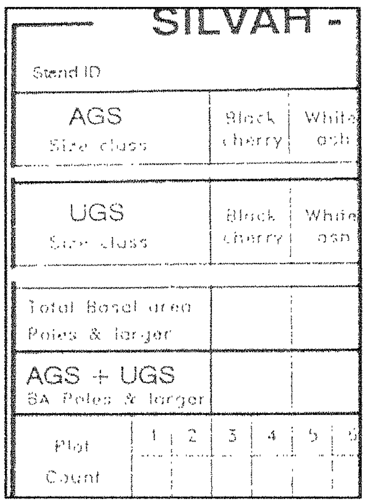
2. Here we review the process by which you use a computer or calculator to summarize the inventory data you collect and use that summary to select a prescription outlining appropriate treatment of the stand. Usually, a computer makes these calculations, but working through the calculations step by step gives you a better understanding of the way the SILVAH program works and of the results that appear on SILVAH printouts.



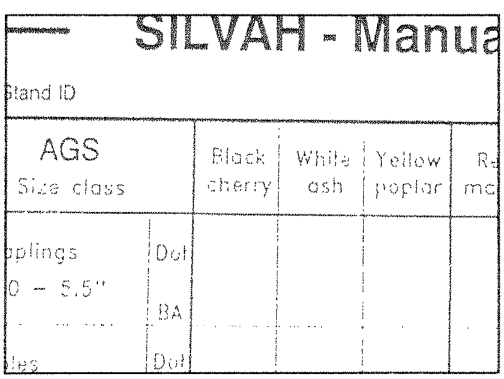
3. The forms used for the calculations are shown in Appendices 1-5. They are provided blank so the reader may practice the procedures described and as an example. The forms have two main purposes: they give users without a computer access to the SILVAH system, and they help computer users learn what the computer does with inventory data.



4. If data are collected on the Computer Overstory Tally form, the data can be transferred to the Manual Overstory Tally form (Appendix 1 and 2), but the reverse is not true because of the groupings by size class.



5. On the Manual Overstory Tally form, data are organized by broad size class, quality class, and species group -- AGS (Acceptable Growing Stock) and UGS (Unacceptable Growing Stock)--definitions for the quality classes are shown in Appendix 6. Rows to total basal area in poles and larger for each species group by quality class and for both quality classes combined are provided.



6. The species are grouped based on the growing space requirements of the different species. The basis for the groups is described in more detail later. However, make note of the groups. The black cherry, white ash, yellow-poplar group includes only these three species.

anual Overstory Tall

USDA, Forest Serv

ellow poplar	Red maple	N. Red oak	Eastern hemlock	All others	Sugar maple

7. The red maple, red oak, eastern hemlock, and others group includes northern red oak, red maple, birch, pin cherry, cucumbertree, and basswood. Because it is the intermediate group in growth rate, growing space, crown size, and tolerance, we assign other species to this group when growth patterns and growing-space requirements are unknown. Eastern hemlock is tallied here as are other conifers.

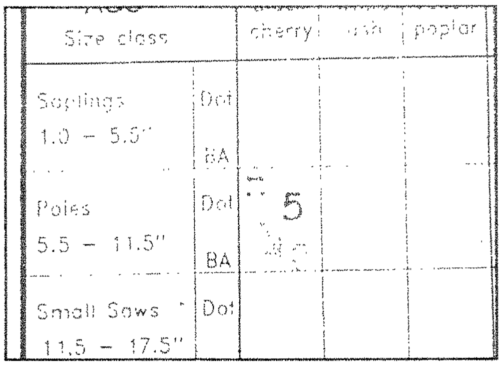
USDA, Forest Service, NEFES, Warren, PA 1/91

Red oak	Eastern hemlock	All others	Sugar maple	Amer. beech	Striped maple	Other oaks, hickory

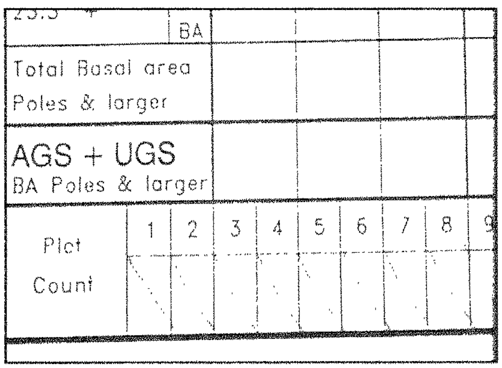
8. The sugar maple, American beech, striped maple, and other oak group includes sugar and striped maple: American beech: white, chestnut, black, and scarlet oak; and the hickories.

Saplings 1.0 – 5.5"	Dot	
	BA	
Poles 5.5 – 11.5"	Dot	
	BA	
Small Saws 11.5 – 17.5"	Dot	
	BA	
Medium Saws 17.5 – 23.5"	Dot	
	BA	
Large Saws 23.5" +	Dot	
	BA	

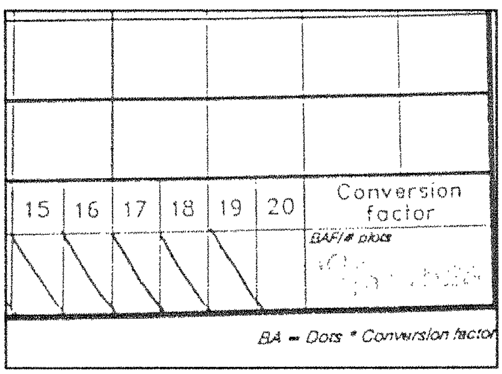
9. The diameter ranges for the five size classes are shown on the Manual Overstory Tally form. These broad groupings are adequate for characterizing and controlling stand structure.



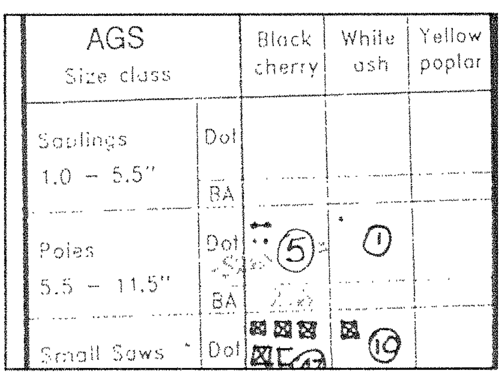
10. The first set of overstory calculations is to be completed on the tally form. We convert the dot tally inventory to estimates of basal area per acre in each size/species/quality cell.



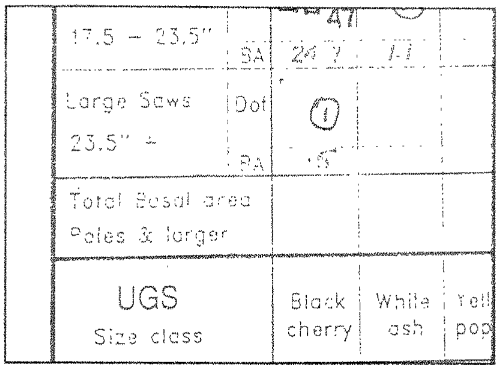
11. To make this conversion, we must record the number of overstory plots tallied. The plot count row may be checked off or the number of trees intercepted by the prism at each plot may be noted. If you note the number of trees per plot, you can determine the variability of basal area from plot to plot and decide whether your inventory represents an adequate sample.



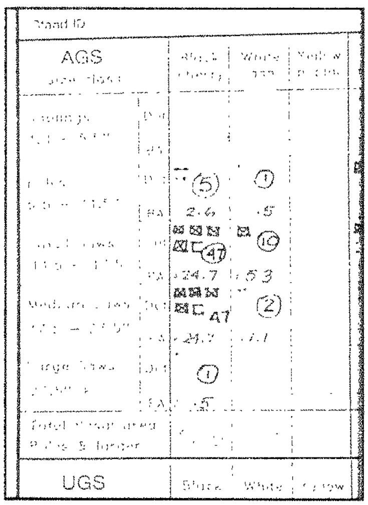
12. The prism conversion factor in the lower right corner of the tally form equals the prism factor--in our example, 10--divided by the number of prism plots. For the sample stand, there were 19 prism plots, so the conversion factor is 10/19, or 0.526. That is, every dot in the sample dot tally represents slightly more than half a square foot of basal area per acre. We recommend that you record this number to three decimal places to minimize rounding error.



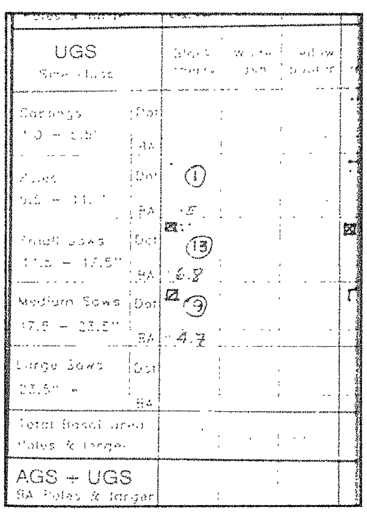
13. Now, multiply the number of dots in each cell times the prism conversion factor. This gives an estimate of the basal area per acre for that cell. For example, our tally form shows five dots in the black cherry/pole/AGS cell. Five times 0.526 is 2.6 square feet per acre for that cell. Record this estimate below the dot tally in each cell. There are 110 cells: 5 size classes x 2 quality classes x 11 species. Record these values to one decimal place to minimize rounding error.



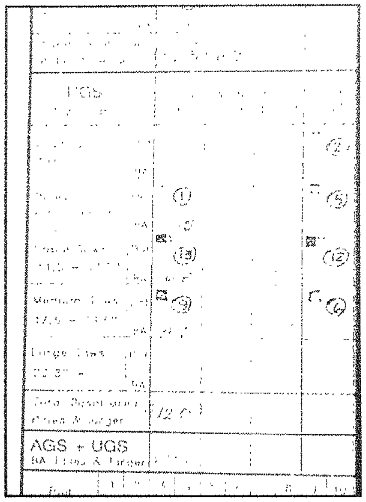
14. We only calculate one subtotal for each species group on the form: the basal area in trees of pole size or larger. We will use this number later to calculate an index value for probable seed production in this stand. The computer makes this calculation using trees 8 inches or larger, since 8 inches is about the threshold for seed production. Since we have grouped trees by size class, we calculate this value for trees 6 inches or larger, that is, the poles and larger size classes.



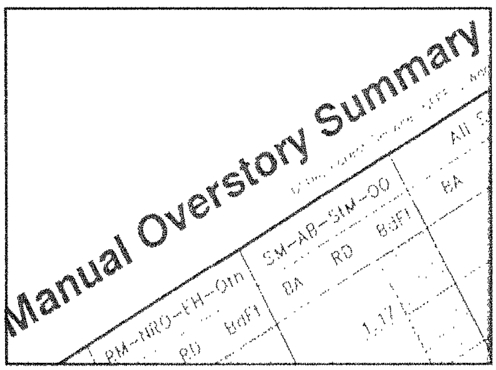
15. For each species, add and record the basal areas for poles and larger AGS and record this on the appropriate line in the middle of the tally form,



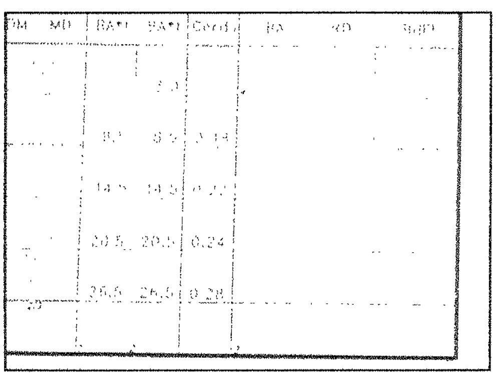
16. then record the basal areas for poles and larger UGS near the bottom of the form



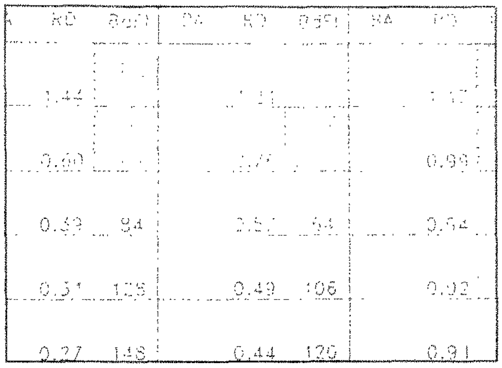
17. and finally record the sum of the values for AGS and UGS on the summary line at the bottom of the form.



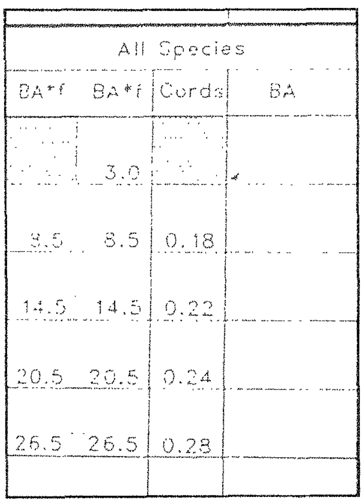
18. At this point, transfer basal area values to the Manual Overstory Summary form (Appendix 3). Two copies are provided so that you can use one to summarize the data from Appendix 2. On this form, fill in basal area data for each of the three species groups, by size and quality class.



19. In the lower right corner of this form, final estimates of basal area per acre, relative density per acre, board-foot volume per acre, and cordwood volume per acre for the entire stand will be recorded. Elsewhere on the form, subtotals of these values by species group, size class, and quality class will be recorded.

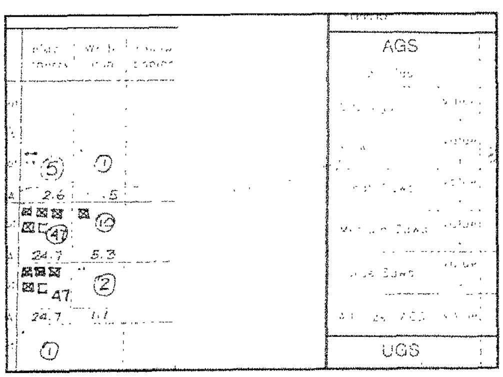


20. The calculations are straightforward. From extensive research, we have developed basal area conversion factors for each size/quality/species combination; so, we can convert the basal area estimates from the inventory to other values that we need. There are factors in the relative density column, factors in the board-foot column,

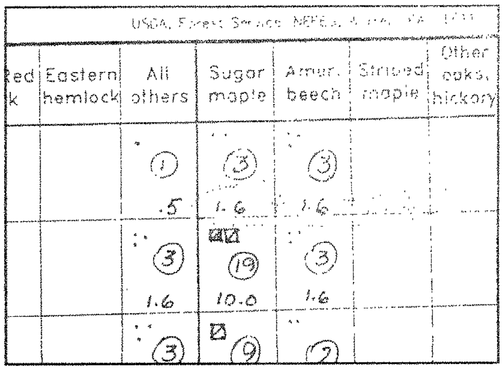


All Species			
BA*f	BA*f	Cords	BA
	3.0		
8.5	8.5	0.18	
14.5	14.5	0.22	
20.5	20.5	0.24	
26.5	26.5	0.28	

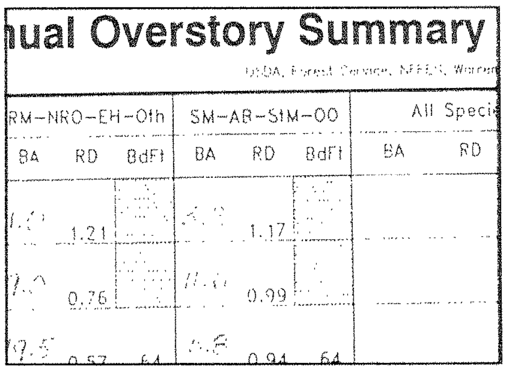
21. and factors in the cords column. Each of these factors is multiplied by basal area for the appropriate size/quality/species combination, and the subtotals added, to get the stand estimates.



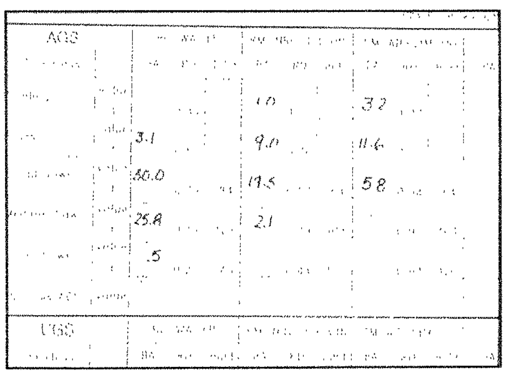
22. The first step in using this form is to transfer the summary basal area information from the tally form to the summary form.



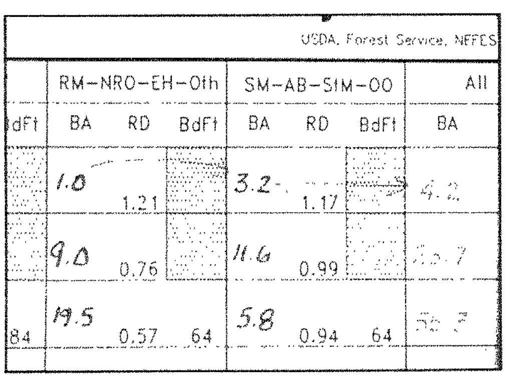
23. To make this transfer, add the basal areas for the species in each species group, by size and quality class. For example, the sample stand has 1.6 square feet of American beech, 1.6 square feet of sugar maple in sapling acceptable growing stock, and no basal area in striped maple or other oaks and hickory.



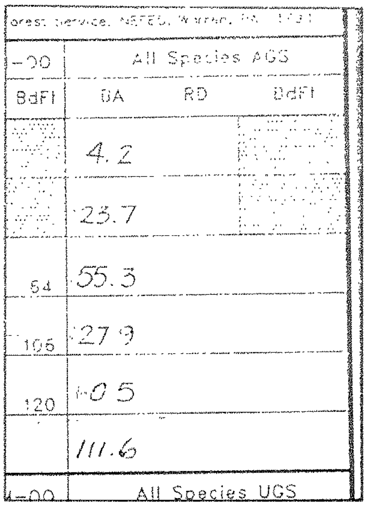
24. So, record 3.2 in the SM-AB-StM-OO sapling acceptable growing stock cell. There are 30 target cells.



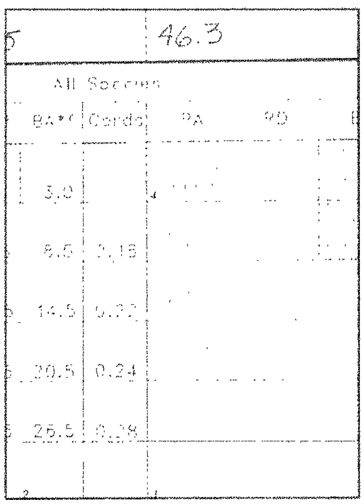
25. After transferring the appropriate basal area sums to all 30 cells, calculate several subtotals. For each quality class, calculate species totals for all size classes, and record at the bottom of the quality class,



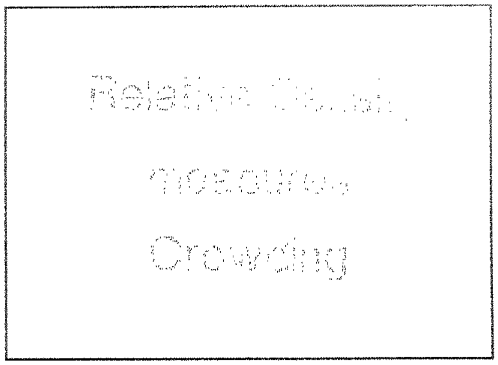
26. and calculate size class totals for all species groups, and record to the right of each size class.



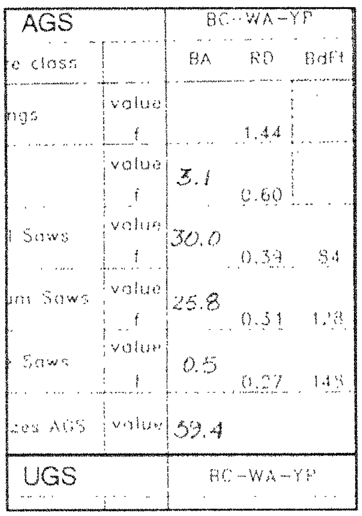
27. Calculate overall totals for each quality class as well.



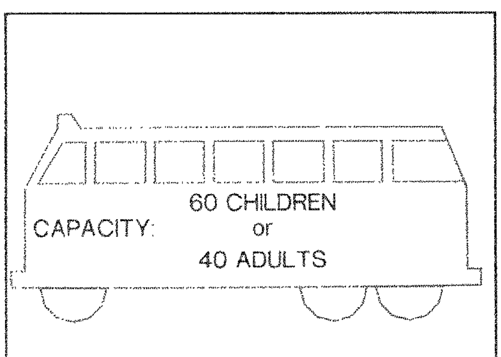
28. Overall totals for each size class and the whole stand are recorded in the BA column of the summary block. After this first step, we know how much basal area is in our stand, and we have a sense of how that basal area is divided by quality, size, and species group. In the sample stand basal area is 158 square feet per acre, of which about 46 square feet are unacceptable growing stock.



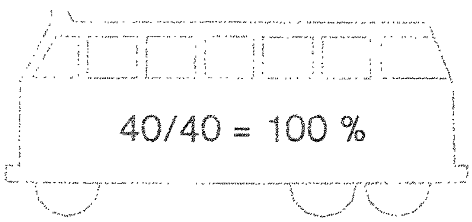
29. But how crowded are these trees? Is their growth likely to be optimal for the stand? Are they using all the growing space on the site and converting it to the wood products that we would like? To answer these questions, we need to know the relative density of the stand.



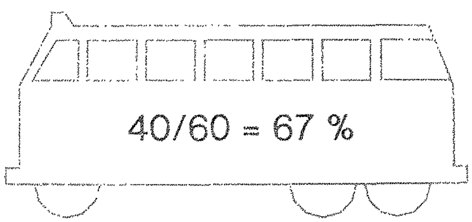
30. Relative density compares the crowding in a forest stand to the crowding in a stand at the average maximum density observed in stands of similar average tree size and species composition. Our research has shown us how much growing space a tree of a given size and species needs in undisturbed, maximum density stands, and we have translated these to the Relative Density factors on this work sheet.



31. Relative density is easy to understand if we consider school bus capacity. School buses usually have two capacities printed on the side: 60 children or 40 adults, for example.



32. So, how crowded is the bus if there are 40 people on it? Well, that depends. If the 40 people on the bus are adults, then the "relative density" of the bus is 40/40, or 100 percent.



33. But if the 40 people are children, then the relative density is 40/60, or about 67 percent, and there is still some room for the kids to spread out or for a few more passengers, perhaps even some adults.

VAH - Manual Overstory

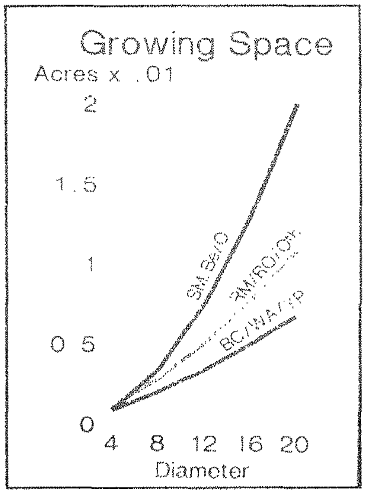
USDA, F

BC-WA-YP			RM-NRO-EH-Oth			SM-AB-StM	
BA	RD	BdFt	BA	RD	BdFt	BA	RD
	1.44		1.0	1.21		3.2	1.17
3.1	0.60		9.0	0.76		11.6	0.99
30.0	0.39	84	19.5	0.57	64	5.8	0.94

34. We could translate these bus capacities to "crowding factors" for children and adults: The crowding factor for a child would be 1/60, and that for an adult, 1/40. The relative density factors on this work sheet are conceptually the same. Black cherry poletimber, for example, regardless of quality, contributes about 0.6 percent per square foot to the crowding of a stand, while red maple poletimber contributes about 0.76 percent per square foot.

SPECIES COMP.	DIAM.	BA	# TREES
80% BC	10"	191 FT.^{2}	350
80% SM/BE	10"	135 FT^2	246

35. The species groupings on this worksheet are based on differences in the relative density factors. In undisturbed stands with a high percentage of black cherry, basal area and number of trees per acre will be much higher than they are in stands of similar tree size with a high proportion of sugar maple and beech. Stands with a high proportion of red maple will have intermediate levels of basal area and number of trees per acre.



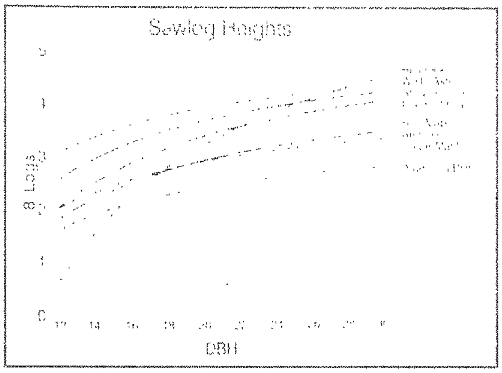
36. This graph shows the growing space required by trees in the three species groups by size class. Trees in the black cherry group have the lowest growing space requirements--that is why natural stands with a high proportion of this species carry higher basal area and number of trees per acre than similar stands with other species. The sugar maple/American beech group has the largest growing space requirements, and those of the red maple group are intermediate.

AGS		BC-WA-YP			RM-NRO-	
Size class		BA	RD	BdFt	BA	R
Saplings	value				1.0	
	f		1.44			1.
Poles	value	3.1	1.9		9.0	
	f		0.60			0.
Small Saws	value	30.0			19.5	
	f		0.39	84		0.
Medium Saws	value	25.8			2.1	
	f		0.31	128		0.

37. We have estimated the basal area in each size/quality/species cell, so calculating the relative density for that cell is a matter of a multiplication: Basal area per acre times relative density factor equals relative density per acre. Do that 30 times,

8.5	8.5	0.18	37.4	32.7	
14.5	14.5	0.22	73.1	38.8	
20.5	20.5	0.24	35.8	12.1	
26.5	26.5	0.28	0.5	0.1	
			157.9	[illegible]	

38. and then calculate the various subtotals again. The relative density of this stand is approximately 97 percent, or very close to the maximum that we expect in a stand of that size and species composition.



39. The next set of calculations is used to estimate the board-foot volume of the stand. Again, we have calculated a board foot factor for each species group, by quality and sawtimber size class. In the SILVAH program, the volume of each tree is calculated by an equation based on species, diameter, and height. If you do not record height, SILVAH uses the heights on this chart, based on data from the Allegheny National Forest and Hammermill Paper Company. For the manual calculations, we have developed factors to give a rough estimate of the average volume per square foot of basal area in each size and species group. The total will be a very rough estimate of the actual board-foot volume in the stand, but the relative volume calculated for different stands should give you an idea of which ones are carrying high volumes and which ones are not.

AGS		BC-WA-YP			RM-NRO-EH-Oth		
class		BA	RD	BdFt	BA	RD	BdFt
Saws	value						
	f		0.39	84		0.57	64
n Saws	value						
	f		0.51	128		0.49	106
Saws	value						
	f		0.27	148		0.44	120
s AGS	value						

40. Note that the black cherry/white ash/yellow-poplar species group has different board foot factors than the other two groups. The black cherry group has more volume per square foot than do trees in the other groups.

value	30.0	11.7		19.5	11.1
f		0.39	84		0.57
value	25.8	8.0		2.1	1.0
f		0.51	135		0.49
value	.5	0.1			
f		0.27	148		0.44
value	59.4	21.7		31.6	20.1
	BC-WA-YP			RM-NRO-E	
	BA	RD	BdFt	BA	RD
value				1.1	1.3
f		1.44			1.21
value	.5	0.3		3.7	2.8
f		0.60			0.76
value	6.8	2.7		6.8	3.9
f		0.39	42		0.57
value	4.7	1.5		3.2	1.6
f		0.51	64		0.49

41. Note, too, that the factors for UGS are half those for AGS. This allows for the fact that at least some of the UGS will have no sawtimber volume, and, in general, the volume will be less per square foot.

Saplings	value				1.0
	f		1.41		
Poles	value	3.1	1.9		9.0
	f		0.60		
Small Saws	value	30.0	11.7		19.5
	f		0.39	84	
Medium Saws	value	25.8	8.0		2.1
	f		0.31	128	
Large Saws	value	.5	0.1		
	f		0.27	148	

42. Again, the calculation involves multiplying basal area per acre in each size/species/quality cell by the board foot factor. Be sure to multiply the board foot factor by the basal area, not the relative density. There are only 18 cells this time, since we are dealing with sawtimber only.

Species			
Cords	BA	RD	BdFt
	11.1	13.0	
0.18	37.4	32.7	
0.22	73.1	38.8	[illegible]
0.24	35.8	12.1	[illegible]
0.28	0.5	0.1	[illegible]
	157.9	96.7	[illegible]

43. But we have just as many subtotals, by size classes within qualities, by species within qualities, and overall.

MDM	MD	BA*f	BA*f	Cords	BA	RD	BdFt
			3.0		11.1	13.0	
		8.5	8.5	0.18	37.4	32.7	
		14.5	14.5	0.22	73.1	38.8	4777
		20.5	20.5	0.24	35.8	12.1	4003
		26.5	26.5	0.28	0.5	0.1	74
					157.9	96.7	8854

44. Finally, we need to estimate the cordwood volume in the stand. Again, we have developed factors that convert basal area to cordwood volume, and these do not vary enough by species or quality to perform separate calculations. So, the cordwood factors are printed in the cord column near the grand total block. Multiply basal area per acre times the cordwood factor to obtain an estimate for each size class. This total is the last of our four grand totals.

Cordwood Only (rough estimate):

$$\text{Total Cords} - \frac{\text{BdFt}}{600}$$

45. This figure represents the total--cordwood including the sawtimber. A rough estimate of the cordwood excluding sawlogs can be made by dividing the board foot volume by 600 and subtracting the quotient from the total cordwood volume.

Regeneration Data

	1	2	3	4	5	6
Black cherry	30	40	15	25		40
Small oak						
Other desirables	5	10	25	20		50
All desirables 1+2+3						
Large oak						
Any small regen 1, 2, 4, or 5						

46. We will extract other overstory values to use in determining the prescription, but first we need to summarize the understory values collected in the form of weighted counts on the ID & Regen Tally Form (Appendix 4). The form contains inventory data to be used in completing a sample summary. The procedure for making these counts is reviewed in the article "Stand Examination Procedures."

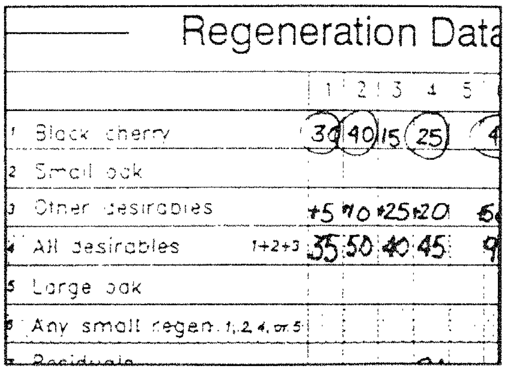
Deer Index	Black Cherry	Small Oak
5	50	60
4	25	40
3	20	30
2	15	20
1	10	10

47. The first step in data summary on this form is to summarize data for advance regeneration. You must calculate the total number of plots that have sufficient regeneration stocking for the level of deer pressure on that stand in the black cherry, small oak, all desirables, and large oak categories. The criteria are partially displayed on this table, see Appendix 6B. Choose the appropriate level of deer pressure, and for each advance regeneration category, count the number of plots that meet or exceed the count in the table. For example, in the sample stand, the deer pressure index is 4. That means we need a weighted count of at least 25 black cherry seedlings for a plot to be considered stocked.

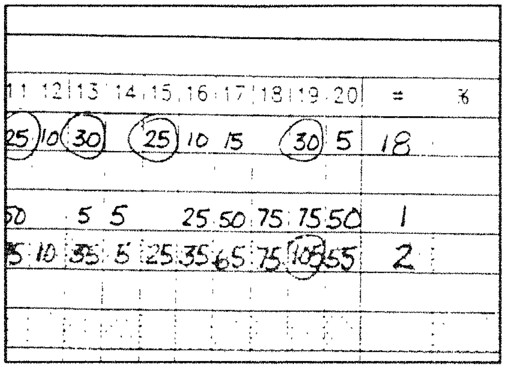
p 1 of 3

11	12	13	14	15	16	17	18	19	20	#	%
25	10	30		25	10	15		30	5	[illegible]	
50		5	5		25	50	75	75	50		

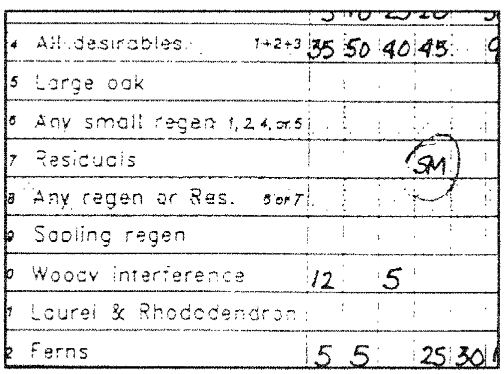
48. The stocked plots are circled on the tally form, and the count recorded in the # column to the right.



49. Add the counts in rows 1, 2 and 3 (black cherry, small oak, and other desirables) to calculate an "all desirables" total to compare with the appropriate "all desirables" criterion.



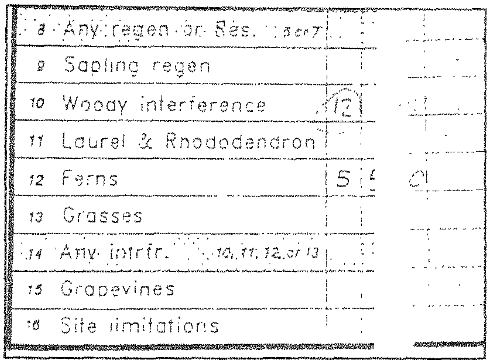
50. Record this number in the "all desirables" # column.



51. For the residuals and sapling regen rows, count the number of plots that have an entry and record the value in the # column.

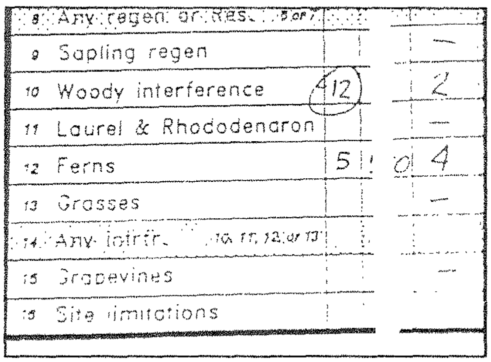
Type	Counting Criteria
Woody Interference	All plots with 12 stems or more
Fern	All plots with at least 30% coverage
Grass	All plots with at least 30% coverage
Laurel and Rhododendron	Count plots coded 4 as 1, count plots coded 2 or 3 as 1/2
Grapevine	All plots with at least 1 vine

52. Critical levels of interference are listed on this table, also found in Appendix 6C.



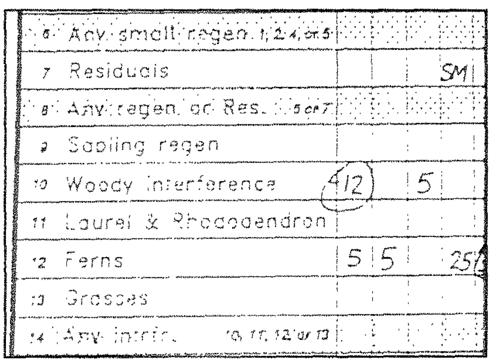
8 Any regen or Res. 5 or 7			
9 Sapling regen			
10 Woody interference	12		
11 Laurel & Rhododendron			
12 Ferns	5		0
13 Grasses			
14 Any intrfr. 10, 11, 12, or 13			
15 Grapevines			
16 Site limitations			

53. For the woody interference, laurel and rhododendron, fern, grass, and grapevine rows, count the number of plots that meet these criteria and record in the # column.



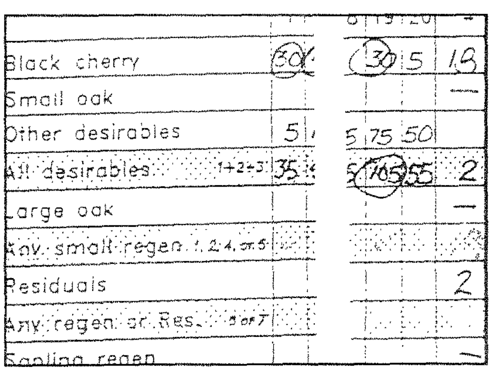
8 Any regen or Res. 5 or 7			
9 Sapling regen			—
10 Woody interference	4 12		2
11 Laurel & Rhododendron			—
12 Ferns	5	0	4
13 Grasses			—
14 Any intrfr. 10, 11, 12, or 13			
15 Grapevines			—
16 Site limitations			

54. For the site limitations row, count the number of plots with an entry and record this value in the # column.



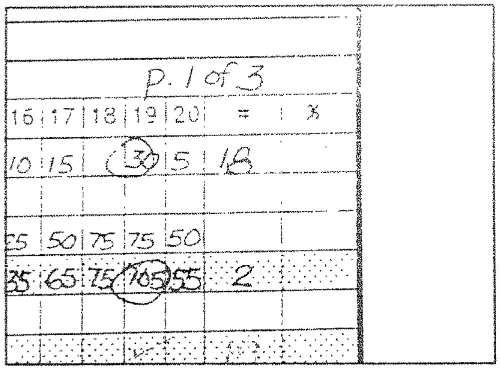
6 Any small regen 1, 2, 4, or 5			
7 Residuals			SM
8 Any regen or Res. 5 or 7			
9 Sapling regen			
10 Woody interference	4 12	5	
11 Laurel & Rhododendron			
12 Ferns	5	5	25
13 Grasses			
14 Any intrfr. 10, 11, 12, or 13			

55. Three rows of regeneration data are combinations of other categories: any small regen, any regen or residuals, and any interference. Each of these is highlighted on the tally sheet, and a list of row numbers combined to form this row is in the title block.

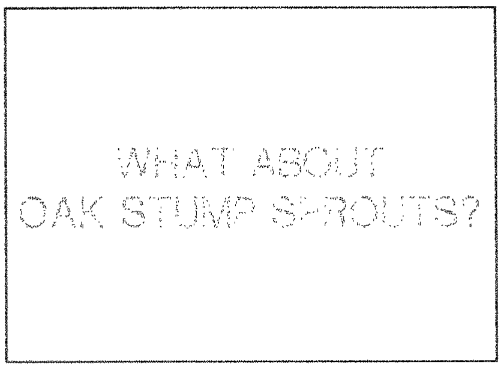


Black cherry	30	30	5	15	
Small oak					—
Other desirables	5	5	75	50	
All desirables 1+2+3	35	5	105	55	2
Large oak					—
Any small regen 1, 2, 4, or 5					
Residuals					2
Any regen or Res. 5 or 7					
Sapling regen					—

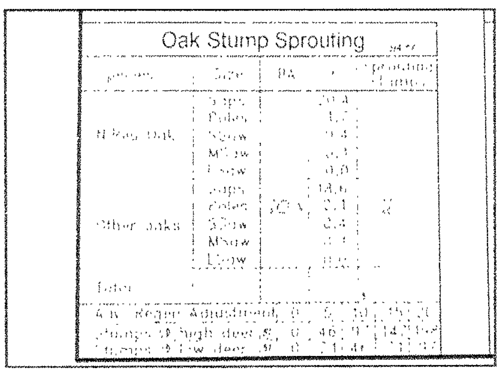
56. To complete these combined rows, determine whether any of the rows listed meet the appropriate criteria. For example, the numbers in the any small regen block are 1,2,4, and 5, or black cherry, small oak, all desirables, and large oak. So, for each plot that met the criteria for one or more of those rows, put a check mark in the any small regen, or sixth, row. Total the number of check marks and record the value in the # column. Do likewise for any regen or residuals (row 8) and for any interference (row 14).



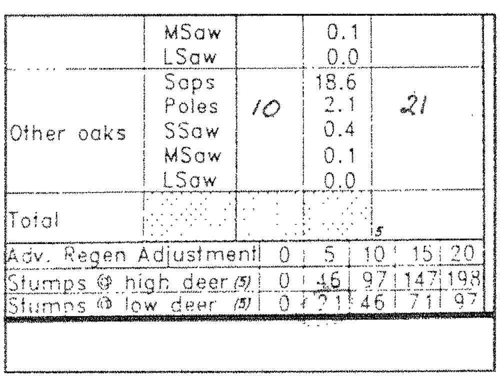
57. To determine the percentage that meet the various criteria divide by the number of plots taken. This is why it is critical to cross off the number of each plot that you take, whether or not it has any countable seedlings or interference. The prescription selection for any stand is based on the percentage of regeneration plots meeting stocking criteria. The percentage can be correct only if the total number of regeneration plots is accurately reflected on the form, so it is critical to record plots that had no recordable data.



58. There is one exception to this procedure for summarizing regeneration data. In stands with a significant component of oak, the probable contribution of oak stump sprouts to the next stand can be calculated from overstory data and added to advance regeneration stocking.



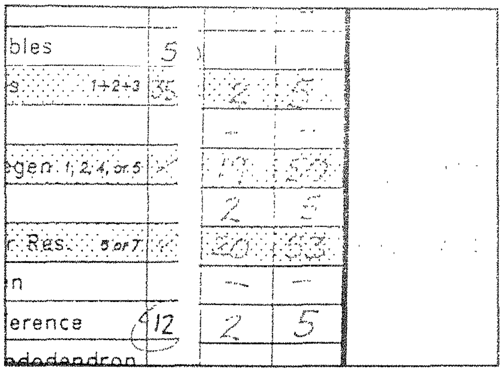
59. The Prescription Summary Worksheet (Appendix 5) contains the oak stump sprouting section required to complete this calculation. To calculate the expected number of stump sprouts per acre, record the basal area for each size class and each oak species group represented in the stand in the BA column. Multiply the basal area times the appropriate factor on the table. Add these to estimate the total number of stumps that will contribute sprouts to the next stand. For example, 10 square feet of white oak poletimber would yield 21 sprouting stumps per acre.



	MSaw		0.1	
	LSaw		0.0	
Other oaks	Saps		18.6	
	Poles	10	2.1	21
	SSaw		0.4	
	MSaw		0.1	
	LSaw		0.0	
Total				5

Adv. Regen Adjustment	0	5	10	15	20
Stumps @ high deer (5)	0	46	97	147	198
Stumps @ low deer (5)	0	21	46	71	97

60. The bottom of this section has figures used to determine the adjustment to advance regeneration stocking represented by oak stump sprouts. Locate the number of sprouts you calculated in the last step in the column for the appropriate deer pressure, then read the adjustment factor in the first column. The maximum adjustment for stump sprouts is 20 percent. For example, the 21 sprouts per acre we expected from our 10 square feet of white oak poletimber would add 5 percent to our advance regeneration stocking in a low deer pressure area. In a high deer pressure area, we would interpolate from the table and add about 2 percent to advance regeneration stocking.



bles	5		
s 1+2+3	35	2	5
		--	--
gen 1, 2, 4, or 5	✗	19	55
		2	5
r Res 5 or 7		20	63
n		--	--
erence	4/12	2	5
hododendron			

61. Add this adjustment percentage to the any regen or residuals row of the regeneration data summary (row 8) on the ID & Regen Tally Form.

SUMMARY DATA SHOWS:

Overstory species composition, basal area, density, structure and quality

Understory species composition, seedling numbers, residual trees, interfering plants, and site problems

62. After completing the three summary forms, we know a great deal about the present overstory--species composition, density, basal area, structure, and quality. We also know a great deal about the present understory--seedlings, potential residual trees or saplings of a different age class, site problems, and interfering plants.

ANALYSIS:

Extract 17 variables that will uniquely determine a prescription for this stand

63. The next step is to extract the particular overstory and understory values needed to determine the best prescription for this stand. Record the values on the Prescription Summary worksheet (Appendix 5).

Prescription Variables

Site & Environmental Factors

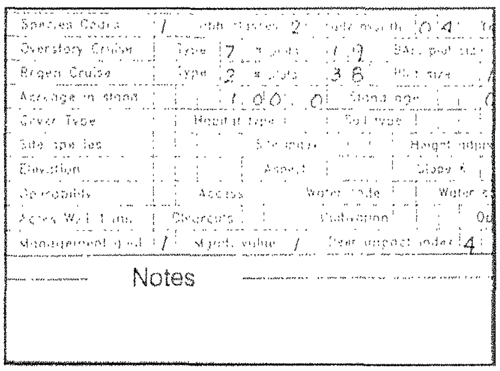
Understory Factors

Overstory Factors

64. The values we will extract are those needed to use SILVAH'S decision charts. In concept, we are extracting key information about management objectives and constraints, the regeneration capacity of the stand, and the maturity and present growing conditions of the overstory.

Prescription Variables	
Site & Environmental Factors	
Management Goal	
Deer impact index	
Seed source index	
Site limitations	

65. The first group of considerations are site and environmental factors. Management goal and deer impact index are the first of these factors.



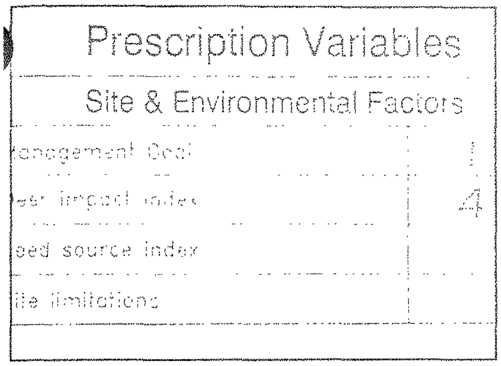
66. They are found in the identification data block of the ID & RegenTally Form (Appendix 4).

Prescription Variables	
Site & Environmental Factors	
Management Goal	1
Deer impact index	
Seed source index	
Site limitations	

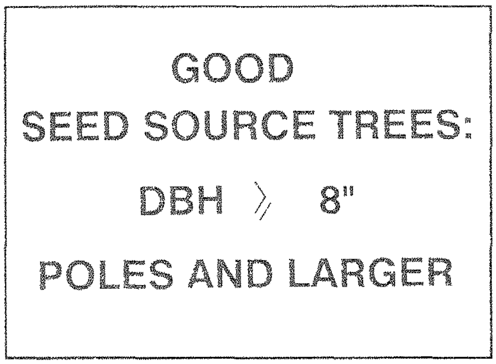
67. The codes for these values are reviewed in the article "Stand Examination Procedures." Management goal is the code that represents management objectives and constraints for the stand. Management goal ranges from 1 for those whose goal is maximum timber production with even-age practices to 4 for those whose goal includes some timber production while retaining many large trees.

Prescription Variables	
Site & Environmental Factors	
Management Goal	1
Deer impact index	4
Seed source index	
Site limitations	

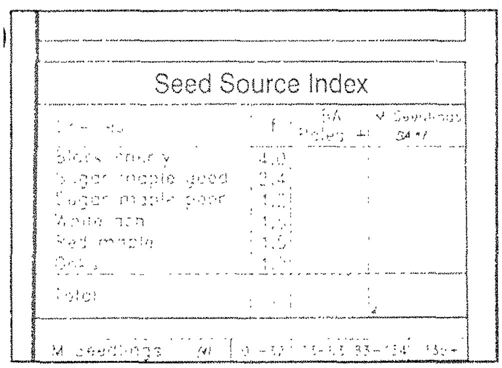
68. The values for deer pressure range from 5 for very high to 1 for very low.



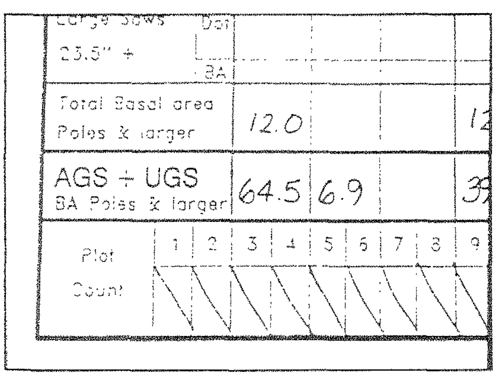
69. The third of the site and environmental factors is seed source index. It indicates the adequacy of seed source, which, if too low, is a very important limiting factor for regeneration.



70. Our research indicates that trees 8 inches and larger are the principal sources of seed in Allegheny hardwood and oak stands. Using the manual form, we can not break out trees 8 inches and larger, as the computer does. However, we can total the basal area in trees 6 inches--or pole size--and larger. Make this compromise when using the manual procedures.



71. This calculation is performed in the Seed Source Index column in the left hand column of the Prescription Summary worksheet.



72. We have already calculated the basal area in poles and larger for each species or species group on the Manual Overstory Tally form. In the sample stand, there are 64.5 square feet of basal area in pole size and larger black cherry trees. Record this value in the BA column of the Seed Source Index section on the Prescription Summary worksheet.

Seed Source Index

Species	f	BA Poles +	M Seedlings BA • f
Black cherry	4.0		
Sugar maple good	2.4		
Sugar maple poor	1.2		
White ash	1.5		
Red maple	1.5		
Oaks	1.0		
Total			

73. Our data on seed production cover the major species in the Allegheny hardwood and oak forests of the Allegheny Plateau region. Record the basal area in poles and larger for black cherry, white ash, red maple, the oaks, and sugar maple in the Seed Source Index section.

Seed Source Index

Species	f	BA Poles +	M Seedlings BA • f
Black cherry	4.0	64.5	
Sugar maple good	2.4		
Sugar maple poor	1.2		
White ash	1.5	6.9	
Red maple	1.5	39.5	
Oaks	1.0		
Total			

74. Two rows are provided for sugar maple basal area. In some parts of the Allegheny region, such as southwestern New York state, sugar maple trees tend to be in the main crown canopy, have vigorous healthy crowns, and produce ample seed. If the stand you have sampled is similar, record the basal area in poles and larger trees on the sugar maple good row.

Seed Source Index

Species	f	BA Poles +	M Seedlings BA • f
Black cherry	4.0	64.5	
Sugar maple good	2.4		
Sugar maple poor	1.2	[illegible]	
White ash	1.5	6.9	
Red maple	1.5	39.5	
Oaks	1.0		
Total			

M Seedlings (4)	0 – 32	33 – 83	83 – 134	135+
Seed Source Index	4	3	2	1

75. In other regions of the Plateau, however, such as the Allegheny National Forest, sugar maple rarely reaches into the main crown canopy. The crowns of sugar maple in such stands are often small and lack vigor. In some stands, seed production is also limited by disease, insect defoliation, or decline. When the stand you have sampled is similar, record its basal area in pole and larger trees in the sugar maple poor row.

Seed Source Index

Species	f	BA Poles +	M Seedlings BA • f
Black cherry	4.0	64.5	[illegible]
Sugar maple good	2.4		
Sugar maple poor	1.2	26.3	[illegible]
White ash	1.5	6.9	[illegible]
Red maple	1.5	39.5	[illegible]
Oaks	1.0		
Total			[illegible]

M Seedlings (4)	0 – 32	33 – 83	83 – 134	135+
Seed Source Index	4	3	2	1

76. Next, multiply each basal area by the seed source factor in the column labeled f. Record the answer, which is an estimate of the number of seedlings in thousands of that species likely to be produced per acre over the 5-year period of a shelterwood seed cut, in the last column of the section, and sum the values.

Seed Source Index

Species	f	3A Poles —	M Seedlings 3A * f
Black cherry	4.0	64.5	258.0
Sugar maple good	2.4		
Sugar maple poor	1.2	26.3	31.6
White ash	1.5	6.9	10.4
Red maple	1.5	39.5	59.3
Oaks	1.0		
Total			(359.3)

M Seedlings (4)	0-32	33-83	83-134	135+
Seed Source Index	4	3	2	1

77. Finally, match your total to the values in the M seedlings row, and read the appropriate index value below. An index value of 1 indicates abundant seed production, while an index value of 4 indicates severe limitations to regeneration due to seed production.

Prescription Variables

Site & Environmental Factors

gement Goal	1
impact index	4
source index	1
mitations	

78. Record the index value in the seed source index row in the Site and Environmental Factors section.

8 Any regen or Res. 6 or 7					
9 Sapling regen					
10 Woody interference	(12)		5		
11 Laurel & Rhododendron					
12 Ferns	5	5		25	(30)
13 Grasses					
14 Any intrfr. 10, 11, 12 or 13	✓				✓
15 Grapevines					
16 Site limitations					

79. The final row in the Site and Environmental Factors section, site limits, is the percentage of regen plots that were checked off as either wet or rocky.

Prescription Variables

Site & Environmental Factors

anagement Goal	1
eer impact index	4
eed source index	1
ite limitations	0

80. The value for this prescription variable can be transferred directly from the ID & Regen Tally Sheet (Appendix 4). In the sample stand, it was zero.

Understory Factors	
Any small regen	
Any regen or residuals	
Any small regen – no deer	
Any regen or residuals – no deer	
Sapling regen	
Any interference	

81. Most of the Understory Factors also can be transferred directly from the understory summary (Appendix 5) to the appropriate space on this form.

Any small regen 1, 2, 4, or 5		19	50
Residuals		2	5
Any regen or Res. 3 or 7		20	53
Sapling regen			
Woody interference		2	5
Laurel & Rhododendron			
Ferns	20	4	11
Grasses			
Any intrfr. 10, 11, 12, or 13		5	13

82. We have already calculated the values for any small regen, any regen or residuals, sapling regen, and any interference.

Understory Factors	
Any small regen	[illegible]
Any regen or residuals	[illegible]
Any small regen – no deer	
Any regen or residuals – no deer	
Sapling regen	[illegible]
Any interference	[illegible]

83. So, we record the values: 50 percent of understory plots stocked with any small regen, 53 percent with any regen and residuals, none with sapling regen, and 13 percent with any interference.

Understory Factors	
Any small regen	50
Any regen or residuals	53
Any small regen – no deer	
Any regen or residuals – no deer	
Sapling regen	0
Any interference	13

84. We need to make two new calculations, however. Because seedlings inside fences are protected from deer browsing and the associated losses, the regen stocking required for successful regeneration cuts inside a fence is lower than that in moderate to high deer pressure areas. The values that we need for any small regen-no deer and for any regen or residuals-no deer are calculated from our weighted counts, just as the original values for any regen and any regen or residuals were calculated. For the no deer values, however, we use the criteria for plot stocking associated with a deer pressure of 1 on the advance regen stocking table in Appendix 6B.

Deer Index	Black Cherry	Small Oak	Ot D
5	50	60	2
4	25	40	1
3	20	30	
2	15	20	
1	10	10	

85. For example, we only considered those plots with 25 or more black cherry seedlings stocked in our original calculations, since 25 was the criterion associated with our ambient deer pressure level of 4. But if we were inside a fence, 10 seedlings per plot would be ample stocking.

	1	2	3	4	5
1 Black cherry	30	40	15	25	
2 Small oak					
3 Other desirables	5	10	25	20	
4 All desirables 1+2+3	35	50	40	45	
5 Large oak					
6 Any small regen 1, 2, 4, or 5	✓	✓		✓	
7 Residuals				SM	
8 Any regen or Res 5 or 7	✓	✓	✓	✓	

86. With this criteria, many more of the understory plots can be considered stocked with the various categories of advance regeneration. The criteria for other desirables and all desirables under a Deer Impact Index of 1, for example, is 15 seedlings; so, there is a very big change in these figures.

	#	%	NO DEER #	NO DEER %
herry	18	47	29	76
ok				
esirables	1	3	15	39
ables 1+2	2	5	20	53
ok				
lt regen 1, 2, 4, 5	19	50	29	76
s	2	5		
en or Res 5 o	20	53	29	76

87. In the sample stand, using these changed criteria, 30 of the regeneration plots in the sample stand, or 76 percent, can be considered stocked with any regen, and with any regen and residuals.

Understory Factors	
Any small regen	50
Any regen or residuals	53
Any small regen – no deer	76
Any regen or residuals – no deer	76
Sapling regen	0
Any interference	13

88. We transfer these values to the Understory Factors section.

Oak Stump Sprouting				
Species	Size	BA	f	Sprouting stumps
N.Red Oak	Saps		20.4	
	Poles		1.7	
	SSaw		0.4	
	MSaw		0.1	
	LSaw		0.0	
Other oaks	Saps		18.6	
	Poles		2.1	
	SSaw		0.4	
	MSaw		0.1	
	LSaw		0.0	
Total				

Adv. Regen Adjustment	0	5	10	15	20
Stumps @ high deer	0	46	97	147	198
Stumps @ low deer	0	21	46	71	97

89. To these values, we would add the oak stump sprouting adjustment for low deer pressure in a stand with oak.

Overstory Factors	
Sapling basal area	
Shade tolerant basal area	
Relative stand density	
Relative density AGS	
Stand diameter (MD)	
Merch. stand diameter (MDM)	
Years to maturity	

90. The final category of values that we need to extract from our data summary is Overstory Factors. Three of these can be transferred directly from the Manual Overstory Summary sheet (Appendix 3).

All Species				
A*f	Cords	BA	RD	BdFt
.0		11.1	13.0	
.5	6.7 0.18	37.4	32.7	
.5	16.1 0.22	73.1	38.8	4777
.5	8.6 0.24	35.8	12 1	3996
.5	0.1 0.28	0.5	0.1	74
	31.5	157.9	96.7	8847

91. Sapling basal area is the grand total for saplings, all species, all qualities. For this stand, the value is 11 square feet, and it is found in the sapling cell of the basal area totals column, and recorded on the Prescription Summary worksheet.

		All Species		
...f	Cords	BA	RD	BdFt
5.0		11.1	13.0	
3.5	6.7 0.15	37.4	32.7	
4.5	16.1 0.22	73.1	38.8	4777
0.5	8.6 0.24	35.8	12.1	3996
5.5	0.1 0.28	0.5	0.1	74
	31.5	157.9	96.7	8847

92. Relative stand density is also the total, for the whole stand. The total relative density is in the lower right corner of the Manual Overstory Summary sheet.

-00	All Species AGS		
BdFt	BA	RD	BdFt
	4.2	4.9	
	23.7	20.2	
371 64	55.3	28.3	4139
106	27.9	9.0	3525
120	0.5	0.1	74
371	111.6	62.5	7738

93. The relative density AGS is the total relative density for the Acceptable Growing Stock only. This is found in the AGS summary block near the top of the Manual Overstory Summary sheet. For this stand, the value is 63 percent.

Overstory Factors	
Sapling basal area	11
Shade tolerant basal area	
Relative stand density	97
Relative density AGS	63
Stand diameter (MD)	
Merch. stand diameter (MDM)	
Years to maturity	

94. Record all three values on the Overstory Factors section of the Prescription Summary worksheet (Appendix 5).

M Seedlings	(4) 0-32	33-33	83-134	135+
Seed Source Index	4	3	2	1

Shade Tolerant Composition

Species	Total basal area
Sugar maple	
American beech	
Eastern hemlock	
Total	

Oak Stump Sprouting BA • f

Species	Size	BA	f	Sprouting stumps

95. The next value is shade tolerant basal area. We are interested in this value because we need ample basal area in shade tolerant species if uneven-age management techniques are to succeed in this stand. A section is provided for this calculation on the left side of the Prescription Summary worksheet.

N. Red oak	Eastern hemlock	All others	Sugar maple	Amer. beech	Striped maple	Other oaks hickory
		(1)	(3)	(3)		
		.5	1.6	1.6		
		(3)	(19)	(3)		
		1.6	10.0	1.6		
		(3)	(9)	(2)		
		1.6	4.7	1.1		

96. Calculate the total basal area in sugar maple, American beech, and eastern hemlock. The total you calculate should include all size classes and both quality classes.

Seed Source Index	4	3	2

Shade Tolerant Compositio

Species	Total basal area
Sugar maple	30.0
American beech	10.1
Eastern hemlock	
Total	40.1

Oak Stump Sprouting

Species	Size	BA	f	Spro stu

97. Record each species total on the appropriate line and sum these values. For this stand, the total is 40 square feet.

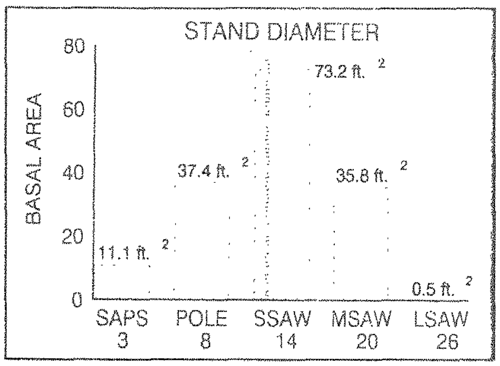
Overstory Factors

Sapling basal area	11
Shade tolerant basal area	4
Relative stand density	97
Relative density AGS	63
Stand diameter (MD)	
Merch. stand diameter (MDM)	
Years to maturity	

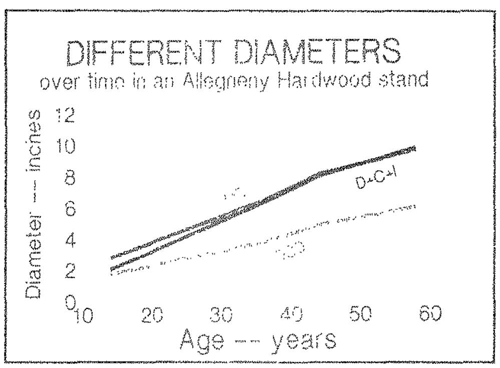
98. Record the sum as the shade tolerant basal area in the Overstory Factors section.

Overstory Factors	
Sapling basal area	11
Shade tolerant basal area	40
Relative stand density	97
Relative density AGS	63
Stand diameter (MD)	
Merch. stand diameter (MDM)	
Years to maturity	

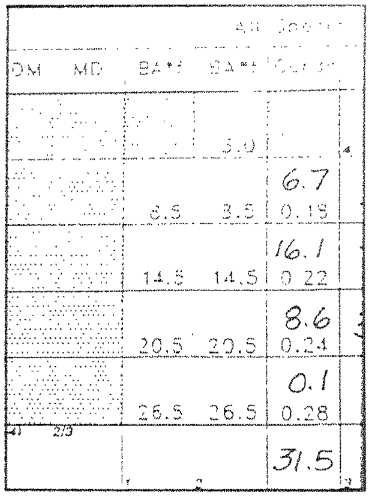
99 The next three calculations are interrelated, and are used to assess the maturity of the stand. They also will be reference values for development of a marking guide if the stand prescription calls for any intermediate cuttings.



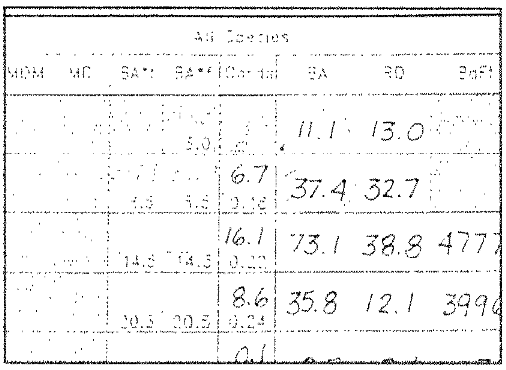
100. The stand diameters that we calculate are the diameters at the midpoint of the basal-area distribution. Diameter (MD) is the diameter at the midpoint of the entire distribution, while the merchantable diameter (MDM) is the diameter at the midpoint of the distribution of merchantable stems, or poles and sawtimber. We choose these diameters because they reflect the diameter of the trees that will be managed. We can also determine these diameters accurately from prism data.



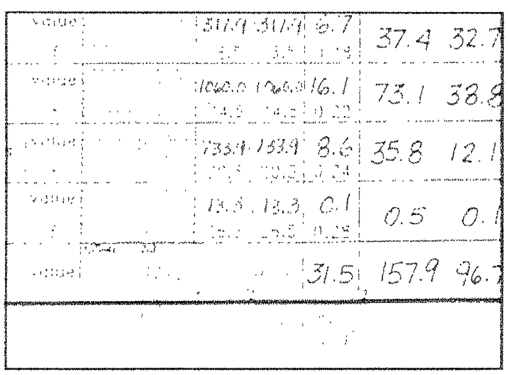
101. Other diameters are greatly affected by the numerous small trees that persist in the understories of mixed hardwood stands. This graph compares three different diameters over the life of a hardwood stand with a persistent understory of shade tolerant species. You can see that "MD", the diameter used in the SILVAH calculations, tracks right along with the diameter of the dominants, codominants, and intermediates, whereas the diameter of the tree of average basal area (QSD, or quadratic stand diameter) falls behind early. This occurs because its calculation is heavily influenced by the numerous small trees.



102. A section is provided at the bottom of the Manual Overstory Summary sheet to help calculate these diameters. The factors are the mid-point diameters for each size class: 8.5 is midway between 5.5 and 11.5, 14.5 is midway between 11.5 and 17.5, and so on. There is one column for calculating MD, the medial diameter of the whole stand, and another, to the left, for calculating MDM, the medial diameter of the merchantable portion of the stand.



103. Multiply the basal area in each size class times the appropriate diameter, and record these products on the form. Record the answers for poles and larger trees twice, to make the calculation for the whole stand and another for the merchantable trees.



104. Then sum and divide the result by the total basal area of the included classes. For MD, divide the total weighted basal area for all size classes, 2158.3, by the total basal area in the stand, or 157.9, and record this answer in the appropriate cell at the bottom.

[illegible]		[illegible]	[illegible]	[illegible]	27.4	32.7
[illegible]		[illegible]	[illegible]	16.1	73.1	38.8
[illegible]		[illegible]	[illegible]	8.6	35.6	12.1
value		13.5	13.5	0.1	0.5	0.1
value	13.7	[illegible]	31.5	157.9	96.7	

105. For MDM, divide the total in the next column, 2125.0, which excludes the saplings, by the basal area in the merchantable sizes, 157.9 minus 11.1 equals 146.8. The answer, 14.5, is recorded as the MDM.

Overstory Factors	
Sapling basal area	11
Shade tolerant basal area	40
Relative stand density	97
Relative density AGS	63
Stand diameter (MD)	[illegible]
Merch. stand diameter (MDM)	[illegible]
Years to maturity	

106. Then record the values to one decimal place on the MD and MDM rows in the Overstory Factors section on the Prescription Summary worksheet.

Overstory Factors	
Sapling basal area	11
Shade tolerant basal area	40
Relative stand density	97
Relative density AGS	63
Stand diameter (MD)	13.7
Merch. stand diameter (MDM)	14.5
Years to maturity	

107. The final calculation is that for years to maturity. Our definition of stand maturity is based on many simulations of stand development, using an economic criteria of dollars per acre per year, or the culmination of mean annual increment of dollar value.

Stand is mature

when merchantable

diameter is 18"

108. With this criteria, most Allegheny hardwood stands reach maturity when the medial diameter of the merchantable portion of the stand reaches 18 inches.

$$\text{YEARS} = \frac{(18'' - \text{DIAM})}{\text{GROWTH FACTOR}}$$

109. Years to maturity is an estimate of how long it will take the stand to reach that point. To make this estimate, we need to know the present merchantable diameter and something about the rate at which that diameter increases. We have used growth data from some 200 plots to develop an equation that will estimate years until MDM equals 18 inches.

Years to Maturity

Species	BA	BA Sums	f	BA*f
Black cherry White ash Yellow poplar Red maple No. red oak Eastern hemlock All others			.20	
Sugar maple American beech Striped Maple			.15	

110. Calculate years to maturity in that section in the upper left corner of the Prescription Summary worksheet.

GROWTH OF AV. DIAM.

BC, RM ⟶ .2"/YR

111. The rate of average diameter growth for species in the black cherry and red maple groups is about 0.2 inches per year. This is an increase in average diameter, which comes about both through the growth of living trees and through the mortality of the smaller ones.

GROWTH OF AV. DIAM.

SM, AB ⟶ .15"/YR

112. The rate of average diameter growth for species in the sugar maple/American beech group is about 0.15 inches per year. Both of these factors are recorded in the factor columns of the Years to Maturity section.

$$GF_{stand} = \frac{\sum BA_{sp} * GF_{sp}}{\text{Total BA}}$$

113. Use the Years to Maturity formula to calculate the years to maturity for each individual species group, or use a weighted average growth rate, reflecting the species composition of the entire stand, and calculate the years to maturity for the stand as a whole. This weighted average growth factor equals the basal area in each species group times its appropriate growth factor, divided by the total basal area of the stand. The answer will always be between 0.15 and 0.2.

Years to Maturity

Species	BA	BA Sums	f	BA*f
Black cherry	[illegible]			
White ash	[illegible]			
Yellow poplar				
Red maple	[illegible]		.20	
No. red oak				
Eastern hemlock				
All others	[illegible]			
Sugar maple	[illegible]			
American beech	[illegible]		.15	
Striped Maple				
Other oaks, hick.				
Total		[illegible]	[illegible]	
Yrs. to Mat. = (18 − MDM)/growth factor (2)				

114. To determine the answer for the sample stand, record the basal area from each species or species group in the first column of this section. Be sure to include saplings here.

Years to Maturity

Species	BA	BA Sums	f	BA*f
Black cherry	[illegible]			
White ash	[illegible]			
Yellow poplar				
Red maple	[illegible]	[illegible]	.20	[illegible]
No. red oak				
Eastern hemlock				
All others	[illegible]			
Sugar maple	[illegible]			
American beech	[illegible]		.15	[illegible]
Striped Maple				
Other oaks, hick.				
Total	[illegible]	[illegible]	[illegible]	
Yrs. to Mat. = (18 − MDM)/growth factor (2)				

115. Subtotal the basal area by the two species groups in the BA sums column. Multiply each subtotal by the appropriate growth factor and record the product in the BA*f column.

Species	BA	BA Sums	f	BA*f
Black cherry	[illegible]	[illegible]	.20	23.5
White ash	6.3			
Yellow poplar				
Red maple	[illegible]			
No. red oak				
Eastern hemlock				
All others	5.3			
Sugar maple	[illegible]	40.1	.15	6.0
American beech	[illegible]			
Striped Maple				
Other oaks, hick.				
Total		[illegible]	[illegible]	[illegible]
Yrs. to Mat. = (18 − MDM)/growth factor (2)				

116. Sum these products and divide by the total basal area to determine the weighted average growth factor for the stand: 0.19.

Years to Maturity

Total	[illegible]

Yrs. to Mat. = (18 − MDM)/growth factor
18 − 14.5 = 3.5 / .19 = 18

117. The diameter of the merchantable portion of the stand, MDM, is 14.5 inches. With 3.5 inches in merchantable diameter to grow to stand maturity, at a rate of 0.19 inches per year, we anticipate that this stand will mature in about 18 years.

Overstory Factors	
Sapling basal area	11
Shade tolerant basal area	40
Relative stand density	97
Relative density AGS	63
Stand diameter (MD)	13.7
Merch. stand diameter (MDM)	14.5
Years to maturity	18

118. The transfer of this value to the years to maturity row of the Prescription Summary worksheet (Appendix 5) completes the list of prescription variables for this stand. Now we are ready to determine the prescription.

Management Goal	1
Relative density AGS	63
Years to maturity	18

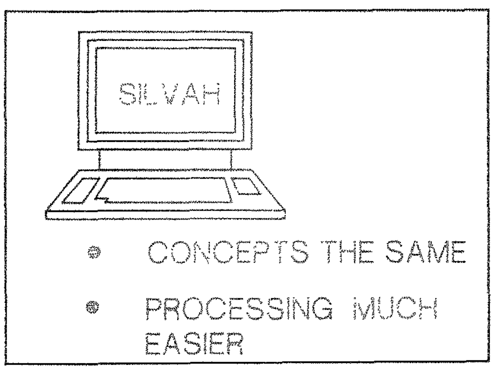
119. What is this prescription? The prescription selection process is described in another chapter. For this stand with a management goal of 1, 63 percent acceptable growing stock, and 18 years to maturity, we are considering intermediate treatments under an even-age silvicultural system.

All Species				
	Cords	BA	RD	Bdft
5.3 .0		11.1	13.0	
.9 .5	6.7 0.18	37.4	32.7	
0.0 .5	16.1 0.22	73.1	38.8	4777
3.9 .5	8.6 0.24	35.8	12.1	3996
.3 .5	0.1 0.28	0.5	0.1	74
3.3	31.5	157.9	96.7	8847

120. The stand's relative density exceeds 80 percent and its sapling basal area is less than 20 square feet, so a commercial thinning should be quite feasible in this stand. In fact, with a board-foot volume of approximately 9,000 board-feet or more than 30 cords, this thinning should make quite an attractive sale.

Prescription:

121. Thus, the prescription is for a commercial thinning.



122. We hope that this material has helped you understand the processing "inside" the computer program. All of the calculations that I have described are basically what happens--with lightning speed--inside a computer running the SILVAH program. All you have to do is give the program some good data. By going through the calculations by hand once or twice, you really can "see through" the case of your computer to understand the calculations that are being made.

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SILVAH - Computer Overstory Tally Form

USDA, Forest Service, NEFES, Warren, PA 1/91

Overstory Data

Stand ID Comp 171, Stand 123 Sheet 1 of 3

Species	dbh	Quality	Ht. or Count	Grade	Defect	Crown	Wildlife	Species	dbh	Quality	Ht. or Count	Grade	Defect	Crown	Wildlife	Species	dbh	Quality	Ht. or Count	Grade	Defect	Crown	Wildlife
BC	18	1	2					RM	12	2		6				SM	12	1	1				
SM	2	2						SM	6	1						AB	14	2		8			
BC	16	1	4					SM	10	2						SM	8	2		6			
BC	12	1	1					RM	14	1	4					AB	6	2		6			
BC	18	1	4					RM	10	1						0							
RM	8	1						BC	22	1	5					SM	4	1					
RM	8	1						B	10	1						AB	6	2		6			
RM	10	1						AB	6	2						RM	14	1	2				
RM	14	1	1					BC	22	2	3					RM	12	1	1				
RM	16	1	1					RM	14	1	4					SM	6	1					
RM	18	2	1					RM	12	2		6				SM	10	2		6			
BC	12	1	2					0								BC	18	1	4				
RM	8	1						SM	8	1						BC	14	1	2				
R'M	8	1						BC	16	1	4					BC	18	1	4				
RM	14	1	2					BC	14	1	4					BC	18	1	3				
0								BC	12	2	2					BC	18	1	3				
RM	12	1	2					BC	16	1	4					BC	18	1	4				
RM	20	2		8				BC	20	1	4					BC	16	1	3				
RM	18	2		8				SM	4	1						BC	16	1	3				
RM	12	1	2					WA	8	1						0							
RM	16	1	3					BC	16	1	3					BC	20	1	5				
BC	20	1	5					BC	16	1	3					SM	8	2		6			
RM	6	2						BC	18	1	3					BC	20	1	6				
RM	4	1						WA	14	1	3					SM	6	1					
BC	18	1	2					SM	2	2		6				SM	12	1	1				
BC	22	1	6					BC	12	2	1					RM	10	2		6			
RM	14	2	1					BC	22	1	4					SM	10	1					
RM	12	1	1					WA	20	1	4					SM	14	1					
BC	12	2		6				BC	18	1	3					0							
BC	20	1	3					0								RM	10	1					
0								SM	6	1						RM	12	2		6			
SM	10	1						AB	2	1						RM	10	1					
BC	18	2	3					BC	18	2	3					RM	18	1	4				
RM	16	1	3					BC	16	1	3					AB	8	2		8			
SM	10	2						SM	6	1						RM	8	1					
SM	10	1						SM	10	1						RM	12	1	1				
BC	18	1	3					SM	10	1						RM	16	1	4				
RM	16	1	2					BC	16	2	2					RM	8	2		6			

SILVAH - Computer Overstory Tally Form

U.S.A. Forest Service, NEFES, Warren, PA 1/91

Overstory Data

Stand ID ______________________ Sheet ____ of ____

Species	dbh	Quality	Ht. or Count	Grade	Defect	Crown	Wildlife	Species	dbh	Quality	Ht. or Count	Grade	Defect	Crown	Wildlife	Species	dbh	Quality	Ht. or Count	Grade	Defect	Crown	Wildlife

SILVAH - Manual Overstory Tally Form

Stand ID

USDA, Forest Service, NEFES, Warren, PA 1/91

AGS Size class		Black cherry	White ash	Yellow poplar	Red maple	N. Red oak	Eastern hemlock	All others	Sugar maple	Amer. beech	Striped maple	Other oaks, hickory
Saplings 1.0 – 5.5"	Dot				1			1	3	3		
	BA				.5			.5	1.6	1.6		
Poles 5.5 – 11.5"	Dot	5	1		14			3	19	3		
	BA	2.6	.5		7.4			1.6	10.0	1.6		
Small Saws 11.5 – 17.5"	Dot	47	10		34			3	9	2		
	BA	24.7	5.3		17.9			1.6	4.7	1.1		
Medium Saws 17.5 – 23.5"	Dot	47	2		4							
	BA	24.7	1.1		2.1							
Large Saws 23.5" +	Dot	1										
	BA	.5										
Total Basal area Poles & larger		52.5	6.9		27.4			3.2	14.7	2.7		

UGS Size class		Black cherry	White ash	Yellow poplar	Red maple	N. Red oak	Eastern hemlock	All others	Sugar maple	Amer. beech	Striped maple	Other oaks, hickory
Saplings 1.0 – 5.5"	Dot				2				4	7		
	BA				1.1				2.1	3.7		
Poles 5.5 – 11.5"	Dot	1			5			2	15	3		
	BA	.5			2.6			1.1	7.9	1.6		
Small Saws 11.5 – 17.5"	Dot	13			12			1	7	1		
	BA	6.8			6.3			.5	3.7	.5		
Medium Saws 17.5 – 23.5"	Dot	9			6							
	BA	4.7			3.2							
Large Saws 23.5" +	Dot											
	BA											
Total Basal area Poles & larger		12.0			12.1			1.6	11.6	2.1		
AGS + UGS BA Poles & larger		64.5	6.9		39.5			4.8	26.3	4.8		

Plot	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Conversion factor
Count	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		BAF/# plots 10/19 = .526

BA = Dots * Conversion factor

SILVAH - Manual Overstory Tally Form

Stand ID

USDA, Forest Service, NEFES, Warren, PA 1/91

AGS Size class		Black cherry	White ash	Yellow poplar	Red maple	N. Red oak	Eastern hemlock	All others	Sugar maple	Amer. beech	Striped maple	Other oaks, hickory
Saplings 1.0 – 5.5"	Dot											
	BA											
Poles 5.5 – 11.5"	Dot											
	BA											
Small Saws 11.5 – 17.5"	Dot											
	BA											
Medium Saws 17.5 – 23.5"	Dot											
	BA											
Large Saws 23.5" +	Dot											
	BA											
Total Basal area Poles & larger												

UGS Size class		Black cherry	White ash	Yellow poplar	Red maple	N. Red oak	Eastern hemlock	All others	Sugar maple	Amer. beech	Striped maple	Other oaks, hickory
Saplings 1.0 – 5.5"	Dot											
	BA											
Poles 5.5 – 11.5"	Dot											
	BA											
Small Saws 11.5 – 17.5"	Dot											
	BA											
Medium Saws 17.5 – 23.5"	Dot											
	BA											
Large Saws 23.5" +	Dot											
	BA											
Total Basal area Poles & larger												
AGS + UGS BA Poles & larger												

Plot	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Conversion factor
Count																					BAF/# plots

*BA = Dots * Conversion factor*

SILVAH - Manual Overstory Summary

Stand ID

USDA, Forest Service, NEFES, Warren, PA 1/91

AGS		BC-WA-YP			RM-NRO-EH-Oth			SM-AB-StM-OO			All Species AGS		
Size class		BA	RD	BdFt	BA	RD	BdFt	BA	RD	BdFt	BA	RD	BdFt
Saplings	value				1.0	1.2		3.2	3.7		4.2	4.9	
	f		1.44			1.21			1.17				
Poles	value	3.1	1.9		9.0	6.8		11.6	11.5		23.7	20.2	
	f		0.60			0.76			0.99				
Small Saws	value	30.0	11.7	2520	19.5	11.1	1248	5.8	5.5	371	55.3	28.3	4139
	f		0.39	84		0.57	64		0.94	64			
Medium Saws	value	25.8	8.0	3302	2.1	1.0	223				27.9	9.0	3525
	f		0.31	128		0.49	106		0.92	106			
Large Saws	value	.5	0.1	74							0.5	0.1	74
	f		0.27	148		0.44	120		0.91	120			
All Sizes AGS	value	59.4	21.7	5896	31.6	20.1	1471	20.6	20.7	371	111.6	62.5	7738
UGS		**BC-WA-YP**			**RM-NRO-EH-Oth**			**SM-AB-StM-OO**			**All Species UGS**		
Size class		BA	RD	BdFt	BA	RD	BdFt	BA	RD	BdFt	BA	RD	BdFt
Saplings	value				1.1	1.3		5.8	6.8		6.9	8.1	
	f		1.44			1.21			1.17				
Poles	value	0.5	0.3		3.7	2.8		9.5	9.4		13.7	12.5	
	f		0.60			0.76			0.99				
Small Saws	value	6.8	2.7	286	6.8	3.9	218	4.2	3.9	134	17.8	10.5	638
	f		0.39	42		0.57	32		0.94	32			
Medium Saws	value	4.7	1.5	301	3.2	1.6	170				7.9	3.1	471
	f		0.31	64		0.49	53		0.92	53			
Large Saws	value												
	f		0.27	74		0.44	60		0.91	60			
All Sizes UGS	value	12.0	4.5	587	14.8	9.6	388	19.5	20.1	134	46.3	34.2	1109

Multiply factor (f) by basal area (BA)

AGS + UGS		All Species							
Size class		MDM	MD	BA*f	BA*f	Cords	BA	RD	BdFt
Saplings	value				33.3		11.1	13.0	
	f				3.0		[4]		
Poles	value			317.9	317.9	6.7	37.4	32.7	
	f			8.5	8.5	0.18			
Small Saws	value			1060.0	1060.0	16.1	73.1	38.8	4777
	f			14.5	14.5	0.22			
Medium Saws	value			733.9	733.9	8.6	35.8	12.1	3996
	f			20.5	20.5	0.24			
Large Saws	value			13.3	13.3	0.1	0.5	0.1	74
	f			26.5	26.5	0.28			
All Sizes	value	1/(3-4) 14.5	2/3 13.7	2125.0 [1]	2158.3 [2]	31.5	[3] 157.9	96.7	8847

SILVAH - Manual Overstory Summary

Stand ID

USDA, Forest Service, NEFES, Warren, PA 1/91

AGS		BC-WA-YP			RM-NRO-EH-Oth			SM-AB-StM-OO			All Species AGS		
Size class		BA	RD	BdFt	BA	RD	BdFt	BA	RD	BdFt	BA	RD	BdFt
Saplings	value												
	f		1.44			1.21			1.17				
Poles	value												
	f		0.60			0.76			0.99				
Small Saws	value												
	f		0.39	84		0.57	64		0.94	64			
Medium Saws	value												
	f		0.31	128		0.49	106		0.92	106			
Large Saws	value												
	f		0.27	148		0.44	120		0.91	120			
All Sizes AGS	value												

UGS		BC-WA-YP			RM-NRO-EH-Oth			SM-AB-StM-OO			All Species UGS		
Size class		BA	RD	BdFt	BA	RD	BdFt	BA	RD	BdFt	BA	RD	BdFt
Saplings	value												
	f		1.44			1.21			1.17				
Poles	value												
	f		0.60			0.76			0.99				
Small Saws	value												
	f		0.39	42		0.57	32		0.94	32			
Medium Saws	value												
	f		0.31	64		0.49	53		0.92	53			
Large Saws	value												
	f		0.27	74		0.44	60		0.91	60			
All Sizes UGS	value												

Multiply factor (f) by basal area (BA)

AGS + UGS		All Species							
Size class		MDM	MD	BA*f	BA*f	Cords	BA	RD	BdFt
Saplings	value								
	f				3.0	4			
Poles	value								
	f			8.5	8.5	0.18			
Small Saws	value								
	f			14.5	14.5	0.22			
Medium Saws	value								
	f			20.5	20.5	0.24			
Large Saws	value								
	f			26.5	26.5	0.28			
All Sizes	value	1/(3-4)	2/3	1	2	3			

SILVAH - ID & Regen Tally Form

Identification Data

USDA, Forest Service, NEFES, Warren, PA 1/91

Sheet 1 of 2

Owner/Agency	USFS
Forest/Property	KANE EXP FOREST
County/District	ELK
Compartment/Unit	171 — Stand No. 23
Remarks	P.1 REGEN DATA
Species Codes	1 — dbh classes 2 — Tally month 04 — Year 1989
Overstory Cruise	Type 7 — # plots 19 — BAF/plot size 10.00
Regen Cruise	Type 2 — # plots 38 — Plot size 1
Acreage in stand	100.0 — Stand age 0
Cover Type	Habitat type — Soil type — Site class
Site species	Site Index — Height adjustment
Elevation	Aspect — Slope % — Topo. position
Operability	Access — Water code — Water code
Acres W/I 1 mi.	Clearcuts — Cultivation — Open — Water code
Management goal	1 — Mgmt. value 1 — Deer impact index 4 — Gypsy moth — Stress

Notes

Regeneration Data

(38 plots)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	#	%
1 Black cherry	30	40	15	25		40	75	50	20	15	25	10	30		25	10	15		30	5		
2 Small oak																						
3 Other desirables	5	10	25	20		50	20	20	75	100	50		5	5		25	50	75	75	50		
4 All desirables 1+2+3																						
5 Large oak																						
6 Any small regen 1, 2, 4, or 5																						
7 Residuals				SM					SM													
8 Any regen or Res. 6 or 7																						
9 Sapling regen																						
10 Woody interference	12		5							8	5	9	25									
11 Laurel & Rhododendron																						
12 Ferns	5	5		25	30	15		5	10	15	20	30	40	50		10	5		15	20		
13 Grasses																						
14 Any intrfr. 10, 11, 12, or 13																						
15 Grapevines																						
16 Site limitations																						

SILVAH - ID & Regen Tally Form

Identification Data

USDA, Forest Service, NEFES, Warren, PA 1/91

Sheet 2 of 2

Owner/Agency	USFS
Forest/Property	KANE EXP FOREST
County/District	ELK
Compartment/Unit	171
Stand No.	23
Remarks	P.2 REGEN DATA - ID ON P. 1
Species Codes	dbh classes: Tally month: Year:
Overstory Cruise	Type: # plots: BAF/plot size:
Regen Cruise	Type: # plots: Plot size:
Acreage in stand	Stand age:
Cover Type	Habitat type: Soil type: Site class:
Site species	Site Index: Height adjustment:
Elevation	Aspect: Slope %: Topo. position:
Operability	Access: Water code: Water code:
Acres W/I 1 mi.	Clearcuts: Cultivation: Open: Water code:
Management goal	Mgmt. value: Deer impact index: . Gypsy moth: Stress:

Notes

Regeneration Data

	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	19	20	#	%
1 Black cherry	30	50	20	25		10	20	10	5	10		50	75	90	80			25				
2 Small oak																						
3 Other desirables	20	40	5			5	15	5	5			10	30	75	50			15				
4 All desirables 1+2+3																						
5 Large oak																						
6 Any small regen 1, 2, 4, or 5																						
7 Residuals																						
8 Any regen or Res. 6 or 7																						
9 Sapling regen																						
10 Woody interference	5					2			8	10	5											
11 Laurel & Rhododendron																						
12 Ferns		25	10	5			5	20	10						10	10	10	10				
13 Grasses																						
14 Any intrfr. 10, 11, 12, or 13																						
15 Grapevines																						
16 Site limitations																						

SILVAH - ID & Regen Tally Form

USDA, Forest Service, NEFES, Warren, PA 1/91

Identification Data

Sheet 2 of 2

Owner/Agency	USFS							
Forest/Property	KANE EXP FOREST							
County/District	ELK							
Compartment/Unit	171	Stand No.	23					
Remarks	EXAMPLE OF SUMMARIZED FORM							
Species Codes		dbh classes		Tally month		Year		
Overstory Cruise	Type		# plots		BAF/plot size			
Regen Cruise	Type		# plots		Plot size			
Acreage in stand		Stand age						
Cover Type		Habitat type		Soil type		Site class		
Site species		Site Index		Height adjustment				
Elevation		Aspect		Slope %		Topo. position		
Operability		Access		Water code		Water code		
Acres W/I 1 mi.	Clearcuts		Cultivation		Open		Water code	
Management goal		Mgmt. value		Deer impact index		Gypsy moth		Stress

Notes

Regeneration Data

(38 plots)

	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	19	20	#	%
1 Black cherry	(30)	(50)	20	(25)		10	20	10	5	10		(50)	(75)	(90)	(80)			(25)			18	47
2 Small oak																						
3 Other desirables	20	40	5			5	15	5	5			10	30	75	50			15				
4 All desirables 1+2+3	50	90	25	25		15	35	15	10	10		60	(105)	(165)	(130)			40			5	13
5 Large oak																						
6 Any small regen 1, 2, 4, or 5	✓	✓		✓								✓	✓	✓	✓			✓			19	50
7 Residuals																					2	5
8 Any regen or Res. 6 or 7	✓	✓		✓								✓	✓	✓	✓			✓			20	53
9 Sapling regen																						
10 Woody interference	5					2			8	10	5										2	5
11 Laurel & Rhododendron																						
12 Ferns		25	10	5			5	20	10						10	10	10	10			4	11
13 Grasses																						
14 Any intrfr. 10, 11, 12 or 13																					5	13
15 Grapevines																						
16 Site limitations																						

SILVAH - ID & Regen Tally Form

Identification Data

Sheet ____ of ____

Owner/Agency					
Forest/Property					
County/District					
Compartment/Unit		Stand No.			
Remarks					
Species Codes		dbh classes		Tally month	
Overstory Cruise	Type	# plots	BAF/plot size		
Regen Cruise	Type	# plots	Plot size		
Acreage in stand			Stand age		
Cover Type	Habitat type		Soil type	Site class	
Site species		Site Index	Height adjustment		
Elevation		Aspect	Slope %	Topo. position	
Operability	Access	Water code	Water code		
Acres W/I 1 mi.	Clearcuts	Cultivation	Open	Water code	
Management goal	Mgmt. value	Deer impact index	Gypsy moth	Stress	

Notes

Regeneration Data

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	#	%
1 Black cherry																						
2 Small oak																						
3 Other desirables																						
4 All desirables 1+2+3																						
5 Large oak																						
6 Any small regen 1, 2, 4, or 5																						
7 Residuals																						
8 Any regen or Res. 6 or 7																						
9 Sapling regen																						
10 Woody interference																						
11 Laurel & Rhododendron																						
12 Ferns																						
13 Grasses																						
14 Any intrfr. 10, 11, 12, or 13																						
15 Grapevines																						
16 Site limitations																						

SILVAH - Prescription Summary Worksheet

Stand ID

USDA, Forest Service, NEFES, Warren, PA 16365

Years to Maturity

Species	BA	BA Sum.	f	BA*f
Black cherry	64.5			
White ash	6.9			
Yellow poplar				
Red maple	41.1	117.8	.20	23.5
No. red oak				
Eastern hemlock				
All others	5.3			
Sugar maple	30.0			
American beech	10.1	40.1	.15	6.0
Striped Maple				
Other oaks, hick.				
Total		157.9 (1)	.19 (2)	29.5 (3)

Yrs. to Mat. = (18 − MDM)/growth factor (2)

$(18-14.5)/0.19 = \frac{3.5}{0.19} = 18$

Seed Source Index

Species	f	BA Poles +	M Seedlings BA*f
Black cherry	4.0	64.1	256.4
Sugar maple good	2.4		
Sugar maple poor	1.2	26.3	31.6
White ash	1.5	6.9	10.4
Red maple	1.5	39.5	59.3
Oaks	1.0		
Total			357.7 (4)

M Seedlings (4)	0 − 32	33 − 83	83 − 134	135+
Seed Source index	4	3	2	1 (circled)

Shade Tolerant Composition

Species	Total basal area
Sugar maple	30.0
American beech	10.1
Eastern hemlock	
Total	40.1

Oak Stump Sprouting

Species	Size	BA	f	Sprouting stumps BA*f
N.Red Oak	Saps		20.4	
	Poles		1.7	
	SSaw		0.4	
	MSaw		0.1	
	LSaw		0.0	
Other oaks	Saps		18.6	
	Poles		2.1	
	SSaw		0.4	
	MSaw		0.1	
	LSaw		0.0	
Total				(5)

Adv. Regen Adjustment	0	5	10	15	20
Stumps @ high deer (5)	0	46	97	147	198
Stumps @ low deer (5)	0	21	46	71	97

Prescription Variables

Site & Environmental Factors

Management Goal	1
Deer impact index	4
Seed source index	1
Site limitations	0

Understory Factors

Any small regen	50
Any regen or residuals	53
Any small regen − no deer	79
Any regen or residuals − no deer	79
Sapling regen	0
Any interference	13

Overstory Factors

Sapling basal area	11
Shade tolerant basal area	40
Relative stand density	97
Relative density AGS	63
Stand diameter (MD)	13.7
Mercn. stand diameter (MDM)	14.5
Years to maturity	18

Prescription:

COMMERCIAL THINNING

SILVAH - Prescription Summary Worksheet

Stand ID

USDA, Forest Service, NEFES, Warren, PA 5/90

Years to Maturity

Species	BA	BA Sums	f	BA*f
Black cherry White ash Yellow poplar Red maple No. red oak Eastern hemlock All others			.20	
Sugar maple American beech Striped Maple Other oaks, hick.			.15	
Total		1	3/1 2	3

Yrs. to Mat. = (18 − MDM)/growth factor (2)

Seed Source Index

Species	f	BA Poles +	M Seedlings BA*f
Black cherry	4.0		
Sugar maple good	2.4		
Sugar maple poor	1.2		
White ash	1.5		
Red maple	1.5		
Oaks	1.0		
Total			4

M Seedlings (4)	0 -32	33-83	83-134	135+
Seed Source Index	4	3	2	1

Shade Tolerant Composition

Species	Total basal area
Sugar maple	
American beech	
Eastern hemlock	
Total	

Oak Stump Sprouting BA*f

Species	Size	BA	f	Sprouting stumps
N.Red Oak	Saps		20.4	
	Poles		1.7	
	SSaw		0.4	
	MSaw		0.1	
	LSaw		0.0	
Other oaks	Saps		18.6	
	Poles		2.1	
	SSaw		0.4	
	MSaw		0.1	
	LSaw		0.0	
Total				5

Adv. Regen Adjustment	0	5	10	15	20
Stumps @ high deer (5)	0	46	97	147	198
Stumps @ low deer (5)	0	21	46	71	97

Prescription Variables

Site & Environmental Factors

Management Goal	
Deer impact index	
Seed source index	
Site limitations	

Understory Factors

Any small regen	
Any regen or residuals	
Any small regen − no deer	
Any regen or residuals − no deer	
Sapling regen	
Any interference	

Overstory Factors

Sapling basal area	
Shade tolerant basal area	
Relative stand density	
Relative density AGS	
Stand diameter (MD)	
Merch. stand diameter (MDM)	
Years to maturity	

Prescription:

Appendix 6A. Growing Stock Quality Class Definitions

Code	Definition
1	**Acceptable Growing Stock (AGS)** - These trees are suitable for retention in the stand for at least the next 15 year period. They are trees of commercial species and of such form and quality as to be salable for sawtimber products at some future date. In making this determination, judge each tree on its own merits; assume that every tree will be allowed to grow to sawtimber size even though it is now a small tree in an older stand. Saplings are especially difficult to judge; most knots, bumps and stoppers will be confined to a small core if the sapling actually grows to a larger size, so most saplings are acceptable. If in doubt about the correct quality class for any tree, consider it acceptable. Many acceptable trees will be removed if a partial cutting is prescribed for the stand, so do not consider the quality determination a cut-leave tally.
2	**Unacceptable Growing Stock (UGS)** - These trees do not have the potential to make salable sawtimber products in the future. They may be high-risk trees--trees with disease, damage, or dieback that threatens their survival--or trees of such poor form that they just have to be removed regardless of the effect that removal will have on stand structure and species composition.
3	**Dead** - Standing dead trees.

Appendix 6B.

Deer Impact Index	Advance Regen Species Group				
	Black Cherry	Small Oak	Other Desirable Species	All Desirable Species	Large Oak
	Weighted no. per plot				
5	50	60	200	200	1
4	25	40	100	100	1
3	20	30	50	50	1
2	15	20	30	30	1
1	10	10	15	15	1

Appendix 6C.

Type	Counting Criteria
Woody Interference	All plots with 12 stems or more
Fern	All plots with at least 30% coverage
Grass	All plots with at least 30% coverage
Laurel and Rhododendron	Count plots coded 4 as 1; count plots coded 2 or 3 as 1/2
Grapevine	All plots with at least 1 vine